Abate and switch: steel seeks low carbon solutions

Steel production is extremely carbon and energy intensive, and there are technological challenges to reducing emissions. But such "hard-to-abate" sectors will come under increasing pressure. How do we engage with companies in this sector and what are the industry's options?

Setting the scene

Steel is used in everything from construction and cars to white goods, as well as wind turbines and mass transportation systems, which help to mitigate climate change. But steel production is both carbon and energy intensive, and there are considerable challenges to overcome to cut emissions. Although steel can be recycled, there is not enough scrap steel to meet the continued growth in steel demand. In addition, scrap impurities limit the potential for recycled steel, meaning that smelting of virgin iron ore is required for high grade products. Steel is therefore considered a hard-to-abate sector, but national net-zero commitments and pressure from customers mean that solutions must be found to help drive down emissions.

Steel goods will play a vital role in the transition to a low-carbon world, but the production process itself is notoriously carbon and energy intensive, accounting for around 7% of energy sector CO_2 emissions.[1] Blast furnaces must run at temperatures of over 2,000°C, and the raw materials themselves – coking coal and iron ore – are extracted from the ground in other energy intensive processes.

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According to the International Energy Agency (IEA), the steel industry is currently the largest industrial consumer of coal, which satisfies about 75% of its energy demand. The IEA's recent *Net Zero by 2050* report shows that emissions from heavy industry, including steel, must decline by 20% by 2030 and by 93% by 2050, versus 2020 levels.[2] Almost 60% of this reduction is modelled to come from technologies that are under development today. Over the same period, global demand for steel is expected to increase by more than a third.[3]

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[1] https://iea.blob.core.windows.net/assets/eb0c8ec1-3665-4959-97d0-187ceca189a8/Iron_and_Steel_Technology_Roadmap.pdf
[2] Net Zero by 2050 – A Roadmap for the Global Energy Sector (windows.net)
[3] https://www.iea.org/reports/iron-and-steel-technology-roadmap

Steel producers need to reduce the carbon intensity of their processes, rather than continuing on their current path. If they fail to act, they may find themselves exposed to regulatory risks and chasing increasingly expensive carbon offsets alongside other high-emitting sectors such as airlines. But the industry faces a number of challenges on the road to decarbonisation.

Decarbonisation challenges

Over 70% of global steel production currently comes from blast furnaces, where coke is used to achieve the very high temperatures needed. Electric arc furnaces emit significantly less carbon than traditional blast furnaces, using electricity to melt recycled steel in a process that is estimated to use up to 10 times less energy.

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years before steel reaches the end of its useful life and becomes available for recycling.

However, a large-scale switch from blast to electric arc furnaces is not feasible, as scrap impurities in recycled steel mean that manufacturing high value-added products is more of a challenge. In addition, there is not enough recycled steel to meet the demand in fast-growing emerging markets. Unlike plastics or paper, which have a short life cycle, it can be 20-50 years before steel reaches the end of its useful life and becomes available for recycling.

Another problem is the large fleet of relatively young blast furnaces in Asia. With so much sunk capital, switching to electric arc furnaces is not feasible in the near-future, so there is a strong imperative to find ways to decarbonise existing blast furnace steel production.

Risks and opportunities

Given the urgent need to align all sectors with the goals of the Paris Agreement to keep global temperature increases within safe limits, maintaining a business-as-usual stance presents a number of risks for steel producers and their investors.

Countries such as Sweden, the UK, France, Denmark, New Zealand and Hungary have already made legally-binding national net-zero emissions commitments[4], and some three-quarters of 2020 steel production came from countries where such commitments were in law, in proposed legislation or set out in a policy document.[5]

At the same time, buyers of steel products such as car manufacturers and construction companies are committing to net-zero targets that apply across their supply chains, and so will be seeking zero-carbon steel to help them get there. SteelZero, an initiative launched in December 2020, is bringing steel buyers together to drive the demand for zero-carbon steel.[6] Steel producers who can decarbonise early will benefit from a first-mover advantage by satisfying this demand. However, regulatory intervention may be required to support investment and help the sector as a whole.

In another sign of the growing impetus for change, a group of six banks formed the Steel Climate-Aligned Finance Working Group, to help define common standards of action for steel sector decarbonisation through a collective climate-aligned finance agreement.[7]

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Producers who fail to innovate may run the risk of asset stranding. This may be the case for some of the newer blast furnaces in Asia, particularly if the European Union introduces a carbon border tax or similar adjustment mechanism to level the playing field and avoid carbon "leakage". This describes a situation where higher carbon-emitting players gain a trade advantage by avoiding locally-applicable carbon taxes.

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[4] Which countries have a legally-binding net-zero emissions target? (nsenergybusiness.com)
[5] Calculated by the international business of Federated Hermes using World Steel Association data from 2020 production by country and Net Zero Tracker, Energy & Climate Intelligence Unit
[6] Building demand for net zero steel | The Climate Group
[7] Six global banks join forces to decarbonize steel – Climate Action

Our engagement approach

We engage with some of the world's largest steel producers including Posco and Severstal, where we co-lead the collaborative engagement with the companies as part of Climate Action 100+ (CA100+). Our expectations of steel companies to address climate change are as follows:

- **Net-zero emissions by 2050 at the latest –** Several companies including ArcelorMittal and Posco have recently made this commitment, following engagement.
- **Supporting short and medium-term targets –** Once a long-term goal is in place, short- and medium-term targets should be set, aligning with Paris Agreement goals along the journey to net zero. This is to avoid a disorderly, late transition and steel producers continuing to pump out high levels of greenhouse gases up until 2050, baking in catastrophic levels of global heating for decades to come.
- **A strategy for how these goals will be met –** Targets should be supported by a clear strategy for decarbonisation, indicating the technologies the company will be relying upon.
- **Capex and R&D spend aligned with the goals of the Paris Agreement –** These should be reflective of the company's chosen strategy and demonstrate its contribution to the commercialisation of key technologies.
- **Strong governance and aligned executive remuneration –** We expect strong oversight from board directors with the skills and experience to hold management to account for delivering on the long-term climate strategy; executive pay should be tied to successful climate strategy delivery.
- **Reporting in line with the TCFD recommendations, including scenario analysis –** Financial reporting and underlying risk management processes should be aligned with the four TCFD pillars; scenario analysis should be used to test the viability and resilience of business models under regulatory and market changes, including an EU Border Carbon Adjustment Mechanism and a 1.5°C scenario.
- **Paris-aligned lobbying and policy advocacy activity –** Companies should ensure lobbying and public policy activities are aligned with the Paris Agreement goals, including withdrawing from industry associations where views do not align.

Steel company engagements

1. ArcelorMittal

To this end, we engaged with ArcelorMittal, encouraging it to set a global net-zero target. In September 2020 it set such a group-wide commitment, building on its 2019 pledge for its European business to reduce emissions by 30% by 2030, and to be carbon neutral by 2050. It is exploring the use of hydrogen as a reducing agent at a demonstration plant in Hamburg, and in March 2021 it launched three initiatives under its XCarb trademark. These include an innovation fund that will invest up to $100m annually in companies developing pioneering or breakthrough technologies to accelerate the transition to carbon neutral steelmaking. Meanwhile, its Smart Carbon projects are aimed at reducing emissions from blast furnaces.[8]

2. NLMK

We have also engaged with Russia's largest steelmaker, Novolipetsk Steel (NLMK), on climate change and carbon emissions reduction with the objective of improving the management of climate-related risks. In September 2020, the company announced greenhouse gas emission reduction targets for 2023, which included investment projects to boost energy efficiency, reduce the consumption of carbon-containing fuels and develop decarbonisation technologies.[9]

It also joined Step Up, the World Steel Association's decarbonisation programme, which aims to reduce the industry's environmental impact. NLMK has worked to improve its energy intensity through equipment upgrades and better processes and aims to increase its electricity self-sufficiency to 94% by 2023.[10]

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In 2021 we wrote a letter to the chair following the company's low Level 1 score by the Transition Pathway Initiative. Reviewing its response, we agreed it should be graded better at Level 3. NLMK has improved the management, governance and disclosure of its climate change risks and opportunities, aligning its reporting with the four pillars of the Task Force on Climate-related Financial Disclosures. It is also participating in the Net Zero Steel Pathway Methodology Project, which aims to develop recognised guidance on the net-zero transition pathway for steelmaking. We encouraged it to work on medium-term and long-term emission reduction targets to accompany its 2023 target.

3. Posco

Finally, we have engaged extensively with Posco on climate change as a co-lead for the company under CA100+. We asked Posco to set new, ambitious, long-term targets for reducing its Scopes 1 and 2 emissions in line with the Paris Agreement, and to adopt the recommendations of the TCFD. Posco has now set targets to reduce its carbon emissions by 20% by 2030, by 50% by 2040, and for carbon neutrality by 2050, against the 2017-

[8] https://corporate.arcelormittal.com/media/press-releases/arcelormittal-launches-xcarb-signalling-its-commitment-to-producing-carbon-neutral-steel
[9] https://nlmk.com/en/media-center/news-groups/nlmk-group-updates-ghg-emission-reduction-targets-leading-up-to-2023/
[10] https://nlmk.com/upload/iblock/bee/NLMK-_-ESG-presentation-November-2020.pdf

2019 average baseline of its Scopes 1 and 2 emissions. It has also adopted the recommendations of the TCFD. You can read about this in detail online in our Posco case study.

Decarbonisation options and potential pitfalls

There are three possible routes to decarbonisation for steel producers to consider, but as each is insufficient alone, the industry will need to pursue all three.[11] Increasing the production of low-carbon steel will be expensive, so regulatory support is also required to facilitate decarbonisation and the scaling-up of technologies.

1. Demand management

According to the Energy Transition Commission, demand management could reduce emissions by over 35%[12]. In theory, a fully circular economy for steel is possible. However, as emerging markets continue to industrialise and urbanise at a rapid pace, the demand for steel is expected to remain strong well past 2050, particularly in countries such as India. Although companies can give some consideration to the redesign of products for efficiency and circularity, steel may be locked away for decades in bridges, ships, trains and buildings before it is scrapped and recycled.

2. Energy efficiency and renewable power

Promoting energy efficiency measures and best-in-class technologies could help to drive down emissions from the steel production process, especially in the next five to 10 years, according to the IEA.[13] This could reduce emissions from the steel sector by up to 20%.[12] The World Steel Association encourages its members to adopt measures such as heat or energy recovery, coke dry-quenching and electricity savings.

As the proportion of steel produced from electric arc furnaces increases, it is important to ensure the electricity is generated from renewable sources. However, if all electric arc furnaces currently in operation were fully powered by electricity from renewable sources, this would gobble up about 40% of existing global wind and solar generating capacity.[14] Nevertheless, the number of electric arc furnaces must increase significantly to reduce the sector's overall emissions.

3. Decarbonisation technologies

- **Carbon capture, utilisation and storage (CCUS) and offsetting –** At its most basic level, CCUS means capturing carbon dioxide emissions from sources such as blast furnaces and preventing them from entering the atmosphere either by reusing or storing the emissions. Offsetting means compensating for carbon dioxide emissions produced by the industry through other means, such as planting trees. However, reducing emissions is always preferable to CCUS and offsetting, which should be treated as a last resort.

  As steel production tends to be concentrated in particular locations (unlike aviation) it might be possible to capture the carbon emitted at source, by retrofitting the steel plant. This could then be stored – perhaps in depleted oil and gas fields – but this is currently untested. Even if it were technologically viable, CCUS would not be commercially viable without a very high carbon price (estimated at up to €215[15]). This is because it brings no benefits to the steelmaking process but would require significant additional energy and infrastructure to capture, transport and store the carbon. If the steel industry relies solely on offsetting, it will find itself in fierce competition for land from aviation and other hard-to-abate sectors, as well as agriculture.

- **Green hydrogen, biomass, and other alternatives to fossil fuel reductants –** Some companies are already exploring using replacements for coal in blast furnaces. For example, Brazil's Gerdau is trying out biomass (wood or charcoal), which is how steel was originally produced. But this relies on local availability, and the sustainability of the biomass production.

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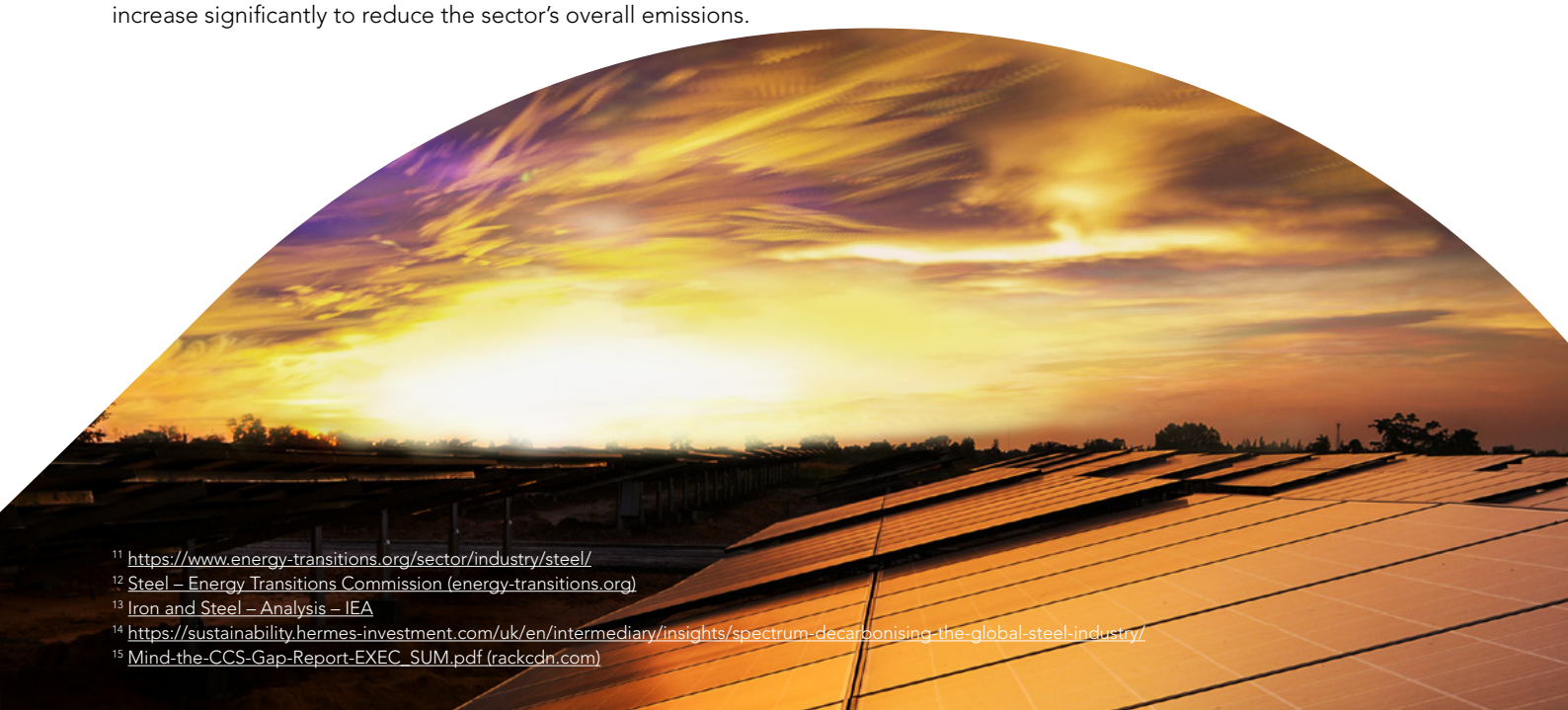


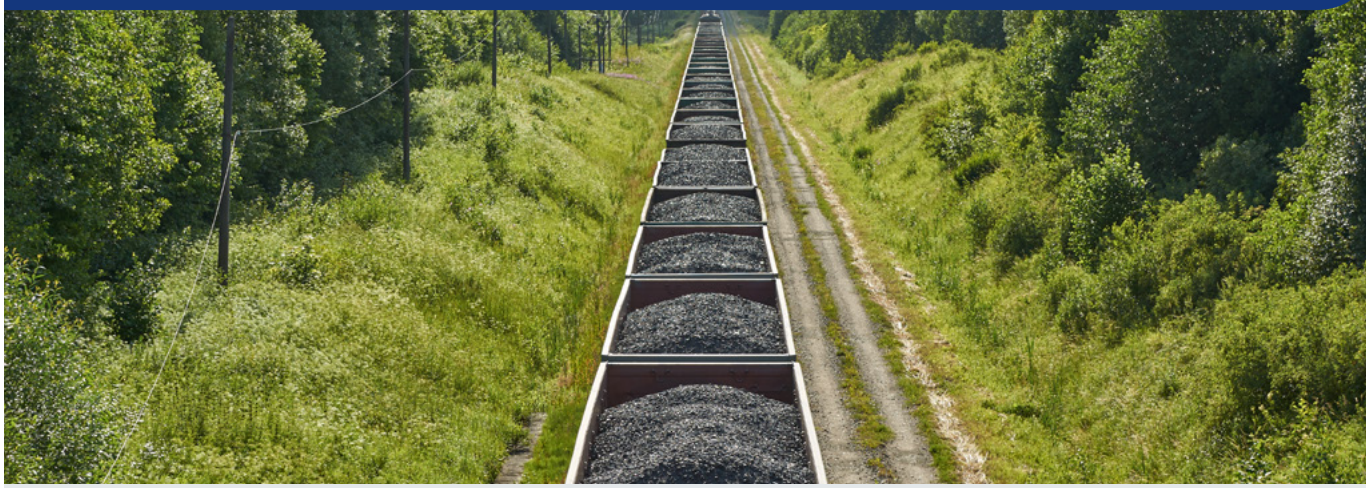
[11] https://www.energy-transitions.org/sector/industry/steel/
[12] Steel – Energy Transitions Commission (energy-transitions.org)
[13] Iron and Steel – Analysis – IEA
[14] https://sustainability.hermes-investment.com/uk/en/intermediary/insights/spectrum-decarbonising-the-global-steel-industry/
[15] Mind-the-CCS-Gap-Report-EXEC_SUM.pdf (rackcdn.com)

Companies such as ArcelorMittal and China Baowu are among those trialling hydrogen as a reducing agent in blast furnaces. However, climate neutral hydrogen is not likely to be available in sufficient quantities in the foreseeable future so natural gas may be used as a bridge. Hydrogen is also being used to produce directly reduced iron (DRI) as a potential feedstock for electric arc furnaces. Industrial hydrogen is currently regarded as "grey" – meaning it is derived from fossil fuels such as natural gas and lignite. Green hydrogen can be electrolysed from water using renewable power, but this is small-scale and highly energy-intensive. Another possible approach is to use electrolysis to reduce iron, as explored by Boston Metal and Siderwin, but to date this has only been achieved in lab conditions, not industrial trials.

Looking ahead

Now that some companies have announced net-zero by 2050 targets, we will be encouraging them to set ambitious short- and medium-term targets, to ensure there is progress in the near term. The significant technological challenges facing the steel industry mean that it must invest and innovate to achieve carbon neutrality, with appropriate support from regulators. We will look at companies' capital allocation decisions, to assess whether they are investing sufficient resources to achieve net zero, as well as collaborating with miners and the buyers of steel. In the coming years we will seek far greater clarity on the actions taken by each entity along the steel value chain, and the resources they have invested in pursuing net-zero solutions.

Reducing carbon emissions along the supply chain



Steel companies have an interest in reducing the emissions from their supply chain as iron ore and coal mining are energy intensive. These raw material inputs for steelmaking are also bulky and heavy to transport, generating more carbon emissions. How can each sector help the other, and how are we engaging with miners on this issue?

Although carbon emissions from the steel industry dwarf those from iron ore mining, the diggers, haulage equipment, pit winding gear and crushing and processing machinery all consume a great deal of power. Once the raw materials have been extracted, they must be transported to the steel plant – either by rail or by ship, with the latter burning dirty bunker fuels.

These emissions could be reduced if miners transitioned their dig, haul and rail fleets from diesel to electric power, hydrogen or fuel cell electric vehicles. The latter is a longer-term ambition, although mining EVs such as huge dumper trucks are being piloted. But mining companies should also work towards cutting their Scope 3 emissions – those arising from the use of their iron ore and coal in the steelmaking process.

To this end, miners are teaming up with their customers to develop and trial new technologies:

- We have engaged with Rio Tinto on climate action both one-to-one and as part of CA100+. Rio Tinto's iron ore customers are now 88% covered by national net-zero goals. We engaged with the company on related value chain actions and aims and welcomed its new Scope 3 Partnership Goals. Although we challenged that the goals remain high level without detail on emissions outcomes, the company stated that it will be able to articulate its goals better and report its progress against them as its partnerships develop.

  Rio Tinto has announced partnerships with steelmakers in China, Japan and Canada such as its $10m investment with Baowu for two ore preparation pilot plants, one using biomass and the other exploring microwave technology. In engagement we investigated the company's exposure to the substantial, and often new, blast furnace fleets in Asia, and the company's related view on carbon capture and storage. The company's partnership funding will also support work on carbon dioxide utilisation and conversion.[16]

[16] https://www.riotinto.com/en/news/releases/2020/Rio-Tinto-advances-climate-partnership-with-China-Baowu-Steel-with-US10-million-investment

- Vale is seeking to reduce its Scope 3 emissions by 15% by 2035 "through active engagement with clients from the steel and metallurgy industries". In 2020 it announced a tie-up with Kobe Steel and Mitsui & Co to supply low greenhouse gas metallics and steelmaking solutions to the steel industry.[17]

  We recently engaged with Vale's head of climate change, as part of CA100+, exploring its action plan to achieve its medium-term carbon emissions reduction targets. Vale aims to be a leader in low carbon mining and expects its peak carbon emissions to come in 2023, declining by 33% by 2030 in comparison with 2017.

  To achieve the 2030 target, Vale does not plan to use offsets for Scopes 1 and 2 emissions, with 80% of its electricity consumption coming from renewable sources already. It has invested in wind farms and other renewable energy projects in order to secure its energy supply.

  We said that we expect to see an ambitious plan to reduce Vale's Scope 3 emissions. Emissions from steelmaking account for 94% of these, and shipping accounts for 3%. The head of climate change said that approximately 20% of the Scope 3 reduction will come from Vale's own initiatives, such as developing new iron ore blends that will result in lower emissions when transformed into steel.

- BHP has agreed a five-year partnership with China Baowu with the intention of investing up to $35m and sharing technical knowledge to help the steel industry decarbonise.[18] BHP has also committed to reducing its Scopes 1 and 2 emissions by at least 30% by 2030 relative to 2020. The target is science-based and aligned with the company's ambition to be carbon-neutral by 2050. The plan to achieve the medium-term target is based on decarbonisation of the electricity supply and the truck fleet.

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We had asked BHP to strengthen the link between climate performance and remuneration, and this has been implemented. Actual reduction in operational emissions, actions to reduce operational emissions on the pathway to net-zero emissions, and actions to address Scope 3 emissions will be KPIs accounting for 10% of the short-term incentive plan.

- We co-lead the Climate Action 100+ collaborative engagement with Anglo American. The company is making substantial progress on technologies to reduce direct and energy use emissions. This includes technologies in the short-term for methane vent air capture, renewables at all sites during the decade, and piloting and rolling out hydrogen fuel cell trucks, as well as other technologies to reduce energy use.

  Regarding its value chains, we welcomed the company undertaking a 1.5-degree disruptive scenario analysis, which we see as key to really understanding the transition risks in the iron ore and metallurgical coal business in particular. We believe that greater disclosure is needed at the company, and the sector more broadly, on how value chain transition risks will be mitigated and capital allocated accordingly. We have also called on the company to set measurable goals for actions that will lead to emissions reduction outcomes in the value chain.

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[17] http://www.vale.com/EN/aboutvale/news/Pages/vale-informs-on-non-binding-heads-of-agreement-with-kobe-steel-and-mitsui-co.aspx
[18] https://www.bhp.com/media-and-insights/news-releases/2020/11/bhp-partners-with-china-baowu-to-address-the-challenges-of-climate-change/

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