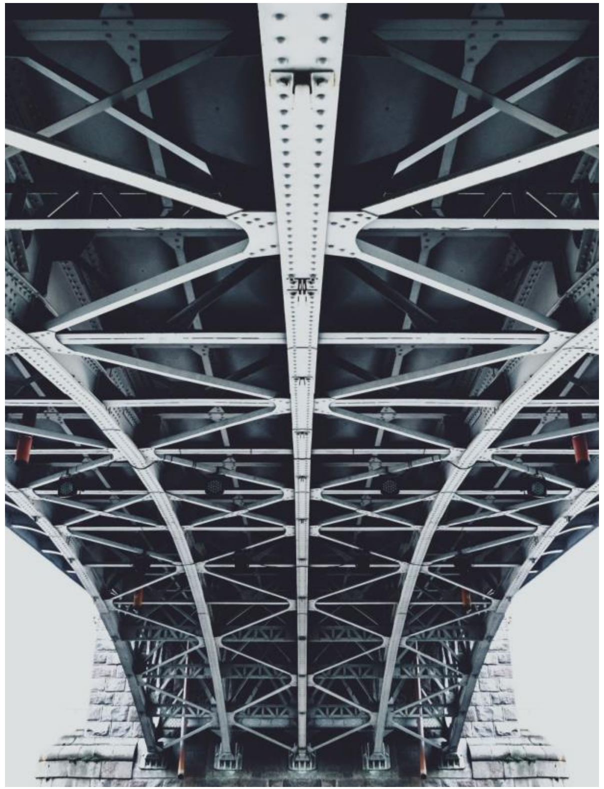
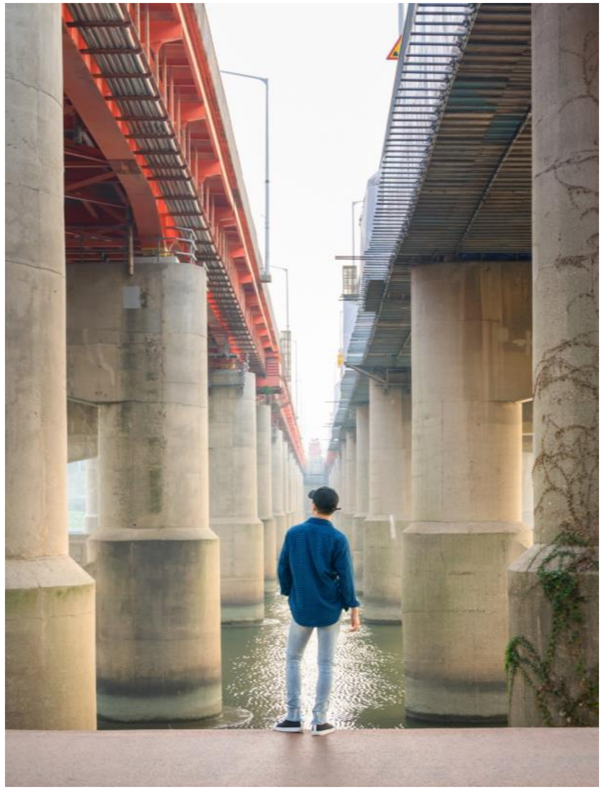
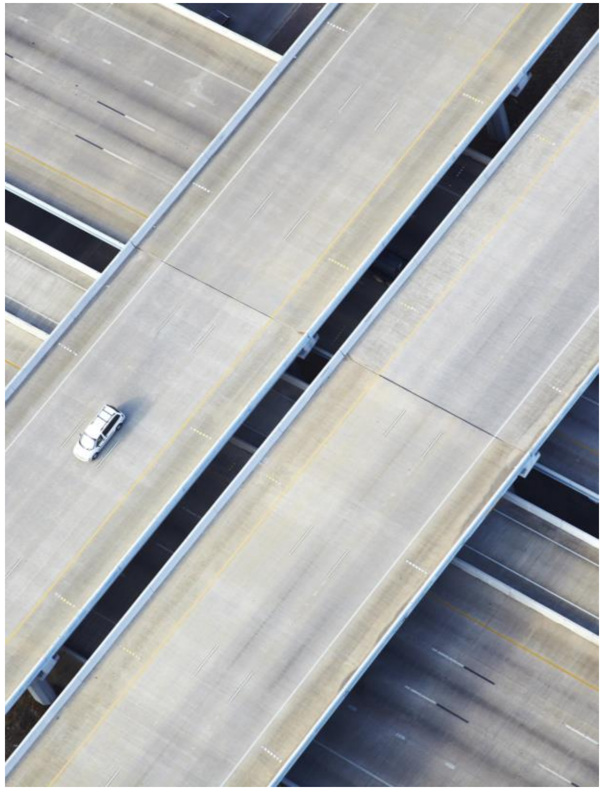
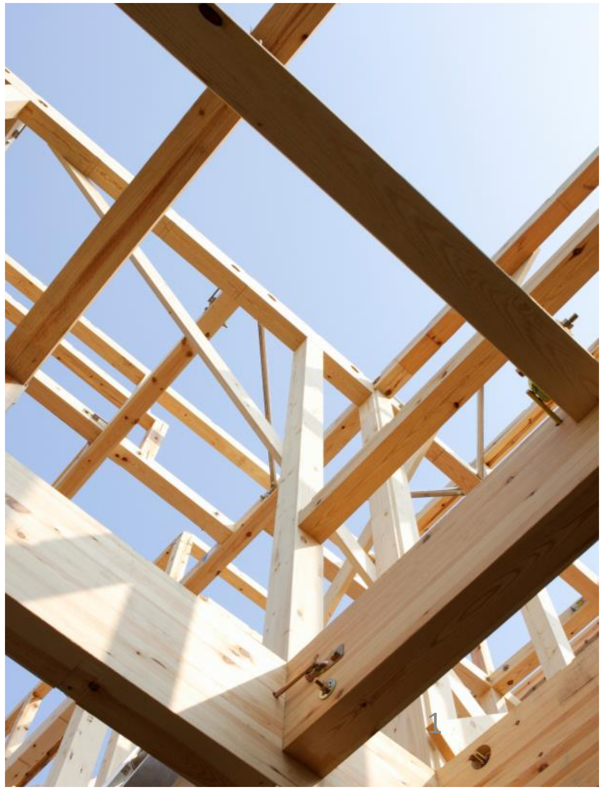
Rijkswaterstaat
Ministry of Infrastructure and Water Management

International supply chain analysis

Research on the value chains of steel, concrete, asphalt and wood

January 2024

Research on the value chains of asphalt, steel, concrete and wood

conducted for Rijkswaterstaat

by

VacWerk consortium

Lonneke de Nooijer – Alba Concepts (concrete, steel)

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Rijkswaterstaat: moving towards circular construction and infrastructure

Rijkswaterstaat (RWS) is responsible for the renewal and maintenance of construction and infrastructure to keep the Netherlands sustainable and liveable.

RWS operates in international supply chains to secure the materials which are needed for construction and infrastructure. However, RWS has insufficient insights into, the developments in, international supply chains. RWS does not know to what degree the supply chains are closed loops or what would be the impact of closing the loops. Insights into the value chains are needed to determine effective actions in the supply chain and possible new policies to move towards circular construction and infrastructure.

Therefore, RWS launched a series of studies to provide insights into the most relevant supply chains to lead to a clear international strategy.

VacWerk was invited to conduct research regarding four value chains (asphalt, steel, concrete & wood). This research provides insights into the volumes of these value chains and the main risks in these chains. Moreover, it describes the circular developments and solutions and provides policy recommendations and suggestions for stakeholder collaborations in order to move towards circular construction and infrastructure.

International Supply Chain Analysis - approach

To determine the four materials on which to focus, we engaged in discussions with material experts from RWS. Together, we decided not to emphasize critical raw materials as identified by the European Commission. Instead, our focus turned to more mainstream materials, namely steel, concrete, asphalt, and wood.

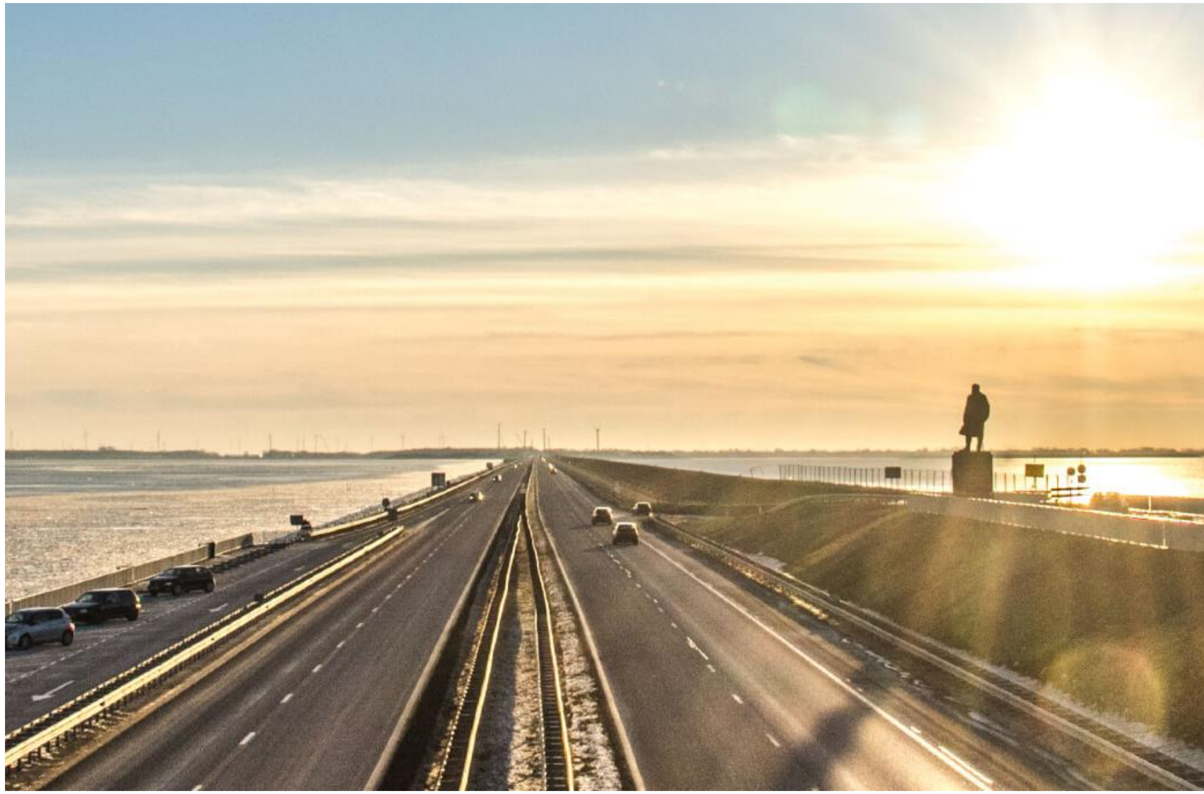
We gathered international trade volume data, especially outside the EU, and conducted a thorough investigation of research publications related to these four value chains. We identified the primary risks within these value chains, encompassing geopolitical, scarcity, social, and environmental risks. To validate our data and assess the risks, we conducted interviews with approximately five stakeholders for each material. Our findings are presented in infographics that provide a global overview of risks and volumes but are not directly comparable among themselves.

In the second phase of this project, our attention shifted towards collecting circular solutions and developments. We collaborated with CE Delft, which was engaged in research on circular solutions for materials, including steel, concrete, and asphalt. Our findings were harmonized with theirs.

In the third phase, we integrated the results of our data collection and interviews with the findings from CE Delft's and our research on circular developments and solutions in the four value chains. Subsequently, we outlined the primary policy recommendations and identified key stakeholders with whom RWS should collaborate to mitigate risks and promote circularity.

Limitations

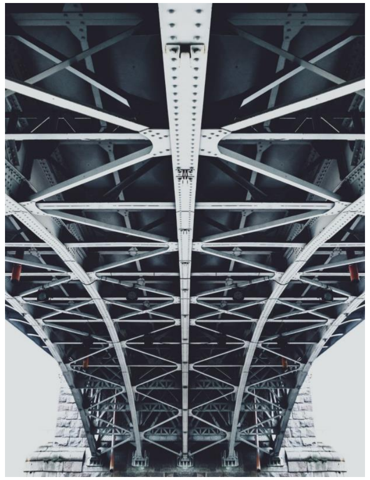
- The viewpoints presented in the interviews may be influenced by the interviewed experts' involvement and interests in a specific material, potentially leading to biased perspectives.
- Variability in data collection methods and practices among different organizations and countries can lead to inconsistencies and inaccuracies in the reported data.
- The risk infographics for the four materials cannot be compared because they are based on different sets of reference data. Each material's risks should be evaluated individually.
- The results of this research are limited and intended as an initial global exploration of value chains.

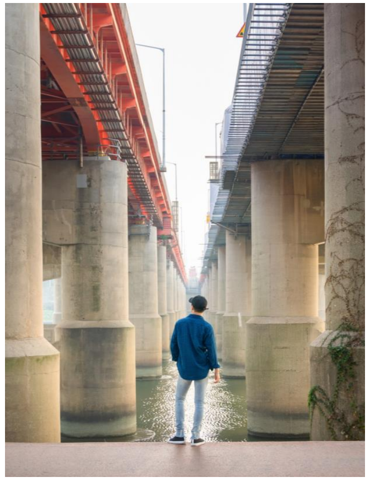


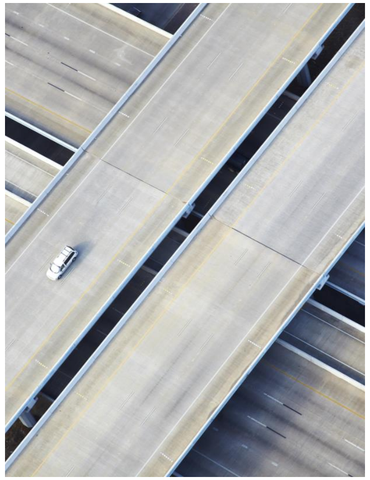
Content

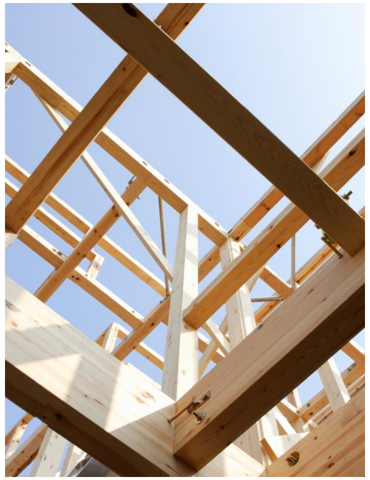
The following chapters present material-specific findings. Each chapter adheres to a consistent structure, which includes the following key elements:

- Introduction and description of the current situation.
  - Trade volumes
  - Current situation
  - Infographic of risks
  - Description of risks
- Circular solutions and developments
- Policy and strategic stakeholder collaboration recommendations

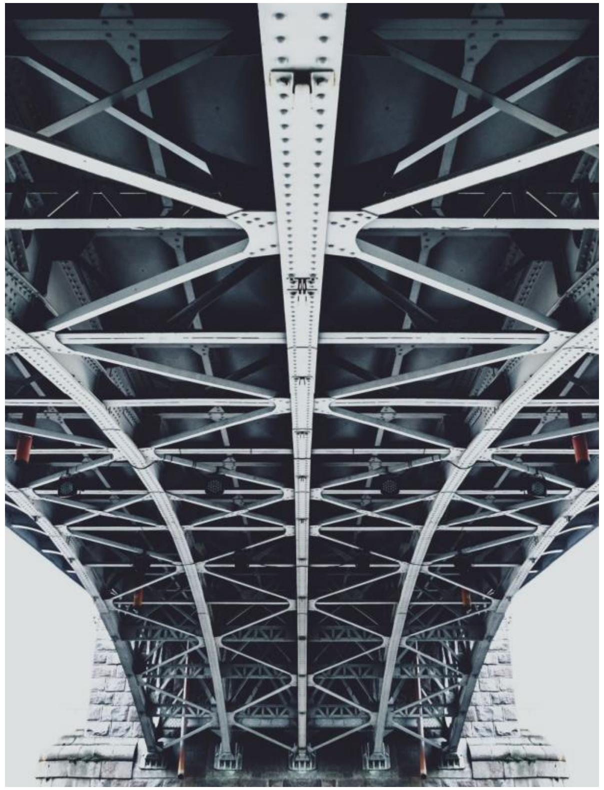








Steel



Supply chain & risk analysis steel - introduction

INTRODUCTION

Steel is a versatile material and plays a pivotal role in the construction industry, serving various applications. Commonly used steel products within this sector include rebar, structural steel, sheet and plate (e.g. quarter plates used in bridges), pipes, tubes and wire products, collectively contributing to approximately 25% of total steel consumption.

The production of steel products can take two primary routes. One method involves melting primary raw materials like iron ore a second one involves the melting of ferrous scrap to create pig iron, which is further refined to produce steel. The resulting steel is then shaped into flat (sheet and plates) and long products (rebar, pipes, tubes and wire products).

In the context of the construction industry, long products are of particular significance. The composition of steel for long products doesn't require as stringent control and can effectively be produced from ferrous scrap using an electric arc furnace (EAF).

Rijkswaterstaat (RWS) predominantly procures long products. It is noteworthy that the Netherlands has limited domestic steel production focus, with Tata Steel being the sole steel production site, primarily emphasizing flat products, which hold more critical importance.

The Netherlands primarily imports the long products required for construction from other European countries, including Belgium, Spain, Germany and possible Italy and Poland. RWS's procurement approach involves direct orders from steel factories or, in the case of smaller orders, intermediaries like ArcelorMittal (EU, quarter plates), Dillinger (Germany), Celsa (Spain), and local companies such as Van Hattum, Blankevoort, and Mourik.

Interviewed experts:

1. **Edwin Basson**
Director General of the World Steel Association

2. **Frank Maatje**
Director Bouwen met Staal

3. **Fred Vasquez**
Policy Officer for Standardization at Metal Union / Branch Manager for Dumebo-DWS and BFN

4. **Guido Joosen**
Senior Economist, Group Strategy at Tata Steel

5. **Ad Vester**
Board Member - VWN- Vereniging Wapeningsstaal

Supply chain & risk analysis steel – trade volumes iron ore

IMPORT IRON ORE to EU (27) 2021

Submaterials

Ferrous scrap

Iron ore

Steel

From region	To region	import/ export	Som van Amount (Mt)
European Union (27)	European Union (27)	import	32,20
Russia & Other CIS + Ukraine	European Union (27)	import	30,00
Other America	European Union (27)	import	23,30
USMCA	European Union (27)	import	22,80
Africa & Middle East	European Union (27)	import	20,40
Other Europe	European Union (27)	import	2,20
Asia	European Union (27)	import	0,40
Oceania	European Union (27)	import	0,20
Totaal			**131,50**

EXPORT IRON ORE from EU (27) 2021

Submaterials

Ferrous scrap

Iron ore

Steel

From region	To region	import/ export	Som van Amount (Mt)
European Union (27)	Africa & Middle East	export	7,10
European Union (27)	China	export	1,50
European Union (27)	European Union (27)	export	32,20
European Union (27)	Oceania	export	0,00
European Union (27)	Other America	export	0,00
European Union (27)	Other Asia	export	0,40
European Union (27)	Other Europe	export	3,80
European Union (27)	Russia & Other CIS + Ukraine	export	0,00
European Union (27)	USMCA	export	0,90
Totaal			**45,90**

KEY INSIGHTS

- **EU-27 2021: Net importer of iron ore (-85.6 Mt)**
- **Most iron ore imports are from:**
  - Significant iron ore trade within EU-27 countries (32,2 Mt)
  - Russia & Other CIS + Ukraine (net import of 30 Mt)
  - Other America (net import of 23,3 Mt)
  - USMCA (21,9 Mt)
  - Africa & Middle East (13,2 Mt)

Source data:
World Steel Association, 2021

Supply chain & risk analysis steel – trade volumes steel

IMPORT STEEL to EU (27) 2021

Submaterials

Ferrous scrap

Iron ore

Steel

From region	To region	import/ export	Som van Amount (Mt)
European Union (27)	European Union (27)	import	108,00
Russia & Other CIS + Ukraine	European Union (27)	import	16,90
Other Europe	European Union (27)	import	12,40
Other Asia	European Union (27)	import	11,60
China	European Union (27)	import	3,00
Africa & Middle East	European Union (27)	import	2,40
Japan	European Union (27)	import	1,00
Other America	European Union (27)	import	0,60
USMCA	European Union (27)	import	0,10
Oceania	European Union (27)	import	0,00
Totaal			**156,00**

EXPORT STEEL from EU (27) 2021

Submaterials

Ferrous scrap

Iron ore

Steel

From region	To region	import/ export	Som van Amount (Mt)
European Union (27)	Africa	export	2,50
European Union (27)	China	export	1,20
European Union (27)	European Union (27)	export	108,00
European Union (27)	Japan	export	0,00
European Union (27)	Middle East	export	1,20
European Union (27)	Oceania	export	0,30
European Union (27)	Other America	export	1,10
European Union (27)	Other Asia	export	1,60
European Union (27)	Other Europe	export	11,50
European Union (27)	Russia & Other CIS + Ukraine	export	0,80
European Union (27)	USMCA	export	5,90
Totaal			**134,10**

KEY INSIGHTS

- **EU-27 2021: Net importer of steel (21,9 Mt)**
- **Most steel imports are from**:
  - Significant steel trade within EU-27 countries (108 Mt)
  - Russia & Other CIS + Ukraine (net import of 16,1Mt)
  - Other Asia (net import of 10 Mt)
  - China (net import of 1,8 Mt)
  - Other Europe (net import of 0,9 Mt)

Source data:
World Steel Association, 2021

Supply chain & risk analysis steel – trade volumes ferrous scrap

IMPORT FERROUS SCRAP to EU (27) 2021

Submaterials

Ferrous scrap

Iron ore

Steel

From region	To region	import/ export	Som van Amount (Mt)
European Union (27)	European Union (27)	import	28,60
Other Europe	European Union (27)	import	3,30
USMCA	European Union (27)	import	0,70
Russia & Other CIS + Ukraine	European Union (27)	import	0,60
Other America	European Union (27)	import	0,50
Africa & Middle East	European Union (27)	import	0,30
Japan	European Union (27)	import	0,00
Oceania	European Union (27)	import	0,00
Other Asia	European Union (27)	import	0,00
Totaal			**34,00**

EXPORT FERROUS SCRAP from EU (27) 2021

Submaterials

Ferrous scrap

Iron ore

Steel

From region	To region	import/ export	Som van Amount (Mt)
European Union (27)	Africa	export	2,20
European Union (27)	China	export	0,00
European Union (27)	European Union (27)	export	28,60
European Union (27)	Japan	export	0,00
European Union (27)	Middle East	export	0,10
European Union (27)	Oceania	export	0,00
European Union (27)	Other America	export	0,00
European Union (27)	Other Asia	export	1,80
European Union (27)	Other Europe	export	14,30
European Union (27)	Russia & Other CIS + Ukraine	export	0,40
European Union (27)	USMCA	export	0,60
Totaal			**48,00**

KEY INSIGHTS

- **EU-27 2021: Net exporter of ferrous scrap (14 Mt)**

- **Most ferrous scrap exports are from**:
  - Significant steel trade within EU-27 countries (28,6 Mt)
  - Other Europe (net exporter of 11 Mt)
  - Africa & Middle East (net exporter of 2 Mt)

Source data:
World Steel Association, 2021

CURRENT INTERNATIONAL STEEL VALUE CHAIN

EU iron ore and steel trade dynamics:

- EU-27 2021: Net importer of iron ore (-85.8 Mt) and steel (-22 Mt).
    - Iron ore is globally traded to meet production demands:
        - Trade within EU-27, and most net import from Russia & Other CIS + Ukraine, Other America, USMCA and Africa & Middle East.
    - Steel is more locally traded: 70% of steel used within 500 km of production.
        - Significant trade within EU-27 and in lower volumes import from Russia & Other CIS + Ukraine and Other Asia.

EU ferrous scrap trade dynamics:

- EU-27 2021: Net exporter of ferrous scrap (13.9 Mt).
    - Ferrous scrap is mostly exported to Other Europe (Turkey).
        - Trade within EU-27, and most net export to Other Europe (mostly Turkey).

Netherlands construction steel dynamics:

- The Netherlands does not have an iron ore mine. Steel production in the Netherlands (Tata Steel) does not prioritize the production of construction steel. Tata Steel's focus is primarily on flat products, which are considered more crucial to produce than long products.
- Relevant steel product for the Ground/Road/Water industry are imported primarily from within EU-27.
- Netherlands 2021: Net importer of construction-relevant steel products.
    - Imports include concrete reinforcing bars (225k tonnes) and wire rods (1079k tonnes) mainly from Spain, Poland, and to a smaller extent Germany.
    - Additional imports: HR bars (302k tonnes) and heavy sections (592k tonnes).

Conclusion:

The EU is net importer of iron ore and steel and is net exporter of ferrous scrap.

The Netherlands imports construction steel from other EU countries because the primary steel producer in the Netherlands, Tata Steel, specializes in flat products rather than construction steel (long products).

CURRENT EU POLICY FOR THE STEEL VALUE CHAIN

The European Union (EU) has enacted a comprehensive policy framework targeting the iron ore, steel, and ferrous scrap chain. This framework is designed to promote resource efficiency, reduce emissions, enhance energy efficiency, support fair trade, and encourage investments in low-carbon technologies.

- **Iron Ore Market:** No major challenges; focus on resource efficiency and emission reduction.
- **Steel Market:** The EU follows a domestic-focused strategy that aligns with CO_2 reduction objectives. Key concern: eventual insufficiency of ferrous scrap volumes to meet EU steel demand, necessitating increased reliance on green energy sources for low-CO_2 steel production.
- **Carbon Border Adjustment Mechanism (CBAM):** The EU prioritizes the reduction of steel's environmental impact and is actively exploring the implementation of CBAM. External low-value steel imports could potentially face tariffs based on their CO_2 emissions. A transition to electric furnaces has the potential to reduce CO_2 emissions from 1800kg/ton (blast furnaces) to 800kg/ton.
- **CE Marking & Reuse:** Regulations related to CE-marked construction products present challenges to steel reuse. However, Dutch technical guidance is available to promote sustainable practices and encourage steel reuse.
- **CO_2 Emissions Target:** The EU has set an ambitious target of achieving a 55% reduction in CO_2 emissions by 2030. However, concrete policies from authorities are currently lacking. Collaborative efforts within the steel value chain, exemplified by initiatives like those undertaken by ‘Bouwen met Staal’, are crucial for achieving these targets.
- **Import Ceilings:** The EU has established import limits for 27 product categories in which steel is included. Ensuring self-sufficiency, secure supply chains, and sustainable raw material sources are top priorities in this context.

For the latest developments and changes in the Construction Products Regulation (CPR) regulation regarding steel construction products, it is recommended to consult official sources such as the European Commission's website, national authorities, or legal databases for the most up-to-date information

Supply chain & risk analysis steel – current situation

- **Tata Steel's Transformation:** the EU places significant emphasis on the sustainable transformation of Tata Steel, particularly within the automotive sector. Important to note is that this transformation may have limited direct impact on the reinforcement steel market due to external sourcing practices.

Conclusion:

The EU's current policy for the iron ore/steel/ferrous scrap chain encompasses import limitations, secure supply chains, sustainability enhancement, and self-sufficiency.

Supply chain & risk analysis steel – current situation

CURRENT EMERGING TECHNICAL REGULATION IN THE STEEL VALUE CHAIN

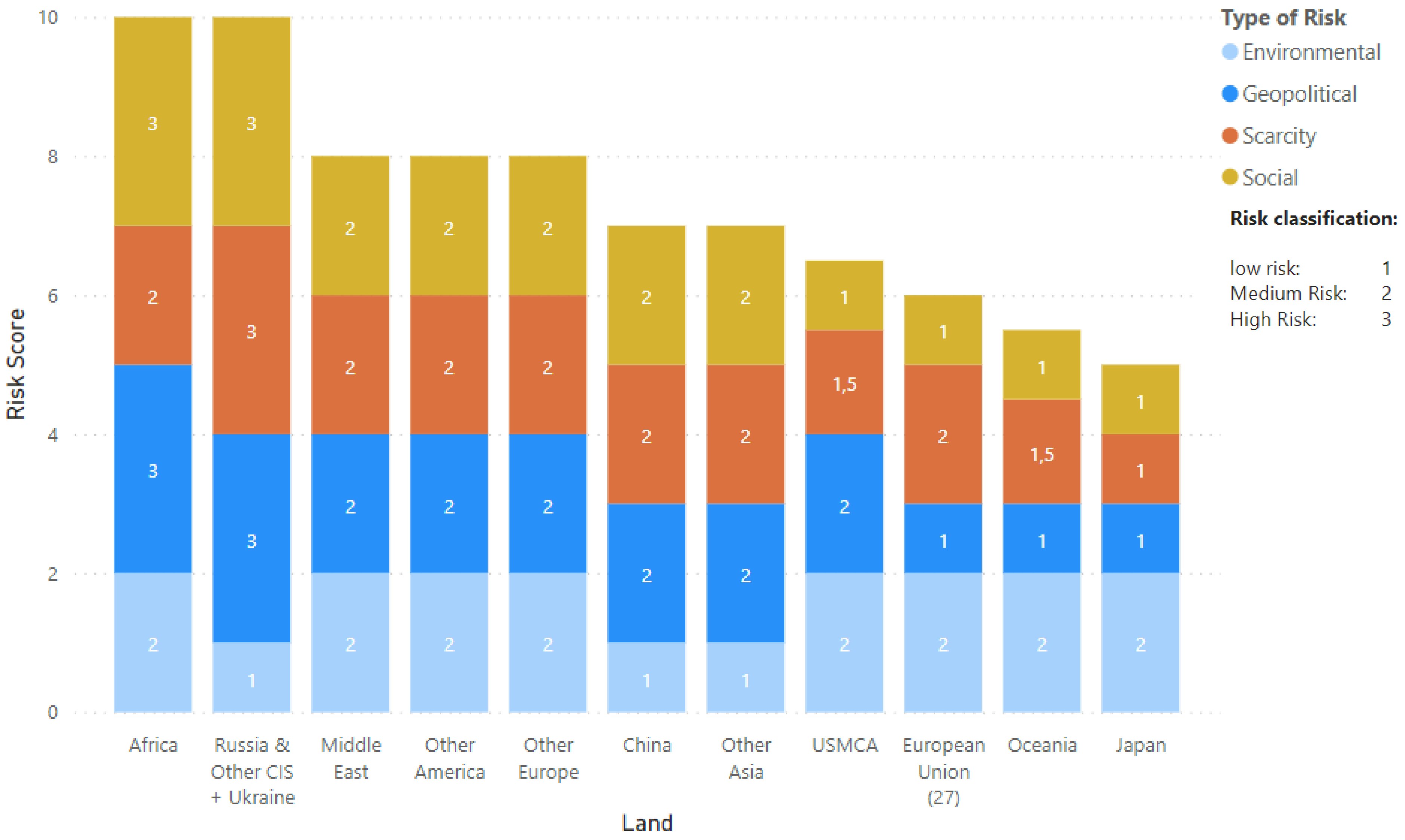
- **ROK Revision (Guidelines on Crown Works)**: Currently undergoing revisions to address sustainability concerns, including limiting the use of high-strength steel. These changes aim to align the guidelines with environmentally responsible practices.
- **CE Marking and Norm 178013**: CE marking plays a pivotal role in certifying the quality and safety of steel products. The development of Norm 178013 is geared towards simplifying processes related to steel product reuse, though infrastructure steel is not yet encompassed within these standards.
- **Reinforcing Steel and Rebar Recovery**: Reinforcing steel prominently utilizes recycled materials, especially scrap steel, contributing to increased circularity. The process of rebar recovery further strengthens the circular nature of steel in construction.
- **Lifespan Extension and Durability**: Efforts are increasingly focused on extending the life of steel structures through durability enhancements, maintenance practices, and corrosion protection measures for sustained performance.
- **Automatic Reuse Trend**: Increasing automatic steel and concrete reuse aligns with circular economy principles, reducing environmental impact.

Conclusion:

RWS should monitor evolving regulations to ensure adherence, fostering sustainable practices and enhancing material efficiency within the steel value chain. RWS should also support/encourage shift in demand to lifespan extension and automatic reuse in line with national circular ambitions.

Supply chain & risk analysis steel – infographic risks

Risks per region, defined by the interviewed experts



Overview of regions where steel is sourced from:

Iron Ore:
Trade within EU-27, and most **net import** from Russia & Other CIS + Ukraine, Other America, USMCA and Africa & Middle East.

Steel:
Significant trade within EU-27 and in lower volumes **net import** from Russia & Other CIS + Ukraine and Other Asia

Ferrous scrap:
Trade within EU-27, and mostly **net export** to Other Europe (Turkey)

Supply chain & risk analysis steel – description of risks

Geopolitical Risk

- **Open to Closed Markets**: A shift from open to closed steel markets due to countries' desire for steel industry participation.
- **Impact of Conflict**: Political events such as the Russia-Ukraine war halted steel production and disrupted trade.
- **Quick Recovery**: Geopolitical issues can cause temporary disturbances, but the industry tends to recover swiftly.
- **Higher costs**: Ferrous scrap is used in greener production. As the demand for greener production increases, the demand for ferrous scrap will rise. A shortage of ferrous scrap is likely and prices are expected to rise.

Scarcity Risk

- **Abundance of Resources**: Iron ore, the fourth most available substance globally, ensures a consistent supply.
- **Cyclical Overcapacity**: The EU sometimes faces cyclical overcapacity. However, structural overcapacity is not prevalent.
- **Green Energy Transition**: Shift to green energy for steel production might create scarcity if not managed properly.

Environmental Risk

- **EU Focus on Sustainability**: Steel industry pressured to reduce environmental impact, focusing on renewable energy use presents challenges.
- **Carbon Adjustment System**: Carbon Border Adjustment Mechanism (CBAM) promotes a level playing field by pricing carbon.
- **Transition Challenges**: Shift to hydrogen-based steel production to align with sustainability goals presents environmental challenges.
- **Energy Challenges**: Potential energy shortage in 2025 to align with EU environmental plans.

Social Risk

- **Need for Further Research**: Due to lack of comprehensive information, a definitive conclusion regarding social risks cannot be drawn. Further research is required to assess potential social risks within the steel industry.

Conclusion:

The geopolitical context of the steel industry is influenced by political events, trade dynamics, and sustainability efforts. Scarcity risks are generally low due to ample iron ore availability and proactive sourcing strategies. Environmental challenges arise from the need for sustainable steel production and energy transition. Social risks within the steel industry need further research to comprehensively understand and address potential social risks within the industry.

Circular solutions and developments - steel

DEVELOPMENTS IN THE STEEL VALUE CHAIN

- **Energy Transition and Sustainability:**
    - Shifting to sustainable steel production with increased scrap usage.
    - Exploration of cleaner steelmaking techniques and adoption of renewables and hydrogen.
    - Emergence of Direct Reduced Iron (DRI) technique for reduced emissions and higher efficiency.
    - EU's standardization efforts aligned with circular economy principles.
- **Material Availability, Scarcity, and Global Demand:**
    - Abundant global availability of steel material, including primary raw material iron ore.
    - Medium scarcity risk due to energy consumption challenges in European steel.
    - Rising global demand for environmentally friendly, sustainable steel.
    - Market adaptation through diverse sourcing to manage price fluctuations and shortages.
    - Price fluctuations and temporary shortages may occur due to energy cost changes.
- **Geopolitical Influences on Circular Construction:**
    - Limited direct impact on circular construction due to EU-sourced steel.
    - Reliance on EU steel reduces vulnerability to geopolitical disruptions.
    - Focus remains on sustainability, energy transition, and material recycling/reuse in circular construction.

Conclusion:

The steel material chain is witnessing shifts towards sustainability, navigating scarcity risks, meeting rising global demand for green steel, and adapting to geopolitical influences through circular construction's focus on local sourcing and sustainable practices

Circular solutions and developments - steel

CIRCULAR SOLUTIONS

- **Substitution:** Promote other building materials. Prioritizing reducing steel use where it is possible.
- **Reduce environmental impact of steel**: Promote DRI technology to lower energy consumption and emissions, promote low CO_2 emission X-carb steel and promote weathering steel to reduce maintenance.
- **Lifespan Extension:** Optimize design for longer-lasting structures.
- **Designing for Future Reuse (Detachable or modular)**: When creating new structures, plan for their potential for future reuse, ensuring they can be easily disassembled.
- **Structural Repurposing**: Ensure the use of detachable steel constructions to facilitate extended lifespans, thereby contributing to a closed-loop system through the repurposing of steel structures.
- **Reusing Elements**: Reuse standardized steel components to reduce engineering and customization.

Circular solutions and developments - steel

CIRCULAR SOLUTIONS

- **Promote the production of steel from ferrous scrap:** Globally, 70% of steel production comes from new iron ore, while 30% is derived from recycled ferrous scrap. The production of construction products is well-suited to using ferrous scrap. The steel industry achieves an impressive 99% recycling rate, demonstrating a robust closed-loop material cycle. Nonetheless, while producing steel from ferrous scrap results in lower CO_2 emissions compared to melting primary raw materials, it still involves a significant amount of CO_2 emissions**.**
- **Recycling Priority:** Europe is a net exporter of ferrous scrap; ensure that ferrous scrap remains in Europe for domestic recycling and lower transportation impacts.
- **Material Passports:** Creating comprehensive material passports to trace steel, enhancing transparency, and facilitating proper handling, reuse, and recycling.
- **Promoting Smart Demolition:** Encouraging deconstruction over demolition to salvage and reuse steel elements, conserving valuable resources. Promote the reuse of existing structural components when they become available.

Conclusion:

The steel industry's 99% recycling rate and its capacity for structural repurposing are indicative of a highly closed material chain. Considering the substantial environmental impact associated with steel production, the adoption of a circular strategy becomes a focal point. This strategy prominently emphasizes the reduction of imported steel through the incorporation of circular measures. These measures include the promotion of alternative materials and responsible sourcing. Such actions are pivotal in fostering heightened sustainability, extending the lifespans of structural elements, and ensuring a conscientious recycling process. To establish a resilient and sustainable circular steel supply chain, collective collaboration and crucial regulatory adaptations are indispensable.

POLICY RECOMMENDATIONS

- **Policy Level initiatives:**
  - RWS should play a crucial role in promoting circularity at all stages of the value chain through a demand-led approach.
  - RWS needs to set clear guidelines and requirements for sustainable and green steel usage in its projects. Currently, there is a growing demand for green steel, particularly from sectors like automotive and wind energy. However, RWS is not explicitly its utilization.
  - By actively promoting and incorporating green steel (secondary route steel production with ferrous scrap of produced with renewable energy in its projects), RWS can create a market for sustainable steel and encourage its adoption.
  - RWS doesn't need to specify material-level requirements; this can also be done through performance requirements at the object level. For instance, specific object ceiling values can be set for MKI/m2, CO_2/m2, and primary material use per m2 for each object type. It is then up to the market to make choices in design and materials to meet the specified performance requirements. These requirements can be tightened every two years.

- **Technical Regulation Level (CEN):**
  - The European Committee for Standardization (CEN) can contribute by developing and updating technical regulations that support circularity in the steel value chain.
  - This can include standards for recycled content, eco-design principles, and product labelling schemes that encourage the use of sustainable steel.
  - Additionally, CEN can collaborate with industry stakeholders to develop guidelines for the proper handling, reuse, and recycling of steel materials throughout their lifecycle.

POLICY RECOMMENDATIONS

- **Within Material Chains/RWS:**
  - While RWS is not yet demanding the use of green steel, it is imperative to align with the increasing demand for sustainability. The steel industry could play an important role in driving circular changes. For example, supplier Dillinger has experienced a surge in the demand for green steel, particularly from sectors such as automotive and wind energy. It is essential for RWS to actively engage with companies like Dillinger and support their endeavours in producing and supplying green steel (within the legal boundaries provided by procurement regulations).
  - RWS can set a significant example by incorporating circularity principles into their procurement practices and contracts. This entails specifications for the use of recycled content, advocacy for measures that extend the lifespan of steel products, and active support for recycling initiatives.
  - The focus should shift toward collaborative solutions rather than current adversarial approaches. Moreover, a balanced approach that combines legal and technical expertise is key to effectively address the challenges at hand.

Conclusion:

A combination of policy-level initiatives, updated technical regulations, and collaboration within the steel value chain can promote circular changes. By actively promoting and adopting sustainable practices, RWS can create a market demand for green steel and encourage the entire industry to transition towards a circular and more sustainable steel value chain. These efforts align with RWS's target to be circular by 2050 and to work circularly and climate-neutral by 2030.

Strategic collaboration recommendations - steel

STRATEGIC COLLABORATION RECOMMENDATIONS

Strategic collaborations for circular concrete advancement in Europe and identifying relevant policy & regulation partners:

1. **European Steel Industry Alliances:**
   - Engage in the **"Circular Steel Standards Development Project"**: Active involvement in shaping circular steel standards and specifications.
   - Collaborate within the **"Eco-friendly Steel Manufacturing Initiative"**: Lobby for greener production methods and sustainability criteria (next to making it part of RWS's own procurement policies).
2. **Environmental Organizations:**
   - Collaborate with the **European Environmental Bureau (EEB)**: Contribute to the **"Circular Steel Policy Advocacy Group"** for policy influence and regulation.
   - Participate in the **"Circular Steel Environmental Impact Assessment"**: Research the ecological footprint of circular steel.
3. **Technical and Normative Framework:**
   - Participate in the **European Committee for Standardization (CEN)**: Actively contribute to the **"Circular Steel Technical Standards Task Force"** for circular norm development.
   - Collaborate with **European Chemicals Agency (ECHA)**: Advocate for **"Circular Steel Chemical Regulations Alignment"**.
4. **Sustainability Networks and Certification:**
   - Join the **"Circular Steel Certification Scheme Project"**: Collaboration to establish a certification system for circular steel.
   - Engage with **"Green Building Councils Europe"**: Partner on the **"Circular Steel Integration in Sustainable Construction Standards"** project.

STRATEGIC COLLABORATION RECOMMENDATIONS

5. Financial Institutions:

- Collaborate with the **European Investment Bank (EIB)**: Participate in the **"Circular Steel Financing Exploration"** for funding circular steel projects.
- Engage in the **"Circular Steel Investment Forum"**: Advocate for **"Circular Steel Financing Strategies"** and investment opportunities.

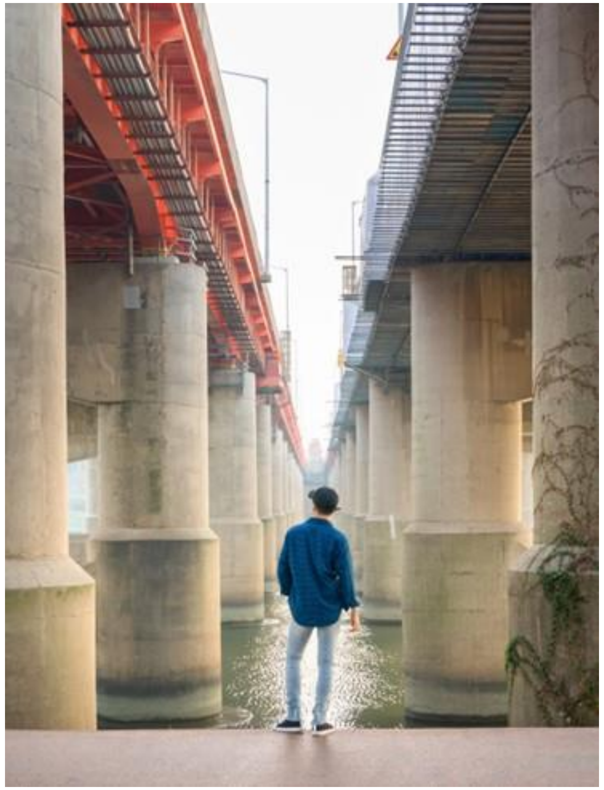
6. European Policy Initiatives:

- Contribute to the **"EU Circular Economy Action Plan Implementation"**: Shape the **"Circular Steel Integration Roadmap"** within the EU action plan.
- Engage in the **"EIP Raw Materials Circular Steel Task Force"**: Collaborate on EU initiatives for circular raw materials and steel production.

Conclusion:

By forming key partnerships with regulatory bodies, RWS and the steel value chain can drive circular steel practices in Europe. Active involvement in projects, initiatives, and advocacy can shape policies, standards, and certifications, establishing RWS as a sustainability leader and reshaping the steel industry for a greener, circular future.

Concrete



Supply chain & risk analysis concrete - introduction

INTRODUCTION

Concrete, a composite material, is primarily composed of water, aggregates (sand + gravel), and binding materials, with cement being the most prevalent of the latter. Binding materials are not always cement, although cement is still the most widely used binding material. It is important to note that there is the potential for alternative binding materials to emerge in the future.

The production process of concrete involves the precise blending of sand, gravel, water, and the chosen binding material to create a homogenous mixture. The mixture is then poured into moulds and allowed to cure and harden over time.

The binding materials used in concrete production fall into various categories, including CEMI, CEMII, and CEMIII. CEMI refers to Ordinary Portland Cement (OPC), which is the most widely used type of cement in the construction industry. CEMII encompasses Portland Composite Cement (PCC), a blend of Portland cement and supplementary cementitious materials. CEMIII denotes Blast Furnace Cement (BFC), crafted from a mixture of ground granulated blast furnace slag and Portland cement.

RWS utilizes a range of concrete products, including paving materials, concrete mixes, ready-mixed concrete and precast concrete. RWS only allows specific types of concrete mixes and imposes restrictions on recycled aggregates. For more information, please refer to RWS framework RTD1033. Within the global cement industry, there are prominent players such as the Heidelberg Materials Group, alongside others like LafargeHolcim, Cemex (Mexico), and CRH (Ireland). Furthermore, China boasts significant groups in the cement industry, such as China National Building Material Group (CNBM) and Anhui Conch Cement Company.

Interviewed experts:

1. **Remco Kerkhoven** Advisor Marketing, Communication and Statistics at Betonhuis

2. **Leonie van der Voort** Director Cascade

3. **Jos Brouwers** Professor and Chair of Building Materials at Eindhoven University of Technology (TU/e

4. **Mark Van Halderen** Cementitious material manager bij ENCI

5. **Vagner Maringolo** Sustainable Construction Manager at CEMBUREAU

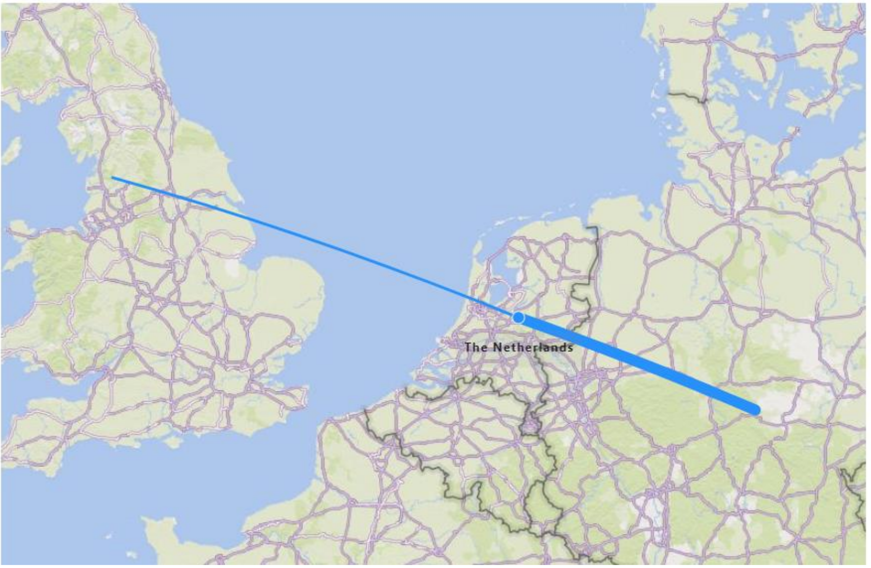
6. **Rob van der Meer** Industrial Policy Director of CEMBUREAU

7. **Alessio Rimoldi** Secretay General at BIBM

8. **Peter De Vylder** Director (FEDBETON) & Secretary-General (ERMCO)

Supply chain & risk analysis concrete – trade volumes concrete/masonry sand

IMPORT CONCRETE/MASONRY SAND to the Netherlands 2020

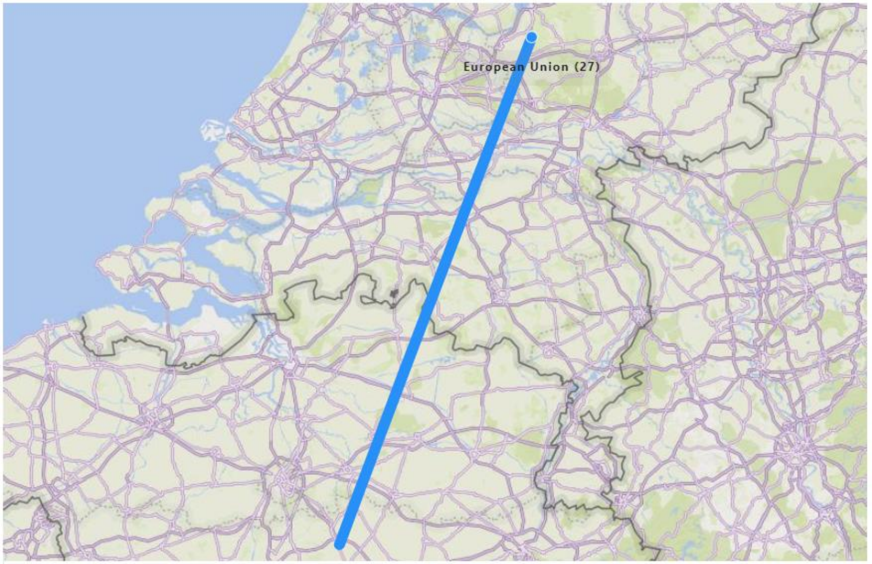


Submaterials

- Concrete and masonry sand
- Crushed stone/broken gravel
- Gravel

From land	To land	import/ export	Som van Amount (Mt)
Germany	The Netherlands	import	4,60
United Kingdom / North Sea	The Netherlands	import	1,20
Totaal			**5,80**

EXPORT CONCRETE/MASONRY SAND from the Netherlands 2020



Submaterials

- Concrete and masonry sand

From land	To land	Som van Amount (Mt)	import/ export
Belgium	The Netherlands	5,00	export
Totaal		**5,00**	

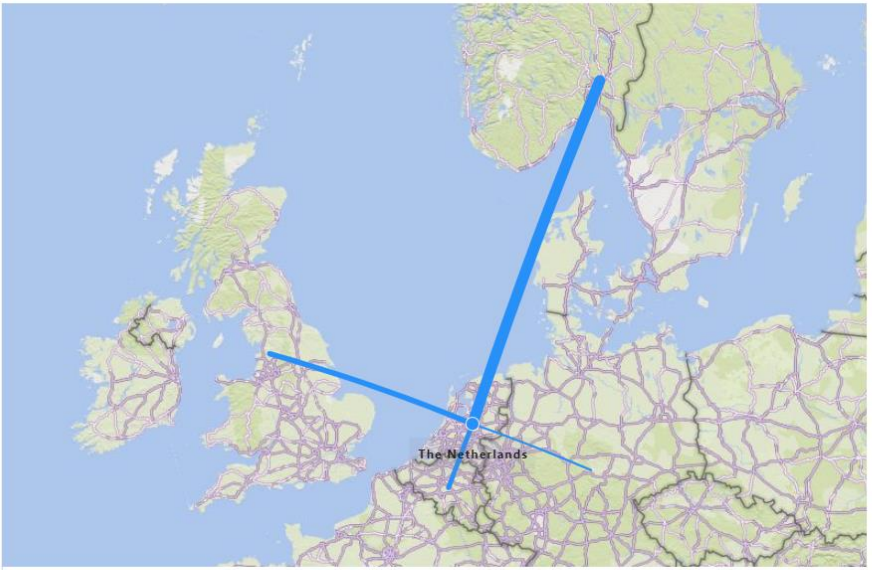
KEY INSIGHTS

- **The Netherlands produced/extracted** in 2020: 16,3 Mt of concrete/masonry sand
- **The Netherlands used** in 2020: 17,1 Mt of concrete/masonry sand
- **The Netherlands was in 2020: Net importer of concrete/masonry sand (0,8 Mt)**
  - **The concrete/masonry sand** imports coming from:
    - Germany (4,6 Mt)
    - United Kingdom / North Sea (1,2 Mt)
  - **The concrete/masonry** sand exports going to**:**
    - Belgium (5 Mt)

Source data:
Cascade, 2020 (Rapportage Monitoring bouwgrondstoffen 2019-2020)

Supply chain & risk analysis concrete – trade volumes crushed stone/broken gravel

IMPORT CHRUSHED STONE/BROKEN GRAVEL to the Netherlands 2020



Submaterials

- Concrete and masonry sand
- Crushed stone/broken gravel
- Gravel

From land	To land	import/ export	Som van Amount (Mt)
Norway	The Netherlands	import	4,90
United Kingdom	The Netherlands	import	1,90
Belgium	The Netherlands	import	1,50
Germany	The Netherlands	import	0,10
Totaal			**8,40**

No export of crushed stone/broken gravel from the Netherlands to other countries

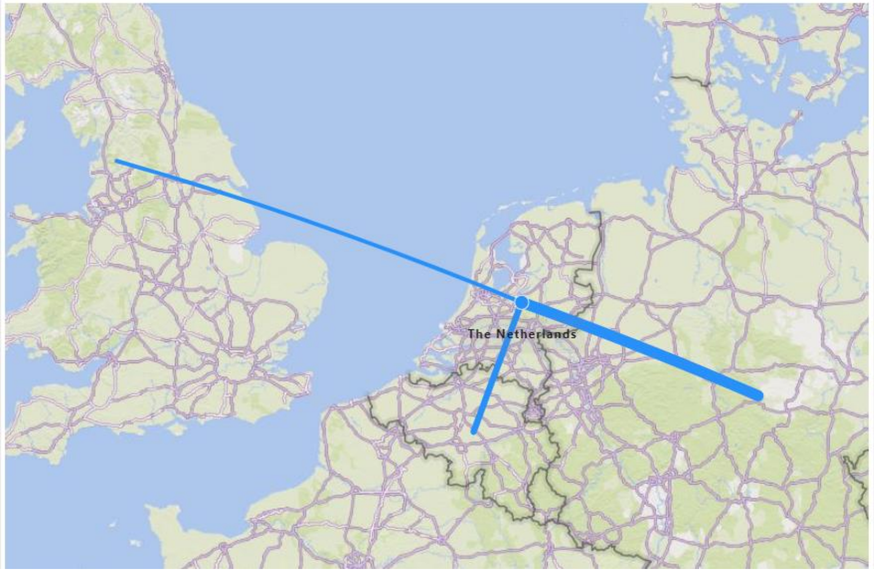
KEY INSIGHTS

- **The Netherlands produced/extracted** in 2020: 1 Mt of crushed stone/broken gravel
- **The Netherlands used** in 2020: 9,3 Mt of crushed stone/broken gravel
- **The Netherlands was in 2020: Net importer of crushed stone/broken gravel (8,4 Mt)**
  - **The crushed stone/broken gravel** imports coming from:
    - Norway (4,9 Mt)
    - United Kingdom (1,9 Mt)
    - Belgium (1,5 Mt)
    - Germany (0,1 Mt)
  - **The Netherlands does not export crushed stone/broken gravel.**

Source data:
Cascade, 2020 (Rapportage Monitoring bouwgrondstoffen 2019-2020)

Supply chain & risk analysis concrete – trade volumes gravel

IMPORT GRAVEL to The Netherlands 2020



Submaterials

- Concrete and masonry sand
- Crushed stone/broken gravel
- Gravel

From land	To land	import/ export	Som van Amount (Mt)
Germany	The Netherlands	import	3,80
Belgium	The Netherlands	import	2,20
United Kingdom / North Sea	The Netherlands	import	1,40
Totaal			**7,40**

No export of gravel from the Netherlands to other countries

KEY INSIGHTS

- **The Netherlands produced/extracted** in 2020: 5,1 Mt of gravel
- **The Netherlands used** in 2020: 12,5 Mt of gravel
- **The Netherlands was in 2020: Net importer of gravel (7,4 Mt)**
  - **The gravel** imports coming from:
    - Germany (3,8 Mt)
    - Belgium (2,2 Mt)
    - United Kingdom (1,4 Mt)
  - **The Netherlands does not export gravel.**

Source data:
Cascade, 2020 (Rapportage Monitoring bouwgrondstoffen 2019-2020)

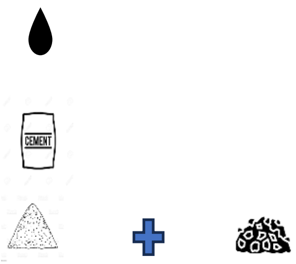
Supply chain & risk analysis concrete– current situation

CURRENT INTERNATIONAL CONCRETE VALUE CHAIN

- Concrete products, encompassing ready-mix concrete and precast elements, are primarily produced locally. This is attributed to the weight of these materials, rendering long-distance transportation and imports impractical.
- The transportation distances of concrete products vary based on their type and value:
  - Simple Products: Paving units, blocks, etc.
    - Travel distance: up to 50 km.
  - Average Products: Beams, columns for buildings, etc.
    - Travel distance: 100 to 200 km
  - High added value products: Large beams, architectural concrete.
    - Travel distance: 300 km or more. Road transport not preferred.

Concrete =

- Water
- Binding materials (mostly Cement)
- Aggregates (sand + gravel)



Cement =Most common binding material in concrete.

- CEMI: Portlandcement
- -> made with 100% grinding clinker (limestone)

- CEMII: Composite Portland cement
  - Mix of clinker and blast funace slag (Approximately 20-30% fly ash from coal-fired power plants)

- CEMIII: blast furnace cement
  - Made with blast funace slag, by product of iron-making process.
  - CEM3A contains 30% blast funace slag, CEM3B contains 50-80% blast furnace slag (lower CO_2 emissions).

Supply chain & risk analysis concrete – trade volumes bonding agents

No import and export data available for bonding agents such as limestone or high furnace slag.

KEY INSIGHTS

- **The Netherlands produced/extracted** 0,1 Mt of limestone in 2020
- Scarcity in limestone extraction within the Netherlands is primarily attributed to the closure of marl quarries.
- The ENCI quarry in Pietersberg and the 't Rooth quarry ceased their operations in 2018, along with the shutdown of the cement factory in Maastricht. While the cement factories in Rotterdam and IJmuiden continue their activities, the critical semi-finished product, clinker, is now being imported from external sources.
- The demand for semi-finished products containing marl within the Netherlands is met by sourcing from Belgium and other regions in Europe, where limestone extraction remains adequate.

Source data:
Cascade, 2020 (Rapportage Monitoring bouwgrondstoffen 2019-2020)

Supply chain & risk analysis concrete– current situation

CURRENT INTERNATIONAL CONCRETE VALUE CHAIN

Conclusion: The supply chain for the materials required in concrete production predominantly operates locally. Given the substantial weight of concrete products, long-distance transportation is essentially ruled out. Notably, binding materials like cement are produced in IJmuiden, utilizing high furnace slag from Tata Steel. In contrast, binding materials like clinker are imported from Belgium. As for aggregates, sand is extracted locally in the Netherlands, while gravel is both extracted domestically and imported from Germany.

Supply chain & risk analysis concrete– current situation

CURRENT INTERNATIONAL CONCRETE VALUE CHAIN

Binding Materials: Cement

- Most common binding material in concrete is cement
  - Cement is typically transported within a maximum distance of 200 kilometres.
  - The demand for cement in the Netherlands is around 5 million tons per year.
  - The Netherlands has a unique situation in the cement industry, because the county has 3 to 4 grinders that import clinker. Usually clinker is not imported but locally sourced.
  - The clinker mining location (HeidelbergCement: ENCI) in the Netherlands closed in 2019.
  - Clinker is primarily imported from Belgium, Germany and potentially other places like the North Sea or Ireland.
  - HeidelbergCement is the sole producer of cement in the Netherlands and has two factories in Belgium that produce clinker.
  - In IJmuiden, clinker is combined with blast furnace slag to produce CEMIII cement
  - CEMI and CEMII are predominantly used in the production of prefab elements. In practice, approximately 40-50% of all concrete is 'mixed in place’.
  - In the Netherlands, we use about 50%-70% blast furnace cement, often CEM III B, which is why we are a global leader in terms of low CO_2 cement.

Supply chain & risk analysis concrete– current situation

CURRENT INTERNATIONAL CONCRETE VALUE CHAIN

Aggregates: Sand and Gravel

- **Locally sourced**: The Netherlands have 18 companies engaged in sand and gravel extraction.
- **Transportation**: Sand and gravel are predominantly extracted from riverbeds along major Dutch rivers, facilitated by convenient waterway transportation.
- **Geographical Distribution:** Sand and gravel distribution varies. Limburg holds ample gravel, while finer fraction, like sand, are near the coastline. Only specific Dutch provinces offer essential concrete raw materials.
- **Gravel sourcing:** The Netherlands, about half of the gravel used in concrete production originates from Germany.
- **Sand sourcing:** Netherlands is largely self-sufficient in sand resources.
- **Environmental Impact and Processing:** Sand and gravel's main environmental impact is transportation, not extraction although there is a minor local impact on nature and environment. Opting for local aggregates reduces transportation-related emissions.
- **Processing and Delivery:** Extracted materials sorted and delivered to concrete makers. Striking the right balance between sand and gravel is crucial for these manufacturers, as it aids in reducing water usage, vital for their operations. These manufacturers create cement-based products for entities like Rijkswaterstaat
    - The ideal concrete possesses a precise particle size distribution, without discontinuities. With a perfect grain distribution, you can reduce the use of cement by up to 30%. However, nature doesn't provide this structure naturally. If you still aim for a perfect particle arrangement, you will need extensive sieve installations to achieve the ideal particle distribution. This process results in leftover materials and is expensive, requiring a considerable amount of advanced knowledge on the factory floor.

Supply chain & risk analysis concrete – current situation

CURRENT EU POLICY OF THE CONCRETE VALUE CHAIN

EU Policy on the Concrete Value Chain:

- Focuses on reducing carbon footprint of concrete production in line with Paris Climate Agreement's goals.
- High carbon emissions of concrete due to binding materials.
- Calls for reduced concrete use while recognizing its durability.

Alternative Binders and Concerns:

- Exploring biobased binders to cut carbon emissions.
- Concerns about biobased material's impact on deforestation.

EU Regulations and Standards:

- Cement complies with EU construction norms and Dutch NEN 197.
- Netherlands uses high blast furnace cement with slag (which has a negative environmental impact).

Initiatives for Sustainability:

- Concrete Sustainability Council (CSC) certifies responsible concrete sourcing.
- "Betonakkoord" (Concrete Agreement) in the Netherlands promotes CO_2 reduction.
- Focus areas: Circular economy, carbon reduction, sustainable procurement, and innovation.

Supply chain & risk analysis concrete – current situation

CURRENT EU POLICY OF THE CONCRETE VALUE CHAIN

EU Policy Evolution:

- Sand and gravel extraction regulations evolved post-WWII.
- For sand, gravel and limestone: shift towards societal-purpose extraction for environmental considerations.
- Sand and gravel: new permits expire by 2027; imports from Germany may rise, causing tensions. There is no lime production anymore in the Netherlands. It is imported from neighbouring countries

Conclusion:

The EU's evolving approach to the concrete value chain reflects a strategic commitment to reducing carbon emissions, promoting sustainability, and fostering innovation in line with global climate goals.

Supply chain & risk analysis concrete– current situation

CURRENT TECHNICAL REGULATION (CEN) IN THE CONCRETE VALUE CHAIN

Technical Regulations (CEN) in the Concrete Material Chain:

- European Committee for Standardization (CEN) establishes key technical regulations for construction materials like concrete.
- Regulations ensure safety and quality, meeting requirements for European norms and standards.
- NEN 197 norm in the Netherlands governs cement production and properties.

Cement Standards (NEN-EN 197):

- Cement standards define requirements for cement production, properties, and quality.
- High blast-furnace cement, Portland cement, and Portland fly ash cement commonly used in the Netherlands.
- Compliance with standards crucial for ensuring construction materials' safety, quality, and sustainability.

Concrete Material Standards (EN 206, EN 12620):

- EN 206 specifies requirements for concrete itself.
- EN 12620 sets standards for aggregates used in concrete.
- Standards ensure consistency and compatibility within the concrete industry across Europe.

Supply chain & risk analysis concrete– current situation

CURRENT TECHNICAL REGULATION (CEN) IN THE CONCRETE VALUE CHAIN

Transitioning to Performance-Based Standardization:

- Shift from composition-based to performance-based standardization for environmental considerations.
- Balance between durability, strength, and environmental impact is crucial.
- Stakeholders seeking both CO_2 emissions reduction and product strength.

Recycling Concrete and Circular Economy:

- Circular economy emphasizes maximum material reuse. Concrete standard allows up to 50% recycled coarse concrete incorporation.
- Variability across countries and national standards (EN 206).
- Balance strength, durability, environmental impact within standard framework.

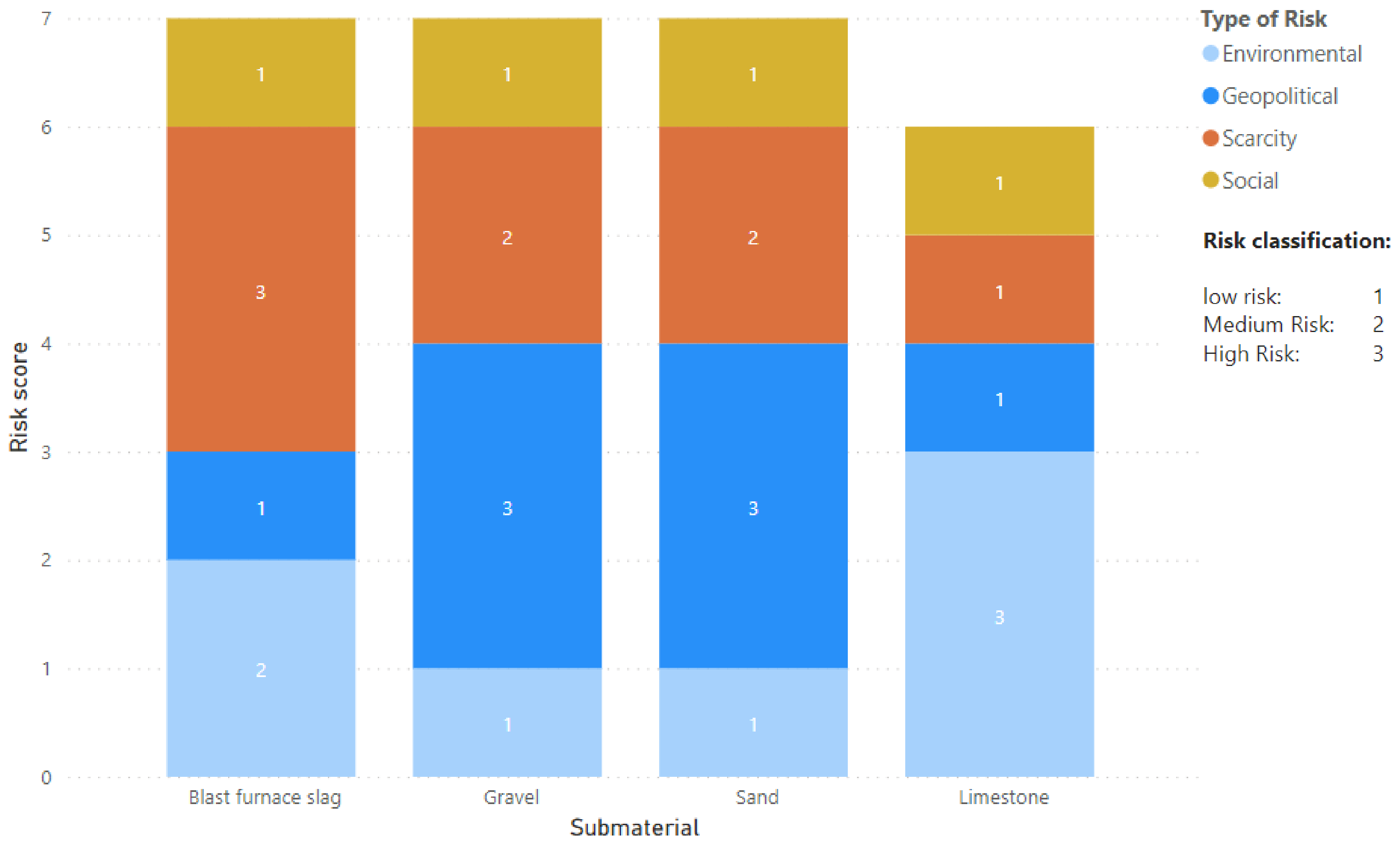
For the latest developments and changes in the Construction Production Regulation (CPR) regarding concrete construction products, it is recommended to consult official sources such as the European Commission's website, national authorities, or legal databases for the most up-to-date information.

Conclusion:

CEN's Technical Regulations play a pivotal role in steering the concrete industry towards safety and sustainability. However, the shift from composition-based to performance-based standards, though responsive to environmental concerns, necessitates a delicate equilibrium between durability, strength, and environmental impact. Stakeholders' dual priorities of CO_2 reduction and product strength further underscore the industry's challenges. CEN's influence is indispensable, yet the concrete sector must traverse significant ground to effectively address these complexities and align with evolving expectations while fulfilling environmental obligations

Supply chain & risk analysis concrete – infographic risks

Risks per region, defined by the interviewed experts



The Netherlands was in 2020:

- Net importer of concrete/masonry sand (0,8 Mt)
- Net importer of crushed stone/broken gravel (8,4 Mt)
- Net importer of gravel (7,4 Mt)
- No import and export data available for bonding agents such as limestone or blast furnace slag.

Supply chain & risk analysis concrete – description of risks

GEOPOLITCAL CONTEXT OF CONCRETE MATERIALS

Blast Furnace Slag:

- **Geopolitical Risk**: **High** geopolitical risk, as blast furnace slag is a byproduct of iron-making processes. Future of Tata Steel is uncertain.
- **Scarcity Risk**: **High** scarcity risk due to uncertainties in Tata Steel's future and potential shift to hydrogen-based iron production.
- **Environmental Risk**: **Medium** environmental risk associated with blast furnace slag as a byproduct.
- **Social Risk**: **Low** social risk.

Gravel:

- **Geopolitical Risk**: **High** geopolitical risk exists due to dependence on imports, which can lead to potential friction with neighboring countries. Moreover, land use in gravel extraction holds political, social, and environmental implications. Decisions regarding the type of extraction significantly affect the potential repurposing of deep sand or gravel extraction pits.
- **Scarcity Risk:** There is a **medium** level of scarcity risk associated with gravel. This risk is contingent on permit expirations and reliance on imports in cases where local alternatives are unavailable.
- **Environmental Risk**: The environmental risk related to gravel is **low**, with the primary impact being associated with transportation rather than extraction itself.
- **Social Risk**: the social risk is **low**, given that extraction practices align with societal objectives and responsible river management.

Supply chain & risk analysis concrete – description of risks

Sand:

- **Geopolitical Risk**: Sand faces **high** geopolitical risk due to political and societal concerns associated with extraction. Land use, once again, represents a multifaceted political, social, and environmental risk, with the nature of extraction influencing the potential repurposing of deep sand or gravel extraction pits.
- **Scarcity Risk**: Sand carries a **medium** level of scarcity risk, with potential concerns related to permit expiration and the necessity of imports.
- **Environmental Risk**: The environmental risk for sand is **low**, with an emphasis on local sourcing to minimize emissions resulting from transportation.
- **Social Risk**: Social risk in the context of sand extraction remains **low**, with no significant conflicts typically linked to this activity.

Clinker/Limestone:

- **Geopolitical Risk**: **Low** geopolitical risk, as clinker and limestone are widely available within the region and imported from Belgium.
- **Scarcity Risk**: **Low** scarcity risk, as there are no significant limitations on availability or ending permits.
- **Environmental Ris**k: **Medium** environmental risk, particularly due to the environmental impact of limestone extraction.
- **Social Risk**: **Low** social risk, as clinker and limestone extraction practices adhere to EU regulations.

Conclusion:

The geopolitics of concrete materials present a nuanced landscape. Geopolitical, scarcity, environmental, and social risks differ across blast furnace slag, clinker/limestone, gravel, and sand. While challenges exist, these risks are contingent on factors like availability, extraction practices, and industry trend.

- **Blast Furnace Slag: Varied risks call for careful management in Tata Steel's uncertain landscape.**
- **Clinker/Limestone: Balancing extraction and environmental impact is key for sustainable sourcing.**
- **Gravel: Dependency on imports highlights the need for local alternatives and responsible extraction to get new permits.**
- **Sand: Political concerns emphasize the importance of eco-friendly sourcing strategies to get new permits.**

Circular solutions and developments - concrete

DEVELOPMENTS IN THE CIRCULARITY OF THE CONCRETE VALUE CHAIN

Local and Regional Cement Production:

- Cement and concrete production to remain predominantly localized in Europe by 2050.

Sourcing Challenges in the Netherlands:

- Limited resources of clinker, sand, and gravel pose unique challenges: Despite having ample reserves of sand, gravel, and limestone, policymakers have discouraged further extraction.
- Impending issues related to the expiration of existing extraction licenses.
- Transportation challenges due to river water levels affecting the movement of raw material.
- Dependence on slag and fly ash from coal-fired power plant Tata Steel is a concern due to their diminishing availability.
- A significant portion (approximately 5%) of concrete products is imported from neighbouring countries, a trend anticipated to continue.

Profitable Sustainability Practices:

- The industry is observing a prominent shift towards sustainability, with concrete products bearing the CSC (Concrete Sustainability Council) label proving profitable in the Dutch market.

Circular solutions and developments - concrete

Rising Prices and Competition:

- Expected price hikes for sand, gravel, and clinker driven by CO_2 policies, are expected to double or triple existing costs.
- Price increases are contributing to intensified competition within the industry, as companies seek varied materials and sources to remain cost-effective.

Sustainability and CSR Challenges:

- Despite achieving the theoretically achievable 100% concrete waste recycling rate, the practical utilization is constrained to approximately 30% due to technical limitations:
  - The quality of recycled materials restricts their high-grade recycling to roughly two-thirds, covering only about 20% of the overall demand.
  - The financial viability of the recycling sector remains unattractive despite the impressive recycling rate.
  - Meeting concrete demand sustainably remains a significant challenge, necessitating innovative solutions.
- Recycled material incorporation demands additional components for performance. However, innovative techniques such as the Smart Crusher, eliminate the need for additional cement and required additives.
- Transition to low-carbon cement requires significant investments and financing decisions.

Conclusion:

The concrete value chain's developments encompass localized production, challenges in sourcing, profitability, sustainability, and geopolitical influence. The industry's progress hinges on addressing these challenges through collaboration, innovation, and strategic planning.

Circular solutions and developments - concrete

CIRCULAR SOLUTIONS FOR CONCRETE VALUE CHAIN

- **Substitution:** Promoting the use of alternative building materials. Prioritizing reducing concrete use where it is possible.
  - Notably, substituting materials, especially for concrete, is intricate. Wood, often considered an alternative, may not always be suitable for large-scale infrastructure or wet conditions.
  - Additionally, steel presents environmental and scarcity concerns that can rival or exceed those associated with concrete.
  - Given the substantial demand for concrete in modern society, genuine alternatives are limited, leading to complex environmental challenges.
- **Designing for Future Reuse (Detachable or modular)**: When creating new structures, we carefully plan for their potential for future reuse, ensuring they can be easily disassembled. Extend the lifespan of existing structures. Design materials more efficiently.
- **Enhanced Recycling:** Increasing the incorporation of recycled materials, particularly concrete waste, into concrete and cement production. Overcoming technical challenges related to recycled material quality is crucial.
- **Exploring Alternative Binders:** Developing and adopting clinker substitution materials (binders) from industrial byproducts or waste materials to reduce reliance on traditional raw materials.
- **Reducing Cement Content:** Investigating options to reduce cement content in concrete while maintaining performance, through alternative materials or optimized mixtures.
- **Material Passports:** Creating comprehensive material passports to trace concrete materials, enhancing transparency, and facilitating proper handling, reuse, and recycling.
- **Promoting Smart Demolition:** Encouraging deconstruction over demolition to salvage and reuse concrete elements, conserving valuable resources. Promote the reuse of existing structural components when they become available
- **Collaboration and Innovation:** Fostering collaboration among stakeholders, from designers to recyclers, to drive the adoption of circular measures and achieve a sustainable built environment.

Circular solutions and developments - concrete

CIRCULAR SOLUTIONS FOR CONCRETE VALUE CHAIN

Conclusion:

The material chains of cement and concrete are currently not closed. Circular measures for the concrete value chain are essential to enhance sustainability and promote a more closed material cycle. Closing the material chains of cement and concrete requires a comprehensive approach, including reducing concrete products, recycling enhancement, alternative binders, reduced cement content, design for reuse, material passports, smart demolition, and industry collaboration. These circular measures pave the way towards a more sustainable and closed concrete industry.

RWS can play a pivot role as procurer. In terms of circularity the concrete industry is not yet mature and has big challenges to face.

Policy recommendations - concrete

POLICY RECOMMENDATIONS

- **At the Policy Level:**
  - **Lead Advocate:** RWS/Min IenW should champion sustainable concrete practices and set clear implementation guidelines. Prioritizing reducing concrete use where it is possible and retaining economic value in concrete products (i.e. reusing rather than recycling).
  - **Financial Incentives:** Provide financial incentives to encourage adoption of sustainable concrete practices.
  - **Regulation Enforcement:** Enforce regulations mandating the use of recycled materials and carbon reduction measures.
  - **Procurement Prioritization:** Implement procurement policies that prioritize sustainable concrete sourcing.

- **At the Technical Regulation Level (CEN):**
  - **Collaboration with CEN:** RWS should collaborate with the European Committee for Standardization (CEN) to develop technical regulations supporting alternative binders and clinker substitution materials.
  - **Standardizing Circular Practices:** Development of standards and guidelines that encourage the use of circular materials and innovative production methods.

Policy recommendations - concrete

POLICY RECOMMENDATIONS

- **Within the material chains themselves**:
  - **Stakeholder Collaboration:** Foster collaboration and communication among stakeholders to promote sustainable concrete practices.
  - **Design for Sustainability:** Refuse, reduce, reuse, repurpose, and then recycle. Encourage sustainable considerations right from the design stage to ensure circularity throughout the lifespan.
  - **Waste Management & Recycling:** Continuing to advance and encourage high-quality recycling (such as Smart Crusher and related technologies) to establish separation between sand, gravel, and a reusable cement fraction (as filler). This can be achieved by both influencing the supply side (as RWS generates a substantial amount of concrete waste annually, further exacerbated by the renovation surge) and encouraging the demand for high-quality recycled secondary materials.
  - **Clinker Substitution Evaluation:** Evaluate the performance of clinker substitution materials for concrete production, fostering informed decision-making.

Conclusion:

Advancing circularity within the concrete sector requires coordinated efforts at multiple levels. Policymakers, regulatory bodies, and industry stakeholders must collaborate to champion sustainable practices, enact financial incentives, enforce regulations, and prioritize sustainable procurement. Collaboration with technical regulation bodies, such as CEN, is vital to develop standards supporting circular materials and innovative production methods. Additionally, encouraging sustainable design, efficient waste management, and comprehensive evaluation of alternative materials are pivotal steps towards achieving a truly circular concrete industry.

Policy recommendations - concrete

STRATEGIC COLLABORATION RECOMMENDATIONS

Strategic Collaborations for Circular Concrete Advancement in Europe: Identifying Relevant Policy & Regulation Partners:

1. **European Concrete Platform:**
    1. Collaborate on **"Circular Concrete Standards Harmonization Project"**: Contribute to the development of standardized circular concrete specifications, enhancing cross-border circularity.
    2. Engage in the **"Concrete Carbon Footprint Reduction Initiative"**: Jointly lobby for policies promoting low-carbon concrete solutions.
2. **European Aggregates Association (UEPG):**
    1. Co-create the **"Sustainable Aggregates Guidelines"**: Develop guidelines for responsibly sourced aggregates in concrete, influencing concrete regulations.
    2. Participate in the **"Circular Aggregate Sourcing Advocacy"**: Collaborate to lobby for EU policies supporting circular aggregate supply chains.
3. **European Environmental Bureau (EEB):**
    1. Drive the **"Circular Concrete Advocacy Coalition"**: Partner to advocate for stringent circular concrete regulations, influencing EU sustainability policies.
    2. Collaborate on the **"Concrete Environmental Impact Assessment Project"**: Research and recommend guidelines for assessing concrete's environmental impact.
4. **CEN (European Committee for Standardization):**
    1. Participate in the **"Circular Concrete Standards Development Task Force"**: Contribute to the formulation of circular concrete standards, ensuring regulatory coherence.
    2. Engage in the **"EU Circular Building Materials Policy Alignment"**: Advocate for integrating circularity principles in EU building materials regulations.

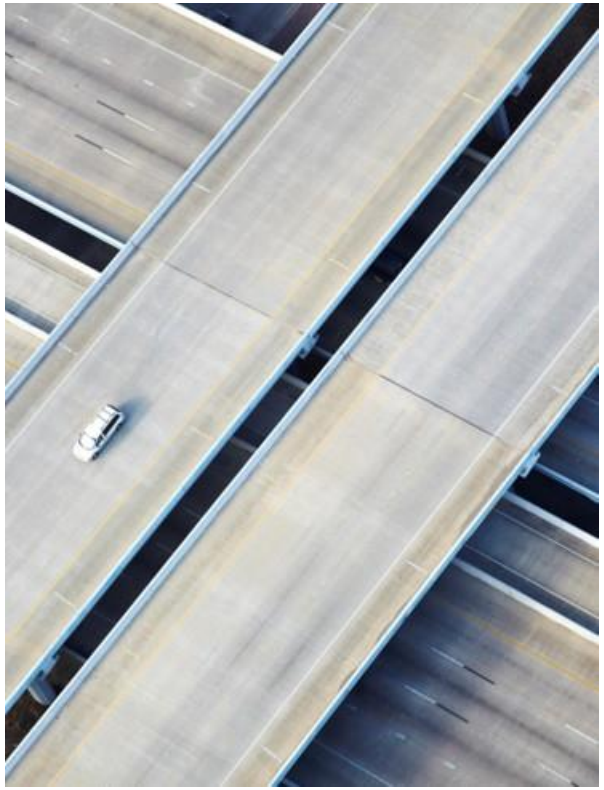
Policy recommendations - concrete

5. **European Investment Bank (EIB):**
    1. Collaborate on the **"Circular Concrete Financing Mechanisms Exploration"**: Explore funding opportunities for circular concrete pilot projects.
    2. Join efforts in the **"EIB Circular Infrastructure Investment Focus Group"**: Influence investment strategies aligned with circular concrete goals.
6. **EU Circular Economy Action Plan:**
    1. Participate in the **"Concrete Circular Economy Roadmap Working Group"**: Contribute to shaping a roadmap for circular concrete within the EU action plan.
    2. Engage in the **"Concrete Circular Innovation Grants Advisory Panel"**: Advise on grant distribution for innovative circular concrete projects.
7. **European Innovation Partnership (EIP) on Raw Materials:**
    1. Collaborate on the **"Circular Concrete Raw Materials Innovation Hub"**: Drive innovation in circular concrete raw materials and advocate for supportive policies.
    2. Participate in the **"Circular Materials Knowledge Sharing Forum"**: Share insights on circular concrete practices with other raw material sectors.

Conclusion:

By strategically collaborating with policy and regulation partners, Rijkswaterstaat can actively contribute to the development of circular concrete policies and technical guidelines, driving sustainable advancements in the European concrete supply chain.

Asphalt



Supply chain & risk analysis asphalt - introduction

Definition
Asphalt is a composite material comprising sand, gravel and a binding substance bitumen. Its primary application lies in road and highway construction. This analysis focuses on Bitumen. Bitumen is a product derived from crude oil refinement, serving as a vital primary product for producers, rather than a mere oil byproduct. It's worth noting that bitumen lacks a legally binding definition in NEN standards, only possessing a descriptive one. This opens the possibility for mixtures containing bitumen, perhaps including substitute substances, to also be labeled as bitumen for use in construction. This, in turn, may impact the quality and durability of asphalt.

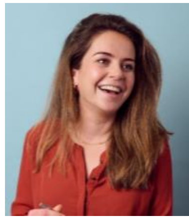
The current supply chain
The current supply chain of bitumen is not transparent due to procurement clauses in the industry, resulting in limited specific data availability. However, bitumen is generally accessible on the market, and its supply chain operates in a near-closed loop. As a product, Bitumen has an enduring life cycle. When asphalt renewal is required, the granulates can be heated or burned to recover the bitumen for creating a novel mixture.

Ongoing changes
Currently, the bitumen industry is undergoing changes, marked by a reduction in the number of refineries producing bitumen and centralization of production in a few larger facilities. For example:

- The Netherlands sold its producer, Q8. Additionally, Shell ceased bitumen production at its export refinery, Vitol, in Antwerp.
- Shell, a major bitumen producer, cited the shifted production from numerous smaller refineries to larger, global production sites. This trend is steering towards a scenario in 2050 where one or two 'bitumen factories' will be responsible for nearly all bitumen production.

Interviewed experts:

1. Mirjam Vis
Programmamanager Asfalt Impuls



2. Pascal Kregting
Senior Beleidsmedewerker bij Koninklijke Bouwend Nederland / Adviseur vakgroep bitumineuze werken

3. Max von Devivere
Manager Eurobitume Benelux

One contributing factor to this shift is the declining demand for bitumen in Europe since 2008. This is attributed to reduced investment budgets, an increase in bitumen reuse, and innovations in modification extending bitumen's lifespan. In recent times, the demand and supply of bitumen have stabilized with minimal fluctuations.

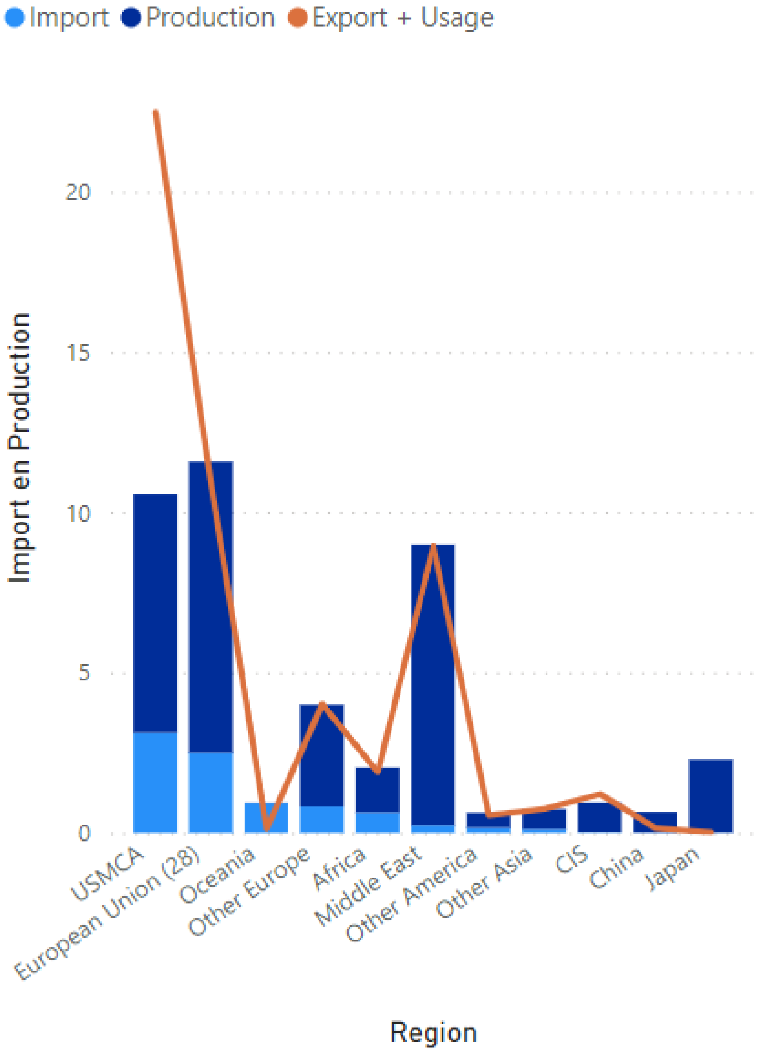
Another change in the bitumen supply chain is the increasing legislation governing emissions related to bitumen, although the pace of change is gradual. Certain European countries, such as the Netherlands, Norway, Sweden, and Germany, are at the forefront of such legislation. For instance, Germany, with over 800 asphalt production sites, is in the process of adapting to evolving regulations, a task that takes time.

Conclusion:

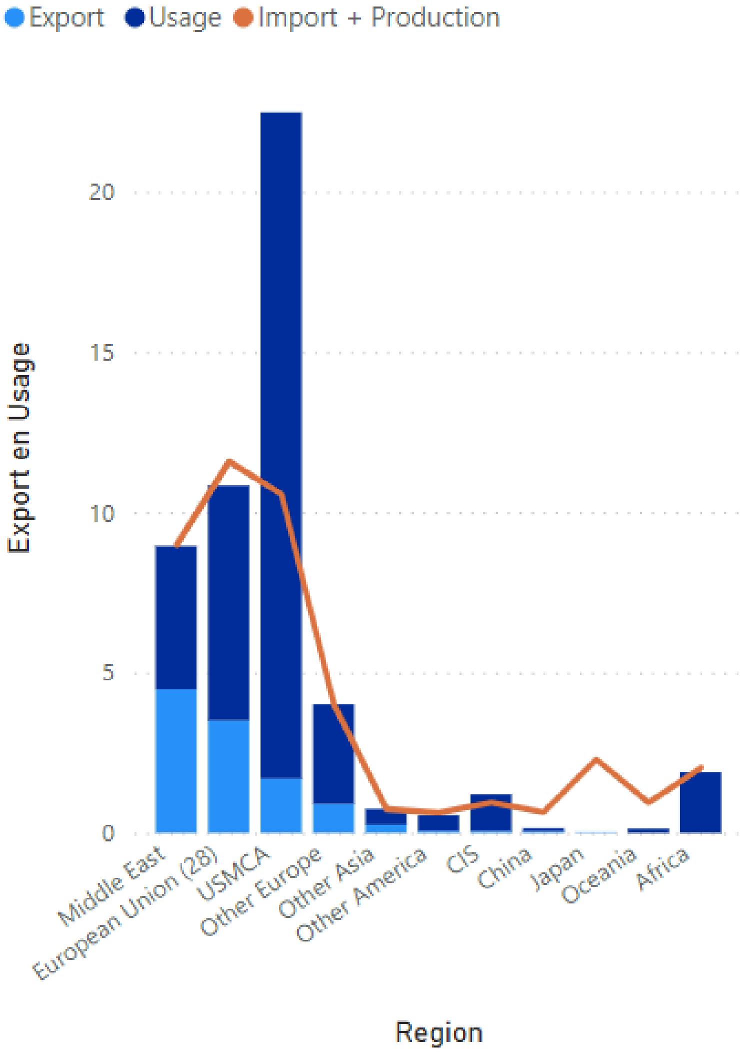
The bitumen supply chain is experiencing a transformation due to a period of reduced demand and evolving legislation. This transformation has led to the centralization of production. However, possibly caused by the ambiguous definition of bitumen, obtaining precise numbers on bitumen supply remains challenging.

Supply chain & risk analysis asphalt – trade volumes infographic

Import and Production in Mt X 1.000.000



Export and usage in Mt X 1.000.000



Import, export, usage and production in Mt X 1.000.000

Region	Import	Production	Import + Production	Usage	Export	Export + Usage
European Union (28)	2,50	9,08	11,58	7,32	3,52	10,84
USMCA	3,12	7,44	10,56	20,79	1,69	22,48
Middle East	0,24	8,74	8,98	4,47	4,47	8,94
Other Europe	0,82	3,17	4,00	3,11	0,90	4,01
Japan	0,01	2,28	2,29	0,00	0,02	0,02
Africa	0,63	1,40	2,03	1,90	0,00	1,90
CIS	0,02	0,93	0,95	1,15	0,06	1,21
Oceania	0,93	0,01	0,94	0,13	0,00	0,13
Other Asia	0,12	0,62	0,74	0,49	0,26	0,75
China	0,01	0,64	0,65	0,09	0,05	0,14
Other America	0,16	0,46	0,63	0,47	0,07	0,54
Totaal	**8,57**	**34,76**	**43,33**	**39,92**	**11,04**	**50,96**

Note:
Since specific numbers are difficult to find on the origin and destination of import and export, this overview shows a profile per region on how much bitumen is going in and how much is going out, based on the **UN database** of bitumen in the year 2020.

Based on the interviews, the biggest producers of bitumen are the Russia, Saudi Arabia and Venezuela.

Source: United Nations Statistics Division - Bitumen

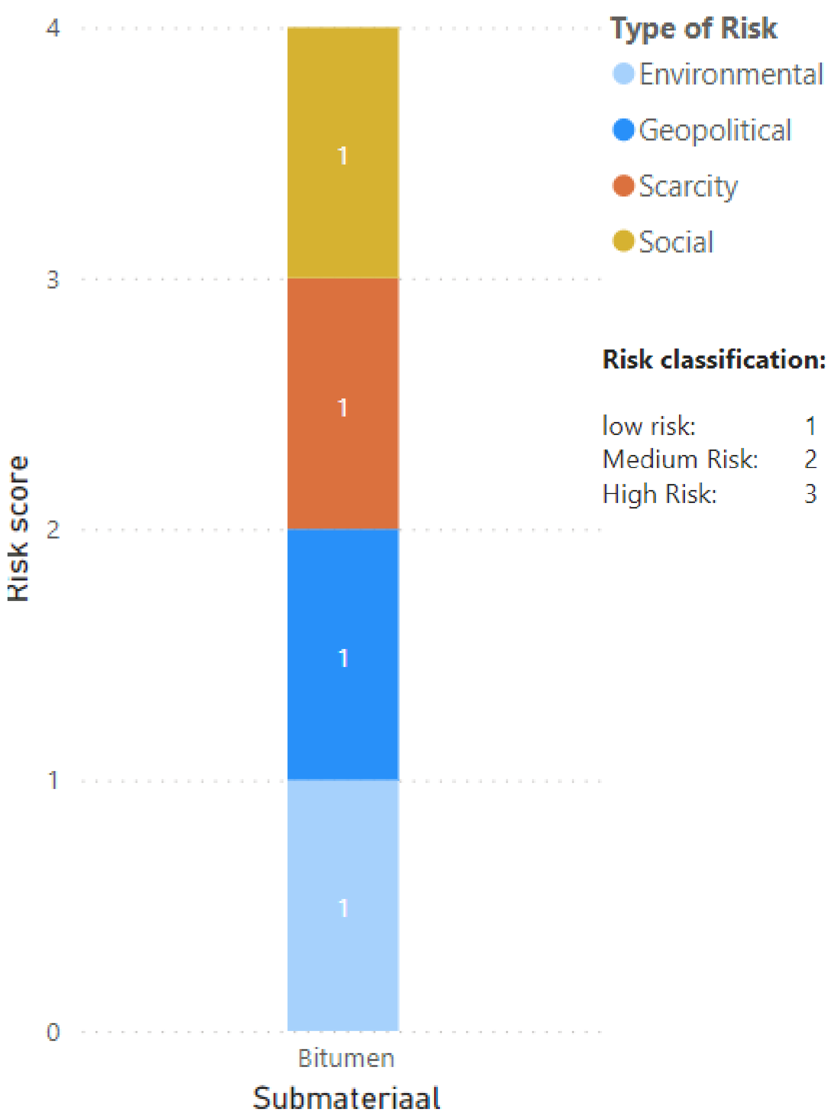
Supply chain & risk analysis asphalt – description of risks

- **Geopolitical risk:** The geopolitical risk is generally **low**. However, current events have caused shifts in the supply chain. Notably, the decreased import of oil from Russia due to the Ukraine conflict has led to refineries adapting to alternative oil sources available from various origins. This adaptation include the following:
    - Transitioning from pipeline-connected refineries to truck-delivered crude oil, a process that requires time.
    - Geopolitical factors, such as US sanctions on Venezuela, have influenced the market. Potential relief of these sanctions in response to the Ukrainian war's impact may further impact bitumen pricing.

- **Scarcity risk:** The scarcity risk for bitumen is **low**. Despite a decrease in the demand for fossil fuel, abundant global oil resources with consistent quality support the bitumen production. Bitumen is also inherently part of a nearly closed material loop, with increasing opportunities for reuse. For instance, the Netherlands already recycles 60% of bitumen, and emerging alternatives like "harsfalt" are poised to further reduce scarcity.

- **Environmental risk:** Despite bitumen accounting for 80% of asphalt emissions of CO_2, the environmental risk is **low**. Due to recycling, the lifecycle becomes longer and thus there is comparatively less impact of emissions. Environmental regulations governing production are on the rise, especially with the centralization of refineries. Continuous advancements in material reuse and quality improvement contribute to the low environmental risk. However, the production of crude oil necessary for bitumen still impacts the environment.

- **Social risk:** The social risk for bitumen is **low to medium**. Worker protection legislation in refineries is improving, and many producers maintain favorable working conditions for their employees. However, there is room for government intervention to further mitigate social risk.



Conclusion:

The risks within the bitumen supply chain are generally low. There exists an ample supply of oil for bitumen production to meet demand, and bitumen is increasingly recyclable. Geopolitical changes primarily impact supply and demand costs. Although bitumen, as an oil-derived product, has inherent pollution aspects, environmental emissions during production are rigorously monitored, with growing availability of more sustainable alternatives, particularly in the Netherlands. Social risks are largely mitigated by both producers and expanding worker protection legislation.

Circular solutions and developments - asphalt

Substitute binding

- An expanding array of alternatives is emerging for the binding substance in asphalt. A notable example is the adoption of harsfalt, a 100% biological binder. The Asphalt Knowledge centre (Asfalt Kenniscentrum) has thoroughly assessed the health, environmental, reusability, material, and mixture characteristics of all harsfalt components.
- Another example of a substitute for binding is lignin, which is used by Circuroad (previously known as Chaplin). Lignin is a biobased substance that gives plants its strength. Lignin is a byproduct in the production of paper and cellulose. One of the advantages is that lignin absorbs CO_2 from the atmosphere which can be stored for a long time when used as a binding in asphalt.

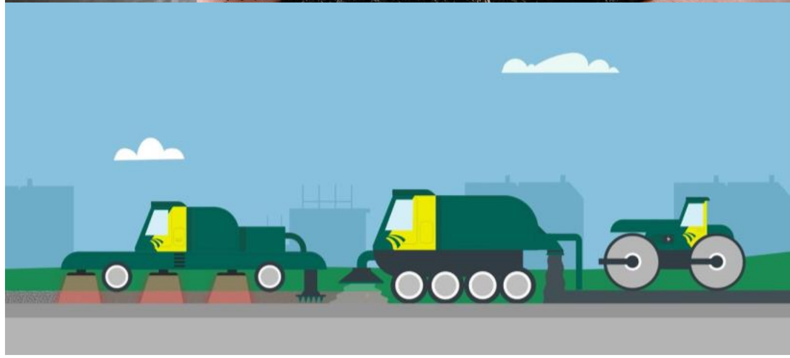
Modification

- Bitumen modification, such as the incorporation of polymers, plays a pivotal role in significantly augmenting material durability while simultaneously reducing the requisite bitumen quantities.

Innovations

- *Hot in situ Recycling*: this method facilitates on-site asphalt recycling, reducing primary resource consumption and logistical requirements. Notably, RWS has recognized this method as a winner in their sustainable asphalt contest.
- *The LAM calculating model* (expected to launch by year-end): this model allows for theoretical prediction of the asphalt lifespan based on predetermined parameters.

Conclusion: **In the case of bitumen, multiple developments align with the principles of the circular construction movement. In essence, one can opt to substitute bitumen, enhance its material properties for prolonged lifespan, or refine the bitumen utilization process itself.**



Policy recommendations - asphalt

Clear definitions

- Effective policy development for asphalt, particularly bitumen, necessitates a need for robust information comprising coherent and comprehensive data. This foundation commences with establishing a clear definition of bitumen, given its lack of a legally binding definition in NEN standards. This ambiguity contributes to the proliferation of diverse asphalt mixes in the market, complicating the process of comparison and regulation.

Formulate a unified strategy within RWS

- While RWS has asphalt experts and invests in training and education, the decentralized nature of the organization disperses its knowledge, expertise, and decision-making authority. To foster greater standardization and facilitate policy formulation, it is imperative for RWS to adopt a comprehensive, organization-wide stance on the acquisition, usage, and recycling of asphalt.

CO_2 reduction

- A noteworthy 80% of emissions from the asphalt mix can be attributed to bitumen. In alignment with environmental policies, the most substantial positive impact can be achieved by extending the longevity of asphalt, thereby circumventing the need to incinerate granules to retrieve bitumen. This is particularly significant in the context of growing emphasis on asphalt recyclability.

Incentive

- Contractors currently possess minimal incentive to apply innovations in their use of asphalt. The common mindset suggests that investments should match the desired quality. In the Netherlands, those responsible for road maintenance are often reluctant to invest in higher-quality asphalt or innovative alternatives, such as harsfalt, if conventional methods suffice.

Conclusion: **To move towards circular building, good quality robust information is key. The supply chain is untransparent and definitions are ill-defined. Once a deeper understanding of the bitumen supply chain is attained, a priority will be to develop a strategy. This strategy should focus on creating incentives for stakeholders to adopt alternative, more sustainable approaches in their practices.**

Strategic collaboration recommendations - asphalt

- **CROW – Program Asphalt Impulse**
  The Asphalt Impulse program combines various stakeholders with the common objective of extending the lifespan of asphalt.

- **NEN-EN**
  To establish standards for bitumen quality and, consequently, asphalt, it's imperative to closely scrutinize the legal definition of bitumen.

- **Eurobitume, the European Association of Bitumen Producers**
  For insights into bitumen production, contacting Eurobitume is advisable. In interviews, they expressed a willingness to provide valuable information about bitumen, which can significantly contribute to the development of sound policies.

- **Vakgroep Bitumineuze Werken (VBW)**
  For a deeper understanding of the potential applications of bitumen, it's recommended to engage with VBW. They play a role in shaping European regulations related to asphalt.

Conclusion: **Numerous initiatives and organizations can serve as valuable resources to enhance our understanding of bitumen and asphalt. When embarking on further research, these organizations serve as excellent starting points.**

Wood

Supply chain & risk analysis wood - introduction

Wood is a versatile natural material that is used extensively in the construction industry for different applications. Within infrastructure, wood plays a pivotal role in both wet and dry applications. Wet applications encompass sheet piling, shoring, bridges, bridge decks, jetties, locks, lock gates, bollards, and fenders. In contrast, dry applications include traffic signs, light poles, gantries, guide rail, noise barriers, and outdoor furniture.

Infrastructure construction incorporates four primary categories of wood products: sawn softwood (18%), sawn temperate hardwood (4%), sawn tropical hardwood (61%), and panel materials (17%). Notably, the Dutch sawmill sector is witnessing a transformation, favoring a trend of processing logs in closer proximity to the source forest. In recent years, tropical hardwood-producing nations have expanded local activities, processing wood logs at the point of origin prior to shipment.
Wood products are predominantly stored in the form of planks or beams. RWS, municipalities, provinces, and the Water Boards emerge as the most significant consumers of wood in infrastructure construction. The overall share of wood used in infrastructure construction is low.

Within the European market, the majority of temperate hardwood and softwood products are sourced from EU production, which is largely self-sufficient. In contrast, tropical hardwood is sourced from regions such as South America, West Africa, and Southeast Asia. Within the Netherlands, tropical hardwood, specifically, is primarily procured from countries including Malaysia, Brazil, Cameroon, Congo, and Indonesia. A substantial portion of imported wood in the Netherlands carries certification, primarily from organizations such as PEFC or FSC, with non-certified wood accounting for a mere 6.3% in 2020..

Interviewed experts:

1. **Cor van Dijken**
Senior Specialist Circulaire Economie/ voorzitter NEN CE / CB'23

2. Michelle ter Stede
Projectleider Hout en Circulaire Economie
FSC - Nederland

3. **Mark van Benthem**
Directeur bestuurder - PROBOS

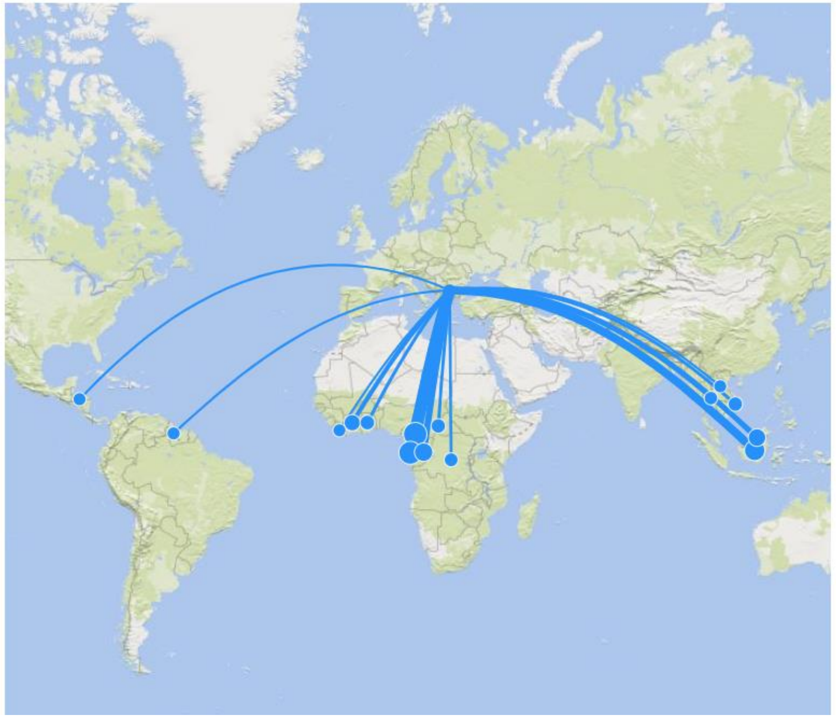
4. **Ron Oorshot**
Business Development houtbouw/biobased - TNO

5. **Eric de Munck**
Vertegenwoordiger Centrum Hout

6. Evert Schut
Sr. Adviseur / expert circulair RWS

Supply chain & risk analysis wood – trade volumes infographic

IMPORT TROPICAL HARDWOOD to EU (27) 2021



Submaterials

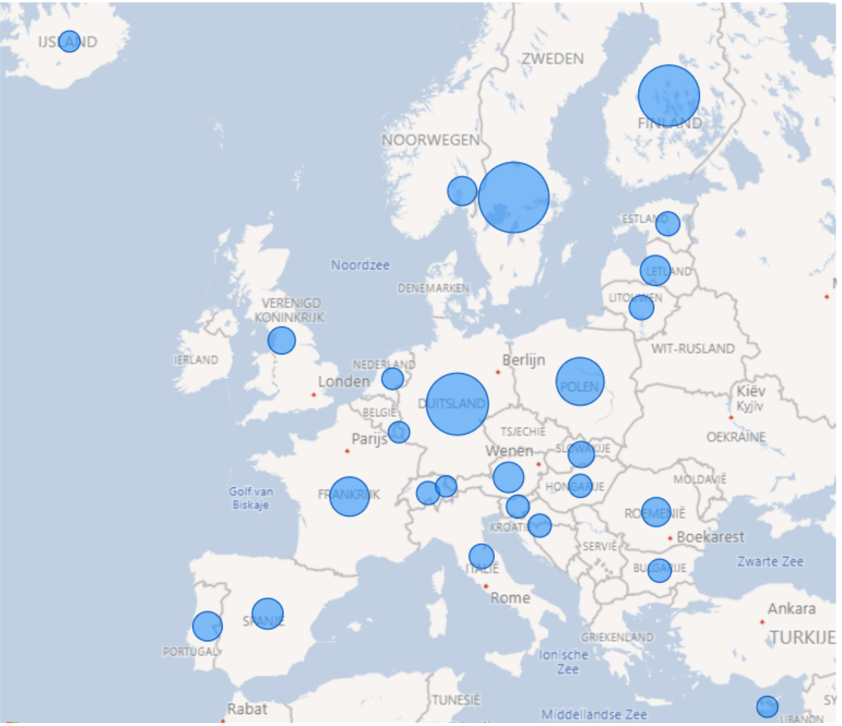
Tropical Hardwoord

From land	To land	Som van Amount (Mt)
Cameroon	European Union (27)	0,19
Gabon	European Union (27)	0,18
Indonesia	European Union (27)	0,12
Congo	European Union (27)	0,08
Malaysia	European Union (27)	0,06
Côte d'Ivoire	European Union (27)	0,04
Ghana	European Union (27)	0,02
Vietnam	European Union (27)	0,02
Central African Republic	European Union (27)	0,02
Democratic Republic of the Congo	European Union (27)	0,01
Thailand	European Union (27)	0,01
Guyana	European Union (27)	0,00
Honduras	European Union (27)	0,00
Liberia	European Union (27)	0,00
Laos	European Union (27)	0,00
Totaal		**0,75**

KEY INSIGHTS

- **EU-27 2021: Net importer of tropical hardwood (0,75 Mt)**
- **Tropical Hardwood imports**:
  - Most tropical hardwood is imported from West Africa, with Cameroon and Gabon supplying the most tropical Hardwood
  - Southeast Asia is the second biggest regional supplier with Indonesia and Malaysia supplying the most tropical Hardwood.
  - Wood comprises a modest 2% of total volume of construction materials in the Netherlands (CE Delft 2015). For infrastructure specifically, wood accounts for 8% of total construction materials in the Netherlands.
  - Belgium is the largest port for the import of tropical hardwood, also for the Netherlands. Apart from Belgium, the Netherlands predominantly receives its imports of tropical hardwood through the port of Rotterdam.
  - The Netherlands stands as the primary importer of certified tropical hardwood, accounting for 33% of the EU's import in this category. Within the Netherlands, it is estimated that approximately 60-70% of tropical hardwood imports bear certification. In contrast, Belgium, the second-largest importer at 24.3%, imports an estimated 30-35% of its tropical hardwood with certification.
  - Tropical hardwood is the main wood type used in infrastructure in the Netherlands: 60% (70.330 m^3 in 2015)

PRODUCTION GENERAL WOOD IN EU (27) 2021



Submaterials

General Wood

From land	To land	Amount (M3)
Sweden	European Union (27)	71.400,00
Germany	European Union (27)	59.187,50
Finland	European Union (27)	57.802,90
Poland	European Union (27)	38.586,80
France	European Union (27)	26.188,50
Spain	European Union (27)	14.100,00
Austria	European Union (27)	13.520,80
Latvia	European Union (27)	13.003,00
Portugal	European Union (27)	11.883,00
Norway	European Union (27)	11.451,90
Romania	European Union (27)	11.335,30
United Kingdom	European Union (27)	8.715,60
Slovakia	European Union (27)	7.169,70
Italy (²)	European Union (27)	5.002,10
Lithuania	European Union (27)	4.729,00
Totaal		**373.804,50**

KEY INSIGHTS

- **EU-27 2021 Production of general wood (373.804 m³)**

General wood:

- General wood amounts to 40% (44.692 m³) of the wood used in infrastructure in the Netherlands. This is a mix from pinewood, temperate wood and sheet material.
- 80% of EU wood consumption is produced within the EU, 10% is sourced from North America and 8% from South-America. The remainder includes tropical hardwood.
- Only 2% of EU wood is imported from Russia. Sanctions against Russia therefor have a very limited impact on EU wood supply.

Supply chain & risk analysis wood – current situation

CURRENT STATE OF INTERNATIONAL WOOD VALUE CHAIN

- In the EU, there has been a consistent upward trend in wood production and imports, encompassing a broad array of wood products, including furniture and fuelwood.
- Temperate hardwood and softwood primarily originate from Europe, while tropical hardwood is transported over substantial distances from regions such as South America, West Africa, and Southeast Asia.
- Global wood demand is on the rise, with significant contributions from the US and China.
- The top five wood-producing countries in the EU are Sweden, Finland, Germany, Poland and France. A substantial portion of European wood resources is allocated for non-infrastructure purposes. The Netherlands maintains 15% self-sufficiency in wood production, with a predominant focus on temperate hardwood.
- Demand for wood in infrastructure construction declined between 2014 and 2019. In 2014, approximately 610 ktons of wood were used in Dutch infrastructure construction, which decreased to 440 ktons in 2019.
- Demand for tropical hardwood has stabilized since 2015. Compared to the early 2000s, the demand for tropical hardwood in the EU has more than halved over the past 23 years.
- Data and analysis of the use of wood in infrastructure is outdated. Latest estimates date form 2015.

Conclusion: **The wood supply chain for infrastructure primarily involves imports of tropical hardwood and EU-based production. On a global scale, there is an observable increase in wood demand, with notable contributions from the United States and China. Conversely, the demand for wood in construction and infrastructure is declining based on the most recent data available. Importantly, data regarding wood usage in construction and, more specifically, infrastructure, is significantly outdated.**

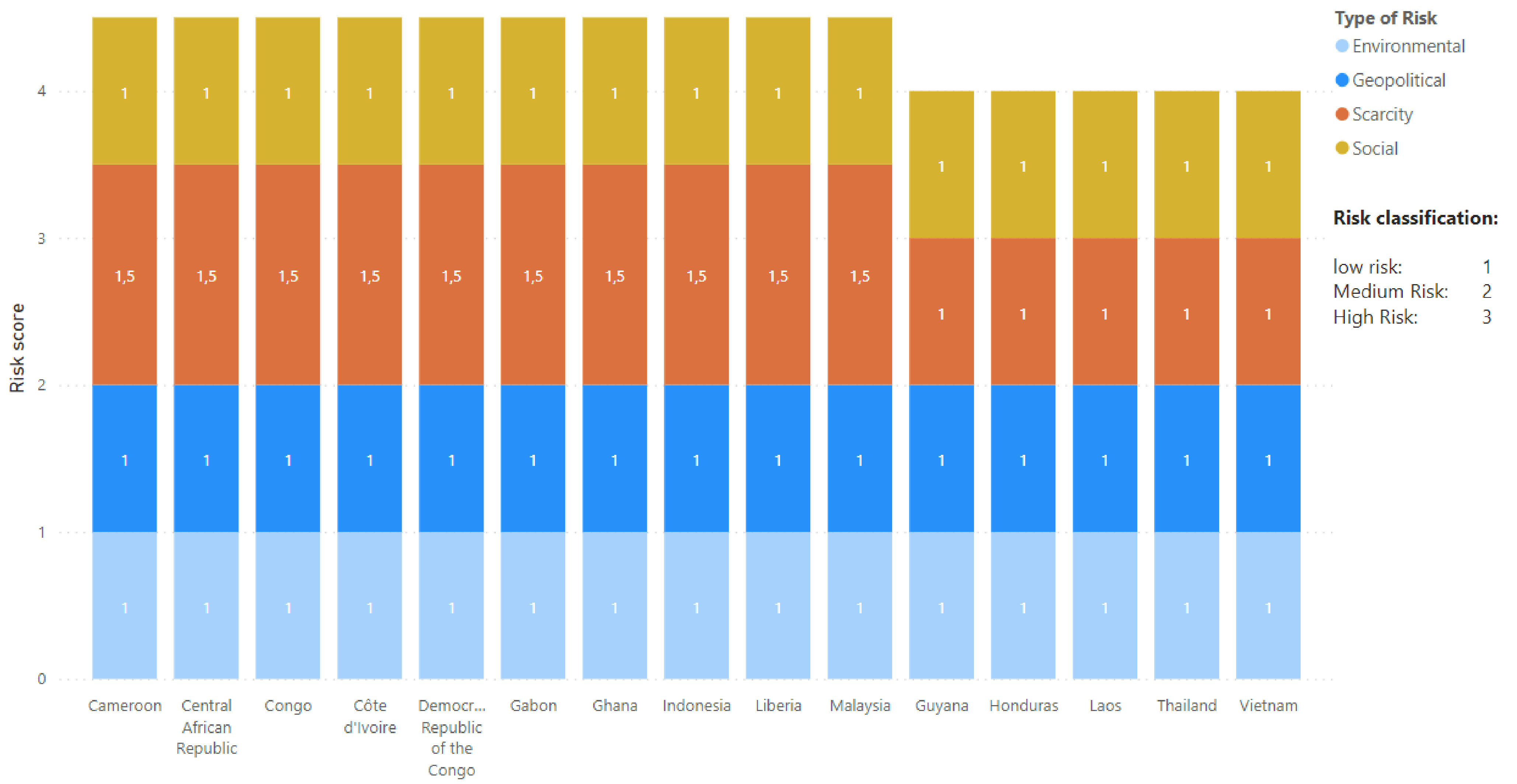
Wood in infrastructure in the Netherland =

- Tropical Hardwood 60%
- Pinewood 18%
- Sheetmaterial 17%
- Temperate wood 5%

Top 5 uses of wood in infrastructure

Sheet piles	**28%**
Posts (sawn)	**15%**
Post (round wood)	**12%**
Parapets	**11%**
Jetties	**7%**

Supply chain & risk analysis wood – infographic risks



Risk classification:

low risk: 1
Medium Risk: 2
High Risk: 3

Risk score applies to tropical hardwood

Supply chain & risk analysis wood – description of risks

Geopolitical Risk

The geopolitical risk for wood in the EU is in generally **low**. The EU is relatively self-sufficient in softwood and temperate hardwood production. In the case of tropical hardwood, the EU primarily relies on multiple certified production sites in South America, Southeast Asia, and West Africa. The production of tropical hardwood in these regions plays a crucial role in the economic and ecological development of exporting countries, especially when it adheres to sustainable growing and harvesting practices.

Globally, the demand for tropical hardwood has experienced a decline and stabilization, mirroring the trend observed in the EU, except for China. China imports tropical hardwood from similar regions and countries as the EU, albeit without the prioritization of certified tropical hardwood. Nevertheless, as more countries embrace sustainable forest management, political shifts could rapidly influence this landscape.

Scarcity Risk

Given existing production and demand patterns, as well as the potential to expand both certified and uncertified hardwood production, the scarcity risk is **low to moderate**. There is ample supply of wood within the EU and tropical hardwood in exporting countries. However, two key developments may affect the supply of certified tropical hardwood in the future:

1) A decline in the number of certified tropical hardwood concessions may occur due to the current low demand, rendering operations economically unviable. Alternatively, concession holders may look to make their operations economically viable by abandoning certified wood production practices.

2) Escalating demand for uncertified tropical hardwood from other regions may pose a less stringent operational choice for concession holders. As a result of growing demand for uncertified hardwood combined with less operational requirements, producing uncertified wood becomes more appealing. Leading to Concession holders pivoting to uncertified wood production and a decline in supply of certified wood production.

Supply chain & risk analysis wood – description of risks

Environmental Risk

In terms of supply chain risks, the environmental risk remains relatively **low**. Environmental risks in wood production are primarily related to concession type and forest management practices. The majority of wood within the EU is certified, including most imports in the Netherlands, especially the tropical hardwood used in infrastructure projects. Risks related to biodiversity loss, species loss, and climate change can be managed through sustainable forest management and have long-term effects on tropical hardwood health and supply chain.

Social Risk

Social risk is **low within the EU** but slightly **higher in tropical regions**. Certification schemes do consider social impact as part of the certification process. However, if the number of certified concessions were to decline, the social risk would increase.

Conclusion:

Overall, the risk associated with the wood supply chain is assessed as low. Substantial progress in mitigating risks has been achieved through sustainable forest management and certification schemes like FSC and PEFC. The Netherlands stands among the top performers in certified wood consumption, and the available supply of certified wood is sufficient with potential for further growth. However, it's worth noting that the declining demand for tropical hardwood may prompt certified concession holders to reconsider their certification practices, particularly when faced with increased demand for uncertified wood, which could become more economically viable.

DEVELOPMENTS IN THE WOOD VALUE CHAIN

- **Local and Regional Policy developments:**
  - New standards and norms (CEN, NEN) and regulation (Bouwbesluit) are believed to accelerate use of more sustainable building materials. Under current rules and regulations, there is some flexibility to deviate from established standards if it can be proven that the performances is equal or superior. However, in practice, this option is rarely exercised. Setting new CEN, NEN standards can help to shift the standard move beyond common practice.
  - In 2023, the EU parliament passed a new act to reduce global deforestation, the EU Deforestation-free Regulation (EUDR). This legislation necessitates wood products to undergo due diligence, including a risk assessment and risk mitigation surveys/audits.

- **Profitable Sustainability Practices:**
  - Current RWS sourcing policy does not require 100% certified wood purchasing. The Netherlands is among the leading countries in the EU in terms of certified wood sourcing. Despite the high rate of certified wood sourcing there is still room for improvement.

- **Sustainability and CSR Challenges:**
  - The technical capacity for increased wood usage in infrastructure is estimated to allow a 67% increase over current wood consumption, equivalent to an additional 73 kton annually in infrastructure products.
  - Wood products can significantly decrease CO_2 impact and improve MKI score. RWS executed as study with Bouwcampus in 2018 to research more wood usage for circular motorways. Wooden guide rails, wooden bridges, or wooden portals have significant CO_2-reduction performance in comparison to typical practices, -77%, 119% and -78% respectively.
  - Industry standards dictate a 75-year life for wood, after which it is typically incinerated in compliance with ISO standards. The actual usage phase of wood products can be longer or shorter. Especially wood products in infrastructure require maintenance or repairs based on the conditions to which the wood is exposed during the usage phase.

- Reusing wood and wood products is feasible and more frequent than commonly assumed. The most substantial product group in infrastructure, sheet piles, currently exhibits a minimum reuse rate of around 25%. In practice, estimates suggest that 40-60% of sheet piling materials are reused when feasible, enabling the prolongation of the resource's lifespan.
- Knowledge and awareness regarding increased wood utilization in infrastructure are deemed insufficient. Buyers often lack awareness of available possibilities, and the available information on this subject is outdated. Consequently, circular procurement, while on the rise, remains a limited practice.
- Testing and certifying wood and wood products is a time-consuming and costly endeavour. Thousands of wood types currently remain underutilized due to a lack of testing. Expanding testing and expediting product certification would open the door for a wider array of wood types to be employed in various applications.

Conclusion:

When sourced sustainably, wood possesses significant untapped potential for infrastructure use beyond current practices. Wood products can substantially enhance the sustainability performance of infrastructure projects. Further research is necessary to explore the diverse types of wood and its application in infrastructure. The adoption of more circular and sustainable procurement practices is pivotal in translating this potential into practice. The introduction of new, innovative norms, standards, and regulations can expedite this transformative process.

Circular solutions and developments - wood

CIRCULAR MEASURES FOR THE WOOD VALUE CHAIN

1. **Extent of Closed Material Chain:** The material chains of wood and wood products are currently not fully closed. Implementing circular measures are crucial to enhancing sustainability and promoting a more closed material cycle.

2. **Circular Solutions:**
   - **Substitution:** promoting the adoption of wood as an alternative to fossil-based building materials, either through exclusive wood usage or hybrid construction methods.
   - **Designing for Reuse and Recycling:** Incorporating circular principles by designing structures with an eye toward future repurposing and recycling, including specifying properties of wood and wood products to facilitate their reutilization.
   - **Certifications and testing**: Conducting structural research to establish the performance benefits of wood and wood products in infrastructure. Certifications and standardization of wood product utilization will stimulate increased usage. Additionally, a broader range of wood types necessitates testing for enhanced infrastructure application potential.
   - **Material Passports:** Developing comprehensive material passports to trace wood materials, thereby enhancing transparency and streamlining proper handling, reuse, and recycling.
   - **Collaboration and Innovation:** Fostering collaboration among stakeholders, ranging from designers to recyclers and buyers, to drive the adoption of circular practices and achieve a sustainable built environment. This collaboration is fostered through knowledge exchange, pilot projects and demonstrations.

3. Improve CO_2 calculation methods and scoring (MKI) to benefit biobased materials such as wood. Wood can be used as carbon storage and will serve this purpose throughout the lifespan. In current calculation methods it is assumed that wood is burned after initial use of the wood. However, this is not necessarily the case and many wood applications in infrastructure are suited for re-use, re-manufacturing or repurposing of wood applications. Making the end-of-life scenario for wood in infrastructure construction more realistic and closer to current technical possibilities will improve the MKI-score of wood in comparison to other applications.

Conclusion: **To establish a closed material chain for wood, a deeper understanding of wood products performance in infrastructure is requisite. Wood products hold promise as a more sustainable alternative to traditional building materials, but their greater integration in infrastructure necessitates shifts in contracting, design, and collaboration approaches. Providing insights into wood product performance serves to improve knowledge and address barriers associated with their usage in infrastructure.**

Policy recommendations - wood

POLICY RECOMMENDATIONS

At the Policy Level:

- Lead Advocate: RWS should champion sustainable wood practices and set clear implementation guidelines.
- Financial Incentives: Provide financial incentives to encourage adoption of sustainable wood practices.
- Regulation Enforcement: Enforce regulations mandating the use of recycled materials and carbon reduction measures.
- Procurement Prioritization: Implement procurement policies that prioritize sustainable wood sourcing.

At the Technical Regulation Level (CEN):

- Testing and certification: Perform testing and certification projects to research performances of wood type products.
- Standardizing Circular Practices: Develop standards and guidelines that encourage the use of biobased materials and innovative production methods.

Within the Material Chains Themselves:

- Stakeholder Collaboration: Foster collaboration and communication among stakeholders to promote sustainable wood practices through knowledge sharing, pilot projects and demonstrations.
- Design Sustainability: Refuse, reduce, reuse, repurpose, and then recycle. Encourage sustainable considerations right from the design stage to ensure circularity throughout the lifespan.
- Update monitoring and data management: monitoring and data managed on wood usage in infrastructure, the origin of tropical hardwood and usage in infrastructure is greatly outdated.

Conclusion: Advancing circularity within the wood sector requires coordinated efforts at multiple levels. Policymakers, regulatory bodies, and industry stakeholders must collaborate to champion sustainable practices, enact financial incentives, enforce regulations, and prioritize sustainable procurement. Collaboration with technical regulation bodies, is vital to develop standards supporting circular materials and substitution. Additionally, encouraging the use of wood in design and comprehensive evaluation of alternative materials are pivotal steps towards achieving a circular wood resource loop.

Strategic collaboration recommendations - wood

COLLABORATION RECOMMENDATIONS

- **Water boards, provinces and municipalities** to develop and share knowledge, best practices and make joint ambitions/commitment to apply wood in construction projects. In close collaboration with initiatives such as PIANOO, knowledge can be developed and distributed among the organisations and the teams working on designing and procuring infrastructure projects.
- **(C)NEN** on EU-level and the national level work with them to develop new norms and standards for the application of wood and experimentation of the use of wood as a substitute material. RWS is involved in the CB'23 which is aiming to work on the standards for circular construction.
- **Certification and knowledge partners** such as FSC, PEFC, ProBos and Centrum Hout. RWS has longstanding relationships with these organisations. Data and research for the use of certified wood by RWS is outdated. Knowledge platforms such as *houtdatabase* and *houtindegww* hold valuable information but require updates and better usage of the information.

Conclusion: RWS is involved in various platforms and initiatives for circularity in the construction sector. The use of wood as a construction materials is one of the measures to reduce negative environmental impact improve environmental performances of infrastructure. Existing initiatives aim to help overcome existing bottlenecks in more sustainable infrastructure construction, mostly aiming at awareness, data availability, creating sustainable standards and norms and best practices. Closer collaboration with existing initiatives is recommended to stimulate the use of wood in infrastructure construction.

Concluding remarks

As mentioned before, current research serves as an initial global exploration of the value chains associated with the four materials: steel, concrete, asphalt and wood. It provides an initial indication of trade volumes to better understand the impact of a specific value chain in construction and infrastructure. Additionally, we offer initial insights into geopolitical, scarcity, environmental, and social risks associated with these four materials. In the light of ongoing developments and potential circular solutions, we offer recommendations for the focus of policy advocacy and strategic collaboration with stakeholders.

It's important to note that not all value chains have the same impact, and the adoption of closed-loop models varies across different value chains. Furthermore, RWS (or any relevant organization) may not always be the primary procurer of a particular material and often depends on other actors within the value chain. However, what this research demonstrates is the significance of gaining insights into the materials used in construction and infrastructure.

Transitioning from a linear to a circular economy can be accelerated by taking the appropriate measures, which also serve to mitigate risks. The current study represents only a preliminary step towards developing a well-informed, material-based international strategy.