



# Best Practice Policy Development

International Review of Policies and Programs  
for Low Emissions Building Materials

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2022





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## Acknowledgment

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Our thanks and appreciation to the NSW and Federal Governments as well as all interviewees, participants and peer reviewers.

## About Presync

Established in February 2014, Presync and its founders are all about sustainability. We have many years' experience in integrated sustainability strategies and climate change risk and adaptation. We also work on climate mitigation, developing integrated energy strategies, renewable energy procurement and project support. We focus on the intersection of technology, innovation and sustainability where it applies to the energy and property sectors. As a certified B Corporation, Presync is excited to be supporting the uptake of innovative renewable energy solutions and contributing to the energy transition, now well underway. Working to support the transition of the materials sector is the next logical step.

## About WWF-Australia

WWF is one of the world's largest and most experienced independent conservation organisations, with over five million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption. WWF-Australia works with industry and governments to address the biggest and most complex issues including transforming markets to create a climate safe and decarbonised economy.

## About Climate-KIC

Climate-KIC Australia is an independent, not-for-profit organisation that aims to inspire and enable climate action by being a catalyst for systemic change, through innovation. We believe that system level innovation is necessary to avoid potentially devastating economic, environmental and social losses and capture the opportunities of a circular, net-zero economy. Climate-KIC Australia works in collaboration with EIT Climate-KIC, Europe's largest climate change innovation initiative.

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# Executive Summary

Government policy to cut embodied carbon emissions is a relatively new field. This research has investigated the policy landscape, both internationally and here in Australia, to identify what has been implemented to date. It is clear that policy has a key role to play, as does strong action by industry, if we are to reach an emissions trajectory consistent with the Paris Agreement.

The significance of embodied carbon as a proportion of our carbon budget will continue to grow as the transition of the electricity sector continues to build momentum. Operational emission reductions have over a decade's head start, but there is opportunity to now implement informed policies with the support of industry and the benefit of international examples.

The construction sector ecosystem is complex. So too are the industrial processes that produce big-ticket construction materials like cement, steel and aluminium. Appreciating this complexity is central to good policy development. It shows that system-wide change is needed to reach net-zero embodied carbon.

Fortunately, many participants in the construction and material supply industries are already cutting emissions to align with a net-zero future. Working with progressive industry members to co-develop government policy will contribute to meeting the required pace of change and help de-risk policy development.

## Government as a *driver* of change.

- Procurement policies that reward and require embodied carbon reductions through low emission construction materials and practices.

## Government as an *enabler* of change.

- Supporting the development of required tools, such as taxonomy laws, inventories and calculators and an independent carbon database.
- Supporting skills development of professions, trades and researchers.
- Supporting the development of circular economy structures.

The examples of policy levers in this report come from the USA, Europe, and our own Asia-Pacific region. We spoke with experts from multiple parts of the construction ecosystem with networks extending into these major regions where policies to address embodied carbon are in place and continuing to develop.

## The range of policies and programs identified can be grouped into the following five categories:

1. Policy levers to drive the market;
2. Role of industry and the market;
3. Rating schemes for building performance;
4. Procurement – Government as an enabler of change;
5. Data, tools and skills needed to get to net-zero.

Details of the policy levers from each of these categories are set out in this report, as are many examples and case studies. Links are provided throughout the document to make this report a useful 'go to' resource for policy makers at all levels of government in Australia.

This research has benefitted from a strong sense of collaboration that exists among the professionals working to cut emissions in the construction sector, in industry, government and research bodies around the world. Policy makers here can leverage this collaboration to help rapidly implement the policy settings needed to support the take-up of low and zero carbon construction materials in Australia. Read on to find the policy levers that best fit your jurisdiction, and the organisations already engaged.



# 1. Introduction

This is the critical decade to bring greenhouse gas emissions onto a trajectory consistent with meeting the Paris Agreement to limit global warming to 1.5°C.

The transition of the stationary energy sector is underway in Australia. Operational emissions in the built environment have been a focus for many years. The next *big-ticket* item to address in our carbon budget is embodied carbon.

To help Australian governments of all jurisdictions, this review has scanned the policy levers used by governments around the world to identify examples that support the transition to low- and zero carbon construction materials, which is key in cutting embodied carbon.

Tackling embodied carbon is so complex that we believe a systems-wide approach is needed and that collaboration across sectors is vital to tackle the barriers to change in a coordinated fashion. Australian industry has begun to actively collaborate. Some are calling it *radical collaboration* through the [Materials and Embodied Carbon Leaders' Alliance \(MECLA\)](#). To complement industry actions, government policy is a key component of the required systems-wide approach, both as a *driver* and *enabler* of change.

Government procurement policies can be a major *driver* for low and zero embodied carbon materials. Industry has told us in "*The Time Is Now: Tackling Embodied Carbon in the Building and Construction Sector - WWF*"<sup>1</sup> that the government has a key role to play in sending a demand-signal to the market. This demand-signal will help give industry the confidence to invest in skills, technology, and capacity through the supply chain.

Government can help *enable* the shift to low and zero carbon materials by helping overcome knowledge gaps, providing access to and management of material data, and the modification of standards and codes. The circular economy is closely related to our consideration of embodied carbon. Government policy is needed to enable the whole-of-system approach needed for circularity.

MECLA, along with many industry players including the Green Building Council of Australia (GBCA) and the Infrastructure Sustainability Council are all working and collaborating to facilitate industry action. But they can't reduce embodied carbon emissions onto a trajectory consistent with the Paris Agreement without government policies and programs that support the required and rapid shift.



## 1.1 Context: climate change mitigation

Reducing the emissions intensity of construction materials will be fundamental to achieving a zero carbon economy.

Embodied carbon refers to the total greenhouse emissions generated during the manufacture of the materials and products used in the construction and refurbishment of new and existing buildings and infrastructure. There is an urgency around embodied carbon to reduce the greenhouse footprint of these materials, but it requires collaboration, leadership and a sound policy framework to support industry to harness the opportunities of the required transition.

Embodied carbon is a growing focus for emission reduction opportunities. As the national electricity grid transitions to renewables and energy efficiency measures are implemented, operational emissions in the built environment reduce. This means that the proportion of emissions attributable to embodied carbon will increase unless governments and industry take action.

Reducing the emissions intensity of construction materials will be fundamental to achieving a zero carbon economy. Governments and industry can play a pivotal role in the transition to low- and zero carbon construction materials.

## 1.2 Identifying embodied carbon

Embodied carbon can be identified throughout a construction project life cycle. To assist the understanding and management of embodied carbon, this internationally agreed model categorises the stages of the construction project life cycle.

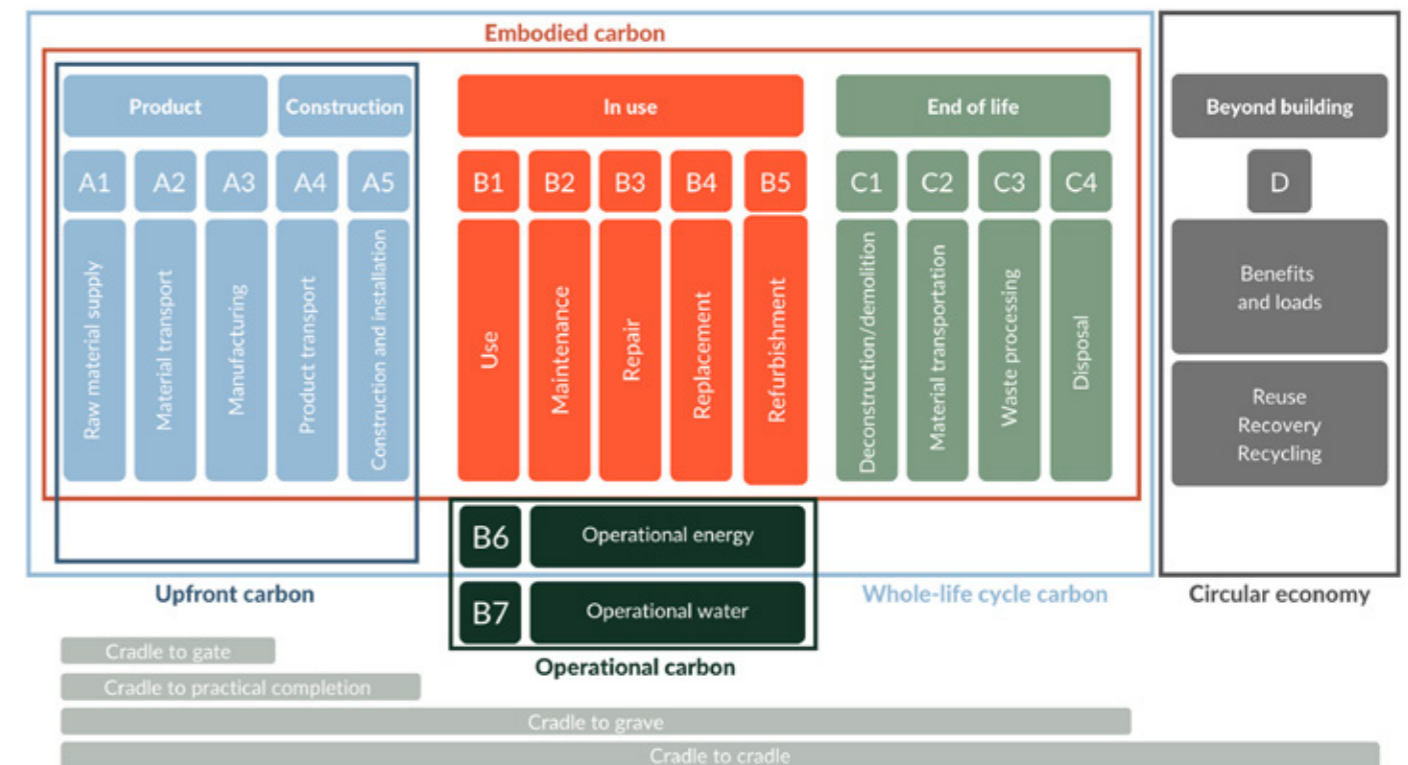


Figure 1: Internationally agreed model categorises the stages of the construction project life cycle.<sup>2</sup>

### 1.3 The construction ecosystem

The construction ecosystem is complex. Decisions that impact embodied carbon are made at many points in the project life cycle, and by many different parties. A systems-wide approach is therefore needed to have an impact.

This systems diagram was developed as part of the original research into understanding the key components of the construction ecosystem including barriers and enablers of change. It forms the conceptual basis for the design of MECLA's working groups and intervention points.

#### CONSTRUCTION PROJECT LIFECYCLE

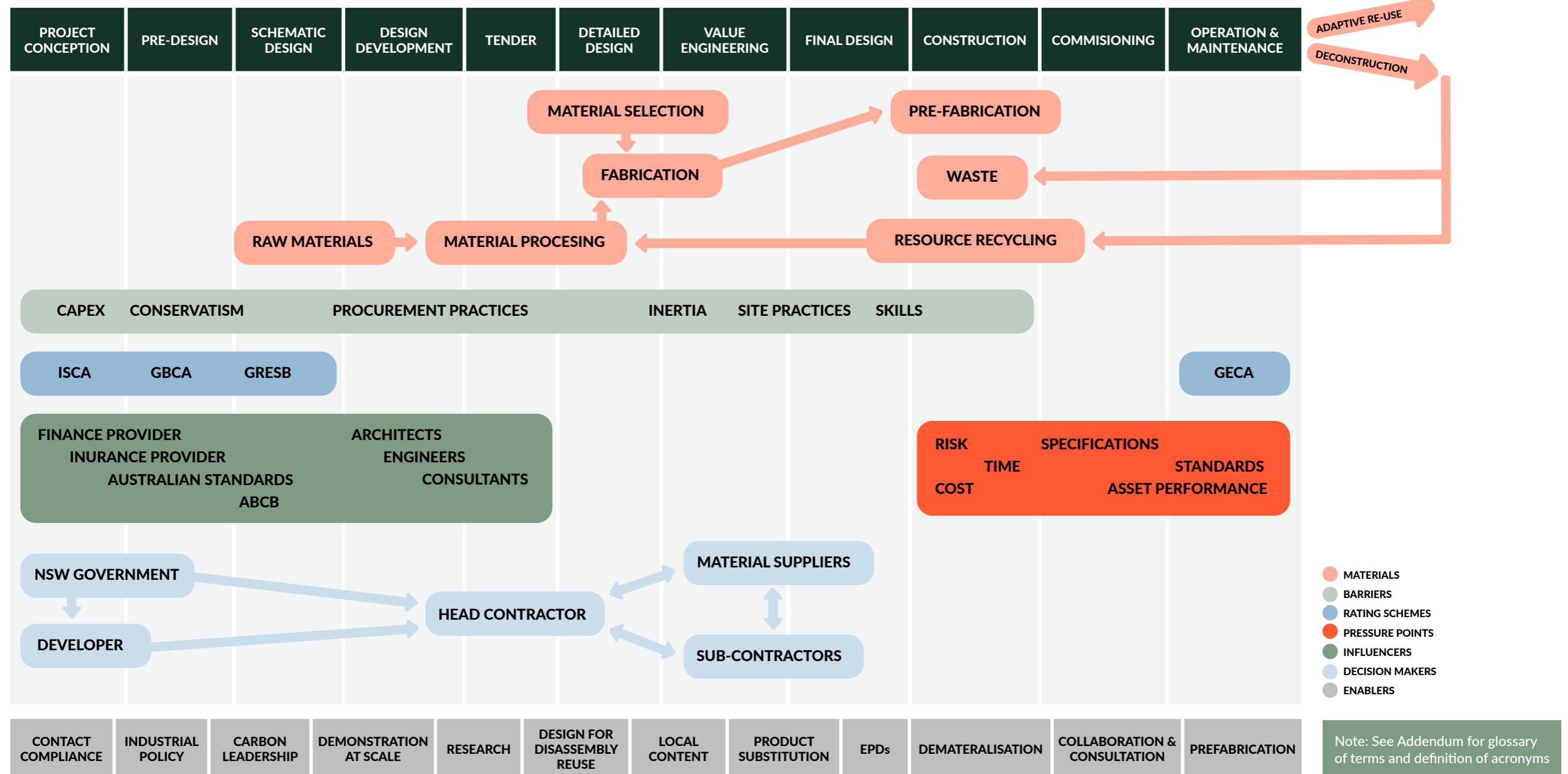


Figure 2: System diagram – decarbonisation of construction materials.<sup>3</sup>

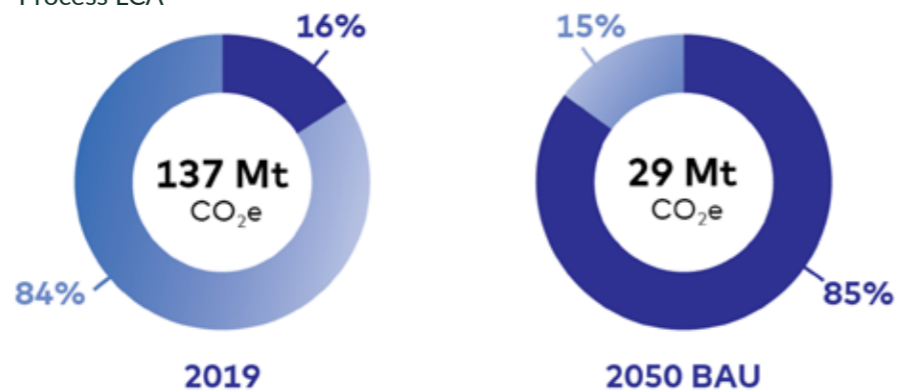
## 1.4 Why does embodied carbon matter?

As operational emissions are reduced and the national electricity grid transitions to renewables, the proportion of embodied carbon in buildings and infrastructure will grow. If we are to align with Paris Agreement emission reduction targets, we need to start focusing on embodied carbon.

These diagrams, developed by Thinkstep-anz for the Green Building Council of Australia (GBCA), demonstrate the relative significance of embodied carbon and its sources in the manufacturing of construction materials.

In summary, while embodied carbon was 16% of total building emissions in 2019, it will become the vast majority (estimated at 85%) of total emissions in buildings as the electricity grid decarbonises.

### BUILDING EMISSIONS IN AUSTRALIA Process LCA



Operational carbon  
Embodied carbon

Figure 3: Carbon emissions from Australia's buildings in 2019 and 2050 (Process LCA)<sup>4</sup>

### CARBON EMBODIED IN THE MANUFACTURE OF BUILDING PRODUCTS excluding transport to site (A4), construction (A5), and end-of-life (C1-C4)

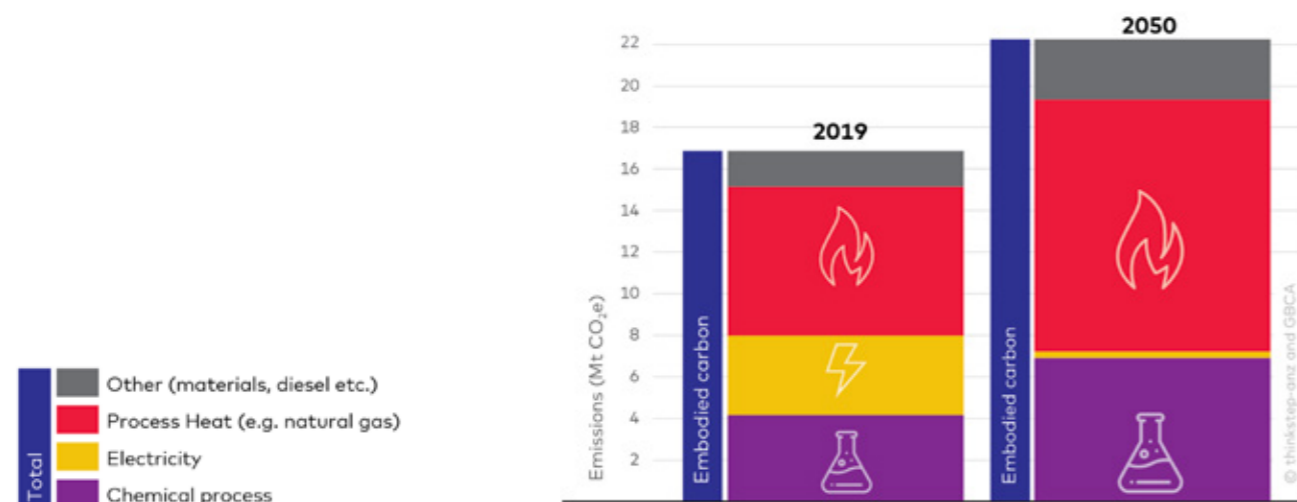


Figure 4: Sources of embodied carbon emissions from the manufacture of building products used in construction and maintenance<sup>5</sup>

## 1.5 Objective of the project

As part of the NSW Government's efforts to meet the objectives set out in *Net Zero Plan Stage 1: 2020-2030*, the Department of Planning and Environment is working closely with the Major Project Implementation Team (MPIT) in the Federal Department of Industry, Science, Energy and Resources (DISER). Together they are helping other jurisdictions better understand and consider policies and other incentives that support the uptake of low emission building materials to help achieve both the Paris Agreement goals and to contribute to creating a more circular economy.

There are currently no published reviews or assessments available on the fast-growing policy landscape for voluntary or mandatory requirements for governing low or zero emissions building materials. This project intends to remedy this and provide examples from overseas of best practice policy development to encourage the uptake of low and zero embodied construction materials.

A collaboration between Presync, WWF-Australia, and Climate-KIC Australia (Climate-KIC), this project aims to:

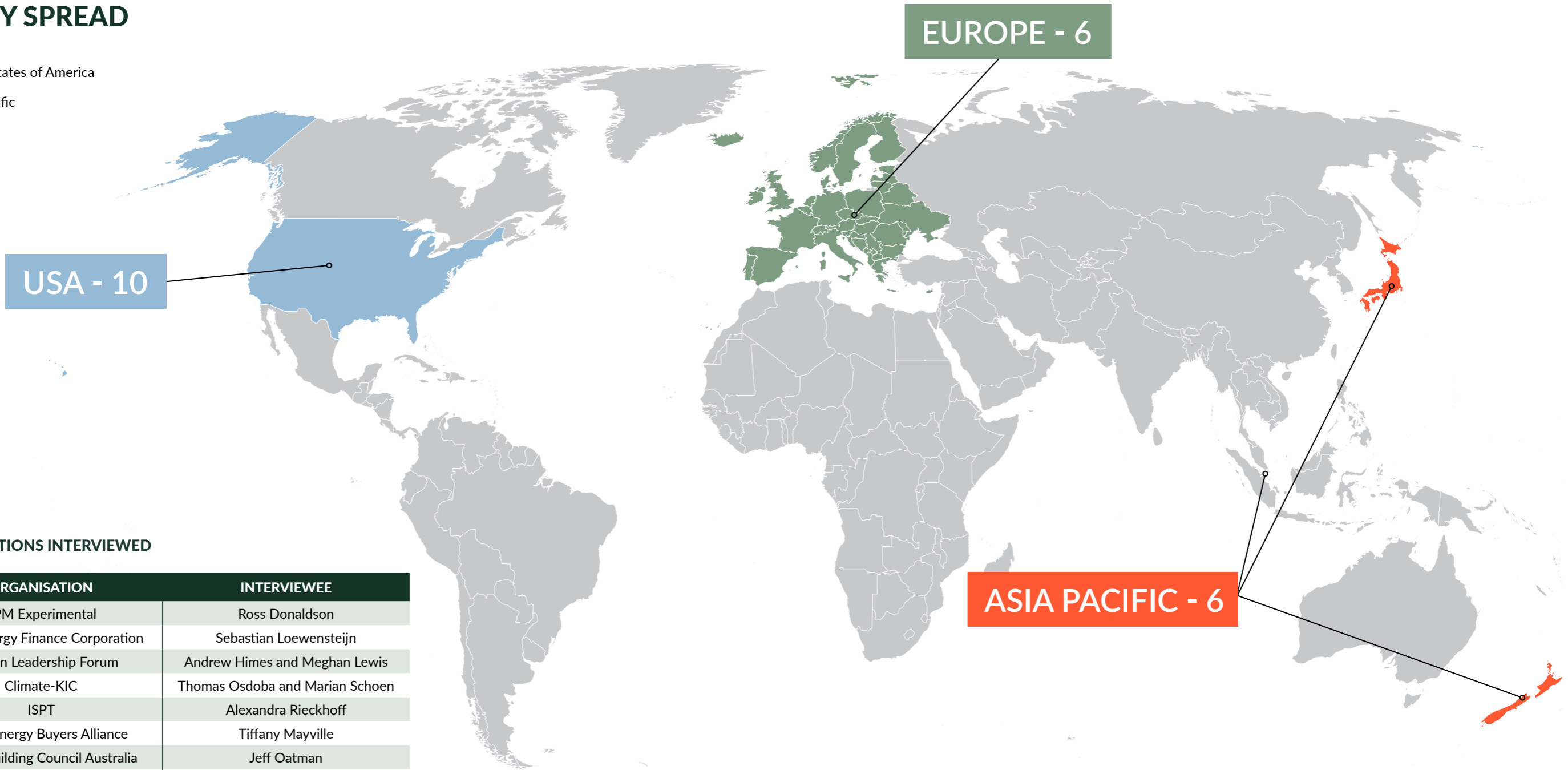
- Scan international action and other proposed actions that directly and indirectly impact the growth of markets for low and zero emissions building and construction materials;
- Identify policy and regulatory measures that are working successfully to support both business and government in other international jurisdictions;
- Align with the previous Commonwealth Government's Technology Investment Roadmap First Low Emissions Technologies Statement (2020), where low emissions building materials are one of the technologies on the watching brief; and
- Provide Australian jurisdictions with an understanding of both the policy and market interventions to drive and scale uptake of low emissions building materials for the built environment.

## 1.6 The research approach and range

We spoke with 17 carbon policy and practitioner experts and identified 14 voluntary and 8 mandatory policy mechanisms from 3 key regions.

### POLICY SPREAD

- Unites States of America
- Asia Pacific
- Europe



### ORGANISATIONS INTERVIEWED

ORGANISATION	INTERVIEWEE
EPM Experimental	Ross Donaldson
Clean Energy Finance Corporation	Sebastian Loewensteijn
Carbon Leadership Forum	Andrew Himes and Meghan Lewis
Climate-KIC	Thomas Osdoba and Marian Schoen
ISPT	Alexandra Rieckhoff
Clean Energy Buyers Alliance	Tiffany Mayville
Green Building Council Australia	Jeff Oatman
University of Technology Sydney	Leena Thomas
Start2See	Rob Rouwette
University of New South Wales	Deo Prasad
OneClick LCA	Johanna Jarvinen
Curtin University	Greg Morrison
Graz University of Technology	Michael Kriechbaum
Climate Friendly Materials Platform	Karsten Neuhoff
Agora Industry	Helen Burmeister

### THE SPLIT OF VOLUNTARY AND MANDATORY POLICIES INVESTIGATED

	VOLUNTARY	MANDATORY
USA	10	0
Europe	1	5
Asia Pacific	3	3
<b>Total</b>	<b>14</b>	<b>8</b>



The range of policies and programs identified is broad and provides a range of options to suit different jurisdictions and sectors of focus.

## POLICY LANDSCAPE

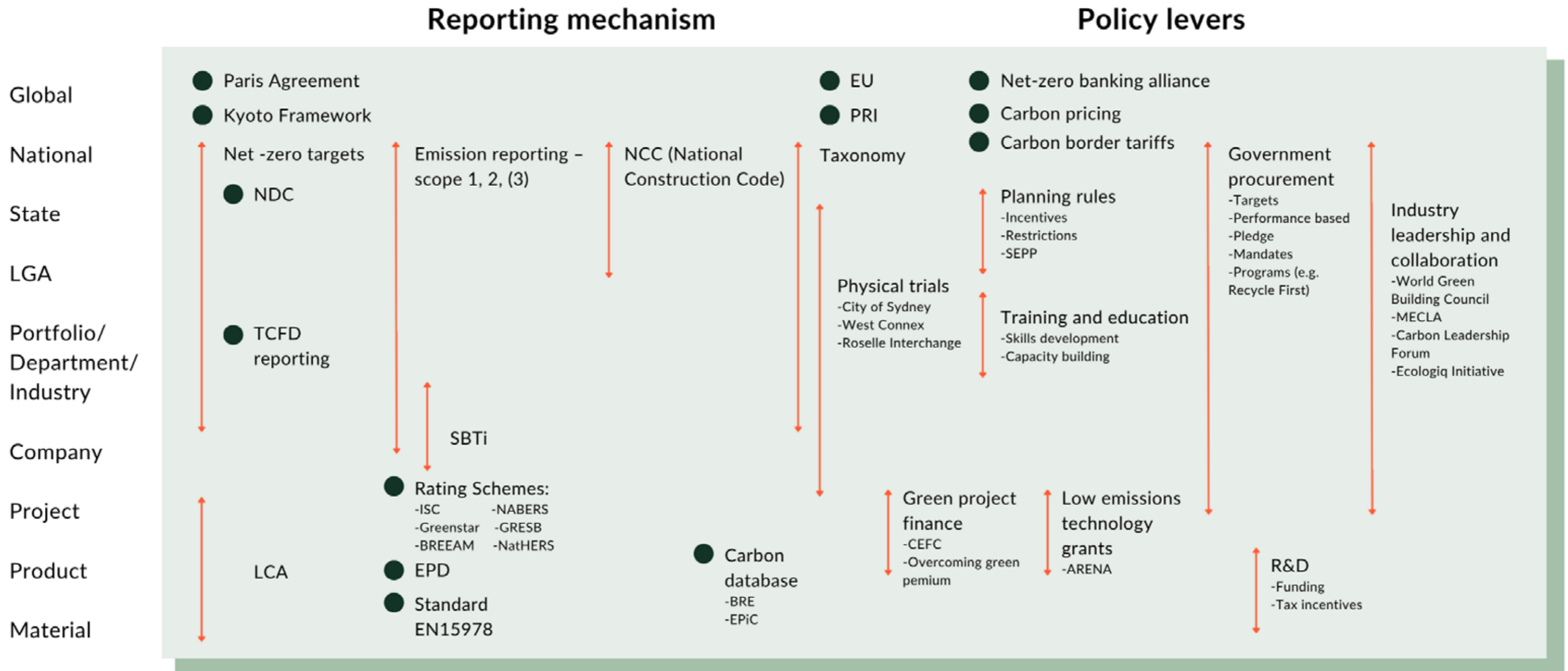


Figure 5: Landscape of policies encountered during research

Note: See Addendum for glossary of terms and definition of acronyms

## 1.7 Five categories of take-up drivers

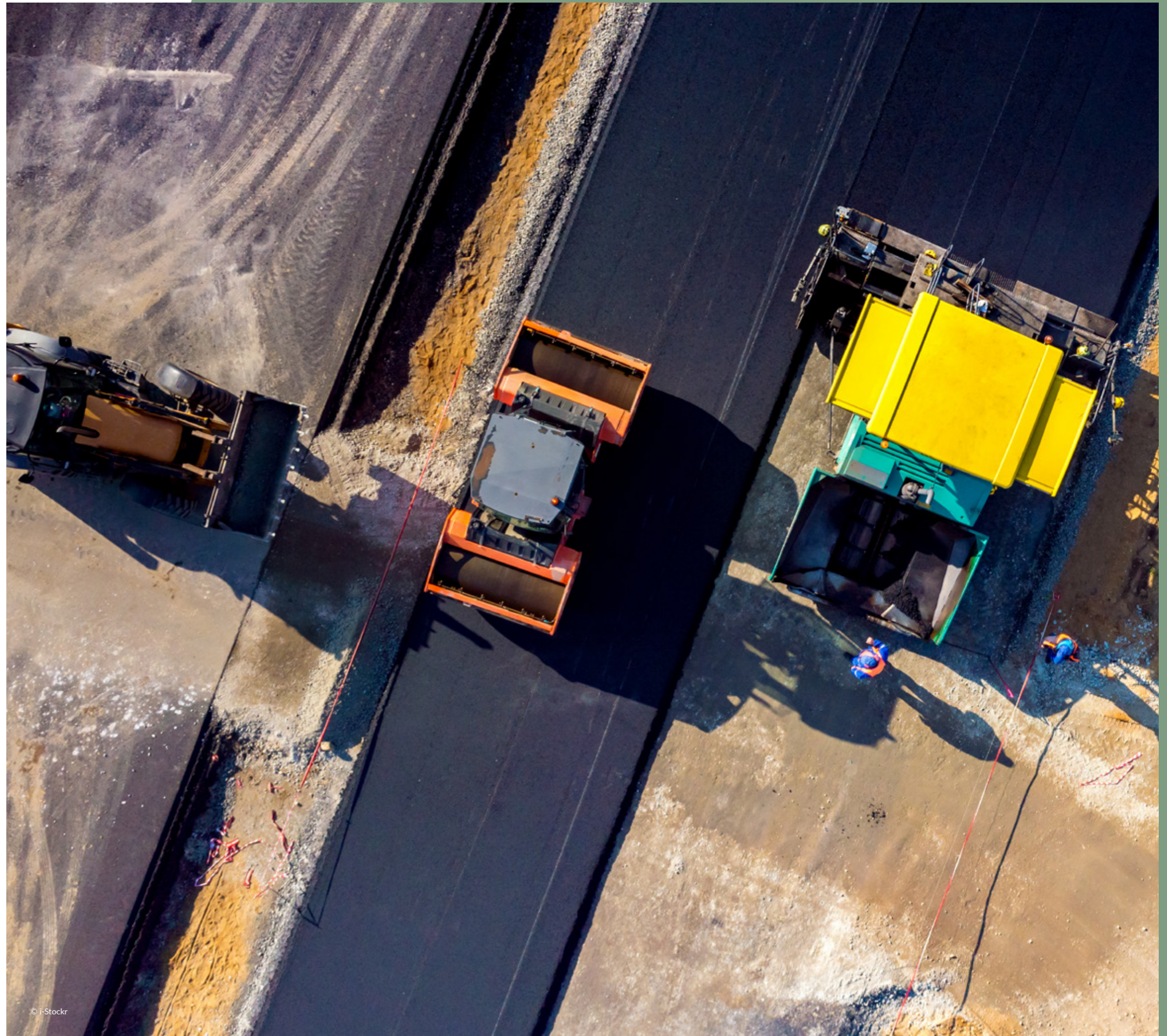
Low emission building materials (LEBM) policies and programs can be grouped into five categories of government-led take up drivers.

1. Policy levers to drive the market
2. Role of industry and the market
3. Rating schemes for building performance
4. Procurement – Government as an enabler of change
5. Data, tools and skills needed to get to net-zero

Examining these five government actions forms the structure and body of this report.

Our research confirms that industry is beginning to act and is striving to overcome the barriers inherent in change of this scale. Government can also support collaborative bodies working to effect change. Many organisations in the built environment sector are seeking to transition towards a zero carbon future. The building and construction sectors are very complex and there are many industry players and government agencies involved.

The fact that governments around Australia have set net-zero goals means there is considerable alignment to achieve this.



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## 2. Policy levers to drive the market

**Carbon pricing is an efficient and effective market mechanism that applies a cost of carbon in the production of a good and service. It is a broad economy-wide policy lever that addresses operational carbon and embedded carbon.**

A carbon price seeks to internalise the cost of carbon so that products and services that are responsible for carbon emission are more expensive than lower emitting alternatives. [Carbon pricing](#) takes several forms, most notably:

- Carbon taxation schemes (domestic products)
- Emissions trading schemes (domestic products)
  - Cap and trade
  - Baseline and credit
- Carbon border adjustment mechanisms (international products)

There are two main types of **emissions trading scheme (ETS)**:

### Cap-and-trade:

A cap-and-trade scheme sets a cap on emissions that a sector can emit in a given period. It then splits that cap into an allowance that businesses are expected to stay within by either improving their processes to be less carbon intensive, or trading their emissions with businesses that have already made carbon savings. The EU's ETS is the largest cap-and-trade scheme in the world.

### Baseline-and-credit:

A baseline-and-credit scheme does not set an upper limit, rather an emission intensity is set for given activities against a baseline. Emission reductions below that baseline generate a credit which can be sold to other parties whose activity emits above the baseline.

Including the cost of carbon in a product will naturally advantage lower embodied carbon products and materials. The consequences of this is that markets will then favour lower cost, and therefore lower carbon alternatives.

Since carbon pricing is not applied in every economy in the world, companies could move their production elsewhere and avoid the carbon cost. This is known as 'carbon leakage' and puts domestic businesses that do pay for carbon emissions at a potential disadvantage. A **Carbon Border Adjustment Mechanism (CBAM)** is applied in some jurisdictions to balance out this comparative advantage/disadvantage by applying a carbon charge to imported goods.

Carbon border adjustments are of particular interest to export industries that would face a price penalty if exporting carbon intensive materials and products when an equivalent local carbon pricing mechanism is not in place.

## 2.1 Rebates

A rebate is a form of post-construction incentive for buildings that meet desired policy objectives above codes and minimum standards. Rebates can also be based on meeting existing green building ratings which can include embodied carbon as the criteria for eligibility.

### [California - Voluntary - Rebates](#)

The City of Burbank's Water and Power (BWP) offers a limited range of rebates that apply to varying levels of certification under the [Leadership in Energy and Environmental Design \(LEED\)](#)<sup>6</sup> Green Building Rating System. The rebates offered by BWP increase depending on the LEED rating achieved:

- Certified (40–49 points) – US\$15,000
- Silver (50–59 points) – US\$20,000
- Gold (60–79 points) – US\$25,000
- Platinum (80 points and above) – US\$30,000

### [New York - Voluntary - Tax Exemption<sup>7</sup>](#)

Buildings complying with LEED, Green Globes, American National Standards Institute, or substantially equivalent green building certification can be partially or fully exempt from property tax between 20-100% (administered by local government) if the new construction or improvement costs more than US\$10,000.



## 2.2 Green loans

Financial markets are increasingly seeking green investment classes for both debt and equity positions. Broadly, this refers to assets' operational emissions, embodied carbon, climate resilience, and social sustainability. Informed by the TCFD\* framework, finance can have a significant influence as a driver of sustainability credentials of infrastructure and construction projects, including embodied carbon.

Loans are a tool that allow financial institutions to influence the sustainability of the built environment by placing conditions on the loans that prioritise the mitigation of embodied carbon, and other environmental factors. This includes a discount to the interest rate, eligibility requirements, or limits to loans connected to building performance.

Green finance can also be easily integrated with green building rating mechanisms as part of the loan conditions. For example, a financial institution could stipulate that the building must have a decommissioning plan for the end-of-life phase of particular materials or the entire structure.

### Pennsylvania – Voluntary – Green Loans and Grants<sup>8</sup>

Projects must achieve minimum certification under LEED, Green Globes, or the National Green Building standard (e.g., Gold under LEED NC) to be eligible for such a loan. The loan must be repaid in 5 years and has a dollar-for-dollar matching investment requirement of all program funds awarded. Residential applicants are eligible for a maximum loan of US\$100,000, while small businesses are eligible for a maximum loan of US\$2 million. Additionally, the scheme offers developers up to 10% or US\$500,000 of project costs (whichever is less).

\*Task Force on Climate-Related Financial Disclosures (TCFD)<sup>9</sup>



### AUSTRALIAN CASE STUDY:

Announced in March 2021.

"In its first direct investment to reduce embodied carbon in property construction, the Clean Energy Finance Corporation (CEFC) has committed \$95 million on behalf of the Australian Government, to help deliver the 56-hectare Roe Highway Logistics Park (RHLP) as a carbon neutral development. The project's environmental initiatives are being led by Hesperia in collaboration with its development partners, Fiveight and Gibb Group.

The developers will use low carbon construction materials across at least five new warehouses to be built in the next 18 months. The use of low carbon concrete at RHLP could reduce emissions by up to 42 per cent compared to traditional concrete, according to analysis by leading sustainability consultant Edge Environment."<sup>10</sup>

## 2.3 Overcoming the green premium

**Carbon Contracts for Difference are designed to minimise price uncertainty and to help alleviate costs associated with the upfront investment in upgrading and using new technology.**

Carbon Contracts for Difference (CCfDs) are interventions in the market to help secure the required finance and cover higher production costs associated with upfront capital expenditure in upgrading industrial plant. A CCfD works in a similar way to a feed-in tariff for renewable energy projects, guaranteeing producers of low carbon materials (e.g. steel, aluminium, cement) a fixed carbon price, with national governments or other agent providing the funding to overcome the 'premium gap' until the commodity is able to attract market demand in its absence.

CCfDs can help correct two problems:

- As a hedging instrument for future carbon prices CCfDs address regulatory credibility issues. They reduce financial costs by stabilising revenue streams for low emission projects particularly at the beginning of the investment cycle.
- Helping to address traditional market failure for innovative products coming into the market place by providing additional financial support.

To limit the exposure of government to individual projects and prevent the contract being fulfilled by a portfolio or traded, CCfDs should be awarded only on a project-specific basis. Government benefits by capturing the upside of carbon price development. Focusing on projects where the cost of carbon is an important component would minimise risk.

Pilot CCfD are being explored in the EU primarily to accelerate the replacement of equipment with the deployment of hydrogen production for low carbon steel, cement, and chemicals. The EU and member state Germany is reasonably well advanced in thinking through the details of how a CCfD will support industry transformation. It needs to be combined with other policy instruments including targets, CBAM, a carbon price, and development of green lead markets to support the transition to a market-based system.<sup>11 12 13 14</sup>

## 2.4 Dematerialisation and building smarter

**There is general consensus that smarter design can deliver serious savings through design optimisation and substitution of carbon intensive materials where possible and practical.**

The US based Carbon Leadership Forum (CLF<sup>15</sup>) has a goal to eliminate embodied carbon in buildings and infrastructure by inspiring innovation and spurring change through collective action. Rather than focusing on the materials themselves, the CLF suggests that design and construction teams can systematically discuss how to limit the embodied carbon (EC) in buildings through limits placed on buildings, rather than material limits which is likely to be more complicated, and where data may not be available.

The CLF has developed a template<sup>16</sup> for city projects:

1. Build less, reuse more
2. Design lighter and smarter
3. Use low carbon alternatives
4. Procure low(er) carbon products

Planning laws that put limits on and reward EC can provide greater incentives to collaborate between industries, as well as providing the widest options for architects and designers to choose alternative materials.

Dematerialisation is best achieved through planning rules changes, building code upgrades, city zoning regulations, and incentives for deviation from standard minimum building standard requirements. In the case of the USA, executive orders have also been implemented to address embodied carbon of building and industrial sector emissions.

That being said, construction material limits do have the potential to also drive change. By establishing a low carbon cement standard<sup>17</sup> that sets a limit on the emissions intensity of cement by using tradable credits, government can encourage the adoption of existing abatement opportunities while setting a clear regulatory road map to inspire long-term investment in deep emissions reductions. However this needs to be done carefully and it might be best to consider performance based standards rather than solely prescriptive standards.

## 2.5 Importance of taxonomy laws

A taxonomy is a classification system. Traditionally found in the science of biology, taxonomies are now used in a range of fields to provide an agreed set of definitions and classifications.

Sustainable finance taxonomies provide a classification system of sustainable economic activities in 20 regions around the world. In Australia, the [Australian Sustainable Finance Institute](#)<sup>18</sup> is currently leading a collaboration of finance sector organisations to develop a taxonomy here.

One of the most relevant international examples can be found in the European Union, which has developed a Sustainable Finance Taxonomy “to help transform investment and reporting to help the EU reach its target of carbon neutrality by 2050”.<sup>19</sup> The EU Taxonomy is legally binding.

By establishing this list of recognised environmentally sustainable activities, including life cycle assessment, the taxonomy underpins the EU’s sustainability policy framework and seeks to support six environmental objectives.<sup>20</sup>

1. Climate change mitigation;
2. Climate change adaptation;
3. The sustainable use and protection of water and marine resources;
4. The transition to a circular economy;
5. Pollution prevention and control; and
6. The protection and restoration of biodiversity and ecosystems.

The EU Taxonomy focusses on seven main economic sectors. The breadth of coverage may be of interest to Australian policy makers:

1. Manufacturing
2. Buildings
3. Energy
4. ICT
5. Agriculture
6. Water
7. Transport

The taxonomy can be considered a driver of change by setting objectives and priorities. As an enabler of change, it provides the framework and tools to communicate and report. The taxonomy supports the finance sector by providing agreed categories and screening criteria for economic activity that contribute to the six objectives. This provides investors with certainty that their investments are recognised as sustainable and can be advertised and reported as such. The EU Taxonomy also features minimum safeguards in place to ensure social standards are also met in the pursuit of economic and environmental objectives. To enable usability of the EU Sustainable Finance Taxonomy, the EU has also developed the Taxonomy Compass<sup>21</sup>, which provides a visual representation of the contents of the taxonomy. The compass aims to make the integration of criteria in business databases and other IT systems.

A taxonomy of this nature would be applicable at a national or supra-national level, as in the example of the EU, and would need to be periodically updated to reflect changes in financial markets, science, and policy development.

There is an opportunity to help influence the development of the Australian Sustainable Finance Initiative (ASFI) process to include embodied carbon given that ASFI is at the early stages of developing its taxonomy and technical analysis.

## 2.6 Circular economy

With embodied carbon considered as the carbon footprint of a material, changing the way we design, produce, assemble, sell and use building construction materials and whole of life carbon will be fundamental to achieving a net-zero economy.

### Updates from Europe

Launched in March 2020, the EU’s New Circular Economy Action Plan<sup>22</sup> is one of the main building blocks to achieving the European Green Deal. With initiatives right along the life cycle of products, it targets how products are designed, promotes circular economy processes and practices, encourages sustainable consumption, and aims to ensure that waste is prevented. There are legislative and non-legislative measures included for building and construction materials. A number of cities have a range of incentives and requirements. For example: *Be Circular Be Brussels* - ‘BCBB Circular Building Sites’: provides financial incentives to developers for helping to create a circular economy building sector.<sup>23</sup>

The Greater London Authority is striving ahead with its circular economy guidance which will establish a common understanding, approach and language for **whole life carbon management** in the provision of economic infrastructure (defined as water, energy, transport, communications and waste). As the world’s first low carbon infrastructure specification, it could eventually form the basis of an international standard (ISO).<sup>24 25 26</sup>

### Updates from New Zealand

The New Zealand government intends to introduce a Whole of Life Embodied Carbon Emissions Reduction Framework and recently released its first Emissions Reduction Plan. For the building and construction sector, the plan focuses on five key areas of action, including reducing the whole of life carbon of buildings, as well as accelerating the shift to low carbon buildings. Some specific areas of implementation include:

- Reduce the embodied carbon of construction materials by supporting innovation and regulating to promote the use of low-emissions building design and materials.
- Establish foundations for future emissions reduction by improving data, building relationships with Māori, and progressing behaviour change and workforce transition programmes.
- Work with Māori developers and housing networks to address barriers to low-emissions urban development and building construction.
- Proposed investment in resource recovery for construction and demolition waste materials, and development of a national resource recovery network.<sup>27</sup>

### 3. Role of industry and the market

Government policy does not exist in isolation. Some of the most successful policy is developed in collaboration with industry to drive mutually beneficial outcomes. Given the complexity of tackling embodied carbon and the urgency of cutting greenhouse gas emissions, government must recognise the role of industry and a functioning market to help achieve its policy objectives.

Cutting greenhouse gas emissions in line with the Paris Agreement target is now a stated objective of all major government jurisdictions in Australia, as well as many progressive businesses and industry bodies. This mutual objective provides an opportunity for engagement and collaboration to assist both government and industry to progress their emission cuts.

Governments at all levels can de-risk policy development by testing concepts and approaches with industry participants, such as a “public pledge” to decarbonise. Likewise, industry can help shape policy by communicating the most effective policy levers to achieve the goal whilst also identifying any unintended consequences which could impact investment certainty.

A key challenge when addressing embodied carbon is that it often falls into a company’s or government entity’s scope-3 emissions and can make up to 90% of a head contractor’s emission profile. The size and complexity of supply chains can make this very difficult as the emissions occur well out of the direct control of the reporting entity. Engagement and collaboration along the supply chain is therefore crucial.

The *green premium* (real and perceived) for lower-carbon alternative material and products is a further challenge until economies of scale can be applied. Some interim policy actions can however help reduce this. The risk averse nature of the building and construction sector is a further barrier that government action can help overcome to incentivise and speed up the adoption of low emission materials.

This section explores the role of industry through the following lenses:

- **Industry leads or risks being regulated. Industry helps shape government policy and collaborates to** achieve mutual objectives.
- **Industry remains globally competitive** to benefit from the growing international market for low emission construction materials, and to adapt to broader carbon price adjustments.
- **Industry calculates embodied carbon** meaningfully to ensure robust, consistent frameworks that give confidence to all parts of the construction ecosystem.



One of the exemplar organisations working on embodied carbon is the Carbon Leadership Forum (CLF), in the United States of America, supported by the University of Washington and the private sector. The CLF mission is to eliminate embodied carbon in buildings and infrastructure by inspiring innovation through collective action to create a just and thriving future. They have a deep focus on research and cross collaboration across industry across all sectors of the building and construction ecosystem, such as architects, engineers, contractors, material suppliers, building owners and policymakers, with a keen focus on eliminating embodied carbon from buildings and infrastructure. CLF’s seminal Embodied Carbon Benchmark Study concluded “there is an urgent need to standardise general building design data [including area, life cycle and materials scope], critical for comparison”.<sup>28</sup>

## Collaboration and industry action around the world

In Australia, over the last 18 months, industry and government have partnered to create an alliance called **MECLA (Materials & Embodied Carbon Leaders Alliance)** to drive reductions in embodied carbon in the building and construction industry, and to harness the opportunities for Australian industries prepared for a decarbonised and more resilient economy.

Internationally, organisations that directly address embodied carbon in construction materials have been operating for some years with the purpose of engaging industry to accelerate the innovation needed to reduce carbon emissions. Some of the organisations we encountered during this study include:

- Carbon Leadership Forum – United States of America
- Rocky Mountain Institute (RMI) – United States of America
- Boston Architecture – United States of America
- Building Transparency – United States of America
- Boston Society of Architects – United States of America
- Ellen MacArthur Foundation – United Kingdom
- BRE – Building Research Establishment – United Kingdom
- Building Construction Authority – Singapore
- Carbon Neutral Cities Alliance – International
- World Green Building Council – International
- Architects 2030 – International
- Green Building Council of Australia (GBCA) – Australia
- Infrastructure Sustainability Council (ISC) – Australia
- Climate Friendly Materials Platform – EU

### Research insight: language

Policies addressing embodied carbon do not need to be labelled as such. We identified a variety of terminology tailored to suit the policy environment in which it was developed:

- Material conservation (Climate-KIC EU)
- More efficient building (Start2See)
- Clean construction (C40)
- Buy clean (USA)

## 3.2 Industry leads or risks being regulated

With many industry players setting ambitious science-based targets across their direct and indirect greenhouse gas emissions, they are stepping up to prepare for the realities of a rapidly decarbonising economy, including through their industry associations and other cross-industry collaborations.

### World Green Building Council

The World Green Building Council's 2019 report, *Bringing Carbon Upfront*<sup>29</sup>, was one of the first global industry sectors to recognise the challenges and opportunities around embodied carbon. The report developed a 'call to action' focusing on these emissions as part of a whole life cycle approach and the systemic changes needed to achieve full decarbonisation across the global buildings sector.

Buildings are currently responsible for 39% of global energy related carbon emissions: 28% from operational emissions (energy needed to heat, cool and power), and the remaining 11% from materials and construction. Developing a plan of action has been necessary to keep ahead of any regulatory changes that might develop.

### Clean Energy Buyers' Alliance Decarbonising Industry Supply Chain Energy (DiSCe)

The Decarbonising Industrial Supply Chain Energy (DISC-e<sup>30</sup>) program uses the collective power of large consumers to accelerate the market for low carbon industrial commodities that use carbon-free energy.

The Clean Energy Buyers Institute's DISC-e program advances climate goals by tackling industrial sector emissions through the power of the private sector market. Industrial emissions are a primary driver of energy-related greenhouse gas emissions growth, some of the most difficult emissions to address, and are critical to achieving a global zero carbon energy system.



### 3.3 Remaining globally competitive

**Industry-led innovation is fundamental to staying ahead of the competition. Overcoming conservatism and risk adversity in the building industry will increase demand and investment in new materials.**

Without strong innovation by industry in export markets, government support and incentives including research and development grants are needed to increase market competitiveness. Organisations like Race to Zero Cooperative Research Centre (CRC), Smartcrete CRC, HILT CRC, Green Loans, CSIRO, and Mineral Carbonation International play an active role in providing incentives and collaborative opportunities to the embodied carbon industry.

#### Singapore – Voluntary – R&D<sup>31</sup>

In 2007, Singapore allocated S\$50 million to support R&D in the building sector, and S\$5 million to support the Green Mark Incentive Scheme for Design Prototypes. The rationale behind Singapore's investment into low embodied carbon materials was that R&D provided a means to a unique solution to Singapore's context and emission reduction plans. The other view was that through thorough research, Singapore could become an international leader in the green construction space.

A further S\$15 million was invested through Singapore's Sustainable Construction Capability Development Fund in 2010 to provide monetary support to industry players like demolition contractors and waste recyclers to test sustainable construction practices and technologies. Their approach was to build a new industry through R&D which incentivises early movers to go green by reducing the financial investment required to innovate.

Towards the end of the main R&D investment campaign, Singapore spent a total of S\$190 million over 7 years in facilitating industry to uptake the green building scheme. This has resulted in over 1000 buildings that are green-rated and Singapore being regarded as world leaders in this field.



### 3.4 Calculating embodied carbon meaningfully

**How to calculate embodied carbon meaningfully and accurately has been one of the most challenging areas for the industry across the board. Access to better data where building professionals can achieve consensus around emissions factors and comparability of materials has proven to be complex and difficult. Industry has collaborated to lead this work in several jurisdictions around the world. Here are a few examples.**

#### **RICS – Royal Institute of Chartered Surveyors**

In May 2019, RICS officially launched the whole life Building Carbon Database. The purpose of the database reinforces the RICS professional statement *'Whole life carbon assessment for the built environment, 1st edition'*<sup>32</sup>, which RICS members must act in accordance with. The aim of the database is to allow users to identify where associated carbon emission reductions can be made, during all stages of a building's life cycle. For organisations who submit their data, the database is free to use and registration is available [here](#). To access the data, users are required to input construction project data into the database (both theoretical and completed projects), which in turn allows users to estimate/benchmark whole life carbon emissions.<sup>33</sup> **LETI** was also involved in the development of the UK Net Zero Carbon Building Standard.

#### **Carbon Leadership Forum<sup>34</sup>**

The *Embodied Carbon Benchmark Study 2017* was the first stage of the *LCA for Low Carbon Construction project*. Although there is growing recognition of the need to track and reduce embodied carbon emissions, building industry professionals need better data and guidance on how to implement low carbon methods in practice. This project compiled the largest known database of building embodied carbon and created an [interactive database](#). This stage of the project established consensus on the order of magnitude of typical building embodied carbon, identified sources of uncertainty, and outlined strategies to overcome this uncertainty. The report summarises the key findings of this research, including benchmarks, and provides the foundation for stage two of this project, the development of an [LCA Practice Guide](#).

## 4. Rating mechanisms for building performance

**Rating mechanisms play an important role in providing verified performance benchmarks for buildings and infrastructure that can inform tenants, investors and lenders in a voluntary *race to the top*.**

Ratings mechanisms are any set of criteria (often voluntary) that displays behaviour towards best practice within industry. Effective systems attribute the essence of a building's rating into a singular metric that simplifies comparisons between buildings for the benefit of consumers and to stimulate competition among market participants.

A lack of reliably available and consistent data has been one of the key barriers preventing the construction industry from actively measuring and reducing carbon emissions.

Aligning metrics, methods, sources of raw data, and developing software about embodied carbon in building materials is key to allowing developers, architects, governments, and manufacturers to compare products on criteria that extends beyond economic costs. These tools support the uptake of proven products to meet public procurement and industry requirements in a transparent way. They also support the government and industry's ability to report embodied carbon savings, while streamlining the methods they use. Through the tools, innovators have a means to market their impact to the industry and carbon conscious consumers. They allow benchmarks to be set, measured, and reported over time.

In Australia, such mechanisms are used predominantly for operational carbon derived from energy consumption of the building during its use phase. For example, a popular government administered rating mechanism is the [National Australian Built Environment Rating System \(NABERS\)](#)<sup>35</sup> which focuses on water, waste and energy efficiency in addition to the quality of the indoor environment.

Any NABERS rating is valid for 12 months and requires yearly audits in order to retain or upgrade its score. Due to how rigorous, transparent and respected these ratings have become, they are attractive to investors and other major stakeholders including government tenants, resulting in them being included as requirements in procurement submissions or leasing criteria. The [NABERS team intends to include EC](#) within its rating requirements for the future with the access to consistent and trusted data.

The fragmented nature of the industry where data, tools, benchmarks and standards lack industry harmonisation present challenges to addressing EC.

As such, the government could clarify some of these issues by defining best practice (at least in the early stage of this technical shift) to avoid industry overly engaging in disputes. Two ways to achieve this are:

- Presenting many options of the various tools, inventories, and calculators that are available (with pros and cons of each).
- Supporting the development of a database, which is maintained and managed independently from any one industry body or entity.



## 4.1 Early stage intervention

Projects can meet significant embodied carbon targets through smart design and being provided upfront incentives.

Embracing embodied carbon as a default setting in the design stages of a project can be incentivised through government policy and planning conditions, as demonstrated by local authorities in Arizona and California:

- Zoning permit rejection due to structures not meeting minimum EC ratings;
- Expedited processing time for approvals that meet minimum EC ratings;
- Setting carbon caps on new projects.

### City of Chandler – Voluntary – Expedited Plan Review<sup>36</sup>

The City of Chandler in Arizona offers expedited plan review times for private sector buildings if pursuing a LEED certification level of silver or higher. Review times are reduced by half for environmentally friendly/low embodied carbon/less energy intensive designs.

### San Diego County – Voluntary – Expedited Plan Review<sup>37</sup>

The San Diego County in California encourages the use of straw bale and recycled material through the *Green Building Incentive Program*. The scheme offers reductions in plan review processing time and building permit fees.

## 4.2 Easing design constraints for fulfilling voluntary ratings

Flexibility in design and planning regulation can offer an incentive by rewarding the construction of buildings and infrastructure that reduce embodied carbon or comply with an efficiency rating.

As more industry players embrace efficiency ratings in design, EC compliance moves from a voluntary adoption to default design practice across the construction industry.

Governments can support this by connecting bonuses for critical design constraints to key criteria thresholds in rating mechanisms. For example, several constraining parameters in the commercial sector that impact profitability of a development are the Floor Lot Ratio (FLR) and number of floors. Both parameters can be used as incentives to enhance the quality of a building by linking bonuses to a range of green building rating scores. In effect, the government entity can achieve its EC reduction policy objective while the developer can produce a bigger, more carbon efficient building with greater potential for profit. The intention of this approach is to offer developers the potential to improve the economics of their project while simultaneously giving them the flexibility to alter their design in creative ways and allow them to enhance their EC skills internally. Another method is to financially support industry to apply the building performance rating criteria through grants and cash incentives.

### Miami – Voluntary – Density bonus<sup>38</sup>

In the city of Miami in Florida, local government administers expedited permitting for green buildings as well as density bonuses based on the level of LEED certification. Eligibility for buildings under 50,000 square feet involve completing any level of LEED certification whereas buildings larger than 50,000 square feet must satisfy certification higher than silver. When said conditions are met the following FLR density bonuses are allowed:

- Silver: +2.0%
- Gold: +4.0%
- Platinum: +13.0%

### Singapore – Voluntary – Incentivising uptake of building performance ratings<sup>39</sup>

This next case study shows how incentivised rating mechanisms are the bridge between voluntary building performance assessment and regulated standards. Singapore's S\$20 million Green Mark Incentive Scheme was introduced in 2005 and offered cash incentives to developers, building owners, architects and M&E Engineers who achieved a rating of at least gold for new design and construction of buildings. The Building and Construction Authority (BCA) was the government body administering these incentives and collaborated heavily with non-profits, industry players, educational institutions, and other government agencies. In 2008 the Building Control Act was amended to include Green Mark certification as mandatory for all new buildings and major retrofits for existing buildings. From 2009 to 2013, several other schemes had funds committed including the S\$100 million *Green Mark Incentive for Existing Buildings* in the form of cash incentives.



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### 4.3 Trusted sources of data

Industry collaborating with government to develop a trusted and reliable source of data is fundamental to giving confidence on the embodied carbon tools and measurements that industry, government and the finance sector will use to measure progress.

#### UK Built Environment Carbon Database

The Built Environment Carbon Database was launched in November 2021 and has been developed in the UK by a collaboration between industry organisations including Structural Engineers, Institute of Civil Engineers, BRE, Carbon Trust, RIBA, RICS, and the UK Green Building Council.<sup>40</sup> This group is working towards a [Net Zero Building Standard](#).

The database will be developed to collect and support product data and entry level data to the industry through its own portal, and by interacting with existing databases and software solutions.

There is still some way to go to develop a trusted and more comprehensive database for the Australian market, but efforts are underway to address the key issues.

## 5. Procurement – Government as an enabler of change

**Government procurement is a key lever for change for infrastructure projects.**

As a major procurer of infrastructure, goods and services, the government is a key enabler of low and zero carbon procurement practices, particularly when it comes to the tendering of its energy contracts, infrastructure and public works projects, and major services spending.

By setting measurable targets that call for greater levels of ambition from industry to promote embodied carbon, and by adding sustainable criteria to public tenders, governments can drive large-scale change. Design briefs for procurement should include carbon in addition to the traditional constraints of time, cost, and quality.

A government that leads with strategic implementation of embodied carbon shapes and activates a progressive domestic private sector industry that mutually benefits the economy through innovation and development of sustainable choices.

A diverse and robust domestic manufacturing base and supply chain of carbon intensive materials eliminates the need for imports. Government procurement provides assurance for risk averse private sectors. It enables a thriving domestic industry to establish and provides the foundation for a robust export industry.



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## 5.1 Government pledge as it sets net-zero targets

### C40 Cities Clean Construction Forum

The [C40 Cities Climate Leadership Group](#)<sup>41</sup> is a group of 96 major cities around the world that represents one twelfth of the world's population and one quarter of the global economy. It's a network of city mayors taking urgent action to address climate change within their local government areas. Through the C40 cities network, knowledge, experience and resources are shared to accelerate local communities and governments achieving the scale of change required. The Clean Construction Forum (CCF), established by C40, supports cities to achieve their ambitious goals through strong relationships, information sharing and collaboration.

To ensure that cities develop net-zero emission buildings and infrastructure of the future, the members of C40 CCF have pledged to bring together and inspire stakeholders to take action, and enact policies and regulations where they have the powers to achieve the following:

- Reduce embodied emissions by at least 50% for all new buildings and major retrofits by 2030, striving for at least 30% by 2025;
- Reduce embodied emissions by at least 50% of all infrastructure projects by 2030, striving for at least 30% by 2025;
- Require zero emission construction machinery in municipal projects from 2025 and zero emission construction sites city-wide by 2030, where available.

#### Committing to:

1. Better use, repurposing and retrofitting;
2. Lead by example with municipal procurement;
3. Demand transparency and accountability – LCAs in planning permissions;
4. Work with business, industry, civil society to establish a joint roadmap on CE;
5. Approve at least one net-zero emission flagship project by 2025.

Both the City of Melbourne and City of Sydney are active members of C40 Cities Alliance and driving ambitious programs and projects for their own civil works programs, as well as seeking to influence the property sector to drive down embodied carbon emission reductions.

## 5.2 Influencing supply chains through mandated public procurement

By mandating public procurement targets, governments can drive not just emission reduction targets but also achieve many other social co-benefits that provide the right demand side signal for industry material suppliers to scale up their production facilities. Oftentimes, manufacturing occurs in regional towns outside of major cities, and therefore can contribute to diversifying employment opportunities in the regions.

#### [UK's Mandatory Emission Reduction Plan](#)

The UK has introduced new rules that any relevant bids advertised **on or after 30 September 2021** will now require the submission of a Carbon Reduction Plan detailing the bidders' organisational carbon footprint along with confirmation of their commitment to achieve net-zero carbon for their UK operations by 2050.<sup>42</sup>

The UK Green Building Council has developed a brief to support clients taking their first steps in reducing embodied carbon.<sup>43</sup>

#### [U.S. Buy Clean Task Force](#)<sup>44</sup>

In February 2022, the US Administration announced new actions to support the clean manufacturing sectors including support to manufacture low carbon steel and aluminium for electric vehicles, wind turbines and solar panels, and cleaner concrete for upgrading transport infrastructure.

The US Council on Environmental Quality and White House Office of Domestic Climate Policy are establishing the first-ever Buy Clean Task Force, which will harness the federal government's massive purchasing power to support low carbon materials made in American factories. The General Services Administration and the Department of Transportation are also announcing new efforts to promote use of low carbon materials in construction projects funded by the Bipartisan Infrastructure Law, and the State Department and U.S. Special Presidential Envoy for Climate are securing corporate purchasing commitments for low carbon materials and technologies through the First Movers Coalition.

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## 6. Data, tools and skills needed to get to net-zero

**The research found that governments are supporting industry efforts to develop the databases and tools needed to underpin the transition to net-zero.**

Often, governments' role is verification and support of the development of trusted databases and existing tools such as calculators and ratings mechanisms, rather than developing them from scratch. This helps provide confidence in the accreditation schemes for buildings and infrastructure.

One of the most common types of database needed to address embodied carbon are those containing digitised Environmental Product Declarations (EPDs). An EPD contains the inputs and outputs that were used to make a unit of a specified construction material. The inputs and outputs vary according to each country's base data (e.g. emission factors in the electricity grid) and methodology, however most of them include the energy consumed and carbon emitted.

Developing an EPD can be expensive, which can be a barrier to take-up, especially for smaller suppliers. Government subsidies and incentives could play a role in reducing this barrier.

Government support to boost training and skills development is also helping the take up of low emission materials. This can be in the form of accredited training and informal discussion forums allowing industry participants to ask questions and share experiences.



## 6.1 Building common databases

Databases are accurate libraries of construction material inputs and outputs that industry and government can rely on for policy compliance.

Supporting the development of common databases was found in six countries reviewed, including: Netherlands, UK, USA, Denmark, Sweden and Finland, with four key examples shown below:

### [Netherlands – Voluntary – EPD Database<sup>45</sup>](#)

The Netherlands is regarded as a leader in the reduction of embodied carbon in the European construction sector. The EN 15804 policy was revised to define methodologies for creating EPDs, which eventually led to the creation of the Dutch Environmental Database (de Nationale Milieudatabase or NMD). The policy-backed database represents how Life Cycle Analysis (LCA) of a product, from its creation to its disposal, can be used to improve the knowledge of construction material which contributes to intelligent and responsibly designed buildings.<sup>46</sup>

### [UK – Voluntary – Built Environment Carbon Database \(BECD\)<sup>47</sup>](#)

In the UK, the BRE (originally the Building Research Establishment) is collaborating with other industry leaders such as [RICS](#), the [UK Green Building Council](#), the [Carbon Trust](#), [RIBA](#), the [Institution of Structural Engineers](#), and the [Institution of Civil Engineers](#) to develop a new Built Environment Carbon Database. The BECD will become the country's primary source for the construction industry to measure and reduce carbon.

The database is designed to be launched this year.

### [USA – Voluntary – Embodied Carbon in Construction Calculator \(EC3\)<sup>48</sup>](#)

The free, cloud-based EC3 tool hosted by the Carbon Leadership Forum and Building Transparency in the USA, initially debuted as a database of third-party verified building material EPDs, with a focus on graphing comparisons between products to inform procurers of the EC impact. It also includes a large array of environmental impact categories, including the carbon emitted in transporting the material to site, as well as who verified the LCA of the product and the ability to compare between manufacturers. It can also integrate with 3D modelling software to allow quick application of the material data into project designs.

### [Los Angeles – Voluntary – EPD Incentive<sup>49</sup>](#)

Since 2018, the U.S. Green Building Council-Los Angeles, has been using incentives of up to US \$15,000 to allow manufacturers in California to acquire Environmental Product Declarations (EPDs). The intent behind this policy is to encourage compliance of the [Buy Clean California Act](#), which places Global Warming Potential (GWP) limits on the production of structural steel (hot-rolled sections, hollow structural sections, and plate), concrete reinforcing steel, flat glass, and mineral wool board insulation. This is an example of government facilitating material manufacturers' ability to use EC mechanisms to report on emissions and reduce them.

## 6.2 Building software and calculators

Government needs to define the methodology for industry to follow to avoid ambiguity and delayed action.

Government policy can be a driving force of industry action. Software and calculators are important tools to help implement that policy. The role of government in relation to software and calculators is to support their development and their use.

In Australia we observed the Embodied Carbon Explorer Tool, created in 2019 by the Sustainability Assessment Program (SAP) at the University of New South Wales. Supported by the [CRC for Low Carbon Living](#), it takes inputs from the [Integrated Carbon Metrics \(ICM\) database](#) and presents a variety of graphs and visualisations of emission intensities and impacts to assist with EC reporting.

### [Scotland – Voluntary – BIM Decision Support Tool<sup>50</sup>](#)

Scotland provided an example of developing software add-ons or plugins focused on allowing more users to calculate their emissions by interfacing current software with EC databases. This makes older methods compatible with this upcoming way of managing embodied emissions, which should improve take up by reducing the cost of software integration. This model is exemplified by the [Edinburgh Napier University in Scotland](#), with support from Scottish Forestry, which created a Building Information Model (BIM) decision support tool for EC in imported and domestic timber-framed buildings. The plugin interfaces with 3D modelling software "Sketchup Pro" and is free and open source to encourage use.

### [UK – Hawkins Brown: Emission Reduction Tool \(HBERT\)<sup>51</sup>](#)

HBERT is a free and open-source plugin designed by [Hawkins/Browns](#) in collaboration with the UCL Institute for Environmental Design and Engineering. It calculates embodied carbon of models made in Autodesk's "Revit" software using data taken from life cycle analysis of materials found in the [Inventory of Carbon and Energy \(ICE\) database](#).

### [Netherlands – Voluntary – Contract Generator Tool<sup>52</sup>](#)

The government of the Netherlands created a free online tool called the "MVI Criteria" to generate the requirements that bidding businesses need to address to win a given contract. These requirements extend beyond scope 1 and 2 emissions and express ambition related to achieving greater sustainability quality through inclusion of EC impact. MVI Criteria standardises contracts among different government departments and provides a unified approach to government action which sends transparent signals down the supply chain.

### [USA – Voluntary – Embodied Carbon in Construction Calculator \(EC3\)<sup>53</sup>](#)

The success of the EC3 tool software has seen its evolution to include a "Building Planner" tool which allows for imported BIM models from external software to interface with the EC3 database resources. This means businesses can continue business-as-usual, then export their BIM from their usual software, then import their BIM into EC3 and select which materials to build their design. The EC3 will provide their EC emissions based on the most up to date and verified records of the materials used. This example represents an effective inclusion of new entrants and current players into the method of EC reporting by making it free and accessible to all, compatible with most platforms, and as a platform that satisfies information needs about materials.



## 6.3 Virtual discussions and tutorials

**Online assistance offers resources and general assistance which enable industry-wide skills development and the uptake of lower EC designs.**

After supporting the establishing of databases and tools, governments need to ensure that industry knows how to use them. Governments can develop and disseminate training materials, or support bodies that do so. Additionally, the government could provide incentives for institutions and businesses to share their knowledge to industry through commissioning of tutorial videos.

Other bodies also contribute to training and skills development. For example, Engineers Australia has a webinar series<sup>54</sup> that also covers strategies for minimising embodied carbon using Life Cycle Assessment. It follows the mantra that by understanding everything about a product, inefficiencies can be identified and optimisations can be made. MECLA also shares awareness-raising resources, including embodied carbon focused webinars, case studies and briefing papers.

Virtual guides and discussions are used in all the countries reviewed that have any form of software tool – whether a 3D modelling program or a virtual database of material properties. Some international examples include:

1. The “Material EPD Comparison” and the “Building Planner” tutorials that use the EC3 tool, hosted by the Carbon Leadership Forum, highlight basic functionality of the software as well as how to achieve compliance with relevant policy.<sup>55</sup>
2. The Netherlands hosts a live symposium, which is also freely available on YouTube, to presenting a range of construction industry topics, including upcoming legislation and the role of national databases, like the NMD, in decarbonising the sector.<sup>56</sup>
3. The tutorial of the EC decision support tool which was hosted by Edinburgh Napier University in Scotland.<sup>57</sup>
4. The YouTube tutorial on using the Hawkins/Brown Emissions Reduction Tool.<sup>58</sup>



## 6.4 Accredited education courses

**Government’s direct involvement in training industry in embodied carbon has two main effects:**

1. Sends a strong signal to industry that embodied carbon is being considered by government; and
2. Guarantees the quality of the education satisfies government standards.

Government can help industry develop skills and enhance education by administering, supporting and recognising training courses, bootcamps, masterclasses and workshops that directly address the skills necessary to comply with emerging EC policies and practices. Such training will help the workforce become proficient in reducing EC. Moreover, accredited training can set a uniform methodology that industry can use to inform emissions reporting practices. Our research suggested that this is critical because when the methodology for EC reporting is not agreed by either government or the majority of industry, disputes can arise over technicalities and slight differences in approach, which can slow EC reduction efforts.

In Australia, training courses or masterclasses run by well established (and globally connected) organisations such as the Green Building Council of Australia’s Embodied Carbon Masterclass put this into practice by identifying EC’s importance, drivers, barriers to reduction and examples of implementation. Upon completion, participants receive four Green Star CPD points Embodied carbon masterclass - Course - Green Building Council Australia (GBCA).

Another example of an institution delivering targeted training courses is Singapore’s [Building Council Authority](#)<sup>59</sup> (BCA) running courses in the form of diplomas, undergraduate and graduate degrees, and specialist certifications at multiple levels of the industry ecosystem (architects, developers, manufacturers) to train under the BCA Green Mark Certification.

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# Conclusion

Addressing embodied carbon as part of emission cuts is crucial if all Australian jurisdictions are to successfully cut greenhouse gas emissions in line with the Paris Agreement trajectory. This report has identified examples of relevant policy implementation from around the world to inform all levels of government in Australia.

- Collaboration within government and with industry is key to the accelerated development of the required policy frameworks. Industry has demonstrated its willingness to engage and collaborate.
- There are a range of policies and programs required to assist our industry and economy to decarbonise.
- Clearly there is a role for government intervention through procurement. Government is the largest lever to enable change to occur directly through its procurement tendering requirements and specifications.
- Governments can also enable and fast-track change to occur through industry policy including support and encouragement for industries seeking to decarbonise, and those looking to drive new and innovative materials into the market.



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## The five key levers identified through our research are:

1. Policy levers to drive the market;
2. Role of industry and the market;
3. Rating mechanisms for building performance;
4. Government as an enabler of change;
5. Data, tools and skills needed to get to net-zero.

Learning from other jurisdictions and sharing our learning with others will be fundamental to the global efforts towards net-zero. It is clear that industry is willing to step up and work in partnership with both the finance sector and the government to achieve a net-zero and more climate safe future.

Australian governments of all jurisdictions now have the opportunity to develop policies that are informed by leading practice around the world, that harness the growing momentum of industry and seize the opportunities presented by the shift to net-zero. This is the critical decade in which to do it.

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# Addendum – Glossary

Acronym/term	Definition	Link if applicable
<b>ABCB</b>	Australian Building Codes Board is a standards writing body responsible for the <a href="#">National Construction Code</a> , WaterMark and CodeMark Australia Certification Schemes.	<a href="http://abcb.gov.au/">abcb.gov.au/</a>
<b>ARENA</b>	Australian Renewable Energy Agency's purpose is to support the global transition to net zero emissions by accelerating the pace of pre-commercial innovation, to the benefit of Australian consumers, businesses and workers.	<a href="https://arena.gov.au/about/">https://arena.gov.au/about/</a>
<b>BAU</b>	Business as usual	
<b>BCA</b>	Singapore's Building and Construction Authority (BCA) champions the development and transformation of Singapore's built environment sector.	<a href="https://www1.bca.gov.sg/about-us/about-bca">https://www1.bca.gov.sg/about-us/about-bca</a>
<b>BECD</b>	Built Environment Carbon Database - BRE is working with RICS, the <a href="#">UK Green Building Council</a> , the <a href="#">Carbon Trust</a> , RIBA, the <a href="#">Institution of Structural Engineers</a> , and the <a href="#">Institution of Civil Engineers</a> to create the Built Environment Carbon Database (BECD), which will become the lead source for the construction industry to measure and reduce carbon.	<a href="https://bregroup.com/news/bre-helps-build-new-embodied-carbon-database/?cn-reloaded=1&amp;cn-reloaded=1">https://bregroup.com/news/bre-helps-build-new-embodied-carbon-database/?cn-reloaded=1&amp;cn-reloaded=1</a>
<b>BIM</b>	A Building Information Model is a method of designing and storing information about building assets digitally. Commonly used by the construction industry to plan and collaborate on buildings in 3D virtual space.	See p47
<b>BRE</b>	Building Research Establishment, established in 1921, UK	<a href="http://bregroup.com/">bregroup.com/</a>
<b>BREEAM</b>	Building Research Establishment Environmental Assessment Method (BREEAM) is a science-based suite of validation and certification systems for sustainable built environment, since 1990	<a href="http://bregroup.com/products/breeam/">bregroup.com/products/breeam/</a>
<b>C40 CCF</b>	Climate Cities Leadership Group Clean Construction Forum. C40 is a network of mayors of nearly 100 world-leading cities collaborating to deliver the urgent action to confront the climate crisis.	See p42 <a href="http://c40.org/accelerators/clean-construction/">c40.org/accelerators/clean-construction/</a>
<b>CBAM</b>	Carbon Border Adjustment Mechanism, applied in some jurisdictions to balance out a comparative advantage/disadvantage by applying a carbon charge to imported goods.	See p20
<b>CCfD</b>	Carbon Contracts for Difference are interventions in the market to help secure the required finance and cover higher production costs associated with upfront capital expenditure in upgrading industrial plant.	See p24
<b>CEFC</b>	Clean Energy Finance Corporation is an Australian Government-owned Green Bank that was established to facilitate increased flows of finance into the clean energy sector.	<a href="http://cefc.com.au">cefc.com.au</a>

Acronym/term	Definition	Link if applicable
<b>CLF</b>	Carbon Leadership Forum based in the United States of America, supported by the University of Washington and the private sector. The CLF mission is to eliminate embodied carbon in buildings and infrastructure by inspiring innovation through collective action to create a just and thriving future.	See p29 <a href="http://carbonleadershipforum.org">carbonleadershipforum.org</a>
<b>CSIRO</b>	Commonwealth Scientific and Industrial Research Organisation, an Australian Government agency responsible for scientific research.	<a href="http://csiro.au/en/">csiro.au/en/</a>
<b>DISC-e</b>	Decarbonising Industrial Supply Chain Energy program organizes large consumers with Scope 3 GHG commitments to create demand-signals that reverberate down supply chains	See p31 <a href="http://cebi.org/programs/disc-e/">cebi.org/programs/disc-e/</a>
<b>DISER</b>	Federal Department of Industry, Science, Energy and Resources	<a href="https://www.industry.gov.au">https://www.industry.gov.au</a>
<b>EC3</b>	Embodied Carbon in Construction Calculator (EC3) tool is a free and easy-to-use tool that allows benchmarking, assessment and reductions in embodied carbon, focused on the upfront supply chain emissions of construction materials. Developed by the Carbon Leadership Forum.	See 46 <a href="https://carbonleadershipforum.org/ec3-tool/">https://carbonleadershipforum.org/ec3-tool/</a>
<b>Embodied Carbon (EC)</b>	Embodied Carbon refers to the total greenhouse emissions generated during the manufacture of the materials and products used in the construction and refurbishment of new and existing buildings and infrastructure.	See p8-9
<b>EPD</b>	Environmental Product Declarations, independently verified and registered document that communicates transparent and comparable data and other relevant environmental information about the life-cycle environmental impact of a product. Administered in Australia and New Zealand by EPD Australasia.	<a href="https://epd-australasia.com">https://epd-australasia.com</a>
<b>EPiC</b>	Environmental Performance in Construction (EPiC) database is a comprehensive and consistent open-access Life Cycle Inventory of environmental flow coefficients for construction materials. The database contains over 850 coefficients that can be incorporated into existing Life Cycle Assessment workflows and processes.	University of Melbourne, <a href="#">EPiC site</a>
<b>ETS</b>	Emissions Trading Scheme refers to policies that incentivise reductions in emissions by creating trading units linked to a party's emission behaviour	See p20
<b>EU</b>	European Union is a political and economic union of member countries predominately within Europe.	
<b>GBCA</b>	Green Building Council of Australia's purpose is to lead the sustainable transformation of the built environment.	<a href="https://new.gbca.org.au/about/about-us/">https://new.gbca.org.au/about/about-us/</a>
<b>GECA</b>	Good Environmental Choice Australia is a multi-sector not for profit ecolabeling program.	<a href="http://geca.eco">geca.eco</a>
<b>Green Globes</b>	Green Globes is a North American online assessment protocol, rating system, and guidance for green building design, operation and management.	<a href="http://greenglobes.com">greenglobes.com</a>

# Addendum – Glossary continued

Acronym/term	Definition	Link if applicable
<b>GRESB</b>	Global Real Estate Sustainability Benchmark collects, validates, scores and benchmarks environmental, social and governance (ESG) data to provide business intelligence, engagement tools and regulatory reporting solutions for investors, asset managers and the wider industry – Netherlands.	<a href="https://gresb.com/nl-en/faq/what-is-gresb/">gresb.com/nl-en/faq/what-is-gresb/</a>
<b>HBERT</b>	Hawkins\Brown: Emission Reduction Tool is a free and open-source plugin designed by Hawkins/Browns in collaboration with the UCL Institute for Environmental Design and Engineering.	See p47 <a href="https://hawkinsbrown.com/services/hbert">hawkinsbrown.com/services/hbert</a>
<b>HILT CRC</b>	Heavy Industry Low-carbon Transition Cooperative Research Centre	<a href="https://hiltcrc.com.au">hiltcrc.com.au</a>
<b>ISCA</b>	Infrastructure Sustainability Council (ISC) – Australia is a member-based, purpose-led peak/industry body operating in Australia and New Zealand to enable sustainability outcomes in infrastructure.	<a href="https://www.iscouncil.org">https://www.iscouncil.org</a>
<b>ISO</b>	International Organization for Standardization	<a href="https://www.iso.org/home.html">iso.org/home.html</a>
<b>ISPT</b>	ISPT Super Property is a property investment company.	<a href="https://ispt.net.au/about/">https://ispt.net.au/about/</a>
<b>LCA</b>	Life Cycle Assessment	See p46
<b>LEBM</b>	Low Emission Building Materials	See p18
<b>LEED</b>	Leadership in Energy and Environmental Design is a green building certification program developed by the United States Green Building Council and used worldwide.	<a href="https://www.usgbc.org/leed">usgbc.org/leed</a>
<b>LETI</b>	London Energy Transformation Initiative, established to support the transition of the capital's built environment to net zero carbon, providing guidance that can be applied to the rest to the UK.	<a href="https://leti.london/">leti.london/</a>
<b>MECLA</b>	Materials & Embodied Carbon Leaders' Alliance is a collaboration of organisations that has come together to drive reductions in embodied carbon in the building and construction industry. It seeks to align with the Paris Agreement targets and principles of the circular economy and recognises that the building and construction sector is a complex ecosystem.	<a href="https://mecla.org.au/">mecla.org.au/</a>
<b>MPIT</b>	Major Project Implementation Team	
<b>MT</b>	Megatonne, abbreviated as Mt, is a metric unit equivalent to 1 million (10 <sup>6</sup> ) tonnes	
<b>NABERS</b>	National Australian Built Environment Rating System, is a national government program administered by the NSW Government to measure and compare the environmental performance of Australian buildings and tenancies.	<a href="https://nabers.gov.au/">nabers.gov.au/</a>
<b>NatHERS</b>	Nationwide House Energy Rating Scheme measures a home's energy efficiency to generate a star rating. It was first introduced in 1993.	<a href="https://nathers.gov.au/">nathers.gov.au/</a>
<b>NCC</b>	National Construction Code is Australia's primary set of technical design and construction provisions for buildings. As a performance-based code, it sets the minimum required level for the safety, health, amenity, accessibility and sustainability of certain buildings	<a href="https://ncc.abcb.gov.au/">ncc.abcb.gov.au/</a>

<b>NDC</b>	Nationally Determined Contribution or intended nationally determined contribution is a non-binding national plan, under the Paris Agreement, highlighting climate change mitigation, including climate-related targets for greenhouse gas emission reductions	See p16
Acronym/term	Definition	Link if applicable
<b>Net Zero</b>	Also referred to as net zero carbon, A calculated result of zero GHG Emissions, via netting of inward and outward flows of GHG Emissions and carbon offsets or other compensation mechanisms. expressed on a whole-of-life basis or otherwise by reference to clearly expressed boundaries. A net zero definition can be applied across any defined boundary, including a whole life cycle of an asset or product, upfront embodied carbon, operational emissions, etc.	See p4
<b>PRI</b>	Principles of Responsible Investment is an organization dedicated to promoting environmental and social responsibility among the world's investors.	<a href="https://www.unpri.org/about-us/what-are-the-principles-for-responsible-investment">https://www.unpri.org/about-us/what-are-the-principles-for-responsible-investment</a>
<b>R&amp;D</b>	Research and Development	
<b>RIBA</b>	Royal Institute of British Architects (RIBA) is a professional body for architects primarily in the United Kingdom, but also internationally, founded for the advancement of architecture.	<a href="https://www.architecture.com">architecture.com</a>
<b>RICS</b>	Royal Institute of Chartered Surveyors promotes and enforces high professional qualifications and standards in the development and management of land, real estate, construction and infrastructure.	See p33
<b>RMI</b>	Rocky Mountain Institute is an independent, non-partisan, non-profit organization of experts across disciplines working to accelerate the clean energy transition and is based in the United States of America.	See p30 <a href="https://rmi.org">rmi.org</a>
<b>SBTi</b>	Science Based Targets initiative drives ambitious climate action in the private sector by enabling organizations to set science-based emissions reduction targets.	<a href="https://sciencebasedtargets.org/about-us">https://sciencebasedtargets.org/about-us</a>
<b>Taxonomy</b>	A taxonomy is a classification system. Traditionally found in the science of biology, taxonomies are now used in a range of fields to provide an agreed set of definitions and classifications.	See p26 <a href="https://asfi.org.au/taxonomy">asfi.org.au/taxonomy</a> <a href="https://ec.europa.eu/economy_finance/eu-taxonomy-for-sustainable-activities/">EU taxonomy for sustainable activities</a>
<b>TCFD</b>	Taskforce on Climate Related Disclosure, created by the Financial Stability Board (which was established by the G20) to improve and increase reporting of climate-related financial information.	<a href="https://www.fsb-tcfd.org">fsb-tcfd.org</a>
<b>UCL</b>	University College London is an educational and research institution based in London.	<a href="https://www.ucl.ac.uk">ucl.ac.uk</a>
<b>Up front carbon</b>	Also referred to as embodied up front carbon: The emissions caused in the materials production and construction phases (Modules A1-5 in Figure 1) of the lifecycle before the building or infrastructure begins to be used. In contrast to other categories of emissions, these emissions have already been released into the atmosphere before the building is occupied or the infrastructure begins operation.	See p9

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MECLA acknowledges and pays respect to the past, present and future Traditional Custodians and Elders of this nation and the continuation of cultural, spiritual and educational practises of Aboriginal and Torres Strait Islander peoples.

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