Roadmap for Carbon Structural Adjustment in the Built Environment Sector

A Sustainable Built Environment National Research Centre (SBEnrc)

Industry Report

LOW CARBON LIVING CRC COLLABORATOR

Sustainable Built Environment National Research Centre

Core Partners:

GOVERNMENT OF WESTERN AUSTRALIA

Queensland Government

Curtin University

Griffith UNIVERSITY

aurecon

SWINBURNE UNIVERSITY OF TECHNOLOGY

John Holland

NSW GOVERNMENT Transport Roads & Maritime Services

University Research Team

Program Leader: Prof. Peter Newman (Curtin)
Project Leader & Researcher: Karlson 'Charlie' Hargroves (Curtin)

Project Steering Group

Meg McDonald, *CEFC (Chairperson)*
Keith Hampson, *CEO, SBEnrc*
Peter Newman, *Curtin University Sustainability Policy Institute*
Carolyn Marshall, *WA Department of Finance*
Damon Carter, *John Holland Group*
Angela Heymans, *WA Building Commission*
Daniel Ellis-Jones, *WA Building Commission*
Amandine Denis, *ClimateWorks Australia*
Con Lambous, *NSW RMS*
Dr Hugh Saddler, *Energy Economics and Policy Expert*
Louis Bettini, *Main Roads Western Australia*
John Thwaites, *Sustainability Policy Expert*

Acknowledgements

The paper has been developed as part of the Sustainable Built Environment National Research Centre (SBEnrc) 'Greening the Built Environment' Program, led by Professor Peter Newman. The project is supported by the Western Australia Government Department of Treasury, Queensland Government Department of Transport and Main Roads, Main Roads Western Australia, John Holland Group, and the New South Wales Roads and Maritime Services. The research is advised by ClimateWorks Australia and, the Clean Energy Finance Commission. The research team is based at the Curtin University Sustainability Policy Institute (CUSP).

Citation: Hargroves, K. (2014) Roadmap for Carbon Structural Adjustment in the Built Environment Sector – A Report to the Sustainable Built Environment National Research Centre, Curtin University Sustainability Policy Institute, Curtin University, Perth.

Table of Contents

Accelerating the Transition to a Low Carbon Built Environment

Introduction

Governments around the world are recognising that a 'carbon-constrained future' lies ahead, and that leadership is needed to transition economies to low carbon operation, especially in the area of public procurement. By the end of 2014 the world's largest economies had set ambitious greenhouse gas emissions targets with:

- European Union committing to reducing emissions by at least 40 per cent by 2030 (compared to 1990 levels),
- China committing to 40 to 45 per cent by 2020 (compared to 2005 levels),
- India committing to 20-25 per cent by 2020 (compared to 2005 levels), and
- United States of America committing to 26-28 per cent by 2025 (compared to 2005 levels).

These ambitious targets will create significant pressure to reduce emissions in the coming decades in a manner that delivers ongoing prosperity, jobs, and profits. According to the project Leader Charlie Hargroves, this means that 'we are going to need to quickly move from amazing showcases of green buildings and lighthouse projects that are showing the world how to be more sustainable and transition into updating the structures of our economy'.

The key to preparing to meet such ambitious targets is to have a clear awareness of where we are now, where we would like to go, and how we can get there. This report outlines a roadmap taking actions to deliver on emissions reduction targets in a way that involved various actors across society appropriately.

Situational Awareness: Where are we now?

Environmentally Induced Economic Decline

In the 21st Century much of the world will experience untold wealth and prosperity that could not even be conceived only some three centuries ago. Much of this prosperity has been based on rapid industrialisation, mechanisation, electrification, and digitization, beginning in the mid 1700's with the Industrial Revolution. However as with most, if not all, of the human civilisations over the last 5,000 years such increases in prosperity have accumulated significant environmental damage that threaten to result in what esteemed sustainable development expert Lester Brown refers to as 'environmentally induced economic decline.

World leaders will face a range of serious global environmental, social, and economic challenges throughout the 21st Century, with one of the most pressing due to the fact that the fuel source that has underpinned the industrial revolution and allowed the staggering amounts of development in much of the world, namely fossil fuels, is now widely recognised to have a sinister legacy. The combustion of fossil fuels such as oil and coal

has resulted in the generation of vast quantities of air pollution, a proportion of which that along with specific agricultural and industrial emissions are increasing the heat captured by our atmosphere, and are referred to as 'greenhouse gases'.

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased. **Intergovernmental Panel on Climate Change (2014)**

An Issue Whose Time has Come

Following significant advances in technology in the mid to late 1700's many were focused on ever expanding development with little concern for the potential for environmental impacts. Apart from a few lone voices such as Svente Arrhenius in the late 1800's that raised concerns for such an eventuality it was widely considered very unlikely that the activities of industrialising countries could generate enough pollution to affect the entire globe on a meaningful scale. At the time the idea must have sounded ludicrous. However these few voices became many voices by the late 1900's, leading to the build-up of scientific investigation and industry experimentation that has now led to the world

<table>
<tr><td rowspan="3">CO_2eq concentrations in 2100 (CO_2eq)
Category Label (concentration range)</td><td colspan="4">Temperature change (relative to 1850-1900)</td></tr>
<tr><td colspan="4">Likelihood of staying below temperature levels over 21st century</td></tr>
<tr><td>1.5 °C</td><td>2.0 °C</td><td>3.0 °C</td><td>4.0 °C</td></tr>
<tr><td>450
(430-480)</td><td>More unlikely than likely</td><td>Likely</td><td rowspan="4">Likely</td><td rowspan="7">Likely</td></tr>
<tr><td rowspan="3">500
(480- 530)</td><td rowspan="5">Unlikely</td><td>More likely than not</td></tr>
<tr><td>About as likely as not</td></tr>
<tr><td rowspan="2">More unlikely than likely</td></tr>
<tr><td>550
(530-580)</td><td rowspan="3">Likely</td></tr>
<tr><td>(580-650)</td><td rowspan="3">Unlikely</td></tr>
<tr><td>(650-720)</td><td>More likely than not</td></tr>
<tr><td>(720-1000)</td><td>Unlikely</td><td>More unlikely than likely</td></tr>
<tr><td>(+1000)</td><td></td><td>Unlikely</td><td>Unlikely</td><td>More unlikely than likely</td></tr>
</table>

Table 1: Key characteristics of the scenarios collected and assessed for The IPCC Working Group III of Assessment Report 5. Source: IPCC (2014)

entering the 2000's with much of its attention fixed on the issue of reducing pollution from the use of fossil fuels as a matter of urgency, among a number of other pressing challenges.

In the 1700's if it were possible to comprehend the future impacts of a fossil fuel based system it may have been feasible to take action to reduce such pollution with a global population of less than 700 million people. However, today in a world with over 7 billion people the potential for large scale change in the basis of the energy system is a seemingly overwhelming and complex challenge. Especially considering the tools and strategies that have led to the highly successful fossil fuel based economy may not be as useful to help transition to low carbon operation, and new tools and strategies may be needed. Ironically it may also prove to be the case that without having first harnessed fossil energy to develop primary industries it may have been impossible to develop technology required for a transition to large scale non-fossil based energy production (such as through solar photo-voltaic panels, solar thermal, wind turbines, ocean turbines, fuel cells, geothermal, cogeneration equipment etc…). This highlights the fact that the early part of the 21st century is indeed an era of major transition, one that requires a long term strategic approach.

> *Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.* **Intergovernmental Panel on Climate Change (2014)**

Opportunities for Australia

This has been understood by some parts of the Australian economy for over a decade. In 2004 the Australian Council for Infrastructure Development pointed out that '… sustainability offers companies a way to grow their businesses and provides a new impetus for attracting investment in the nation's infrastructure requirements'. In 2006, the Energy Supply Association of Australia (ESAA) recognised that climate change was a key factor influencing decisions over Australian energy infrastructure. The Environment Business Australia 'Targets for Our Future' report in 2007 outlined key research that showed Australia could achieve 50 percent reductions in greenhouse gas emissions by 2020.

Such findings are supported by numerous other studies, which show that through initial investment in energy efficiency, Australia can achieve significant emissions cuts, and become a regional hub for technologies and industries associated with lower greenhouse gas emissions, in a cost effective manner. According to the Sustainable Development Solutions Network, led by Professor Jeffery Sachs:

> *'There are strong reasons to believe that the necessary technologies for deep decarbonization are within reach from an engineering and cost standpoint. But their commercial readiness needs to be accelerated by providing appropriate policy support and by building public-private partnerships on research, development, demonstration, and deployment'.*

Aspirational Awareness: Where do we want to go?

Preventing Dangerous Anthropogenic Interference with the Climate System

In 2010, Governments of the world responded to the objective of the UNFCCC to 'prevent dangerous anthropogenic interference with the climate system' by setting a target of achieving a global rise in mean surface temperature of no more than 2°C higher than the pre-industrial average. This target has been adopted by the 'The Deep Decarbonization Pathways Project', led by Professor Jeffery Sachs, initiated to support the United Nations Sustainable Development Goals, and will be adopted as the goal of this roadmap.

Considering this goal in terms of concentration of greenhouse gases in the atmosphere the IPCC 5th Assessment Report provides the likelihood of a range of concentrations resulting in particular increases in mean surface temperature, as shown in Table 1. Hence if the goal of 2°C is to be achieved the concentration of greenhouse gas emissions needs to be in the order of 450-550ppm.

Greenhouse Gas Stabilisation Trajectories

The key to achieving such concentrations is the balancing of efforts to achieve a peaking of emissions (effectively halting in the short term the growth of emissions) and the corresponding tailing off of emissions annually (over a number of decades). The combination of a 'Peak' and corresponding 'Tail' creates what Stern (2006) refers to as a 'Stabilisation Trajectory', with each trajectory having a different impact on the economy.

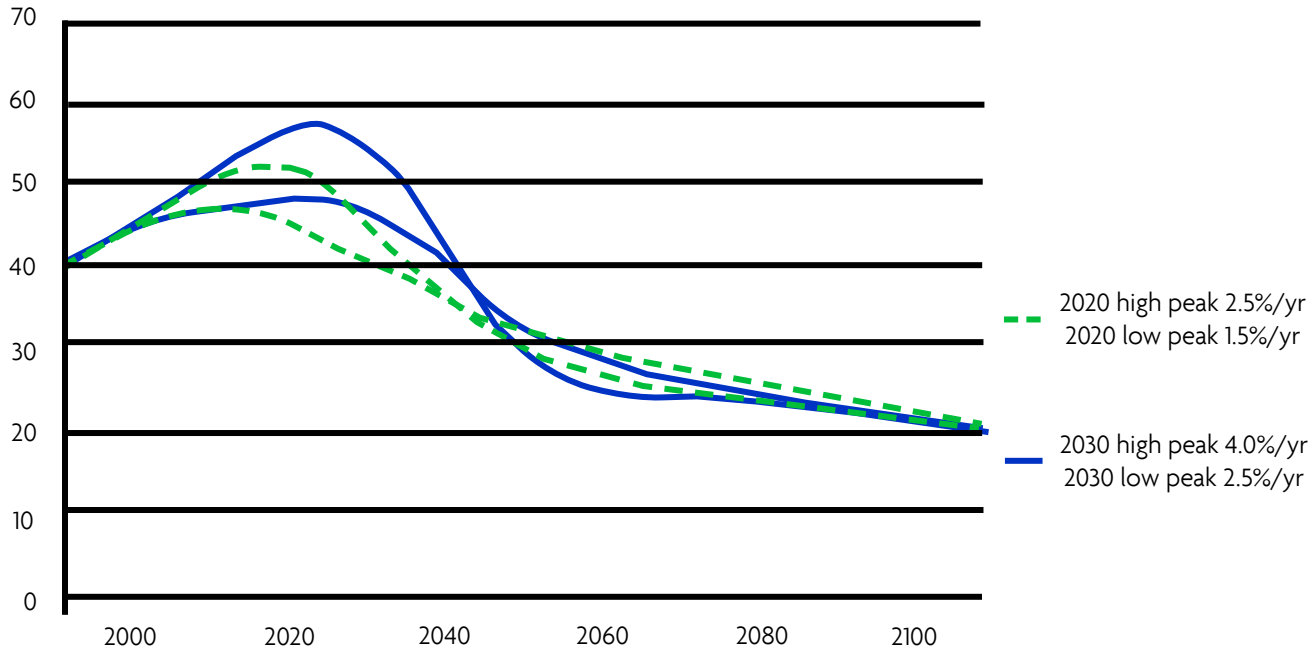

Figure 1: Illustrative emissions paths to stabilise at 550ppm CO2e Source: Stern, N. (2006)

A late peak will allow short term reduction levels to be relaxed but will then require a greater level of annual sustained reduction to meet the overall target. An early peak will require a rapid short term reduction level, but these efforts will be rewarded by a lower level of required sustained annual reductions, providing greater flexibility.
The Stern Review: The Economics of Climate Change

As Figure 1 shows there are a range of peaks and corresponding tails that can deliver a given stabilisation level. Each of the four trajectories shown are anticipated to result in a stabilisation level of 550ppm, however, each will have a different impact on the economy. A late peak, shown by the '2030 High Peak' curve, will allow a slow short term reduction level, but will require a 4 per cent annual sustained reduction, whereas an early peak, shown by the '2020 Low Peak' curve, will require a rapid short term reduction level but will afford a level of sustained reduction at 1.5 per cent per annum. The Stern Review points out that:

'Given that it is likely to be difficult to reduce emissions faster than around 3% per year, this emphasises the importance of urgent action now to slow the growth of global emissions, and therefore lower the peak.'

In line with the sustained reductions model the inaugural members of the Chicago Climate Exchange in 2005 (including DuPont, ST Microelectronics, Baxter Health Care, the City of Chicago, Natural Capitalism Inc and 12 other businesses) contracting to reduce their emissions by 1 per cent a year. In 2008 CCX had over 330 members, companies, cities, states, counties, universities, NGOs and others, with new members being required to reduce their emissions 2 per cent a year. Other early examples include Salt Lake City setting a goal to reduce emissions by 3 per cent per year for a 10 year period, with its long term goals to reduce emissions 70 per cent by 2040.

The benefit of using stabilisation trajectories as the basis for reducing greenhouse gas emissions in the built environment sector is that it allows the sector to capitalise on the already abundant opportunities for short term reductions to achieve the peak, while also building the experience and economies of scale to seriously tackle the issue of sustained reductions. The beauty of the sustained reductions model (i.e. tailing) is that it allows efforts to be staged out across the sector to focus on areas that can be actioned in the short term while preparations are made for talking the more greenhouse gas intensive parts. Considering economies, as Stern points out:

'It will be cheaper, per tonne of GHG, to cut emissions from some sectors rather than others because there will be a larger selection of better-developed technologies in some… However, this does not mean that the sectors with a lack of technology options do nothing in the meantime. Indeed, innovation policies will be crucial in bringing forward clean technologies so that they are ready for introduction in the long term.'

Strategic Awareness: How do we get there?

Developing a Sense of Urgency

In 2003 the NSW Premier Bob Carr reflected in the AusCID Sustainability Framework, that 'Sustainability has emerged as one of the most powerful drivers influencing the direction of

Australia's infrastructure industry'. Despite this and numerous other calls for action progress to reduce greenhouse gas emissions over the last two decades has been slow, and one might conclude that the challenge to respond to climate change in the coming decades appears to be insurmountable. In order to respond effectively the coming decades will need to see a significant acceleration of action to reduce greenhouse gas emissions that will involve all sectors across the many economies of the world.

> *'A range of physical infrastructures are required to support urban living: transport, energy, water, waste, communications and buildings. The consensus is that the sustainability performance of each is currently poor, given that they all emerged in an era where there were few resource constraints and climate constraints. Next generation infrastructures and urban designs will need to demonstrate significantly greater eco-efficiency and resilience in their operation than those that they need to replace.'* **Engineers Australia 2010 Infrastructure Report Card**

There is little precedent for this type of rapid economy wide change, other than war-time urgency, with WW2 for instance having a significant impact on the US economy involving a near complete retooling of many industries to the war effort in a very short period of time. According to TNEP, 'In the period 1939–1945, unemployment in the USA fell from 14.6 per cent to 1.9 per cent, and GDP grew 55 per cent. Wages grew 65 per cent over the course of the war to far outstrip inflation, and company profits boomed, all at a time when personal consumption was dampened by the sale of war bonds, some basic goods and foods were rationed, and at the height of the mobilisation 42 per cent of the economy was directed towards the war effort.' However unlike the threat of war, or the need for post war reconstruction, which are both immediate and aimed at the powerful, the threat of climate change is less immediate, uncertain, and will play out over decades, typically affecting the poor and vulnerable first.

> *"The challenge is to waste no time in embarking on this transformative journey. An urgent goal will be to manage the difficult trade-offs between short-term demands and longer-term impact, and the need to make choices that will deliver a more stable and sustainable future while also securing immediate gains."* **Angel Gurría, OECD Secretary-General**

Learning from Structural Adjustment Programs

Another example of economy wide changes in a short period of time is that of conditional lending by the IMF and the World Bank, creating 'Structural Adjustment Programs', or SAP's, and it is here that we find a strong precedent for informing economy wide strategic interventions

to transition society to low carbon living. Fundamentally the term 'Structural Adjustment' can be interpreted as the process of making system wide changes to the very structure of an economy, typically through government policy, to improve its performance. Such changes are typically driven by an intention to improve the economic performance of the economy in a response to a need to reduce debt or position itself to replay development loans.

According to the OECD structural adjustment is a 'process of market-oriented economic reform aimed at restoring a sustainable balance of payments, reducing inflation, and creating the conditions for sustainable growth in per capita income'. Structural adjustment mechanisms are typically promoted by financial institutions, such as the International Monetary Fund (IMF) or the World Bank, when offering development loans, typically to clear existing debt, or in order to secure lower interest rates on such loans. In such cases the intention is to reduce the risk of the loan by requiring restructuring of economic policy, typically involving:

- Changes to the level of taxation,
- Controls on inflation,
- Stabilising of investments,
- Devaluation of local currency,
- Privatisation of government assets and industries,
- Reduction of wages,
- Reducing government expenditure (typically on health, education, and social welfare) and subsides,
- Lifting trade restrictions and reducing local business protections, and
- De-regulation of industry (typically related to labour protection and environmental requirements) to reduce production costs.

According to the IMF, structural adjustment is focused on 'changing the way in which an economy is organized in order to raise productive capacity.' Hence according to such definitions the application of structural adjustment is basically to secure sustained productive capacity and income for a country. However this goal is hindered over time by a number of social and environmental impacts that affect the economy, and hence it draws heavy criticism.

Such impacts include an increase in the cost of living from a focus on wealth generation, an increase in unemployment from a focus on short term cost reduction by industry, a decrease in social welfare expenditure by government (including healthcare and education), and a focus on the rapid liquidation of natural resources for profit, and increased levels of fertilizers and pesticides to boost agricultural exports (leading to significant environmental degradation).

Hence often structural adjustment measures include little to no consideration of the impact on the society or the environment and as such the associated economic impacts are considered to be either an avoidable cost or on a much longer timeframe than the duration of the program. Hence in order for economies to achieve 'conditions for sustainable growth in per capita income', advocated by the OECD, the scope of structural adjustment needs to be amended and expanded to focus on mechanisms that lead to a significant reduction in environmental pressures. When considering approaches to achieve

sustainable development outcomes Newton and Newman reflect that:

> *'A common feature for all transition arenas is the set of critical normative goals that they address: using resources more efficiently and reducing non-renewable resource consumption, reducing emissions and utilising wastes as resources, restoring environmental quality, enhancing human wellbeing, and developing human settlements that are liveable, productive, environmentally sustainable, socially inclusive and resilient'.*

Learning from Green Growth Strategies

One place to look for guidance as to how to incorporate a greater focus on environmental outcomes into economic development is the area of 'Green Growth Strategies', as outlined in the previous project briefing report. According to the OECD, at its heart green growth is focused on '…encouraging economic activity to take place where it is of best advantage to society over the long-term.' According to Newton and Newman:

> *'The green economy has been identified as a vehicle for overcoming the shortcomings of previous economic development paradigms, enabling economic growth to be decoupled from unsustainable resource consumption and environmental degradation as well as leading to a narrowing of socio-economic inequalities'.*

Much of the focus on green growth is targeted at developing countries as they are most vulnerable to environmental impacts and often rely on natural resources. However much can be learned from this valuable growing field of understanding that can inform developed countries.

According to the OECD, green growth involves holistic strategies that include:

1. Equitable and efficient tax systems (including green taxes),
2. Phase out of environmentally harmful subsidies (including reconsideration of fossil fuel subsidies),
3. Free and open trade including environmental products and services (and note that eco-labelling may in fact create non-tariff trade barriers),
4. Policies that incentivize investment in green technologies and practices (including forest management and organic agriculture),
5. Industrial and other sector policies that promote innovation,
6. Risk assessment and management,
7. Labour market and skills policies that maximize the benefits for workers to help to ensure that adjustment costs are equitably shared, and
8. A host of flanking and complementary policies to explicitly address poverty reduction and social equity issues.

Each of these strategies will have economy wide implications and rather than piecemeal approaches a systemic economy wide approach is needed with the OECD pointing out that green growth:

> *'… must support the structural transformation of the economy to achieve higher productivity and more value-added products.'*

Achieving 'Carbon' Structural Adjustments

Key Structural Areas for Adjustment

In order to achieve the rapid reduction in greenhouse gas emissions in the built environment sector in Australia strategic approaches need to be modelled on the scope and pace of structural adjustment programs and based on the actions advocated in green growth strategies, as outlined above and in previous project reports. This new form of economic development would focus on bringing about a rapid reduction in greenhouse gas emissions in a manner that underpins and supports economic growth and increased societal well-being. A key focus of such an approach will be to encourage the greater development and uptake of low carbon technologies and processes.

> *Directed technological change should not be conceived as picking winners, but as making sure the market has enough winners to pick from to achieve cost-effective low-carbon outcomes. While directed-technological change is essential to meeting the challenge of deep decarbonization, there are many alternative technologies under development now and that may emerge in the future… Efforts aimed at building public support and acceptance for key technologies will also play an important role.* **Pathways to Deep Decarbonisation Project (2014)**

In order for such an approach to be successful it will need to draw on lessons learned over the last two decades from efforts to progress the sustainable development and climate change response agenda's and merge this knowledge into structural change processes. Considering the areas of focus for structural adjustment programs and for green growth strategies the following key structure areas are nominated for 'carbon structural adjustment'. This list does not represent all possible opportunities for adjustment however are suggested as the key areas for initial focus. These structural areas have a direct impact on the greenhouse gas emissions of the built environment sector and changes to them can deliver reductions in emissions.

- Standards and Codes,
- Government Requirements (Local, State, Federal, and Statutory Agencies),
- Taxation and Subsides,
- Investment and Procurement Policies (government and private),
- Professional Accreditation Requirements, and
- Education Program Accreditation and Requirements (Higher and Vocational).

Each of these areas will form the focus of a process to identify strategic approaches to achieve carbon structural adjustment.

Core Elements of Carbon Structural Adjustment Roadmap

Given the compelling imperative to reduce greenhouse gas emissions the ideal response would be to make rapid shifts in policy and regulation to achieve a rapid reduction in fossil fuel use and a transition to low carbon operation in order to reduce the likelihood of dangerous climate change. However despite this understanding such efforts are in the early stages internationally and are yet to grow to levels that will impact global greenhouse gas emissions. Hence as the countries of the world consider their response to the challenge of climate change there is much investigation that can be carried out that will both inform such efforts in the future (when they are taken seriously) and also provide benefits to businesses and organisations across all sectors.

The purpose of the carbon structural adjustment roadmap is not to persuade the implementation of items contained but rather to inform such activities at such a time when a focus on significantly reducing the greenhouse gas emissions of the built environment sector in Australia is called for. There is much work being done to encourage a transition to sustainable development and it is assumed that this, combined with the mounting evidence of the impacts of not taking such action, will result in such a call in the coming decade. Once the willingness to transform sectors and economies to reduce greenhouse gas emissions in a meaningful way is achieved it will be imperative that a strategic and holistic approach is taken, and this roadmap is intended to be a contribution to such an approach.

Figure 2: Schematic of Key Elements of the Proposed Carbon Structural Adjustment Roadmap

In order to inform the development of carbon structural adjustment strategies the following steps are recommended, with an overview related to each structural area provided in the following section:

- Identify Key Aspects of Areas to Adjust,
- Identify Potential for Value Creation,
- Identify Steps, Enablers, and Actors,
- Identify Roadblocks, Challenges, and Delays,
- Identify and Map Tools, and
- Develop Strategic Approaches.

The Carbon Structural Adjustment Roadmap is created when each of the steps (or 'stops' on the roadmap) are undertaken for each of the 'structure areas' identified above, as represented in Figure 2 as a schematic and in Figure 4 as a stylistic representation of the path for each structure area.

An important consideration in the undertaking of these steps is the understanding that each involves a range of actors from across society and that in order to maximize the potential for carbon structural adjustment to be successful it is encouraged to take a 'whole of society' approach, as presented in Figure 2. It is important to consider that the process of carbon structural adjustment must be led by government however organisations, businesses, institutions and groups across society must be actively involved and empowered to contribute to the overall process.

Using a transit map as the stylistic inspiration Figure 4 shows the path for the carbon structural adjustment of a particular structural area with the main steps outlined above shown as stops along the main rail line and the collector bus lines representing the input for various actors across society to each of the main stops (or steps) along the roadmap.

Short film on project available on SBEnrc website (link)

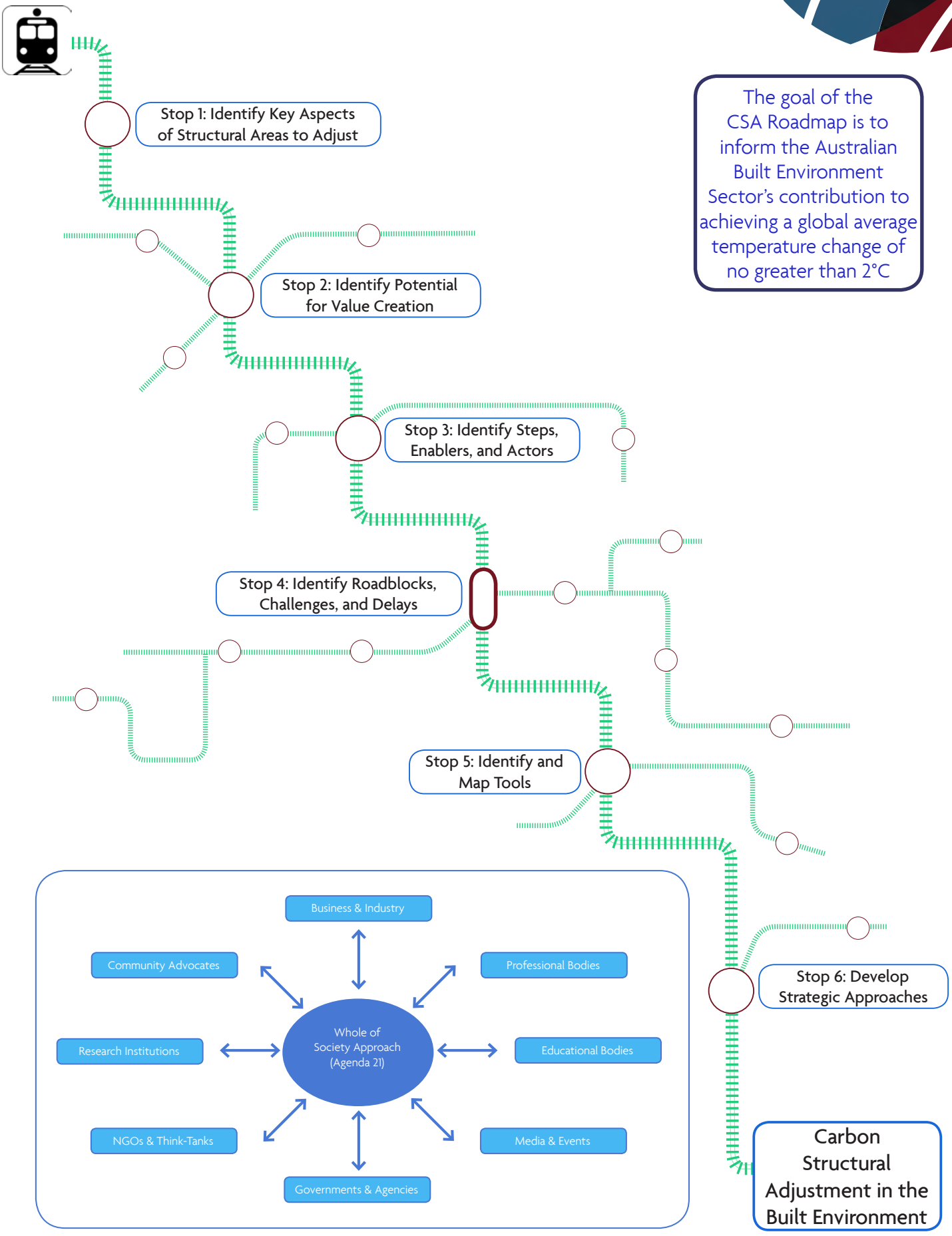

Figure 4: A Stylistic Representation of the Carbon Structural Adjustment Roadmap

Operationalising the Carbon Structural Adjustment Roadmap

The following provides an explanation of each of the 6-stops on the carbon structural adjustment roadmap that are intended to create a robust approach to the rapid reduction of greenhouse gas emissions in the built environment sector in Australia. In order to illustrate each stop the example of 'Taxation and Subsides' is used, and in particular the Fuel Tax Credit. Currently taxation credits and subsidies are provided in Australia for fossil fuel consumption including fuel tax credits ($6.3 billion/yr), accelerated depreciation on fossil fuel assets ($1.7 billion/yr), concessions on the excise on aviation fuels ($1.4 billion/yr), tax concessions for the private use of company cars ($950 million), and the Energy Security Fund that provides power stations with payments and free permits ($1 billion/yr).

Stop 1: Identify Key Aspects of Structural Areas to Adjust

The first stop on the roadmap to achieve carbon structural adjustment is to identify specific aspects of the structural area being considered, such as 'Standards and Codes' that are deemed to 'need' adjustment in order to ensure greenhouse gas emissions reductions across the sector.

> *Taxation and Subsidies (Fuel Tax Credit): In Australia an estimated 10.8 billion dollars a year is provided in fossil fuel subsidies, including coal and petroleum, with subsidies of over $110 billion estimated to be provided to the fossil fuel industry between 2005 and 2016. This is compared to a cost to tax payers of $21.6 billion estimated by the Minerals Council of Australia from the renewable energy target, roughly a fifth of the cost to tax payers of the fossil fuel industry subsidies. A large component of the fossil fuel related subsidies is the Fuel Tax Credit offered to the mining sector that subsidises the cost of diesel for mining companies and reduces the tax paid from 30 cents a litre to 6 cents a litres, reducing taxation revenues by an estimated $2.35 billion dollars a year.*

This stop would deliver the following outcomes:

- The identification of specific aspects of the structural area being considered that contribute to increasing the greenhouse gas emissions of the built environment sector.
- The provision of a clear and concise summary of the aspects, demonstrating the direct link to greenhouse gas emissions in the sector, and highlighting precedent and evidence for cost-effective emissions reductions.
- The identification of any current or previous efforts to bring about change in this aspect of the structural area, both that have gained traction and that have not. This may include the identification of existing recommendations related to the adjustment of the areas or similar areas internationally.

Stop 2: Identify Potential for Value Creation

Once the specific aspects of the structural areas that require adjustment have been identified, the next stop on the roadmap involves identifying the potential value that can be created by the adjustment of these aspects. This is important as it identifies potential supporters for the adjustment and demonstrates the value to the economy, sector, and community for taking action to adjust the structural areas to reduce greenhouse gas emissions.

Value can be created in a number of direct and in-direct areas with the initial focus on both the economic value and the reductions in greenhouse gas emissions. Other areas of value may include job creation, increased trade in services and high value manufactured goods, generation of voter good will, along with direct savings to business through reduced energy use.

> *Taxation and Subsidies (Fuel tax Credit): According to the World Bank, 'expenditures reduced by removing inefficient and environmentally-harmful subsidies … can be used to finance the adoption of less polluting and more efficient household energy sources as well as other critical priorities, such as health, education, or infrastructure development.' It is important to encourage the use of saved subsides or received taxation to support the shift to low carbon operation. Should the fuel tax credit be waived the increase taxation revenue, in the order of $2.35 billion per year, could be invested to support greater energy efficiency and renewable energy generation across the sector, both of which will provide economic and greenhouse gas benefits to the Australian economy. Options may include providing subsidies to encourage the investment in energy efficient technology and products along with their use by consumers.*

This stop would deliver the following outcomes:

- The identification and quantification, where appropriate, of the potential value that would be created through the adjustment of the aspects of the structural area being considered, both direct and in-direct.
- The identification of evidence to support this value creation and precedent of such value being captured. This would include identification of value created for particular parties and stakeholders.

Stop 3: Identify Steps, Enablers, and Actors

Once the specific aspects of the structural areas that require adjustment have been identified, and the value of such adjustments demonstrated, the next stop on the roadmap involves identifying the main steps that are required to adjust the aspects. Consideration of the steps includes an investigation in to the existence of current enablers to such adjustment that will support the process. Further, as mentioned above it is important to take a whole of society approach to the process and at this stage the various actors that should be involved in each step are identified. It may be the case that investigations have been undertaken to identify steps to adjust the selected aspects either in Australia or internationally that can inform the identification of specific steps.

Taxation and Subsidies (Fuel Tax Credit): In order to achieve reform of the 'Fuel Tax Credit' the Australian Government would need to support such change and achieving this would involve a number of steps, such as demonstrating voter support. A survey of just over 1,000 Australians in 2014 found that 77% of respondents believed that 'the fuel tax credits scheme should be scrapped for mining companies'.

Stop 4: Identify Roadblocks, Challenges, and Delays

Once the steps required to adjust the aspects of the structural area being considered have been identified, the next step in the roadmap involves the identification of major roadblocks, challenges and areas of potential delay that will be faced should the steps be implemented. Once identified investigation can be carried out on how to avoid, amend, or remove such barriers.

Taxation and Subsidies (Fuel tax Credit): It is anticipated that a major challenge in removing the 'Fuel Tax Credit' will be the response from the Mining Sector to having subsidies on the cost of fuel removed, and the influence on Government.

This stop would deliver the following outcomes:

- The identification of potential roadblocks, challenges and/or delays to the specific steps to adjust the structural area under consideration, which may include technological, institutional, or market barriers.
- The identification of possible ways to avoid, amend, or remove the potential roadblocks, challenges or delays, with specific mention of parties involved.
- The consideration of the strength of such barriers to carbon structural adjustment and the identification of leverage points to focus tools to reduce such barriers.

Stop 5: Identify and Map Tools

Once the potential for value creation has been established, and the existence of major roadblocks, challenges, and/or delays identified, the next step in the roadmap involves identifying and mapping tools that can either manage roadblocks, challenges, and delays, or enhance the value created by the adjustment.

Taxation and Subsidies (Fuel tax Credit): A tool for reducing roadblocks to adjustment of the 'Fuel Tax Credit' may be community consultation to gauge the views of voters, a campaign to ensure the community is aware of the subsidy and its impact on taxpayers, and the garnering of support for political candidates/parties that carry such reform as part of their agendas.

Tools identified will be specific to the steps to be undertaken and will include a range of activities such as those identified by a review by Swinburne University of built environment roadmaps in Australia commissioned by the CRC for Low Carbon Living, including:

Policy Intervention: 'The iGrid roadmap and ClimateWorks plans both emphasise the need for actions to address institutional barriers to energy efficiency and decentralised energy.'

Capacity Building: 'COAG reports have a strong emphasis on building local supply chains, markets, and technical capacity'.

Coalition-Building: "The ASBEC Zero Emissions Home Industry Roadmap has a strong focus on coalition building and collaboration … envisaged to be actioned through a new 'Net Zero Energy Alliance' which would include both private and public sectors actors".

Technology Forcing: "Innovation studies scholars define 'technology forcing' as the intentional use of standards, regulation and other government policies to better link technology and science to societal goals. Variants of this are included in the COAG roadmaps … [and] have also been more widely advocated by The Australian Academy of Technological Sciences and Engineering ."

Demand-driven Commercialisation: "While the Enabling Technology Futures survey notes the role of government (e.g. in creating a regulatory environment that ensures responsible use and development of such technologies), it most strongly emphasises 'the need for demand driven commercialisation strategies that focus on developing new products and services to address existing problems and challenges' ."

This stop would deliver the following outcomes:

- The identification of potential tools that may be used to implement the steps. It is anticipated that these tools will be suitable for implementation with involvement across the

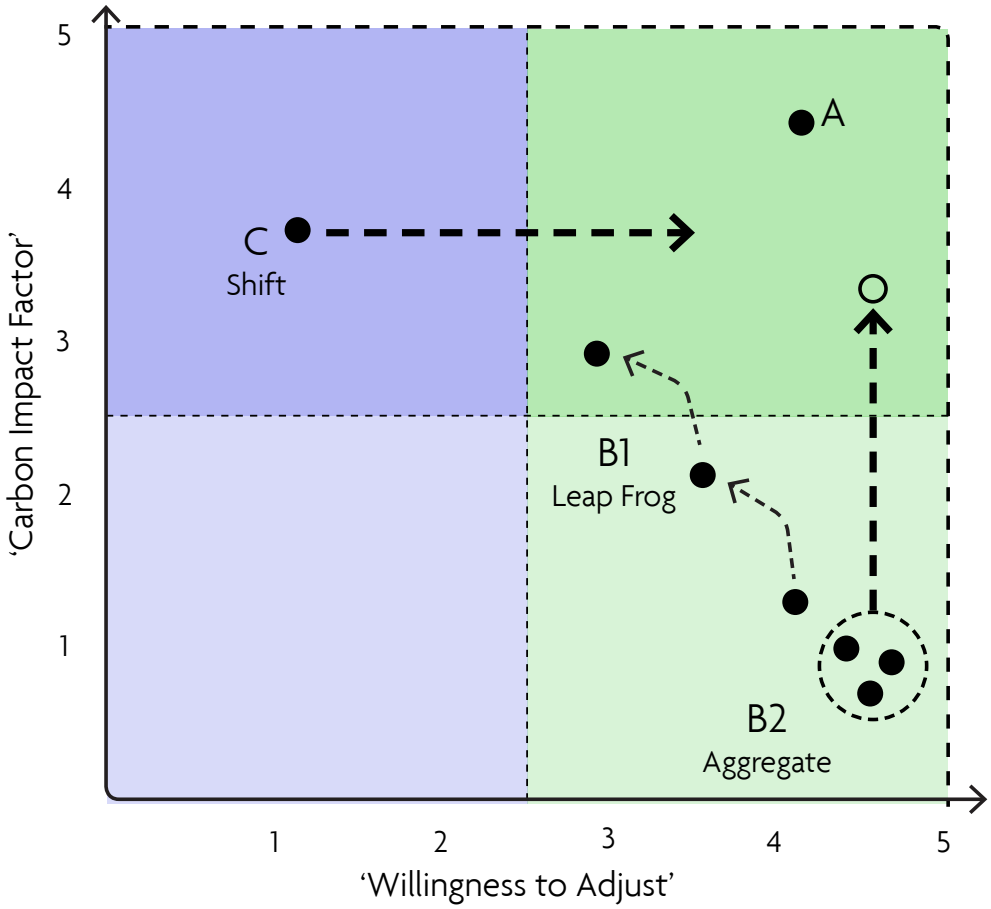

Figure 5: A method for the prioritisation of efforts based on the likely impact on greenhouse gas emissions and the likely willingness to adjust in the area of focus. Source Figure D: Adapted from the CBSM Methodology

various actors involved in the process.

- The mapping of such tools to specific roadblocks, challenges, and/or delays, as well as specific opportunities to enhance value creation.
- The investigation of perceptions related to the identified tools held by stakeholders in the process as to their suitability and requirements for implementation.

Stop 6: Develop Strategic Approaches

Now that the process of following the roadmap has created a list of specific aspects of the structural area being considered that are recommended for investigation, an estimation of the potential value that can be created, identification of steps involved and the associated barriers, and a list of possible tools to both reduce the barriers and increase the value creation the final stop in the roadmap is to develop strategic approaches. Such approaches will draw on enablers and engage with key actors to create work plans to undertake each step and implement the associated tools. This may include consideration of options for cross-sectorial collaborations.

Understanding that it is not feasible for all aspects of each structural area to be adjusted at the start of the carbon structural adjustment process, there needs to be a prioritisation process. In order to identify the priority of aspects to focus on it is important to consider two factors, a) the likely 'Carbon Impact Factor', and b) the likely 'Willingness to Adjust'. The carbon impact factor would take into account the impact on the greenhouse gas emissions in the built environment sector should the aspect identified at Stop 1 be adjusted as per the steps at Stop 3. The willingness to adjust would take into account the roadblocks, challenges, and delays identified at Stop 4 along with a range of other considerations including gauging political will, potential business and industry support, and community views.

Once these criteria have been estimated they can be plotted as shown in Figure 5 and three strategic approaches can be identified, namely:

Route A: A focus on progressing actions with high 'Carbon Impact Factor' and high 'Willingness to Adjust'.

Route B: A focus on progressing parts with high 'Willingness to Adjust' and low 'Carbon Impact Factor' by either:

- 'Leapfrogging', by starting with an aspect with a high willingness to adjust and low carbon impact factor to build momentum to then move on to aspects with slightly less willingness and slightly higher carbon impact, and so on… and/or
- 'Aggregating', by grouping aspects high willingness to adjust and lower carbon impact factor into a single multi-pronged program that delivers a combined high carbon impact factor.

Route C: A focus on increasing the low 'Willingness to Adjust' of aspects, including targeting specific barriers, starting with those with high 'Carbon Impact Factor'.

The tools identified at Stop 5 can be used to

progress activities along Route A and B with the willingness to adjust able to be influenced by a range of direct and in-direct measures such as encouraging community behaviour change to build support amongst voters for measures to reduce greenhouse gas emissions.

Taxation and Subsidies (Fuel tax Credit): The carbon impact factor of the Fuel Tax Credit may be estimated based on the resulting increase in efficiency of transportation in the mining sector along with anticipated benefits from investing further in energy efficiency and renewable energy. The willingness to adjust may be informed by the political positions of the major parties and the policy statements of the current government.

This stop would deliver the following outcomes:

- The investigation of both the likely 'Carbon Impact Factor' and likely 'Willingness to Adjust' of aspects of the structural areas recommended for adjustment.
- The development of strategies based on the strategic approaches outlined above to provide the basis of implementing the steps to adjustment in selected aspects of the structural area being considered. This would include the assignment of tasks to particular actors and parties and may involve inter-sectoral collaboration.

Figure 6: Construction of Barangaroo South

Sustainable
Built Environment
National Research Centre

The Sustainable Built Environment National Research Centre (SBEnrc) is the successor to Australia's CRC for Construction Innovation. Established on 1 January 2010, the SBEnrc is a key research broker between industry, government and research organisations for the built environment industry.

The SBEnrc is continuing to build an enduring value-adding national research and development centre in sustainable infrastructure and building with significant support from public and private partners around Australia and internationally.

Benefits from SBEnrc activities are realised through national, industry and firm-level competitive advantages; market premiums through engagement in the collaborative research and development process; and early adoption of Centre outputs. The Centre integrates research across the environmental, social and economic sustainability areas in programs respectively titled Greening the Built Environment; Developing Innovation and Safety Cultures; and Driving Productivity through Procurement.

Among the SBEnrc's objectives is to collaborate across organisational, state and national boundaries to develop a strong and enduring network of built environment research stakeholders and to build value-adding collaborative industry research teams.

SBEnrc Core Partners:

GOVERNMENT OF WESTERN AUSTRALIA

Queensland Government

Curtin University

SWINBURNE UNIVERSITY OF TECHNOLOGY

John Holland

Griffith UNIVERSITY

NSW GOVERNMENT Transport Roads & Maritime Services

aurecon

For more information:

Professor Peter Newman (Program Leader)
Professor of Sustainability
Curtin University Sustainability Policy (CUSP) Institute
P.Newman@curtin.edu.au

Charlie Hargroves (Project Leader)
Senior Research Fellow
Curtin University Sustainability Policy (CUSP) Institute
charlie.hargroves@curtin.edu.au