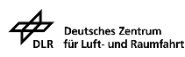




ENRICH

EUROPEAN NETWORK OF
RESEARCH AND INNOVATION
CENTRES AND HUBS, USA

US Research Handbook on Smart Cities



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Executive Summary

This research handbook is a product of ENRICH in the USA, a European Network of Research and Innovation Centers and Hubs. Promoted by the European Commission (EC) through Horizon 2020, ENRICH in the USA is a central contact point for European research and innovation actors seeking to grow and reinforce collaboration across the Atlantic. The mission of the Network is to provide standardized and various tailor-made research & innovation internationalisation support services to European researchers and innovators, to accelerate access to the US market, and maximize chances of success.

This research handbook on US R&D related to smart cities provides an assessment of the United States (US) research community landscape and aims to support research and innovation cooperation between the European Union (EU) and the US.

The research handbook identifies the US key university research groups, research centres and industry clusters, as well as some of the main research networks, professional associations and conferences/events focused on Smart City research. Furthermore, it identifies potential approaches to develop collaborative projects with the US smart city research community and assesses the opportunity for EU researchers to participate in US funding programs related to Smart City R&D. Therefore, this research handbook aims to be an effective source of knowledge on the US Smart City research community and possible first contacts for initial approaches to establishing collaborative activities.



Figure 1 - Initial Approaches for Establishing Collaborative Innovation and Business Activities

2

The EU and the US are key partners in R&D and innovation. R&D and innovation are key components of the EU and US smart growth strategies, as they share research values of openness, transparency, fairness, inclusiveness, academic freedom, and ethics. As of 2022, the US has the biggest level of participation in the EU research and innovation programs of all non-EU and non-associated countries¹. Therefore, the EU and the US have achieved many significant scientific innovations due to the quality

¹ https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/europe-world/international-cooperation/united-states_en

of the research developed by their universities, research centres and industry clusters in strategic research areas, including the topic of Smart Cities².

Through desk research, this research handbook reveals the US research community encompasses a complex set of different actors that work in concert towards the development of Smart City R&D activities. These key actors are primarily university research groups, research centres, and industry clusters.

Smart Cities are a broad topic as it is composed of different cross-cutting operation domains, such as smart infrastructure, smart transportation, smart energy, smart healthcare, smart technology, and sustainable districts. In addition, Information and Communication Technologies (ICT) are a key enabler to transform traditional cities into Smart Cities, especially now that the Internet of Things (IoT) and Big Data (BD) are widespread in improving the efficiency of Smart Cities. In this research handbook, we focus on understanding and collecting the research centers that are more active in these domains.

University research groups

Due to the interdisciplinary nature of the topic of Smart Cities, many universities have been active in supporting and carrying out research activities. The research groups identified in this section have been selected based on an extensive literature review of their citations. This research handbook has included university research groups that are active in one of the three main thematic research areas: Smart Mobility, Smart Energy, and Smart Transportation. Many more could be added if ICT elements are further explored. These key universities are:

- > Carnegie Mellon University
- > Massachusetts Institute of Technology
- > University of California Berkeley
- > Purdue University
- > Columbia University
- > University of Pennsylvania
- > Georgia Tech
- > The University of Alabama at Birmingham
- > Arizona State University

Research Centres

Smart City research centres are crucial to translate scientific knowledge into discoveries that can lead to innovation, development, and deployment. Smart city research requires an interdisciplinary approach that includes researchers and industry members from different disciplines, such as ICT, transportation, and energy.

- > Smart cities (UC Berkeley and Lawrence Berkeley National Laboratory)

² <http://www.eusscienceandtechnology.eu/assets/content/BILATUSA4.0%20-USFunding%20Opportunities%20for%20EU%20Researchers.pdf>

- > Georgia Tech's initiative on Smart Cities and Inclusive Innovation (SCI2)
- > Smart City Internet of Things Innovation (SCITI)
- > Institute for Smart, Secure and Connected Systems (ISSACS)
- > SMART Cities Research Cluster, University of Memphis
- > UAB Sustainable Smart Cities Research Center
- > Smart Cities Research Centre, Columbia University Data Science Institute Center for Smart Cities and Regions (CSCR)

Industry clusters

In this research handbook, industry clusters are defined as geographic concentrations of businesses of closely related industries. In the US, the industry clusters have been a catalyst for economic growth for over a century, mostly due to the ability of some leading universities in the country to work cooperatively with the industry. Industry clusters are the most active domain in Smart Cities since the White House Smart Cities Initiative in 2015, as many clusters were initiated to support the Smart Cities initiative. In addition, many cities collaborated with big companies to support this endeavor. The following list indicates some active clusters:

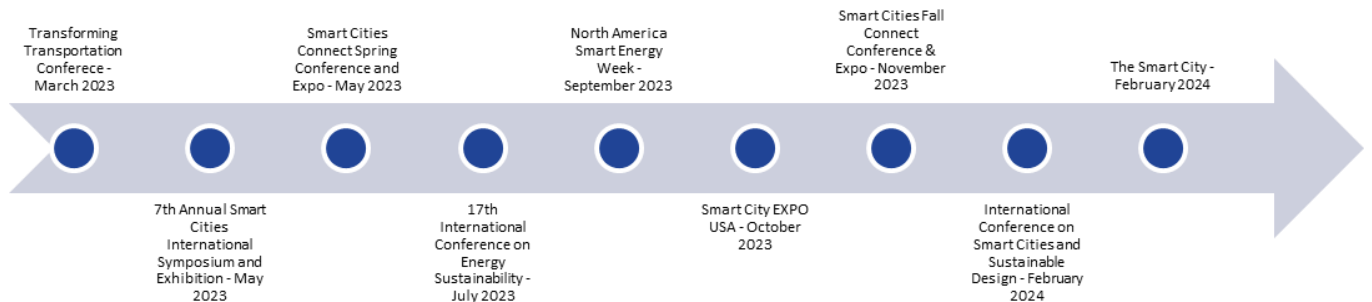
- > **MetroLab Network.** MetroLab Network consists of 29 cities, 5 counties, and 35 universities focused on civic innovation with an emphasis on data and technology that are poised to transform cities.
- > **California**
 - San Diego
 - Silicon Valley
 - San Francisco
 - Los Angeles
 - Sacramento
- > **Chicago, Illinois**
- > **Atlanta, Georgia**
- > **Seattle, Washington**
- > **New York, New York**
- > **Dallas, Texas**

Research networks, professional associations, and networking events

Organizing conferences and events is one of the main activities of research networks and professional associations. Therefore, a review of the US conferences and events focused on Smart Cities was conducted to identify the most relevant professional associations in the field of Smart Cities. The picture below provides a snapshot of the most relevant planned events for 2023, 2024 and 2025.

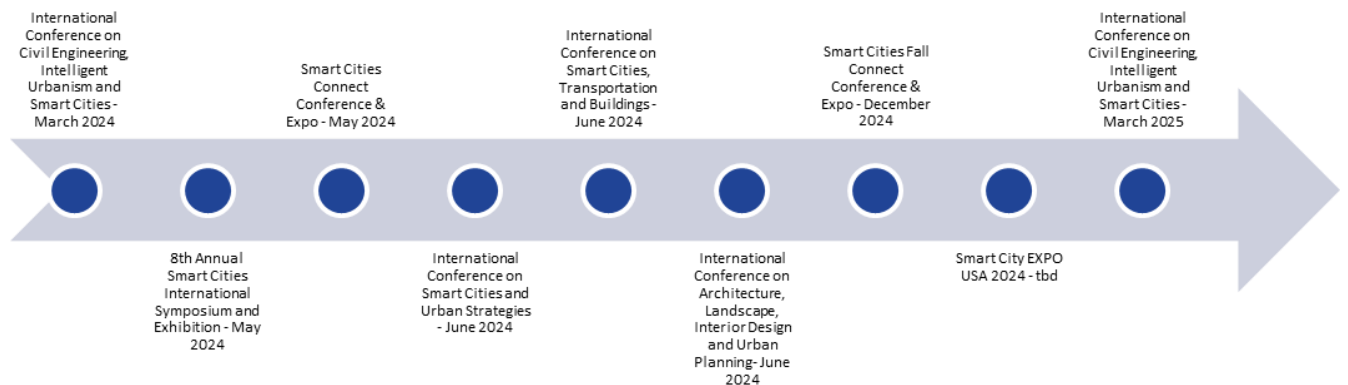


Figure 3 - List of Smart Cities Conferences and Events 2023-2024



Several further conferences are already foreseen for 2024:

Figure 4 - List of Smart Cities Conferences and Events 2024-2025



US R&D initiatives and Programs

The US R&D funding system is highly decentralized and comprises several key actors, such as agencies of Federal and state governments³, the National Institutes of Health (NIH)⁴, the National Science Foundation (NSF)⁵, the Department of Energy (DOE)⁶, and the Defence Advanced Research Projects

³ <https://www.grants.gov/>

⁴ <https://www.nih.gov/>

⁵ <https://www.nsf.gov/>

⁶ <https://www.energy.gov/>

Agency (DARPA)⁷), universities⁸, the private sector and non-profit organizations⁹. R&D is a key driver of innovation and economic growth and therefore, has particular importance for the aforementioned actors. In the US, the research developed by universities and research centres is highly supported by funds that prioritize groundbreaking research areas¹⁰. The major categories that initiatives are divided are the following two major categories:

- > Federal initiatives/Programs
- > State initiatives/Programs

⁷ <https://www.darpa.mil/>

⁸ <https://new.nsf.gov/funding/opportunities>

⁹ <http://www.eusscienceandtechnology.eu/assets/content/documents/InnovationSystemInnovationPolicyUS.pdf>

¹⁰ <http://www.itif.org/files/2011-university-research-funding.pdf>



ENRICH in the USA Summary

ENRICH is the European Network of Research and Innovation Centres and Hubs. Promoted by the European Commission through Horizon 2020, the ENRICH network currently offers services to connect European research, technology, and business organizations with five global front-runner innovation markets: North America, South America, China, India, and Africa.

ENRICH in the USA is a H2020 initiative to establish a Network of European Research and Innovation Centres throughout the United States of America. ENRICH in the USA is a central contact point for European research and innovation actors seeking to grow and reinforce collaboration across the Atlantic. The mission of the Network is to provide standardized, as well as various tailor-made, research & innovation internationalization support services to European researchers and innovators to accelerate access to the US market and maximize chances of success.

ENRICH in the USA targets to serve the following actors:

- Accelerators
- Business Networks
- Clusters
- Trade Agencies
- Funding Agencies
- Incubators
- FDI Agencies
- R&D institutes and labs
- Research and Innovation Networks
- Research Parks
- Trade Associations
- Chamber of Commerce
- Universities
- University Associations

ENRICH in the USA includes the following entities:

- **One “Coordination Node” in Europe** (represented by ENRICH Global, Paris, France)
- **One “Coordination Node” in the US** (represented by Temple University SBDC, Philadelphia, PA)
- **Three physical ENRICH in the USA Centres:**
 - **San Francisco Centre** (managed by Temple University SBDC)
 - **Boston Centre** (managed by Temple University SBDC)
 - **Washington, DC Centre** (managed by NCURA)
- **Nine Landing Hubs across the US and plans to expand the ENRICH in the USA Network beyond these Hubs. Five Associate Hubs across the US**, and plans to expand the ENRICH in the USA Network beyond these first five Hubs, over four years:
 - In **PA**: Temple University
 - In **VA**: George Mason University
 - In **CA**: California Polytechnic University or Cal Poly
 - In **CA**: UC Berkeley
 - In **IN**: Purdue University
 - In **MA**: Northeastern University
 - In **CA**: Santa Clara University
- **Planned for 2023:**
 - In **MI**: University of Michigan



- In **TX**: UT Austin
- In **MO**: University of Missouri or Mizzou

The ENRICH in the USA Network is built on local US experience and strong existing ties between the EU and US, while providing new researcher and entrepreneur serving capabilities that address resource gaps to enable access for all EU Member States and Associated Countries, as well as every state in the US and Canada.

A variety of services were proposed for researchers and entrepreneurs engaged by the Network during the pilot phase. The Centres' pilot activities will be evaluated to retain the initiative's most successful components to ensure a sustainable plan for ENRICH in the USA in the future.

Piloted services will target various commercially viable technology maturity levels, both research-oriented and market-oriented, and will include research connection symposia, business matchmaking opportunities, immersion weeks, working visits and innovation tours to US organizations to explore technology/product partnerships and/or business development middle-/long-term opportunities, pitching to potential investors, entrepreneurial bootcamps, workspace access, mentorship/advisory, hands-on business acceleration programs, enrichment programs, and more will be included.

ENRICH in the USA Consortium:

Coordinator: GAC Group (GAC), France

Partners:

- > German Aerospace Centre (DLR), Germany
- > Temple University SBDC (Temple), USA
- > European Business and Innovation Centre Network (EBN), Brussels - Partner in Phase 1 (2017-2020)
- > International Business Innovation Association (InBIA), USA - Partner in Phase 1 (2017-2020)
- > European American Enterprise Council (EAEC), USA - Partner in Phase 1 (2017-2020)
- > INTRASOFT International (INTRA), Luxembourg - Partner in Phase 1 (2017-2020)
- > Sociedade Portuguesa de Inovação (SPI), Portugal
- > Regional Centre for Information and Scientific Development (RCISD), Hungary
- > National Council of University Research Administrators (NCURA), USA



Figure 5 - ENRICH in the USA Services

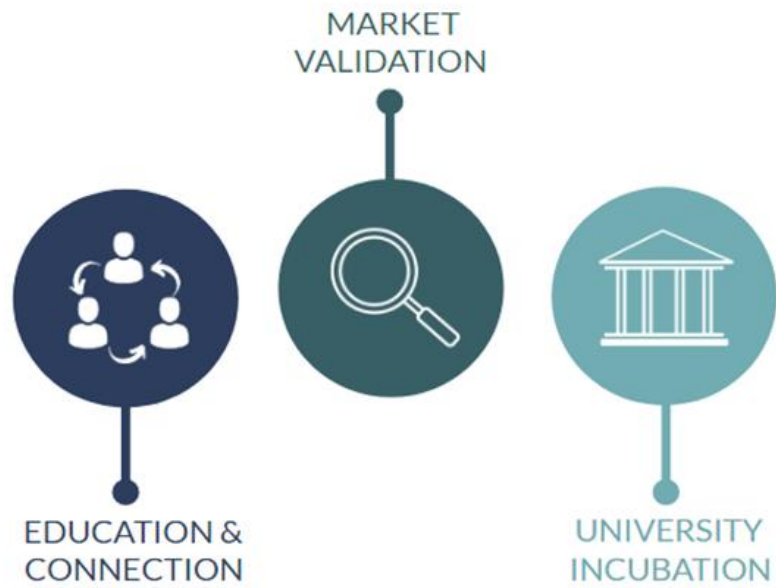


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List of Abbreviations

Table 1 - List of Abbreviations

Abbreviation	Explanation
ACE	Advanced Clean Energy
CPS	Cyber-Physical Systems
DHS	U.S. Department of Homeland Security
DOE	US Department of Energy
DoT	US Department of Transportation
EERE	Office of Energy Efficiency and Renewable Energy
EIP SCC	European Innovation Partnership on Smart Cities and Communities
EPBD	Energy Performance of Buildings Directive
EU	European Union
FTA	Federal Transit Administration
GCTC	Global City Teams Challenge
GDP	Gross Domestic Product
H2020	Horizon 2020 Framework Program
ICT	Information and Communication Technologies
IMD	Institute for Management Development
IoT	Internet of Things
IUC	International Urban Cooperation
IWG	Interagency Working Group
NIST	National Institute of Standards and Technology
NITRD	Networking and Information Technology Research and Development



Abbreviation	Explanation
NSF	National Science Foundation
NSTC	National Science and Technology Council
NYSERDA	New York State Energy Research and Development Authority
ODOT	Ohio Department of Transportation
OISE	Office of International Science and Engineering
PON	Program Opportunity Notice
R&D	Research and Development
R&I	Research and Innovation
RFP	Request for Proposals
RFQ	Requests for Quotation or Qualifications
S&T	Science and Technology Directorate
SCC Task Force	Smart Cities and Communities Task Force
SCCF	Smart Cities and Communities Framework
SCI2	Smart Cities and Inclusive Innovation
SCIS	Smart Cities Information System
SCITI	Smart City Internet of Things Innovation
SET Plan	Strategic Energy Technology plan
SUTD	Singapore University of Technology and Design
TAS Initiative	Transportation as a System Initiative
USA	United States of America
ESI	Eden Strategy Institute
OXD	ONG&ONG Experience Design

1 Introduction

Context

This research handbook, developed in the context of the ENRICH in the USA Network¹¹, aims to provide relevant information on the United States (US) landscape concerning the Smart City research community. It provides information on key research universities, centers, networks, relevant conferences, and events, as well as important industry clusters and initiatives within the public and private sectors.

This research handbook can be an effective source or tool to gain knowledge on the US Smart City research community and:

- To identify potential approaches to developing collaborative projects with US researchers, research groups and research organizations. The researchers, research groups and organizations act directly to develop a rapport and potential interest in collaborating.
- To identify relevant networks and conferences that can be used as a conduit for meeting potential collaborators.
- To identify and assess the opportunity to participate in US funding programs related to Smart City research and development (R&D) to propose potential project opportunities to US research counterparts.

Therefore, the authors of this research handbook hope that the information is useful in assisting European Union (EU) researchers in their efforts to develop stronger ties to the US Smart City research community.

About Smart Cities

The global market for Smart Cities will reach \$5.3 trillion (around €4.9 trillion) in 2030¹², with the US market estimated at \$26.9 billion (around €24.89 billion) in 2022. The top priorities for global Smart Cities initiatives are technological and data-driven solutions, centred around infrastructure and mobility, sustainability and energy efficiency, digital connectivity, and decision-making. According to the latest IDC Worldwide Semi-annual Smart Cities Spending Guide, in 2017, \$67.8 billion (around €62.73 billion) were spent on Smart Cities, where its top 3 use cases are \$13.9 billion (around €12.86 billion) on intelligent traffic and transit, \$7.3 billion (around €6.75 billion) on fixed visual and

¹¹ <https://enrichintheusa.com/>

¹² https://www.researchandmarkets.com/reports/3633914/smart-cities-global-strategic-business-report?utm_source=GNE&utm_medium=PressRelease&utm_code=t3qmw3&utm_campaign=1841796+-Global+Smart+Cities+Strategic+Report+2023%3a+Market+to+Reach+%245.2+Trillion+by+2030+-Advanced+Technologies+Create+Perfect+Ground+for+Transformation&utm_exec=chdo54prd#product--toc

surveillance and \$2 billion (around €1.85 billion) on environmental monitoring¹³. The fastest growing use cases are office wearables, Vehicle to Everything (V2X) connectivity and smart city platforms¹³.

Importance of Smart City research to the EU

Smart Cities in the European Union (EU) are defined as cities using technological solutions to improve the management and efficiency of the urban environment. In more detail, "a smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business"¹⁴.

In fact, according to the European Commission (EC), a "smart city goes beyond the use of information and communication technologies (ICT) for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population"¹⁴.

This means that Smart Cities are intricately connected to other EU policies such as the Digital Single Market¹⁵, the European Green Deal¹⁶, the European Data Strategy¹⁷, and the European Mobility Strategy¹⁸

Digital Single Market and Smart Cities

The Digital Single Market is a driver for growth, innovation and Smart Cities as it aims to leverage digital technologies to drive innovation, economic growth, and improve the quality of life for citizens developing the digital infrastructure, promote the adoption of IoT technologies, e-government services and data-driven solutions, in addition to promoting digital skills and literacy¹⁹.

The Digital Single Market Strategy aims to create a seamless and coherent digital environment within the EU, promoting digital innovation, economic growth, and job creation. Smart Cities heavily rely on digital technologies and data-driven solutions, making them a fundamental part of the strategy.

The European Innovation Partnership on Smart Cities and Communities, together with the Digital Transition Partnership of the Urban Agenda for the EU, H2020 projects and the Digital Cities challenge initiative, together with the work done via the Green Digital Charter have contributed to addressing city-related challenges²⁰.

¹³

https://cdn.idc.com/downloads/IDC_Smart_Cities_Infographic.pdf?utm_medium=social&utm_source=usa&utm_campaign=smartcitiesinfo-graphic

¹⁴ https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

¹⁵ https://ec.europa.eu/commission/presscorner/api/files/attachment/8210/DSM_communication.pdf

¹⁶ https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

¹⁷ https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en

¹⁸ https://transport.ec.europa.eu/transport-themes/mobility-strategy_en

¹⁹ <https://ec.europa.eu/eurostat/cache/infographs/ict/bloc-4.html>

²⁰ <https://www.consilium.europa.eu/en/policies/digital-single-market/>



The European Innovation Partnership on Smart Cities and Communities (EIP SCC), a major market-changing undertaking supported by the EC bringing together cities, industries, SMEs, investors, researchers, and other smart city actors²¹, constitutes a significant first block for a future European policy on cities since its launch in 2012. The EIP SCC has successfully contributed to bringing stakeholders together in six action clusters²²: (i) Citizen Focus, (ii) Business Models, Finance and Procurement, (iii) Integrated Infrastructures and Processes, (iv) Integrated Planning, Policy and Regulations, (v) Sustainable Districts and Built Environment, and (vi) Sustainable Urban Mobility and generating a seven-year series of calls for Smart Cities Lighthouse projects under the Horizon 2020 Framework Program (H2020). Also, it brought together cities, industry, SMEs, banks, research and other Smart City actors, as it intends to (i) Improve citizens' quality of life, (ii) Increase competitiveness of Europe's industry and innovative SMEs, (iii) Make European cities more competitive and better places to live in, (iv) Share knowledge to prevent mistakes being repeated, (v) Reach European energy and climate targets and (vi) Support in finding the right partners and solutions, achieving social, environmental and economic sustainability for European cities.

Horizon Europe (HEU) has ushered in a transformative era of Research and Innovation (R&I) by introducing the pioneering EU Missions, particularly focused on Smart Cities. This initiative aims to create 100 climate-neutral Smart Cities by 2030, representing a significant step towards a more sustainable and technologically-advanced future. These 100 cities represent a collective effort from the 27 Member States. Additionally, the inclusion of 12 cities from countries associated or in the process of association with HEU further emphasizes the Mission's international reach and collaboration. With a substantial investment of approximately €360 million allocated to R&I within the Mission, spanning key areas like mobility, energy, and urban planning from 2021 to 2023, Horizon Europe is poised to drive meaningful progress in building smarter and more environmentally conscious urban environments for current and future generations²³.

Moreover, some projects on Smart Cities have been built under the scope of HEU, such as CitiObs²⁴ and REALLOCATE²⁵.

Energy, European Green Deal, and smart cities

Given that roughly 75% of Europe's population lives in cities²⁶, the EU's urban areas are important contributors to the EU's energy consumption and greenhouse gas emissions, which have a huge impact. At the same time, cities are the main drivers of the EU's economy, opening effective pathways to growth and jobs for Europe.

²¹ <https://e3p.irc.ec.europa.eu/articles/european-innovation-partnership-smart-cities-and-communities>

²² <https://smart-cities-marketplace.ec.europa.eu/>

²³ https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en

²⁴ <https://citiobs.eu/>

²⁵ <https://reallocate-mobility.eu/>

²⁶ https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Urban-rural_Europe_-_introduction



Several EU policies, proposals and initiatives promoting more attractive and competitive urban areas and healthier and more sustainable places to live in, while also tackling climate challenges, are in place²⁷:

- The [energy union strategy](#) sets out the targets and actions to transform the European energy system into the most sustainable in the world. At the same time, this strategy is linked with the European Green Deal, which aims to make Europe the world's first climate-neutral continent by 2050. The European Green Deal is the most ambitious package of measures that should enable European citizens and businesses to benefit from sustainable green transition. These measures, accompanied by an initial roadmap of key policies range from ambitiously cutting emissions, to investing in cutting-edge research and innovation, aim to preserve Europe's natural environment²⁸.
- The [Urban Agenda for the EU](#) promotes better laws, easier access to funding and more knowledge sharing on issues relevant for cities, bringing together the Commission, national ministries, city governments and other stakeholders.
- The [energy performance of buildings directive](#) (EPBD) promotes smart technologies in buildings to increase their energy efficiency.
- The [EU Covenant of mayors for climate & energy](#) brings together thousands of local governments, voluntarily committed to implementing EU climate and energy objectives in cities. At the same time, the Communication on the European Green Deal mentions the EU Covenant of Mayors as a "central force" to "provide assistance to cities and regions that want to commit to ambitious pledges on climate and energy policies" and "an essential platform to share good practices on how to implement change locally".
- The [Strategic Energy Technology Plan \(SET Plan\)](#)²⁹ promotes research and innovation efforts across Europe by supporting the most impactful technologies in the EU's transformation to a low-carbon energy system. Since the creation of the energy union, the SET Plan has become one of the main instruments of the energy union's 5th pillar on research, innovation, and competitiveness.
- The [Smart Cities Information System \(SCIS\)](#) is a knowledge platform to exchange data, experience, and expertise and to collaborate on the creation of Smart Cities, providing a high quality of life for its citizens in a clean, energy efficient and climate friendly urban environment. SCIS brings together project developers, cities, research institutions, industry, and experts³⁰.

²⁷ <https://ec.europa.eu/energy/en/topics/technology-and-innovation/energy-and-smart-cities>

²⁸ https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

²⁹ https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan_en

³⁰ <https://smart-cities-marketplace.ec.europa.eu/node/3022>



Sustainable transport for smart cities

The European Commission has funded several initiatives³¹ under sustainable transport for Smart Cities and is promoting sustainable urban mobility and increased use of clean and energy-efficient vehicles. The objective is to enhance mobility while reducing congestion, accidents, and pollution in European cities. The new European Urban Mobility Framework³² aims for a more sustainable, smart, and healthy inter-urban and urban mobility focusing on enhancing urban mobility and reducing congestion in cities through various measures, including encouraging the use of public transport, cycling, and walking. It also aims to provide more sustainable and connected transportation options for citizens. Regarding funding, the European Commission provides various funding programs such as the Horizon Europe³³, the Connecting Europe Facility³⁴ and the European Regional Development Fund³⁵, which all fall within the sustainable transport for smart cities initiatives and funding program.

Other examples of EU programs dedicated to promoting sustainable transport are the Sustainable Urban Mobility Plan^{36, 37} (strategic planning tools to guide sustainable urban mobility designed to promote a better quality of life) and the European Mobility Week (“annual awareness-raising campaign to behavioural change in favour of active mobility, public transport, and other clean, intelligent transport solutions”³⁸).

Importance of Smart City research to the US

Smart Cities research is a topic of great interest in the US. In September 2015, the Obama administration announced a Smart Cities Initiative, with the goal of investing over \$160 million (around €145.2 million) in Federal research and leveraging more than 25 technology collaborations to assist local communities in addressing key challenges such as reducing traffic congestion, fighting crime, fostering economic growth, managing the effects of climate change, and improving city service delivery³⁹. More recently, Congress passed the Smart Cities and Communities Act of 2021, which creates initiatives for the adoption and application of smart technology and systems in communities of various sizes⁴⁰. The National Science and Technology Council (NSTC) is the principal means by which the Executive Branch coordinates science and technology policy across the diverse entities that make

³¹ For example, Eltis, which facilitates the exchange of information, knowledge and experience in the field of sustainable urban mobility in Europe (<https://www.eltis.org/>); or CIVITAS, a network of cities for cities dedicated to cleaner, better transport in Europe and beyond. Since it was launched by the European Commission in 2002, the CIVITAS Initiative has tested and implemented over 800 measures and urban transport solutions as part of demonstration projects in more than 80 Living Lab cities Europe-wide (<https://civitas.eu/>).

³² https://ec.europa.eu/commission/presscorner/detail/en/ganda_21_6729

³³ https://cinea.ec.europa.eu/programmes/horizon-europe/transport-research-horizon-europe_en

³⁴ [https://cinea.ec.europa.eu/programmes/connecting-europe-facility_en#:~:text=The%20Connecting%20Europe%20Facility%20\(CEF,and%20upgrading%20the%20existing%20one.](https://cinea.ec.europa.eu/programmes/connecting-europe-facility_en#:~:text=The%20Connecting%20Europe%20Facility%20(CEF,and%20upgrading%20the%20existing%20one.)

³⁵ https://ec.europa.eu/regional_policy/funding/erdf_en

³⁶ <https://www.eltis.org/mobility-plans>

³⁷ https://transport.ec.europa.eu/news-events/news/commission-guides-member-states-sustainable-urban-mobility-planning-2023-03-09_en

³⁸ <https://mobilityweek.eu/home/>

³⁹ <https://obamawhitehouse.archives.gov/the-press-office/2015/09/14/fact-sheet-administration-announces-new-smart-cities-initiative-help>

⁴⁰ <https://www.congress.gov/bill/117th-congress/house-bill/3386/text?r=11&s=1>



up the Federal research and development enterprise. A primary objective of the NSTC is to ensure science and technology policy decisions and programmes are consistent with the President's stated goals. The Networking and Information Technology Research and Development (NITRD) Programme is the US' primary source of Federally funded work on pioneering information technologies (IT) in computing, networking, and software. The multiagency NITRD Programme, guided by the NITRD Subcommittee of the NSTC, seeks to provide the R&D foundation to ensure continued US technological leadership and meet the advanced IT needs of the US. For instance, the National Telecommunications and Information Administration (NTIA) within the Department of Commerce (DOC) developed and released a new toolset, under this initiative, to assist communities in leveraging private-sector resources and experience to build Smart Cities. One of the most significant challenges that communities face when implementing Smart City Solutions is a lack of skills and resources to create and deploy new large-scale technological projects⁴¹.

The Smart Cities and Communities⁴² (SCC) Task Force (discontinued in November 2018) was a body that was under the NITRD Cyber-Physical Systems (CPS) Interagency Working Group (IWG). The CPS IWG's purpose was to coordinate programs, budgets, and policy recommendations for CPS R&D across the Federal Government. This included identifying and integrating requirements, facilitating joint programs, and developing joint strategies for the CPS R&D programmes conducted by members of the NITRD Subcommittee and CPS IWG. Specifically, the SCC Task Force was created to coordinate Federal action and partnerships with academia, industry, local cities and communities, and other government entities to enable cities and communities of all types to access networking and information technologies and services. The SCC Task Force created the "Federal Smart Cities and Communities Programs Resource Guide"⁴³ to facilitate collaboration and coordination among Smart Cities and Communities (SCC) Task Force member agencies, academia, industry, local cities and communities, and other government entities. The Resource Guide describes Federally funded R&D programmes in Smart Cities communities. These R&D programmes seek to embed new digital technologies into city/community infrastructure, systems, and services.

Additionally, the SmartAmerica Challenge, a project initiated by the White House Presidential Innovation Fellows, seeks to unite (CPS) research by integrating testbeds, projects, and endeavors from diverse sectors such as: Building, Smart Manufacturing, Healthcare, Smart Energy, Intelligent Transportation, and Disaster Response, that in turn can be applied in a complex city-wide system⁴⁴.

Besides the government-driven initiatives, there are also grassroots initiatives worldwide, such as Smart Cities Council, a Washington, DC-based Social Impact Organization created in 2012. The Smart Cities Council has team members on the ground in North America, Southeast Asia (SEA), the Subcontinent, Europe, the United Kingdom, Ireland, and Australia/New Zealand, as well as a global network of around 400,000 Smart Cities practitioners and stakeholders, both direct and indirect.

⁴¹ https://ec.europa.eu/regional_policy/funding/erdf_en

⁴² <https://www.nitrd.gov/nitrdgroups/index.php?title=SCC>

⁴³ <https://www.nitrd.gov/pubs/NITRD-Connecting-Securing-Communities-Federal-Guide-2018.pdf>

⁴⁴ <https://smartamerica.org/about/>



Moreover, government bodies trust SCC to be impartial, seeking out joint partnerships to address both urban concerns and opportunities. SCC employs its global network of business sector and academic partners to assist the government in addressing these challenges and possibilities in an open, ethical, professional, and innovative manner⁴⁵.

Smart City research cooperation between the EU and the US

Although cities in the US and EU are different in many respects, they struggle with similar urban problems, such as traffic congestion, poor air quality, social and digital exclusion, poverty, public safety, digital transformation, and aging infrastructure⁴⁶.

Following the consultation process of the BILAT4.0 project, Smart Cities were an area of mutual interest for cooperation between the EU and the US⁴⁷. Smart Cities are a broad area since it is composed of several factors, such as smart infrastructure, smart transportation, smart energy, smart health care, and smart technology. In addition, ICT is a key enabler in transforming traditional cities into Smart Cities, especially now that the IoT and BD, are technologies that contribute to making Smart Cities efficient and responsive.

In Smart City rankings, Europe stands out as a global leader. The Institute for Management Development (IMD) and Singapore University of Technology and Design (SUTD) presented the first edition of the IMD World Competitiveness Center Smart City Index 2019, which ranks 102 cities worldwide⁴⁸. In 2023, an updated version of The IMD Smart City Index was released, and it uniquely focuses on how citizens perceive the scope and impact of efforts to make their cities ‘smart’, balancing “economic and technological aspects” with “humane dimensions”⁴⁹.

The top 10 smartest cities in 2023 are Zurich (1st), Oslo (2nd), Canberra (3rd), Copenhagen (4th), Lausanne (5th), London (6th), Singapore (7th), Helsinki (8th), Geneva (9th) and Stockholm (10th)⁵⁰. The highest-ranked US city in this ranking is New York City (21st), given a “BBB” grade on Structures and “A” on Technologies, followed by Boston (34th), valued with an “A” grade for its Structures and Technologies.

In the US, some cities have been positively remarked for their “smart” capabilities: New York city through smart waste management, Washington D.C. by incentivizing citizen engagement, Chicago by the reduction of energy costs enabled through the “Array of Things” and “Smart + Connected Community Initiatives”, Seattle by way of data analysis for the reduction of food waste, San Francisco

⁴⁵ <https://www.smartcitiescouncil.com/about-us>

⁴⁶ <https://www.smartcitiesdive.com/news/smart-city-expo-world-congress-collaboration-2018/542699/>

⁴⁷ <https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5ae4cc8ca&appId=PPGMS>

⁴⁸ <https://www.imd.org/research-knowledge/reports/imd-smart-city-index-2019/>

⁴⁹ The researchers surveyed 120 residents, chosen at random, in each city. Each survey has 40 questions, mainly focused on infrastructure and technology and relating to health and safety, mobility, activities, opportunities for work and education, and governance. Citizens were also asked about their attitudes to the use of personal data, facial recognition, and overall trust in local authorities. A final question asked them to summarize the perceived priority areas out of 15 possible options.

⁵⁰ <https://imd.cld.bz/IMD-Smart-City-Index-Report-20231/6/>

in their sustainable mobility endeavors, and Denver in their centralization and analytics of information for optimal deliberation⁵¹.

Cooperation between US and EU cities is already happening on a small scale through the International Urban Cooperation (IUC) program. The IUC programme⁵² with major international financial institutions and partners to link city decision-makers with potential funders. The EU is an important partner for sustainable urban development and innovation cooperation for local and regional development. Cooperation and city partnerships on sustainable development goals, urban planning and climate change between EU and US cities is undergoing through the IUC program.

Through IUC, the Italian city of Turin is partnered with the US city of Baltimore to incentivize urban innovation, urban regeneration, and equitable economic development⁵³. Strasbourg, France, has a joint initiative with San Diego, as well as Italian Padova and the American Birmingham. The Portuguese city of Vila Nova de Famalicão is working with the US city of Fort Collins to achieve sustainable urban mobility and climate resilience and increase citizen engagement⁵⁴. The Italian city of Bologna is collaborating with Austin, Texas on a range of issues, from advancing a healthy local food system and improving resource efficiency to enhancing resilience to climate change⁵⁵. Other pairings include the Bulgarian city of Varna which is collaborating with the US city of Santa Monica on sustainable transport and mobility planning, sustainable tourism, and community engagement in urban decision-making⁵⁶. Additionally, the French city of Lyon is collaborating with the US city of Boston on smart city development, smart mobility, and equity and social inclusion⁵⁷. Finally, the Spanish city of Barcelona is partnered with the US city of New York to work on access to affordable housing through community land trusts, housing finance, disposition of city assets and development of modular housing⁵⁸.

According to a BILAT 4.0 publication⁵⁹ about Cooperation indicators analysis on emerging topics EU-US, co-publications in Smart Cities research (with a focus on transport) between 2005 and 2016 amount to 25; without the focus on transport, this number would be close to 110.

Thematic Research Areas related to Smart City research

Considering the research areas involved in EU-US Smart City research output, Computer Science leads the field (see table below), which is no real surprise as ICT is deeply ingrained in the Smart City concept and considered the enabling technology. Computer Science is followed by Engineering and Social Sciences.

⁵¹ <https://tomorrow.city/a/smart-cities-united-states>

⁵² <https://iuc.eu/>

⁵³ https://iuc.eu/city-pairings/?c=search&pairing_id=nyud176f

⁵⁴ https://iuc.eu/city-pairings/?c=search&pairing_id=vnzkg81p

⁵⁵ https://iuc.eu/city-pairings/?c=search&pairing_id=2hszv1o4

⁵⁶ https://iuc.eu/city-pairings/?c=search&pairing_id=ayg981

⁵⁷ https://iuc.eu/city-pairings/?c=search&pairing_id=c1zwc6g8

⁵⁸ https://iuc.eu/city-pairings/?c=search&pairing_id=nlojgk6s

⁵⁹ https://www.euussciencetechnology.eu/assets/content/Deliverables/BILATUSA4.0_D3.3_revision_20170530.pdf

Table 2 - Research areas in EU-US Smart City research (with a focus on transport), 2005-2016⁵⁹

Subject areas	Co-publications
Computer Science	19
Engineering	10
Social Sciences	3
Mathematics	2
Business, Management and Accounting	1
Chemical Engineering	1
Chemistry	1
Decision Sciences	1
Earth and Planetary Sciences	1
Energy	1
Medicine	1
Multidisciplinary	1

Apart from *Smart City/-ies* and *transport(ation)*, the keywords most frequently used in the EU-US co-publications in Smart City research are *Cloud* (and *Cloud Computing*, respectively), *distributed computer systems*, *traffic control*, *vehicles*, and *intelligent transportation systems*. The table below contains the full list of the top 12 keywords.

Table 3 - Most used keywords (top 12) in EU-US Smart City research co-publications, 2005-2016⁵⁹

keyword	co-publications
Smart City/-ies	16
Transport(ation)	7
Cloud (incl. Cloud Computing)	5
Distributed Computer Systems	5
Traffic Control	4
Vehicles	4
Intelligent Transport Systems	4
Digital Storage	3
Intelligent Systems	3
Internet Of Things	3
Motor Transportation	3
Public Transport	3

2 US research community landscape

The US is the world's leading country in R&D investment, spending a total of \$679 billion (around €623.3 billion) on R&D in 2022, which represents roughly 2.6% of its Gross Domestic Product (GDP), which peaked at \$25.5 trillion (around €23.83 trillion)^{60,61}.

The main sponsors of R&D programs are industry (\$463.7 billion, nearly €415.5 billion, in 2021), the Federal Government (\$138.9 billion, nearly €124.5 billion, in 2021), academia (\$21.8 billion, nearly €19.5 billion, in 2021), Non-Federal Government (\$5 billion, nearly €4.5 billion, in 2021), and non-profit organizations (\$26.7 billion, nearly €23.9 billion, in 2021). R&D investment is estimated to exceed \$171.3 billion (around €155.32 billion) in FY2022, an increase of \$13.5 billion (around €12.24 billion) (8.5%) over the \$157.8 billion (around €143.08 billion) predicted in FY2021. The R&D request for FY2022 is \$10.6 billion (around €9.61 billion) (6.6%) higher than the request for FY2021⁶².

The US Federal Government supports Smart City R&D activities through grants and opportunities that promote the development and deployment of new technologies. At the Federal level, the DOE, DOT, NIST and NSF are Federal bodies with large budgets for Smart City R&D activities⁶³. Furthermore, Federal agencies have subprograms to support renewable energy R&D activities from early to advanced stages in development and implementation. Therefore, a review of the US Federal Government R&D initiatives and programs was conducted to identify the most relevant ones in the research fields related to Smart Cities.

The US research landscape is comprised of world-leading universities, research centres, research networks and industry clusters that are primarily funded by an extensive network of Federal and state funding initiatives and industry endowments⁶⁴. The US research community encompasses a complex set of different actors that receive support through many agencies, such as the Department of Health and Human Services (HHS), the Department of Defence (DOD) and the NSF. The key actors in the US research landscape are university research groups, research centres and industry clusters, which play different but complementary roles in the R&D field⁶⁵.

⁶⁰ <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=US>

⁶¹ <https://www.statista.com/statistics/188105/annual-gdp-of-the-united-states-since-1990/>

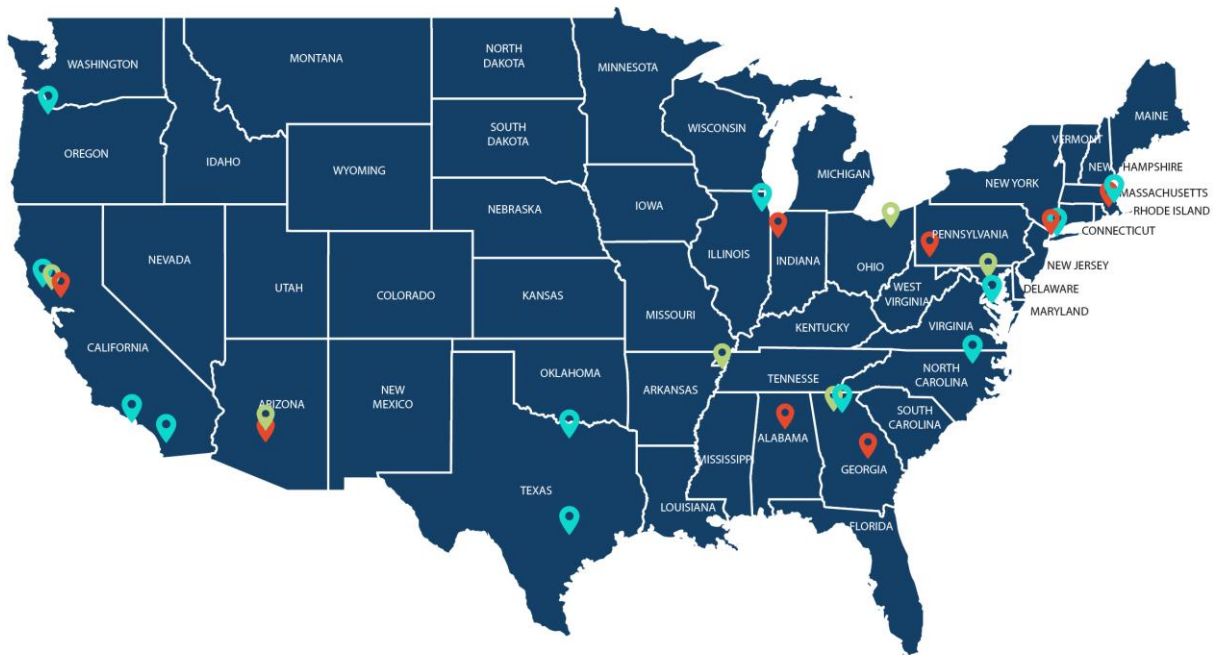
⁶² <https://crsreports.congress.gov/product/pdf/R/R46869>

⁶³ <https://www.usaspending.gov/agency>

⁶⁴ <https://www.dwih-newyork.org/en/research-innovation/the-research-and-innovation-landscape-in-the-usa/general-overview/>

⁶⁵ <https://itif.org/publications/2014/06/30/understanding-us-national-innovation-system>





University Research Groups

Carnegie Mellon University
Pittsburgh, Pennsylvania

Massachusetts Institute of Technology
Cambridge, Massachusetts

University of California Berkeley
Berkeley, California

Purdue University
West Lafayette, Indiana

Columbia University
New York City, New York

Georgia Tech
Atlanta, Georgia

The University of Alabama at Birmingham
Birmingham, Alabama

Arizona State University
Tempe, Arizona

Research Centres

Smart Cities (UC Berkeley and Lawrence Berkeley National Laboratory)
Berkeley, California

Georgia Tech's initiative on Smart Cities and Inclusive Innovation (SCI2)
Atlanta, Georgia

Smart City Internet of Things Innovation (SCITI)
Washington D.C.

Institute for Smart, Secure and Connected Systems (ISSACS)
Cleveland, Ohio

SMART Cities Research Cluster, University of Memphis
Memphis, Tennessee

Center for Smart Cities and Regions, Arizona State University
Tempe, Arizona

Industry Clusters

California
- Los Angeles
- San Francisco
- San Diego

Illinois
Chicago

Georgia
Atlanta

Washington
Seattle

New York
New York City

Texas
Dallas

Texas
Austin

Oregon
Portland

North Carolina
Raleigh

Massachusetts
Boston

Figure 6 - US Geographic Distribution of University Research Groups, Industry-University Research Centers, and Industry Clusters Focused on Smart Cities R&D Activities



2.1. University research groups

University research groups are comprised of researchers who share common and complementary research interests in leading areas and have similar needs regarding research infrastructure. They organize themselves around the same research topic, with a principal investigator and resources^{66, 67}. With respect to this research handbook, a university research group is either a research centre or institute housed at a university campus, or a division, department, or laboratory of a university.

The research groups identified in this section have been selected based on extensive literature review of their citations. The identified research groups are focused on at least one of the three main thematic research areas: Smart mobility, Smart energy, and Smart Transportation.

Some examples of smart cities technologies being developed are cleaner energy technologies and new models of transportation, such as smart parking spots, self-driving cars, electric vehicles, and e-bikes, as well as 5G sensors coupled with smart traffic system management to better understand traffic patterns, trends, and influences via AI, reducing travel time and idling⁶⁸. Other smart cities solutions include ⁶⁸water conservation technologies, adaptable and reconfigurable building-construction innovation, low-water and soil-less agriculture, and clean and small-scale manufacturing⁶⁸.

The research of smart cities requires knowledge from several different disciplines, such as sensors, mobility, energy, smart buildings, and transportation. Hence, universities can have more than one research group focused on Smart City research. This is also visible on Table 2 Sample of University Research Groups where there are various institutes for each of the university research groups.

⁶⁶ <http://www.sussex.ac.uk/research/about/groups/>

⁶⁷ <https://lib.luc.fi/c.php?g=653835&p=4942381>

⁶⁸ <https://www.forbes.com/sites/forbestechcouncil/2022/07/27/smart-city-technologies-that-could-soon-change-the-way-we-live-and-work/>



Table 4 - Sample of University Research Groups

Carnegie Mellon University

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Metro21: Smart Cities Institute	Dr. Raj Rajkumar	raj@ece.cmu.edu	Smart city	https://www.cmu.edu/metro21/index.html
Traffic21: Smart Transportation Institute	Dr. Stan Caldwell	stancaldwell@cmu.edu	Smart mobility	https://traffic21.heinz.cmu.edu/
Wilton E. Scott Institute for Energy Innovation	Dr. Daniel Tkacik	dtkacik@andrew.cmu.edu	Sustainability and smart energy	https://www.cmu.edu/energy/index.html





Massachusetts Institute of Technology

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Department of Urban Studies & Planning	Eran Ben-Joseph	ebj@mit.edu	Urban and physical design	https://dusp.mit.edu/
Senseable City Laboratory	Carlo Ratti	ratti@mit.edu	Smart city	http://senseable.mit.edu/
Urban Mobility Lab and Transit Lab	Prof. Jinhua Zhao	jjinhua@mit.edu	Smart mobility	https://mobility.mit.edu/
Future Energy Systems Center	Randall Field	rpfield@mit.edu	Smart energy	https://mobilitysystemscenter.mit.edu/research
Mobility Systems Center	William Green	whgreen@mit.edu	Smart mobility	https://www.mmi.mit.edu/groups/Mobility-Systems-Center
Sustainable Urbanization Lab	Siqi Zheng Shilpy Singh	sqzheng@mit.edu	Sustainable urbanization	https://sul.mit.edu/





University of California Berkeley

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Smart Cities Research Center	Jane Macfarlane	janemacfarlane@berkeley.edu	Smart city, Smart Transportation	https://its.berkeley.edu/research-centers/smart-cities
Transportation Sustainability Research Center	Susan Shaheen, PhD Timothy Lipman, PhD Arpad Horvath, PhD	sashaheen@tsrc.berkeley.edu telipman@berkeley.edu horvath@ce.berkeley.edu	Smart transportation, smart mobility	https://tsrc.berkeley.edu/
California Partners for Advanced Transportation Technology (PATH)	James Fishelson	jfishelson@berkeley.edu	Smart transportation, smart mobility	https://path.berkeley.edu/
Center for Cities and Schools	Deborah McKoy	culler@cs.berkeley.edu	Sustainable cities	https://citiesandschools.berkeley.edu/





Purdue University

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Joint Transportation Research Program	Darcy Bullock	darcy@purdue.edu	Smart transportation	https://engineering.purdue.edu/JTRP
Center for Global Urban Sustainability	Sandra S. Liu	liuss@purdue.edu	Smart city	https://www.purdue.edu/cgus/
Energy Center	Maureen McCann	mmccann@purdue.edu	Smart energy	https://engineering.purdue.edu/Engr/Research/LabsFacilities/Archive/EC
INtegrated Smart Energy Technology Lab	J. Eric. Dietz	jedietz@purdue.edu	Smart energy	https://polytechnic.purdue.edu/facilities/integrated-smart-energy-technology-lab
Center for Intelligent Energy Systems	Lefteri Tsoukalas	tsoukala@purdue.edu	Smart energy	https://engineering.purdue.edu/CiENS
Institute for a Sustainable Future	Matthew Huber	huberm@purdue.edu	Sustainability	https://research.purdue.edu/isf/





Sustainable Transportation Systems Research	Konstantina Gkritza	nadia@purdue.edu	Sustainable Transportation	https://engineering.purdue.edu/STSRG
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Columbia University

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Smart Cities Center	Andrew Smyth	aws16@columbia.edu	Smart city	https://datascience.columbia.edu/smart-cities
Center for Sustainable Urban Development	Elliott Sclar Jacqueline Klopp	eds2@columbia.edu jk2002@columbia.edu	Smart city	http://csud.ei.columbia.edu/
Lenfest Center for Sustainable Energy	Ah-Hyung Alissa Park	ap2622@columbia.edu	Sustainable energy	https://energy.columbia.edu/
Center for Resilient Cities and Landscapes	Thaddeus Pawlowski	t.pawlowski@columbia.edu	Smart city	https://www.arch.columbia.edu/research/centers/4-center-for-resilient-cities-and-landscapes





Center for Sustainable Development	Jeffrey D. Sachs	sachs@columbia.edu	Sustainable development	https://csd.columbia.edu/
Columbia Population Research Center	Jennifer Hirsch Jane Waldfogel	jw205@columbia.edu	Urban development Smart city	https://cprc.columbia.edu/

University of Pennsylvania.

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Kleinman Center for Energy Policy	Dr. Cornelia Colijn	ccolijn@upenn.edu	Smart energy	https://kleinmanenergy.upenn.edu/
Vagelos Institute for Energy Science and Technology	Karen Goldberg	kig@sas.upenn.edu	Smart energy	https://web.sas.upenn.edu/viest-institute/
Penn Institute for Urban Research	Eugénie L. Birch Susan Wachter	elbirch@design.upenn.edu wachter@wharton.upenn.edu	Smart city	https://penniur.upenn.edu/





Georgia Tech

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Brook Byers Institute for Sustainable Systems	Beril Toktay	aberil.toktay@scheller.gatech.edu	Smart city/Gigatechnology	https://datascience.columbia.edu/smart-cities; https://research.gatech.edu/sustainability/about
Center for Quality Growth and Regional Development	Arthi Rao	arthir@gatech.edu	Smart city	https://cqgrd.gatech.edu/
Center for Spatial Planning Analytics and Visualization	Subhrajit Guhathakurta	subhro.guha@design.gatech.edu	Smart city	https://cspav.gatech.edu/
Center for Urban and Regional Air Mobility	Laurie Garrow	laurie.garrow@ce.gatech.edu	Smart city	https://airmobility.gatech.edu/





Climate and Energy Policy Laboratory	Marilyn A. Brown	marilyn.brown@pubpolicy.gatech.edu	Smart city	https://cepl.gatech.edu/
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The University of Alabama at Birmingham

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
Sustainable Smart Cities Research Center	Dr. Rouzbeh Ross Nazari	rnazari@uab.edu	Smart city	https://www.uab.edu/engineering/smartcities/
Transportation Engineering and Development Laboratory	Dr. Virginia P. Sisiopiku	vsisiopi@uab.edu	Smart transportation	https://www.uab.edu/engineering/trendlab/

Arizona State University

Research group	Research coordinator (RC) name	RC email address	Relevant research areas	Internet link
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Decision Center for a Desert City	Dave D. White	Dave.White@asu.edu	Smart city Sustainable water management policies	https://sustainability-innovation.asu.edu/dcdc/
Sustainable Smart Cities Research Center	Dr. Rouzbeh Ross Nazari	rnazari@uab.edu	Smart city	https://www.uab.edu/engineering/smartcities/
Transportation Engineering and Development Laboratory	Dr. Virginia P. Sisiopiku	vsisiopi@uab.edu	Smart transportation	https://www.uab.edu/engineering/trendlab/
Center for Environmental Economics and Sustainability Policy	Michael Hanemann	michael.hanemann@asu.edu	Sustainable urban policies	https://ceesp.wpcarey.asu.edu/
Center for Efficient Vehicles and Sustainable Transportation Systems	Hongbin Yu	yuhb@asu.edu	Sustainable transportation	https://evsts.asu.edu/
Center for Urban Innovation	David Swindell	david.swindell@asu.edu	Smart city	https://urbaninnovation.asu.edu/
Center for Smart Cities and Regions	Diana Bowman Erik Johnston	diana.bowman@asu.edu erik.johnston@asu.edu	Smart city	https://law.asu.edu/centers/law-science-innovation/smart-cities-and-regions





LightWorks	Gary Dirks	garydirks@asu.edu	Smart energy	https://sustainability-innovation.asu.edu/lightworks/
UREx Sustainability Research Network	Charles Redman	charles.redman@asu.edu	Sustainable urban policies	https://sustainability-innovation.asu.edu/urbanresilience/
Urban Climate Research Center	Matei Georgescu	Matei.Georgescu@asu.edu	Urban climate policies	https://sustainability-innovation.asu.edu/urban-climate/
https://sustainability-innovation.asu.edu/hue/	Matthew Fraser Charles Redman	Matthew.Fraser@asu.edu charles.redman@asu.edu	Urban climate policies	https://sustainability-innovation.asu.edu/hue/
Global Institute of Sustainability and Innovation	Ira Bennett (support staff)	gfss@asu.edu	Sustainable urban policies	https://sustainability-innovation.asu.edu/



2.2. Research centres

Smart Cities research centres are crucial to translate scientific knowledge into new discoveries that can lead to technology innovation, development, and deployment. Therefore, research on Smart Cities requires an interdisciplinary approach which includes researchers and industry members from different disciplines, such as ICT, transportation, and energy.

Smart Cities (UC Berkeley and Lawrence Berkeley National Laboratory)

Research Areas: Urban Data Analytics, Grid / Transportation Integration, Smart Transportation, Data Driven Energy Modelling and Analytics of Geospatial Temporal Data Analytics

Coordinator: Jane Macfarlane, Director of Smart Cities Research Center

The Smart Cities Research Center is a collaboration between UC Berkeley and Lawrence Berkeley National Laboratory to improve energy-efficient mobility systems. Urban mobility understanding can be improved significantly by taking advantage of a new generation of data that has been collected by mobile devices. The Smart Cities Research Center studies mathematical models and data analytics with approaches ranging from urban-scale simulation to control theory. The centre collaborates with industry and public agencies to collect and model data to develop more efficient transportation networks. The research focuses on novel approaches of modelling interdependent energy and transportation systems. The work leverages the analytics capabilities of rich geospatial data and develops novel approaches to studying multiple aspects of urban dynamics in the nexus of cyber, physical, and social systems. Machine learning, high-performance computing, along with a variety of optimisation algorithms and infrastructure control methods informs our work to produce transportation development scenarios and recommendations to practitioners and decision makers. Research areas are grounded in the disciplines covered by master's and doctorate programs in civil, systems, urban planning, and transportation engineering.

In addition, UC Berkeley has other research centres such as: Transportation Sustainability Research Center, California Partners for Advanced Transportation Technology (PATH) and the Center for Cities and Schools.

<https://its.berkeley.edu/research-centers/smart-cities>

Georgia Tech's initiative on Smart Cities and Inclusive Innovation (SCI2) Research and Public Sector Collaborations in: Mobility and Equity, Connected and Digital Society, Resilient and Sustainable Growth, Civic Innovation



Coordinator: Debra Lam, Managing Director for Smart Cities and Inclusive Innovation

Located in Tech Square and in partnership with local governments, industry and communities, Georgia Tech's initiative on Smart Cities and Inclusive Innovation (SCI2) develops cutting-edge approaches to shaping resilient and sustainable communities through a suite of applicable technology and data applications. SCI2 is university-wide and intentionally works across the Georgia Tech's schools, colleges, and research units to foster multidisciplinary research and teaching for community impact. SCI2's goal is to provide communities of any size with applied, multidisciplinary research on the most challenging, complex civic and societal issues. SCI2 uses different technologies and data that support a smart city to develop programs in mobility, sustainability, connectivity, and community engagement.

<https://smartcities.gatech.edu/>

Smart City Internet of Things Innovation (SCITI)

Research area: IoT

Coordinator: To learn more about the SCITI, contact: first.responder@hq.dhs.gov.

Smart City Internet of Things Innovation (SCITI) is a smart city solutions innovation lab created in collaboration between the US Department of Homeland Security Science and Technology Directorate, CIT, TechNexus and Smart City Works. DHS Science and Technology Directorate's (S&T's) SCITI Labs initiative leverages cutting-edge smart city and IoT technologies to build new capabilities in DHS components and enhance public safety in communities across the country. SCITI brings together key government and private sector partners to identify new and existing technologies that meet first responders' operational needs and enhance commercial buildings, ensuring the nation's critical infrastructure and those who protect it are secure and resilient. To advance and integrate technologies, in addition to implementing a streamlined process for getting these capabilities commercialized and available to users, selected technologies need to be useable, affordable, and scalable to suit the mission needs of responders and industry. The SCITI Labs partnership continues to support R&D and test of a variety of prototype technologies in areas such as Intelligent Building Sensor Suite, Cybersecurity for IoT and Industrial Control Systems and Wildland Fire Sensors.

<https://www.dhs.gov/science-and-technology/st-smart-city-internet-things-innovation-sciti-labs>

Sustainable Smart Cities Research Center (SSCRC), University of Alabama at Birmingham (UAB)

Research area: IoT, BD, data analytics

Coordinator: Dr. Rouzbeh R. Nazari, Center Director



The UAB SSCRC plays a pivotal role in supporting researchers to engage in collaborative endeavors that focus on the sustainability of both built and natural environments. By harnessing the power of cutting-edge technologies, the Center aims to optimize transportation systems, enhance energy-efficient buildings, establish smart-grid infrastructure, explore technological advancements, and foster the development of healthier city infrastructures. Through its commitment to innovative research, the Center aims to address the pressing challenges of urbanization and create more environmentally friendly, resource-efficient, and liveable cities. By bringing together multidisciplinary expertise and fostering partnerships with various stakeholders, the UAB SSCRC drives transformative solutions that build a more sustainable future for urban communities and the natural world.

<https://www.uab.edu/engineering/smartcities/research>

Institute for Smart, Secure and Connected Systems (ISSACS)

Research area: IoT

Coordinator: Nick Barendt, Executive Director, Institute for Smart, Secure and Connected Systems (ISSACS) Office of Research and Technology Management

The Institute for Smart, Secure and Connected Systems (ISSACS) conducts research on Smart Cities for Case Western Reserve University. Case Western Reserve University launched the ISSACS in the spring of 2016 to focus on the Industrial Internet of Things (IIoT). ISSACS seeks to catalyze efforts in Cleveland and Northeast Ohio and seize the \$6.2 trillion (around €5.62 trillion) economic opportunity of the IoT.

To meet the challenges and opportunities of IoT, the ISSACS acts as a technological core of key laboratories and the four vertical themes (Manufacturing, Healthcare, Energy, and Infrastructure—with a focus on Smart Cities and Communities). The key laboratories address both the foundational and translation aspects of IoT. These include sensing, embedded systems, communications and networks, cyber-security, data management, data analytics, visualization and signal processing, control, and decision-making across applications. These tools span manufacturing, infrastructure, hospitals, homes, and every other area where products and services are produced and delivered.

<https://case.edu/issacs/>

Smart Cities Research Center, Columbia University Data Science Institute

Research area: Data Science

Coordinator: Xiaofan (Fred) Jiang and Andrew Smyth, Chairs of the Smart Cities Research Center

The Smart Cities Research Centre at Columbia University Data Science Institute develops, monitors, and enhances infrastructure, buildings, transportation routes, power supply, and everyday activities in busy urban areas. The Centre's research tackles aging urban infrastructure, improves smart grid



technology, optimises transportation routes in congested traffic, and deploys sensing devices. The Research Centre collaborate with affiliated labs, including the Columbia Intelligent and Connected Systems Lab, Computer Graphics and User Interfaces Lab, Research Coordination Network: Sustainable Cities, Robert A.W. Carleton Laboratory, and Urban Design Lab, to drive innovative solutions for sustainable and efficient urban development.

<https://datascience.columbia.edu/research/centers/smart-cities/>

SMART Cities Research Cluster, University of Memphis

Research area: Smart transportation networks

Coordinator: Sabya Mishra, Assistant Professor and Charlie Santo, Assoc Professor Chair

The University of Memphis and the City of Memphis are partnering on a SMART City Initiative (as part of a larger national-level MetroLab Network program) to address the needs of Memphis citizens by using emerging technologies and innovations from the University of Memphis. A key focus is on research, development, and deployment projects that offer technological and analytical solutions to challenges facing urban areas, including inequality in income, health, mobility, security and opportunity, ageing infrastructure and environmental sustainability and resiliency. City-university research and innovation projects help position the university as the city's R&D partner and the city as a testbed for University of Memphis research. Projects are designed to present an opportunity to scale effective solutions, accelerate best practices, and advance the understanding of urban science.

<https://www.memphis.edu/fedex/research/smartcities/smartcities.php>

Center for Smart Cities and Regions (CSCR), Arizona State University

Research area: IoT, BD

Coordinator: Diana Bowman and Erik Johnston, PhD, Co-directors

The Center for Smart Cities and Regions (CSCR) is committed to advancing urban and regional innovation, striving to create more inclusive, vibrant, resilient, and sustainable communities. By fostering collaboration among researchers, policymakers, planners, entrepreneurs, industry, and the public, the CSCR aims to enhance cities' and regions' capacity to responsibly embrace emerging technological infrastructures and improve overall quality of life. While smart technologies and BD have emerged as potential solutions to various urban challenges, the CSCR acknowledges the importance of bridging the gap between technology innovators and the needs and contexts of local communities and policymakers. Leveraging the resources from Arizona State University, the CSCR works diligently to develop anticipatory capabilities and responsible innovation processes, contributing to positive and prosperous futures for cities, regions, and their diverse populations. With affiliations to prestigious



institutions, such as the Sandra Day O'Connor College of Law, the Thunderbird School of Global Management, and the School for the Future of Innovation in Society within the College of Global Futures, the CSCR generates innovative ideas, methods, scenarios, networks, and collaborative spaces, empowering partners to leverage technological innovations effectively in shaping their desired urban and regional landscapes.

<https://law.asu.edu/centers/law-science-innovation/smart-cities-and-regions>

2.3. Industry clusters

In this research handbook, industry clusters are defined as geographic concentrations of businesses of closely related industries. In the US, the industry clusters have been a catalyst for economic growth for over a century, mostly due to the ability of leading universities in the country to work cooperatively with industry.

Los Angeles (LA), California The city of LA is built on the earthquake-prone San Andreas Fault and its landscape is characterized by its urban sprawl. According to the ESI, the city prizes resilience and sustainability through open data. Los Angeles has an online portal for the distribution of large datasets and statistics on traffic, pollution, infrastructure, demographics, economic, health, climate, and cultural activities⁶⁹. [L.A. City GeoHub](#) is the city's new public platform for exploring, visualizing, and downloading location-based Open Data. At the same time, the LA Data Catalog is available also here: <https://data.lacity.org>. Recently, LA developed a Smart City strategic policy, SmartLA 2028, which includes smart infrastructure, data tools and practices, digital services and applications, connectivity and digital inclusion and governance.

San Francisco, California

San Francisco is home to some of the US's most successful tech startups: Uber, Lyft, Airbnb, Twitter, and Dropbox to name a few⁷⁰. The city was a finalist in the 2016 Smart City Challenge, receiving \$11 million (around €9.98 million) to be divided between six initiatives to reduce transit problems. In addition, the San Francisco Municipal Transportation Agency (SFMTA) established the SFpark pilot project to use new technologies and policies to improve parking in San Francisco, such as using smart meters, parking sensors, and a sophisticated data management tool⁷¹. Also, the city of San Francisco

⁶⁹ <https://www.businesschief.com/top10/7933/Top-10-smart-cities-in-the-US>

⁷⁰ https://static1.squarespace.com/static/5b3c517fec4eb767a04e73ff/t/5b513c57aa4a99f62d168e60/1532050650562/Eden-OXD_Top+50+Smart+City+Governments.pdf

⁷¹ https://www.sfmta.com/sites/default/files/reports-and-documents/2018/08/sfpark_pilot_project_evaluation.pdf



has been working on a Strategic Vision for Smart Cities and the Internet of Things focusing on urban mobility and smart governance.

San Diego, California is another important smart city in California. Smart Cities San Diego was a result of a collaboration⁷² that combined the resources of the city's local government, San Diego Gas & Electric, the University of California San Diego, General Electric, and a major non-profit partner, Cleantech San Diego. The city has been successful in strengthening their electric transportation infrastructure. San Diego is home to more than 14,000 electric vehicle (EV) drivers, nearly 1,000 charging stations, and car2go's fleet of 400 EVs. Plus, the streets have also been installed with smart LED lights, wireless sensors, and adaptive controls. This action allowed the region to reduce its overall energy consumption. The city's next project will focus on utilizing solar power and overhauling its drinking water system⁷³.

Silicon Valley, California Silicon Valley is a global technology powerhouse that influences smart city improvements through its dynamic ecosystem of tech titans, startups, and major research institutes. This industry cluster promotes advancements in a variety of smart city fields, including IoT, smart grid technologies, and sustainable urban solutions. Companies such as Google's Sidewalk Labs and Cisco Systems play critical roles in developing cutting-edge technology for smarter and more sustainable cities, with a collective focus on creating efficient, connected, and eco-friendly urban settings. Silicon Valley's collaborative culture fosters cross-disciplinary alliances that promote forward-thinking urban initiatives, altering the urban landscape in the digital era.

Sacramento, California

Sacramento, the capital city of California, is strongly working towards transforming itself into a Smart City, implementing measures such as providing free wi-fi in parks, developing intelligent traffic solutions, partnering with Verizon to improve sustainability, providing technology, increasing efficacy on services, meeting community needs and reducing resources consumption⁷⁴.

ENRICH in the USA Soft Landing Hubs: Initial contact points for California

⁷² <https://www.digitaltrends.com/home/san-diego-smart-city-technology/>

⁷³ <https://www.boldbusiness.com/infrastructure/top-12-rising-smart-cities-in-u-s/>

⁷⁴ <https://www.cityofsacramento.org/Smart-City>

Through the **ENRICH J-1 Soft-Landing Programs**, interested participants can access Incubators/Innovation Centers of Universities dedicated to R&I in the **Smart Cities** domain.

ENRICH in the USA has some Soft-Landing Hubs located near the California industry clusters. These Soft-Landing Hubs help SMEs to venture into North America, through a low-cost strategy and temporary visa. All tools are provided to conduct proof of concept tests, to connect with new strategic partners and potential clients, and to revamp your product development, research, and intellectual property strategy within the US market. Soft-Landing Hubs also ease access to local funding opportunities and grants to support research and commercialization efforts. Through the ENRICH J-1 Soft Landing Programs, interested participants can access Incubators/Innovation Centers of Universities dedicated to R&I in the Smart Cities domain, namely: CalPoly University – CIE, Citris Foundry at UC Berkeley, Galvanize – San Francisco and Santa Clara University.

CalPoly University – CIE

Cal Poly is a highly rated public university located in San Luis Obispo, California. It is one of two polytechnical universities in California, with the other being located in Pomona. It is a large institution with an enrollment of 19,685 undergraduate students.

Admissions is competitive as the Cal Poly acceptance rate is 28%. The university has six colleges that offer 65 undergraduate degrees and 39 Masters degrees. Popular majors include Business, Mechanical Engineering, and Biology. Cal Poly was ranked 115 out of 650 in a list of the best colleges in America by Forbes in 2019.

The CIE HotHouse is a community space created through the efforts of Cal Poly, the city and county of San Luis Obispo, the business community, and the Cal Poly Center for Innovation and Entrepreneurship (CIE). It is an off-campus location that houses CIE programs. The goal of the HotHouse is to support students and community members as they work to create new innovations and start business ventures.

Citris Foundry at UC Berkeley

The University of California, Berkeley is a public land-grant research university in Berkeley, California. Established in 1868 as the University of California, it is the state's first land-grant university and the first campus of the University of California system. Its fourteen colleges and schools offer over 350-degree programs and enroll some 31,000 undergraduate and 12,000 graduate students. Berkeley is ranked among the world's top universities by major educational publications.

When it comes to Research, from expeditions to Egypt in the late 1800s to stem cell research and artificial intelligence today, Berkeley has been at the forefront of research throughout its history.



Here students can work side-by-side with Nobel Laureates, Fields medal winners, Fulbright Scholars and MacArthur fellows.

Uniquely situated across multiple UC campuses, the CITRIS Foundry is ideally positioned to help new generations of innovators and entrepreneurs bridge the gap from lab to market and actualize rigorous, validated solutions to society's biggest challenges. The Foundry's Incubator offers guidance, education, and a home-base to de-risk entrepreneurship for early-stage founders, especially supporting those who have been historically marginalized, allowing innovators to confidently identify pathways to success and reach the next stage of development and investment for their emerging technology venture.

CITRIS FOUNDRY is part of CITRIS as one of its programs. Citris Banatao Institute departments focus on health research, energy, robots, policy lab, and enterprise innovation represented by Citris Foundry.

Galvanize – San Francisco

Galvanize helps to build and scale companies or projects with a custom co-working solution. Companies can get access to mentors, workshops, talent, and resources.

- Upskill & train teams: With custom curriculums, businesses can upskill their technical talent and accelerate business growth.
- Hire bootcamp graduates: At no cost, Galvanize's partnerships team connects organizations with job-ready software engineering talent graduating from their coding bootcamps.
- Hire trained veterans: As a VA VET TEC Preferred Provider, Galvanize matches talented, job-ready Veterans to open roles.
- Access corporate resources: Galvanize has the resources to help companies upskill or reskill their organizations, find efficiencies, and onboard talents.

Santa Clara University

Santa Clara University (SCU) is partnering with tech companies to bring smart solutions to its campus. Thus, in 2017 USC have adopted smart parking technology (which includes sensors to keep track of open spaces in parking garages; up to the minute information about the status of parking spaces), but also a system that detects pedestrians crossing the streets and automatically activates warning lights.

Additionally, SCU has been working towards energy savings, to the extent that photovoltaics, solar thermal systems, and wind turbines have been gradually installed on the campus as part of the Green Power Program, a program that aims to prevent the emission of over 21,545 tons of carbon dioxide each year and at the same time provide smart energy solutions to the campus.

Chicago, Illinois

Chicago launched “Smart Chicago” in partnership with a local foundation and fund, to co-create Smart City solutions with residents through civic participation, functioning alongside the government’s own systematic application of Smart City solutions. Smart Chicago has been working on improving people’s lives using technology. The city has spearheaded multiple projects around health, education, justice, and the ecosystem. Some of their current projects include Chicago Health Atlas, Smart Health Centers, Youth-Led Tech, Chicago Early Learning Portal and CUTGroup⁷³. In 2017, the Smart Chicago Collaborative and City Digital merged to form City Tech. City Tech is dedicated to reimagining cities as places where technology fuels opportunity, inclusion, engagement, and innovation.

On the data side, the city is working with the University of Chicago to break down silos and funnel smart cities data into a platform called Plenario, which funnels information back through an application programming interface (API) and makes it available around locations. To create hardware that can be seamlessly placed throughout the city, Chicago is also collaborating with the School of the Art Institute of Chicago on stylish hardware boxes. Other efforts are underway at Northwestern University, which is studying applications in transportation⁷⁵.

The city of Chicago launched Array of Things (AoT), an experimental urban measurement project that deploys a network of sensors across the city to collect data on various environmental factors such as air quality, noise levels, and weather conditions. This data was intended to be used for research and to inform urban planning decisions⁷⁶.

Atlanta, Georgia

The city of Atlanta focuses on five core pillars for its Smart City efforts—multi-mode transport, public safety, the environment, city operations efficiency, and public and business engagement. The city’s Smart City initiatives—dubbed “[SmartATL](#)”—are currently focused on projects addressing crime, traffic, and water management⁷³. According to the Eden Strategy Institute (ESI), what Atlanta apart from other smart cities is the drive to transform at scale⁷⁷.

Atlanta is collaborating with academia, specifically with the Georgia Institute of Technology (Georgia Tech), on predictive analytics in transportation, using advanced sensors to predict potholes and identify intersections with frequent near-crashes. The city can then direct resources to fix potholes before they happen and make changes to dangerous roads, thereby improving efficiency and reducing costs⁷⁵.

⁷⁵ <https://www.govtech.com/dc/articles/GT-December-2017-Smart-City-Pioneers-Where-Are-They-Now.html>

⁷⁶ <https://arrayofthings.github.io/faq.html>

⁷⁷



Atlanta is also working with Georgia Tech on public safety through a machine learning algorithm that uses natural language processing to draw connections between thousands of case reports generated by police. This project seeks to identify similarities in cases in real time, a vast improvement from manual review.

Seattle, Washington

Home to tech giants, such as Microsoft, Amazon and Valve, Seattle, Washington has a history of leadership in the digital age. In January 2019, Microsoft announced its commitment to invest \$500 million (around €453.47 million) in affordable housing to offset the income inequality caused by the area's saturation with high-pay, high-skill tech jobs⁷⁸. In January 2020, the tech giant followed up the announcement with a \$250 million (around €226.74 million) increase to their affordable housing initiative in the form of a line of credit to the Washington State Finance Commission^{79,80}.

Due to its innovative initiatives, Seattle is frequently known as a leading smart city. Seattle has a high-speed fibre-optic network that enables effective data transfer and communication between various industries⁸¹. Additionally, it is committed to sustainability and has several initiatives to promote clean energy, like the [Seattle City Light](#) program. The city also has various programs to provide affordable internet access and devices to low-income residents, such as the [Technology Matching Fund](#). Seattle was ranked first on the Forbes list for the “best place in the US for business and career” in 2019 and named the top city for young professionals in 2022⁸².

ENRICH in the USA Soft Landing Hubs: Initial contact points for Washington

Through the **ENRICH J-1 Soft Landing Programs**, interested participants can access Incubators/Innovation Centers of Universities dedicated to R&I in the **Smart Cities** domain.

ENRICH in the USA has some Soft-Landing Hubs located near the Washington industry clusters. These Soft-Landing Hubs help SMEs to venture into North America, through a low-cost strategy and temporary visa. All the tools are provided, to conduct proof of concept tests, to connect with new strategic partners and potential clients, and to revamp your product development, research, and intellectual property strategy within the U.S. market. Soft-Landing Hubs also ease access to local funding opportunities and grants to support research and commercialization efforts. Through the ENRICH J-1 Soft Landing Programs, interested participants can access Incubators/Innovation Centers

⁷⁸ <https://archpaper.com/2019/01/microsoft-invest-500-million-affordable-housing-seattle/>

⁷⁹ <https://blogs.microsoft.com/on-the-issues/2020/01/15/one-year-later-affordable-housing/>

⁸⁰ <https://news.microsoft.com/affordable-housing/>

⁸¹ <https://techbehemoths.com/blog/top-smart-cities-in-the-us>

⁸² <https://visitseattle.org/press/press-kit/seattle-accolades/>

of Universities dedicated to R&I in the Smart Cities domain, namely: The National Council of University Research Administrators (NCURA) and George Mason University.

The National Council of University Research Administrators (NCURA)

The National Council of University Research Administrators (NCURA) began in 1959 with 45 members and one Annual Meeting a year. Today NCURA has approximately 7,500 individual members from over 2,200 colleges, universities, teaching hospitals, and non-profit research institutes globally and is the oldest and largest Research Administration organization globally serves its members and advances the field of research administration through education and professional development programs, sharing of knowledge and experience and fostering a professional, collegial, and respected community.

NCURA hosts a variety of meetings and workshops, the most significant being the NCURA Annual Meeting with approximately 2,000 attendees, the Financial Research Admin (FRA) Conference with 1,100 attendees, the Pre-Award Research Admin (PRA) Conference ~500 attendees as well as Regional Meetings and Traveling Workshops.

George Mason University (GMU)

George Mason University (GMU) is a public research university in Fairfax County, Virginia. Established in 1957 as the Northern Virginia branch of the University of Virginia, it became an independent university in 1972 and has since grown to become the largest four-year public university in the Commonwealth of Virginia. The university is named for the Founding Father George Mason, a Virginia planter and politician who authored the Virginia Declaration of Rights that later influenced the future Bill of Rights of the United States Constitution. Mason operates four campuses in Virginia (Fairfax, Arlington, Front Royal, and Prince William), as well as a campus in South Korea.

The university is classified among "R1: Doctoral Universities – Very high research activity". It is particularly well known in the fields of economics and law and economics. Two George Mason economics professors have won the Nobel Memorial Prize in Economics: James M. Buchanan in 1986 and Vernon L. Smith in 2002.

Mason Enterprise Center (MEC) is a unique workspace for the community, it is a space for individuals and businesses to release their full potential, transform and achieve their goals. The collaborative atmosphere, strong camaraderie, and structured enterprise solutions to help you reach success. The Center is trying to grow the community through innovation: with flexible leases and fully furnished workspaces, unique business programs, and one-on-one mentorship services for entrepreneurs of all experience levels, George Mason University business supports services, and more.

New York City, New York



Over 8.6 million people live in New York City (NYC). To cope with the complexities of scale, the New York government has taken steps to decentralise its leadership, splitting its smart city initiatives between the Mayor’s Office of Sustainability, the Mayor’s Office of Recovery and Resiliency and the Mayor’s Office of the Chief Technology Officer. Together, these offices implement their portfolio of projects with flexibility, involving other departments and agencies as required. Collectively, they focus on smart water, waste, and electric lighting management to reduce environmental pollution while coping with the city’s ever-growing population⁷³.

NYC currently has LinkNYC kiosks throughout the city, providing free public Wi-Fi, device charging, and access to city services. These kiosks also served as data collection points to gather information about pedestrian traffic and other urban metrics⁸³.

Dallas, Texas

Born from necessity, as Dallas-Fort Worth-Arlington is the fourth largest populated metropolitan in the US with annual influx of 100,000 people, government and citizens have strived for public solutions to improve traffic, safety, pollution, and other challenges because of the high growth population.

With major initiatives across the metropolitan area, such as the Dallas Fort Worth International Airport’s stunning commitment to innovative traveller amenities, Plano’s FritoLay IoT-infrastructure laden manufacturing plant, and the North Central Texas Council of Governments’ impressive intelligent transportation system plan, visiting EU innovators will have access to a breadth of applications in one location. Awarded 2nd place on the 2022 Forbes list for the “best place in the US for business and career”, as well as 11th on Business Insider’s most high-tech city in the world, Dallas, Texas provides a rich ecosystem of incentives and benefits for EU companies. In fact, the EU corporations Nokia, Alcatel-Lucent, and Ericsson Inc. join 200 other foreign companies who have their North American headquarters in Dallas.

The DIA is a private-public partnership made up of the city of Dallas and more than two dozen large companies and local foundations. DIA is focused on creating a living lab in Dallas’ historic district (West End) that is piloting and leveraging smart technology to improve the intersection of community, technology, and data solutions to facilitate sustainable growth, increase efficiency and, most importantly, improve quality of life. The DIA partnership with City leadership was launched at the White House in September 2015 as part of the Office of Science and Technology Policy announcement of Federal Smart City initiatives. Currently, the DIA has nearly 30 partner organizations across the public, private, civic, and academic sectors and has worked with over 20 City departments. The partnership has working reciprocal relationships with nearly 40 cities around the world.

⁸³ <https://www.link.nyc/home.html>

In addition to DIA's living lab, their new Innov8te Smart Cities Incubator was launched in February 2019 to support entrepreneurs and early-stage companies supporting urban and civic transformation. Founding public, private, and academic collaborators include AT&T, Cisco, Microsoft, the University of Texas at Dallas, and The Dallas Entrepreneur Center network. This incubator's presence in the Dallas Innovation District and Smart Cities Living Lab continues to drive smart city technology research and development for the region.

Austin, Texas

Austin, positioned as a growing Smart City cluster, is devoted to adopting technological innovations for better urban living. Austin's industry cluster focuses on smart grid technology, intelligent transportation systems, and sustainable urban development. Startups, academic institutions, and government programs work together to create a unified ecosystem that promotes innovation. The vibrant tech community in the city contributes to forward-thinking solutions by harnessing data and technology to improve energy efficiency, transit connections, and overall urban infrastructure. Austin's Smart City initiatives are consistent with its reputation as a progressive and inventive city committed to building a more liveable and connected urban environment.

Raleigh, North Carolina

Raleigh's industry cluster focuses on smart utilities, sustainable infrastructure, and linked mobility, putting it at the forefront of smart city developments. The commitment of the city to technological integration and data-driven decision-making drives its attempts to build a more responsive, efficient, and sustainable urban environment. Collaborative initiatives between the public and commercial sectors, as well as academic institutes, feed the city's desire for innovation, resulting in projects that address urban concerns while making the city more inclusive and liveable. Raleigh's Smart City initiatives are consistent with the city's objective of being a modern, technologically sophisticated city that prioritizes its citizens' well-being.

Portland, Oregon

Portland, known for its commitment to sustainability and environmentally aware legislation, has received acclaim for its smart city efforts. Portland's industry cluster prioritizes sustainable practices, smart mobility, and green infrastructure. The city hopes to build a more connected, efficient, and eco-friendly urban landscape by combining IoT technologies and data-driven solutions. Portland's smart city programs are consistent with its dedication to environmental stewardship, reflecting the city's objective of becoming a greener, more liveable city that welcomes innovation to address urban concerns.



Boston, Massachusetts

Boston, located in the heart of Massachusetts, has a thriving digital environment that serves as a driving force behind its Smart City efforts. The city's industry cluster focuses on smart transit, renewable energy, and data-driven urban planning. Boston hopes to develop more efficient, inclusive, and resilient urban environments by embracing emerging technologies. The region is home to world-class research centres, academic institutions, and businesses that are actively working to develop novel urban mobility solutions, cleaner energy sources, and more effective city management tactics. Boston's Smart City efforts are aimed at assuring a sustainable and prosperous future for its citizens, with an emphasis on sustainability and technological integration.

Boston has been using data analytics to inform city planning, improve services, and make data-driven decisions. The city collects data from various sources, including sensors and government systems with the Citywide Analytics team⁸⁴, and has also eliminated traffic-related fatalities and serious injuries through data-driven strategies, including redesigning streets and intersections to improve safety, with the Vision Zero program⁸⁵.

ENRICH in the USA Soft Landing Hubs: Initial contact points for Massachusetts

Through the **ENRICH J-1 Soft Landing Programs**, interested participants can access Incubators/Innovation Centers of Universities dedicated to R&I in the **Smart Cities** domain.

ENRICH in the USA has some Soft-Landing Hubs located near the Massachusetts industry clusters. These Soft-Landing Hubs help SMEs to venture into North America, through a low-cost strategy and temporary visa. All the tools are provided, to conduct proof of concept tests, to connect with new strategic partners and potential clients, and to revamp your product development, research, and intellectual property strategy within the U.S. market. Soft-Landing Hubs also ease access to local funding opportunities and grants to support research and commercialization efforts. Through the ENRICH J-1 Soft Landing Programs, interested participants can access Incubators/Innovation Centers of Universities dedicated to R&I in the Smart Cities domain, namely: Northeastern University.

Northeastern University and its Innovation Campus at Burlington, Massachusetts (ICBM)

Northeastern University's unique, customizable research-partnership model offers:

- Co-location of industry, government, and Northeastern research laboratories and access to university faculty and PhD students
- Joint project planning and management to speed progress toward goals
- Flexible IP policies that benefit all participants
- Customized training and educational programs to give teams a competitive edge

⁸⁴ <https://www.boston.gov/departments/analytics-team>

⁸⁵ <https://www.boston.gov/transportation/vision-zero>

- Expertise in areas that include novel materials and devices; manufacturing; national security, cybersecurity, and intelligence; drug analysis and testing; structural testing of materials and designs; large-structure design and testing; and data analytics, systems modeling, and network science
- Rigorous, ITAR-compliant protocols and practices in a secure environment
- A venture creation center with wet lab, recently tripled in square footage to accommodate 40 companies



3 Recognized research networks/professional associations and events

Research networks and professional associations play a crucial role in fostering collaboration between academia, industry, and Federal/state entities. Research networks are collaborative forums that foster interaction between researchers and stimulate information exchange^{86, 87}, whereas a professional association is a body of practitioners of a given profession, formed usually to control entry into the profession, maintain standards, and represent the profession in discussions with other relevant bodies⁸⁸.

In the US, research networks are highly focused on science and engineering research and education. The US government supports a large variety of research networks focused on the country's priorities, such as electronics research. In the case of Smart Cities, most of the US networks/ associations would be considered professional associations with a connection to the research community.

Professional associations are a crucial segment of the non-profit sector in the US. In 2013, membership organizations alone employed over 1.3 million people in the US⁸⁹. It is important to note that professional and trade associations are simply one segment of the membership organization community. Many new associations are created each year in the US, especially associations focused on key fast-growing industries, such as renewable energy.

The organization of conferences and events is one of the main activities of research networks and professional associations. Therefore, a review of US conferences and events focused on Smart Cities was conducted to identify the most relevant professional associations in the field of Smart Cities.

Through gaining knowledge of the relevant research networks, professional associations, and organized conferences, one can determine the most effective approach to establish relevant contacts in the US research community to pursue research collaborative opportunities.

⁸⁶ <https://www.ecb.europa.eu/pub/economic-research/research-networks/html/index.en.html>

⁸⁷ <https://councilforeuropeanstudies.org/research/research-networks>

⁸⁸ <http://www.dictionary.com/browse/professional-association>

⁸⁹ <http://www.thepowerofa.org/wp-content/uploads/2012/03/PowerofAssociations-2015.pdf>

3.1. Research networks and professional associations

Smart Cities Council North America

The Smart Cities Council is a network of leading companies advised by top universities, laboratories, and standards bodies. The Smart Cities Council envisions a world where digital technology and intelligent design have been harnessed to create smart, sustainable cities with high-quality living and high-quality jobs. To tap into the transformative power of smart technologies, cities need a trusted, neutral advisor.

Smart Cities Council promotes cities that embody their three core values:

- **Liveability:** Cities that provide clean, healthy living conditions without pollution and congestion. With a digital infrastructure that makes city services instantly and conveniently available anytime, anywhere.
- **Workability:** Cities that provide the enabling infrastructure — energy, connectivity, computing, essential services — to compete globally for high-quality jobs.
- **Sustainability:** Cities that provide services without stealing from future generations.

<https://na.smartcitiescouncil.com/>

Boston Area Research Initiative (BARI)

The mission of the Boston Area Research Initiative (BARI) is to spur original, cutting-edge research in the greater Boston area that both advances urban scholarship and improves public policy and practice. Central to this mission is an overarching effort to forge active and mutually beneficial relationships between the region’s researchers, policymakers, practitioners, and civic leaders. BARI supports research-policy collaborations, BARI projects provide insights into daily life in greater Boston, help policymakers and practitioners to better serve their constituencies, and increase our understanding of human behaviour.

In terms of international collaboration opportunities, the BARI offers several seed grants for graduate students from any university conducting original research on the Boston area at the intersection of research and policy that either: a) conducts pioneering work on a novel digital data set; or b) develops, implements, or evaluates new programs that incorporate research insights into policy or practice.⁹⁰

⁹⁰ <https://www.northeastern.edu/cssresearch/bostonarearesearchinitiative/grants-fellowships/>

Smart City efforts often involve using sensors and connected IoT devices to bring more efficiency to lighting, transportation or public safety. Yet following a broader definition, the Harvard Kennedy School Government Performance Lab (GPL) helps governments become smarter in several other ways — with performance improvement, procurement, and results-driven contracting.

GPL conducts research and holds national competitions to select government partners for technical assistance, usually in the form of consulting from a Kennedy School government innovation fellow. Philanthropically funded, GPL is one of five technical assistance partners for the What Works Cities initiative⁹¹. GPL assists cities that seek to adopt results-driven contracting strategies for critical grants and procurements. Of the 100 cities in What Works Cities initiative, GPL has worked with 26.

<https://govlab.hks.harvard.edu/>

MetroLab Network

The MetroLab Network is a network of 29 cities, 5 counties, and 35 universities focused on civic innovation. Data and technology are poised to transform cities. Partnerships between local governments and universities are critical to effectuate that transformation and that national and international collaboration will streamline civic innovation. The MetroLab Network Lab was launched as part of the White House Smart Cities Initiative in 2015.

MetroLab Network's cities and universities are partnering on research, development, and deployment projects to address challenges facing urban areas: inequality in income, health, environmental sustainability and resilience, and aging infrastructure. Several projects are under development to transform US cities into smart cities with the support of industry and universities. An example of a city is Houston which is currently deploying the Houston accelerator program for smart cities technology, alongside startup hub Station Houston and manufacturing workspace TXRX Labs. Microsoft and Intel are partners in this program

<https://metrolabnetwork.org/>

Smart City Observatory

Through its global reach and diverse expertise, the IMD Smart City Index Research Network serves as a platform for knowledge exchange and collaboration among researchers, policymakers, and practitioners. By sharing best practices, innovative ideas, and data-driven insights, the network

⁹¹ <https://whatworkscities.bloomberg.org/>

fosters a collective effort to address urban challenges and harness the potential of smart technologies for the benefit of communities worldwide. With a focus on inclusivity and sustainability, the research network continually drives the evolution of the Smart City Index, ensuring its relevance as a valuable tool for decision-makers in shaping the future of smart and resilient cities. As a driving force behind cutting-edge research and evidence-based urban policies, the IMD Smart City Index Research Network plays a crucial role in advancing the global smart city movement and creating a brighter future for urban inhabitants.

<https://www.imd.org/smart-city-observatory/home/>

Open & Agile Smart Cities (OASC)

The OASC is an international network of cities that extends its support to local administrations worldwide, regardless of their size or location, in their quest for digital transformation. The network's primary goal is to create a sustainable impact for cities via a minimal technical ground for digital tools and systems, known as Minimal Interoperability Mechanisms (MIMs). By working closely with its members, partners, and independent experts, the network promotes seamless sharing and reusability of digital, data-driven solutions. This approach effectively mitigates vendor lock-in, reduces innovation costs, and enhances overall efficiency using open standards and APIs. Through its collective efforts, the International Network of Cities empowers urban centres to navigate the complexities of digital transformation, fostering a more connected, innovative, and efficient future for cities worldwide.

<https://oascities.org/>

Smart City Research Network

The Smart City Research Network is made up of nine industrial research projects, as well as partner organizations and universities, that are unified by the theme 'Smart Buildings & Smart Cities: Balancing Technology and People'. The Network's primary purpose is to promote collaboration among researchers, corporations, and scientific institutions to generate creative ideas and solutions with an emphasis on productivity, marketing, and export potential. Furthermore, the Network critically assesses the dynamic interplay between technology and the physical environment, as well as its impact on the well-being of people who live in these smart urban areas. The Smart City Research Network hopes to contribute to a more harmonious integration of technology and human experiences through this collaborative effort, paving the path for sustainable and people-centric improvements in smart cities.

<https://bloxhub.org/smart-city-research/>

Urban Center for Computation and Data (URBANCCD)



The Urban Center for Computation and Data (UrbanCCD) grew out of the work researchers at the University of Chicago and the Argonne National Laboratory were already doing informally by partnering with city of Chicago departments to help them more effectively use their data to improve city operations.

One UrbanCCD focus is on urban measurement — exploiting new internet-connected hardware and software to help cities measure their environments and operations. Its Array of Things project, established with a \$3 million (around €2.72 million) grant from the National Science Foundation (NSF), includes more than 100 nodes collecting data on temperature, humidity, air pressure, magnetic field, vibration, light and air quality. It publishes the results openly for scientists, city officials and residents to use.

UrbanCCD also works on using urban computational modelling in planning and design for major projects that involve zoning and investments of over hundreds of acres of city land.

With funding from NSF and the MacArthur Foundation, UrbanCCD has created an analytics platform called Plenario, which seeks to make the data released by cities, Federal agencies, and other sources more accessible.

<http://www.urbanccd.org/>

3.2. Conferences and other networking events

Conferences and other networking events provide an important platform for Smart City researchers and professionals to present and discuss high-quality research advances. Smart City conferences are also an excellent opportunity to foster R&D collaboration between researchers, professionals, and industry members, share knowledge and discuss next-generation diagnostics and treatments.

There are numerous conferences and other networking events focused on smart city research in the US. Some of the leading Smart City research conferences and other networking events were identified by desk research, which included an extensive literature review and a review of the conferences sponsored by recognized Smart City research networks and Smart City professional associations.

Figure 7 - List of Smart Cities Conferences and Events 2023-2024

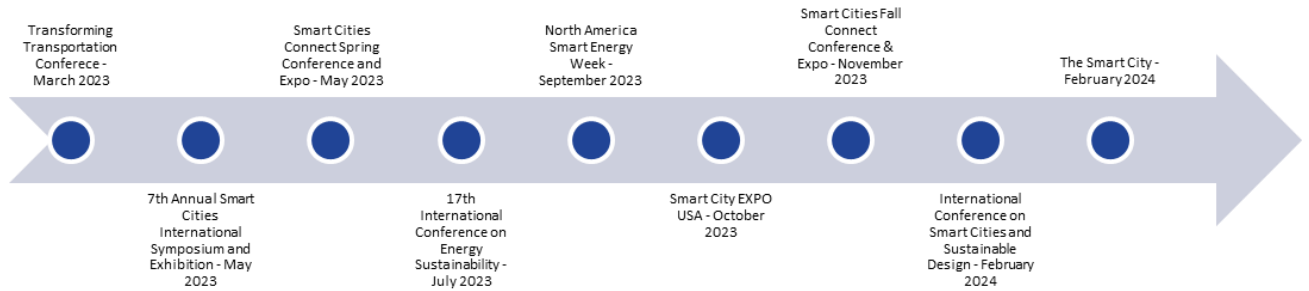


Figure 8 - List of Smart Cities Conferences and Events 2024-2025

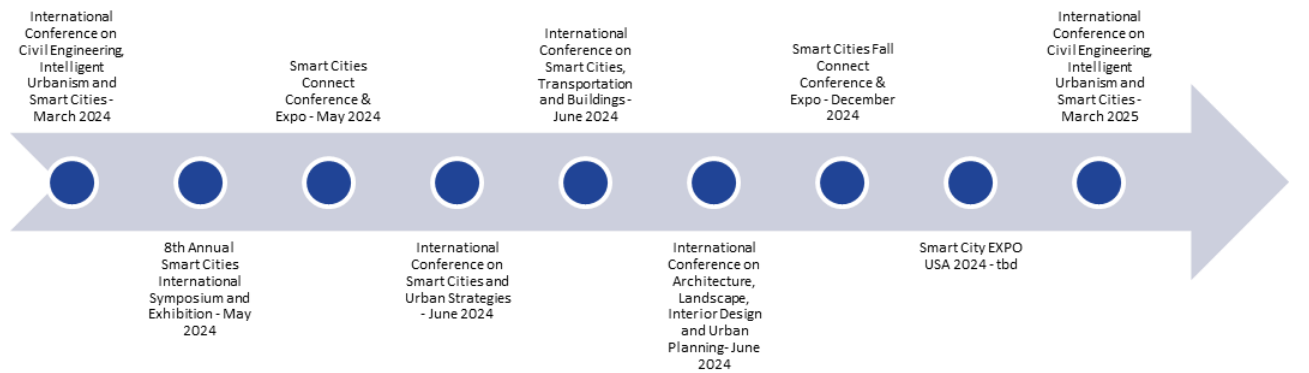




Table 5 - Conferences and Other Networking Events Focused on Smart City Research

Date	Conference/event title	Interval	Location	Research areas	Internet link
14-15 March 2023	Transforming Transportation Conference	Annual	Washington DC	Smart transportation	https://www.transformingtransportation.org/
15-18 May 2023	Smart Cities Connect Spring Conference and	Annual	Denver, Colorado	Smart city	https://spring.smartcitiesconnect.org/
30-31 May 2023	Expo 7 th Annual Smart Cities International Symposium & Exhibition	Annual	Chicago, Illinois	Smart city	https://conferencealerts.com/show-event?id=250739
10-12 July 2023	17th International Conference on Energy Sustainability	Annual	Washington DC	Smart energy	https://event.asme.org/ES
20-23 September 2023	North America Smart Energy Week	Annual	Anaheim, California	Smart energy	https://www.re-plus.com/2020/04/29/north-america-smart-energy-week-adds-evi-partnership-with-forth/
4-5 October 2023	Smart City EXPO USA	Annual	New York City, New York	Smart city	https://www.smartcityexpousa.com/





Date	Conference/event title	Interval	Location	Research areas	Internet link
28-30 November 2023	Smart Transit Smart Cities Fall Connect Conference & Expo	Annual	Washington DC	Smart city	https://fall.smartcitiesconnect.org/
13-15 February 2024	Smart City Event	Annual	Fort Lauderdale	Smart city	https://www.thesmartcityevent.com/east/
19-20 February 2024	International Conference on Smart Cities and Sustainable Design	Biannual	New York City, New York	Smart city	https://waset.org/smart-cities-and-sustainable-design-conference-in-february-2024-in-new-york
16-17 May 2024	International Conference on Civil Engineering, Intelligent Urbanism and Smart Cities	Annual	Miami, Florida	Smart infrastructure	https://waset.org/civil-engineering-intelligent-urbanism-and-smart-cities-conference-in-march-2023-in-miami?utm_source=conferenceindex&utm_medium=referral&utm_campaign=listing
TBD May, 2024	Expo 8 th Annual Smart Cities International Symposium & Exhibition	Annual	Chicago, Illinois	Smart city	https://www.clocate.com/smart-cities-international-symposium-and-exhibition/98360/





Date	Conference/event title	Interval	Location	Research areas	Internet link
8-10 May 2024	Smart Cities Connect Conference & Expo	Annual	Raleigh, North Carolina	Smart City	https://spring.smartcitiesconnect.org/
03-04 June 2024	International Conference on Smart Cities and Urban Strategies	Biannual	New York City, New York	Smart city	https://waset.org/smart-cities-and-urban-strategies-conference-in-june-2024-in-new-york
7-8 June 2024	International Conference on Smart Cities, Transportation and Buildings	Biannual	San Francisco, California	Smart mobility	https://waset.org/smart-cities-transportation-and-buildings-conference-in-june-2024-in-san-francisco
5-6 June, 2024	International Conference on Architecture, Landscape, Interior Design and Urban Planning	Annual	New York City, New York	Smart Urbanism	https://waset.org/architecture-landscape-interior-design-and-urban-planning-conference-in-june-2023-in-new-york?utm_source=conferenceindex&utm_medium=referral&utm_campaign=listing
2-5 June 2024	Smart Cities Fall Connect Conference & Expo	Annual	Austin, Texas	Smart City	https://smartcitiesconnect.org/smart-cities-connect-conference-expo-fall-2024/





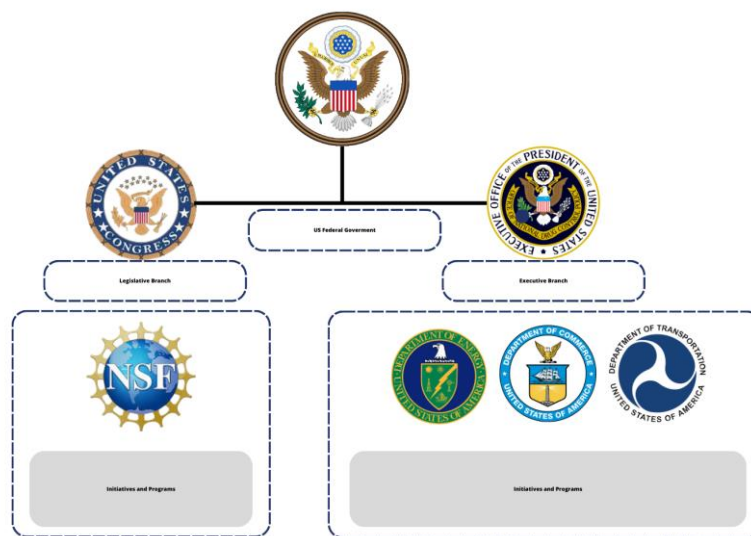
Date	Conference/event title	Interval	Location	Research areas	Internet link
TBD	Smart City Expo USA 2024	Annual	Miami, Florida	Smart City	https://www.showsbee.com/fairs/80777-Smart-City-Expo-USA-2024.html
16-17 March 2024	International Conference on Civil Engineering, Intelligent Urbanism and Smart Cities	Annual	Miami, Florida	Smart Urbanism	https://waset.org/civil-engineering-intelligent-urbanism-and-smart-cities-conference-in-march-2023-in-miami?utm_source=conferenceindex&utm_medium=referral&utm_campaign=listing



4 US R&D initiatives and programs

The US R&D funding system is highly decentralized and comprises several actors, such as agencies of Federal and state governments, universities, the private sector, and non-profit organizations⁹². R&D drives innovation and economic growth and, therefore, has particular importance for the aforementioned actors. In the US, research in universities and research centres is largely supported by funds that prioritize ground-breaking research topics⁹³.

Figure 9 - US Government Organizational Chart highlighting the main sponsors of innovation programs in Smart Cities related fields



4.1. Federal initiatives/programs

The US Federal Government supports smart city R&D activities through grants and opportunities that promote the development and deployment of new technologies. At the Federal level, the DOE, DOT, NIST and NSF are the Federal bodies with large budgets for Smart City R&D activities⁹⁴. Additionally, Federal agencies have subprograms to support Smart City R&D activities from early to advanced stages in development and implementation. Therefore, a review of the US Federal Government R&D

⁹² <http://www.euussciencetechnology.eu/assets/content/documents/InnovationSystemInnovationPolicyUS.pdf>

⁹³ <http://www.itif.org/files/2011-university-research-funding.pdf>

⁹⁴ <https://obamawhitehouse.archives.gov/the-press-office/2015/09/14/fact-sheet-administration-announces-new-smart-cities-initiative-help>

initiatives and programs was conducted to identify the most relevant ones in the research fields related to Smart Cities.

4.1.1. Department of Energy (DOE)

The DOE is highly committed to support advanced transportation projects focused on smart energy and smart mobility systems. In this context, the DOE has initiatives and subprograms focused on promoting smart cities and smart mobility.

Transportation as a System (TAS) Initiative

The TAS Initiative aims to explore opportunities for energy efficiency above the traditional vehicle-level focus. This initiative is part of the Sustainable Transportation Program and is focused on evaluating how the transportation system connects and influences multiscale and multisystem models, with the longer-term aim of promoting the efficiency of the modern transportation system⁹⁵.

First Approach	
Information about Grants	European researchers interested in participating in this initiative can find administrative information and application requirements on .. For further information, European researchers reach out to the point of contact identified in the funding opportunities ⁹⁶
Internet link	www.grants.gov ; www.energy.gov/eere/office-energy-efficiency-renewable-energy

4.1.2. Department of Transportation (DOT)

The DOT is highly committed to supporting research on smart cities. The DOT has created subprograms and initiatives to support smart city innovations from early to advanced stages of technology development⁹⁷.

Federal Transit Administration (FTA)

The FTA drives public transportation innovation research to promote economic competitiveness, sustainability and improve the quality of life in communities through public transportation systems and

⁹⁵<https://fas.org/sgp/crs/misc/R44262.pdf>

⁹⁶<https://www.energy.gov/eere/articles/doe-announces-15-million-accelerate-deployment-energy-efficient-transportation>

⁹⁷ <https://www.transportation.gov/smartcity>

services⁹⁸. Through testing and deployment, FTA's Research, Demonstration, and Innovation program helps the transit industry adopt tried-and-proven technologies. Demonstrations of new technologies can reduce risk and help create both supply and demand.

First Approach	
Contact Person	European researchers interested in international collaborations can contact Mr. Vincent Valdes, the Associate Administrator of Office of Research, Demonstration, and Innovation.
Email	Vincent.Valdes@dot.gov
Internet link	https://www.transit.dot.gov/research-innovation

4.1.3 Department of Commerce (DOC)

The DOC leads various programs and initiatives through the National Institute of Standards and Technology (NIST) to support Smart Cities. NIST focuses on developing guidelines, standards, and partnerships that promote interoperability, data sharing, and technology innovation within urban environments. These initiatives serve to advance the adoption of smart technologies and foster more efficient, sustainable, and people-centric cities across the nation. Through its collaboration with NIST, the DOC plays a crucial role in driving the development and implementation of Smart City solutions, ensuring cities' readiness for the challenges and opportunities of the digital age.

4.1.3.1 National Institute of Standards and Technology (NIST)

The NIST provides the foundation and measurement science for Cyber-physical Systems (CPS) and IoT. NIST considers Smart Cities to be an opportunity for studying CPS and IoT at scale, across sectors, and their interactions between devices, applications, and humans. NIST seeks to facilitate stakeholders' development of replicable, scalable, and interoperable smart cities and communities⁹⁹.

Global Community Technology Consortium

¹⁰⁰.

The Global Community Technology Consortium¹⁰¹, formerly known as the Global City Teams Challenge (GCTC) is an initiative of the Department of Homeland Security (DHS) Science and Technology Directorate (S&T) and the National Institute of Standards and Technology (NIST). Together, they sponsor the challenge, which focuses on integrating cybersecurity into smart-city systems to enhance

⁹⁸ <https://www.transit.dot.gov/research-innovation>

⁹⁹ <https://www.nist.gov/el/cyber-physical-systems/smart-american-global-cities>

¹⁰⁰ <https://www.nist.gov/el/cyber-physical-systems/smart-american-global-cities/global-city-teams-challenge>

¹⁰¹ <https://cahmp.gmu.edu/global-city-teams-challenge/>

security, reliability, resilience, and privacy protection. The GCTC aims to foster collaboration between communities and technology innovators to address urban challenges using networked technologies. This joint initiative, known as the Smart and Secure Cities and Communities Challenge (SC3), strives to develop cutting-edge solutions that secure complex device networks against cyber-attacks while simultaneously improving community services. By leveraging NIST's expertise in smart-city ecosystems and S&T Cyber Security Division's connections to the cybersecurity industry, the GCTC initiative fosters innovation and advancements in the realm of smart and secure urban development.

First Approach	
Information about Grants	European researchers interested in participating in this initiative can find administrative information and application requirements on Grants.gov. For further information, European researchers can reach out to the point of contact identified in the funding opportunities. In this case, you can reach out to Michael Dunaway.
Email	michael.dunaway@nist.gov
Internet link	https://www.nist.gov/ctl/smart-connected-systems-division/iot-devices-and-infrastructure-group/smart-american-global-1

Smart Cities and Communities Framework (SCCF) series

In the pursuit of smarter, more sustainable urban environments, cities and communities worldwide are seeking standardized solutions that are both replicable and scalable. The NIST Smart Cities and Communities Framework (SCCF) series emerges as a beacon of guidance in this endeavor. It aims to provide best practices and technical guidelines for the planning, development, and implementation of smart solutions. This initiative serves as a valuable reference for a broad spectrum of stakeholders, including city and community officials, technology innovators, researchers, project planners, managers, and implementers, fostering innovation and product development while enhancing service quality.

The SCCF series is the result of NIST's collaboration with the Global City Teams Challenge (GCTC), accumulating an extensive repository of best practices within the smart cities and communities domain. This series not only consolidates this wealth of information but also evolves to encompass emerging topics. It covers both theoretical and practical aspects, offering insights into cross-cutting issues, sector-specific challenges, implementation methods, and case studies.

The SCCF series is categorized into four distinct groups. Category 1 addresses cross-cutting and foundational issues such as data management, platforms, IoT, and cybersecurity. Category 2 delves into sector-specific topics like transportation and public safety. Category 3 focuses on implementation,

methods, and approaches, covering collaboration, education, and economic sustainability. Lastly, Category 4 exclusively presents in-depth case studies¹⁰².

First Approach	
Information about Grants	European researchers interested in participating in this initiative can find administrative information and application requirements on Grants.gov. For further information, European researchers can reach out to the point of contact identified in the funding opportunities. In this case, you can reach out to Michael Dunaway.
Email	michael.dunaway@nist.gov
Internet link	https://www.nist.gov/ctl/smart-connected-systems-division/iot-devices-and-infrastructure-group/smart-american-global-1

Cyber-Physical Systems/IoT for Smart Cities

Enabled by cyber-physical systems (CPS), Smart Cities leverage IoT technologies to connect devices and systems in innovative ways. These advancements have transformative effects across various sectors such as transportation, energy, manufacturing, and healthcare, enhancing services, fostering economic growth, and improving residents' quality of life. NIST has cultivated a dynamic community of smart city stakeholders, collaborating to identify scalable and standard-based best practices. Through its Global City Teams Challenge, NIST has collected sector-based examples and technical solutions deployed in partnership with municipal governments. In FY20, NIST focused on consolidating insights into publications and guidelines and actively participating in Standard Development Organizations (SDOs). This project aims to establish consensus standards-based foundations, promoting interoperability, replicability, and trustworthiness, alongside measurement science for performance evaluation and real-world applicability. The strategy emphasizes real deployments at scale to ensure relevance and effectiveness in practical smart city implementations¹⁰³.

First Approach	
Contact Person	European researchers interested in international collaborations could contact the Associate Director, Cyber-Physical Systems Innovation, Dr. Sokwoo Rhee. European researchers can also choose to contact Dr. Edward Griffor or Dr. Michael Dunaway.
Email	sokwoo.rhee@nist.gov , edward.griffor@nist.gov ,

¹⁰² <https://www.nist.gov/el/cyber-physical-systems/smart-american-global-cities/nist-smart-cities-and-communities-framework>

¹⁰³ <https://www.nist.gov/programs-projects/cyber-physical-systems/internet-things-smart-cities>

	michael.dunaway@nist.gov
Internet link	https://www.nist.gov/el/cyber-physical-systems/smart-american-global-cities

4.1.4. National Science Foundation (NSF)

The NSF provides support through grants and cooperative agreements to universities, businesses, informal science organizations and other research organizations that are most likely to produce considerable technological progress¹⁰⁴. The NSF funds initiatives aimed to advance the scientific community's understanding of smart cities, through projects such as the Smart & Connected Communities program¹⁰⁵, Civil Infrastructure Systems (CIS) program¹⁰⁶ the Civic Innovation Challenge¹⁰⁷ and the Communications, Circuits, and Sensing-Systems (CCSS) program¹⁰⁸. The NSF supports cooperative research between universities and industry, as well as US researchers' participation in international scientific and engineering research activities. Collaboration between US researchers and European researchers can receive funding in almost all new proposals to NSF or in supplements to existing NSF awards. Thus, European researchers interested in collaborating with US researchers can ask their US counterparts to contact the NSF disciplinary program officer or use the Office of International Science and Engineering (OISE) Regional and Country Contacts to inquire about funding possibilities¹⁰⁹.

Smart and Connected Communities (S&CC)

The NSF S&CC program solicitation seeks to accelerate the development of scientific and engineering foundations that will enable smart and connected communities to provide new levels of economic opportunity and growth, safety and security, health and wellness, accessibility and inclusivity, and overall quality of life¹¹⁰.

The S&CC program invites researchers to collaborate with community stakeholders to identify and characterize difficulties, which then create use-inspired research questions. Residents, neighborhood or community groups, nonprofit or philanthropic organizations, businesses, and municipal organizations such as libraries, museums, educational institutions, public works departments, and health and social services agencies may all be considered community stakeholders for this solicitation. The S&CC initiative funds integrative research that tackles fundamental technological and social

¹⁰⁴<https://www.nsf.gov/about/how.jsp>

¹⁰⁵<https://www.nsf.gov/cise/scc/>

¹⁰⁶<https://new.nsf.gov/funding/opportunities/civil-infrastructure-systems-cis>

¹⁰⁷<https://nsrcivinnovation.org/>

¹⁰⁸<https://new.nsf.gov/funding/opportunities/communications-circuits-sensing-systems-ccss-0>

¹⁰⁹<https://www.nsf.gov/od/oise/IntlCollaborations/EuropeanUnion/index.jsp>

¹¹⁰<https://new.nsf.gov/funding/opportunities/smart-connected-communities-scc>



scientific components of smart and connected communities, as well as piloting solutions in collaboration with communities.

First Approach	
European Union OISE Regional Contact	eeinfo@nsf.gov, sstandri@nsf.gov .
International Collaboration	OISE fosters institutional partnerships throughout the global science and engineering research and education community, and it supports international collaborations in NSF's priority research areas. OISE encourages funding applicants to include an international component in proposals submitted to the appropriate research directorate ¹⁰⁴ .
Internet links	www.nsf.gov/od/oise/country-list.jsp ; https://www.nsf.gov/od/oise/IntlCollaborations/EuropeanUnion/index.jsp

4.2. State initiatives/programs

State initiatives are one of the major ways states can support public projects in key areas, such as smart cities. Some US states focus on being at the forefront of smart city technology development. These states recognize the potential impact of bring together companies, research facilities and testing programs¹¹¹. Therefore, state agencies, such as the CDOT, support important smart mobility initiatives that will contribute to the development of smart cities. Examples of several state initiatives are provided below.

4.2.1. Ohio: Ohio's 33 Smart Corridor

Ohio's 33 Smart Corridor initiative is a collaborative effort between the Ohio State University, Ohio Department of Transportation (ODOT), the Ohio Department of Public Safety, Wright-Patterson Air Force Base, Ohio State University, Case Western Reserve University, University of Cincinnati, University of Dayton, Wright State University, the Transportation Research Center and the Ohio Turnpike and Infrastructure Commission. This initiative aims to provide an environment to safely test innovative

¹¹¹ <https://www.johndaylegal.com/state-laws-and-regulations.html>

technologies that will change the mobility system in Ohio¹¹². The Corridor is a key element of Ohio's new Smart Mobility Initiative^{113, 114}.

The Corridor comprises a network of over 70 automotive companies and is ranked second in the US for auto production¹¹⁵. Since its launch in 2016, \$100 million (around €93.28 million) has been invested in smart infrastructure and has a \$6 million (around €5.6 million) grant awarded by the US Department of Transportation. The Ohio state government invested \$15 million (around €13.65 million) to expand fibre optic networks connecting to US-33, install highway sensors, and retrofit government and private industry fleets to send and receive data. This will allow the development of a new mobility system in which C&AV will be the main piece¹¹³.

First Approach	
Contact Person	European researchers interested in Ohio's Smart Mobility Initiative can contact Jonathan Bridges, the Director of Automotive.
Email	bridges@jobs-ohio.com
Phone Number	(937) 642-6279
Internet link	www.33smartcorridor.com/

4.2.2. Illinois Smart State Initiative

The State of Illinois has established the vision, plan, and execution road map to enact the digital transformation of the government by investing in 3rd Platform ICT and the necessary large-scale changes in leadership, information management, workforce development, operations, and customer experience. 3rd Platform ICT includes mobile technologies, BD and analytics and cloud services as the foundation for a set of innovation accelerators, such as IoT, blockchain, cognitive computing, augmented reality, robotics, and next-generation security, that enable the development of new work processes, services, and products¹¹⁶.

First Approach

¹¹² <http://www.truckinginfo.com/channel/fleet-management/news/story/2016/11/ohio-dot-otto-initiate-smart-mobility-corridor.aspx>

¹¹³ <http://www.33smartcorridor.com/mobility>

¹¹⁴ http://www.cargroup.org/wp-content/uploads/2017/04/CAV_International_Survey_2017_555402_7.pdf

¹¹⁵ <https://www.thebetadistrict.com/us-33-smart-mobility-corridor/>

¹¹⁶ <https://www.nascio.org/portals/0/awards/nominations2018/2018/NASCIO-IL-2018-State-CIO-Office-Special-Recognition-Smart-State.pdf>

Contact Person	European researchers interested in Illinois Smart State Initiative could contact Kevin O’Toole, Chief of Transformation Applications/Architecture and Digital Innovation
Email	Kevin.O’Toole@illinois.gov
Internet link	https://www2.illinois.gov/sites/doi/Strategy/Pages/SmarterIllinois.aspx

4.2.3. New York State Energy Research and Development Authority (NYSERDA)

The NYSERDA provides objective information and analysis, innovative programs, and technical expertise. The NYSERDA also supports the development of smart energy, promotes the use of renewable energy, and reduces reliance on fossil fuels. In this context, NYSERDA has been actively advancing energy solutions and working to reduce climate change effects¹¹⁷.

The NYSERDA provides funding opportunities through various programs, such as residential, commercial, transportation and environmental¹¹⁸. In addition, the NYSERDA uses four types of competitive solicitations: Program Opportunity Notice (PON), Request for Proposals (RFP), Open Enrolment PON and Requests for Quotation or Qualifications (RFQ)¹¹⁸. The NYSERDA also finances programs on clean energy research, such as the Advanced Clean Energy (ACE) Exploratory Research Funding¹¹⁹.

First Approach	
Information about Funding Opportunities	European researchers interested in NYSERDA funding opportunities can contact the representative identified in each program. European researchers interested in the ACE Exploratory Research Funding can contact Mr. Richard Drake.
Email	richard.drake@nyserda.ny.gov
International Collaboration	The NYSERDA funding opportunities are targeted towards businesses and researchers. Technical questions should be directed to the project managers identified in each solicitation ^{Error! Bookmark not defined.} .
Internet link	www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities

¹¹⁷ <https://www.nyserda.ny.gov/>

¹¹⁸ <https://www.nyserda.ny.gov/Funding-Opportunities>

¹¹⁹ https://portal.nyserda.ny.gov/CORE_Solicitation_Detail_Page?SolicitationId=a0rt0000000QnqdAAC



5 Observations

The analysis of the US research landscape reveals that its research community consists of a wide range of actors that conduct multidisciplinary R&D activities. The Smart City research community encompasses the joint effort of academia, industry, and Federal/State entities, which have been working together to develop innovative technologies that can accelerate the use of Smart City applications in the country.

Key players of the US Smart City community are highly concentrated in San Francisco, California, Atlanta, Georgia, Chicago, Illinois, New York City, New York and Dallas, Texas, which are cities where Smart City research is also displayed in action.

In the field of smart cities, partnerships between industry and universities are important since they promote the development and deployment of new innovative technologies. In this context, the need to refine the existing technologies and to use them to develop smart city applications illustrates the need for research-industry partnerships. Therefore, in the US, the development of industry-university research partnerships has been crucial to exchange knowledge and develop advanced technologies.

Moreover, it is important to highlight that the development of R&D activities in the field of Smart Cities requires an interdisciplinary team. Thus, professional associations and networking events provide an opportunity for the different smart city-related professionals and researchers of various fields to share knowledge and information that can lead to the development of new applications.

In the US, research is highly supported by programs and initiatives from Federal and state government entities, such as the DOE, DOT, DOC, NIST and the NSF. Currently, the US Federal Government supports Smart City R&D activities through grants and opportunities that promote the development and deployment of new applications. It is important to emphasize that President Trump's Administration had a different strategy regarding Smart Cities. The Smart Cities and Communities (SCC) Task Force was a body that was under the NITRD Cyber-Physical Systems (CPS) Interagency Working Group (IWG)⁴², but it was discontinued in November 2018.

Specifically, the SCC Task Force was created to coordinate Federal action and partnerships with academia, industry, local cities and communities, and other government entities to enable cities and communities of all types in accessing networking and information technologies and services. During its activities, it created the "Federal Smart Cities and Communities Programs Resource Guide" to facilitate collaboration and coordination among Smart Cities and Communities (SCC) Task Force member agencies, academia, industry, local cities and communities, and other government entities.

Since 2015, the US have enhanced their initiatives to support Smart Cities, such as fostering EU & US research. Nevertheless, it is important to highlight it is difficult to find information on federal and state funds and grants for European researchers. European researchers interested in US initiatives and programs focused on smart cities often need to contact the program to find out specific details on international eligibility. In fact, only a few programmes and initiatives have specific information

available online regarding eligibility, which hinders access to information and delays the establishment of partnerships.





Annex 1: Examples of US Federal and Private Funding Initiatives and Programs

Table A1 - Examples of US Federal and State Funding Initiatives and Programs

Agencies	Programs/ Initiatives	Relevant Research Areas	Contact Info	Internet link
<u>Federal Initiatives and Programs</u>				
DOE	DOE's Energy Efficient Mobility Systems (EEMS) subprogram and Fiscal Year 2017 Vehicle Technologies Program	Energy efficiency and smart mobility	Contact the point of contact identified in the funding opportunities. www.grants.gov/ https://eere-exchange.energy.gov/	https://eere-exchange.energy.gov/#F0ald6741205e-c524-4da1-894b-74cc4092fe51
	DOE Efficient Transportation Technologies	Energy efficient transportation technologies and systems	Contact the point of contact identified in the funding opportunities. www.grants.gov/ https://eere-exchange.energy.gov/	www.energy.gov/eere/office-energy-efficiency-renewable-energy
	Transportation as a System (TAS) Initiative	Energy efficient transportation technologies and systems	Contact the point of contact identified in the funding opportunities. www.grants.gov/	www.energy.gov/eere/office-energy-efficiency-renewable-energy





Agencies	Programs/ Initiatives	Relevant Research Areas	Contact Info	Internet link
			https://eere-exchange.energy.gov/	
DoT	Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD)	Mobility safety, efficiency, system performance and infrastructure	-	www.fhwa.dot.gov/fastact/nofo_atcmtd_20160325.pdf
	Connected Vehicle Pilot Deployment Program	Advanced mobile and roadside technologies	Katherine K. Hartman Kate.Hartman@dot.gov (202) 366-2742	https://www.its.dot.gov/pilots/
	FHWA Exploratory Advanced Research (EAR) Program	Exploratory Advanced Research with a high remuneration potential	David E. Kuehn david.kuehn@dot.gov (202) 493-3414	www.fhwa.dot.gov/advancedresearch/about.cfm#gen
NIST	NIST Funding Program	Smart city (no specific thematic area)	Contact the contact identified in each program.	https://www.nist.gov/oam/grants-management-division/nist-nofo-information
NIST	Cyber-Physical Systems/Internet of Things for Smart Cities	Smart city	Dr. Michael Dunaway michael.dunaway@nist.gov	https://www.nist.gov/programs-projects/cyber-physical-systemsinternet-things-smart-cities





Agencies	Programs/ Initiatives	Relevant Research Areas	Contact Info	Internet link
NIST	Smart Cities and Communities Framework (SCCF) series	Smart city	Dr. Michael Dunaway michael.dunaway@nist.gov	https://www.nist.gov/cti/smart-connected-systems-division/iot-devices-and-infrastructure-group/smart-america-global-1
NIST	Global City Teams Challenge (GCTC)	Smart city	Dr. Michael Dunaway michael.dunaway@nist.gov	https://www.nist.gov/cti/smart-connected-systems-division/iot-devices-and-infrastructure-group/smart-america-global-0
NSF	NSF awards	Smart city, Smart mobility, Smart energy	eeinfo@nsf.gov	www.nsf.gov/od/oise/country-list.jsp ; https://www.nsf.gov/od/oise/IntlCollaborations/EuropeanUnion/index.jsp/
NSF	Civil Infrastructure Systems (CIS)	Smart city	eeinfo@nsf.gov	www.nsf.gov/od/oise/country-list.jsp ; www.nsf.gov/od/oise/europe/





Agencies	Programs/ Initiatives	Relevant Research Areas	Contact Info	Internet link
NSF	Communications, Circuits, and Sensing-Systems (CCSS)	Smart city	eeinfo@nsf.gov	www.nsf.gov/od/oise/country-list.jsp ; www.nsf.gov/od/oise/europe/
NSF	Smart & Connected Communities	Smart city	eeinfo@nsf.gov	www.nsf.gov/od/oise/country-list.jsp ; www.nsf.gov/od/oise/europe/
NSF	Civic Innovation Challenge	Smart city	eeinfo@nsf.gov	www.nsf.gov/od/oise/country-list.jsp ; www.nsf.gov/od/oise/europe/
State Initiatives and Programs				
ODOT	Ohio's 33 Smart Corridor	Energy efficiency and smart mobility	Jonathan Bridges bridges@jobs-ohio.com (937) 642-6279	www.33smartcorridor.com/
IDOIT	Illinois Smart State Initiative	Smart city (no specific thematic area)	Kevin O'Toole Kevin.O'Toole@illinois.gov (312) 814-3648	https://www2.illinois.gov/sites/doi/Strategy/Pages/SmarterIllinois.aspx





Agencies	Programs/ Initiatives	Relevant Research Areas	Contact Info	Internet link
NYSERDA	NYSERDA funding opportunities	Smart city (no specific thematic area)	Contact the contact identified in each program.	www.nyscrda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities

