TRANSITION TOWARDS

THE STRATEGIC RESEARCH

SUSTAINABLE

AND INNOVATION AGENDA

AND LIVEABLE

OF JPI URBAN EUROPE

URBAN FUTURES

URBAN EUROPE

ACKNOWLEDGEMENTS

JPI URBAN EUROPE

JPI Urban Europe is a transnational research and innovation programme built upon and aligning national strategies and research programmes. According to our mission statement 'Global Urban Challenges – Joint European Solutions', the main ambition of the initiative is to provide relevant solutions and improvement for cities, their inhabitants and businesses.

September 2015

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EXECUTIVE SUMMARY

Cities are wonderfully vibrant loci of education, employment and commerce, social encounter and recreation; they are the nerve centres of the modern global economy and as such they continue to attract migrants in search of a better quality of life for themselves and their families. Indeed with the 21st century we have entered *the urban age*, in which the urban half of the global population is responsible for around 80% of global economic activity. Europe is yet more urbanised (around three quarters) so that our fortune, our position on the global economic stage, is highly concentrated in our urban areas and the technology, commerce and industry and supporting service, retail and leisure sectors accommodated within them.

This concentration of economic and social activity is matched by a similar concentration in the metabolism of energy and materials as well as of technology and infrastructure, with consequences for raw materials depletion, greenhouse gas emissions and climate change; likewise a concentration in societal challenges. Increased disparity in income and social inequality can adversely affect social capital and cohesion and in the worst of cases lead to exclusion of access to home ownership, education, welfare and healthcare.

But this concentration also brings considerable opportunities. By improving the liveability of Europe's towns and cities we can improve the liveability of its urban majority; whilst improving their attractiveness to visitors and migrants. By reducing the dependency on non-renewable energy and materials of Europe's urban areas and increasing the efficiency with which these resources are metabolised, we can achieve our greenhouse gas emission reduction targets *whilst* demonstrating our solutions, showcasing our technologies, and maintaining our economic competitiveness in a global market.

But of course, understanding how to go about this, for the diversity of Europe's cities and in their local contexts, requires an ambitious programme of research, technological development and innovation. It was against this backdrop that the Joint Programming Initiative (JPI) Urban Europe was initiated in 2011. In parallel with launching two pilot research funding calls the process of developing a Strategic Research and Innovation Agenda (SRIA) was initiated, with a view to developing a coherent programme of research through to 2020 to:

- Enhance capacities and knowledge on transition towards more sustainable, resilient and liveable urban developments.
....
- Reduce the fragmentation in funding, research and urban development; to build critical mass to realise urban transitions.
....
- Increase the profile of European urban science, technological development and innovation and foster exploitation of European technological, social and economic models and solutions on the global stage.
....

In preparing the SRIA, the following have been reviewed and deliberated upon: results from dedicated stakeholder focus groups; reports relating to the urban research priorities of national research councils (the Dutch NWO, French ANR, German BMBF, Slovenian ARRS, Swedish Vinnova, UK ESRC...) and the EC-funded projects Social Polis, Urban-Nexus and SEiSMiC; responses from national research councils on the Scientific Advisory Board's (SAB) Urban Megatrends report. From these deliberations and continuing from the conclusions of the Urban Megatrends report, it is evident that:

JPI Urban Europe: Transition towards sustainable and liveable urban futures

- There is a common desire to support cities in improving their attractiveness and liveability whilst improving their economic competitiveness as well as their resilience to major disruptions (whether sudden or progressive).
....

- Building upon our technological advancements and scientific expertise, the potential of these solutions in the urban context needs to be tested and demonstrated, demands and opportunities for future technological solutions and social innovation have to be identified, and the economic benefit of these achievements has to be exploited.
....

- There is a dearth of research relating to the rigorous definition, measurement and modelling of complex and interwoven factors influencing urban sustainability in the nexus of technological, economic, social, and environmental issues. Several research programmes have tackled aspects of this research challenge, but none have done so in an integrated and comprehensive way.
....

- Urban technologies and infrastructures are often perceived as a problem, rather than a solution to urban needs. Without the capacity to make our European technological prowess a part of the solution, urban infrastructures will fall short of contributing to the resource efficiency, sustainability and liveability of cities.
....

- Without the ability to define, measure and model, it is not possible to define ambitious yet realisable context-specific targets for the improvement of cities' sustainability and liveability, nor to identify the most promising transition strategies for their achievement.
....

In addition to these general sustainable urban transition challenges, Europe's cities also face some specific but closely related challenges in terms of their social, economic and environmental functioning. They are:

- Highly differentiated in terms of the composition of their economies and of the benefits they enjoy from their local and regional agglomerations. Some are growing, stable or re-growing whilst others are declining; enhanced or exacerbated by in- and out-migration; experiencing varying degrees of social inclusion, capital and cohesion.
....

- Facing varying degrees of austerity measures, leading to a declining welfare state and increasing calls on society to fill the void through voluntary efforts. The role of social entrepreneurship, local economy and shared economy is under debate, with frameworks needed to tap the full potential of these opportunities, as well as social innovation.
....

- Subject to change due to social, economic and environmental pressures, with a corresponding need to be more resilient and adaptive to these internal and external influences.
....

- Varied in terms of the accessibility they afford to their citizens to amenities and the connectivity of these amenities; with the less able and less well-off being particularly disadvantaged.
....

- Hosts to incredibly creative people who, if suitably empowered, could be a powerfully positive force in creating and implementing innovations to tackle challenges to improve citizens quality of life.
....

Addressing these interrelated urban challenges in earnest requires a joined up approach, in which academic experts from different complementary disciplines work together, in concert with non-academic experts and stakeholders, to tackle them for the first time and/or in more comprehensive and innovative ways than has hitherto been the case. A combination of inter- and transdisciplinary research is called for, addressing the entire research, technology and innovation lifecycle with the ambition to position our cities as hubs of technological and social leadership and as venues for successful European economy on global markets.

SO WHAT IS SO SPECIAL ABOUT JPI URBAN EUROPE AND ITS STRATEGIC RESEARCH AND INNOVATION AGENDA?

JPI Urban Europe's SRIA responds to the urgent need for ambitious, sustained and truly inter- and transdisciplinary research to radically improve our understanding of how socially, economically and environmentally sustainable our urban areas are; and to support Europe's cities in their transition towards a future that maximises their sustainability, resilience and their liveability in this era of global competition for commerce, industry, tourism, labour and investment; to drive urban innovation and technologies.

Following this principle and to address the above challenges, the SRIA is comprised of two complementary components:

- An ambitious longitudinal research programme that is focused on the development and application of methodologies supporting the definition and measurement of urban sustainability and the establishment of transition targets and strategies to achieve them. This is chronologically structured, enabling the methods and outcomes from earlier projects to inform those of later projects.

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- Thematic priorities that are directly relevant to and inform this longitudinal programme, but which are destined to enable research teams to tackle a specific societal urban challenge in detail:

  - Vibrancy in changing economies
  - Welfare and finance
  - Environmental sustainability and resilience
  - Accessibility and connectivity
  - Urban governance and participation

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Through careful programme management, backed up by investments in shared resources including urban observatories, datasets, models and living labs, this structure will ensure that the whole is greater than the sum of its parts; that outcomes from research projects and the methods employed in realising them are mutually informative. This will be complemented by ongoing alignment with national and institutional research programmes, to build European urban research, technology and innovation capacity, and European solutions to address global urban challenges.

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PREAMBLE

The Joint Programming Process was opened in 2008 with a Communication of the European Commission[1] and subsequent Conclusions of the European Council[2]. The JPI Urban Europe was established following the Council recommendation of 2010[3], with a formal launch by the European Council in 2011[4]. The attractiveness of Joint Programming lies in its structured and strategic process, whereby Member States voluntarily agree to work in partnership towards common visions, encapsulated in a SRIA and implemented through joint actions.

The JPI Urban Europe responds to *Global Urban Challenges* by developing *Joint European Solutions*. Through joint actions, JPI Urban Europe aims to:

▶
- Enhance the capacities and knowledge on transition towards more sustainable, resilient and liveable urban developments.
- Reduce the fragmentation in funding, research and urban development; to build critical mass to realise urban transition; and to
- Increase the profile of European urban science, technology and innovation on the global stage.

Through these aims JPI Urban Europe will contribute to the EU 2020 Strategy on smart, sustainable and inclusive growth. The European Commission, in its recommendations from 2011[5], stresses the relevance of the JPI Urban Europe and its importance to support the transition of urban areas – Europe's hubs of innovation, growth and competitiveness.

The JPI Urban Europe has now developed its Strategic Research and Innovation Agenda that sets out clear medium and longer term research objectives together with instruments for their implementation. The European Commission and the European Council's High-Level-Group for Joint Programming (GPC) emphasise the importance of a SRIA as an integral element of the Joint Programming Process.

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1   EC, Towards joint programming in research: Working together to tackle common challenges more effectively, COM(2008) 468 final, Brussels, July 2008, <http://ec.europa.eu/research/press/2008/pdf/com_2008_468_en.pdf>.

2   CEU, Council conclusions concerning joint programming of research in Europe in response to major societal challenges, 16775/08, Brussels, 3 December 2008, <https://ec.europa.eu/research/era/pdf/programming_st16775_en.pdf>.

3   CEU, Conclusions concerning various issues related to the development of the European Research Area, 10246/10, Brussels, 26 May 2010, <https://ec.europa.eu/research/era/docs/en/council-conclusions---may-2010.pdf>.

4   CEU, Council conclusions on the launching of the joint programming initiatives on 'Healthy and Productive Seas and Oceans', 'Urban Europe – Global Urban Challenges, Joint European Solutions', 'Connecting Climate Knowledge for Europe', 'Water Challenges for a Changing World' and 'The Microbial Challenge – An Emerging Threat to Human Health' – Adoption, 17424/11, Brussels, 29 November 2011, <http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2017424%202011%20INIT>.

5   EC, Commission recommendation on the research joint programming initiative „Urban Europe – Global urban challenges, joint European solutions', C(2011) 7406 final, Brussels, October 2010, <https://ec.europa.eu/research/participants/portal/doc/call/fp7/fp7-jprog-regions-2013/33268-commission_recommendation_c%282011%297406_final_en.pdf>.

The overarching principle of the SRIA is that it actively supports the alignment and coordination of regional, national and European research, technological development and innovation in the field of urban development (Figure 1). Achieving this requires a cooperative alignment process defining joint objectives, developing common values; agreeing on a joint strategy which builds upon national strategies and strengths to define common frameworks for collaboration that finally provide the operational basis for ioint actions.

ALIGNED OBJECTIVES

> European hub for urban research

COMMON VALUES

> JPI Urban Europe Principles & Research Approach

ALIGNED STRATEGIES

> JPI Urban Europe Strategic Research & Innovation Agenda

COMMON FRAMEWORKS & INFRASTRUCTURE

> Call Procedures
> Programme Management

JOINT ACTION & COMMON PRACTICES

> Joint Calls
> Urban Europe Research Alliance
> Urban Observatories
> Shared Data
> Shared Infrastructure

Figure 1
Alignment process of JPI Urban Europe to develop and implement its
Strategic Research and Innovation Agenda

In practice this includes the alignment of:

- National and regional research, technological development and innovation policies and programmes, via targeted and open calls.
- Institutional funding, via the Urban Europe Research Alliance (UERA); and
- Research infrastructures, e.g. via Urban Models, Observatories, Datasets and Living Labs.

Through this alignment principle, JPI Urban Europe contributes to the development of a European Research Area, striving to make the whole of European urban research and technological development and innovation (RTDI) more than the sum of its parts.

JPI Urban Europe's SRIA defines research priorities that need consolidated efforts and benefit from transnational cooperation. As emphasised by the GPC in its biannual reports[6] this crucially also requires an implementation plan. In the case of JPI Urban Europe, this aims to provide the basis for more intensive cooperation with the European Innovation Partnership on Smart Cities and Communities, Horizon 2020, the European Urban Agenda and with Structural Funds. Its ambition is to set the scene for a new paradigm in research, technology development, and innovation (RTDI), embracing the complexity of the grand challenge of urbanisation, and bridging the innovation space from strategic research to implementation.

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6   EU, 2014 Biennial Report, European Research Area and Innovation Committee, High Level Group for Joint Programming, ERAC-GPC 1310/14, Brussels, 21 November 2014, < register.consilium.europa.eu/doc/srv?I=EN&f=ST 1310 2014 INIT>; EU, 2012 Biennial Report, European Research Area and Innovation Committee, High Level Group for Joint Programming, ERAC-GPC 1301/13, Brussels, 7 february 2013,
<http://register.consilium.europa.eu/doc/srv?I=EN&f=ST%201301%202013%20INIT>.

DEVELOPING THE SRIA:
A CONSULTATIVE AND DELIBERATIVE APPROACH

Developing a strategic agenda for such a complex topic as urban development requires an appropriate process that:

▶
- builds upon national urban priorities, strategies and programmes as well as city visions and strategies,
- considers the practical needs of civil society and a diverse set of urban actors,
- takes advantage of the latest scientific findings and technological developments,
- supports the development of a visionary programme of research, technological development and innovation,
- establishes links to national, European and international policies and programmes for joint implementation.

To meet this ambition a co-creative process was established, involving representatives from all parties – scientists, funding agencies, cities, companies, civil society – in an iterative approach; developing a common vision and raising commitment by regularly reflecting on ideas, topics and implementation measures (Figure 2). The JPI Urban Europe SRIA thus considers the diversity of research needs across Europe, and decidedly opens the door for small and less RTDI intensive countries to contribute towards JPI Urban Europe's activities (and vice versa).

In addition to the SAB's Megatrends Report[7], recent research results, policies and strategies have been taken into account in developing the SRIA; as have the findings of two particularly pertinent FP7 funded projects – Social Polis[8]
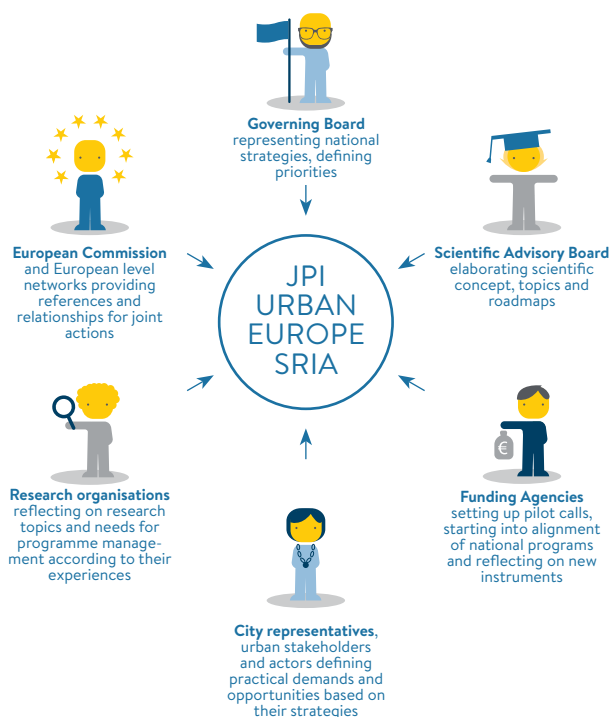
Figure 2
Multi-stakeholder involvement in the SRIA process

Governing Board
representing national strategies, defining priorities

European Commission
and European level networks providing references and relationships for joint actions

Scientific Advisory Board
elaborating scientific concept, topics and roadmaps

JPI URBAN EUROPE SRIA

Research organisations
reflecting on research topics and needs for programme management according to their experiences

Funding Agencies
setting up pilot calls, starting into alignment of national programs and reflecting on new instruments

City representatives,
urban stakeholders and actors defining practical demands and opportunities based on their strategies

7 O. Coutard, G. Finnveden, S. Kabisch, R. Kitchin, R. Matos, P. Nijkamp, C. Pronello, D. Robinson: Urban Megatrends: Towards a European Research Agenda; A report by the Scientific Advisory Board of JPI Urban Europe, March 2014.

8 D. Cassinari, J. Hillier, K. Miciukiewicz, A. Novy, S. Habersack, D. MacCallum, F. Moulaert, Transdisciplinary Research in Social Polis, Social Platform on Cities and Social Cohesion, 2011, EC ERA FP 7, <http://www.socialpolis.eu/uploads/tx_sp/Trans_final_web_single_page.pdf>.

and Urban-Nexus[9]. European and international policy debates have also been reflected upon; including the conclusions of UN-HABITAT II[10], the progress made in defining Sustainable Development Goals by the UN[11], the EU urban agenda[12] and the European Innovation Partnership (EIP) on Smart Cities and Communities[13]. Furthermore, national consultations have been conducted in several JPI Urban Europe countries[14] and national research strategies have been analysed[15]. The ideas and concepts emerging from the resultant reflections have been challenged in both scientific workshops and workshops with city representatives. Finally, the SRIA development process has benefitted from a close cooperation with the FP7 funded project SEiSMiC[16], which focuses on urban social innovation through societal engagement in Europe.

Throughout these activities the development of the SRIA has been coordinated by the JPI Urban Europe Management Board (MB). In particular the MB has: supported the SAB in its scientific analysis and concept development, liaised with funding agencies to prepare the multi-annual call agenda and instrument development, and consulted with external stakeholders and related projects. The resultant SRIA has been approved by the Governing Board of JPI Urban Europe for the implementation phase 2016–2020.

9   Urban-Nexus, EC ERA FP7 CSA, <http://www.urban-nexus.eu>.

10 UN, Progress to date in the implementation of the outcomes of the second United Nations Conference on Human Settlements (Habitat II) and identification of new and emerging challenges on sustainable urban development, Report of the Secretary-General of the Conference, A/CONF.226/PC.1/5, 26 July 2014.

11   UN, Report of the Open Working Group of the General Assembly on Sustainable Development Goals, A/68/970, New York, 12 August 2014,
<http://www.un.org/ga/search/view_doc.asp?symbol=A/68/970&Lang=E>; in particular Goal 11: *Make cities and human settlements inclusive, safe, resilient and sustainable.*

12   EC, The urban dimension of EU policies – Key features of an EU Urban Agenda, COM(2014) 490 Final, Brussels, 18 July 2014,
<http://ec.europa.eu/regional_policy/sources/consultation/urb_agenda/pdf/comm_act_urb_agenda_en.pdf>;

13 EIP SCC, The European Innovation Partnership on Smart Cities and Communities,
<http://ec.europa.eu/eip/smartcities/>.

14 National consultations were performed in AT, SE, DK, DE, NO, CY, IT, UK

15 National research strategies on urban issues have been provided by UK, SL, FR, NE, DE

16 SEiSMiC, Societal Engagement in Science, Mutual Learning in Cities, EC ERA FP7 CSA,
<http://www.seismicproject.eu/>.

THE CHALLENGES OF AN URBANISED EUROPE

With the 21st century we have entered *the urban age*. The megatrend of urbanisation is the result of the sigmoidal growth in world population and rural-urban migration in the search for improved socio-economic opportunities in urban agglomerations. In 2007 the urban fraction of the 6.7B strong global population reached parity with the rural for the first time.[17] By 2050 it is projected (assuming medium fertility) that the population will increase to 9.5B and its urban fraction to three quarters. Since urban areas are responsible for around 80% of global economic activity and a similar fraction of resource use, it follows that – under business as usual conditions – urbanisation will impose greater stress on the natural environment; and this at a time for which the intergovernmental panel on climate change is counselling the reduction of greenhouse gas emissions to 40–70% of 2010 levels by 2050, and near-zero emission by 2100, to limit global mean temperature rise to 2°C. To achieve greenhouse gas emission reduction targets will require **transformative research to understand how cities' functioning can be decarbonised**; replenishing not reducing natural capital in a variety of resources. But urban areas and societies are not only a substantial part of contemporary planetary challenges; as hotspots for innovation and technological development, and resource nodes (particularly financial), they have considerable potential to resolve them.

Some 73% of the European population was considered urbanized in 2010. In contrast with for example Asia and South America, Europe has relatively few cities with more than 1M inhabitants and a relatively high number of small and medium sized cities (SMCs). The larger urban areas are also mainly formed of amalgamated SMCs. Urban Europe thus poses some rather specific constraints and opportunities, in particular due to a relative abundance of functional urban regions rather than of standalone or discrete administrative territories.

Comparatively speaking, European urban areas are also historically, architecturally and culturally rich, offering attractive urban and green spaces, so that quality of life is in large part considered to be high. They are also embedded within states that traditionally have highly developed welfare services. Europe's urban areas are also particularly **diverse** in their forms and organisation, spatial dynamics, local economies, governance structures, sociotechnical infrastructures, cultural heritage. Notwithstanding higher order (national, continental, global) influences, actions will ultimately need to be integrated in complex local conditions and requirements so that responses (strategies to bring about performance improvements) fit to their contexts.

The 2008 crisis hit European urban areas hard and the aftermath still presents major challenges for European urban economies, overall sustainable development and economic structures, since it resulted in increased unemployment and redirected priorities from ongoing urban development. These challenges and the opportunities available to tackle them depend on, for example, planning and management capacities

17 Note that *urban* here refers to an extremely diverse set of settlement configurations, with a rough common denominator qualified by agglomerations by 2000 inhabitants and above.

and economic structures.

Hence, there is a need to maintain economic competitiveness in this era of global competition and a shift in economic and political power from G7[18] to E7[19] states, as well as to maintain, even to improve upon, citizens' social welfare. This latter is complicated by a number of factors.

In general, urban Europe suffers an increase in inequalities concerning e.g. housing, education, work, health, transport/mobility, and ICT. Marginalisation and polarisation tends to affect specifically youth, migrants, and ethnic minorities.

Reflecting the contrasting developments of south-eastern and north-western Member States, Europe continues to experience considerable migratory flows. Young, mobile and often well-trained people are leaving their home regions in search of employment and educational opportunities; changing the demography of their home regions, reducing the skill base and exacerbating economic decline, whilst increasing sociocultural diversity as well as opportunities for growth and innovation in their destination cities. Meanwhile, less mobile youth in declining economies are increasingly faced with long term unemployment prospects and insufficient opportunities and supportive structures to help themselves – to innovate and exercise their entrepreneurial capacity. Reflecting low fertility rates and increased life expectancy, Europe's population is also aging. This places greater pressure on the welfare state and also poses challenges in terms of inclusion and connectivity. As wealth is increasingly concentrated, income inequality and levels of poverty are increasing; leading to social polarisation and exclusion. Finally, although functional redevelopment of land-use increases, urban sprawl remains a challenge. This is a challenge not only for a resource efficient public service but also for e.g. biodiversity and water sustainability.

For further information on these and related global and European urban challenges, we refer the interested reader to the SAB's Megatrends Report[20].

18 The Group of Seven (G7, formerly G8) is a governmental political forum of leading advanced economies in the world. It was originally formed by six leading industrial countries and sub-sequently extended with two additional members, one of which, Russia, is suspended. Since 2014, the G8 in effect comprises seven nations and the European Union as the eighth member.
<https://en.wikipedia.org/wiki/G8_(forum)>

19 The E7 is a group of seven countries with emerging economies. The E7 are predicted to have larger economies than the G7 countries by 2020.
<https://en.wikipedia.org/wiki/E7_(countries)>

20 O. Coutard, G. Finnveden, S. Kabisch, R. Kitchin, R. Matos, P. Nijkamp, C. Pronello, D. Robinson: Urban Megatrends: Towards a European Research Agenda; A report by the Scientific Advisory Board of JPI Urban Europe, March 2014.

THE URBAN POLICY DEBATE:
CALLING FOR REVITALISED EFFORTS TO IMPROVE URBAN SUSTAINABILITY

These urban challenges are addressed on various policy levels and high emphasis is given to gain social and economic benefit from the urban dynamics by calling for integrated urban development and intensifying efforts to realise models for a transition towards truly sustainable urbanisation.

On a global scale, the United Nations Human Settlement Programme (UN-HABITAT) focusses on housing and sustainable urban development. In its latest progress report on the implementation of the outcomes of UN-HABITAT II, UN-HABITAT clearly stress the importance of strengthening urbanisation as the engine for global sustainable development; of overcoming the current unsustainable model of urbanisation. Since current forms of urbanisation are deeply unsustainable new conditions need to be defined to achieve inclusive, human-centred and sustainable global development.[21]

Habitat III, the UN conference on Housing and Sustainable Urban Development will take place in Quito, Ecuador in October 2016 and is set to focus on securing renewed political commitment for sustainable urban development and to assess the accomplishments to date, address poverty and identify and address new and emerging challenges which will result in a forward looking document highlighting policy requirements on a global scale. This New Urban Agenda will guide the efforts in support of cities by national governments, urban stakeholders, international development funders and others with the objective of integrated sustainable development of cities and urban areas worldwide.

In a European context, cities play a pivotal role in the territorial development of the European Union and for reaching the EU 2020 objectives, an European Urban Agenda is currently under development, with the aim of strengthening and fastening policy responses at European level. By integrating and aligning the diverse strategies and policies at European level, EU policies should be highlighting measures with high effectiveness for "sustainable development, better participation and contribution of urban areas in achieving common EU goals, as well as exchange of knowledge and increase in learning"[22].

Besides this, the EC strategy 2014-2019 includes numerous elements of sustainable development with a strong impact on the urban dimension. In particular the Juncker

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21 UN, Progress to date in the implementation of the outcomes of the second United Nations Conference on Human Settlements (Habitat II) and identification of new and emerging challenges on sustainable urban development. Report of the Secretary-General of the Conference, A/CONF.226/PC.1/5, 26 July 2014.

22 Ministry of Environmental Protection and Regional Development of the Republic of Latvia: Declaration of Ministers towards the EU Urban Agenda, Riga, 10 June 2015, <https://eu2015.lv/images/news/2015_06_10_EUurbanDeclaration.pdf>.

Plan calls for a new start for Europe in terms of jobs, growth, fairness and democratic change[23].

The policy areas identified in the Juncker Plan have a high relevance for urban research, technological development and innovation. As hubs for the regional development, European cities play a pivotal role in tackling challenges at hand. Therefore, within this Strategic Research and Innovation Agenda, the policy areas in the "Juncker plan" are reflected in the thematic research priorities of JPI Urban Europe's priorities. Urban research, technological development and innovation can support boosting jobs, growth and investment in certain areas, such as large scale infrastructure projects, a resilient energy union with a forward-looking climate change policy, and a deeper and fairer economic and monetary union. JPI Urban Europe's ambition is to contribute to the priorities of the EC strategy and the Juncker Plan by providing evidence for policy making and strengthening science-policy cooperation on urban transition towards sustainable and liveable futures. In line with the Juncker Plan a cooperation of research, technological development and policy can help tackling issues such as migration and the effects of the increasing movement of people towards the European Union or the development of a Union of democratic change. As European cities are becoming even more important for implementing the policy measures, JPI Urban Europe aims at teaming up with the European Commission in certain research areas and developing an aligned set of research, technological development and innovation measures to strengthen the European research community and achieve highest impact and relevance for our urban areas.

One particular action is the contribution of JPI Urban Europe to the European Innovation Partnership on Smart Cities and Communities to support the implementation of sustainable technologies as part of a human-centred approach, better coordinated policies, actors and governance levels and improve the understanding of policy making contexts in urban development.

The urban policy debates underline the importance for new urban agendas with the aim of supporting sustainable urban development. Furthermore, the efforts taken by the European Commission as well as UN-Habitat stress the need for integration and coordination of sectoral organised endeavours and actions. In this regard, urban research, technological development and innovation with the objective of supporting the transition towards a holistic concept of sustainability are asked to keep the close link to the current urban policy debate and support administration and governments with applicable results and recommendations.

23 J-C. Juncker, A New Start for Europe: My Agenda for Jobs, Growth, Fairness and Democratic Change. Political Guidelines for the next European Commission, European Parliament plenary session, Strasbourg, 15 July 2014, <http://europa.eu/rapid/press-release_SPEECH-14-546_en.htm>.

THE LANDSCAPE OF TRANSNATIONAL, URBAN-RELATED RESEARCH COOPERATION IN EUROPE

JPI Urban Europe aims to coordinate research and make better use of Europe's public funds in order to address common European urban challenges more effectively. Strengthening and aligning urban research, technological development and innovation means at the same time to build upon existing expertise, technologies, networks and results. In the frame of the European Research Frameworks FP5, FP6 and FP7 substantial funding has already been provided to foster urban-related research on transnational level, supporting research, technological development and innovation in various urban fields and disciplines and generating networks among scientists, industry and public authorities. A solid understanding of the gained achievements allows to position JPI Urban Europe against this background.

A recent report[24] showed that nearly 600 projects related to urban research were funded from FP5 to FP7; most of which were conducted collaboratively. The urban research community has grown from a rather small, but strongly connected community, to a larger, more loosely connected one. While the number of funded projects dropped after FP5 due to changing priorities and funding schemes in the framework programmes, the amount of project funding increased from 273m to 430m Euros from FP5 to FP7. Half of the projects were conducted in the areas of urban transport, energy and urban environment receiving two third of the total project funding. Furthermore, the structural characteristics of the network of urban research project changes from F5 to FP7. While very strong collaboration clusters have emerged for some topics, such as urban transport, ICT-systems and services, energy or security; other topics like urban governance or urban sustainability are much more fragmented.

In general the transnational collaboration pattern can be described by a core-periphery structure. Countries, like Germany, France, the United Kingdom, Spain, the Netherlands, and Italy established themselves as the key partners for European collaboration on urban issues. Other countries show weaker interactions or are more focused in their participations. Such specialisation was identified, e.g. for Swedish actors in the energy cluster, Norwegian partners in urban climate or Spanish organisations in socio-economic development.

24 B. Heller-Schuh, M. Barber, T. Scherngell: Urban Research in the European Framework Programmes, Final Report, April 2015; see also Appendix 1.

Since JPI Urban Europe highly emphasises transdisciplinary research and a multi-stakeholder involvement the collaboration pattern of different actor groups was investigated as well. The analysis showed that the participation of different stakeholder groups varied widely depending on the respective topic. However, there is a rather low involvement of non-commercial (societal) actors and in some cases of cities.

A pertinent conclusion from this is that the identified collaboration patterns clearly call for specific framework conditions to strengthen and support cooperation between research and cities, societal actors and/or industry, depending on the particular thematic area.

Summarizing the analysis it can be stated that JPI Urban Europe can build upon a differentiated and in many cases well established urban research community but that efforts are needed to link the different clusters, competences and experts and strengthen the community on urban sustainability and related fields through inter- and trans-disciplinary research. To support urban transition from an integrated perspective, JPI Urban Europe aims at

- building upon the achieved results, technologies and expertise and connecting them more closely with national activities,
- benefitting from transnational cooperation by connecting the competences of a strong core community to those of more specialized European countries, and
- developing framework conditions that facilitate a multi-actor engagement and a balanced and early involvement of cities and urban stakeholders in research projects to ensure high impact and a mutual benefit form transdisciplinary research.

BUILDING UPON AND
ALIGNING NATIONAL STRATEGIES
THE BENEFIT OF
TRANSNATIONAL COOPERATION

Analyses of European cooperation patterns in the field of research, technologies and innovation for urban development demonstrated the importance and role of national strategies and programmes – addressing national needs and priorities and preparing the national community for European level collaboration. Transnational cooperation takes advantage of these national activities by connecting them on a European scale, enhancing profiles and competencies, increasing efficiency, fostering innovation and implementation and benefitting from sharing experiences. Figure 3 summarizes the objectives and expected added value of developing and implementing the Strategic Research and Innovation Agenda of JPI Urban Europe.

ENHANCING PROFILES & COMPETENCES

- Connecting national strengths

- Cover national gaps

- Establish knowledge cluster

- Rethink national strategies

INCREASING EFFICIENCY & INNOVATION

- Sharing research infrastructure

- Exchange of experts

- Harmonising research frame-works for better solutions

- Joint calls and evaluation panels

MUTUAL PRACTICE & LEARNING

- Comparative research

- Sharing models and experiences

- Improving practice and reducing non-successful projects

Figure 3: Alignment objectives and added value of transnational cooperation

In the case of JPI Urban Europe this alignment strategy is based on the landscape of national urban research programmes that has developed over the last years. Thematic, urban related programmes are established in many European countries; or else urban research and technological development may be funded under open responsive calls for proposals. Analysis of urban research programmes of 9 JPI Urban Europe countries including 32 national programmes covering all phases in the research life cycle, from basic research to technological development, piloting, demonstration and training, suggests a shift from rather sectorial programmes and calls to a more integrated approach to urban research, technological development and innovation. Indeed, some thematic clusters are identified that provide a sound basis for joint calls as well as future bi- and multilateral calls and alignment activities, such as the Smart City Cluster or a Future Mobility Cluster. A corresponding alignment strategy is under development reflecting the thematic priorities of the SRIA and the national potentials and priorities in current or future research, technological development and innovation programmes.

– 7 –

JPI URBAN EUROPE:
GLOBAL URBAN CHALLENGES –
JOINT EUROPEAN SOLUTIONS

The ongoing policy debate on urban development clearly indicates that: (1) sustainability remains high on the agenda; (2) efforts should be both intensified and enlarged to develop and implement better integrated and more comprehensive sustainable development pathways; (3) to support this endeavour, fragmentation in policy and in research needs to be overcome; requiring multi-stakeholder involvement in a process of co-creation.

The **Joint Programming Initiative (JPI) Urban Europe** has the ambition to support the transition of European urban areas towards sustainable, resilient and liveable ones by establishing a transnational mission-oriented research, technological development and innovation programme and acting as the European hub on sustainable urban development; supporting collaborative research, technological development and innovation within and beyond Europe.

We know that **urban areas are complex systems**, or indeed systems of systems, whose emergent physical, social and economic structures depend on the interactions of the cities, administrative bodies, firms and individuals that inhabit them, as well as on their interactions with other cities in this era of globalisation. Cities are vibrant loci of education, employment and commerce, social encounter and recreation; they are the nerve centres of the modern global economy and as such they continue to attract migrants in search of a better quality of life for themselves and their families. This economic and social activity entails the metabolism of energy, matter, finance and information, highly influenced by the increasing digitalisation and new urban technologies. The throughput of these resources can have negative implications for raw materials depletion, greenhouse gas emissions and climate change. To minimise this dependency, we need to radically improve our understanding of how the functioning of our urban areas can be made more sustainable and resilient to climate change, and which role technological and social innovations can play, the current economic asset of Europe in global markets. Urbanisation brings with it other societal challenges. Increased disparity in income and in social inequality can adversely affect social capital and cohesion and in the worst of cases exclusion of access to home ownership, education, welfare and healthcare. We need to better understand how we can balance economic growth with social and economic equality, to balance vibrancy with accessibility, within carefully defined and measurable environmental limits.

The demand for new urban governance concepts, new approaches for urban planning and development and low cost technological solutions following such an integrated approach has been confirmed by city representatives as well as local and European

policy makers[25]. Economic disparities that lead to social ones, pressures on urban development and services provision due to financial constraints and in-migration, the need for economic growth and improved employment prospects, the call for more social innovation and an increased participation of civil society, the need to set and achieve greenhouse gas emission reduction targets. These are related challenges that have been identified as research, technological development and innovation priorities needing multi-stakeholder involvement and a better understanding of urban complexities.

Through a better coordination of national research, technological development and innovation funds and the application of dedicated instruments and measures, we aim to achieve the following **objectives**:

▶

- Enhancing capacities and knowledge in sustainable urban transitions by developing (radical) new ideas and solutions that meet the needs of cities and citizens.
- Reducing the fragmentation in the funding and delivery of research, technologies and innovation, in policy formulation and implementation; building critical mass.
- Increasing the visibility of European urban science, technological development and innovation at the global scale: providing international leadership in the planning and practice of sustainable urban transitions.

To this end a **set of principles** has been identified which build the fundament of the JPI Urban Europe programme:

▶

- **A mission- and demand-oriented, long-term programme addressing city and societal needs.** To achieve sustainability requires a long-term strategy, whilst also providing a framework for innovation in the achievement of shorter term complementary needs. This requires a combination of multi-timescale research, technological development and innovation activities.

- **Interdisciplinary approaches to enhance understanding of urban complexity** and generate radical new knowledge and concepts to tackle urban society's multifaceted challenges. Relevant expertise and knowledge from the range of urban-related disciplines needs to be better and more systematically brought to bear (natural sciences, the social and economic sciences, engineering and technology, planning, architecture, the arts…) in our quest for cities that are more vibrant and resilient hubs of economic and social activity, whilst minimising unintended social and environmental consequences.

- **Transdisciplinarity, in order to ensure impact and relevance.** Urban research should develop understanding, knowledge, tools and evidence to underpin the formulation of *effective* urban transition policies and strategies. It should also support subsequent *implementation* and contribute *sociotechnical innovation* to this end. This requires collaboration between interdisciplinary research teams, businesses, cities and other urban stakeholders; to ensure that the entire research, technological development and innovation cycle is addressed, that a milieu for co-creation is established and that outcomes successfully inform

policy and implementation and subsequent monitoring of effectiveness. These aims may be supported through shared resources including integrated urban models, datasets, urban observatories and urban living labs.

A PROGRAMME ON TRANSITION TOWARDS SUSTAINABLE AND LIVEABLE URBAN FUTURES

The conceptual framework of the JPI Urban Europe SRIA has been informed by ongoing policy debates, national urban research strategies and priorities, international research activities and the outcomes of recent EU-funded projects and initiatives[26], together with the outcomes of dedicated consultations with urban stakeholders in a process of co-creation. This framework is summarised in Figure 4 and described in the text that follows.

TRANSITION TOWARDS SUSTAINABLE AND LIVEABLE URBAN FUTURES

Figure 4
Framework of the SRIA

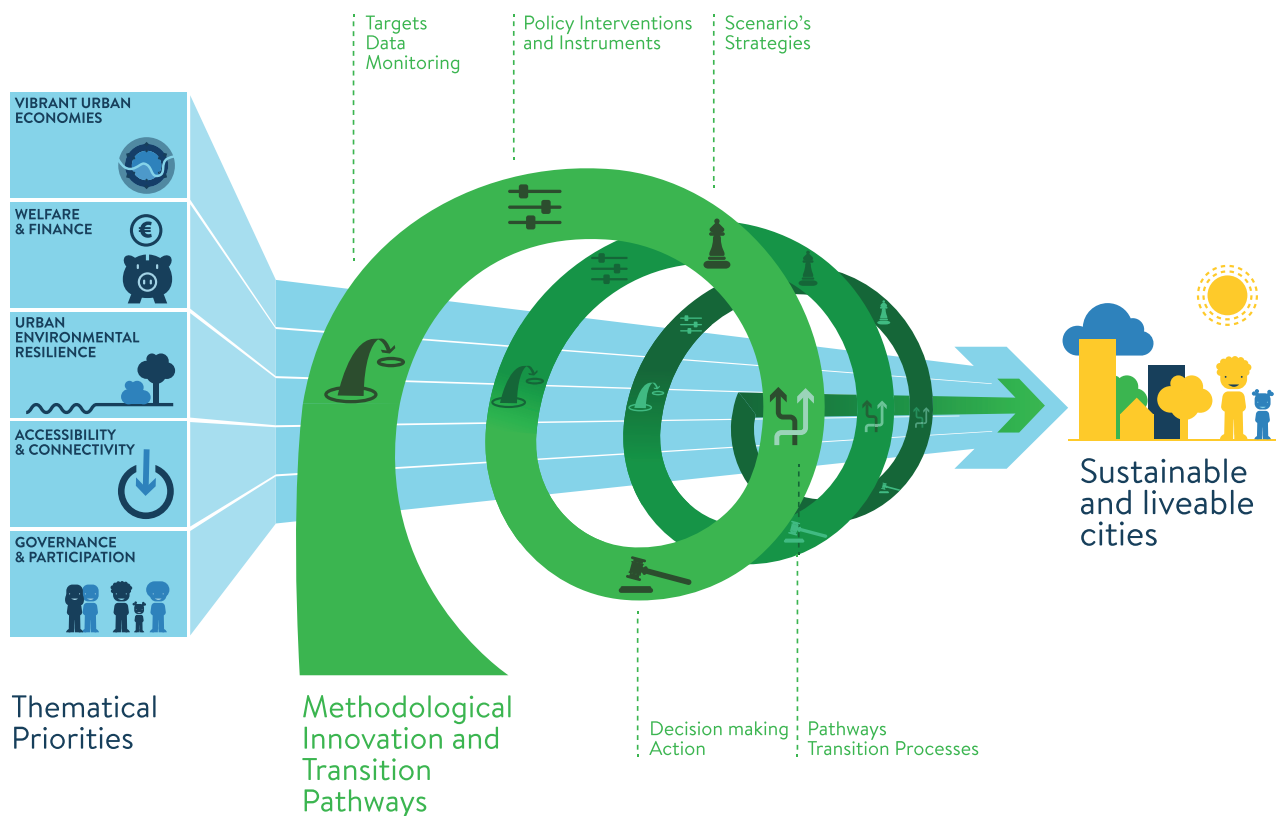26 In particular the EU-funded projects SEiSMiC and Urban-Nexus are considered. The conclusions of the Urban-Nexus project (www.urban-nexus.eu) provide an important reference for the elaboration of the research priorities. In addition the still ongoing project SEiSMiC (www.seismicproject.eu) focuses on social innovation needs for urban development and brings the societal view into the strategic debate.

TRANSITIONING TOWARDS SUSTAINABILITY AND LIVEABILITY: A LONGITUDINAL PROGRAMME

The dominant theme emerging from debates of the challenges faced by European urban society is the need to improve upon its sustainability, in all of its complexity; to better understand how we can create economic growth and social and economic equality – vibrancy and accessibility, within carefully defined and measurable environmental limits. The core issues at hand are:

- Enhancing our understanding of the complexity of urban sustainability in the nexus of economic-social-environmental issues.
- Providing a framework to assess and monitor urban sustainability.
- Identifying and quantifying the levers that influence sustainability and its constituent factors as well as the interrelationships between them.
- Preparing and testing context-specific transition strategies.
- Providing tools and methods that support cities in this decision making process, as well as to support the implementation of the most promising strategies.
- Taking advantage of new data sources, the opportunities provided by big data and their potential for urban decision making and governance.

There is at present no theoretically rigorous and empirically grounded **definition of and framework for evaluating urban sustainability**. Sustainability is here understood as the nexus of economic-social-environmental issues faced by urban regions, societies and governments. At the same time, global ecological crises call for a substantial reworking of, in particular, how urban regions are planned, built, governed, managed, practiced – and therefore researched. The development of an advanced framework is therefore required to define and measure sustainability and to determine where a city lies in its transition towards the achievement of its sustainability goals; be these short, medium or long term.

These **transition targets** should be ambitious yet feasible as well as inclusive; representing for example the range of city specialisations, spatial scales, economic growth trajectories and geographic contexts and the interests of the range of core stakeholder groups.

Of equal importance to identifying, understanding and quantifying the factors influencing all key aspects of sustainability is identifying, understanding and quantifying the **policy interventions that can bring about change**, be these positive or negative, and the potential interrelationships between them. Whilst these may take many forms, it is important to understand where the greatest potentials, or indeed risks, lie to help prioritise transition strategies.

This requires a **decision making framework** that enables the effectiveness of city-specific transition strategies to be studied; to identify the most promising transition pathways from cities' current to target states. To inform urban governance and policy making processes, it is important that relevant stakeholders have access to and utilise decision support systems with which to test and compare alternative strategies to improve services and performance. These services might relate to healthcare, mobility, welfare, energy supply; whilst performance might relate to the interconnections between social (cohesion, inclusion, housing provision...), economic (employment levels, income equality, local authority indebtedness...) and/or environmental (greenhouse gas emissions, urban heat island...) measures.

Such decision support frameworks require that data of different scales (region (whether national or transnational), city, district, street, neighbourhood, building, household) and rates of change (from slow changing infrastructure to instantaneous flows of traffic, energy and water) be managed and integrated. Science is at an embryonic stage in investigating the potential of big data for urban operations and development. Data acquisition, analysis and management for decision making as well as for urban planning and governance, needs to be investigated to support sustainable urban transitions.

THEMATIC PRIORITIES

The following themes have been identified as particular priorities, where JPI Urban Europe and the research effected directly or indirectly under its auspices, can make a significant and lasting contribution. This contribution can take the form of new methodologies, new insights and data evidence allowing an increased understanding of urban systems, new technologies, and implementation of innovative solutions:

Vibrancy in changing economies: Cities are engines of economic growth and the places where innovations emerge. Yet some cities are economically more successful than others. Across Europe we find cities with rapid economic growth and severe decline as well as cities with a re-growing economy. These trajectories as expressions of vibrancy are closely related to population dynamics in terms of growth or shrinkage. We need a better understanding of the factors that drive the economic success or failure of cities. We need to know how innovation shifts the size and segmentation of labour markets and how migration patterns change in response to these shifts. Furthermore new strategies are necessary to combine the creation of economic opportunities with social innovation in order to create open, inclusive, cohesive and more liveable cities. In short we need to find new ways of achieving and sustaining socio-economic vibrancy and equality in cities with changing economies.

Welfare and finance: Stimulated by post-2008 austerity measures, civic services and the size of the welfare state are reducing as civil society is being increasingly called upon to fill the void through bottom-up voluntary efforts. This leads to changing roles of public services and the need to redefine the contribution of and cooperation with community-based activities. It also results in the call for new business models. The role of social entrepreneurship, local economy and shared economy is under debate and frameworks are needed to tap the full potential of these opportunities, as well as social innovation. New business models and financing schemes are also required to support sustainable urban transitions and smart cities developments, potentially with solutions that transcend vertical structures from individuals, through cooperatives, to firms, and local and central government; possibly augmented with policy and regulation to support and incentivise the effective uptake of the investments arising from these models.

Environmental sustainability and resilience: Urban areas are dependent on inflows of materials, energy, food, water, products and services. Through this metabolism cities are causing negative environmental externalities at a planetary scale. But cities are also themselves victims of these externalities through e.g. climate change and extreme weather conditions, poor air quality and declining ecosystem services. Cities must both change this metabolism in order to satisfy Europe's commitments to curb climate change (to keep warming to within 2°C of pre-industrial levels through reduced greenhouse gas emissions) as well as to adapt to climate change and to be resilient to less probable events with potentially severe consequences. Partly because of climate change, water scarcity will affect increasing numbers of the world's population. Water quality, air quality and the resilience of ecosystem services are issues that cities must handle in order to continue to be attractive and vibrant. Technological and social innovations will play a pivotal role in enabling cities to do so.

Accessibility and connectivity: Cities' economic competitiveness and citizens' quality of life in urban areas are directly influenced by the accessibility of urban amenities and services within and beyond cities as well as by connectivity. Accessibility is a function of proximity to destinations and the directness of routes to them (the connectivity of the network), but it also depends on travellers' ability to utilise this network, which may for example diminish as travellers become older and less physically able or emotionally secure or simply through changing economic circumstances. The mobility of goods and people is often assumed to be in conflict with environmental sustainability. But analysing transport systems through the lens of accessibility and connectivity can facilitate the joint pursuit of mobility and sustainability goals. This change of paradigm requires new research relating to: a) travellers' needs, their behaviours and locational proximity; b) the design of new technologies supporting improved integration of land use and transport systems; c) bridging the gap between travellers' needs and behaviours to improve urban performance. This paradigmatic shift also requires an improved understanding of the sectorial changes at stake, their interrelationships and their overall effects on urban performance.

Urban Governance and Participation: Strategies to transition cities to a more sustainable and resilient future state will, if they are to be successfully designed, adopted and implemented, arguably rely on collaborative processes involving all key stakeholders, from public and private organisations to concerned civil society. New forms of governance are also called for by the changing nature of urban issues, especially the increasing importance of 'real time' in urban governance and management, e.g. in the face of the growing importance of extreme events. This will involve an enabling environment of new collaborative governance and policymaking frameworks to ensure productive and creative engagement. The utilisation of big data, new enabling technologies and methods to support these participatory approaches hold great potential here.

RESEARCH THEMES

SUSTAINABLE TRANSITION PATHWAYS

Motivation

Population (P, Capita = Ca) and economic activity (A, GDP/Ca) as well as the environmental impacts per unit of economic activity (T, e.g. tCO_2/GDP) – are thought to be proportional to environmental impact (I, tCO_2 in this example): $I = P.A.T.$ But this is not a forgone conclusion. Following the 1973 oil crisis, Europe's energy expenditure and CO_2 emissions reduced considerably. This was due to improvements in for example: standards of energy conservation and efficiency in buildings; industrial process efficiencies (and reduced industrial activity); vehicular mechanical efficiencies; deployment of renewable energy technologies; use of more efficient energy conversion technologies in power stations. By reducing the environmental impacts of our economic activity, it could be possible to accommodate both population and economic growth without increasing impacts on our global and local environments.

This is an important observation, as both population and economic activity are on average increasing. Since the majority of our future population will reside in towns and cities, it stands to reason that these settlements will play a pivotal role in the quest for more sustainable living. New ways of accommodating more and wealthier people must be invented, having increased standards of living in towns and cities, with reduced environmental impact. A key global and thus European challenge is to radically transform how cities function; to improve their environmental sustainability whilst simultaneously increasing their resilience to the vagaries of social, economic and environmental shocks.

Just as global fortunes are changing, with E7[27] states set to overtake the G7, so there are considerable changes in fortune within Europe, with migratory flows and increasing social diversification, as well as aging due to healthcare improvements, accompanying these changes. The nature of the state is also changing; public services are being rolled-back and the welfare state is being cut as economies liberalise; changing the social characteristics of urban locations. After a century of societies becoming more equal and egalitarian, cities in many cases are becoming more socially polarised, with growing wealth inequalities, increased segregation between groups, and rising social tensions. Sections of society are being denied full participation in everyday activities and marginalised with respect to resources such as housing, work, social services and the political sphere. This is often manifest in social stratification and fragmentation, segregation to certain parts of the city, alienation, and undermines social cohesion leading to social unrest, protest and riots; as witnessed recently in a number of European cities. Such issues pose significant threats to cities' long-term social stability, unless adequately addressed.

To summarise then, whilst cities are the engines of economic activity, of resource metabolism and its adverse environmental consequences and of social mobility, there is a dearth of understanding of the forces influencing the associated dynamical flows of finance, information, energy, materials and people; the impacts on firms' and individuals' wellbeing and of strategies for improving them. There is an urgent need for transformative interdisciplinary research to radically improve our understanding of the complex, interrelated and competing factors influencing cities' social, economic and environmental sustainability, underpinned by quantitative and qualitative research into cities' functioning and the effectiveness of strategies and policy measures for improving upon this functioning.

TOPICS TO BE ADDRESSED

To achieve the anticipated improvement in our understanding of cities' functioning and sustainability, and the considerable complexity that this entails, we see two core challenges:

1. To better understand what we mean by city[28] sustainability: to define, measure and rate or categorise city sustainability.
2. To support city actors in defining sustainability targets and in making the transition towards their achievement.

Our efforts in defining, measuring and labelling or categorising sustainability will define the present state of a city; but city actors will need support to define a future target state which is ambitious yet achievable and more particularly to determine the most promising strategies to be employed to achieve these transitions and to translate these into realisable projects.

We describe below a research programme designed to improving our understanding of city sustainability, the setting of suitable targets and transitioning towards their achievement.

27   See footnote 19

28   For linguistic simplicity in this section we use 'city' in place of 'urban', acknowledging that the latter, which should be our focus, is broader than the former.

Understanding sustainability

There have been numerous endeavours to rate *aspects* of city sustainability, with environmental sustainability having received particular attention. But the results are neither comprehensive – accounting for the environmental, social and economic pillars and their myriad factors – nor are they rigorous – having been developed upon solid theoretical and empirical foundations. Theoretical advances should be combined with analysis of empirical evidence from a representative cross section of case study sites to define a new methodology for characterising the overall sustainability of a city; isolating the influences of the principle underlying factors to help identify where efforts should be focussed for further improvement. It is also important to identify what the forces are that influence these factors and how they relate to one another (for example, understanding the relationships between economic growth, inwards migration and social cohesion) and how negative effects can be mitigated and positive effects reinforced. It is similarly important to understand how and to what extent social and economic factors influence environmental factors of sustainability (for example firms' and individuals' perceptions of their environmental footprint and their willingness to reduce it) and vice versa (such as health impacts arising from environmental impacts).

But as noted earlier, cities should not only strive for a more sustainable future, they should also be resilient and able to absorb, adapt to and recover from external or internal forces for change; be they social economic or environmental in nature; fast or slow in character. This will help to ensure that cities' transition strategies are robust to these forces, that they continue to evolve towards a more sustainable future when subject to them; that they do not diverge towards less favourable future states.

Transitioning towards sustainability: targets and strategies

By far the most onerous pillar of this proposed research programme is the identification of transition targets and the most promising strategies and accompanying action plans, translated into realisable projects, to be employed in achieving them.

Informed by the outcomes from the above a process should be established to identify social, economic and environmental transition targets, ensuring that these are ambitious yet feasible and that they are inclusive; representing for example the range of city specialisations (culture and tourism, industry, innovation…), spatial scales (small to medium sized cities, mega-cities and city regions), economic growth trajectories (declining and depopulating, through stability to growing and populating) and geographic contexts (coastal, inland, mountainous…) and the interests of the range of core stakeholder groups.

Of equal importance to identifying, understanding and quantifying the factors influencing social, economic and environmental aspects of sustainability is identifying, understanding and quantifying the levers that can bring about change (by quantifying here we refer to the response to a given lever change), be these positive or negative, and the potential interrelationships between them. These levers may for example be social (peer influences), educational (public engagement; primary, secondary and tertiary teaching), socio-technological (more efficient utilities and transport infrastructure; e-governance tools), regulatory (planning instruments; construction regulations…) or financial (taxation, subsidies, loans). Whilst these may take many informs, it is important to understand where the greatest potentials, or indeed risks, lie to help prioritise transition strategies.

The next logical step is to integrate the knowledge gained from the previous steps into a decision making framework that enables the effectiveness of city-specific tran-
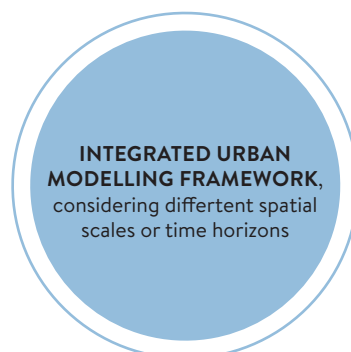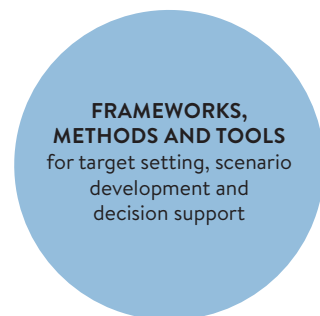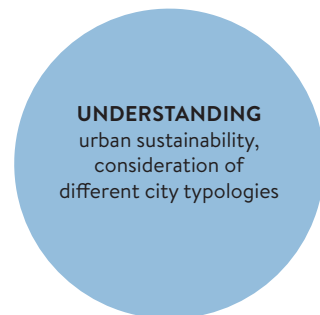
sition strategies to be studied; to identify – through a transdisciplinary approach – the most promising transition pathways from cities' current to target states. This implies that we first characterise the current (social, economic and environmental) state of our city and then adapt the typology-dependent targets to the particular context of this city.

A decision-making framework to support the evaluation of transition strategies might take many forms. It may simply involve a deliberative exercise amongst key stakeholders in which city-specific candidate transition strategies are identified, followed by the application of multiple decision making criteria to iteratively exclude the less promising until the most favourable candidate solutions remain. An alternative would be to complement this process through computer simulation, with which the impact of specific transition strategies on the performance of the city would be simulated. This would require that the knowledge gained elsewhere in the programme of funded work be embedded within a (physical and social) simulation framework: the phenomena influencing resource flows and the levers to bring about change in the behaviours of the firms and individuals responsible for these flows; perceptions of sustainability and its numerous component parts. Encoded at an appropriate level of abstraction, this would provide powerful decision-making support – providing quantitative feedback on the effectiveness of alternative strategies as part of a multi-criteria decision making analysis process involving key city stakeholders.

The final step in involves supporting stakeholders in translating specific strategies into actionable implementation plans and associated financing strategies, to transition cities along the pathway from current to target states. This co-creative transdisciplinary process should also incorporate plans to monitor the effectiveness of implemented transition strategies; socially, economically and environmentally.

ROADMAP

SUSTAINABLE TRANSITION PATHWAYS

UNDERSTANDING
urban sustainability, consideration of different city typologies

↓

FRAMEWORKS, METHODS AND TOOLS
for target setting, scenario development and decision support

↓

TRANSITION STRATEGIES AND VALIDATION of tools, methods and frameworks

↓

INTEGRATED URBAN MODELLING FRAMEWORK, considering different spatial scales or time horizons

VIBRANT URBAN ECONOMIES: GROWTH AND DECLINE OF EUROPEAN CITIES

Motivation

Cities are engines of economic growth and the places where innovations emerge. Yet some cities are economically more successful than others. Across Europe we find cities with rapid economic growth and severe decline as well as cities with a re-growing economy. These trajectories as expressions of vibrancy are closely related to population dynamics in terms of growth or shrinkage. Economically prosperous cities experience in general in-migration of people from declining regions but also immigration from abroad. In contrast, economically declining cities experience population loss, mostly of the young generation which increases the average age of the remaining population. Both cases have links between economic performance and labour market outcomes which are complex and context specific. Not every citizen profits from the economic opportunities which exist in a city in the same way.

JPI Urban Europe: Transition towards sustainable and liveable urban futures

Major innovations such as new production and service systems can lead to more employment opportunities in cities. To pursue this target, circular economies including "green economies" and the close collaboration with practitioners and stakeholders are decisive. For example, new infrastructure types need to be identified that include citizens as producers and consumers and in addition integrate different services in a new cycle.

These developments not only impact the economic performance of cities but also the living conditions of the population. More localised economies can enhance the equal access of citizens to new services and infrastructures, and increase their responsibility in terms of sustainable consumption. Thus there is a need for sustainable production and consumption patterns to drive social cohesion within vibrant urban dynamics and to avoid negative outcomes such as increased exclusion and polarisation.

We need a better understanding of the factors that drive the economic success or failure of cities. Cities themselves evolve into economic actors by taking over an active role in offering innovative and creative environments and defining their future perspectives. We need to better understand how innovation shifts the size and segmentation of labour markets and how migration patterns change in response to these shifts. Furthermore new strategies are necessary to combine advanced economic opportunities with social innovation in order to create open, inclusive, cohesive and more liveable cities.

TOPICS TO BE ADDRESSED

Understanding success and failure of agglomerations and smaller cities

Cities and urban agglomerations have become focal points in the global economy and the hallmarks of the competitiveness of nations. The economic growth of Europe will therefore depend on the success of its cities in the global market. The major and most successful players are urban agglomerations, in which three types of advantages exist: sharing, matching and learning. As a result of larger and denser populations in urban agglomerations, firms not only have a larger home market (workforce and consumers) but they can also share the city's high level amenities like educational institutions (including universities), research centres, harbours, airports, leisure facilities or a diverse service economy. Larger markets also allow more specialisation, as the probability of successfully matching supply and demand increases (localisation advantages). Proximity and local variety also facilitate knowledge spill-over and enable learning processes that trigger social and technological innovation. City councils and municipal administrations provide the framework to connect and strengthen these advantages and to minimize agglomeration disadvantages like the unequal distribution of increasing wealth, higher crime rates, congestion and pollution, segregation and a reduction in affordable housing.

MAIN RESEARCH QUESTIONS

- Is specialisation and innovation really dependent on the mass of the agglomeration or is a dynamic evolutionary view in which new activities arise from older competences and place based qualities more appropriate?

- To what extent can alternative strategies which aim at improving the connectivity and complementarity among cities – also across national borders – contribute to the sharing of amenities and allow specialisation within and across sectors, whilst preserving access to employment for lower income households?

- How can more isolated cities team up in a joint strategy of complementary economic development, and which institutional and geographical barriers need to be addressed to support such a strategy?

- What are the driving forces that determine the adaptive and innovative capacity of cities to 'reinvent' themselves and to re-grow?

Besides the big metropolitan areas, Europe's urban landscape consists of a mix of smaller and medium sized cities. They are more isolated and only loosely connected with metropolitan networks. Many of them are not competitive and face urban decline and shrinking populations. Probing deeper one finds that many smaller European cities are less troubled by the mentioned agglomeration disadvantages. Some of the smaller cities have fostered smart specialisation and are doing remarkably well. Some experience an economic re-growth after a period of decline.

Further research is required: i) to understand how urban agglomerations form, and to identify the impacts that agglomeration and specialisation effects have on economic functioning and on societal wellbeing. Of particular value is to understand how advantages can be reinforced and disadvantages minimised or avoided; ii) to identify effective strategies for the development of isolated smaller and medium-sized cities considering their restricted financial and human resources and local environmental contexts. Transferable experiences, knowledge and good practices are of particular interest.

Detecting labour market turbulence and its consequences for city liveability

The diverse economic development of cities in Europe impacts on their liveability and on their labour market operations. On the one hand, many cities have failed to make the transition towards the knowledge economy, including smart specialisation in industry, and this has led to structural unemployment. Many low-skilled labour workers have found their skills to be obsolete and their workforce to be redundant, so that they depend on welfare arrangements for their livelihood. In cities with manufacturing and chemical industries with renewed production bases, economic growth has not been matched with job creation, as capital intensive technological innovations have displaced jobs. On the other hand, cities which have transitioned towards a service-based economy, have witnessed a shift in the labour market towards larger segments of more highly skilled employees and a growth of labour demand in basic services linked to their population growth. Many of these positions have been taken up by migrant workers. Free labour movement in Europe has increased competition at the lower end of the labour market, as migrant workers offer their labour in a context of differentiated welfare arrangements and labour legislation.

In addition the triple crisis (financial, currency and real estate) has hit European economies. The private sector responds by laying off a substantial part of its workforce, and the public sector has in many cities introduced austerity measures, leading to a loss of jobs in public services; the situation exacerbated by reduced unemployment benefits. Entrants to the labour market, young people and migrants in particular, found their opportunities for gainful employment blocked, so that their position in the urban labour market has become precarious.

The current debate is whether the urban economic systems will revert to their pre-crisis state or whether more profound shifts are taking place. Further complicating factors are disruptive technologies and market innovations (winner-takes-all) that can threaten the employment of both low- and medium-skilled employees.

These tendencies have already caused social tensions and disturbances, which have been concentrated in large cities. If labour market turbulence further intensifies, social tensions will be exacerbated, affecting the quality of life as well as the attractiveness of these cities.

MAIN RESEARCH QUESTIONS

- What is the reciprocal relation between the system of labour migration and the urban economic system; do jobs direct migration or is migration also a force in economic development?

- Which innovations are required to improve social and economic inclusion; particularly of those whose skills have become obsolete or whose labour has become redundant in urban economies in transition?

- How can new production and service systems in terms of circular economies including "green economies" and the close collaboration with practitioners and stakeholders create more employment opportunities?

- How can youth employment and economic growth opportunities best be matched?

The governance of economic transitions: from competition to collaboration

Current European governance is dominated by the creation of a single market: regulation to create a level playing field and to harmonise national policies through European directives. With metropolitan regions and cities becoming a dominant competitive unit in the global economy, we may need to look for other partnership mechanisms within and across national borders. This could range from Pan-European cooperation in sectors that profit from scale advantages (aviation, transportation, communication), through city-partnerships, to (groups of) transnational entrepreneurs. The starting point for collaboration would be to identify the niche within the global economy for different types of cities.

MAIN RESEARCH QUESTIONS

- Which policies to stimulate the urban economy have proven to be effective and efficient, why do successful economic policies differ between cities and regions and what is the role of transnational entrepreneurship?

- What is the best way to deal with urban regions in economic decline? When is decline inevitable and how can policies ameliorate the consequences or even counter this decline?

- How can European urban areas shift from competition to collaboration in partnerships that welcome specialisation, complementarities and synergy?

UNDERSTANDING
agglomeration and smaller cities dynamics in the context of urban specialisation and innovation

CITIES AS ACTORS
promoting sustainable production and consumption patterns to drive social cohesion

IMPACT OF MIGRATION
on economic development, employment and social inclusion

URBAN TRANSITION AND INNOVATION CAPACITIES
built upon national and cross-boundary cooperation and partnership

JPI Urban Europe: Transition towards sustainable and liveable urban futures

WELFARE AND FINANCE

Motivation

Stimulated by post-2008 austerity measures, civic services and the size of the welfare state are reducing as civil society is being increasingly called upon to fill the void through bottom-up voluntary efforts. This leads to changing roles of public services and the need to redefine the contribution of and cooperation with community-based activities. It also results in the call for new business models. The role of social entrepreneurship, local economy and shared economy is under debate and frameworks are needed to tap the full potential of these opportunities as well as social innovation.

Poverty in urban areas is increasingly clustered territorially, including a growth in inequalities relating to housing, employment, energy poverty, education and training and accessibility to (public) services such as healthcare, transport infrastructures, and ICT in general; with a widening of the 'digital divide'. As the difference between contributors to and beneficiaries of welfare services increases, this situation risks generating urban social unrest and intolerance.

There is of course no easy solution to these welfare challenges. Progress requires multilateral efforts combining a range of responses and underlying business models. Social innovation and other forms of co-creative activity to shape, design and deliver urban welfare services hold much promise. Such co-creative approaches can also render the underlying services more resilient to socioeconomic pressures, particularly in the co-design of policies and new development models that reconcile global economic competitiveness with sustainable local economies, and to counteract urban segregation.

New business models are also required to support sustainable urban transitions. The investments required to achieve radical transitions in cities' environ-

mental performance – to decarbonise them, render them more resilient and improve their adaptive capacity – whilst simultaneously maintaining or improving upon their liveability and economic productivity, are likely to be of an unprecedented scale. These investments will require careful planning and may benefit from creative partnerships between public and private institutions; even with citizens and groups of them.

TOPICS TO BE ADDRESSED

Changing roles of public services

Public services were mainly developed under a strong rational planning paradigm, with a high degree of centralisation that rendered municipal or even regional administration of public services uniform. But uniform and inflexible services rarely respond well to the demands and dynamics of urban communities at the levels of cities, districts and neighbourhoods. New methods and tools are needed for more effective, representative and adaptive local decision-making and the delivery of solutions arising from these decisions; to make urban areas effective drivers in sustainable urban transitions.

Specific priorities in the design and delivery of innovative public services to improve societal quality of life and health include the provision of: green and more vibrant public places, infrastructures that support good quality of life, pathways to achieve inclusive societies subject to demographic change arising from migration and aging; technological development to increase accessibility; while modes of delivery may require innovations in land readjustment policy, even constitutional reforms.

MAIN RESEARCH QUESTIONS

- How to co-design and co-create innovative solutions for urban public services concerning quality of life and health; green and vibrant public spaces; urban segregation and polarisation?

- How to enable research, technological development and innovation in new and collaborative service delivery models to enhance cohesion and inclusion?

Redefine the contribution of and cooperation with community-based activities

Cities play an active role in shaping the connections and social processes that take place within them. Urban planning, design, and governance can help to support creative and inclusive communities, or they can literally build walls between groups and close down possibilities for interaction and innovation. There are many explanations for why some cities face challenges in mobilising and integrating different communities such as: digital exclusion; lack of appropriate technologies or infrastructures; centralised and bureaucratic planning processes; language, education or skills barriers; discrimination. These failures and their consequences – which include slower growth, reduced wellbeing and health outcomes, lower community and democratic participation, higher rates of crimes, growth in racial, religious and ethnic violence – have significant impacts on the quality of urban life, on social inclusion and cohesion. These 'wicked issues' should be reflected upon in the formulation and implementation of urban policy.

MAIN RESEARCH QUESTIONS

- How to enable community-based activities and achieve social innovation to tackle unemployment and increasing urban inequalities?

- How community-based action in urban planning, design, and governance may be conducive to inclusion and creativity in policy towards urban transition?
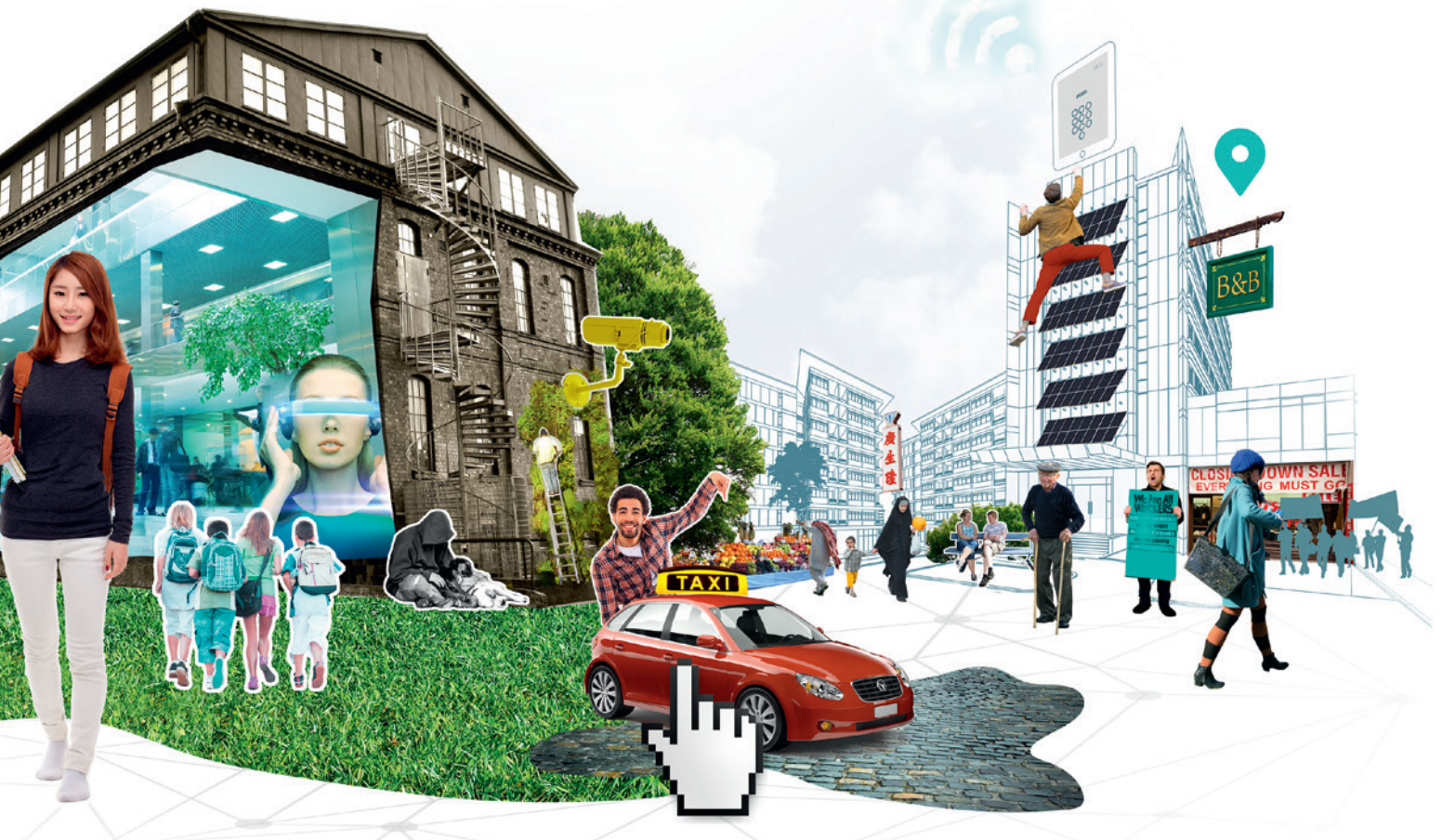
New business models to finance sustainable urban transitions and smart city developments

Given the likely scale of required investments to achieve transitions to more sustainable, liveable and economically productive futures, including the challenges facing urban welfare systems, conventional business models and centralised state provision may be outmoded; alternative, more inclusive and more resilient models may be required. This includes the financial sector players – e.g. pension funds and most importantly insurance companies – that are today facing issues in insuring calamities related to abrupt shocks induced by long term developments in climate change. The new models may include crowd-funding, cooperatives and public-private partnerships; likewise, in case where significant public investments require compromises elsewhere, new forms of public engagement and co-productive practices – social innovation – may be required.

UNDERSTANDING NEEDS
for new public services, community-based action and new welfare schemes

FRAMEWORKS
for new financial instruments to support smart cities and a circular economy

INCLUSIVE URBAN WELFARE
and new public-private collaboration for urban sustainability

NEW BUSINESS MODELS
and financing schemes for urban transition

JPI Urban Europe: Transition towards sustainable and liveable urban futures

- Understanding how more empowered local authorities can best finance the delivery of their plans; including through taxation, levies, land readjustment policies and through planning gain.

- Understanding under which circumstances municipalities and private enterprises can engage in close and effective collaborative practices and how these practices can be best encouraged and facilitated.

- The identification of new viable forms of business model that include civil society e.g. forms of crowd-funding in which civil society co-funds and co-creates urban development and infrastructures.

- Understanding to what extent business models can be vertically inclusive; involving state (national and / or regional or city scale), private institutions and citizens and cooperatives of them; to what extent regulation and policy support can incentivise these practices.

- Defining effective mechanisms to engage with the public in the co-creation of investment solutions that may require short-to-medium term compromises; favouring investment in one form of infrastructure or service at the temporary cost of another.

URBAN ENVIRONMENTAL SUSTAINABILITY AND RESILIENCE

Motivation

The achievement of international commitments to *mitigate* climate change will require significant greenhouse gas emission reductions; carbon dioxide in particular. This will have significant impacts on cities' metabolism of energy and materials. Moreover, climate change *adaptation* requires changes in long-term planning in order to build resilience, and adaptive capacity. Climate change is however not the only environmental issue cities have to face. Poor air and water quality cause major health risks, but these risks can be mitigated through reduced emissions and effective ecosystem services which can simultaneously improve the attractiveness of cities. Indeed developing these services can help to attract and retain skilled workers, advance technological development, and help to stimulate economic growth.

TOPICS TO BE ADDRESSED

Low (virtually zero) carbon cities

The European Union has committed to the achievement of the 2°C target; meaning that greenhouse gas emissions need to be progressively reduced to ensure that climate change induced global mean temperatures rise is limited to 2°C. This will require that Europe's cities are close to carbon neutral by the end of the 21st century. This will have a transformative impact; requiring radical improvements to the functioning of cities; from land and

MAIN RESEARCH QUESTIONS

- How cities should be configured to minimise their future carbon emissions, even to fully decarbonise, including the goods and services imported into them.

- How cities can be planned, developed and governed to achieve the transition to such future low or zero carbon future states; what the societal impacts might be.

- How to bring about the integration of new and "smart" technologies, which will form the basis of sustainable infrastructures of the future, enabling the transition to renewable resources.

building uses, through energy and water networks and underlying technologies, to food production and waste management strategies and techniques. These systems, and those that produce goods and services used by cities that originate outside of their borders, typically have high inertia meaning that long-term-planning and governance, including business models, is needed to support the transition towards more sustainable and liveable (low-carbon) cities.

Urban climate change: resilience and adaptive capacity.

Modern cities depend on a number of infrastructure systems: transportation, energy, information, water, sewage... These systems need to be resilient to internal and external forces for change, from abrupt and severe climatic shocks and cyber-attack to slow changing social attitudes. Resilience engineering is concerned with analysing and improving upon the resilience of networks and infrastructures; but typically in isolation from one another. There is considerable scope for applying and extending resilience science and engineering principles to the complex systems (of systems) that are our cities; considering the relationships between physical systems as well as with social and economic systems that operate in and between cities.

Inspired by natural ecosystems, successful strategies include developing diversity and redundancy and managing intra- and inter- system connectivity. In these endeavours it is also important to consider relationships between resilience and sustainability, to ensure that cities' trajectories towards meeting their sustainability targets are not deflected towards less sustainable social, economic and/or environmental pathways.

Even with a 2°C increase in temperature, adaptation to climate change is necessary. Rising sea levels and extreme events like floods, droughts and heat waves are examples of climate change impacts that will continue to or increasingly influence Europe's cities. Other potential impacts include drinking water scarcity, disease and

food insecurity. It is predicted for example that water scarcity will affect some 60% of the World´s population by 2025, while water quality is threatened by new and more harmful contaminants (pharmaceutical residues, pesticides, nano-materials etc). With higher temperature increases, larger impacts can be expected. A systemic approach is needed to better understand the environmental *and* the socioeconomic impacts of climate change; to enhance cities' resilience to them.

MAIN RESEARCH QUESTIONS

- How forces for change (incl climate change impacts) propagate through cities' physical, social and economic systems and how cities can be made more resilient – to dampen the propagation of negative impacts and to recover more quickly from them, to improve their adaptive capacity; how resilience science and engineering principles can support these endeavours. We also need to better understand how city resilience should be measured; accounting for multiscale system interactions (from neighbourhoods to the city and beyond).

- Which are the most effective strategies for improving upon cities' resilience, and the resilience of their component systems.

- The extent to which city resilience interrelates with sustainability; how negative outcomes can be predicted and avoided and positive outcomes enhanced.

- The planning and governance structures and social innovation strategies that should be fostered to improve cities' resilience and adaptive capacity to climate change; including building resilience to events with lower risks but larger impacts.

- Smart technological frameworks that support and underpin urban resilience.

Urban ecosystem services
Ecosystem services are the benefits and services that people derive from natural ecosystems. They encompass provisioning (food, water, fuel), regulating (climate, disease control, purification) and cultural (aesthetic and recreation) services that are based on overall supporting services (including primary production, soil formation and nutrient recycling). Cities depend on these ecosystem services within their borders and their hinterlands.

Nature based solutions to improve air quality control, noise and hydrological and micro-climate regulation are typically cost-effective, resource efficient and multi-purpose; simultaneously benefiting environmental, social and economic goals. Examples include greening cities to reduce urban heat island intensity, urban biodiversity and natural solutions to coastal erosion and improve air quality. Urban air quality is seen as particularly important, since it is estimated that poor air quality caused 400 000 premature deaths in Europe in 2010, corresponding to 8% of all deaths and 4 million life years lost. Current policy suggestions are expected to decrease the number of premature deaths
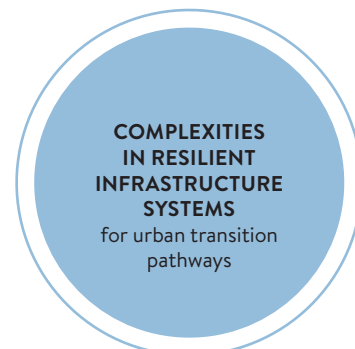
by a third up to 2030. More efforts will therefore be needed to reach the long-term target of air quality levels that do not cause significant impacts on human health and the environment.

Maintaining and developing ecosystem services can play an important underpinning role in improving cities' resilience to climate change and their adaptive capacity. These services and their effectiveness across domains need to be better understood; likewise planning and governance strategies for improving this effectiveness.

MAIN RESEARCH QUESTIONS

- What the specific benefits of urban ecosystem services are, which are the most effective of these ecosystem services, and which are the most effective strategies for enhancing them. This with a view to improving cities' resilience and adaptive capacity and well as citizens' quality of life.

- Which are the most promising general and/or city-specific planning and governance strategies for improving urban air quality and how city-specific strategies compare between cities; exploring synergies with other topics such as urban climate change mitigation and the strengthening of ecosystem services more generally.

ROADMAP

ENVIRONMENTAL SUSTAINABILITY & RESILIENCE

UNDERSTANDING URBAN ECOSYSTEMS, planning and governance of ecosystem services

↓

ADAPTIVE URBAN GOVERNANCE STRATEGIES and tools for CC and other critical events

↓

TRANSITION STRATEGIES AND TECHNOLOGIES to decarbonise cities and manage their societal impact

↓

COMPLEXITIES IN RESILIENT INFRASTRUCTURE SYSTEMS for urban transition pathways

ACCESSIBILITY AND CONNECTIVITY

Motivation

Accessibility represents the ease with which territorial destinations may be reached using a transport system. These destinations may relate to employment, leisure or a service such as education, healthcare or retail; access to which allows travellers to satisfy both their essential and their more complex aspirational needs, defining and defined by their personal identities.

Links between accessibility, territorial cohesion and social exclusion are important. The EU Cohesion Report (CEC, 2004) includes the spatial distribution of accessibility in its list of indicators to measure disparities amongst regions, since "equality of access" to "services of general economic interest" is considered a key condition for territorial cohesion. Accessibility using public transport services has also been highlighted as being of fundamental impor-

tance by the European Commission in its Green Paper (EC, 2007). Several researchers show that deficient public transport services (amongst other factors) increase social exclusion, particularly for less able or well off users; a situation compounded by the recent economic crisis, which has been found to influence both residential location and modal choice. People are travelling less and walkability is increasingly preferred.

Although mobility and accessibility are correlated, they are not necessarily complementary. In urban areas with high degrees of land and building use diversity (collocation of employment, leisure and service uses) mobility is not required for people to meet their needs. Likewise, high levels of mobility may be encountered from locations rich in transport infrastructure to distant destinations. Thus, if the purpose of a transport system is not one of movement but of access, transport policies should focus on mobility *reduction*. Pricing policies should also promote connectivity over speed. If transport systems facilitate quicker travel to remote retail and workplace locations, these behaviours will be reinforced, potentially at the cost of travel to and within more compact and clustered urban locations in which travel may be achieved using slower modes. Thus, mobility should not be considered in isolation from connectivity and proximity when evaluating accessibility. Indeed accessibility is a function of proximity to destinations and the directness of routes to them (the connectivity of the network), but it also depends on travellers' ability to utilise this network, which may for example diminish as travellers become older and less physically able or emotionally secure or simply through changing economic circumstances. Connectivity thus has social implications. Mobility influences social activities and the strength of social ties.

TOPICS TO BE ADDRESSED

The mobility of goods and people is often assumed to be in conflict with environmental sustainability. But analysing transport systems through the lens of accessibility and connectivity can facilitate the joint pursuit of mobility and sustainability goals. This change of paradigm implies that three main challenges be addressed.

Users' needs, behaviours and locational proximity
Improving accessibility can complement sustainability objectives in two main ways:

▶
- By reducing the demand for travel, through better clustering of complementary land and building uses combined with improved transport connectivity; reducing the distances from origin to destination, improving the efficiency of the journeys between them and facilitating soft or slow modes of transport (walking and cycling);
- Favouring more sustainable transport systems by increasing the generalised cost of less sustainable modes, through transport policies or traffic management. For example, by fixing minimum average speed targets accompanied by strategies to encourage modal shifts to achieve these targets, such as through congestion charging or by imposing time-varying limits to access to certain parts of a city.

The potential of such approaches needs to be investigated through better understanding of users' needs and behaviours, to better locate activities in cities and plan the transport system. This implies three main research questions:

MAIN RESEARCH QUESTIONS

- What are the main reasons behind passengers' (and freight operators') behaviours and their residential and mobility choices?

- To what extent does activity location influence journey frequency and modal choice?

- What are the potential variables supporting a shift towards more sustainable (particularly soft, or slow) modes? What is their likely effectiveness?

Integration technologies
Modern integrated transport systems should allow for improved accessibility through better network connectivity: the use of the new technologies to find the best trip solution in real time using info-mobility and integrated tariff policies, and to exploit alternatives to personal mobility. This requires a better understanding of the role of mobility surrogates, facilitated through ICT (e.g. teleworking, on-line shopping), on travellers' utility, mobility patterns and environmental impacts; likewise the extent to which connectivity influences the uptake of mobility surrogates and the corresponding environmental impacts.

Connectivity can be improved through better connections in the network between different transport modes; supporting more effective multimodal travel. Advanced Traveller Information Systems (ATISs) can also play a key role in supporting better informed real-time (multi-)modal travel decisions, to reduce trip cost and duration. But the effectiveness of these systems is hampered through a lack of integrated travel fares in multi-modal systems; facilitating smooth transitions from one mode to another with a single ticket or daily pass. This is both a technological issue and an organisational one. Dematerialising tickets through smart technologies provides a seamless integration mechanism, but this also requires that travel providers collaborate; that they exchange data and agree on the pricing mechanisms and the consideration of soft modes in travel planning tools. Research questions include:

MAIN RESEARCH QUESTIONS

- To what extent do ATISs change travellers' behaviour and residential choices?

- What are the most effective business models and sociotechnical solutions for improved mobility; including ATIS and integrated tariffs?

- Which strategies are most effective at improving connectivity and systems (including tariff) integration?

- How should cities monitor and continually improve upon accessibility? Are current planning and management systems sufficient or in need of reform?

- Which policy measures are required to support more sustainable forms of mobility?

This latter relates to the lack of internalisation of negative externalities in the pricing of alternative transport modes and insufficient incentivisation for low or zero carbon modes.

Historic attempts to disincentivise the use of cars through traffic limited zones and paying car parks, have enjoyed limited success; while users of public transport or cycles have limited incentives. Since experiences of other instruments such as congestion charges indicate that these can be effective it is important to study if more effective mechanisms to charge the true cost of travel can be introduced to improve investments in public transport and cycling networks.

Bridging the gap between travellers' needs and behaviours
There is a fundamental need for improved understanding of the extent to which travellers' behaviours match their aspirations and the extent to which planning, technological and economic mechanisms can improve accessibility and connectivity, to minimise any mismatch.

ROADMAP

ACCESSIBILITY & CONNECTIVITY

USER NEEDS AND BEHAVIOUR
and its impact on urban accessibility and mobility systems

INTEGRATED TRANSPORT SYSTEMS
and technologies to ensure accessibility & connectivity for all

CONNECTED NEIGHBORHOODS AND CITIES:
policy measures, business models and the role of social innovation

INTEGRATED TRANSPORT
and urban planning and design for urban transition pathways
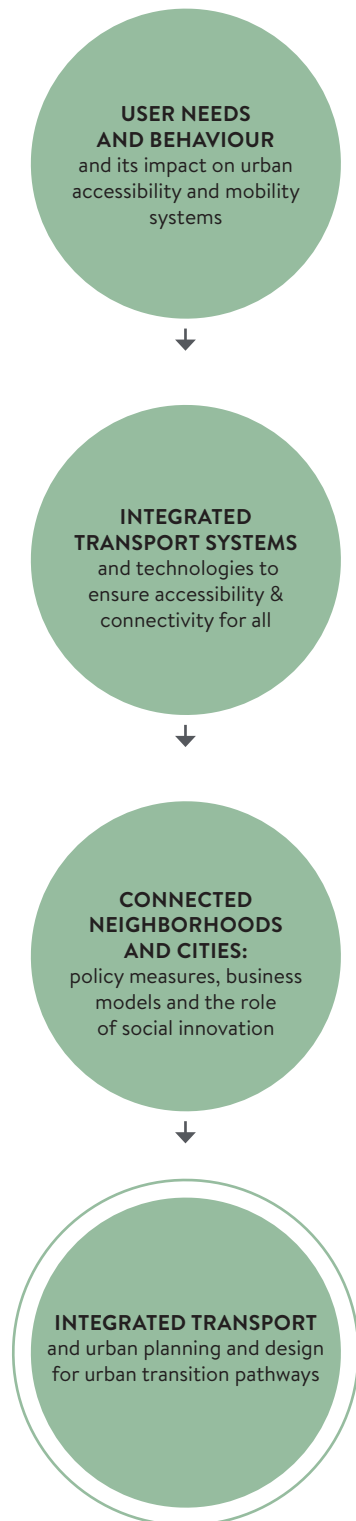
As already noted, connectivity and accessibility can improve social inclusion. But in less dense areas, ensuring good accessibility is challenging using alternative modes to the car, as demand for public transport may be too low to render it viable. This situation can be compounded for less able and/or less well-off people, such as the elderly, who do not have access to a car:

▶ - What are the solutions (technological (e.g. driverless), social, economic, etc.) to increase accessibility and connectivity in low density areas and for the less able or less well off?

URBAN GOVERNANCE AND PARTICIPATION

Motivation – need for action

Strategies to transition cities to a more sustainable and resilient future state will, if they are to be successfully designed, adopted and implemented, arguably rely on collaborative processes involving all key stakeholders, from public and private organisations to concerned individual citizens. New forms of governance are also called for by the changing nature of urban issues, especially the increasing importance of 'real time' in urban governance and management, e.g. in the face of the growing importance of extreme events. This will involve an enabling environment of new collaborative governance and policy making frameworks to ensure productive and creative engagement. The utilisation of big data, new enabling technologies and methods to support these participatory approaches potentially has particular promise here.

JPI Urban Europe is interested in research to better understand and influence how various forms of expert and lay knowledge may be mobilised in novel forms of urban governance and in the design, realisation and management of urban services, spaces or systems. Of particular interest is how governance processes and devices address both short and long term issues facing urban societies and governments.

The need for a more collaborative governance

Global and European trends, climate change in particular, suggest that cities and urban areas face risk and uncertainty. Urban climate change adaptation, mitigation and resilience building has become more and more foregrounded in both academic and policy debates as well as urban planning consultancy. Urban governance, planning, and management functions may in the future be more concerned with resilience and adaptation to extremes rather than with modern planning's central concern for operational efficiency under predictable conditions. What does this entail for governance, and for urban research, technology development, and innovation in and for governance, including transdisciplinary research and experiments with urban stakeholders?

But there is a more general justification for more participatory and co-creative forms of urban governance as we transition towards more sustainable and liveable urban futures. Conflict and friction in complex policy problem solving are a common dilemma in urban governance and planning. So-called 'wicked problems', where a solution to X gives rise to problems in Y, are probably as old as urban life itself. However, due to the increasingly dense and complex networks of relations in urban areas, the potential for adverse unintended consequences of actions and for associated tensions in urban societies is aggravated – to the point that many city authorities may experience a severely limited room for manoeuvre in day-to-day urban management. The interrelated nature of wicked problems requires collaborative approaches to governance, as solutions otherwise run the great risk of being 'stuck in their silos'.

But there is currently a lack of representation in urban decision making, with segments of society having no voice: the need for representative and democratic urban governance calls for social innovation, participatory approaches, and deliberate co-creation of urban knowledge and policy. This co-creation should in principle involve citizens and public and private collective actors as well as urban experts of all sorts (scholars, consultants…); because the issues at stake, including highly technical ones, overflow traditional disciplinary boundaries. Governance, it is argued, has thus to start to deliver on its promises of a more networked lateral decision-making rather than vertical regulation.

However, in the social sciences, the role of citizens and lay knowledge, and how it combines with expert knowledge and vested (political, financial…) interests, in decision-making concerning high-risk objects with uncertain effects has been a key interest for quite some time. Here, governance is observed to have invited public participation to enhance transparency, accountability and thus democratic legitimacy in the policy sphere to restore or establish public trust in political institutions and decision-makers – a strategy which many times reduces public participatory events to an end in themselves. While the notion of governance may have been introduced in urban planning and management to increase democracy and inclusive decision-making, many observers caution that it may have had counter-productive effects, in that strategies and action lines concerning major urban public and private investments are shaped in informal institutions that evade public scrutiny and democratic accountability.

Hence, networked lateral decision-making should not succumb to opaque and informal settings out of democratic reach. This means, for instance, that innovation-driven transitions to improved resource efficiency and public participatory and other open deliberative political explorations may need to go hand in hand.

MAIN RESEARCH QUESTIONS

- What do climate change and other major changes in urban areas entail for governance, and for urban research, technological development and innovation in and for governance, including transdisciplinary research and experiments with urban stakeholders?

- Which participatory urban planning and design approaches best facilitate the achievement of more just and sustainable distributions of public and private resources and amenities in urban areas?

- Where are the genuine knowledge gaps to understand how urban socio-technical and political systems interact with each other and with the urban landscape of buildings, open space and green areas?

Participatory devices

The development of ICT infrastructures both supports, and provides convenient tools for, more distributed or horizontal forms of urban management and more participatory forms of governance. For instance, the spread of open urban data and the possibilities provided by crowdsourcing and open innovation may facilitate new forms of governance in the quest for more effective solutions to demands for public space, affordable housing, the management of urban sprawl or the provision of more sustainable urban infrastructure and systems.

ICT is also an increasingly integral part of political infrastructures for urban democracy (including material and technological aspects), enabling new forms of knowledge and issues to be publicised, deliberated and shaped in ever new ways (e.g. GIS and PPGIS).

These aspects of urban governance, policy formulation and planning warrant a more systemic approach to urban complexity, paying attention to interdependencies within and between the sociotechnical assemblages that constitute the contemporary urban.

In addition, increased attention to 'real time' urban issues, in particular response to crises, has arguably combined with ubiquitous ICT to challenge and transform traditional forms of urban governance and of management of urban services and spaces; enabling the emergence of bottom-up responses. But these phenomena are ill understood, as is the potential to positively direct emergent responses; calling for more sociotechnical approaches to urban governance that account for complex real-time dynamics of more decentralised governance and management systems.
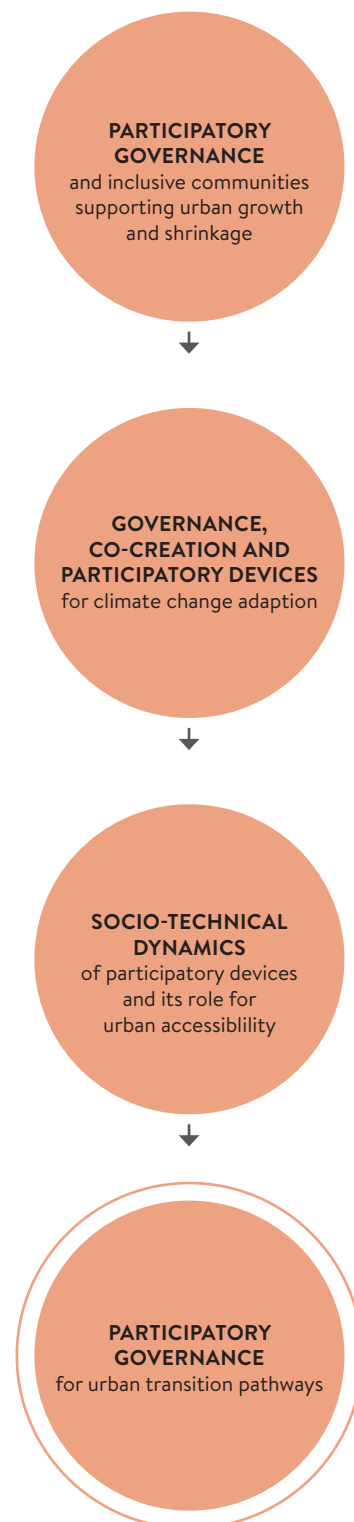
Urban governance and participation thus require research, technological development, and innovation concerning:

MAIN RESEARCH QUESTIONS

- How to establish co-creative processes in highly technicised and/or complex areas of urban governance; taking into account the (very) long term (e.g. preparedness for major risks) and the (very) short term (e.g. responding to extreme and possibly catastrophic events).

- How ubiquitous use of ICTs to generate urban data and to support (novel forms of) urban agency affect how cities are practiced and governed.

- How to enhance the capacity (skills, competence, etc.) for urban governance, planning, and management to absorb, translate, and implement participatory and collaborative approaches (integrated governance, integrated research, technological development and innovation) as well as other urban issues, in particular those identified in the other thematic priority areas of the JPI Urban Europe SRIA?

PARTICIPATORY GOVERNANCE
and inclusive communities supporting urban growth and shrinkage

↓

GOVERNANCE, CO-CREATION AND PARTICIPATORY DEVICES
for climate change adaption

↓

SOCIO-TECHNICAL DYNAMICS
of participatory devices and its role for urban accessiblility

↓

PARTICIPATORY GOVERNANCE
for urban transition pathways

JPI Urban Europe: Transition towards sustainable and liveable urban futures

THE JPI URBAN EUROPE
MULTI-ANNUAL CALL AGENDA

Based on the SRIA and its defined priorities and research topics a multi-annual call agenda has been developed to fund and manage the SRIA. This call agenda, which builds on two previous pilot calls as well as an ERA-NET Cofund on Smart Cities and Communities, covers the timeframe 2016–2020.

The multi-annual call agenda takes an integrated view on urban development with the ambition to foster cross-fertilisation of the thematic priorities but at the same time to have clearly defined and focused call topics. Based on the call agenda the specification of call topics will be defined considering already achieved results from earlier calls, latest scientific developments, external cooperation opportunities and newly identified research needs; including those of JPI Urban Europe's partners and funding agencies; who will assess their priorities and opportunities to join and support each call in turn.

To fully tap the potential of the call agenda, a programme management is needed to connect the thematic priorities, make use of results for future calls, to develop the research community through dedicated events and to facilitate a multi-stakeholder involvement and exchange. In addition funding schemes or frameworks will be developed to exploit the potential for alignment between national calls and those of JPI Urban Europe. These accompanying measures will be addressed in the SRIA implementation plan.

The call agenda also provides a basis to assess and negotiate joint actions and cooperation with other funding programmes and initiatives, such as other JPIs, Horizon 2020, the European Innovation Partnership on Smart Cities and Communities, and activities under the EU Cohesion Policy such as Urban Innovation Actions or URBACT. Regular exchange with those actors and initiatives should ensure a high effectivity of investments and cooperation whenever possible.

	OBJECTIVES ↓	FOCUS AREA ↓
2015 ERANET Smart Urban Futures	Investigating transition towards new models of urban development *reinforcing* European cities as hubs of innovation, co-creation and centers of job creation	• Establishment of urban innovation ecosystems with particular regard to new dynamics of public services and inclusive and vibrant urban communities • Investigating concepts and strategies for urban transformation considering different urban scales in growth and shrinkage scenarios
2016 Urban Nexus	Develop and support new strategies, knowledge platforms based on the food-energy-water nexus to accelerate transitions to urban sustainable consumption and production, develop goals, targets, and policy solutions for sustainable urbanisation including equity issues and local-to-global/cross scale dynamics	Integrated approach for defining and rating urban sustainability within the realms of: • Financial instruments • Governance and social innovation for ecosystem services • Agglomeration dynamics :green urban economies / circular economies to foster sustainable production and consumption patterns for driving social cohesion • Resilient urban systems' engineering • Resilient mobility systems

2017
Urban Accessibility and Governance
	Paving the way towards sustainable transition by developing tools and strategies to enhance the accessibility of infrastructure, services and urban amenities considering sustainable mobility sytems, inclusive welfare, people's needs and the dynamics of cross-city/district cooperation	• Targets and tools for transition pathways:
		  - New public-private cooperation models
		  - Tools and adaptive governance for climate change and big events
		• Investigating accessibility and connec-tivity
		  - Considering the dynamics of polycentric cities
		  - Urban connectivity and its economic benefit
		  - Role of participatory devices
		  - integrated mobility systems

2018 Quality of urban Life	Improvement of the quality of life through social innovation, new matrix for sustainable city performance, decarbonising urban areas and tapping on the potential of migration	• characterising sustainable urban performance • social innovation for improving the quality of life, fostering decarbonisation and reducing the societal impact • potential of migration for urban economic and welfare development • increasing the quality of life by connecting neighbourhoods
2019 Urban Transitions	Designing integrated strategies and pathways considering new financing schemes for resilient infrastructure, participatory governance and economic transition.	• Experimentation and living labs for for detailed transition strategies for economic and economic transition • Identification of challenges to be overcome for full-scale transition
2020 Sustainable Urban Areas	Integrated urban modelling and decision making frameworks to accelerate sustaina-ble urban development on various scales	• policy interventions • scaleable models (from small to big, from local to regional, from short to long term)

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SRIA IMPLEMENTATION PLAN

The implementation of the multi-annual call agenda does not only demand the development and realisation of joint calls but goes along various measures to meet the high ambition of the SRIA. Figure 5 summarises the Action Lines that have been defined to support the full and effective implementation of the strategy.

Figure 5
Implementation plan structured along seven action lines

JOINT CALLS

The development and execution of joint calls is an essential measure for a targeted implementation of the SRIA. The two pilot calls (2012, 2013) as well as the first ERA-NET Cofund – EN Smart Cities & Communities – have provided useful experiences in designing the framework conditions for a demand-oriented, trans- and inter-disciplinary programme. With an increasing number of funding agencies teaming up in these joint calls, dedicated research questions can be promoted to a wider European audience; addressing the diversity of Europe's cities and enabling the best possible European talent to be brought to bear in tackling their challenges.

Accordingly, JPI Urban Europe aims to connect and cooperate with other initiatives to strengthen research, technological development and innovation in Europe to the highest degree. In particular ERA-NET Cofunds provide the opportunity to benefit from bringing together European and national programmes. In line with the defined call themes, options for ERA-NETs under different Horizon 2020 Societal Challenges will be assessed.

PROGRAMME MANAGEMENT

Programme management is key to realize JPI Urban Europe's ambition. Fundamental to JPI Urban Europe is its long-term, mission- and demand-oriented programme, stimulating interdisciplinary research, focussed on the defined priorities, and being transdisciplinary in its activities.

The success of JPI Urban Europe's strategic research, technological development and innovation agenda will require careful program management, to ensure the cross fertilisation of research results and methods amongst and between the different projects and calls; ensuring that the whole is greater than the sum of its parts. This success also implies that research teams, companies, cities and other urban stakeholders involved in the different activities collectively contribute to the overall goal of JPI Urban Europe.

In order to realise this ambition the goal of programme management can be defined as stimulating a community of research and practice around the common challenges faced by European cities and urban areas. Such a community requires the presence of formal and informal networks between researchers and urban stakeholders, structural opportunities to exchange knowledge and experiences and instruments that stimulate a milieu where both researchers and stakeholders are actively involved in the implementation and dissemination of research outcomes beyond the scope of individual projects.

Table 1 summarises the target groups that need to be addressed by program management through different instruments and means.

TARGET GROUPS	AMBITION	POTENTIAL INSTRUMENTS
Scientific and research community	Platform for experience exchange to build projects upon each other, to ensure uptake of latest insights and achievements in future projects; to bring together experts from various disciplines and sectors	Workshops, conferences, summer schools, exchange programmes
Cities	Validation and promotion of new concepts and results, strengthen involvement in research and innovation projects Definition of new requirements for and implementation of new technologies establishing strong city partnerships along project clusters	Workshops, local events, living labs
Business & entrepreneurship	Supporting uptake of results into business solutions, developing new technologies and infrastructure solutions; enhancing involvement of companies and consideration of business needs in the projects	Workshops, invited talks
Science – practice cooperation	Ensuring a regular exchange of concepts and achievements and to develop innovative projects ideas, foster uptake of latest scientific and technological results, enhance understanding of practical needs for research and technological development	Sandpits or hackathons, JPI Urban Europe Award, road shows, annual conference, local events
Funding Agencies	Project monitoring, reflection and improvement of instruments and framework conditions	Workshops, analysis, funding schemes

Table 1: Target groups and potential instruments for program management

NEW INSTRUMENTS AND FRAMEWORK CONDITIONS

To achieve the defined objectives and deliver concrete benefits for and with our cities the funding schemes and framework conditions need to be critically reflected and – if needed – new instruments established.

One particular instrument that is already envisaged as an important measure to ensure multi-stakeholder engagement, a close researcher-city-civil society collaboration and the establishment of a comprehensive and long-term urban database are urban observatories and living labs. Set up in strategic located cities urban observatories will support the acquisition and management of detailed datasets to deepen our insights in to the functioning of cities; support the calibration and validation of urban decision support tools. Urban Living Labs will be strategically used for testing and validating research results, involving relevant urban stakeholders; to prepare for full scale implementation of new solutions.

At the same time the strong cooperation of research with urban stakeholders needs appropriate funding schemes and conditions. Since current funding schemes are very much based on a linear innovation model the existing framework conditions need to be adapted to strengthen the involvement of urban actors in all phases of the research, technological development and innovation cycle. This might result in new evaluation criteria or improved funding rules to overcome current barriers for transnational as well as inter- and transdisciplinary research and cooperation.

ALIGNMENT ACTIONS

To tap the full potential of national alignment a set of measures is planned that covers the alignment of national programmes, institutions, research infrastructure up to programmes for expert exchange or PhD-students. Based on the established cooperation procedures additional bi- and multi-national calls are envisaged, opening up national programmes for international cooperation and aligning these programme strategies and priorities with the SRIA.

One particular measure addresses research institutions since substantial national resources are allocated directly to those organisations that can decide on their strategic research priorities and activities. Building upon and aligning these resources and competences with topics of common strategic importance will strengthen the overall capacity of the European Research Area (ERA). 2013 saw the launch of the Urban Europe Research Alliance (UERA); allowing member organisations to contribute to the SRIA development and jointly defining procedures and targets. It is expected that the UERA will support community building, foster transnational exchange of knowledge and people and amplify the implementation of the SRIA.

In JPI Urban Europe's alignment strategy, additional measures are suggested to foster transnational exchange such as joint PhD programmes or the exchange of experts on all levels, might that be researchers, staff of funding agencies or cities. Experiences have shown that such exchanges can be a powerful mechanism for mutually beneficial collaboration.

STRATEGIC DIALOGUE AND RELATIONSHIPS

The SRIA has been developed in a comprehensive process of co-creation which will be continued as it evolves throughout the implementation phase. The regular reflection

of urban needs and scientific achievements as well as the involvement of new partners and countries will drive the further process and result in the update of the roadmaps and the call agenda. As one measure to support this, JPI Urban Europe intends to extend its Advisory Board; complementing the existing Scientific Advisory Board by setting up a new Urban Stakeholder Board, to better reflect the interests of cities, society and business.

On the other hand it is essential to broaden the national network and reach out to new countries and cities, in particular to Eastern and Southern European countries. This will bring new insights, new partnerships and funding opportunities. The increasing network of JPI Urban Europe partners will be developed and supported through dedicated measures on national and transnational levels.

Since it is part of the strategy to liaise with the European Commission and contribute in their actions, JPI Urban Europe has given a commitment for the European Innovation Partnership Smart Cities and Communities. It will therefore be assessed how to best integrate the JPI Urban Europe measures and actions into the EIP SCC roadmap and team up with the other EIP partners to accelerate the validation and implementation of smart city concepts.

EVALUATION

JPI Urban Europe has defined an ambitious programme and selected a series of implementation measures for its implementation phase 2016-2020. Since new instruments and approaches are to be developed complementing well established procedures a regular monitoring and evaluation of its impact and achievements is required to continuously improve the methods, instruments and actions.

VALORISATION, DISSEMINATION AND COMMUNICATION

Efficient information sharing through website and newsletters, knowledge sharing among partners, coordinated outreach activities and jointly organised events with European institutions and various city stakeholders being at the core of the business. The ambition is to spread the message of the SRIA to national funding agencies, research institutions, cities, European institutions and other relevant stakeholders and to support the long-term ambitions of the JPI Urban Europe to grow and recruit new members.

JPI Urban Europe will make continuous efforts to learn from partners and experiment with techniques, methods and channels for knowledge dissemination and valorisation in order to identify and develop effective, cost efficient and dynamic ways to synthesize knowledge and communicate with targeted groups.

Instruments and measures dedicated to facilitate new and improved connections between the scientific, policy and practice communities will be employed and developed in cooperation with program management, including measures to facilitate match-making between researchers and potential partners and to exploit the results from research, technological development and innovation activities and leverage potential policy impact.

Support inclusive, sustainable and green growth through urban innovation: JPI Urban Europe aims at contributing to the European Agenda and the Europe 2020 Strategy[29] by facilitating urban social and technological innovation and contributing to the establishment of competitive, inclusive and innovative urban areas. In this context, urban development provides great potential for innovation and the commercialisation of new services, systems, or products. To manage and realise urban innovation the engagement and contribution of companies is indispensable, as is alignment with the smart cities initiatives. With our holistic approach JPI Urban Europe seeks to ensure that urban areas' social and economic needs are consistently addressed in its research, technological development and innovation activities; ensuring the relevance and continuity of results through an improved understanding of societal needs, business opportunities, new technologies required to optimise urban infrastructures, and the policy measures needed to maintain socially and economically vibrant and inclusive environments, whilst maximizing their resilience and sustainability; to provide environments that attract talent and investment, so enhancing European competitiveness.

Improve quality of urban life: In addition to helping to sustain socially and economically inclusive environments, we wish to enhance Europe's position as the home to many of the world's most liveable cities; to work towards the improvement of quality of life for all. Through joint efforts to reduce the environmental impact of urban activities and its infrastructure on the one hand through scientific evidence, new methodologies, and new technologies, and to improve socioeconomic conditions on the other, we aim to support the achievement and maintenance of places where all people can engage, where societal and cultural life prospers and urban services, affordable housing and jobs are accessible for all.

Raise the scale and ambition of research in the urban domain: Although there are many links to urban research in Horizon 2020, there is no urban challenge defined so far. JPI Urban Europe emphasises the importance of comprehensive urban research, technological development and innovation and provides an integrated framework for future activities. This framework also serves to align and reduce fragmentation in research funding, to deliver an ambitious and integrated programme of research destined to support Europe's cities in setting and achieving ambitious yet realisable transition targets; to improve their social, economic and environmental performance.

Related to international activities, JPI Urban Europe has the ambition to increase the international visibility and scientific excellence of European urban research, technological development and innovation, and to enhance the impact of these activities far

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29 EC, Europe 2020: A strategy for smart, sustainable and inclusive growth, COM(2010) 2020 final, Brussels, 3 March 2010,
<http://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20 Europe%202020%20-%20EN%20version.pdf>.

beyond Europe's boundaries. In particular we aim to:

- **Increase societal relevance:** The inter- and transdisciplinary approach will enhance and consolidate current urban research. Supporting evidence based policy measures and decision making is at the heart of this initiative, to ensure the applicability and utility of the developed knowledge.

- **Ensure long-term continuity:** Urban development has to be addressed in a comprehensive way and with a long-term perspective. Limitations of short-term programmes and activities need to be overcome by a long-term commitment and appropriate framework conditions. JPI Urban Europe aims at providing such a framework for international cooperation, establishing long-term partnerships and accompanying implementation measures.

- **Strengthen Europe's global position:** JPI Urban Europe will be used to increase the visibility of Europe's urban research, technological development and innovation actors on the international stage. Promotion of scientific expertise and knowledge will not only strengthen Europe's scientific profile but will also result in economic benefits to European products and services. Sustainable partnerships between academia and business as well as with cities and civil societal organisations will be supported to ensure the best possible knowledge transfer.

- **Demonstrate and showcase European solutions for global urban challenges:** Solutions which address the challenge of urbanisation will be based on a new understanding of the urban system, but take on board technological innovation, in a co-creative effort of stakeholders across the board. The solidity of those solutions will give European industry the competitive edge when it comes to selling European technologies and services in the global market.

GLOSSARY

Agglomeration Economies

Agglomeration economies arise when firms cluster (agglomerate) spatially, as this reduces the cost of production and stimulates innovation. This is an important cause of the formation and growth of cities (urban agglomerations). Firms share the advantage of having multiple suppliers, of access to amenities and of a larger home market of labourers and consumers (urbanisation advantages). Larger markets also allow for more specialisation, as the chances of successful matches between supply and demand increase (localisation advantages). Proximity and local variety also facilitate knowledge spill-over, enabling learning processes that trigger innovation.

Big data

A large collection of structured and/or unstructured datasets that is difficult to process using traditional tools, due to the volume and complexity of the underlying data. Innovative processing and visualisation techniques are increasingly being developed and applied to provide powerful insights and decision making support.

City

A large built-up area with a name, defined boundaries, and local government.

Co-creation

An approach where heterogeneous actors collaborate to produce knowledge, instruments, technology, artefacts, policy, know-how, etc.

Complex systems (complexity)

Systems, such as cities, whose macroscopic properties (social, economic, physical...) emerge from the microscopic behaviours and interactions of their component parts; properties that are dynamic and may be sensitively dependent to microscopic changes.

Decision making framework

Decision making frameworks may be conceptual in nature to structure comprehensive discourse and analysis. They may also be quantitative, representing key phenomena within a mathematical model with which to test improvements to system functioning. Often the former will inform the latter. In either case, their purpose is to provide a basis for better informed (evidence-based) decision making.

Energy-Food-Water Nexus

Implies that the three sectors — energy security, water security and food security — are inextricably linked and that actions in one area more often than not have impacts in one or both of the others. As global population grows, increasing demands for basic services and the desire for higher living standards, the need for more conscious stewardship of these interrelated resources to achieve those services and desires becomes more urgent. Technology will play a decisive role in enabling a shift to renewable resources, and in optimising the efficiency of their use.

Externality

Externalities can be positive or negative. Positive externalities are benefits while negative externalities are costs produced by the behaviour of an agent (individual, household, enterprise, etc.), that influences the result of another agent. The effect (advantage or disadvantage) does not create changes in the price system. Negative externalities produce market inefficiency and are also called social or external costs.

Innovation

A process in which new ideas (technologies, designs, procedures, etc.), and combinations of them, bring about changes in (sub)systems like supply chains, markets, urban regions, etc. This process can be incremental, radical or even disruptive.

Interdisciplinarity

A collaboration spanning multiple academic disciplines (e.g. natural sciences, social sciences, engineering sciences, technological sciences, medical sciences) and involving the application of complementary methodologies to more innovatively and comprehensively tackle a common problem than would otherwise be possible.

Quality of life

Refers to the general well-being of individuals and societies. Standard indicators of quality of life include the quality of the built and natural environment, housing, physical and mental health, education, recreation and leisure time, and social belonging; less tangible appreciations of quality of life include feeling good, happiness, and being satisfied with what life offers. Quality of life should not be confused with the concept of standard of living, which is based primarily on economic indicators, such as income, wealth and employment.

Resilience

Describes the adaptive capacity of a complex system such as a city; a system's ability to redirect, absorb, recover from and even to evolve in response to internal or external forces of change; whether these be social, economic or environmental in nature; slow, medium, fast or immediate in rate.

Smart city

Refers to cities in which ICT is increasingly pervasive and ubiquitous. Cities whose knowledge economy and governance is being progressively driven by innovation, creativity and entrepreneurship; and in which digital technologies can be used to efficiently and effectively run cities and the services provided by them. The integration of technologies needed to manage the Energy-Food-Water Nexus offers the potential to optimise the efficiency and effectiveness of the resources involved.

Social innovation

Any innovation, whether involving an artefact, process, strategy or practice, that aims to tackle societal challenges such as quality of life; particularly where current institutions, whether public or private, cannot satisfactorily address these challenges in isolation.

Sustainability

A multifaceted property that describes the extent to which social, economic and environmental objectives are in balance; that economic activity is not declining, that non-renewable resource throughputs are minimised and that society has high capital and is cohesive, equitable and inclusive.

Transdisciplinarity

A collaboration spanning multiple partners, both academic and non academic, to solve a common problem. Non academic partners may include city officials, (non-) governmental agencies and offices, charitable organisations, firms, civil society, grassroots movements etc.

Transition

A process by which a system, such as a city, transits from one state to some other future state. This state may be characterised by social, economic or environmental performance factors, or measures, or (preferably) some combination of them. Together with new forms of governance, the process may involve educational, regulatory or financial stimuli, the actions of peers or (socio-) technological innovations; or some combination of them.

Transport system

The set of components supporting the mobility of goods and people in space and time. This system comprises the infrastructure, the vehicle, the rules of traffic management and the driver or user, interacting together dynamically. New technologies can dramatically increase the efficiency of the system.

Urban areas

From a morphological perspective: an area encompassing one or more cities plus its built-up environs, irrespective of local body administrative boundaries, often subject to a minimum built-up density threshold and a minimum population size (e.g. clusters of contiguous grid cells of at least 300 inhabitants per km^2 and a minimum population of 5 000)[30]. From a functional perspective: a continuous area including one or several urban centre(s) and all population settlements in which a significant proportion of the employed population works in the urban centre(s) or in localities connected to the urban centre(s).

Urban living lab

A forum for innovation, applied to the development of new products, systems, services, and processes in an urban area; employing working methods to integrate people into the entire development process as users and co-creators to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and everyday contexts.

Urban observatory

A facility to observe and record the dynamic evolution of an urban area such as a city or a part of a city and its functioning. This may involve the recording of artefacts with slow rates of change, such as land uses and networked infrastructure; medium rates of change, such as buildings and building uses; fast rates of change, such as population and employment: household and firm composition; and immediate, such as flows of finance, energy, goods and materials, people and information. Urban observatories may also record qualitative observations, such as human perceptions. The purpose of an urban observatory may be to record and analyse the evolution of an urban area, or to calibrate and validate a decision making framework, or both.

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30 Regional Working Paper 2014 (WP 01/2014): A harmonized definition of cities and rural areas: the new degree of urbanization, Directorate-General for Regional and Urban Policy

APPENDIX

Urban tansport
Energy
Urban environment
ICT-systems & services

Urban governance
Urban planning
Urban climate
Urban demography

Rural-Urban relationship
Socio-economic development
Urban sustainablility
Urban health

Security
Urban infrastructure

Figure 6
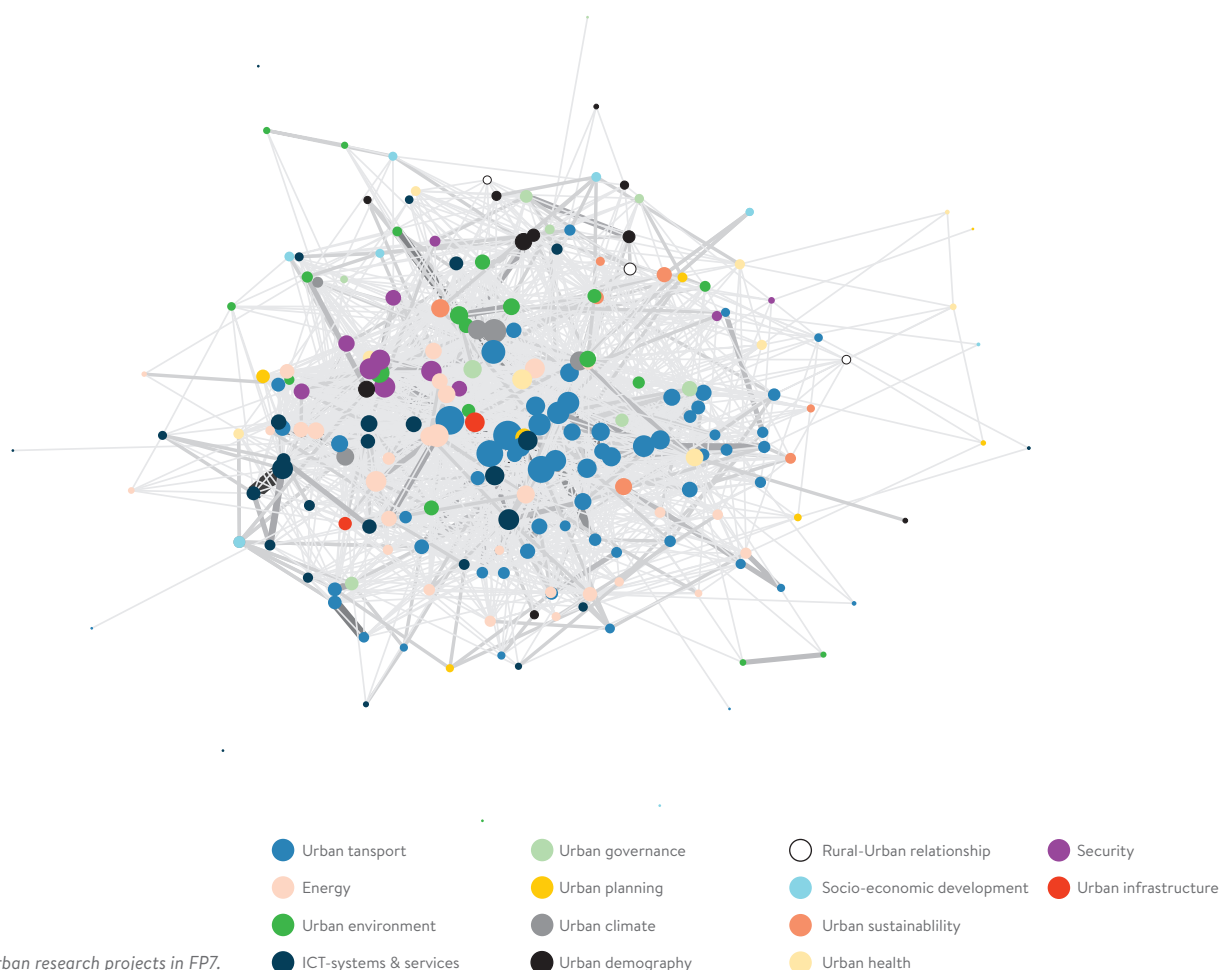*Network of urban research projects in FP5.*

The Landscape of transnational, urban-related research collaboration in Europe

JPI Urban Europe aims to coordinate research and make better use of Europe's public funds in order to address common European urban challenges more effectively. Strengthening and aligning urban research, technological development and innovation means at the same time to build upon existing expertise, networks and results. In the frame of the European Research Frameworks FP5, FP6 and FP7 substantial funding has already been provided to foster urban-related research on transnational level, supporting research, technological development and innovation in various urban fields and disciplines and generating networks among scientists, industry and public authorities. A solid understanding of the gained achievements allows to position JPI Urban Europe against this background.

Utilising the EUPRO database a systematic analysis of thematic clusters and transnational collaboration patterns between countries, regions and actor groups was performed to draw conclusions regarding future requirements and opportunities for a new transnational research, technological development and innovation programme[31].

Nearly 600 projects related to urban research were funded from FP5 to FP7; most of which were conducted collaboratively. The urban research community has grown from

31   B. Heller-Schuh, M. Barber, T. Scherngell: Urban Research in the European Framework Programmes, Final Report, April 2015

Urban tansport · Urban governance · ○ Rural-Urban relationship · Security
Energy · Urban planning · Socio-economic development · Urban infrastructure
Urban environment · Urban climate · Urban sustainablility
ICT-systems & services · Urban demography · Urban health

Figure 7
Network of urban research projects in FP7.

a rather small, but strongly connected community, to a larger, more loosely connected one. Figure 6 and figure 7 show the network of research projects for FP5 and FP7 respectively. The *size of a node* represents the number of directly connected projects (degree). The *grey scale of the connections* (line values) indicates the relative number of jointly participating organizations in two projects. The *position of the nodes* depends on the number of organizations collaborating in these projects. Projects are positioned next to each other, if many organizations jointly participate in these projects. The *colour of the nodes* denotes the research topic, which were assigned manually to the project according to their thematic orientation.

In total, 1.5 billion Euros were invested in projects dealing with urban research from FP5 to FP7 (Figure 8). Since in FP6 a number of large-scale Integrated Projects were funded the number of projects dropped after FP5, but the amount of project funding increased from 273 million Euros to 430 million Euros. Half of the projects were conducted in the areas of urban transport, energy and urban environment receiving two third of the total project funding.

The structural characteristics of the network of urban research project changes from F5 to FP7. While very strong collaboration clusters have emerged for some topics, such as urban transport, ICT-systems & services, energy or security; other topics like urban governance or urban sustainability are more fragmented. The latter have been also pushed from a more central position in FP5 towards the periphery of the network of FP7 projects. The change of collaboration patterns, both in number of projects and
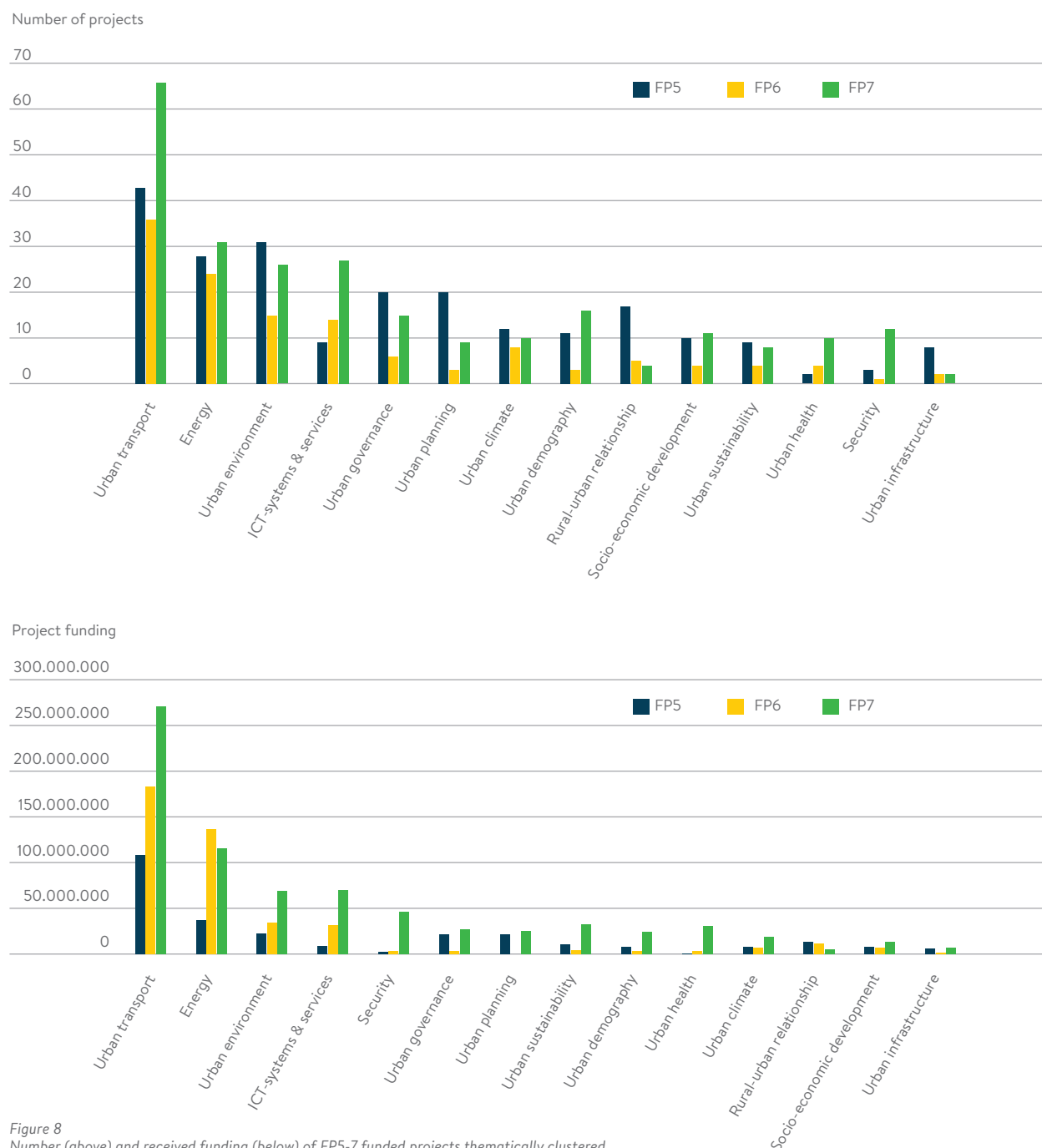
Number of projects

Project funding

Figure 8
Number (above) and received funding (below) of FP5-7 funded projects thematically clustered

intensity of collaboration, is also observable from analysis of the geographical collaboration pattern. Figure 9 gives the comparison of the collaboration pattern for the clusters energy and urban governance, highlighting different development trends over the last 15 years.

In general the transnational collaboration can be described by a core-periphery structure. Germany, France, the United Kingdom, Spain, the Netherlands, and Italy define the core structure of European collaboration on urban issues. Other countries are more weakly interacting although some countries show a strong contribution in particular areas. Such specialisation was identified, e.g. for Swedish actors in the energy cluster, Norwegian partners in urban climate or Spanish organisations in socio-economic development. Understanding this pattern allows to build upon national strengths on the one hand and consolidate and provide the European expertise to overcome (national) gaps on the other hand.
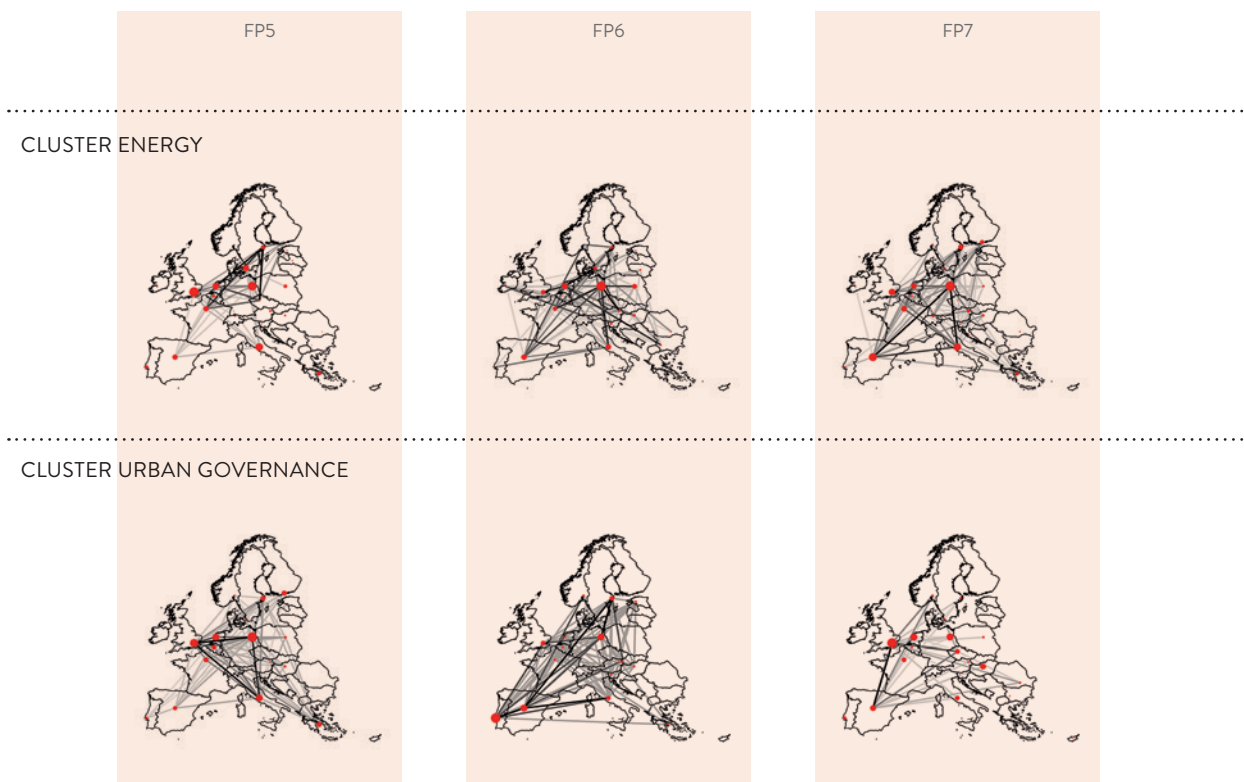
CLUSTER ENERGY

CLUSTER URBAN GOVERNANCE

Figure 9
Comparison of the geographical collaboration pattern from FP5 to FP7 for the thematic cluster Urban Governance and Energy; the size of the nodes gives the relative number of projects with actors from the respective country, the grey scale of the connections indicates the relative number of collaboration of actors from the countries.
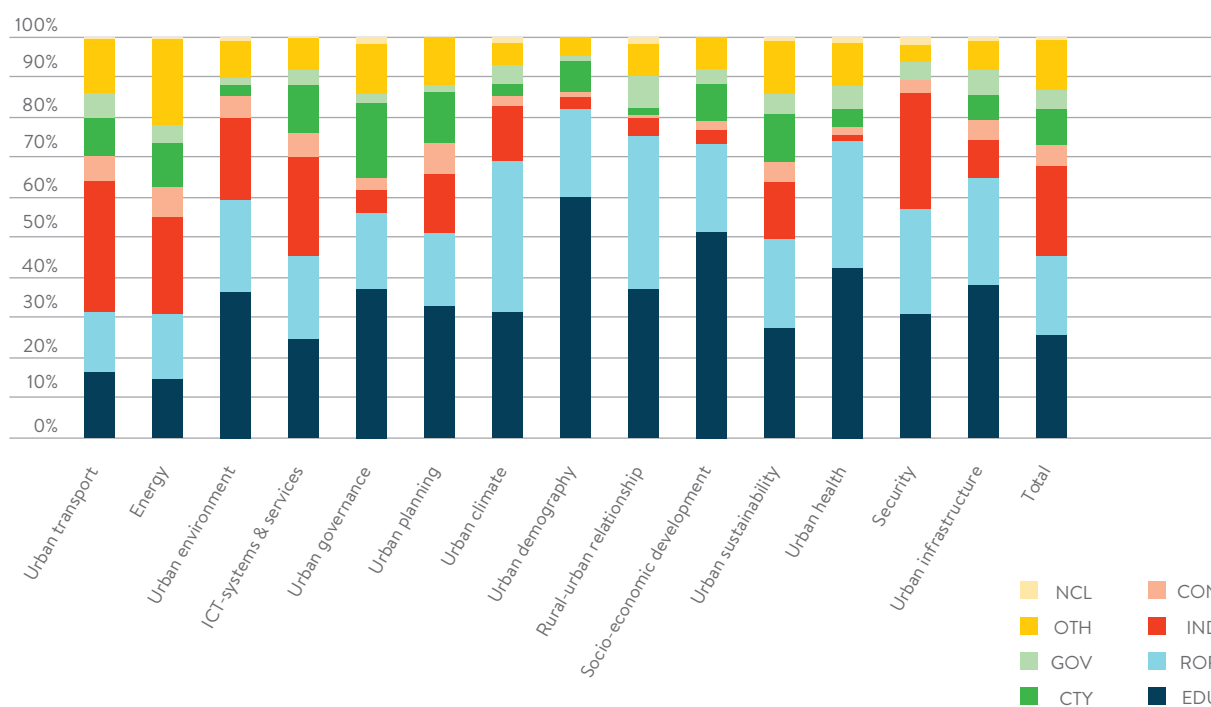

Figure 10
Participation of actor groups in urban research projects in FP5-FP7 per cluster

Since JPI Urban Europe supports transdisciplinary research and a multi-stakeholder involvement the collaboration pattern of different actor groups was investigated in the FP projects as well. Figure 10 summarises the share of actor groups participating in the projects which varies widely for the different clusters. In general there is a rather low involvement of non-commercial (societal) actors and in some cases of cities which should be addressed for future programmes. In any case the collaboration pattern clearly calls for specific framework conditions to ensure and support collaboration between research and cities, societal actors and/or industry, depending on the particular thematic area.

Regarding the development of the research, technological development and innovation programme of JPI Urban Europe a number of key conclusions and ambitions can be drawn from this analysis. In particular, JPI Urban Europe should strive to:

JPI URBAN EUROPE SHOULD STRIVE TO

- Complement the existing profile of European urban research by linking the different clusters and strengthening the community on urban sustainability and related fields, through interdisciplinary research. JPI Urban Europe should consolidate what has become a fragmented community or project landscape, re-strengthening research efforts in these important areas.

- Build upon the achieved results and expertise; connecting them more closely with national activities.

- Benefit from transnational collaboration by building upon the competences of a strong core community as well as on the specializations and national strengths of smaller European countries.

- Develop framework conditions that facilitate multi-actor engagement and a balanced and early involvement of cities and urban stakeholders in research projects to ensure high impact and a mutual benefit from transdisciplinary research.

URBAN EUROPE

GLOBAL URBAN CHALLENGES – JOINT EUROPEAN SOLUTIONS