T20 Policy Brief

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Task Force 02

SUSTAINABLE CLIMATE ACTION AND INCLUSIVE JUST ENERGY TRANSITIONS

Industrial Decarbonisation: Circular Construction Practices

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Abstract

The construction industry is known for its significant environmental footprint, marked by its major contribution to the depletion of natural resources, extensive energy consumption, greenhouse gas (GHG) emissions, air pollution, environmental degradation, and global warming. The adoption of the circular economy (CE) within the construction industry holds promise in mitigating these adverse impacts. CE represents a departure from the wastefulness inherent in the current linear economic model, aiming to establish a closed-loop system across the value chain.

G20 India 2023 has launched an industry-led coalition on resource efficiency and CE to facilitate knowledge-sharing, best practices, and sustainable approaches among participating industries. The OECD (2021) has identified key actions for G20 members including promoting resource efficiency throughout the product lifecycle, aligning sectoral policies with resource efficiency goals, strengthening policy development through enhanced data, and fostering international cooperation.

While two policy briefs from Think 20 (Augustina et al., 2020; Anbumozhi et al., 2021) addressed CE, they did not specifically focus on construction sector-specific strategies. This policy brief outlines key cost-effective actions that the construction industry can adopt today, which G20 nations can choose to promote within their economies and beyond. These evidence-based policy recommendations incorporate stakeholder perspectives on the costs and benefits of CE implementation in construction. They incorporate waste hierarchy principles such as the 3-R (Reduce, Reuse, Recycle) for finding effective actions while using empirical methods to analyze data. This brief provides proven cost-effective solutions for G20, highlighting circularity in building renovation and construction processes.

Diagnosis of the Issue

One of the sector's pressing challenges is reaching decarbonization targets by 2050, given the upward trajectory of CO_2 emissions. Adopting Circular Economy (CE) principles holds immense potential to reduce GHG emissions in construction through the establishment of a closed-loop system, enhanced resource efficiency, and minimized waste generation. The construction industry faces two main challenges with reaching decarbonization and highlighting the importance of CE in the construction sector. First, GHG emissions in the construction sector are not only from fossil fuel consumption but also from the production process. The construction industry exerts a significant environmental impact, contributing to 10% of global GHG emissions and consuming 6% of the world's energy solely through building construction. This means that even if all energy sources are replaced with renewable energy, GHG emissions will persist. Switching to renewable energy is not sufficient for decarbonizing the sector. Second, renewable energy cannot replace fossil fuels everywhere, for example where high temperature is needed (hard-to-abate sectors). Due to the above challenges, CE is crucial for the construction sector.

Despite the availability of technologies supporting circular construction and the array of benefits, widespread adoption of CE remains limited, primarily driven by regulatory mandates, while concerns persist regarding the elevated costs associated with CE, as highlighted by stakeholders (Figure 1). Furthermore, we have outlined the primary benefits and costs associated with the implementation of CE within the construction sector (Figure 2).

The construction industry is often characterized as conservative and slow to embrace change. The complexity of the value chains in construction and the multiple stakeholders involved who sometimes have conflicts of interest further amplify this challenge. Financial considerations stand out as a major obstacle hindering the industry's transition. Construction companies and professionals exhibit hesitancy in adopting new practices, primarily due to concerns about potential cost escalations and uncertainties about the long-term benefits of the CE paradigm. This reluctance can stifle innovation and hinder the adoption of CE principles. The costs associated with CE in the construction sector can be attributed to four main factors:

- Market development
- Measurement methods
- Policy frameworks and
- Knowledge levels

Considering geographical variations, different countries and regions experience varying costs and benefits based on contextual factors.

Advantages of CE in construction include:

- Reduced waste generation
- Diminished use of virgin resources
- Lower environmental impacts
- Decreased energy consumption and GHG emissions
- Resource reuse
- Cost-effective refurbishment
- Enhanced economic competitiveness through new market opportunities
- Reduced reliance on imports of raw materials

- Creation of new employment opportunities
- Tax benefits (where provided)

Challenges of CE in construction include:

- Quality and usability of reclaimed materials for different applications
- Various direct costs, including energy and water consumption, transportation, and additional machinery and equipment maintenance
- A shift in product design methods, such as Design for Disassembly (DfD) and modular design, requires changes in technological software and specialised expertise.

This diagnosis is based on our recent study that gathered views on CE practices from construction sector professionals representing diverse backgrounds and countries (Karaca et al., 2024). The implementation of CE practices within the construction sector brings forth a range of challenges and opportunities, which vary across different regions. Recent studies have shown that in Europe, optimizing the reuse of construction materials emerges as a critical strategy for cost reduction, underscoring the importance of circularity in material management (CEAP, 2020). Stakeholders in the EU region prioritize concepts like Design for Disassembly (DfD) and the offsite production of structural elements (Bertram et al., 2019). However, persistent challenges include the initial investment required to establish reuse businesses and the inadequate supportive infrastructure in some countries like Latvia (Netherlands Enterprise Agency, 2022). Similarly, while the adoption of modular construction methods shows potential, it entails substantial upfront costs. The stringent CE regulations and penalties for non-compliance in Europe further influence stakeholders' perceptions and practices. Thus, investing in research and

development to enhance the cost-effectiveness of offsite production and fostering knowledge-sharing platforms become imperative for advancing CE practices in the region.

Non-European countries exhibit similar concerns regarding offsite production and material reuse, albeit with regional variations. While the prioritization of structural element optimization reflects a less mature CE landscape, challenges in waste management infrastructure and regulatory frameworks impede progress. Some countries, like Kazakhstan and the UAE, face hurdles in complying with existing regulations due to inadequate infrastructure and operational challenges (European Environment Agency, 2022). Furthermore, differing perspectives on cost factors and CE practices highlight the need for tailored approaches, emphasizing the importance of regional contexts in shaping CE strategies (Do et al., 2021).

The interplay between regulatory compliance, labour costs, and operational efficiency significantly impacts the cost of implementing CE strategies. In the EU, fines and penalties for regulatory violations and resistance to change among workers contribute to cost increases, necessitating measures to enhance compliance and raise awareness (CEAP, 2020). Conversely, in non-European countries, high waste treatment costs and logistical challenges pose significant economic burdens, calling for investments in infrastructure development and workforce training (Hittini & Shibeika, 2019). Moreover, the divergence in prioritized actions between regions underscores the necessity of context-specific interventions to address operational barriers and foster CE adoption.

Despite these challenges, CE strategies offer substantial benefits. European stakeholders prioritize initiatives promoting material reuse, backed by robust legislative frameworks and investments in recycling infrastructure. Conversely, non-European

countries focus on offsite production and collaborative construction efforts to enhance resource efficiency (Tleuken et al., 2022). However, both regions recognize the economic potential of resale markets and reduced environmental impact, highlighting the dual benefits of CE practices for business and the environment.

Ultimately, prioritizing activities affecting financial performance requires a nuanced understanding of regional dynamics. In Europe, reducing transportation costs and fostering stakeholder collaboration emerge as critical drivers, necessitating policies that support sustainable logistics and skill development (Gonzalez et al., 2023). In contrast, in non-European countries, minimizing new material use and optimizing workflow efficiency become focal points, that emphasize the need for tailored interventions to address operational challenges (Tleuken et al., 2022).

To implement CE practices effectively in the construction sector, policy makers and industry stakeholders need to develop region-specific strategies that balance regulatory compliance, operational efficiency, and stakeholder engagement. By leveraging insights from stakeholder analyses and machine learning-supported decision-making tools, they can develop targeted policies and interventions that maximize the economic, environmental, and social benefits of CE practices while addressing region-specific challenges and opportunities.

Recommendations

The G20 can voluntarily adopt these actions. The recommendations are evidence-based, drawn from our recent study where we measured stakeholders' perspectives on the costs and benefits of implementing CE principles in construction, employing waste hierarchy principles such as the 3-R (Reduce, Reuse, Recycle) (Figure 1). Based on our study, we provide the following recommendations to G20 members.

1. **Need for Updates in Regulation:** Implementing fines for non-compliance, enhancing worker motivation through incentives, and addressing maintenance costs are crucial in Europe. In non-European regions, the focus should be on improving waste treatment infrastructure and regulations and optimizing logistics.
2. **Need for Information and Guidance on Cost-Effective CE Practices:** Some G7 countries already have comprehensive guidance for CE practices. The guidance serves as a model for others to develop similar resources, providing clarity and direction for cost-effective implementation of CE in construction including practical steps, case studies, and metrics for evaluating cost-effectiveness.
3. **Tailoring Policies to Local Conditions:** Our research indicates regional variations in prioritizing CE practices. In Europe, the emphasis is on reuse and recycling initiatives, while in non-European regions, strategies like disassembly are prioritized. Tailored policies that address specific regional needs and challenges are essential for effective CE implementation across diverse contexts.
4. **Consideration of Financial Performance Impact to Prioritize CE Strategies:** Recognizing the impact of CE activities on financial performance is vital. In Europe,

policies should focus on reducing transportation costs, leveraging resale markets, and fostering stakeholder collaboration, all contributing to financial benefits. In contrast, non-European regions should concentrate on strategies like minimizing reliance on raw material and non-renewable resources, optimizing workflows, and investing in staff training to enhance operational efficiency and financial sustainability.

5. **Promoting Public Awareness and Certification:** Our study reveals a surprising lack of emphasis on brand improvement related to CE efforts. This indicates the importance of public awareness campaigns and certification programs to promote recognition and visibility of CE initiatives. Given the increasing focus on responsible investments, establishing a globally recognized CE certification similar to green building certification is recommended. This certification should be tied to a ranking system that incentivizes and rewards high-performing CE efforts, thereby attracting green finance and fostering international collaboration in sustainable construction practices.

6. **Need for Construction Industry Stakeholders Hubs:** Collaborative efforts for equitable resource utilization are paramount. The success of any business model relies on engaging main stakeholder groups: contractors, material providers, designers, engineers, service providers, clients, users, the local community, academicians, and government agencies and administrations, fostering their collaboration. Policies should foster and establish stakeholder hubs, forums, and organized events as vital platforms for actively listening to diverse perspectives, needs, and interests. This support and involvement help governments and policy makers establish regulations that balance global sustainability and circularity objectives with stakeholder needs and interests.

7. **Need for Fostering Digitalization and Automation in Construction Practices:** Conventional construction management models often lack proper connectivity among

stakeholders, hindering effective collaboration. Ensuring circularity in feedback systems is crucial for enhancing information accessibility and exchange among all relevant actors. Despite the recognized advantages of digitalization, its adoption in the industry remains limited to voluntary initiatives by some companies and regions. Therefore, government policies play a critical role in fostering the adoption of digital technologies and facilitating synergies between circularity strategies and digital tools to maximize their potential in achieving the dual transition: digital and green in construction.

By adopting these recommendations, G20 members can significantly contribute to advancing CE practices in the construction sector, fostering sustainability, and promoting economic growth through resource efficiency and waste reduction initiatives.

Scenarios of Outcomes

CE in construction presents a significant opportunity to reduce GHG emissions, pollution, and energy consumption within the sector. These efforts yield multiple positive externalities for society, including mitigating global temperature increase, decreasing air pollution, optimizing resource utilization, and improving energy security. The preceding section outlines policy recommendations for G20 members to promote CE efforts. To attract investments in CE endeavors, it is important to acknowledge and showcase these efforts for greater visibility.

The potential outcomes stemming from the aforementioned recommendations are:

Recommendation 1: Providing comprehensive guidance establishes a foundational framework and clear pathways for less developed regions to adopt CE practices, following the lead of more developed regions. Providing practical steps supported by successful case studies aids organizations and policy makers in navigating implementation challenges, fostering efficient and effective adoption, and enabling stakeholders to learn from evidence and past experiences. Moreover, supporting the provision of metrics and key performance indicators (KPIs) facilitates informed decision-making through measurable outcomes.

Recommendation 2: In the EU, (1) introducing fines for non-compliance incentivizes adherence to CE regulations; (2) Providing incentives for workers fosters their engagement and commitment to CE practices; and (3) Addressing maintenance costs enhances the long-term sustainability of CE projects and encourages stakeholders to

uphold regulatory standards and best practices. In non-European regions, improving waste treatment processes and streamlining logistics can create new job opportunities while simplifying compliance, ultimately saving costs for stakeholders.

Recommendation 3: Customizing policies to accommodate regional variations ensures the effective implementation of CE practices based on local resource availability, context-specific challenges, and national and regional priorities. Addressing the needs of local stakeholders fosters higher-level implementation and stimulates market uptake of CE technologies.

Recommendation 4: Prioritizing CE-supporting strategies based on their financial performance has implications for encouraging their adoption by stakeholders aligned with their interests in cost savings. Facilitating stakeholder collaboration can lead to innovative solutions, improved resource management, and shared benefits, contributing to overall financial benefits. Supporting the establishment of secondary materials markets fosters local businesses and minimizes Construction and demolition waste (CDW). Minimizing the consumption of raw materials by setting appropriate policies fosters industrial symbiosis and promotes the development and utilization of novel and reclaimed materials.

Recommendation 5: An exemplary construction company earns a globally recognized CE certification for its circularity practices. This certification, tied to a ranking system, attracts green finance opportunities, leading to increased investments in sustainable construction projects. CE certification can be at the national or G20 level.

While external (3rd party) certification entails costs, it enhances the ability to attract green investments due to its credibility compared to self-declaration. This mirrors the funding of green buildings certified through national or internationally recognized green building certification using green bonds (Azhgaliyeva, 2022). Moreover, public awareness campaigns regarding CE initiatives gain momentum, leading to a shift in consumer preferences toward environmentally friendly and circular construction practices. This rising demand encourages more companies to embrace CE principles, creating a positive feedback loop for CE adoption in the construction industry.

Recommendation 6: Establishing construction industry stakeholders' hubs, and forums and organizing events plays a pivotal role. These platforms serve as invaluable opportunities to actively listen to the diverse perspectives, needs, and interests across stakeholder groups. By doing so, governments, policy makers, and industry leaders can gain a comprehensive understanding and work toward establishing a vision that meets the collective requirements and aspirations of all stakeholders involved. This inclusive approach not only fosters collaboration, but also motivates widespread adoption of industry standards, policies, practices, and innovations.

Recommendation 7: Simulating future scenarios and conducting real-time examinations of alternatives in construction projects enabled by digital technologies help stakeholders anticipate the long-term financial implications of their decisions. Digitalization centralizes information, making it accessible to all stakeholders, thereby improving decision-making processes.

G20 could lead the efforts in CE within the construction sector, setting an example for other industries and countries to follow suit.

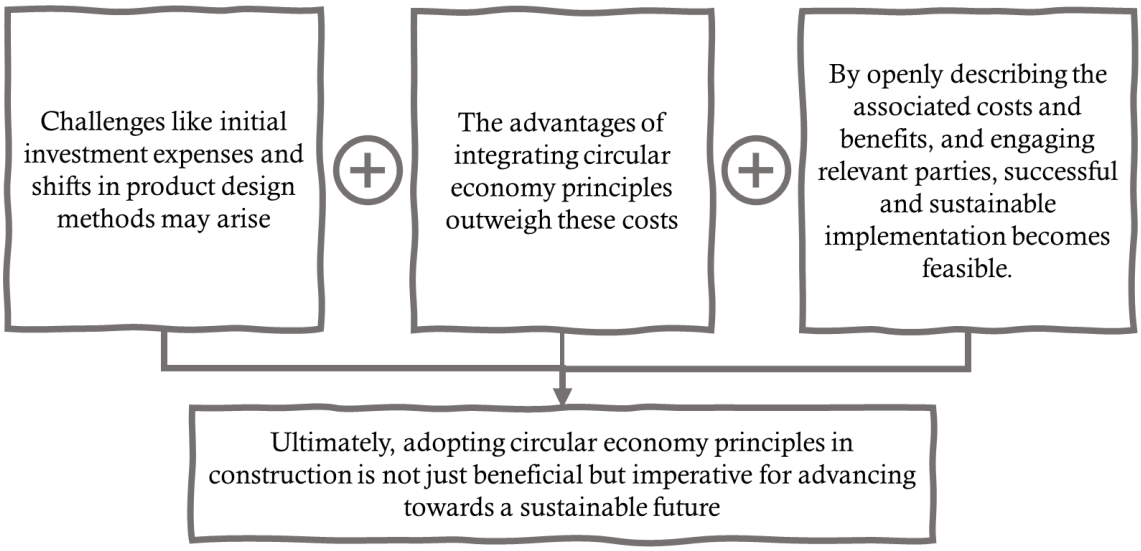

FIGURE 1. Costs and Benefits of a Circular Economy in the Construction Industry

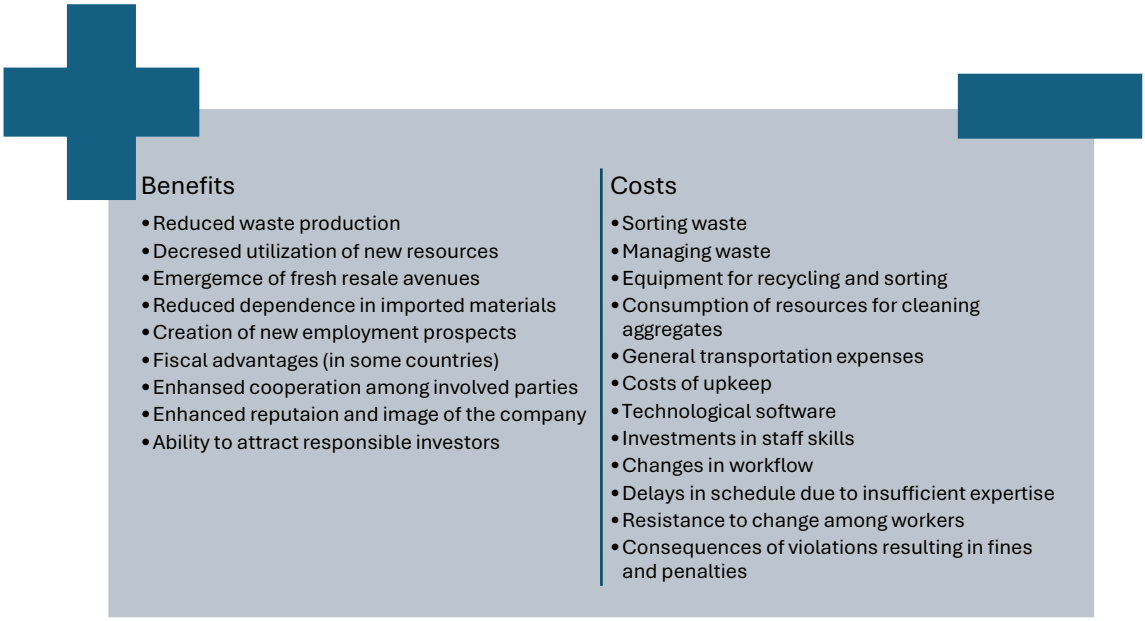

FIGURE 2. Benefits and Costs of CE in the Construction Industry

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