

Visions and Pathways for Low- to Zero-Carbon Urban Living - Australia 2050

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Abstract

Visions and Pathways 2050 is a new research and engagement program which will explore and articulate visions and policy-technology pathways for a low- to zero-carbon built environment in Australia. The program involves three universities (University of Melbourne, UNSW and Swinburne), CSIRO and a large number of government and industry partners, and has been funded as a four year project of the newly established CRC for Low Carbon Living. Guided by the possibility that a systems-level transformation will be necessary to achieve low- to zero-carbon urban living, the research team aims to track current research, industry and policy intelligence, coordinate with other international foresight and back-casting projects, identify emerging technical and social innovations, and refine a set of visions for a future low- to zero-carbon urban Australia. Each year, two large workshops (in different cities) will deliberate on futures that are seen as desirable and feasible, as well as examine possible pathways to these futures. In this paper we outline the motivation and conceptual framework of the project, concurrent research in the area and the planned phases of the project.

1. Introduction

The challenge of the decarbonisation of the built environment involves no less than a transition from one set of technologies, infrastructures, practices, perceptions, values, policies and regulations to a (potentially very) different set. Nobody knows exactly what the future of low carbon living will look like, how quickly or smoothly such a transition might occur, and how it may be brought about. Nevertheless, there are various tools that can help us explore futures and investigate the diverse and complex systems dynamics of technological and societal changes required to pursue the visions we want for society. This can both help in our attempts to 'co-create our future' as well as help build more robust decisions and strategies which are less brittle to the unfolding of key uncertainties.

Beck (2010) has argued that negotiating a process of transition in a democratic society quickly confronts the "urgent and somehow tabooed question" in the huge project of the "greening of society": how to develop support *from below*, the "backing of everyday people of different classes, different nations, different political ideologies", support which in many cases appears to undermine current "lifestyles... consumption habits... social status and life conditions" (p.255). Co-creating envisaged futures, in the process of engagement between diverse social agents, is widely accepted as a valuable way of developing support for change, for the acceptance of new socio-technical conditions and patterns of living that can provide the basis for innovation towards a new desired state.

As a flagship project for the newly established Cooperative Research Centre (CRC) for Low Carbon Living, *Visions and Pathways 2050* aims to explore and articulate visions, scenarios and policy-technology pathways for a low- to zero- carbon built environment in Australia. The program involves three universities

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(University of Melbourne, UNSW and Swinburne), CSIRO and a large number of government and industry partners, and has been initially funded for four years and was officially launched in October 2013. Based on wide stakeholder engagement, including workshops, expert reviews and inputs from CRC research, the project aims to characterise possible futures, understand and analyse socio-technical innovations to realise them, and identify policy, research, investment and governance implications.

This activity aims to serve as both a valuable process for the CRC as well as delivering on CRC outputs for stakeholders and the wider community. Bringing together the technical, economic and social aspects of low carbon living can help build the network of CRC participants, uncover and explore key interrelationships and uncertainties across CRC projects, and create a forum for wider engagement. Envisioning low carbon futures is also understood to be critical for developing sufficient community support to use such futures to back-cast pathways for transitional change.

There is a lot of valuable research already in this space from initiatives and projects in Australia, but this knowledge is largely fragmented across different domains. The role of the project will be very much in synthesising such knowledge and using it as a base to provoke, explore and test, first through research and then in workshops, possible coherent and feasible visions and pathways for low- to zero-carbon urban living in Australia. The project has also established collaborative linkages to some large EU projects developing scenarios for low-carbon retrofitting of existing built environments, for low-carbon lifestyles and consumption and for creating innovative sustainability pathways for cities. These collaborations will also provide critical input to the scenarios developed. While the project has only just begun and there are no results to present, it is hoped that conveying the aims and methodologies of this venture may provoke further interest and involvement in this collaborative project.

The outline of this paper is as follows. Section 2 briefly describes the systems level and cross-disciplinary thinking that we believe is necessary to achieve transformative change to sustainable living. This includes understanding the interlinking of technologies, institutions, infrastructures, values, attitudes, perceptions and social practices. Section 3 discusses the value of using visioning and backcasting, which will be a core methodology of the project. Section 4 briefly describes some other projects that have provided inspiration or will be involved in collaboration with the project. Section 5 provides background on the CRC for Low Carbon Living, within which the *Visions and Pathway 2050* project is an integrating venture. The methodology and project phases are presented in Section 6. Section 7 concludes the paper.

2. Transformative socio-technical change in the urban environment

The challenges of climate change and end of the fossil fuel era are well known (IPCC, 2007). Similarly, in accounting for three quarters of global energy demand and greenhouse gas emissions, the role of cities and urban lifestyles has been identified as a crucial element of any attempt to respond to these challenges (UNEP, 2011; Newton 2011; Ryan 2013). However, there is less agreement as to whether the significant declines in energy use and greenhouse gas emissions that scientists say are necessary can be achieved by means of simple incremental improvements in efficiency and waste reduction (mostly via, say, technical improvements to products and processes) that keep our lifestyles and surrounding physical and social infrastructures relatively unchanged. Increasingly the view is that there needs to be a radical and transformative restructuring of our most fundamental systems for urban living. It is the potential necessity of the latter that is a key focus of the *Visions and Pathways 2050* project.

Radical systems innovations or transitions involves “innovations that are directed to redesigning entire systems of practices and provisions, instead of individual products or processes” (Sterrenberg et al, 2013, p.9). These include the domains of housing, mobility, food, community practices, city infrastructures and urban form. By widening the boundaries to include the entire system, the sustainability gains that are achievable are potentially much greater than those from single product or process innovations that are the focus of traditional eco-design or end-of-pipe innovations.

Furthermore, the systems perspective of transitions approaches encapsulates more than just technological innovation but also involves social and (infra)structural innovations. This is a recognition of the importance of institutions, regulations, social norms, networks, and physical infrastructures that enable and constrain our (un)sustainable behaviours. This also means, as highlighted in social practices theory,

avoiding reliance on a simple, linear, rational and individualised conception of human attitudes and actions that are employed in some behavioural economics approaches to sustainability (Doyle and Davies, 2013). Our behaviours are embedded into our surrounding physical, social and cultural environment (Ryan 2013) and addressing the inertia or 'lock-in' that consequently arises is critical for understanding how to achieve major transformative change.

Recognizing the full complexity of our economic and social systems and the possibility of disruptive system-wide changes rather than just incremental changes differs from the traditional approach of mainstream neo-classical economics. The latter draws much of its analytical power from the idea of perfect rationality and so-called 'marginal' analysis. Marcuzzo and Rosselli (2011) and Foxon et al (2013) provide a nice illustration of the weakness of marginal analysis via comparisons of two passages by esteemed economists: one by Alfred Marshall, a hugely influential figure in the establishment of neoclassical economics and the other a response by Piero Sraffa, a well known detractor of aspects of neoclassical economics. In the first passage they quote Marshall's explanation of the relevance of marginal analysis in the case of a train service manager, followed by Sraffa's doubts:

... an alert manager is constantly weighing the net product in saving of time and of annoyance to passengers, that will accrue from the aid of a second guard on an important train and considering whether it will be worth its costs. (Marshall, 1920, p. 5)

Sraffa never found this representation convincing, and made reference to it on various occasions over the years. He eventually wrote on 29 March 1963:

This suggests that his [the alert manager's] *main* task is to sack a porter here, add a coach to a train there, or shorten a platform elsewhere. The idea is that the process of change can be reduced to a continuous process, like shortening platforms. 'A penny is the basis of a million', and so a process of shortening, adding, sacking in detail is the route from one position to another. In Marshall's view the 'alert Dr. B' never needs to take a bird's eye view of his enterprise. (D3/12/42/12)
(Marcuzzo and Rosselli, 2011, p.224–225; Foxon et al, 2013, p.188)

The systems view that is adopted by the *Visions and Pathways 2050* project means having such a 'bird's eye' view, generated through visioning and scenario exercises, to see the bigger picture of what changes to our various structures and practices is required and what policies and strategies could bring them about.

In adopting this standpoint, there are a number of overlapping schools of thinking that one can draw upon (Foxon et al., 2013). These include complexity economics (Beinhocker, 2005; Dolphin & Nash 2012), evolutionary and institutional economics (Marletto, 2013), ecological economics (Barker, 2011), social practices theory (Cohen et al 2013); socio-technical transition theory and transition management (Geels, 2004; Sterrenberg et al, 2013) and 'back-casting' (Vergragt and Quist 2011).

These schools have different emphasis in focuses, levels of analysis and the tools they use, and thus do not provide a single coherent body of thought. Nevertheless, there are a number of overlapping themes. Beinhocker (2006) offers the following useful summary of the main themes that characterize what he terms Complexity Economics, as they contrast with traditional Neoclassical economics, but could also fairly be used to characterise the other alternatives school above:

- (i) *Dynamics*: The complex economy is thermodynamically open, dynamic, nonlinear, and generally far from equilibrium.
- (ii) *Agents*: In the complex economy, agents have limited information and face high costs of information processing. However, under appropriate conditions, they evolve non-optimal but highly effective heuristics for operating in complex environments. There is no assurance that when faced with novel environments, individuals will shift efficiently to new heuristics. In the neoclassical economy, by contrast, agents have perfect information and can costlessly optimize.
- (iii) *Networks*: Agents in the complex economy participate in sophisticated overlapping networks that allow them to compensate for having limited information and facing formidable information processing costs. In the neoclassical economy, agents do not interact at all. Rather, each agent faces an impersonal price structure.

- (iv) *Emergence*: In the complex economy, macroeconomic patterns are emergent properties of micro-level interactions and behaviours
- (v) *Evolution*: In the complex economy, the evolutionary process of differentiation, selection, and amplification provides the system with novelty and is responsible for the growth in order and complexity. In the neoclassical economy there is no mechanism for creating novelty or growth in complexity. (p.97)

In applications to questions of sustainability and applied research, probably the most active is the socio-technical transition theory and transition management school that has increasing influence in European policy most strongly in the Netherlands and Scandinavia. The *Visions and Pathways 2050* project, as well as many of the exemplar projects discussed below, are particularly guided by this strand of conceptualizing sustainability transitions, although building on other Australian and European research and practice, including that of the lead institution for this project – the Victorian Eco-Innovation Lab (VEIL) at the university of Melbourne (VEIL 2013; Ryan 2013; DESIS 2013; Vergragt and Quist 2011). In these projects there is a greater emphasis on the role of alternative *visions* of (non-business-as-usual) futures as a significant point for intervention in the feedback loops between the multi-levels of the transitions model, in particular as a way of exposing tensions at the socio-technical landscape level and then connecting those tensions to alternative innovations (existing or to be created) at the niche level (Ryan 2009a).

3. The value of visioning and backcasting

In this augmented transition theory approach, the creation of visions is an important first step in the challenge of turning aspirations for a sustainable society into practice. Visioning can be seen in the context of three types of futures thinking (Sterrenberg et al., 2013; Wangel, 2012):

- *Predictive futures*, which aim at answering the question of what is the most likely future and is often based on trend extrapolation or econometric style modelling. The usefulness of such predictions usually depends on the whether the phenomenon under study is characterized by low complexity and low uncertainty.
- *Explorative futures*, which accepts that making point predictions of the future is often an unwise endeavour and shifts the question from "what will happen" to "what could happen". Scenario planning/analysis, pioneered by Shell in the 1970s, is representative of this approach.
- *Normative or desirable futures*, which usually focuses on longer time spans and preferred societal systems which are normative in nature and reflective of the structural and societal changes required to pursue sustainability. This scenario process is intended to produce a picture of the future we (collectively) want. The question then becomes: "what do we actually want the future to look like?". Börjeson et al. (2006) define two different kinds of normative scenarios. 'Preserving normative scenarios' can meet their targets without major institutional or structural change, whereas 'transformative normative scenarios' require such change.

Both the predictive futures and explorative futures are useful in transitions studies for understanding unsustainable trends and creating robustness in policies and strategies. However, in the transitions literature, most of the attention goes to normative futures (where the term 'visioning' is used in a more generic sense than the specific process of creating engaging and communicable visions of futures as an active intervention to build shared social and political commitment to a transition) (Rotmans and Kemp, 2001; Berkhout et al., 2004). There are a number of reasons for this:

- Firstly, visions can challenge what is conceived as possible (Wangel, 2012). As Quist and Vergragt (2006, p.1035) note, visions are not only analytical constructs employed by researchers but are also social constructs. Some type of image of the future (often the status quo or trend thereof) shape the practices of today and therefore reproduce themselves tomorrow (Ryan 2002a; 2002b). Thus Grin and Grunwald (2000) argue "that one way to shape socio-technological systems is through the visions that guide their development... the assumption is that these visions exist already in most societal sectors, that these visions tend to reproduce the ways in which these sectors have developed hitherto, and that a critical discussion of these visions is a prerequisite for changing the course of development". A recent case of visioning work resulting in

the realignment of mainstream thinking is the development of 100% renewable electricity system plans for Australia. Until only recently this was scorned as a crack-pot idea, however the pioneering work of institutions such as Beyond Zero Emissions and UNSW have brought the idea into mainstream consideration such that even the Australian Energy Market Operator (AEMO) is now producing 100% renewable energy scenarios as part of its strategy planning process.

- Secondly, visions can be used to problematise the current sustainability trajectories and demonstrate the tension between short term actions and long term goals by illustrating the gap between visions where sustainability targets are met and those that cannot be reached without more radical changes than are being proposed today (Wangel, 2012).
- Thirdly, visions can be utilised to build and bind the network of actors and have a role in the integration and alignment of different constituencies of actors towards a common aim. Visions can similarly serve as bridge between different cultures (e.g. engineers, architects, economists, social scientists) and contribute to learning between the actors. Furthermore, they provide a ground towards which to orient the perceptions, decisions and behaviour of actors in the process of developing and enaction of policy and strategies (Ryan op cit; Rohracher, 2008)
- Fourthly, visions can be used to set a framework and reference point for target setting and monitoring (Smith et al., 2006).
- Fifthly, visions can be a place to examine conflicts or synergies between sustainability and other societal goals (Höjer et al., 2011; Robinson, 1990)
- Finally, visions can be inspiring and have mobilizing power for sustainability action (Ryan op cit; Sterrenberg et al, 2012).

Visions do not always have to be radical, but sustainability visions do often contain out-of-the-box ideas that break with the dominant way of thinking of how things must be; a feature of bottom up or 'grassroots' innovations of sustainable development (Seyfang and Smith 2007). In the follow-up to envisioning a system innovation, a typical exercise involves tracing back the vision to the present in a process called back-casting (or 'revealing the present' where niche, novel and 'outsider' innovations exist unseen within the mainstream economy) (Ryan 2013; Geels and Schot 2007). Here the aim is to determine what should be done to reach the desired future. There are a number of different views and practices of backcasting (see for a review; Vergrag and Quist, 2006) and the exact approach to be taken in the *Visions and Pathways 2050* project has not yet been decided.

4. Related Australian and overseas projects

In Australia, there are, or have been, a number of research projects and initiatives on many elements of low carbon living that will provide valuable resources and inspirations for the *Visions and Pathways 2050* project. These include work in buildings and housing (e.g. ClimateWorks, 2013; Newton and Tucker, 2011; Zero Carbon Australia, 2013), cities (e.g. City of Sydney, 2008), energy and transport visions (e.g. CSIRO, 2006) and nation-wide sustainability (e.g. DSEWPC, 2013). One of the major partners of the project, the Victorian Eco Innovation Lab (VEIL) has conducted scenario research and modelling and co-production of twenty-five year visions for Victorian neighbourhoods (Ryan, 2011) and their physical modelling of multiple scenarios for food production in Australia (Turner et al, 2012). Furthermore, also at the University of Melbourne, the Victorian Centre for Climate Change Adaptation Research (VCCAR) has conducted research on the use of climate scenarios for adaptation policy (Wiseman et al, 2011).

However, there has been no broad based work as proposed here that links together a diversity of scenario and visioning processes, reviews of innovation niches, potentially disruptive socio-technical innovation, barriers analysis, low-carbon community visions, back-casting/pathways and transition scenarios, all within a socio-technical and transitions theory framework. The CRC for Low Carbon Living is in a position to draw upon the wide range of expertise and resources that are available to the CRC, including the knowledge being gained from embedded community ateliers and living laboratory interventions by VEIL; what-if modelling of urban design options, by the MUTOPIA team in engineering at Melbourne University and projects of urban visioning and neighbourhood transition by various researchers in urban design and landscape at University of Melbourne and UNSW. A similar and growing knowledge base in these areas is developing within many of the CRC industry and government partners, a knowledge domain that is critical to strategic planning and investment in social capital for those partners and one that can be greatly enhanced by the CRC network and activity.

The approach taken in this project of using a participatory processes of envisioning futures, reviewing trends in niche socio-technological innovation, back-casting from these futures and then developing transition strategies, does have some similarities to a number of recent international projects in Europe. The focuses vary; some concentrate on sustainable consumption and mobility, whereas others have a greater focus on urban form and city design. Key projects that the project will collaborate with, or draw on data and scenarios that will be interrogated for the areas of relevance in the Australian context, include:

- RETROFIT 2050: an urban foresight and transition management study involving six universities in the UK focusing on social and technological options for systemic retrofitting of houses in the UK. The project is running from 2010-2014, crafted around (i) problem framing and identification of key drivers and issues (ii) developing a set of annotated visions of sustainable cities at the building, neighbourhood and city-regional levels, including narratives of a day-in-the-life of residents in such cities, and (iii) analysing the co-evolutionary dynamics of socio-technical innovation and providing narrative descriptions of prospective pathways, including technology and policy roadmaps, for reaching the visions. The project then intends to translate the contextual socio-technical scenarios to explore their prospective implementation in two specific case study regions (Cardiff/SE Wales and Greater Manchester).
- SPREAD Sustainable Lifestyles 2050: a major European social platform project running from January 2011 to December 2012, supported under the European Commission's Seventh Framework Programme (FP7). Different societal stakeholders - from business, research, policy and civil society - were invited to participate in the development of a vision for sustainable lifestyles in 2050. Across a series of workshops, their work focused around four key areas: sustainable living (homes), moving, consuming and healthy living. They developed four different sustainable lifestyle scenarios based around two critical uncertainties – whether technology becomes globally uniform or locally variant and whether society's governing principle is either human centric or meritocratic. Using a back-casting approach they developed concrete action and research roadmaps with a timeline on how to achieve sustainable lifestyles by 2050. The work included a breakdown of ecological footprints, which limited people in all scenarios to 8000 kgs per person per annum.
- CONSENSUS is a 4 year collaborative research project (2009-2013) involving Trinity College Dublin and National University of Ireland, Galway, and examines four key areas of household consumption: transport, energy, water and food. It is seeking to address four key themes: how consumption can be measured and evaluated; how sustainable behaviours and incentives are being developed and implemented; identifying links between consumption, health and well being; and finally how matters of household consumption are being governed through institutional practice and participation. They have adopted a social practices framework, within which people are the carriers of practices which hold together and reinforce the system of consumption through their continuous enactment of practice. The group have positioned participatory visioning and backcasting methods as the key methodology for their work.
- CORPUS was another European FP7 project running from 2010-2012 whose main objective was enhancing the connectivity between research and policy-making in sustainable consumption and fostering evidence-based policy-making in three particular areas: food, mobility, and housing. A key output from this work, *Sustainable Street 2030*, is a set of images and videos providing snapshots of different aspects of possible sustainable living in 2030.
- CRISP (CREating Innovative Sustainability Pathways) is another EU FP7 project running from 2011-2014 and has a team from several EU countries whose core objective is to identify sustainable low carbon futures and pathways. Their aim is to recommend new policy mixes and innovative cooperation mechanisms that will support and promote transitions, employing transition scenarios and participatory backcasting approaches to ensure people of all ages and backgrounds are actively involved in the discourse on sustainable development.
- *Images of the Future City: Time and Space For Sustainable Development*, was a research project of fourteen researchers in Sweden from numerous disciplines that offered scenarios of a future sustainable city, including travel, housing, eating and consumption. The scenarios were based around urban form and pace of life and used Stockholm in 2050 as the geographical and temporal setting.
- The global Design for Social Innovation and Sustainability (DESIS) project with university linked 'designing the future' projects in 18 countries.

- Future Cities Catapult, a global centre of excellence on urban innovation being established in the UK.
- UNEP - Global Initiative for Resource Efficient Cities.

5. The CRC for Low Carbon Living

The CRC for Low Carbon Living is a multi-disciplinary effort to enable Australia to reduce carbon emissions and transform the built environment to a low carbon future. The centre is headed by Professor Deo Prasad and was launched in December 2012. The CRC is funded to \$100 million by industry and government over seven years. Participants in the CRC include industry (property developers, materials suppliers, energy specialists, architects, planning, urban design and engineering service companies and built environment related peak bodies), state and federal governments, city councils, universities from Australia, Europe, Asia and North America, public utilities, planning agencies, the national standards organisation, TAFE and CSIRO. The collaborative activity of these partners is aimed at developing new and practical technological, social and policy tools, products and strategies for reducing greenhouse gas emissions in the built environment.

The CRC is divided into three programs:

- Integrated Building Systems
- Low Carbon Precincts
- Engaged Communities.

The *Visions and Pathways 2050* project has been developed explicitly as a cross-cutting flagship project for the CRC with the aim of serving a number of functions, supporting the interdisciplinary and integrative spirit of the CRC, bringing together of experts from the various physical and social sciences across the CRC, other experts, built-environment professionals and members of the general public, in a series of workshops with the purpose of:

- Visioning future low-carbon futures (building systems, urban form, infrastructure, systems of provision and lifestyles);
- proposing innovation pathways for reaching those futures;
- providing consistency and harmony across the CRC on various modelled assumptions and scenarios that may be used as input into other CRC research;
- assisting in identification of areas of research that the CRC may consider prioritising;
- promoting the CRC's identity by mapping out and advocating a vision for Australia's low carbon future.

As outlined above, reflecting the interdisciplinary spirit of the CRC, these project aims have been framed within a socio-technical and innovation systems framework which recognises sustainable development as a complex adaptive system and sees physical technology and infrastructure as but one element within a dynamic of knowledge systems, social innovation, culturally and individually established practices and behaviours for a network of various different actors (Geels 2004; Geels and Schot, 2007; Suurs, 2009; Shove and Walker 2010).

6. Methodology and project stages

The methodology to develop the visions and transition scenarios particularly draws upon the theoretical and practical insights gained in recent work in the transitions research space as described above. The project also borrows from the wider literature on scenario generation (Börjeson et al 2006). The Victorian Eco-Innovation Lab (VEIL) at Melbourne University also has five years of research refining a methodology for engagement across disciplines and sectors using a 25-year horizon for visions of low carbon resilient urban environments and a complementary capability is developing at Swinburne University (a partner in the development of the early VEIL methodology). The VEIL methodology (drawn from action research, design research, back-casting and scenario development) was first tested in a global project with EU and

Australian funding (Eco-Sense) in 2004-7. It is now used in support of projects funded by the Natural Disaster Resilience Fund, VicHealth Innovation and Discovery grants, and the ARC.

A recursive process of workshops over the four years to be held in Sydney, Melbourne, Adelaide and Perth (involving the CRC partners, representatives of the research, business and government sectors, relevant professional bodies and the general public), will use various approaches to public engagement, scenario generation and planning, visualisation, back-casting and road-mapping. The work will mark out indicators of what directions we need to take to move towards these futures. The approach in this project is consistent with methodologies adopted for the consideration of 'wicked problems' (APSC 2007).

The workshop engagement-visualisation process will provide an opportunity for critical public reflection on research and case studies brought to it by the CRC partners (from all CRC related research projects). This will be an important testing ground for understanding the interrelationships between those research projects and the complex interactions that can occur with the diffusion of technology and system innovations into new contexts, or from scaling them up. Most importantly this process will help ensure that all CRC research projects take into account their social, economic, cultural and policy dimensions.

The project is being implemented through a set of overlapping work programs that are expected to evolve over the life of the project and are summarized below:

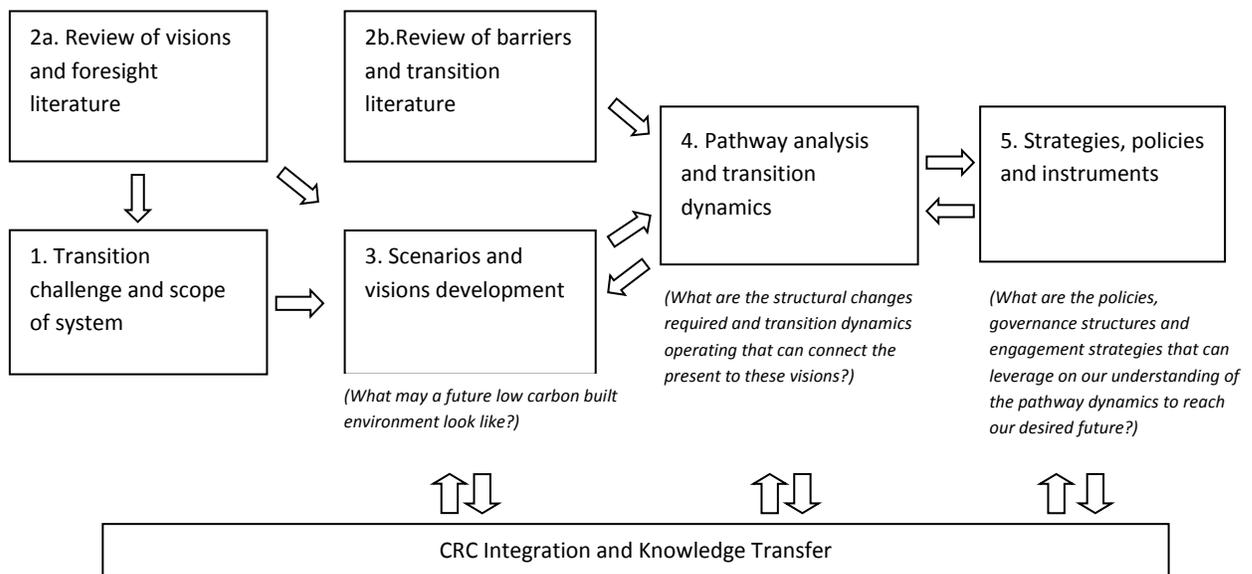


Figure 1. Project work program

1. Transition challenge and scope of system (underway)

The first work-package involves internal project discussions working sessions as well as consultations with wider partners to define the detailed goals of the project including a clear formulation of the transition challenge to be examined and other demarcations of the scope of the project. An important aim here is to guide the research so as to maximise its relevance and the usefulness of its outputs. Scoping and boundary setting involves decisions about which contributions of urban systems are to be considered (energy, water, food, transport, construction, waste) as well as about appropriate scales for scenario projections.

2. Review of visions and transition research and emerging disruptive innovations (underway)

The second work-package involves desktop research as well as communication with selected international programs aligned with the aims of this project. It prepares the visions and transitions pathway work and provides current background intelligence for the workshops from (a) current visioning and scenario research and processes; (b) low carbon urban development, including emerging innovations (social and technical), post-carbon pathway planning, urban adaptation; (c) barriers that inhibit the movement to a low carbon built environment and (d) current theories of transition and disruptive change, innovation and transition. This research builds on the range of future

technology and innovation oriented research projects based in the two centres at UNSW and Melbourne University that will host two researchers for this project (along with work of the Swinburne Institute for Social Research and the International Post-carbon Pathways project). An important contribution to this project will involve CRC work related precinct-scale transformation and from early Living Lab projects supported by the CRC.

3. *Engagement and consultation - scenarios and visions development (planned)*

Work program 3 will involve the creation of scenarios and visions of a low carbon built environment in Australia in 2030-2050. These scenarios and visions will derive from a wide engagement process including an iterative series of workshops and consultations, backed by the on-going research from WP2. This WP will provide the CRC stakeholders with on-going strategic intelligence about the likely future shape of a low carbon future and the trajectories of change – social, technical, organisational, and policy – that could help achieve the desired futures (inputs to sector and partner specific roadmaps). Linkages to the current ‘foresight’ and ‘back-casting’ projects listed above (and others as they emerge) will be critical to the success of this work program (tapping into their greater resources and international expertise). Subject to budget constraints, the project will aim for six workshops (commencing in the first half of 2014) covering Sydney, Melbourne, Adelaide and Perth. Invitees will include CRC members and other participants, including built environment organisations (architects, urban designers, builders, property developers, planners), government policy officers, other built environment professionals as appropriate and relevant NGOs. With further work by the project team on synthesizing and developing the results, the output of this engagement process will be a cumulative set of characterisations of socio-technical and design innovations for plausible low carbon urban futures (including possible outliers or wild cards). These characterisations will form the ‘briefs’ for a design and visualisation process to communicate visions of future Australian urban possibilities.

4. *Pathway analysis and transition dynamics (planned)*

Building upon the outputs of WP 2 and 3, WP4 will seek to illuminate and provide descriptions of the prospective pathways from the present to the envisioned futures. Following Sondejker (2009), this stage can be broken down into (a) identifying the *necessary structural changes* in culture, structure and practices to bring about the possible futures; this includes identifying what structural changes need to be *built up* and what need to be *broken down*, and (b) identifying the *drivers of the structural change*. Linkages to the other ‘foresight’ and ‘back-casting’ projects mentioned above will be critical to the success of this work program (tapping in to their greater resources and international expertise).

5. *Strategies, Policies and Instruments (planned)*

WP 5 will use the previous insights and understandings to suggest, consider and select potential strategies, (novel) governance structures and policy instrument mixes that can help facilitate and support the positive dynamics that have been identified as potential drivers of structural change.

As the project evolves it will provide a ‘space’ for ongoing interaction with other projects within the CRC for Low Carbon Living. It is anticipated that this might lead to new break-out research projects as the knowledge from this program impacts on others.

For the findings to contribute towards driving the transition to a low carbon built environment they need to reach the government, industry and the community widely. This will be achieved in part through the wide involvement of practitioners who will jointly contribute in the consultative processes. It is also to be achieved through the use of the ‘visions’ (digital images) by the CRC throughout its many publications and through their diffusion into the extensive VEIL (national and international) network of design and planning professionals. Those same ‘visions’ will also be made available to the participants, in all the consultative processes, who would be likely to disseminate them through their own networks. In various projects for government and industry partners, VEIL has demonstrated the power of the dissemination of ‘visions’ as a way to shift thinking and strategic investment (and innovation trajectories) and, as in this case, draw in a greater audience for the more detailed innovation reports and roadmaps that the visions encapsulate. It is acknowledged that different users will have different interests and needs, and an ongoing role of the project will be to seek how to address such interests and ways (within budget limitations) to tailor information to identified audiences. Finally there is a clear recognition that the scenarios and visions will need, at some point, to be ‘translated’ into estimates of quantitative improvement in reductions of

greenhouse gas emissions. This is a complex issue as any modelling will have to consider the aggregate impacts of economy-wide adoption of alternative products or new systems of production and consumption, clearly relevant, for example, in the wide-scale adoption of changes in multiple domains – e.g. new building designs, new materials, new transport systems and new behaviours. It is critical that a low-carbon transition is tested within the context of a changing population and economy and within the natural constraints associated with environmental resources (e.g., fuels, water). In one of the ‘parallel’ projects of VEIL (an ARC linkage project) the ex-CSIRO, now University of Melbourne, Australian Stocks and Flows (ASFF) model (Turner et al 2012; Larsen et al 2001) is being modified to provide a much finer-grain spatial delineation for its dynamic calculations (down to SLA level). Other research projects to link the Visions and Pathways work to ASFF modeling for metropolitan Melbourne are in development, with the intent of providing quantitative outcomes for carbon reduction.

7. Conclusion

There are many valuable research projects and initiatives in Australia that are identifying barriers, solutions and potential trajectories for achieving more sustainable outcomes in various aspects of our living. However, much of this knowledge is currently fragmented into sector based projects. A key aim of the *Vision and Pathways 2050* project is to bring together current knowledge, experience and imagination in order to develop a more holistic vision of low- to zero-carbon living that can both bind and mobilise action.

Visioning and backcasting can be characterised as a view of the future as something that becomes, or is designed or created, rather than something that only needs to be predicted and accommodated. Undoubtedly, as complexity science would suggest, deep uncertainties and forces beyond our control mean that any plans or roadmaps towards a desired future are likely to be sideswiped by unexpected developments in the technological, economic, social or natural environment. Hence, resilience and robustness needs to be incorporated into any action plan that translates desirable visions into short-term policies and strategies. Combined, visioning and resilience means that we can proactively shape the direction we want society to head while readying for the surprises that we will undoubtedly encounter.

In creating such change it is vital to recognize the institutions and structures that facilitate and constrain our (un)sustainable practices and which create a persistence that can be difficult to escape from. While incremental innovation can be accommodated under such circumstances, radical innovation will often run up against institutional barriers. The value of visioning is to allow one to make leaps of imagination that turn institutions and structures into changeable elements that can be innovated themselves rather than accepted as immutable inheritances from our past.

Finally, to facilitate transformative change requires acknowledging that it is a collaborative, multi-actor and multi-level process that will involve business, government, research and civil society. By bringing together stakeholders in a dialogue process to develop visions and pathways for a more sustainable future, the *Visions and Pathways 2050* project and the CRC for Low Carbon Living can hopefully make a small contribution towards this transformative change for Australia.

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