NSW Circular

Finance & Investment Rapid Review: Identification and measurement of circular assets and risks for the finance and investment sector in the transition to a circular economy

March 2022

Prepared for NSW Circular by University of Technology Sydney Institute for Sustainable Futures & UNSW Sydney Business School and Collaboration on Energy and Environmental Markets

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This review was initiated by NSW Circular's Finance and Investment Taskforce and conducted via a collaboration between the UTS Institute for Sustainable Futures (UTS ISF) and UNSW Business School and CEEM (Collaboration of Energy and Environmental Markets).

UTS ISF is an interdisciplinary research and consulting organisation that has been setting global benchmarks since 1997 in helping governments, organisations, businesses, and communities achieve change towards sustainable futures. For further information visit: www.isf.uts.edu.au

The Collaboration on Energy and Environmental Markets (CEEM) at UNSW undertakes interdisciplinary research in the design, analysis and performance of energy and environmental markets and their associated policy frameworks. CEEM brings together UNSW researchers from the Business School, Built Environment, the Faculty of Engineering, Faculty of Arts and Social Sciences, and the Faculty of Law, working alongside a growing number of international partners. For further information visit: http://www.ceem.unsw.edu.au/

Citation: Kobelentz, K., Balatbat, M., Nagrath, K., Hunt, P., Blair, J., Lagisz, M. (2022). Identification and measurement of circular assets and risks for the finance and investment sector in the transition to a circular economy. Report prepared for NSW Circular by University of Technology Sydney Institute for Sustainable Futures and UNSW Sydney Business School and Collaboration on Energy and Environmental Markets.

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Executive Summary

The finance and investment sector can be an important enabler in the transition from the current "take-make-waste" linear economy to a more circular economy in NSW, which will help to achieve NSW net zero emissions by 2050 and other sustainability goals. Addressing climate change and other sustainability issues such as waste, pollution and biodiversity has become increasingly urgent to stay within planetary boundaries, and the transition to a more circular economy is an important pathway to address some of these challenges. Effective identification, measurement and assessment of circular assets and associated risks will be critical to drive financing the transition to a more circular economy both in NSW and globally.

UTS Institute for Sustainable Futures (UTS) and UNSW Business School (UNSW) were appointed by NSW Circular to co-lead the Finance and Investment Rapid Review research to address the challenge of identification and measurement of circular assets and risks relevant to the finance and investment sector in the transition to a circular economy. The scope of the research was to undertake a rapid review of both academic and grey (non-academic) literature in three areas: i) global initiatives to identify and measure circular assets (led by UTS); ii) linear risks and circular economy as a de-risking strategy (led by UTS); and iii) a sector focus on the built environment, given its large contribution to emissions and waste as well as its importance to the finance and investment sector (led by UNSW).

Key insights and findings from the rapid review are as follows:

1. **Key global initiatives to identify and measure circular assets**

Global initiatives in early stages but rapidly evolving, with leadership from the EU

- Global initiatives to identify and measure circular assets and metrics for the finance and investment sector are still in early stages but are rapidly evolving. Initiatives have been led by organisations such as the European Commission (EU), Ellen Macarthur Foundation (EMF) and the UNEP Finance Initiative (UNEP FI), with the EU playing a leading role in developing circular economy criteria for sustainable investment via the EU Taxonomy in support of the EU Green Deal.

- The EU Taxonomy in relation to the circular economy is likely to have global implications, including for the finance and investment sector in Australia. Both the EU and the International Capital Market Association (ICMA - who set voluntary standards for the Green Bond Principles (GBP) and have been guided by the work of the EU) released working papers in 2021 focussed on screening criteria and reporting metrics for circular projects.

- UNEP FI Principles for Responsible Banking (PRB) also released guidance in 2021 for bank signatories to consider circular economy target setting in bank portfolios, including identifying activities that they finance that contribute to the circular economy. This work is expected to continue, with updated EU criteria to be released in 2022.

- The EU recognises that the circular economy can reduce pressure on the other EU Taxonomy environmental objectives, including climate, water, biodiversity and pollution – but also that the transition to a circular economy is the most challenging of its six objectives.

- There are various global taxonomies that are being developed, at both country and regional level (including in Australia), with only limited incorporation of the circular economy.

Business model tools are being used by the finance and investment sector, with metrics still under development

- The Value Hill Business Model tool, which depicts value in the circular economy, is being used by both the EU and ICMA to help define circularity and identify circular business models, with circular metrics expected to be further refined in future. UNEP FI also recommends using the Value Hill business model for banks that are looking at circular economy target setting under the PRB.

Tools and frameworks to measure circularity for business important first step

- EMF, World Business Council for Sustainable Development (WBCSD) and other organisations have developed tools and frameworks to identify and measure circularity for business, and these are an important first step for businesses to consider circularity in their strategies and supply chains.

- The finance and investment sector can play a role in informing their customers and investee companies – from SMEs to large corporates and projects – to consider using these or other appropriate tools for their sustainability-related business planning.

- There is scope for the various tools and frameworks being used by both the business and finance and investment sectors to further align, including standard definitions and metrics.

Standardisation of circular definitions, metrics and practices will help drive circular finance

- Standardisation of circular economy definitions, metrics and practices for the finance sector will become increasingly important in coming years to prevent “greenwashing” and to ensure that appropriate circular business models and projects are financed.

- Incorporating circular measurement into corporate reporting and accounting frameworks, such as the forthcoming International Sustainability Standards Board (ISSB), will also be important to drive the transition to the circular economy globally.

- Scientifically sound definitions and taxonomies that are globally comparable and harmonised will be critical in driving effective growth of circular finance to enable the transition to a more circular economy.

2. Linear risks and circular economy as a de-risking strategy

Understanding linear risks is an integral part of managing successful investment and lending portfolios

- Linear risks are the risks a business is exposed to as a consequence of following the conventional 'take-make-waste' linear economic model. Ignoring these external risks could have severe implications on business models which could be value destroying, and current approaches to risk management often overlook risks associated with linear business models.

- Five typologies of risks have been identified in the literature which include market, operational, business, legal and reputational risks. These include risks from future resource shortages and associated impacts on prices, restricted access to supply chains due to geopolitics and trade wars and their impact on market dynamics.

- Investors and lenders are exposed to linear risks through the businesses in their portfolio that continue to operate using linear business practices. These risks may negatively impact business assets, and subsequently devalue the investment and/or loan. They run the risk of stranded assets, i.e. assets that have suffered from unanticipated or premature write-downs or devaluations.

- Businesses, and thus by extension their banks and investors can insulate themselves against linear risks by adopting circular approaches. This can be a business opportunity for the finance and investment sector, however they need to embed circularity in their operational and strategic processes.

Assessing and measuring linear risks in financial decision making is important for de-risking finance for circular approaches

- A few organisations have developed approaches and matrices to help businesses and financiers to identify and assess linear risks. These function as guides to understand risk across business practices or value chains.

- However, most conventional risk assessment and disclosures do not comprehensively address linear risks. Additionally, there are no metrics to quantify these risks.

- Challenges in correctly evaluating linear risks include the lack of historic track records to value them into business models, unpriced externalities both negative ones like linear risks and positive ones like the benefits of circular propositions, unfamiliarity with circular knowledge, lack of metrics particularly for non-financial impacts and the lack of a common language to inform stakeholders.

Linear risk can be mitigated by adopting a proactive approach to stimulating circular business practices

- Financiers and businesses are increasingly recognising the value circular solutions bring. Research shows that circular strategies can curb investment risk and drive superior risk-adjusted returns. Primarily European banks and pension funds have already recognised

the importance of the circular economy and started embedding it in their planning processes.

- The finance and investment sector can manage linear risks by improving their risk assessment frameworks to better balance linear and circular risks and opportunities as well as focus on the longer term. They can also support businesses they invest in or lend to in the transition to a circular economy with appropriate financial structures and technical advice.

- They also play an important role in raising awareness through dialogue with clients, helping them identify linear risks and transition to more circular solutions. They can require greater transparency through reporting and disclosure of linear risks from businesses they invest in or lend to. This will encourage businesses to build capacity, understanding and skill to ensure that linear risks within their portfolios or operations are appropriately identified, evaluated and addressed.

3. State of adoption of circular economy principles in the built environment sector

The built environment sector is responsible for almost half of global resource use and transitioning the sector to a more circular economy will have significant positive impact on sustainable development

- Due to its size and scale, from a circular economy perspective the built environment is comprised of the: 1) micro-level (products, companies, consumers), 2) meso-level (building, estate, town), and 3) macro-level (city, region, nation and beyond).

- When assessing the built environment from a finance and investment perspective, consideration is at the meso and micro levels of the individual building, precinct or company, the level where investment funds are primarily directed.

- Built environment is under significant pressure to reduce its negative impact to society and the circular approach could help reduce its carbon footprint, rising costs of raw materials and increasing delays in project completion.

- Built environment needs to embrace the use of materials where the selection, composition, structural integrity and compatibility of materials reduces environmental impacts over the building lifecycle in the manufacture, construction and operation processes.

Circular economy strategies are being supported by governments and private sector and there is a proliferation of frameworks and tools to measure and assess adoption of circularity principles in the built environment

- The EU has adopted a Circular Economy Action Plan, one of the main segments of the Green Deal, as part of Europe's agenda to sustainable growth. The EU is yet to launch a comprehensive Strategy for a Sustainable Built Environment.

- The RESOLVE framework developed by McKinsey for the EMF has been adapted to the built environment with their R List detailing materials and components criteria to guide the sector and promote the transition to a circular economy.

- There are various tools to assist the built environment practitioner in understanding and incorporating circular economy practices into the design, delivery and operation of the project.

- Life Cycle Assessment (LCA) is widely used and has the potential to increase recycled content of materials used and components of building construction and also reuse of materials at end of life of the building.

- LCA performed early in the design process results in the highest carbon reductions and lowest costs. As the project progresses, the ability to reduce carbon decreases drastically.

- Building Information Management (BIM) is an integrated design and development tool used to assist in understanding the complexity of materials choice in construction of buildings and depository of data for analysis over a building's life cycle.

There are significant circular economy synergies with existing built environment rating schemes including the Green Building Council of Australia's (GBCA); the International Living Future Institute's (ILFI) and National Australian Built Environment Rating System (NABERS)

- Green Star – Buildings' tool includes several requirements that align with the circular economy, including: 1) diversion of construction waste from landfill; 2) design for effective operational waste management; 3) responsible procurement of products and services; 4) low energy consumption and energy sourced from renewables; and 5) low environmental impacts from resource use over the building's lifespan shown through comparative life cycle assessment.

- WBCSD provides numerous business case examples of circular buildings overseas demonstrating that these buildings are not assessed purely by economic benefits, instead the interconnected environmental, social and economic benefits relevant to geography, culture and demographics.

- UNEP FI suggests that a pathway for integrating circularity into construction and real estate finance is through the integration of circular economy metrics into mainstream building certification (e.g., BREEAM, GRESB or LEED).

Lendlease is a best practice example of a global organisation based in NSW as one of the leaders in implementing circular economy strategies

- Lendlease is a significant issuer of green bonds, having issued over A$1 billion of green bonds in both the Australian and UK markets, as well as sustainability linked loans.

- Lendlease has been adopting the IIRC's Integrated Reporting Framework since 2016. This is an alternative business reporting that explains to financial capital providers how value is

created, retained and/or destroyed from resource use. Circularity principles have a role in managing the natural capital inputs to the business model to create and retain value.

The transition to a circular economy will require scaling up the financing towards investments that provide environmental and social benefits but the market lacks guidance on how to uniformly define and apply circular economy thinking

- Measuring economic return on investment is still a challenge when stakeholders still perceive circular buildings as innovative deriving value from market differentiation.
- Policy makers require an evidence base of the benefits of a circular economy and demonstrate that value, and the way in which it is created from real estate assets is set by investors and construction clients through investment requirements, tenure models and design briefs.
- There are new business models that capture source of lost value in the built environment sector (e.g., vacancy, premature demolition, vacant lot, depreciated materials and underperforming components) and responses to market trends using circular economy principles may create value for the sector.
- Financial value created by circular business models could be compared with a linear model using discounted cash flow analysis.
- ICMA in their latest Green Bond Principles lists both circular economy initiatives and green buildings as eligible use of green bond proceeds.
- Transition to a circular economy requires a process and suggested steps are discussed in the report with a view that this will not be a linear process. Governments, financial institutions and property developers may need to work simultaneously for cross-industry collaboration to be successful.

Conclusions and proposed programme of work

The adoption of the circular economy is in early stages, especially with regards to finance and investment, but global initiatives are occurring. From an Australian perspective there is some sporadic adoption of the circular economy, but it is not widespread. The rapid review of the literature showed that there were relatively few academic sources that were relevant to the research topics, and that there is the opportunity for more academic research as well as education to be undertaken in this important and rapidly evolving area:

- Capacity building and professional development in the finance and investment sector will help to facilitate the transition and growth of financing the transition to a more circular economy in NSW.

- Research has an important role to play in building the evidence base for circular economy financing, and developing relevant metrics, tools and frameworks to enable informed decision making.

A proposed programme of work has been developed based on the outcome of the rapid review research, which outlines the key recommendations for future research and education:

Proposed programme of work: global initiatives and linear risks

- Develop a common understanding and language for circular economy finance relevant to NSW.
- Metrics to measure circularity and circular impact for the finance and investment sector, including common metrics and consideration of datasets.
- Develop linear (and circular) risk identification and evaluation tools.
- Improve company reporting and disclosure of circularity, including reporting standards for linear risks and learning from climate disclosure.
- Building an evidence base for circular economy finance, including identifying and addressing barriers.
- Circular economy professional development for the finance and investment sector, including sharing good practice to encourage implementation and case studies.

Proposed programme of work: built environment

- Examine evidence of financial and non-financial benefits of circular initiatives in the built environment at the meso level.
- Assess the effectiveness of financial evaluation tools of the circular economy in real estate.
- Evaluate the use of technology in the collection and management of databases for materials over the building lifecycle to provide financial capital providers up-to-date metrics to incorporate circularity principles in decision making.
- Perform cost benefit analysis of material impacts over the building life cycle as opposed to “take, make and waste” approach in the construction process.
- Assess social benefits of the circular economy in the built environment to allow inclusion of quantifiable and non-quantifiable ESG dimensions in decision making.

Acronyms & Abbreviations

APLMA – Asia Pacific Loan Market Association
APRA - Australian Prudential Regulation Authority
ASFI – Australian Sustainable Finance Institute
ASX – Australian Stock Exchange
BIM – Building Information Modelling
BREEAM – Building Research Establishment's Environmental Assessment Method
CBD – Central Business District
CBI – Climate Bonds Initiative
CO_2 – Carbon Dioxide
COP26 – UN Climate Change Conference, Glasgow 2021
COSO – Committee of Sponsoring Organizations of the Treadway Commission
CPG – Cross industry Prudential Guide
CTI - Circular Transition Indicators
DCF – Discounted Cash Flow
DGNB – German Sustainable Building Council
EC – European Commission
EMF – Ellen MacArthur Foundation
EOL – End of Life
EPD – Environmental Product Declaration
ESG – Environmental, Social and Governance
EU – European Union
GBCA – Green Building Council Australia
GBCI – Green Building Council India
GBP – Green Bond Principles
GRESB – Global Real Estate Sustainability Benchmark
GRI – Global Reporting Initiative
ICMA – International Capital Market Association
IFRS - International Financial Reporting Standards
IIRC – International Integrated Reporting Council
ILFI – International Living Future Institute
ISO – International Organisation for Standardisation
ISSB – International Sustainability Standards Board
LCA – Life Cycle Assessment
LEED – Leadership in Energy and Environmental Design
LMA – Loan Markets Association
LVL – Laminated Veneer Lumber
MFA – Material Flow Analysis
NABERS – National Australian Built Environment Ratings Scheme
NCC – National Construction Code

NGFS – Network of Central Banks and Supervisors for Greening the Financial System
NSW – New South Wales
PESTLE - Political, Economic, Social, Technological, Legal & Environmental factors
PGGM - Pension Fund for Care and Well-Being
PRB – Principles for Responsible Banking
RBA – Reserve Bank of Australia
SASB – Sustainability Accounting Standards Board
SDG – United Nations Sustainable Development Goals
SME – small and medium-sized enterprise
TCFD – Taskforce on Climate-related Financial Disclosure
TNFD – Taskforce on Nature-related Financial Disclosure
UK – United Kingdom
UNEP - United Nations Environment Programme
UNEP FI – United Nations Environment Programme Finance Initiative
UNSW – University of New South Wales
UTS – University of Technology Sydney
VOC – Volatile Organic Compound
WBCSD – World Business Council for Sustainable Development
WEF – World Economic Forum

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1. Introduction

1.1 Objectives and scope

The finance and investment sector has an important role to play in enabling the transition from the current "take-make-waste" linear economy to a more circular economy, which is key to addressing sustainability challenges such as climate change, biodiversity loss, pollution and waste. Finance for circular business models, projects, products and services is needed to achieve New South Wales' (NSW) net zero emissions and other sustainability goals and to secure associated social, economic and environmental benefits.

What is the Circular Economy?

There are many definitions of the circular economy, with the most widely used incorporating the following key principles developed by EMF (Kirchherr et al, 2017; Dewick et al, 2020):

- design out waste and pollution,
- keep products and materials in use, and
- regenerate natural systems.

Addressing these environmental challenges is increasingly urgent from a resource-based point of view as we are already overshooting planetary boundaries, and the transition to a circular economy is an important way to address some of these challenges. For example, although much of the focus of reducing greenhouse gas emissions has been on the energy sector, products and food account for 45% of total emissions. Much of these emissions can be addressed by applying circular economy principles (Ellen MacArthur Foundation, 2020).

The NSW government is committed to making the transition to a circular economy, having released both a Circular Economy Policy Statement and the NSW Waste and Sustainable Materials Strategy.[1] The importance of sustainable finance is also recognised as key to meeting NSW decarbonisation and sustainable resource goals, and Sydney as a global financial hub is well-placed to play a role in financing the transition to a low carbon and circular economy.[2]

In October 2021, UTS Institute for Sustainable Futures (UTS) and UNSW Business School (UNSW) were appointed by NSW Circular to co-lead the Finance and Investment Rapid Review research

[1] https://www.dpie.nsw.gov.au/our-work/environment-energy-and-science/waste-and-sustainable-materials-strategy; https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/response-to-china-national-sword/circular-economy-policy
[2] https://www.chiefscientist.nsw.gov.au/independent-reports/decarbonisation

to address the following challenge statement: “Identification and measurement of circular assets and risks for the finance and investment sector in the transition to a circular economy.”

Following consultation with NSW Circular, the scope of the rapid review research was agreed to be limited to the following topics:

- Key global initiatives to identify and measure circular assets relevant to the finance and investment sector (led by UTS);
- Initiatives to identify and measure linear risk, and how the circular economy can be used as a de-risking strategy (led by UTS); and
- Sector focus on the built environment, including circularity measurement and assessment tools, best practice examples and circular risks (led by UNSW).

Understanding global initiatives in identifying and measuring circular assets as well as the role of the circular economy in addressing linear risks are important to address current barriers in financing the circular economy. Focus on the built environment is important as this sector consumes 40% of Australia’s resources, emitting 40% of the country’s carbon emissions and contributing to 35% of wastes in landfill. The built environment is also highly relevant to the finance sector, as property and infrastructure investments and housing loans make up a large proportion of Australia's superannuation assets under management and bank loan portfolios respectively. NSW also has a significant infrastructure project pipeline that will also rely on finance and investment to be funded. The sector offers great opportunities to remove linear economy practices and could play a leading role in realising a circular economy with tangible examples of circularity practices already in place.[3]

Based on the findings of the rapid review and analysis, a proposed programme of work has been developed to consider actions that can contribute to the advancement of financing the circular economy in NSW, including current relevant initiatives and industry actions as well as recommendations for professional development and a data and research agenda to address gaps in knowledge and practice.

1.2 Research approach

The research teams used a rapid review methodology to collect key academic and grey (non-academic) literature for the period 2016 – 2021 (desktop review) to use as evidence to address the research scope (i.e., global initiatives, linear risks and built environment). Academic sources included those found using relevant screening criteria in the Scopus and EBSCOHost GreenFile databases. Grey literature sources included publications from international and national organisations active in financing the circular economy, including Ellen MacArthur Foundation (EMF), UNEP Finance Initiative (UNEP FI), International Capital Market Association

[3] Australian Government, State of the Environment (SOE) report, Built Environment, 2016. *https://soe.environment.gov.au/sites/default/files/soe2016-built-launch-20feb.pdf?v=1488792899*

(ICMA), European Commission (EC), Circle Economy and the World Business Council for Sustainable Development (WBCSD). A full list of sources is provided in Appendix 4.

Selection and prioritisation of evidence has been tailored to each research topic, with a focus on key findings that can be applied to NSW to advance the financing of the transition to a more circular economy. UTS and UNSW used different but complementary approaches to the rapid review:

- **UTS:** 158 documents were sourced from over 500 academic and grey documents collected by the research team since April 2020 on both sustainable finance and the circular economy, supplemented by additional database searches, documents and websites based on topic expertise. Documents and other sources were screened and selected based on relevance for the research, of which nine academic and 24 grey literature were used in this report (with additional grey references in footnotes).

- **UNSW:** 76 documents were downloaded using rapid review methodology to systematically capture academic and grey literature, of which six academic and 13 grey literature were relevant to the built environment sector and subsequently used in this report. Details of UNSW search and screening strategy are provided in Appendix 4.

Screened academic and grey documents were combined with additional documents provided by topic experts in the research teams and collated into a shared Zotero[4] referencing library containing 182 potentially relevant documents and weblinks. During final assessment, the most relevant documents were selected by at least two experts working on each of the review topics.

Overall, 38 grey documents and 15 academic literature sources were referenced in this report. It is worth noting that there were relatively few academic sources that were directly relevant to the research topics for the finance and investment sector, and there is the opportunity for more academic research to be undertaken in this important and rapidly evolving area.

[4] Online open-source reference management software

2. Key global initiatives to identify and measure circular assets

Global initiatives to identify and measure circular assets and metrics are still in the early stages of development, but rapidly evolving.

This section provides an overview of the main global initiatives that are being used and developed for the identification and measurement of circularity, including finance and investment sector initiatives where circular principles are being incorporated into existing frameworks as well as tools available for business. It also discusses a business model strategy tool and some of the metrics that are currently being considered for use by the sector.

2.1 Background

In recent years, global initiatives addressing both the challenges and opportunities in financing the circular economy have been led by organisations such as the European Union via the European Commission (EU), Ellen MacArthur Foundation (EMF) and the UNEP FI. A key identified barrier for implementing the circular economy (and financing the circular economy transition) is the lack of standard definitions, metrics and data (Ellen MacArthur Foundation, 2020; European Commission, 2019; Schröder & Raes, 2021; UNEP FI, 2020). There are various global initiatives underway to identify and measure circularity for both business and the finance and investment sectors, which are outlined in Sections 2.2 and 2.3 below.

The standardisation of scientifically sound circular economy definitions, metrics and practices will play an important role in ensuring appropriate financial decision-making in the transition to a more circular economy, and that the market for circular finance grows. A commonly accepted definition of circular economy projects and business models, as well as a circularity measurement methodology, are important for investment and credit risk assessment. To support the development of circularity in business, definitions used by the finance and investment sector could, for example, acknowledge that circular business models and projects should not need to be fully circular but may incorporate significant circular principles to qualify for sustainable finance.

Academics highlight the need for more effective oversight of circular economy finance, given "contested understanding, fuzzy indicators and inadequate information" (Dewick et al., 2020, p 1193). Two important global sustainable finance-related initiatives were announced in 2021 that are expected to influence government policy and regulatory oversight in the finance and investment sector: i) the G20 Sustainable Finance Roadmap (including circular economy as part of the cross-cutting focus area) and ii) the International Sustainability Standards Board (ISSB) to standardise sustainability reporting globally (currently focused on climate, but which could also integrate circular economy in future).[5]

[5] https://g20sfwg.org/archive/roadmap/; https://www.ifrs.org/groups/international-sustainability-standards-board/.

2.2 Key circular economy initiatives for the finance and investment sector

The finance and investment sector globally has begun to consider how circular economy principles can be incorporated into existing frameworks used by the sector. These initiatives are being led by the EU, through the EU Taxonomy, which is being used to drive investments to support the EU Green Deal and includes the transition to a circular economy as one of six environmental objectives (European Commission, 2020b). The International Capital Market Association (ICMA), who set voluntary standards for the globally recognised Green Bond Principles (GBP) and other debt capital market products, have also developed impact reporting metrics for circular economy projects (International Capital Market Association, 2021). Further, UNEP FI provided guidance under the Principles for Responsible Banking (PRB) for signatory banks to consider circular economy target setting, including identifying activities that they finance that contribute to the circular economy (UNEP FI, 2021).

EU Taxonomy

A common classification system for environmentally sustainable economic activities to provide companies, investors and policymakers with appropriate definitions in order to direct investment towards sustainable projects and activities.

In 2020, the EU Circular Economy Finance Expert Group, who support the EU Sustainable Finance Platform (the technical expert advisory body to the EC) on the Taxonomy, developed a sector-agnostic categorisation system to define categories of activities that substantially contribute to a circular economy, including minimum criteria and methodological guidance (European Commission, 2020a)

In 2021, the EU, the ICMA and UNEP FI released working papers focussed on financing the circular economy (EU Platform on Sustainable Finance, 2021; International Capital Market Association - GBP Impact Reporting Working Group, 2021; UNEP FI, 2021):

- EU Platform on Sustainable Finance - Technical Working Group – Taxonomy Pack for Feedback (August 2021): the initial focus on the EU Taxonomy has been on the objectives of climate change mitigation and adaption (to ensure that sustainable investment is consistent with emission-reduction pathways to meet EU net zero commitments). The EU Platform on Sustainable Finance has released draft technical screening criteria (e.g., substantial contribution and “do no significant harm” criteria) to meet the other four environmental objectives, including the transition to a circular economy. After a public feedback round, these criteria are currently being revised to be released as the final Platform recommendations in 2022.

- ICMA - GBP Impact Reporting Working Group – Suggested Impact Reporting Metrics for Circular Economy and/or Eco-Efficient Projects (June 2021): the ICMA is working towards a harmonised framework for impact reporting for circular economy projects, including

example quantitative indicators and suggested reporting templates for issuers of green bonds.

- UNEP FI Principles for Responsible Banking – Guidance for Banks – Resource Efficiency and Circular Economy Target Setting (December 2021): UNEP FI have released guidance for banks that are signatories to the PRB to set targets for circular economy financing. This includes identifying activities that they finance that substantially contribute to the circular economy. By using the guidance, banks can work to align their portfolios with the UN Sustainable Development Goals (SDG), in particular SDG 8.4 (improve global resource efficiency in consumption and production) and SDG 12 (responsible consumption and production) and contribute to financing the transition to a more circular economy.

An overview of the EU, ICMA and UNEP FI circular economy initiatives is summarised in Table 1.

Table 1: Key circular economy initiatives for the finance and investment sector

	European Union (EU)	International Capital Market Association (ICMA)	UNEP Finance Initiative (UNEP FI)
Initiative	EU Taxonomy (technical screening criteria for circular economy)	Green Bond Principles (GBP) (metrics for circular economy projects)	Principles for Responsible Banking (PRB) (circular economy target setting)
Description	Framework to facilitate sustainable investment – including environmental objective to transition to a circular economy	Voluntary guidelines for issuing green bonds – eligible green projects include circular economy products, production technologies and processes	Bank strategies and practice align with UN SDGs and Paris Agreement
Key drivers	Sustainable investments to support the EU Green Deal (including Circular Economy Action Plan)	Green bond market to promote the role of finance in helping to address environmental issues	Circular economy approach to support alignment with SDGs (primarily SDG 8.4 and SDG 12)
Application	- Investment (investors, banks, corporates) - Global relevance	- Green bonds - Global relevance	- Bank portfolios - Global relevance for PRB signatories (including Australian banks)
Status	EU Taxonomy Regulation (climate focus) - Taxonomy pack including circular	ICMA Impact Reporting Working Group – working to develop a harmonised framework for reporting on	PRB signatory banks are encouraged to set circular economy targets by following a multi-tiered approach, including

	economy (August 2021) – to be updated in 2022 - Links to EU corporate and financial disclosure guidelines	circular economy projects (June 2021)	identifying activities that substantially contribute to the circular economy (December 2021)
Resources	- EU Categorisation System for Circular Economy - Taxonomy – Final Report of the Technical Expert Group on Sustainable Finance - EU Platform on Sustainable Finance – Taxonomy Pack for Feedback - EU Green Bond Standard (voluntary standard)	Suggested Impact Reporting Metrics for Circular Economy and/or Eco-efficient Projects (Guidance from EU Report "Categorisation System for the Circular Economy" and EMF)	Guidance for Banks - Resource Efficiency and Circular Economy Target Setting

The EU, ICMA and UNEP FI (PRB) circular economy finance initiatives have the following key implications:

- **Global relevance, including for corporates, banks and investors operating in NSW**: financial markets are globally integrated, and international corporates, banks and investors that, for example, need to comply with EU regulations and standards often use these as a baseline for their international operations. EU investors that invest in Australian companies (as well as Australian companies that seek EU investment) need to comply with EU regulations (including those related to the EU Taxonomy). Further, the ICMA, together with the Loan Markets Association (LMA), are internationally recognised in setting best practice (voluntary) standards for global financial markets. All major Australian banks (and major international banks operating in Australia) are signatories to the PRB and have committed to align their strategies and practices to the UN SDGs, and are encouraged to follow UNEP FI's circular economy guidance.[6]

- **EU, ICMA and UNEP FI draw on similar expertise (and guided by EMF):** the EU Platform on Sustainable Finance includes the UNEP FI (chair), EMF, ICMA and EU banks and asset managers and owners as well as academics and EU bodies with circular economy expertise.[7] The ICMA working group includes key EU institutions, the World Bank as well as global banks and investors and has been guided by the work of EMF and the EU on financing the

[6] https://www.unepfi.org/banking/bankingprinciples/

[7] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/overview-sustainable-finance/platform-sustainable-finance_en

circular economy. UNEP FI – PRB has a Resource Efficiency working group, which includes major international banks, and the Expert Review Panel includes the EMF.

- **Circular finance aspects can be applicable for business**: the EU Taxonomy (and the Green Bond Principles) are also useful for business, as they are designed to apply to companies and their activities. The EU Taxonomy criteria are developed for companies to measure their alignment with the EU Taxonomy (e.g. substantial contribution to circularity goals). Investors then use the information reported by companies to report on their portfolio alignment, e.g., company reporting on Taxonomy criteria is key.

- **Application focus on investment, green bonds and bank portfolios**: the EU is primarily focussed on creating a common language for sustainable investment (with a focus on capital expenditure), but applicable to banks, investors and corporates, while the ICMA is focused on green bonds. Note that the EU also has voluntary Green Bond Standards that are aligned with the EU Taxonomy.[8] The UNEP FI encourages circular target setting in bank portfolios.

- **ICMA standards may apply to loan products in future**: ICMA standards also influence the LMA – note that the Green Bond Principles and the Green Loan Principles use the same language for accepted "use of proceeds" to finance green projects, including circular economy products and processes (International Capital Market Association, 2021; Loan Market Association & Asia-Pacific Loan Market Association, 2021). The application of the EU Taxonomy to core banking products has also been tested by UNEP FI and the European Banking Federation, which outlines some of the challenges related to circular economy.[9]

- **EU Taxonomy driven by regulation, ICMA and PRB are voluntary guidelines**: the EU Taxonomy Regulation 2020/852 has been focussed on the EU's climate objectives, with taxonomy regulation supporting the circular economy transition expected to be legislated in coming years.[10] The EU Taxonomy is further supported by EU corporate and financial institution disclosure guidelines and regulations, including the Non-Financial Reporting Directive (which integrates the recommendations of the Taskforce on Climate-related Financial Disclosures – TCFD – and will be replaced by the proposed Corporate Sustainability Reporting Directive) and the Sustainable Finance Disclosure Regulation. The ICMA are voluntary guidelines, but regularly used in global financial markets, and the UNEP FI PRB are also voluntary commitments.

The EU Taxonomy uses science-based principles to set ambition levels and is increasingly viewed as best practice for classification of sustainable activities for the finance and investment sector (noting recently contested given gas and nuclear as transitional activities).[11] Lucarelli et al.,

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8 https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/european-green-bond-standard_en

9 https://www.unepfi.org/publications/banking-publications/eu-taxonomy-testing-core-banking-products/

10 https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/overview-sustainable-finance/platform-sustainable-finance_en#activities

11 https://ec.europa.eu/info/files/220121-sustainable-finance-platform-response-taxonomy-complementary-delegated-act_en

(2020) view the EU Taxonomy as an important example of scientifically-sound, evidence-based policy.

The Netherlands are also making substantial progress in driving finance for the circular economy, in line with their government's goal of reaching a fully circular economy by 2050. In February 2022, the Sustainable Finance Platform in the Netherlands (led by the Dutch central bank) launched a roadmap with key players in the Dutch financial system to drive the financing of the circular economy, including considering circular metrics (and linear risks) in financial decision making.[12]

Note that there are other global initiatives that incorporate circular principles, but do not specifically refer to the circular economy. For example, the Climate Bonds Initiative (CBI) has developed a science-driven certification scheme for bonds, including a taxonomy that provides guidance on which assets and activities are consistent with the transition to a low carbon economy in nine sectors, including waste and pollution control.[13]

There are also a number of country-specific taxonomies that are being developed globally, including in China, Canada and the UK, with several taxonomies including resource efficiency and/or waste management (but limited circular economy).[14] The Chinese green bond project catalogue has similarities to the EU Taxonomy, and the UK intends to draw on the EU approach to structure its taxonomy.[15] The ASEAN regional taxonomy for sustainable finance was released in November 2021, and includes the "promotion of resource resilience and transition to circular economy" as one of four environmental objectives.[16]

Overall, the sustainable finance taxonomy space is complex and rapidly developing, and the circular economy focus has been relatively limited. In November 2021, the EU-led International Platform on Sustainable Finance (which includes the EU and 17 countries representing 55% of global GDP and greenhouse gas emissions) released a Common Ground Taxonomy working document, which ICMA has also responded to.[17] Although this document is initially focused on comparison between China and the EU (and does not specifically mention the circular economy), it is an important step in improving comparability and interoperability of global sustainable finance standards.

In Australia, the Reserve Bank of Australia (RBA) has indicated the need for an Australia-specific taxonomy that would be appropriate to the Australian economy and consistent with other

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[12] https://www.dnb.nl/en/green-economy/sustainable-finance-platform/circular-economy-working-group/
[13] https://www.climatebonds.net/standard/taxonomy
[14] https://www.greenfinanceinstitute.co.uk/programmes/uk-taxonomy-gtag/; https://www.oecd-ilibrary.org/finance-and-investment/developing-sustainable-finance-definitions-and-taxonomies_134a2dbe-en; https://www.cn.undp.org/content/china/en/home/library/poverty/technical-report-on-sdg-finance-taxonomy.html; https://smith.queensu.ca/centres/isf/resources/primer-series/taxonomies.php
[15] https://www.climatebonds.net/files/reports/comparing_chinas_green_definitions_with_the_eu_sustainable_finance_taxonomy_part_1_en_final.pdf; https://www.gov.uk/government/publications/greening-finance-a-roadmap-to-sustainable-investing
[16] https://asean.org/wp-content/uploads/2021/11/ASEAN-Taxonomy.pdf
[17] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/international-platform-sustainable-finance_en; https://www.icmagroup.org/News/news-in-brief/icma-responds-to-the-international-platform-on-sustainable-finance-ipsf-common-ground-taxonomy-consultation/

global taxonomies.[18] The recently established Australian Sustainable Finance Institute (ASFI) may develop a taxonomy relevant to the Australian market, where the circular economy could also be incorporated. A scientifically-sound taxonomy together with financial regulation and PRB bank alignment with the SDGs will all help to drive effective growth in financing the circular economy, including in NSW.

2.2.1 Defining circular business models and metrics

The EU, ICMA and UNEP FI refer to the same tool to identify circular business models, whereas circular metrics remain work-in-progress. The EU circular economy categorisation system and ICMA working paper refer to the Value Hill Business Model tool, developed by Circle Economy, Technical University Delft and the Sustainable Finance Lab (Netherlands) to identify circularity in business (Achterberg et al., 2016). UNEP FI PRB also recommends screening bank portfolios for circular activities using the Value Hill for guidance.

The Value Hill is a business strategy tool which depicts value in the circular economy (e.g., keep products at their highest value for as long as possible) relative to value in the linear economy (e.g., where value is destroyed post-use). Please refer to Figures 1 and 2 for an overview of the tool and how it is used in the EU Taxonomy, ICMA and PRB (EU Platform on Sustainable Finance, 2021; European Commission, 2020a; International Capital Market Association - GBP Impact Reporting Working Group, 2021; UNEP FI, 2021).

There are four high level business model category groups that are mapped on the Value Hill:

- **Circular design and production:** design and produce products to retain long-term value and reduce waste (including production processes that reduce waste by closing material loops);
- **Circular use:** extend life and optimise use of products and assets during use phase to retain resource value and reduce waste (including product-as-a-service and sharing models);
- **Circular value recovery:** capture value from products and materials after they are used (including waste management and valorisation); and
- **Circular support:** develop enabling tools, education and advisory services to support circular strategies and business models.

18 https://www.rba.gov.au/publications/fsr/2021/oct/box-a-australian-financial-regulators-actions-on-climate-change-related-risks.html

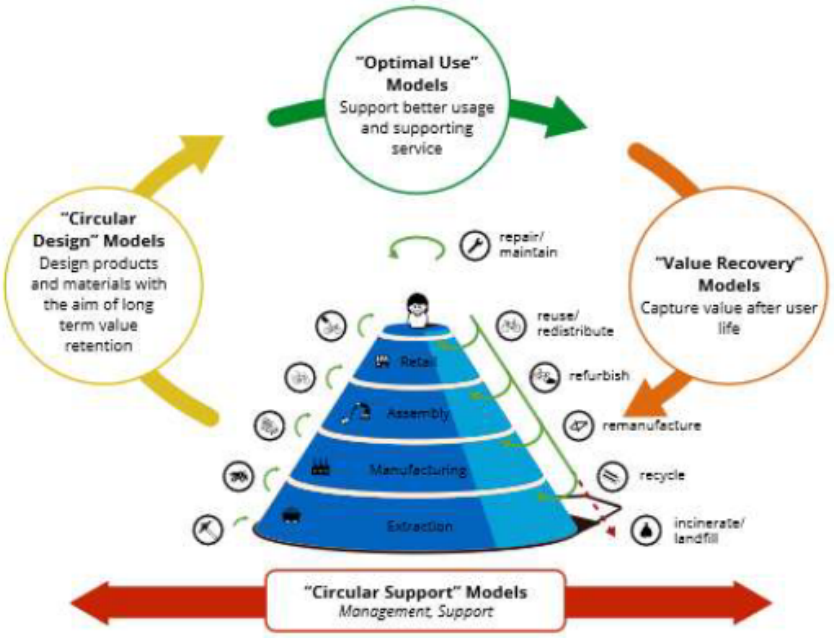

Figure 1: Value Hill Business Model Schematic
Sources: EC (2020) Categorisation System for the Circular Economy – a sector agnostic approach for activities contributing to the circular economy; also referred to in ICMA (2021) and UNEP FI (2021)

The Value Hill Business Model tool is used by the EU to define categories of activities that substantially contribute to a circular economy, whereas the ICMA propose the use of indicators to demonstrate the environmental and sustainability benefits of the circular economy using the Value Hill for guidance. They both incorporate qualitative and quantitative methodologies, as well as impact and performance-based metrics. In the case of the EU, these are intended to either directly or indirectly contribute to increasing resource efficiency and decrease environmental impacts through value chains by applying or enabling one or more circular economy principles (European Commission, 2020a). Some of these methodologies and metrics could potentially be used in the NSW context.

Circular economy within EU Taxonomy

The circular economy is interconnected with and can reduce pressure on the other EU environmental objectives including climate, water, biodiversity and pollution. The transition to a circular economy is also the most challenging of the six EU objectives.

The EU Taxonomy considers the circular economy objective to be focussed on system change to enable the achievement of the other environmental objectives (including climate, biodiversity, water and pollution), with a goal to decouple economic growth from extraction of non-renewable resources to stay within planetary boundaries. It also acknowledges that the transition to a circular economy is "the most challenging environmental objective because it is a relative new concept in scientific literature" (EU Platform on Sustainable Finance, 2021, p. 43).

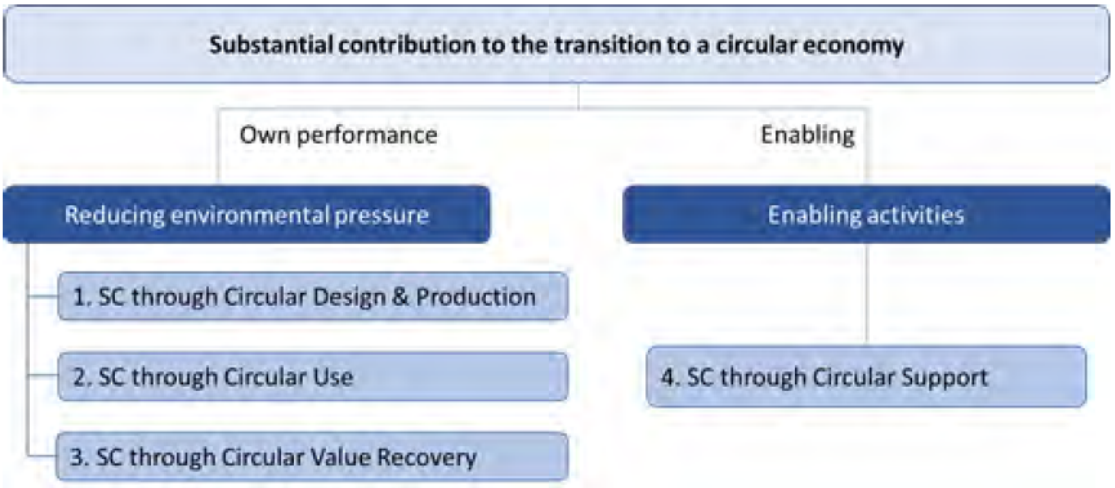

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Figure 2: Types of Substantial Contribution Relevant to the Circular Economy (EU Taxonomy)
Source: EU Platform of Sustainable Finance (2021) Technical Working Group – Taxonomy Pack for Feedback

Circular economy metrics and indicators are expected to be further refined in future, as the development of metrics and indicators for the circular economy remains work-in-progress globally (International Capital Market Association - GBP Impact Reporting Working Group, 2021).

2.3 Emerging circular identification and measurement initiatives for business

As the finance and investment sector lend to and invest in companies, it is important to also understand how business is identifying and measuring circularity. Many large corporates are already beginning to incorporate circular economy principles in their business models (including global companies such as Brambles, Unilever, Philips and Arup), and this is expected to increase as the business opportunity and advantages of the circular economy become recognised (Ellen MacArthur Foundation, 2020).

There are however no standardised metrics that currently exist to measure circular performance for companies that are transitioning to more circular business models, and there are limitations on data available to measure for example emissions, waste or material flows through value chains, making it difficult for investors and lenders to effectively and consistently assess and compare circular economy projects and businesses (Circle Economy, 2020; Schröder & Raes, 2021).

Metrics and indicators used by large corporates should ideally measure the complete lifecycle of materials, circulation loops and supply chains (Howard et al., 2019). Measurement of circularity for business is recognised as being work-in-progress, as the circular economy is still a relatively new concept, with a main challenge being the limited understanding of circular measurement

tools and their effect on financial outcomes (Aranda-Usón et al., 2019; Kambanou & Sakao, 2019; Scarpellini et al., 2020).

Nevertheless, there are a number of initiatives and tools available to assist business in identifying and measuring circular activities and progress towards circular business models, including from EMF (Circulytics), the WBCSD (Circular Transition Indicators - CTI), Circle Economy and others (Circle Economy, 2020; Ellen MacArthur Foundation, 2020; WBCSD, 2021b). These initiatives and tools use a variety of circular metrics ranging from headline indicators (e.g., % circularity) to performance indicators (e.g., recycling rate, share of renewable energy) and process indicators (e.g., share of sustainable products in portfolio, employee awareness, etc) (Circle Economy, 2020). The key global initiatives and tools to identify and measure circularity for business are outlined in Appendix 1.

Further, there are business sustainability reporting initiatives that consider waste, for example the Global Reporting Initiative (GRI 306) waste standard which incorporates circular principles (and provides linkages to EMF's Circulytics tool), and product level initiatives such as Cradle to Cradle.[19] The International Organisation for Standardisation (ISO) is also developing global standards for both sustainable finance and the circular economy (guidelines on business models and value chains).[20]

These initiatives, tools and metrics used by business to measure circularity are expected to further develop in the coming years and are an important first step for companies to begin to consider how to incorporate circularity in their business strategies and models. Incorporating scientifically sound circular economy principles into these frameworks are an important way to ensure circular economy objectives such as reductions in greenhouse gas emissions and waste are successfully achieved (Dewick et al., 2020).

Standardisation of metrics and disclosures regarding circularity will play an increasingly important role for the finance and investment sector to appropriately assess companies that they invest in or lend to as they transition to more circular business models.

Integration of circular measurement into financial reporting will also become increasingly important for both business and the finance and investment sector on the premise that "what gets measured gets managed" (Coalition Circular Accounting, 2021). Current accounting rules do not currently sufficiently capture the economic value of circular business models. Global reporting standards such as the newly created ISSB can help harmonise non-financial metrics and disclosures, which can assist the finance and investment sector in assessing the opportunities and risks of the circular transition (Dewick et al., 2020; Ellen MacArthur Foundation, 2020).

It is however unclear how the tools and frameworks that can be used by business align with the initiatives being undertaken by the finance and investment sector, including the EU Taxonomy

[19] https://www.globalreporting.org/about-gri/news-center/help-for-companies-on-circular-economy-progress/; https://www.c2ccertified.org/

[20] https://www.iso.org/standard/80649.html

and ICMA guidelines. It is important that metrics and indicators used by both the business and finance and investment sectors are aligned and comparable.

2.4 Global initiatives remain work in progress

Tools and frameworks to identify and measure circular assets and metrics for both business and the finance and investment sectors continue to evolve. EMF, WBCSD, Circle Economy and others have developed tools to measure circularity for business, and these are an important first step for companies to consider circularity in their strategies and supply chains. The finance and investment sector can play a role in informing their customers and investee companies – from small and medium-sized enterprises (SMEs) to large corporates and projects – to consider using these or other appropriate tools in their sustainability-related business planning. Incorporating circular measurement into accounting frameworks, including with the forthcoming ISSB, will also be important to drive the transition to the circular economy globally.

The standardisation of circular economy definitions, metrics and practices for the finance and investment sector will also become increasingly important in coming years to prevent "greenwashing" and to ensure that appropriate circular business models and projects are financed. The EU is playing a leading role in developing scientifically-sound circular economy criteria for sustainable investing within the EU Taxonomy, and the ICMA is taking guidance from the work of the EU in providing draft voluntary guidelines and metrics for circular projects under the Green Bond Principles. UNEP FI have also provided guidance for banks that are signatories to the PRB for circular economy target setting and identification of circular activities in their portfolios. The Value Hill Business Model tool is being used by the EU, ICMA and PRB to help define circularity and ensure that positive environmental outcomes are achieved. These initiatives have global relevance for the finance and investment sector.

Work is currently underway in several countries and markets to develop sustainable finance taxonomies, including in Australia. Scientifically sound definitions and taxonomies that are globally comparable and harmonised will be critical in driving effective growth of circular finance to enable the transition to a more circular economy, including in NSW.

3. Linear risks and circular economy as a de-risking strategy

This section explores the risks faced by businesses and the finance and investment sector from continuing with business-as-usual linear practices and presents circular economy as a de-risking strategy. It also touches upon challenges in understanding these risks, discusses emerging initiatives to assess risks, and prioritises the need for action.

3.1 Understanding linear risks in business models

Risk management is an integral part of running a successful business, as well as investment and lending portfolios. The World Economic Forum's (WEF) Global Risk Report 2022 highlights that over a ten-year horizon, environmental risks are perceived to be the five most critical long-term threats to the world, with "climate action failure", "extreme weather", and "biodiversity loss" ranking as the top three most severe risks (World Economic Forum, 2022). Ignoring these external risks could have severe implications on business models which could be value destroying, and current approaches to risk management often overlook risks associated with linear business models.

Linear risks are the risks a business is exposed to as a consequence of following the conventional 'take-make-waste' linear economic model. The pressures standard business practices put on the environment and non-renewable resources are systemically ignored, and "the regulatory system, markets and financial risk assessment are distorted and biased in favour of the financing of linear projects" (Sepetis, 2022, p. 213).

> Linear Risks are the exposure to the effects of linear business practices - utilise scarce and non-renewable resources, prioritise sales of new products, fail to collaborate, and fail to innovate or adapt – which will negatively impact an organisation's ability to continue as a going concern. *(Ramkumar et al., 2018)*

While there is growing awareness of the risks of unsustainable consumption and disposal of resources, the implications of their extraction on the environment and local communities, and their increasing scarcity, many conventional business and risk models do not account for the risks that come with continuing with business as usual. These include risks from future resource shortages and associated impacts on prices, restricted access to supply chains due to geopolitics and trade wars and their impact on market dynamics. Linear risks depend on the industry, geographic scope of operations, procurement decisions, and end-of-life product handling, among other factors (WBCSD, 2018).

Investors and banks are exposed to linear risks, for example, through businesses in their portfolio that continue with linear business processes becoming "stranded assets, i.e. assets that have suffered from unanticipated or premature write-downs, devaluations, or conversion to liabilities" (FinanCE Working Group, 2016, p. 73).

3.1.1 Linear risk typology

There is increasing agreement on the risks that businesses and investors face while following the standard 'take-make-waste' linear economic model. Five key types of linear risks have been identified in the literature as seen in Table 2. This risk typology has been adapted from the Open Risk Manual to describe Linear Risks.

Table 2: Linear Risk Typology

Risk	Description
Market risks*	involve market and trade related factors that impact business' assets and liabilities
Operational risks*	involve factors that threaten the internal operations of a firm
Business risks*	result of emerging societal, economic and political trends that threaten the firm's strategic business plan objectives
Legal risks*	arise from the failure to comply with current as well as future regulations, standards or protocols
Reputational risks**	involves a business's brand image, license to operate, and general customer and investor perception. These are increasingly turning into legal liability with stakeholders suing companies on unsubstantiated sustainability claims.

* The FinanCE working group (Ramkumar et al., 2018)
** Circular Economy Practitioners Guide (WBCSD, 2018)

WBCSD, in collaboration with The Committee of Sponsoring Organizations of the Treadway Commission (COSO), developed an Enterprise Risk Management Guide for businesses for environmental, social and governance (ESG)-related risks. While it does not use the term 'linear risk', it highlights typical risk categories – strategic, operational, financial and compliance (COSO and WBCSD, 2018) that businesses would face in non-circular, i.e. linear approaches, which are very similar to the categories identified by the FinanCE working group above.

3.1.2 Financial impacts of linear risk to investors and lenders

Financial portfolios are currently dominated by investments and loans that are exposed to linear risks. Equities, fixed income debt, loans and commodities all inherit their own form of linear risks. Investors and lenders could experience a deterioration of their risk return ratio when these risks materialise, leading to negative outcomes (Ramkumar et al., 2018).

Businesses, and thus by extension their banks and investors can insulate themselves against linear risks by adopting circular approaches like purchasing circular supplies, or recovering

resources at end of life (WBCSD, 2017). Identifying and assessing linear risks in investment and loan portfolios is therefore the first step for the sector.

> "The risks of a linear economy are outweighed by the opportunities of a circular economy, and a coordinated transition is therefore necessary."
>
> *Frido Kraanen, Director of Societal Impact at PGGM*

These risks may negatively impact business assets, and subsequently devalue the investment and/or loan. For example, a change in policy to move away from coal-fired power would lead to early decommissioning of coal-fired power plants and may leave stranded assets for investors and power companies. These trends are expected globally, with anticipated premature devaluations of fossil-fuel based assets, with energy companies for example adjusting their strategies to manage these risks. Similarly, real estate which is not built to the latest sustainability (including circularity) principles will increasingly become a burden – it will lose value in comparison with higher ranking real estate or will require additional investments to improve circularity.

China's 2018 ban on waste imports shocked Australia's recycling industry, and led to plummeting prices for certain waste materials, increased costs from stockpiling and short-term landfilling. In 2020, the Australian federal parliament banned the export of unprocessed waste overseas, pushing businesses to reprocess and re-manufacture recyclables onshore, towards a more circular economy (Downes et al., 2020). Policy shifts can impact on costs of waste disposal and the valuation of waste and recycled materials. This is another indication of growing financial risks associated with linear business models as companies navigate changing international and national policy directives.

Sustainability is a business opportunity for the finance and investment sector and financial institutions need to embody circularity in their own thinking and way of doing business if they want to play a leading role in the circular economy (ING, 2015).

3.2 Assessing and measuring linear risks

Current risk assessments and disclosures do not comprehensively price or account for linear risks, leaving financial portfolios with investments exposed to these risk factors without an appropriate risk assessment and mitigation process (Ramkumar et al., 2018). While it is difficult to estimate the quantitative magnitude of linear risks, without change, these risks will manifest and result in additional costs; if not, complete disruptions in businesses could occur (FinanCE Working Group, 2016).

A few organisations have developed approaches and matrices to help businesses and financiers to identify and assess linear risks. However, there are no established evaluation metrics to quantify risks of, e.g., stranded assets. The existing tools and frameworks are summarised in Table 3. For details please see Appendix 2.

Table 3: Different Risk Matrices

Parameters	Linear Risk Matrix	Linear Risks Matrix	Circular Transition Indicators framework
Developed by	FinanCE working group	ReThink Global	WBCSD
Developed for	Investors and companies	Business, public sector and community groups	Companies
Purpose	Guide to understand exposure to linear risks across linear business practices.	Guide to understand risks across the business value chain	Quantitative framework for businesses to measure circularity
Risk categories	Market, operational, business, legal	Political & economic, social & demographic, technological, legal & environmental	Market, operational, business, legal
Other elements considered	Linear business practices: utilise non-renewable resources, prioritise sales of new products, fail to collaborate, fail to innovate or adapt	Value chain elements: materials, design, strategy, production, supply chain, use and end-of-use	Risk severity: threat and vulnerability prioritisation

While circularity can help de-risk businesses, financiers need to work on de-risking finance for circular approaches. Financiers and investors need to understand the differences between linear and circular business models and their risks in order to be able to correctly value business models and their longer-term economic potential (European Commission, 2019). This requires incorporating linear risks into financial decision making, which relies on historic track records and is often not available for assessing circular approaches or linear risks (Schröder & Raes, 2021).

Work done by the EMF, Chatham House and the EU has also highlighted the challenge with unpriced externalities. This refers to both negative externalities like linear risks not being priced and positive externalities like the benefits of circular propositions not being rewarded by existing risk models. While emerging linear risk matrices recognise some of the environmental aspects of materials driven circular business models, they still do not completely address social aspects related to business operations as well as the supply chain. Similarly outdated accounting rules do not fully reflect the value creation of circular business models or linear risks (Ellen MacArthur Foundation, 2020). However, there are alternative reporting frameworks such as the International Integrated Reporting Council's (IIRC) Integrated Report which consider the capitals or resources used by the organisation to create value, including the value creation of social, intangible and environmental capitals. The Integrated Reporting Framework can encourage businesses to include circularity principles through this integrated thinking approach. There is a need to develop new assessment methodologies and/or fine-tune existing ones to accommodate these aspects.

The EU's informal Expert Group on Circular Economy Financing noted the need to create "a level playing field between linear and circular investment decisions by including the financial and non-financial impacts of the project's delineation" (European Commission, 2019). Integrating

circular metrics into risk assessment could enable businesses and investors to "more accurately assess the benefits of circular business models, as well as the risks and potential negative externalities associated with linear business models" (Bocconi University et al., 2021).

However, unfamiliarity with this knowledge limits the scaling up of circular finance. Addressing the lack of standardized and comparable data and metrics particularly for non-financial impacts is critical for assessing the risk/return ratio for circular economy financing particularly for SMEs and start-ups (Schröder & Raes, 2021).

The other challenge is around communication and the lack of a "common, cross-industry language and provide consistent insights into circular opportunities and linear risks" (WBCSD, 2018). There are various attempts, also described in the previous Section 2.2 to establish this for businesses. Circular economy terminology and metrics need to be integrated into financial terminology and risk models (UNEP FI, 2020). The EU Taxonomy provides a framework to help the finance sector do so for climate and the environment and circular economy objectives will be integrated into it in future (refer Section 2.3).

3.3 Circular economy as a de-risking strategy for financiers

Surprisingly, there is limited research on the assessment and measurement of risk and the impact of circularity on risk, given circular economy offers effective mitigation of linear risks and shields from the risk of stranded values both in the short and long term, though long term contribution is more relevant (Zara & Iannuzzi, 2021; Zara & Ramkumar, 2021).

A circular economy will help avoid some of the negative externalities arising from a linear economy approach. However, the transition to a circular economy requires systemic change.

There are risks associated with this transition. Circular business models have a different risk and return profile than linear models, often called circular risks. This report acknowledges the importance of circular risks but does not look at them in detail.

Recent analysis from Bocconi University et al (2021) highlights that "circular economy strategies can curb investment risk and drive superior risk-adjusted returns" (Bocconi University et al., 2021). It confirms the positive effect of circularity on risk, thus ensuring persistent performance of businesses and portfolios without compromising financial returns.[21]

Rethinking how investment portfolios are constructed by approaching circularity at a portfolio level rather project level might be a more effective approach. (Figge et al., 2021) showed that for an individual business, "an increase in the circularity of resources does not necessarily mean that resources will be used more efficiently" and a portfolio (or group) level is a more conducive approach to increasing circularity (p. 8). They may apply different strategies to do so, such as, positive screening, negative screening, engagement with companies, setting thresholds or performance benchmarks, providing discount on capital for compliant entities, which is often done in the case of ESG investments and sustainability linked loans. Banks can also support

[21] This research considered 222 companies across 14 resource-intensive industries, such as the manufacturing sector, utilities, real estate, and construction materials (with some exclusions), headquartered in the EU-15 area, plus Switzerland for the period 2013–2018.

circular economy in assessing capital adequacy ratios and lowering this requirement for circular projects.

Some banks and pension funds have already recognised the importance of the circular economy and started embedding it in their planning processes. The Dutch pension fund PGGM is committed to investing responsibly and has been actively looking for circular opportunities across climate change, water scarcity, healthcare and nutrition issues. Additionally, they are engaging in dialogue with companies and requesting circular assessments from several companies in their equities portfolio to evaluate exposure to linear risks (WBCSD, 2018). Intesa Sanpaolo, an Italian banking group, has integrated circular economy approaches into its strategic plan and is leading innovation in financial products like the dedicated EUR 6 billion credit facility - Plafond for innovative companies (SMEs), with business practices aligned to circular economy principles (Bocconi University et al., 2021).

The G20 Resource Efficiency Dialogue 2019 highlighted the importance of banks and other lenders and investors in raising awareness through dialogue with clients, helping them identify linear risks and transition to more circular solutions (G20 Resource Efficiency Dialogue 2019, 2019). Federated Hermes developed a guide for professional investors on plastics highlighting linear risks and circular opportunities. The guide includes questions investors must ask to initiate a dialogue with businesses (Federated Hermes, 2020). Tools like this can help investors understand the risks in their own portfolios and influence businesses towards more circular approaches.

	Starting Out	Evolving the Approach	Market Leadership
Strategy	1. What is your long-term strategy for managing plastics risks and opportunities?	1. Which elements of the plastics challenge is your strategy focused on?	1. What is the company's plan for addressing weaknesses in the strategy as it continues its journey?
	2. What are the costs to which the business is exposed in relation to plastics?	2. How are customer, market or regulatory changes influencing your strategy?	2. How are the R&D, design, marketing and customer functions working to deliver the strategy?
	3. What changes in demand has the company observed from customers or regulators?	3. What investments are being made to ensure the strategy is successful?	3. What are the longer-term challenges with which the company is grappling?

Figure 3: Sample questions for investors highlighting linear risks and circular opportunities
Source: (Federated Hermes, 2020)

3.4 Pathways for mitigating linear risk

Financiers and businesses are increasingly recognising the value circular solutions bring. However, the challenge in financing these new business models lies in appropriately assessing risks in comparison to conventional models, i.e. linear risks. The FinanCE Working Group (2016) highlighted that linear risk can be mitigated by coming to terms with: the unsustainability of the current situation, the financial implications of linear risks, and a proactive attitude in stimulating circular business activities.

Banks and investors can manage these risks by improving their risk assessment frameworks to better balance linear and circular risks and opportunities as well as focus on the longer term. They can also support businesses they invest in the transition to a circular economy with

appropriate financial structures and technical advice. Research has an important role to play in building the evidence base for circular economy financing, and developing relevant metrics, tools and frameworks to enable informed decision making.

An important responsibility for financiers and investors is to require greater transparency through reporting and disclosure of linear risks from businesses they invest in or lend to. This will encourage businesses to build capacity, understanding and skill to ensure that linear risks within their portfolios or operations are appropriately identified, evaluated and addressed. Global efforts on developing climate risk reporting and disclosure guidelines like the TCFD have laid the groundwork for this. Other initiatives could include the private sector integration of linear risk reporting through the International Financial Reporting Standards (IFRS), and the introduction of linear risks reporting standards through central banks facilitated by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS). Australian initiatives like the CPG 229 from APRA have mandated climate risk disclosures for APRA regulated institutions. Circular and linear risk reporting can build on these disclosure initiatives. Linear risk disclosures could be documented in terms of companies' governance, strategy, risk management measures, and metrics and targets used to evaluate the impacts of these risks and to emphasise potential material impacts on income statements and balance sheets of businesses (European Commission, 2019).

Beyond investors, decision makers in the financial system need to incorporate reporting standards for the linear risks of investments and companies into standard accounting practices to ensure linear risks are sufficiently evaluated and disclosed (European Commission, 2019). Additional evaluation metrics will be needed to account for and reduce the risk of stranded assets linked to linear sectors (Schröder & Raes, 2021).

4. Sector focus: Built Environment

4.1 Existing circularity measurement and assessment tools

The built environment encompasses everything people live in and around, such as housing, transport infrastructure, service networks or public spaces, requiring vast amounts of resources. Hence it is not surprising the sector is responsible for almost half of global resource use (WBCSD, 2021) and a similarly high proportion of waste, as very few construction components and materials are reused or recycled.

> "The circular economy is an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed as both process and output, to maximize ecosystem functioning and human well-being" (Murray et al., 2017, p. 369)

> "The circular city model incorporates the principles of the circular economy, establishing an urban system that is regenerative and accessible, but it is not a simple sum of urban circular economy projects" (Fusco Girard & Nocca, 2019, p.13)

From a building design and construction perspective, material efficiency is core to circular approaches, as well as designing for adaptation and disassembly and to preserve the value of materials beyond their initial use. A key conceptual shift is to think of buildings not just for their primary purpose, but also as a method of storing thousands of tons of valuable products and materials, which can be traded and reused at the end of the building's life, rather than just discarded.

Due to the size, scale, and constituent parts of the built environment it is important to contextualise the built environment from a circular economy perspective. Kirchherr et al. (2017) suggest that the built environment from a circular economy perspective comprises of: the micro-level (products, companies, consumers), the meso-level (building, estate, town), and the macro-level (city, region, nation and beyond).

A city comprises a mix of buildings of different ages and structural materials, designed to provide a variety of services to the community, linked by various forms of infrastructure. All buildings and associated infrastructure are interdependent upon each other, contributing toward the effective operation of a city, but each component operates on an individual lifecycle, requiring capital investment at different times to keep pace with the functional demands of the city. As the consideration of the circular economy moves from the micro-level, as inputs into the construction of buildings and then beyond the meso-level, towards the macro-level with the development of cities, the circular economy principles of regeneration, material life and integration are extended across all facets of the built environment to ensure that infrastructure and buildings are interconnected and function in a manner that supports the efficient operation of a city or urban environment.

When assessing the built environment from a finance and investment perspective, consideration is generally at the meso level of the individual building or precinct and also from the micro level when funding is obtained at the company level.

4.1.1 Circular economy strategies and frameworks

Voluntary and mandatory circular economy initiatives for the building sector are occurring in Europe, the USA, Asia and Australia. For example, the European Commission (EC) released 'The New Circular Economy Action Plan for a Sustainable Built Environment' in 2021. In this context, the stated aim of the strategy is to increase material efficiency and to reduce climate impacts of the built environment, particularly promoting circularity principles throughout the life cycle of buildings. The strategy is expected to ensure coherence across policy areas related to climate, energy, management of construction and demolition waste, digitalisation, and skills. The EC is still working on the details of a separate Sustainable Built Environment Strategy. There is also a shift towards reporting against circular economy indicators in green building certifications and planning regulations (e.g., in Australia, the Green Building Council of Australia (GBCA) voluntary Green Star rating schemes; the National Australian Built Environment Rating System (NABERS); in the UK, Building Research Establishment's Environmental Assessment Method (BREEAM), the US Green Building Council's, Leadership in Energy and Environmental Design (LEED)). This section provides an overview of some strategies, tools and frameworks used to support the assessment of circular economy principles in the built environment.

Circular Economy Strategies

Table 4, adopts the principles of the "R List" strategy to describe the circular economy approach for materials as it relates to the built environment (Rahla et al., 2021).

Table 4: Findings of materials and components criteria.

Circular Economy Strategy	Description
Recycled or recovered content	Reduction of the input of virgin materials content and partially rely on recycled or recovered waste
Recyclability	The ability for a material to be recyclable through a particular process at its end-of-life
Reusability	The capability for materials to be reusable at the end-of-life and thus providing the building elements a second life
Ease of deconstruction	The selected materials facilitate different design strategies to adopt reversibility such as: adaptability, disassembly, while undergoing little or no damage
Maintainability	This feature characterizes materials and components over time while meeting the minimal requirements
Durability	The resistance of materials and components to deterioration over time while meeting the minimal requirements
Energy recoverability	The potential of converting building materials and components to energy by incineration
Upcycling potential	Re-introducing the materials and components in the loop for a higher value
Biodegradability	The ability of disintegrating the building elements to the natural environment with no ecological damage

Source: Rahla. K, et al. 2021, p. 11.

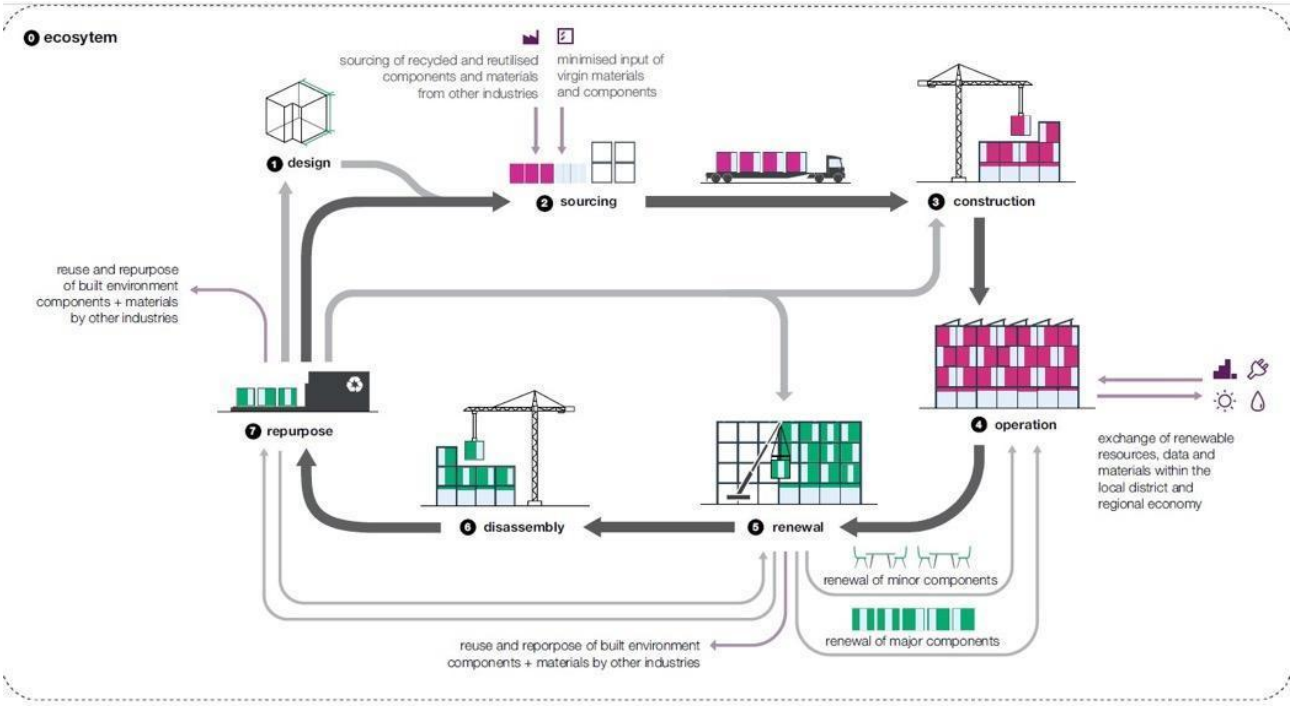


Figure 4: Application of Circular Economy Principles to Commercial Property
Source: StopWaste & Arup (2018)

The circularity process in Figure 4 demonstrates the process of adopting circularity in the building sector (Arup & European Circular Economy Stakeholder Platform, 2020). When this circularity process incorporates strategies such as the Value Hill Business Model tool (as discussed in Section 2.3.1) from a built environment perspective, it provides the opportunity to add value to the built environment through the design and construction process by reducing the amount and subsequent cost of materials and retains value of the asset throughout its' operational lifecycle by improving materials efficiency in use.

4.1.2 Tools for measuring and assessing the circular economy for the built environment

The life cycle of the built environment commences as early as raw material extraction, then planning stage, proceeding onto the design stage, to the construction stage and through the operational life of the building. After the operational life there is also the end-of-life including demolition and reuse. Throughout this life cycle numerous circular economy assessment tools are applicable. These tools, detailed and illustrated in Appendix 3, including Life Cycle Assessment (LCA), Material Flow Analysis (MFA) and Environmental Product Disclosure (EPD), assist built environment practitioners in understanding and incorporating circular economy practices into the design, delivery and operation of a project.

LCA is a widely adopted method to quantify environmental benefits of circular economy strategies in the built environment (Rahla et al., 2021). When approaching LCA from a circular economy perspective, an appreciation of the significance of recycling, re-use and refurbishment is gained, to reduce the impact on the environment, starting as early as resource extraction, and

moving away from a linear economy based on extraction, use and disposal. To meet net-zero carbon targets, it is important to measure embodied carbon in addition to operational carbon emissions. LCA performed before the design process results in the highest carbon reductions and lowest costs. As the project progresses, ability to reduce carbon emissions decreases drastically (WBCSD, 2021a).

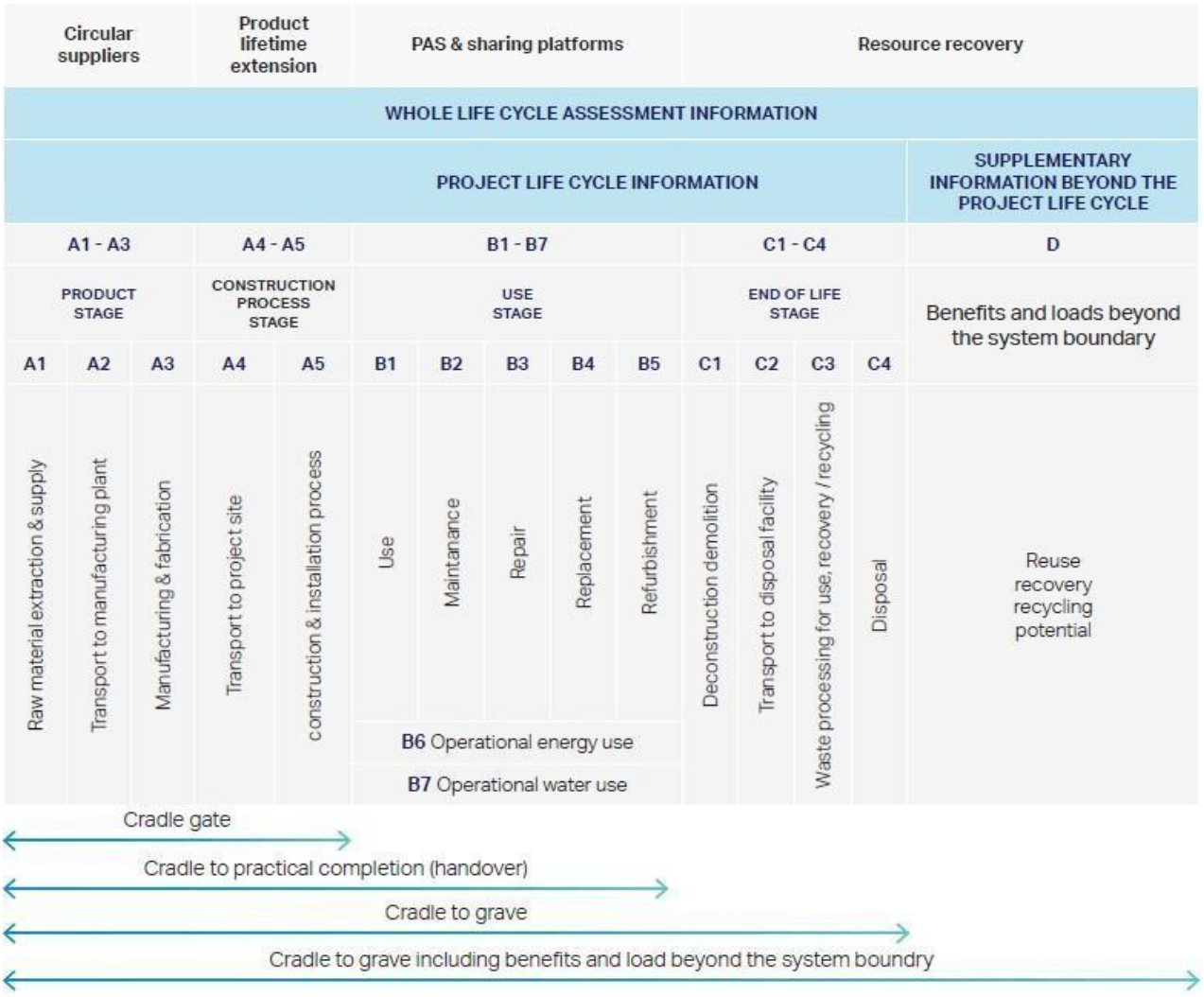


Figure 5: Life Cycle Assessment
Source: WBCSD (2021).

4.1.3 The Hierarchy of Elements Approach. One Building, Six Layers

The 'Hierarchy of Elements' adopts a LCA methodology to assess a building by its layers.

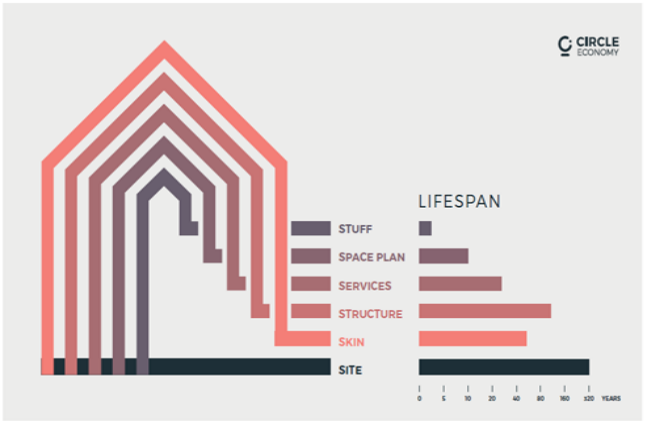


Figure 6: Hierarchy of Elements, Products and Materials. One Building, Six Layers.
Source: Circle Economy (2019)

> The building layers approach developed in conjunction with the Circle Economy, where "each layer has a different function, subset of elements, products and materials and lifespan". In developing a business case for CE, the approach claims: "...it makes more sense to look at the value of separate layers than of the building as a whole"
>
> (Fisher, 2019)

The One Building, Six Layers approach adopts a micro-level LCA considering each of the layers that constitute the fundamental components of a building, allowing the performance of a building to be measured as the sum of its parts. Building literally in layers means elements with different lifespans can be separated and removed, allowing longer-lasting elements to be kept in use even if those with shorter lifespans require replacing. This facilitates reuse, remanufacture and recycling. This also avoids large scale wastage of assets, lowers resource use and other environmental impacts, and obviates the need to construct entirely new buildings and assets. Building in separate layers with different lifespans also allows each element to be repaired, replaced, moved, or adapted at different times without affecting the whole building or infrastructure asset. This reduces unnecessary obsolescence and increases flexibility of use and longevity over time (Arup & European Circular Economy Stakeholder Platform, 2020).

> "The current iteration of the 'Green Star – Buildings' tool includes several requirements that align with the circular economy:
>
> - diversion of construction waste from landfill
> - design for effective operational waste management
> - responsible procurement of products and services for best practice environmental and social principles in building structure, envelope, systems, and finishes
> - low energy consumption and energy sourced from renewables, and
> - low environmental impacts from resource use over the building's lifespan shown through comparative lifecycle assessment".
>
> (GBCA, 2021)

More importantly, these assessment tools, along with green building rating schemes, are critical for understanding the quantification of costs and benefits over the investment lifecycle and the ESG benefits through the development process of the built environment. There are significant circular economy synergies with existing built environment schemes including the GBCA's - Green Star rating system, the International Living Future Institute's (ILFI) – Living Building

Challenge[22], and NABERS[23], which have been continuously developed and enhanced since their inception, over the last two decades. “Internationally, other rating tools and frameworks have sought to address circular economy issues, with the most comprehensive example being DGNB (Germany), LEED (US) and BREEAM (UK) have similar credits to Green Star, with some additional regional variations to account for their supply chains” (GBCA, 2021). NABERS rates buildings on their operational performance in energy, waste, and water. As a federal government endorsed scheme, it now mandates that all commercial office buildings with a floor area exceeding 1,000 square metres must have a NABERS energy rating before they can be leased or sold. This mandate is raising awareness of the energy efficiency of buildings and creating a competitive investment marketplace, lifting the energy performance of buildings across the commercial office sector of the built environment.

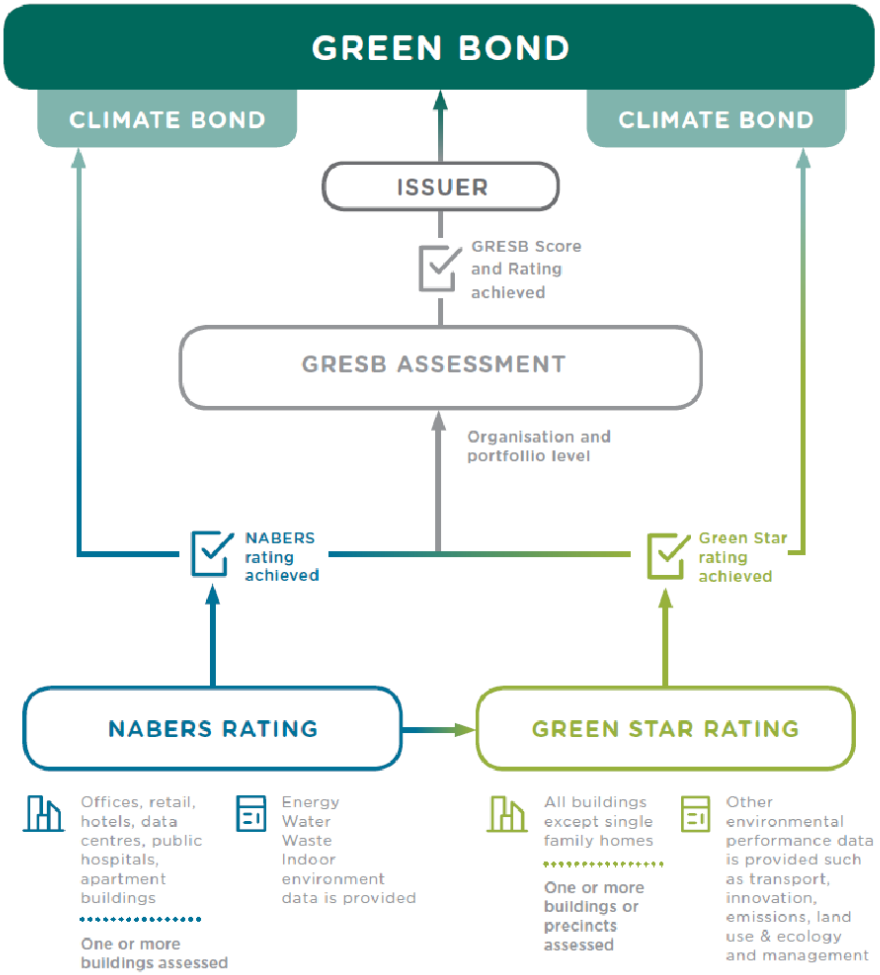


Figure 7: Ratings Schemes and Benchmarking for Issuing Green Bonds.
Source: Sustainable Finance Industry Guide (2019)

[22] Living Building Challenge – environmental impact & materials assessment
[23] NABERS – Energy, Water and Waste flows in commercial buildings, with mandatory reporting of energy ratings in the sale and lease of commercial buildings over 1,000m²

Figure 7 provides an indication of how the information contained in the combination of NABERS and Green Star is used to provide a GRESB assessment to leverage the issue of green bonds in the international commercial property market. ICMA (2021) lists both circular economy initiatives and green buildings that are eligible for use of green bond proceeds.

In recent years we have started to see various circular economy strategies, tools and frameworks incorporated into existing built environment sustainable development tools and schemes. However, when assessing the circular economy of the built environment from a finance perspective, the UNEP FI Financing Circularity: Demystifying Finance for Circular Economies Report (UNEP FI 2020) identifies the following gaps that remain to be addressed for circular buildings to become mainstream:

- For the financial picture to succeed out, the environmental externalities of the construction industry need to be included so that the measurement of the financial benefits of circular buildings really materialise.

- To conform with the 'Value Hill' approach, the development of markets for secondary materials and building components needs to be established. Without efficient marketplaces for second-hand building materials, the costs of planning and designing circular buildings will be higher than a conventional building (take-make-waste). Recycled materials can potentially be more expensive due to the processes of retrieval, logistics and cleaning.

- Agreement on the timing of the future availability of building materials can potentially be facilitated by financial forward contracts. These forward contracts on building materials could financially settle the right to harvest the materials in a building as a financial and transferrable contract between building owner and the reusing party. Forward contracts on building materials would make a case for planned obsolescence of buildings with such buildings acting as materials banks.

- From an accounting (e.g., the amount to be written down) and valuation approach (e.g. residual value) need to be adopted to the creation of a market for secondary materials.

- Practical alignment of the use of the materials passport with the reduction of maintenance cost of the building is needed (e.g., reduce cost through planned preventive maintenance and less incident-based maintenance).

Adopting a circular economy approach for the built environment requires strategies, tools, schemes and frameworks that are capable of measuring and assessing material flows from inception to the end-of-life across the built environment from the materials that constitute the micro or product level that are combined to form buildings, to their interaction in the cities we occupy with associated infrastructure. Assessment tools such as LCA, MFA, and EPD are generally capable of functioning at the micro and the meso-level, but the quantity of information required to be shared amongst the numerous stakeholders over the life cycle of the building is enormous and to be relevant to a circular economy they must function in a continuous, dynamic manner, with the data required and information flow to be constantly updated for all stakeholders throughout the building lifecycle. To facilitate a shift toward the circular economy, these evaluation tools and systems require significant data input of the

constituent materials that constitute the built environment to measure and quantify appropriate impacts over the material life cycle. Integration of data from tools such as LCA and MFA can occur in programs such as Building Information Modelling (BIM) to facilitate data management across the construction and operational life cycle of a building.

The built environment rating schemes such as Green Star and NABERS when measured on a continuous basis against circular economy initiatives and benchmarked through international sustainable building schemes such as GRESB, provide an avenue for the procurement of investment capital by issuing green bonds. When considering the circular economy aspects of the built environment these established green building rating schemes provide an approach to measure circular economy benefits.

4.2 Best practice example: Lendlease

This example showcases how circular economy creates value for financial capital providers to attract investment inflows. WBCSD (2021) provides numerous business case examples of circular buildings demonstrating that these buildings are not assessed purely by economic benefits, but also by the interconnected environmental, social and economic benefits relevant to geography, culture and demographics. Measuring economic return on investment is still a challenge when stakeholders still perceive circular buildings as innovative deriving value from market differentiation.

Lendlease was selected as a best practice exemplar of a global organisation, based in NSW as one of the leaders in implementing circular economy strategies and at the same time creating value for financial capital providers. Lendlease has been adopting the IIRC's Integrated Reporting Framework since 2016 (see Section 3.2 for details of this alternative reporting). Some of their development projects that have adopted circularity strategies and the outcomes achieved are discussed in this section.

Barangaroo South is a CBD renewal project built to the west of the Sydney CBD on what was a 22-hectare freight terminal in Sydney/Darling Harbour. The precinct wide approach to the development of Barangaroo was recognised with a 6 Star Green Star Communities rating, the first precinct of its kind to receive this rating (Lendlease, 2018).

Leveraging off the success of Barangaroo and other international developments, and furthering their commitment to sustainability, Lendlease have recently raised capital through sustainable finance. Over A$1 billion (equivalent) in green bonds has been raised in the UK and Australian markets. Lendlease is now the largest ASX listed non-bank issuer of green bonds. In the past year, Lendlease also completed approximately $1.5 billion of sustainability linked loans denominated in AUD, USD and EUR (Lendlease, 2021).[24]

[24] https://www.lendlease.com/media-centre/media-releases/lendlease-completes-first-uk-green-bond/

Figure 8: Barangaroo South, Source: Lendlease, 2021. (left) ; International House Barangaroo South, Source: Architect News 2018 (right)

The development of Barangaroo South embraces many components of the circular economy. The site required extensive remediation from significant environmental degradation and contamination from the previous industrial activities.

The environmental targets set for Barangaroo South of carbon neutral, net water positive and net zero waste have established new precedents for sustainable design, construction, and operation of large-scale precincts. One building at Barangaroo South that exemplifies the materials aspect of the circular economy is International House, Sydney. This building was Australia's first commercial office building constructed of mass engineered timber using Glulam/Laminated Veneer Lumber (LVL) beams. This type of construction resulted in a 40% reduction in embodied carbon, a reduction in the building's global warming potential by 91% as revealed by LCA.

International House was an innovative design and ambitious construction project using unproven materials in the construction of commercial office accommodation. The initial concept was rejected by the capital investment markets as being too risky, with uncertainty as to how the commercial market would perceive this innovative building. The developer, Lendlease persevered, and the building has gone on to win numerous design and architectural awards and is regarded as the pioneer of timber construction in commercial buildings in Australia, laying the foundations for influencing new design, materials use and construction techniques.

Following on from the success of International House, Lendlease developed 25 King Street, Brisbane, a nine-storey office building, the tallest timber commercial building built to date, in Australia. The building was developed by Lendlease in conjunction with engineering firm Aurecon, the major tenant of the building. By using this type of timber construction, the gross weight of the building is reduced, requiring less materials with a reduced environmental

footprint. This innovative use of timber in commercial construction addresses fire risk concerns meeting National Construction Code (NCC) requirements for occupant fire egress. To meet relevant Australian standards, phenolic adhesives are now used in commercial timber buildings which do not give off formaldehyde or other volatile organic compound (VOC) gases (The Green List, 2018). The production of timber materials for construction are now covered under ISO 14025 and EN 15804. The construction method indicates a 74% reduction in embodied carbon (when carbon capture is included) or a 48% reduction in embodied carbon in materials excluding carbon capture (Lendlease, 2021).

Figure 9: 25 King Street Brisbane.
Source: Aurecon Projects 2021

25 King Street, Brisbane, was purchased by IIG Impact Investment Group whose primary objectives are stated on their website as:

"We have investments in high performing commercial properties, aiming for those with industry-leading environmental credentials, A-Grade accommodations, and long tenancies. Once acquired, we take an active approach to managing them, liaising with tenants and operators to improve their environmental and social impacts and maintain strong leases. With this style of investment, we aim to deliver attractive yields with the potential for capital appreciation over the terms of the investments. These investments can have significant

long-term benefits; we aim to marry capital growth with the deepest of environmental and social impacts." (Impact Group, 2021).

Lendlease recently announced two new sustainability targets that reflect the group's commitment to this area:

- The environmental target sets a global benchmark for the real estate industry by becoming a 1.5°C aligned company and committing to 'Net Zero Carbon' for scope 1 and 2 emissions by 2025, and 'Absolute Zero Carbon' across all operations, including the supply chain, by 2040.

- The social target signposts Lendlease's aspiration for delivering social benefit by committing to the creation of $250 million of measured social value by 2025 (Lendlease, 2021).

Financial capital investment is now being attracted to these highly rated Green Star buildings. These 6-Star, premium rated buildings are attracting premium net rents, and in conjunction with high operational performance efficiency in energy, water, and waste as measured through NABERS are resulting in decreased operational expenses incurred over the life cycle of the building. This provides an incentive toward investment in these properties as the long-term return on investment is superior to those buildings that do not engage in these circular economy practices. The requirement for ongoing capital investment is reduced, along with reduced operating expenses over the life cycle of the building. By incorporating a circular economy approach using tools such as LCA, MFA, EPD, coordinating this information through BIM and measuring compliance and performance through Green Star and NABERS, this coordinated approach ensures a decreased risk over the investment lifecycle, therefor reducing the investment hurdle rate, equating to a superior investment opportunity.

4.2.1 Summary

In Australia we have yet to see the widescale adoption of the circular economy within the built environment, but leading commercial development organisations such as Lendlease, who have adopted a sustainable development and green building approach are adopting many of the aspects of the circular economy in the design, construction and operation of their buildings. The benefits of adopting a circular economy approach are being realised across the whole life cycle of the development, from the cost benefits in materials selection through to financial benefits by improving operational efficiency. Moreover, growing industry influence in green building construction and operational efficiency is increasing market acceptance of the circular economy attributes of the built environment.

4.3 Circular liability and transition risks

There is a shifting emphasis for investments in the built environment in that, "investors are increasingly looking at ESG reporting credentials of business to help determine future business viability" (WBCSD, 2021a, p. 5). To satisfy this investment market demand, a shift toward ESG is required across all stakeholders operating in the built environment. UNEP FI (2018) in collaboration with other financing institutions developed the Positive Impact Real Estate Investment Framework to assist property investors develop and implement an impact-based

approach at any stage of the property investment cycle. While the framework seeks the positive integration of ESG principles and also meet the SDGs, circularity objectives could be added as elements with a corresponding outcome that will support the transition to a circular economy.

> "The circular economy approach changes ways of thinking, designing, constructing, and managing assets … a huge amount of data will be generated and shared between multidisciplinary stakeholders … and require efficient and specific management"
>
> Charef & Lu, 2021).

There is an adaptation process required for built environment stakeholders to transition toward a circular economy approach and modify their role in the 'value chain', "…the full exploitation of the strategic, analytical, and communicational benefit of business models for a circular transition requires three additional dimensions: the sustainable value creation, proactive management and the enlargement of the stakeholders' network and a long-term perspective" (Centobelli et al., 2020, p. 8). (Charef & Lu, 2021) identify 64 factors impacting the adoption of the circular economy in the construction industry across stakeholder interests. These factors are summarised in a table in Appendix 3.

One of the key risks associated with the transition toward a circular economy is the paradigm shift required away from the linear economy. The transition to a circular economy will require scaling up the financing towards investments that provide environmental and social benefits but the market lacks guidance on how to uniformly define and apply circular economy thinking. UNEP FI (2020) suggests a pathway for integrating circularity into construction and real estate finance is through the integration of circular economy metrics into mainstream building certification (e.g., BREEAM, GRESB or LEED). For example, the following circular building criteria metrics using the 'R' List, incorporating the 'Value Hill' model could potentially be used:

- **Reduce –** material usage for construction, the search for lighter, less carbon intensive materials e.g. by using wood instead of concrete;
- **Refurbish –** upgrade existing buildings to avoid starting from scratch, e.g., restoration or stripping of facades and outer layers of the building to maintain the constructive core;
- **Retrofit –** design the building for future disassembly, e.g., by developing and using non-destructive connections between various building materials. The decision on whether to demolish a building or to retrofit it can be supported by calculations of embodied emissions of the existing building in comparison to building a new structure and adherence to the building layers principle displayed in Figure 6;
- **Reuse –** design the building with as much reused material as possible, e.g., adding a percentage of reused material to concrete;
- **Redesign –** use bio-based materials or lighter materials or materials that are easier to disassemble;

- **Refuse –** builders, users and companies in supply chains can avoid using chemicals harmful to humans and the environment.

As discussed in Section 2.3, ICMA (ICMA, 2021) has developed guiding principles through their green, social and sustainability bonds as well as sustainability-linked bonds to attract capital to finance these requirements. These principles have become the leading framework globally for the issue of sustainable bonds.

Arup and EMF released a joint report that aims to demonstrate the value and process of implementing circular economy principles in the built environment to real estate investors and construction clients (Arup & European Circular Economy Stakeholder Platform, 2020). This report also revealed that policy makers require an evidence base of the benefits of a circular economy and demonstrated that value, and the way in which it is created from real estate assets is set by investors and construction clients through investment requirements, tenure models and design briefs, developed within the confines of the policy environment in which they operate. The report further proposes five new business models which capture each source of lost value in the built environment sector (e.g., vacancy, premature demolition, vacant lot, depreciated materials and underperforming components) and responses to the market trends using circular economy principles to create value. For each business model, there is a demonstration of how circularity could be qualitatively assessed. The report also illustrates the evaluation of the financial value created by the circular business model in comparison to a linear model using the discounted cash flow analysis.

In the report, 'Funding and Financing Infrastructure for a Net Zero Future', PricewaterhouseCoopers (2021) explores lessons learnt from global cases of innovative approaches to fund and finance green and circular infrastructure from a private investor perspective. Their key findings suggest that significant innovations are in-place with some common characteristics such as:

- government programs addressing technology risk by supporting scale and "industrialisation" of new technology,
- aligning incentives so savings from improved performance are captured by the financier and
- long-term savings or avoided costs amortised to high capital costs suitable to private finance where government can guarantee payments.

The World Circular Economy Forum 2021 suggested that new financial instruments and innovative models are fundamental to progressing the circular economy. In tandem with conventional lending, micro financing has proved to be valuable in facilitating smaller community-led circular initiatives. Blended financing models, such as concessional financing, can help de-risk emerging technologies. One of the mechanisms suggested to accelerate financing include capacity building.

Many financial stakeholders do not yet fully understand circular business models, in comparison with more traditional linear models. Financial capital providers may perceive that investing in

circular businesses is higher risk, with higher costs and potentially lower performance. Some European banks (e.g., ABN AMRO) hold workshops with clients on how to move from linear to circular business models and are also educating their employees, particularly those on the front-end of the subject, to increase their awareness of the circular economy. Another mechanism suggested at the Forum was to de-risk investment decisions through transparency and awareness building. Investors and risk committees involved in financial decision-making often lack an understanding of the long-term benefits of circular products, services, and/or business models, and often consider them higher risk. To help educate investors, business owners and developers should look to build confidence by adequately showcasing their business models and product manufacturing processes.

4.3.1 Mapping the circular economy transition process

The rejection of the entrenched linear economy is unlikely to eventuate until a superior alternative is determined. For the circular economy to be adopted as a relevant alternative, the merits must be demonstrated and need to be adopted by all stakeholders. The following nine steps are proposed as a method of navigating through the transition toward a circular economy.

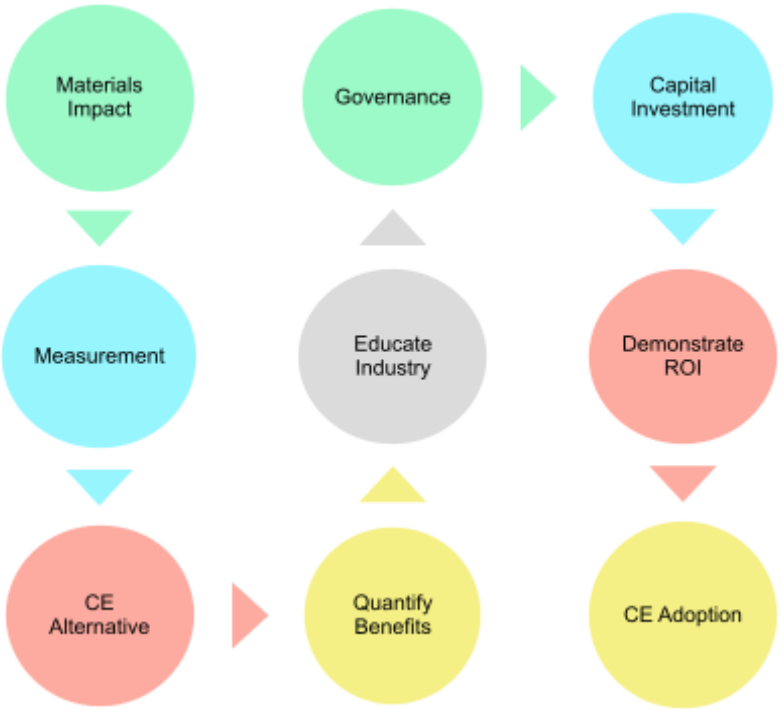
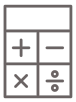


Figure 10: Circular Economy Transition Process.
Source: Author 2022

The Circular Economy Process

Steps	Key Recommendations
	**Step 1. Material Impacts** The transition process commences with an understanding and acknowledgement that the flow of materials through the production process cannot continue unabated under a linear economy approach of take, make and waste. The material impacts of the production process are clearly demonstrated in the rising levels of CO_2 in the atmosphere due to anthropogenic emissions, scientifically proven to contribute to climate change.
	**Step 2. Measurement** Appropriate measurement tools are required to understand the material impacts as they effect the economy. Tools such as LCA and MFA provide the ability to calculate inputs and measure flows over the life cycle of the material.
	**Step 3. Circular economy as an alternative** When global impacts are identified and measured, the limitations of the linear economy are demonstrated and acknowledged, the continuation of pursuing a linear economy is not a viable option. The rejection of the linear economy will not occur until a viable alternative approach is determined. Step 3 promotes the circular economy as an alternative to the linear economy, but the circular economy will not supersede the entrenched linear economy until the benefits of the circular economy are demonstrated and accepted as superior to the linear economy. This is where the adoption of the circular economy approach currently resides, where organisations such as the UN and EMF are demonstrating the attributes of circular economy in preference to a potentially destructive linear economy.
	**Step 4. Quantify the benefits of a circular economy approach** Once the concept of the circular economy is developed, it is then necessary to demonstrate the concept and quantify the benefits. From a built environment perspective, the circular economy approach is a dynamic construct over the life cycle of a building from design through to the end of life (EOL) of the building. The financial benefits of a circular economy approach to financiers and investors in the built environment can be determined by financial tools where the capital investment in the built stock can be assessed against material flows income and expenditure, over the investment lifecycle.
	**Step 5. Educate industry** The concept of the circular economy is relatively recent in the built environment but aligns with many green building rating schemes. There are built environment market leaders that adopt highly rated green building schemes and where these schemes integrate circular economy concepts and criteria. Industry organisations such as the GBCA and GRESB provide tools and benchmarks for widespread industry adoption.
	**Step 6: Governance** Governance is an essential component of the transition toward a circular economy. Governance relates to corporate, government, non-government organisations (NGO's), public and private enterprise. Many of the green building and circular economy initiatives are based on voluntary agreements and codes such as ISO 14025 and EN 15804 or the GBCA Green Star rating schemes, or even international net zero carbon emission agreements as discussed and adopted at COP26. As stated in the interviews conducted by the GBCA in their circular economy workshop "one of the strongest perceived barriers to circular economy progress in Australia's built environment is a lack of supportive policies, regulations, and standards across levels of government" (Arup & European Circular Economy Stakeholder Platform, 2020). For governance to be effective in the adoption of the circular economy many of these voluntary codes and agreements need to become mandatory.

	**Step 7: Capital Investment** As we transition through the process and the supporting evidence for a circular economy becomes quantified, as well as mandated through government, and adopted by industry, capital investment in the circular economy will be directed toward this preferred investment approach.
	**Step 8. Demonstrated return on investment** For a shift toward capital investment in a circular economy, industry acceptable cash flows from circular economy investments are required to demonstrate that superior returns on the capital investment is achievable. The return on investment under a circular economy approach must be superior to that derived from a linear economy investment. For a relevant comparison between the linear and circular economy, the cost of externalities needs to be considered in the linear economy calculation.
	**Step 9: Circular economy adoption** A circular economy is complex in comparison to a simple linear economy. Each of these steps need to be integrated into the process to ensure a circular economy approach is adopted and seen as a viable alternative to linear economy approach. It is also worthwhile to note that the circular economy transition process is not linear. The parties in a circular economy (governments, financial institutions and property developers) will also have to work in conjunction with each other. For example, return on investments (ROI) and ESG benefits must be demonstrated across all stakeholders. From the corporate sector there is increasing investor interest in the circular economy and green building initiatives, initiated from overseas investment companies. This is resulting in a lifting in industry compliance within the Australian commercial property industry as evidenced by the performance of Australian listed property funds on the GRESB ratings index. Businesses that continue to operate under the 'business as usual' or linear economy approach are being downgraded, increasing their cost of raising capital. In the case of the built environment, highly rated green buildings with high NABERS ratings are attracting a premium in the investment market, whereas those that are not, are being discounted. The primary risk for the finance and investment sector is to continue to operate as 'business as usual' ignoring the transition toward a circular economy.

4.3.2 Summary

The circular economy provides a necessary alternative to the linear economy, but the complexity of the circular economy in contrast to the simplicity of the entrenched linear economy creates a barrier to acceptance across the broader economic community. It is becoming increasingly important for sectors such as the built environment that are significant users of materials and contributors to waste and pollution, that alternative systems to the construction and operation of our buildings and cities reduces environmental and consequential social impacts. The circular economy approach provides this opportunity and is starting to be incorporated by built environment practitioners and accepted by government, business institutions and investors.

5.Proposed programme of work

The rapid review of the literature showed that there is the opportunity for more academic research as well as capacity building to be undertaken in this important and rapidly evolving area.

A proposed programme of work has been developed based on the outcome of the rapid review research, which outlines the key recommendations for future research and education (professional development), as well as current initiatives that are underway (where relevant). Education and research for the finance and investment sector will help to facilitate the growth of financing the transition to a more circular economy in NSW.

5.1 Proposed programme of work – Global initiatives and linear risks

The following proposed programme of work is relevant to Sections 2 (Key Global Initiatives) and 3 (Linear Risks) of this report. The review of the literature highlights that there are limited relevant academic publications regarding the circular economy and finance, and there exists the opportunity to conduct further research as well as capacity building (education) in this important and rapidly evolving area.

Initiative	Description
Develop a common understanding and language for circular economy finance	**Why:** There is a need to deepen understanding of circular vs linear and comparison of alternative business models, frameworks and measurement methodologies, which are important for investment and credit risk assessment. **What:** Develop a common language for circular economy for the finance and investment sector. Definition of circular economy and circular finance relevant to NSW – test with sector – given early stage, acknowledge that circular business models and projects are on a spectrum moving from linear to circular. Further exploration of alignment of circularity measurement tools between business and finance and investment sectors. A glossary of terms that are interpretable across technical circular economy practitioners, business as well as lenders and investors financing the opportunities, including linear (and circular) risks. Alignment with global and Australian initiatives, including sustainable finance taxonomy development to include circular economy. **Other parallel initiatives:** • EU Taxonomy is being expanded to incorporate the circular economy (working paper) and is to be updated in 2022. • ICMA voluntary guidelines and metrics for circular economy projects under the Green Bond Principles (working paper). • UNEP FI circular economy target setting for PRB signatory banks.

	• EU-led International Platform on Sustainable Finance – Common Ground Taxonomy (working paper) and country/region specific sustainable finance roadmaps and taxonomies that incorporate circular economy. • ASFI is considering an Australian sustainable finance taxonomy, based on the EU taxonomy, with the potential to incorporate circular economy.
Metrics to measure circularity and circular impact for the finance and investment sector	**Why:** to standardise metrics to measure circularity for the finance and investment sector, which can be used in financial decision-making, as well as the impact of circular loans and investments to make them more attractive. **What:** Develop/identifying business circularity measurement tools relevant to the finance and investment sector. • Compare metrics used by business vs used by finance and investment sector and arrive at a common set. • Consider datasets for measuring circularity and impact, including in supply chains. • Consider how circularity could change the strategies of the finance and investment sector itself. **Other parallel initiatives:** • Circular economy metrics relevant to NSW (ISF work for NSW Circular) – how apply to finance and investment sector. • Metrics being developed for EU Taxonomy and ICMA, as well as those being used by business (including EMF, Circle Economy, WBCSD, etc) • Sustainable Finance Platform in Netherlands (led by Dutch central bank) undertaking work on circular metrics for financing.
Develop risk identification and evaluation tools for the finance and investment sector	**Why:** Improving risk identification and assessment to better balance linear and circular risks and opportunities in loan and investment business portfolios as well as investment and credit risk assessment / financial decision making. **What:** Developing or fine-tuning risk evaluation / measurement tools, frameworks and identifying relevant metrics. • Consider linear (and circular) risk assessment as key part of credit applications and investment decisions. • Standardise metrics to measure linear (and circular) risks across the finance and investment sector and for specific industries. • Incorporate technical and operational circular economy terminology into risk assessments (e.g., CTI indicators). • Recalibrate credit risk assessment methods to correctly value circular business models and longer-term economic potential (cost-benefit models). • Develop improved understanding of risk and return profiles of circular business models. **Other parallel initiatives:** • Financial sector in the Netherlands through central-bank led Sustainable Finance Platform focus on assessment of linear and circular risks. • Risk assessment tools are being developed by the finance and investment sector and peak bodies (e.g. FinanCE Working Group and WBCSD).
Improve company reporting and disclosure of circularity	**Why:** to improve transparency and accountability of business and finance and investment sectors to include linear risks and circular economy considerations **What:** • Develop reporting standards for linear (and circular) risks as well as investment and loan assets/portfolios that include circularity. • Establish methodologies for valuing negative externalities of linear economy and advantages of circular economy.

	• Develop accounting and reporting standards regarding circular economy for companies, that can be used by the finance and investment sector. **Other parallel initiatives:** *including learning from climate disclosure* • Sustainability reporting (TCFD and potentially Taskforce for Nature-related Financial Disclosure (TNFD); ISSB) – circular economy integration into ESG reporting & recognition of linear and circular risks. • Regulatory – APRA: CPG 229 (climate risks) and Basel (climate related financial risks) - include circular economy. • ICMA and LMA/APLMA – ensure circular economy is considered for green, social and sustainability (GSS) bonds and loans.
Building an evidence base for circular economy finance	**Why:** to address data gaps and grow circular economy finance **What:** Reports on • How the circular economy can anticipate and mitigate linear risks for business and the finance and investment sector, including in supply chains. • Identify and address barriers that may currently impede investors and lenders from capturing the opportunity. • Understanding the circular economy market including the flow of materials and policy ecosystems.
Circular economy capacity building for the finance and investment sector	**Why:** Sharing good practice to encourage implementation and capacity building (professional development) **What:** Print, virtual and in person opportunities for learning and sharing • Communication and engagement plan – for research, financiers and investors • Learning and upskilling opportunities- e.g., masterclasses, professional development, networking forums, etc. • Sectoral case studies to demonstrate good practice examples of companies that pursue circular principles in their business models and strategies, including key insights into circular reporting, linear and circular risk mitigation and circular value creation - e.g. EIB, Intesa Sanpaolo, Dutch financial sector, Circularity Capital, Closed Loop Partners, PGGM, Brambles, Holcim and other Australian and international examples. • Encourage asset managers/investment firms and banks to make pledges to increase circular finance. **Other parallel initiatives:** • Some ESG-related professional development programs currently underway for finance and investment sector (e.g., NAB & University of Melbourne; Westpac & Monash University, UTS & Australian Institute of Superannuation Trustees)

5.2 Proposed programme of work – Built Environment

This paper was based on a rapid review of the literature pertaining to the circular economy. In undertaking the initial literature review through academic search engines Scopus and EBSCO Host GreenFILE with 'circular economy' as the primary indicator, 'built environment' or 'construction' as the secondary indicator and 'finance' or 'investment' as the third indicator, the searches failed to provide any relevant articles on these related topics. This indicated that there are opportunities for further exploration of the circular economy as it relates to finance and investment in built environment.

Initiative	Description
Evidence of circular economy initiatives in the built environment at the meso level.	**Why:** We identified organisations that were developing high rated green star and NABERS rated buildings, that exemplified circular economy attributes. **What:** Are there built environment practitioners in Australia that are specifically engaging in circular economy practices as a core initiative or is the circular economy accounted for in these high-level green building rating schemes? What barriers are built environment industry practitioners facing when undertaking a circular economy approach? Do built environment practitioners see the circular economy as a relevant initiative?
Effectiveness of financial evaluation tools of the circular economy in the commercial property market.	**Why:** Developers, asset managers, investors and financiers use recognised financial evaluation tools when investing in the built environment. These accepted methodologies consider buildings under a linear economy approach. Differentiated methodologies are required for appraisal of buildings to determine the investment attributes under a circular economy approach. **What:** Valuation methodologies The 'Hierarchy of Elements' suggests viewing materials as comprising different layers of a building and applying the summation valuation method across each layer. Although this is presented as a valid valuation methodology, is it an acceptable methodology for the investment community? Discounted cash flow analysis (DCF) A discounted cash flow under a linear economy approach provides the opportunity to assess the initial capital investment against the income and expenditure cash flows over the investment lifecycle. As the circular economy assesses inputs, stocks and flows of materials over a lifecycle, can a DCF be adapted to consider the material flows of buildings and convert the outcomes to financial investment criteria?
The use of technology in the collection and management of data bases for materials over the building life cycle.	**Why:** One of the significant risks to the implementation of the circular economy in the built environment is collection, collation and updating of data in relation to the material composition over the life cycle of a building. **What:** The Smart City approach is being developed in response to the increasing impacts of urbanisation in our cities. The Smart Cities approach and Big Data presents an opportunity to incorporate the LCA assessments of materials and potentially assess the circular economy at a city level. Can those buildings and associated infrastructure constructed in a linear economy be assessed and integrated into a smart city analysis?

	BIM as a data base – Although BIM has been in existence for a decade, the utilisation of this program is only infiltrating the built environment design and engineering professions. BIM has the ability to integrate materials assessments and compositions and store them as As-Built documents for a building. The technology within BIM has the potential to translate materials assessments to building and facilities managers allowing improved operational performance of the building. What are the limitations of BIM technology in translating materials analysis over the operational life cycle, to building asset managers? What other asset management systems are available to manage this storage and assessment of data?
Cost benefit analysis of material impacts over the building life cycle.	**Why:** Continuing global population growth and urbanisation has resulted in the depletion of certain raw materials and serious impacts to ecology. **What:** To compensate for raw material depletion substitute materials may be incorporated into the supply chain. Do these substitute materials adequately address resource depletion, meet the needs of the building and construction industry, reflect the thermal and daylighting requirements of the occupants, and are they compatible with existing material compounds. Are they an inferior or superior alternative? What are the costs and benefits of materials use in the construction process and facilities management over the life cycle of a building? How do we effectively address boundary limitations and assess the cost of externalities in the assessment of materials in the circular economy?
Quantifying social benefits of the circular economy in the built environment.	**Why:** Under a linear economy approach improvement of social capital has been difficult to quantify and therefore largely ignored. A circular economy approach needs to consider ESG to be effective. The quantification of social capital provides an opportunity for the circular economy to differentiate itself from the linear economy. **What:** Many of the leading property development companies are attempting to differentiate themselves in the marketplace by addressing societal needs, with catch phrases such as “making places where people thrive”. Major infrastructure investment is leveraged off the value it creates for the community, but how is this value measured and calculated? What are the social benefits in undertaking a transformation to the circular economy and how are these benefits quantified? Could evaluating the reduction of environmental benefits be used as a proxy for the societal value of the circular economy?

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Appendix 1: Key Initiatives and Tools for Business

Table 5: Key initiatives and tools to identify and measure circularity for business

Initiative (Tool) / Developer	Purpose / comment
Circulytics -EMF https://ellenmacarthurfoundation.org/resources/circulytics/overview	• Company level circularity measurement tool that measures circularity across company operations • Categorises enabling indicators (such as strategy, innovation, systems, process and skills), as well as outcome indicators to measure circular performance
Circular Transition Indicators (CTI) - WBCSD (and KPMG) https://www.wbcsd.org/Programs/Circular-Economy/Factor-10/Metrics-Measurement/Circular-transition-indicators	• Self-assessment framework to provide insights into circular performance and identification of opportunities and linear risks • Focus on indicators such as resource use optimisation and material flows for products, including across value chains • Sets a baseline and prioritises actions to monitor progress • Aligned with EMF circular economy principles
Circle Assessment – Circle Economy https://www.circle-economy.com/services/businesses	• Focus on performance and process indicators, such as recycling, digital platforms and circular business models • (also, Circularity Gap Metric - focus on percentage of circular materials in single value chains)
CIRCelligence -Boston Consulting Group https://www.bcg.com/capabilities/social-impact-sustainability/circular-economy-circelligence	• Proprietary metric and tool that allows companies to develop a detailed understanding of circularity performance • Includes quantitative and qualitative aspects, including across value chains

Figure 11: Circularity metrics and tools for business

Source: Circle Economy (2020) Circular Metrics for Business – Finding opportunities in the circular economy

Appendix 2: Linear Risk Matrices

FinanCE working group:

The FinanCE working group, supported by the EMF, was founded in 2014 and brought together a group of organizations interested in the transition to a more circular economy. They developed the 'Linear Risks Matrix' as a guiding framework to help investors and companies identify and understand their exposure to linear risks across a range of linear economic business practices. Similarly, businesses can also use the matrix to identify which aspects of their operations follow linear practices and as a result, what types of risk factors they should be aware of. These practices are outlined in Table 6 and include (Ramkumar et al., 2018):

- Utilise non-renewable resources – the company supplies or relies on primary resources that will become scarce or non-renewable for its operations.
- Prioritise sales of new products – the company designs for short, single product ownership lifetimes that results in landfilling, incineration and export of waste products.
- Fail to collaborate – the company maintains strict control over knowledge and does not engage in partnerships or collaborative projects.
- Fail to innovate or adapt – the company maintains their perspective on the market and does not innovate or adapt to evolving market conditions.

Table 6: Linear risk matrix (FinanCE working group)

Risk Factor	LINEAR BUSINESS PRACTICES			
	Utilise non-renewable resources	Prioritise sales of new products	Fail to collaborate	Fail to innovate or adapt
Market	Scarcity of primary resources	Bans on trade of waste	Limited opp. to expand to new markets	Scarcity of resources
	Volatility of resource prices	Volatility of resource prices		Volatility of resource prices
Operational	Internal process failures	Worker safety issues	Supply chain inefficiencies	Inability to hire new talent
Business	Changing demand for sustainable solutions	Disruptive new business models	Disruptive new technologies	Disruptive new technologies
	Decreasing cost of renewables	Decr. margins from commoditisation		Disruptive new business models
Legal	Fines for legal violations	Requirements for extended producer responsibility	Fines for legal violations	More stringent environmental laws
	More stringent environmental laws			

Source: Ramkumar et al (2018) Linear Risks

Rethink Global:

Rethink Global is a consultancy that helps business, public sector and community groups to encourage and support sustainable, circular approaches. Their matrix uses PESTLE[25] analysis to highlight potential business risks across each stage in the value chain from material selection to end of use practices, as outlined in Table 4 overleaf (Rethink Solutions Limited, 2021).

Table 7: Linear Risks Matrix (Rethink Solutions)

RISK FACTOR	VALUE CHAIN ELEMENTS					
	Materials Rely on virgin resources	**Design** Design for disposal	**Strategy** 'Sell more' business model	**Production** Cost-down processes	**Supply Chain** Complex and long-distance	**Use & end-of-use** Waste & pollution impacts
Political & Economic	Demand exceeds supply for key resources		Investors switch to sustainable projects		Geopolitical issues; trade tariffs	Bans on international movement of waste
	Resource costs impacted by tariffs & export limits		Customers shifting away from ownership to services		Value leakage' from failure to recover, repair etc	Difficult to recycle/reuse products damages reputation
Social & demographic	Unsustainable resource use puts off customers & employees	Planned obsolescence turns off customers & employees	Trend towards experience & sharing economy	Cost-down approaches undermine safe processes	Best suppliers prefer to work with circular businesses	Not recovering own products creates competitor opportunities
	Consumers preferring sustainable products	Customers avoid items that are difficult to repair/resell	Difficulty in attracting & engaging employees			Customers avoid items that are difficult to reuse/recycle
Technological	Use of toxic/unsafe materials impacts worker's safety	Failure to 'virtualise' offer	Overproduction for economies of scale leads to overstocks	Use of toxic and unsafe process inputs - worker safety	Vulnerability to shocks e.g. extreme weather events	Mixed materials are difficult and costly to recycle
			Sales forecasting for trend-driven market is difficult	Improved technology reduces cost of closed-loop systems	Large-scale production lacks agility	Design for disposal inhibits disassembly & recycling
Legal & Environmental	Tax on virgin resources (or incentive on recycled resources)	EPR* regulations may add cost to short lifecycle products	Tax incentives for repairs or reselling	Restrictions on discharge of waste & effluents	Carbon & clean fuel taxes drive up transport costs	Green taxes e.g. on landfill and waste disposal
	Regulations limit extraction, water use,	Right to repair legislation - impacts	Right to repair legislation - needs service & spares	Right to repair legislation - higher costs e.g. no glues	Right to repair legislation -provision of spare parts etc	EPR regulations require producers to

[25] Political, Economic, Social, Technological, Legal & Environmental factors

	land use change etc	product design				pay for end-of-life
					Lack of transparency increases risk of failure/ESG issues	Risk of claims from end-of-use pollution/illegal disposal

Source: Rethink Solutions (2021) Linear Risks Matrix

Circular Transition Indicators (CTI) framework, WBCSD

The CTI framework recommends a three-step approach to assessing identified risks.

- Scenario Planning: this involves describing different scenarios and using metrics from the CTI (framework described in Section 2.2) to assess the impact of linear risks on the business or investment. It references back to the four types of linear risks identified by the FinanCE working group. The different scenarios should include: business as usual, compliant with national/ international targets and a combination of global trends.
- Risk Severity: The CTI framework recommends assessing risk using 'Threat' and 'Vulnerability' as the two criteria, which correspond to inherent risk and residual risk respectively. Threats are defined in terms of impacts and speed of onset and Vulnerability is defined in terms of adaptability and recovery.
- Prioritisation Framework: the final step uses the Threat and Vulnerability variables defined above to set up a prioritisation framework to help identify which risks to address first and related circular opportunities and solutions.

Appendix 3: Built Environment Tools

Tools for Measuring and Assessing the Circular Economy for the Built Environment

LCA – Life Cycle Assessment

The Life-Cycle Assessment (LCA) is a widely adopted method to quantify environmental benefits of circular economy strategies in the built environment (Rahla et al., 2021). LCA examines the inputs and outputs of materials and energy and the associated environmental impacts over a building's operational life cycle from raw materials extraction, planning and design, construction to demolition/disposal/reuse.

Figure 12 provides an illustration of life-cycle stages as adapted for circular buildings, as defined in LCA European Standard EN 15978 and circular business models. Each element or a combination of many elements could be used as performance indicators when assessing the circularity of projects.

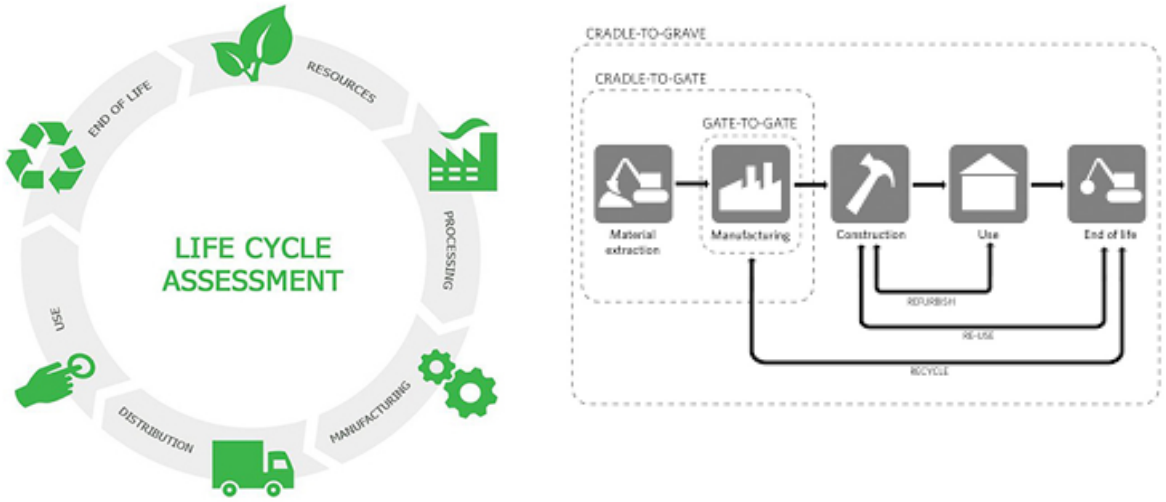

Figure 12: Life Cycle Assessment
Source: WBDG (Vierra, 2019)

When approaching LCA from a circular economy perspective, an appreciation of the significance of recycling, re-use and refurbishment is gained, to reduce the impact on the environment, starting as early as resource extraction, and moving away from a linear economy based on extraction, use and disposal. To meet net-zero carbon targets, it is important to measure **embodied carbon** in addition to **operational carbon** emissions. LCA performed before the design process results in the highest carbon reductions and lowest costs. As the project progresses, ability to reduce carbon emissions decreases drastically (WBCSD, 2021a).

MFA - Materials Flow Analysis/Accounting

Materials Flow Analysis/Accounting is a bottom-up approach to measure material input flows into an economy; how materials flow through the production process; what portion and amalgamation of materials is processed to provide new building stock; what quantity of materials are required to keep buildings and cities functioning effectively; and what level of material waste that is created during the demolition process. MFA assesses how much material is wasted throughout the process and expelled to landfill or as atmospheric and water pollution, versus how much is recycled and reused through the process.

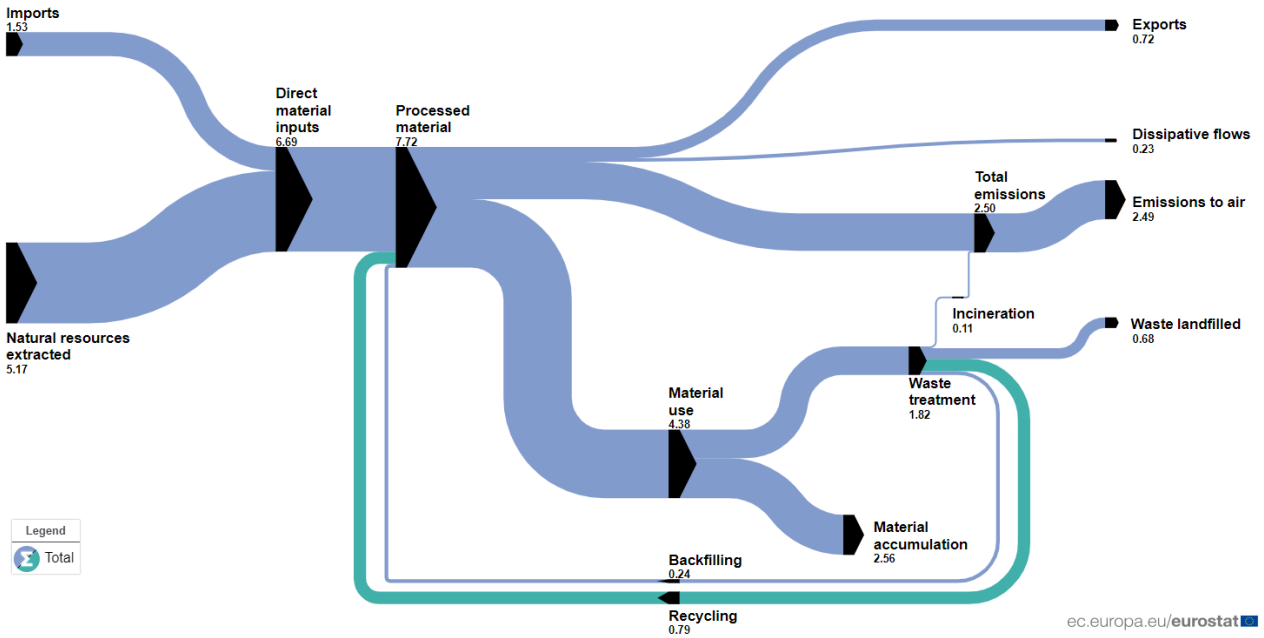

Figure 13: Material Flows in Gt/year EU 2020.
Source: Eurostat 2021

The Sankey diagram depicted in Figure 13 indicates the material flows of the EU in 2020. This flow diagram depicts both the linear nature of materials flows and the circular flows. In 2020, approximately 7.72 Giga Tonnes (Gt) of material flows into the EU economy of which 67% of material stock is from extracted natural resources; 19.8% of material inputs are from imports and only 0.79Gt (10.2%) of materials is through recycling, representing the circular economy. Through the production process, 2.5Gt (32.3%) of energy is expelled as emissions to air and 0.68Gt (8.8%) of waste is sent to landfill. Only 2.56Gt of material (33%) is accumulated as stock. Although this example focusses on the macro-level, MFA's can be conducted at the micro and meso-level. MFA is an important measurement tool to assess the productive capacity and flow of natural capital and understand the impact of materials outflow on the environment and resource efficiency of the economy.[26]

The following Figure 14 provides an assessment of the material flows for the construction industry at a city level for Paris France, 2013 (Augiseau & Kim, 2021). The material flows are calculated on a per capita basis and demonstrate that material inflows for construction stock in

[26] The Eurostat MFA webpage provides a comparison of the annual MFA of the EU over the last decade.

2013 are estimated to be between 1.8 – 2.1 tonnes/capita whereas the outflows are between 1.0 to 1.5 tonnes/capita.

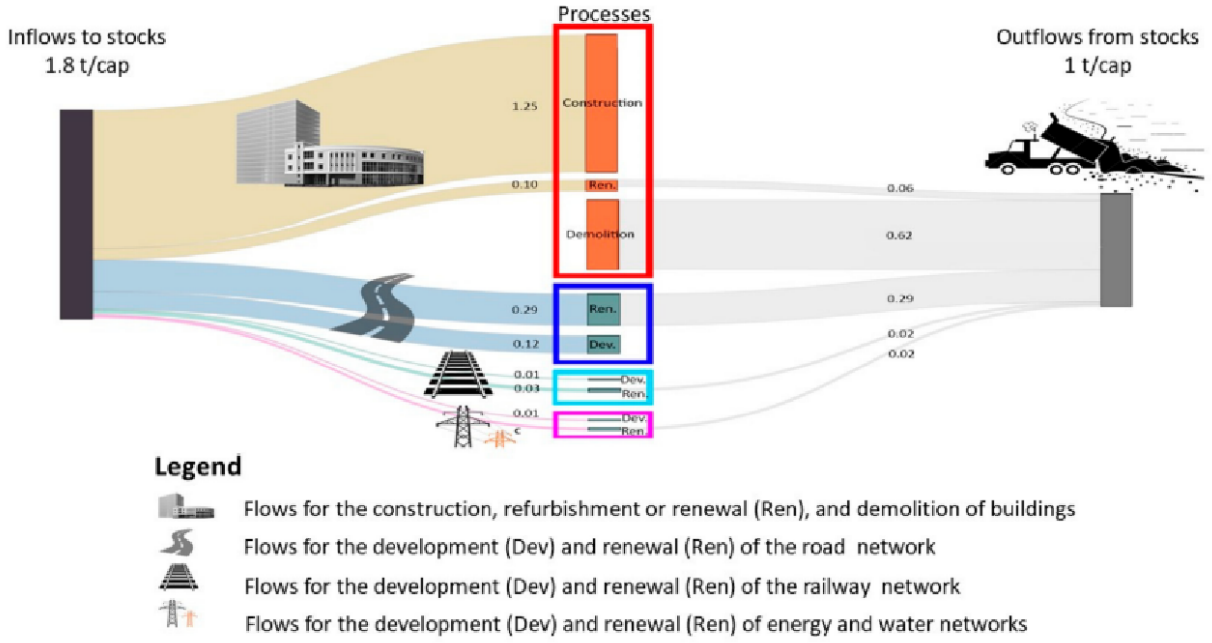

Figure 14: Inflows and Outflows by process, Paris Region 2013.
Source: Augiseau & Kim (2021).

The inflows and outflows MFA as outlined in Figure 14 provides an analysis of the material flows for construction and associated infrastructure, the material flows required to add to the stock of the built environment in the Paris region in 2013. The opportunity of employing a circular economy strategy into this process, is to reduce or eliminate the waste to landfill by diverting these material flows back into the construction process, significantly reducing the requirement for new material.

EPDs - Environmental Product Declarations

An **Environmental Product Declaration (EPD)** is an independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products. The International EPD System is a global program for environmental declarations based on ISO 14025[27] and EN 15804. Their database currently contains more than 500 EPDs registered by 150 companies in 27 countries. (Vierra, 2019).

[27] ISO 14025 Type III is the international standard for environmental declarations. The standard states that an environmental declaration must use quantified product life cycle environmental information according to predetermined parameters. EDPs include additional environmental information that enables comparisons between products. EN 15804 is the EPD standard for the sustainability of construction works and services for the construction sector. (Ecomatters, 2021)

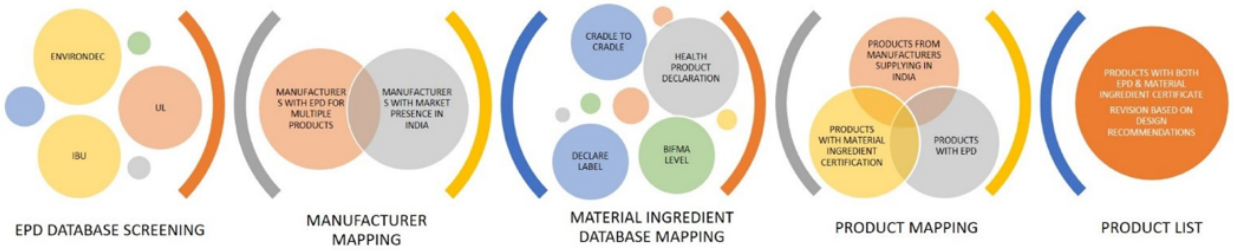

Figure 15: EPD flow chart adopted by GBC India to achieve LEED V4 MR BPDO credits
Source: GBCI 2021

Figure 15 provides an indication of the comprehensive process that the Indian Green Building Council (IGBC) undertook in using EPDs to achieve LEED V4[28] requirements for their new office space (GBCI 2021).

EPDs analyse the composition, interaction, durability, environmental impact, and lifespan of the materials of a product, component, and/or building. The widespread evaluation of EPDs of building materials can be used as an effective input into building level LCAs assisting in quantifying the circular economy concept in the construction process. EPDs are starting to be used as a measurement device in selected building products in Australia. The GBCA recently released the 'Responsible Products Framework' (GBCA, 2021) incorporating EPDs into their updated Green Star rating schemes.

Building Information Modelling (BIM)

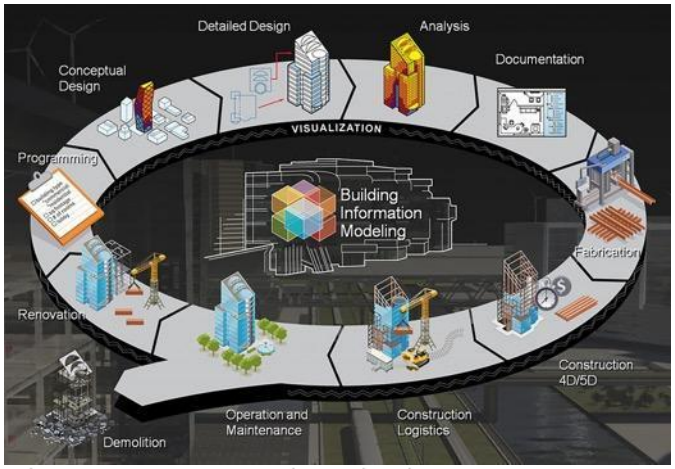

Figure 15: BIM approach to Circular Economy
Source: IQ-IM 2021

BIM is a digital tool that can integrate all the design, engineering, and materials data of a building into one shared digital library, that can then be used by all stakeholders over the design, the construction, and operational phases of a building. By using BIM as an integrated design tool, alternative designs can be developed to improve circular economy outcomes including the use and composition of materials, waste reduction strategies, building operational efficiency mechanisms and disassembly processes. The effective use of BIM across the life cycle of the built environment, from planning, design, engineering, materials use and compatibility, supply chain and construction through to operation provides the opportunity for the efficient use of materials in the construction process and a tool to integrate into the management of the building to optimise its lifecycle performance. From a financial investment

[28] LEED v4 is a more flexible, performance-based approach that calls for measurable results throughout the life cycle of a building. (USGBC, 2016)

perspective, BIM reduces wastage thereby reducing the capital cost of materials and by designing a building with integrated systems, the operating expenses over the life of the building can also be reduced increasing investment returns. BIM also allows the formation of a materials database incorporating data from LCA, MFA and EPD assessments. (Information Quality, 2021)

Charef and Lu (2021) identified 64 factors impacting circular economy adoption in the construction industry. “The circular economy approach changes ways of thinking, designing, constructing, and managing assets … a huge amount of data will be generated and shared between multidisciplinary stakeholders … and require efficient and specific management (Charef and Lu. 2021, pg10).”

Table 8 is a summary of the 64 factors highlights the issues and relationships in adopting the circular economy into the construction process, identified by the interviews conducted by Charef and Lu which outlines categories factors, identifies entities and determines relationships.

Table 8: Factors highlighting the issues and relationships in adopting the circular economy, adapted from Charef & Lu, (2021)

	Factors Affecting the Circular Economy Implementation				
	Asset	**Stakeholders**	**Collaborative Platform (Asset)**	**Collaborative Platform (Material Bank)**	**Regulation Bodies**
Organisational, Political and Procedural	Use technical sheet for decision making and materials passport	Set up rules for data exchange between project stakeholders		Consider zero waste strategy during entire asset life cycle	Early selection of contractors and manufacturers.
	Set up and manage collaborative platforms (assets and materials)	Define new deliverables for CE (BIM models etc)		Technology update to be able to access data anytime	Contract adaption for CE.
	Establish rules for interoperability between materials banks and recovered materials facilities	BIM execution plan, stakeholder requirements for CE		Set up EOL management requirements	Change in the tendering and procurement phases.
	Specify classification system			Set up a BIM dimension for EOL activities (assess the asset circularity)	Ease the approval for use of reclaimed material
	Ensure data availability and accessibility (assets and materials)			Data required for managing digitally and sustainably the asset EOL	Strategies for storing recovered materials
	Set up validation step (CE requirements) throughout the asset lifecycle			Improve design to avoid premature asset EOL (modularity, reversibility, flexibility, urbanism and social issues)	Clearance of materials specification and manufacturers responsibility about recyclability

	Factors Affecting the Circular Economy Implementation				
	Asset	**Stakeholders**	**Collaborative Platform (Asset)**	**Collaborative Platform (Material Bank)**	**Regulation Bodies**
	Set up Client Requirements & CE objectives			Design with reclaimed components	Establish Certification Program (CE)/ Cost
	Handover: Digital 'As-Built' documentation	Provide the digital 'As- Built' record to facilitate CE implementation		Establish waste management scheme	Define collaborative boundaries
	Establish processes and requirements to ensure reliability and update of the data and models in the platform	Scan existing building for BIM use/3D model for management		Recycling processes for waste generated 'in use' phase	Check the CE approach during the permit approval &Tax system
	Whole asset lifecycle cost estimation for CE (incomes from resell)			Preference for onsite recycling and waste management to reduce transport cost/impact	
	New budget division (Builders, control office, designers)			Create a new and reclaimed material database	
	New role creation – CE skills requirement			Keep as much as possible from existing buildings	
Social & demographic			Start CE by considering whole site history		
Technological	Rigorous material selection		Avoid using complex components		

	Factors Affecting the Circular Economy Implementation				
	Asset	**Stakeholders**	**Collaborative Platform (Asset)**	**Collaborative Platform (Material Bank)**	**Regulation Bodies**
			Consider buildings as systems		
Legal & Environmental	Product content transparency		Set up the responsibility of manufacturers for products recycling		
			Labelling salvaged materials to meet standards	Identify polluted materials	

Appendix 4: Rapid Review Search Sources

Academic databases:

- Scopus
- EBSCOHost GreenFile

International and national organisations (grey literature):

- Ellen MacArthur Foundation
- UNEP Finance Initiative
- International Capital Markets Association
- European Commission (and European Union)
- World Business Council for Sustainable Development
- Chatham House
- OECD
- World Economic Forum
- Circle Economy
- Chatham House
- Global Reporting Initiative
- Taskforce for Climate-Related Financial Disclosure
- Sustainability Accounting Standards Board
- Accounting for Sustainability
- Natural Capital Coalition
- Circular Impacts
- Green Finance
- The European Construction Sector Observatory
- Circular City Funding Guide

UNSW literature search and screening strategy

List of searched databases and websites (sources), with dates of search and search strategy details. When more than one search was conducted for a given source, the searches are

numbered. Lists of references assessed from separate searches were not duplicated (i.e. removing duplicate references), since many of the sources do not provide reference export functionality. Duplicated publications were removed during full-text downloading and assessment.

N1 = Number of references preliminary assessed, N2 = Number of full-text publications downloaded and assessed.

Sources	Search dates	Search method, keywords or search strings used	N1	N2
Ellen MacArthur Foundation (EMF) https://ellenmacarthurfoundation.org	26/10/2021 12/11/21 8/11/21	1. “circularity measurement“ OR “circularity assessment” OR “circularity tools” OR “circularity indicator” 2. “circular value” 3. “circular liability” OR “circular risk”	25 12 4	5 3 1
UNEP Finance Initiative (UNEPFI) www.unepfi.org	26/10/21 12/11/21 8/11/21	1. “Circular” OR “circularity” 2. “Circular” “value” “capital” 3. “Circular risk”	20 18 17	6 1
Scopus	29/10/21 8/11/21 14/11/21	1. TITLE-ABS-KEY ("circular economy" OR "circular*principl*" OR "circular* process*") AND TITLE-ABS-KEY ("financ*" OR "invest*" OR "asset*") AND TITLE-ABS-KEY (urban* OR building* OR built OR city OR cities OR construction*) AND TITLE-ABS-KEY (index* OR indicator* OR tool* OR assess* OR quantif* OR measur* OR score*) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)) 2. TITLE-ABS-KEY ("circular economy" OR "circular*principl*" OR "circular* process*") AND TITLE-ABS-KEY ("financ*" OR "invest*" OR "asset*") AND TITLE-ABS-KEY (urban* OR building* OR built OR city OR cities OR construction*) AND TITLE-ABS-KEY (value* OR capital*) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)) 3. TITLE-ABS-KEY ("circular economy" OR "circular*principl*" OR "circular* process*") AND TITLE-ABS-KEY ("financ*" OR "invest*" OR "asset*") AND TITLE-ABS-KEY (urban* OR building* OR built OR city OR cities OR construction*) AND TITLE-ABS-KEY (risk* OR liabil*) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)) TITLE-ABS-KEY ((circular*) AND (real AND estate*)) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)	299 231 49 43	22 10 4

EBSCOHost GreenFile	30/10/21 14/11/21	1. “circular economy business models” OR “circular economy indicators” 2. “circular economy" AND “risk” AND "built environment"	41 6	10
International Capital Market Association (ICMA)	30/10/21	“Circular” OR “circularity”	50	1
European Commission (EC) https://futurium.ec.europa.eu/en	1/11/21	Manual browsing (publications)	35	5
OECD, World Economic Forum (WEF)	30/10/21	Manual browsing (publications)	50	7
Circle Economy	1/11/21	“Built environment” AND “publications”	7	4
Global Reporting Initiative (GRI)	1/11/21	“circular”	12	1
Taskforce for Climate Related Financial Disclosure (TCFD)	1/11/21	Knowledge Hub: “Circular” OR “circularity” OR “recycling” OR “recycle”	0	0
Sustainability Accounting Standards Board (SASB)	1/11/21	SASB website manual browsing	10	4
World Business Council for Sustainable Development (WBCSD)	1/11/21	Manual browsing: Circular Built Environment	4	1
Accounting for Sustainability (A4S)	1/11/21	“Circular” OR “circularity”	25	1
Natural Capital Coalition **capitalscoalition.org**	1/11/21	“Circular” OR “circularity”	73	0
Circular Impacts circular-impacts.eu	1/11/21	Manual browsing: Deliverables	15	0
Green Finance https://www.greenfinanceplatform.org	14/11/21 14/11/21 14/11/21	1. Circular Transition Indicators 2. Circular value 3. Circular risk	125 150 161	1 4 3
The European Construction Sector Observatory (ECSO) **https://ec.europa.eu/growth/sectors/construction/observatory_en**	14/11/21 14/11/21 14/11/21	1. "Circular economy" AND "built environment" AND indicators (filters: last year, pdf) 2. "Circular economy" AND "built environment" AND “investment” AND “value” (filters: last year, pdf) 3. "Circular economy" AND "built environment" AND “investment” AND “risk” (filters: last year, pdf)	169 131 115	3 2
Green Building Council Australia new.gbca.org.au	21/11/21	“Circular”	521	2
Circular City Funding Guide www.circularcityfundingguide.eu	14/11/21 14/11/21 14/11/21	1. “Indicators” 2. “Circular value” 3. “Transition risk”	7 11 21	1
Chatham House **chathamhouse.org**	18/11/21	Publications: Article, Circular economy	51	

NSW
Circular