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Steel for the Future:

The transition to responsible, zero carbon steel making

HSBC

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Foreword

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Steel is the largest industrial emitter of CO_2; it contributed 7% to global emissions in 2018. If the steel sector were a country, it would rank 5th in the world after China, USA, Europe and India. It provides the backbone to our infrastructure and built environment, as well as cars, electrical appliances and industrial equipment. But keeping temperature rises under control while continuing to meet population and economic demands means transitioning to a low-carbon production process.

The sector is technically feasible to decarbonise, as shown by the work of the Energy Transition Commission, but a demand boost from buyers for low-carbon steel would help accelerate low-carbon transition. To that end, the new ResponsibleSteel standard provides the industry's first framework for facilitating a sustainable transition across the value chain. With it, steel producers can now demonstrate to investors and buyers that their activities are certifiably aligned with the goals of the Paris Agreement.

This report sets out the solutions to decarbonise steel, introduces the ResponsibleSteel standard, and highlights the financing opportunities.

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Contents

Introduction

Industrial sectors currently contribute nearly 30% to global Greenhouse Gas (GHG) emissions, and of this, steel is the largest emitting sector contributing over 7% of the total[1]. With governments, investors and civil society stepping up efforts to address the global climate problem, it is inevitable that the industrial, or so called 'harder-to-abate' sectors, also come up with a plan. This report sets out how the steel sector can deliver decarbonisation and how the ResponsibleSteel standard is an enabler of low-carbon transition.

Nearly 70% of the 1.8 billion tonnes of steel produced annually is primary, or new, steel.[2] It is produced from iron ore using carbon intensive processes that emit an average of 2.3 tonnes of carbon-dioxide per tonne of steel produced.[3]

While using recycled steel helps to deliver on emission reduction goals, the available quantities of recycled scrap are only sufficient to supply around a third of today's total steel demand[4]. Growth forecasts point to a 30% increase in steel production by 2050[5], which clearly means that without change, the steel industry will be adding to global emissions stocks instead of supporting emission reduction goals.

Work by the Energy Transition Commission shows that it is technically feasible to decarbonise primary steel production[6]. The challenge is that there are multiple routes to achieving low carbon emissions, which relate to industry structures and eco-systems as well as technical solutions. This makes it difficult for individual companies to make the first move. However, there is increasing demand from large end markets for steel, such as the automotive and construction sectors, to source lower carbon products through the supply chain, thus creating a demand driver for responsible steel.

To address the complexities, a group of leading industry players founded a not-for-profit collaboration, ResponsibleSteel and have now launched the first global multi-stakeholder standard and certification for the steel industry. It sets out standards for responsibly sourced and produced steel, based on a series of conversations with multiple stakeholders from across the steel value chain.

This work is relevant for the finance industry for two reasons. First, the financing requirement to transition the industry is in the region of USD$80 billion annually to 2050 according to the Energy Transition Commission[7]. This means that investors and financers need to get comfortable with how to effectively price risk across the industry, as, for example the technical solutions to industrial process decarbonisation, such as hydrogen, become more prevalent, alongside solutions for capturing emissions. Second, as governments become clearer on policy drivers to deliver low-carbon goals and civil society pushes for clearer low-carbon solutions, carbon pricing and reputational factors also become a factor for the steel industry.

The purpose of this paper is to highlight how the steel sector can accelerate low-carbon transition, by focusing on steel production and the ResponsibleSteel certification as a key demand side enabler.

Global Steel Production

7% of total global emissions	**Today** 2.3 $GtCO_2$	**2050 BAU** 3.3 $GtCO_2$

Mt per year, IEA reference technology scenario

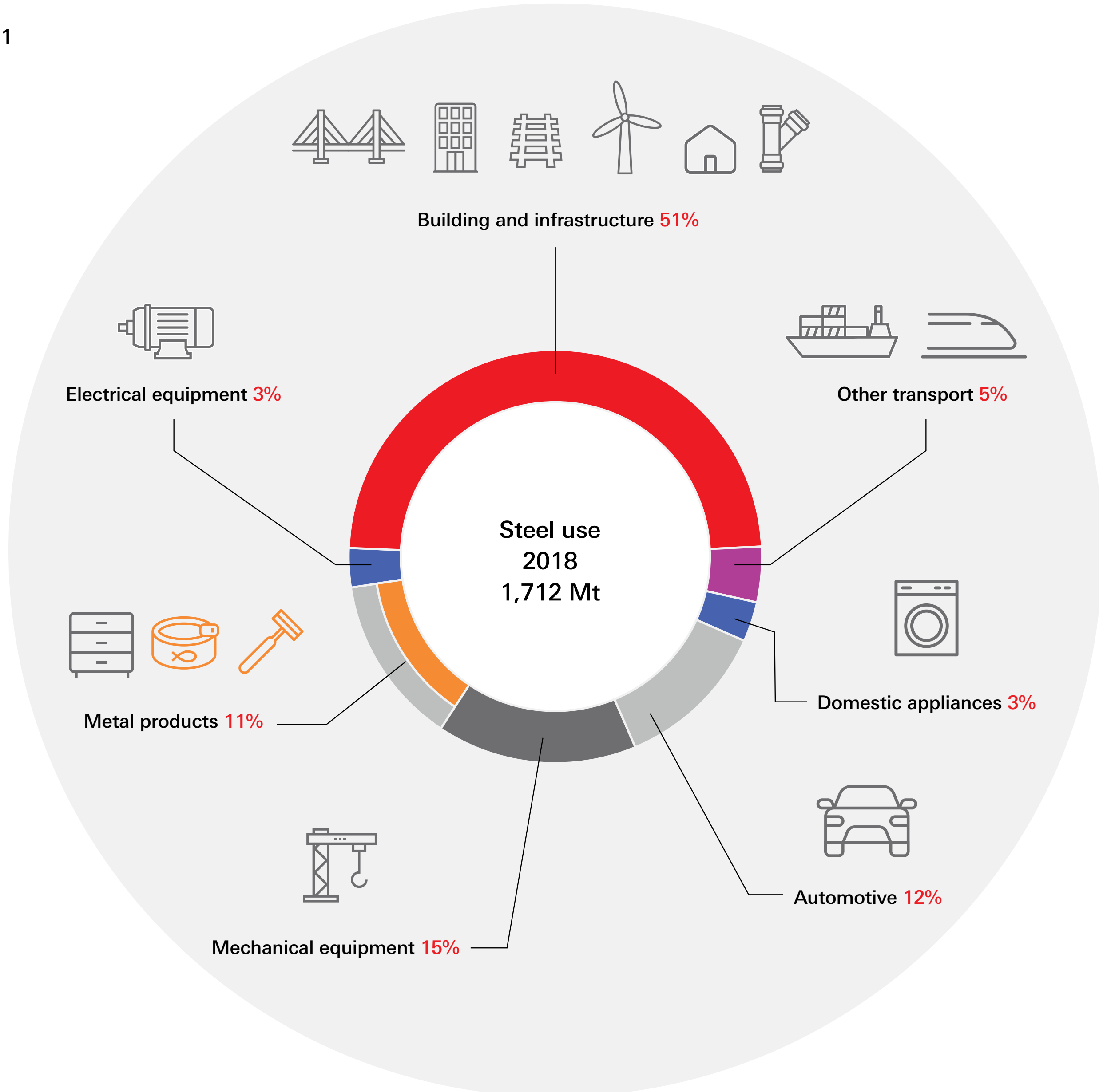
[1] McKinsey & Company (2018), Decarbonization of industrial sectors: the next frontier
[2] Worldsteel Association (2019); World Steel in Figures
[3] Material Economics (2018), The Circular Economy: a powerful force for climate mitigation
[4] Material Economics (2018), The Circular Economy: a powerful force for climate mitigation
[5] IEA (2017) Energy Technology Perspectives
[6] Energy Transition Commission (2018) Mission Possible: Reaching Net-Zero Carbon Emissions from Harder-to-Abate sectors by Mid-Century
[7] Energy Transition Commission (2019), Mission Possible; Reaching net-zero emissions from harder to abate sectors by mid-century (steel sectoral paper)

Growth in a Decarbonising World

The use of steel in the global economy will persist because it is a critical material used for buildings and infrastructure, cars, ships, rail, machinery and equipment, and numerous other applications including the production, distribution and storage of energy. The automotive and construction sectors together account for nearly 70% of all steel consumed.[8]

In addition, many low carbon technologies use steel as a construction material. For instance, steel accounts for around 80% of the material used in a wind turbine.[9] According to Bloomberg New Energy Finance, global installed wind capacity is forecasted to increase from currently 549 GW to nearly 3,500 GW by 2050.[10]

Figure 1



[8] Worldsteel Association (2019); https://www.worldsteel.org/steel-by-topic/steel-markets.html
[9] Worldsteel Association; https://www.worldsteel.org/steel-by-topic/circular-economy/case-studies/remanufacture-case-studies.html
[10] Bloomberg New Energy Finance (BNEF); New Energy Outlook

The World Steel Association highlights that no other material has the same unique combination of strength, formability, and versatility as steel.[11] The steel industry generates over USD$1 trillion in annual turnover, making it among the world's largest materials industry.[12] The London Metal Exchange highlights steel is more economic as it typically costs around USD$500 per tonne, compared to aluminium at around USD$1,700 per tonne.[13]

Emissions come from production processes

Annual emissions from iron and steel production currently stand at 2.3 Gt CO_2.[14] The International Energy Agency forecasts that population growth, rapid urbanisation and economic development will result in a steel production increase of 30% to mid-century, resulting in 3.3 Gt CO_2 by 2050 under business as usual growth and production trends, as shown in Figure 2 that's been adapted from a report by the Energy Transition Commission.

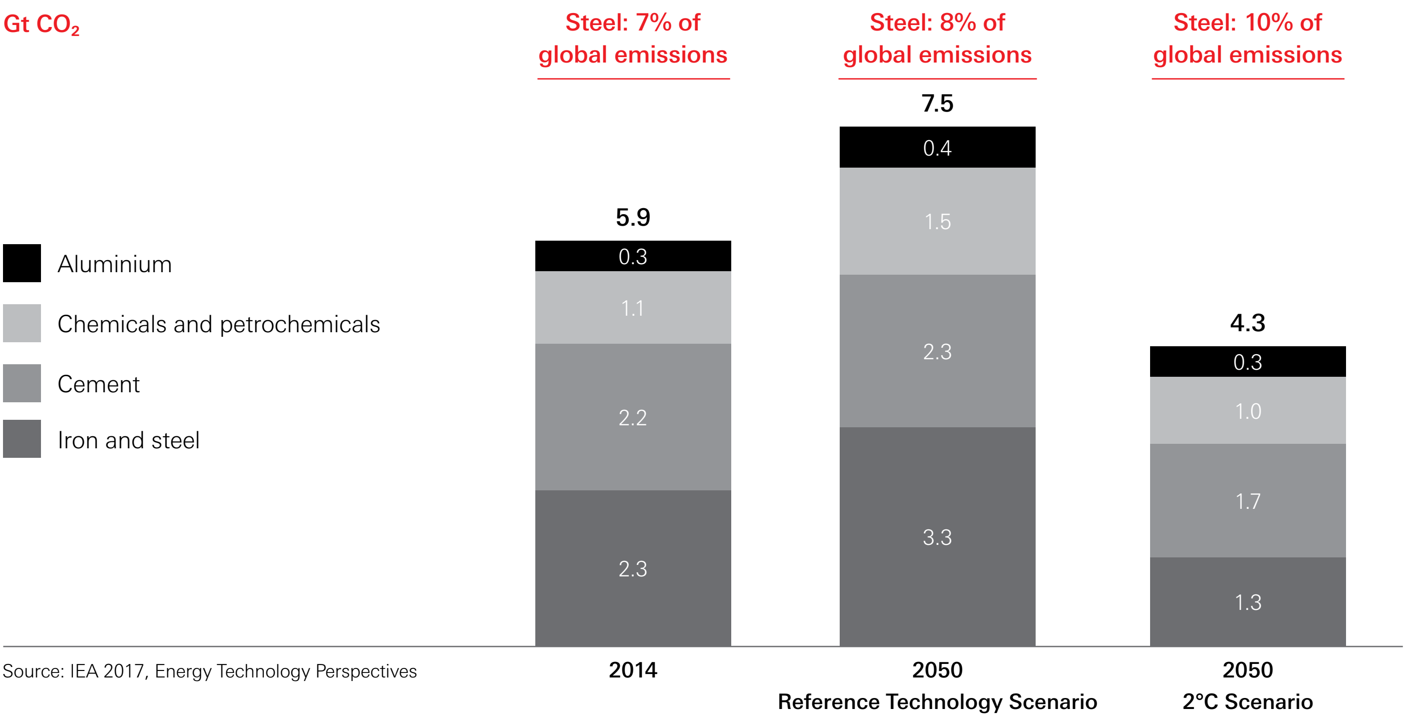
Of the nearly 1.8 billion tonnes of steel currently produced annually, approximately 70% is primary steel[15]. Primary steel is the most carbon intensive type of steel produced. This is because it requires producing iron as the starting material, which typically uses coking coal as the main source of carbon. About 95% of primary steel is produced in a Blast Furnace – Basic Oxygen Furnace (BF-BOF), using coking coal and emitting 2.3 tonnes of CO_2 per tonne of steel produced.[16] Figure 3 shows the amount of steel produced by region and type with forecast demand to 2050.[17]

Secondary steel, on the other hand, uses recycled steel as its starting material and therefore avoids the need for raw materials like iron ore and coal. Secondary steel is typically produced in an Electric Arc Furnace (EAF), which uses electricity to create heat and emits just 0.4 tonnes of CO_2.

Figure 2

With no action, emissions from the steel industry could represent 3.3 Gt CO_2 in 2050

Direct and process emissions from the heavy industry

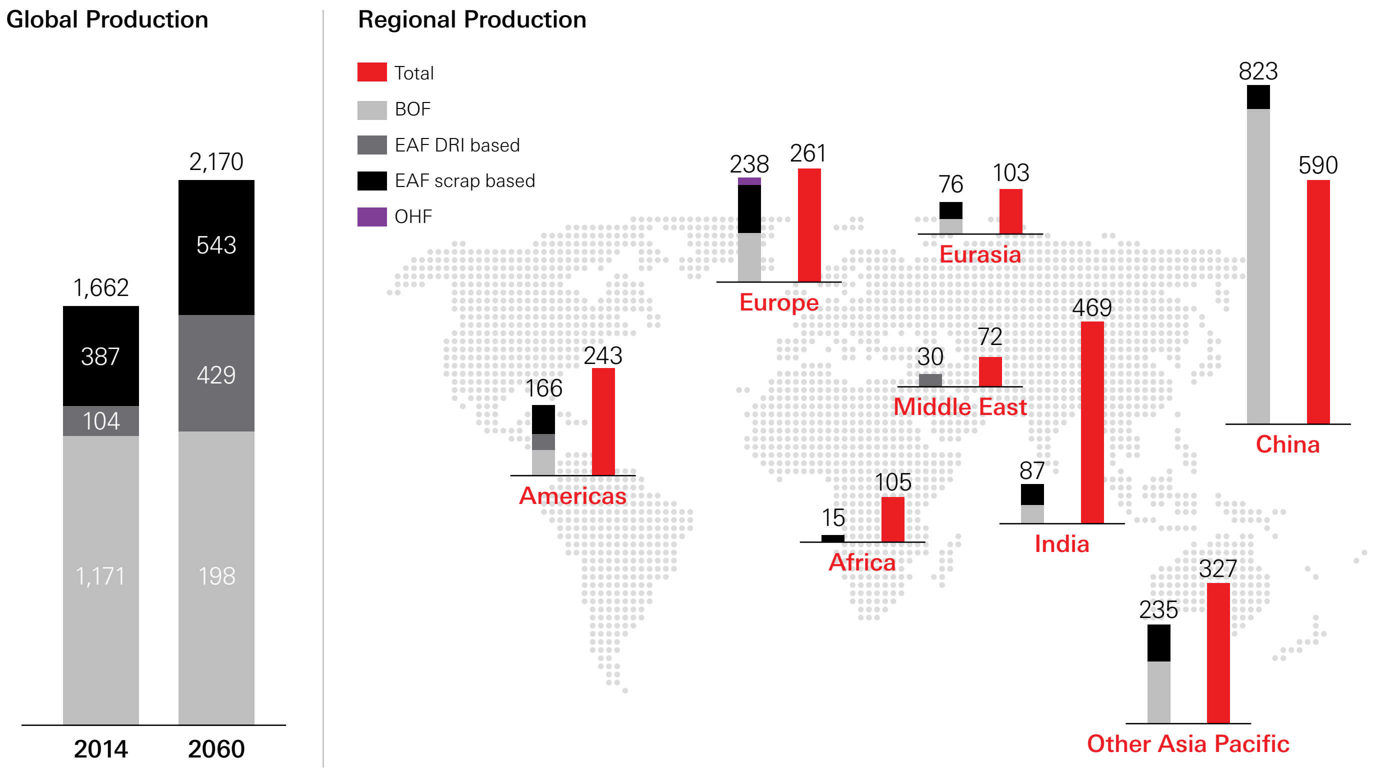


Source: IEA 2017, Energy Technology Perspectives

[11] Worldsteel Association; https://www.worldsteel.org/steel-by-topic/steel-markets.html
[12] ResponsibleSteel; https://www.responsiblesteel.org/
[13] London Metals Exchange: https://www.lme.com/en-GB/Metals/Ferrous/Steel-Rebar#tabIndex=0
[14] IEA (2017), Energy Technology Perspectives
[15] Worldsteel Association (2019); World Steel in Figures
[16] IEA (2017), Energy Technology Perspectives
[17] Energy Transition Commission (2019), Mission Possible; Reaching net-zero emissions from harder to abate sectors by mid-century (steel sectoral paper)

Figure 3

Mt per year, IEA reference technology scenario



Source: Energy Transition Commission
Data source: IEA (2017), Energy Technology Perspectives

BOF = Basic Oxygen Furnace

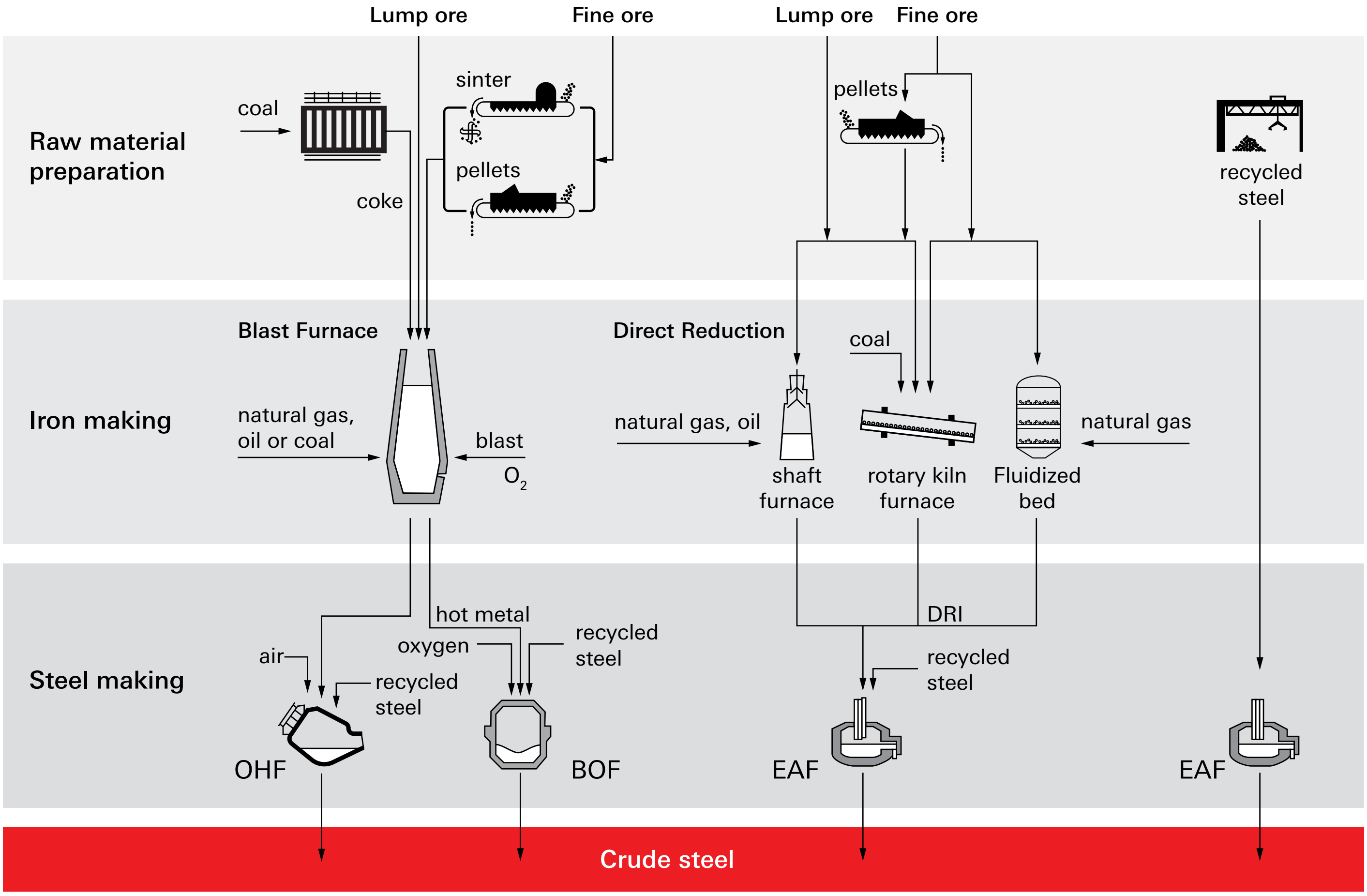
DRI = Direct Reduced Iron

EAF = Electric Arc Furnace

OHF = Open Hearth Furnace

Primary steelmaking involves an energy intensive two-step process that begins by producing iron from iron ore in a Blast Furnace (BF). The process involves mixing iron oxide (iron ore), coke and other materials such as limestone into the blast furnace. The burning of coke releases carbon monoxide and carbon dioxide gases that remove the oxygen from the iron oxide causing it to melt. The result is high carbon iron (carbon content is about 4%), referred to as hot metal or pig iron, which is the starting material for steelmaking.

Figure 4: Overview of the steelmaking process



Source: Worldsteel Association

The second step in the steelmaking process combines high carbon iron with steel scrap and transferring it into the Basic Oxygen Furnace (BOF). Pure oxygen is blown into the furnace, heating the materials and causing impurities to oxidise and carbon content to reduce, resulting in liquid steel. Once liquid steel is produced, it's transferred into a casting machine which rolls the steel and moulds it into components.

Different uses of steel can accept different grades of steel. The World Steel Association estimates that there are over 3,500 different types of steel grades in use, each with their own unique chemical and physical properties.[18] High-speed railways, for instance, require steel that won't crack under extreme impact and pressure. Autos require steel that is malleable, strong, and resistant to rust. According to Material Economics, only 8% of steel recycled from vehicles can be re-used again for the same purpose.[19]

This is relevant because end-use applications determine the steel grade, which in turn has consequences for the carbon content. Recycled scrap can also have higher levels of impurities, such as copper, compared to primary steel and can limit the range of end-use applications, leaving room for the primary market to continue to grow.

Low carbon content grades cannot be as efficiently produced with recycled scrap, because it can be 'lower quality and lower value than the steel from which it originally came'[20]. Ultra low carbon content steel is more easily produced using BF-BOF, where the producer has control over the quality of iron used as the starting material. Other steel grades used, for instance in the construction industry, are more efficiently produced using the secondary production route.

[18] World Steel Association; Steel Facts (2018) https://www.worldsteel.org/en/dam/jcr:ab8be93e-1d2f-4215-9143-4eba6808bf03/worldsteel-SteelFACTS
[19] Material Economics (2018); The Circular Economy – A powerful force for climate mitigation
[20] Energy Transition Commission (2019), Mission Possible; Reaching net-zero emissions from harder to abate sectors by mid-century (steel sectoral paper)

End markets are driving demand for responsible steel

Construction and the built environment

The construction sector and the built environment go together and are the largest buyers of steel. They have an interest in driving down product emissions because about a third of global carbon emissions are attributed to the built environment[21], with the underlying drivers to decarbonise coming from policy makers and communities[22]. The growth of the zero-carbon cities approach is encouraging the building sector to look for new areas to reduce its carbon footprint beyond energy efficiency and decarbonising power. Material economics estimate that construction materials account for about 20% of a building's carbon footprint, for which steel is among the highest emitting.[23]

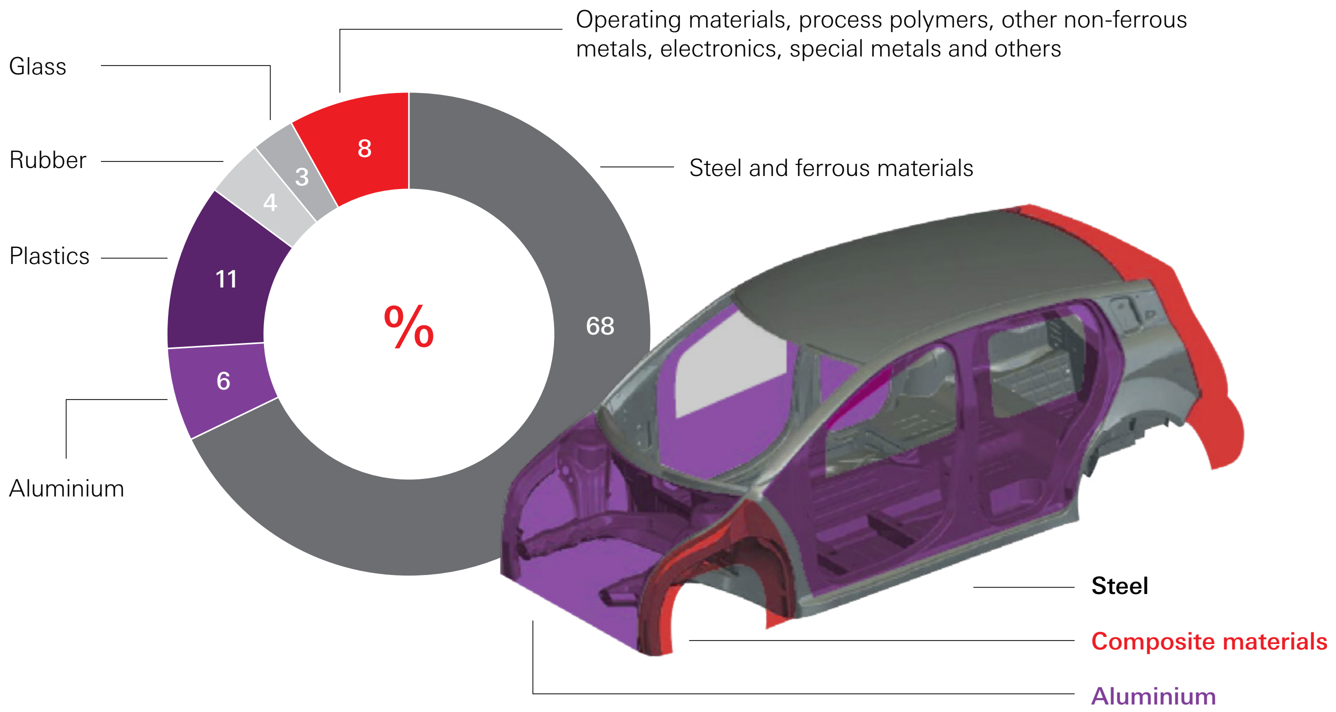
Auto manufacturers

The auto sector is a key driver for establishing a certification standard for responsible sourcing and production of steel and are the second largest buyers of steel.

For the autos sector, growing public awareness of the environmental impact of resource use is becoming a bigger factor in consumer choice for purchases which is also extending to the supply chain. This is important for steel as it makes up nearly 70% of the total material composition of a car, as shown in Figure 5. In addition, since it is among the more challenging materials to map along the supply chain, assurance on raw material provenance is becoming a bigger issue.

Auto manufacturers themselves are also under scrutiny to demonstrate how they are assisting with low-carbon transition and accounting for emissions used for steel is part of a car makers total carbon footprint.

Figure 5:



Source: WWF (2019): Boom in Raw Materials: Germany's ecological footprint in steel and aluminium

[21] Material Economics (2018); The Circular Economy, A powerful force for climate mitigation
[22] HSBC Centre of Sustainable Finance; Towards the Zero-Carbon City
[23] Material Economics (2018); The Circular Economy, A powerful force for climate mitigation

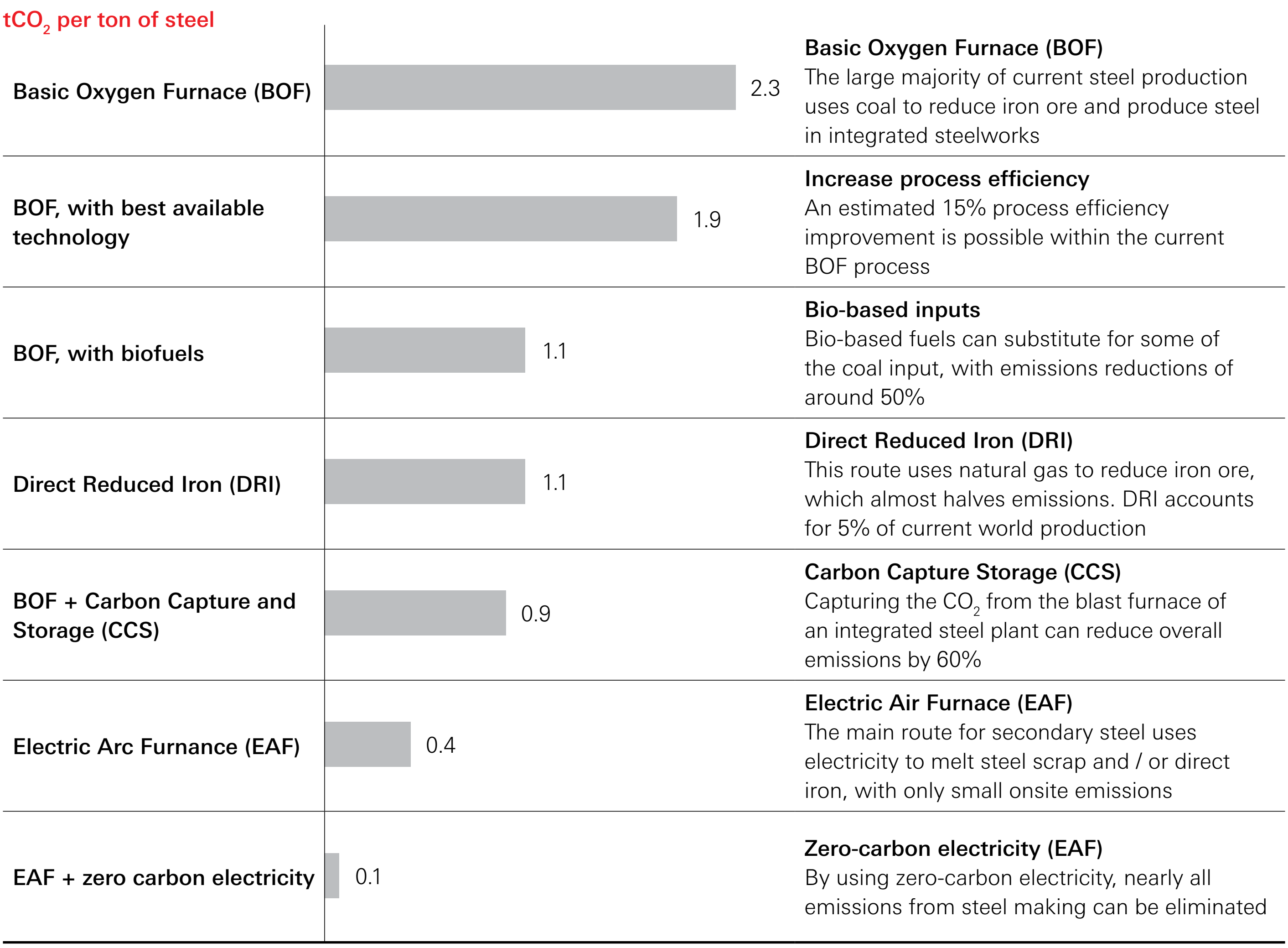
Solutions for Decarbonising Steel Production

Primary steel production
Natural evolution has improved processes. The World Steel Association estimates that producing one tonne of steel today requires 60% less energy than it did in 1960.[24] Progress has come from the natural plant replacement cycle and a shift towards higher purity iron ore. In spite of these improvements, further innovation is still needed to accelerate emission reduction.

Several technology routes could enable near zero carbon emissions in steel production, according to the Energy Transition Commission. These include energy efficiency gains, carbon capture usage and storage (CCUS) usage, hydrogen based direct reduction of iron, and electrification of steel production using low carbon electricity sources. The technologies are at various stages of commercial viability, with many still in the pilot phase. Figure 6 shows the relative benefits for each category.

Figure 6: CO_2 intensity of steel production

Classification of different technologies



Source: Material Economics, 2018 The circular Economy: A powerful force for climate migration

[24] WorldSteel Association; https://www.worldsteel.org/en/dam/jcr:f07b864c-908e-4229-9f92-669f1c3abf4c/fact_energy_2019.pdf

Energy efficiency improvements

- Modern blast furnaces are capturing carbon monoxide (CO) from the blast furnace and converting it into a synthetic gas (syngas). This can be reinjected into the blast furnace in place of fossil fuels to reduce iron ore. Since the amount of coke needed in steelmaking is reduced, this process helps to reduce CO_2 emissions.

Substitution of fossil fuels with alternative feedstock's in BF-BOF

- Coke can now be displaced with alternative sources of carbon such as pulverised coal or natural gas.
- Bio-waste from agriculture and forestry residues can be used in place of fossil fuels to reduce iron ore to iron and used as fuel in a modern blast furnace. Technology that uses bio-coal from wood waste to displace fossil fuel coal in the blast furnace is being piloted.
- Hydrogen can partially displace coke as a feedstock within the BF-BOF.

Replacement of BF-BOF plants with low carbon production technologies

- Direct Reduced Iron (DRI) plants replace coal based BF-BOF for the production of primary steel, where appropriate. DRI uses iron pellets which reduces the amount of carbon required in iron reduction and natural gas in place of coal, resulting in lower carbon emissions compared to BF-BOF. DRI currently produces 5% of global primary steel and growing. However, DRI is relatively more expensive and typically produces fewer quantities compared to a BF-BOF plant.
- Hydrogen can partially or fully displace fuels used in DRI. A hydrogen based -production of steel would be zero carbon emission and is currently in the research phase.
- Direct electrolysis has the potential to reduce iron ore and is already being done in aluminium production. The process, however, is still in the R&D phase for steelmaking.

Capturing emissions for use or storage

- Carbon Capture Utilisation and Storage (CCUS) captures CO_2 from BF-BOF production sites has the potential to reduce emissions by 60%.[25] The benefit of CCUS is that it can be retrofitted to existing assets without requiring significant changes to existing plants. The cost of carbon capture decreases as the purity of the CO_2 increases and carbon captured can be recycled for use into other products such as bio-ethanol. Storage and transport infrastructure that makes use of industrial clusters will be important to the scale up of CCUS.

Circularity and secondary steel

Steel can be recycled multiple times over. About 85% of steel is recovered and recycled which is more than any other industrial material. Secondary steel produced in an Electric Arc Furnace (EAF) uses recycled steel scrap as a starting material. EAF uses electricity as the main heat source (instead of coal) resulting in 0.4 tonnes of CO_2 emissions per tonne of steel produced and is the least carbon intensive production process. It can be further reduced to 0.1 tonnes depending on the availability of zero carbon electricity in the location of the plants. This is possible by replacing fossil fuel based electricity in EAF with low carbon electricity. Producing steel using the secondary route can result in lower production costs because it does not require producing iron.[26]

However, the quantity of recycled steel today is only sufficient to supply around 30% of total steel demand.[27] Further, certain grades of steel can be more easily produced using primary steel, where the producer has control over the quality of the starting material.

[25] Material Economics (2018); The circular economy, a powerful force for climate mitigation
[26] Material Economics (2018); The circular economy, a powerful force for climate mitigation
[27] Material Economics (2018); The circular economy, a powerful force for climate mitigation

ResponsibleSteel Initiative and Standard

While the technical capability exists to decarbonise the production of steel, the current incentives for producers to implement change are relatively limited. In 2017, a group of leading industry players founded a not-for-profit aiming to set a standard, which could result in a certification for best practices in responsible sourcing and production of steel. The standard focusses on steel producers, steelmaking sites and raw materials sourcing.

Twelve principles, covering the broad categories of corporate leadership and governance of social and environmental factors underpin the standard. These are included in Appendix 1. Climate change and greenhouse gas emissions are naturally important components because of the carbon intensity of steel production.

To achieve certified status, the standard requires corporates to take a number of overarching steps. These include:

1. Demonstrating commitment to the goals of the Paris Agreement by setting a medium and long-term emissions reduction target(s) at the corporate level that is compatible with the goals of the Paris Agreement

2. Implementing the recommendations of the Task Force on Climate-Related Financial Disclosure (TCFD)

3. Embedding climate related risk and opportunities into its corporate strategy

In addition, there are requirements for the steel producing sites. These include:

4. Setting emission reduction targets at the steelmaking site(s) that are aligned with the corporate owner's overall emission reduction targets

5. Developing a time bound plan to achieve these targets at the individual steelmaking site(s), including milestones such as raising financing for related projects

6. Disclosing total GHG emissions and the emissions intensity associated with the sites steel production. This includes estimating the emissions associated with the mining and transportation of raw materials for steel production

ResponsibleSteel does not yet certify raw material suppliers directly. However, the steel industry is among the largest consumers of all mined goods, including iron ore and metallurgical coal. The requirement is that raw materials are assured within a certain period of time under an existing credible mining initiatives, such as the Mining Association of Canada's Towards Sustainable Mining (TSM), and the Initiative for Responsible Mining Assurance (IRMA).

Given current data constraints and knowledge gaps, steel producers can currently use generic data to estimate the emissions associated with the raw materials mining and transportation to the steelmaking sites. Going forward this will evolve to provide more specificity. In addition, downstream consumption of steel will be addressed by ResponsibleSteel in 2020, such as by including specifications for steel product certification.

Financing Requirements and Opportunities

Financing the low-carbon future means supporting existing industries to deliver on their decarbonisation strategies, as well as providing capital for suppliers and solution providers to adopt low-carbon roadmaps. The challenge for steel producers is that investing in emission reduction solutions too early risks making steel more expensive in a competitive market, while investing too late could mean losing market share as end markets move to more responsible suppliers.

The Energy Transition Commission estimates that the total annual investment requirements for decarbonisation across the industry globally are around USD$80 billion per year, depending on factors such as the technology pathway and cost of low carbon electricity. However, the ETC also expect that the end-product cost to the consumer will be modest, for instance, an increase of 1% to the price of an average car[29], and are therefore not expected to impact consumer demand.

There are plenty of reasons why the pace of financing has been slow, which include;

- Steel production is generally a capital intensive, less than 10% margin business
- With current technological status, low carbon emissions steel is more expensive and could add up to 20% to the cost of production[30]
- Additional upfront costs in abatement technologies with long-term paybacks can be challenging, especially when some producers are looking to reduce their debt levels
- Production facilities have up to 50 year lifespans and are highly integrated, such that any change in one part of the process affects the others[31]
- Identifying the cost benefit of retrofitting existing assets against investing in new zero carbon production processes is a challenge without standards in place, long term consumer demand and appropriate financing
- Abatement technologies are in the pilot stage, and financing to date has been difficult to secure
- A lack of clarity among the investor community about how to support a best practise transition for a steel company

Creating demand to de-risk investment

The solutions to achieving full decarbonisation of steel production are not solely technical, but eco-system related as well. ResponsibleSteel aims to encourage activities that support the growth of responsible sourcing and production of steel, by providing a market for best in class steel production.

For producers, the ResponsibleSteel standard helps by:

- Outlining a set of requirements for certification at the corporate and steelmaking sites that serve as a proxy for best practices that's recognized by the market.
- Devising a transition roadmap that is technology agnostic and enables producers to design the optimal mix of technologies that support achieving their targets in the future

For steel buyers, the ResponsibleSteel standard helps by:

- Providing transparency on a definition of responsibly sourced and produced steel
- Widening the universe of suppliers and quantities
- Enabling buyers to more easily differentiate between producers that are aligning their activities with the transition to the low carbon economy
- Mitigating risks associated with responsible sourcing

For the investing and finance community, ResponsibleSteel helps by:

- Providing transparency and a proxy for best practices that makes it easier for investors to differentiate between steel companies
- Certification can provide greater transparency and confidence that capital raised will support responsible steel making

For regulators, ResponsibleSteel helps by:

- Providing a framework to create the regulatory environment to accelerate the decarbonisation of steel making

[29] Energy Transition Commission (2019), Mission Possible; Reaching net-zero emissions from harder to abate sectors by mid-century (steel sectoral paper)
[30] Energy Transition Commission (2019), Mission Possible; Reaching net-zero emissions from harder to abate sectors by mid-century (steel sectoral paper)
[31] McKinsey & Company (2018), Decarbonization of industrial sectors: the next frontier

Potential financing solutions

Green and Transition Bonds

Green bonds are bonds where the use of proceeds are explicitly used defined for 'wholly' green projects and can be issued by any bond issuing entity.

Steel companies are not precluded from issuing Green Bonds, but the use of proceeds scope is narrow. The majority of low carbon production technologies in steelmaking are not typically 'wholly green' as of yet. This is because many low-carbon steelmaking projects use a portion of fossil fuels for the raw material or fuel source, while displacing another portion with alternatives such as natural gas, biomass or other energy efficient technology applications. Because many CO_2 emission reduction projects in carbon intensive sectors are not yet wholly green, they have not been eligible to tap green bond route and have therefore had fewer green financing alternatives to date as a result.[32]

Transition bonds are emerging as a potential alternative to green bonds for carbon intensive industries like steelmaking. This is an important development for them, because it helps to provide transparency on how corporates are addressing climate factors.

The main difference between green and transition bonds is that a transition bond would enable capital to flow towards emission reduction projects that use non-green technology, but that are moving towards a Paris aligned pathway. However, firms issuing transition bonds would need to provide strong credentials that their transition strategy is robust.[33]

Transition bonds, however, are still early stage. A few banks are exploring transition bonds, however, there is still debate about how to characterise a carbon intensive company in transition. This is important because investors need assurances that capital is, in fact being allocated towards companies that are truly transitioning and that their capital is being allocated towards projects and activities that are contributing towards an overall transition strategy, as opposed to merely lock in future fossil fuel use. In addition, the second party opinion providers used to provide green bond expertise are not yet widely used to providing transition opinions.

ResponsibleSteel provides a certification that makes it easier for investors to differentiate between companies that are taking climate action seriously, and those that either do not have a strategy or do not want to disclose it. Under the standard, companies commit to a long term transition pathway aligned with the Paris Agreement paired with a near term underlying strategy to achieve emission reductions on a steelmaking site basis.

[32] HSBC Research (2019); 'Time for Transition'
[33] HSBC Research (2019); 'Time for Transition'
[34] HSBC Centre of Sustainable Finance (2019), Lending to Low-Carbon Technologies

Green and Sustainability Linked Loans

Other financing tools include privately placed loans, such as Green Loans, Sustainability Linked Loans and Sustainability Linked Revolving Credit Facilities. Certain producers may opt to secure privately placed loans early on in their transition for the following reasons;

- Privately placed loans will enable them to test technology solutions while they develop their optimal transition roadmap
- Ticket sizes can be small which may be more suitable for companies that are already highly levered and looking to reduce their debt
- It enables them to strengthen their transition track record and fine-tune their transition strategy before issuing larger more public amounts of debt later on
- Brand recognition and investor demand are less of an issue because loans are privately placed
- Green and sustainability linked loans can be used for a variety of purposes, green loans for specific projects and sustainability linked loans for general purposes

Other capital solutions and considerations

Low carbon steel production technologies are at various stages of maturity and their associated risks vary depending on their application. The type of financing and its corresponding structure, therefore, will be influenced by such factors.

For instance, project financing for certain technologies may be a better solution than on balance sheet financing. This could be the case for steel companies who are not investment grade and are highly levered, as not all will have access to international bond offering.

Carbon Capture Utilisation and Storage (CCUS), for instance, has a longer track record than other emission reducing technologies like hydrogen from electrolysis[34]. CCUS can be located near or far from the emission producing sites and can potentially store CO_2 from multiple emitters. Steel producers could secure long-term agreements with 3rd party transport and storage providers for a fee, as opposed to financing, building and operating it themselves. This could be value adding for steel producers that are highly levered and looking for ways to reduce their debt burden. Alternative structures could also enable ownership and risk to be spread across multiple capital providers.

The viability of such structures will depend on infrastructure available and location of the storage site, paired with a robust business case usually tied to a price on carbon, which can be used as a revenue stream for the project. Other factors include the long term risk of sequestering CO_2 into the ground, legal and regulatory frameworks that clarify who bears liability.

Certain technological solutions for low carbon steel production are still in the commercialisation phase, for instance hydrogen and CCUS, and may require risk oriented capital to help reduce project risks and demonstrate proof of concept. De-risking projects can typically be done using mechanisms such as greater equity cushions, concessional financing and/or guarantees. Other factors such as the regulatory environment and carbon pricing could have an impact as well.

Conclusion

Steel producers are critical for urbanisation, infrastructure development and economic prosperity. Yet addressing the climate challenge at the same time as delivering growth means a re-think of operational processes and value creation.

Steel producers need incentives to change, as the current economics are unfavourable for market forces to provide the decarbonisation solution. On the supply side, the decarbonisation roadmaps are technically feasible now, but not yet commercially viable. The ResponsibleSteel standard helps buyers in the critical steel markets of construction and autos differentiate between suppliers that are leading on taking climate into account versus those that are slower in a low-carbon transition pathway. This creates a demand signal for steel producers.

As this report shows, there is more than one route to achieving low carbon production of primary steel. The solutions are not technical, but rather structural and eco-system related. ResponsibleSteel aims to tie together the critical elements – supply, demand, and financing – in a framework that incentivises low carbon transition activities using market based rewards. In addition, regulatory action, for instance in the form of a price on carbon, would also accelerate change.

Appendix 1: ResponsibleSteel Standard Principles

The ResponsibleSteel Standard consists of twelve principles for the responsible sourcing and production of steel.

Principle 1 - Corporate Leadership; ResponsibleSteel certified sites are led responsibly.

Principle 2 - Social, Environmental and Governance Management Systems; ResponsibleSteel certified sites have an effective management system in place to achieve the social, environmental and governance objectives to which they are committed.

Principle 3 - Occupational Health and Safety; ResponsibleSteel certified sites protect the health and safety of workers.

Principle 4 - Labour Rights; ResponsibleSteel certified sites respect the rights of workers and support worker well-being.

Principle 5 - Human Rights; ResponsibleSteel certified sites respect human rights wherever they operate, irrespective of their size or structure.

Principle 6 - Local Communities; ResponsibleSteel certified sites respect the rights and interests of local communities, avoid and minimise adverse impact and support community well-being.

Principle 7 - Stakeholder Engagement and Communication; ResponsibleSteel certified sites engage effectively with stakeholders, report openly on issues of importance to stakeholders, and remediate adverse impacts they have caused or contributed to.

Principle 8 - Climate Change and Greenhouse Gas Emissions; The corporate owners of ResponsibleSteel certified sites are committed to the global goals of the Paris Agreement, and both certified sites and their corporate owners are taking the actions needed to demonstrate this commitment.

Principle 9 - Noise, Emissions, Effluents and Waste; ResponsibleSteel certified sites prevent and reduce emissions and effluents that have adverse effects on communities or the environment, manage waste according to the waste management hierarchy and take account of the full life cycle impacts of waste management options.

Principle 10 - Water Stewardship; ResponsibleSteel certified sites demonstrate good water stewardship.

Principle 11 – Biodiversity; ResponsibleSteel certified sites protect and conserve biodiversity.

Principle 12 - Decommissioning and Closure; ResponsibleSteel certified sites minimise the adverse social, economic and environmental impacts of full or partial site decommissioning and closure

About the Centre of Sustainable Finance

"For more than a decade, HSBC has been at the forefront of the sustainable finance market. In November 2017, HSBC made five sustainable finance pledges. We committed to provide USD100 billion of sustainable financing and investment by 2025, source 100 per cent of electricity from renewable sources by 2030, reduce our exposure to thermal coal and actively manage the transition path for other high carbon sectors, adopt the recommendations of the task force on climate related financial disclosures to improve transparency, as well as leading and shaping the debate around sustainable finance and investment.

Taken together, these commitments reflect the scale of the challenge of delivering the Paris Agreement and UN Sustainable Development Goals. They also demonstrate the heights of our ambition to be a leading global partner to the public and private sectors in the transition to a low-carbon economy."

Daniel Klier, Global Head of Sustainable Finance

"Each and every one of us has a stake in developing a sustainable economic system. It is the combined responsibility of all players in society to respond to climate change, rapid technological innovation and continuing globalisation to secure a prosperous future. Yet addressing these changing forces is by no means straightforward. More work is needed to provide the financial system with the right toolkit to solve sustainability challenges.

Working with internal and external partners, this central think tank is uniquely positioned to lead and shape the debate. We will promote the sustainable finance agenda using our global network which covers the world's largest and fastest growing trade corridors and economic zones. We can provide the connections needed to foster sustainable growth across borders and geographies. We aim to mobilise the capital flows needed to address the world's major sustainability challenges."

Zoë Knight, Group Head, HSBC Centre of Sustainable Finance

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