

Thought Piece

The Role of Infrastructure in the Circular Economy



15 April 2021



Global
Infrastructure
Hub

A G20 INITIATIVE

Executive summary

This thought piece for the G20 Infrastructure Working Group (IWG) is an examination by the Global Infrastructure Hub (GI Hub) of: the need to transition to a circular economy, the role of infrastructure in such a transition and the enablers for this transition. The purpose of this thought piece is to consolidate available literature and industry sentiment on the circular economy, specifically around the drivers, enablers and opportunities surrounding infrastructure's role in accelerating the transition to a circular economy. **This thought piece serves as a baseline for the discussions that will take place at the G20 IWG Workshop on the 30 April 2021.**

The extraction, manufacturing and production of materials is responsible for around 45% of global greenhouse gas emissions. A study shows that moving to renewables can only address 55% of these emissions, indicating that the 1.5°C target of the Paris Agreement can only be achieved by combining current efforts on renewable energy and energy efficiency with circular economy approaches.¹ The circular economy is therefore a powerful solution for meeting long-term policy objectives related to climate change. The circular economy can also reduce supply chain risks and short-term supply shortages by requiring less material input and establishing local secondary material supply.

The circular economy is centred around the 6R principles for circularity. The aim is to *refuse* (or significantly *reduce*) the amount of new materials entering the system. This is achieved by 'closing the loop' and maximising the amount of materials recovered and subsequently *reused, repaired, refurbished* and *recycled*. *Residual* materials are those that can no longer be reused or recycled, and the available pathways are to extract the embedded energy (e.g. through waste-to-energy) or to safely dispose of these.

Within this 6R framework, infrastructure has a dual role to play, first by increasing the 'circularity of infrastructure' in line with the 6R principles, and second by implementing 'infrastructure for circularity' (i.e. providing infrastructure that supports circular economy activity and the delivery of these 6R principles). Six opportunities for infrastructure were mapped to the 6R framework, and these include:

1. **Reducing or foregoing the need for finite materials in infrastructure:** Better and more efficient design, planning and delivery of infrastructure could have a big impact by reducing the demand for materials in construction.
2. **Replacing finite materials with renewable materials:** Replacing conventional infrastructure solutions with green, climate-resilient, nature-based and pre-fabricated solutions could reduce the demand for construction materials.
3. **Infrastructure that enables material reuse, repair, refurbishment and recycling:** 'Closing the loop' will require new kinds of waste recovery, reuse and recycling facilities – including treatment processes, sharing networks, reverse logistics and marketplaces.
4. **Infrastructure that enables resource recovery / near zero waste strategies:** Infrastructure for waste collection and sorting needs to be in place to enable the reuse, repair, refurbishment and recycling of materials.
5. **Infrastructure that enables waste-to-energy:** This type of infrastructure enables the recovery of the embedded energy within residual materials that can no longer be reused or recycled within the system. Waste-to-energy is not technically considered 'circular' as it is dealing with materials at the end of life. However, it is part of a solution to waste and pollution, and would help many countries step away from landfill reliance in the transition to a circular economy.
6. **Digital infrastructure / InfraTech:** Implementing digital infrastructure and technology enables connectivity, automation and optimisation of circular economy activities across the value chain.

¹ Ellen MacArthur Foundation (2019). *Completing the picture: How the circular economy tackles climate change*. Ellen MacArthur Foundation. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-Tackles_Climate_Change_V3_26_September.pdf

To effectively implement these infrastructure opportunities at scale, significant systemic change and technological innovation will be needed. This thought piece uncovered key elements of transition, which policymakers should contemplate. These include:

- Raising awareness by presenting the evidence for change, specifically for infrastructure
- Facilitating policy dialogue
- Identifying opportunities for innovation and incentivising them
- Enabling international collaboration to support the funding and financing of circular infrastructure activity.

Transition pathways will differ by country as they will be influenced by a range of economic and demographic factors. This presents both a challenge and an opportunity for policymakers. The challenge is that a uniform approach to circularity will not be possible. The opportunity is the significant benefit that can be derived through international collaboration, particularly in developing innovative blended financing solutions for infrastructure circularity in upper-middle and lower-middle income countries.

This thought piece was prepared ahead of a G20 IWG Workshop that will examine what it takes to transition to a circular economy, why infrastructure is important to a circular economy and what the future of infrastructure in a circular economy could look like. In June 2021, the GI Hub will also be releasing a circular economy roadmap to provide high-level guidance on how to transition infrastructure towards a circular economy.

For the GI Hub, this thought piece and the subsequent workshop and roadmap are just the beginning of a journey in the transition towards a circular economy. The aspiration beyond these deliverables is for the G20 to continue the policy dialogue in collaboration with international organisations and industry stakeholders, and to agree on priority areas of focus in the coming months. The GI Hub encourages those interested in being part of this engagement to contact us and get involved.

1. Background and context

On the 7 April 2021, G20 Finance Ministers and Central Bank Governors reaffirmed the pivotal role of infrastructure in the G20 Action Plan for steering economic recovery post COVID-19. In the collective effort to build back better and achieve sustainability and climate goals, the G20 is committed to promoting higher-quality infrastructure investments while mobilising private capital and enabling innovation across the infrastructure lifecycle.

The G20 IWG has identified sustainable infrastructure as one of its priorities, and this year the circular economy is a topic that will be covered under this priority. The GI Hub, the G20's only dedicated infrastructure entity, supported this priority by launching an initiative to examine the role that infrastructure can play in accelerating the transition to a circular economy.

The major global drivers for the transition to a circular economy stem from the unsustainable extraction and consumption of materials and finite resources that has led to the rise in global emissions and the challenges of climate change that we face today. Between 1970 and 2017, annual global extraction of materials grew from around 27 billion tonnes to 92 billion tonnes, a yearly growth of 2.6%.² However, a global study shows that currently only 8.6% of all materials used are cycled back to close the loop.³

This global material demand is expected to more than double by 2060 if historical trends continue.⁴ With the rapidly growing human footprint on earth, the current trajectory of 'take-make-dispose' will need to be disrupted to enable more sustainable and inclusive growth. Ambitious policies for resource efficiency, greenhouse gas abatement and land management can only reduce global material demand by about 25%, leaving global demand still well above the levels that global resources and ecosystems can support. The circular economy has a clear potential to address the

² IRP (2019). *Global Resources Outlook 2019: Natural Resources for the Future We Want*. United Nations Environment Programme. Available at: <https://www.resourcepanel.org/reports/global-resources-outlook>

³ Circle Economy (2021). *The Circular Economy Report 2021*. Circle Economy. Available at: <https://www.circularity-gap.world/2021>

⁴ OECD (2019). *Global Material Resources Outlook to 2060. Economic Drivers and Environmental Consequences*. OECD. Available at: <https://www.oecd.org/environment/global-material-resources-outlook-to-2060-9789264307452-en.htm>

gap between what is needed to achieve global sustainability goals and what can be achieved with resource efficiency, greenhouse gas and land management policies.

In recognition of these challenges and opportunities, the GI Hub launched its circular economy initiative to examine the role that infrastructure can play in accelerating the transition to a circular economy. In our research, we identified a gap in the literature on this topic. Our work, beginning with this thought piece, aims to fill that gap.

1.1 Purpose of this thought piece

The purpose of this thought piece is to consolidate available literature and industry sentiment on the circular economy, and more specifically around the drivers, enablers and opportunities surrounding infrastructure's role in accelerating the transition to a circular economy. This thought piece serves as the baseline for the discussions that will take place at the G20 IWG Workshop on 30 April 2021.

1.2 Key insights

This paper was developed through a literature review and interviews with 22 experts on the circular economy and infrastructure. Through this paper, the audience can expect to derive insights into three key topics:

1. What is the circular economy and why does it matter?
2. What is the role of infrastructure in the circular economy?
3. How can policymakers enable the transition of infrastructure towards a circular economy?

2. What is the circular economy and why does it matter?

A 'circular economy' is an economic system that organises production, supply and consumption of materials into closed loops, thereby reducing the pressure on the world's finite materials and natural resource depletion. With the extraction, manufacturing and production of materials responsible for around 45% of global greenhouse gas emissions,¹ the transition towards a circular economy is a powerful solution to the challenges of climate change. A study shows that moving to renewables can only address 55% of global greenhouse gas emissions, indicating that the 1.5°C target of the Paris Agreement can only be achieved by combining current efforts on renewable energy and energy efficiency with circular economy approaches.¹

By 'closing the loop' – that is, by eliminating avoidable waste and pollution through the careful use and reuse of already available materials – the circular economy decouples economic growth from the ever-increasing natural resource demands of the current 'take-make-dispose' (i.e. linear) economy. This mechanism doesn't just preserve the world's biological and finite materials; it also presents compelling economic, environmental and social benefits, as will be outlined below.

In Europe, it is estimated that the circular economy has added around 3.5 million jobs, around €126bn of economic value and mobilised private finance of around €15bn. Furthermore, it has been observed to empower lower income groups and support economic productivity.

- European Commission 2018 and Ellen MacArthur Foundation 2020

The 1.5°C target of the Paris Agreement can only be achieved by combining current efforts on renewable energy and energy efficiency with circular economy approaches.

- Ellen MacArthur Foundation, 2019

The circular economy has the potential to achieve the United Nations Sustainable Development Goals and support the implementation of the G20's Principles for Quality Infrastructure Investment, raising living standards while satisfying the infrastructure needs of a growing global population.

In the development of this paper, the GI Hub interviewed 22 circular economy and infrastructure experts globally to understand the drivers, enablers and opportunities in the circular economy. These interviewees represented international organisations, multilateral development

banks, infrastructure bodies, government line agencies, infrastructure practitioners, non-governmental organisations (NGOs) and financiers. Of those interviewed, 10 people (45%) represented governments, 8 people (36%) represented private sector and 4 people (18%) represented NGOs.

Our stakeholder interviews identified that climate change, resource scarcity and waste were three of the strongest drivers in the transition towards a circular economy. A summary of these three key drivers, the associated problems and the potential benefits are provided in the table below.

Key driver	How big is the problem?	What are the benefits?
Climate change - The circular economy is a powerful solution for meeting long-term policy objectives related to climate change.	<ul style="list-style-type: none"> The extraction, manufacturing and production of materials is responsible for around 45% of global greenhouse gas emissions.¹ This also causes more than 90% of land- and water-related impacts, including biodiversity loss and water stress.² 	<ul style="list-style-type: none"> Combining resource efficiency with sustainable consumption and production could reduce global CO₂ emissions to 90% less than what they were in 2015.⁵ A circular economy requires building greater flexibility into manufacturing and encouraging diversity in supply chains. While more research is needed, this could reduce climate-risk exposure.⁶
Resource scarcity - The circular economy can reduce supply chain risks and short-term supply shortages by requiring less material input and establishing local secondary material supply.	<ul style="list-style-type: none"> Global resources may eventually be unable to meet the rapidly increasing demand for materials and energy, resulting in depletion and regional resource scarcity. Renewables are critical to addressing 55% of global greenhouse gas emissions, but their deployment (in particular solar power and energy storage) requires many critical raw materials.⁷ The relative infancy of renewable energy technology and long asset life means that current recycling rates are low.⁷ The COVID-19 crisis has highlighted the fragility of global trade flows and the need for countries to look at the availability of materials currently existing within their economy. 	<ul style="list-style-type: none"> Recycling offers an opportunity to secure the supply of materials critical to the future reduction of CO₂ emissions, particularly those related to renewable energy and electric vehicles. While current recycling rates are low, up to 80% of rare earth elements in batteries can be recycled.⁷ Recycling can also reduce the environmental impacts of discarding certain technologies, such as solar photovoltaic, which contains rare earths.⁷
Waste disposal and pollution – Under a circular economy, waste and pollution is addressed upstream (e.g. through better design to eliminate waste). However, in these nascent stages of the transition, many initiatives are	<ul style="list-style-type: none"> Urbanisation and population growth are forecast to result in a 70% increase in global waste production by 2050.⁸ Currently only 8.6% of all materials that are used in the global economy are recycled to close the loop.⁹ This presents an opportunity to use existing materials in 	<ul style="list-style-type: none"> The utilisation of prefabricated materials in construction can reduce waste through the optimisation of design. Currently, 15% of building materials are wasted during construction.¹⁰

⁵ UNEP Circularity Platform (2020). *Understanding Circularity*. UNEP. Available at: <https://buildingcircularity.org/>

⁶ Bugler, W (2019). *Why is the path to a resilient economy circular?* Global Centre on Adaptation. Available at: <https://gca.org/why-is-the-path-to-a-resilient-economy-circular/>

⁷ The European Commission has created a list of critical raw materials (CRMs) for the EU. CRMs combine raw materials of high importance to the EU economy and of high risk associated with their supply.

Joint Research Centre (2018) *Critical raw materials and the circular economy*. European Commission. Available at: <https://op.europa.eu/en/publication-detail/-/publication/d0c609d2-f4ef-11e7-be11-01aa75ed71a1/language-en/format-PDF/source-60481865>

⁸ World Bank (2018). *Global Waste to Grow by 70 Percent by 2050 Unless Urgent Action is Taken: World Bank Report*. World Bank. Available at:

<https://www.worldbank.org/en/news/press-release/2018/09/20/global-waste-to-grow-by-70-percent-by-2050-unless-urgent-action-is-taken-world-bank-report>

⁹ Circle Economy (2021). *The Circularity Gap Report 2021*. Circle Economy. Available at: <https://www.circularity-gap.world/2021>

¹⁰ Material Economics (2019). *Industrial Transformation 2050: Pathways to Net-Zero Emissions from EU Heavy Industry*. Material Economics. Available at: <https://materialeconomics.com/publications/industrial-transformation-2050>

Key driver	How big is the problem?	What are the benefits?
still focused on addressing waste and pollution downstream (i.e. after it has already been produced).	<p>production and construction to reduce overall CO₂ emissions.</p> <ul style="list-style-type: none"> While dealing with waste will not be enough to offset the challenges with resource scarcity, waste and pollution drivers were consistently mentioned during the stakeholder interviews for this paper. 	

In addition to the potential benefits above, the circular economy presents compelling economic and social advantages. For example, in Europe, it is estimated that the circular economy has added around 3.5 million jobs, added around €126bn of economic value and mobilised private finance of around €15bn.¹¹ Furthermore, it has been observed to empower lower income groups and support economic productivity. One example of this is the use of multimodal mobility systems, which could reduce household costs by 70% within Europe by 2050 and reduce CO₂ emissions by 70% by 2040.¹²

3. What is the role of infrastructure in the circular economy?

The circular economy transition is centred around the 6R principles for circularity,¹³ shown in Figure 1. The principles are to *refuse* (1) or significantly *reduce* (2) the amount of new materials entering the system. This is achieved by 'closing the loop' – by maximising the amount of materials recovered and subsequently *reused* (3), *repaired and refurbished* (4) and *recycled* (5) back into the system. *Residual* (6) material that can no longer be reused or recycled is that for which the only available pathways are to extract the embedded energy (e.g. through waste-to-energy) or to safely dispose.

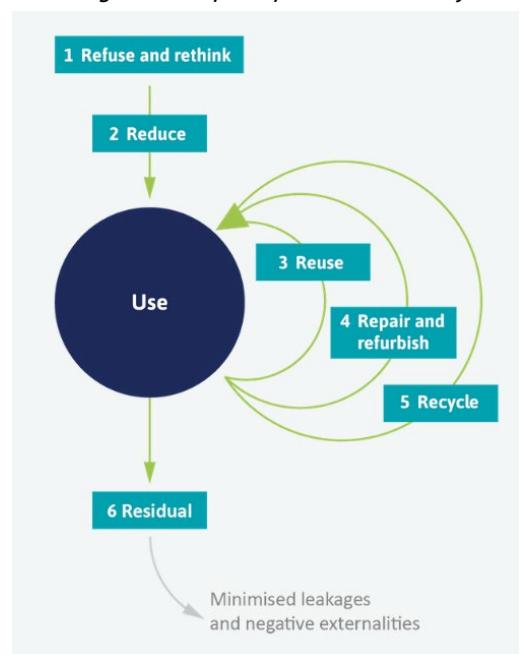
Considering these principles for circularity, infrastructure has a dual role to play:

1. Circularity of infrastructure: Increasing the circularity of infrastructure in line with the 6R principles

The demand for materials and resources across the G20 strongly correlates with the size of an economy in terms of population and GDP. As global population is expected to grow by 22% to 9.7 billion by 2050, so too will the demand for materials. It is estimated that 60% of the infrastructure needed to meet that growth does not exist today.¹⁴ This is equivalent to building a city like Paris every week for the next 30 years,^{Error! Bookmark not defined.} indicating that strain and scarcity of materials could be experienced with the current trajectory of consumption.

It is estimated that manufacturing is responsible for around 20% of global emissions. In particular, the production of four materials commonly used in construction – cement, steel, plastics and aluminium – is responsible for around 60% of these emissions.¹⁵ While the demand for these materials will continue to grow, reducing demand

Figure 1: 6R principles for circularity



¹¹ European Commission (2018). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the monitoring framework for the circular economy*. European Commission. Available at: <https://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework.pdf>

¹² Ellen MacArthur Foundation (2020). *Covid-19: The economic recovery*. Ellen MacArthur Foundation. Available at: <https://www.ellenmacarthurfoundation.org/our-work/activities/covid-19>

¹³ The circularity diagram for the 6R principles was adapted from PBL Netherlands Environmental Assessment Agency (2019). *Outline of the Circular Economy*. PBL Netherlands Environmental Assessment Agency. Available at: <https://www.pbl.nl/sites/default/files/downloads/pbl-2019-outline-of-the-circular-economy-3633.pdf>

¹⁴ Magali Anderson (2020). *Chief Sustainability Officer Magali Anderson on the '40 billion tonnes' challenge*. LafargeHolcim. Available at:

<https://www.youtube.com/watch?v=oZQgk2o5YjQ>

¹⁵ IPCC (2014). *Climate Change 2014 Synthesis Report*. IPCC. Available at: <https://www.ipcc.ch/report/ar5/syr/>

for virgin forms of these materials through circularity can make a significant contribution to reducing these carbon emissions and therefore to a circular economy.

2. Infrastructure for circularity: Providing infrastructure that supports circular economy activity and the 6R principles

In addition to taking action to increase the circularity of infrastructure, it will be necessary to create new assets to support circular economy activity, as per principles 3 through 5 in Figure 1. This can be termed infrastructure for circularity, and could include new types of recycling facilities, sharing networks, reverse logistics and marketplaces.

Six opportunities for infrastructure in the circular economy were identified through interviews with the experts in the circular economy and infrastructure. These are mapped to the 6R principles in the table below.

6R Principle(s)	Opportunity	Description
1. Circularity of infrastructure		
Refuse and rethink (1)	1a. Reducing or foregoing the need for finite materials in infrastructure	Better and more efficient design, planning and delivery of infrastructure could have a big impact by reducing the demand for materials in construction (by more than 50% ¹⁶).
Reduce (2)	1b. Replacing finite materials with renewable materials	Replacing conventional infrastructure solutions with green, climate-resilient, nature-based and pre-fabricated recycled solutions could reduce the demand for construction materials. This enables the 'return to nature' of biological materials at the end of an asset's life.
2. Infrastructure for circularity		
Reuse (3)	2a. Infrastructure that enables material reuse, repair, refurbishment and recycling	'Closing the loop' will require new kinds of waste recovery, reuse and recycling facilities, including treatment processes, sharing networks, reverse logistics and marketplaces.
Repair and refurbish (4)		In particular, infrastructure is a large user of resources and it is ideally placed to reuse and recycle construction and demolition waste.
Recycle (5)	2b. Infrastructure that enables resource recovery / near zero waste strategies	Waste collection and sorting infrastructure needs to be in place to enable the reuse, repair, refurbishment and recycling of materials. As waste management activities transition to technology-intensive and localised activity, innovative business models will also be needed to connect feedstock with recycling facilities.
Residual (6)	2c. Infrastructure that enables waste-to-energy	Waste-to-energy includes the recovery of the embedded energy within residual materials that can no longer be reused or recycled within the system. Waste-to-energy is not technically considered 'circular' as it is dealing with materials at the end of life. However, it is part of the solution to waste and pollution, and help many countries step away from landfill reliance in the transition to a circular economy.

¹⁶ Material Economics (2020). *The Circular Economy: A powerful force for climate mitigation*. Material Economics. Available at: <https://materialeconomics.com/publications/the-circular-economy>

6R Principle(s)	Opportunity	Description
All principles (1-6)	2d. Digital infrastructure / InfraTech	Implementing digital infrastructure and technology enables connectivity, automation and optimisation of the circular economy value chain. Digital platforms can link resource suppliers with the demand for secondary materials.

Some examples that demonstrate the ability for infrastructure to become more circular and for infrastructure to promote circularity include:

Transport: Circular economy initiatives can enable up to 40% of the reduction in CO₂ emissions generated in the manufacturing of cement, plastics, steel and aluminium needed to meet infrastructure needs.¹⁷ An example of this is the introduction of artificial intelligence (AI) into the design of infrastructure.

LafargeHolcim has developed Oris in collaboration with IBM, which utilises secondary materials (for instance from demolition sites) for road construction, with the design optimised to match the available materials.¹⁸

Energy: The decentralisation of energy infrastructure is gaining traction as the technology develops and renewable energy becomes increasingly prevalent. This reduces the need for large, centralised power generators but creates the need for alternative transmission and distribution infrastructure.

Ausgrid launched a community battery that is designed to optimise the output of nearby rooftop solar in Sydney, Australia.¹⁹

Waste: Digital monitoring dashboards can help track materials (ensuring transparency around circularity) and enable the creation of marketplaces for trading of feedstock and recycled products.

Suez developed CircularChain, which tracks wastewater sludge as fertiliser. This eliminates the disposal of organic and nutrient-rich waste to landfill, which can also benefit agricultural production.²⁰

Social: Concrete contributes a large proportion of carbon emissions to infrastructure. New 'green concrete' has been developed to reduce the carbon footprint of construction.

An example is ECOPact, which recycles materials from demolished buildings and generates 30% less carbon emissions than standard concrete.¹⁷ This product has been used in the construction of social housing in France.²¹

¹⁷ LafargeHolcim (2020). *40 billion tonnes challenge*. LafargeHolcim. Available at: <https://www.lafargeholcim.com/40-billion-tonnes-challenge>

¹⁸ LafargeHolcim (2020). *Oris*. LafargeHolcim. Available at: <https://www.lafargeholcim.com/oris>

¹⁹ Ausgrid (2021). *Ausgrid launches community Based battery to inject renewable energy into the grid*. Ausgrid. Available at: <https://www.ausgrid.com.au/About-Us/News/community-battery-trial>

²⁰ Suez (2020). *SUEZ launches CircularChain, the circular economy blockchain, and support the agricultural transition, the keystone of sustainable food*. Suez. Available at: <https://www.suez.com/en/news/press-releases/suez-launches-circularchain-circular-economy-blockchain-and-support-agricultural-transition-keystone-of-sustainable-food>

²¹ LafargeHolcim (2018). *aggneo®: building a circular economy in the heart of historic French cities*. LafargeHolcim. Available at: <https://www.lafargeholcim.com/aggneo-building-circular-economy-avignon-bordeaux>

4. How can policymakers enable the transition of infrastructure to a circular economy?

4.1 Key elements of a global transition

To effectively take advantage of the opportunities for infrastructure in a circular economy, significant systemic change and technological innovation will be needed at a global scale. Some themes related to the transition, which were uncovered through the literature review and stakeholder interviews conducted for this thought piece, include opportunities to:

- Raise awareness by presenting the evidence for change, specifically for infrastructure
- Facilitate policy dialogue
- Identify opportunities for innovation and incentivise them
- Enable international collaboration to support the funding and financing of circular infrastructure activity.

For example, the transition to a new plastics economy captured the world's attention in 2016, with the publication of evidence of the magnitude of the problem and its related impacts. This evidence played an important role in changing the global debate on plastics, mobilising a systemic shift towards a common vision for a circular economy for plastic, with both governments and industry reinforcing each other on the path to making it a reality.²²

4.2 National pathways to a transition

The transition pathways for infrastructure in the circular economy will differ by country, as they will be influenced by a range of factors, including:

- Economic and demographic factors, such as total population, total GDP and GDP per capita
- Infrastructure factors, such as levels of infrastructure investment, the infrastructure gap and quality of infrastructure
- Infrastructure capabilities, such as those covered by the GI Hub's Infracompass tool.²³

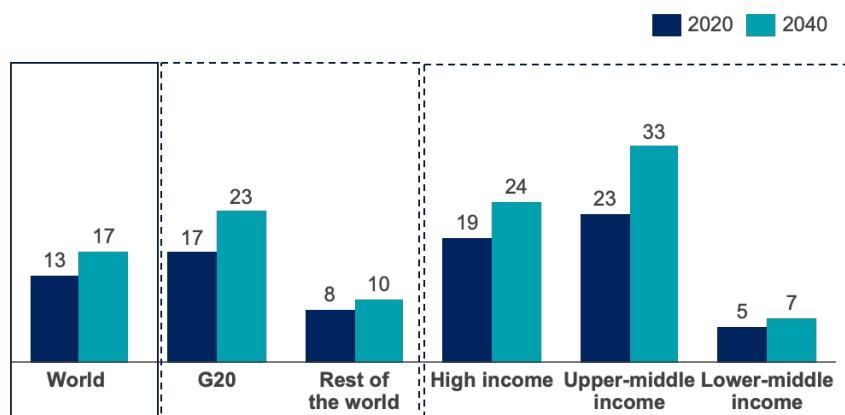
Economic and demographic metrics have a strong correlation²⁴ with domestic material consumption. Figure 2 depicts the estimated material consumption per capita from 2020 to 2040, which shows that the G20 rate for material consumption is more than double that of the rest of the world. Furthermore, countries within a specific income grouping have distinctly different material consumption and growth profiles which could dictate how they will address the transition to a circular economy.

²² Ellen MacArthur Foundation (2017), *New Plastics Economy*. Ellen MacArthur Foundation. Available at: <https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy>

²³ Global Infrastructure Hub (2020). Infracompass Tool. Global Infrastructure Hub. Available at: <https://infracompass.gihub.org/>

²⁴ There is a very strong correlation among domestic material consumption and total population and total GDP (at 0.9 and 0.7 respectively). Income levels measured by GDP per capita have a reasonably strong correlation (0.5) with materials consumption per capita.

Figure 2: Domestic material consumption per capita (tonnes)²⁵



This topic of transition pathways, and how this varies from country to country, will be discussed at the G20 IWG workshop on the 30 April 2021 and covered by the roadmap that will be released by the GI Hub in June 2021.

4.3 Focus areas for policymakers in relation to infrastructure

Our stakeholder interviews indicated that policymakers could drive the circular economy transition by strengthening the enabling environment for infrastructure within the elements of transition as outlined above. Specific areas of focus identified through the interviews and the literature review are outlined below.

Raising awareness by presenting the evidence for change: Substantial literature is available on the circular economy broadly. However, there is currently limited awareness of the role of infrastructure and the related opportunities and potential for impact. One purpose of the GI Hub's initiative is to raise this awareness and highlight the benefits of a circular economy. There is, however, more to do when it comes to circular economy metrics as outlined below.

- **Metrics** – A consistent approach is needed at a broad scale to quantify economic, social and environmental costs and benefits achieved through circular infrastructure. This would also increase awareness of the challenges and assist to justify decisions across the infrastructure lifecycle.
- **International reporting** – Reporting progress on circular economy metrics and sharing best practice can create greater awareness of performance and encourage transparency in circular economy activity for infrastructure.

Some examples that demonstrate raising awareness by presenting the evidence for change include:

The European Statistical Office has defined and tracked circular economy indicators across the EU since 2018. This includes material flows, resource productivity, waste generation, and treatment and circular material use. The indicators cover four thematic areas: production and consumption, waste management, secondary raw materials, and competitiveness and innovation. The indicators are used to monitor the EU as a whole and the individual countries that make up the EU on their progress towards a circular economy.²⁶

In 2007, China's Ministry of Environmental Protection and China's National Bureau of Statistics developed the first iteration of the circular economy index, making China a frontrunner in the development of circular economy indicators. It has evolved to track the Chinese economy at a national and local level against the circularity principles. This includes material flows, resource productivity, waste generation and utilisation, and emissions. The circular economy development indicator combines these indicators to track the country's overall progress towards becoming a circular economy.²⁷

²⁵ Schandl et al. (2021). *Domestic Material Consumption (DMC) per-capita 2020-2060*. CSIRO

²⁶ Eurostat (2020). *Material flows in the circular economy*. European Union. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Material_flows_in_the_circular_economy#Circularity_rate

²⁷ Ellen MacArthur Foundation (2018). *The circular economy opportunity for urban & industrial innovation in China*. Ellen MacArthur Foundation. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/The-circular-economy-opportunity-for-urban-industrial-innovation-in-China_19-9-18_1.pdf

Facilitating policy dialogue: A common vision and strategy are needed for infrastructure in the circular economy, to define clear objectives that can drive policy, regulation, procurement and financing of infrastructure.

- **Regulations** – Regulations around material use can incentivise the use of recycled materials within construction or drive investment into new recycling facilities.
- **Procurement** – Incorporating circular principles into procurement specifications can drive the adoption of circular economy principles for infrastructure during the design and construction stages of the project.
- **Funding and financing** – Governments have several financial levers to pull to progress the adoption of circular economy principles. Nascent technologies and business models can be supported through government financing mechanisms such as loans and bonds or grant funding until they become economically viable. Government can provide this financial support from direct budget allocations or through government financial institutions such as specific facilities, state owned enterprises or National Banks. In parallel to this thought piece, the GI Hub is also preparing a compendium of innovative funding and financing case studies for circular infrastructure, which will be made available in May 2021.

Some examples that demonstrate facilitating policy dialogue include:

Japan's Ministry of Economy, Trade and Industry developed the 'Circular Economy Vision 2020' to present basic future directions of policies for a circular economy.²⁸

The movement towards the 'Right to Repair' is gaining momentum globally. The Australian Government recently released an issues paper on the 'Right to Repair' in Australia, with the view to have a final report completed by October 2021.²⁹

Multilateral development banks (MDBs) and international financial institutions have a natural role to play in implementing circular economy principles. Examples such as USAID's collaboration with venture capital fund Circulate Capital in South and South East Asia on improving recycling infrastructure,³⁰ and the European Investment Bank's Innovfin Financing Tools³¹ demonstrate what is already possible.³²

The number of public equity funds dedicated to the circular economy have grown steeply from 2 in 2018 to 13 at the end of 2020, totalling USD 4.6 billion in assets under management.³³ This includes funds by BlackRock, BNP Paribas, Credit Suisse and Goldman Sachs.

Identifying opportunities for innovation and incentivising them: Digital infrastructure and InfraTech can be a powerful enabler across the infrastructure lifecycle (for example, optimising the design of infrastructure to minimise materials and waste). Central governments can play a key role in enabling the adoption of technological innovation, and the following points summarise three key areas where this can happen.³⁴

- **Developing a national strategy for InfraTech** – There is a need for a vision for technology in strategy and design of infrastructure assets and services.

²⁸ Ministry of Economy, Trade and Industry (2020). *Circular Economy Vision 2020 Compiled*. Government of Japan. Available at: https://www.meti.go.jp/english/press/2020/0522_003.html

²⁹ Productivity Commission (2020). *Productivity Commission Issues Paper*. Australian Government. Available at: <https://www.pc.gov.au/inquiries/current/repair/issues/repair-issues.pdf>

³⁰ Circulate Capital (2020). *Circulate Capital And USAID Team Up To Fight Ocean Plastic Pollution*. Circulate Capital. Available at: <https://www.circulatetcapital.com/post/circulate-capital-and-usaid-team-up-to-fight-ocean-plastic-pollution>

³¹ European Investment Bank (2021). *What InnovFin products are available and who can benefit from them?*. European Investment Bank. Available at: <https://www.eib.org/en/products/mandates-partnerships/innovfin/products/>

³² Under the Italian G20 Presidency, the GI Hub will be expanding its [Innovative Funding and Financing Tool](#) to cover Circular Economy related examples

³³ Ellen MacArthur Foundation (2021). *Universal circular economy policy goals: enabling the transition to scale*. Ellen MacArthur Foundation. Available at: <https://www.ellenmacarthurfoundation.org/publications/universal-circular-economy-policy-goals-enabling-the-transition-to-scale>

³⁴ The outcomes from the GI Hub's InfraTech Ecosystem workshop in November 2020 identified three policy tools (based on the [World Bank's InfraTech Policy Toolkit](#)) with the highest potential impact in facilitating scalable adoption of InfraTech

- **Focusing on outcomes** – Policies and procurement should take a user-centric view and focus on outcomes rather than output.
- **Innovation sandboxes** – Establishing designated ‘sandbox’ areas can allow for testing of technology and innovation to inform policy and regulatory changes.

Governments also have a role to play in incentivising and structuring accelerators for emerging technologies in the circular economy. This can include government support in terms of knowledge and resources but also financial incentives that aim to de-risk private investment into this space.

Some examples that demonstrate these include:

Digital twins can enable the circular economy through less disruption, less waste, more reuse and greater resource efficiency.³⁵

The UK’s National Digital Twin Programme was launched by HM Treasury in 2018 to integrate all aspects of its infrastructure system across regions and sectors. The UK expects the program to generate £7 billion a year from cost savings and efficiency gains.³⁶

Fondaction in Canada has launched a new, circular economy fund to create a financial tool offering venture capital to companies in this emerging sector.³⁷ The fund is focused on agri-food, recycling, resource development and eco-construction.

Fondaction has partnered with Quebec and the City of Montreal to incentivise and de-risk investments into the fund through financial contributions and technical assistance.

International collaboration and co-operation: In light of the regional differences in material consumption shown in Figure 2, benefit can be derived through international collaboration especially in terms of financing. Export Credit Agencies (ECAs), MDBs and national governments can work together to develop innovative blended financing solutions for infrastructure circularity in upper-middle and lower-middle income countries. These financing solutions are not currently in existence for circular infrastructure, and there appears to be strong interest from the multi-lateral community to look at opportunities around this topic.

Furthermore, a ‘synchronised’ infrastructure investment across the G20 can achieve two-thirds more at the same cost than if each country acts alone.³⁸ The GI Hub advocates for collective action on key issues and opportunities such as economic recovery, climate change and circular economy (and the role that infrastructure can play). We encourage those interested in continuing this dialogue beyond this thought piece to contact us for collaboration.

5. Conclusion

This thought piece presents the available evidence on infrastructure’s role in the circular economy, gathered through a combination of a literature review and stakeholder interviews with 22 experts in the circular economy and infrastructure sectors. The decoupling of economic growth from natural resource demands will take the global economy beyond the 21st century. The circular economy can be an economic pain reliever and an economic gain creator by addressing ever-present problems such as climate change, resource scarcity, waste disposal and pollution while also providing compelling economic, environmental and social benefits.

Five opportunities for infrastructure were identified under two key themes of ‘circularity of infrastructure’ and ‘infrastructure for circularity’. Progress is being made across these five opportunities, albeit in an ad-hoc and sporadic manner.

³⁵ Centre for Digital Built Britain (2018). *National Digital Twin Programme*. Centre for Digital Built Britain. Available at: <https://www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme>

³⁶ World Bank (2020). *InfraTech Policy Toolkit*. World Bank. Available at: <https://cdn.github.org/umbraco/media/3061/world-bank-group-s-reference-note-on-infratech-toolkit.pdf>

³⁷ Fondaction (2021). *Fondaction launches the Circular Economy Fund with its partners RECYC-QUÉBEC and the City of Montreal*. Fondaction. Available at: <https://www.fondaction.com/nouvelles/lancement-fonds-economie-circulaire/>

³⁸ International Monetary Fund (2020) How a Collective Infrastructure Push Will Boost Global Growth. International Monetary Fund. Available at: <https://blogs.imf.org/2020/11/24/how-a-collective-infrastructure-push-will-boost-global-growth/>

To effectively implement the infrastructure opportunities at scale, significant systemic change and technological innovation will be needed. The key elements of a transition uncovered by this thought piece that policymakers should contemplate include:

- Raising awareness by presenting the evidence for change, specifically for infrastructure
- Facilitating policy dialogue
- Identifying opportunities for innovation and incentivising them
- International collaboration to support the funding and financing of circular infrastructure activity.

The transition pathways will differ by country as they will be influenced by a range of economic and demographic factors. This presents both a challenge and an opportunity for policymakers. The challenge is that a uniform approach to circularity will not be possible. The opportunity is the significant benefit that can be derived through international collaboration, particularly in developing innovative blended financing solutions for infrastructure circularity in upper-middle and lower-middle income countries.

5.1 Next steps

This thought piece was prepared ahead of a G20 IWG Workshop on 30 April 2021, wherein the GI Hub will facilitate an interactive session with policymakers, investors and circular economy experts to raise awareness of the drivers, opportunities and impact of infrastructure on the circular economy. This workshop will examine what it takes to transition to a circular economy, why infrastructure is important to a circular economy and what the future of infrastructure in a circular economy could look like.

In June 2021, the GI Hub will release a circular economy roadmap that will summarise the outcomes of the workshop and provide governments and the infrastructure sector with high-level guidance on how best to transition infrastructure towards a circular economy.

For the GI Hub, this thought piece and the subsequent workshop and roadmap are just the beginning of a journey in the transition towards a circular economy. The aspiration beyond these deliverables is for the G20 to continue the policy dialogue in collaboration with international organisations and industry stakeholders, and to agree on priority areas of focus in the coming months. The GI Hub encourages those interested in being part of this engagement to contact us and get involved.

Reference list

#	Footnote
1	Ellen MacArthur Foundation (2019). Completing the picture: How the circular economy tackles climate change. Ellen MacArthur Foundation. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-Tackles_Climate_Change_V3_26_September.pdf
2	IRP (2019). Global Resources Outlook 2019: Natural Resources for the Future We Want. United Nations Environment Programme. Available at: https://www.resourcepanel.org/reports/global-resources-outlook
3	Circle Economy (2021). The Circularity Gap Report 2021. Circle Economy. Available at: https://www.circularity-gap.world/2021
4	OECD (2019). Global Material Resources Outlook to 2060. Economic Drivers and Environmental Consequences. OECD. Available at: https://www.oecd.org/environment/global-material-resources-outlook-to-2060-9789264307452-en.htm
5	UNEP Circularity Platform (2020). Understanding Circularity. UNEP. Available at: https://buildingcircularity.org/
6	Bugler, W (2019). Why is the path to a resilient economy circular?. Global Centre on Adaptation. Available at: https://gca.org/why-is-the-path-to-a-resilient-economy-circular/
7	Joint Research Centre (2018) Critical raw materials and the circular economy. European Commission. Available at: https://op.europa.eu/en/publication-detail-/publication/d0c609d2-f4ef-11e7-be11-01aa75ed71a1/language-en/format-PDF/source-60481865
8	World Bank (2018). Global Waste to Grow by 70 Percent by 2050 Unless Urgent Action is Taken: World Bank Report. World Bank. Available at: https://www.worldbank.org/en/news/press-release/2018/09/20/global-waste-to-grow-by-70-percent-by-2050-unless-urgent-action-is-taken-world-bank-report
9	Circle Economy (2021). The Circularity Gap Report 2021. Circle Economy. Available at: https://www.circularity-gap.world/2021
10	Material Economics (2019). Industrial Transformation 2050: Pathways to Net-Zero Emissions from EU Heavy Industry. Material Economics. Available at: https://materialeconomics.com/publications/industrial-transformation-2050
11	European Commission (2018). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the monitoring framework for the circular economy. European Commission. Available at: https://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework.pdf
12	Ellen MacArthur Foundation (2020). Covid-19: The economic recovery. Ellen MacArthur Foundation. Available at: https://www.ellenmacarthurfoundation.org/our-work/activities/covid-19
13	PBL Netherlands Environmental Assessment Agency (2019). Outline of the Circular Economy. PBL Netherlands Environmental Assessment Agency. Available at: https://www.pbl.nl/sites/default/files/downloads/pbl-2019-outline-of-the-circular-economy-3633.pdf
14	Magali Anderson (2020). Chief Sustainability Officer Magali Anderson on the '40 billion tonnes' challenge. Lafarge Holcim. Available at: https://www.youtube.com/watch?v=oZQgk2oSYjQ
15	IPCC (2014). Climate Change 2014 Synthesis Report. IPCC. Available at: https://www.ipcc.ch/report/ar5/syr/
16	Material Economics (2020). The Circular Economy : A powerful force for climate mitigation. Material Economics. Available at: https://materialeconomics.com/publications/the-circular-economy
17	Lafarge Holcim (2020). 40 billion tonnes challenge. Lafarge Holcim. Available at: https://www.lafargeholcim.com/40-billion-tonnes-challenge
18	Lafarge Holcim (2020). Oris. Lafarge Holcim. Available at: https://www.lafargeholcim.com/oris
19	Ausgrid (2021). Ausgrid launches community Based battery to inject renewable energy into the grid. Ausgrid. Available at: https://www.ausgrid.com.au/About-Us/News/community-battery-trial
20	Suez (2020). SUEZ launches CircularChain, the circular economy blockchain, and support the agricultural transition, the keystone of sustainable food. Suez. Available at: https://www.suez.com/en/news/press-releases/suez-launches-circularchain-circular-economy-blockchain-and-support-agricultural-transition-keystone-of-sustainable-food
21	Lafarge Holcim (2018). aggneo®: building a circular economy in the heart of historic French cities. Lafarge Holcim. Available at: https://www.lafargeholcim.com/aggneo-building-circular-economy-avignon-bordeaux
22	Ellen MacArthur Foundation (2017). New Plastics Economy. Ellen MacArthur Foundation. Available at: https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy
23	Global Infrastructure Hub (2020). Infracompass Tool. Global Infrastructure Hub. Available at: https://infracompass.gihub.org/
24	Schandl et al. (2021). Domestic Material Consumption (DMC) per-capita 2020-2060. CSIRO
25	Eurostat (2020). Material flows in the circular economy. European Union. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Material_flows_in_the_circular_economy#Circularity_rate
26	Ellen MacArthur Foundation (2018). The circular economy opportunity for urban & industrial innovation in China. Ellen MacArthur Foundation. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/The-circular-economy-opportunity-for-urban-industrial-innovation-in-China_19-9-18_1.pdf
27	Ministry of Economy, Trade and Industry (2020). Circular Economy Vision 2020 Compiled. Government of Japan. Available at: https://www.meti.go.jp/english/press/2020/0522_003.html
28	Productivity Commission (2020). Productivity Commission Issues Paper. Australian Government. Available at: https://www.pc.gov.au/inquiries/current/repair/issues/repair-issues.pdf
29	Circulate Capital (2020). Circulate Capital And USAID Team Up To Fight Ocean Plastic Pollution. Circulate Capital. Available at: https://www.circulatencapital.com/post/circulate-capital-and-usaid-team-up-to-fight-ocean-plastic-pollution

- 30 European Investment Bank (2021). What InnovFin products are available and who can benefit from them?. European Investment Bank. Available at: <https://www.eib.org/en/products/mandates-partnerships/innovfin/products/>
- 31 Global Infrastructure Hub (2019). Innovative Funding and Financing: Solutions to structure infrastructure projects. Global Infrastructure Hub. Available at: <https://www.gihub.org/innovative-funding-and-financing/>
- 32 Ellen MacArthur Foundation (2021). Universal circular economy policy goals: enabling the transition to scale. Ellen MacArthur Foundation. Available at: <https://www.ellenmacarthurfoundation.org/publications/universal-circular-economy-policy-goals-enabling-the-transition-to-scale>
- 33 Global Infrastructure Hub (2020). *Global Infrastructure Hub InfraTech Ecosystem workshop (November 2020)*. Global Infrastructure Hub
- 34 Centre for Digital Built Britain (2018). National Digital Twin Programme. Centre for Digital Built Britain. Available at: <https://www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme>
- 35 World Bank (2020). InfraTech Policy Toolkit. World Bank. Available at: <https://cdn.gihub.org/umbraco/media/3061/world-bank-group-s-reference-note-on-infratech-toolkit.pdf>
- 36 Fondaction (2021). Fondaction launches the Circular Economy Fund with its partners RECYC-QUÉBEC and the City of Montreal. Fondaction. Available at: <https://www.fondaction.com/nouvelles/lancement-fonds-economie-circulaire/>
- 37 International Monetary Fund (2020) How a Collective Infrastructure Push Will Boost Global Growth. International Monetary Fund. Available at: <https://blogs.imf.org/2020/11/24/how-a-collective-infrastructure-push-will-boost-global-growth/>