



CIRCLE SCAN ROCKWOOL

• Opportunities to grow
the Circular Economy in
the Built Environment

May 2019



ROCKWOOL



**CIRCLE
ECONOMY**

EXECUTIVE SUMMARY

ROCKWOOL is and has been committed to taking responsibility in shaping a prosperous, sustainable and circular economy. ROCKWOOL is upcycling

secondary materials from other industries, recycling its own waste in closed loops and designing products for long life and indefinite recycling. ROCKWOOL uses a significant amount of non-virgin materials and fuels to produce stone wool products, the majority of which are recyclable without loss of material value. However, most of these materials are not recycled or reused at the end-of-life. This is a known problem faced throughout the value chain of the construction sector. The majority of waste material from construction and demolition sites end up in landfills.

Consequently, only a small share of the materials in ROCKWOOL's value chain can be considered 'circular materials' based on the circularity metric put forth by Circle Economy. In this metric, circular materials describe the share of materials in products that is continuously cycled: Cycled materials come from non-virgin sources in the first place and are reused, recycled or safely returned to the biosphere at the end of products' life time.

ROCKWOOL has set ambitious goals to improve its circularity by reducing the amount of production waste going to landfill by 85% and by offering recycling services for its products in 30 countries by 2030. Reaching these goals is an important step and will significantly increase the share of circular materials in ROCKWOOL'S products.

ROCKWOOL's value chain has the potential to become fully circular. But ROCKWOOL cannot achieve this alone. The help and collaboration of stakeholders across the value chain is required. In this report, we have identified a range of levers for the ROCKWOOL value chain to bridge the circularity gap.

1. **Increasing the use of non-virgin and regenerative materials** to decrease impacts from extraction and use of virgin materials and fossil resources. The most powerful levers for this were identified in increasing the share of non-virgin raw materials and shifting to renewable energy sources in production.

2. **Developing more high-value and circular product applications** by taking advantage of the durability of stone wool products. By developing high-value products that adhere to principles of circular design, ROCKWOOL can facilitate reuse and refurbishment as well as high-value recycling. Co-creating products with partners will allow integration in modular building elements in adaptive buildings. New ownership models can be explored as well, but pose a challenge for long-lasting products.

3. **Reclaiming more waste from the construction sector** to reduce the share of waste landfilled and facilitate the use of more non-virgin materials in production. Promising levers for this are identified in the current goal of expanding the network of recycling services and supporting the development of more advanced recycling infrastructure for mineral and stone wool demolition waste.

Table of contents

1. Introduction	p 4
2. Current production system	p 6
3. Circular opportunities	p 10
5. The way forward	p 20

ABOUT CIRCLE ECONOMY

We work to accelerate the transition towards a circular economy. As an impact organisation, we identify opportunities to turn circular economy principles into practical reality.

With nature as our mentor, we combine practical insights with scalable responses to humanity's greatest challenges. Our vision is economic, social and environmental prosperity, without compromising the future of our planet. Our mission is to connect and empower a global community in business, cities and governments to create the conditions for systemic transformation.



INTRODUCTION

Every year, the built environment consumes 41 billion tonnes of resources, most of which end up landfilled or downcycled to low value applications at the end of product life cycles. In fact, a third of global waste production originates from the construction sector, which makes it the largest producer of waste by mass. By transitioning to a fully circular model, ROCKWOOL can address this global ecological and social challenge and simultaneously explore new commercial opportunities. This also reinforces the company's long-term commitment to combating climate change and limiting negative environmental impacts from operations.

ROCKWOOL has a long standing ambition on sustainability, as is exhibited in its contribution to climate mitigation or limiting the negative impact of its operations.

“ROCKWOOL has shown its commitment to becoming a profitable business with a strong commitment to sustainability goals and ambitions at its core. At Circle Economy, we are delighted to welcome Rockwool as a member and further deepen our collaboration by connecting them with other frontrunners in the circular economy. This formula for radical collaboration is an effective and proven route to inspire scalable action in the built environment and beyond”

Harald Friedl
CEO, Circle Economy

“In 2018, ROCKWOOL partnered with Circle Economy to analyse gaps in our value chain and to identify more opportunities for circular economy thinking. Thanks to this partnership, we have identified ways to strengthen ROCKWOOL's business model.

Rockwool Sustainability Report
2019

A circular business model is part of this and represents a natural step for ROCKWOOL in building a stable and prosperous future with its key stakeholders.

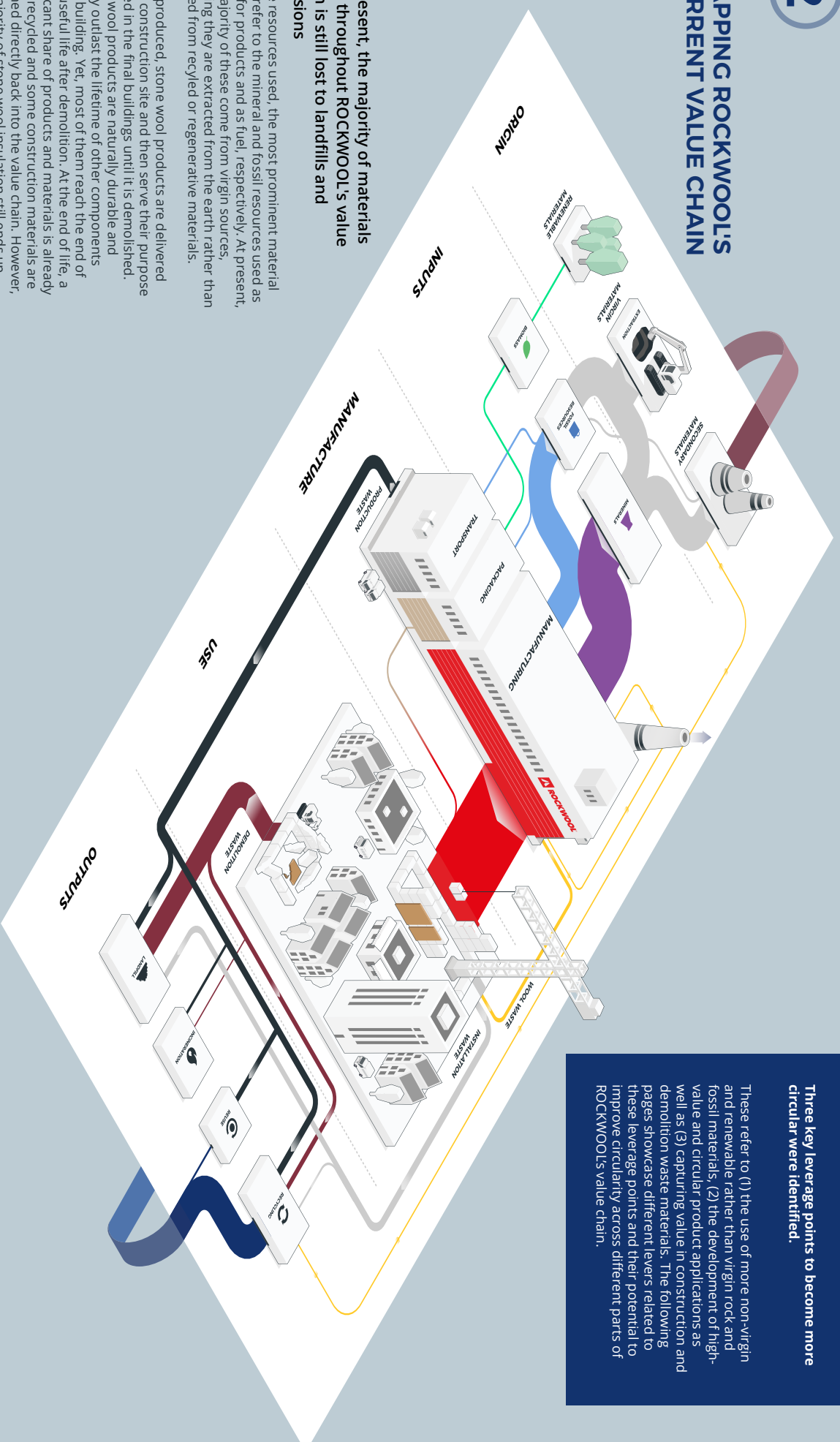
ROCKWOOL is committed to contribute towards shaping a Circular Economy. Building on the existing commitment towards improving on the circularity of its business model, ROCKWOOL has set out to analyse and assess the current status of its value chain and identify leverage points throughout the products' life cycle.

ROCKWOOL aims to extend circular economy thinking in its business model. ROCKWOOL is already upcycling secondary materials from other industries, recycling its own waste in closed loops and designing products for long life and indefinite recycling. In addition, ROCKWOOL has set ambitious goals to reduce the amount of production waste going to landfill by 85% as well as to offer recycling services for its products in 30 countries by 2030. With the Circle Scan analysis used in this report, Circle Economy set out to assess and challenge ROCKWOOL's business model and value chain by identifying circular hotspots and levers to accelerate circular impact.

In upcoming years, ROCKWOOL plans to initiate a number of new collaborations to realize its circular economy agenda. Thereby, they can become change agents spreading their circular vision throughout the construction sector and inspire action beyond the company.



MAPPING ROCKWOOL'S CURRENT VALUE CHAIN



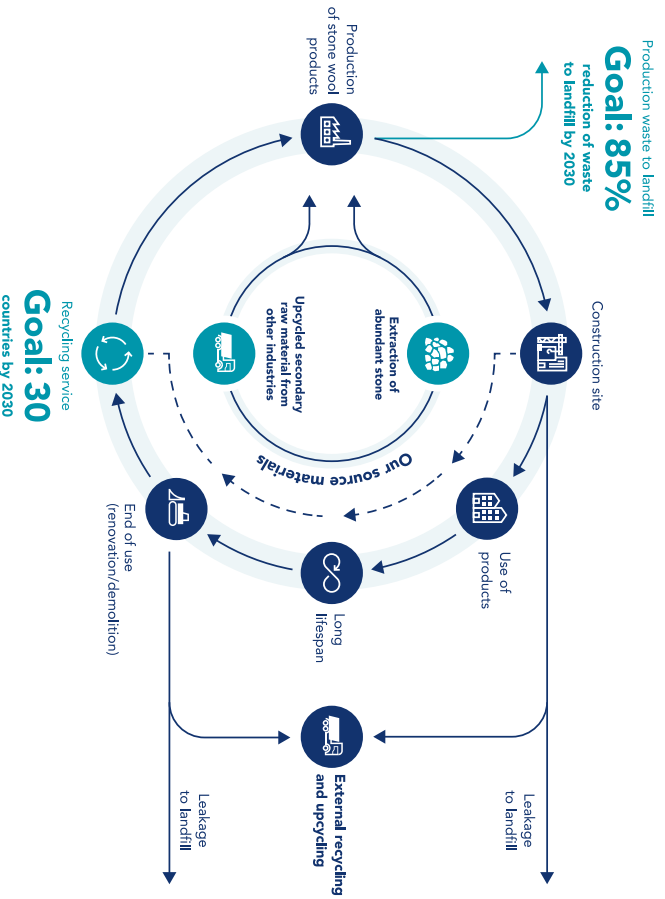
At present, the majority of materials used throughout ROCKWOOL's value chain is still lost to landfills and emissions

Of the resources used, the most prominent material flows refer to the mineral and fossil resources used as input for products and as fuel, respectively. At present, the majority of these come from virgin sources, meaning they are extracted from the earth rather than sourced from recycled or regenerative materials.

Once produced, stone wool products are delivered to the construction site and then serve their purpose stocked in the final buildings until it is demolished. Stone wool products are naturally durable and usually outlast the lifetime of other components in the building. Yet, most of them reach the end of their useful life after demolition. At the end of life, a significant share of products and materials is already being recycled and some construction materials are returned directly back into the value chain. However, the majority of stone wool insulation still ends up in landfills where it is mixed with other demolition waste streams and adds to the vast volumes of waste materials that are unavailable for further use.

Three key leverage points to become more circular were identified.

These refer to (1) the use of more non-virgin and renewable rather than virgin rock and fossil materials, (2) the development of high-value and circular product applications as well as (3) capturing value in construction and demolition waste materials. The following pages showcase different levers related to these leverage points and their potential to improve circularity across different parts of ROCKWOOL's value chain.



ROCKWOOL IS HEADING TOWARDS CIRCULARITY

ROCKWOOL is already addressing the challenges causing the low circularity in its existing goals. More specifically, it aims to reduce to reduce the amount of production waste going to landfill by 85% as well as to offer recycling services for their products in 30 countries by 2030. These goals constitute an important step towards closing the circularity gap as they aim for a reduction in waste as well as an increase in the

recycling rate of materials that still reach end-of-life. Based on the analysis conducted as part of the collaboration between Circle Economy and ROCKWOOL, these measures will improve the circularity of the value chain significantly. While there is a potential for the value chain to become fully circular, further action as well as collaborative effort are needed across the value chain.



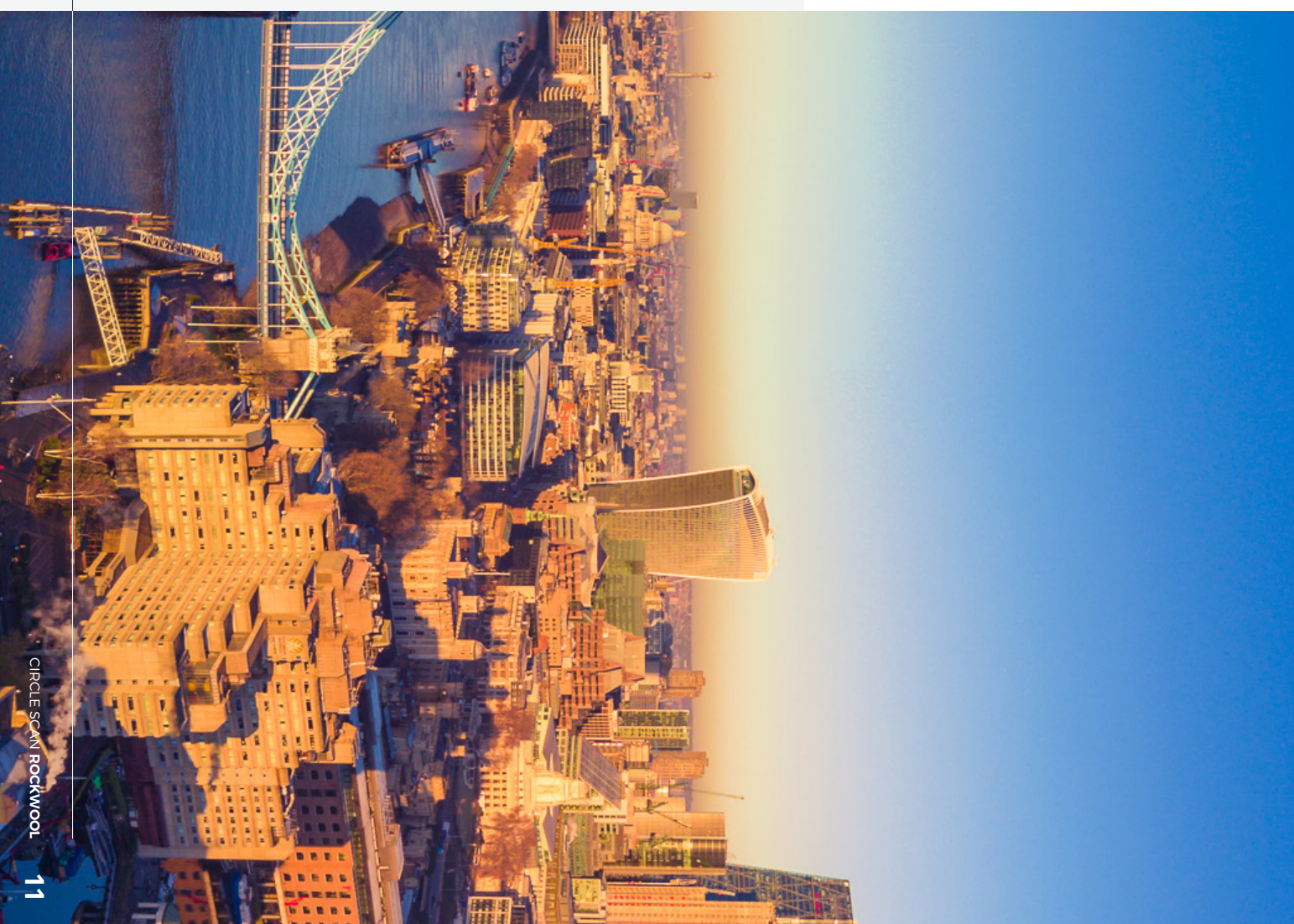
CIRCULAR OPPORTUNITIES

The circular economy offers various opportunities to improve ROCKWOOL's value chain and deliver additional value to society. The following pages describe a selection of high-level opportunities that demonstrate how improving the circularity of the ROCKWOOL value chain is feasible. This selection of levers has been developed using the "7 elements" framework depicted below and aims to inspire all associated stakeholders to join the effort of improving the circularity of ROCKWOOL's material flows. The levers are organised according to the three leverage points identified in the current value chain: (1) using more non-virgin and regenerative materials rather than virgin rock and fossil resources, (2) developing high-value, circular product applications and (3) capturing the value in construction and demolition waste.

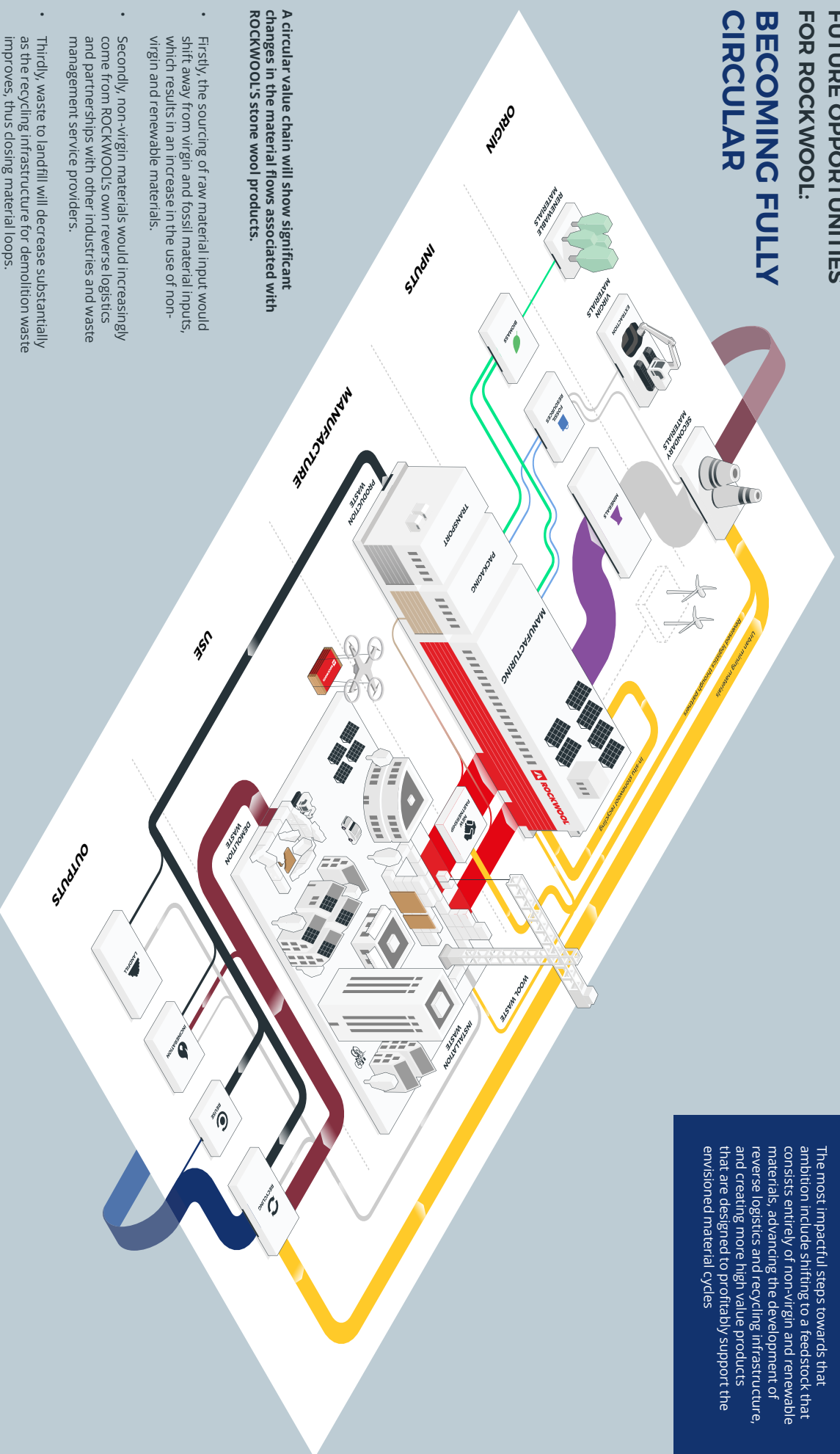
7 ELEMENTS OF THE CIRCULAR ECONOMY



- Prioritise Regenerative Resources:** Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way.
- Preserve and Extend What's Already Made:** Maintain, repair and upgrade resources in use to maximise their lifetime and give them a second life through take-back strategies, where applicable.
- Use Waste as a Resource:** Utilise waste streams as a source of non-virgin resources and recover waste for reuse and recycling.
- Rethink the Business Model:** Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services.
- Design For the Future:** Adopt a systemic perspective during the design process, to employ the right materials for appropriate lifetime and extended future use.
- Incorporate Digital Technology:** Track and optimise resource use and strengthen connections between supply-chain actors through digital, online platforms and technologies.
- Collaborate to Create Joint Value:** Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create shared value.



FUTURE OPPORTUNITIES FOR ROCKWOOL: BECOMING FULLY CIRCULAR



ROCKWOOL'S value chain can become fully circular.

The most impactful steps towards that ambition include shifting to a feedstock that consists entirely of non-virgin and renewable materials, advancing the development of reverse logistics and recycling infrastructure, and creating more high value products that are designed to profitably support the envisioned material cycles

LEVERAGE POINT A

1. Shift to renewable energy sources in manufacturing processes
2. Scale up non-virgin raw material sourcing from open and closed loops
3. Use renewable energy sources for transportation
4. Use renewable or cycled materials for packaging
5. Shift to bio-based binders

INCREASE THE USE OF NON-VIRGIN AND RENEWABLE MATERIALS

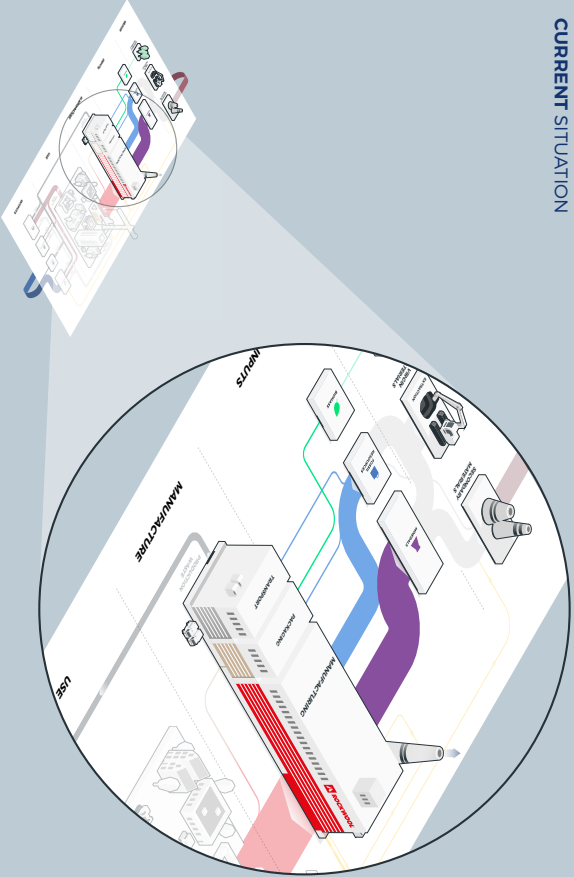
Shifting towards non-virgin and renewable materials will enable ROCKWOOL to close its circularity gap by decreasing virgin material consumption. Thereby, ROCKWOOL will be able to minimize environmental impacts associated with extracting and processing minerals and burning fossil fuels. Simultaneously, this shift may increasingly hold commercial potential due to changing material and energy prices and growing attention for sustainability among clients.

ROCKWOOL already uses a considerable amount of non-virgin materials from waste stone wool as well as other industries such as metallurgic and utilities industries. In addition, ROCKWOOL could actively engage in building new collaborations with other

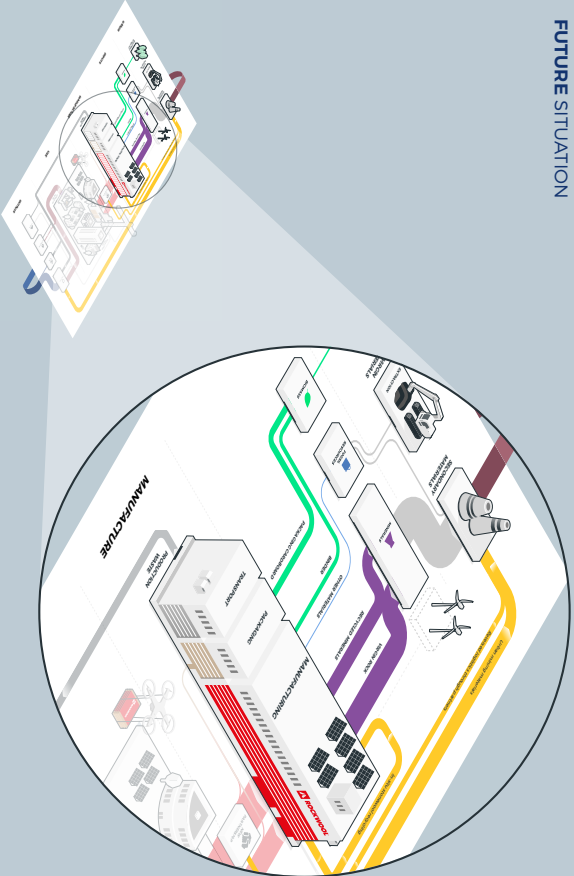
industries to increase its intake of non-virgin materials. In addition to collaborations with other industries, ROCKWOOL also plans to expand its own closed-loop reverse logistics programme. Especially, used stone wool materials from construction and demolition waste hold potential to close the loop in ROCKWOOL's value chain.

Shifting to renewable energy sources lowers the resource footprint of ROCKWOOL products. Most prominently, this would entail replacing fossil fuels used during manufacturing processes and transportation with renewable energy sources. Similarly, switching to bio-based materials in binders and packaging will further reduce the amount of fossil materials that end up incinerated and in waste streams.

CURRENT SITUATION



FUTURE SITUATION



LEVERAGE POINT B

- 1. Expand the product portfolio by prefabricated systems and high-value products
- 2. Support a diverse portfolio of solutions for product modularity and adaptive buildings
- 3. Offer different leasing and ownership models to provide access rather than ownership

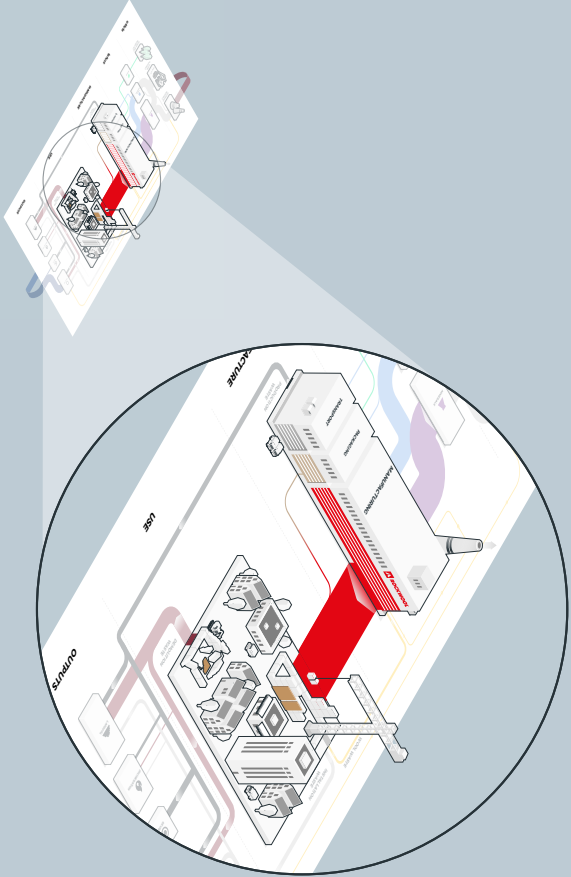
EXPAND THE PORTFOLIO OF HIGH-VALUE AND CIRCULAR PRODUCT APPLICATIONS

By developing high-value circular product applications, ROCKWOOL can reshape its value chain to foster circularity. Low value, non-durable products that are not designed for reuse or recycling inhibit the profitability of circular business models due to the relatively high cost of retrieving resources through reverse logistics. In contrast, high-value, durable products that adhere to principles of circular design improve the business case for reuse, refurbishment and high value recycling. They are designed to deliver maximum functional value throughout and beyond an individual product life cycle. Due to its extreme durability, ROCKWOOL's stone wool can be

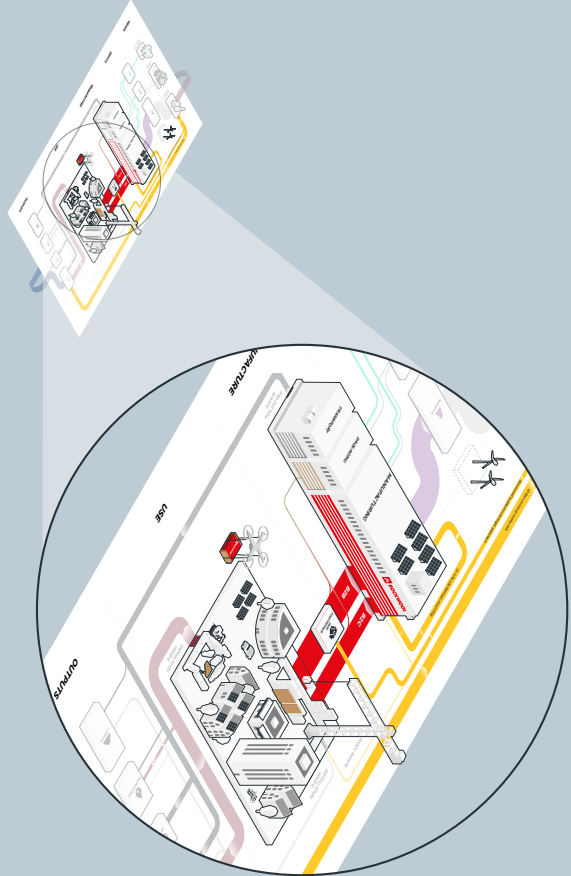
reused, refurbished and recycled without losing its quality. By integrating this characteristic into high-value, modular applications, ROCKWOOL will support reuse, refurbishment or recycling.

ROCKWOOL can deliver additional value by co-creating products, such as modular building elements, solutions for adaptive buildings and prefabricated building elements. Further, collaborating with partners to offer prefabricated systems will enhance the effectiveness of reverse logistics that handle installation and demolition waste. The ROCKZERO product line is a prime example of a prefabricated, modular product system for newly built construction and refurbishment. Lastly, ROCKWOOL could also collaborate with partners to develop financial services based on different leasing and ownership models to complement its more high-value products.

CURRENT SITUATION



FUTURE SITUATION



LEVERAGE POINT C

1. Material- and building-passports
2. Advanced sorting technology for demolition waste
3. Reverse construction approach

CAPTURE MATERIALS FROM CONSTRUCTION AND DEMOLITION WASTE

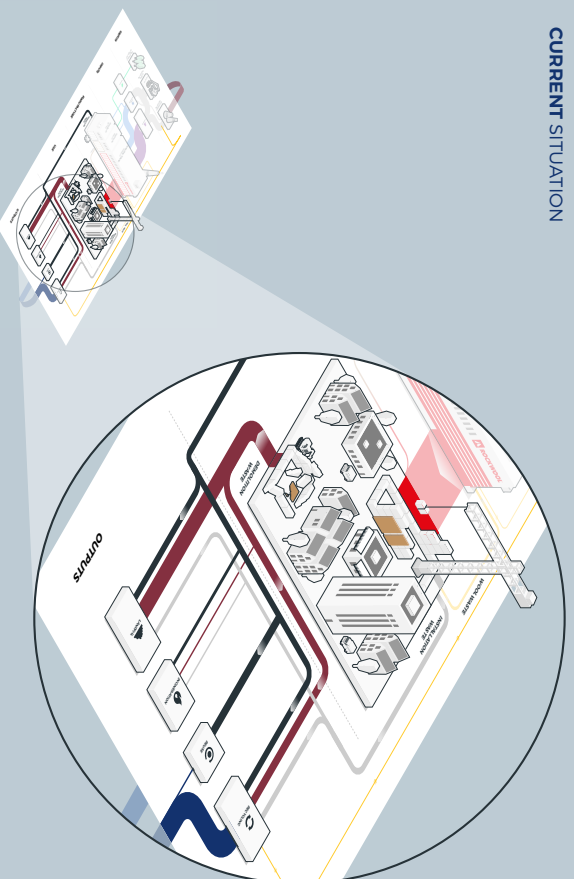
Urban areas act as a massive stock of resources, a part of which is released into demolition waste every year. Part of these waste flows include stone wool and other minerals, which could be recycled into ROCKWOOL production processes. Therefore, ROCKWOOL has formulated the goal to expand its existing network of ROCKCYCLE recycling services to other countries.

The recovery of resources can be greatly facilitated by digital technology that tracks necessary information on material quantity, quality and accessibility. For example, the introduction of material or building 'passports' and integrated building information management systems, that carry information about the specific materials used in ROCKWOOL's products and how they are applied in the building will assist demolition

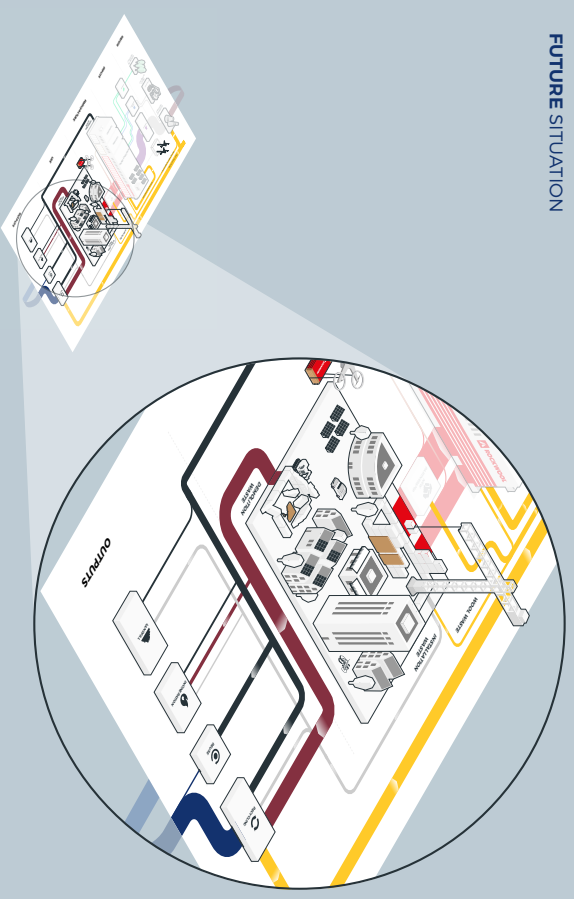
companies in extracting resources in a more targeted manner. This will improve the business case due to cost reductions and higher material quality. Likewise, advances in machine vision and sensor technologies facilitate smart sorting technologies that help extracting resources from mixed waste streams. Alternatively, adopting a reverse construction approach is another opportunity that allows to reuse products as constructions are disassembled in the reverse order they were constructed in. Thereby, products can be extracted in higher quality and are more likely to be fit for reuse.

ROCKWOOL will need to build new partnerships to tap into the material stocks of buildings and constructions. By collaborating with waste management providers and legislators, ROCKWOOL can create awareness about existing opportunities and drive change needed to advance reverse logistics and recycling infrastructure.

CURRENT SITUATION



FUTURE SITUATION



OUR RECOMMENDATIONS

ROCKWOOL's value chain can become fully circular. Even though, only a small share of the materials used in ROCKWOOL's value chain can currently be considered 'circular materials' based on the circularity analysis by Circle Economy, there is tremendous potential to improve on this due to the inherent recyclability of stone wool products. To bridge this circularity gap, a number of levers that can improve the circularity of the value chain significantly were identified and analysed.

ROCKWOOL is already on a pathway towards circularity. In the upcoming years, ROCKWOOL's existing goals will strengthen the circularity of ROCKWOOL's value chain. Simultaneously, substantial improvements can still be attained within ROCKWOOL's own operations, by increasing ambitions on the existing goals and following some of the outlined recommendations. In particular, we assessed that further reach and higher efficiency in recycling services, increased sourcing of non-virgin materials from secondary material suppliers and shifting towards renewable energy sources used in production processes would significantly enhance circularity throughout ROCKWOOL's operations.

ROCKWOOL cannot reach full circularity on its own. Beside its potential to improve its own operations, our assessment showed that the biggest steps towards circularity can only be taken with the support of and collaboration with value chain partners, legislators and customers. For example, transforming the existing recycling infrastructure for construction and demolition waste requires industry participation in the design of demolition processes, the development of new technologies for material sorting and comprehensive information modelling to produce the necessary information on material quantity and quality.

At the same time, a strong legislative framework is required to prevent landfilling of recyclable wastes and incentivize high quality recycling of materials.

ROCKWOOL can leverage its existing efforts and visibility by developing a clear action plan towards a circular future. This will allow to capture the potential of the outlined levers, accelerate progress towards the end goal, and most importantly engage industry partners and external stakeholders to join the transition.

ROCKWOOL has already shown its commitment to becoming a profitable business with sustainability at its core. This report showcased how moving towards a more circular future could enable ROCKWOOL to strengthen and expand on its current ambitions while capturing the opportunities associated with a circular economy for the decades to come.

JOIN THE TRANSITION

Do you want to learn more?
Do you have any suggestions
or otherwise, want to support the
ambitions of ROCKWOOL?

Join the discussion here

www.rockwoolgroup.com/sustainability



COLOPHON

Authors

Jacco Verstraeten-Jochimsen (Circle Economy)
Michelle Steenmeijer (Circle Economy)
Caspar von Daniels (Circle Economy)
Marc de Wit (Circle Economy)

With contributions from

Agnes Schuurmans (ROCKWOOL)
Dorte Vigsø (ROCKWOOL)

Design

Alexandru Grigoras (Circle Economy)
Inge ter Laak (Circle Economy)

Contact

Marc de Wit | Circle Economy, Director of Business and Insights
marc@circle-economy.com
Agnes Schuurmans | ROCKWOOL, Sustainability manager
sustainability@rockwool.com



ROCKWOOL International A/S

Hovedgaden 584
DK-2640 Hedehusene Denmark
www.rockwoolgroup.com



CIRCLE ECONOMY

Mauritskade 64
1092 AD Amsterdam
www.circle-economy.com