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RESEARCH ARTICLE

Towards transformative climate actions in landscape architecture

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Abstract

Context Transformative actions are required in the built environment if we are to avoid breaching planetary boundaries. To do so, climate actions within cities need to be coordinated across both adaptation and mitigation, and across knowledge boundaries. Landscape architects are well-positioned to drive climate actions through strong ecological underpinnings and creative design thinking. However, their capacity to support transformative climate actions is relatively unknown.

Objectives The aim of this study is to identify actions that current landscape architects are taking to mitigate climate change, and to adapt to climate impacts. It examines whether these actions are in line with what's required for transformative climate actions.

Methods Semi-structured interviews were undertaken with 24 landscape practitioners across Australia, covering different states, practice types and sizes. An analytical framework based on theories of transformative change and boundary work was adopted to scrutinise actions taken in current practice against three categories: *Practical, political* and *personal*.

Results The findings show that in Australia, while actions taken in current practice are increasingly informed by climate change risks and focused on adaptation, transformative actions for mitigating climate change are not sufficiently considered. Results show that complementary to technical design skills for climate actions, skills such as negotiation, coordination and entrepreneurship are necessary to help practitioners act as boundary spanners and change makers across multiple dimensions of transformation, especially the political and social spheres.

Conclusions In transitioning to a positive climate future, landscape architects can connect and span different knowledge areas, but their agency and impact should expand beyond individual projects. This requires practitioners to question the *status quo*, negotiate for positive climate outcomes, and in coordination with allied built environment professionals aim for catalyzing social-cultural and political change through advocacy and activism.

Keywords Landscape architecture · Climate actions · Transformation · Boundary spanning · Agency

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Introduction

There is a critical need for significant action to reduce greenhouse gas emissions (GHGE) to avoid catastrophic impacts and adapt to a changing climate (IPCC 2023). Built environments (cities) are responsible for 70% of total energy use and subsequent emissions (UN-HABITAT 2022), therefore requiring actions to respond to the need of limiting global temperatures to 1.5 °C (IPCC 2022). Given the likelihood of a 1.5 °C temperature increase, the required climate actions are increasingly being viewed as having to be transformative and a combination of adaptation and mitigation actions (Grafakos et al. 2018; Hürlimann et al. 2021a, b). It is increasingly evident that the 1.5 °C target cannot be limited to decarbonisation strategies, and the real challenge involves broader and deeper social transformation, challenging business-as-usual practices, and shifting fundamental systems, including existing norms, rules, functioning, and power relations (O'Brien 2018).

With a long history of environmental stewardship and integration of socio-ecological knowledge systems into built environments (Hough 2002; McHarg 1969; Weller 2014), the profession of landscape architecture is seemingly well-placed to bring about positive systemic change that goes beyond temporal and territorial boundaries in responding to complex challenges exacerbated by climate change (Hou 2021). According to the International Federation of Landscape Architecture's (IFLA) definition of the profession, "landscape architects plan, design and manage natural and built environments, applying aesthetic and scientific principles to address ecological sustainability, quality and health of landscapes, collective memory, heritage and culture, and territorial justice" (IFLA 2020). What distinguishes landscape architecture from other design disciplines is the imperative to work with dynamic ecosystems and how they perform across spatial–temporal scales.

While the landscape profession strongly advocates for being leaders in climate change actions, its agency to influence transformative change in climate actions is relatively unknown and unreported (Moosavi et al. 2023). The role of the landscape architecture profession in taking a spectrum of different types of actions to address climate change requires further empirical investigation. This includes understanding how professionals perceive climate risks and associated actions, how they advocate for transforming design practices to have a greater impact on desired futures, and what agency they have in driving change across social and political boundaries.

The aim of this study is to establish an understanding of future pathways to climate actions in landscape practices, and to identify actions taken by Australian designers that go beyond generalised approaches to mediating climate change towards transformative climate actions.

This research taps into social sciences, human geography and theories of change including boundary theory, and adopts an interdisciplinary analytical lens. We first provide an overview of the theoretical framework applied in this study for identifying transformative climate actions across three spheres of practical, political and personal influence. Then the link to the role of boundary spanning in driving transformative change is explained. Climate actions in landscape architecture are then discussed as reported in the literature, before outlining the research design and presenting the results. The transformative actions identified through this empirical research can inform the co-production of the built environment through landscape-led approaches, and enhance the agency of the landscape profession in coordinating these actions.

Transformative climate actions and the role of boundary spanners

Defining transformative actions in landscape design practice

Design disciplines can play a crucial role in supporting the transformative change required in built environments to respond to climate change. This paper examines the practice of landscape architecture within Australia through the lens of transformation and transformative actions.

The use of *transformation* terminology has increased rapidly in recent years, however, there is conceptual plurality around how it is defined across scholarship (Moore et al. 2021). The lack of a shared definition arguably poses some challenges to scholarship and evidence-based policy making. Here we provide definitions that are most relevant to the focus of this paper.

Hürlimann et al. (2021a, b) argue that for *transformative climate actions*, both adaptation and mitigation measures must be considered in coordination across all sectors to meet the Paris agreement of limiting global warming to 1.5 °C. Drawing on the definitions provided by Grafakos et al. (2018), they frame the design and implementation of policies and practices to reduce anthropogenic GHG emissions as mitigation actions, and the responses to climate-related impacts and risks as adaptation. They further differentiate *status quo,* partial and incremental actions from transformative actions, which are deep, steep and timebound with clear goals (Hürlimann et al. 2021a, b). To Fazey et al. (2018) *transformative change* revolves around three key dimensions: The depth of change; the speed of change, and the distribution or breadth of change. Complementary to this, O'Brien (2018) argues to achieve climate targets of limiting global warming to 1.5 °C, *transformative change* is needed across many different domains, social scales and processes, and defines three spheres of influences: The practical, the political and the personal. Similarly, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) defines transformative change as "a fundamental, system-wide reorganisation across technological, economic and social factors, including paradigms, goals and values" (IPBES 2019, p. 14).

In the context of this research, we define transformative climate action in landscape architectural practice as:

> "Actions that go beyond a focus on the technical domains of design and implementation, and considers the impact/implications at the organisational, institutional, governance, procedural, political, personal, and cultural dimensions."

In addition, we argue that transformation requires considering synergies and trade-offs between mitigation and adaptation actions across the life stages of projects, from change initiation, to end-of-life of projects (Hürlimann et al. 2021).

Landscape-led and nature-based solutions (NBS) have the potential to be transformative through providing multiple benefits across socio-ecological systems (Palomo et al. 2021). While they may not strongly contribute to the speed of change in systems as a result of their slow establishment processes and temporal nature (Moosavi et al. 2023), they can contribute to the breadth of change through their potential for co-creation, community engagement, collaborative governance and co-benefits (Palomo et al. 2021). For example, within the context of urban living labs, where experiments with NBS are undertaken, for innovations to have enduring influence beyond the life of these experiments, the whole process is designed to influence other systems, including governance through a realignment of institutional arrangements, resources, and networks of actors (Croeser et al. 2024). Additionally, experiments with nature-based solutions are often designed to achieve multiple benefits (Moosavi 2022), including biodiversity enhancement, climate change adaptation (e.g. regulating microclimates), and mitigation through reducing GHGE (e.g. saving resources and increasing carbon sequestration). Another example of NBS and transformative actions could be moving beyond generic greening strategies, towards designs underpinned by life cycle thinking, systems dynamics and long-term performance (Babí Almenar et al. 2023). These largely highlight the need to move beyond *status quo* and off-the-shelf design approaches, towards a focus on targeted climate actions with greater socio-ecological impacts.

Spheres of transformative actions: personal, political, and practical

O'Brien (2018) argues that transformative actions need to be taken across three interacting spheres of influence: *Personal, political* and *practical*. In relation to design practices, the ***practical sphere*** includes specific interventions, and the choice of design strategies and techniques including technological innovation that directly contributes to addressing climate change. The ***political sphere*** refers to actions influencing structures and systems that translate into practical actions, including governance systems, norms, rules, regulations, institutions, regimes, power structures, vested interests, and incentives. These can define how practitioners work and what agency they have in decision-making related to climate change. O'Brien (2018) frames 'systems and structures' as the political sphere because "they are often created, codified and managed through political processes, which include collective actions and struggles that shape the spaces for responses in the practical sphere" (ibid, p. 156). Finally, the ***personal sphere*** represents

subjective beliefs, values, worldviews and paradigms, which influence individual and collective behaviors and practices.

Transformative change across all spheres of influence to address climate change is not possible through traditional disciplinary approaches, and requires the inclusion of different modes of knowledge and the acquirement of different skills. Nassauer (2023) argues that while landscape architecture has no defined knowledge domain unique to the profession, which may be seen as a disadvantage, this uniquely positions the profession to draw upon different knowledge areas including social sciences, ecology, engineering and arts in addressing complex socio-ecological challenges. Grose (2014) observes that sister disciplines such as ecology may interpret this as the lack of credibility to lead decisions. To Nassauer (2023), transdisciplinary approaches can help the profession and empower landscape architects to become credible leaders. For landscape architects to address grand challenges of complex socio-ecological systems, they need "to leave the comfort zone that '*designerly ways of practicing*' appears to afford (cf. Cross, 2001) and develop additional skills and capacities" (van den Brinket al. 2022, p. 2). This means that in addition to domain-specific expertise, it will be critical to master *process skills* such as political sensitivity, process innovation, communication and organisational skills for bridging knowledge boundaries (van Dijk et al. 2023).

Boundary theory and links to transformative actions

'Boundary work' theory has been useful in understanding how to address the complexity inherent in managing socio-ecological systems through inter- and transdisciplinary communication, translation and mediation (Mollinga 2010; Nassauer 2023). In crossing disciplinary boundaries and connecting science to policy and action, the critical roles of 'boundary concepts' (Westerink et al. 2017) and 'boundary spanners' (Schröter et al. 2023; van den Brink et al. 2019) has been highlighted by a number of scholars. Boundary spanners are often those who undertake cross-boundary work needed to develop coordination and collaboration across organisational, sectoral, and disciplinary boundaries (Van Meerkerk & Edelenbos 2018). They often engage in three activities: ***Selecting*** relevant information on both sides of boundaries, ***translating*** and interpreting this information across boundaries, and ***connecting*** different actors across boundaries through effective collaboration (van den Brink et al. 2019). They possess wide-ranging skills that cross different knowledge areas and disciplines.

The three boundary spanning activities are interrelated and can happen in parallel; translating activities implies selecting activities, and connecting activities in turn infers both selecting and translating activities. In the context of design practice, these three activities can be explained through the three spheres of transformation: The practical sphere requires domain expertise in design through *selecting* and collecting information or the choice for a specific design strategy and outcome; the political sphere relates to *translating* design practice activities to and from policies and regulations; and the personal sphere requires designers to engage with *connecting* and entrepreneurial activities to develop a shared vision for the future in close collaboration with other key actors and communities. These three groups of activities offer a useful lens to identify a spectrum of transformative actions in landscape architecture. We now discuss the literature focused on current actions that landscape architects take in addressing climate change.

Climate actions within landscape architecture

Landscape architects in a position to influence climate actions

Landscape architects are known to be in a unique position to become some of the most influential voices in identifying solutions to the climate crisis (Grove 2019). However, a review of the literature by Hürlimann et al. (2022) revealed that there were few empirical studies that investigate climate change actions in landscape architecture scholarship, when compared to other built environment sectors such as urban planning and architecture. The extant studies prominently focus on case study critiques and reviews of conceptual and built design projects, or research through design approaches (Cortesão & Lenzholzer 2022). Hürlimann et al. (2022) found that there is a dominant focus in the literature on climate change adaptation, with an emerging body of work focusing on climate change mitigation. The dominant focus

on adaptation actions corresponds to a review of research streams by the Council of Educators in Landscape Architecture (CELA) over the last seven years—finding that landscape research has primarily focused on adaptation and resilience, often tied to water related impacts (Newman et al. 2021). Prominent research topics on climate change adaptation actions in landscape architecture include climate-adaptive design for coastal communities and designing living shorelines (Berger et al. 2020; Moosavi 2017), flood resilient and adaptive water sensitive design strategies (Bobbink & de Wit 2020; Van Long & Cheng 2018), street trees and thermal comfort (Langenheim et al. 2020), planting design as an adaptation strategy (Hunter 2011), future adaptability of street trees to climate change (Sari & Karaşah 2020), and to a lesser extent atmospheric design for mitigating UHI effects and pollution (Walliss & Rahmann 2015). Through a review of design research projects, Zhang and Zhang (2022) mapped the expertise of landscape architects in climate change adaptation across three lexicons: Spatialise, Synthesise and Speculate, emphasizing the importance of *process-driven* approaches and frameworks as alternatives to 'problem-solving' climate adaptation efforts.

An emerging body of study has turned the focus to the role that landscape architects can play in reducing GHGE, through considering embodied emissions of projects (Moosavi et al. 2022; Nikologianni et al. 2022; Solera Jimenez et al. 2023), understanding carbon systems in vegetation and soils (Kuittinen et al. 2021), circularity and metabolic thinking in landscape infrastructure design (Marin & De Meulder 2018; Perrotti et al. 2023), and energy landscapes for energy transitions (Stremke et al. 2022). The recent focus on the power of territorial landscapes in generating energy is particularly a promising avenue for landscape architects to expand their expertise and scale of intervention in addressing global challenges by shifting their focus to designing at the planetary scale (Nickayin 2022). To this end, Stremke et al. (2023) urge the next generation of landscape architects to move beyond impact mitigation and, instead, explore local value creation through leveraging the power of landscapes and redefining the cultural landscapes of the twenty-first century.

The role of professional associations in facilitating climate action

Underpinning the shift in practice are the recent initiatives by the landscape professional body associations to galvanise the leading role of landscape architects in both climate change mitigation and adaptation. The International federation of landscape architects (IFLA) in 2019 published a guidance for Climate Change Action (2019–2021) (IFLA 2019), followed by the 2021 Climate Action Commitment (IFLA 2021), developed in support of sovereign governments accelerating their Nationally Determined Contributions. Other national associations have ratified IFLA's climate action commitment including the Australian Institute of Landscape Architects' (AILA) Climate Positive Design Guidelines (AILA 2022), the American Society of Landscape Architecture (ASLA)'s Climate Action Plan (ASLA 2022), and landscape institutes in the UK, Singapore, and Germany, among others, through developing resources dedicated to address climate change (McQuillan & Ryba 2024). These and other emerging initiatives have shed light on the important role of landscape architects as change agents.

Method

Research context

Climate change is one of the most pressing issues for Australian cities (Maheshwari et al. 2020). Some of the climate-related risks facing Australian cities include increasing frequency in extreme heatwaves, bushfires, flooding, sea level rise and coastal erosion (Bureau of Meteorology & CSIRO 2020). The role of nature-based solutions and landscape-led approaches in addressing climate change in Australian cities is increasingly recognised, highlighting the important role of landscape architects in the shift towards nature-based cities (Bush et al. 2023; Moosavi et al. 2021). Given the diversity of climate change impacts, understanding the array of actions that Australian landscape architects are currently taking to address climate change is of critical importance. Furthermore, identifying areas where landscape architects can aspire to transform practice for expanding their impact is needed.

In Australia, the landscape architecture profession is not regulated, however professionals can choose to become a 'registered landscape architect' through the AILA. In 2019, AILA officially declared a Climate and Biodiversity Loss Emergency (AILA 2019), and initiated a Climate Positive Working Committee, assisting with the development and implementation of actions which support climate positive design in landscape architecture. This resulted in the recent release of three Climate Positive Design guidelines in 2022 (O'Dea et al. 2022).

The landscape architecture profession within Australia is relatively small compared to other built environment professions, with the latest figures indicating there were just over 3000 Landscape Architects (ABS, 2021). Of these, over 80% work in the private sector with approximately 25% of these self-employed, and approximately 47% are female (Matthewson 2018).

Participants

Seventy landscape architects were shortlisted from a long list of potential interviewees. The initial selection of practices aimed for a distribution of practices in line with the national averages, with practice size and type, and interviewee characteristics considered. Across the practices, landscape architects in more senior roles were prioritised as they were deemed to be more likely to be involved in design decision-making processes. The shortlisted designers were contacted via email or LinkedIn to participate in an in-depth semi-structured interview. In total, 24 landscape architects participated in the interviews, from private (19) and public (4) sectors, with one representative from AILA with insights across public and private sectors. Table 1 shows the breakdown of those interviewed by state, firm type, practice size and gender.

Table 1 Interviewees' Characteristics

Characteristics	States								Org. type			Org. Size			Gender	
	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Public (Pu)	Private (Pr)	AILA (AI)	S	M	L	M	F
Number of respondents (total = 24)	2	6	2	2	2	1	9	5	4	19	1	16	6	7	19	10

Interview design

A range of different questions were designed for the interviews, and informed by empirical studies that use a framework for assessing preparedness to climate change adaptation in different sectors (Moser & Tribbia 2006; Tribbia & Moser 2008). These included

questions around the barriers to and facilitators of climate action in Australian landscape practice, the designers' level of awareness of climate risks relevant to the profession, and their analytical capacity to translate climate impacts into designs, as well as actions taken by design practitioners in addressing climate impacts.

This paper focuses on the responses to the subset of questions related to awareness of climate risks relevant to the profession, and the actions taken to address climate change. These questions were broadly framed as:

- *What climate change risks are relevant to landscape architecture/to your work?*
- *What actions does your organisation/firm take to address climate change?*
- *Do you advise or discuss with your clients the implications of your activities on climate change?*

Data collection and analysis

Due to COVID-19 travel restrictions across Australia during the data collection period (May to October 2022), the interviews took place primarily via video calls. The interviews lasted forty-five minutes to one hour, and were all digitally recorded except for one who did not consent to being recorded. In this instance, detailed notes were taken throughout the interview. The digital recordings were transcribed and imported into NVivo (2020 release) for content and thematic analysis. An analysis protocol was developed by the research group, including the key question themes to inform the initial coding by a single coder. We used open coding for the first-order analysis of interview data. Once the open coding had been completed, another researcher from the team did a second round of coding, grouping actions and attributing them to different components of the three spheres of transformation adapted from O'Brien (2018): *Practical, political, and personal*. For example, actions that could be described as designers' advocacy and activism actions to promote what is individually and collectively imaginable, desirable, and achievable in designing climate responsive landscapes were grouped under the *personal* sub-theme. Some actions were coded under more than one category.

After attributing the actions across the three themes, a third round of coding was undertaken by the lead author, to identify those actions that can be framed as 'boundary spanning' activities, or 'transformative actions.' These included actions that challenge the *status quo* and regulatory compliance, and could transform the ways of practice (van den Brink et al. 2019). Actions that were coded under 'transformative action', have a greater focus on the '*how'* rather than '*what'* actions.

Results

Identification of climate change risks by Australian landscape architects

Generally, we found that there is a high level of awareness among practitioners in terms of understanding climate change risks relevant to landscape architecture and actions that they can take to help address risks, which often fall under climate change *adaptation*. Discussions around designing to address the source of climate change through reducing GHGE emerged in some interviews, but to a much lesser extent.

An array of different climate-related risks was discussed by the respondents, with a large focus on urban heat, sea level rise, biodiversity loss, and flooding. Other risks such as bushfires, erosion, health and pollution were also mentioned but to a lesser extent. Figure 1 lists the climate change risks relevant to the profession based on the number of mentions across all interview questions.

Many interviewees highlighted the interconnectedness between different climate change impacts and how cities are prone to multiple impacts, hence situating the profession in having to tackle an array of different climate risks,

> *Sea level changes, everything getting hotter and what effect it has on the population. Increase of fires. Yeah, I think it's all got disastrous effects for landscape architecture (LA19, Pr)*

The interviewees often discussed these risks in the context of examples of relevant actions that landscape architects often take. We categorised these actions into adaptation and mitigation or both, summarised in

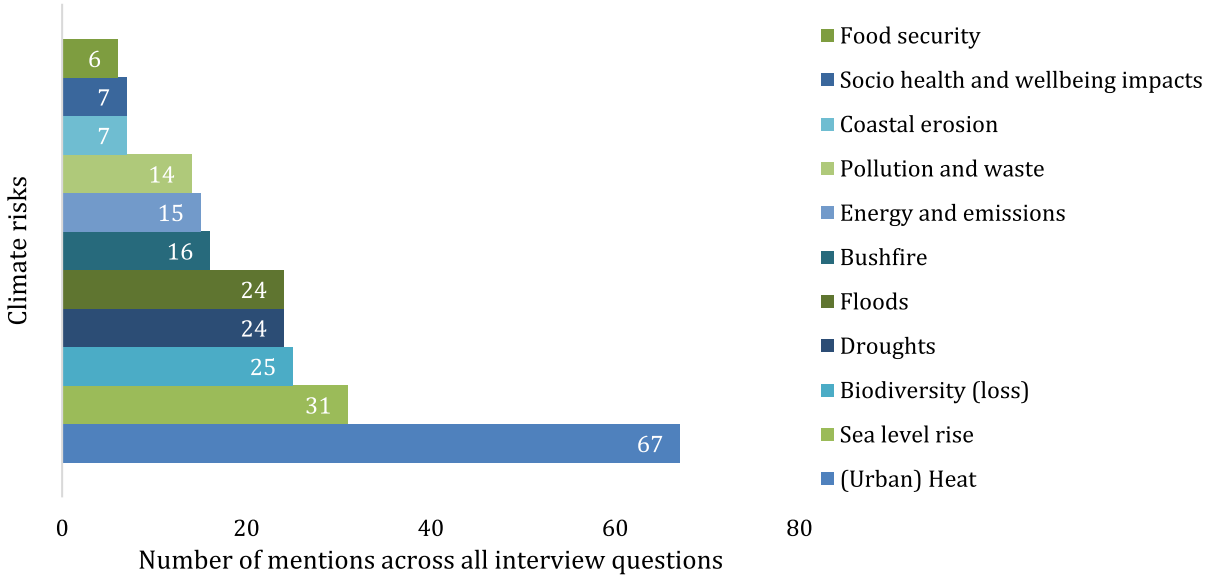

Fig. 1 Climate change risks identified in the interviews by the order of mentions

Table 2. As demonstrated, the majority of risk-related actions fall into the category of adaptation actions, although they might have indirect effects on mitigating GHGE (e.g. planting more trees to adapt to more frequent heat extremes, which can also help with carbon sequestration). Actions that were discussed in direct relation to GHGE reductions include the role of landscapes to address food and energy security. In the following section we provide a further layer of analysis, unpacking the actions against the spheres of transformation.

Current practice and climate actions in Australian landscape architecture

Across the identified climate risks Australian landscape architects were found to be engaging in actions across the three categories of practical, political, and personal spheres. The following section explores the actions within each of these categories, drawing on examples from interview responses.

- **Practical:** Design actions and strategies

  The majority of actions identified fall under the practical sphere, which are technical interventions, design strategies and design products that directly or indirectly address climate change. Actions to address the effects of a warming climate on vegetation systems frequently emerged in response, and the consequences on plant selections for landscape architects were emphasised. Sea level rise was the second most cited climate risk, however, compared to mitigating urban heat island effects, the discussions around sea level rise were focused on stating the problem, rather than practical actions. One respondent was critical of some international examples labeled as 'best practice' including the Sand engine (Zand Motor) project in the Netherlands, for providing short-term fixes or temporary solutions,

  There's the great sand engine project in Europe, which people always reference. That's just a short-term fix. That's not a long-term fix, […] because the sand will just wash away the same way it has previously (LA05 Pr)

  Very few mentioned involvement in projects that address sea level rise impacts, and the actions were focused on land management, investigating suitability of foreshore projects and strategic planning. Furthermore, engagement with sea level rise was seen as a context specific issue and not a major task for many landscape architects in the near future. Its prominence depended on where practices and projects were located, compared to other issues such as heat, which the impacts are already being felt across many Australian cities,

Table 2 Examples of climate change actions mentioned by respondents to address identified risks by the order of mentions

Climate risks relevant to landscape architecture	Examples of climate actions related to risks	Adaptation (A) or Mitigation (M) actions
(Urban) Heat	*The climate is changing and we have to respond. So, for example, maybe in the past thinking about how our elderly people could walk from destination A to B comfortably, it has changed now because the globe is getting warmer and* ***maybe we need to plant more trees to create that nicer environment*** *for them. (LA06 Pub)*	*A/M*
Sea level rise	*So, we're considering things like* ***saltmarsh migration in our thinking*** *on some projects, […] which foreshores are we going to protect, with hardening or whatever, as opposed to which ones are we going to give up? And we've got very good data in Tasmania about the foreshore management, [using this information to]* ***set the levels for walkways and boardwalks*** *and* ***the engineering of seawalls*** *where we need them*	*A*
Biodiversity (loss)	*I think that climate change presents such a threat to* that [protecting and enhancing biodiversity]*, that's where we see our importance, as well as obviously providing nice, aesthetic outcomes, it is really fighting as much as we can* ***to protect, the greenery and the animals*** *and everything we can do within sites (LA04 Pr)*	*A/M*
Droughts	***Appropriate scale of lawn****, appropriate because obviously lawn, you have to irrigate here [in Australia], you don't in the UK, but you do here. You know what type of planting, temporary irrigation systems, all those when the client asks for* ***a big water feature****, and you go, well really, that's* ***a lot of wasted water****. You know, even proposing gigantic water features that you see in kind of Chinese masterplan imagery and stuff like that. I always think of those things are way old school, we shouldn't be doing that (LA12 Pr)*	*A*
Floods	*And I've only just noticed in the last five years, the* ***one in a hundred flow path*** *has become a real thing for a site design now, where does the water go in one in a hundred years flow path? That's because the one in a hundred years is not once as you would know, it can happen three times in a year. It's the scale of events and that has become far more, people have become far more aware of that and we're* ***having to factor that into subdivision design, park design*** *and everything we do now. (LA07 Pr)*	*A*
Bushfire	*In terms of bushfire. Practically day to day, we've got our* ***geospatial systems team*** *who map all that and we* ***utilise that mapping as a resource*** *when we're planning for things.(LA25 Pub)*	*A/M*
Energy and emissions	*We're conscious to try and reduce concrete use, but it's difficult because, again, the maintenance issues, the lasting investment issues. But we do try to source materials that have a lower climate impact or lower environmental impact, which is typically climate related. So we've done a lot of work with the red listing of materials, looking at the red list of materials and understanding their carbon, the recyclability, etcetera, etcetera.(LA07 Pr)*	*A/M*
Pollution and waste	*Either the energy use of that mower or the impact of using a particular species or* ***the reduced pollution from building a bike path so more people ride****, even though you build it out of concrete (LA02 Pr); Do we need to be* ***asking questions about: can this material be recycled*** *[…]? (LA17 Pr)*	*A /M*
Coastal erosion	*We've got* ***drones which can capture footage of beach erosion****. So I know, one of our guys can fly the drones and do all that. And that's been happening a lot for Stockton because of the erosion problem there. (LA23 Pub)*	*A*

Table 2 (continued)

Climate risks relevant to landscape architecture	Examples of climate actions related to risks	Adaptation (A) or Mitigation (M) actions
Socio health and wellbeing impacts	*If we're not responding to this* [Urban Heat Island effects] *directly,* ***we are omitting people from using public space****, from walking and spending more time in open spaces and that is going to have a negative impact on their mental and physical health and wellbeing. (LA06 Pub)*	*A*
Food and energy security	*So, again, if you think about 80 percent of the public realm is streets, how much* ***food*** *would you be able to* ***produce in all those [street] verges****… how much* ***power would you be able to produce*** *in that? (LA10 Pr)*	*M*

When I was working in Holland, sea level rise was, of course, a major part [of my work] (LA 10 Pr)So, for example, City of (a municipality in Melbourne), we're doing [the] foreshore, which is like one meter above sea level, their target is to get something sorted by 2030. Whereas, I don't know... the City of Moreland could probably wait another 100 years (LA 02 Pr)

In terms of climate related biodiversity loss, discussions were focused on how climate change can be a threat to biodiversity, but also on the role of landscape architects in seeing landscapes as *palimpsests*; respecting the layers of natural and cultural heritage, and resisting a *tabula rasa* approach to development,

The landscape architects in those cases are really the only people a lot of the time that are going to fight for things like natural and cultural heritage, and that kind of thing is going to affect climate change because a lot of the developments just coming in, assuming it's a blank slate, whereas we know that it's not (LA04 Pr)

Shifting away from an 'anthropocentric bias was also mentioned by multiple designers; that is moving away from a human-centric approach to development, to considering 'more-than-human' agencies in design decisions (LA17 Pr). This resonates with the study by Bina et al. (2024), which suggests that changing agencies that are projected in desired future, is a central pillar of any transformative change process.

The emerging concerns around planting design, particularly urban trees, and how they will hold up to a changing climate in the future emerged several times, highlighting the responsibility of designers to carry a horticultural perspective informed by climate science:

So, if we're talking about temperature and rainfall, planting designs we're putting together may be sufficient now, but we don't know whether they're going to be suitable for future climate, especially with the long lived things like the trees in the urban forests. There's a lot of research and thought and work being done around that. Again, it's difficult, but it's also interesting and it's sort of forcing us out of our habit of doing what they know and doing what they've always done. (LA08 Pr)

In my practice, my particular actions are always to increase local species biodiversity, always increase or at least retain canopy cover. (LA09 Pr)

Adaptability of urban fauna to temperature changes was also seen as an emerging area that landscape architects should increasingly engage with.

I was a guest crit at QUT and one of the students were talking about the temperature impacts on fruit bats and flying foxes and their inability to deal with, heat waves. And then also that being tied into, you know, they're significant pollinator. Everyone thinks of bees and stuff as a pollinator, but those in terms of pollinating our local species. So, impacts on species and habitats, and those kinds of things. (LA17 Pr)

This is reinforced by AILA's recent publication of a 'Biodiversity Positive Design Position Statement' (AILA 2023), promoting landscape

architects as strategically being positioned to demonstrate leadership to embed and normalise biodiversity positive design in Australia's cities, settlements and landscapes.

A number of respondents expressed concerns around 'business as usual' approaches to greenfield development, with little consideration for protecting biodiversity (LA03 Pr). Other challenges such as increasing droughts and floods were equally mentioned as important design questions to tackle as landscape architects. Many respondents emphasised the importance of context specific and climate-proof approaches to planting designs, where plants are selected based on future projections of water availability, and reducing the need for irrigation given the increasing drying climate across Australian cities. Design approaches that mobilise capturing rainwater and utilizing it within the landscape and retaining it on site were seen as opportunities (LA13 Pr) to address these challenges. Additionally, considerations of soil quality to increase moisture retention were discussed to have long-term benefits, and outweigh short-term cost implications (LA16 Pr; LA19 Pr). It terms of dealing with more frequent and heavier rainfalls, taking a risk averse approach, and designing for worst case scenarios of projections were suggested (LA13 Pr), including considering a 1:100 flooding benchmark in designing drainage systems in subdivisions: With regards to designing for bushfires, many respondents mentioned it as a challenge to tackle in Australia and highlighted the need to discuss with clients and develop bushfire management plans (LA11 Pr; LA07 Pr; LA23 Pub). The majority of those engaged with actions dealing with bushfires worked in the public sector, and they highlighted the use of mapping and modeling to make decisions at the strategic planning scale phase.

we've got a 'Simtable' which the team uses to model bushfire scenarios. So I guess that's kind of quite a unique piece of equipment that's quite useful. And that's one of the tools that we have. (LA25 Pub)

Other risk related actions were briefly mentioned including health and well-being, pollution, and coastal erosion. Risks to farming, agriculture and food security were the least mentioned and seen as an area that falls under urban planning and urban design responsibilities. However, some highlighted them as an emerging and necessary area that landscape architects should start engaging with:

my big ones are farming. I think everyone should know more about food and land use, and I think it's also the more you learn about it, the more you realise it's all so interconnected that human health goes right back to the land health, and, I think the method of agriculture that's currently practiced on masse is really not something that's going to encourage long term sustainability of land use. (LA15 Pr)

Actions such as high-density greenfield development, creating multifunctional green spaces that can also be productive while addressing social inclusion, were mentioned by a number of respondents (LA03 Pr, LA10 Pr, LA15 Pr). For example, designing communal roof gardens in urban dense areas, and promoting sustainable farming approaches such as permaculture with a focus on improving soil health were discussed.

The actions that were mentioned for the reduction of GHG emissions were mainly limited to using recycled and local materials with lower carbon footprint. There was some level of ambiguity in terms of the role and responsibility of landscape architects in reducing emissions, beyond material choices:

I suppose in terms of climate response, like minimizing carbon, there's not a lot we can do. (LA08 Pr)

One participant pointed to operational emissions, which relate to the management and maintenance of built landscapes. Decisions made at this phase in terms of use of machinery for maintenance of plants, often fall out of the control of designers, unless the project contract indicates a timeframe for ongoing management by designers,

So a lot of the project emissions, over twelve point two percent was actually the maintenance. So mowers and blowers and whipper snippers and things. So by even converting to electric power and moving to solar power and removing that from it, would make a huge difference as well. (LA20 Pr)

A focus on carbon sequestration in plants and soils was also mentioned and a simple solution was suggested: To plant as many trees as possible. However, it was highlighted that the profession should expand its knowledge around carbon systems in vegetation more generally, and on the critical role of healthy soils more specifically:

soil and how soil deals with carbon and everything else, which that's what we deal with a lot is, soil! But do we have the knowledge and understanding about what such an important role soil can take? Both in sequestering carbon, but then leading to, good shady trees and all the rest. (LA20 Pr)

Farming, agriculture, and food security were only highlighted by three respondents, as an emerging and necessary area that landscape architects should start engaging with:

[…] combining beautiful aesthetic landscape solutions with things that start addressing edible landscapes and multi-functional landscapes and, you know, again, enabling social interactions, especially when you're dealing with something like a communal rooftop type of space in that more urban dense kind of environment. (LA03 Pr)

Similarly, energy landscapes and the potential for energy production was only mentioned by one respondent, reflecting the novelty of this area of work as an emerging field expanding landscape architecture,

again, the green fields, the low-density suburbs, they have huge potential... to actually solve a lot of the climate change issues with the food production, energy production, etc. (LA10 Pr)

- **Political:** Structures and systems defining practical actions

  The actions identified in relation to the *political sphere* were identified through coding the following key themes: Rules, regulations, policies; advocacy and lobbying; institutional and organisational structures; awards, competitions, incentives; education and learning, and organisational culture.

  The importance of effective policies and legislation relevant to design, and engaging with their development were mentioned by a number of respondents. Respondents who worked in the public sector, particularly highlighted their involvement in policy development or review of environmental standards and regulations related to climate change. The adequacy of design-relevant codes and standards in the Australian built environment policy context was questioned, highlighting the need for their further development:

  What we found was that there wasn't a lot of design in the planning and design code and there's not a lot of climate change in the planning and design code, unfortunately. […] how do we embed climate change in our planning system to better provide, you know, mitigation, adaptation of it? (LA18 Pr)

  Some actions that expand beyond the traditional role of landscape architects were proposed in response to these questions, including getting involved in Climate Change Councils (LA18 Pr), reviewing relevant policies (LA16 Pr; LA23 Pub) and making submissions to governments (for example for the amendments to the Planning Scheme and design codes (LA21 AI) or submission of white papers on shading and cooling (LA20 Pr; LA07 Pr)), taking advisory roles in national committees, working groups and alliances, such as AILA National Council (LA11 Pr), the Legislative Assembly Committee for Urban Open Spaces (LA16 Pr) or internationally, with the Climate Change Working Group of IFLA (LA21 AI).

  With regards to advocacy and lobbying, few respondents also pointed to the responsibilities of landscape architects to actively advocate for the profession through engagement in lobbying, as well as demanding more recognition for the profession through communicating the value of design and landscape architecture to state and local governments (LA21 AI).

  Other actions identified in the interviews relate to value-driven advocacy. One respondent discussed involvement in a research project to make the case for the value of trees in urban areas, stating:

  we recently did a little research piece called 'The Case for Trees'. And so it was sort of a studio process that we went through with a few dif-

ferent people, that we treated it like a research project, that you might do at university and try to put some numbers or values, particularly in Melbourne, for social, economic and biodiversity, but we actually put numbers and a bit of rigor around that so that we could explain to our client what the tangible economic benefits were for planting those trees. So that was really interesting in terms of the cooling, the social aspects of what trees provide. (LA19 Pr)

Value-driven advocacy actions can be leveraged by creating awareness and educating the public through effective communication of values, which also falls under the personal sphere; this emphasises the interactions between the three spheres of influence.

Influencing the procurement processes, design tenders and briefs to embed climate change targets and sustainability ambitions were also identified as actions for transforming systems of practice. One respondent suggested that the way the state and national awards programs at the institute level is set up, reflects the industry's climate ambitions (LA20 Pr), suggesting that the inclusion of clear climate agenda in the AILA awards assessment criteria can incentivise practices to compete for higher standards.

In relation to education and ongoing learning opportunities for practitioners, many highlighted the key influence of tertiary education.

So, I would say I still think the leaders of climate change for our industry are in tertiary education (LA02 Pr)

Actions such as involvement in teaching at universities to share practical knowledge and expose students to real-world design challenges relevant to climate change were also highlighted,

And so in teaching, and particularly my plants unit is very much focused on all those things that I focus on in my practice, which is local species biodiversity, canopy cover, mitigating the urban heat island effect. You know, low maintenance, low water landscapes. (LA09 Pr)

Within design firms and organisations, learning, and development opportunities were noted by a few, to keep abreast of the latest climate change science, data, methods and tools, particularly in the public sector, cross-pollination between different teams, and with academia was suggested,

I think what would probably help within our organisation is just more communication between different sections of council, so presentations of what people have discovered. I suppose that did happen with the Smart Trees project. So they did bring in a lot of different players from the council and there were workshops hosted by the university. So it does happen to a certain extent. It could possibly be just broadened and a bit more holistic. (LA23 Pub)

Related to enhancing in-house climate change competency and improving internal culture, an interesting initiative was shared by one of the practitioners in the private sector,

we do our own kind of fortnightly what we call Green Sessions, where we share learnings from different projects. So we recently saw Sydney had done this amazing strategy around greening forest stuff in a particular municipality in Sydney. So we'll share that sort of knowledge internally as well. (LA21 AI)

Finally, the important role of associations and professional bodies such as IFLA and AILA in providing career development opportunities through workshops, webinars and conferences and the role of Continuing Professional Development points as incentives were seen to complement other actions to transform systems and structures.

- **Personal**: Beliefs, values and perceived agency

The actions attributed to this group were identified through analysing the responses to a range of different questions including: *Do you advise/discuss with your clients the implications for climate change? And if not, why?* Responses to these questions revealed individual and shared values and the ways through which these values are communicated by designers to influence mindsets and create awareness.

One common thread identified across the personal sphere of actions was the designers' perceived agency, either related to the recognition

of their value by the public, or their own perception of their influence in decision-making. The strategies and *tactics* used by designers to push for sustainability and climate change agendas in projects are as important as their knowledge and design skills. We found that the majority of the interviewees were quite reticent when discussing the implications of climate change and the respective impacts with clients. Very few mentioned that they directly refer to 'climate change', and conversations with clients are rather focused on *sustainability*, *risks* or *impacts*. Using the language of risk was generally seen as a way to remain realistic within the bounds of the project. Others mentioned using a *costs and benefit* language, or pointing to '*win–win solutions*' such as focusing on amenity outcomes to garner attention,

not climate change specifically, but talking with our clients about materials selection, sustainability, the infrastructure to reduce environmental impacts… I think translating it into an economic benefit and making financial links so that when we're having conversations with our clients where we don't need to approach it from an emotional plea (LA17 Pr)For whatever reason I don't use the word 'climate change', I would probably use the word impacts on heat island, impacts on shade, amenity. I use the amenity card a lot because I think that emotionally might hit more targets (LA14 Pub)

Those few that explicitly discuss climate change with clients were critical of carrying an *anthropocentric bias* and business-as-usual approach detached from climate change,

we're still on an anthropocentric bias, and until we can kind of address that or weave in other layers into the project, whether it's communicated or subconsciously, I think that's an issue (LA17 Pr)

Additionally, a key challenge from the perspective of some interviewees was the engagement with landscape architects late into projects where often little room remains for supporting climate agendas. Yet, actions driven by the ethical responsibilities and conscience of designers to negotiate and change the brief are identified as important levers,

what we're doing with the most impact for climate change, those decisions have already been made at a planning level or a policy level or a political level. And we end up with a brief that has very little rigor, or need to address sustainability or climate change because of the financial impacts (LA17 Pr)

In this regard, actions identified through the interviews included educating clients through effective engagement and communication (LA24 Pub) and challenging their values and ambitions by questioning the brief (LA16 Pr). This was also supported by leveraging landscape architects' activist role,

I think as a landscape architect, you are a climate activist by nature. So whether we think about those things specifically, no, but I think they're part of our ethos generally (LA19 Pr)

Many highlighted the importance of changing mindsets and public perceptions over the agency of landscape architects in terms of what they can actually do to address climate change,

One of the biggest challenges is that the perspective of... or lack of understanding of what landscape architects do and can do.. in terms of design as well as broader advocacy and policy and decision-making fields. And so people don't quite understand the complexity of the kinds of things that landscape architects can influence and do (LA09 Pr)

Similarly, the designers' own perception of their influence and agency is critical in shifting mindsets, that is whether they perceive the profession as solely a commercial activity, or if they portray their profile as change agents with high ambitions. This was seen in relation to *value alignment* with clients, and in some instances, consciously being selective about what projects to get involved with,

You know, the number of reasons sometimes why we wouldn't bid on a project, climate is definitely one of them. So is biodiversity or if we think the project isn't ethical I guess or we don't want to be associated with it in that sense (LA19 Pr)

This is not always feasible, particularly with smaller practices that financially rely on the number of commissioned projects. It also raises

questions around ethical responsibility and dismissing the opportunities to convert the clients, or educate the general public through conversation and dialogue around projects, as noted by this interviewee,

every project is an opportunity to educate not only the client, but also the people, the consultants and contractors that we work with. But it has to be done in a in a sensitive way that isn't just sort of, hard out tree hugging, sort of climate activists, because while I may feel those emotions, there's no surer way to lose people (LA15 PR)

Hence, it is difficult to conclude that being explicit about climate change in communicating with clients implies transformative action, because depending on the clients' values, taking a more *tactical* approach to communication to achieve climate outcomes may lead to better climate change outcomes. One interviewee suggested finding a '*middle ground'* between financial and time-based agendas, and climate change strategies is the responsibility of designers (LA17 Pr).

Multiple interviewees suggested that working with public sector clients, particularly local governments, facilitates climate actions compared to private clients, as they are often on board with 'championing' climate agendas,

But the local government ones, the clients are across all that, that's already front of mind for them anyway (LA11 Pr)

In contrast, another interviewee believed that as designers they had more influence when working directly with the end-users as clients in private projects, reflecting the diversity in views on client-designer relations,

My client is the end user of the project. And in that I can influence the outcomes towards my values as well as influence lifestyle of the client (LA09 Pr)

Discussion: towards transformative actions in landscape architecture

The results of our analysis of actions across the three spheres of transformation reveal a spectrum of actions, some with a business-as-usual approach to designing landscapes, while others demonstrating the potential for crossing boundaries, enabling transformative change and enhancing the agency of landscape architects in leading climate actions. Here we discuss these actions resulting from the interviews, and link the findings to more recent initiatives in practice and broader international scholarship. In Fig. 2, we summarise some of these actions across the spheres of transformation, and link them to the three boundary spanning roles of selecting, translating, and connecting knowledge boundaries to expand impacts beyond the boundary of projects, towards transforming the political and social spheres. Some of these actions are only a step towards enabling transformative change.

Within the *practical* sphere, transformative actions can be underpinned by considering climate change science, setting clear targets and goals, and employing data-driven design approaches, as well as the *selection* and use of tools and technological innovation for performative outcomes, which are increasingly advocated by scholars (Ackerman et al. 2019; Walliss 2019). Other actions such as developing in-house low-carbon material inventories and engaging with life cycle approaches were also identified. While bushfires are a major climate risk to Australian landscapes, we noted that it was not mentioned extensively by the interviewees. The reason may be that bushfires are considered less of an urban issue, which many practicing landscape architects we interviewed often deal with. Nevertheless, similar to energy landscapes, designing for bushfires is a promising area for expanding the role of landscape architects in developing and implementing fire-resilient designs and policies (Gonzalez-Mathiesen et al. 2021).

Transformative actions in the *political* sphere highlight the required advocacy role of landscape architects as 'process-based' designers and 'ambassadors' that *translate* information across the boundaries and policy and practice (van den Brink et al. 2022). The leadership role of AILA emerged through the interviews, as being critical in making institutional changes and driving policy influence. Effective communication beyond traditional approaches to design representations enables political engagement, which in turn, elevates the voices in design to express values that underpin landscape projects, including more-than-human values (McQuillan & Ryba 2024) and their agency in leveraging transformative change

(Bina et al. 2024). The emergence of international projects with a landscape-led approach such as the Room for Rivers, Rebuild by Design, NY Cool Roofs Program, and the Garden by the Bay showcase the agency that landscape architecture can bring in translating practice-driven information and influencing built environment policies in line with international goals. For example, the Gardens by the Bay project in Singapore has an internal sustainability framework and governance structure aligned with the United Nations' Sustainable Development Goals, which support Singapore's GreenGov.SG initiative, and inform the *Singapore Green Plan 2030* (Gardens by the Bay 2022). This confirms our findings on involving landscape architects in the early stages of change initiation.

The practice in Australia is also shifting towards an increase in demonstrated agency for the profession; the exhibition, '*Landscape Architects as Change Makers'* was showcased in Melbourne Design Week in 2023, reflecting on practices in Australia and Japan. Driven by academic scholars in collaboration with industry, the exhibition highlighted alternative communication techniques beyond the static and often reductive representation offered by images and text (Barun 2023). More importantly, it was an advocacy statement to demonstrate authorship and agency in landscape architecture in driving change. Academic scholars can play a significant boundary spanning role in critical interpretation, translation and innovative reflections on design practice and its future directions, given that designers rarely have time to do so with the high pace of industry.

Finally, the actions identified in the *personal* sphere reveal an array of additional skills needed for driving transformative change in landscape practice. These include soft skills for *connecting* different boundaries including negotiation, coordination, critical reflection, entrepreneurship, and activism. These align with the third tier of Boundary Spanning roles identified in van den Brink et al. (2019), emphasizing the *connecting* and *coordinating* activities designers

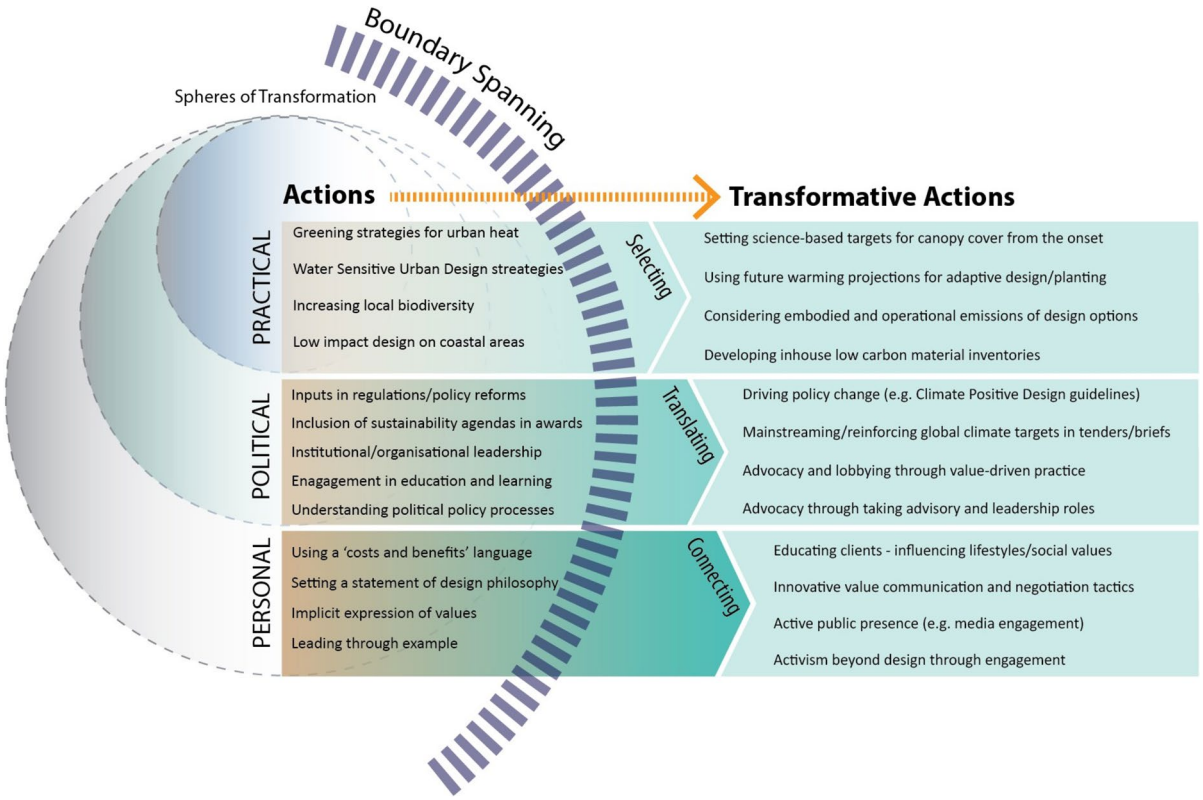

Fig. 2 Depicting current practices and boundary spanning towards transformative actions across the three spheres of transformation

can play. Some examples emerging from our results include challenging the climate ambitions in design briefs and refusing projects where values are not aligned. Table 3 presents some examples of *status quo* versus boundary spanning towards transformative actions across the three categories of transformation.

According to O'Brien (2018), actions taken in the personal sphere can have greater impact on transforming practices, because they focus on fundamental social changes in the belief systems and behaviors that often create barriers to change. Our findings confirm this, but we also found that in design practice, paradigm-shifts are more challenging to materialise. One reason may be the way designers are educated. If traditionally rooted in the beaux-arts model, education is often focused on promoting and developing individual creativity and originality, with less attention to soft skills (Ruggeri 2019), and therefore leading to projects in which values remain implicit rather than explicit. Enabling spanning the practical, political and personal boundaries calls for a renewed design culture in landscape architecture (Kempenaar 2021), and as Jeffrey Hou points out, new approaches to teach design "*as a form of activism and a vehicle for change*" (Hou 2021).

It is also important to note that while individual actions included in Fig. 2 and Table 3 may not be considered transformative per se, a portfolio of collective actions are required across all three spheres to enable transformative climate actions. Therefore, we are not advocating for all landscape architects to become boundary spanners, but rather to identify and support those individuals and practices that are normalising working across knowledge boundaries for wider impact.

Conclusion

The Anthropocene demands designers to direct the evolutionary fate of the planet, and landscape architects are well-positioned to leverage the potential of nature-based approaches to address climate change. Their capacity in taking transformative climate actions is understudied. In this paper we adopted an analytical framework underpinned by theories of transformation (O'Brien 2018), and boundary spanning (van den Brink et al. 2019; van den Brink et al. 2022), to empirically investigate current design practices in Australian landscape architecture, and identify actions that go beyond business-as-usual and generalised actions, towards driving transformative change across the practical, political, and personal spheres of influences.

Our results reveal prominent climate risk areas that Australian landscape architects often engage with, which mainly fall under adaptation actions. These include reducing urban heat impacts through designing effective green and blue infrastructures, adapting to sea level rise through nature-based approaches, and reducing the impacts of droughts and floods through bioengineering approaches. For transformative climate actions, it is critical that both mitigation and adaptation actions are considered across all sectors of the built environment (Hürlimann et al. 2021a, b). The interviews revealed that mitigation actions were not a key focus in Australian landscape practice, suggesting new avenues for expanding the territory of landscape architecture to increasingly engage with more holistic approaches including consideration of metabolic flows such as carbon, water, food, waste and energy systems across life cycles in designing with socio-ecological systems. This does not mean deemphasizing '*design and aestheticizing approaches'*, but rather considering them as critical supplements to purely scientific approaches, to sustain confidence in designers' agency to care for the landscape in dire times (Larsen 2018), and moving from acting as boundary defenders, to becoming boundary spanners.

We conclude that while actions taken in the practical sphere are increasingly informed by climate change risks in Australia, landscape architecture may have to step up its game through challenging the *status quo* in current practice, and employ advocacy and activism to elevate its voice. This can be supported through transdisciplinary collaboration and connection with other knowledge areas and allied disciplines. The discipline can catalyse social-cultural and political change through enhanced presence and entrepreneurship (e.g. engagement in policy change and public debates). This might mean a (re)new(ed) approach to how landscape architecture is taught and how we can equipe the future generation of designers with soft skills such as negotiation and coordination to act as boundary spanners and change makers across multiple dimensions of transformation especially the political and social spheres. The active presence and involvement

Table 3 Examples of status quo versus transformative climate actions identified in the interviews

Transformation spheres	Examples of current (*status quo*) practice	Examples of Transformative actions	Boundary Spanning activities
Practical (design strategies-responses)	*"I do get a sense that a lot of the climate change response is just lip service. And it's actually when you look at it, it's very difficult to—with a definitive answer in landscape architecture—to say that we are, measurably benefiting the climate impacts. It's not like we can reduce the amount of energy in our [projects], we don't have a lot of carbon emitting elements."*	*"We have started to look at lifecycle impacts of materials for some sort of sustainability of materials and having an awareness of the total lifecycle of a product of how it's, mined or the natural resources, how it's processed, how it's manufactured and then how it's transported."*	*Selecting & translating strategies/tools/information/data aligned with climate goals and targets*
Political (systems and structures)	*"I think another challenge for landscape architects is a lot of what we're doing, the most impact for climate change, those decisions have already been made at a planning level or a policy level or a political level. And we end up with a brief that has very little rigor, or need to address sustainability or climate change because of the financial impacts."*	*"We've just put out a media release for the stakeholders about the Infrastructure Australia Plan and we'll be doing quite a bit of advocacy around that and trying to align that with our climate action plan."*	*Translating information across practice-policy, and connecting boundaries through creative communication and engagement*
Personal (socio-cultural)	*"I don't think we do deliberately. And, you know, we are a commercial operation, and sometimes I suppose we do get involved in projects where you just say, you know, I suppose we are still driven initially by standard economics and commercial imperatives, rather than necessarily factoring in climate change more deliberately, it's probably it's a good question."*	*"We take every project and opportunity not only to undertake the tasks that are required to satisfy the client's requirements, but also to educate and to challenge the client with regards to what he's doing and why he's doing it. We ask why and we ask why not."*	*Connecting science-policy-practice spheres through shifting mindsets and education by using effective tactics to increase buy-ins (e.g. reframing climate actions into tangible outcomes with multiple benefits)*

of landscape architects in the last two COP meetings to '*represent IFLA and the profession to advocate for nature-based solutions and the role that Landscape Architects can play to accelerate and underpin global climate action'* is testimony to an expanding field of practice. In Australian landscape practice, an incremental, but promising avenue for carbon and biodiversity positive design has been advocated by AILA's working groups, aiming for better alignment with global initiatives such as the Taskforce on Nature-related Financial Disclosures (TNFD) framework, which is supported by Australian Government's Department of Climate Change, Energy, the Environment and Water. These create a promising space for landscape architects to leverage to generate much needed change.

This research provides valuable insights into a spectrum of current actions in landscape practices in Australia, and practices that are increasingly shifting towards transformative actions by highlighting transformative attributes for climate action. These attributes may encompass strategies, tactics and maneuvers that landscape architects can employ, to critically foreground their agency in addressing the urgencies we're facing. Further research is needed to identify boundary spanning attributes and enabling factors towards transdisciplinary practices that promote transformative climate actions.

This research's original contribution, we argue, is its' interdisciplinarity—applying theories of change, adopted from sociology and human geography into landscape design scholarship. This study unpacks and expands design agency in advancing climate actions and suggests an exciting outlook for the future of landscape architecture education and practice. While this study focuses on Australian practices, the impacts of actions taken by landscape architects go beyond national and regional boundaries, hence, the insights are relevant to other contexts globally. The developed framework for assessing transformative actions and boundary spanning activities can be applied in other contexts and for other relevant disciplines, to further evaluate the climate change agency and impact of different actors beyond the boundaries of projects. It is time for the profession to reflect on its' capacity to act on climate change through spanning multiple knowledge boundaries and transforming design practice.

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Declarations

Competing interests The authors declare no competing interests.

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