

# The journey to net-zero

**Inspiring climate action in the  
Australian transport sector**

May 2022





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# Acknowledgements

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We warmly thank the formal and informal contributions made during the production of this report, including those who participated in the initial workshops and interviews, as well as those who provided feedback throughout the report drafting process.

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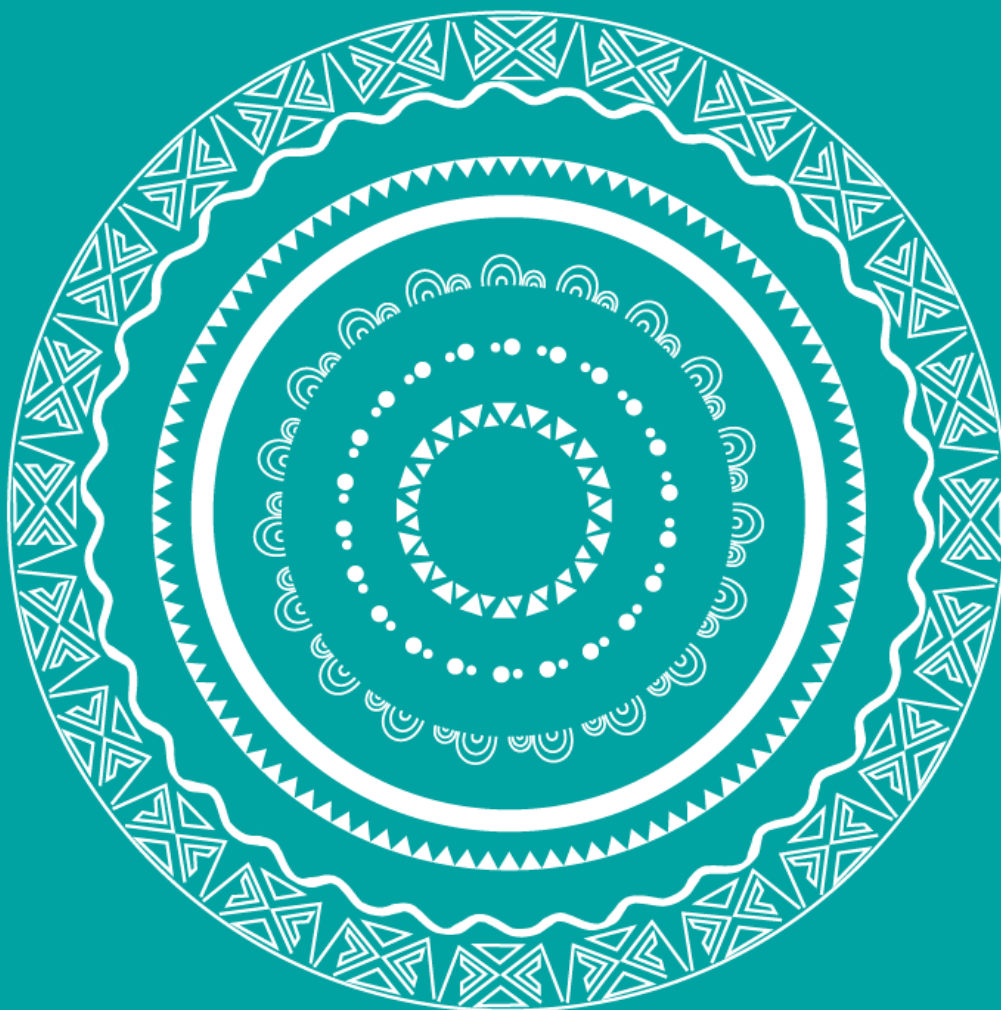
**This report is the beginning of an ongoing collaboration and partnership across the transport industry, and we thank our members, suppliers, regulators, policy makers, industry bodies and supporters of this project, and look forward to continuing to work together.**

## Acknowledgement of Country

We acknowledge the traditional custodians of the lands on which we carry out our work, acknowledge their deep connection to land, water and culture, and pay our respects to their elders past, present and emerging.

## Respect for Te Ao Māori

We respect the tangata whenua of aotearoa and are committed to upholding the principles of te tiriti o waitangi and to safeguarding te reo and other taonga.



In 2013, we commissioned Gilimbāa, a certified Indigenous creative agency, to design an artwork that reflects the diversity of Aboriginal and Torres Strait Islander cultures and KPMG's commitment to reconciliation.



# Report Sponsor - Arup

**Transformation of our transport systems to achieve net zero emissions mobility is one of the most significant challenges the world faces as we seek to prevent extreme climate change. Yet transport decarbonisation also offers us a powerful opportunity to achieve positive change at a global scale – improving the quality of mobility for all is an outcome we should pursue as part of decarbonisation.**

The world as a whole is experiencing enormous stresses at the moment. We are seeing change and shock at unprecedented levels. In just the last three years in Australia, we have collectively overcome the challenges of a water crisis, bushfires, extreme weather and floods, financial uncertainty and, of course, a pandemic. We saw effects of those stresses impact our infrastructure, upon which we rely so greatly as a society, ranging from disruption to supply distribution logistics to downtime of infrastructure assets due to weather events. We are seeing the disruptive and converging forces of climate change, urbanisation and a technological revolution impact every aspect of our built environment.

We have the chance – now – to reconsider how we embed improved sustainability and resilience into our infrastructure, to ensure that the infrastructure we are investing in is robust in the face of ongoing uncertainties.

New business models, new technologies, new policies, new sources of power – the transport industry is changing rapidly. From hydrogen trains to walking plans for tropical cities, from timber stations to city-scale low emission zones, from electric bus fleet conversions to

low-carbon airports – Arup is helping to drive decarbonised transport in all its forms.

While we navigate a complex future, one thing is certain – none of us can make real change by acting in isolation. It's critical for the industry to work together and act in unison to create change and help build a sustainable future. Governments, businesses and transport users can achieve rapid decarbonisation at scale, provided they work together.

Our belief in the need for and power of collective industry action drove our involvement in this report. We are proud to be partnering with organisations from across the infrastructure sector – competitors, clients and partners alike – to establish a shared understanding of the need for and unified desire to achieve real change. We are active members of the organisations who brought this report together – Roads Australia, Australasian Railway Association and Infrastructure Sustainability Council.

Most importantly, we believe the time to act is now. Today, transport is the source of a quarter of global carbon emissions, but the sector's outsized contribution to climate change can be turned around if we act swiftly.



**The decarbonisation agenda creates a fantastic opportunity to drive other beneficial outcomes – from better connected communities to cleaner air to better cities. We believe transport is becoming a flywheel for change, not only within the transport sector itself, but by catalysing wider change in energy systems and cities.**



**ARUP**

It is not simply the short-term provision of infrastructure that is of prime importance, but planning and designing infrastructure which takes full account of its own impact and its operational needs and use. Infrastructure must be sustainable if it is to benefit coming generations and make a positive contribution to the future. Providing such infrastructure now is an investment that will pay off many times over. Arup wants to be a part of this, both now and in the future.

Sustainable infrastructure design is not just about new infrastructure. It is about rehabilitation, reuse or optimisation of existing infrastructure, which is consistent with the principles of urban sustainability and global sustainable development. This encompasses infrastructure renewal, long-term economic analysis of infrastructure, energy use and reduced infrastructure costs, the protection of existing infrastructure from environmental degradation, material selection for

sustainability, quality, durability and energy conservation, minimising waste and materials, the redesign of infrastructure in light of global climate change and the remediation of environmentally damaged soils and water. Importantly, we believe sustainable infrastructure should lead to improved socio-economics. Responsible design needs to balance social, economic and environmental issues.

The aim is to set a responsible standard of sustainable design in both the short and the long term. We all have a significant impact on the world around us and each of us should play a part in protecting future generations. Engineers and planners have a big responsibility to set standards of design that benefit the environment and the people who live in it. Arup's aspiration is that ultimately, talking about sustainability will become superfluous, because it will be the expected norm of a good design.



**Kate West &  
Kerry Coker**

Australasia co-Chairs  
Arup





# Report Partner – RA

**The movement of people and goods along paths, streets and roadways has always been a driver of progress for our cities. Yet like many other things that bring great rewards, there have also been great costs.**

In Roman times, Julius Caesar was forced to ban the movement of private vehicles during the majority of daylight hours to alleviate congestion and improve safety on Rome's streets.<sup>1</sup>

In the 1880's, New York City was said to have 150,000 horses moving people and goods around its roads producing significant environmental challenges managing manure, urine and dead animals.<sup>2</sup> London and other major cities faced similar issues.

As these examples show, the tendency to deploy transport solutions to meet immediate needs – and put off dealing with negative externalities – is not new, especially in our cities. Similarly, the Roman example highlights that some problems require strong leadership and interventions that are potentially unpopular to produce the right outcomes.

The current circumstances we face of an over-reliance on privately owned, fossil-fuel powered vehicles for the movement of people and goods around our city, with climate impacts as well as congestion and safety issues that arise from that reliance, is similar to the historical examples above. But we cannot simply ban something or sit back and wait for the “great technological shift”. The problem is too severe and pressing for that.



**Michael Kilgariff**

Chief Executive Officer

Roads Australia

Today's world is more complex, more interconnected and less inclined to simply accept top-down imposition of policy solutions. What's needed is genuine collaboration – across industry, across sectors, across governments and with the wider community.

This is why RA asked the Infrastructure Sustainability Council and the Australasian Railway Association to collaborate with us on this report. While our collective members (especially Arup who have assisted greatly including helping us to fund this project) have been individually working on sustainability issues, they understand the need for industry wide collaboration. RA is proud to have initiated the industry-first partnership that has led to this report and its recommendations.

Of course, we recognise this document is only a beginning. Success will require more collaboration with an increasing number of partners and strong political and community will to achieve lasting change.

RA is committed to working with our members, partners and everyone else who wants to see a more sustainable integrated transport system delivering efficient, safe and accessible services for the community.



**RA is committed to working with our members, partners and everyone else who wants to see a more sustainable integrated transport system delivering efficient, safe and accessible services for the community.**



# Report Partner - ARA

## The transport sector has been at the heart of our communities for generations.

Just as new towns emerged along our railway lines in the years preceding Federation, today's road and rail network has significantly influenced the shape of our cities and regional centres.

The development of new transport networks – and the creation of faster, more reliable transport options – have unlocked urban renewal, created economic opportunity and realised a range of wider benefits for the communities they support.

As we look towards a strong and sustainable future, the transport sector must also be at the heart of creating new solutions.

It has been more than 100 years since Australia's first electric train trial in 1918, heralding a new era of rail that improved the health of our cities and changed our approach to the daily commute in Australia.

We have seen the rapid development of our transport network since then, with new advances helping us move faster and more efficiently across the nation.

While the innovations of years past have been transformational in their own way, the step change we must achieve in the years to come is perhaps both our biggest challenge and opportunity.

And as 2030 nears, we must move quickly to meet the

moment.

It should come as no surprise that some of the key recommendations of this report are focused on the importance of place, and ensuring our transport networks are grounded in our communities. They have always been intrinsically linked.

A truly integrated, connected and responsive transport network that aligns with how we work, live and connect is essential to meeting the needs of generations to come.

But the report also confirms that industry, government and the community must work together to enable the innovation, investment and new behaviours required to support our journey to net-zero.

A shared commitment is essential to driving real change, particularly as we prepare to deliver the significant pipeline of new projects underway or planned over the next decade.

That is why this collaboration is such an important first step. We welcome this partnership between the ARA, Infrastructure Sustainability Council and Roads Australia, with the support of Arup, to lead this effort and look forward to continuing to advance the recommendations of this report in the future.



**Caroline Wilkie**

Chief Executive Officer

Australasian Railway  
Association



**While the innovations of years past have been transformational in their own way, the step change we must achieve in the years to come is perhaps both our biggest challenge and opportunity.**





# Report Partner - ISC

**The last two centuries could be considered the golden age of transport, an era of transformational technologies which has not only shrunk distance and time but connected people, places, goods and services. The age of modern transport has made the previously impossible, expected; and has moved beyond utility into cultural institution, whether through the great summer road trip or the shared experience of the urban Monday to Friday rail commute. Most powerfully, transport has been transformative in the creation of access to social and economic opportunity.**

In this decade of action where we individually and collectively must achieve accelerated emission reduction by 2030 to keep global warming to 1.5 degrees, transport plays a critical direct and enabling role. It is estimated that transport contributes around 18.3 per cent of Australia's emissions. Some of these are embodied; a consequence of the materials and products and energy required to construct and maintain the assets. A much larger slice is in the emissions from how we use transport; the vehicles, the rolling stock, the lifestyles, and economies that are so dependent on carbon-intensive modes of mobility. Now is the time to lift our gaze beyond our immediate needs and set our sights and ambition, transforming the seemingly-impossible to expected common place – our net-zero future.

We are so very proud to be able to work in collaboration with Roads Australia and Australasian

Railway Association, with the critical support of Arup and KPMG on this project. In doing this we have been able to reinforce that no one person or organisation can achieve this alone, there is a seat for everyone at the table so together we achieve the system-wide change required. This paper aggregates and synthesises global best practice in the hopes that it will shorten the learning curve for others; but also act as a strong call to action for co-ordinated collaboration and co-investment in the solutions that are going to accelerate climate action at pace and at scale.

We look forward to continuing to work with Roads Australia, Australasian Railway Association, other collaborators and our collective community to help deliver this transformational transition for the people and places now and for generations to come.



**Ainsley Simpson**

Chief Executive Officer

Infrastructure  
Sustainability Council



**This paper aggregates and synthesises global best practice in the hopes that it will shorten the learning curve for others; but also act as a strong call to action for co-ordinated collaboration and co-investment in the solutions that are going to accelerate climate action at pace and at scale.**



# Report Author & Partner – KPMG

**The urgency to ‘close the loop’ with respect to resource use has never been greater. There are many undesirable consequences resulting from our current approach to uphold the standard of living we are accustomed to in Australia. How we live, build our communities, move our materials and products, and traverse this landscape has a huge impact on the planet.**

As recent weather events have highlighted, our climate is changing faster than anticipated. The need to address carbon emissions to minimise the warming of our planet, and the impacts to our way of life is an imperative.

We need to move towards a place making approach to our built environment. One which allows access to services for everyone, embeds natural environments at its very core. A built environment which accounts for all externalities, especially carbon, in its design, construction and operation.

Our transport infrastructure - the lifelines between our communities, towns and cities - has a huge role to play in the transition from a linear economy to a more circular focused, low carbon economy. A transport system that reduces its impact on the environment, and actively encourages and assists in restoration of our natural landscapes. A transport sector optimised to be more efficient, connect, enable and enhance our communities.

Sound too good to be true?

We are already on the journey. This paper identifies exemplar projects and case studies from Australia and beyond, where this thinking is already being put into practice. Where innovators are actively seeking to address the imbalances between humanity and the environment. We have the technology, the skills and the innovative drive to make this happen.

We now need to bring the industry together, collaborate at scale and build the ambition to grow these seeds of innovation into a flourishing movement. A movement that assists us innovating, designing and building our way out of the malaise and polarised state that the global pandemic has exacerbated.

We are delighted to be part of this amazing opportunity to assist in shaping a circular approach to the transport infrastructure sector on the journey to net-zero. We look forward to building upon this significant step together with RA, ARA ISC, Arup and all stakeholders who play an active part in this transition.



**Alistair Coulstock**

Director

Climate Change & Sustainability



**Adrian King**

Partner

Head of Climate Change & Sustainability



**What if we had a chance to fundamentally change the way we approach the transport sector in Australia?**

**To revisit the way we connect our communities, transport our goods and services, and power our movements?**



**That time is now.**





# Contents

|           |  |            |
|-----------|--|------------|
| <b>00</b> | <b>Executive Summary</b>   | <b>1</b>   |
| <b>01</b> | <b>Introduction</b>  | <b>14</b>  |
| <b>02</b> | <b>Purpose, scope and objectives</b>   | <b>18</b>  |
| <b>03</b> | <b>The current landscape</b>   | <b>20</b>  |
|           | 3.1 A growing population and a large land mass   | 21         |
|           | 3.2 Leading the transition following COP26   | 26         |
|           | 3.3 Driving sustainable transport with policy  | 28         |
|           | 3.4 Resource efficiency and the need for a Circular Economy  | 28         |
| <b>04</b> | <b>Key considerations for a sustainable transport network</b>  | <b>30</b>  |
|           | 4.1 A national strategy is needed  | 32         |
|           | 4.2 Policy and investment  | 33         |
|           | 4.3 Governance and accountability  | 33         |
|           | 4.4 Collaboration and capacity building  | 34         |
|           | 4.5 Technology and solutions   | 35         |
| <b>05</b> | <b>The opportunity</b>   | <b>36</b>  |
|           | 5.1 A place-based approach   | 40         |
|           | 5.2 Creating safe and accessible routes for pedestrians and cyclists is key in reducing transport related emissions. | 43         |
|           | 5.3 Sustainable Transport solutions for urban and regional communities   | 46         |
|           | 5.4 Shifting freight and heavy haulage to more sustainable forms of transport  | 50         |
|           | 5.5 Sustainable transport infrastructure needs new approaches and collaboration                                      | 51         |
|           | 5.6 Policy, planning and governance  | 64         |
|           | 5.7 Enabling technology  | 75         |
| <b>06</b> | <b>Summary and recommendations</b>   | <b>99</b>  |
| <b>07</b> | <b>Contact Us</b>  | <b>110</b> |
| <b>08</b> | <b>References</b>  | <b>111</b> |

# List of Case Studies

|                      |   |           |
|----------------------|---|-----------|
| <b>Case Study 1</b>  | True innovation in mobility and transport                       | <u>39</u> |
| <b>Case Study 2</b>  | Fisherman's Bend Precinct                                       | <u>42</u> |
| <b>Case Study 3</b>  | Eco Cycle   | <u>44</u> |
| <b>Case Study 4</b>  | Australia's first Veloway on the West Gate Tunnel Project       | <u>45</u> |
| <b>Case Study 5</b>  | Wynyard Walk  | <u>47</u> |
| <b>Case Study 6</b>  | Enabling communities to leverage shared transport               | <u>48</u> |
| <b>Case Study 7</b>  | Moorebank Logistic Park   | <u>52</u> |
| <b>Case Study 8</b>  | Re-purposing heat energy from London's Underground Rail Network | <u>57</u> |
| <b>Case Study 9</b>  | Fibercon eMesh  | <u>58</u> |
| <b>Case Study 10</b> | Early works - incorporating recycled and re-used materials      | <u>59</u> |
| <b>Case Study 11</b> | Social procurement –The Victorian Government's approach         | <u>66</u> |
| <b>Case Study 12</b> | Collaboration with industry to decarbonise supply chains        | <u>67</u> |
| <b>Case Study 13</b> | Alstom's Eco-Design Policy                                      | <u>70</u> |
| <b>Case Study 14</b> | Standard industry carbon measurement tool                       | <u>71</u> |
| <b>Case Study 15</b> | Sydney Metro  | <u>76</u> |
| <b>Case Study 16</b> | Canberra Light Rail   | <u>77</u> |
| <b>Case Study 17</b> | Brisbane Metro  | <u>79</u> |
| <b>Case Study 18</b> | Local city council's zero emissions vehicle policy              | <u>81</u> |
| <b>Case Study 19</b> | IKEA switch to an electric fleet                                | <u>81</u> |
| <b>Case Study 20</b> | HECTOR Project  | <u>84</u> |
| <b>Case Study 21</b> | Toyota showcases new hydrogen engine                            | <u>85</u> |
| <b>Case Study 22</b> | Green steel production in Australia                             | <u>88</u> |
| <b>Case Study 23</b> | Low Carbon Concrete Trials                                      | <u>90</u> |
| <b>Case Study 24</b> | Pacific Motorway M1 Varsity Lakes to Tugun upgrade              | <u>91</u> |
| <b>Case Study 25</b> | Using BIM to provide better public transport                    | <u>94</u> |
| <b>Case Study 26</b> | Blockchain technology creating a Building Assurance Solution    | <u>94</u> |
| <b>Case Study 27</b> | KiwiRail's Driver Advisory System                               | <u>96</u> |
| <b>Case Study 28</b> | LA Metro  | <u>98</u> |
| <b>Case Study 29</b> | Sharing carparks in cities                                      | <u>98</u> |



# Abbreviations

|                   |   |              |   |
|-------------------|---|--------------|---|
| <b>AHC</b>        | Australian Hydrogen Council                         | <b>SBTi</b>  | Science Based Targets Initiative                    |
| <b>AMGC</b>       | Advanced Manufacturing Growth Centre                | <b>SINSW</b> | Schools Infrastructure NSW                          |
| <b>ARA</b>        | Australasian Railway Association                    | <b>SMaRT</b> | Sustainable Materials Research and Technology       |
| <b>ARENA</b>      | Australian Renewable Energy Agency                  | <b>TAP</b>   | Transport Access Program                            |
| <b>ARTC</b>       | Australian Rail Track Corporation                   | <b>TCFD</b>  | Task Force on Climate-related Financial Disclosures |
| <b>ASFI</b>       | Australian Sustainable Finance Institute            | <b>TFND</b>  | Task Force on Nature-related Financial Disclosures  |
| <b>BAS</b>        | Building Assurance Solution                         | <b>TfL</b>   | Transport for London                                |
| <b>BCT</b>        | Biodiversity Conservation Trust                     | <b>TfNSW</b> | Transport for NSW                                   |
| <b>BEV</b>        | Battery Electric Vehicle                            | <b>WRA</b>   | Wildlife Refuge Agreement                           |
| <b>BIM</b>        | Building Information modelling                      | <b>WWF</b>   | World Wildlife Fund                                 |
| <b>BSA</b>        | Biodiversity Stewardship Agreement                  | <b>ZEV</b>   | Zero Emission Vehicle                               |
| <b>BTI</b>        | Building Trustworthy Index                          |              |   |
| <b>CA</b>         | Conservation Agreement                              |              |   |
| <b>C-DAS</b>      | Connected Driver Advisory Systems                   |              |   |
| <b>CEFC</b>       | Clean Energy Finance Corporation                    |              |   |
| <b>CLT</b>        | Cross Laminated Timber                              |              |   |
| <b>COP26</b>      | The 26th Conference of Parties (for Climate Action) |              |   |
| <b>CPPA</b>       | Corporate Power Purchase Agreement                  |              |   |
| <b>CTCCL</b>      | Community Transport Central Coast Limited           |              |   |
| <b>DAS</b>        | Driver Advisory Systems                             |              |   |
| <b>DfMA</b>       | Design for Manufacture and Onsite Assembly          |              |   |
| <b>EAF</b>        | Electric Arc Furnace                                |              |   |
| <b>EME</b>        | Enrobés à Module Elevé                              |              |   |
| <b>EPC</b>        | Energy Performance Contracts                        |              |   |
| <b>EPDs</b>       | Environmental Product Declarations                  |              |   |
| <b>EPS</b>        | Expanded Polystyrene                                |              |   |
| <b>ESG</b>        | Environmental, Social and Governance                |              |   |
| <b>ETC</b>        | Energy Transitions Commission                       |              |   |
| <b>EU</b>         | European Union                                      |              |   |
| <b>EV</b>         | Electric Vehicle                                    |              |   |
| <b>FRIP</b>       | Freight Rail Infrastructure Project                 |              |   |
| <b>FCEV</b>       | Fuel Cell Electric Vehicle                          |              |   |
| <b>FSB</b>        | Financial Stability Board                           |              |   |
| <b>GBCA</b>       | Green Building Council of Australia                 |              |   |
| <b>IA</b>         | Infrastructure Australia                            |              |   |
| <b>ICE</b>        | Internal Combustion Engine                          |              |   |
| <b>IoT</b>        | Internet of Things                                  |              |   |
| <b>IPA</b>        | Infrastructure & Project Authority                  |              |   |
| <b>IPCC</b>       | Intergovernmental Panel on Climate change           |              |   |
| <b>ISC</b>        | Infrastructure Sustainability Council               |              |   |
| <b>LCA</b>        | Life Cycle Assessment                               |              |   |
| <b>LXRP</b>       | Level Crossing Removal Project                      |              |   |
| <b>MaaS</b>       | Mobility as a Service                               |              |   |
| <b>MECLA</b>      | Materials & Embodied Carbon Leaders' Alliance       |              |   |
| <b>MLP</b>        | Moorebank Logistics Park                            |              |   |
| <b>MMS</b>        | Modern Manufacturing Strategy                       |              |   |
| <b>MRPV</b>       | Major Road Projects Victoria                        |              |   |
| <b>MTIA</b>       | Major Transport Infrastructure Authority            |              |   |
| <b>NCOS</b>       | National Carbon Offset Standard                     |              |   |
| <b>NDC</b>        | Nationally Determined Contributions                 |              |   |
| <b>NDIS</b>       | National Disability Insurance Scheme                |              |   |
| <b>NGER</b>       | National Greenhouse and Energy Reporting scheme     |              |   |
| <b>NR C&amp;P</b> | Network Rail Commercial & Procurement Team          |              |   |
| <b>NWPA</b>       | North Western Program Alliance                      |              |   |
| <b>PIT</b>        | Polymer injection Technology                        |              |   |
| <b>PV</b>         | Photovoltaic  |              |   |
| <b>RA</b>         | Roads Australia                                     |              |   |
| <b>RPV</b>        | Rail Projects Victoria                              |              |   |

# Executive Summary





# Executive Summary

**This report presents a compelling case for a great opportunity to change the way we approach our transport sector, and indeed our towns and communities. It is a 'call to action' for the industry to stop and rethink the way we approach transport in Australia. It presents an opportunity for the industry to come together to collaborate, ideate and explore new methods, approaches, and tools to improve the impact our industry has on society, the environment, our culture and our climate.**

Our vision is for a future where people and communities are connected through safe, accessible, resilient and efficient transport systems. This report marks the beginning of an ongoing partnership to drive positive change in our industry.

An industry first partnership between Roads Australia, the Australasian Railway Association and the Infrastructure Sustainability Council, together with

KPMG and Arup, seeks to be the catalyst for change for the transport sector. This partnership provides an opportunity to advocate, connect, build capacity, and assist in fostering a culture of collaboration across the industry - an opportunity to provide more sustainable solutions for all Australians (the community) using, or impacted by the transport sector, its systems and infrastructure.

The purpose of this report is to inform and provide the foundation for Roads Australia, the Australasian Railway Association and the Infrastructure Sustainability Council to galvanise action from government and industry to address the need to decarbonise the transport sector.







By showcasing examples of environmental sustainability leading practice in this report, we demonstrate that the industry is on the path to a low carbon future. However, the journey has only just begun. Much more is required to achieve this challenging goal and meet our obligations of net-zero by 2050. By exploring the current landscape, issues and solutions that exist today in this complex part of our built environment, we identify key recommendations that can assist the industry to decarbonise over the coming years. These recommendations can assist the industry to deliver on its responsibilities as part of Australia's Nationally Determined Contribution (NDC) of net-zero carbon emissions by 2050, in line with COP26 and the Paris Agreement to limit global warming to 1.5 degrees Celsius.

The scope of this report is focused on land-based transport and associated infrastructure which includes road, rail, bridges, intermodal and active transport

solutions such as pedestrian and bicycle paths, and other related infrastructure.

This report presents case studies and examples of leading practice solutions that are transforming our places and our transport systems in Australia and around the world. It demonstrates that there are green shoots of progress emerging that will enable the sector to arrive at a low carbon economy by 2050. An audacious challenge has been set - one that requires a collaborative approach and political will, but also presents significant rewards.

Roads Australia, the Australasian Railway Association and the Infrastructure Sustainability Council, together with KPMG and Arup, are excited to bring you this report that highlights the many ways we can take meaningful steps on the journey to decarbonise our industry and implement more sustainable practices for future generations. The journey has only just begun, and the opportunities are numerous.





## The need for decarbonisation

In Australia, 70% of greenhouse gas emissions are attributable to, or influenced by infrastructure. Once operational, 55% of Australia's annual emissions are related to the operations they enable.<sup>3</sup> Australia's National Greenhouse Gas Inventory estimates that the transport sector contributed to 18.3% of Australia's emissions in 2020 (94 MtCO<sub>2</sub>e), and is projected to increase to 100 MtCO<sub>2</sub>e by 2030.<sup>4,5</sup>

The recent events at COP26 highlighted the need to urgently address emissions in high emitting sectors and take action to decarbonise our transport network.<sup>6</sup>

The IPCC's sixth climate assessment report released in February 2022 underlines this urgency. Hoesung Lee, Chair of the IPCC, states "This report is a dire warning about the consequences of inaction." Lee goes on to state "It shows that climate change is a grave and mounting threat to our wellbeing and a healthy planet."<sup>7</sup>

Our industry heavily relies upon the use of fossil fuels, not only during the construction of the infrastructure but also during the operational lifecycle of the assets. In addition, many of the vehicles (both road and rail) that use these systems are also reliant on fossil fuels. Whether this is from fuels burnt in the vehicles themselves or the electricity used to operate them (such as trains), the alternatives are few and far between. Decarbonisation should not, however, come at the cost of other environmental or social issues. A balanced and measured approach should be taken to ensure that the outcomes are equitable across all material issues and Australians are provided with just and resilient solutions for the transport sector.

The risk of missing this opportunity should not be underestimated. The costs alone of not mitigating the

effects of climate change will be extensive and far reaching. The impacts to society and the environment are already being felt through weather events that have intensified due to climate change. The Climate Council estimated that in Australia "on current trends, the accumulated loss of wealth due to reduced agricultural productivity and labour productivity as a result of climate change is projected to exceed \$211 billion by 2050 and \$4 trillion by 2100." In addition, climate change and extreme weather events are also projected to reduce infrastructure and property values by \$770 billion by 2100.<sup>8</sup>

There is a need to re-think and re-shape the way we plan, design, build and operate transport infrastructure in Australia.

Our reliance on the private motor vehicle has influenced the way we have designed our cities and our transport networks. Most modern cities have been built to serve cars, not people, and we are now reaching a point where population growth, congestion, resource use, and the associated environmental impacts mean we cannot continue with 'Business as Usual'. In addition, much of our freight and heavy haulage is transported by road.<sup>9</sup> With our current knowledge of the issues relating to carbon and climate change, more efficient methods of transportation are necessary. Not only for the transportation of goods, but our road and rail fleets as a whole. GHG emissions are predicted to increase in all classes (both road and rail), with light vehicles as the exception. GHG emissions from heavy-duty truck and rail are both projected to consistently grow over the decade to be 1 MtCO<sub>2</sub>e higher in 2030 compared to 2020.<sup>10</sup>



**Most modern cities have been built to serve cars, not people, and we are now reaching a point where population growth, congestion, resource use, and the associated environmental impacts mean we cannot continue with 'Business as Usual'**





Key drivers for change are:

- The electrification of our fleets;
- Investment in sustainably produced biofuels; and
- The development of a zero emissions hydrogen industry that can assist in the transition of our long distance, heavy haulage road and rail stock.

Policy change and investment in these areas can also assist in the reduction of our reliance on mineral diesel for the construction of infrastructure assets. Another key area of focus to reduce our impact on the environment is material selection for the construction of those assets.

Decisions relating to the transport sector should be made with the interests of the communities they serve in mind. Leading sustainable transport projects improve the experience for commuters, operators, owners, and the community they serve. They enable effective and efficient mobility throughout our states and cities. Great transport solutions also readily promote active modes of transport. Regional areas will require investment and incentives to transition to cleaner vehicles as public and active transport solutions are less viable. Transitioning our freight and heavy haulage sector will also require significant investment to tackle the heavy reliance on mineral diesel as a major fuel source.

Benchmarking the industry is already underway. We have the approaches, tools and expertise in the

industry capable of making the changes we need.

Government agencies are setting ambitious plans to decarbonise their assets and operations, and are putting policies in place to achieve these objectives. Funders of capital are continuing the journey to understanding the risks and opportunities that relate to climate change impacts on their investments. Organisations and associations are unpacking the complexities of the sector to understand the changes required.

Whilst we have started on the path to decarbonising our industry, much more is needed. We must refocus the view from 'having less impact' to the future state we desire. To arrive at a low carbon future with zero emission transport, and connected and fluid active transports systems, we will need significant political will, bipartisan agreement, collaboration at all levels of government and community engagement. New policies will be required to attract investment in the new energy sectors. These emerging sectors will underpin fossil fuel free transport and construction of the associated infrastructure. New approaches will need to place a value not only on financial returns, but also social, environmental, and cultural issues to achieve a truly successful outcome for future generations to come.

The following pages of this report identify key focus areas to assist in this transition to net-zero.





## **Placemaking is the first step to a sustainable transport network**

Placemaking is a multi-faceted approach to the planning, design, and management of quality spaces in which people can work, live, learn, and play in. Successful placemaking can limit the need for people to travel long distances to access work, education, healthcare and other services. A national approach to placemaking is required, first and foremost, and is best planned and implemented at a local level with learnings shared across geographies. A truly sustainable transport network can then be implemented in conjunction with smart, creative urban planning and development.

Considering the sustainable transport hierarchy, smart urban design should encourage active transport, such as walking and cycling, to be the first choice. Secondly, providing safe, efficient and accessible public transport options can significantly reduce operational and enabled emissions (emissions which result from the activities of infrastructure's end-users). Generally speaking, the aim is for private vehicle use to reduce, as this is the least sustainable option (noting that this may be challenging for regional communities and investment in zero emission infrastructure for private ZEVs will be required).



## **Introduce policy, investment and incentives for an efficient, sustainable and resilient transport system**

Introducing the right levers, both at a state and federal level, can assist with the attraction of investment in technology and solutions for renewable energy, sustainable materials and manufacturing.

Regional areas will require investment in infrastructure to support cleaner transport solutions and incentives for the community to transition their private vehicles away from a reliance on fossil fuels.

Investment in cleaner energy solutions will be required to transition long distance freight and heavy haulage sectors, as well as the plant and machinery used to construct our transport infrastructure.



## **The greatest potential for emissions reduction is at the planning stage**

Smart and sustainable procurement choices can enable significant emissions reduction across the transport industry. Planning for lower emissions at the beginning of projects provides the greatest potential for decreasing emissions at every stage of the lifecycle of the asset.

Government and industry need to work together from the onset – at the business case and investment decision stage - to recognise carbon as a material issue to be addressed, create significant carbon reduction targets, include a shadow carbon price, and optimise the solutions to address social, environmental, governance and cultural needs and issues.

Alongside this collaborative approach, greater governance, accountability and transparency is needed for decisions relating to our transport infrastructure. The reasons investment decisions are made should be clear and be supported by a strong community consultation process.





## Circular and whole-of-life thinking should inform decision making and materials selection

There is huge potential to reduce the embodied carbon of transport infrastructure by considering the entire life cycle of those assets and their materials.

According to the Energy Transitions Commission (ETC), a more circular economy can reduce CO<sub>2</sub> emissions from four major industry sectors (plastics, steel, aluminium and cement) by 40% globally, and by 56% in developed economies like those in Europe by 2050.<sup>11</sup> Arguably, these statistics are transferable to the Australian context (Australia is a developed country with similarities in relation to infrastructure and the economy, and is also dealing with similar fundamental issues relating to plastics, steel, aluminium and cement).

By targeting these major materials used in infrastructure projects, there is a significant opportunity to reduce the industry's emissions. These are finite resources, and the sooner we implement more circularity into our designs and our material selections, the better.



## Collaboration and capacity building

Enabling collaboration, capacity building and education at all stages of an asset's lifecycle will assist in solving these wicked problems related to the transport sector. We need to advocate for new approaches to procurement that places value on social, environmental and cultural issues. It is imperative we enable a culture of collaboration that is fostered at national, state and local government levels in planning and regulation. This culture of collaboration should extend to the projects and assets being constructed. The processes should involve the community and all major stakeholders ensuring voices are heard, especially from the indigenous communities impacted by projects.



## Innovation and technology will play a key role in decarbonising the transport sector

We need to adopt and promote innovative technology solutions that optimise both asset design, construction, operation and enabled solutions so that new solutions can be deployed to assist in the transition to a low carbon economy. Advancements in zero emission vehicles (ZEVs), biofuels and hydrogen technology will assist industry in reducing operational emissions, but only if we invest now in the required research and development, and infrastructure to support these technologies.

In 2021, we saw the positive impacts of progress in digitisation, automation, and building information modelling across all sectors of the industry. By further harnessing these technologies there is great potential to change the way transport infrastructure is procured, constructed, operated and maintained. In addition, Mobility as a Service (MaaS) also has a role to play in increasing shared transport options and reducing our reliance on private vehicles.



# Recommendations

Throughout this report, we explore opportunities and considerations for decarbonisation of the transport sector, and offer the following key recommendations:

## 01

**Create a national, strategic approach to the transport sector and its infrastructure** revolving around placemaking to address the social, environmental and cultural imbalances in our existing urban landscape. Ensure new communities are designed with all material social, environmental, and cultural issues appropriately considered.

## 02

**Introduce policy, investment, and incentives for an efficient, sustainable and resilient transport system both at a state and federal level**, to assist with the transition to new renewable energy solutions, sustainable materials and advanced manufacturing.

## 03

**Implement exemplar governance structures, processes and approaches** to drive transparency and enable sound decision making around the decarbonisation of transport systems. Advocate for clear governance structures in both government and industry with transparency and accountability to be implemented during not only the planning stage but also design, construction, and operational stages of all land-based transport infrastructure projects.

## 04

**Enable collaboration, capacity building and education at all stages of the process.** Advocate for new approaches to procurement to ensure a culture of collaboration is fostered both at a national and state level in planning and regulation but also at the local and project level between all major stakeholders.

## 05

**Adopt and promote technology solutions that optimise asset design, construction, operation and road and rail fleets** to assist in the transition to a low carbon economy.

## 01

## Create a national strategic approach to the transport sector and its infrastructure.

- 1.1 Advocate for a national measurement framework** to ensure progress towards net-zero is accurately tracked and measured.
- 1.2 Advocate for a national and coordinated approach to regulations** across states for both road and rail to reduce red tape when transitioning fleets to zero emissions.
- 1.3 Implement an integrated design approach** to our transport infrastructure, favouring active and public transport solutions, connectivity between modes, shared use paths and cycleways over private vehicle solutions where practical.
- 1.4 Advocate for a coordinated approach to place making** for our existing urban environments ensuring a focus on all aspects of what makes a great place to live, in balance with social, environmental, cultural, and economic requirements, including climate resilience.
- 1.5 Ensure systems thinking, circular economy, and whole of life approaches are utilised** to inform business cases, feasibility studies, masterplans and concept designs, enabling a balanced approach to decision making for our communities and our transport sector.
- 1.6 Advocate for a coordinated planning approach by governments** to ensure the number of projects are balanced and can be delivered by the resources available to industry without adverse impacts on budget or workforce.





## DETAILED RECOMMENDATIONS

## 02

**Introduce policy, investment, and incentives for an efficient, sustainable and resilient transport system.**

- 2.1 Advocate for the Australian Government to increase investment and incentives in the technology that is required to support the decarbonisation** of transport including alternative materials, electric vehicles infrastructure, hydrogen, and other renewables.

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- 2.2 Support discussion with industry and government on pathways to transition from fossil fuels to renewable sources of energy generation** including hydrogen, biofuels and the renewable sector generally.

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- 2.3 Advocate for the investment in cross industry working groups to create comprehensive blueprints for our communities** that include optimised transport solutions.

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- 2.4 Advocate for greater investment in financial vehicles that benefit the community, environment and social needs** with proper governance structures (green bonds, sustainable finance etc.).

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- 2.5 Advocate for all new infrastructure projects to incorporate net-zero emissions targets.**

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- 2.6 Advocate for all new and existing infrastructure projects to consider climate resilience and climate impacts in their design and operation.**

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- 2.7 Advocate for sufficient investment in a new-zero emission hydrogen energy sector** that also contributes to decarbonising our long-distance commercial transport and logistics fleets, for both rail and road.

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- 2.8 Advocate for the development of government policies and incentives that will attract investment** and support the appropriate design and construction of transport infrastructure to facilitate the use of ZEV's.

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- 2.9 Implement requirements in the draft National Construction Code** to ensure all future class 2 and 5 buildings (apartments, office buildings) have the infrastructure required to charge EVs. In addition, extend the deployment of ZEV infrastructure to all government owned assets such as train stations and car parks.

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- 2.10 Advocate for a national policy and incentives to assist in driving the uptake of EVs and FCEVs,** both for commercial fleet vehicles and private passenger vehicles.

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- 2.11 Build on the Modern Manufacturing Strategy (MMS)** and advocate for a portion of this investment to be targeted at supporting innovation in technology and materials, specifically for the transport sector.

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- 2.12 Introduce fuel efficiency standards.**

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- 2.13 Advocate for enhanced carbon sequestration and biodiversity outcomes** (fauna and flora).

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## DETAILED RECOMMENDATIONS

## 03

**Implement exemplar governance structures, processes and approaches to ensure transparent, sound decision making.**

- 
- 3.1 Advocate for the adoption of sustainability performance standards** for projects to ensure a consistent response from industry and government including national and internationally recognised environmental rating systems suited to infrastructure projects.
- 
- 3.2 Facilitate industry wide collaboration** to focus on designing out waste and utilise systems thinking to drive circular economy principles into the planning and design processes for new assets.
- 
- 3.3 Advocate for new ownership and delivery models for government infrastructure** which will be required to respond to all material risks to the assets (Task Force on Climate related Financial Disclosures [TCFD], and Taskforce on Nature related Financial Disclosures [TNFD] type approaches), including accountability to persons in decision making positions.
- 
- 3.4 Advocate for the adoption of sustainable procurement practices** in line with ISO 20400 across the transport sector - including government and industry.
- 
- 3.5 Advocate for Life Cycle Analysis (LCA)** to be implemented in early concept stages of design to ensure all aspects of sustainability are accounted for. This ensures carbon emissions are considered for the full asset lifecycle before the project is advanced and should be used as part of a wider circular economy decision making process.
- 
- 3.6 Incorporate transparent processes in decision making at all gates of a project lifecycle** ensuring accountability of government spend.
- 
- 3.7 Advocate, as a key part of sustainable procurement, for governments to ensure policy incorporates whole of life assessments into early decision making.**
- 
- 3.8 Advocate for business cases to include the environmental, social and cultural benefits** of the proposed infrastructure and apply shadow carbon pricing in the financial modelling.
- 
- 3.9 Engage with industry, government, and regulators to create a nationally approved supported approach to the measurement, identification and selection of low carbon materials, products, and services.**
- 
- 3.10 Advocate for collaborative contracting models such as alliance contracting to improve upon social, sustainable and cultural outcomes**
-



## DETAILED RECOMMENDATIONS

## 04

**Enable collaboration, capacity building and education at all stages of the process.**

- 
- 4.1 Build upon this report by seeking further input from industry** about the current challenges to decarbonisation and collaborate with all stakeholders to develop a detailed action plan.
- 
- 4.2 Educate key stakeholders on systems thinking, circularity and whole-of-life principles** to ensure decisions are made that consider all perspectives and material issues pertaining to projects.
- 
- 4.3 Encourage collaboration to facilitate the multi-pronged approach necessary to overcome barriers and increase uptake of low embodied carbon construction strategies.**
- 
- 4.4 Advocate for early engagement and a collaborative approach with industry** to create blueprints for future communities, and transport infrastructure projects.
- 
- 4.5 Coordinate activities across industry/government to develop better and more coherent policies and drive innovation in industry to transition to a low carbon economy.**
- 
- 4.6 Advocate for a change in culture to allow sustainability to be integrated into the design and planning of infrastructure,** rather than a “nice to have” that is value managed out.
- 
- 4.7 Engage with all construction partners on upcoming government-driven projects** and establish or use existing forums to gather a collective industry voice.
- 
- 4.8 Build capacity across all stakeholders** and for all phases of transport infrastructure projects regarding carbon including planning, design, construction, operation and enabled emissions.
- 
- 4.9 Foster a culture of sharing to ensure lessons learnt** on particular projects are communicated to the industry, other projects and state governments to support continual growth of the industry.
- 
- 4.10. Establish integrated project teams** involving key contractors early in the design process to drive collaborative behaviours.
- 
- 4.11 Utilise key infrastructure projects with innovative solutions or high social, environmental or cultural benefits to build capacity within the industry.**
-

## DETAILED RECOMMENDATIONS

## 05

**Adopt and promote technology solutions that optimise asset design, construction, operation and enabled solutions.**

- 5.1 Advocate for a national and coordinated effort to attract investment in renewable energy solutions** and supporting infrastructure such as hydrogen, renewable biofuels, wind and solar to power the construction of our infrastructure assets and the transport fleet.
- 5.2 Adopt technology solutions that incorporate transparency and accountability** in design and delivery, e.g. blockchain solutions can be used to create an immutable, digital record of the assets.
- 5.3 Increase the use of active monitoring of infrastructure assets and incorporate predictive maintenance regimes** during the operational phase to optimise maintenance, reduce waste, and improve efficiencies.
- 5.4 Engage with industry to ensure all infrastructure projects are created using BIM and internationally recognised open-source protocols and standards**, including the development of digital twins for optimal operation phase management.
- 5.5 Phase out diesel trains** and switch to green hydrogen or battery electric when technology is proven and available, and supporting government policies and infrastructure are in place.





# 01

## Introduction



# Introduction



**The last 24 months have been some of the most challenging, but from adversity blossoms opportunity - for the infrastructure sector and the communities that it serves.**

Ainsley Simpson, CEO - ISC



**This report presents a compelling case for a once in a lifetime opportunity to change the way we approach our transport sector, and indeed our towns and communities. It is a 'call to action' for the industry to stop and rethink the way we approach transport in Australia. It presents an opportunity for the industry to come together to collaborate, ideate and explore new methods, approaches, and tools to improve the impact the transport industry has on society, the environment, our culture, and our climate.**

An industry first partnership between Roads Australia, the Australasian Railway Association and the Infrastructure Sustainability Council, together with KPMG and Arup, seeks to be the catalyst for change for the transport sector. This partnership provides an opportunity to advocate, connect, build capacity, and assist in fostering a culture of collaboration across the industry. An opportunity to provide more sustainable solutions for all Australians (the community) using, or impacted by the transport sector, its systems and infrastructure.

Within this report are presented case studies and examples where leading practice solutions are transforming our places and our transport systems, in Australia and around the world. It demonstrates that there are green shoots of progress emerging that will enable the sector to arrive at a low carbon economy by 2050. This is an audacious goal, and one that requires a collaborative approach and serious political will, but also presents significant rewards.

There is a tremendous opportunity for the transport sector to play a significant role to realise a net-zero emissions future, improve resilience and to assist Australia in building its way out of the impacts of the pandemic. Collaboration and partnerships between governments, associations and organisations will play a critical role in the decarbonisation of hard-to-abate industries such as transport.

As Australia and the world move towards a low carbon future, the adoption of more aggressive sustainability targets and implementation of new practices to achieve these targets will continue to accelerate over the coming years. Decarbonisation should not, however, come at the cost of other environmental, social, or cultural issues and a balanced, measured approach should be taken. It is critical that the outcomes are beneficial for all and Australians are provided with just and resilient solutions to the issues at hand.



## The current landscape



**In Australia, 70% of greenhouse gas emissions are attributable to, or influenced by all infrastructure.**

Once operational, 55% of Australia's annual emissions are related to the operations they enable.<sup>12</sup> Australia's National Greenhouse Gas Inventory estimates that the transport sector contributed to 18.3% of Australia's emissions in 2020 (94 MtCO<sub>2</sub>e) and is projected to increase to 100 MtCO<sub>2</sub>e by 2030.<sup>13 14</sup>

The recent events at COP26 highlighted the need to urgently address emissions in high emitting sectors and take action to decarbonise our transport network.<sup>15</sup> Our industry heavily relies upon the use of fossil fuels, not only during the construction of the infrastructure but also during the operational lifecycle of the assets. In addition, many of the vehicles (both road and rail) that use these systems are also reliant on fossil fuels. Whether this is from fuels burnt in the vehicles themselves, or the electricity used to operate them (such as trains), the alternatives are few and far between. The risk of missing this opportunity should not be underestimated. The costs alone of failing to mitigate the effects of climate change will be extensive and far reaching. The impacts to society and the environment are already being felt through weather events that have intensified due to climate change effects. The Climate Council estimated that in Australia "on current trends, the accumulated loss of wealth due to reduced agricultural productivity and labour productivity as a result of climate change is projected to exceed \$211 billion by 2050 and \$4 trillion by 2100." In addition, climate change and extreme weather events are also projected to reduce infrastructure and property values by \$770 billion by 2100.<sup>16</sup>

There is a need to re-think and re-shape the way we plan, design, build and operate transport infrastructure in Australia.

Our reliance on the private motor vehicle has influenced the way we have designed our cities and our transport networks. We are now reaching a point

where population growth, congestion, resource use and the associated environmental impacts mean we cannot continue with a 'Business as Usual' approach. In addition, much of our freight and heavy haulage is transported by road.<sup>17</sup> With our current knowledge of the issues relating to carbon and climate change, more efficient methods of transportation are necessary. This is relevant, not only for the transportation of goods, but our road and rail fleets as a whole. GHG emissions are predicted to increase in all classes (both road and rail), with light vehicles as the only exception. GHG emissions from heavy-duty truck and rail use are both projected to consistently grow over the decade to be 1 MtCO<sub>2</sub>e higher in 2030 compared to 2020.<sup>18</sup>

Decisions relating to the transport sector should be made with the interests of the communities in mind. Leading sustainable transport projects improve the experience for commuters, operators, owners and the community they serve. They enable effective and efficient mobility throughout our states and cities. Great transport solutions also readily promote active modes of transport. Regional areas will require investment and incentives to transition to cleaner vehicles as public and active transport solutions are less viable. Transitioning our freight and heavy haulage sector will also require significant investment to tackle the considerable reliance on mineral diesel as a major fuel source.

Benchmarking the industry is already underway. We have the approaches, tools and expertise in the industry capable of making the changes we need. Government agencies are setting ambitious plans to decarbonise their assets and operations, and are putting policies in place to achieve these objectives. Providers of capital are commencing the journey to understand the risks and opportunities that relate to climate change impacts on their investments. Organisations and associations are unpacking the complexities of the sector to tackle the changes required.

Whilst we have started on the path to decarbonising our industry, much more is necessary. We need to shift the view from 'having less impact' to focusing on the future state we desire. To arrive at a low carbon future with zero emission transport and connected and fluid active transports systems, we will need significant

political will, bipartisan agreement, collaboration at all levels of government and community engagement. New policies will be required to attract investment in the new emerging energy sectors that will underpin fossil fuel free transport and construction of the associated infrastructure. New approaches will need to place a value, not only on financial returns, but also on social, environmental and cultural issues to achieve a truly successful outcome for future generations.

This report is the first step in an ongoing partnership and collaboration between Roads Australia, the Australasian Railway Association and the Infrastructure Sustainability Council, together with KPMG and Arup and the wider transport industry.

The vision is of a low-carbon future and the transport industry can take us there.





# 02

## Purpose, scope and objectives

# Purpose, scope and objectives

**This report has been commissioned by Roads Australia (RA), the Australasian Railway Association (ARA), and the Infrastructure Sustainability Council (ISC).**



## PURPOSE

**The purpose of this report is to inform and provide the foundation for Roads Australia, the Australasian Railway Association and the Infrastructure Sustainability Council to galvanise action from government and industry to address the need to decarbonise the transport sector.**

By showcasing examples of environmental sustainability leading practice in this report, we demonstrate that the industry is on the path to a low carbon future. However, the journey has only just begun. Much more is required to achieve this challenging goal and meet our obligations of net-zero by 2050. By exploring the current landscape, issues and solutions that exist today in this complex part of our built environment, we identify key recommendations that can assist the industry to decarbonise over the coming years. These recommendations can assist the industry to deliver on its responsibilities as part of Australia's Nationally Determined Contribution (NDC) of net-zero carbon emissions by 2050, in line with COP26 and the Paris Agreement - to limit global warming to 1.5 degrees Celsius.



## SCOPE

The scope of the project encompasses land-based transport and associated infrastructure which includes road, rail, bridges, intermodal and active transport solutions such as pedestrian and bicycle paths and other related infrastructure. It includes enabled emissions from the users of transport infrastructure such as cars, trucks, motorcycles, bicycles and rolling stock. It does not include ports or airports.



## OBJECTIVES

This report provides a view of the current landscape regarding the transport sector in terms of policy, approach, projects and level of sustainability, and has the following objectives:

1. Articulate the opportunity at hand to decarbonise the industry;
2. Present leading practice projects and initiatives in Australia and overseas;
3. Stimulate ideas for improvement of our policies, approaches, initiatives and technologies for the sector;
4. Present recommendations for RA, ARA and the ISC, to assist government and industry to move towards a net-zero economy;
5. Identify the next steps to galvanise action on the critical issue of climate change and carbon reduction.



**The momentum across the transport sector for decarbonisation is undeniable, with industry support coalescing around practical actions that will deliver meaningful and substantial change.**



Michael Kilgariff, CEO - Roads Australia



03

The current  
landscape



# The current landscape



**Collaboration and partnership have long been the hallmarks of driving innovation and progress in the transport sector. As we look towards a net-zero future, those qualities will once again be the very foundation of our success.**

Caroline Wilkie, CEO - Australasian Railway Association



## 3.1 A growing population and a large land mass

Whilst Australia largely benefits from reasonable transport systems and infrastructure, it does not come without its shortcomings. The sheer geographical size of the landscape over which the systems traverse puts a huge financial burden on the states, territories and local governments. This presents a huge challenge when seeking to provide new transport infrastructure solutions or upgrade existing routes.

The growth of the Australian population is placing additional pressure on existing infrastructure and creates significant need for new roads, rail lines and other alternative modes of transport. Australia's current population of nearly 26 million<sup>19</sup> is predicted to reach between 28.3 and 29.3 million in the next five years.<sup>20</sup>

Overlay the ever-increasing effects of climate change wreaking havoc through fire, flood, storm damage and erosion, and parts of the system are at breaking point.

Recently, we have seen a large shift in how we are using our existing transport networks as a result of the COVID-19 pandemic. Public health recommendations to minimise the use of public transport during the pandemic, along with a significant increase in

businesses' reliance on technology and virtual communications has led to a dramatic reduction in commuting and public transport use in urban areas. It is expected that demand for public transport will increase over time, however, it is uncertain when this will be. Moreover, due to the greater acceptance from businesses of employees using flexible working arrangements, it is much easier for staff to stagger their commuting times to miss the traditional peak-hour traffic. This has a positive impact on the use of our transport systems and assists in maintaining patronage by flattening peaks. Another potential beneficial impact resulting in a reduction of patronage on the public transport systems, comes from the rise of micro-mobility in the form of electric scooters and electric bikes. However, it is noted that this is only related to relatively short trips and mostly in inner city areas. Regional areas are less likely to be affected from these types of changes due to the reliance on private vehicles and larger distances travelled.



By 2036, how Australians use, share, operate, and power transport services – from cars to mass transit and even bicycles – will have undergone the biggest upheaval since the internal combustion engine (ICE).<sup>21</sup>

In contrast, the demand for online retail services has increased the transportation of goods and services via courier and postal services. This shift in the usage patterns on our infrastructure impacts the network significantly. It places an increased demand on essential large-scale freight and logistics infrastructure assets such as freight connections, intermodals, warehousing and distribution centres, whilst conversely, commuter traffic has reduced. The jolt to the world economy resulting from the pandemic has also provided us with an opportunity to reassess the existing system and current methods of connectivity for our communities and businesses in Australia.

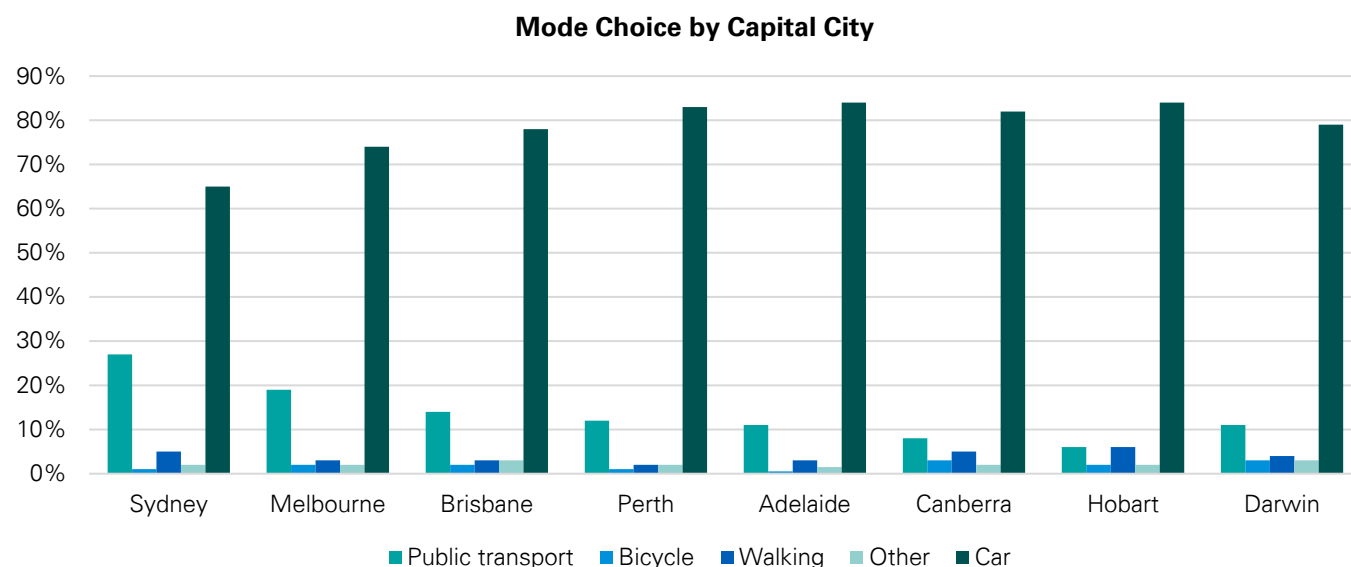
As stated in the Australian Infrastructure Plan, “By 2036, how Australians use, share, operate and power transport services – from cars to mass transit and even bicycles – will have undergone the biggest upheaval since the internal combustion engine (ICE).”<sup>22</sup>

The reality is that for most people in Australia, the car has been the dominant mode of transport (Figure 1).

As Will Fooks, National Transport Planning Lead at Stantec points out in a Roads Australia publication in September 2020, “the reliance on the car has influenced the way we design our transport infrastructure.”<sup>23</sup> Fooks goes on to state that we are now seeing a transition to a multi-modal transport journey. Active transport has become a selling point for major transport projects such as the West Gate Freeway (Case Study 4) and the Level Crossing Removal Projects in Melbourne.

The progression of globalisation and the shift in policy is a significant opportunity to learn from others and the many forms of innovation taking place around the world.

**Figure 1: Mode Choice by capital city**



Source: GTA Consultants

### Limited transport options

In Australia the large geographical expanses and limited public transport options outside of dense inner-city areas mean that for many, private vehicles are a necessity. Examples of this situation even in metropolitan areas include workers who either traverse radially in cities or travel long distances to their place of employment. Others may be impacted due to personal reasons such as disability and transport access equity, or visiting family or vacationing in regional areas. For regional areas, public transport is seldom a viable option.

Once people have owned a private vehicle, the convenience factor is hard to surrender unless it is coupled with a significant lifestyle shift. Relocating to an inner-city location where all needs are met close by and amenities are on the doorstep is not viable for most of the population.

As stated in 'The Conversation' by Christian Brand, an Associate Professor in Transport Energy & Environment, Transport Studies Unit from the University of Oxford, "Most modern cities have been built to serve cars, not people. The necessary roads, parking lots, driveways are set to last decades."

This is certainly true when you see some of the statistics from the United States. It is estimated that almost one half of modern American cities are dedicated to the automobile.<sup>24</sup> This statistic is not surprising when you consider the streets, arterial roads and freeways, car parks, petrol stations, driveways, mechanics, service centres and car dealerships faithfully serving our beloved motor vehicle. It is estimated that 14% of Los Angeles is solely devoted to car storage.<sup>25</sup>

Considering Australia's state and territory capital cities have similar densities to many cities in the US, these statistics are likely to be comparable, and transferable to the Australian context.<sup>26,27</sup>

As highlighted in the Infrastructure Australia's (IA) 2021 Australia Infrastructure Plan, "In Australia, state and territory governments regulate most transport activities. It is at this level of government that rail and main road networks, as well as train, tram, bus and ferry passenger services are managed." These state and territory governments are also responsible for the road networks, freight rail lines and intermodal terminals that are relied upon by export supply chains and domestic distribution networks. Furthermore, local government is responsible for the smaller localised networks which account for around 85% of the total network. This includes the local roads and streets, bus stops, footpaths and cycleways.<sup>28</sup>

Therefore, it can be seen that most of the 'heavy lifting' is provided by state and local government agencies. However, the Federal Government has a key role to play in setting policy to attract investment for the transport sector.

Currently, a coherent national plan does not exist, and this impacts our ability to provide the services on which we depend. State and territory governments all have differing wants and needs with respect to their infrastructure requirements. They are all committed to net-zero by 2050 but recognise that achieving this will be a challenge. Moreover, local governments are faced with insufficient revenue-raising capacity to maintain or upgrade their large portfolio of infrastructure assets under management, or provide the level of services that their communities desire.<sup>29</sup>





### Transport is undergoing a generational change

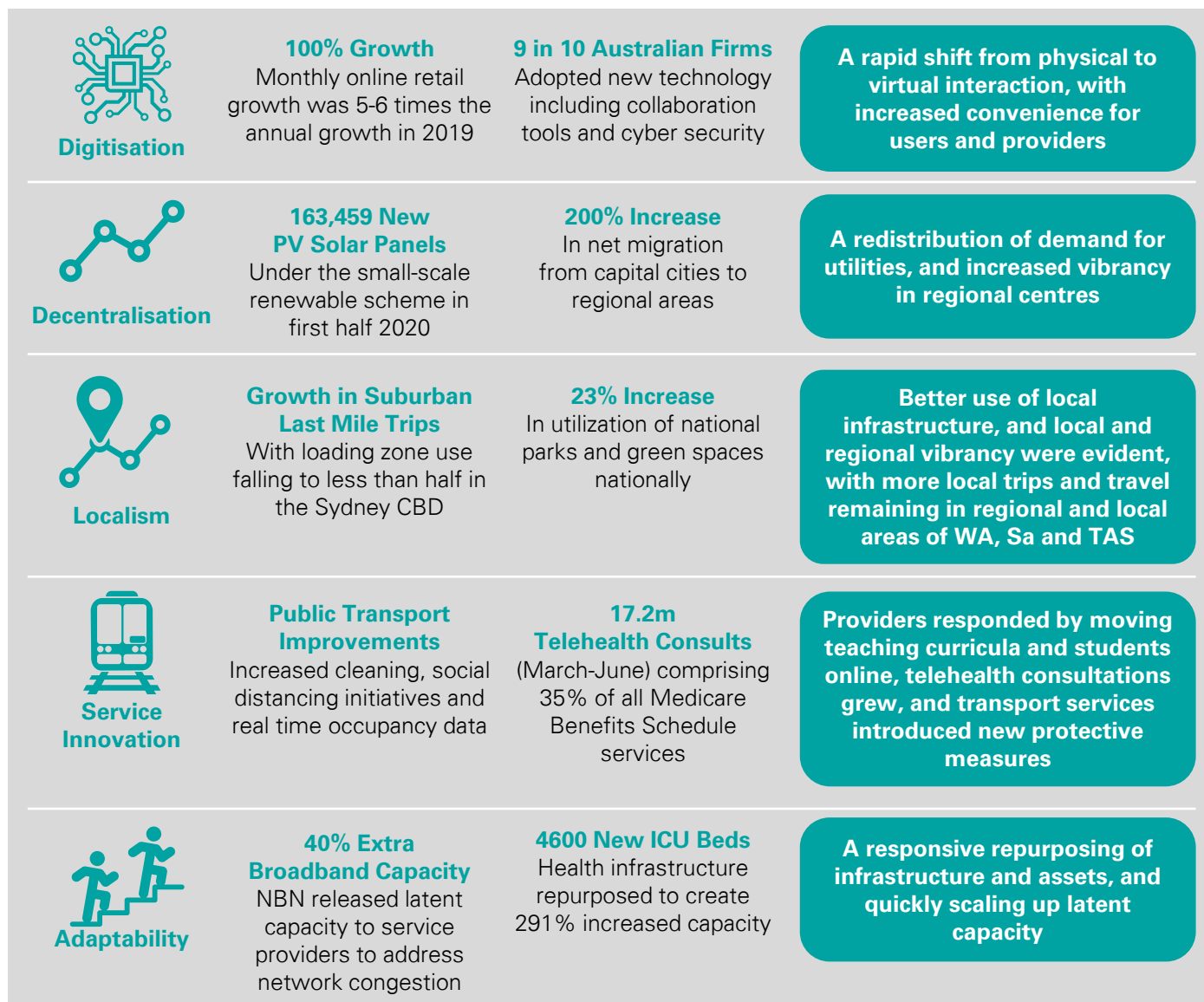
The change of the urban environment in the 1900s, driven by ICE powered vehicles has arguably had the greatest impact on both our urban environment and our natural landscapes. For example, before the invention of the tractor and advanced irrigation, in the US, roughly half of the population was involved in the food industry to feed the entire population. Now, approximately 1.9% of the population works in agriculture.<sup>30</sup> Land clearing was significantly easier using motor powered vehicles to make way for more intensive agriculture.

In urban areas, our cities and towns were redesigned to incorporate all the car parking, maintenance and servicing facilities, petrol stations, and ancillary

provisions required to support the motor vehicle and quench society's insatiable thirst for convenience.

Fast forward to today, we are experiencing another generational shift away from polluting fossil fuel powered vehicles, towards cleaner more efficient methods of mobility. This new wave of the transport revolution, significantly contributed to by the COVID-19 pandemic, is taking place for two key reasons. Not only is there a change in the way that a significant portion of the workforce interacts, there is also an adoption of alternative ZEV technologies, necessitated by our need to address the impacts of climate change.

**Figure 2: Trends emerging across the community that have shaped the infrastructure sector**



Source: Infrastructure Australia.

Considering the effects of the pandemic, the uptake of the private motor vehicle use was the first mode of transport to rebound to pre COVID-19 levels.<sup>31</sup> Perhaps this quicker return took place in part, due to the lingering fear of contagion from exposure to the virus on public transport systems as lockdowns and restrictions eased.

IA states “public transport in most cities fell to 10-30% of normal levels in the initial lockdown but settled at a ‘new norm’ of ~60-70% in the second half of the year (2020).”

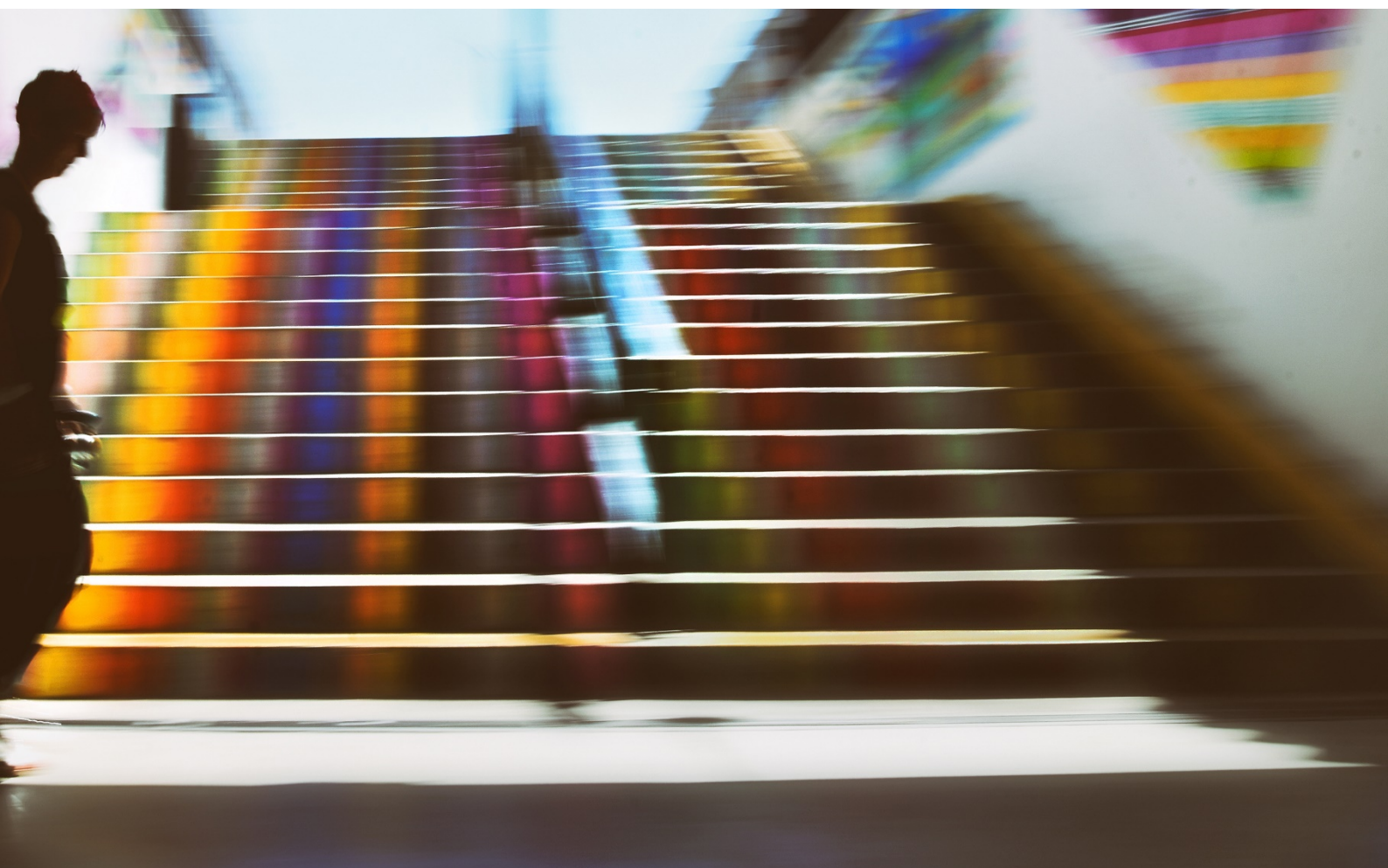
IA goes on to state that “This reflected people partially returning to work and working and travelling more flexibly across the day.”<sup>31</sup>

While road traffic levels returned quite quickly, congestion levels in the CBD areas varies. In some locations, traffic remains suppressed, likely due to the ability of many white-collar workers to continue to work from home.

Over the last few decades, we have seen a decentralisation away from CBD areas, certainly in the service sector. Financial services, banks and insurance companies can relocate their back-office operations to locations that are still within greater metropolitan city areas but do not attract the same rental premiums of the prime real estate CBD locations. This trend of decentralisation is likely to continue, as behavioural changes caused by the pandemic become more permanent. For example, workers who invested in home office setups are likely to continue to work from home for a part of their working week into the future. In addition, households who bought an additional car or bike to avoid public transport are likely to continue using them.

Moreover, the increase of online shopping and food orders such as Uber Eats and Foodora have boosted the demand for last mile deliveries. These services show a demand for the development of more localised transport systems.

We are experiencing another generational shift away from polluting fossil fuel powered vehicles, towards cleaner more efficient methods of mobility.





## 3.2 Leading the transition following COP26

The annual climate negotiations by The Conference of Parties (COP) continue to attract larger attendances and broader participation each year. They are no longer just the domain of environment ministers negotiating a climate agreement but an event that demands global attention and discussion on how we will transition to a decarbonised world.

Last year, the COP26 was held in Glasgow, and throughout the two weeks of meetings and negotiations, the attending parties were successful in:

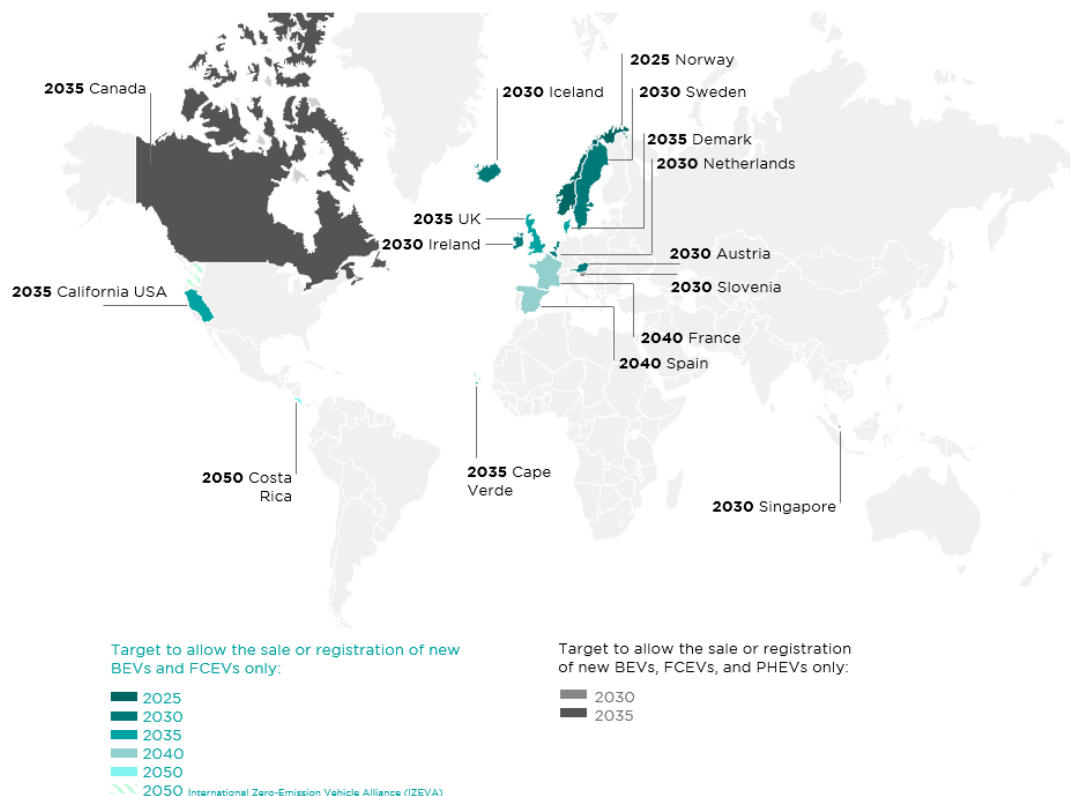
- increasing the collective ambition to reduce emissions and narrowly keeping the ambition of 1.5°C alive;<sup>32</sup>
- completing the last remaining part of the Paris Agreement (Article 6 on the international trading of carbon units); and
- progressing many elements that will facilitate the global economic transformation such as accounting frameworks, transparency mechanisms, rules over carbon trading, new finance and alliances as well as many industry and business led initiatives.

With transport accounting for approximately 22% of global emissions, it was one of the key focus areas at the conference.<sup>33</sup> The UN published a declaration signed by 36 parties on accelerating the transition to 100% zero emissions cars and vans. It states that “together, we will work towards all sales of new cars and vans being zero emissions (one that produces zero greenhouse gas emissions at the tailpipe) globally by 2040, and by no later than 2035 in leading markets.”<sup>34</sup>

The Australian Government was not a signatory, however, the ACT, Victoria, SA and NSW governments formally endorsed the initiatives.

With this updated push towards zero emissions vehicles, there is growing demand for policy makers, manufacturers, fleet owners and investors to drive the uptake of EVs, and other alternative low emission vehicles. Many countries around the world have already set targets to achieve this goal (Figure 3). Whilst the push for fleet upgrades is promising, the current state of the infrastructure in Australia required to service these new fleets is lacking. This is a key obstacle to overcome if we are to address the issue of enabled emissions.

**Figure 3: Governments with official targets in place to phase out sales or registrations of new internal combustion engines cars by a certain date<sup>35</sup>**



Source: United Nations.

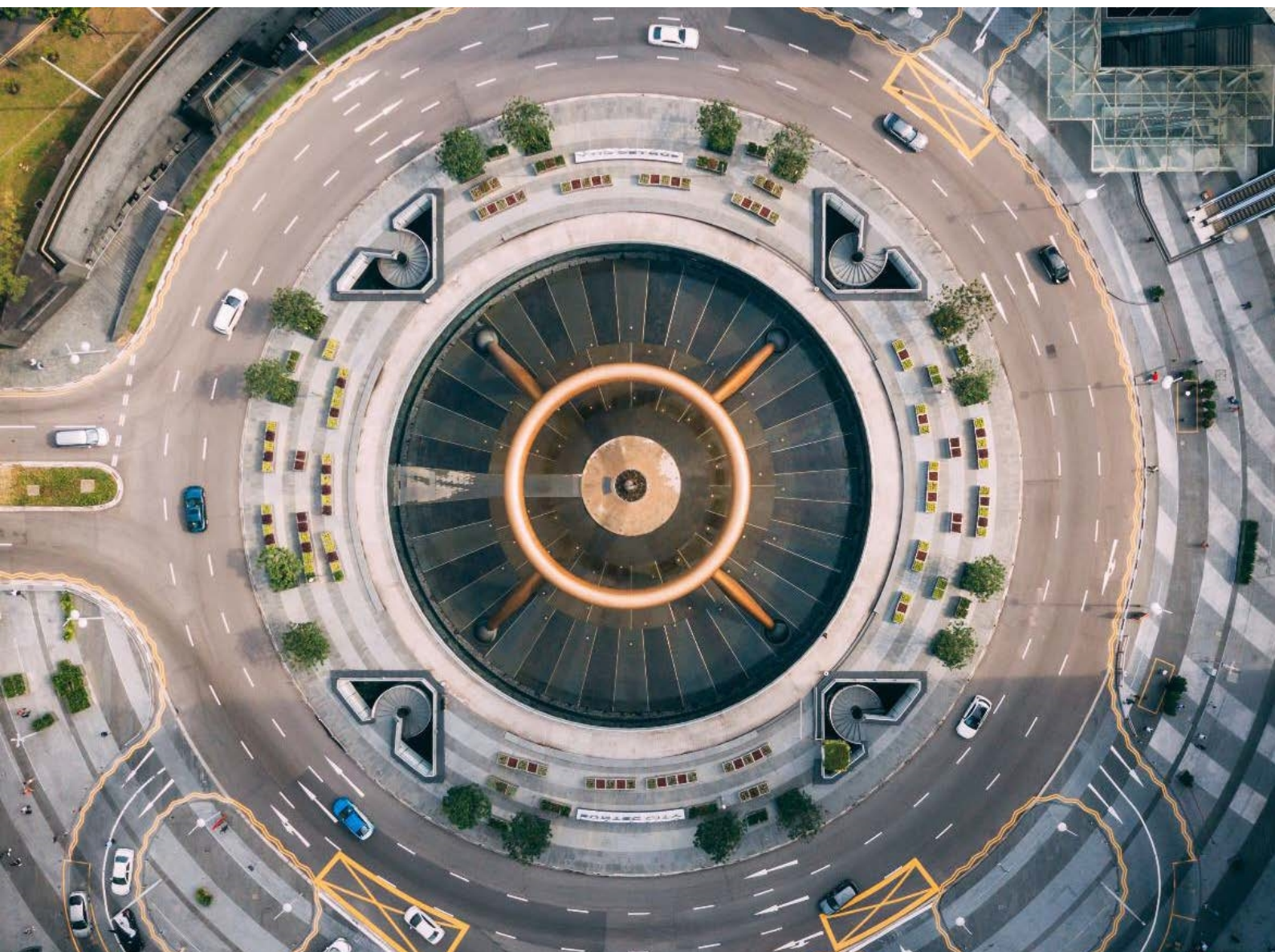
Whilst the discussion of zero emissions transport at COP26 was centred around cars and vans, there is also great potential for emissions reduction by supporting active transport, public transport and shared transport solutions. There is also opportunity in addressing the entire value-chain; from materials sourced for vehicle production, through operation and disposal.

During his address at the plenary session, Deputy Director General of the European Commission Matthew Baldwin, said that “EU member states were legally obliged to cut transport emissions by 90% by 2050 and, to that end, in 2020 the EU adopted a sustainable and smart mobility strategy.”

While the commitments to ZEVs is a starting point, Baldwin argued that it is not enough, and that “moving towards a zero-emission fleet should be part of a broader approach to sustainable and smart multimodal mobility.”

Baldwin emphasized that we should not lose sight of “the big picture”, and more work is needed to shift our reliance on private vehicles and move to more sustainable alternatives. We need to increase public transport use and focus on walking and cycling as key steps towards net-zero transport. It is noted, however, that this approach will be limited for regional areas of Australia where cost effective and efficient public transport solutions are less viable.

We need to increase public transport use and focus on walking and cycling as key steps towards net-zero transport.





### 3.3 Driving sustainable transport with policy

Historically speaking, zero emissions policy has tended to focus primarily on the energy sector, but in recent years we are seeing a significant broadening of the scope of policies being set across the country. As a result of resource impacts, climate change, sustainability issues, and the accompanying social pressure to act, we are now seeing the drafting of policies and their supporting commitments that are focused on addressing these material issues. Targeting zero emissions vehicles, sustainable procurement, and circular economy principles are examples of new policies that have emerged in recent years.

As of July 2020, all Australian states and territories are committed to net-zero emissions by 2050.<sup>36</sup> Federal Government has only just joined this commitment at COP26, although the real details of the plan are yet to

be understood and most of the emphasis seems to be left to industry to solve the problems.<sup>37</sup>

As Climate Works states in their 'Reshaping Infrastructure' paper "Government can play a central role in standardising infrastructure advisory and decision-making to support a net-zero emissions future."<sup>38</sup>

As an example, and from a rail perspective, clear policies, strategies and targets are required to boost the freight capacity of metropolitan rail networks and make them more efficient, especially in the capital cities where they typically run on shared infrastructure. This is a key issue where the public transport system interacts with freight and logistics, impacting the efficiency and productivity of the overall network.

### 3.4 Resource efficiency and the need for a Circular Economy

The demand for materials is increasing rapidly as the human population of the world continues to grow. Global materials use is projected to more than double from 79 Gt in 2011 to 167 Gt by 2060. Non-metallic minerals, such as sand, gravel and limestone, represent more than half of total materials use.<sup>39</sup>

It is estimated that more than half of all greenhouse gas emissions are related to materials management activities, and this will only continue to rise under the current projections.<sup>40</sup>

Moreover, non-renewable natural resources are also becoming scarce, again due to the growing global population but also the growing wealth in upcoming economies and the rapidly reducing global stocks of these resources (e.g. oil, natural gas and rare metals). This has resulted in rising prices and increased price volatility for these types of resources. These market forces drive businesses to look for ways to use their resources more efficiently and investigate methods for re-use, recycling and/or designing out costly and high impact materials from products and services.

The introduction of China's National Sword policy in 2017 (which saw much stricter standards on China's importation of waste from other countries), the pandemic, and the changing political landscape between China and Australia have highlighted a significant risk for Australia's economy. The dependency on overseas manufacturing for many

industries leaves Australia exposed to global supply shocks that may arise in the future. In response, the Federal Government allocated \$1.5 billion in the 2021-22 budget to build Australia's manufacturing capability through the Modern Manufacturing Strategy (MMS), a 10-year whole-of-government approach aimed at delivering scale, enhancing competitiveness, and building resilience of the Australian manufacturing sector.

With the waste export ban that commenced in 2021, circular economy reforms that were urgent before COVID-19 are now critically so. Effort is required to improve waste economics by reforming collection and sorting to reduce municipal waste contamination and to promote investment in new technology.

Currently, from a government perspective and at the national level, the relevant regulations, and policies more generally, refer to macro-level initiatives for managing waste and implementing a circular economy.

A range of government policies, such as the NSW Circular Economy Policy, have recently been established to support a transition to a circular economy (Figure 4) and indirectly the development of industries and manufacturing that will also in part support the transport sector. The prevailing tendency is pursuant on the key tenets of improving resource efficiency, recovery and self-reliance within Australia's borders.

The Federal Government's Modern Manufacturing Strategy revolves around the Modern Manufacturing Initiative. This initiative provides support for commercial projects in the manufacturing sector. The Commonwealth Government will co-fund between \$1 million to \$20 million, or up to 50% of the eligible project expenditure on projects focused on building capability for a variety of manufacturing sectors.

This funding and impetus on local manufacturing can contribute to developments for the transport sector in several ways, some of which are:

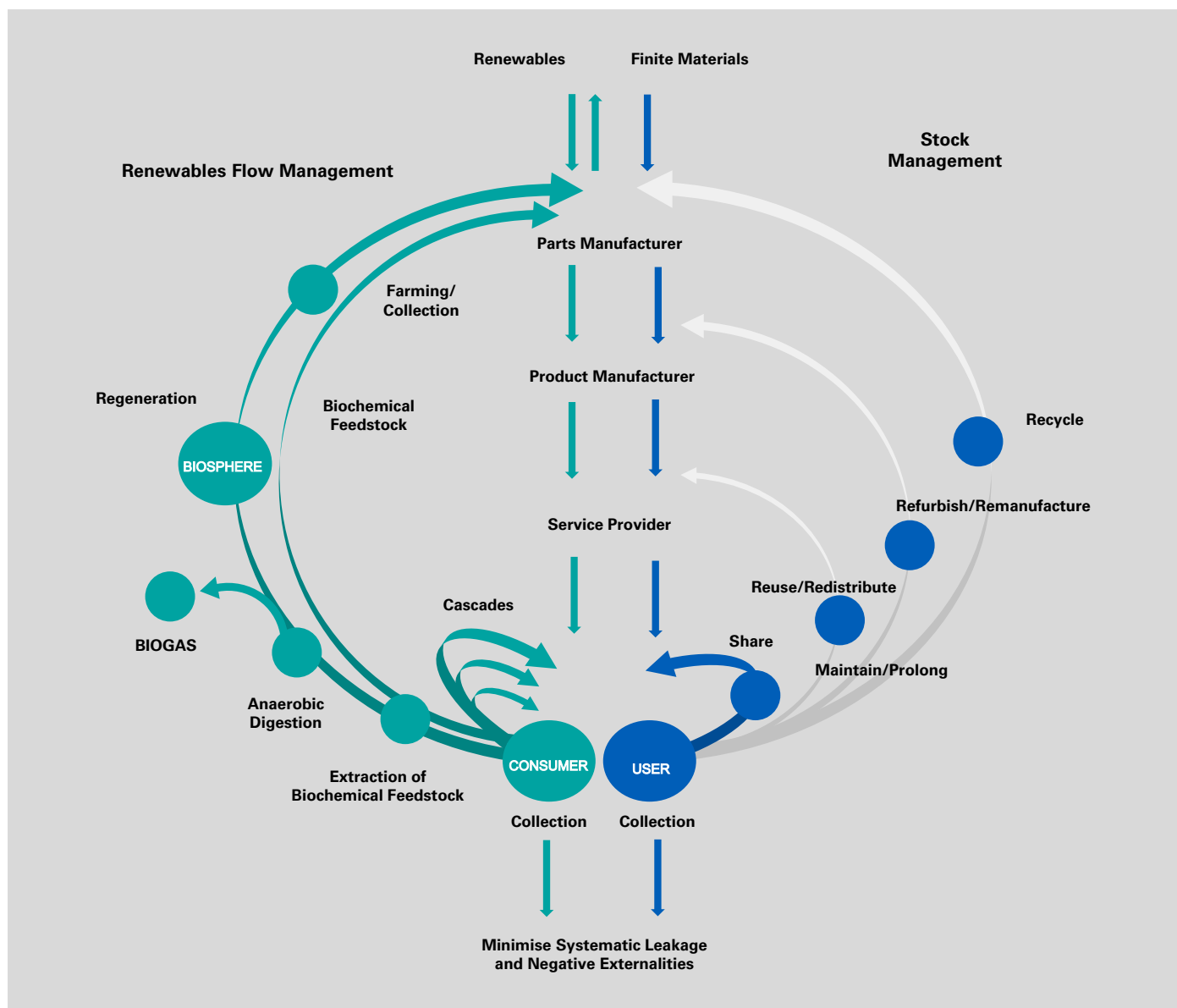
- By building capacity in the manufacturing of low carbon materials used in infrastructure projects,

vehicles and rolling stock;

- Creating a local industry where collaboration can take place to assist in the advancement of innovation;
- Reducing the carbon footprint of materials via reduced transportation.

Utilising circular economy principles to design out waste, keep materials at the highest level of the value chain, and regenerate natural systems, will assist in improving the design of our urban environment. Moreover, it will provide a significant opportunity for the transport sector to improve the assets and their impacts on the environment, and in particular, the selection of the materials used.

**Figure 4: Ellen MacArthur Foundation's butterfly framework<sup>41</sup>**



Source: Ellen MacArthur Foundation.



# 04

## Key considerations for a sustainable transport network



# Key considerations for a sustainable transport network



**Since the scale of the economic crisis began to emerge, the International Energy Agency (IEA) has been leading the calls for governments to make the recovery as sustainable and resilient as possible. This means immediately addressing the core issues of global recession and soaring unemployment – and doing so in a way that also takes into account the key challenge of building cleaner and more secure energy systems.”**

Dr. Fatih Birol, Executive Director - International Energy Agency<sup>42</sup>



**The transport sector is broad and diverse, and up until recently different parts of the industry have operated in isolation, working towards their own emissions reduction strategies or plans with little integration.**

An increase in collaboration is needed to achieve the goal of net-zero by 2050. Joint projects and partnerships – such as this report commissioned by Roads Australia, the Australasian Railway Association and the Infrastructure Sustainability Council, together with KPMG and Arup - can assist in bringing the industry together to work collectively towards a decarbonised sector.

Solely from a climate change perspective, the decisions made in the next five years will be critical to achieving the goals and targets agreed at COP26. The roadmap to net-zero should be determined collaboratively. It should involve federal, state, territory and local governments, industry, and community, and with the society as a whole in mind. The vision requires consultation with the relevant experts across varying disciplines to ensure we arrive at a considered solution

that lays the foundations for the sector and society for generations to come.

The time to act is now.

This section of the report provides a brief summary of some of the key issues that require consideration to work towards a net-zero emissions transport sector. Further discussion with examples of how these considerations can be addressed, (including case studies of projects that demonstrate the application of real-world solutions) is provided in Section 5.

The decisions made in the next five years will be critical to achieving the goals and targets agreed at COP26.



## 4.1 A national strategy is needed

### Placemaking

As the Infrastructure Australia Master Plan 2021 describes, taking a placemaking approach and designing transport solutions to meet the needs of our future communities is the best way to ensure the infrastructure is sustainable and will be future-proofed and resilient in a rapidly changing world.<sup>43</sup> Currently, there are no cohesive national strategies to address either the shortfalls in our planning systems which prioritise development over community, environmental or cultural concerns or needs, or our transport systems that connect our communities. Planning falls within state governments jurisdiction, as do decisions made relating to transport infrastructure within the jurisdiction of state governments. However, the Federal Government has a role to play to ensure investment attraction takes place at a national level to fund the projects we require to make the transition to a net-zero economy.

### Baselining and target setting

While many organisations are already measuring their own performance and striving towards emissions reduction targets, a more formal way to measure and report on solutions for the industry is required. Policies relating to benchmarking infrastructure projects can play a huge role in taking stock of the current status quo and assist us in understanding what is required to bridge the gap between the current situation and the low carbon future we need. Incentives-based solutions could also assist when accounting for externalities and environmental impacts, and provide the necessary guidance for the tools that are needed to drive down emissions.

### Standardised national frameworks

There are no national frameworks or methodologies currently being used across all states that comprehensively cover all stages of an asset's lifecycle which also include mechanisms to assess social, environmental, cultural and carbon impacts to improve decision making. The lack of a coordinated approach is present in the planning, design and operational phases of our transport assets. Whilst IA's Assessment

Framework has been updated recently to address gaps relating to social and sustainability issues, it potentially does not go far enough to ensure these issues are valued appropriately and are adequately considered during the early decision-making stages of a project.

It is also recognised that the ISC's Infrastructure Sustainability Design and As-Built rating tool has been adopted for the majority of government projects and goes a long way to assist in benchmarking projects going forward and improve their ESG impacts. However, this tool does not influence the decisions in the business case and planning stages. The tool only influences projects once an infrastructure option has been selected, missing out on the early stages where the greatest potential for carbon reductions could be realised. The ISC's Planning tool can assist in bridging this gap but to date has only been used on a few projects. The tool shows promise if its uptake can be increased rapidly together with the necessary capacity building required to utilise the approaches identified within for better decision making.

This gap in comprehensive frameworks makes it difficult to compare projects, particularly when accounting for carbon contributions, and ensure that future projects are optimised for ESG considerations during design, construction, operations and for the emissions they enable.

When it comes to road and rail fleets, environmental regulations differ from state to state, as do operational requirements from network to network, making improvements difficult for any vehicles regularly travelling across state borders. As an example, regulations for rail freight are different across all states which in turn has implications when applying low carbon solutions to rolling stock that cross state borders, which includes the vast majority of the freight rail fleet.

Standardising these types of regulations as well as applying a national framework will remove barriers, streamline the process and make it simpler for transitioning both road and rail fleets to zero emissions, but only if the standard is set at the highest existing jurisdictional level.

Incentives-based solutions could also assist when accounting for externalities and environmental impacts, and provide the necessary guidance for the tools that are needed to drive down emissions.

## 4.2 Policy and investment

Both government and industry are investing in sustainable transport solutions ranging from new active transport routes (cycleways and walking paths) to efficiency upgrades, still, the challenge is tackling this problem in a cohesive way. While states are pushing towards their own sustainability and net-zero targets, we require a nationally consistent approach to problems that are present across all states. This will allow the relevant stakeholders to efficiently address the problems and provide solutions for our communities that enable the connectivity between towns, communities, and across state borders. It will also allow for the efficient free flow of goods and services to their destinations to optimise the economic benefits rather than creating inefficiencies and barriers to industry.

The size of investment, both in renewable energy and in cleaner solutions for our energy and material sources for the construction of the infrastructure is considerable. This investment is needed for the construction of both new assets and to meet the needs

of transitioning the existing road and rail fleets, much of which are currently reliant on fossil fuels.

As an example, tax policy could make a difference by encouraging more sustainable transport solutions. Fuel tax benefits that favour cleaner fuels, fringe benefit tax for cars and car parking, or accelerated depreciation for heavy polluting vehicles are just a few ways policy changes can have a positive impact towards a net-zero economy.<sup>44</sup>

In terms of freight, there are significant benefits to moving freight off roads and onto rail. These benefits include lower carbon emissions, improved safety, decreased air pollution and other community benefits. However, this transition requires new policies and significant investment.<sup>45</sup>

Of particular importance will be tackling the workforce impacts that will arise as a result of transitions to new industries and away from old. Investment in employment transition plans will be required to ensure appropriate support is provided to those impacted for re-education, upskilling and assistance in the transition.

## 4.3 Governance and accountability

Decisions made relating to our transport industry should be transparent and accountable. It is not always clear why certain investment decisions for transport and the associated infrastructure have been made or whether sufficient community consultation has taken place.

There are instances of projects being committed to before a business case has been prepared and publicly reported.<sup>46</sup> Moreover, it is not clear that all alternative

options have been considered and some projects lack a rigorous analysis of the benefits and impacts, considerations and predicted costs, with such costs encompassing societal, environmental, cultural and economic.

Furthermore, carbon is not clearly factored in business cases for infrastructure assets, whether it is related to embodied, operational or enabled carbon.





## 4.4 Collaboration and capacity building

There are numerous approaches and methodologies already in existence across the property and infrastructure sector which can be used to assist in the planning, design, construction and operation of our urban environment and our assets. However, selecting the right approaches and tools is only part of the solution. There is also an imperative for improved collaboration and capacity building across the industry.

The current situation for most infrastructure projects is contractual and adversarial in nature due to the method of procurement utilised. For example, the client sets out a set of contractual requirements together with strict obligations that may result in penalties should they not be met. A collaborative approach (such as alliance contracting, shared risk, shared reward, lean construction or similar) is required to address these problems with which we are faced when seeking to improve our communities through the deployment of infrastructure solutions that serve them. These approaches can also create the right environment where carbon reduction, among other things, becomes incentivised.

There are numerous approaches, tools, systems and methodologies that can be used to identify and measure social and environmental sustainability issues. There are also many tools that can be used to design, construct, monitor and verify our built environment, our

assets and their operation. Moreover, the industry is fortunate to benefit many talented people, groups and organisations with specialist skillsets and expertise that can assist in the transition to net-zero. Unfortunately, this specialized talent pool is limited in size and reach. In many cases, their skill sets are not applied to phases of a project where the biggest impact can be made. As an example, during the business case stage where key decisions are made upfront in a project's lifecycle, there is insufficient prioritisation of the tools and resources relating to carbon reduction or circular economy principles. This shortfall can lead to compromised decision making, higher whole of life costs, and potential impacts in carbon that may be locked in for decades.

The sheer scale of the planned transport infrastructure pipeline (over \$110 billion in the next 10 years) exacerbates this issue.<sup>47</sup> Thus together, the sizable pipeline of projects and the limited talent pool challenges industry's capacity to address these social, environmental and cultural issues.

A collective agreement is required to determine the correct approach for the deployment of transport solutions at the national level. Subsequently, decisions relating to the relevant knowledge and capacity building around the tools, systems and methodologies used to achieve the desired outcomes can follow thereafter.

A collaborative approach is required to address these wicked problems with which we are faced.



## 4.5 Technology and solutions

### A decarbonised transport industry is heavily reliant on renewable energy

The magnitude of the task at hand – to transform the transport sector and realise a net-zero future – should not be underestimated. However, it also presents a unique opportunity for Australia. Certainly, we should not shy away from this ambitious goal due to the perceived complexity of the task at hand.

Facilitating the construction of net-zero transport infrastructure solutions including the roads, rail lines, stations, bridges, crossings and intermodals, is renewable energy. Furthermore, the enabled emissions – from the cars, trucks and trains that traverse the myriad of routes, roads and tracks across the country – also need to be reduced.

The current state of the stationary energy sector and our vehicle fleets is sadly lacking in terms of low carbon options. Many construction projects, especially in remote areas, rely heavily on mineral diesel for power and many of the electric cranes and other plant and machinery operate using diesel generators, completely negating any benefits sought. Moreover, current technology for electric cranes limits the size of lifts, slowing speed of construction with a knock-on effect on the overall project programme.

### Road and rail fleets require transformation

When it comes to prime movers, heavy haulage rail and long-distance logistics, Australia's current stock is predominantly diesel with no other real options available. For trucks and rail freight traversing this large continent, incremental improvements in decarbonisation take place with increasing efficiency in diesel engines as opposed to wholesale change.

Alternative options such as fuel cell, renewable biofuels, or even conversion of internal combustion engines to run on hydrogen gas requires investment to drive adoption and assist the transition.

The difference in regulations between states has an impact on the speed of the transition of our fleet to cleaner options, most notably seen in rail freight. Any moves towards replacing diesel engines require review and approvals from all jurisdictions to ensure they meet the regulations of each state they will be traversing.

A lack of action relating to the motorized road and rail fleet is also holding back change in this area. Improved fleet emission standards could be set by the Federal Government to drive the agenda and level the playing field for cleaner vehicles (as is the case in other countries such as the U.S, India and countries in the EU).<sup>48</sup> However, this is yet to be implemented in Australia. This is also yet another example where accounting for externalities that have a direct impact on health and wellbeing of the community is not currently factored into decision making at the government level.

### Zero emission fleet infrastructure

It is all very well to focus on fleet emissions, however, if the infrastructure required to serve these new vehicles is not present, then the uptake of emission free solutions will continue to be limited. Range anxiety is real and problematic for this transition and will only be addressed when the underlying infrastructure is constructed for both EVs, Fuel Cell Electric Vehicles (FCEVs), renewable biofuels, and hydrogen powered vehicles. A coordinated strategy lead by the Federal Government is required to provide a comprehensive solution across the country to ensure emission free commercial and private vehicles can be implemented.





05

The opportunity



# The opportunity



**Rather than simply projecting forward the status quo, infrastructure planning must set an ambitious vision for the country. It should anticipate and adapt to change, manage risk and deliver infrastructure that works towards — rather than against — the current and future needs of the community.**

Julieanne Alroe, Former Chair - Infrastructure Australia



**In the future - if current trends continue - it is likely we will not require all the carparks, parking bays, roads and current transport infrastructure provided for the private motor vehicle. In their place there will be an opportunity to provide more green spaces, inner city farms, and ways to connect with the local community and with nature. Walking, cycling, electric scooters and other innovative modes of transport will become increasingly common in our cities.**

We need to think about how we can future proof our infrastructure by designing to meet future needs/demands of a growing population, and design for end-of-purpose reuse. We must also be able to repurpose, adapt or transform our existing infrastructure to minimise waste and limit resource use. We must design and build our infrastructure assets to meet future needs in a net-zero environment and be resilient in the face of our changing climate.

Transport trends are also changing. Therefore, coupled with the effects of climate change, the necessity to update designs of our assets and their governing standards is of paramount importance.

With intentions set at COP26 and climate action becoming increasingly urgent, there is a real opportunity for the transport sector to play a key role in

driving emissions reduction in Australia.

The opportunity is for stakeholders across the transport industry to come together and reduce emissions across the sector, creating a sustainable transport network that is resilient and ready to take us into the future.




This report showcases projects that have demonstrated innovation and implemented inventive ideas to support decarbonisation and improve resilience. These projects are creating better, more effective and more resilient products, processes, and services, that go against the 'norm', and are in some cases world leading (see [Case Study 1](#)).



By sharing these leading examples, their successes and lessons learnt, this report aims to inspire others in the industry, challenge current views, and consider alternative solutions in the design and operation of our future transport system.

Collaboration and capacity building are key to ensuring this vision plays out. This section discusses the key concepts and approaches we can take to reduce emissions across all phases of transport infrastructure projects, including funding, planning, construction, operation and end-of-purpose life. It considers embodied, operational and enabled emissions, as well as opportunities to tackle carbon at various stages of an asset's lifecycle.

**Figure 5: Definitions of the three sources of carbon emissions<sup>49</sup>**

|   |  |
|---|--|
| <p><b>Embodied emissions</b></p>      | <p>Result from the production of materials used in the construction of infrastructure, as well as those from the construction process itself. Infrastructure decision-makers have control over these emissions through choices made in the planning, siting, designing and procurement stages of a project (for example, sourcing less emissions-intensive steel for the construction of a bridge). Control over these emissions may be limited by the cost and availability of technology and the constraints of their supply chain. However, the magnitude of infrastructure expenditure can be large enough that procurement preferences (for example, for recycled materials or low-carbon construction practices) can transform the activities of their supply chain.</p> |
| <p><b>Operational emissions</b></p>  | <p>Result from the ongoing operations and maintenance of infrastructure assets. Infrastructure decisionmakers and operators have direct control over these emissions through choices made in the planning, design and operating stages of the project (for example, installing LED lights rather than high pressure sodium bulbs in road street lights). As is the case for embodied emissions, control over these emissions may be limited by a project's supply chain, but infrastructure project preferences may transform markets for low-emissions technologies and energy generation.</p>  |
| <p><b>Enabled emissions</b></p>      | <p>Result from the activities of infrastructure's end-users. Infrastructure decision-makers have influence (but limited control) over these emissions. Choices about what infrastructure to build enables or restricts low-emission activity. For example, by offering more charging points and fast chargers, state government highway operators can influence the uptake of EVs. Decisions regarding where infrastructure is built can also influence emissions (for example, the proximity of rail and public transport infrastructure to population centres will influence local road transport emissions).</p>  |

Source: ClimateWorks.



# Case Study 1

## Case Study 1: True innovation in mobility and transport

### Arrival, USA and UK

Arrival was founded in 2015 with a vision to recreate the way vehicles are made.

The company develops electric vehicles with a truly innovative design and build process that enables them to be more efficient, more sustainable, and more equitable than other EVs on the market.

A key part to this is the company's micro factories, which can be quickly set up in new locations around the world. A micro factory can be operational within 6 months after confirming a site's readiness by retrofitting an existing space or warehouse. This means there are far less upfront expenses and overheads than traditional automotive factories, and this model also provides significant social, environmental, and economic benefits that come with local manufacturing.

Arrival uses in-house technology to design and build their vehicles and they are currently targeting commercial vehicles (buses and vans). Commercial vehicles are an underserved market, with fleet managers and asset owners who care about the total cost of operating and have detailed knowledge and understanding of their fleet's needs. Arrival offers a sustainable solution that can be tailored to suit the needs of each customer and is cost-effective.

Arrival vehicles are manufactured using an in-house developed thermoplastic based composite material, that is low cost, strong and 50% lighter than steel. Eliminating the use of sheet metal has removed complicated stamping and welding processes during manufacturing. Everything is moulded and shaped to form the vehicle, which allows the company to create any type of vehicle rapidly and on demand.

The material is also durable and damage resistant – the panels are built to rebound from impact and survive a lot more wear and tear. If they do eventually need repairs, a single panel can be removed and replaced seamlessly, massively reducing maintenance and repair costs for the owners.

When a panel is damaged, Arrival can recycle this material completely and re-use it in future vehicles, completing the circular loop in their design and eliminating waste. They considered the environmental impact throughout the vehicle's lifetime - ensuring the materials are recyclable and reusable at every stage of production, use and end of life.

Even the mileage of these vehicles can be tailored, which means vans that only need to be used over short distances can be built with less battery capacity, reducing the associated weight and costs, and optimising the vehicle for its purpose.

Arrival now employs 2,500 employees internationally and has operations in the US and the UK, with the aim to continue growing their global footprint. They have found a way to overcome economies of scale and service communities with local factories, producing a truly sustainable product.



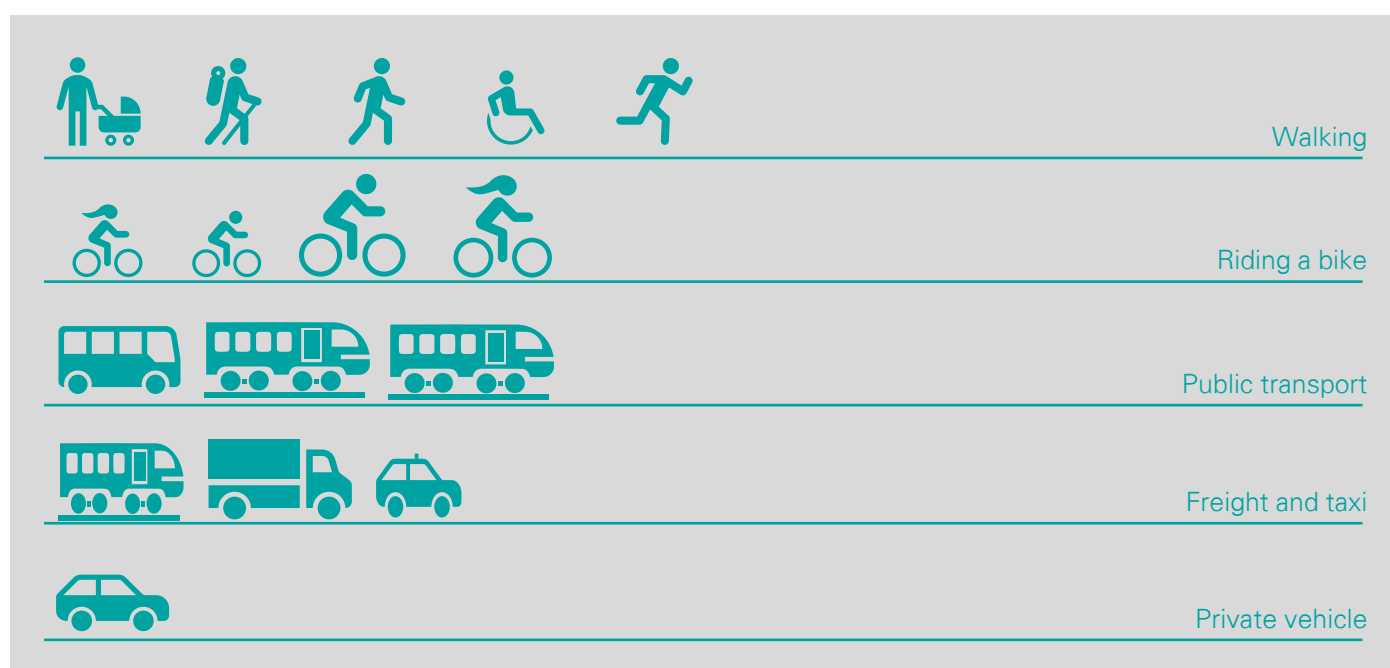
## 5.1 A place-based approach

### Placemaking is the first step to a sustainable transport network

To create a truly sustainable transport network for our urban environment, we need to take a holistic approach to urban planning and development. Considering the sustainable transport hierarchy (Figure 6), smart urban design and placemaking should encourage active transport such as walking and cycling to be the first

choice. Secondly, providing safe, efficient and accessible public and active transport options can significantly reduce operational and enabled emissions. As the least sustainable option, the aim is for private vehicle use to reduce. It is recognised, however, that there are limitations to this approach such as in regional areas where private vehicle use may be the only viable option for some years to come.

**Figure 6: The sustainable transport hierarchy<sup>50</sup>**



Source: Action Net Zero

All placemaking needs to be carefully planned and designed, with consideration of the needs of both the new urban environments and the existing communities. Furthermore, active placemaking requires particular consideration of the implementation of new transport systems to ensure they cater for everyone. Moving swiftly to an active model without due consideration for those less able (i.e. members of the community that have disabilities or other reasons that preclude them from using active or public transport) may result in adverse impacts. It is important to ensure that transport throughout our communities is safe and accessible for everyone.

Any change is often uncomfortable and resisted by the majority. Therefore, gradual incremental improvements, community consultation and transparency are key to ensuring successful outcomes when rethinking our transport systems.

Implementing a placemaking strategy is a long-term approach and can take decades to realise in the built form. Therefore, it should be recognised that in regard to the imperative of achieving net-zero by 2050, a focus on placemaking may only have a significant impact on new communities or inner-city urban-renewal projects. Where existing communities already exist, long term strategies will need to be implemented to address any perceived gaps in community needs. This ultimately means that the transport solutions and infrastructure currently operating for existing communities may need to focus on other decarbonisation strategies simply due to the limited time available rather than implementing wholesale change. A compromise may be required when assessing and adapting our existing built environment through a place making lens.

To create a truly sustainable transport network for our urban environment, we need to take a holistic approach to urban planning and development.

### What is placemaking and how can it assist in addressing decarbonisation?

In its simplest terms, placemaking is the process of creating quality places in which people want to live, work, play, and learn in.<sup>51</sup>

If all amenities, services and workplaces are within a short distance from people's homes, the need to travel long distances is reduced, lessening the burden on road and rail infrastructure, increasing the likelihood of active solutions being utilised, and ultimately lowering greenhouse gas emissions associated with the use of transport.

A concept gaining traction politically and in planning circles is the '15-minute city'. In essence, the 15-minute city is defined as 'an ideal geography where most human needs and many desires are located within a travel distance of 15 minutes by foot or bicycle. While automobiles may be accommodated in the 15-minute city, they cannot determine its scale or urban form.'<sup>52</sup>

The rise of bike sharing is also facilitating the ability for us to redefine our inner-city urban environments due to easy access to bicycles for a greater portion of the population and for short trips and of course the sustainability benefits of less people having to own their own private bikes.

Most of the current commentary regarding placemaking is about public spaces. In this regard,

placemaking can be defined as 'a multi-faceted approach to the planning, design and management of public spaces. Placemaking capitalizes on a local community's assets, inspiration, and potential, with the intention of creating public spaces that promote people's health, happiness, and well-being.'<sup>53</sup> Whilst this view of placemaking is important for addressing some inadequacies in the existing urban environment, it is limited and should be expanded to be all-encompassing. As per the previous definition, placemaking should include the needs of the community such as social infrastructure and services, as well as natural capital integrated into our built environment.

Whilst many view placemaking as a way to address our existing environments and improve their social value, we should not forget the importance of using this approach to design new communities and the infrastructure that serves them. All too often the social, environmental and cultural initiatives of what makes a location a great place to live are reduced, or value-managed out of larger projects in place of aspects that can generate a greater return for developers. If we are to provide new communities for our expanding population that are successful in the long term, these imbalances in the planning and design of our communities must be addressed.

Placemaking is the process of creating quality places in which people want to live, work, play, and learn in.<sup>54</sup>

### Examples of placemaking

A placemaking approach has been shown to be successful on a small scale, such as Kings Cross London UK<sup>55</sup>, or here in Australia with the Laneways in Melbourne VIC<sup>56</sup>, but tends to get lost on the larger projects where the focus becomes skewed towards benefits for developers rather than amenity for the community who will reside in these new urban environments. This emphasises the need for putting a higher value on the social, environmental and cultural factors that makes a city shine and improving liveability. These include initiatives, such as parks, natural capital including wildlife corridors, and services such as schools, childcare, sporting and community facilities. The integration of active and public transport

solutions intertwined within the fabric of the built form, will provide the necessary linkages to these community focused urban environments (see [Case Study 2](#)). An integrated approach needs to be prioritised over solutions that have historically handed over large tracts of land to serve the private motor vehicle.

Ultimately, social, sustainability and cultural issues are required to be addressed for small, large scale and the mega projects that are being procured and are in the current infrastructure pipeline. Comprehensive social impact gap analyses are also required to understand where the focus needs to be in the short, medium and long term to address these social, environmental and cultural imbalances within our communities.





# Case Study 2

## Case Study 2: Fishermans Bend Urban Renewal Area

### Melbourne, Development Victoria State Government

One major project in Australia that is putting placemaking into practice is the Fishermans Bend Urban Renewal Area in Melbourne. With the city growing rapidly, it is expected that the precinct will be home to 80,000 people and host 80,000 jobs by 2050 and the Victorian Government have set an aim for the project to be a leading benchmark for sustainable urban renewal.

The State Government has set a target for 80 per cent of transport movements to be made by public transport, walking, or cycling. They are designing an integrated transport system that includes cycle paths, tram lines and an underground rail line. Their goal for a connected and liveable community has active transport at its heart. They state "People will be connected through integrated walking, cycling and public transport links, as well as high-speed data networks. A walkable street network, safe and connected cycle routes, trams, and a train line will make choosing sustainable transport options easy. Activity centres will be located near public transport, community services and public spaces to ensure that people can access their daily needs close to where they live and work. Less than one in five trips will be made by private car."

Arup independently reviewed the government proposed sustainable design standards and ensured that they were aligned to the Green Building Council of Australia's (GBCA) Green Star Communities and Design and As-Built building scale rating tools.

Arup's role was to identify and embed robust sustainability standards in the State planning requirements related to the project for the built environment. An expert report was created which proposed appropriate design standards at Fishermans Bend. These standards have been implemented into the state planning system relating to the precinct, which provides developers and stakeholders clarity regarding sustainability targets and objectives for the precinct.

While the urban renewal area is still a long-way off completion, it is this kind of long-term and holistic approach to infrastructure planning that is needed to ensure we have transport that can fulfil society's needs for a net-zero and resilient urban environment now and into the future.





## 5.2 Creating safe and accessible routes for pedestrians and cyclists is key in reducing transport related emissions.

Active transport (cycling, walking, scooting, skating, etc.) is considered the most sustainable form of personal transport.<sup>57</sup> Implementing and promoting active transport needs to be a cornerstone of all transport strategies to meet net-zero carbon targets, particularly in urban areas. This mode of transport also delivers added social benefits by improving public health and quality of urban life. COVID-19 has resulted in the opportunity for people to walk or ride more often, especially within their local area. This has generated a hype around active transport, as evidenced through the uptake of tactical urbanism (low-cost, temporary changes to the build environment such as pop-up bike lanes, parklets and pedestrian plazas). While not a new concept, tactical urbanism has been brought to the forefront of discussion as a result of the pandemic.

Transport enabled emissions account for approximately 20% of Australia's total emissions.<sup>58</sup> There are several ways we can encourage more active transport and reduce enabled emissions, and there are many great

examples around the world we can look to for inspiration.

Specifically, opportunities to learn are presented from places such as London, Paris and Copenhagen to shift the mindset of how we manage, plan and deliver transport projects. The opportunities are broad and include examples such as changing specifications around bike lane widths to accommodate a greater number of bicycles safely on the cycle paths. There are also opportunities to store bikes more efficiently in public spaces (see [Case Study 3](#)). Whilst we are some way away from achieving the level of active transport seen in Europe, Australia has commenced this journey and governments are actively looking for solutions that can be implemented here. There needs to be incremental steps to improve the quality and connectedness of the network, with corresponding transfers of road space allocation to active transport over time (see [Case Study 4](#)).







## Case Study 3

### Case Study 3: Eco Cycle

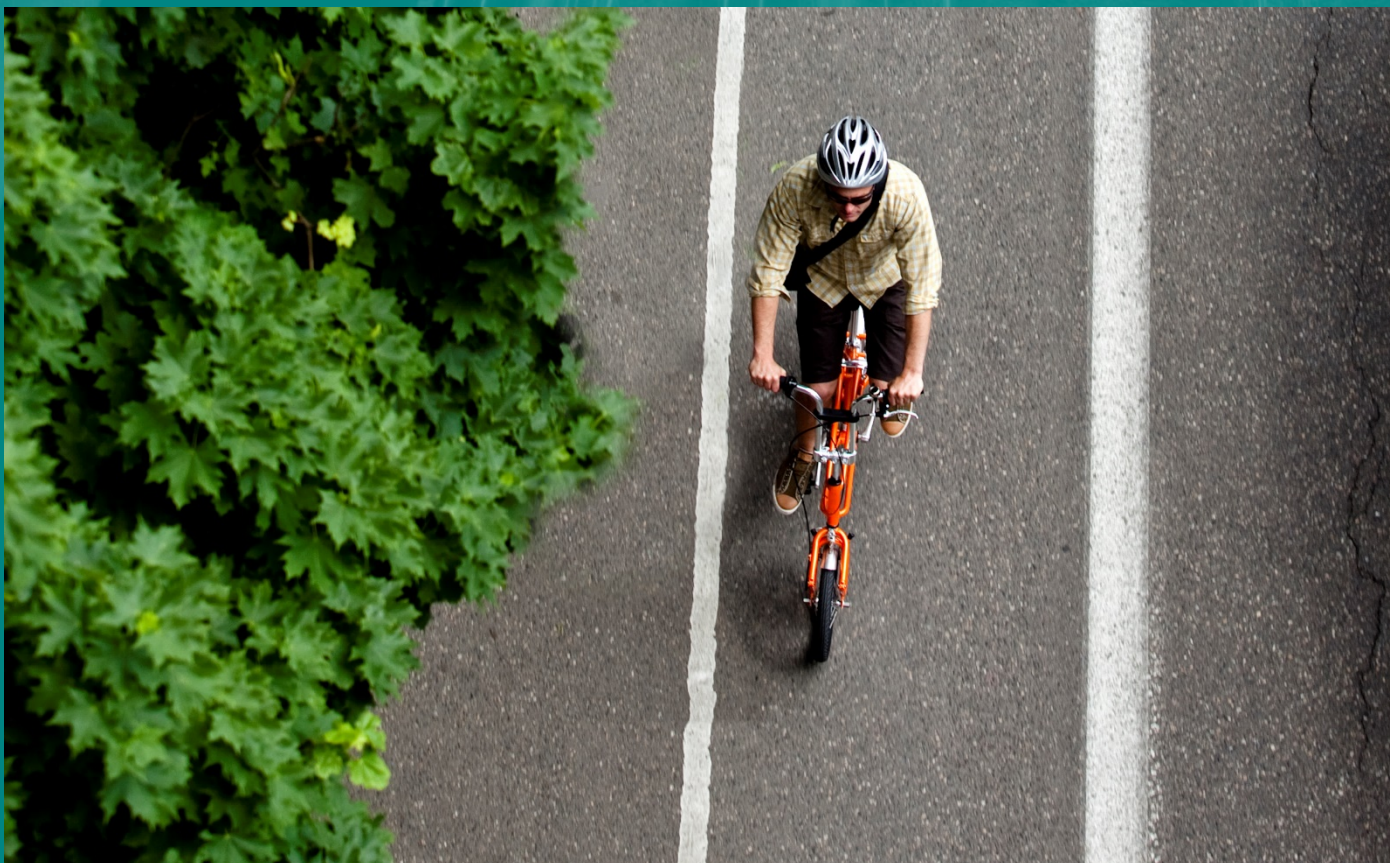
#### Giken, Japan

In Japan, a company called Giken developed “Eco Cycle”, an innovative solution to bike storage issues in Japanese cities where 50% of people own a bicycle.<sup>59</sup> Their technology allows bikes to be safely stored underground, avoiding theft and weather damage, and freeing up public space for other purposes. “A 204-bike capacity underground Eco Cycle uses a similar above ground space to that of a single bike. On the other hand, 204 bikes parked above ground consume an area similar to that of a 25-metre pool.”

The use of Eco Cycle facilitates high volume parking in high density, land scarce locations such as train stations and commuter hubs, leaving above ground area available for green space and other community uses.

These types of system can easily be retrofitted into existing basements or car parks in close proximity to train stations with reduced environmental impacts from excavation.

In the Netherlands, cycling is a part of daily life. In the 1980’s, Dutch towns and cities began to introduce measures to make their streets more cycle friendly.<sup>60</sup> The Hague and Tilburg were the first cities to experiment with official cycle routes using dedicated paths, which led to more and more cities introducing bike friendly infrastructure. Today, Amsterdam is the cycling capital of the world, with cycling accounting for around 38% of all trips through the city.<sup>61</sup>







# Case Study 4

## Case Study 4: Australia's first Veloway on the West Gate Tunnel Project

### Transurban, Major Transport Infrastructure Authority (MTIA), Victoria, CPB Contractors and John Holland Joint Venture | Registered IS Design and As Built rating

The West Gate Tunnel Project will deliver extensive roadway improvements through Melbourne's west, including tunnels, interchanges, and elevated roadways. The project will also deliver more than 14 kilometres of new and improved walking and cycling infrastructure.

One of the key pieces of cycling infrastructure delivered will be Australia's first Veloway. The elevated and enclosed path will connect Melbourne's CBD to Footscray via Footscray Road in Melbourne's inner-west. The Veloway will be 2.5 kilometres long and will provide cyclists a direct route to the CBD, with the design to be integrated into a new elevated roadway over Footscray Road.

The Veloway is completely separate from other shared use path and road infrastructure, with dedicated entry and exit points for cyclists only. It will provide an off-road route that removes six intersections for cyclists, making trips safer and quicker. It runs from Shepherd Bridge to the city side of Moonee Ponds Creek. At four metres wide, the Veloway allows plenty of room for the growing number of cyclists, and space to stop for a break or change a tyre.

The Veloway is part of other active transport upgrades, which include:

- a completed Federation Trail, connecting Spotswood and Yarraville with a new pedestrian and cycling path from Hyde Street Reserve to Spotswood Station; and
- a new, safer cycling and pedestrian bridges over the West Gate Freeway and Moonee Ponds Creek.

The project is seeking to provide communities in Melbourne's inner-west with more sustainable transport connections, encouraging car-free travel, and has registered for a Design v1.2 IS Rating.

Focusing the development of cycling infrastructure around public transport nodes would encourage cycling to and from public transport nodes. It has the potential to increase the catchment area of the train station compared to walking alone. For example, in the Netherlands, around 40% of train passengers arrive at their departure station by bicycle.<sup>62</sup>

Given the current momentum for cycling as a result of the COVID-19 pandemic, now is the time to start planning to convert temporary pop-up lanes to permanent infrastructure and plan, design and execute strategies to make Australian cities cycling friendly. It should be recognised that these types of active transport solutions are relevant to our cities and urban environments, however they may not be as applicable to regional locations where travel distances are greater.



## 5.3 Sustainable transport solutions for urban and regional communities

### Sustainable public transport can connect communities

23% of people regularly use public transport in Australia.<sup>63</sup> In our more heavily populated cities, public transport is generally the preferred mode for commuters if quick, easily accessible and efficient. As urban development continues and the population of our country continues to grow, smart public transport networks are vital for a functioning and thriving communities. Considering the sustainable transport hierarchy, public transport should be prioritised next, after active transport.

The ARA states 'Rail patronage on Australia's passenger services is expected to grow two per cent per year, taking 12 million car journeys off the road from 2018-2026'. Various studies comparing road and rail passenger travel have demonstrated substantial reductions in carbon emissions (with different studies demonstrating different levels of reduction, ranging from 30 to 70 per cent), which in turn support healthier communities in our towns and cities. Each train of commuters reduces air pollution costs by \$26,000 per annum not to mention the health-related impacts this minimises.<sup>64 65</sup>

Public transport will play a key role in the decarbonisation of the transport industry and should be a key focus in decarbonising the sector. However, we need a mode agnostic approach so long as it is sustainable. People don't mind what mode of public transport they take provided the transition is convenient and the journey efficient. To increase public

transport use, aligning routes and improving connections between active transport, road, and rail would make it more conducive for customers (see [Case Study 5](#) and [Case Study 6](#)).

**Keolis Downer currently operates the integrated transport service** for Newcastle and Lake Macquarie in NSW, which is focused on delivering efficient public transport across multiple modes of travel.<sup>66</sup>

The Newcastle control centre monitors the local light rail, ferry, and bus network together and in real time, with live data driving decisions and helping the organisation to understand customer behaviour and make the journey more seamless across multiple modes. The approach to integrated transport has seen a new bus timetable implemented to ensure that passengers could meet the ferry and the light rail with minimal wait times.

This contract, awarded to Keolis Downer in 2017, was the first multi-modal public transport contract in Australia, and was a conscious choice by Transport for NSW to look at the overall customer journey and tailor it to suit the needs of the community. The network includes 190 buses, two ferries and six light rail vehicles.

Through analysis of trip data, approximately 46% of passengers are shown to transfer across the network demonstrating the importance of the multimodal focus, and the advantages that this approach can have in smaller communities and regional centres.





## Case Study 5

### Case Study 5: Wynyard Walk

#### Transport for NSW, Thiess Pty Ltd, Woods Bagot | Certified IS Design Rating – Commended

Wynyard Walk is an accessible pedestrian tunnel that quickly and safely links Wynyard Station with the western Sydney CBD and Barangaroo. At 180m long, Wynyard Walk creates a link between the upgraded Wynyard Station concourse, Kent Street tunnel, Sussex Street pedestrian bridge and Barangaroo.<sup>67</sup>

The walk makes it faster, safer and easier for more pedestrians to move in and through Sydney's CBD between Wynyard Station, the western corridor of the CBD and Barangaroo

The Barangaroo development at its peak can accommodate 23,000 office workers and attracts 33,000 daily visitors. Wynyard Walk was designed to cater for this significant growth in pedestrian demand and was a key component of the NSW Government's commitment to meeting future transport demands in Sydney.

#### Key features include:

- A safe, quick and accessible route for up to 20,000 pedestrians per hour.
- Lifts and escalators help make sure that people with disabilities, older people, and those with strollers and luggage, can all easily use Wynyard Walk and its connecting routes.
- The tunnel relieves road congestion and improves safety by separating pedestrians from traffic.

Wynyard Walk was designed, constructed and is operated following Transport for NSW Sustainability Targets and Transport for NSW Sustainability Guidelines which were a leading set of sustainability criteria for transport infrastructure assets in Australia at the time. The project's Environmental Management Plans took into account these sustainability criteria along with all other relevant Acts, Regulations and best practice management. Monitored by an Environmental Management Representative, the plans dealt with the following:

- Noise, vibration and traffic from construction
- Flora and fauna management
- Earthworks, dust, waste, water and air quality management
- Heritage management

#### Planning for success:

Wynyard Walk was part of the NSW State Government's draft Long Term Transport Master Plan, which for the first time integrated transport planning across all modes - roads, public transport, cycling, walking and freight.

Although building Wynyard Walk was a massive undertaking in a very busy part of the city, detailed planning allowed for the project to go ahead with minimum disruption to the area. Transport for NSW actively consulted with transport stakeholders through the Traffic and Transport Liaison Group to ensure works were well anticipated. Community consultation with directly impacted stakeholders was also carried out.

Detailed traffic studies were performed prior to the construction to assess and model the impact of the works. Traffic performance was then monitored during and post construction. Works that impact on the roadway were undertaken at night to minimise disruption to traffic, and works were staged to minimise overall impact on the area during construction.

Wynyard Walk is a great example of how integrated transport planning can deliver positive outcomes and enable thousands more people to access safer, sustainable modes of transport.

The project achieved a 'Commended' As Built v1 IS Rating.

**Wynyard Walk is a great example of how integrated transport planning can deliver positive outcomes and enable thousands more people to access safer, sustainable modes of transport**





## Case Study 6

### Case Study 6: Enabling communities to leverage shared transport

#### Liftango, NSW

Liftango is working to leverage the potential of shared transport and optimise transport systems.<sup>68</sup> In 2018, shared transport tech company Liftango launched a trial for on-demand public transport on the central coast of NSW.<sup>69</sup> The city of Woy Woy is a low-density area on a peninsula that makes travel in and out challenging during peak periods. CoastConnect is a commuter transport service which set out to solve this problem with a service to connect residents to the train station and allow them to easily commute to and from work.

To encourage usage and create loyal patronage, the service launched 'door-to-hub' capabilities. This means residents received the highest level of convenience and were picked up from any point they chose within the service zone. Later, the service was modified to a 'meeting point-to-hub' service. This enabled Community Transport Central Coast Limited (CTCCL) to service more demand during the operating hours. By condensing multiple passengers within a close proximity to a single pickup location, vehicles can pick up more passengers.

By creating a convenient, safe, and reliable service, CoastConnect increased their month-on-month patronage and retained loyal passengers. The service has recorded a 57% increase in trips since launch and 72% current retention rate between months.



A major transport infrastructure project in Victoria that is working to enhance the integration across multiple modes of transport is **The Level Crossing Removal Project (LXRP)**. At the time of writing, this project has removed 59 level crossings across the Melbourne metro and regional train network. A total of 85 level crossings are set to be removed across Melbourne by 2025 primarily to improve safety, reduce congestion, and create greater capacity for rail transport across the city.

Since 2015, the project has re-connected communities, built new train stations, created nearly 14 Melbourne Cricket Grounds (MCG) worth of new open space, planted more than 1.9 million new plants, shrubs and trees and delivered more than 40km of shared user paths across the city.<sup>70</sup> With more than 40,000 commuters using this train network every day, this project is an important part of ensuring public transport is safe and accessible for the growing population of Melbourne.

This project has also delivered embodied and enabled carbon reduction through implementing sustainable construction methodologies, using alternative concrete solutions and the installation of solar photovoltaics (PV) in several new train stations to power ticket machines, platform and station lighting, and security systems.<sup>71</sup>

At the time of writing, six LXRP ISC submissions had achieved IS certification (including a total of 10 level crossings, two new stations, one station upgrade and two new train stabling yards), with one further submission undergoing a rating. For example, two level crossing removal works, the Aviation Road and Wyndham Vale Stabling projects, together have resulted in a 34% reduction in energy use, mainly due to the use mainly due to the use of solar during construction and operation, a 34% reduction in potable water use, and over 1,000 Tonnes of CO<sub>2</sub>e saved from the reduction and reuse of materials.<sup>72</sup>

### Enhanced customer experience for existing transport routes

The TfNSW's Transport Access Program (TAP) is an example of improving access to existing public transport systems for a larger portion of the population. The program aims to deliver an improved experience for public transport customers across NSW by providing accessible, modern, secure and integrated transport infrastructure. The program seeks to upgrade and enhance over 35 stations across NSW.

In particular, this program aims to deliver the following

key benefits:

- Stations that are accessible to people with a disability, limited mobility and parents with prams
- Modern buildings and facilities for all modes that meet the needs of a growing population
- Modern interchanges that support an integrated network and allow seamless transfers between all modes for all customers.

This type of program enhances the customer experience and as a result increases the attractiveness of public transport solutions for the public who are making decisions relating to the choice for their mode of transport.<sup>73</sup>

### A sustainable solution for regional communities

Faster rail will play an important part in connecting regions to city centres and can reduce reliance of private vehicle use for longer journeys. Upgrades on regional networks to increase their speed, reliability and frequency of services are needed to drive greater use of rail in this context. ARA found that 60 per cent of respondents would be more likely to travel from the region to their nearest city by train if there were faster journey times.<sup>74 75</sup>

However, many of the solutions presented will be challenging to implement in more remote regional communities where population density is significantly less and large distances for commuting are present. The reliance on the use private vehicles is likely to be the norm for decades to come as implementing public transport solutions for these regional communities will be costly and inefficient.

It will be imperative to find solutions that address the carbon issue, are sustainable and efficient, and meet the needs of the people using them.

For these reasons the acceleration in the deployment of solutions that facilitate the uptake of ZEVs such as Hydrogen Fuel Cell Electric Vehicles (HFEVs), EVs and renewable biofuel solutions is imperative. In all three cases policy changes and significant investment are required to ensure the infrastructure is in place to enable this transition. Once the infrastructure is deployed, only then will the regional communities be able to commence the transition of their vehicles, plant and machinery to low carbon options. Incentives will be required to assist with the uptake of new technologies until economies of scale drive the costs down to favourable levels that compete with traditional higher carbon emitting solutions.



## 5.4 Shifting freight and heavy haulage to more sustainable forms of transport

Unlike emissions from passenger vehicles, emissions resulting from heavy duty truck and rail freight did not materially decline in 2020 and 2021 during the COVID-19 pandemic. It is projected that these emissions will continuously increase from 2019 levels of 24 MtCO<sub>2</sub>e (24% of total transport emissions) to 27 MtCO<sub>2</sub>e in 2030 (28% of total transport emissions).<sup>76 77</sup>

In 2016, a National Transport Commission (NTC) study found that rail accounted for around half of Australia's freight transport, and yet it was only responsible 4% of Australia's total transport emissions.<sup>78</sup> Rail Freight produces 16 times less carbon pollution than road freight, is four times more fuel efficient and produces three times less carbon than road freight.<sup>79</sup> Increasing the share of freight carried by rail has significant potential to help reduce carbon emissions, as well as lead to co-benefits such as reducing congestion on local roads, improved safety and reducing air pollution.<sup>80</sup>

**The Australian Rail Track Corporation's (ARTC) Inland Rail** is a Freight Rail Infrastructure Project (FRIP) currently under construction and is set to build new freight connections between Melbourne and Brisbane, via regional Victoria, New South Wales and Queensland. The project, due to be operational by 2027, is forecast to cut carbon emissions by 750,000 tonnes per year from 2050, largely by shifting freight from road to rail.<sup>81</sup>

In addition, the Victorian Government has committed funding to encourage the shift of containerised freight from road to rail and is developing the Port Rail Shuttle to reduce congestion around the Port of Melbourne and make it easier and cheaper for businesses to use rail freight. The Port Rail Shuttle network is set to play a crucial role in Victoria's commitment to achieve net-zero by 2050.<sup>83</sup>

However, shifting to lower emission forms of freight transport (mode-shifting) is difficult given current policies. More work needs to be done by government to identify and pursue opportunities to shift more of Australia's freight to less emission intensive forms of transport.

### **Track duplication to enable efficient transport of freight and safety for passengers**

The LXP includes track duplication works, with one example due to commence imminently on the Hurstbridge Line. These works between Greensborough and Montmorency, and between Diamond Creek and Wattle Glen will ease congestion, allow the public network to provide more frequent services and allow for an increase in freight movements by rail.<sup>84</sup>

From a freight and logistics perspective and as highlighted in the NSW Auditor General's report on rail freight and Greater Sydney "...two-thirds of all freight in NSW (excluding coal) passes through Greater Sydney and that cargo volume is expected to increase by 48 per cent by 2036, from 194 million tonnes in 2016 to 288 million tonnes."<sup>85</sup>

To overcome this issue in Sydney, the track duplication works between Port Botany and Mascot are underway. These works will help to alleviate congestion on the shared infrastructure which will allow more freight to be transported through Port Botany to meet future demands.<sup>86</sup>

These duplication projects not only assist in delivering more efficient systems for both freight and passenger trains, but they also improve safety of the whole network, optimise logistics, and improve energy efficiency through minimising stoppages and wait times due to passenger trains picking up passengers at stations.



**The Inland Rail FRIP will also create more reliable freight connections and help keep store shelves stocked, all while reducing Australia's carbon emissions and heavy reliance on trucks.<sup>82</sup>**

Inland Rail



## 5.5 Sustainable transport infrastructure needs new approaches and collaboration

So, how do we build a sustainable transport network? How do we create a solution that will cater for the future generations, be adaptable and expandable to ensure it is resilient to climate change, and align with future technological trends?

The key is addressing our current planning system, both for our communities and our transport sector. You can't build a world leading, net-zero transport system without considering and responding to the needs of the communities it serves.

A knee jerk reactionary approach will not deliver the solutions we need for the community or deliver on Australia's commitments to achieve net-zero by 2050. A holistic approach is required that reviews our current urban environment, identifies the gaps and responds accordingly both to social, environmental and cultural needs now, and into the future. The transport solutions can then be designed in conjunction with the master

planning of our communities to optimise urban environment.

Moorebank Logistics Park (MLP) by Qube is one such example of a considered, long term vision that is responding to a shortfall in integrated logistics hubs for Sydney (see [Case Study 7](#)). The MLP not only addresses this shortfall in logistics space but also tackles the need to remove heavy freight from roads and onto rail. Another aspect to this particular project is the government's role in assisting with financing the project. The Clean Energy Finance Corporation (CEFC) assisted in the provision of low interest capital to facilitate the implementation of renewable energy solutions and improved energy efficiency of the asset. These types of funding solutions, and sustainable finance in general, will play a huge part in the move to decarbonise the sector.







# Case Study 7

## Case Study 7: Moorebank Logistic Park

### Qube | Design rating – Certified IS As Built rating - Excellent

The Moorebank Logistics Park (MLP) is Australia's largest freight infrastructure project and is set to transform freight transportation. The MLP development includes an import/export (IMEX) rail terminal to enable freight to be moved by rail along the Southern Sydney Freight Line between Port Botany and Moorebank and up to 850,000 sqm of high specification warehousing. The precinct has the capacity to transport up to 1.05 million TEU (twenty-foot equivalent units) a year of import-export freight containers from road to rail each year, and another 0.5 million TEU of interstate freight per year. The MLP is directly responding to the projected demand for freight and logistics for Sydney as the population of the city and surrounding region grows.

Transporting the containers by rail will remove more than 3,000 heavy truck movements from Sydney's road each day. This switch to rail will reduce truck emissions by more than 110,000 tCO<sub>2e</sub> (tonnes of carbon dioxide equivalent) annually.<sup>87</sup> The overall economic benefits are approximately \$11 billion over 30 years. This includes \$120 million a year for the economy of south-western Sydney, through improvements to productivity as well as reduced business costs, reduced road congestion and improved environmental outcomes.

MLP also includes a range of innovative technology solutions to reduce embodied and operational emissions<sup>88</sup>:

- MLP will be constructed and operated as a state of the art, modern intermodal terminal and warehousing distribution facility. Automation will include automated stacking cranes, rail mounted gantry cranes, a fleet of low emission hybrid auto shuttles and computer software to handle all containerised freight on the site. The use of automation reduces energy use and greenhouse gas emissions, enhances safety, minimises environmental impacts and improved productivity.
- The design on MLP has incorporated features to help reduce urban heat island effect including landscaping, green space, lighter coloured building façade, large awnings and bioretention structures such as rain gardens.
- MLP will supply a minimum of 12MW of solar generation capacity. The PV installed onsite will feed into an embedded power network, the network will enable business within MLP to access renewable energy onsite. 3MW of solar has been installed on Warehouse 1 which at the time of installation was the largest single roof top solar installation in Australia.
- An online sustainability performance tool has been implemented to measure and monitor electricity use and fuel consumption.

Stage 1 was certified by ISC as having achieved an "Excellent" rating in July 2020. Warehouses within the precinct have been set to achieve minimum 4 Star Green Star Design & As Built rating and minimum 4 Star Green Star Performance rating.



**Infrastructure is considered a challenging sector to decarbonise, yet this project shows that it also offers great potential. Qube tapped into that potential to find many creative ways to lower its carbon emissions.**



Ian Learmonth, CEO - Clean Energy Finance Council (CEFC)

## Sustainable finance

As the world wakes up to the impacts fossil fuel emissions have on the planet, there has been a spotlight shined on many financial institutions, superannuation funds, and providers of capital that fund this industry. Many of the large pension funds across the world are de-risking their portfolios and minimising their exposure to fossil fuels and this can be seen by the public commitments made.

In December 2019, Bank of England Governor Mark Carney noted that “changes in climate policies, new technologies and growing physical risks will prompt reassessments of the values of virtually every financial asset.”<sup>89</sup> Organisations, financial institutions and providers of capital should consider their longer-term strategies that properly consider the impacts of these risks. Companies that invest in activities that may not be viable in the longer term will likely be less resilient to the transition to a lower-carbon economy. As a result of this exposure, their investors will likely experience reduced returns. In addition, the valuation of companies and their assets may not have factored in these long-term risks due to insufficient information.<sup>89</sup>

To arrive at a zero emissions economy, we need a financial system that is aligned to the commitment and supports initiatives to reduce carbon associated with the construction, operation, and use of our transport systems.

Some pertinent examples of progress within this space are demonstrated with the following two examples:

**1. The Australian Sustainable Finance Institute (ASFI)** is a collaboration of leaders spanning Australia’s major banks, superannuation funds, insurance companies and academia to help shape an economy that prioritises environmental protection, human well-being, and social equity. The ASFI launched the Australian Sustainable Finance Roadmap in 2020, which includes 37 recommendations within four

domains (embedding sustainability into leadership; integrating sustainability into practice; enabling resilience for all Australians; building sustainable finance markets) that contemplate a series of actions for implementation before 2030.

The ASFI states “Globally, momentum is building to better align finance with our sustainable development needs. Countries and regions around the world are setting out Sustainable Finance Roadmaps that provide pathways and policy signals and set frameworks to enable the finance sector to contribute more systematically to the transition to a more resilient and sustainable economy, consistent with these global goals.”<sup>90</sup>

**2. The Clean Energy Finance Corporation (CEFC)** is a government agency that helps to drive private sector investment in clean energy through mechanisms such as direct investments for both small and large clean energy projects, green bonds, clean energy asset finance, and investment funds to co-deliver clean energy developments in agribusiness, infrastructure and property. CEFC states “We’re accelerating investment in Australia’s transition to net-zero emissions by 2050, in agriculture, cleantech innovation, energy generation and storage, hydrogen, infrastructure, property, transport and waste.”<sup>91</sup>

Financial institutions are also making commitments to decarbonise their operations and portfolios. Banks such as SunCorp, NAB, Commonwealth, ANZ and Westpac have all made commitments to lower their emissions and provide financing to low carbon projects or to support their customers to lower their emissions.

Globally, new investment in the energy transition grew from US\$33 billion in 2004 to US\$501 billion in 2020,<sup>92</sup> however, it is estimated that an annual average investment of approximately US\$2.4 trillion will be needed globally for the next 15 years to limit global temperature rises to 1.5°C.

To arrive at a zero emissions economy, we need a financial system that is aligned to the commitment and supports initiatives to reduce carbon associated with the construction, operation, and use of our transport systems.



### Taskforce on Climate related Financial Disclosures (TCFD)

As stated in the TCFD Guide 'Investors, lenders, and insurance underwriters need adequate information on how companies are preparing for a lower-carbon economy. More effective, clear, and consistent climate-related disclosure is needed from companies around the world.'<sup>93</sup>

At the request of the G20 Finance Ministers and Central Bank Governors, The Financial Stability Board (FSB) set up a taskforce to tackle this gap in critical information relating to climate risk.

The TCFD framework was created as a response to this need and sets out guidelines for organisations to review and report, in a consistent and practical way, their risks and opportunities relating to climate change and operating in a low carbon economy.

TCFD and other similar frameworks are assisting organisations in the transport sector to understand their exposure to climate related risk. They also help organisations to set out meaningful and practical strategies to reduce their exposure to these risks whether they are physical (e.g. rising sea levels, increased storm effects) or transitional (e.g. policy impacts, carbon price).

ESG is influencing project finance and a number of organisations are building material issues that arise from their analysis of the ESG landscape into their business planning.

Transurban is one such organisation that has assessed material issues across the three categories of Environmental, Social and Governance to identify those that pose a threat or opportunity for the organisation. They have also carried out a TCFD assessment to determine both physical and transitional risks to business. These assessments directly feed into their strategic planning, and as a result, influence financial decision making.

To this end, when taking on new projects, they not only have an obligation to, but can see value in ensuring social, environmental and cultural initiatives are implemented and issues addressed. ESG and resilience is no longer about altruism. It is where the money is, and projects will attract finance more easily if ESG is addressed.<sup>94</sup>

### Indicators for success

Typically speaking the measures for 'success' of a project revolve around two stages; project delivery stage and post-delivery stage.

Delivery stage success measures have, traditionally speaking, revolved around the indicators of cost, time, quality, efficiency and safety.

Post-delivery success indicators are typically identified as financial, or yield based (e.g. return on investment or users pa).

As an example, using the above metrics for a road project may cause unintended consequences of increased private vehicle use, and decisions leading to an absence of public transport solutions which could incur a negative impact on both environmental and social outcomes.

Rather than purely focusing on the financial benefits and metrics that underpin these KPIs, it is necessary to expand the number of indicators to ensure a balanced view of success can be derived. The inclusion of metrics indicators such as social return on investment, carbon reduction per km travelled in comparison to a base case, or passenger travel time reductions can provide a better understanding of the overall impact and success of a project.

The ISC has carried out a number of third-party assessments of its certified projects and reports that for every \$1.00 spent on their projects reviewed, between \$1.60 and \$2.40 was returned over the period of 2020 - 2040.<sup>95</sup>

This demonstrates that embedding social and sustainability initiatives within projects have a positive benefit. It also provides clearer understanding of the benefits of more sustainable assets and infrastructure and makes them more attractive to providers of capital. This reported level of positive impact, however, is likely to be conservative as many social or sustainability initiatives are difficult to place a value on. They are, therefore, not included in the study. Examples of these 'intangible' benefits are improved water quality, reduced air pollution or noise reduction. Much more work is required to ensure these intangible social and sustainability benefits can be valued more accurately to improve reporting of assets and their impacts.

### Whole-of-life approach and true circularity

Whole-of-Life and circularity principles are currently not well understood across the industry. There is an opportunity, through education and capacity building of key stakeholders, to access opportunities for emissions reduction through whole-of-life considerations in the early stages of a project. Simple design related, and cost-effective changes could be made that would have significant positive impacts on the carbon footprint of our assets (e.g. stiffer, and straighter roads to reduce operational emissions, or smoother higher quality road surfaces to reduce resistance and tire wear). The theories of whole of life thinking and circular economy have been around for a while, however, neither are put into practice regularly on projects. Moreover, during procurement, whilst the evaluation criteria include non-financial components (up to 20% for certain agencies) these components do not appear to significantly influence the outcome. In the majority of cases capital cost appears to be the metric that overrides all others when evaluating a project's merits during a tender process.

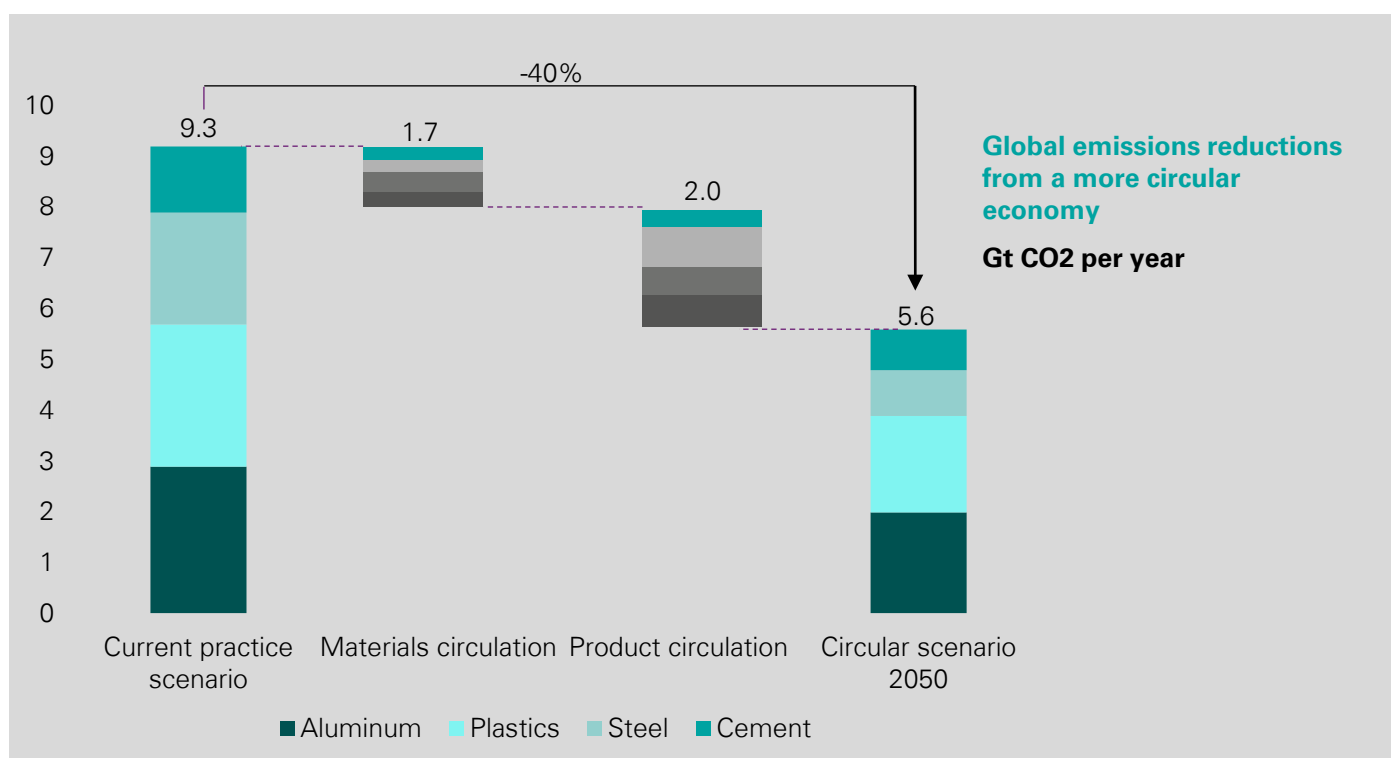
Embodied emissions are those that relate to the production of materials used in the construction of infrastructure, as well as those from the construction process itself. Infrastructure decision-makers have control over these emissions through choices made in the planning, design and procurement stages of a project.

Control over these emissions may be limited by the cost, availability of technology, the constraints of standards and specifications, or a project's supply chain. However, the magnitude of spending for transport infrastructure projects is often large enough that criteria can be set at the procurement stage to drive change (the use of recycled materials or low-carbon construction practices) and more sustainable options can be selected, ultimately transforming the project's supply chain.

Integrated design, circularity and whole-of life thinking is needed for a sustainable transport system to ensure that not only carbon, but all social, environmental and cultural factors are considered in the decision-making process. It should be noted that circular thinking may not necessarily reduce carbon emissions, depending on the issues at hand, however, it should be used to actively pursue the best outcome when considering all factors.

Circular economy principles, among other things, cover the topics of designing out waste, recycling (not downcycling) as well as designing for durability and longevity. Whilst significant focus is currently placed on the recycling part of the puzzle, the impacts of design for deconstruction and reuse, and ensuring assets are durable and have capacity to meet the demands of the future should not be underestimated.

**Figure 7: Potential for emissions reduction by introducing a circular economy<sup>96</sup>**



Source: Energy Transitions Commission.



According to the Energy Transitions Commission (ETC), a more circular economy can reduce CO<sub>2</sub> emissions from four major industry sectors (plastics, steel, aluminium and cement) by 40% globally, and by 56% in developed economies like Europe by 2050.<sup>97</sup> Arguably, these statistics are transferable to the Australian context (Australia is a developed country with similarities to European countries in relation to infrastructure and the economy).

Infrastructure Australia states that road and rail projects account for around 75% of total major public infrastructure pipeline resource demand.<sup>98</sup> By targeting

the materials used in these projects, there is significant opportunity to reduce the industry's emissions. These are finite resources, and the sooner we implement more circularity into our designs and subsequently our materials, the better.

[Case Study 8](#), [Case Study 9](#) and [Case Study 10](#) showcase the breadth of opportunities that incorporate circularity into design and operations. There are a myriad of ways in which transport projects can apply circularity and whole-of-life thinking. Developing an understanding and awareness of these concepts is the first step.

Integrated design, circularity and whole-of life thinking is needed for a sustainable transport system to ensure that carbon and environmental factors are considered in the decision-making process.







## Case Study 8

### Case Study 8: Re-purposing heat energy from London's Underground Rail Network

#### Transport for London, Arup UK

Cities require a huge amount of energy for their daily operation, resulting in significant degradation of energy in the form of heat. This leads to high energy demands for cooling and heating, while also presenting the opportunity to reuse waste heat in order to utilise a low-carbon energy source. Among the many potential emission reduction solutions, waste heat from underground railway stations has the potential to be a significant low-carbon energy option.

The London Underground is exploring several opportunities to be a net-zero railway line by 2030, and one area is exploring how waste heat by underground trains can be captured and repurposed. Arup assisted Transport for London (TfL) with a feasibility study to identify how and where heat from 55 ventilation shafts and 20 pumped ground water locations across the underground network could be captured and repurposed efficiently.<sup>99</sup>

The study was concluded in 2020 and the findings from the work are delivering ground-breaking new insights into the decarbonisation of the city, uncovering viable routes to heating local homes and businesses sustainably and affordably. The feasibility study concluded that repurposing waste heat from the London Underground rail network could heat 15,000 homes and several significant buildings in London, helping to save over 260 kilotonnes of CO<sub>2</sub> emissions over 40 years.<sup>100</sup>







## Case Study 9

### Case Study 9: Fibercon eMesh

#### **Fibercon, North Western Program Alliance (NWP), Major Road Projects Victoria (MRPV) and Rail Projects Victoria (RPV), Victoria**

As part of the Bell to Moreland Level Crossing Removal Project (B2M LXRP), the North Western Program Alliance (NWP) implemented eMesh made from 100% recycled macro synthetic fibre in the shared path and footpaths, replacing steel mesh reinforcement. This eMesh was made in Ballarat and packaged by National Disability Insurance Scheme (NDIS) workers.<sup>101</sup>

This sustainable swap resulted in reductions in CO<sub>2</sub> and phosphate emissions of more than 90% as compared with steel mesh reinforcement. Water and fossil fuel consumption were more than 90% reduced. 200 hours of NDIS employment were created by replacing steel mesh with eMesh, encouraging a deeper examination of other associated benefits, indirect savings and efficiencies of eMesh by NWP. Areas examined included site activities and compliance, which outlined reduced safety risks on site to workers, time lost due to coordinating, moving and unloading steel mesh deliveries, and reduced pre-pour engineering inspection requirements for eMesh reinforced concrete (no steel mesh to inspect).

The savings across these many areas, which are complemented by site efficiencies and time reduction in construction, provided a clear positive outcome. It resulted in the decision to adopt the use of eMesh by Major Road Projects Victoria (MRPV) and Rail Projects Victoria (RPV) for future works, with potential for greater improvements across many of the Big Build projects.

The potential emission reductions and reuse of waste plastic across future projects, since successful implementation at B2M, is extensive and will provide long term repurposing of a waste stream.

Note: Proper stewardship of products such as eMesh at the end of their life is important to ensure the plastics are properly recycled and there are no risks associated with micro-particles entering the environment during demolition and recycling.







# Case Study 10

## Case Study 10: Early works - incorporating recycled and re-used materials

### McConnell Dowell Decmil Joint Venture, MRPV | Certified IS Design rating - Excellent

Major Road Projects Victoria (MRPV) has recently opened Mordialloc Freeway to traffic. The new 9 km route connects the Mornington Peninsula Freeway to the Dingley Bypass, reducing travel times and creating a non-stop connection from Frankston. The project, delivered by the McConnell Dowell Decmil Joint Venture, is notable for its focus on sustainable construction, incorporating 800,000 tonnes of recycled and reused materials into the freeway, including the world's first recycled plastic noise walls. It is now being called "Australia's greenest freeway."<sup>102</sup>





### Smart construction approaches can reduce environmental impacts across the lifecycle of the assets

Design for Manufacture and Assembly (DfMA) is a construction method whereby products are designed for ease of manufacturing and efficiency of assembly on site. This approach has the potential to significantly reduce waste in the industry whilst addressing quality and safety issues. Infrastructure assets such as control offices for tunnels, stations for rail, maintenance sheds, and ancillary buildings all provide the potential for DFMA to be utilized as an approach. In Europe DFMA is not a new concept, and as Laing O'Rourke (LOR) states they can take up to 70% of construction offsite into a controlled environment.<sup>103</sup> This is not just limited to small parts, as popular opinion would have us believe. LOR also states "These include twin walls, floor slabs, pillars, high quality facades and our new digital modular bridges to span roads and railways."<sup>103</sup>

Here in Australia, Schools Infrastructure NSW (SINSW) has a large program underway using modern manufacturing approaches and modular construction. Their 2020 delivery strategy has committed to provide \$7 billion investment to deliver 200 new and upgraded schools across the state, a large part of this will be delivered using DFMA.<sup>104</sup> Whilst these new methods of manufacturing are relatively new in Australia, they have the potential to significantly benefit the transport sector in terms of safety, speed of construction, sustainability and ultimately carbon reduction.

In addition, the use of innovative technologies such as 3D printing have major benefits for construction and the transport sector as a whole.

As reported in the Australian Property Journal by Nelson Yap "One of Laing O'Rourke's highest profile and most notable infrastructure projects in the UK, Crossrail and its core Elizabeth Line, feature curved concrete panels that line the roof and glide around corners never seen before on such a scale."

Yap goes on to state "Using 3D printing, Laing O'Rourke was able to achieve a high degree of control over the geometry and finished form of the precast components. At the same time, with the adoption of re-useable wax as the medium for printing, the

technology will also dramatically reduce the carbon footprint from production."<sup>105</sup>

The use of technology has the potential to not only make significant impacts to the environmental footprint of construction including materials and waste, but also improve the quality of the assets, workers' conditions, speed of construction, deconstruction and re-use. By clever design, much of our built environment could be constructed in a way that can easily be removed and repurposed in its current form rather than the typical process where it is either downcycled or disassembled to the raw materials, to then be reprocessed into new products. This obviously uses significant energy to do so, which is why modular construction methods are attractive from an environmental and carbon reduction standpoint.

### Futureproofing our assets

Another area for exploration would be the approach to the function of our spaces and to ensure they can be used for multiple purposes. A good example of this is multi-storey car parks. These structures are designed to have a life span of 50+ years. If the uptake of autonomous vehicles increases significantly and the ownership and need for private vehicles reduces to a point where many multistorey car parks are not necessary, these assets may become obsolete. With typical floor to ceiling heights of approximately 2.2m, the potential to repurpose current multi-storey car parks is limited.

Designing these facilities with, among other things, floor to ceiling heights of 2.8m to 3.6m will make these spaces easier to repurpose to potentially residential or even commercial uses. Whilst capital cost would increase in the short term, this reduces long term risk for the assets and reduced cost of deconstruction should the trends highlighted in this report play out.

As reported by PTC consultants, other car park repurposing and futureproofing ideas have been a hotel in Cincinnati, retail for a car park in a residential complex, and urban farms in Sydney (Cultivate by Mirvac and Farmwall), and Paris (La Caverne).<sup>106</sup>

By clever design, much of our built environment could be constructed in a way that can easily be removed and repurposed in its current form rather than the typical process where it is either downcycled or ripped apart to the raw materials, to then be reprocessed into new products.

### Collaboration for low carbon materials

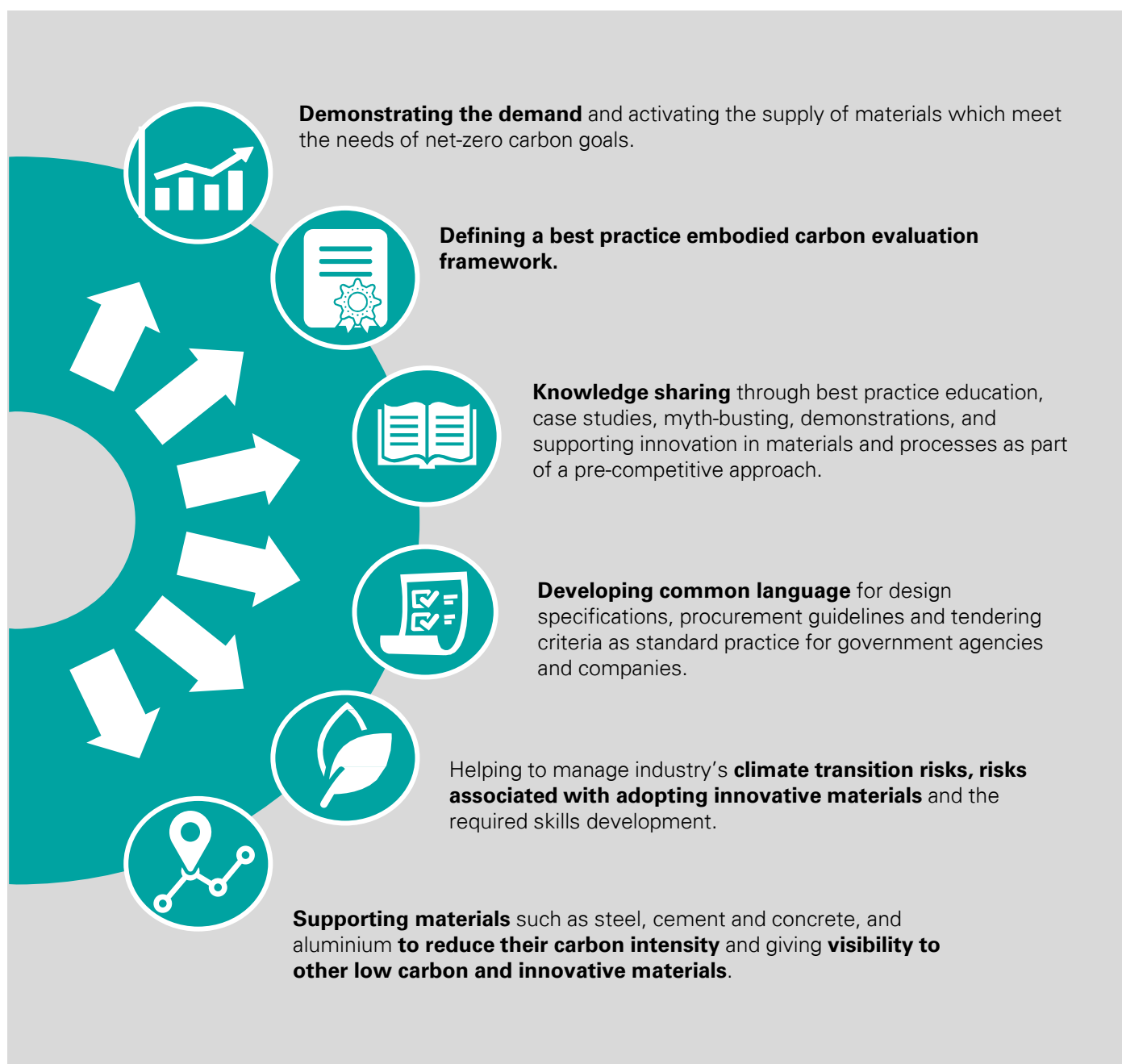
Not-for-profit organisations and industry associations are also actively working to advocate for sustainable outcomes across a range of issues. One such cross industry initiative is being led by WWF and focuses on transforming procurement and materials selection in the construction industry.

The Materials & Embodied Carbon Leaders' Alliance (MECLA) is a collaboration which brings together more than 100 organisations from the building and

construction sector with the aim to drive reduction in embodied carbon.

MECLA seeks to align with the Paris Agreement targets and embrace principles of a circular economy, recognising that the building and construction sector is a complex ecosystem. Therefore, the initiative relies on collaboration to achieve its outcomes.<sup>107</sup> The aim is to drive a market transition across industry and government for low carbon materials as articulated in Figure 8.

**Figure 8: MECLA key priorities<sup>108</sup>**



Source: MECLA



### Natural capital and improved biodiversity are huge opportunities

The world's natural resources provide a wide range of ecosystem services (benefits to humans provided by the natural environment and healthy ecosystems), which enable the health and wellbeing of human life. One of the key ecosystem services is carbon sequestration and storage. By storing carbon in vegetation, ecosystems can keep carbon dioxide out of the atmosphere. Restoration of degraded areas can offset carbon emissions associated with the construction and operation of our transport services.

Ecosystem services are often not considered when making investment decisions as the potential costs and benefits associated with nature degradation, protection and enhancement are often perceived at worst as 'invisible', and at best hard to put a value on. However, infrastructure is one of the five top sectors most at risk from the loss of natural capital assets and ecosystem services. According to the World Economic Forum, transport is one of six industries that has significant 'hidden dependencies' on nature. As a result, it is exposed to significant risks associated with nature loss.<sup>109</sup>

Natural resources also provide other benefits to our transport systems, particularly in regional areas, such as protection from natural hazards such as landslides, flooding, and reducing deterioration by protecting against erosion.

In most states in Australia, biodiversity offsets are an integral component of environmental approvals, and are a policy mechanism that governments, large companies and lenders can use to compensate for biodiversity impacts associated with development. However, biodiversity offset schemes have seen widespread failures, with offsets often given priority over the principle of 'avoid and minimise', or better still enhance and improve.<sup>110</sup>

Our transport sector both depends on and impacts our ecosystem services. Information on ecosystem services should be incorporated into all stages of transport planning, design and implementation to improve sustainability outcomes and maximise benefits to society the environment and culture. Sustainable finance offers a new approach to reframe what and how we invest (including investing in natural capital), and can result in reduced costs for constructing and

maintaining transport infrastructure into the future. Considering the environmental impacts and opportunities (including carbon sequestration, liveability, societal and cultural benefits) at project inception will allow the transport sector to take proactive steps in decarbonising. The use of natural capital is a positive and powerful tool to achieve this objective.

### Taskforce on Natural related Financial Disclosures (TNFD)

Following the success of the Taskforce on Climate Related Financial Disclosures (TCFD), a similar framework has been created to try to more objectively assess the opportunities and risks associated with an organisation's impact upon nature.

As articulated on the TNFD website "Nature loss poses both risks and opportunities for business, now and in the future. More than half of the world's economic output – US\$44tn of economic value generation – is moderately or highly dependent on nature."<sup>111</sup>

Similarly, the drivers that led to the creation of the TCFD framework, are also at play for the TNFD. Financial institutions and companies don't have the information they need to understand how nature impacts them. This absence of information relates to the organisation's immediate financial performance, as well as the longer-term financial risks. Furthermore, an understanding of how the organisation, positively or negatively, impacts nature is lacking.

More information will allow financial institutions, organisations and agencies to incorporate nature-related risks and opportunities into their strategic planning, risk management and asset allocation decisions. Particularly, for the transport sector it is crucial to understand how these risks relate to assets owned or under management and future assets in the pipeline.

A greater understanding in this space directly relates to climate impacts as nature is seen as one of the greatest opportunities to tackle climate change.<sup>112</sup> Nature can assist by minimising our impacts related to the construction of our transport sector but also as an opportunity to sequester carbon through smart, integrated design of our infrastructure assets and enhancing biodiversity of the land the assets themselves are located upon.

Sustainable finance offers a new approach to reframe what and how we invest (including investing in natural capital), and can result in reduced costs for constructing and maintaining transport infrastructure into the future.

### Biodiversity improvements for carbon sequestration

Most transport infrastructure projects require a biodiversity assessment as part of the assessment planning process. However, the connection between the benefits of carbon sequestration and improved biodiversity on site for the final project is seldom made. A real opportunity for many projects presents itself to review the current landscape designs surrounding our assets. Increasing the biodiversity and carbon sequestration potential will improve the overall environmental outcome of the project. In addition, if designed well, can enhance active transport solutions, improve stormwater runoff, create wildlife corridors, improve the overall aesthetics of the assets and build in climate resilience.

Furthermore, where projects struggle to maintain, at the very least a 'net-zero' position in terms of biodiversity before and after the construction, offsets that are underpinned by guaranteed and reputable schemes should be sought.

To achieve a low carbon economy and meet the sector's commitments to reach net-zero by 2050, targets for nature should be included in every new infrastructure project. A net positive outcome should be a requirement in place of a target that just minimises the impact of the asset in construction, as is currently the norm.

### NSW Biodiversity Conservation Trust

The Biodiversity Conservation Trust (BCT) is a statutory not-for-profit body established under the Biodiversity Conservation Act 2016, which commenced operating on 25 August 2017.<sup>113</sup> The BCT's purpose is partnering with landholders to enhance and conserve biodiversity across NSW. Their vision is to facilitate

private land conservation areas protecting unique and diverse plants and animals in NSW.

The BCT's four strategic goals are to:

- Increase private land conservation in areas of strategic biodiversity value;
- deliver efficient, effective and strategic biodiversity offset outcomes;
- support participating landholders to conserve biodiversity; and
- promote public knowledge, appreciation and understanding of biodiversity and the importance of conservation.

This scheme allows developers or governments to fund the BCT to acquire biodiversity stewardship sites that offset biodiversity losses from development.

The scheme covers three different agreements for private landowners, which are Biodiversity Stewardship Agreements, Conservation Agreements and Wildlife Refuge Agreements.

Relevant to the objectives of transport sector, the BSAs in particular, not only assist in protecting biodiversity but also support improvement in biodiversity values. This scheme created 'biodiversity credits' which can be sold to developers. The private landholders receive ongoing annual management payments and potentially profit from the sales of those credits.

Where biodiversity impacts to a transport infrastructure site are negative, or the projects goals are to create a positive biodiversity outcome outside of the site boundaries, schemes such as this provide a robust, transparent, and audited approach to offset the impacts.<sup>113</sup>

To achieve a low carbon economy and meet the sector's commitments to reach net-zero by 2050, targets for nature should be included in every new infrastructure project.



## 5.6 Policy, planning and governance

Smart and sustainable procurement choices can enable significant emissions reduction across the transport industry. Planning for lower emissions at the beginning of projects creates the greatest potential for decreasing emissions throughout the life of the project.

To support decarbonisation, standardised policies and frameworks are needed to ensure that transport sector projects are designed and developed in a way that is sustainable for the environment and our growing communities. Additionally, more transparency and accountability in the planning and procurement phases of developments from government are needed to drive emissions reduction and better track progress across the industry.

### The power of sustainable procurement

Clear guidance and policy for sustainable procurement can be a powerful lever for change. By implementing suitable policy at the business case and investment decision stage, we can create significant carbon reductions in transport projects and optimise the solutions to address multiple issues such as social, environmental and governance issues.

ISO 20400 defines sustainable procurement as “procurement that has the most positive environmental, social, and economic impacts on a

whole life basis.” Putting sustainable procurement into practice ensures that not just the recipient is the beneficiary of the supplier/client interaction but all stakeholders. Sustainable procurement takes into account the needs of the suppliers and products that create positive outcomes for our planet and the global community.<sup>114</sup>

Sustainable procurement also requires introducing procurement processes that provide pathways for partnerships, and joint ventures that allow businesses of all sizes to compete on their merits. It also allows for clients to be able to access leading expertise and best-in-class technology across the whole supply chain.

Setting social, environmental, and net-zero procurement targets in infrastructure projects is an effective method for government bodies to reduce emissions and achieve broad sustainability outcomes.

Governments have an important role to play in promoting sustainability and they can drive change by requiring their suppliers and contractors to adhere to specific sustainability criteria. They also have a role to play by engaging and building capacity within their own agencies about how to determine what these criteria should be for their own specific contracts and projects.

Governments have an important role to play in promoting sustainability and can drive change by requiring their suppliers and contractors to adhere to specific sustainability criteria.



The planning stage, as Figure 9 demonstrates, presents the greatest opportunity for improved holistic outcomes. More time should be taken, with a greater focus on working up comprehensive concept designs for infrastructure solutions to ensure the procurement process runs smoothly and the tender selection process can properly consider the non-financial requirements during tender evaluation. Embodied, operational and enabled emissions of projects should be considered, alongside other sustainability metrics such as the impact on the local environment and the communities' needs and adopt a higher weighting in the decision-making process. A cultural shift is required to ensure that sustainable solutions can be properly evaluated and considered, even if capital costs are higher.

There are numerous examples around the world of governments implementing responsible and sustainable sourcing policies to drive emissions reduction at the planning and procurement phase of major projects (see [Case Study 11](#)).

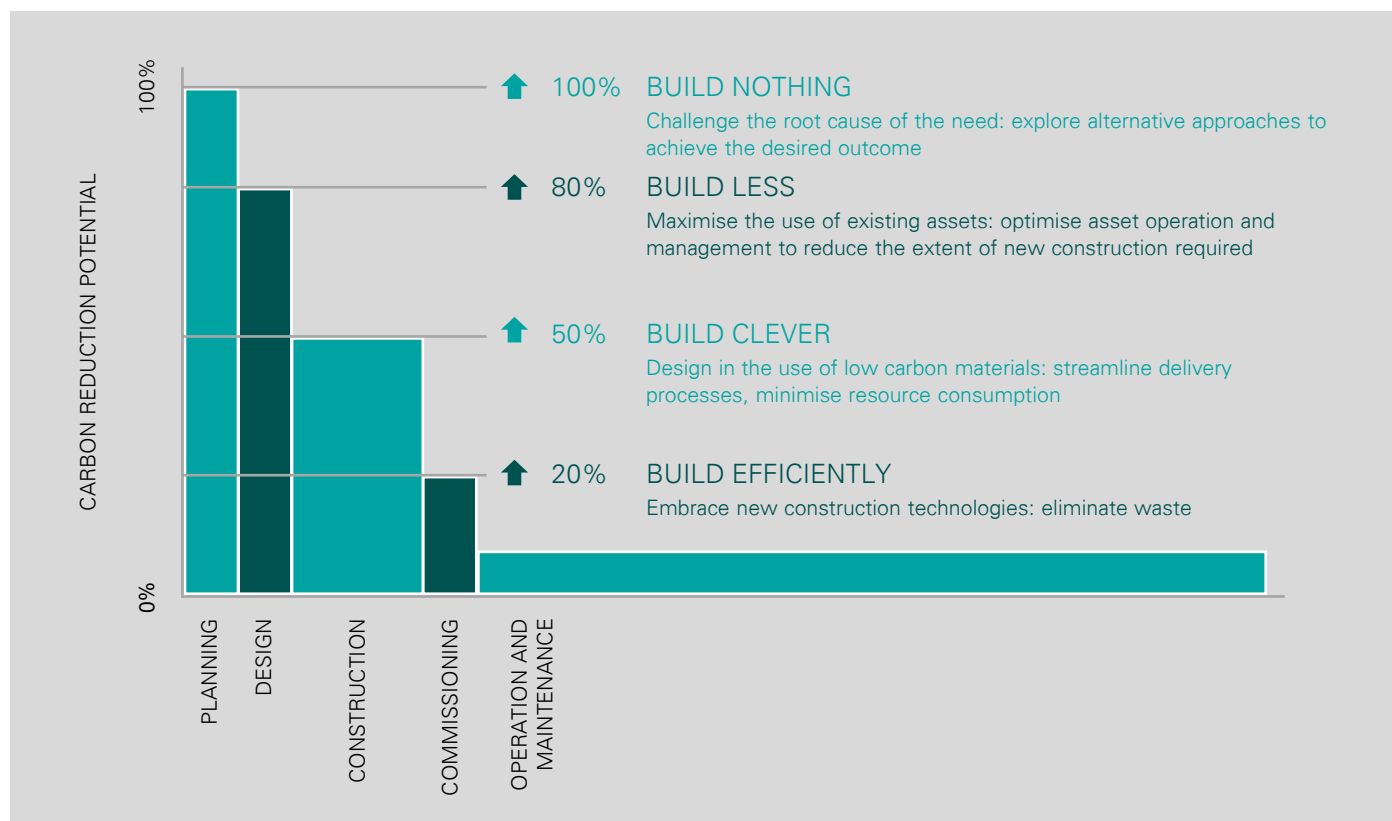
Some examples include:

- In January 2020, California's AB 262, the "Buy Clean California Act" was established. It requires Environmental Product Declarations (EPDs) for

certain materials being specified for state building projects. This means that suppliers' emissions performance will be considered when an agency is contracting to buy steel, flat glass, and mineral wool insulation for infrastructure projects.<sup>115</sup>

- The Welsh Road Review is an initiative by the Welsh Government to assess all road infrastructure projects and ensure they are aligned to the Wales Transport Strategy which aims to reduce Wales' carbon footprint and protect people and wildlife from the climate emergency.<sup>116</sup> An independent panel has been appointed to carry out the review and projects have been paused until this initiative is complete.
- The UK Government's Construction Playbook aims to drive industry reform through procurement actions. The Playbook sets out what is expected (and what it will contract for) from industry, including continuous improvement in building and workplace safety, cost, speed and quality of delivery, greater sharing of better data, investment in training the future workforce through upskilling and apprenticeships, and adoption of the UK BIM Framework. To support this, suppliers should pass the principles and policies set out in this Playbook down through the supply chain.<sup>117</sup>

**Figure 9: Carbon reduction potential of strategic infrastructure choices**



Source: Green Construction Board





# Case Study 11

## Case Study 11: Social procurement – The Victorian Government’s approach

### Victorian Government

Victoria’s Social Procurement Framework is considered the leading social procurement policy in Australia. The Framework outlines a standard and consistent approach across the Victorian Government to drive social, economic and environmental outcomes through procurement. The Framework calls out sustainable procurement as a key pillar within social procurement, and there are commitments to achieving positive environmental outcomes.

This includes:

- Maximising recyclable/recovered content;
- Minimising waste and greenhouse gas emissions;
- Conserving energy and water;
- Minimising habitat destruction and environmental degradation; and
- Providing non-toxic solutions.<sup>118</sup>

The sustainable procurement objectives are:

- Environmentally sustainable outputs;
  - Project specific requirements to use sustainable resources and to manage waste and pollution;
  - Use of recycled content in construction;
- Environmentally sustainable business practices;
  - Adoption of sustainable business by suppliers to the Victorian Government;
- Implementation of the climate change policy objectives;
  - Project-specific requirements to minimise greenhouse gas emissions; and
  - Procurement of outputs that are resilient against the impacts of climate change.

The Victorian Government Social Procurement Framework is designed to embed social procurement throughout the entire procurement process and implement a consistent approach across government. There is a library of resources available to government officials to educate them and empower them to make sustainable procurement choices.

Scope 3, or indirect emissions related to supply chains, can often represent the largest portion of an organisation’s emissions.<sup>119</sup> Responsible and sustainable sourcing needs to consider these factors as part of a holistic approach to decarbonisation. Despite the challenges that come with understanding and addressing Scope 3, doing so can produce significant benefits for our environment (see [Case Study 12](#)).



## Case Study 12

### Case Study 12: Collaboration with industry to decarbonise supply chains

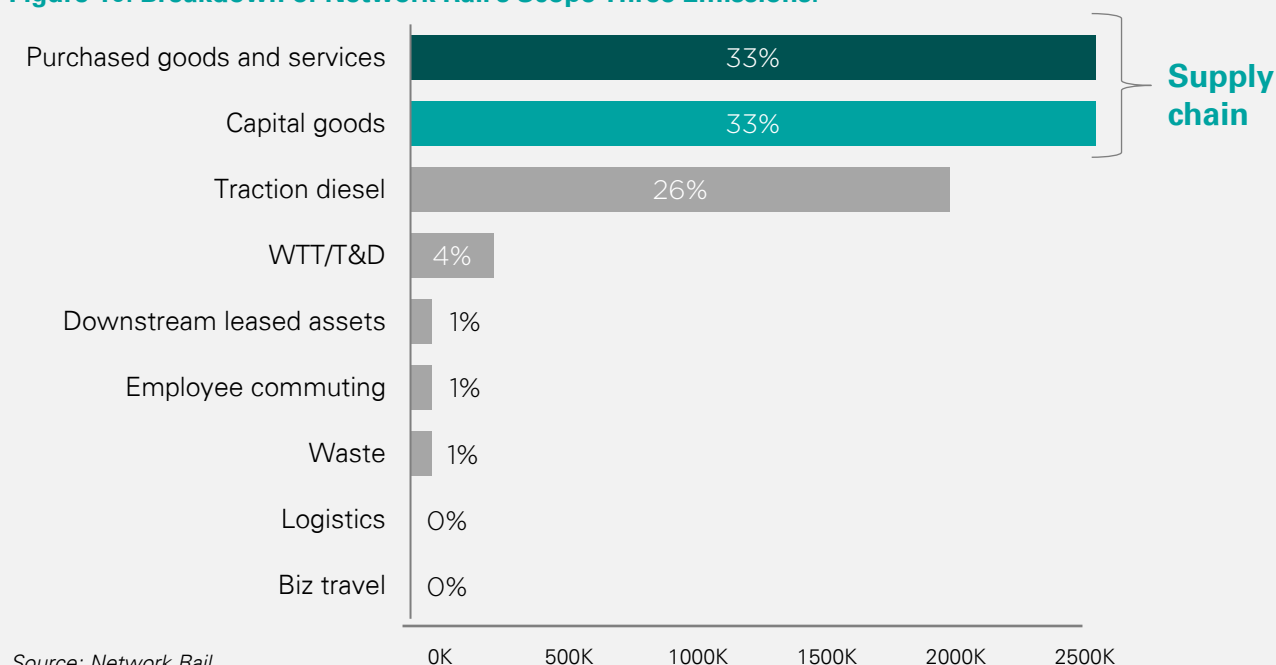
#### Network Rail, UK

Network Rail's Commercial and Procurement team is working to embed environmental sustainability into everything they do. Recently the team has reached an important milestone in partnering with suppliers to tackle climate change by securing commitments from 50% of suppliers to join the Science Based Targets initiative (SBTi) to reduce their carbon footprint.

Science Based Targets are a key part of Network Rail's Environmental Sustainability Strategy to deliver a cleaner, greener railway. These are independently verified plans to reduce carbon emissions to limit global warming to 1.5 degrees Celsius to mitigate the worst effects of climate change. Network Rail was the first railway infrastructure body in the world to adopt science-based targets to this level.

Around 97% of Network Rail's emissions are within Scope 3, meaning emissions largely come from third parties, including suppliers (See Figure 10). To address this, Network Rail's Environmental Sustainability Strategy includes a target for 75% of suppliers to have their own science-based targets by 2025.

**Figure 10: Breakdown of Network Rail's Scope Three Emissions.**



Source: Network Rail

The Network Rail team has worked one-to-one with key suppliers and driven collaboration with transport industry partners (such as Transport for London, National Highways (formerly Highways England), High Speed 2, High Speed 1, Transport Scotland and East West Rail) by running cross-industry supply chain decarbonisation workshops throughout 2021.<sup>120</sup> The workshops have shown suppliers how to commit to science-based targets and the benefits of doing as well as sharing industry best practice and ideas for cutting carbon.

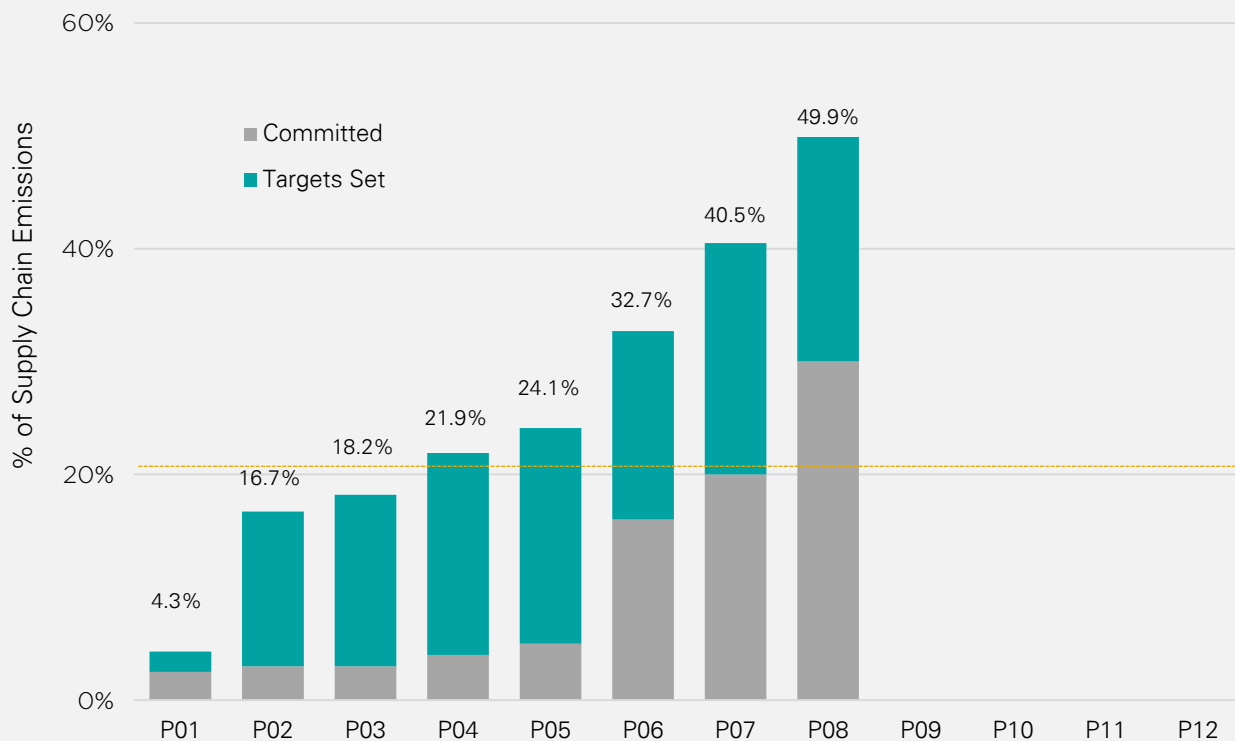
Three workshops have been delivered so far, with each one being attended by over 350 people from the transport sector and supply chain.





## Case Study 12 - Continued

**Figure 11: Progress on the roll out of Network Rail's Science Based Targets.**



Source: Network Rail

For Roger Maybury, Supplier Management Director, the workshops have been positive in bringing transport partners together to tackle climate change. He said: "We've had a wonderful response and we're extremely grateful to our suppliers for showing such positive support for this initiative."

"The success of the science-based targets workshops is reflected in the growing number of suppliers committing to reduce carbon emissions. We have more to do to achieve our goal, but we've made a strong start with 50% of suppliers already committed to science-based targets" (see Figure 11).

Clive Berrington, group commercial and procurement director, added: "As a country we need to show we are serious about climate change by reducing our reliance on fossil fuels to leave a positive legacy for future generations."

He went on to state that "Rail is one of the most environmentally friendly ways to travel but we need our suppliers' help to become an industry powered by renewable energy. It's great that our supply chain is rising to this challenge and we look forward to more companies signing up in future."

**The success of the science-based targets workshops is reflected in the growing number of suppliers committing to reduce carbon emissions.**

In industry, the leaders in the sustainable procurement space have implemented company-wide systems and processes that put sustainability and environment at the fore-front of their decision making. By asking key questions around the design, operation, and the end-of-life plan for projects and assets at the early stage of development, companies can ensure that their products or infrastructure assets are truly sustainable (see [Case Study 13](#)).

### Standardised frameworks

As discussed previously in this report, standardised frameworks are also an effective tool to support decarbonisation (see [Case Study 14](#)). In recent years, multiple industries have adopted standardised

frameworks to help measure and track progress against climate action and other sustainability goals. However, a holistic framework that assesses an infrastructure project from concept through to completion and operation does not exist. Whilst there are tools that are useful for parts of a project timeline, there is nothing that ties it all together and includes social, environmental and cultural issues. Moreover, as can be seen from Moorebank Logistic Park (see [Case Study 7](#)) projects with a mix of both buildings and infrastructure may adopt multiple rating schemes such as the GBCA's Green Star rating and the ISC's Infrastructure Sustainability rating tool to ensure benchmarking takes place across the entire built form.







# Case Study 13

## Case Study 13: Alstom's Eco-Design Policy

### Alstom

Alstom operates globally as a rolling stock manufacturer. In recent years, they have taken significant steps to ensure that all their projects follow their “eco-design policy”.

The eco-design policy is an approach that ensures circular thinking and sustainability are imbedded into their processes, and is based on three key principles:

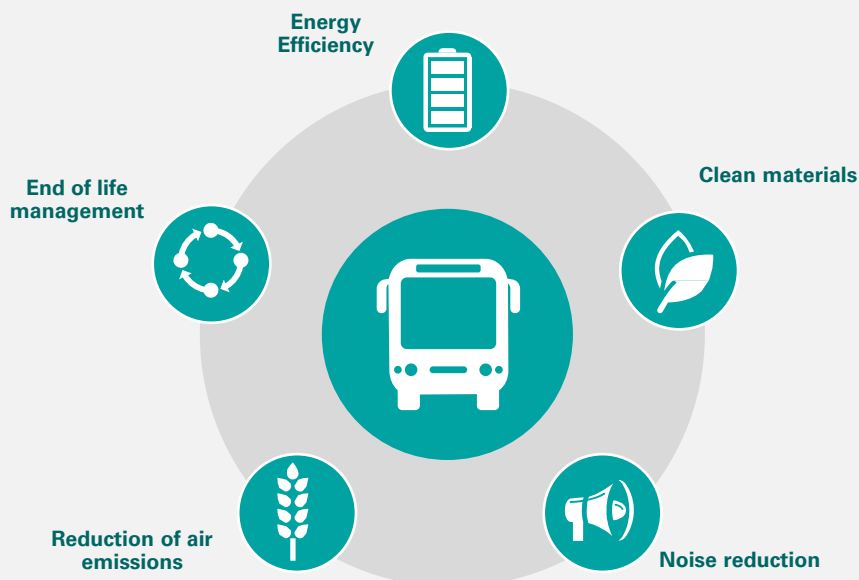
- Considering a product lifecycle from multiple perspectives;
- Taking into account the expectations of all stakeholders (clients, the public, etc.); and
- The continuous improvement of the solutions developed.

Areas of focus include energy efficiency of rail transport systems; use of clean, recyclable, and natural materials; reduction of noise and vibrations; reduction of air emissions; and end-of-life management of products, particularly in maintenance activities.

Alstom states that the policy is applicable to the whole group, is embedded in its design activities as well as in its environmental management system (ISO 14001). It is promoted by senior management, and is aligned with the eco-design referential, supported by a network of more than 100 experts (eco-designers, acoustics experts, materials experts and energy engineers). Each Alstom site with development and design activities is required to define its yearly eco-design objectives. At solutions level, specific and relevant objectives are captured in the ‘eco-design dashboard’.<sup>121</sup>

The following diagram highlights the five eco-design priorities for rolling stock. All solutions are designed integrating environmental targets (energy, use of renewable resources, noise, emission levels etc.) and the company’s achievements are monitored throughout the development process.

**Figure 12: The five eco-design priority areas in Alstom's Eco-design policy.**



Source: Alstom



# Case Study 14

## Case Study 14: Standard industry carbon measurement tool

### Network Rail, UK

Network Rail's Commercial and Procurement (C&P) team is working to better measure their carbon footprint across Scope 1, 2 and Scope 3 emissions.

Network Rail's Scope 3 supply chain emissions are currently estimated based on supplier spend multiplied by an industry factor related to each supplier. This approach to estimating the carbon footprint, whilst widely used across industry due to its relative simplicity, is prone to significant error which will make it difficult to track progress towards supply chain decarbonisation.

With this in mind, the C&P teams are working on agreeing a standard industry tool to capture supply chain emissions (possibly based on the Supply Chain School's 'Carbon Calculator' tool). Agreeing such a tool across industry would be a significant step towards improving the accuracy of Network Rail supply chain emissions and will enable Network Rail to track progress more accurately on reducing these emissions.

The Network Rail C&P team is also leading on the sourcing activity associated with the Network Rail Decarbonisation Programme: a programme with thirteen workstreams covering a wide range of decarbonisation opportunities from reducing the whole life carbon footprint of major construction projects to installation of electric vehicle charging points.

Current key activity relates to the following:

- Creation of an Energy Efficiency Delivery Framework, which can be used to deliver the outputs of 159 energy audits and other energy efficiency measures via capital investment;
- Creation of an Energy Performance Contracts (EPC) framework. EPC is a form of financing for capital improvements to fund energy upgrades from cost reductions. Under an EPC arrangement an external organisation implements a project to deliver energy efficiency, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. The resulting Framework will be used to deliver energy saving via EPC's without the need for capital investment;
- Creation of a pilot Corporate Power Purchase Agreement (CPPA) for between 10-20% of non-traction electricity (electricity not related to the hauling of trains, but instead consumed during the operation of offices, railway stations, yards, etc.) to reduce the carbon footprint, with plans to deliver a further CPPA for the remaining power consumption requirements which may include traction if the pilot proves successful;
- Creation of Direct Power Purchase Agreement's (DPPA's). Network Rail expects to deliver up to 20% of its' power via DPPA's which will reduce its' carbon footprint;
- Design and creation of a catalogue of standardised components designed to be low carbon;
- Creation of contracts aligned to EV Charging infrastructure including:
  - Standard Capital funded EV chargers for Managed Station Car Parks;
  - Fast Chargers for Taxi Ranks;
  - Supplier funded chargers; and
  - EV chargers using a renewable power source.

These activities will assist in driving better environmental decisions, and in particular, aim to achieve a low carbon outcome across Network Rail's assets under management.<sup>120</sup>



## IA's Assessment Framework

In July 2021, IA updated their **Assessment Framework** they use to assess infrastructure project proposals for inclusion on their Infrastructure Priority List. The Assessment Framework comprises of four parts (see Figure 13) and aims to provide guidance on the identification, analysis, and selection of infrastructure projects. This update expands upon and gives new guidance on capturing social, environmental and resilience considerations. The updates are a step in the right direction, however, more could be built in to ensure improved outcomes from the process.<sup>122</sup>

1. The first stage is to assess the problems and opportunities related to the community, and to identify whether there is a need for a solution that involves a new piece of infrastructure or not. From a sustainability (and in particular carbon) perspective, to do nothing is arguably the best way to avoid emissions. Once the problem/opportunity is defined, and a need for infrastructure is required, identification and analysis of the relevant options is necessary. Due to the long-term nature of infrastructure assets the scenario analysis stage needs to focus on potential future outcomes rather than solely solving problems that are apparent today. Current and future need demand forecasting is required. It is also imperative to ensure that social and environmental issues are taken into consideration when identifying and analysing all the options. For example, will the solution provide a positive social impact? What is the magnitude of the environmental or cultural impact? Moreover, what is the carbon impact from not only the construction of the asset (including embodied carbon) but also the operational and enabled emissions related to the asset in operation? This carbon impact should also be priced into the business

case as a shadow carbon price.

2. It is at this stage that a clear and transparent process should be followed to ensure the best option is put forward to build a business case around, and the decisions relating to the selected option considers environmental, social and cultural factors. In addition, the identification of useful KPI's and indicators to use to track the success of the infrastructure should also be included to enable benchmarking of the asset against other projects. This is particularly important for carbon measurement, accounting and reporting.

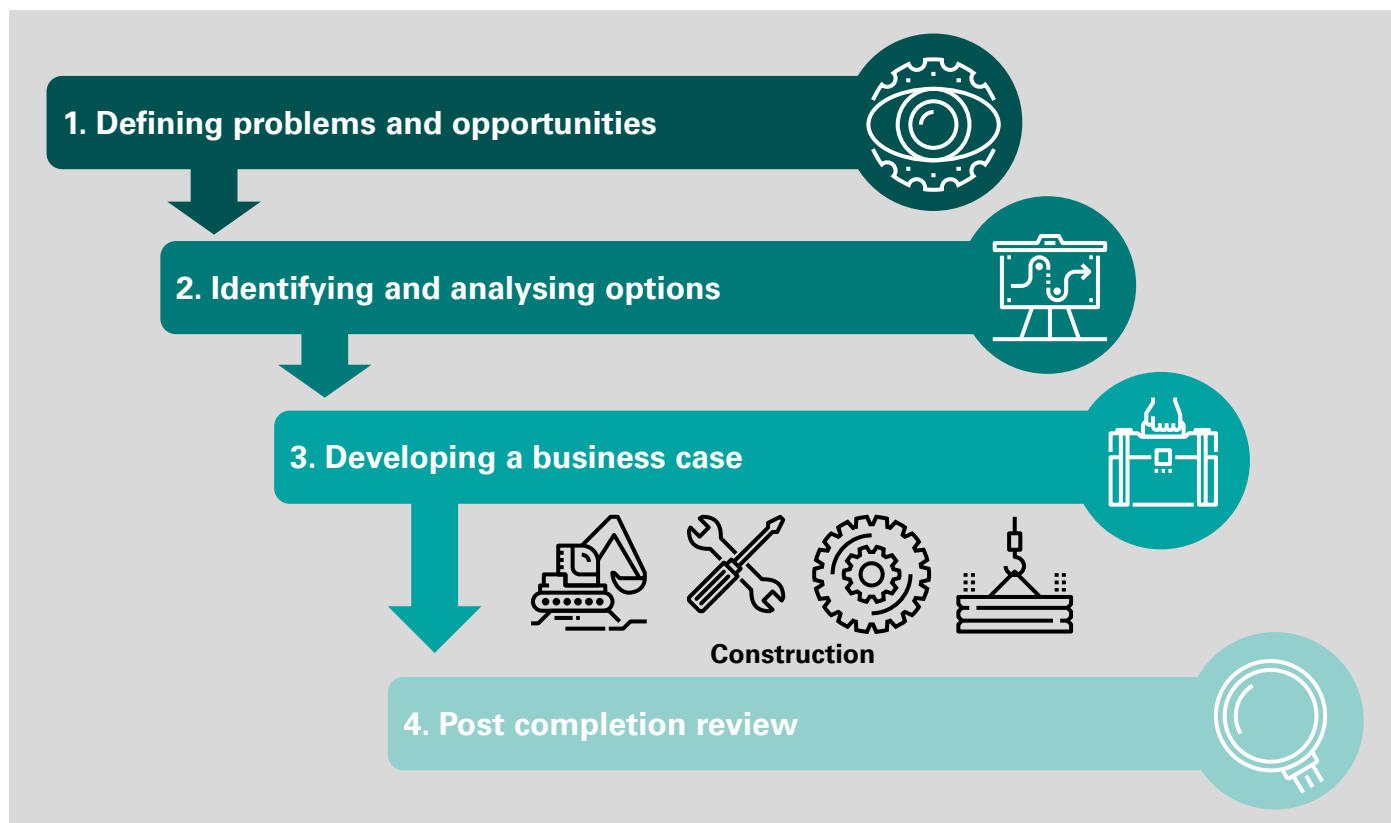
3. The business case should build upon this solid foundation around the selected option (including the assessment of alternatives) and further build out the argument, from economic, social, environmental and cultural perspectives, with all issues and opportunities considered and appropriately weighted. Considering all these factors will assist in determining whether the project should proceed, not just based on cost but also the risks and impacts to society, environment culture, and specifically in this case, carbon.

4. The final stage - post completion review – that takes place after construction should provide important feedback from lessons learnt during the process, both positive and constructive to ensure improvements can be made on future projects.

The updated Assessment Framework is a step in the right direction but needs to ensure that value is placed on social, environmental and cultural issues identified (including a carbon price) and a rigorous assessment process is followed. This type of process should be made mandatory for any transport infrastructure project that materially impacts communities or the environment, especially when considering that any carbon impacts will be locked in for 50-100 years plus.

The Assessment Framework is a step in the right direction but needs to ensure that value is placed on social, environmental and cultural issues identified (including a carbon price) and a rigorous assessment process is followed.

Figure 13: IA's Assessment Framework stages



Source: Infrastructure Australia

Other tools that can assist in measuring, benchmarking, and reporting on carbon related impacts of infrastructure projects are as follows and could be used in conjunction with an overarching framework similar to the IA's Assessment Framework:

In Australia, **The National Greenhouse and Energy Reporting scheme (NGER)** is a national framework for reporting company information related to greenhouse gas emissions, energy production and energy consumption, however, this reporting obligation is currently limited to corporations who produce large enough quantities of greenhouse gas emissions to meet the reporting threshold.

#### The Science Base Targets initiative (SBTi)

SBTi is an international framework that is working to drive climate action in the private sector by requiring companies to set science-based emission reduction targets.<sup>123</sup> The SBTi has commitments from nearly 1,000 companies worldwide setting emissions reduction targets and it attempts to define and promote best practice targets in line with climate science for a variety of sectors.<sup>124</sup>

#### Climate Active

Another initiative in Australia seeking to drive reduction in carbon emissions is the federal scheme Climate Active. Climate Active defines themselves as “an ongoing partnership between the Australian Government and Australian businesses to drive voluntary climate action.” The brand represents Australia’s collective effort to measure, reduce, and offset carbon emissions to lessen negative impacts on the environment.<sup>125</sup> Their focus is on organisations, products, services, events, buildings, and precincts. Whilst they don’t specifically call out infrastructure as a target category for the certification, Geelong Port has recently received Climate Active Carbon Neutral Certification. For any entity or project to be certified it must meet the requirements of the Climate Active Carbon Neutral Standard. This has replaced the National Carbon Offset Standard (NCOS) which was in place prior to Climate Active.<sup>126</sup>





### The IS Rating Scheme

The Infrastructure Sustainability (IS) Rating Scheme is the ISC's rating system that provides Australia and New Zealand organisations with a standardised tool for evaluating the economic, social and environmental performance of infrastructure assets. The scheme can assess the performance across planning, design, construction and operational phases, and at an individual asset level, portfolio or regional scale.<sup>127</sup>

Many transport infrastructure projects including rail, roads, bridges and intermodal projects have been certified under the IS Rating scheme, and the framework is a way to recognise and promote the sustainability outcomes of projects in Australia and New Zealand. This has led to a mutual benefit of promoting projects that are demonstrating real action towards climate, while also providing a standardised way of measuring impact.

To support decarbonisation, the transport sector should look to align with a standardised framework such as

this which can help to provide a consistent approach to measuring, monitoring and governing sustainability initiatives across the industry, and continue to promote the good work that many organisations are already doing. It should be recognised that the uptake of the ISC rating tools has largely focused on the Design and As-Built tool and the Planning tool and Operations tool is only now starting to gain traction. The Planning tool arguably has the potential to provide the most impact if utilised more in the transport sector as it assists stakeholders to evaluate options for infrastructure projects across a number of material issues including social, environmental, carbon, heritage and culture. There are also methods and approaches embedded that assist stakeholders and decision makers to account for externalities, whether they be positive (e.g. improved connectivity, improved biodiversity) or negative (e.g. habitat destruction, pollution).

A framework that comprises a combination of tools and approaches such as the IA's Assessment Framework used in conjunction with ISC's Planning tool could drive significantly better decision making up front and result in better outcomes for social, environmental (including carbon) and cultural issues. However, work needs to be done to ensure the right mix is identified for the appropriate projects and that the knowledge and capacity is present within the industry to properly utilise the approaches at hand.





## 5.7 Enabling technology

To create a sustainable transport network, we must firstly focus on placemaking to ensure our communities are complete with all the social, environmental and cultural requirements they need. Only then, and in conjunction with this planning process, can we really understand and design the connections between.

By bringing a focus on a walkable neighbourhood we can overlay the type of transport methods appropriate for the place and the community. This will assist in prioritising active and public transport routes. Using a systems-thinking approach, and whole-of-life assessments, integrated with a sustainable procurement process we can ensure that new infrastructure projects are properly planned. The projects, backed by sound business cases and designed and developed in a way that considers their total social and environmental impact, will be better placed to stand the test of time. As a result of this improved process, which would include a proper review of material issues related to each project, it is likely reductions in emissions would be inevitable.

A change in mindset and behaviours can have the biggest impact, however, there are many innovative technologies that can further emissions reductions and support a sustainable transport network.

### Electrification of the rail fleet

While regional and remote areas still rely heavily on diesel to power their rolling stock, rail electrification for passenger trains in metropolitan areas has been largely implemented now across Australia. New South Wales,

Queensland, South Australia, Western Australia, the Australian Capital Territory and Victoria all operate electric trains. The first electric train services started in Melbourne in 1919.<sup>128</sup> Energy efficient electric trains have lower operational emissions and air pollution compared to diesel. The next step in decarbonisation is to ensure that the electricity source supplying these networks is from a renewable source.

In NSW, transport accounts for approximately 20% of NSW's greenhouse gas emissions. Transport for NSW (TfNSW) has released its Future Energy Strategy 2020-2050, which focuses specifically on the transport sector and the action it is taking to achieve the 2050 target. The strategy outlines actions being taken by TfNSW to reduce emissions, including the commitment to net-zero operational electricity for rail, light rail and metro train network by 2025.<sup>129</sup>

As part of this commitment, Sydney Trains have already commenced the decarbonisation of their operations. The NSW government has committed to a four-year agreement with Snowy Hydro-owned Red Energy for the electricity used by the network.<sup>130</sup> The commitment - which is already in place - means the network is the first in the country to transition to 100% net zero emissions.<sup>131</sup>

Sydney Metro and the Canberra Metro are two leading examples where the new networks are to be run on 100% renewable energy (see [Case Study 15](#) and [Case Study 16](#)).<sup>132</sup>







# Case Study 15

## Case Study 15: Sydney Metro

### **Transport for NSW, NRT delivery consortium comprising MTR Corporation, John Holland Group, CPB Contractors, UGL Limited | Certified IS Design & As Built ratings – Leading**

Sydney's first metro, the North West Rail Link, opened on 26 May 2019, and is Australia's first fully automated railway line. It is currently being extended into the Sydney CBD and beyond, with the remainder to open in 2024. A whole-of-project Infrastructure Sustainability (IS) As-Built 'Leading' rating was achieved – the first mega infrastructure project in Australia to receive this rating.<sup>133</sup>

The Metro North West Line's outstanding sustainability performance continues into operations, with 100 per cent of its emissions from operational electricity use being offset.

This is achieved through a Green Products Purchase Agreement to procure large-scale generation certificates from a new solar farm at Beryl NSW, incorporating 355,000 solar modules on a 145-hectare site. Securing the operational offset has not only resulted in a direct environmental benefit through reduction of carbon emissions, but also social and economic benefits for the local community of nearby Gulgong with the creation of 150 local jobs during construction and employment opportunities during operation.

Since commencement of operations of the rail line, the operational offset has resulted in a saving of over 83,000 tonnes of carbon dioxide equivalent (CO<sub>2</sub>e). Similar offset commitments have been made for the Sydney Metro City & Southwest project.







# Case Study 16

## Case Study 16: Canberra Light Rail

### Canberra Metro consortium, Canberra Transport, ACT Certified IS As-Built Rating - Leading

The Canberra Light Rail Stage 1, is a 12km line that connects Gungahlin to City Corridor, including 26 signalised intersection and 13 light rail vehicle stops. The Canberra Metro consortium, consisting of Pacific Partnerships, CPB Contractors, John Holland Group, UGL, Mitsubishi Corporation, Aberdeen Infrastructure Investments, DB Engineering & Consulting, CAF and Mitsubishi UFJ Financial Group Ltd (MUFG), was contracted by the ACT Government to complete Stage 1 of the project.<sup>134</sup>

This urban rail system has set a target to achieve net-zero carbon emissions in construction and operations. The project aims to source 100% of electricity from renewable sources through design initiatives such as solar panels on the roof of light rail depot, solar powered lights, and regenerative braking technology. Any residual emissions will be offset to create a carbon neutral project.

Stage One of the project was initially awarded a design rating of 'Excellent', and after construction, achieved an As Built score of 88, which places the project at the 'Leading' level of sustainability – the highest ISC rating category that can be achieved.

At the time of certification this first stage was only the 7th infrastructure project in Australia to be rated at a 'Leading' level by ISC. Canberra Metro also intends to further improve their performance during the operation of the light rail network.<sup>135</sup>





### Electric road vehicle supporting infrastructure

It is expected that by 2027, electric vehicles will reach price parity with internal combustion engine vehicles (ICE).<sup>136</sup> Indeed, it can be argued that at US\$35,000 for the Tesla Model 3 price parity has already been reached in the US.<sup>137</sup> However, the electric vehicle uptake will not rely solely on cost but also the availability and convenience of the charging infrastructure. In addition, perception and range anxiety play a huge factor in Australia, despite the average distance travelled for passenger vehicles being approximately 12,607 kilometres a year – equating to 34.5 kilometres a day. Many people would have range anxiety solely due to the infrequent longer trips and holidays taken once or twice a year.<sup>138</sup> Road trips are more common for Australian families and due to the geography and distances travelled between one town and another, range anxiety plays a big part in the decision making of vehicle purchases. Couple this with the additional cost of EVs compared to ICE vehicles, and the lack of a second-hand market, results in the current slow uptake of EVs in Australia we see today.

This situation is, however, thankfully changing. Across Australia, most state governments are investing in electric vehicle infrastructure (see [Case Study 17](#)) and whilst we are a long way off something that could be considered as comprehensive coverage across the country, it is a start.<sup>139</sup>

At the time of writing, the investment from the state and territory governments in this space is as follows:

- South Australia is investing \$13.4 million in its charging network to increase its charging points to 530, typically with a 7kW capacity.<sup>140</sup>
- Western Australia's Electric Highway is a project by the Royal Automotive Club of Western Australia (WA) and the Australian Electric Vehicle Association. The

'highway' consists of 11 electric vehicle charging stations on local council land along a 520km route between Perth and Augusta.<sup>141</sup>

- The Queensland Electric Superhighway is one of the world's longest electric superhighways in a single state. Phases 1 and 2 of the Queensland Electric Superhighway delivered 31 fast-charging sites, connecting Queenslanders and tourists travelling from Coolangatta to Port Douglas, and from Brisbane to Toowoomba in a low or ZEV.<sup>142</sup>
- The NSW Government has committed \$171 million to help co-fund with private operators the installation of EV charging infrastructure across the whole state – hoping to encourage and incentivise the uptake of EV use. Over the next four years, the master plan will help to plan NSW investment in public fast charging stations and will support industry and planners in finding ideal locations for public fast charging stations.<sup>143</sup>
- In ACT there are currently 42 public charging locations with 50 more coming next year.<sup>144</sup>
- In Victoria the Government is committed to investing in the charging network via a \$19 million fund which plans to quadruple the number of new charging stations.<sup>145</sup>
- The Northern Territory currently has 32 charging stations – 30 public, two of which are high-powered. It plans to install a minimum of 400 charging points at its buildings across the state.<sup>146</sup>
- Tasmania is providing 12 fast chargers and an additional \$600,000 in grants committed to expanding their network.<sup>147</sup>

The speed of which this infrastructure is deployed requires acceleration if we are to ensure the transition of our fleets takes place in a timely manner.

## Zero Emission Vehicles (ZEVs)



**ZEVs do not use fossil fuels. Thus, they do not emit greenhouse gas emissions from their tailpipe.**

**Battery Electric Vehicles (BEVs or EVs) and Hydrogen Fuel Cell Electric Vehicles (FCEVs) are examples of these technologies.**



# Case Study 17

## Case Study 17: Brisbane Metro

### Brisbane City Council, ACCIONA, Arup | Registered IS Design and As Built rating

Brisbane City Council is delivering the turn-up-and-go Brisbane Metro - a new era of connected transport. Brisbane Metro is a new mode of transport, linking the city to the suburbs and making it easier to connect with the people and places you love. As part of Brisbane Metro, a new fleet of 60 battery electric metros will be introduced in 2024, the first of their kind in the Southern Hemisphere. Brisbane Metro is a new high-capacity and high-frequency service that will run along dedicated busways from Eight Mile Plains to Roma Street, and Royal Women's Hospital to The University of Queensland. Brisbane Metro will commence operation from late 2023, with services expected to commence in late 2024 subject to approvals.<sup>148</sup>

Victoria Bridge will be transformed into a green bridge with a new bi-directional cycleway and improved pedestrian connections from Brisbane CBD to South Brisbane, as well as three lanes for Brisbane Metro and bus services.





While electric vehicles can play a role in our future transport system, it is important to acknowledge that, in a similar way to electric rolling stock, electric vehicles are only sustainable if we have access to reliable and renewable energy sources to power them. Moreover, certainly in more urban areas, there needs to be a shift away from private vehicle ownership and towards active and public transport options as well as travelling less to move towards a low carbon economy.

### Cleaner fleet vehicles

A significant opportunity to tackle the uptake of EVs is a focus on government and commercial fleets. Dependent on the nature of the usage patterns, some fleets may not be prone to range anxiety due to the commercial operations for which they are purchased. This presents an opportunity to advance the second-hand EV market as fleet vehicles are typically replaced every three years.<sup>149</sup>

In relation to government fleets, at the time of writing, the states and territories are looking to expand their current EV positions:

- The Victorian Government has a \$10 million budget to supplement the current government fleet vehicles with 400 EVs in the next two years.
- Queensland aims for 288 EVs in the Government's fleet by next year.
- The Northern Territory Government fleet to increase to 200 vehicles by 2030.
- Tasmania is moving towards 100 per cent of the Government's fleet to be electric by 2030.
- WA has a target of twenty-five per cent of the Government's fleet to be electric by 2025/26.
- South Australia is incorporating EVs into its own fleet, with a goal of all vehicles to be fully electric by 2030.
- ACT has a plan to be Net-zero for all emissions (not just from cars) by 2045.<sup>150</sup>

- The NSW Government will set a target to electrify its passenger vehicle fleet of 12,000 cars by 2030.<sup>151</sup>
- TfNSW is currently planning the transition of the 8,000 plus NSW bus fleet to zero emissions buses by 2030.<sup>152</sup>

At a local government level, there are numerous councils across Australia who are leading the way by electrifying their fleet and installing complimentary infrastructure in their local areas (see [Case Study 18](#)).

### Battery electric in the rail sector

There have also been advances in battery electric technology for heavy haulage rolling stock and this has generated interest from BHP, Rio Tinto and Fortescue Metals Group.

BHP are to purchase four battery-electric locomotives and conduct trials at its Western Australia Iron Ore rail network. The four locomotives are scheduled for delivery in late 2023. Two will be supplied by BHP's current provider Progress Rail, a Caterpillar company, and two from Wabtec.<sup>153</sup>

Rio Tinto are aiming to reduce their Scope 1 and 2 carbon emissions in the Pilbara by 50% by 2030, and have purchased four 7MWh FLXdrive battery-electric locomotives from Wabtec Corporation. Production of the locomotives is due to commence in the United States in 2023. Initial trials are scheduled to take place in early 2024.<sup>154</sup>

Fortescue are aiming to achieve carbon neutrality (Scope 1 and Scope 2) by 2030, and have made steps towards the electrification of its locomotive fleet with the purchase of two new Battery Electric Locomotives to transport its iron ore to port.

The new 8-axle locomotives also to be built by Progress Rail, will have an energy capacity of 14.5 megawatt hours and will be manufactured at their facility in Sete Lagoas, Brazil.<sup>155</sup>





## Case Study 18

### Case Study 18: Local city council's zero emissions vehicle policy

#### Moreland City Council, Victoria

Moreland Council has the largest local government EV fleet in Victoria and were early adopters of the technology. They got their first EV in 2013, and then commissioned a feasibility study to understand whether they could transition their entire fleet.<sup>156</sup>

In June 2018, they adopted a zero emissions corporate vehicle procurement policy.

They now use 23 EVs and have invested in 10 private charging stations to refuel them. This includes five publicly available DC fast charge stations that are accessible to the local community. They are now seen as a leader in encouraging and promoting the transition to electric vehicles and zero emissions transport.

Industry is also starting to implement emissions reductions measures through their fleets, and there are a growing number of private companies introducing EVs to reduce their operational and enabled emissions (see [Case Study 19](#)). As was showcased with *Arrival's* approach to targeting commercial vehicles ([Case Study 1](#)), fleet managers are in a good position to drive the uptake of electric vehicles, as understanding their vehicles typical mileage, their operational needs and

maintenance schedule is a key part of optimising their assets.

Considering the total cost of ownership, EVs currently have a higher purchase price than fuel or diesel vehicles, however, factoring in the running costs and increasing costs of fuel, an electric vehicle can save companies money over the total ownership period.



## Case Study 19

### Case Study 19: IKEA switch to an electric fleet

#### IKEA, ANC

In March 2019, IKEA Australia announced a commitment to use only electric vehicles for all operation and services by 2025. This initiative allows for IKEA to make home deliveries and assembly services to realise their vision of creating a better everyday life for the society. This is made possible through an electric vehicle partnership with ANC, where the initial roll out of electric fleets has not only lowered the company's operational emissions, but also delivered capacity and productivity improvements as well as health and safety benefits.

The successful launch of the initiative was due to the extensive planning and research undertaken, three years prior to the launch. The EV fleet rollout by IKEA Australia is a part of the Ingka Group's global initiative to accelerate the global shift to electric vehicles. This is demonstrated through the success of IKEA China, where 100% of deliveries are made through electric vehicles in Shanghai.<sup>157</sup>



Whilst EVs receive the most attention, there is also a significant role to play for hydrogen and biofuels to power the heavy vehicle fleet and in certain circumstances light vehicles.

It is also important to have clear definitions around what constitutes a zero emissions vehicle, and a broader scope beyond just tail-pipe emissions needs to be consistently applied to ensure businesses and consumers can make informed decisions when purchasing.

### Hydrogen can play an important role in transitioning the industry to net-zero

Clean hydrogen (i.e., hydrogen produced with little or no CO<sub>2</sub> emissions) has the potential to be a valuable energy carrier for future transport.

The Australian Hydrogen Council (AHC) is the peak body for this industry, with an objective to support the emerging industry and to secure clean hydrogen as a key part of Australia's energy mix.

Dr. Fiona Simon, Chief Executive Officer of AHC, highlighted several key characteristics of hydrogen during a recent Roads Australia (RA) event.<sup>158</sup>

These characteristics make it desirable, particularly in the context of the transport sector:

- Hydrogen can be transported, stored indefinitely, and unlike batteries, does not lose its energy capacity over time;
- Hydrogen can be made, which means there is unlimited potential. Furthermore, hydrogen can be made in different ways, with several options to produce it with little to no emissions;
- Hydrogen is versatile and can be used as-is or converted for different applications across energy, transport and industrial processes.

Dr. Simon stated that "In the opinion of the AHC, it's not a matter of if Australia could be a global hydrogen powerhouse, but how, and by when." Dr. Simon has repeatedly reinforced the importance of the AHC working with government and other key stakeholders to ensure a coordinated approach to delivering against the National Hydrogen Strategy, including development of policy and regulation.

Whilst the industry is still in the early stages of development and there is more to do to advance our understanding of hydrogen and the opportunities it presents in the broader Australian community, there is growing international activity in this space which is leading to a pipeline of potential projects here onshore.

These include the following:

- **The Central Queensland Hydrogen Project** is a feasibility study that will investigate the large-scale production of green hydrogen (hydrogen produced using renewable energy), liquefy it at the Port of Gladstone in Queensland, Australia, and then export the liquefied hydrogen to Japan.<sup>159</sup> It aims to produce and supply low-cost hydrogen reliably over the long-term, with goals of producing at least 100 tonnes of hydrogen a day by around 2026, and 800 tonnes a day from 2031. Japanese company Iwatani Corp is leading this study, along with five other partner organisations including Australian firms Stanwell and APT Management Services Pty Ltd.<sup>160</sup>
- **The Newcastle Hydrogen Hub** is another feasibility study being undertaken in NSW. As stated in the Infrastructure Magazine by Lauren DeLorenzo 'The \$3 million study will be led by Port of Newcastle and Macquarie's Green Investment Group and supported by project partners Idemitsu, Keolis Downer, Lake Macquarie, Snowy Hydro, and Jemena, along with project collaborators Macquarie Agriculture and University of Newcastle. The applications could include renewable ammonia for agriculture industry, general industrial applications and perhaps a replacement for natural gas, general energy production mobility and bunkering.<sup>161</sup>
- **In 2021 UNSW Sydney released its roadmap for a P2X economy in NSW.** The roadmap paints a compelling picture as to why green hydrogen should be a significant industry opportunity. It can assist in decarbonising our energy and transport sector and also provide transition pathways for those that work in the fossil fuel sector. The roadmap states that with the abundant natural resources already available and indeed tapped (e.g. solar and wind), the production of green hydrogen is a significant opportunity. This opportunity could allow Australia to become a global producer, exporter, and supply the transport sector. This presents an opportunity for enabled emissions from long distance travel and logistics, heavy plant and machinery at remote construction sites, and mining vehicles. Currently, much of our transport infrastructure being built relies upon plant and machinery which uses mineral Diesel fuel.<sup>162</sup>

"It's not a matter of if Australia could be a global hydrogen powerhouse, but how, and by when." Dr. Fiona Simon, CEO - AHC <sup>158</sup>

This focus on the hydrogen sector has the backing of the Federal and State governments, with NSW's recent hydrogen strategy demonstrating a clear commitment with over \$3bn of investment. Minister for Jobs, Investment, Tourism and Western Sydney and Minister for Trade and Industry Stuart Ayres said "This [SW P2X Industry Pre-Feasibility Study, led by UNSW Sydney] is further confirmation that NSW intends to lead the country in green hydrogen production. Our state has an opportunity to capitalise on the global pivot to low-carbon fuels to commoditise our renewable resources and export to overseas markets, creating both clean energy and jobs for NSW."<sup>163</sup>

Whilst many are looking to use hydrogen with fuel cell vehicles ([Case Study 20](#)), an interim step could be to use hydrogen in ICE vehicles ([Case Study 21](#)). If

implemented at scale, this could drastically reduce emissions and particulates associated with the production of the fuel and the vehicles themselves, whilst making minimal impact to the refuelling infrastructure already in place. Hydrogen could also be an answer to range anxiety for the general consumer of the private vehicle, with hydrogen vehicles demonstrating similar ranges to existing ICE vehicles. Limitations still exist with combustion only estimated to deliver about 25% of the energy to power the engine and new refuelling infrastructure required to enable wide-scale deployment. There are also nitrogen oxides produced from the combustion process, however, catalytic converters are already on the market that can overcome this issue.<sup>164</sup> Ongoing research and development is helping to address these challenges.







# Case Study 20

## Case Study 20: HECTOR Project

**A European partnership including Aberdeen City Council, Municipality of Groningen, SUEZ recycling and recovery Netherlands, Publicly owned venture of the municipality of Duisburg, ARP-GAN, Touraine Vallee de l'Indre Municipalities, AGR Waste Management Services, HAN University of Applied Science**

The HECTOR – Hydrogen Waste Collection Vehicles in North West Europe project was approved in January 2019 with a funding of Euro 9.8 million (AUD\$14.9 million).<sup>165</sup> The project aims to demonstrate that fuel cell garbage trucks are an effective solution to reduce emissions from transportation. This is achieved with the deployment of seven fuel cell garbage trucks across seven cities in North West Europe for 4 years.

This includes:

- Aberdeen (Scotland)
- Groningen (Netherlands)
- Arnhem (Netherlands)
- Duisburg (Germany)
- Herten (Germany)
- Touraine Vallee de l'Indre (France)
- Brussels (Belgium).

The pilot sites will cover a wide range of operational context under varying operating conditions. Some examples of the pilot sites include centres, rural areas collecting municipal and industrial waste on different operating schedules.

These vehicles aim to use clean hydrogen and existing hydrogen refuelling infrastructure to maximise emissions reduction.

The HECTOR project is designed to enable a smooth introduction of a zero emission technology in conventional fuels fleets. It will therefore, lay the grounds for upscaling and further deployment of fuel cell garbage trucks in these fleets soon.

The effects of high levels of GHG emissions from the transport sector on health and quality of life are now widely recognised. Decarbonisation of road transport has become a major topic for cities and regions, which are developing and implementing ambitious emission reduction policies.



# Case Study 21

## Case Study 21: Toyota showcases new hydrogen engine

### Toyota

During a practice session in Okayama on 13 November 2021, Toyota showcased a new in-house hydrogen engine, which operates by burning the fuel much like traditional engines use petrol or diesel.<sup>166</sup>

Alongside Mazda, Toyota showcased vehicles running on carbon-neutral propellants in a three-hour road race in Okayama.

Toyota's hydrogen-powered car is in keeping with the company's belief and promotion that a wide variety of vehicle types – including hybrids, hydrogen-powered cars and electrics (EVs) – will play a role in decarbonising road transport.

Toyota believes that different emissions-reducing car technologies are needed for different regions of the world. EVs are a good option for places like Europe, where batteries can be charged with electricity derived largely from renewable sources, it says. Other options, such as hydrogen or hybrids, may be a better fit in other regions.

The technology is separate from the company's other hydrogen projects investigating hydrogen fuel cells. While fuel cells use the chemical reaction between hydrogen and oxygen to generate electricity, which in turn runs a motor, the hydrogen engine burns the element just like petrol or diesel.

Traditional engines only need to be tweaked in minor ways, such as changing out the fuel supply and injection systems, to make them capable of running on hydrogen. Toyota used this race as an opportunity to show their support of hydrogen and prove to industry and consumers that there can be multiple approaches to ZEVs.





Clean hydrogen as an energy carrier could also be used for freight and heavy haulage rolling stock, however, differing regulations for trains between states poses a significant hurdle for this to take place in the short term. To overcome this issue will require a collective approach and collaboration between states and regulators including bipartisan support at government level, which is beginning to emerge with the tri-state collaboration between Victoria, New South Wales and Queensland to support a hydrogen refuelling network across heavy freight routes.<sup>167</sup>

There are a number of trials in the heavy haul sector. Some examples are as follows:

**Aurizon together with Global mining company Anglo American** are working together on a feasibility study to introduce hydrogen powered trains for bulk freight on their Moura rail corridor operating between Anglo American's Dawson metallurgical coal mine and the Gladstone Port, and the Mount Isa rail corridor which operates between the North West Minerals Province to Townsville Port.

Anglo American's unique combination of powertrain technologies are seeking to displace the use of the majority of diesel at its mining operations and are operating an advanced trial of the prototype truck at its Mogalakwena platinum group metals mine in South Africa.<sup>168</sup>

Provision of funding to support heavy FCEV and Hydrogen powered ICE vehicle trials along major logistics routes, in addition to the commitment to develop infrastructure would assist in stimulating the industry whilst providing all important testing of the technology.

### **Biofuels can assist the transition now**

Whilst the main conversation for transitioning our fleets has been largely focusing on the uptake of EVs and FCEVs, there is the potential for 100% renewable biofuels (not bio/mineral blends) to play a role if produced in a sustainable way.

The current biofuel industry in Australia is patchy at best and typically services the industry from which the biofuels are produced (e.g. ethanol from sugar cane used in the production of sugar).<sup>169</sup> Moreover, the outlook for the biofuel industry is not looking promising with a report from USDA Foreign Agriculture Service's Global Agricultural Information Network stating that the ethanol accounting for only 1.4% of the petrol pool in Australia and production at 39.3% of capacity.<sup>170</sup>

The report goes on to state that a lack of federal subsidies, tax credits and mandates are the primary reasons for low biofuel production and use. However, there is significant opportunity to remedy this.



A summary brief delivered to the House of Representatives on the multi-benefits of a National Biofuel Industry estimates that:

- Hundreds of millions of litres of bioethanol can be produced from waste streams from the downstream industrial processing of food crops (e.g., wheat, sugar);
- The 11 million tonnes of bagasse produced annually by the sugar cane industry is an ideal biomass resource for biofuel production;
- Thinning and residues from Australian forests are a huge biomass resource. Forest industry residues alone in Tasmania, for example, are sufficient to replace 65% of all petrol and diesel fuels imported into that state per annum;
- Tens of millions of tonnes of crop stubbles and residues are produced in Australia each year;
- 40% of Australia's annual stockpile of 6 million tonnes of urban waste is available as a biomass resource; and
- In North-Western NSW alone there are sufficient woody weeds to produce over 7 billion litres of bioethanol.<sup>171</sup>

Biodiesel is becoming more popular around the world as it can directly replace mineral diesel in plant and machinery with little or no modifications required. To be sustainable, however, it needs to be sourced from renewable feedstocks derived from non-food sources to ensure it does not compete with an ever-decreasing pool of arable land upon which we depend for food.

As an example, ARENA, together with the Northern Oil Advanced Biofuels Laboratory and the Queensland Government have partially funded a renewable fuels pilot plant in Queensland.

The pilot plant tested a number of feedstocks including:

- Post-consumer and other waste oil (light oils, greases and tars)
- Post-consumer waste solids (plastics, tyres municipal waste)
- Commercial and Industrial Waste (sugarcane tops

and trash, forestry waste, sewage).

The conclusion of this pilot project is that the technology exists to convert Australia's waste into renewable fuel to replace mineral diesel.<sup>172</sup>

There does not appear to be a shortage of sustainably sourced feedstock. We just need the political will to set a national policy and create an environment that incentivises the sector.

This can provide a significant opportunity to rapidly transition the heavy vehicle fleets, plant and equipment related to the construction industry without significant costs to the companies who own these assets. It would also present a huge economic opportunity for regional areas as well as improve degraded land where the biofuel feedstocks could be grown, thereby tackling climate change and emissions on multiple fronts.

### **Innovative manufacturing and materials**

Embodied emissions are a key area the transport industry must address to drive emissions reduction in infrastructure. New technology utilising innovative processes that incorporate waste or low-carbon options will assist tackling this problem.

Concrete and steel are two significant contributors to global warming and methods to reduce the carbon footprints of these two construction materials are underway. Metallurgical coal (which is high in carbon with a higher calorific value to that of thermal coal and burns at a higher temperature) is a primary ingredient in the production of steel. However, research into alternative methods is in progress and one which shows promise is the use of hydrogen (see [Case Study 22](#)).

Embodied emissions are a key area the transport industry must address to drive emissions reduction in infrastructure.





# Case Study 22

## Case Study 22: Green steel production in Australia

### UNSW SMaRT, Molycop, BlueScope, Rio Tinto

Steel is a key component of transport infrastructure, and the embodied emissions in steel alone can account for a significant portion of a project's total embodied emissions.

To address this issue, several manufacturers in Australia are investing in new technology to produce 'green steel'.

The UNSW Centre for Sustainable Materials Research and Technology (SMaRT), renowned for pioneering the transformation of waste for use as a new generation of 'green' materials and products, developed a patented Polymer Injection Technology (PIT) in 2003.<sup>173</sup>

The technology uses end-of-life polymer materials such as tyres, conveyor belts and other rubber products to produce steel. This provides a responsible and sustainable recycling solutions for these products while simultaneously avoiding the need to produce new steel which is traditionally made using iron ore and coal.

Newcastle based steel maker Molycop has recently been awarded a \$750,000 Advanced Manufacturing Growth Centre grant by the Australian Government, to fund the implementation of the SMaRT technology at their manufacturing site.<sup>174</sup>

The technology enables the recovery and reuse of carbon and hydrogen from end-of-life rubber products in the Electric Arc Furnace (EAF) steelmaking process. The introduction of this technology simultaneously reduces Molycop's reliance on imported materials from China, reduces the volume of problematic wastes going to landfill improves energy efficiency of the EAF steelmaking process further reduces the carbon intensity of Molycop's steel products.

The total investment in this project is \$2.6 million which includes the AMGC grant, Molycop's capital investment and the funding of ongoing R&D activities and trials to further increase this innovative technology's resource recovery and recycling capability.

Director of the UNSW SMaRT centre, Professor Veena Sahajwalla, said "The AMGC grant will enable Molycop to work towards fully operationalising our existing technology in its Newcastle facility."

The two organisations are also collaborating in developing our Green Steel 2.0 technologies, with the aim to be able to fully replace coking coal in EAF steel making with a range of waste materials in the coming years.

"Being able to release carbon and hydrogen from waste as a resource improves overall efficiency and helps us move towards decarbonisation because hydrogen is present in waste.", Professor Sahajwalla said.

Another Australian partnership is also exploring low-emissions steel production, this one utilizing green hydrogen production.

BlueScope and Rio Tinto have signed a Memorandum of Understanding (MOU) to research and design low-emissions processes and technologies for the steel value chain across iron ore processing, iron and steelmaking and related technologies.<sup>175</sup>



## Case Study 22 - Continued

The two priority action areas the companies are focusing on are:

### 1. Hydrogen Direct Reduction and Iron Melter

This concept will involve producing a low emissions iron feed for consumption at Port Kembla, NSW and will explore the direct reduction of Rio Tinto's Pilbara iron ores, with the intent of using green hydrogen produced from renewable electricity. The Direct Reduced Iron from this process will be melted in an electrical furnace, powered with renewable electricity, to produce iron suitable for the steelmaking process.

### 2. Enhancing existing processes

BlueScope and Rio Tinto will cooperate to explore the development of projects involving iron ore processing and technologies directed at reducing carbon emissions from existing iron and steelmaking processes.

The companies have acknowledged that this is a program that will need support from government, regulators, customers and suppliers, but they have committed to working together to drive emissions reduction.

Concrete presents one of the greatest challenges in the construction sector and replacements can be difficult, especially for the larger components of a road or rail project. It is estimated that 8% of global emissions are from cement production which is equal to the global car fleet.<sup>176</sup> As is highlighted in this report, there is significant interest and effort being channelled into solving this problem, but there is still a long way to go. Another avenue is to replace the concrete components for low carbon materials where possible (see [Case Study 23](#) and [Case Study 24](#)).







# Case Study 23

## Case Study 23: Low Carbon Concrete Trials

### John Holland CPB Contractors Joint Venture (JHCPB), Roads and Maritime Services, NSW, Rozelle Interchange Project | Design rating – Leading, Registered As Built rating

Alternatives to traditional concrete are gaining increased popularity as an effective way to reduce carbon emissions while diverting waste from landfill. Low carbon concrete demonstrates great performance characteristics including increased durability, early strength gains and good workability. However, there is yet to be widespread implementation of low carbon concrete in major road construction projects.

The John Holland CPB Contractors Joint Venture (JHCPB) conducted a series of low carbon concrete trials within structural and non-structural works in both temporary and permanent areas of the Rozelle Interchange Project (RIC). The RIC is the fifth and final stage of the WestConnex Tunnelling Program which is the largest road Infrastructure project in Australia.<sup>177</sup>

The project has applied a bespoke low-carbon concrete to replace up to 70% cement content, and also uses 8%-15% crushed glass sand as fines replacement. It includes 4-6kg/m<sup>3</sup> of 100% recycled macro polypropylene fibres in lieu of steel mesh. Implementation in permanent and temporary structural and non-structural areas started in early 2020.

Results from low carbon concrete trials showed satisfactory performance of the custom concrete mix implemented, which involved pouring over 1200m<sup>3</sup> across numerous surface site areas. This has facilitated the diversion of 140 tonnes of glass sand and 570kg of plastic fibres from landfill for a total reduction of approximately 127 tCO<sub>2</sub>e emissions.

This project demonstrates that alternatives to traditional concrete can meet and exceed performance requirements, while also working to reduce waste and embodied carbon emissions.







# Case Study 24

## Case Study 24: Pacific Motorway M1 Varsity Lakes to Tugun upgrade

### Queensland Department of Transport and Main Roads (TMR), QLD Certified IS Design Rating – Leading, Registered As Built

The Pacific Motorway (M1) is a vital transport link between Queensland and the southern states, carrying interstate freight, tourist, and commuter traffic.

The section of motorway between Varsity Lakes (Exit 85) and Tugun (Exit 95) currently sees around 90,000 vehicles per day and is frequently congested during both weekday and weekend peak periods. Traffic demand for this section of the M1 is growing and by 2026 is expected to exceed 100,000 vehicles each day.

Now in construction, the Varsity Lakes to Tugun (VL2T) upgrade is a City-shaping project for the southern Gold Coast and forms part of the wider Pacific Motorway M1 upgrade program aimed at improving safety and reducing congestion along one of Australia's busiest highways.

This project utilised a concrete fracturing technique, known as 'rubblisation' – a process that involves cracking the existing concrete road pavement in-situ and using the material as subgrade under the new motorway. This technique removes the need for off-site disposal and recycling and allows the new pavement to be constructed on the newly rubblised layers. Sustainability benefits include reduction in waste, materials, transport, energy (less construction time) and water with lower overall carbon impacts.

This project also features the first Australian use of French manufactured EME (Enrobés à Module Elevé) – a high modulus asphalt that was developed in France in the mid-seventies. EME is predominantly used for the structural layers in asphalt. The distinctive component of EME mixes is a very hard paving grade bitumen applied at a high binder content and lower air voids content.

The main benefit of EME2 (as opposed to traditional AC20 asphalt) is that it can potentially reduce the layer thickness of the base course for heavily trafficked pavements by up to 30%, depending on climatic and traffic conditions. Therefore, a reduction could be seen in the use of virgin materials, haulage distances and associated carbon emissions. (Roads and Infrastructure Australia 2017). Furthermore, EME2 provides the opportunity for improved structural life, this means that less structural maintenance is required during the design life of the pavement.

An average of a 24% reduction in embodied carbon and greenhouse gas emissions has been achieved on the M1, and this project showcases the potential to reduce embodied carbon through multiple different methods.<sup>177</sup>





For the ancillary parts of certain transport infrastructure projects, concrete can simply be replaced. For example, Cross Laminated Timber (CLT) is being used in place of concrete and steel structures in buildings, some achieving 10 storeys in height such as Lendlease's new commercial building at 25 King St, Brisbane which also achieved a 6-star Green Star Design & As Built rating.<sup>178</sup> These types of technologies could be used for control centres, stations and other components in transport infrastructure projects.

Another example is Expanded Polystyrene (EPS). Geofoam, a fill material made from EPS, has been used as a replacement for traditional road embankments in locations where settlement can cause issues with adjacent assets built on piles. Considered a pioneering technology at the time, The Norwegian Public Roads Administration utilized Geofoam in an embankment adjacent a bridge in the 70s. The embankment was subjected to frost action causing significant expansion and shrinkage issues for traditional methods. The trial successfully demonstrated that the EPS fill material was fit for purpose and durable. In addition, when removed in 2005 due to traffic changes, the blocks were still in suitable condition to be reused on another project.<sup>179</sup> Proper stewardship of these types of materials at end of life is required however, to ensure no contamination risk of the surrounding environment and waterways from microparticles is present.

### **Digitisation, automation and digital engineering**

All areas of the economy are seeing the impacts of increased digitalisation and automation, and the transport sector is no different. Advancements are taking place at rapid pace, and innovation that not that long ago seemed revolutionary, already feels outdated.

AI, the Internet of Things (IoT) and Blockchain has enabled data to be collected, stored and used in ways

that previously were too time-consuming - now present exciting opportunities for transport planners, builders and operators.

Building Information modelling (BIM) is another example of technology that has great potential to change the way transport infrastructure is procured, built, operated, and maintained.

BIM has many benefits for the transport industry including:

- Better communication during design and construction;
- Model based cost estimation, improving costs and budget accuracy;
- Ability to visualize projects preconstruction;
- Better coordination and clash detection;
- Mitigate risk (both health and safety and commercial risk) and reduce cost;
- Improving scheduling and sequencing of works;
- Increased productivity with prefabrication reducing waste;
- Better management of safety on construction sites;
- Building higher quality assets;
- Strengthen asset Handover;
- Streamlining Facility Management processes and incorporate proactive maintenance and manage operational expenses; and
- Faster and more accurate assessment and identification of a project's embodied carbon during detailed design and construction stages.

Many of the benefits listed above lead to higher quality assets and improved decision making, which in-turn results in improved safety on site and better environmental outcomes for the design, construction and operation stages of the asset lifecycle.

All areas of the economy are seeing the impacts of increased digitalisation and automation, and the transport sector is no different. Advancements are taking place at rapid pace, and innovation that not that long ago seemed revolutionary, already feels outdated.

One of the challenges for the adoption of BIM, and Digital Engineering (DE) as a whole is the understanding of what it actually is, and its capability. Many BIM conversations 'get stuck' in the 3D modelling aspect of the design stage, primarily because this is where most of the conversations start.

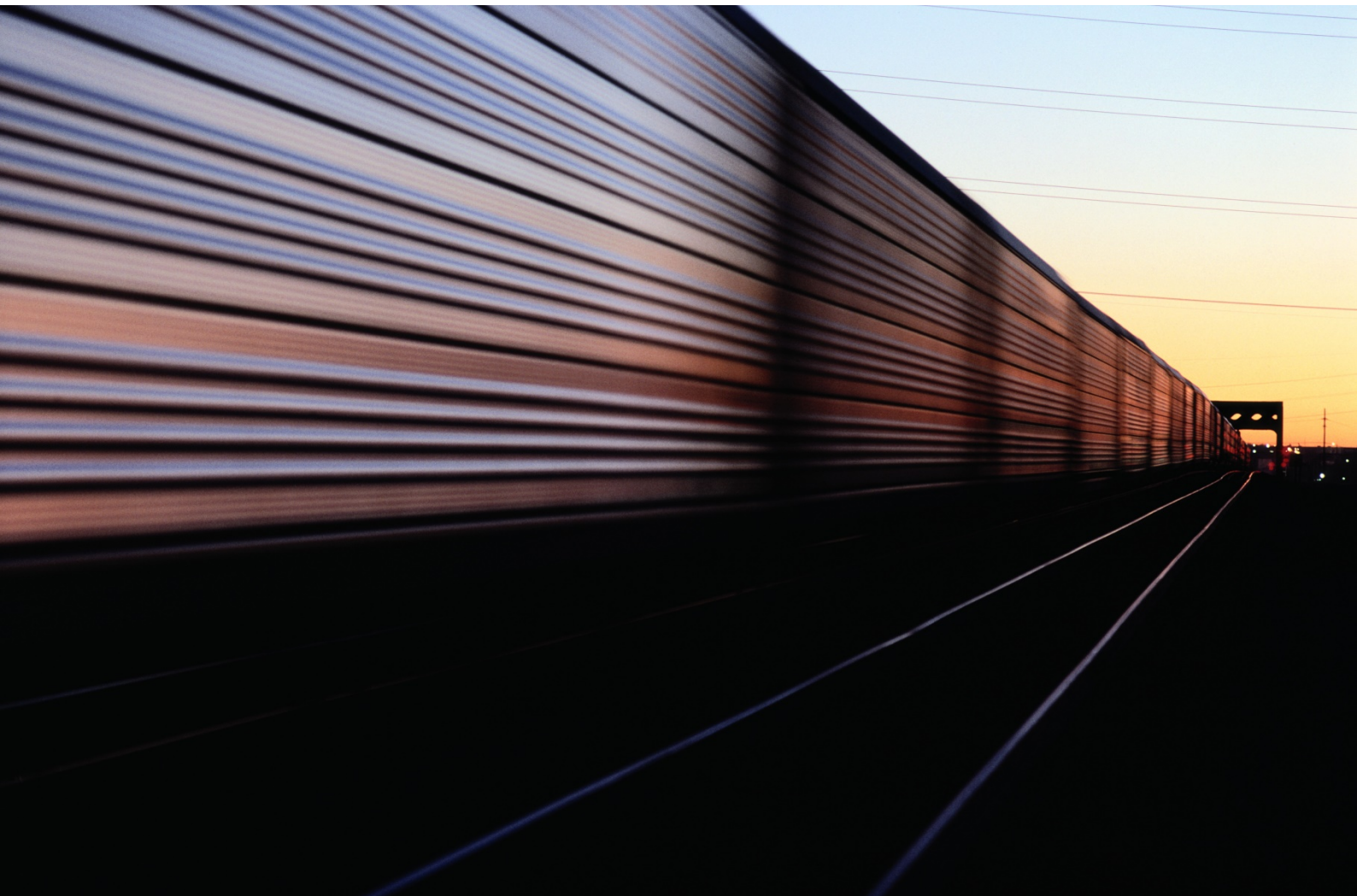
Architects and designers are well versed in the topic when producing concepts designs in 3D, however, BIM, when used to its full capacity has many more use cases, including carbon accounting, materials reduction, clash detection, proactive maintenance and OPEX budgeting to name a few.

As reported by John Ford of Galliford Try Construction, "The Infrastructure & Project Authority (IPA) in the UK has just published on behalf of the government its roadmap to transforming infrastructure performance by 2030. Its purpose is to improve the services and outputs from the built environment so that it benefits

society and project needs, as well as the natural environment." Ford goes on to state "As part of this roadmap, and in collaboration with the UK BIM Alliance and Centre for Digital Built Britain, information management and modelling (BIM) has been mandated."<sup>180</sup>

This roadmap is assisting to drive accountability and the implementation of the BIM framework, which is committed to a coordinated approach to creating and communicating an international wrapper for UK BIM and ensuring a smooth transition in the integration of BS EN ISO 19650 Building Information Modelling.<sup>181</sup>

More initiatives like this are required in Australia to ensure the industry keeps up with the pace of technology and benefits from it, both from a societal perspective but also from an environmental and carbon perspective (see [Case Study 25](#) and [Case Study 26](#)).







## Case Study 25

### Case Study 25: Using BIM to provide better public transport

#### Mott MacDonald, Transport for NSW

Transport for New South Wales (TfNSW) identified BIM as a key tool they could utilize to change their approach to planning for public transport.

Mott MacDonald was engaged to deliver TfNSW's first pilot BIM project, which demonstrated the benefits of BIM to stakeholders and helped to develop cost-effective solutions to key design and construction issues. They explored over 45 different interventions to bring BIM to life.

Mott MacDonald said "Our starting point was to look at their organisational information management and understand where they were best able to add value. We began by establishing key needs and objectives through an intensive period of workshops and interviews with internal and external stakeholders. We assessed the baseline capability and developed a bespoke roadmap to guide TfNSW towards through-life asset information management."

TfNSW is now moving through the next stages of this project to develop a detailed roadmap for their transport network and are already seeing the benefits of embedding BIM across key business functions.



## Case Study 26

### Case Study 26: Blockchain technology creating a Building Assurance Solution

#### KPMG Australia, NSW Government

KPMG Australia is collaborating with the construction industry to develop a Building Assurance Solution (BAS) for the sector. Based on the KPMG Origins platform, the new blockchain-enabled system will allow insurers and property buyers to compare the trustworthiness of buildings – by placing data at the heart of the construction process.

Devised in response to the spate of recent issues in the construction industry, and developed with the support of the NSW Government, the BAS will use several advanced technologies (like blockchain) to provide a trusted and immutable source of data about a building from inception throughout its lifecycle. It will store detailed records throughout the development and construction process, including materials and methods used, certifications achieved, and contractor details.

The aim for this project is to provide a transparent Building Trustworthy Index (BTI) for buildings that has benefits for multiple stakeholders. The BTI will provide investors and buyers with assurance about the quality of the property they purchase, and help insurers make smarter decisions about the risks and associated premiums. The system will also allow regulators to track products from source to installation. While the initial aim of this assurance solution is to create a trustworthy index for buildings and infrastructure, the vision is to integrate embodied carbon and then eventually create a circular economy passport for built environment, its assets and infrastructure.

### Optimisation of the existing transport system

Planning and design of our future transport infrastructure is important to decarbonisation, however, there is a lot that can be done now with the existing networks and the fleets that operate on them. While electric vehicles and hydrogen technology will play a role in emissions reduction, there are also simpler initiatives that can be implemented to reduce the overall energy consumed by buses, trucks and rolling stock.

Sustainability on roads or rail is about being more energy-efficient, regardless of the source of power.

For example, optimising rolling stock operations can be as simple as improving the way they are driven, which can reduce their energy consumption, related emissions and costs.

Driver Advisory Systems (DAS) inform the driver of the optimal travel speed to arrive on time, while also using the least amount of energy. 'Connected' systems (C-DAS) extend this capability by enabling communications with a central control system that monitors train performance and can update train schedules in real-time.<sup>182</sup>

An award-winning C-DAS technology developed in Australia is Trapeze Group's TTG Energymiser, which to date has been installed on more than 8,000 train and driver applications across 80,000 km of track in 10 nations and four continents, and consistently delivers 10-12 per cent reductions in energy consumption when deployed on rail networks.<sup>183</sup>

The technology can be implemented on any train including diesel, electric, high-speed, freight and heavy haul, and works by reinforcing good driving behaviour, providing drivers with information to make accurate and consistent driving decisions. It does not direct drivers on what to do – it simply provides advice based

on track characteristics and the timetable.

The Energymiser technology has been adopted by several leading railway operators including SNCF in France, KiwiRail in New Zealand (see [Case Study 27](#)), and other key operators across UK, Europe, Asia and Africa.<sup>184</sup>

Dale Coleman, founder of TTG Transportation Technology says, "overseas markets' willingness to embrace collaborative models where operators take an outcomes-based approach has increased as the technology underpinning rail networks becomes more crucial to its safe and efficient operation."<sup>185</sup>

"Today's systems are real-time integrated digital systems that seek to optimise capacity, efficiency while maintaining safety" Coleman continues "The challenge for Australian technology providers is to identify the pathway into the global supply chain."

In Australia, implementing these types of systems presents a challenge. Traditional procurement models for rolling stock and train control systems do not provide a whole of system approach. This new technology for monitoring and control spans the systems that integrate rolling stock and the train control itself. It is timely for the states to review this current approach to realise the savings available, both financially and in terms of carbon emissions.

This clearly points to the requirement for a new approach to our procurement processes, both state-based and nationally. Collaboration between states will assist greatly in addressing these differences in network and systems. We need to create a standardized approach where these barriers to innovative ways of optimizing our rail network are removed.

Planning and design of our future transport infrastructure is important to decarbonisation, however, there is a lot that can be done now with the existing networks and the fleets that operate on them.





# Case Study 27

## Case Study 27: KiwiRail's Driver Advisory System

### Trapeze Group, KiwiRail, New Zealand

KiwiRail, New Zealand's largest rail transport operator, services approximately 4,000 kilometres of track. In line with the New Zealand government's commitment to the Paris Agreement, KiwiRail committed to reduce carbon emissions by 30 per cent by 2030 and be carbon neutral by 2050.<sup>186</sup>

One of the pillars of KiwiRail's Carbon Zero Programme is their Driver Advisory System (DAS) – where they have implemented Trapeze Group's TTG Energymiser.

Since implementing the technology, KiwiRail has recorded a 13.5 per cent fuel reduction saving and it has enabled a 10% reduction in fuel costs.

Together with other sustainability efforts across their businesses, DAS has contributed to a total energy cost saving of more than NZ\$ 2.8 million every year. KiwiRail has reduced carbon emissions by saving around 17 million litres of diesel from being burnt over five years.

Annual carbon emissions are down 15% from 272,345 CO<sub>2</sub>e tonnes in 2015/16, to 230,036 CO<sub>2</sub>e tonnes in 2019/20. KiwiRail has also reduced its annual energy usage by 39 GWh.

In 2016, following implementation, KiwiRail won the Deloitte Energy Excellence award, based on the greenhouse gas reductions and fuel savings achieved.

KiwiRail's Business Transformation Manager Soren Low says the DAS is a success for the entire business.

"Ultimately the success of the project came down to our asset servicing teams and locomotive engineers buying into and using the new processes and technology. Having people in the frontline that are committed to the outcome, along with a team of practicing locomotive engineers who 'walk the talk' delivering the training, was a significant influence on our success."<sup>187</sup>



Another factor often overlooked when addressing energy efficiency and carbon emissions, is maintenance.

Predictive maintenance reduces operational costs and reduces time for the maintenance crew, removes unnecessary waste, and as a result, reduces emissions related to both the contractors' operations and the replacement of parts (see [Case Study 28](#)). Optimising the operation of vehicles, including road haulage fleet, rolling stock, buses and trains, is a simple way we can reduce emissions related to logistics and public transport.

Mobility as a Service, or MaaS, is a smart use of technology and innovation implemented in a way that eases congestion and makes commuting more easy, enjoyable and efficient for customers.

Studies have indicated that MaaS not only reduces transport associated emissions and air pollution but can also increase active transport and a sense of community.

The IA Master Plan states that "Sharing has turned vehicles, car parking spaces, e-bikes and e-scooters into public assets." There are numerous companies entering this market to offer a simple solution to mobility, without the ongoing costs and responsibility that private ownership brings (see [Case Study 29](#)).







## Case Study 28

### Case Study 28: LA Metro

#### Los Angeles County Metropolitan Transportation Authority (LA Metro), USA

In the US, The Los Angeles County Metropolitan Transportation Authority (LA Metro) have set a mission to deliver a world-class transportation system by accounting for environmental, social and economic considerations in the decision-making process and operations. Among many sustainability commitments, one of their key targets is to increase onsite renewable energy to 7.5 MW by 2030.

To support their renewable energy target, LA Metro launched the PV Operations and Maintenance Program in 2014 to provide technical training and resources to Metro maintenance personnel at facilities with PV systems. The program aims to educate staff to benchmark energy generation and troubleshoot issues. Since the launch, the program has provided over 700 hours of training to 120 staff members, resulting in faster response times and increased system uptime year over year. In 2019, the program has resulted in utility cost savings of approximately USD \$220,000 with a promise of even greater savings moving forward.<sup>188</sup>



## Case Study 29

### Case Study 29: Sharing carparks in cities

#### Share with Oscar, NSW Government

A Sydney-based start-up is enabling underutilised car-spaces to become passive income streams for their owners, while solving the parking problem in urban areas.

There is only 1 parking space for every 6 drivers in our cities, and the co-founders identified that this problem could be addressed by enabling people to share their private car parking with others.

Share with Oscar is an app that allows people to rent their un-used car-space in inner city locations for a fee. The app offers hourly, daily and monthly booking options and has been highly regarded for its simplicity and ease of use. <sup>189</sup>



06

Summary and  
recommendations



# Summary and Recommendations



**Community needs to be at the centre of decision making when shaping our solutions for the built environment and the transport systems that support it.**

Alistair Coulstock, Director – KPMG Australia



**The depth and breadth of the innovative approaches, technologies, and ambition for change explored in this report shows the wind of change is already here. However, more action is necessary to achieve the targets and goals we desire and to meet our commitments of net-zero by 2050.**

It is clear that community needs to be at the centre of decision making when shaping our solutions for the built environment and the transport systems that support it. Alternative and new transport solutions require open, transparent decision making where community consultation is paramount. These processes must incorporate circular thinking and whole of life approaches to ensure the solutions are balanced allowing for valuing social, environmental, cultural and carbon issues to be addressed, and are based on future state projections of a low carbon economy.

Federal and state governments require bold policy changes and significant investment to drive innovation in both the energy and transport sector. It is not only the transport systems that are required to be designed meet low carbon commitments. Road and rail fleets

need to be adapted and provided with access to zero carbon energy solutions to be able to make this transition.

Working with government to identify pathways to transition from fossil fuels to renewable sources of energy generation including hydrogen, biofuels and the renewable sector is imperative. Fuel tax incentives for cleaner fuel choices can also assist in this transition.

Our industry, whilst having many talented professionals spanning a broad range of skills, has been put under substantial pressure from Australia playing 'catch-up' with respect to the deployment of infrastructure to meet the needs of a growing population. The pipeline of future infrastructure spend is substantial and to meet this demand, education and capacity building across a wide range of disciplines is required.

For a sustainable and low-carbon transport system we need to foster innovation and encourage new technologies, such as the examples showcased in this report. We need to work together to create new solutions, improve efficiency across all stages of our asset lifecycle, and create better outcomes for our transport industry.

As identified throughout this report, decarbonisation of the transport sector requires:

- A placemaking approach to address the social, environmental and cultural imbalances in our current urban landscape, as well as ensure new communities are designed with these issues in mind.
- Clear governance structures with transparency and accountability relating to decision making are to be implemented during not only the planning stage but also design, construction, and operational stages of all transport infrastructure projects.
- A clear message on multiple issues through the development of new policies and their underlying commitments, both at a state and federal level, to assist with the attraction of investment for funding purposes.
- New approaches to procurement to ensure a culture of collaboration is fostered both at a national and state level. Applying methodologies such as the ISO20400 Sustainable Procurement Guidance Standard for the review of regulations and at planning and project level. This is particularly important for procurement teams and commercial managers across planning, design, construction and operational

stages of an asset's lifecycle.

- Capacity building across all stakeholders to improve the understanding of social, sustainability and cultural issues at all stages of a project and to assist in the implementation of the solutions required to address these issues.
- The investigation and implementation of new technologies is to be encouraged and governments to create new approaches to 'get out of the way' and clear the red tape to ensure these solutions can be deployed to move the industry to a low carbon economy.

The recommendations proposed here are necessary to deliver on these objectives and move the sector towards a low carbon future.

These recommendations are presented in a format where the target audience is identified, together with any additional stakeholders that may have a contributing role. In addition, each recommendation is accompanied with a respective timeline; short term, medium term or long term, to assist the parties in prioritising actions.

We need to work together to create new solutions, improve efficiency across all stages of our asset lifecycle, and create better outcomes for our transport industry.



## DETAILED RECOMMENDATIONS

01

## Create a national, strategic approach to the transport sector and its infrastructure.

**Key:**

Leader

Contributor

Audience

|     | Recommendation   | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes   |
|-----|--|-------------------|----|-----|-----|------------|----------|---|
| 1.1 | Advocate for a national measurement framework to ensure progress towards net-zero is accurately tracked and measured.  | 0-1               | X  | X   | X   | X          |          | A standardised framework is required to benchmark and provide accurate, transparent carbon accounting, and ensure that future projects are being optimised for environmental, social and cultural outcomes.   |
| 1.2 | Advocate for a national and coordinated approach to regulations across states for both road and rail to reduce red tape when transitioning fleets to zero emissions.   | 2-5               | X  | X   | X   | X          |          | Addressing differences in regulations between states (red tape) to streamline planning, design and operations of both our urban environments and the transport systems that traverse the country.   |
| 1.3 | Implement an integrated design approach to our transport infrastructure, favouring active and public transport solutions, connectivity between modes, shared use paths and cycleways over private vehicle solutions where practical.                                 | 2-5               |    |     |     | X          | X        | Encourage transport networks to be designed with the commuters' full end-to-end journey in mind.<br>By streamlining public transport routes, improving connections and accessibility across multiple modes of transport, the reliance on private vehicles can be reduced.                               |
| 1.4 | Advocate for a coordinated approach to placemaking for our existing urban environments ensuring a focus on all aspects of what makes a great place to live, in balance with social, environmental, cultural and economic requirements, including climate resilience. | 2-5               | X  | X   | X   | X          | X        | Placemaking is the process of creating quality places that people want to live, work, play, and learn in. Focusing on placemaking and carrying out gap analyses for existing communities to ensure they cater for everyone and include all social, environmental and cultural requirements to function. |
| 1.5 | Ensure systems thinking, circular economy, and whole of life approaches are utilised to inform business cases, feasibility studies, masterplans and concept designs, enabling a balanced approach to decision making for our communities and our transport sector.   | 2-5               |    |     |     | X          | X        | Incorporate whole of life thinking, with a minimum 50-year outlook, at the business case and concept design stage of projects and ensure that decisions are made based upon these findings and not on minimum capital cost outcomes.  |
| 1.6 | Advocate for a coordinated planning approach by governments to ensure the number of projects are balanced and can be delivered by the resources available to industry without adverse impacts on budget or workforce.  | 0-1               | X  | X   | X   |            |          | The large number of projects in the procurement pipeline is putting a huge strain on the industry impacting it's capacity to deliver. A considered, coordinated and planned approach to the procurement of these projects will ensure projects are delivered successfully.                              |

## DETAILED RECOMMENDATIONS

# 02 Introduce policy, investment, and incentives for an efficient, sustainable and resilient transport system.

## Key:

Leader

Contributor

Audience

|     | Recommendation   | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes   |
|-----|--|-------------------|----|-----|-----|------------|----------|---|
| 2.1 | Advocate for the Australian Government to increase investment and incentives in the technology that is required to support the decarbonisation of transport including alternative materials, electric vehicles infrastructure, green hydrogen, and other renewables. | 0-1               | X  | X   | X   | X          |          |   |
| 2.2 | Support discussion with industry and government on pathways to transition from fossil fuels to renewable sources of energy generation including hydrogen, biofuels and the renewable sector generally.   | 2-5               | X  | X   | X   | X          |          | Continued government support for the fossil fuel industry stifles funding that could be channelled into new innovative approaches that will assist the transition to net-zero.  |
| 2.3 | Advocate for the investment in cross industry working groups to create comprehensive blueprints for our communities that include optimised transport solutions.  | 0-1               | X  | X   | X   | X          |          |   |
| 2.4 | Advocate for greater investment in financial vehicles that benefit the community, environment and social needs with proper governance structures (green bonds sustainable finance etc.).   | 0-1               | X  | X   | X   | X          |          | The divestment of the fossil fuel industry presents a significant opportunity for the transition to a low carbon economy. The faster guidelines, processes and products are created for sustainable finance in transport infrastructure the quicker, the transition will be.                            |
| 2.5 | Advocate for all new infrastructure projects to incorporate net-zero emissions targets.  | 0-1               | X  | X   | X   | X          |          | Net-zero targets to be set for all transport infrastructure projects and should include embodied carbon as well as operational carbon. Proposed business plans should accommodate modelling based on a future net-zero scenario.  |
| 2.6 | Advocate for all new and existing infrastructure projects to consider climate resilience and climate impacts in their design and operation.  | 0-1               | X  | X   | X   | X          |          | Carry out climate risk and opportunity assessments for all assets and consider transitional risks where applicable.   |
| 2.7 | Advocate for sufficient investment in a new zero emission hydrogen energy sector that also contributes to decarbonising our long-distance commercial transport and logistics fleets, for both rail and road.   | 0-1               | X  | X   | X   | X          |          | The current focus is for building an industry which supports the export market. There is a need for a focus for use in Australia and for the transport sector. An example would be the provision of funding to support heavy FCEV and Hydrogen powered ICE vehicle trials along major logistics routes. |



## DETAILED RECOMMENDATIONS

# 02 Introduce policy, investment, and incentives for an efficient, sustainable and resilient transport system.

**Key:**

Leader

Contributor

Audience

|      | Recommendation   | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes   |
|------|--|-------------------|----|-----|-----|------------|----------|---|
| 2.8  | Advocate for the development of government policies and incentives that will attract investment and support the appropriate design and construction of transport infrastructure to facilitate the use of ZEV.  | 0-1               | X  | X   | X   | X          |          |   |
| 2.9  | Implement requirements in the draft National Construction Code to ensure all future class 2 and 5 buildings (apartments, office buildings) have the infrastructure required to charge electric vehicles. In addition, extend the deployment of ZEV infrastructure to all government owned assets such as train stations and car parks. | 0-1               | X  |     |     | X          | X        | The availability of ZEV infrastructure will assist in driving the uptake of ZEVs  |
| 2.10 | Advocate for a national policy and incentives to assist in driving the uptake of EVs and FCEVs, both for commercial fleet vehicles and private passenger vehicles.   | 0-1               | X  |     |     | X          |          |   |
| 2.11 | Build on the Modern Manufacturing Strategy (MMS) and advocate for a portion of this investment to be targeted at supporting innovation in construction methods and technology and materials, specifically for the transport sector.  | 0-1               | X  | X   | X   | X          |          | A significant opportunity is present in addressing circularity and low carbon materials for the transport sector. The MMS should specifically target this sector to drive change and build capacity in manufacturing in the country. As an example, Design for Manufacture and onsite Assembly (DFMA) can increase sustainability outcomes, improve safety and quality of products and materials. Local manufacturing of recycled products needs to be supported to reduce transport distance of sustainable materials. |
| 2.12 | Introduce fuel efficiency standards.   | 0-1               | X  |     |     | X          |          | To assist in the transition to low emission vehicle uptake. Fuel efficiency standards have been proven to be effective in driving the transition to a low carbon economy and a cleaner environment.   |
| 2.13 | Advocate for enhanced carbon sequestration and biodiversity outcomes (fauna and flora).  | 0-1               | X  | X   | X   | X          |          | Improving biodiversity around our transport infrastructure can play a significant part in sequestering carbon and offsetting the impacts of the assets themselves. All projects should include net positive biodiversity targets included.  |

## DETAILED RECOMMENDATIONS

# 03 Implement exemplar governance structures, processes and approaches to ensure transparent, sound decision making.

## Key:

Leader

Contributor

Audience

|     | Recommendation   | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes  |
|-----|--|-------------------|----|-----|-----|------------|----------|--|
| 3.1 | Advocate for the adoption of sustainability performance standards for projects to ensure a consistent response from industry and government including national and internationally recognised environmental rating systems suited to infrastructure projects.  | 0-1               | X  | X   | X   | X          |          | A consistent transparent approach to ESG via measurement and reporting of social, environmental, governance, and cultural outcomes will assist in ensuring assets can be benchmarked, lessons learnt, and improvements made for new assets in the future. This is particularly important to drive decision making in the early planning phases of a project. |
| 3.2 | Facilitate industry wide collaboration to focus on designing out waste and utilise systems thinking to drive circular economy principles into the planning and design processes for new assets.  | 0-1               | X  | X   | X   | X          | X        |  |
| 3.3 | Advocate for new ownership and delivery models for government infrastructure which will be required to respond to all material risks to the assets (Task Force on Climate related Financial Disclosures [TCFD], and Taskforce on Nature related Financial Disclosures [TNFD] type approaches), including accountability to persons in decision making positions. | 2-5               | X  | X   | X   | X          |          | Currently, there is little to no accountability for projects and their owners. Applying an approach similar to TCFD or TNFD will provide a framework for assessing climate and natural capital related opportunities and risks, whilst also providing accountability in the decision making process.   |
| 3.4 | Advocate for the adoption of sustainable procurement practices in line with ISO 20400 across the transport sector - including government and industry.   | 0-1               | X  | X   | X   | X          | X        | Utilising guidance standards such as ISO 20400 Sustainable Procurement or similar will provide an approach consistent with internationally recognised leading practice.  |
| 3.5 | Advocate for Life Cycle Analysis (LCA) to be implemented in early concept stages of design to ensure all aspects of sustainability are accounted for. This enables carbon emissions for the full asset lifecycle to be considered before the project is advanced and should be used as part of a wider circular economy decision making process.                 | 0-1               | X  | X   | X   | X          |          |  |
| 3.6 | Incorporate transparent processes in decision making at all gates of a project lifecycle ensuring accountability of government spend.  | 2-5               | X  | X   | X   | X          |          |  |



## DETAILED RECOMMENDATIONS

03

## Implement exemplar governance structures, processes and approaches to ensure transparent, sound decision making.

## Key:

Leader

Contributor

Audience

|      | Recommendation  | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes   |
|------|---|-------------------|----|-----|-----|------------|----------|---|
| 3.7  | Advocate, as a key part of sustainable procurement, for governments to ensure policy incorporates whole of life assessments into early decision making.   | 2-5               | X  | X   | X   | X          |          | Whole of life assessments are required at early planning and options stage to ensure carbon and other environmental, social and cultural factors are appropriately considered. From a carbon perspective this is important not only to consider the construction and operation of the assets but the emissions they enable. |
| 3.8  | Advocate for business cases to include identify the environmental, social and cultural benefits of the proposed infrastructure and include shadow carbon pricing in the financial modelling.          | 2-5               |    |     |     | X          |          | Business cases should be commissioned for all projects and the reasons for their underlying decisions clearly articulated and available to the public for full transparency.  |
| 3.9  | Engage with industry, government, and regulators to create a nationally approved supported approach to the measurement, identification and selection of low carbon materials, products, and services. | 2-5               | X  | X   | X   | X          | X        |   |
| 3.10 | Advocate for collaborative contracting models such as alliance contracting to improve upon social, sustainable and cultural outcomes  | 2-5               | X  | X   | X   | X          | X        | Contracts that are more collaborative allow for earlier engagement, allowing for earlier inclusion of sustainable outcomes.   |

## DETAILED RECOMMENDATIONS

## 04

## Enable collaboration, capacity building and education at all stages of the process.

## Key:

Leader

Contributor

Audience

|     | Recommendation  | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes  |
|-----|---|-------------------|----|-----|-----|------------|----------|--|
| 4.1 | Build upon this report by seeking further input from industry about the current challenges to decarbonisation, and collaborate with all stakeholders to develop a detailed action plan.               | 0-1               | X  | X   | X   | X          |          | An inclusive, comprehensive and coordinated approach is required to ensure all views are heard and considered to co-design the solutions required to address these complex issues.   |
| 4.2 | Educate key stakeholders on systems thinking, circularity and whole-of-life principles to ensure decisions are made that take into account all perspectives and material issues relating to projects. | 0-1               | X  | X   | X   | X          |          | Build capacity within procurement teams and decision makers across government to prioritise sustainability and low-carbon options over lower capital cost solutions. Currently, decisions are largely influenced by low capital cost solutions, and are selected over more sustainable and socially acceptable submissions due to a lack of understanding and/or methods for comparison. Building capacity and the methods for comparing tender submissions which include non-financial related requirements, is needed to ensure projects are selected which meet the needs of the community and take social, environmental and cultural issues into account. |
| 4.3 | Encourage collaboration to facilitate the multi-pronged approach necessary to overcome barriers and increase uptake of low embodied carbon construction strategies.                                   | 0-1               | X  | X   | X   | X          |          | Identify and implement procurement processes which allow for collaboration to exist in place of restrictive contractual instruments.   |
| 4.4 | Advocate for early engagement and a collaborative approach with industry to create blueprints for future communities, and transport infrastructure projects.  | 0-1               | X  | X   | X   | X          |          |  |
| 4.5 | Coordinate activities across industry/government to develop better and more coherent policies and drive innovation in industry to transition to a low carbon economy.                                 | 2-5               | X  | X   | X   | X          | X        |  |
| 4.6 | Advocate for a change in culture to allow sustainability to be integrated into the design and planning of infrastructure, rather than a "nice to have" that is value managed out.                     | 0-1               | X  | X   | X   | X          |          | Change the language around 'sustainability' to reflect better recognition and quantification of broader project benefits i.e. sustainability is building better quality with equal or lesser impact on the environment and communities. Sustainability is quality, thus, we need to advocate for 'a culture striving for excellence' which includes the environment and community. The IA Assessment Framework and the ISC Planning rating tool can assist in bringing social, environmental and cultural issues as well as carbon in focus earlier in the process.  |



## DETAILED RECOMMENDATIONS

## 04

## Enable collaboration, capacity building and education at all stages of the process.

## Key:

Leader

Contributor

Audience

|      | Recommendation   | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes   |
|------|--|-------------------|----|-----|-----|------------|----------|---|
| 4.7  | Engage with all construction partners on upcoming government-driven projects and establish industry forums / use existing forums to gather a collective industry voice.                        | 0-1               | X  | X   | X   | X          |          |   |
| 4.8  | Build capacity across all stakeholders and for all phases of transport infrastructure projects regarding carbon including planning, design, construction, operation and enabled emissions.     | 2-5               | X  | X   | X   | X          | X        | Understanding carbon impacts across the various stages of an asset lifecycle will improve decision making throughout the process. It is of paramount importance that the education relating to the selection of low carbon materials is addressed as this is the next significant impact after operational emissions are mitigated.   |
| 4.9  | Foster a culture of sharing to ensure lessons learnt on particular projects are communicated to the industry, other projects and state governments to ensure continual growth of the industry. | 2-5               | X  | X   | X   | X          |          | For a variety of reasons, stakeholders are reticent to share their experiences, either good or bad. A solution could be achieved via a government backed industry event where governments agree to articulate lessons learnt without fear of litigation, giving away knowledge or share knowledge on controversial projects.  |
| 4.10 | Establish integrated project teams involving key contractors early in the design process to drive collaborative behaviours.  | 2-5               | X  | X   | X   | X          |          |   |
| 4.11 | Utilise key infrastructure projects with innovative solutions or high social, environmental or cultural benefits to build capacity within the industry.  | 0-1               | X  | X   | X   | X          |          | Create 'Academies of Excellence' for the relevant skills needed in the industry based upon the skill sets required for each key project that has high innovative or social and sustainability benefits. Encourage more JVs to enhance cross-percolation of knowledge. This will assist in building capacity across the whole supply chain including planners, commercial managers, designers, contractors and subcontractors. |

## DETAILED RECOMMENDATIONS

05

## Adopt and promote technology solutions that optimise asset design, construction, operation and enabled solutions.

## Key:

Leader

Contributor

Audience

|     | Recommendation  | Timeframe (years) | RA | ARA | ISC | Government | Industry | Notes   |
|-----|---|-------------------|----|-----|-----|------------|----------|---|
| 5.1 | Advocate for a national and coordinated effort to attract investment in renewable energy solutions and supporting infrastructure such as hydrogen, renewable biofuels, wind and solar to power the construction of our infrastructure assets and the transport fleet. | 0-1               | X  | X   | X   | X          | X        |   |
| 5.2 | Industry to adopt technology solutions that incorporate transparency and accountability in design and delivery, e.g. blockchain solutions can be used to create an immutable digital record of the assets.  | 2-5               | X  | X   | X   | X          | X        | The application of Building Trust Indexes and immutable technology solutions that record the design and construction process, the key responsible parties involved, and the materials and products used, creates a record that can be used for greater accountability. They can also assist to potentially drive lower cost of finance or insurance premiums. |
| 5.3 | Industry to increase the use of active monitoring of infrastructure assets and incorporate predictive maintenance regimes during the operational phase to ensure maintenance is optimised, reduces waste and improves efficiencies.                                   | 2-5               | X  | X   | X   | X          | X        |   |
| 5.4 | Engage with industry to ensure all infrastructure projects are created using BIM and internationally recognised open-source protocols and standards, including the development of digital twins for optimal operation phase management.                               | 5-10              | X  | X   | X   | X          | X        |   |
| 5.5 | Phase out diesel trains and switch to green hydrogen or battery electric when technology is proven and available, and supporting government policies and infrastructure are in place.   | 5-10              | X  | X   | X   | X          | X        |   |



# 07

## Contact Us



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08

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The most reliable  
way to predict the  
future is to create it.

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Abraham Lincoln





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