



Australia's National  
Science Agency

# Sydney Science Park CSIRO Urban Living Lab

Progress Report 2019-2023

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# Acknowledgements

The Sydney Science Park CSIRO Urban Living Lab (SSP-ULL) acknowledge the Darug People as the traditional owners of the land where Sydney Science Park is located and acknowledge their continuing connection and custodianship of these lands. We extend that respect to other groups who have a deep bond with this country through their travelling, trading and caring for its sustainability and betterment.



## About

This progress report has been co-authored by CSIRO and Celestino to share the progress, learnings, challenges, and plans for the SSP-ULL.

## Contact us

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Register to receive continued information at: [www.sydneysciencepark.com.au/urban-living-labs/](http://www.sydneysciencepark.com.au/urban-living-labs/)

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# 1 Executive summary

This report provides an update on the establishment of the Sydney Science Park CSIRO Urban Living Lab (SSP-ULL), its operational structures, governance framework, and a summary of strategic activities and projects from its creation in 2019 to early 2023.

Sydney Science Park (SSP), a 271 -hectare mixed-use greenfield development that is owned and being developed by Celestino, is located 3 km's North of the Nancy-Bird Walton International Airport in Western Sydney.

The SSP-ULL is a partnership between CSIRO and Celestino. The SSP-ULL facilitates the collaboration and cross-system learning needed to overcome barriers to change, to identify alternatives, and seeks to foster urban innovation that assists efforts to improve the resilience, sustainability and liveability of Australian cities and towns.

With an agreed mission, objectives and guiding principles in place, CSIRO and Celestino established a Relationship Agreement to support four strategic activities for the SSP-ULL (Foundational Coordination, Development Integration, Market Engagement and Innovation Facilitation).

The governance framework and management of the SSP-ULL are overseen by the SSP-ULL Management Group and the SSP-ULL Board. Both groups consist of members from Celestino, CSIRO and independent members.

The main objectives of the SSP-ULL are:

- Establish the SSP-ULL as a capabilities-based platform.
- Develop frameworks and tools that leverage off community, data and technology to foster smart city outcomes.
- Build the capacity for research-based evidence enable the delivery of better urban liveability, sustainability, resilience, and to drive leading-edge innovations in urban development.
- Bringing together local, state and national skills and expertise to form interdisciplinary and multi-sectoral research collaborations to catalyse innovations at SSP and beyond.
- Create knowledge and experience within Celestino, CSIRO and in partner-organisations that can be used to inform other urban development projects and CSIRO ULLs.
- Develop a sophisticated testing ground so that innovations can be trialled in a real-life urban environment.

During the period 2019 to 2023, the SSP-ULL has explored, supported and/or delivered the following activities:

- SSP data strategy
- Interactions between Western Sydney soils and recycled water
- Moveable nexus (food-water-energy)
- Circular economy procurement for the construction industry
- Western Sydney hydrogen hub
- SSP STEM schools challenge
- SSP smart cities framework
- SSP urban greening
- Air quality monitoring system
- Parkland City arboretum
- Urban typologies and stormwater management at street scale
- Sustainability strategy
- SSP sensor network
- Theory of change

The ongoing monitoring and evaluation reveal the following key impacts the SSP-ULL is delivering to make greenfield developments more liveable, sustainable, and resilient:

- challenges the move beyond business-as-usual and encourages adopting a systems perspective in delivering urban development.
- considers the commercial feasibility of how these novel approaches can be delivered.
- accelerates research due to the trust that industry and research partners have in the model.
- has helped to seed innovative approaches and ideas.

The SSP-ULL continues to learn how to expedite transformation through cross-discipline real-world experiments that accelerate and de-risk innovation. The SSP-ULL invites industry, government and universities to partner to fast-track outcomes in the following areas:

- Connection to Country
- Healthy living
- Urban heat mitigation
- Circular economy
- Sharing economy
- Connected interoperable systems and services
- Energy towards net zero
- Urban agriculture
- Integrated water cycle management
- Transport: connected, low emission, active mobility



## 2 The Urban Challenge

Australian cities are largely regarded as being liveable and rank highly in many global indicator systems (Economist, 2022). The same cannot be said for sustainability performance (Global Footprint Calculator, 2022), and there is a growing realisation of the need for greater resilience against extreme events such as heatwaves, droughts, storms, floods and other disruptions. Other sustainability challenges to be considered include:

*Population movement, changing demographics, growing inequalities, housing affordability, future-ready infrastructure, climate change, car reliance and oil vulnerability, digital and technology disruption, and transition towards net-zero emissions and circular economy.*

These multiple and interconnected challenges are expected to intensify over the remainder of this century, requiring a radical re-think of how we undertake urban development. As the complexity of urban system interdependence is increasingly revealed, there is a growing role for improved collaboration, experimentation and learning to inform urban development. In addition, it is becoming increasingly important to reduce the unforeseen risks associated with the implementation of new innovations as well as to accelerate and mainstream successful innovations across Australian cities.

Coinciding with these challenges, the planned Western Parkland City will arguably be one of Australia's most significant development projects over coming decades. The population of Greater Sydney is projected to grow to 8 million over the next 35 years and over half of this population is expected to reside west of Parramatta (GSC, 2018). Supercharged by the \$11b Western Sydney City Deal, the Western Parkland City is planned to become an economic hub supporting an array of uses from residential through to advanced manufacturing, logistics and research industries, creating an expected 75,000 jobs in mixed-use developments at Bradfield City Centre and SSP, and an agribusiness district with a further 10,000 jobs (NSW Western Sydney Planning Partnership, 2020). The scale of investment and infrastructure will leave a substantial legacy for NSW and the nation, with the promise of a Western Parkland City that delivers improved outcomes for future generations.

The SSP-ULL is an initiative of Celestino and CSIRO to create a mechanism to deal with these multiple and inter-related challenges. The SSP-ULL facilitates the collaboration and cross-system learning needed to overcome barriers to change, to identify alternatives and to make more informed choices in how to build our cities and suburbs to deliver improvements in liveability, sustainability and resilience.

### 3 Evolution of CSIRO ULL's

While the concept of Urban Living Labs originated out of Europe post 2010, the CSIRO approach to Urban Living Labs was informed by The Urban Edge Partnership (2014-16), a collaboration between CSIRO and Celestino that preceded the conception of SSP and explored the barriers and enablers to innovation in greenfield urban development. The Urban Edge Partnership generated data through a nationwide survey, supported by the Urban Development Institute of Australia (UDIA), that highlighted the need for 'urban innovation zones' for place-based innovation to inspire and accelerate much-needed systemic change toward more sustainable development in Australia (Quezada et al., 2016; Quezada et al., 2023).

CSIRO Urban Living Labs seek to progress beyond narrowly-focussed outcomes and acknowledge the need to tackle multiple, innovation challenges and/or wicked problems that spill over the responsibilities of multiple jurisdiction boundaries and areas of expertise. Within this, the importance of 'place' is critical to assemble a novel governance that invites and facilitates the necessary cross-sector interactions - to utilise transdisciplinary expertise, apply systems frameworks and approaches, to learn and co-design targeted efforts, to monitor and evaluate progress towards a transformational new and desired future.

#### Science concepts for ULL's

The science structure supporting research and impact of the ULL has two aspects (Figure 1), which can be understood as:

- (i) the science **OF** the Lab – do the overall activities of the Lab expedite transformation toward more liveable, sustainable and resilient cities and communities?
- (ii) the science **IN** the Lab – what is the impact of an individual research project?

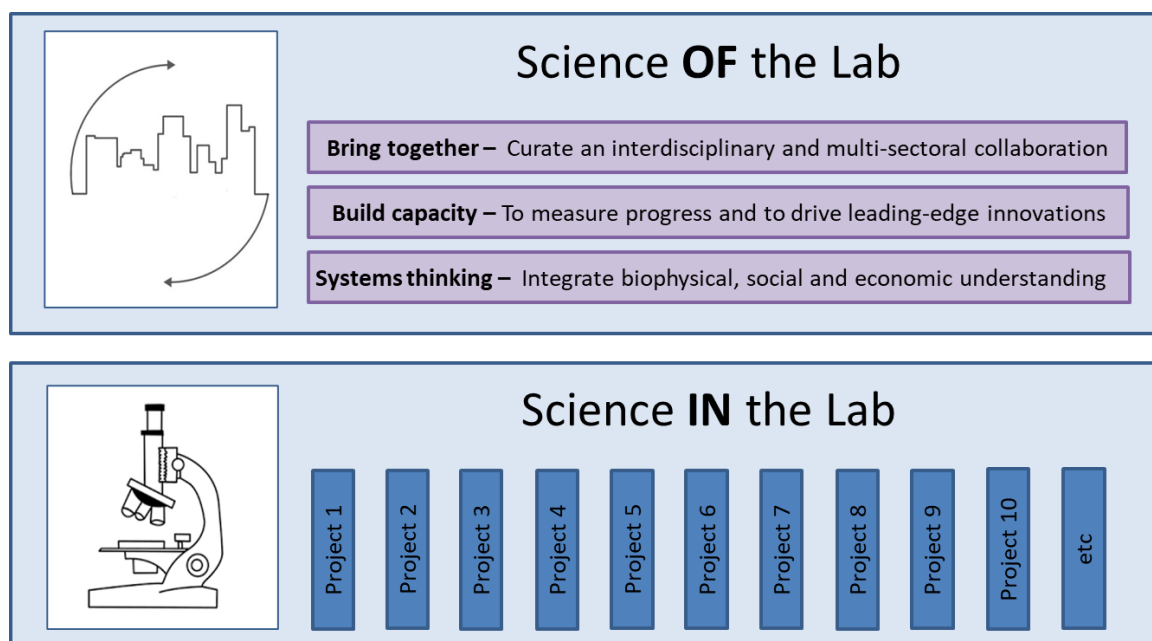


Figure 1. Science framing of how projects fit within the ULL.

The ULL is seeking socio-technical transformations to a new normal by overcoming typical barriers to change (Figure 2). Key enablers are the establishment of a novel governance that has a mandate to experiment and learn in place. It also allows time to nurture connection across the different ‘actors’ in the system to build capacity and cross-sector innovation. Ultimately the focus on experimentation and learning will lead to embedding, translating and scaling innovation (Von Wirth et al., 2018) that will lead to a new normal for SSP, Western Sydney, NSW and beyond.

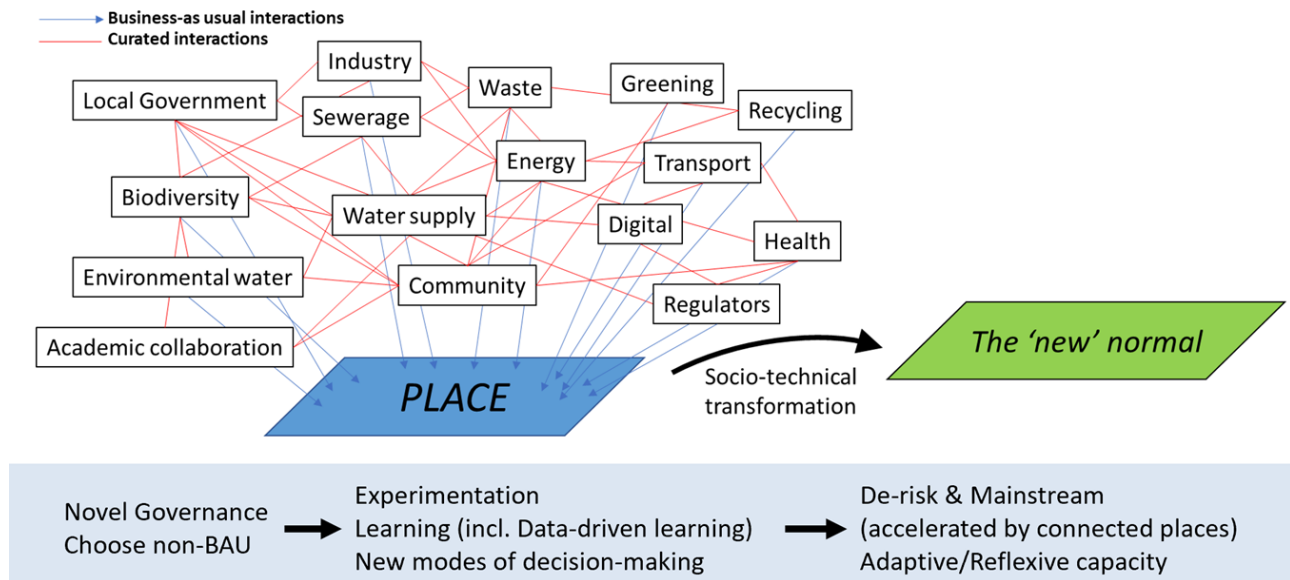


Figure 2. Key components of socio-technical transformation through place-based experimentation and learning.

CSIRO has sought to develop a portfolio of ULLs across Australian cities in order to explore a breadth of development and redevelopment situations. CSIRO has explored ULL concepts with numerous Governments and industry partners. On 2<sup>nd</sup> February 2017 Celestino and CSIRO committed to develop the framework to establish a CSIRO ULL at SSP. The occasion was launched by then Assistant Minister Industry, Innovation and Science, Hon. MP Craig Laundy and attended by approximately 50 government, industry and university officials. Figure 3 provides a timeline of Celestino-CSIRO collaboration, with the formal commencement of the SSP-ULL (CSIRO’s first Urban Living Lab) occurring in May 2019. The CSIRO-led Darwin Living Lab commenced 1 July 2019, and there is a third proposed ULL at Ginninderra, ACT.

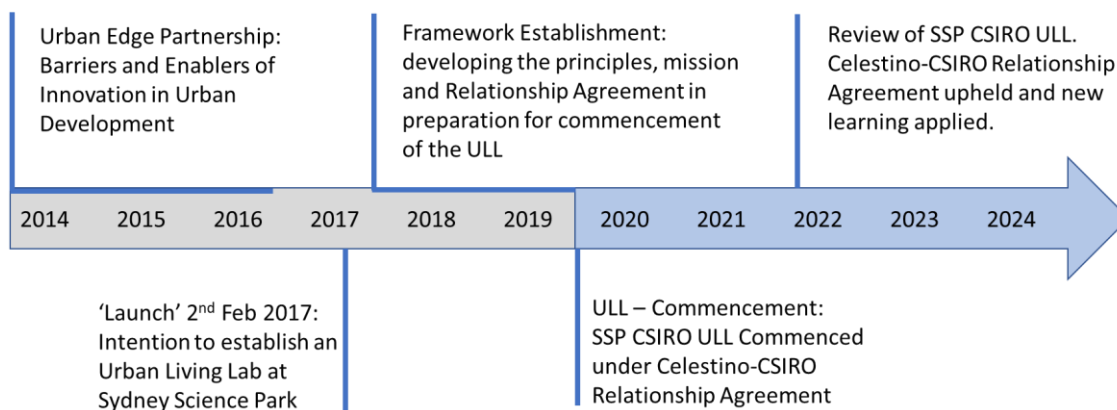


Figure 3. Timeline of Celestino-CSIRO collaboration relating to the SSP-ULL.

## 4 THE SSP-ULL

### Mission and Objectives

CSIRO's vision is for ULL's to expedite transformation toward more liveable, sustainable and resilient cities and communities through real-world experiments that accelerate and de-risk innovation. The establishment of the SSP-ULL is to support CSIRO and Celestino collaboration and ambition to leave a positive legacy for Western Sydney, using Celestino's SSP as the platform to undertake the research and develop the innovations that will support creating resilient, sustainable and flourishing modern urban developments.

The mission of the SSP-ULL is to foster resilient cities of the 21st Century by building innovation capacity into urban planning, design and development. This capacity will be established by:

- Developing place-based experimentation in new and/or redeveloped urban areas; and
- Developing and applying tools and approaches to catalyse innovation and systemic change.

The objectives of the SSP-ULL are:

- Establish the ULL as a capabilities-based platform
- Develop frameworks and tools that leverage off community, data and technology to foster smart city outcomes
- Build the capacity for research-based evidence enabling Celestino to articulate its commitment to urban liveability, sustainability and resilience, measure progress against research objectives, and drive leading-edge innovations
- Bringing together local, state and national skills and expertise to form interdisciplinary and multi-sectoral research collaborations for catalysing the planning and delivery of innovations at SSP and beyond
- Create knowledge and experience within Celestino, CSIRO and in partner-organisations that can be translated in a context specific way to inform other urban development projects and CSIRO ULLs
- Develop a sophisticated testing ground so that innovations can be trialled in a real-life urban environment and innovators can gain an accurate understanding of the impact of their invention.

## SSP-ULL Guiding Principles

| Principle                             | Context                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Shared Values</b>                  | Parties work together through a set of shared aspirations for ‘liveability’, ‘sustainability’, ‘resilience’ and ‘innovative urban development’                                                                                                                                                                                                                                                                              |
| <b>Value Creation</b>                 | Participation in the ULL is based on the premise of creating monetary and non-monetary value for communities, stakeholders, and individual research partners.                                                                                                                                                                                                                                                               |
| <b>Long-term Commitment</b>           | ULLs are appropriately funded either directly by research partners or through input from identified funding and investment sources.                                                                                                                                                                                                                                                                                         |
| <b>Ethical</b>                        | Experimental plans undergo ethical review and comply with National specifications for values, principles, governance and review processes. This includes: voluntary participation, informed consent, confidentiality and anonymity.                                                                                                                                                                                         |
| <b>Inclusion</b>                      | The power of the ULL is its ability to integrate the skills, competencies, and passion of partners, stakeholders and communities to deliver mutually beneficial outcomes.                                                                                                                                                                                                                                                   |
| <b>Systems Focus</b>                  | Bringing together the knowledge and skills of a range of disciplines and groups to enhance urban development innovation and reduce ULLs failures and difficulties across its components and sectors.                                                                                                                                                                                                                        |
| <b>Innovation</b>                     | The initiative focuses on exploring and experiencing new ways of working together rather than replicating, or competing with, current practice and service providers                                                                                                                                                                                                                                                        |
| <b>Transformation</b>                 | ULLs are places where bold, innovative transformations of urban living, form and function that are beyond the current accepted “norm” will be trialled and demonstrated. By their nature, transformational research activities are not assured of success but have strong potential to make major advances in urban development. As such, partners may be required to drive these transformations for long periods of time. |
| <b>Knowledge</b>                      | By working in partnership new knowledge will be created which will inform evidence-based decisions and investments in liveable, sustainable and resilient communities. Knowledge is treated transparently and shared widely in developing and delivering projects.                                                                                                                                                          |
| <b>Experimentation &amp; Learning</b> | Through its activities the ULL initiative will create new knowledge and facilitate learning, capacity building and shared understanding of partners, stakeholders and communities.                                                                                                                                                                                                                                          |
| <b>Evidence-based</b>                 | Promote an evidence-based approach to urban innovation, creating evaluation frameworks and benchmarks along with tools for monitoring and assessment.                                                                                                                                                                                                                                                                       |
| <b>Curation</b>                       | Stakeholders are engaged and maintained, knowledge is actively passed on and scientifically-based impact frameworks are (developed, updated and) used to guide experimentation and learning. Social and institutional networks are grown and strengthened                                                                                                                                                                   |

## The Structure of the SSP-ULL

With agreed mission, objectives and guiding principles in place, CSIRO and Celestino established a Relationship Agreement to support four strategic activities for the SSP-ULL, as outlined below.

| Strategic Activity                    | Context                                                                                                                                                                                                                                              |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Foundational Coordination (FC)</b> | Frameworks to support governance, research and development initiatives, learning and systems integration. This includes a mechanism to monitor and evaluate ULL function with a focus on learning (how to do the Lab better?) and to capture impact. |
| <b>Development Integration (DI)</b>   | Interaction between CSIRO and SSP development team to provide guidance and advice where appropriate. Sharing of new knowledge.                                                                                                                       |
| <b>Market Engagement (ME)</b>         | Development of partnerships and forums (such as think tanks) to participate in the research program at SSP-ULL and bring additional funding and in-kind.                                                                                             |
| <b>Innovation Facilitation (IF)</b>   | Conduct programs to support and foster communications, learning and education centred around research and innovation, such as STEM activities, newsletters.                                                                                          |

During early stages of the SSP-ULL, FC activities focused effort on developing appropriate operational governance to support SSP-ULL principles, and frameworks for the formation of projects, as summarised below.

### Governance of the SSP-ULL

The urban living lab model is based upon foundations of strong collaboration and the building of an innovation ecosystem that is continually nurtured (Sengers et al., 2018).

An expanded SSP-ULL Management Group was formed and a renewed SSP-ULL Governance Framework shown in Figure 4 was implemented.

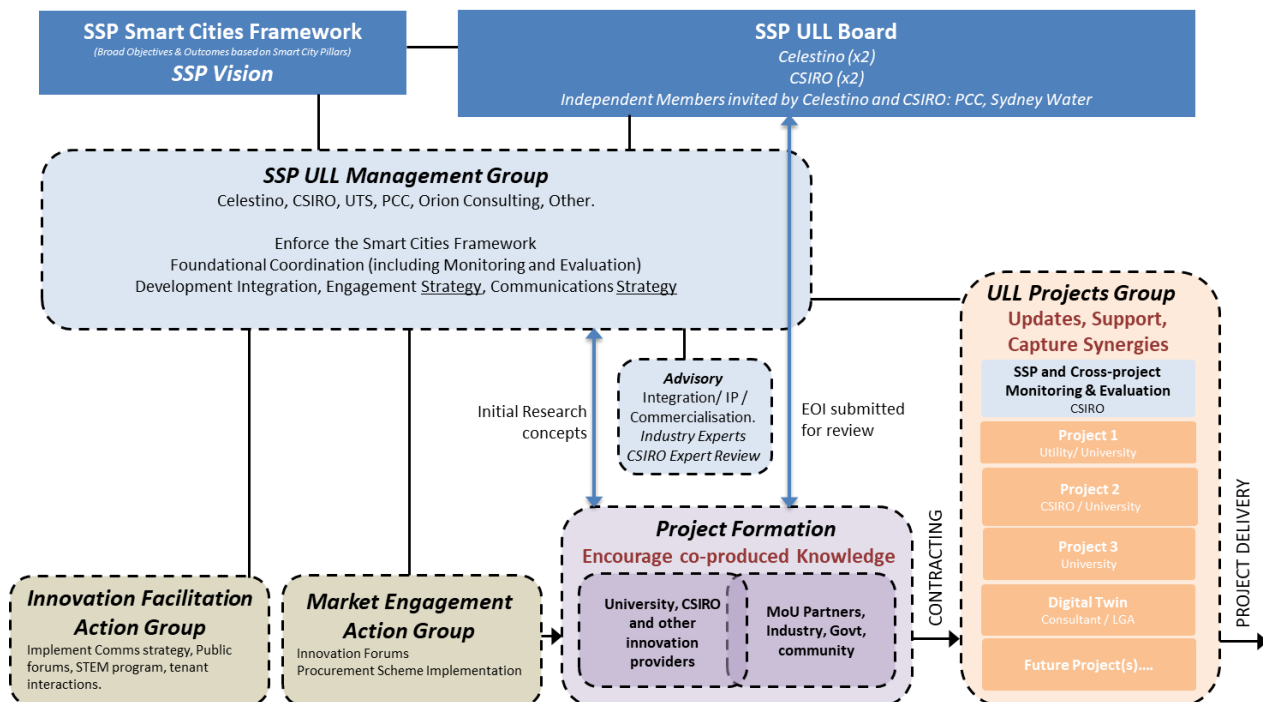


Figure 4. SSP-ULL governance structure, July 2022.

## SSP-ULL Research Project Establishment Process

A review of other project selection processes was undertaken and a seven-step methodology used by GISERA was identified as helpful in relating the project formation process to the governance framework (Table 1). An eighth step has been added to acknowledge the importance of an appropriate agreement that allows effective project function at SSP. Figure 5 provides an explanatory flow diagram for project formation.

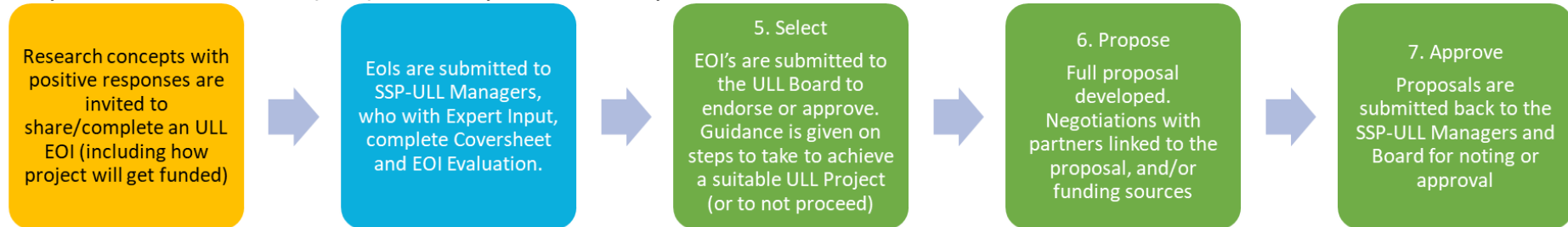
**Table 1. Proposed flowchart linking project formation to SSP-ULL governance structure.**

| Key steps    | Questions we are asking                                                                                      | Process and method                                                                                                                                                                                                            | Governance responsibility                                                                      |
|--------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 1. Awareness | What are the key topics of concern to industry, government and community?                                    | Survey, think tank, forums to develop a collated list of topics.<br><br>Development of Problem Statements.                                                                                                                    | Innovation Facilitation<br><br>Market Engagement<br><br>Development<br><br>Integration (needs) |
| 2. Rank      | How do topics rank in their relative importance to delivering SSP Vision?                                    | Map topics to SSP Smart City Pillars and rank on importance                                                                                                                                                                   | SSP-ULL Management Committee                                                                   |
| 3. Review    | What is the current state of knowledge on the topic and innovation opportunity?                              | Review ranked topic list, and filter based on the level of innovation.                                                                                                                                                        | SSP-ULL Management Committee<br><br>Expert Review (CSIRO & Other)                              |
| 4. Identify  | What research is required to address the topic and who would need to be involved?                            | Request university, CSIRO and other innovation providers (i.e. Innovation Procurement Scheme) to prepare or co-develop EOI                                                                                                    | Project Formation                                                                              |
| 5. Select    | Which project EOI's best deliver to the SSP Vision and meet SSP-ULL evaluation criteria?                     | EOIs are formally reviewed and selected using evaluation criteria                                                                                                                                                             | SSP-ULL Management Committee<br><br>Seek Expert Review (CSIRO & Other)<br><br>SSP-ULL Board    |
| 6. Propose   | For selected EOI's, what are research aims, methods and expected outputs and impact?                         | Selected EOIs are developed into formal research project proposals                                                                                                                                                            | Project Formation                                                                              |
| 7. Approve   | Can SSP-ULL Board endorse or approve the research proposal and SSP-ULL assist research to commence?          | Project proposals are reviewed and endorsed (or where possible pooled funding approved) at SSP-ULL Board meeting                                                                                                              | SSP-ULL Management Committee<br><br>SSP-ULL Board                                              |
| 8. Agreement | How can projects benefit from shared learning with other activities, and their impact effectively monitored? | Research Project Agreements executed at SSP contain clauses that: (i) ensure project leaders engage with the SSP-ULL and provide regular updates, (ii) the project engages with CSIRO to undertake monitoring and evaluation. | SSP-ULL Partners<br><br>Reinforce need to monitor and evaluate Science OF the Lab.             |

## Getting Started with the SSP-ULL



## Expression of Interest (EOI) and Proposal Development



## Getting underway: Active Research within the SSP-ULL Team

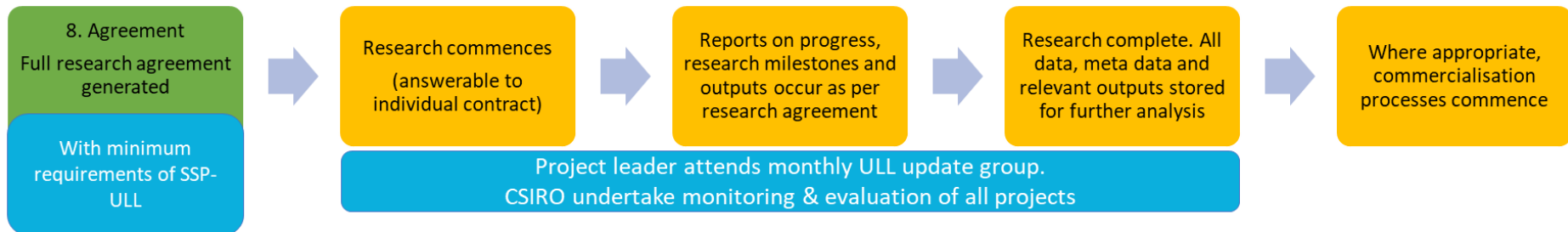


Figure 5. Revised process for project formation

## 5 SSP-ULL achievements

### 5.1 Summary of strategic activities

A summary of the key strategic achievements from the SSP-ULL are shown in Table 2.

**Table 2. Summary of key strategic undertakings of the SSP- ULL (May 2019 to December 2022).**

|                                | 2019-2020                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2020-2021                                                                                                                                                                                                                                                                                                                                                                                         | 2021-2022                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Foundational Coordination (FC) | <ul style="list-style-type: none"> <li>Establishment of SSP-ULL Board and SSP-ULL Management team.</li> <li>Extensive stakeholder engagements that set the initial priority areas of the SSP-ULL (in particular; water, energy and smart cities).</li> <li>The development of a set of future scenarios to aid the long-term planning of the SSP-ULL and the SSP development.</li> <li>Supported university and industry partners on (unsuccessful) 'Future Cities' CRC-bid.</li> <li>Undertook the first, baseline Monitoring, Evaluation and Learning (MEL) of SSP-ULL.</li> </ul> | <ul style="list-style-type: none"> <li>Expansion of SSP-ULL Board to include Sydney Water representation.</li> <li>Expansion of SSP-ULL Management group to include UTS.</li> <li>Development of an initial Theory of Change (ToC) to understand the vision for SSP and to test assumed pathways to achieve the vision.</li> <li>Undertaking the 2<sup>nd</sup> MEL review of SSP-ULL.</li> </ul> | <ul style="list-style-type: none"> <li>Consolidated vision for SSP-ULL (post Covid).</li> <li>Expanded and revised the SSP-ULL governance framework and processes.</li> <li>Creating a clearer vision for SSP with Celestino engaging external agencies</li> <li>Objectives, agenda and plans for ToC workshop developed.</li> <li>Engagement with NSW and Commonwealth agencies to promote increased collaboration and place-based experimentation in western Sydney.</li> <li>Undertaking the 3<sup>rd</sup> MEL review of SSP-ULL.</li> </ul> |
| Development Integration (DI)   | <ul style="list-style-type: none"> <li>SSP Urban Masterplan input.</li> <li>Integration of SSP-ULL principles and processes with the Celestino SSP development team.</li> <li>External industry and research engagements. Workshops to identify potential energy and data innovations at SSP.</li> </ul>                                                                                                                                                                                                                                                                             | <p><i>Delays in Western Sydney (Re)planning impacted SSP development timelines and activity.</i></p> <ul style="list-style-type: none"> <li>Provided input and completed the peer review of the SSP Smart Cities Framework.</li> </ul>                                                                                                                                                            | <ul style="list-style-type: none"> <li>Development of a draft baseline and monitoring strategy for SSP.</li> <li>Provided improvements for the SSP Smart Cities Framework.</li> <li>Sharing of knowledge in the areas of: integrated stormwater management, environment and sustainability mandates, floorspace ratios and building heights.</li> </ul>                                                                                                                                                                                          |

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Market Engagement (ME)       | <ul style="list-style-type: none"> <li>• Meetings with a range of organisations from sectors including government, industry and education (university and secondary).</li> <li>• ThinkTank at UTS Tech Lab that combined the input of +90 key stakeholders and 29 different industry companies, resulting in the development of project concepts under 5 key urban pillars.</li> <li>• Korean delegation (KICT, Korean Dept Environment) workshop at SSP</li> <li>• UTS αCab Workshop (Autonomous Vehicles)</li> <li>• The establishment of four active research projects (approved EOI's) progressing to the proposal development stage, and 5 EOI research concepts.</li> </ul> | <p><i>Covid-19 impacted the ability to undertake research at SSP.</i></p> <ul style="list-style-type: none"> <li>• In conjunction with UTS, CSIRO and Celestino, developed SSP Innovations scheme (SSPi) that aims to embed the delivery of innovation as a key component of the procurement activity at SSP.</li> <li>• Five active projects were progressed.</li> </ul> | <ul style="list-style-type: none"> <li>• Testing of SSPi concept and further refinement of the innovation scheme.</li> <li>• Clarity on the process to initiate SSP-ULL projects.</li> <li>• Industry and Government engagements on innovation in the following domains: purple and green roofs, green hydrogen, NSW clean energy technology ecosystem, drone research, data sharing in smart cities, urban heat, cooling and greening, digital twin and circular economy.</li> <li>• SSP Partner forum to update and engage innovation partners.</li> <li>• Engagement with NSW and Federal Government to discuss the benefits of place-based experimentation and learning in Western Sydney.</li> </ul> |
| Innovation Facilitation (IF) | <ul style="list-style-type: none"> <li>• Presentations at seminars and workshops, most notably the inaugural Darwin Living Lab symposium and the Penrith City Council "Cooling the City Masterclass".</li> <li>• STEM engagement with local Western Sydney Schools, in particular progressing toward the development of a School Science Challenge.</li> </ul>                                                                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>• Engagements continued virtually via video links.</li> <li>• Presentation to Committee for Sydney, Western Sydney Taskforce.</li> <li>• Pymble Ladies College Think Tank (observed by NSW Association of Independent Schools).</li> </ul>                                                                                         | <ul style="list-style-type: none"> <li>• Development (and implementation) of SSP-ULL Communications Strategy.</li> <li>• Supporting the design of the SSP STEM Schools Challenge and its reach to 500 participants from 10 schools. Noting the advanced maturity of the learning experience offered by the cross-schools challenge.</li> </ul>                                                                                                                                                                                                                                                                                                                                                            |

## 5.2 Summary of SSP-ULL project activities

A summary of projects and EOI's supported by the SSP-ULL is provided in Table 3.

**Table 3. Summary of key undertakings aligned with the SSP CSIRO ULL from May 2019 to Dec 2022.**

| Project                                                      | Lead (Partners)                                | Concept                                                                                                                                                                                                                                             | Status                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SSP Data Strategy                                            | CSIRO (Celestino)                              | Strategy to drive investment in a range of services and workflows during the early phases.                                                                                                                                                          | Completed (2019)                                                                                                                                                                                                                                        |
| SSP Urban Greening                                           | CSIRO (Celestino/PCC)                          | A number of solar radiation and temperature sensors installed around existing shade trees at SSP.                                                                                                                                                   | Ongoing data being captured (initial data set limited to solar radiation (Oct 2019 to June 2021).                                                                                                                                                       |
| Interactions between Western Sydney Soils and Recycled Water | WSU (Sydney Water)                             | Assess soil health at sites within the Western Parkland City, including SSP, Penrith Lakes and Picton Farm.<br>Understand soil reaction to three different water types: Rouse Hill recycled water, Picton Water Scheme and Marsden Park Stormwater. | Completed. Results reported in a paper and presentation at Ozwater 2022.                                                                                                                                                                                |
| Air Quality Monitoring system                                | Celestino (CSIRO)                              | Two climate and air quality monitoring sensing stations installed on site to collect baseline data of SSP. Vaisala AQ400, Thomson Eco-measure.                                                                                                      | Data collected and analysed from June 2018-19. Assessed against NSW DPE sites. Good data for Temperature, RH, Windspeed. 5 months of medium quality data for NO <sub>2</sub> , CO and O <sub>3</sub> . Medium quality 1hr and 24 hr PM10 data obtained. |
| Parkland City Arboretum                                      | Sydney Water (Macquarie University/WSU)        | Trial preferred tree species for western Sydney under a range of irrigation (stormwater vs recycled water) conditions and soil amendments to reduce drought stress.                                                                                 | Unable to progress this opportunity due to delays in NSW Government precinct planning for the Aerotropolis. Project was relocated to Mt Annan Botanic Gardens.                                                                                          |
| Moveable Nexus (M-Nex)                                       | Hanze Uni (UTS, Sydney Water)                  | An international project to design urban food-energy-water nexus in a sustainable way.                                                                                                                                                              | Workshop undertaken, however physical implementation could not identify a valid funding source and planning approval an obstacle.                                                                                                                       |
| Circular Economy Procurement for the Construction Industry   | CORE (CSIRO, Celestino, Star Water)            | CRC-P proposal submitted.                                                                                                                                                                                                                           | The CRC-P proposal was unsuccessful for the funding grant.                                                                                                                                                                                              |
| Flexible Solar Cells (vertical blinds)                       | CSIRO                                          | Implementation of novel solar cells into commercial building construction.                                                                                                                                                                          | Project is on hold until construction commences at SSP. Still under consideration for funding once construction commences at SSP                                                                                                                        |
| Urban Typologies and Stormwater Management at Street Scale   | Sydney Water (Celestino, Various Universities) | The proposed implementation of varied street design to test the effectiveness of Wianamatta Street Tree and other variations.                                                                                                                       | EOI to market and progressed through to project planning. Complications with uncertain development approval timelines,                                                                                                                                  |

| Project                          | Lead (Partners)                                    | Concept                                                                                                                                                                                                                                                                                          | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |                                                    |                                                                                                                                                                                                                                                                                                  | scope and shared funding have put the opportunity on hold.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Western Sydney Hydrogen Hub      | UTS (GrapheneX, Providence Asset Group, Celestino) | Prefeasibility study to assess the market opportunity to establish western Sydney's first hydrogen hub at SSP.                                                                                                                                                                                   | Completed. UTS prefeasibility Study report: Western Sydney Hydrogen Hub (WSH2), dated April 2022. Industry roundtable discussion 27 May 2022.                                                                                                                                                                                                                                                                                                                                                                                  |
| Sustainability Strategy          | CSIRO (Celestino)                                  | Develop a sustainability strategy to be used as a guide when developing SSP (and throughout its lifecycle). to guide and improve the delivery of SSP throughout its lifecycle.                                                                                                                   | On-hold until revisioning completed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| STEM Schools Challenge           | Celestino/Association of Independent Schools/CSIRO | The SSP STEM School Challenge has been created to provide Independent, Catholic and Department of Education Sector schools with the opportunity to participate in real Project Based Learning (PBL).                                                                                             | Launched in 2019 to 80 students the program has scaled to reach 1,600 students/year across NSW. The program has aspirations to reach over 8,000 students/year by 2026. The cross-school challenge 2022 (Figure 9) provided an advanced learning experience where students from different schools formed new teams, assign roles, immersed themselves in a place-based social and technical problem, then developed and pitched their solutions. The students met this challenge and produced some inspiring ideas and pitches. |
| SSP Sensor Network               | UTS, OutcomeX                                      | To commence the establishment of sensors within SSP as a first step to developing a comprehensive monitoring network that could be used by Celestino, industry, government and researchers to access live and historical data at SSP during its construction and operation.                      | During 2022 OutcomeX have installed the following sensors onsite: 2 x weather stations, 2 x thermal cameras, 2x soil moisture, 1 x noise sensor (Figure 7).                                                                                                                                                                                                                                                                                                                                                                    |
| Stormwater assessments           | CSIRO (Celestino)                                  | Develop background information on the quantity and quality of water entering and leaving the SSP site. Collection of data commenced with additional sensors installed in 2022 on 2 <sup>nd</sup> order stream inflow, 3 <sup>rd</sup> order inflow and 4 <sup>th</sup> order outflow (Figure 8). | Collection of data commenced with additional sensors installed in 2022 on 2 <sup>nd</sup> order stream inflow, 3 <sup>rd</sup> order inflow and 4 <sup>th</sup> order outflow.                                                                                                                                                                                                                                                                                                                                                 |
| SSP Smart Cities Framework (SSF) | Celestino/CSIRO                                    | The SCF was devised to set SSP objectives and priorities, and to understand these against benchmarks around the world (Figure 6). The SCF takes a systems approach and draws from the work of Giffinger et al. (2007), which was used to rank the Smart Cities maturity of European Cities.      | The SSP-ULL has provided initial shaping of the SCF, incorporating insights from the UN SDG's, ISO37120 sustainable development of communities, Commonwealth National City Performance Indicators, OECD Compact City Indicators and Singapore City Biodiversity Index. SSP-ULL also provided revised                                                                                                                                                                                                                           |

| Project                | Lead (Partners) | Concept                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Status                                                                                                                                                                                                                                                                              |
|------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        |                 | The SSP-ULL has continued to advocate for a clear and consistent vision for SSP. The SCF, a document to guide effective city function, was identified as the key document to help achieve the vision for SSP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | targets and baseline data needs, new targets for Cumberland Plain regeneration and deep soil, utilising digital twins, exploring equitable services and sharing solutions.                                                                                                          |
| Theory of Change (ToC) | CSIRO           | ToC is a logic framework that can assist long term planning and setting of agreed targets and aspirations. Research literature acknowledges that actionable pathways are critical for executing plans at all levels within the 'system' as development proceeds (Mankins and Steele, 2005). It is also known that developments successful in striving towards sustainability outcomes have clear and high aspirations to achieve step changes in outcomes (Young, 2015). Involving both internal and external stakeholders, ToC aims to grow understanding of HOW the vision for SSP can be realised, to test assumptions and ensure all managers and partners have a shared understanding of the critical pathways for non-BAU delivery of key initiatives. | An initial ToC was developed by the SSP-ULL in 2020 based on the SSP Masterplan draft dated 18th July 2019. The proposed use of the Smart Cities Framework as the primary document that contains the vision will be assessed in due course. A ToC workshop is scheduled in Q1 2024. |



Figure 6. Foundations of the SSP Smart Cities Framework.



Figure 7. OutcomeX sensor installations. Left: thermal camera installation, Right: weather station installation.



Figure 8. CSIRO water quantity and quality sensor installations. Left: sensor mounting within culvert (monitoring water flow onto SSP), Right: sensor mounted within the riparian zone, monitoring the third-order stream flow through SSP).



Figure 9. Picture of SSP STEM Challenge cross-schools challenge day finale.

### 5.3 Monitoring, evaluation and learning (MEL) of the SSP-ULL

Regular CSIRO Monitoring, Evaluation and Learning (MEL) reviews have been undertaken to monitor the success, learning and to identify potential improvements that could be implemented by the SSP-ULL. The MEL supports CSIRO's research into 'transforming urban systems'. The MEL research was approved by CSIRO's Social and Interdisciplinary Science Human Research Ethics Committee (#057/20) in accordance with the *National Statement on Ethical Conduct in Human Research* (NHMRC 2007).

The MEL framework for reviewing the SSP-ULL undertakes a series of questions that stakeholders are invited to respond to on an annual basis.

The SSP-ULL formally commenced with the following MEL data collections:

MEL 1: 20<sup>th</sup> May 2020 to 30<sup>th</sup> June 2020

MEL 2: 31<sup>st</sup> May 2021 to 11<sup>th</sup> June 2021

MEL 3: 8<sup>th</sup> Nov 2022 to 12<sup>th</sup> Jan 2023

A summary of MEL data across all three reviews is provided in Table 4.

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Table 4. Summary of key learning from MEL reviews to date.

| ITEM                           | MEL OUTCOME SUMMARY (2020-2023)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Vision</b>                  | SSP-ULL vision validated by the key stakeholders to move beyond business as usual with clear actions and to take a systems perspective in delivering SSP-ULL activities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Trust</b>                   | SSP-ULL stakeholder and partnership relationships continue to be valued and are trusted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Leadership</b>              | <ul style="list-style-type: none"> <li>Resolving perceived probity issues may lead to closer NSW Government collaborations with the SSP-ULL</li> <li>The SSP-ULL approach to urban development has resonated with other stakeholders. There is anecdotal evidence to suggest that the SSP-ULL model is being investigated by other local stakeholders to enable place-based experimentation and learning.</li> <li>Additional effort to further engage with NSW Government Agencies will be of benefit for the SSP-ULL as it has the capacity to act as the 'Beta-test site' for the Western Sydney Aerotropolis. This will enable greater integration across sectors and to share learning and lead the way for broader Western Sydney. This should also create opportunities for surrounding LGA's to get involved.</li> </ul>                                                                                                                                                                                                                                                                                                                       |
| <b>Partnerships</b>            | <ul style="list-style-type: none"> <li>Cross-discipline(sector) projects are important to the success of the SSP-ULL. This includes developing funding models and governance structures to enable more of these collaborations.</li> <li>A more proactive approach to attract industry partnerships in the SSP-ULL should be a priority once development commences on site. This includes seeking broader support across CSIRO's research areas and other Government Agencies to participate in the SSP-ULL.</li> <li>There are strong partnerships among management partners. New partnerships are emerging through project planning and through activities such as the SSP STEM Schools Challenge.</li> <li>Closer engagement between the SSP-ULL with the CSIRO-led Darwin Living Lab will offer more opportunities to share learnings, innovation and explore potential collaborations across the two jurisdictions.</li> <li>Ensuring the SSP-ULL is integrated within the development team and the associated procurement program will be important to test non-BAU innovations at SSP (and understand their commercially viability).</li> </ul> |
| <b>Communication</b>           | <ul style="list-style-type: none"> <li>Internal and external communications regarding the SSP-ULL needs to be continually nurtured and extended to reach a wider audience.</li> <li>Improving the market engagement could improve the potential to secure funding and develop industry partnerships. Further coordination between SSP-ULL management partners in their interactions with potential new partners would create efficiencies and clarity.</li> <li>The extent of awareness of what activities are happening varies. A network should exist across projects to share information and contacts.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Empowering Action</b>       | <ul style="list-style-type: none"> <li>Participants in the SSP-ULL feel they have a role in making western Sydney more liveable, sustainable and resilient.</li> <li>Industry view SSP-ULL as a good model to invest in innovation development and are attracted to the idea of centralised governance to drive collaborative innovation.</li> <li>There is an opportunity to identify projects for the SSP-ULL which are not dependent on the development program of SSP. This will mitigate any project 'holding pattern' if there are any unforeseen delays in the development program.</li> <li>Participants identified that there is a need for more clarity on the role of the SSP-ULL when new partnerships are being developed (e.g. universities, utilities). New partners can be wary of the role of CSIRO and the SSP-ULL with the perception they will be giving away intellectual property. Clearly establishing the role of the SSP-ULL (and value CSIRO adds) in coordinating and delivering research would help to address this concern regarding IP.</li> </ul>                                                                       |
| <b>Learning and Innovation</b> | <ul style="list-style-type: none"> <li>The SSP-ULL has helped to seed innovative approaches and ideas, such as digital twin, assessment of hydrogen economy, SSP STEM Schools Challenge, sensor network, water recycle management, and the SSP Smart City Framework.</li> <li>Further clarity on project formation process, and mechanisms to implement innovation projects through procurement should be considered.</li> <li>Participants noted the SSP-ULL has helped to generate innovative project ideas, but there is need to convert these ideas to funded projects.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                | <ul style="list-style-type: none"> <li>• The SSP-ULL can play a greater role in leading industry forums and discussions.</li> <li>• Using the SSP-ULL brand, could seek to form an Industry Advisory Group (or similar) that can play a role in coordinating forums and developing innovative projects with the SSP-ULL.</li> <li>• SSP-ULL should be the central governance for research and innovation undertaken at SSP.</li> <li>• SSP-ULL needs clear leadership on how researchers (CSIRO and Universities) work together with a clear understanding of what each partner's value contribution is to individual SSP-ULL research projects</li> </ul>                                                                                                                                                                                                  |
| <b>Impact</b>                  | <ul style="list-style-type: none"> <li>• SSP-ULL has been identified as having two main impacts: <ul style="list-style-type: none"> <li>• challenging the development to move beyond business-as-usual and take a systems perspective in delivering approaches that can help achieve the vision for SSP.</li> <li>• Consider the feasibility of how these novel approaches can be delivered.</li> </ul> </li> <li>• There is evidence to suggest that SSP-ULL is accelerating research due to the trust that industry has in the model. This leads to quicker internal approvals and greater certainty that projects can go ahead with purpose.</li> <li>• It has been suggested that the 'brand of SSP-ULL' has influenced NSW Government planning for the aerotropolis core, and that it has been an important part of framing Western Sydney.</li> </ul> |
| <b>Barriers and Challenges</b> | <p>Some external influences that have had an impact on SSP-ULL project activation include:</p> <ul style="list-style-type: none"> <li>- COVID19</li> <li>- Staff turnover and capacity</li> <li>- The NSW Government's Aerotropolis Precinct planning process has impacted on SSP master planning</li> <li>- Lack of clarity on the available sources of government and industry funding to support project activation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                           |

## 6 Future SSP-ULL opportunities

The SSP-ULL continues to focus its efforts on developing initiatives to deliver liveable, sustainable and resilient cities. It continues to learn how to expedite transformation through cross-discipline real-world experiments that accelerate and de-risk innovation.

This includes facilitating collaborations between industry, research and government that seek innovations in the following areas:

- Connection to Country
- Connected interoperable systems and services
- Healthy living
- Urban heat mitigation
- Transport: connected, low emission, active mobility
- Integrated water cycle management
- Energy towards net zero
- Circular economy
- Urban agriculture
- Sharing economy.

The SSP-ULL invites industry, government and university partners to contact us and innovate in these areas.



## 7 References

- Economist Intelligence Unit (2022) <https://www.eiu.com/n/campaigns/global-liveability-index-2022>
- Giffinger R, Fertner C, Kramar H, Kalasek R, Pichler-Milanovic N, Meijers E (2007). Smart cities-ranking of European medium-sized cities. Centre of Regional Science: Vienna University of Technology.
- GISERA (Gas industry social and environmental research alliance) <https://gisera.csiro.au/> accessed Dec 2022.
- Global Footprint Network, Australia has one of the highest ecological footprints per capita <https://data.footprintnetwork.org/> accessed Dec 2022.
- GSC (2018) Greater Sydney region plan – a metropolis of three cities. Greater Sydney Commission. <https://greatercities.au/metropolis-of-three-cities> (accessed 9th Dec 2022).
- Hristov PO, Petrova-Antonova D, Ilieva S, Rizov R (2022) Enabling city digital twins through urban living labs, *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLIII-B1-2022, 151–156, 2022.
- Jazbec, M., Liu, A., Rutovitz, J., Nghiem, L.D. and Turner, A.. 2022 Unlocking the value of food waste: a case study of co-digestion in the Western Parkland City. Report prepared by the Institute for Sustainable Futures, University of Technology Sydney, for NSW Circular & Sydney Water.
- Mankins MC and Steele R (2005) Turning great strategy into great performance. *Harvard Business Review* R0507E.
- NRDC (2021) National Resources Defense Council, USA <https://www.nrdc.org/stories/electric-vehicle-charging-explained> (accessed 25 Aug 2021)
- Quezada, G. and Green, M. (2016) Innovation in Urban Development: A national survey of industry views and experiences. Summary report. CSIRO, Australia. <https://publications.csiro.au/rpr/download?pid=csiro:EP165693&dsid=DS2>
- Quezada G, Green M and Harman B (2016) Urban Edge Partnership – Summary Project Report: Constraints and enablers to innovation in greenfield urban development. CSIRO, Australia. <https://publications.csiro.au/rpr/download?pid=csiro:EP165690&dsid=DS2>
- Quezada, G, Barnett, GB, Muster TH (2023) Transforming cities to meet 21<sup>st</sup> century challenges: insights from new urban developments in Australia (in press).
- Sengers F, Spath P, Raven R (2018) Smart city construction: towards an analytical framework for smart living labs. In: *Urban Living Labs: experimenting with city futures*. Eds. S. Marvin, H. Bulkeley, L. Mai, K. McCormick, Y. Voytenko Palgan. Routledge, NY. 74-88.
- Von Wirth, T., Fuenfschilling, L., Frantzeskaki, N., Coenen, L. (2018) Impacts of urban living labs on sustainability transitions: mechanisms and strategies for systemic change through experimentation. *European Planning Studies*, 27(2), 229-257.
- Voytenko, Y., McCormick, K., Evans, J. (2018) Urban Living Labs: catalysing low carbon and sustainable cities in Europe? In: *Urban Living Labs: experimenting with city futures*. Eds. S. Marvin, H. Bulkeley, L. Mai, K. McCormick, Y. Voytenko Palgan. Routledge, NY. 21-36.
- NSW Western Sydney Planning Partnership (2020) Western Sydney Aerotropolis Plan September 2020.
- Young J (2015) Towards zero energy buildings: lessons learned from the BedZed development. PhD Thesis, University College London. <https://discovery.ucl.ac.uk/id/eprint/1472436/7/Janet%20Young%20UCL%20Thesis.pdf>. REDACTED.pdf (accessed 11 Jan 2023).

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