



June 2020  
**MIDTERM  
VALORIZATION  
EVENT**

Sustainable Urbanisation Global Initiative (SUGI)  
Food-Water-Energy Nexus

# Sustainable Urbanisation Global Initiative – Food-Water-Energy Nexus



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730254.

# Context



The interactions between food, water and energy sectors, both now and over the next few decades, are of critical interest to policy-makers, scientists, and society at large. By 2050, the world population is projected to increase to around 9 billion, with the number of people living in urban areas expected to double. These trends in population density and movement, coupled with land use change and climate variability, will lead to major increases in demand for resources and hold important implications for security and social justice. The reciprocal and dynamic processes of urbanisation, including the physical movements of populations, the build-up of city territories, transformation of economic structures, extension of suburban sprawl, and re-urbanisation, will result in increasing regional stress on the urban food-water-energy (FWE) system.

To date, we have a limited understanding of the FWE system's complexity, resilience and thresholds. Investigations of this complex system will produce discoveries that cannot emerge from research on food or water or energy systems alone. An urban FWE nexus approach focuses on intersections and potential synergies between sectors and fields commonly seen apart in business, policy, and research. Thus, the FWE nexus approach can play a pivotal role in fostering sustainable urbanisation, by proposing potential solutions to govern resource interdependencies through comprehensive spatial perspectives and multi-level governance strategies.

# Overview

The Sustainable Urbanisation Global Initiative – Food-Water-Energy (SUGI-FWE) Nexus initiative was set up as joint effort between JPI Urban Europe, the Belmont Forum, and the European Commission to provide a unique collaboration framework for technical and social scientists, small and large businesses, cities, and non-governmental organisations across the globe, to tackle the urban challenges of the FWE nexus, with coordination support from Future Earth.

The SUGI-FWE Nexus was established in 2016 in order to bring together the fragmented research and innovation expertise across the globe to find innovative new solutions to the challenges of the FWE nexus. Building on the global sustainability challenges identified by Future Earth's 2025 Vision, the ultimate goal of the SUGI-FWE Nexus program is to rapidly evolve the knowledge base, advance indicators and assessment tools that are needed for a comprehensive understanding of the urban FWE nexus, and develop practical new solutions to FWE challenges. The development of novel solutions for the complex challenges, including multi-level governance and management, and dynamic emerging risks and trade-offs, that urbanisation imposes on the FWE systems will contribute to the ability of populations to transition to sustainable consumption and production.

The program aims to bring together integrated teams of natural scientists, engineers, social scientists, arts and humanities researchers, the private sector, and urban stakeholders to develop projects requiring collaborative, international, inter- and transdisciplinary research and innovation. Projects support collaboration that goes beyond individual national efforts and demonstrate sharing, operationalizing and transferring existing knowledge, resources, and research facilities to mutual benefit. All projects integrate across the natural sciences (including engineering), arts and humanities, and social sciences, and clearly engage stakeholders and demonstrate user needs relevant to the project goals, with research outputs that are targeted towards informed decision-making and identifying potential innovations.

# Organizers



## BELMONT FORUM

The Belmont Forum is a group of the world's major and emerging funders of global environmental change research. It aims to accelerate delivery of the environmental research needed to remove critical barriers to sustainability by aligning and mobilizing international resources.

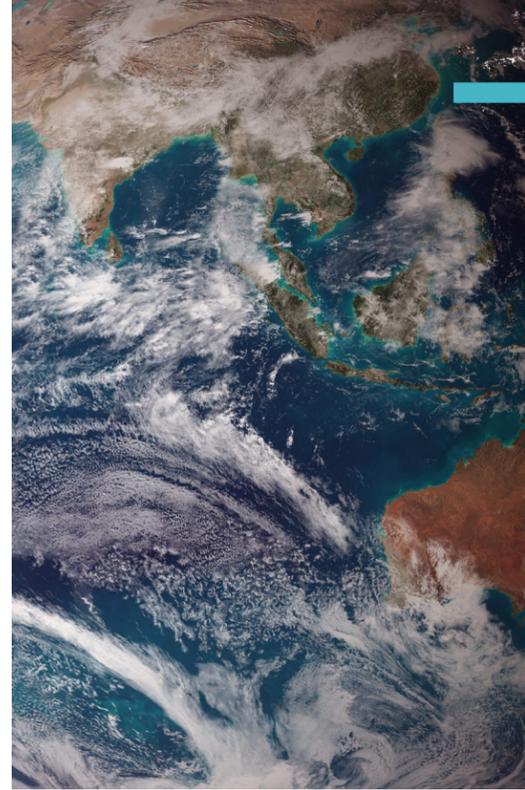
The Belmont Forum pursues the goals set in the Belmont Challenge by adding value to existing national investments and supporting international partnerships in interdisciplinary and transdisciplinary scientific endeavours.

## JPI URBAN EUROPE

The aim of the JPI Urban Europe is to create attractive, sustainable and economically viable urban areas, in which European citizens, communities and their surroundings can thrive.

The JPI Urban Europe focuses on how to:

- Transform urban areas into centres of innovation and technology,
- Ensure social cohesion and integration,
- Reduce the ecological footprint and enhance climate neutrality, and
- Take advantage of technological solutions and realize efficient and sustainable urban systems and networks (mobility, energy, water, ICT, etc.).



## FUTURE EARTH

Future Earth is a global network of scientists, researchers, and innovators collaborating for a more sustainable planet. Its international research program aims to build knowledge about the environmental and human aspects of global change, and to find solutions for sustainable development. Bringing together natural and social sciences, as well as the humanities, engineering, and law, Future Earth aims to:

- Inspire and create interdisciplinary science relevant to major global sustainability challenges,
- Deliver products and services that society needs to meet these challenges,
- Co-design and co-produce solutions-oriented science, knowledge and innovation for global sustainable development, and
- Build capacity among scholars world-wide.

## THE EUROPEAN COMMISSION

By coupling research and innovation, the European Union's Horizon 2020 initiative focuses on excellence in science, industrial leadership, and important societal challenges. The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation.

The initiative offers an opportunity for funding agencies, policy makers and research and innovation actors to tackle the challenge of urban transitions and to develop connections and collaborations worldwide. SUGI-FWE Nexus is partially funded from from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 730254.



# Projects

- CITYFOOD
- CREATING INTERFACES
- CRUNCH
- ENLARGE
- FEW-METER
- FUSE
- GLOCULL
- IFWEN
- IN-SOURCE
- METABOLIC
- M-NEX
- SUNEX
- URBANISING IN PLACE
- VERTICAL GREEN 2.0
- WASTE FEW ULL



## + CITYFOOD

Feeding rapidly growing urban populations requires innovative solutions that ensure efficient water, energy, and nutrients management. CITYFOOD investigates quasi-closed loop integrated aqua-agriculture (IAAC) systems to address this global challenge.

IAAC systems produce fish and plants, while re-using the fish water as fertiliser in nearly emission-free facilities. CITYFOOD will develop strategies to further the popularity and application of this space and resource friendly food production system in urban areas. The multidisciplinary project team will involve city planners, urban farmers, scientists, entrepreneurs, community leaders, and engaged citizens to reach its goals.

## + CRUNCH

The CRUNCH project investigates food, water and energy as one complex system, leading to increased knowledge and discoveries that cannot emerge when investigated separately in 'silos'. It will combine an integrated decision support system and visualisation models with expert knowledge in waste, food, material flows, water and energy management and urban planning, architecture and urban governance. CRUNCH aims for ground-breaking outcomes that are truly transdisciplinary, working closely with local stakeholders at every step of the project.

## + CREATING INTERFACES

Creating Interfaces will address capacity building for the urban FWE nexus, making the linkages understandable to the stakeholders (government, science, business, and citizens), and facilitating cooperation and knowledge exchange among them. It will develop and test innovative approaches for local knowledge co-creation and participation through Urban Living Labs in three midsize cities on water: Tulcea (Romania), Wilmington (USA) and Slupsk (Poland). Complemented by previous research and a citizen science toolbox, these labs comprise a user-defined co-creative approach where research questions, problems, and solutions are decided and implemented with stakeholders themselves.

## + ENLARGE

Developing sustainable future cities depends on the opportunities to optimally integrate and mobilize food, water and energy (FWE) resources in a synergistic way to reduce water, carbon, and ecological footprints, and to increase the community resilience against challenges exacerbated by climate change, population growth, and resources depletion. Through modelling of urban development scenarios and the use of decision support tools, we can better understand how community resilience in relation to natural and anthropogenic stresses can be strengthened by the optimal integration of FWE technology hubs at varying scales.





### + FEW-METER

As urban agriculture grows worldwide, a key need is to ensure that the nexus of food, energy, and water is optimized to utilise urban resources sustainably. This project will ask farmers to measure the efficiency of urban agriculture case studies in five developed countries by quantifying usage of energy, water and other resources. Data gathered will be used to model the resource flows of urban agriculture. This will enable the identification of methods to improve efficiency, also at a city-scale. An online platform for urban food producers will be created to share knowledge and experience gained within this project and to communicate the methods to increase resource efficiency of urban agriculture.

### + GLOCULL

Challenges in food, water and energy systems are locally and globally connected. For local actors, including cities, it is difficult to anticipate whether solutions to one issue in the FWE nexus are sustainable across food, water and energy systems, both at the local and the global scale. The GLOCULL project therefore aims to develop an Urban Living Lab approach for innovations in the FWE nexus that are locally and globally sustainable. To support future implementation of this approach, guidelines and a participatory assessment tool kit will be developed through co-creation in seven Urban Living Labs based on an integrated assessment of local-global interactions in the FWE nexus and transdisciplinary action-research.

### + FUSE

Novel policies and governance forms are needed to address competition for scarce resources in stressed urban food-water-energy systems. FUSE adopts an innovative living lab approach in which stakeholders: 1) produce solutions for future urban-FWE challenges, 2) engage in participatory model building, and 3) examine the merits of proposed solutions. Innovative system models quantify connections and feedbacks among users, producers, distribution mechanisms, and resources. The FUSE approach is being applied to Amman, Jordan and Pune, India: growing urban regions, each with intermittent freshwater supplies and significant competition with agriculture for water and energy.

### + IFWEN

The trade-offs between food, water and energy can generate unsustainable urbanisation pathways, which contribute to socio-economic problems including poverty, conflicts and diseases. However, too little is known about the intersection of FWE in cities. On the other hand, Green and Blue Infrastructure (GBI) has emerged as a viable solution to many urban problems with low cost, sustainable outcomes. Based on empirical research, the project will develop a framework and tools to assess changes in FWEN, their related trade-offs and the building of innovative capabilities in cities for developing innovative solutions to FWEN (IFWEN - Innovation in Food-Water-Energy Nexus) and manage GBI at the urban level.

### + IN-SOURCE

As cities across the globe confront rapid change, they face common metabolic challenges to provide Food Water and Energy (FWE) supplies. IN-SOURCE will develop a shared urban data and modeling framework to help decision makers (such as governments, utilities, developers, investors) identify, quantify and visualize FWE systems and their interrelations for urban strategic planning and FWE infrastructure investments. IN-SOURCE is based on three case studies in Ludwigsburg (Germany), New York (US) and Vienna (Austria), and will examine scenarios for an integrated CO2-neutral and sustainable infrastructure as well as the scalability and transferability of prototype solutions to other cities.

### + M-NEX

Urban communities are particularly vulnerable to the future demand of food, water and energy, and this is further exacerbated by the onset of climate change. A solution needs to be found for a FEW nexus. This internationally diverse project, based around urban design practice, sees urban agriculture as a key facilitator of the Nexus, needing water and energy to become productive. Working directly with living labs in some of the most vulnerable communities in the partner cities, the team aims to co-design new food futures with stakeholders that leave them less vulnerable to forces disturbing the nexus. The lessons learned from these stakeholder workshops will be shared outside the team, so that lessons learned locally can be applied globally.

### + METABOLIC

Effective management of urban metabolisms is the key to the health of our urban centers of tomorrow. The project will identify critical factors and define critical pathways of FWE delivery to urban centers using advanced tools such as artificial intelligence, data mining, system dynamics modeling, agro-logistics and scenario analysis to understand the intertwined nature of FWE in terms of lifecycles, including production, processing, delivery, consumption, and disposal. The underlying rationale is that FWE Nexus forms the basis of the urban metabolic system that sustains the development of urban centers. The primary outcome will be the development of the intelligent urban metabolic systems appropriate for cities and the unique challenges for green urban centers of tomorrow.

### + SUNEX

SUNEX provides an integrated modelling framework of advanced tools to model and assess the Food-Water-Energy (FWE) systems' demand and supply sides, capture their interdependencies and maximize synergies through a nexus view that endorses efficient solutions for energy, water and food supply for urban regions. The approach will be applied in four case study cities reflecting different socio-economic and climate characteristics, different consumption patterns and different local and remote FWE resource shares. A monitoring and control sensor network will be tested to improve water and energy savings for local food production. The results will feed into FWE-supply guidelines ensuring replication to support the transition towards higher urban resilience.





### + URBANISING IN PLACE

Farmers and food growers can play a role in managing the urban food-water-energy nexus. The process of urbanisation today disables the metabolic agency of urban food growers. This projects seeks to define components of an “agroecological urbanism”: a model of urbanisation which places food, metabolic cycles and an ethics of land stewardship, equality and solidarity at its core. Working with communities of practice in Rosario, Riga, Brussels and London, the project will identify ways of structuring urbanisation that value proximity, account for the reproduction of nutrients and soils, mobilize technologies and decommodified value chains in order to keep the control over resources localised.

### + WASTE FEW ULL

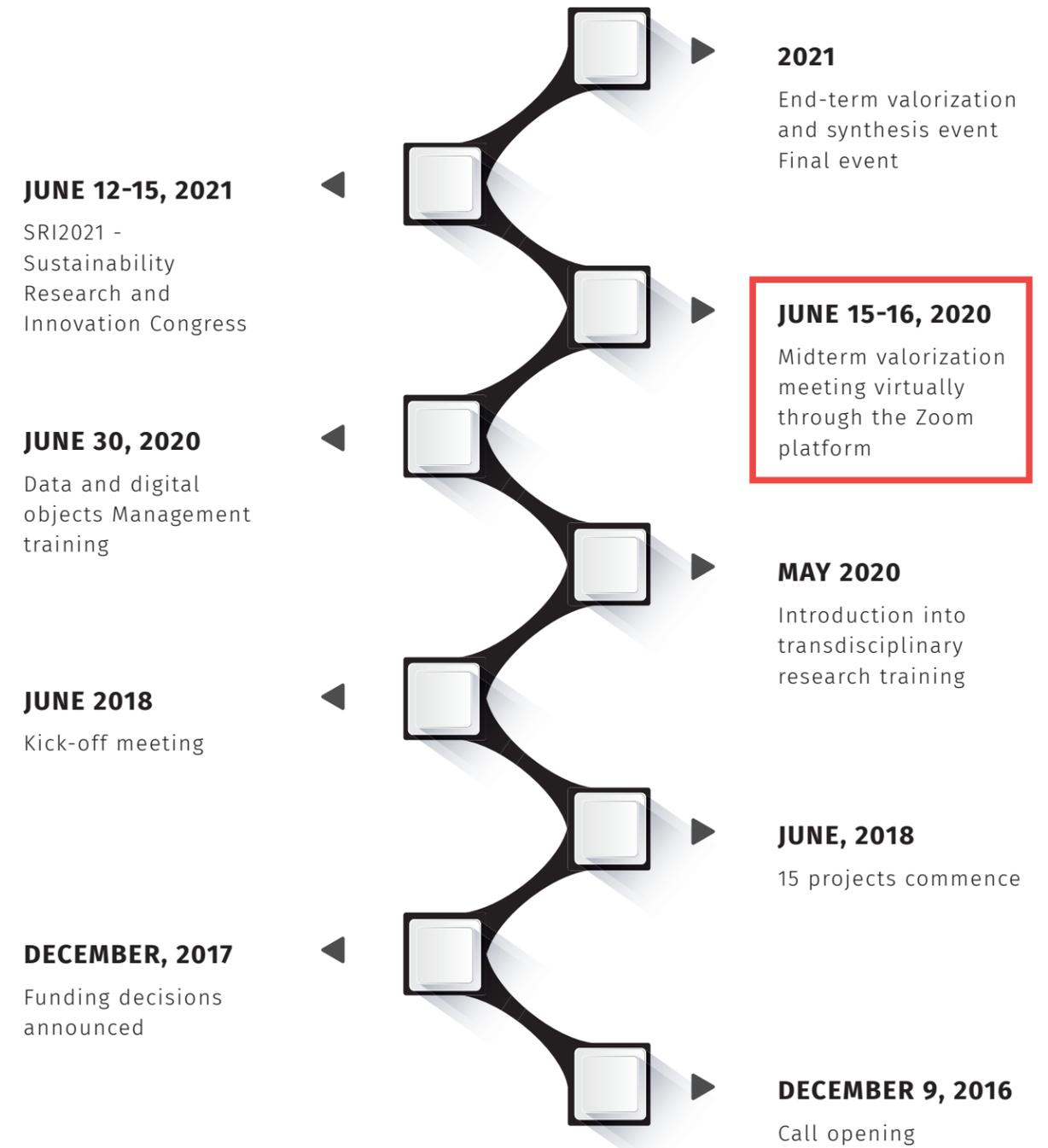
WASTE FEW ULL will map and substantially reduce waste in the food-energy-water nexus in cities across three continents: Europe, Africa and South America. It will establish four Urban Living Labs (ULLs) of stakeholders to a) map resource flows b) identify critical dysfunctional linear pathways c) agree the response most appropriate to the local context d) model the market and non-market economic value of each intervention and e) engage with decision makers to close each loop. The project will contribute with policy decision support models for economically viable waste reduction, rethinking waste as a resource as well as establish entrepreneurship networks in each ULL to continue working after the formal end of the project.

### + VERTICAL GREEN 2.0

Vertical green (VG) has a great potential to cool buildings, to recycle and upcycle wastes, rainwater and grey water, to produce food or bio-energy and to generate green spaces nearly everywhere in cities - almost independent of available horizontal space. The project approaches the different chances and challenges associated with VG together with citizens affecting or being affected by it in order to maximize VG’s acceptance. We will re-develop VG according to stakeholder needs, e.g. we will adapt it to different architectures, different climates and reduce maintenance costs through automated machinery so that VG may unfold its full positive impacts to as many urban neighbourhoods as possible.



# Timeline



## Virtual Midterm Valorization Event

# Overview

**162**

**TOTAL NUMBER OF PUBLICATIONS**  
(reports, books, journal articles, etc.)

**448**

**NUMBER OF STAKEHOLDERS**  
(undergrad, grad students, community, industry, city municipality, farmers, etc.)

**25**

**NUMBER OF EVENTS HELD/TYPE**  
(workshops, symposia, trainings, policy engagement)

The SUGI-FWE Nexus Midterm Valorization Event, held 15-16 June 2020, was an important bridging opportunity for projects, organizers, and funders from around the globe. The virtual event facilitated new connections between teams, provided a unique space to share best practices, and gave project members a chance to network with hosting institutions – all important drivers for project success and longevity. In addition to interventions from representatives of the European Union, JPI Urban Europe, and the Belmont Forum, smaller breakout sessions during the event allowed participants to explore some of the common challenges, and innovative solutions, within the projects to date. Additionally, project teams received valuable feedback on their impact from an expert evaluation committee, as well as information on additional funding opportunities through Future Earth's PEGASuS grants to continue taking their projects further.

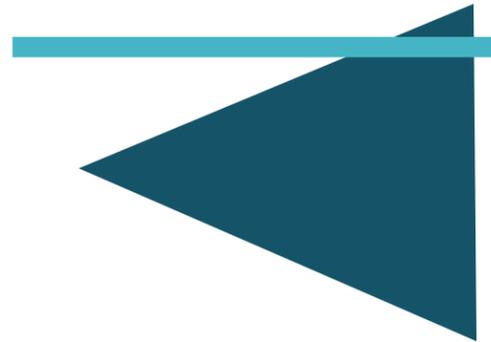
# Common Challenges, Innovative Solutions

## COMMUNICATING WITH STAKEHOLDERS

The collaborative, transdisciplinary nature of the SUGI-FWE Nexus initiative necessitates effective communication with a wide variety of stakeholders in order to align efforts and create commonality across sectors. Providing equal consideration and representation of multiple stakeholders to drive project goals and outcomes is a key aspect of effective communications within individual projects.

However, the complex, interwoven nature of food-water-energy systems presents several communications challenges. First, individual stakeholders may not fully understand the interconnections between food, water, and energy systems, and making these connections explicit can be difficult or time consuming. This step is crucial, however, in helping overcome silo thinking, which makes up another communication difficulty as diverse stakeholders often lack a shared 'language' or terminology to transcend traditional sectoral, industry, or discipline boundaries. This transdisciplinary approach also made synchronization of the outputs difficult, and some teams also encountered criticism from the public and civil society due to a lack of knowledge of project technologies.

Some proposed solutions to these communication hurdles at this stage of the project cycle include more flexible, audience-specific outreach. While the food-water-energy nexus is a complex topic, determining a suitable access point with a focus on one of these topic areas may best provide an entryway for the nexus as a whole. In this effort, using multiple methods to communicate with stakeholders may be helpful, including the introduction of new communication tools such as elements of pop culture, film, and images, in line with relevant publications and policy briefs. Developing relationships with key community members to act as ambassadors of top-line messages, and providing capacity building on the topic – such as through engagement with local universities – can help create effective linkages between various industries and projects. Finally, traditional language barriers were also a project constraint, so providing adequate translation services and making sure that all voices are accounted for is a critical step towards ensuring effective communication, alongside the more creative 'translation' of industry or expert jargon into a common narrative that can bring together diverse stakeholders towards common goals.



## MOVING FROM RESEARCH TO POLICY CHANGE

Connecting rigorous research to policy can provide long-lasting, innovative solutions for communities. However, with the wide variety of stakeholders involved in these projects, teams experienced difficulty in crafting policy language that satisfies all participants. Government agencies, for example, might be reluctant to implement significant policy changes or might encounter limited political will to institute proposed changes highlighted by the projects. Engagement of various stakeholders is also a challenge when working to scale up policies, as specific, local-level details often did not translate to higher orders of complexity, presenting further issues regarding funding sources. In addition, the historical context of the various cities represented within projects varies drastically, such as rapid growth over recent decades contrasting with economic shrinkage. Cities also often vary in their level of development, accessibility, and functionality of their infrastructure, presenting unique policy challenges that vary by urban context.

It is here that engagement with multiple stakeholders moves from an operational challenge to an asset for securing project goals, in that preparing and effectively communicating information about economic outcomes for initiatives and policies on various timescales can be helpful in motivating necessary policy changes, and appreciating the different perspectives of policymakers can help shift the narrative accordingly.

## DETERMINING AN APPROPRIATE SCALE

Defining an appropriate study area is often the first step in conducting a research case study. Within the FWE nexus, defining this specific area of study is a complex challenge, as each system is simultaneously interwoven and spatially dissociated. Additionally, there are important differences between cities that encompass multiple interests and necessitate unique approaches. Interestingly, the nexus may extend outside one jurisdiction, consequently, there is a need to think of how the cities are connected to other regions, as well as how these connections link different parts of the nexus within the city and beyond.

In order to identify an appropriate scale for the study of FWE nexus, it is recommended to base work on case-specific approaches, ensuring a community-led effort in delineating the study sites. In addition, experiences from the teams demonstrated that the best results could be achieved by defining flexible and dynamic frameworks that will consider appropriate linkages when necessary.



### ENSURING QUALITY DATA

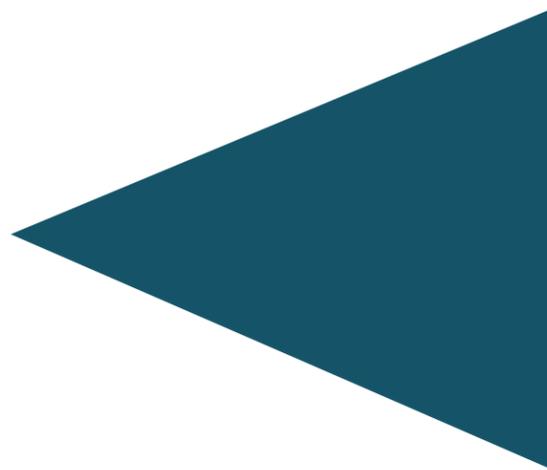
Innovation often requires new and better data which may not be available in all contexts. While there is a need to characterize interwoven systems of the FWE nexus, there is also a need to collect a variety of data across sectors and environments that will help establish a baseline understanding of connections within the nexus.

The main data-related challenge in this regard is a lack of available, open, and high-resolution data (e.g. geospatial data, economic data). Oftentimes, difficulties in accessing existing data limits opportunities for analysis and hinders the study process. In addition, there is often a need for combining data from different sectors that are not necessarily designed to be analyzed together. And, while scientists are sometimes more familiar with quantitative data collection and analysis processes, there is a growing need for stakeholder outreach and qualitative analysis as well. Lastly, an overwhelming amount of data can further compromise the agility of the decision-making process.

In order to address these challenges, it is recommended to utilize an appropriate framework to understand what pivotal pieces of data are necessary to make decisions and at what scale. Here, a critical component is not only the identification of the necessary data but also pointing out the unavailable, but necessary pieces. Effective communication with relevant entities that possess the required data and careful development of strategies to produce missing data pieces is recommended.

### RE-DEFINING INNOVATION

As many project teams have experienced, there is a strong need to better define what is meant by the term “innovation.” Often, innovation does not require major technological advancement, or a complete overhaul of established processes. Rather, sometimes innovation can come in the form of small changes or improvements that bring larger impacts through their wider implementation. Innovation, therefore, can also take the form of convincing society as a whole to make small changes for the better. This was especially emphasized in the projects’ ‘close to market’ approach that directly involved local businesses.



### SUPPORTING EFFECTIVE DECISION-MAKING

Integrated decision-making support systems for urban food - water - energy challenges include better access to general and case-specific data, also data organization for efficient analysis. In addition, establishment of frameworks for decision-making, allowing information modeling and simulations to better understand future tendencies in population change and urban consumption patterns are important. For the long-term sustainability of decision-making, effective knowledge transfer tools, and information dissemination mechanisms should be introduced.

### ENABLING CITIZEN SCIENCE

Generating software tools to help facilitate citizen science is a rewarding but challenging aspect of projects, often due to a disconnect between software engineers and lay individuals in the community. To help bridge this gap, several teams designed the software development process to be iterative in order to account for the many needs of the various beginning and end users.

In addition to the value of the added data citizen science can create, engagement with a wider group of stakeholders and the creation of a common space for many different people to collaborate can lead to greater buy-in from members of the community. Involving the next generation of local leaders, such as students, can also help ensure the longevity projects.

### COSTS AND TIMELINES

Many teams recognize that the timeframe for the projects may not be adequate to generate meaningful policy results. Citizen science in particular is difficult to complete in the current timeframe of these projects because it cannot be determined when information will become available. Life cycle costs also remain for maintaining infrastructure after funding is extinguished, threatening the longevity of proposed solutions. Creating partnerships with industry, NGOs, and municipalities to discover opportunities to leverage resources is one way to overcome these limits and ensure the projects’ long-term sustainability.



## THE COVID-19 PANDEMIC

As cities around the world grappled with the initial outbreak of the COVID-19 pandemic, many aspects of everyday life were revised in real-time. The pandemic has, in an important way, underlined the importance of sustainability and resilience within cities around the globe. Compact and well-connected urban areas buttressed by mass transportation are important aspects of sustainable development, but the novel coronavirus has also shown the vulnerabilities of this approach. Rethinking how cities function, and reconsidering how to build self-reliance into urban areas, could benefit future populations.

Operationally, the pandemic has significantly hindered the process of data collection, impacting project timelines. However, strong connections amongst partners in different countries has been able to continue because of well-established and accessible ways of communication within the virtual space. Whether the pandemic will be brought under control quickly, or whether the rapid and radical changes COVID-19 has brought will become the 'new normal' for the foreseeable future, remains to be seen, but it is clear that the FWE nexus must also take into account external and unforeseen shocks that can quickly disrupt business as usual.



## GLOBAL SUSTAINABILITY SCHOLARS

Four SUGI-FWE Nexus projects hosted U.S. undergraduate students participating in the Global Sustainability Scholars program, a life-long network of peer and professional change leaders in global sustainability. These projects included:

- CITYFOOD
- Creating Interfaces
- FUSE
- VERTICAL GREEN 2.0

The Global Sustainability Scholars program brings together the brightest undergraduate students and young professionals from under-represented groups to work with leading scientists on critical sustainability challenges that face communities and environments in the future. Each year, the program selects 7-10 undergraduates from participating countries to join a GSS cohort and the larger international sustainability solutions community. Each cohort of scholars will focus their training and research experience on a theme within sustainability, with the 2019 cohort centered on the food-water-energy nexus.

This prestigious, three-year summer experiential learning opportunity fosters professional development within a new generation of scientists who represent the diversity of today's society, and is focused on transdisciplinary sustainability science and innovation. As part of the program, the 2019 cohort will receive additional paid internships next summer, resulting in a capstone study.



# Next Steps

## PEGASUS 3: SUGI-FWE NEXUS 'TAKE IT FURTHER' GRANTS

The SUGI-FWE Nexus program provides a unique collaboration framework for technical and social scientists, small and large businesses, cities and non-governmental organisations, to tackle the urban challenges of food, energy and water nexus. The 15 existing SUGI/Nexus projects are currently developing new knowledge, innovative and integrated solutions and tools to address food, water, and energy challenges in urban areas.

Future Earth, with funding from the Gordon and Betty Moore Foundation's Science Program, is partnering with the Belmont Forum to make available a new grant opportunity to the existing SUGI/Nexus teams and new partners. This opportunity focused on enhancing and accelerating the existing Belmont-funded projects as well as fostering new cross-project collaborations and facilitate the involvement of new partners. Four proposals from the existing SUGI/Nexus Teams were chosen in late 2020 to receive the grant.



## SRI2021

The Sustainability Research & Innovation Congress 2021 (SRI2021), the world's first transdisciplinary gathering in sustainability, will take place in June 2021 in Brisbane, Australia, and will mark a closing chapter for many of the projects within the SUGI-FWE Nexus program. As a space of fierce advocacy for sustainability scholarship and innovation, collaboration and action, SRI2021 will serve as a natural gathering point for project teams, whether virtual or in person. The event will unite global leaders, experts, industry and innovators to inspire action and promote a sustainability transformation.



## WORKSHOPS

In January 2021, a 1,5 hour virtual workshop is planned to further define activities to leverage results and outcomes from the projects involving the project partners.



**Sustainable Urbanisation  
Global Initiative (SUGI)**

FOOD - WATER - ENERGY NEXUS

### WITH FUNDING FROM:

EUROPEAN COMMISSION	BMBF (DE)	FORMAS (SE)
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