AURIN's response to the National Urban Policy consultation paper

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Introduction

The Australian Urban Research Infrastructure Network (AURIN) welcomes the opportunity to provide feedback on the draft National Urban Policy for Australia. The document outlines the Australian Government's Vision, Goals, Objectives and Principles supporting the sustainable growth of our cities and suburbs. The draft policy aligns with the United Nations Sustainable Development Goal (SDG) 11: sustainable cities and communities. It also addresses aspects of SDG 3: good health and wellbeing, SDG 9: industry, innovation and infrastructure, as well as SDG 13: climate action.

AURIN is a National Digital Research Infrastructure (NDRI) facility, hosted by the University of Melbourne and funded by the Department of Education through the National Collaborative Research Infrastructure Strategy (NCRIS). A product-focused and impact-driven national facility, AURIN engages with Government and industry sectors to support academic innovation and research translation addressing key challenges for Australia: the impact of climate change, energy transition and demographic transformation on our cities, regional communities and infrastructure systems (see AURIN Strategy 2023-28).

DITRDCA is to be commended for coordinating such an important piece of work, reestablishing credentials of the Commonwealth in a policy space left mostly to the States over nearly a decade. We also salute the creation of the Urban Policy Forum, bringing much needed diversity and expertise about extremely complex and highly dynamic urban systems. We hope that the process leading to the final version of the National Urban Policy will pave the way for better coordination between the three tiers of government and greater engagement with communities who live, work and shape our cities.

Although the five goals (liveable, equitable, productive, sustainable and resilient urban places) correspond to well-established, contrasted and complementary dimensions used to analyse cities, the six objectives constitute a slightly uneven bunch. Objectives 1, 4, 5 and 6 are well-defined and focused. Each aspect of the objective relates to another and there is a plausible pathway to achieve the objective. Conversely, objectives 2 and 3 bring together aspects that can hardly relate to each other. For example, objective 2 brings together crime prevention and climate resilience under the same banner. Pathways to achievement are utterly different and will compete for resources.

The latter point brings us to the crucial issue of prioritisation. Such a broad set of objectives with competing needs, contrasted scales of intervention and varying implementation timelines will need arbitration in a context of limited resources. The nature of this visionary document prevents its content to dive into the weeds of implementation. However, the excellent list of principles (Appendix A) could include a section about prioritisation.

Embracing Digital Technologies and Data

As a National Digital Research Infrastructure, AURIN is well placed to embrace and harness innovative research, technology and data to underpin the goals of the National Urban Policy. As highlighted in Principle 6 (Appendix A, p 43), AURIN looks forward to the opportunity to embrace digital city technologies and innovation to assist government and industry to improve urban and regional efficiency, enhance services, and address contemporary challenges, including building and supporting digital research infrastructure to enable data-driven decision-making, and technology solutions that contribute to sustainable urban development and productivity.

When implementing the National Urban Policy, the Commonwealth should seek to create more opportunities to harness investments made in research and to translate that investment into real world impact through the development of new or enhanced urban and regional digital technologies and data solutions.

Improving the evidence base

AURIN also supports Principle 4 (Appendix A, p 42): "Improving the evidence base will underpin urban innovation". There is indeed an urgent need to monitor changes in cities and provide the evidence to inform future improvements and drive innovation. Evidence exists, data is abundant (if not redundant); however, data is too often locked into private or public silos, lack of monitoring standards limit data discoverability and exchange, lack interoperability between urban analytics platforms limit modularity and reusability. With the rise of so-called Urban Digital Twins (UDTs), these limitations create wasteful duplications, high transaction costs and missed opportunities for Australia to become a powerhouse in urban analytics, alongside Singapore and its Cooling Singapore 2.0 program, supported by the Digital Urban Climate Twin collaborative platform (see Cooling Singapore 2.0).

In a book chapter soon to be published, two former AURIN directors, Prof Stuart Barr and Prof Peter Newton, alongside Prof Chris Pettit (UNSW) and Dr Loren Bruns Jr (AURIN, Head of Engineering) describe frontiers in urban analytics needed to effectively inform evidence-based policies for more sustainable cities (see Appendix A):

"*The extent to which an urban-sustainability transition can be realised more rapidly will depend on the speed with which digital transformation and sustainability transformation can merge into one coherent process of change.*"

A well-coordinated national initiative, based on the concepts proposed by the authors would support key elements listed under Principle 4, namely: place-based approach to collecting and sharing evidence, consistent monitoring of policy implementation, and rigorous evaluation of intervention outcomes.

Sustainable and resilient urban areas

AURIN is well-placed and willing to coordinate such an initiative, collaborating with government, industry and academia to deliver a long-term, cost-effective and fit-for-purpose solution to support the National Urban Policy. We are already making progress towards this objective by proposing, in collaboration with ACCESS-NRI (another NCRIS-funded facility), the creation of an Australian Urban Climate Research Initiative (AUCRI). AUCRI aims to federate all relevant organisations (public or private) to address two complementary challenges:

1. Downscaling and enriching regional climate models to a relevant scale in order to inform effective urban policies and interventions aimed at mitigating the effects climate change on cities, regional centres and local communities.

2. Establishing a robust urban analytics workbench to assess the potential effect of (large) urban areas on regional climate and its variations.

The latter point has been a weakness of all global and regional climate models for over three decades: against growing anecdotal evidence, cities aren't yet considered in atmospheric processes (see Yang et al., 2022). Appendix B provides an overview of AUCRI's rational and objectives. When AUCRI is successfully established, it will provide invaluable evidence to inform progress towards safer and more sustainable urban areas, as well as healthier communities.

Inclusive and equitable urban areas

We also commend the Australian Government for their unequivocal stand on 'no one left behind' and 'all people belong' objectives. Here again, our ability to enforce all the elements of Principle 4 will influence our capacity to adequately monitor progress towards policy targets. In its *Decadal Plan for Social Science Research Infrastructure 2024-33*, the Academy of Social Sciences in Australia (ASSA) calls for: (1) a coordinated Australian Research Infrastructure Ecosystem for the Social Sciences (ARIESS), (2) nationwide accessible and reusable social sciences data, and (3) robust investments in research capabilities and infrastructure (see Decadal Plan 2024-33).

AURIN is also making significant investment in that space with the recent announcement of the Housing Analytics Lab (HAL), hosted by the City Futures Research Centre (UNSW) and supported by Housing Australia and key industry partners such as Pexa, Commonwealth Bank and Mirvac. AURIN and the Office of Chief Scientist NSW will both contribute to the establishment of HAL over the next two years (see HAL).

Conclusion

The National Urban Policy is a welcomed and timely move into a space that has been left for nearly a decade to the vagaries of jurisdictional interpretations, resource allocations and political framing. The housing and climate crises affect people and businesses, regardless of the State they live in. Energy transition and demographic transformation need to be delt with in a nationally coordinated, cost-effective and equitable way.

AURIN acknowledges the immense effort that is required to achieve the objectives listed in the National Urban Policy. In a context of limited resources, such an ambitious agenda needs to be supported and informed by a comprehensive and coherent monitoring framework to assess, predict and evaluate interventions associated with each objective.

AURIN is the only NCRIS-funded National Digital Research Infrastructure facility that focuses on cities, regional centres and infrastructure systems. We are ready to serve the Australian Government through our extensive network of partners in industry, government and academia, with data acquisition, data sharing and analytical products.

Appendix A – Extract book chapter (in press) by Newton P., Pettit C., Barr S. and Bruns Jr L.

"*The extent to which an urban-sustainability transition can be realised more rapidly will depend on the speed with which digital transformation and sustainability transformation can merge into one coherent process of change. The critical connections between the two are briefly outlined below as a prelude to a more focused discussion of the key digital domains capable of accelerating sustainable development:*

*1. **Stakeholder collaboration and engagement**. Capacity to more effectively assemble representatives for more-collaborative "joined up", top-down and bottom-up decision-making is central to successful urban development projects, whether at neighbourhood or metropolitan scale. [...] Providing an arena for both face-to-face and virtual input (for example, from geographically remote experts) represents a new mode of urban governance capable of greater alignment of multi-actor intentions and practices associated with city greening and re-urbanisation.*

*2. **Urban data**. There is an exponential explosion of economic, social, and environmental data – the triple bottom line of the domains of sustainable development. The complexity of urban and environmental systems requires assembling multiple indicators for analysis, an area where considerable time is lost in accessing and harmonising data for evidence-based discussion and decision-making. Pathways for accelerating the emergence of a data commons covering built, environmental, and population data from both public and private sectors are also key to sustainable development.*

*3. **Urban analytics**, digital infrastructure platforms and integrated sustainability assessment. The UN 2030 Agenda for Sustainable Development highlights the fact that all 17 Sustainable Development Goals are integrated, and that these interlinkages need to underpin analyses that guide planning frameworks, strategies, and plans. The level of integration needs to incorporate multi-criteria, multi-scale, and multi-stakeholder connections, embodying key trade-offs that are a common feature in urban decision-making.*

[...] For this approach to gain traction requires three components to be prototyped and made available at scale, and to have their usage championed by a national research-infrastructure facility:

*• a standard **Urban Analytics Container** format that defines how urban analytics should be containerised,*

*• an open **Urban Analytics Exchange** that provides access to uploaded containers on a cloud-based platform – hosted on a national research infrastructure – and makes them findable and accessible following the FAIR Principles for Research Software (FAIR4RS Principles; see Hong, 2022), and*

*• an **Urban Analytics Engine** that can execute the analytics within these containers on demand and at scale on cloud-based computational infrastructure, providing Urban Analytics as a Service (UAaaS) to both individual researchers and large, persistent decision-support platforms through a common API following modern software-architecture best practices*."

Appendix B - Australian Urban Climate Research Initiative (AUCRI)

Consultation

This draft document was prepared after consultation with the following organisations: ACCESS-NRI (A. Hogg), ARDC (R. Hicks), PHRN (M. Smith), ARC-CoE Climate Extremes (A. Pitman), UNSW-City Futures Research Centre (C. Pettit), QCIF (S. Jayasinghe), UQ-Research Infrastructure (P. Bonnington), UoM-Systems Innovation (L. Sonenberg), RMIT-Information Systems and Engineering (M. Duckham), SWINBURNE-Centre for Urban Futures (A. Nygaard), and UTS-Institute for Sustainable Futures (D. Giurco).

The above discussions were only meant to inform this draft proposal. Although some individuals or organisations have already expressed interest in supporting the initiative, overall, these consultations shouldn't be currently interpreted as formal endorsements of a future proposal. In coming months and weeks, other key institutions will be approached, such as DCCEEW, DITRDCA, CSIRO, Australian Bureau of Meteorology, Geoscience Australia, Australian Climate Services and more research groups around the Country.

We thought it was a good time to inform the Department of Education, ahead of next month's NCRIS National Forum and forthcoming ICRI 2024 conference. We'd appreciate any constructive feedback and suggestions.

This document was prepared in close collaboration with Dr N. Nazarian, leader of the Climate Resilient Cities Lab (UNSW) and Board member of the International Association for Urban Climate.

Challenge

A recent report (KPMG, 2024) estimates that ten million Australians live in areas of very high to hazardous heat risk. Heat waves already cause 3,000 deaths per year and rising temperatures will cost Australia AU$ 19 billion by 2030 in lost agricultural and labour productivity. AdaptNSW (2024) estimates that: "on average, flooding costs the NSW economy around $250 million per year. Storms and floods cause direct damage to property and infrastructure, such as roads and services. They also affect the health and wellbeing of NSW communities by causing emotional distress, injury and loss of life". Climate change is expected to make storm and flood events more severe.

86% of the Australian population live in cities and this percentage continues to increase. Urban areas represent one of the most extreme cases of human modification to natural landscapes. Consequences of extreme events such heat waves, flooding, air pollution peaks and bushfires are exacerbated in urban environments. Climate change will increase their frequency and severity.

Most recent scientific evidence shows that under a high-emissions scenario, many cities are estimated to experience substantial warming of more than 4°C, larger than regional warming by the end of the century. Consequently, relying solely on current global projections proves insufficient for accurately evaluating climate-driven risks to urban populations, and effectively inform relevant policies and interventions.

Urban areas are also significant sources of anthropogenic emissions. However, they are frequently overlooked in both global and regional climate analyses. The assumption under which urban areas don't influence significantly regional climate needs to be properly tested, especially for capital cities with large footprints as climate change will compound and accelerate their eventual contributions. This oversight not only undermines the accuracy of current climate

assessments but also limits our ability to develop effective strategies for climate adaptation and mitigation.

Worldwide, a growing number of experts call for an immediate and coordinated effort to address our knowledge gap, build the evidence, inform current and future policies to combat the effects of climate change in cities. Thanks to its existing research capabilities and national research infrastructure, Australia is well placed to make significant contributions towards addressing the issue and becoming an international leader in the field.

Objective

To address the challenge, the Australian Urban Climate Initiative (AUCRI) aims to leverage existing capabilities and coordinate a national initiative that will provide:

• A coherent urban monitoring system in major cities and regional centres. A significant amount of data is already collected around the country. AUCRI will ensure that current sensing networks are adequately supported for long-term monitoring and contribute to additional capabilities wherever needed. ARDC (NAPMD database) and AURIN (NAQD database) are already supporting the creation and maintenance of national air quality database for research purposes.

• A scalable digital research infrastructure that will allow for seamless data exchange and long-term storage, and support effective model orchestration. AUCRI will support a cloud-based, Terraform-compliant and REST-API-driven architecture, based on current developments led by AURIN, ARDC and their industry partners.

• A modular model orchestration, based on Docker-created and Kubernetes-managed containers. This digital organisation will allow for complex modelling workflows associating interdependent tools such as: Atmosphere–Biosphere exchange model, urban canopy model, urban canyon model and heat vulnerability model. ACCESS-NRI has already developed foundational tools that AUCRI will leverage.

AUCRI will provide Australia with a unique National Digital Research Infrastructure, able to (1) assess the impact of climate change on urban areas at a scale commensurate with climate adaptation policies and interventions, and (2) estimate the relative impact of urban areas on regional climate models. The first outcome will deliver crucial benefits to urban planning, population health and settlement strategies in Australia. The second outcome will give Australia an international scientific leadership with a unique monitoring and modelling workbench.

Rationale

To achieve the objective, it is imperative to integrate urban physics into the Australian climate model across various scales. This entails developing modelling techniques that can resolve urban features and inform high-resolution simulations tailored to different climate-related hazards in Australia. The models should also incorporate detailed urban data to accurately capture the distinct characteristics of urban landscapes, and their eventual impact on regional weather and climate.

First, as models (both globally and within ACCESS) reach higher resolutions, neglecting cities and their diverse land cover becomes increasingly problematic. While at 25km resolution, focus on large-scale processes might justify this omission, significant biases emerge at finer resolutions, underscoring the need for attention to urban impacts. Second, recent research reveals that cities have feedback on regional climates and extreme events beyond their physical boundaries. Urbanisation exacerbates heat waves, alters the water cycle, and generates increased precipitation over and downwind of cities. These regional effects, on par with those of non-urban

land covers, underscore cities' role in exacerbating climate hazards beyond our current understanding.

So far, the Australian Bureau of Meteorology uses climate prediction models with 12.5 km resolution (ACCESS-G) and 25 km resolution (ACCESS-S), whereby a single 'tile' simulates atmospheric exchanges above urban areas, including large cities such as Sydney or Brisbane. In such a coarse approach, an urban area resembles a concrete slab, thus failing to capture the intricacies of urban landscapes.

The AUS2200 initiative, supported by ACCESS-NRI, aims to enhance regional modelling at higher resolution (2.2 km). This is an adequate stepping stone to start integrating urban features and dynamics. At that scale, it becomes essential to capture the spatial variability of urban forms, anthropogenic activities, open spaces and green infrastructure in order to understand better the impact of climate extremes and inform future adaptation strategies. Conversely, at that scale, it becomes more realistic to estimate the endogenic effect of urban areas on regional climate.

Within the ACCESS modelling framework, the Community Atmosphere–Biosphere Land Exchange model (CABLE) serves as a critical tool, calculating the fluxes of momentum, energy, water, and carbon between the land surface and the atmosphere. However, a significant gap exists as the CABLE model treats impervious urban surfaces as bare soil. As ACCESS simulations transition to higher resolutions, this oversight becomes increasingly problematic, necessitating urgent attention to incorporate urban canopy models (UCMs).

UCMs can parameterize the interactions between the urbanised surface and the atmosphere above in land-atmosphere components and are able to ingest realistic datasets of land cover variation in cities. With urban land cover and morphology datasets becoming more accessible, the implementation of urban models is imminent and has been shown to significantly improve the accuracy of surface fluxes, as seen in the latent heat flux predictions in JULES (the Joint UK Land Environment Simulator). It is urgent to undertake the equivalent work with CABLE.

AUCRI will address this gap by developing scale-dependent urban canopy models in CABLE and further integrating urban data inputs developed for JULES. This includes investigating the model capability development to a) effectively characterise surface fluxes from urban land covers and b) represent in-canopy parameters (such as air temperature and wind speed) that are needed for assessing urban climate challenges. Leveraging detailed urban morphology datasets facilitated by AURIN and ARDC, as well as advancements in model development based on physical processes and machine learning approaches, this project will enable Australia to accurately represent the vulnerability of urban areas to climate extremes and their eventual impact on regional climate.

A crucial aspect of urban climate research is to anticipate the exposure and vulnerability of local communities and infrastructure assets to extreme events such as heat waves, floods or pollution peaks. AUCRI intends to leverage recent work supported by ARDC, PHRN and AURIN and bring population health data and models into the overall framework, including secure handling of highly sensitive data.