



Sector Report **Industry**

October 2026

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Questions and comments are welcome at hello@givinggreen.earth.

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Summary

Why did we decide to focus on industry?

Industry accounts for 31% of global greenhouse gas emissions, yet receives just 2.8% of philanthropic climate mitigation funding and 1.5% of total climate finance. Many industry processes remain technically difficult and expensive to decarbonize because of their high energy intensity, high-temperature heat requirements, and chemical process emissions. The market for near-zero-emission industrial products has struggled to scale, with project pipelines for steel and cement, the heaviest-emitting sectors, meeting less than 3% of demand.

What do we recommend funding to decarbonize industry?

We assessed the scale, feasibility, and funding need of a shortlist of strategies to decarbonize industry. Based on our assessment, we think the following are the most promising:

- **Decarbonizing iron and steel:** The iron and steel subsector accounts for 8% of global emissions. Several decarbonization pathways exist, but green premiums of 12-145% have slowed their commercialization.
- **Decarbonizing cement and concrete:** The cement and concrete subsector accounts for 6% of global emissions, with most emissions coming from cement production. Supplementary cementitious materials can be used to cut emissions, while also being cheaper than conventional cement in many cases. However, for deep decarbonization, green premiums remain high, at 75-150%. We think further innovation is needed to develop cost-effective near-zero pathways.
- **Decarbonizing ammonia:** Ammonia accounts for 1.3% of current global emissions, but its demand is expected to rise substantially because it can also serve as a green energy vector and shipping fuel. Ammonia has an outsized mitigation potential because it is also a near-term demand source for green hydrogen, so it is a key leverage point to scale green hydrogen for use in other sectors, such as steel.
- **Decarbonizing light industry:** Light industries, such as food, beverages, and textiles, emitted about 3 billion tons of CO₂ from burning fuel on site in 2023, or 5.5% of global emissions. Most of their heat needs are low- to medium-temperature and can already be met with mature technologies like electric boilers and industrial heat pumps. High electricity prices relative to natural gas and slow grid connections have held back adoption.
- **Supporting cross-cutting enablers for industrial decarbonization:** Alongside support for specific industrial subsectors, we see additional leverage in the following sub-strategies that advance technologies and build capacity for actors that can decarbonize several industry sectors:
 - **Decarbonizing high-temperature heat**
 - **Building civil society in specific regions with high industrial emissions but limited civil society capacity**

- **Advancing carbon capture, utilization, and storage**
- **Providing technical assistance to micro-, small-, and medium-sized enterprise clusters to pilot and adopt decarbonization measures in India**

Across industry, we prioritize work in East Asia, the EU, India, and the U.S. based on our assessment of innovation potential, expected future emissions, and policy leadership, expanding our purview to additional geographies under our subsector-specific strategies (see [Decarbonizing Iron and Steel](#) and [Decarbonizing Cement and Concrete](#)). More information on prioritized sub-strategies and geographies in these industrial subsectors can be found in their respective strategy reports.

We plan to consider organizations working on our prioritized strategies for our [Top Climate Nonprofits](#) and as potential grantees from the [Giving Green Fund](#).

Why Do We Focus on Industry?

Giving Green's mission is to improve human and ecological wellbeing. We aim to increase funding for high-impact strategies that reduce greenhouse gas (GHG) emissions, thereby mitigating the negative effects of climate change on people and the planet.

Industry Accounts for One Third of Global Emissions

According to the U.N. Industrial Development Organization (UNIDO), industry accounts for 31% of global greenhouse gas (GHG) emissions (~16.4 billion tCO₂e per year).¹

Direct emissions from fuel combustion and process emissions account for 11.4 billion metric tons of CO₂-equivalent (tCO₂e) per year (22% of global emissions), while indirect emissions from energy generation account for the remaining 5 billion tCO₂e per year (9% of global emissions).² Steel, cement, and chemicals are responsible for over 71% of industry's CO₂ emissions.³ According to ClimateWorks Foundation data, the annual mitigation potential of decarbonizing industry will grow over time, from about 976 million tCO₂e in 2030 to 10.5 billion tCO₂e in 2050, to 16.3 billion tCO₂e in 2100.⁴

Heavy industry refers to industries with large capital requirements and energy intensities, including steel, cement, chemicals, and aluminum. Light industry refers to other industries with lower energy demands, such as textiles, food processing, and electronics. **Many heavy industry processes remain technically difficult to decarbonize because of their high energy intensity, high-temperature heat requirements, and chemical process emissions.** For example, near-zero-emission pathways have not been demonstrated at scale for cement and several chemicals.⁵ Several economic factors also make heavy industry especially difficult to decarbonize, including high capital costs, long infrastructure lifetimes, and low profit margins.⁶

¹ "Industry is a major contributor to global greenhouse gas emissions, with direct industrial emissions responsible for almost 22 per cent of the global total, and nearly 31 per cent when factoring in indirect emissions from electricity use."; "Total global emissions (excluding Land Use, Land Use Change, and Forestry, or LULUCF) reached 52,963 Mt, putting industry's direct share at 21.54 per cent." Calculation: 0.31×52.9 billion tCO₂e/year = 16.4 billion tCO₂e/year. [UNIDO, 2024](#)

² "Direct industrial GHG emissions – from combustion and industrial processes – amounted to 11,408.47 Million tons of CO₂ equivalent (Mt CO₂e)."; "Including these indirect emissions, industry's share of global GHG emissions (excluding LULUCF) would be about 31 per cent in 2023." [UNIDO, 2024](#)

³ "the so-called 'hard-to-abate' sectors (like steel, cement, and chemicals) contribute over 71 per cent of CO₂ emissions from industry globally." [UNIDO, 2024](#)

⁴ We define mitigation potential as all potential emissions reductions from a given sector or strategy, not exclusively emissions reductions attributable to philanthropic funding. We exclude impacts of greening the electricity grid from this calculation, since we attribute those mitigation impacts to the [power sector](#). We source the majority of our [mitigation potential estimates](#) from ClimateWorks Foundation.

⁵ "161 landmark commercial-scale, deep-decarbonisation projects are now financed or built worldwide, with a further 800+ in development." [MPP, 2026](#)

⁶ "Steel, cement, and chemicals are the top three emitting industries and are among the most difficult to decarbonize, owing to technical factors like the need for very high heat and process emissions of carbon dioxide, and economic factors including low profit margins, capital intensity, long asset life, and trade exposure." [Brookings, 2021](#); "In addition, these sectors are highly capital-intensive, have long investment and asset replacement cycles, and have a high cost of carbon mitigation." [CPI, 2023](#).

Our view is that the main barrier to decarbonizing heavy industry is that near-zero-emission products still incur significant green premiums. For example, the green premiums for near-zero emissions products are 75-150% for cement and 12-145% for steel.⁷ We therefore prioritize efforts to reduce the green premium, primarily through a) developing and scaling up low-carbon technologies, and b) supporting policies that price in the negative externalities of fossil-based production.

Industry Receives Under 2% of Climate Finance

Industry made up just 2.8% (\$170 million USD) of philanthropic foundation spending for climate mitigation in 2024, far below its share of global emissions.⁸ Funding is growing, having increased by 23% from 2023 to 2024.⁹ Within industry, most philanthropic funding goes to cross-sector interventions and steel (over 30% each), while cement and chemicals draw significantly less funding (under 15% each).

When looking at broader climate finance (private-sector, public-sector, and philanthropy), industry funding is even lower; industry accounted for just 1.5%, or \$29 billion, of the total \$2 trillion in climate finance in 2024.¹⁰

Deep Decarbonization Plant Pipeline

Reflecting the very low funding levels of industry decarbonization, progress in commercializing several key sectors is severely off track to meet decarbonization goals. Mission Possible Partnership (MPP) tracks deep decarbonization projects across seven hard-to-decarbonize sectors.¹¹ It found that most industrial subsectors have fewer than five operating commercial-scale deep decarbonization plants (**Figure 1**). Across all sectors other than aluminum, the pipeline of financed projects would meet 5% or under of the sectors' needs.

⁷ Section: near-zero emissions cement, Figure: Cost premiums for initial projects are significant, but the impact on end products is more manageable; Section: near-zero emissions steel, Figure: Cost premiums for initial projects are significant, but the impact on end products is more manageable; [IEA, 2026](#); Figure 4 [Rhodium Group, 2026](#)

⁸ Calculation: $170/6000 = 2.8\%$ Figure 3. Foundation Funding for Climate Change Mitigation, 2020-2024, USD billions; Figure 4. Known foundation funding to sectors, 2024, USD Millions [Climateworks, 2026](#)

⁹ *ibid.*

¹⁰ Landscape of Climate Finance in 2024 [CPI, 2026](#)

¹¹ [MPP, 2026](#); MPP defines deep decarbonization as a minimum emission reduction of 70-80%. It also includes aviation as part of its tracking, which we do not include as part of our industry strategy. (see Giving Green's strategy to [Reduce Aviation Emissions](#))

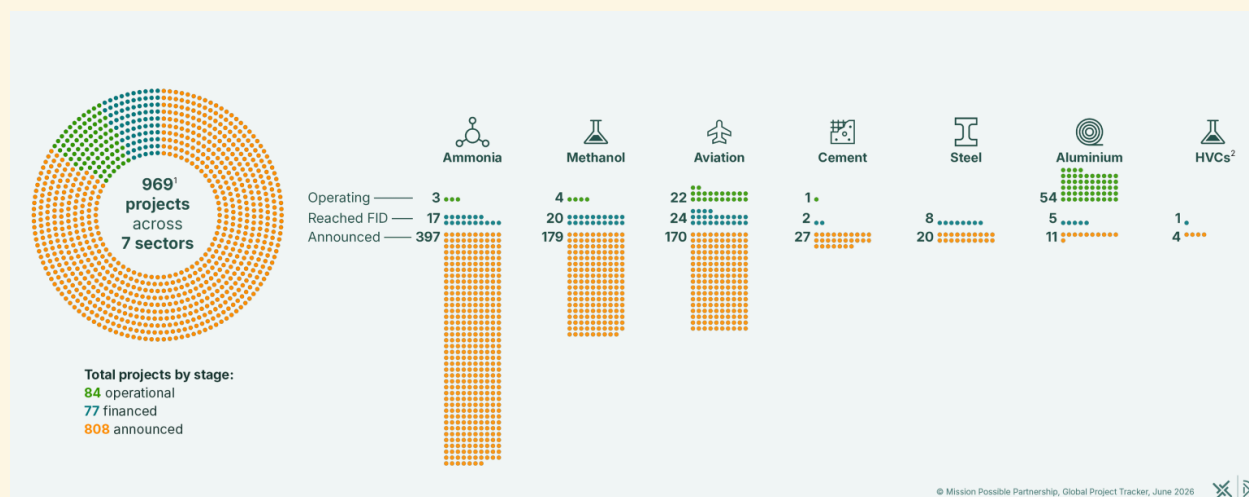
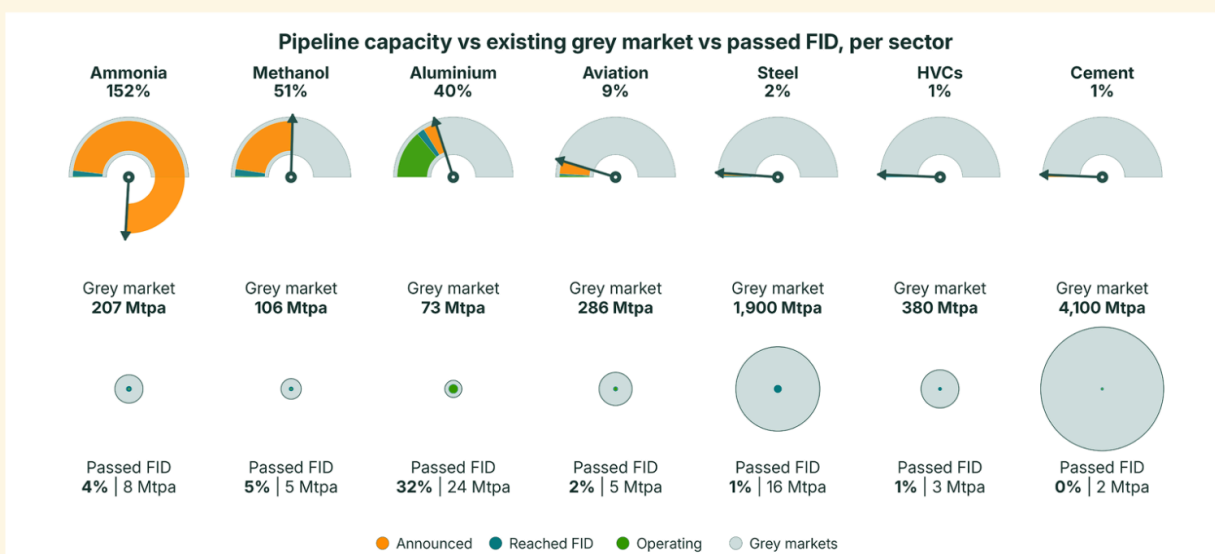


Figure 1: The number and capacity of operational and pipeline projects across seven heavy-emitting sectors.¹² Note: Although the ammonia pipeline could meet current grey demand, future demand is expected to increase because it can also be used as a green energy carrier and shipping fuel.

¹² Figure: 161 landmark commercial-scale, deep-decarbonization projects are now financed or built worldwide, with a further 800+ in development.; Figure: Pipeline capacity vs existing grey market vs passed FID, per sector [MPP, 2026](#)

Our Prioritization Approach

To determine where to focus our analysis within this sector, we considered how philanthropic efforts might be targeted to reduce industry emissions. We evaluated each strategy's scale, feasibility, and funding need in **Table 1**. See [Giving Green's Research Process](#) for more information.

Table 1: Scale, feasibility, and funding need of various strategies to decarbonize industry

Strategy	Scale	Feasibility	Funding Need
Decarbonizing iron and steel	High	Medium	High
Decarbonizing cement and concrete	High	Medium	High
Decarbonizing ammonia	High	High	Medium
Decarbonizing light industry	High	High	Medium
Supporting cross-cutting enablers for industrial decarbonization	High	Medium	High
Sub-strategies rated individually below			
↳ Building civil society in specific regions with high industrial emissions but limited civil society capacity	High	Medium	High
↳ Providing technical assistance to MSME clusters to pilot and adopt decarbonization measures	High	Medium	High
↳ Decarbonizing high-temperature industrial heat	High	Medium	High
↳ Advancing carbon capture, utilization, and storage (CCUS)	High	Medium	High
↳ Exploring the potential of geologic hydrogen	Medium	Low	High
Decarbonizing chemicals (excluding ammonia)	High	Low	Medium
Decarbonizing aluminum	Low	High	Medium

We chose to focus on strategies with two 'high' ratings as our priority strategies for reducing industry emissions and expand on our reasoning for choosing these strategies in the following section. **Based on the above evaluations, we think the most promising philanthropic strategies are: decarbonizing iron and steel, decarbonizing cement and concrete, decarbonizing ammonia, decarbonizing light industry, and supporting cross-cutting enablers for industrial decarbonization.**

Further information on our top prioritized strategies can be found in our [Decarbonizing Iron and Steel](#) and [Decarbonizing Cement and Concrete](#) strategy reports; in the future, we may prioritize a deeper investigation into other prioritized strategies. Our reasoning for deprioritizing aluminum and chemicals (excluding ammonia) can be found on [Giving Green's Research Dashboard](#).

Decarbonizing Iron and Steel

Scale ●●● High

Feasibility ●●● Medium

Funding need ●●● High

Scale: High. Iron and steel is the heaviest-emitting industrial subsector, at ~4.4 billion tCO₂e per year (8% of global emissions).¹³ We do not expect the subsector to decarbonize without intervention, since the International Energy Agency's (IEA's) stated policies scenario forecasts that direct (Scope 1 and 2) iron and steel CO₂ emissions are predicted to be 4% greater in 2050 than in 2025, a result of substantial growth in demand (~33%), counteracted by a considerable reduction in emissions intensity (~21%).¹⁴

MPP's green steel roadmap estimates that the sector can reduce its emissions from 4.3 billion tCO₂e per year to 0.3 billion tCO₂e per year by 2050 through a combination of increasing the use of a) green hydrogen, b) blue hydrogen + carbon capture and storage, c) scrap steel, and d) circularity and material efficiency strategies.¹⁵ We think this roadmap presents an optimistic view of what is theoretically achievable under ideal policy and market conditions, but we do not think the industry is on track to meet this projection. ClimateWorks Foundation data is less optimistic, estimating a sector mitigation potential of 2.5 billion tCO₂ in 2050.¹⁶

Feasibility: Medium. Several pathways to near-zero-emission primary steel exist that use low-carbon hydrogen or electricity in place of coal as the reductant, but they remain in early or pre-commercialization stages.

- **Direct reduced iron (DRI):** DRI is the most mature pathway for green iron ore production. It replaces traditional coal-fired furnaces by using hydrogen as a reducing agent. We prefer fully renewable DRI, which runs on green hydrogen, to transitional natural gas DRI, but see transitional DRI as an important intermediate to prevent the construction of new coal-powered plants.
- **Electrochemical technologies:** Electrochemical technologies, such as molten oxide electrolysis and electrowinning, use electricity to convert iron ore directly

¹³ "In 2023, the global steel industry emitted about 4.43 Gt CO₂e, with CO₂ emissions from fuel/reductant and electricity use making up 82% and methane from coal mining contributing the rest on a GWP20 basis." [Global Efficiency Intelligence, 2025](#)

¹⁴ We did not find a reliable source for how scope 3 emissions and non-CO₂ emissions will change in 2050, a gap also noted by [Rumsa, John & Biswas, 2025](#). "Global demand for steel is projected to increase by more than a third through to 2050."; Figure: Direct CO₂ emissions in the iron and steel sector by scenario, 2019-2050 [IEA, 2020](#)

¹⁵ Exhibit A: Key emissions reduction levers to achieve net zero in the steel industry; Exhibit D: Key levers to reduce primary steel demand [MPP, 2022](#)

¹⁶ We define mitigation potential as all potential emissions reductions from a given sector or strategy, not exclusively emissions reductions attributable to philanthropic funding. We exclude impacts of greening the electricity grid from this calculation, since we attribute those mitigation impacts to the [power sector](#). We source the majority of our [mitigation potential estimates](#) from ClimateWorks Foundation.

into iron. Development is still in its early stages, but these new technologies could potentially outcompete DRI in energy efficiency, hydrogen dependence, and ore selectivity.¹⁷

- **Electric arc furnaces (EAFs):** EAFs are a commercially mature technology for converting iron into steel. EAFs are already widely used in scrap steel and natural gas DRI plants.
- Low-emissions pathways for **secondary steel** have been commercialized, but have limited growth potential because 80-85% of all steel is already recovered and recycled.¹⁸

Momentum on green steel commercialization is slowing, with only two new primary green steel plants announced in 2025, falling from 11 in 2024.¹⁹ Our view is that the main bottleneck to decarbonizing iron and steel is the green premium, mainly driven by high hydrogen costs. Reducing the green premium could be facilitated by supportive policies, learning-by-doing, greater availability of low-carbon hydrogen, and the development of alternative, more efficient pathways (e.g., molten-oxide electrolysis). Modeling shows that if hydrogen costs were reduced from \$5 per kg to \$1 per kg, green steel would be cost-competitive with fossil steel in several key geographies such as China, Japan, Australia, and Brazil.²⁰ We have high certainty that green premiums can be reduced or eliminated in some geographies, but low certainty about the speed and geographic coverage of these reductions.

Funding need: High. Steel is the industrial subsector that receives the most philanthropic funding, drawing roughly one-third of industrial decarbonization funding.²¹ Still, it draws less than 1% of foundation climate philanthropy, far under its 7-8% share of global emissions.²² We are unsure of the level of public and private funding going toward steel decarbonization. However, given that industry decarbonization makes up just 1.5% of total climate finance, we are confident that it also receives a disproportionately low share of non-philanthropic funding.²³

The funding deficit is reflected in green steel commercialization. As of 2026, only 60,000 metric tons per year of primary green steel capacity is operational, a small fraction (.003%) of the global grey steel market of 1.9 billion metric tons per year.²⁴ The current

¹⁷ "As a result, the DRI-EAF pathway requires high-grade iron ore with minimal impurities, commonly referred to as DR-grade ore" [IEEFA, 2026](#); "Fan, the green-steel expert at Columbia, estimates that making green steel using green hydrogen requires at least 30% more energy than MOE — and possibly as much as 50% to 60% more." [Canary Media, 2022](#)

¹⁸ "Around 80-85% of all steel is currently recovered and recycled at the end of its life in use, with little evidence to suggest a substantial increase on this percentage is achievable." [The Climate Group, 2025](#)

¹⁹ "Momentum slowed in 2025, with new project announcements captured in the Leadership Group for Industry Transition (LeadIT) Green Steel Tracker falling from a peak of 15 projects in 2021 to just two in 2025." [SEI, 2026](#)

²⁰ Figure 1 [Global Efficiency Intelligence, 2024](#)

²¹ Confidential data accessed through an industry funder consortium

²² Figure 3. Foundation Funding for Climate Change Mitigation, 2020-2024, USD billions [Climateworks, 2026](#)

²³ Figure: Landscape of Climate Finance in 2024 [CPI, 2026](#)

²⁴ "Progress on the ground remains limited. At present, only around 270 000 tonnes per year of green iron capacity and 60 000 tonnes per year of green steel capacity are operational" [SEI, 2026](#);

pipeline of announced primary commercial-scale deep decarbonization plants would add a further 16 million metric tons per year, but would still meet less than 2% of global steel demand.²⁵

Most philanthropic funding for steel goes to Asia & Oceania (~50%), Europe (~20%), and North America (~20%).²⁶ We think this geographic distribution is roughly appropriate, given the importance of these regions for their manufacturing capacity (Asia and Oceania), policy leadership (Europe), and innovation capacity (all three regions). Still, we think more funding could be allocated to other important regions, such as Brazil and Middle East and North Africa (MENA). We also think there is a funding gap to support promising emerging pathways, especially electrochemical technologies, which draw orders of magnitude less funding than DRI.²⁷

Decarbonizing Cement and Concrete

Scale ●●● High

Feasibility ●●● Medium

Funding need ●●● High

Scale: High. Cement and concrete are the second-largest source of industry emissions at 2.6 billion tCO₂ per year (6% of global emissions).²⁸ We focus on decarbonizing cement production, which makes up 80% of these emissions.²⁹ Future emissions are highly uncertain and sensitive to economic growth and population dynamics, but are projected to lie between 1.4 billion and 2.8 billion tCO₂e in 2050 (central estimate: 2.1 billion tCO₂e).³⁰ Process emissions from the calcination reaction account for most cement emissions (63%), followed by combustion heat (27%) and electricity (10%).³¹

Without further technological innovation, only a predicted 28% of 2050's cement emissions can be mitigated, namely through electricity decarbonization, clinker ratio reduction, and efficiency gains.³² Though decarbonization roadmaps project that cement and concrete emissions can reach net-zero in 2050, we note that they all rely on rapid, large-scale implementation of carbon capture and storage as the primary decarbonization lever (~36% of cumulative abatement).³³ We are skeptical about this assumption, given that a) carbon capture, utilization, and storage (CCUS) is very costly (for instance, CCU has an abatement cost in the range of \$80 to \$280 per tCO₂) and b) there is just one

Grey steel demand: Figure: Pipeline capacity vs existing grey market vs passed FID, per sector [MPP, 2026](#)

²⁵ Figure: Pipeline capacity vs existing grey market vs passed FID, per sector [MPP, 2026](#) Note: MPP defines deep decarbonisation as a minimum emission reduction of 70–80%

²⁶ Confidential data accessed through an industry funder consortium

²⁷ Ibid., Electrochemical pathways were reported as 0% of clean steel investment, implying that this investment is essentially a rounding error.

²⁸ "The concrete and cement industry emits roughly 2.6 gigatonnes (Gt) of CO₂ per year" [Mission Possible Partnership, 2023](#); "Today, cement is responsible for 6% of global GHG emissions" [Rhodium Group, 2024](#)

²⁹ Figure: Components of concrete by volume and associated emissions, global average [WRI, 2024](#)

³⁰ Figure 6 [Rhodium Group, 2024](#)

³¹ Figure 8 [Rhodium Group, 2024](#)

³² Figure 9 [Rhodium Group, 2024](#)

³³ Figure: Actions to a Net Zero Future, [Global Cement and Concrete Association, 2022](#)

commercial-scale plant actively using CCUS (as of 2026), and meaningful deployment lags net-zero projections.³⁴ As such, we prioritize innovation for alternative pathways to reduce cement emissions.

Feasibility: Medium. We see several potential technological pathways to decarbonize cement, though note that there are no commercialized and cost-competitive deep-decarbonization pathways:

- **Supplementary cementitious materials (SCMs)** can be mixed into cement to reduce its emissions. We see SCMs such as calcined clay as an important near-term win, since they can reduce cement emissions by up to 40%, are compatible with 75% of existing cement plants, and save 15-25% of production costs, while performing as well or better than ordinary Portland cement.³⁵
- **Electrochemical processes** are an alternative to cement kilns. These processes use electrolyzers that can operate at ambient temperature—reducing heat emissions—and can use feedstocks that do not contain carbon, thereby eliminating process emissions.
- **Electric kilns** replace fossil-fuel combustion in cement kilns with electricity. Electrifying kilns reduces direct emissions and makes CO₂ easier to capture, though it does not, in itself, reduce process emissions.
- **Carbon capture, utilization, and storage (CCUS)** is the only deep-decarbonization pathway with an operational commercial-scale plant. However, it has a high abatement cost estimated at \$160 per tCO₂.³⁶ We therefore see it as a backstop option for decarbonizing cement, should other options fail to commercialize.

Momentum for near-zero-emission plant announcements stalled in 2025, with just 12 projects announced globally and only three at commercial scale, down from a peak of 15 in 2024.³⁷ Our view is that the main bottleneck to decarbonizing cement and concrete is the lack of proven, cost-effective deep-decarbonization technologies. Green premiums for near-zero-emission cement remain significant at 75-150% across regions, though their impact is minimal at the final product level, adding just 1-2% to the cost of a house and

³⁴ "The total cost across all sources ranges from around €70-250 per tonne of CO₂(low estimate) based on using currently planned storage sites alone [for European projects]." [CATE, 2023](#); "CCUS is the most expensive lever among all solutions, with an abatement cost of \$160 per ton of CO₂," [RMI, 2023](#); "The world's first commercial project is an important breakthrough, but scaling the impact of this technology could be limited without significant support and infrastructure. When the projects currently planned become operational, the total volume of captured emissions would represent less than 2% of the sector's overall footprint by 2035, highlighting a critical gap between ambition and impact." [SEI, 2026](#)

³⁵ "This systematic review highlights limestone calcined clay cement (LC3) as a low-carbon alternative to ordinary Portland cement (OPC), reducing carbon dioxide emissions by 30 % to 40 % while maintaining similar or superior performance."; "with production costs estimated to decrease by 15-25 % when employing a 50 % clinker replacement with calcined clay and limestone, make LC3 a competitive choice" [Ghazy et al., 2025](#)

³⁶ "CCUS is the most expensive lever among all solutions, with an abatement cost of \$160 per ton of CO₂." [RMI, 2023](#)

³⁷ "After years of steady growth, new cement carbon capture project announcements slowed sharply in 2025, with just 12 projects announced globally. Only three of these were commercial scale, down from a peak of 15 in 2024." [SEI, 2026](#)

2-5% to a road.³⁸ We have low certainty that the green premium for cement will decrease significantly, since no pathway is yet both proven and affordable, and the pathway currently projected to deliver the most abatement (CCUS) is also the most expensive.

Funding need: High. Decarbonizing cement and concrete drew ~\$8 million of philanthropic funding in 2024, which is under 5% of funding for industrial decarbonization and under 1% of total foundation funding for climate mitigation, far lower than its 6% of global emissions.³⁹ We are unsure of the level of public and private funding going toward cement decarbonization. However, given that industry decarbonization makes up just 1.5% of total climate finance, we are confident that it also receives a disproportionately low share of non-philanthropic funding.⁴⁰

The funding deficit is reflected in the commercialization of green cement. As of 2026, only 500,000 metric tons per year of primary green cement capacity is operational, a tiny fraction of the global grey cement market of 4.1 billion metric tons per year.⁴¹ The current pipeline of announced primary commercial-scale deep decarbonization plants would add a further 3 million metric tons per year, but would still meet less than 1% of global cement demand.⁴²

Within cement and concrete, philanthropic funding is spread globally, distributed across Asia and Oceania (~40%), Global (~27%), North America (~20%), and Europe (~13%).⁴³ We think this geographic distribution targets some of the most important regions for cement and concrete decarbonization, but that more support is needed for Africa and other low-income regions, where cement demand is expected to rise sharply.⁴⁴

Decarbonizing Ammonia

Scale ●●● High

Feasibility ●●● High

Funding need ●●● Medium

Scale: High. Ammonia is responsible for 450 million to 620 million tCO₂e per year (1.3% of global emissions).⁴⁵ The pipeline of announced green ammonia plants is strong, covering

³⁸ Figure: Cost premiums for initial projects are significant, but the impact on end products is more manageable [IEA, 2026](#)

³⁹ Confidential data accessed through an industry funder consortium; Figure 3. Foundation Funding for Climate Change Mitigation, 2020-2024, USD billions [Climateworks, 2026](#)

⁴⁰ Figure: Landscape of Climate Finance in 2024 [CPI, 2026](#)

⁴¹ "The Brevik plant has annual production capacity of just over one million tons of cement, around half of which will be produced under the evoZero brand." [Reuters, 2025](#); Grey steel demand: Figure: Pipeline capacity vs existing grey market vs passed FID, per sector [MPP, 2026](#)

⁴² Figure: Pipeline capacity vs existing grey market vs passed FID, per sector [MPP, 2026](#) Note: MPP defines deep decarbonization as a minimum emission reduction of 70-80%.

⁴³ Confidential data accessed through an industry funder consortium

⁴⁴ Figure 4: Historic and projected global cement production; [Rhodium Group, 2024](#)

⁴⁵ "Direct emissions from ammonia production currently amount to 450 Mt CO₂ – a footprint equivalent to the total energy system emissions of South Africa. Indirect CO₂ emissions are around 170 Mt CO₂ per year"; "Ammonia production accounts for around 2% of total final energy consumption and 1.3% of CO₂ emissions from the energy system." [IEA, 2021](#)

152% of current grey ammonia demand.⁴⁶ However, we do not think rapid commercialization is a given, since only 4% of the announced capacity has actually reached final investment decision (FID). Green ammonia also has applications beyond the current grey ammonia market as a shipping fuel and energy carrier, leading expected demand to grow by ~37% by 2050.⁴⁷

We think the scale of commercializing low-carbon ammonia exceeds potential direct emissions reductions, since it is a key demand-side lever to scale low-carbon hydrogen and its derivatives. We therefore expect technology spillover benefits for other parts of the hydrogen economy.

Feasibility: High. Green ammonia production is an established technology, but rollout is held back by green premiums. Green ammonia costs \$600 to \$650 per metric ton in locations with the best renewable energy resources and up to \$1,400 in other contexts, whereas fossil ammonia costs \$110 per \$340 per metric ton to produce.⁴⁸ However, the selling price of fossil ammonia is highly volatile due to location-specific differences and gas prices. For example, Africa and Europe experienced prices of \$680 per metric ton in 2026.⁴⁹

Geopolitical shocks, such as the war in Iran, have also led to local fertilizer production, including green ammonia production, rising in prominence as a national security priority.⁵⁰ If green ammonia is not competitive, countries like China and India could instead prioritize coal-based ammonia.⁵¹ Furthermore, the International Maritime Organization's proposed Net Zero Framework, which incentivizes the use of low-carbon shipping fuels like green ammonia, has increased demand certainty.⁵²

Funding Need: Medium. We estimate that chemical decarbonization receives <0.5% of climate philanthropy.⁵³ Ammonia is among the chemicals we think draw the most funding. Still, based on our conversations with nonprofits and funders, we think nonprofits can effectively absorb more funding, especially in countries that have historically received less philanthropic funding but favor green ammonia production, such as China and India.

Green ammonia commercialization is more advanced than some other industrial subsectors, with a strong project pipeline. However, critically, only 0.5 million metric tons

⁴⁶ Figure: Fuels and chemicals continue to lead the transition [MPP, 2026](#)

⁴⁷ Calculation $(253-185)/185 = 37\%$ from Figure: Change in ammonia demand between scenarios, 2020-2050 [IEA, 2021](#)

⁴⁸ "This year's price benchmarks for green ammonia in India and China of \$600-\$650 per ton" [Energy Intelligence, 2025](#); "The cost of renewable ammonia is currently an estimated USD 720 per tonne at locations with the best solar and wind resources"; Table 14: Cost estimate for renewable ammonia production; "The cost of producing fossil-based ammonia is typically in the range of USD 110-340 per tonne, depending on the fossil fuel price." [IRENA, 2022](#)

⁴⁹ "The ammonia prices in Africa reached 0.68 USD/KG in March 2026"; "The ammonia prices in Europe reached 0.68 USD/KG in March 2026." [iMARC Group, n.d.](#) [accessed August 2026]

⁵⁰ "The war in Iran has exposed a major vulnerability in global food production: half the world's crops depend on nitrogen fertilizer from natural gas and a third of fertilizer trade passes through a single chokepoint." [WEE, 2026](#)

⁵¹ Section: A divided response across the green ambition and commitments to coal [Climate Catalyst, 2026](#)

⁵² "China, already the global leader in coal-to-chemicals, will double down on that route to insulate itself from maritime chokepoint risks." [Wood Mackenzie, 2026](#)

⁵³ Confidential funding data from an industry funder consortium

is currently in production.⁵⁴ We think continued philanthropic support will be needed in the near term to secure the construction of this wave of ammonia plants, but green ammonia could become cost-competitive in the future, at which point it may no longer require support.

Decarbonizing Light Industry

Scale ●●● High

Feasibility ●●● High

Funding need ●●● Medium

Scale: High. Light industry, such as food and drink or textiles, produces smaller, mostly consumer-oriented goods and uses less capital, energy, and raw materials than heavy industry. Electricity supplies just over 40% of light industry's energy, mostly to run motors. Natural gas and other fuels supply the rest, primarily for heat processes such as sterilization, cooking, and drying. Most of these heat processes operate at low temperatures (below 200°C), and the rest at medium temperatures (up to 500°C).⁵⁵

Three pathways could decrease light industry's emissions: electrifying low- and medium-heat processes, improving energy efficiency, and decarbonizing the grid. We focus on the first two pathways because other strategies cover grid decarbonization.

According to the International Energy Agency, industries that rely mainly on low-temperature steam and heat emitted nearly 3 billion tons of CO₂ from burning fuel on site in 2023, about half of all direct energy-related emissions from industry.⁵⁶ Emissions from the electricity these industries buy were nearly twice as large. Our conservative mitigation potential estimates, which attribute electricity-related mitigation potential to the power sector, suggest that decarbonizing light industry could avoid about 2.7 billion tons of tCO₂e per year by 2050 and about 6.0 billion tons per year by 2100, compared with a business-as-usual scenario. We treat near-term mitigation potential as roughly zero and see the 2050 figure as a better indicator of the strategy's scale.

Feasibility: High. Improving energy efficiency and electrifying low- and medium-temperature heat in light industry are technically feasible today. We think the main obstacles are economic and institutional, not technical. Electricity often costs more than natural gas, grid connections can be slow, and light industry is spread across many

⁵⁴ Page 10, Annual production capacity by sector, Mtpa [MPP, 2025](#)

⁵⁵ "In less energy-intensive industries (such as food and drink, and textiles), a larger share of the demand can be addressed in the short term with proven, economically feasible and readily available efficient technologies and methods. Electricity supplies over 40% of the demand in these industries and is primarily used to power motor-driven systems. The remainder is supplied by natural gas and other fuels for heat production. Most of the required heat falls within low-temperature ranges (up to 200°C), which could potentially be efficiently electrified with existing technologies, or medium-temperature ranges (up to 500°C)." [IEA, 2025](#)

⁵⁶ "Other manufacturing sectors, including food, beverages, tobacco, textile and leather, rely on low-temperature heat and steam. In 2023, these sectors accounted for 3 Gt of direct energy-related CO₂ emissions, which is an 8% decline since 2013. China contributed around 30% of this total. However, indirect energy-related CO₂ emissions arising from purchased electricity and heat in these sectors were nearly double direct CO₂ emissions, and grew by 18% since 2013, which highlights the significant upstream carbon footprint embedded in the energy supply of these sectors." [IEA, 2025](#)

micro-, small-, and medium-sized enterprises (MSMEs) that often lack the capital and in-house expertise to invest in improvements. Well-designed policies could likely address these barriers and speed up progress.

We think efficiency is the most immediately feasible step. Proven measures such as improved steam systems and better insulation could reduce light industry's fuel use by around 25% and electricity use by around 30%. They also make electrification cheaper later, because plants with lower heat demand need smaller electric equipment and less grid power.⁵⁷ Our impression is that the dispersed, MSME-heavy structure of light industry is a key reason efficiency improvements have lagged.

Mature technologies, such as electric boilers and industrial heat pumps, can electrify heat processes that run up to 300°C, so the challenge is mainly cost and grid access.⁵⁸ Alongside energy efficiency measures, policies such as clean heat premiums can help close the cost gap by making electrified heat more competitive with gas.

Funding need: Medium. We do not know how much philanthropic funding goes to light industry, because funding data is typically reported for industry as a whole or for heavy-industry subsectors such as iron and steel. Industry as a whole is underfunded. Foundations gave about \$170 million for industrial decarbonization in 2024, or 2.8% of all foundation funding for climate, even though industry accounts for about 30% of global greenhouse gas emissions. We expect light industry to receive only a small share of that total, because philanthropic work in industry has focused on heavy materials, which account for most of industry's emissions.

That said, we think light industry's funding need is likely lower than that of heavy industry. Its main solutions rely on mature technologies and benefit from broader philanthropic funding for clean electricity. The bigger gap may be geographic. Most philanthropic funding for industry goes to global efforts, followed by the U.S. and Europe, with

⁵⁷ "Improving the overall energy efficiency of an industrial site is a foundational step before designing and installing electrified replacement heating systems. Reducing heat demand at source lowers both the scale and complexity of subsequent electrification investments, improving economic viability and easing system integration. Efficiency improvements deliver multiple, reinforcing benefits, including reduced energy losses and associated emissions, lower process heat loads and temperature requirements, and avoidance of oversizing new electric heat equipment. They also reduce electricity demand and peak loads, which can significantly lower operational costs and, in many cases, reduce grid connection capacity requirements and associated connection delays. Well-established technologies and operational practices offer substantial scope for efficiency gains. Across the light industry, energy efficiency measures could reduce fuel use by around 25% and electricity use by around 30%, although the achievable savings vary widely depending on site-specific factors." [IEA, 2026](#)

⁵⁸ Electric boilers and heat pumps: "The greatest electrification uptake is expected in industries that require low-temperature heat and steam (below 300°C), such as food and beverages, paper, textiles and chemicals. In these subsectors, mature technologies such as electric boilers and industrial heat pumps can be readily deployed without major process disruptions and paired with thermal energy storage systems to buffer fluctuations in electricity supply from directly connected variable renewables." [IEA, 2025](#)
Barriers and policies: "For mature technologies such as heat pumps, electro-thermal storage, electric boilers, and resistance heating, the main barrier is often not technical feasibility but operating costs. These technologies can already replace large shares of fossil fuel demand for low- and medium- temperature heat. Governments should use time-limited contracts for difference, operating grants, or clean heat premiums to bridge the price gap for eligible industrial processes. That reduces exposure to gas price spikes while giving firms a viable business case to switch at speed and scale." [Etter-Wenzel & Rosenow, 2026](#)

comparatively little directed specifically at China and India, which are expected to account for more than half of the growth in industrial heat through 2030.⁵⁹

Supporting Cross-Cutting Enablers for Industrial Decarbonization

Sector-specific strategies leave two kinds of gaps: regions and firms without the capacity to act or act rapidly on decarbonization opportunities, and technologies that serve many industries but belong to none. The sub-strategies below address both, broadening the range of solutions available and the set of actors positioned to deploy them.

Building Civil Society in Specific Regions With High Industrial Emissions but Limited Civil Society Capacity

Scale ●●● High

Feasibility ●●● Medium

Funding need ●●● High

Scale: High. Analyzing the top 10 cumulative industry emitters from 2026 to 2050 (China, India, United States, European Union, Saudi Arabia, Russia, Brazil, Indonesia, Mexico, and Turkey), we see a large gap in climate nonprofit activity between the U.S. and EU versus the remaining eight countries (referred to as 'our priority countries' for industry decarbonization).⁶⁰ We think it is important to build civil society—such as domestic NGOs, research institutes, and professional networks—in such countries. We think philanthropy can strengthen the capacity of existing CSOs that are currently underfunded, while also incubating and supporting newer organizations.

Industrial emissions in our priority countries are projected to be 8 billion tCO₂e per year under business-as-usual, or 67% of cumulative global industrial emissions through 2050.⁶¹ Though we are unsure of the exact share of these emissions that can realistically be addressed, we would rate this strategy as 'high-scale' even if it were as low as 25%. Our priority countries account for 67% of cumulative global industrial emissions through 2050, yet their civil society ecosystems appear relatively underdeveloped.⁶² Building out civil society capacity in these countries would enable them to provide more high-quality education, advocacy, and technical assistance to corporations and governments on decarbonization pathways. This strategy carries particularly high leverage for rapidly industrializing countries by avoiding carbon lock-in.

Feasibility: Medium. The feasibility of this strategy varies across countries. We analyzed pathways to decarbonize industry in India, identifying several promising philanthropic

⁵⁹ Europe and U.S.: See Figure 10. Known foundation funding by geographies and sectors, 2024 USD Millions. [ClimateWorks Foundation, 2026](#)

China and India: "Industrial heat demand is projected to expand 14% (+16 EJ) globally during 2025-2030, with China and India together accounting for more than half of the growth." [IEA, 2025](#)

⁶⁰ Giving Green's [analysis](#) of projected emissions data from [World Emissions Clock](#)

⁶¹ *ibid.*

⁶² *ibid.*

sub-strategies and funding opportunities, summarized in the 'Geographic Prioritization' section. We have also scoped work in China, Brazil, and the Middle East, and think they could also present highly impactful funding opportunities. We think feasibility in several of our priority countries may be limited, since some of these countries have strict legal restrictions on where nonprofit funding can come from, may lack the resources to decarbonize fully, or may not be amenable to civil society advocacy.

We have formally assessed the work of several nonprofits in [India](#) and [Indonesia](#) and found it highly impactful (see, for example, Giving Green's [list of grantees](#) in India and Indonesia).

Funding Need: High. Despite their large share of emissions, all of our priority countries receive a disproportionately small share of climate-related foundation funding. The countries that absorb the highest share of funding are India (4%), China (3%), Brazil (3%), and Indonesia (1%).⁶³ While philanthropic climate funding for most of these countries is growing, such funding for China notably dropped 30% from 2023 to 2024.⁶⁴

According to CPI's analysis of total public-sector, private-sector, and philanthropic climate funding, 'advanced economies' receive 41% of climate funding, China receives 37%, and the rest of the world receives just 22%.⁶⁵ Based on this data, we also think there is a public- and private-sector funding gap across all of our priority countries other than China.

Providing Technical Assistance to MSME Clusters to Pilot and Adopt Decarbonization Measures

Scale ●●● High

Feasibility ●●● Medium

Funding need ●●● High

Note: This sub-strategy is currently specific to India, but may be expanded to China and Southeast Asia in the future following further assessment.

Scale: High. Micro-, small- and medium-sized enterprises (MSMEs) contribute to 20-25% of India's industrial energy consumption and 45% of India's manufacturing output.⁶⁶ Sectors such as iron and steel, textiles, and paper processing are highly fragmented, with MSMEs dominating anywhere between 35-80% of the production volumes depending on

⁶³ Figure 8. Share of foundation funding to a single geography or country, 2024, USD millions [ClimateWorks, 2026](#)

⁶⁴ Figure 9. Funding growth and decline in geographies, 2023 to 2024, USD millions [ClimateWorks, 2026](#)

⁶⁵ Figure: Landscape of Climate Finance in 2024 [CPI, n.d.](#) [accessed 2026]

⁶⁶ "MSMEs contribute 45% to manufacturing output, and consume over 25% of energy use in the industrial sector[...]Figure 3 illustrates the sectoral energy consumption among MSMEs with an emphasis on the Specific Energy Consumption (SEC) for each of the five sub-sectors: paper, textiles, steel rerolling, foundry and forging. These subsectors alone account for more than 60% of the total MSME emissions." [NITI Aayog, 2026](#)

the sector.⁶⁷ Within these sectors, MSMEs have historically lagged in adopting decarbonization measures and are much more carbon-intensive than larger enterprises. Given the significant share of MSMEs in India's industrial sector and their high emissions intensity, we think decarbonizing MSMEs in the industrial sector has significant mitigation potential, as the sector is poised for growth and has historically made limited progress in this segment.

Feasibility: Medium. We think cluster-level pilots paired with financing and capacity-building support are a feasible entry point for MSME decarbonization. The core barriers to MSME decarbonization include high upfront costs, limited in-house technical capacity, low awareness of relatively new technologies, limited evidence on process impacts, and constrained access to formal credit, with only 19% of MSME credit demand met through formal sources.⁶⁸

We think these barriers are addressable through sustained cluster engagement. Since MSMEs in a cluster share comparable processes and economics, a credible demonstration in one unit generates peer evidence that spreads to similar units nearby. Such an approach has already demonstrated tractability in Odisha and Uttar Pradesh, where engagement with industrial clusters has helped drive adoption of renewable energy as well as electric boilers within MSMEs.⁶⁹ Given that heat electrification and efficiency measures are already commercially available and often cost-competitive with conventional energy sources, MSME engagements become even more tractable. Despite the tractability, we think cluster-level engagement is likely to be time-consuming and require significant on-the-ground support, necessitating strong local partners to effectively execute such work.

Funding need: High. Industrial decarbonization in India is broadly underfunded, with only 3% in total foundation philanthropic funding for industry directed to India.⁷⁰ While a granular breakdown of this funding within the industrial decarbonization space is unavailable, our conversations with experts and other funders suggest that support for MSME decarbonization is highly neglected.

Decarbonizing High-Temperature Industrial Heat

Scale ●●● High

Feasibility ●●● Medium

⁶⁷ "MSMEs dominate the sector, accounting for nearly 80% of textile capacity, especially in handlooms, powerlooms, and garment manufacturing." [Gol, Accessed July 2026](#); MSMEs contributed to 33 MT out of 91 MT of finished steel production based on "Figure 2: Classification of Steel Production in India". [ORF, 2025](#)

⁶⁸ "Only 19% of MSME credit demand was met formally by FY21, leaving an estimated ₹80 lakh crore unmet." [Press Bureau of India, 2025](#); "The MSME ecosystem, however, faces several structural constraints, including limited awareness of green technologies, restricted access to finance, fragmented value chains, ageing capital stock, and inadequate technical capacity. These challenges have slowed the adoption of climate smart solutions and call for a coordinated and structured policy response." [NITI Aayog, 2026](#)

⁶⁹ Tractability of industrial cluster pilots based on current activities pursued by our grantee iFOREST in Odisha and Uttar Pradesh.

⁷⁰ Funding share estimated based on ClimateWorks data in "Figure 3. Known Foundation Support To Regions, Sectors, And Strategies, 2019 To 2023, USD Millions" and "Table 1. Known Foundation Funding By Regions, Sectors, And Strategies, Annual Average, 2019 To 2023, USD Millions". [ClimateWorks, 2024](#)

Funding need ●●● High

Scale: High. Industrial heat emissions account for about 10 billion tons of CO₂e per year (19% of global emissions) and, under current policies, are expected to grow to 12.8 billion tons of CO₂e per year by 2050, driven by industrial expansion.⁷¹ About 60% of industrial heat emissions (roughly 6 billion tons of CO₂e) are from high-temperature processes above 400°C, such as ironmaking and steelmaking.⁷²

Overall industrial heat demand is expected to rise by 14% between 2025 and 2030, with China and India accounting for more than half of that growth.⁷³ Renewables met about 12% of industrial heat demand in 2025, and although that share is expected to increase, fossil fuel use is still expected to grow and to meet the large majority of demand.⁷⁴ We believe deployment of clean heat in sectors that rely on high-temperature heat has been slow. Our conservative mitigation potential estimates, which attribute electricity-related mitigation potential to the power sector, suggest that this strategy could mitigate about 3 billion tons of CO₂e per year by midcentury relative to a business-as-usual scenario.

Feasibility: Medium. Electrifying most high-temperature industrial heat is technically feasible, meaning the needed technologies already exist or are in development, setting aside whether they are cost-competitive.⁷⁵ Most high-temperature heat applications can be decarbonized with emerging technologies, but technology readiness levels (TRLs) vary substantially across applications. For example, as of 2025, electric arc furnaces for high-temperature heating have a TRL of 6 (out of 9), meaning a full-scale prototype has been operated in real conditions.⁷⁶ Although electric arc furnaces are widely used in secondary steel production, adapting them to other industrial processes remains at the prototype stage. In comparison, electrolyzer-based processes that decarbonize limestone before it enters the cement kiln have a TRL of 5, meaning that a large prototype has been tested, but not in real conditions.⁷⁷ Neither technology is ready for sale or licensing.

⁷¹ Calculation: 10/53.2 = 18.8% of global emissions.

10 GT Emissions at Stake 2025, 12.8 GT Emissions at Stake 2050 [Climate Tech Map, n.d.](#)
"According to the latest data, global GHG emissions in 2024 reached 53.2 Gt CO₂eq." [Emissions Database for Global Atmospheric Research, 2025](#)

⁷² We assume that the remaining 60% is high-temperature heat. "Industrial heat below 400°C is called low- to medium temperature heat, and is responsible for about 40% of total industrial heat emissions." [Systemiq, 2024](#)

⁷³ "Industrial heat demand is projected to expand 14% (+16 EJ) globally during 2025-2030, with China and India together accounting for more than half of the growth." [IEA, 2025](#)

⁷⁴ "While the share of renewables in industrial heat demand has remained roughly stable at 12% since 2018, new policies and industry initiatives are expected to raise this portion to 16% by 2030. However, fossil fuel use is also expected to grow and will continue to meet the significant majority of industry sector demand." [IEA, 2025](#)

⁷⁵ "Conversely, electrifying high-temperature industrial processes (above 300°C, and often exceeding 1000°C) in sectors such as iron and steelmaking will remain challenging." [IEA, 2025](#)

⁷⁶ See "Electric arc and plasma arc furnaces (high temperature heating)." "6 Prototype operated in real conditions... Not technically ready for sale or licensing... Electric arc furnaces are already commonly used in secondary steel production, while electric glass melting furnaces are used in glass production." [IEA, 2026](#)

⁷⁷ See "Electrolyzer-based process for decarbonating calcium carbonate prior to clinker production in the kiln." "5 Large prototype tested... Not technically ready for sale or licensing..." [IEA, 2026](#)

This need to commercialize emerging technologies is why we think decarbonizing high-temperature heat is less feasible than decarbonizing low- and medium-temperature heat, which can already be electrified with commercially available technologies such as electric boilers and heat pumps.⁷⁸ Moreover, electrification of high-temperature heat will require major process redesigns, high upfront investment, and stronger policy support to create demand for low-emissions products.⁷⁹ Governments and funders need to develop demonstration programs for high-temperature electrification and align them with commitments to build out clean generation from solar and wind.⁸⁰ More broadly, barriers to electrifying industrial heat include the high cost of electricity relative to natural gas and long grid connection times.⁸¹

Funding Need: High. We do not know how much philanthropic funding for industrial decarbonization goes to clean heat, because funding data is typically reported by sector (e.g., industry) or subsector (e.g., iron and steel) rather than by cross-sector applications such as heat. Annual foundation funding for industry was about \$170 million USD in 2024, or 2.8% of all foundation funding for climate, compared to about 30% of global emissions today. As such, philanthropic funding for industrial decarbonization is low relative to industry's share of global emissions, and we expect clean heat to be similarly neglected. We expect the funding gap to be larger for high-temperature heat than for low- and medium-temperature heat, which benefits more from broad clean electricity funding.

We think philanthropic funding can help by steering public and private investment toward the most cost-effective decarbonization pathways, supporting the rollout of existing technology, reducing risk for early movers, and building support for policies that incentivize clean heat.

Advancing Carbon Capture, Utilization, and Storage

Scale ●●● High

Feasibility ●●● Medium

Funding need ●●● High

⁷⁸ "The greatest electrification uptake is expected in industries that require low-temperature heat and steam (below 300°C), such as food and beverages, paper, textiles and chemicals. In these subsectors, mature technologies such as electric boilers and industrial heat pumps can be readily deployed without major process disruptions and paired with thermal energy storage systems to buffer fluctuations in electricity supply from directly connected variable renewables." [IEA, 2025](#)

⁷⁹ "While technically feasible, it will require major process redesigns, high upfront costs, the adoption of emerging technologies such as plasma heating, and stronger policy support to drive demand for these low-emissions products." [IEA, 2025](#)

⁸⁰ "Finally, policy needs to scale innovation for hard-to-electrify processes and coordinate grid and industry strategies, so electrification delivers genuine emissions reductions rather than shifting them upstream. Demonstration programmes for high-temperature electrification — including electric kilns and furnaces, plasma-based systems, microwave heating, and induction technologies — alongside integrated plants and enabling infrastructure, should be paired with commitments to clean generation build-out from solar and wind." [Etter-Wenzel and Rosenow, 2026](#)

⁸¹ "Despite technological readiness, practical hurdles impair the attainment of full electrification, especially grid connection issues and high electricity prices in many regions, which often make electrification less competitive with natural gas." [IEA, 2025](#)

Scale: High. In theory, a large share of emissions in almost every heavy industry subsector could be addressed with carbon capture, utilization, and storage (CCUS), but our view is that it is most applicable to persistent process emissions that other pathways, such as electrification, cannot reach. Under its Sustainable Development Scenario, the IEA predicts that CCUS will capture 2.04 billion tCO₂ per year from steel, cement, and chemicals by 2050, and that ~93% of captured emissions will be stored, implying total mitigation of ~1.9 billion tCO₂ in 2050.⁸² We note low certainty in this figure, since real-world capture rates have historically fallen short of design targets, especially for heavy industry projects.⁸³ In our broader industry sector strategy, we think developing CCUS provides value as a hedge against the failure of other industry decarbonization technologies to scale.

Feasibility: Medium. Although CCUS has been reasonably criticized for enabling continued use of fossil fuels, we think it can feasibly reduce persistent emissions in certain contexts, most importantly for process emissions with no viable substitute, such as cement kilns and certain chemical processes. CCUS can also be a more palatable pathway to carbon management than pure decarbonization in fossil-fuel-dependent economies and businesses, as evidenced by India and Gulf States investing heavily in CCUS-based ammonia and hydrogen projects.⁸⁴

There is mixed evidence on performance. The Institute for Energy Economics and Financial Analysis (IEEFA)'s review of real-world projects found that no heavy industry project had a capture rate above 30%, but a separate technical review of 13 major projects found that several have "consistently met high levels of technical performance," and that at least one project improved markedly within its own operating life from 72% to 95% in two years.⁸⁵

Funding Need: High. We have observed several climate funders and nonprofits exclude CCUS from their portfolios due to concerns that it prolongs fossil fuel use, leaving the space relatively neglected. We think there is an important role for philanthropy in ensuring CCUS is well regulated and that resources are directed toward applications where alternatives do not exist (such as cement), rather than toward applications where better solutions are already available (such as the power sector). Without philanthropic funding, there is a risk that CCUS is co-opted by incumbents and used for greenwashing.

Although deployment is growing quickly (54% year-on-year in 2025), it remains concentrated in natural gas processing (over 60% of operational capacity), a much easier capture environment than the industrial, low-grade-heat conditions typical of cement or

⁸² Calculation: $394 + 461 + 1174 = 2029$ million tCO₂/year; $5266 / (5266 + 369) = 93.45\%$; $2029 \times 93.45 = 1896$ million tCO₂/year Table: Key global CCUS indicators in the Sustainable Development Scenario [IEA, 2020](#)

⁸³ "an IEEFA review of 16 projects finds that even though the industry claims a 95% capture rate is achievable, no existing project has consistently captured more than 80% of carbon."; Table: Real-World CO₂ capture [IEEFA, n.d.](#) [accessed July 2026]

⁸⁴ India will allocate 200bn rupees (\$2.2bn) over the next five years for carbon capture, utilisation and storage (CCUS)" [Argus Media, 2026](#); "The amount of CO₂ being captured from industrial facilities in the GCC countries alone account for 10% of the CO₂ that is being captured globally." [Global CCS Institute, 2022](#)

⁸⁵ "an IEEFA review of 16 projects finds that even though the industry claims a 95% capture rate is achievable, no existing project has consistently captured more than 80% of carbon."; Table: Real-World CO₂ capture [IEEFA, n.d.](#) [accessed July 2026]; "captured 83% of the planned volume of CO₂, but with a steady increase from 72% in 2017 to 95% in 2019." [CATF, 2024](#)

steel.⁸⁶ Of the 734 facilities in development or operation, just 87 are for heavy industry applications.⁸⁷

Exploring the Potential of Geologic Hydrogen

Scale ●●● Medium

Feasibility ●●● Low

Funding need ●●● High

Scale: Medium. Since geologic hydrogen is still a nascent field, we are unsure of its potential to scale. Current evidence suggests that total hydrogen stores are sufficient to comfortably meet current demand, but it is unclear whether they can be extracted at a flow rate sufficient to meet annual demand.⁸⁸

Because of green and blue hydrogen's historical underperformance relative to growth projections, we think a portion of future hydrogen demand may not be cost-effectively met by other forms of low-carbon hydrogen.⁸⁹ Therefore, we see a large upside in better understanding the potential of geologic hydrogen to assess its viability as an alternative.

Feasibility: Low. Geologic hydrogen is in its infancy and has generated a lot of hype based on reports of its low cost (<\$1 per kg of H₂) and emissions intensity (<1 kg of CO₂ per kg of H₂).⁹⁰ While these figures have been demonstrated under ideal conditions, we do not think there is sufficient evidence to suggest they can be replicated at most geologic hydrogen sites.

Our main uncertainty is that although geologic hydrogen has a very large total resource potential, far exceeding current annual demand according to the U.S. Geological Survey, no well has been discovered that can sustain large flow rates over multiple years.⁹¹

Stimulation techniques currently being piloted could increase flow rates of typical wells, with early results suggesting their feasibility while maintaining competitive costs and emissions intensities.⁹²

⁸⁶ "Operational projects have seen a 54% year-on-year increase, from 50 to 77." [Global CCS Institute, 2025](#); "The majority (more than 60%) of operational capture capacity remains at natural gas processing facilities, mirroring historical trends." [IEA, 2025](#)

⁸⁷ Calculation: 48 + 30 + 9 = 87; Data from graph: Number of projects by industry and stage of development [Global CCS Institute, 2025](#)

⁸⁸ "stochastic model results predict a wide range of values for the potential in-place hydrogen resource [103 to 1010 million metric tons (Mt)] with the most probable value of $\sim 5.6 \times 10^6$ Mt. Although most of this hydrogen is likely to be impractical to recover, a small fraction (e.g., 1×10^5 Mt) would supply the projected hydrogen needed to reach net-zero carbon emissions for ~ 200 years." [USGS, 2024](#); Table 3 plus our interview with the paper's author [OEIS, 2024](#)

⁸⁹ "Tracking 190 projects over 3 years, we identify a wide 2023 implementation gap with only 7% of global capacity announcements finished on schedule... Given past and future implementation gaps, policymakers must prepare for prolonged green hydrogen scarcity." [Odenweller & Ueckerdt, 2025](#)

⁹⁰ geologic hydrogen cost and emissions intensity: Table 1 [RSC, 2025](#)

⁹¹ Table 3 plus our interview with the paper's author [OEIS, 2024](#)

⁹² Unpublished work, shared in a conversation with [the Chimaera Fund](#).

We are cautiously optimistic about the political feasibility of geologic hydrogen, since it aligns with both right-wing energy dominance and left-wing climate priorities. Still, it is a low-salience issue and currently lacks strong evidence base to support favorable governmental interventions. However, as with other forms of low-carbon hydrogen, geologic hydrogen is also bottlenecked by the lack of hydrogen infrastructure, placing further limitations on its total mitigation potential.⁹³

Funding Need: High. This field is still in its infancy. To our knowledge, just a handful of nonprofits engage with geologic hydrogen, and only [the Chimaera Fund](#) is exclusively dedicated to it. We think the nonprofit ecosystem has substantial room to grow, but is also constrained by limited funding opportunities. We estimate that most philanthropic funding for geologic hydrogen has come through the Chimaera Fund (\$1.4 million as of February 2026) plus a handful of small (<\$200,000) projects executed by other nonprofits.⁹⁴

Because of this exceptionally high funding need, we think geologic hydrogen efforts are worth funding, despite their low feasibility, viewing this sub-strategy as a high-scale, low-certainty bet in our industrial decarbonization portfolio.

Geographic Prioritization

We prioritize key geographies based on three main factors:

- **Innovation potential**, as indicated by the number of commercial-scale industry project announcements (including operational, FID-approved, and announced deep decarbonization plants).⁹⁵
- **Expected future emissions** from industry (from 2026 to 2050).⁹⁶
- **Policy leadership**, as indicated by substantial innovation funding commitments, procurement commitments, emissions trading system (ETS) inclusion, or other major policies.

East Asia

East Asia is arguably the most important region for decarbonizing industry. China is the country with the highest projected industrial emissions (21% of global total) and the largest project pipeline (208, 28% of global total), with cement, steel, and aluminum all covered in its national ETS.⁹⁷ Japan and Korea are comparatively minor but still rank

⁹³ "turning this type of hydrogen into a competitive product will also require addressing the issues of its storage and transportation. In this context, the low number of successfully developed large-scale underground H2 storage facilities, as well as land and maritime hydrogen transport options would substantially hamper this process." [OEIS, 2024](#)

⁹⁴ See also: [The Chimaera Fund](#) Spotlight

⁹⁵ Giving Green's [analysis](#) of the deep decarbonization project pipeline from [MPP, 2026](#). We excluded MPP's data about aviation plants, since aviation is not in scope for our industry work.

⁹⁶ Giving Green's [analysis](#) of projected emissions data from [World Emissions Clock](#)

⁹⁷ "The China National Carbon Market regulates more than 3,300 companies from the power, steel, cement, and aluminum smelter sectors with annual emissions in excess of 26,000 tCOe." [ICAP, 2022](#)

among the top 25 countries in projected emissions and are especially important for the iron and steel sector. They have also shown strong policy support for green steel through their domestic ETSs and green innovation funding (at least ~\$2.8 billion and ~\$220 million in funds committed by Japan and Korea, respectively), and house several leading companies in the field of green industry.⁹⁸

The EU

The EU is the clearest policy leader. Its ETS and carbon border adjustment mechanism (CBAM) were influential in catalyzing a global wave of similar regulations.⁹⁹ It also enacted the Clean Industrial Deal in 2025, which includes over \$115 billion in innovation funding and an upcoming procurement framework.¹⁰⁰ It has 125 pipeline plants (~17% of the global total) and is expected to be the fifth-largest source of future industry emissions (3.6% of the global total).

India

India's industry sector accounts for ~16% of future global industrial emissions, second only to China. It also houses 60 pipeline industry plants—the second most in the world, and 8% of the global pipeline.¹⁰¹ These developments are supported by an increasingly proactive policy environment, with the national government introducing policies and incentives to accelerate industrial decarbonization. Notably, under the Government of India's Green Hydrogen Mission, India is actively positioning itself as a low-cost producer of hydrogen and hydrogen derivatives, particularly ammonia.¹⁰² Further, India is in the early implementation phase of the Indian Carbon Market (ICM), with the Carbon Credit Trading Scheme (CCTS) providing the compliance framework and initial

⁹⁸ ETSs for [China](#), [Korea](#) and [Japan](#); Project: Hydrogen Utilization in Iron and Steelmaking Processes [NEDO, n.d.](#) [accessed August 2026] "The government will allocate around 500 billion won of public funds to research and development to boost the sector's competitiveness, including 308.8 billion won for the development of hydrogen-based steel production technology" [GMK Center, 2026](#)

⁹⁹ "A systematic review found CBAM-linked policy responses across dozens of countries: "policy adoption (24 countries), followed by opposition (22 countries) and cooperation (15 countries)." [Otto, 2025](#)

¹⁰⁰ "The act introduces "Made in EU" and low-carbon requirements for public procurement and public support schemes in key strategic sectors."; "The Clean Industrial Deal will mobilise over €100 billion to support EU-made clean manufacturing." [European Commission, n.d.](#) [accessed August 2026]

¹⁰¹ Giving Green's [analysis](#) of the deep decarbonization project pipeline from [MPP, 2026](#). We excluded MPP's data about aviation plants, since aviation is not in scope for our industry work.

¹⁰² "Recognising India's renewable energy capacity and green hydrogen potential, the Government of India launched the National Hydrogen Mission (NHM) in 2021 which aims to take annual green hydrogen production to a minimum of 5 million metric tonne per annum (MMTPA) by 2030 thereby capturing around 10 percent of the estimated global demand. The Government has approved the provisions of the NHM by sanctioning INR 19,744 crore (EUR ~2.18 billion) in January 2023. In January 2024, the Government through Solar Energy Corporation of India (SECI) has successfully auctioned direct subsidies for green hydrogen production, direct incentives for green ammonia production and Production Linked Incentives (PLI) for electrolyser manufacturing." [GIZ, 2024](#)

emissions-intensity targets for energy-intensive sectors, while verification, registration, and trading systems are under development.¹⁰³

Given the scale of India's emissions and the enabling environment for decarbonization, we conducted a [deeper assessment](#) of India's industrial decarbonization needs and identified priority industrial subsectors.

We also prioritize further region-sector pairs in our [iron and steel](#) and [cement and concrete](#) strategies. Our full geographic and strategy prioritization matrix can be found [here](#).

What Do We Recommend Funding in Industry?

Based on our assessment of industry emissions, we think the most promising philanthropic strategies are:

- Decarbonizing iron and steel
- Decarbonizing cement and concrete
- Decarbonizing light industry
- Decarbonizing ammonia
- Supporting cross-cutting enablers for industrial decarbonization

We plan to consider organizations working on these topics for our Top Climate Nonprofits and as potential grantees from the Giving Green Fund. We also conducted deeper analysis on sub-strategies focused on [Decarbonizing Iron and Steel](#) and [Decarbonizing Cement and Concrete](#). More information on our chosen sub-strategies can be found in their respective strategy reports.

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¹⁰³ "The Government of India has notified Greenhouse Gas Emission Intensity (GEI) targets for additional carbon-intensive sectors under the Carbon Credit Trading Scheme (CCTS). The notification, issued on 13.01.2026, brings Petroleum Refineries, Petrochemicals, Textiles and Secondary Aluminium under the compliance mechanism of the Indian Carbon Market (ICM). A total of 208 obligated entities across these sectors will now be required to meet specified emission intensity reduction targets. With this expansion, the compliance mechanism of the ICM now covers 490 obligated entities across India's most emission-intensive industries. The Government of India first notified GEI targets in October 2025 for the Aluminium, Cement, Chlor-Alkali, and Pulp & Paper sectors covering 282 obligated entities." [Press Bureau of India, 2026](#)

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Giving Green was founded to help donors cut through the complexity of climate philanthropy and direct their resources for maximum impact.

Our founder, Dan Stein, Ph.D., spent 15 years developing evidence-based strategies in global philanthropy. He saw people eager to fight climate change but paralyzed by its scale. In 2019, with support from IDinsight, he launched Giving Green to rigorously evaluate solutions and share clear guidance.

What began as a side project is now a team directing tens of millions of dollars to high-impact initiatives. Our success is shared—with donors ranging from kids donating allowances to retirees investing in a better future. We believe anyone can start small and still make a huge difference.

Thank you for joining us on the path to net zero.
Together, we keep moving forward.