# CSIRO Submission 19/666

## Infrastructure SA

## 20 Year Infrastructure Strategy Discussion Paper

**July 2019**

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# Introduction

CSIRO welcomes the opportunity to provide input to Infrastructure SA in relation to the 20 year Infrastructure Strategy Discussion Paper available at: https://infrastructure.sa.gov.au/our-work/20-year-strategy/discussion-paper.

The following information highlights relevant research activities being conducted by CSIRO with examples of how science is informing infrastructure development and investment. This submission is framed against the questions posed in the Discussion Paper, covering:

- Examples of systems science and integrated approaches to inform urban development;
- Technology based approaches such as Urban Living Labs;
- Data analytics research to forecast scenarios and to inform investments;
- Research to inform infrastructure developments as well as responses to water availability and extreme scenarios (e.g. floods, bushfires);
- Research to inform investments in the health system;
- Decision support tools to inform strategic planning;
- Science underpinning energy and transport planning.

CSIRO would be happy to provide further information regarding any aspect of this submission.

# Responses to Discussion Paper Questions

## *Population growth challenges*

***What strategies should be adopted to ensure Adelaide maintains its liveability as it grows?***

Applying integrated approaches will be valuable in addressing the complexities of population growth. Science can inform integrated approaches to urban development and help to address challenges which cross institutional, regional and sector boundaries, such as:

- Sustainable climate-ready buildings and infrastructure (providing innovations and business models to deliver sustainable, resilient and cost-effective built assets).
- Future of work, mobility and communities (providing tools and technologies for precincts that are responsible, vibrant, future-proofed, and adaptable).
- Ageing population and intergenerational living (providing novel and effective health and wellbeing solutions that provide community benefits across generations).
- Governance considerations (e.g. cross-institutional learning and sharing; engagement of citizens).

Some examples of relevant CSIRO research are:

- CSIRO is leading Urban Living Labs in Sydney and Darwin, which provide a 'safe space' for collaboration and a testbed for innovation, going beyond business-as-usual and demonstrating the potential of alternative ways of thinking. To maximise learning and opportunities for innovation, CSIRO is developing a portfolio of Urban Living Labs that span a range of urban development types and environmental contexts across the country. Operating as 'innovation zones', Urban Living Labs bring together local community knowledge with trusted scientific expertise to undertake action-based projects that produce information, tools, technologies and processes for more resilient cities. Undertaking research in real-world contexts enables the evaluation of the wider outcomes of the

labs in terms of empowering the community, delivering integration, and monitoring the broader benefits and impacts of the urban innovations tested.

- CSIRO has applied systems approaches to deliver future integrated servicing options which span energy, digital, water, waste, food and health servicing. Outcomes have been delivered to the Consolidated Land and Rail Australia (CLARA) which has involved exploring options for future infrastructure and technology.
- CSIRO is currently running a digital challenge program focused on cities. The vision of the program is to integrate and leverage data to improve efficiencies of service, environment and social sustainability, liveability and prosperity, and to create new services by incorporating novel new data, analytics and cyber security, and developing the concept of the city as a digital marketplace. To this end there are projects that are relevant for infrastructure planning, including:
    - Population and movement: to increase temporal and spatial understanding and more accurately estimate and predict population and its movement for improving city services and planning decisions supporting (for example) housing demand, consumption, infrastructure requirements and labour supply.
    - Assessing inter and intracity resilience: this seeks an improved understanding of resilience to allow comparing of cities and their inter-city dependencies. This will allow better definition around the type of support, investments or development activities that may be appropriate to mitigate risks and increase their adaptive capacity. It could also be used to highlight positive examples of resilient cities where further investigation is warranted to determine what lessons can be learnt. The new data sources used to support the measures will have uses in other socio-ecological systems. Importantly, the resilience indicators will have strong theoretical underpinnings, making them more robust than many of the current urban indicator systems, which lack the urban systems conceptualisation.
- CSIRO also has developed an integrated modelling platform (Australian National Outlook) that can run scenarios for how population growth intersects across all sectors and allows for testing policy levers for optimising triple bottom-line outcomes.

## *Our Place*

***How can infrastructure provide resilience against, bushfires, drought, flooding, sea level rises and the like?***

CSIRO has been working with South Australian Government to undertake water assessments that quantify drought and flooding regimes under historical climate and the likely changes we will see under future climate scenarios. CSIRO is also a key partner in the Goyder Institute for Water Research which brings together South Australia's leading water research capabilities through collaboration with the South Australian Government, Flinders University, the University of Adelaide, UniSA and the International Centre of Excellence in Water Resources Management (ICE WaRM). The climate resilience, adaptation and mitigation research undertaken by CSIRO and partners is focusing on developing strategies to build system resilience against these threats by putting in place appropriate infrastructure across the state. Examples of these include construction of levees and embankments along the low lying floodplain areas to protect against increasing flood risk under future climate, conserving water and improving on farm efficiency to build resilience against droughts, putting in appropriate transport infrastructure for assisting evacuation during bushfires as well as guidelines for powerline bushfire safety, bushfire and flood warning systems to provide advanced warnings, and construction of sea walls/barriers to protect against sea level rise and storm surges.

Flash flooding and coastal inundation due to extreme rainfall and storm surge is a major economic and social challenge. CSIRO and partners have a full suite of analysis and computer modelling tools that have been used many times in other states to inform infrastructure decisions (such as backflow valve placement, retention system capacity, artificial wetlands design) around flood and inundation for current and future scenarios: e.g., Elwood VIC, Bunbury WA, Townsville QLD and Surf Coast VIC. These have also been applied with partners internationally.

CSIRO's bushfire expertise, particularly regarding fires caused by electricity networks, has been applied in major studies of powerline bushfire safety in SA, WA, NSW, Chile and Victoria: the latter including being the analytics partner to the Victorian State Government for many years as part of the Powerline Bushfire Safety Program. Analytics-informed targeting of investment in fire mitigations have delivered benefits in other states.

Additionally, the study of road infrastructure capacity for evacuation, in combination with fire and flood warning systems, has been a major focus in Victoria and NSW in order to inform policy and infrastructure change in those states. CSIRO, RMIT and commercial partners have delivered the simulation-based geospatial and traffic analysis to those state government stakeholders for several years.

Other examples of CSIRO research that are informing government's consideration of climate and disaster risk include:

- Climate Risk Information and Services Platform (CRISP): The CRISP prototype project was a one year exploration of the policy and technological feasibility of making climate risk information more accessible, relevant and useable to decision-makers on a web-based platform. The first phase of the project provided a core case study of the assessment process undertaken for large infrastructure projects by Infrastructure Australia. The prototype phase 1 of CRISP has advanced understanding of the desirability and feasibility of creating a platform, which went beyond the existing plethora of approaches, tools and websites that provide access to or analyse data, to be capable of delivering data and process guidance into existing workflows. Ancillary benefits to the comprehensive engagement included widespread awareness-raising of the issues associated with climate risk, and the development of a structured approach to applying climate risk data to policy decisions which was fleshed out in one domain (infrastructure). At the end of Phase 1, there is now an opportunity for continuing the development of CRISP towards a more sustained operational system. Further information is available at: http://www.crisp.csiro.au/
- Australian Vulnerability Profile: CSIRO has provided a report to the Department of Home Affairs on climate and disaster risks: what they are, why they matter and how to consider them in decision making. This project, using a structured process, explored the systemic risks, root causes, and interacting and cascading impacts of catastrophic disaster to explore how to move from vulnerability to resilience. The project sought to answer two questions: what makes Australia vulnerable to disaster, what do we value, and what do we stand to lose? Further information is available at: https://research.csiro.au/eap/australian-vulnerability-profile/

## *Our Regions*

***What strategies should the Government adopt to ensure the necessary infrastructure is in place so our regions can thrive?***

Gas supplies: Through the CSIRO Gas Industry Social and Environmental Research Alliance (GISERA), CSIRO is conducting a study on "Assessing the value of locally produced conventional gas in South Eastern South Australia" which includes consideration of issues related to gas supply in the region. Currently pipeline infrastructure to deliver gas to manufacturing businesses in South Eastern South Australia is limited and there is a lack of competition for gas supply, which puts upward pressure on gas supply charges for

manufacturing businesses in and around Mt Gambier. Options to increase competition could include new pipelines or policies to increase competition within existing pipeline infrastructure. Consideration of these issues is particularly relevant given the SA Plan for Accelerating Exploration (PACE) Program to increase gas supply in the region, and the CSIRO GISERA project will help to address questions such as to what extent is it possible to supply gas more competitively in South East South Australia and what are the obstacles (e.g. current pipeline configuration). Further information about the CSIRO GISERA project is available at: https://gisera.csiro.au/project/assessing-the-value-of-locally-produced-conventional-gas-in-sas-south-east/ . The CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA) is a collaboration between CSIRO, Commonwealth and state governments (including the Government of South Australia) and industry established to undertake publicly-reported independent research. Further information about GISERA is available at: https://gisera.csiro.au/

CSIRO is also partnering with Geoscience Australia, The Department of Environment and Energy and the Bureau of Meteorology, to undertake the Geological and Bioregional Assessment Program investigating shale and tight gas prospectivity and impacts in the Cooper Basin that lies across the SA-Queensland border. The aim of the program is to bring new shale and tight gas resources to the East Coast Gas Market in 5-10 years, through providing an improved understanding of the potential impacts on water and the environment, and to increase the efficiency of assessment and regulation.

Waste management: With an increase in population and development activities, there will also be a corresponding increase in waste production, including municipal waste, wastewaters and organic waste. Growth in the generation of waste will provide opportunities for further development of waste management as well as proper management to offset environmental impacts. For example, resource recovery presents opportunities for other industries, such as primary production (e.g. wastewater irrigation schemes) and increased diversion of organic wastes and sludges (or biosolids) for beneficial reuse to land. However, increasing diversion of wastes for beneficial reuse would need to be done in a sustainable manner that does not affect human health and the environment. CSIRO is currently working with various agencies, including the SA EPA, to help ensure that waste management (including of municipal and organic wastes) can continue developing sustainably into the future.

## *Cross-sectoral considerations: a systems approach*

***What factors should be considered when making inevitable trade-offs about investment in public infrastructure in the context of funding constraints? How can we best plan and accommodate the infrastructure needed to create vibrant and economically productive precincts? How can South Australia better manage demand on current infrastructure? What opportunities are there to better leverage private investment to drive public infrastructure development?***

CSIRO's Future Scenarios for Cities work can support improved strategic planning given an uncertain future, and this work has been delivered to a range of jurisdictions in Australia. The approach involves developing a set of forward projections against population growth, climate, infrastructure, technology scenarios. This can then be used as a cross-agency collaboration platform to support strategic planning. A summary of some of this work can be found at: https://www.sciencedirect.com/science/article/pii/S0959378017309536.

CSIRO has developed approaches that emphasise the importance of people, community and institutions to deliver systems outcomes, for example the Resilience, Adaptation Pathways and Transformation Assessment (RAPTA) Framework can help project designers and planners build the ideas of resilience, adaptation and transformation into sustainable development projects from the start. This will help to ensure outcomes that are practicable, valuable and sustainable through time and change. The approach has been developed to address challenges of the future security of agriculture and the world food supply but applies equally well to planning for climate change adaptation, urban development, disaster

management, conservation and other fields. This approach supports the design of actions which can help to guide linked social and ecological systems into the future, informed by sound science, underpinned by a structured learning process to gather and analyse evidence, followed by continual adjustment of actions based on what has been learned. Further information is available here: https://research.csiro.au/eap/rapta/

## *Infrastructure Sector Considerations*

***Health - What complementary infrastructure can be built to support better health outcomes across the population?***

CSIRO has undertaken a highly consultative process to develop a Future of Health report which aims to shape future investments in the health system. Specifically, by providing an industry informed vision for how Australia's health sector can shift from a focus around illness treatment to one of health and wellbeing management over the next 15 years. While the health sector will always be required to deliver a degree of illness treatment, improvements to health outcomes can arise through a shift in focus towards cost-effective and evidence-backed preventative, precision-based, and digitally enabled health and wellbeing solutions.

Long-term and multifaceted planning around behavioural change and policies that target holistic health and wellbeing management can help enable the shift. Digital technologies could assist many of the necessary changes – complementing the role of health professionals and providing consumers with greater autonomy in their health and wellbeing management. Many of the digital platforms and tools required already exist but are not heavily utilised. The sector will need to consider how to facilitate greater uptake of novel and effective health solutions; how to provide health professionals and organisations with the necessary support required to successfully navigate change; what system changes are required to securely unlock value from the growing volume of personal health information; and how to divest away from obsolete or lower value health solutions.

Balancing these efforts with the continued need for face-to-face interactions and humanity in health will help to ensure Australians receive the most suitable care for their situation. With clinical care only accounting for 20% of the factors influencing an individual's length and quality of life, focussing on the remaining 80% – the role that healthy behaviours, social and economic support, and the physical environment play in impacting health outcomes – is critical.

Based on extensive desktop research and stakeholder consultation, enabling themes and actions were identified to achieve the shift towards precision, preventative, and holistic health and wellbeing management (Table 1).

**Table 1: Enabling themes and actions for Australia's health system shift**

| Theme | Enabler | Summary of potential enabling actions |
|---|---|---|
| Empowering consumers | Addressing information asymmetry | Develop robust consumer rating tools, symptom checker applications (apps), and publicly available information sources for market rates of common health services. |
| | Expanding telehealth services and improving | Encourage the provision of telehealth services across additional health service types and regions, ensure new mobile health (mHealth) offerings pair output and |

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| | consumer controlled devices | interpretation with actionable recommendations, and incentivise the uptake of in-home and wearable technology to support preventative behaviours. |
| Addressing health inequity | Providing community-tailored solutions for digital and health literacy | Develop tools and initiatives that target health issues faced by Australians experiencing inequitable health outcomes, including community-tailored early childhood education programs, improved access to healthy foods, and incentives for engagement in personal health and wellbeing. |
| | Maintaining and strengthening Aboriginal and Torres Strait Islander health | Co-create health and wellbeing solutions by bringing together industry and research with key Aboriginal and Torres Strait Islander influencers in the region to develop health initiatives that consider the diverse demographics and population attributes of each community. |
| Unlocking the value of digitised data | Facilitating electronic health record (EHR) engagement | Ensure EHRs involve clear value communication, are easy to use, have Key Performance Indicators (KPI) around usage, are securely interconnected (within the health sector as well as other related sectors), and are accompanied by education and training programs. |
| | Ensuring interoperability | Invest in digital infrastructure and ensure Australian representation in international discussions around the global harmonisation of interoperability standards. |
| | Creating trust in digital tools | Improve healthcare networks and infrastructure such that all new systems and upgrades are secure by design, improve communication to all stakeholders around how data will be handled, and ensure data sharing guidelines account for ethical and cultural diversity. |
| Supporting integrated and precision health solutions | Accelerating the move to integrated care | Improve the stratification and triage of consumers, expand the number of integrated care sites, encourage the sharing of infrastructure, and develop consortiums to tackle issues around data management and easing the consumer journey. |
| | Moving to models of value-based care | Improve understanding of clinical variation to more effectively implement outcomes-based funding models, which include the incorporation of patient-reported experiences and outcomes that can be shared through a national outcomes database. |
| | Improving the quality of predictive analytics | Invest in diagnostic and health management tools that integrate medical data with data from an individual's environment, lifestyle, and internal biology. Ethical |

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| | | implications of increased predictive capabilities must also be considered. |
| | Preparing the future health professional | Shift education and training focus away from detailed textbook knowledge and towards learning from new and high quality evidence, digital health literacy, interpersonal skills, and a greater understanding of equity, diversity, population health, and ethics. |
| Integrating with the global sector | Improving international collaboration | Identify areas of competitive strength for investment and pursuit of global excellence, enhance national coordination, and collaborate with global technology companies and international research groups. |
| | Improving pathways to market for novel health management solutions | Explore more efficient ways of conducting clinical trials and develop partnerships between research, industry, and regulators that help inform regulators early of complex emerging health solutions and to test regulatory classifications and pathways for new technologies. |

***Utilities - What options are there to establish a reliable, decarbonised energy system that presents export opportunities?***

CSIRO has been working with SA Power Networks (SAPN) to improve our understanding of the infrastructure needs for rooftop solar, household batteries, electric vehicles and other forms of smart device or controllable load. This work will help inform how challenges associated with rooftop solar are overcome to ensure stability and better management of the growth in distributed energy resources.

Additionally, CSIRO and partners compiled the National Hydrogen Roadmap (https://www.csiro.au/en/Do-business/Futures/Reports/Hydrogen-Roadmap), which aims to provide a blueprint for the development of a hydrogen industry in Australia. With a number of activities already underway, it is designed to help inform the next series of investments amongst various stakeholder groups (e.g. industry, government and research) so that the industry can continue to scale in a coordinated manner. The Roadmap identified a number of areas in which Australia could consider hydrogen and hydrogen-related technology. Applications and areas of opportunity for Australia could include: remote area power supplies; transport (both heavy and light vehicles); hydrogen enriched natural gas; hydrogen for green chemical production (in particular ammonia); and hydrogen export. In terms of infrastructure requirements in the near to medium term South Australia would need to establish hydrogen distribution networks (pipeline or road transport), establish refuelling infrastructure, offer stable and clear position on the vol% of hydrogen gas that may be injected into the natural gas network, look at methods of reducing the cost of hydrogen for green chemical production, and attract commercial partners for construction of a suitable export terminal for export of hydrogen or its carriers.

***Transport - How can South Australia take the lead on reducing emissions from transport?***

CSIRO has developed the Transport Network Strategic Investment Tool (TraNSIT) that maps and optimises every supply chain from production to markets or ports. It takes into account all of the road and rail features, from origin to destination, to estimate the cost of transport to move each commodity by supply chain path. By scaling up across all supply chains, it provides freight map for the country, state or region, and can be used to test the sensitivity of a wide range of transport related infrastructure upgrades. TraNSIT

includes the entire road and rail network for Australia, and has mapped all primary production supply chains within South Australia, and between South Australia and the other states. It is based on a wide range of industry data, and TraNSIT now covers over 550,000 supply chains over 85+ commodities. The construction of TraNSIT for South Australian supply chains was done in part with the support of the South Australian Government and major industries operating in the state. It is currently being used to inform road and rail infrastructure investments in South Australia, through a project around the Limestone Coast.

***Future considerations – SA's future infrastructure needs may be impacted by evolving requirements to support the rapid growth of the Space sector***

CSIRO is working closely with the Australian Space Agency to help deliver their goal of tripling the size of the Australian space industry by 2030.
CSIRO has proven capabilities to develop, advance and grow the space sector:

- Space science and astronomy
- Space communications
- Space engineering and technologies
- Satellite operations and data applications
- Space education and outreach
- Commercialisation and space industry development.

CSIRO developed a national space industry roadmap, which was released on 24 September 2018. It is available online from: https://www.csiro.au/en/Do-business/Futures/Reports/Space-Roadmap

Alongside this, CSIRO has capabilities in research areas that can support Australia's space activities, such as:

- Robotics
- Data analytics
- Advanced manufacturing
- Energy
- Mineral resources, agricultural production systems, and oceanic research
- Health and biosecurity.

CSIRO has established a Future Science Platform which will build expertise and technologies in these areas and others, helping to grow Australia's space industry and identifying niche areas for world-leading Australian capability.

Globally CSIRO has strong and ongoing relationships with a range of international space agencies, and research organisations undertaking space related activities including NASA, ESA, DLR, JAXA, and CNES, and in the UK, CSIRO currently has a 10% stake in the NovaSAR satellite built by SSTL and is a collaborative partner in the CEOS OpenDataCube.

# Closing Remarks

CSIRO appreciates the opportunity to comment on the formation of a plan that will be instrumental in the future liveability of Adelaide and South Australia. Commentary provided here has briefly summarised how science is informing infrastructure development and investment in the context of the themes raised in the Discussion Paper. However, breadth of CSIRO capabilities extend beyond those discussed here.
CSIRO is committed to working with the State Government and in May this year signed a Strategic Relationship Agreement (SRA) with the government of South Australia. CSIRO is happy to provide further information and investigate collaborative opportunities with ISA and related agencies. In the first instance please contact Sarah Mortellaro who is the dedicated South Australian Government Relationship Manager based in Adelaide.