



Clean industry: dawn of a new era

Global Project Tracker Update | NOV 2025



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Foreword



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Our latest Global Project Tracker shows a shift we would have been reluctant to predict even a year ago. Despite the geopolitical and macroeconomic turmoil, momentum is building. The data points to a real inflection point: clean industry is no longer a vision of the future; it is fast becoming an investment reality. So far, 19 clean industrial projects have reached Final Investment Decision since COP29, with China powering ahead and accounting for more than half of FIDs this year. And outside China, 70 projects are ‘poised’ for investment — meaning they use better-known technologies and have already secured part of their offtake and/or a portion of their financing. These projects represent an immediate \$140 billion opportunity that could dramatically accelerate the industrial transformation in the next few years.

Behind these headline numbers lies the most detailed analysis we have produced to date.

- We have applied stricter criteria to select the clean industrial projects we count as near-zero production projects, capturing only those plants with a clear route to near-zero carbon lifecycle emissions.
- Beyond the near-zero production technologies, we have provided, for the first time, an analysis of some of the complementary approaches that are driving broader industry decarbonisation progress across sectors, including circularity, transitional technologies and last-mile decarbonisation solutions.
- We have improved our coverage of China, bringing new visibility to its rapidly growing clean industry pipeline.
- We have deepened our assessment of projects approaching FID, identifying the most advanced of the 857 announced projects across the world and carefully removed those that have recently been cancelled.

Clean industry is no longer a vision of the future
- it is fast becoming an investment reality

Together, these refinements give us the clearest and most credible picture yet of the clean industrial transformation.

The findings show both increased pace and growing potential. While China is powering ahead, the ‘new industrial sunbelt’ first identified in the June edition of our tracker - stretching from Brazil to Australia across the renewables-rich regions of the world - stands ready to capitalise on this next wave of investment, and Europe faces a defining opportunity to renew its flagging industrial base and secure global competitiveness through clean production.

This edition also offers the view from inside the transition. Interviews with more than 20 project developers with projects that are operational, passed FID, or close to FID, have generated valuable insights on what it takes to unlock much-needed investment – from a compelling long-term vision and a stable policy framework to a robust business case and strong value chain partnerships. I’d like to thank all those who shared their experiences and lessons learnt.

Only a short time ago, any momentum on clean industrial developments felt distant. Today, it is visible and measurable. The task now is to turn this surge of intent into a wave of investment, starting with projects that are poised for investment. Through **Build Clean Now**, we are mobilising governments, industry and finance to seize this window of opportunity - and to make the clean industrial revolution unstoppable.

Executive summary

We are on the cusp of a clean industrial revolution. For the first time the Global Project Tracker records more than 1,000 commercial-scale clean industrial plants in development across the world's most energy-intensive industries. These facilities will produce the essential clean materials, fuels and chemicals that our economies rely on: aluminium, cement and steel for equipment, buildings and infrastructure, chemicals for fertiliser and household items, and fuels to move people and produce around the world.

Our new data shows growing momentum and a near-term opening to move much faster.

Overall, 144 projects have reached Final Investment Decision (FID). It has taken nearly ten years of technological progress, policy development and corporate experimentation to reach this point. So far, 19 of those have achieved this milestone in the past year, which means they are now ready to build, with many already under construction. This marks a significant change of pace from earlier this decade.

Our analysis now shows that around 70 more projects are 'poised' to secure funding and unlock the benefits that investment will bring. These projects use better-known technologies and have already secured a portion of their offtake and/or part of their financing. The Final Investment Decision now often depends on securing additional volumes of offtake, which in turn requires effective and predictable implementation of announced policies incentivising demand, and on securing permits and access to critical infrastructure. If realised, that would represent around \$140 billion of investment and the biggest step change in clean industry to date, potentially matching half of the last decade's progress in a fraction of the time.

The total remaining pipeline now represents almost \$2 trillion in potential investment, underscoring the scale of opportunity waiting to be seized.

Each plant that attracts investment reinforces the business case for the next, strengthening and diversifying supply chains, and building investor confidence. The opportunity to accelerate is clear: with the right policy and financial signals, today's progress can trigger exponential growth.

What the data tells us about leading geographies...

The global pipeline of projects spans 70 countries.

China has emerged as the single largest source of momentum, with more than 200 projects in the tracker and 54 projects financed or operated – for comparison, Europe has 35 and the US has 18. Nearly 40% of reported FIDs to date have been on Chinese projects. Rapid renewable power deployment and policy frameworks that support green hydrogen and its derivatives are driving clean manufacturing growth, and actual activity is likely to be higher than public announcements suggest.

Nearly half of investment-ready projects outside China lie in the 'new industrial sunbelt', many in emerging economies. First identified in our June tracker, these countries span Latin America to Australia through Africa and Asia. They are capitalising on abundant low-cost clean energy to build new industries for green ammonia, low-carbon fertiliser and clean fuels and chemicals, creating skilled jobs, strengthening energy and food security, and opening new export markets.

Europe faces a strategic opportunity for renewal. Replacing ageing industrial assets with clean production capacity can revitalise longstanding industrial regions, reinforce energy independence and strengthen industrial competitiveness, making use of globally leading carbon border adjustments and clean trade frameworks.

...and the sectors that are driving the transition.

Clean fuels and chemicals are leading the way, largely due to existing and upcoming aviation and shipping mandates

Green ammonia is the breakout market, now representing nearly half of all tracked projects and more than half of those close to FID. The reason is clear: ammonia is central to the next wave of clean shipping fuels and can also serve as a hydrogen carrier, linking production and consumption regions in ways that will accelerate deployment of the wider hydrogen ecosystem. In addition, around 80% of global fertiliser relies on ammonia, much of it imported by developing economies. In emerging economies with abundant renewable power, building domestic green ammonia plants can strengthen food security, reduce import dependence and create new export industries.

Methanol benefits from similar momentum, with now close to 200 projects in the pipeline, given its potential as a clean shipping fuel. The pipeline of sustainable aviation fuel plants also continues to grow, now representing more than 10% of current jet fuel demand.

In other sectors, progress on near-zero technologies deployment is slower, but industry is taking steps to decarbonise. In cement for example, the carbon capture technologies that will be critical tools in the long-term are taking time to develop, but complementary solutions are bringing about a step-change in cleaner production. Materials such as calcined clay have emerged as an option that can cut up to 70% of cement emissions at no extra cost to the producer. This can allow fast-growing economies to build faster, but cleaner.

View from the ground – what's driving momentum?

In-depth interviews with more than 20 developers behind projects at advanced stages of development, passed FID or operational, reveal consistent reasons for the increased momentum:

- The economics are now starting to make business sense. Clean industry is increasingly viewed as a strategic growth area and an opportunity to lead in new technology integration and markets, rather than an experiment.
- Predictable and coherent policy matters. Demand signals, from blending mandates to public-procurement rules, are critical to building a business case.
- Experience is creating replicable playbooks. Developers are creating blueprints for project design and execution; and for commercial and financial structuring. This will enable an accelerated roll-out beyond first projects.

Developers tell us that the business case for clean industry is now becoming clearer. Policy ambitions and investor confidence will determine how quickly projects can now move from plans to plants.

Early developments are showing tangible benefits

Operational projects already demonstrate that clean industry delivers national and local economic and social dividends, alongside emissions cuts. For countries, clean industry helps deliver greater energy and food security, reducing exposure to volatile fossil fuel imports and diversifying supply chains. In both developed and emerging economies, it boosts competitiveness, transforming renewable energy resources into competitive products for domestic and international markets. In addition, developers report that investment is creating skilled employment and revitalising regional economies, often in places that have been historically reliant on fossil-based industries.

THE WAY FORWARD

Build Clean Now



We are now on the edge of a clean industrial revolution. Technologies are ready, early plants are proving commercial viability, and the project pipeline is broad, with 70 projects in a strong position to secure financing in the near future. Year-on-year acceleration is achievable with the right mix of policy certainty and strategic risk appetite from the private sector.

For governments, the priority is to turn ambition into steady, long-term regulations to drive market scale-up and enabling infrastructure.

For investors and industry, this is the moment to act with confidence through bold investment decisions that can turn plans into plants, underpinned by adaptable business models and strategic value chain partnerships.

The evidence shows these sectors are ready to grow and that they can drive competitiveness, resilience and prosperity while cutting emissions and producing the materials, chemicals and fuels that are the building blocks of the modern world.

With the groundwork laid and early benefits already visible, the coming years will determine how quickly this opportunity becomes the next engine of economic growth.

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- **Methanol:** E-Methanol, Biomethanol, and Low Carbon (blue) Methanol Plants (2025), Methanol Institute and Gena (2025) <https://www.methanol.org/renewable/>; MPP Primary research
- **High Value Chemicals:** Systemiq primary research; IEA, Hydrogen Production and Infrastructure Projects Database, IEA, Paris <https://www.iea.org/data-and-statistics/data-product/hydrogen-production-and-infrastructure-projects-database>, Licence: CC BY 4.0; IEA, CCUS Projects Database, IEA, Paris <https://www.iea.org/data-and-statistics/data-product/ccus-projects-database>, Licence: CC BY 4.0; The Global Partners for Plastics Circularity Progress Tracker
- **Aviation:** Atoma Research; Global SAF Capacity (2025), Argus Media (2025), <https://view.argusmedia.com/global-saf-capacity-map.html>; MPP Primary research
- **Aluminium:** MPP Primary research; historical data from the International Aluminium Institute, Innovations in the Aluminium Industry (2025), IAI (2025), <https://international-aluminium.org/innovations-in-the-aluminium-industry/>
- **Steel:** MPP Primary research; Rocky Mountain Institute; historical data from the Leadership Group for Industry Transition: Green Steel Tracker (2025), LeadIT. (2025). Green Steel Tracker. Leadership Group for Industry Transition. <https://www.industrytransition.org/green-steel-tracker>.
- **Cement:** MPP Primary research; historical data from the Leadership Group for Industry Transition: Green Cement Technology Tracker (2025), Lorea, C; Sanchez, F; Torres-Morales, E. 2025. Green Cement Technology Tracker, Version May 2025 (05/2025) , Stockholm, Dataset, <https://www.industrytransition.org/green-cement-technology-tracker>.

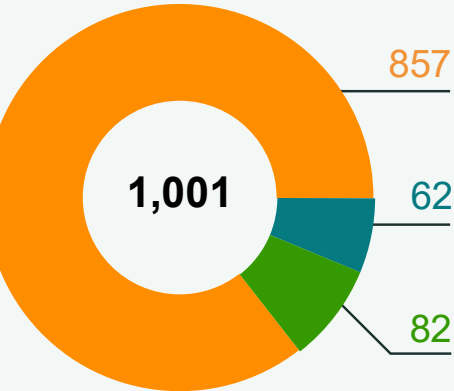
Momentum is building

The opportunity to accelerate clean industry



On the cusp of a clean industrial revolution: 1,000 projects are now tracked globally with 144 already financed or built and a **more than \$1.8 trillion opportunity to be unlocked**

Global Project Tracker pipeline
Total projects by project stage¹



- Announced
- Reached FID
- Operational³

 Ammonia	 Methanol	 HVC ²	 Aviation	 Aluminium	 Cement	 Steel	 Estimated Investment
434	164	3	208	5	28	15	\$1.84 tr
19	15	0	17	3	1	7	\$81 bn
2	3	2	28	46	1	0	\$97 bn

More than 1,000 commercial-scale projects have now been identified across the world’s most energy-intensive industries, of which 144 have been financed or built

These facilities will produce the essential clean materials, fuels and chemicals that our economies rely on: aluminium, cement and steel for equipment, buildings and infrastructure, chemicals for fertiliser and household items, and fuels to move people and produce around the world.

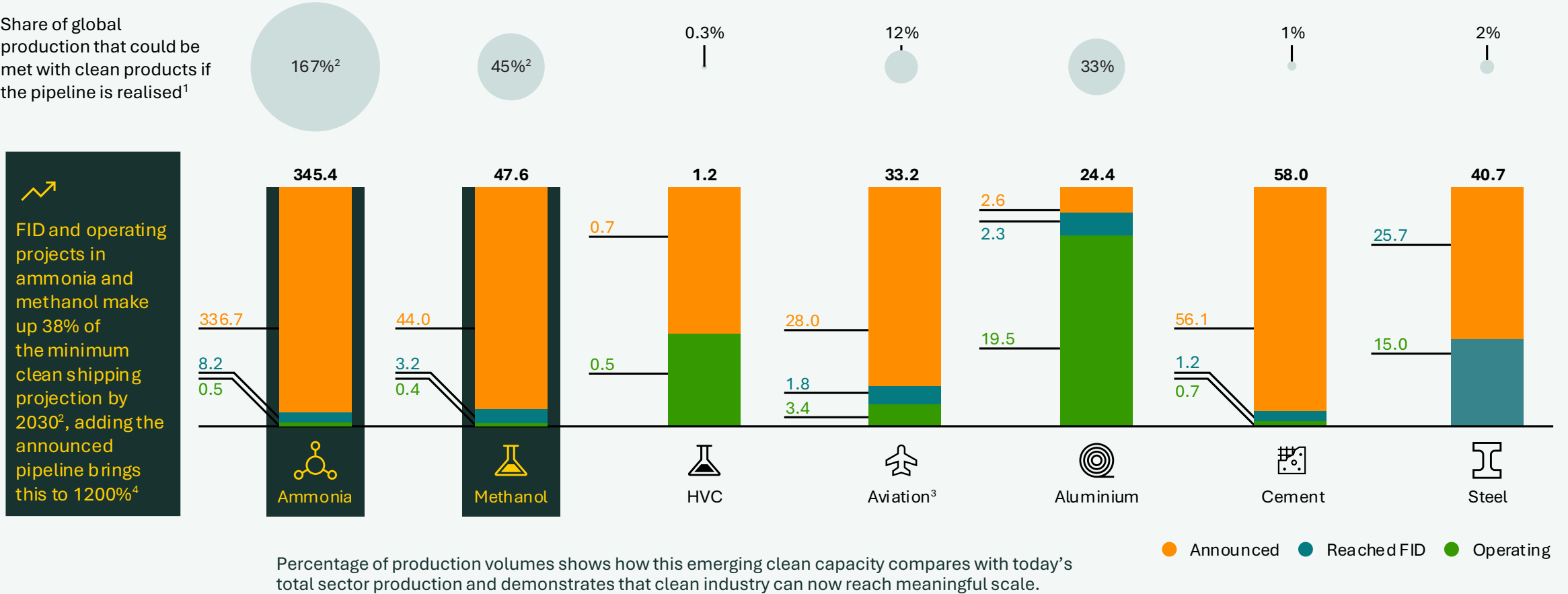
Investment is gathering pace

The announced pipeline holds \$1.84 trillion investment potential.

Clean production capacity is becoming a reality: the growing number of projects is translating into measurable output, with different speeds of progress across sectors

Annual production capacity by sector, Mtpa

Share of global production that could be met with clean products if the pipeline is realised¹



1. Global production estimates by IFA, Argus, IATA, International Aluminium Institute, CEMBUREAU, World Steel Association 2. If the IMO's proposed target of achieving a 5% share of clean fuels in the shipping sector's energy mix by 2030 is met using ammonia and methanol, the annual demand for these fuels will increase by 30 million tonnes per annum (mtpa). Taking into account the demand for clean ammonia and methanol from the shipping sector (assuming 5% of today's energy demand), the ratio of planned capacity to projected demand decreases. 3. Many instances of HEFA aviation projects list capacity as a combination of diesel and SAF without a given split. In these cases, we apply an assumption of 15% capacity attributed to SAF to proxy the amount. 4. Assumes volumes are not used for any other applications Source: MPP Global Project Tracker

Clean industry plants are moving from design to execution, with 19 projects financed this year – 12 of them in China

In the past year, 19 projects¹ have reached Final Investment Decision (FID), a faster rate than previously observed. These plants are now ready to be built, with many already in construction.

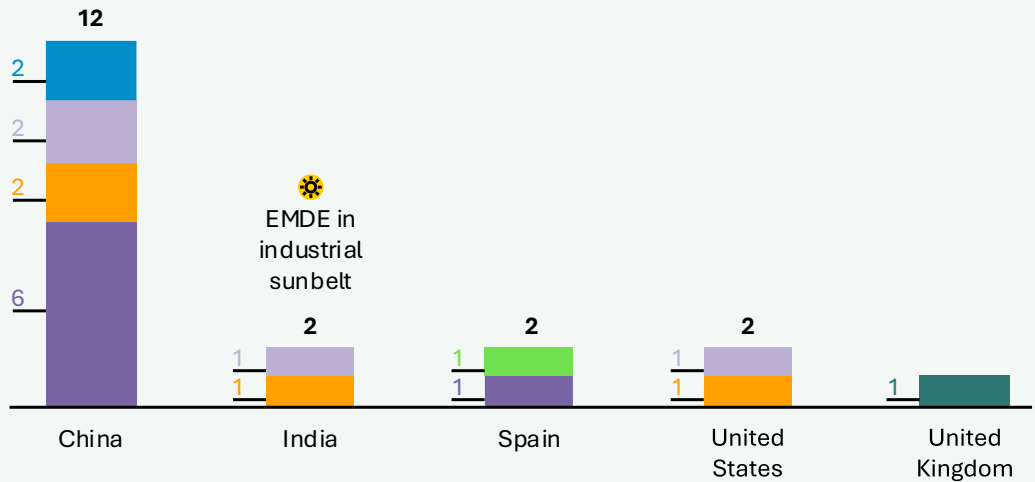
China is leading the pack

Its 12 FIDs represent more than half of all those recorded this year, six of which were in clean methanol. The remainder were split between ammonia, steel and sustainable aviation fuel (SAF).

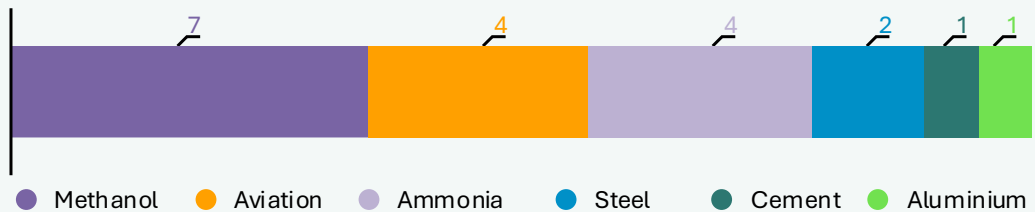
- China has ambitious renewables targets and has installed solar at an unprecedented rate (360 GW in 2024, >200GW in the first half of 2025) and at highly competitive costs.
- Green hydrogen and its derivatives, such as methanol and ammonia, are an effective way to monetise its cost-competitive renewable power potential, especially in regions with abundant and complementary wind and solar resources that face grid curtailment challenges.
- China is already the world’s largest methanol producer and consumer, mainly derived from coal. Methanol is used to create products like plastics, textiles, paint and pharmaceuticals. Transitioning from coal-based to bio- and e-methanol ensures access to export markets where emissions thresholds are expected and supports China’s dual-carbon goals (peak emissions before 2030 and carbon neutrality by 2060), while using existing production and transport infrastructure.
- Methanol is now also being promoted as a low-carbon vehicle fuel, with blending in taxis, buses, and official fleets.
- Ammonia and hydrogen-based steelmaking are additional ways to translate renewable potential into value-added, exportable products.

After methanol, most FIDs were in sustainable aviation fuels and ammonia, consistent with their leading positions in the overall pipeline. However, the materials sectors that are lagging in the pipeline still recorded four FIDs combined – in steel, cement and aluminium – while there were none tracked in the high-value chemicals sector.

19 FIDs from 2025, by country and sector (# projects)



19 FIDs from 2025, by sector (# projects)



1. For methodology, see technical Appendix, Source: MPP Global Project Tracker

There are signs of a rapid acceleration, with **70 projects ‘poised’ for financing outside China**, representing a ~\$140 billion investment opportunity that could be unlocked in the short term

144 projects have now reached Final Investment Decision (FID). It has taken nearly ten years of technological improvement, corporate leadership, and policy development to achieve the progress to date. The data now shows growing momentum and a near-term opening to move much faster.

Analysis identifies 70 projects as ‘poised’ to secure financing. These projects use better-known technologies and have already secured part of their offtake and/or part of their financing. The Final Investment Decision now often depends on securing additional volumes of offtake, which in turn requires effective and predictable implementation of announced policies incentivising demand, and on securing permits and access to critical infrastructure (e.g. grid connections). Further financial derisking is welcome, but can be difficult to access, especially for less established developers. Most of the identified projects are in ammonia and aviation fuels, where existing and expected mandates are driving demand.

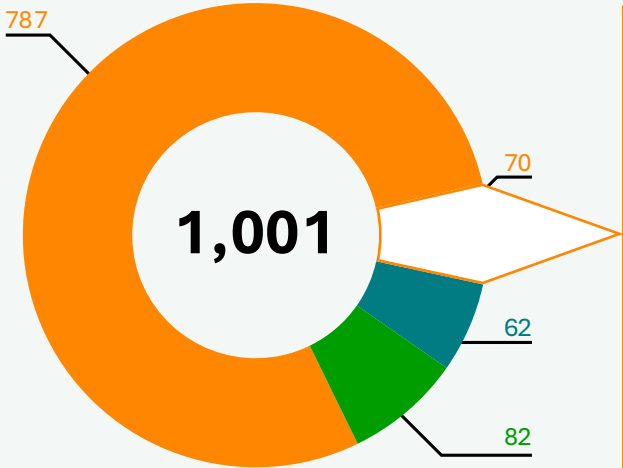
If realised, this next wave would expand the total the number of projects passed FID by almost 50% to more than 210 and would represent an estimated \$142 billion in new investment – a major capital injection into the global industrial ecosystem.

The figure of 70 projects ‘poised’ for financing is likely an underestimation, as it does not include Chinese projects, for which such granular data is unavailable. Projects in China accounted for ~60% of FIDs over the past two years, so a significant number of new FIDs from China are expected in coming years.

The opportunity to accelerate is clear

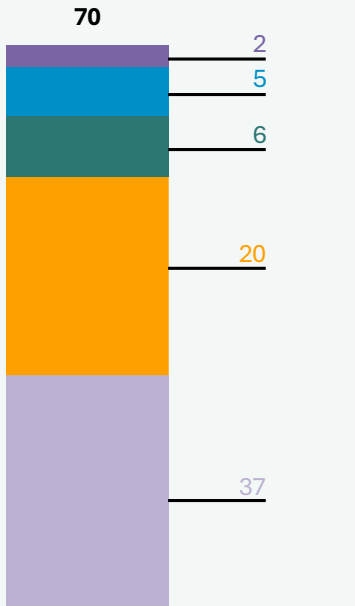
Realising this opportunity depends above all on effective regulation to drive and de-risk future demand, starting with the preservation of existing regulations and the effective implementation of announced measures. This will unlock the critical volumes of offtake necessary to underpin investments at scale and reduce risk (perceptions), driving down the cost of capital. Each project reaching investment also reinforces the business case for the next, driving technology improvement and cost reduction, strengthening and diversifying supply chains, and building investor confidence, eventually unlocking exponential growth.

Pipeline by project stage (# projects)



- Announced (excl. Poised)
- Announced – Poised to reach FID
- Reached FID
- Operating

70 poised projects by sector, excluding China¹ (# projects)



- Cement
- Aviation
- Ammonia
- Methanol
- Steel



1. There are no Chinese projects in the poised list, likely due to the relatively lower visibility into the Chinese project pipeline as well as the relatively higher speed of execution in region. Notably, there are also no aluminium or high value chemicals projects in our list, likely driven by the small pipeline and relative lower activity in new project announcements in these sectors. *Source: MPP Global Project Tracker*



Powering the shift

Progress snapshot of sectors and countries

Driven by existing and anticipated mandates, **fuels and chemicals continue to lead the transition**

Ammonia remains the leading clean industry sector in absolute volume and relative to total sector capacity: the pipeline exceeds the sum of existing demand today plus expected shipping demand by 2030, and is driven by three factors:

- **New application in shipping:** The International Maritime Organization (IMO) targets at least 30 Mtpa clean shipping fuel demand by 2030, half of which we include in the ammonia sector capacity estimates (given current ship orders, ammonia may ultimately represent more than half).
- **New application as a hydrogen carrier:** Ammonia is intricately linked to the growing hydrogen economy as it provides an efficient way to transport hydrogen. Therefore, European, Korean and Japanese regulation-driven demand for hydrogen is a key driver of growth.
- **Clean fertiliser demand:** Ammonia's key existing use is in fertiliser production. Regions such as Sub-Saharan Africa, Latin America, and parts of Asia rely heavily on fertiliser imports, driving up costs for farmers and exposing communities to macro-economic shocks. Clean electricity is relatively cheap in these areas, creating an incentive to develop local clean production. However, demand will remain limited until there is cost parity with grey ammonia supply.

Methanol follows, with a pipeline representing 45% of total sector capacity and the largest share of this year's FIDs.

- Methanol's key existing use is as a chemical building block and it is also used as a fuel.
- Key new application is in shipping: As for ammonia, we include 50% of the minimum projected IMO 2030 demand in the methanol sector capacity estimate.
- Clean methanol can also be used to produce clean gasoline and kerosene.

China is the world's largest methanol producer and consumer – and accounts for 14 of the 18 clean methanol projects passed FID (3.0 Mtpa of 3.6 Mtpa capacity). For China, methanol also provides an effective way to monetise low-cost renewable power.

A critical clean ammonia and methanol demand driver is anticipated IMO regulation that would reward clean shipping fuels and penalise 'dirty' fuel oil use. In addition, a diverse range of end uses for both products provides valuable optionality that helps de-risk business cases and increase potential upside..

The aviation pipeline covers 12% of total kerosene use volume, and sustainable aviation fuel (SAF) and ammonia both represent the highest number of FIDs this year after methanol. Demand is driven by anticipated EU and the UK regulation that specifies minimum SAF blending mandates. Developers are eager to bring supply online before 2030 to meet the expected ramp-up in blending requirements.

Materials sectors are lagging

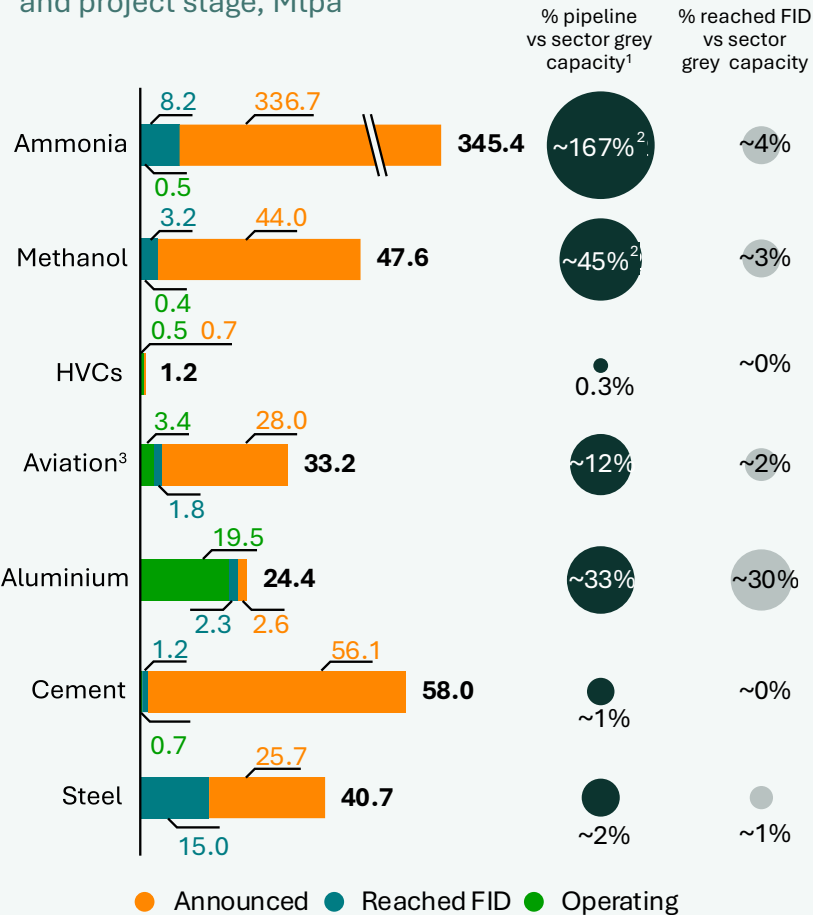
There is less progress in the materials sectors and for high-value chemicals, due to a lack of demand-side regulation.

The aluminium pipeline represents ~30% of total sector volume, though much of this comes from hydro-powered legacy assets, explaining the high share of operational projects. Conversion of legacy brownfield assets to renewable power has been slow, and there is limited new capacity planned.

For cement and steel, the clean pipeline covers <2% of total sector output.

We track High-Value Chemicals (HVCs) separately for the first time, as applications and demand drivers are distinct from methanol and ammonia. The pipeline represents less than 0.5% of total sector capacity. In the absence of regulatory demand drivers, developers face an uncertain outlook. However, given the higher value-added of these products and their derivatives, early lead markets could emerge where clean production would have minimal impact on end prices.

Project pipeline capacity by sector and project stage, Mtpa



1. Global production estimates by IFA, Argus, IATA, International Aluminium Institute, CEMBUREAU, World Steel Association; 2. If the IMO's proposed target of achieving a 5% share of clean fuels in the shipping sector's energy mix by 2030 is met using ammonia and methanol, the annual demand for these fuels will increase by 30 million tonnes per annum (Mtpa). Taking into account the demand for clean ammonia and methanol from the shipping sector (assuming 5% of today's energy demand), the ratio of planned capacity to projected demand decreases; 3. Many instances of HEFA aviation projects list capacity as a combination of diesel and SAF without a given split. In these cases, we apply an assumption of 15% capacity attributed to SAF.

In the materials and high-value chemicals sectors, where near-zero technologies have been slower to scale **complementary approaches are driving additional clean progress**

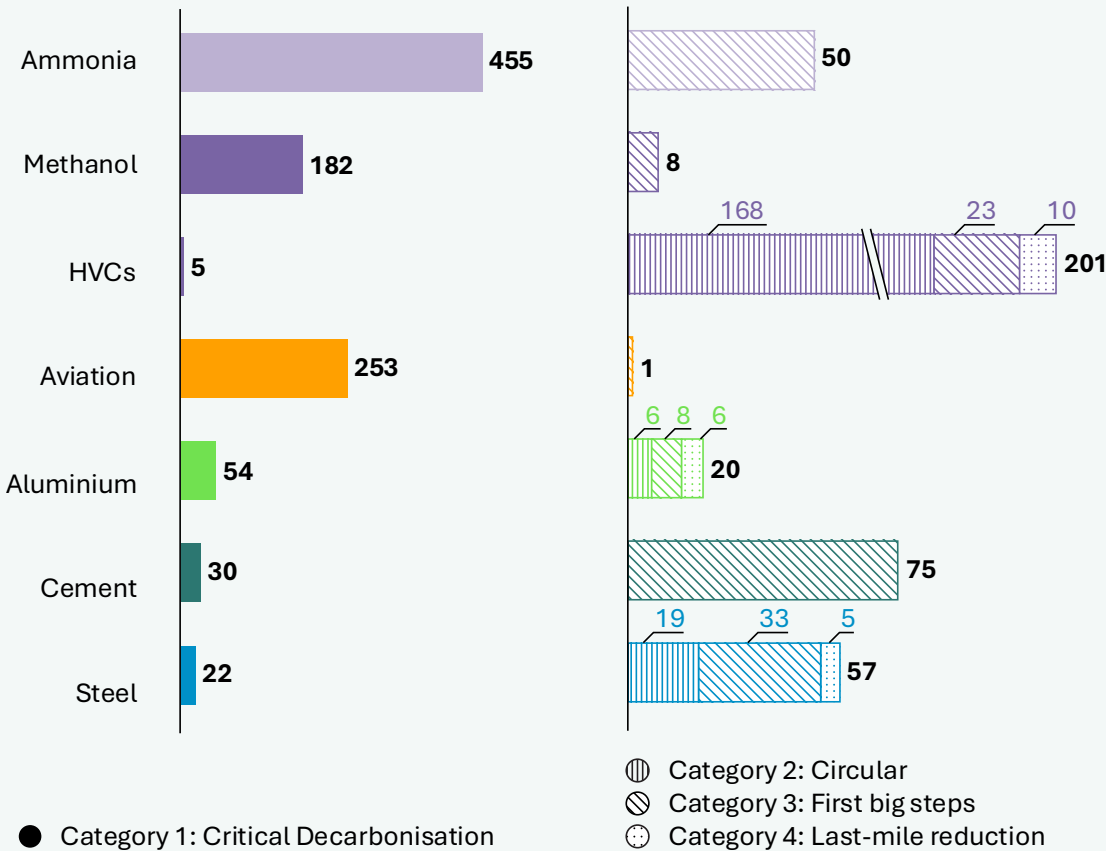
For the first time, the analysis looks beyond projects based solely on ‘critical decarbonisation technologies’ – meaning technologies that reduce emissions by at least 70-80% across the production process – to include a broader set of complementary approaches that are contributing to industry decarbonisation. These additional categories are not part of the formal project pipeline but demonstrate areas of progress that are particularly relevant in materials sectors where deployment has been slower.

The approaches are divided into three categories:

- **Circular technologies:** emissions reduction through recycling and reuse. Plastics recycling reduces the need for virgin plastic production¹, and scrap use in steel and aluminium reduces primary production in those sectors. Given the large number of pre-existing scrap Electric Arc Furnaces (EAFs), only new scrap projects are included.
- **First big step technologies:** options that deliver substantial emissions reductions but are insufficient on their own to reach near-zero. In cement, supplementary cementitious materials (SCMs) can be blended into cement mixes to reduce the emissions-intensive use of clinker. While carbon capture is needed to fully decarbonise, SCMs can already cut emissions by 30-70%, and often at lower costs (thereby also reducing the capital-intensive carbon capture still needed). This is particularly relevant for fast-growing economies needing to expand capacity quickly. If standards evolve more rapidly, SCMs could scale at pace.
- **Last-mile technologies:** measures that build on critical decarbonisation technologies to deliver the final emissions cuts needed for net zero. For example, in aluminium, clean electricity cuts total production emissions by ~70%. Additional levers can decarbonise the remaining ~30%, for example, clean alumina production or replacing carbon anodes with inert anodes.

Including these technologies provides a fuller picture of progress. In cement, steel and high-value chemicals, where ‘critical decarbonisation technology’ deployment has been slower, these approaches reveal additional emissions reduction opportunities.

Total number of projects in core pipeline and for complementary technologies



1. Plastics recycling makes up the significant majority of the Category 2: Circular of the High Value Chemicals sector. There are many recycling projects, and this reflects what data could be sourced based on Systemiq Primary research and The Global Partners for Plastics Circularity tracker. These projects are also the only ones without a set capacity threshold given data availability. Source: MPP Global Project Tracker

In cement, SCMs such as **calcined clay or other innovative blends can cut emissions by up to 70% at no additional cost**, enabling fast and cleaner growth in developing economies

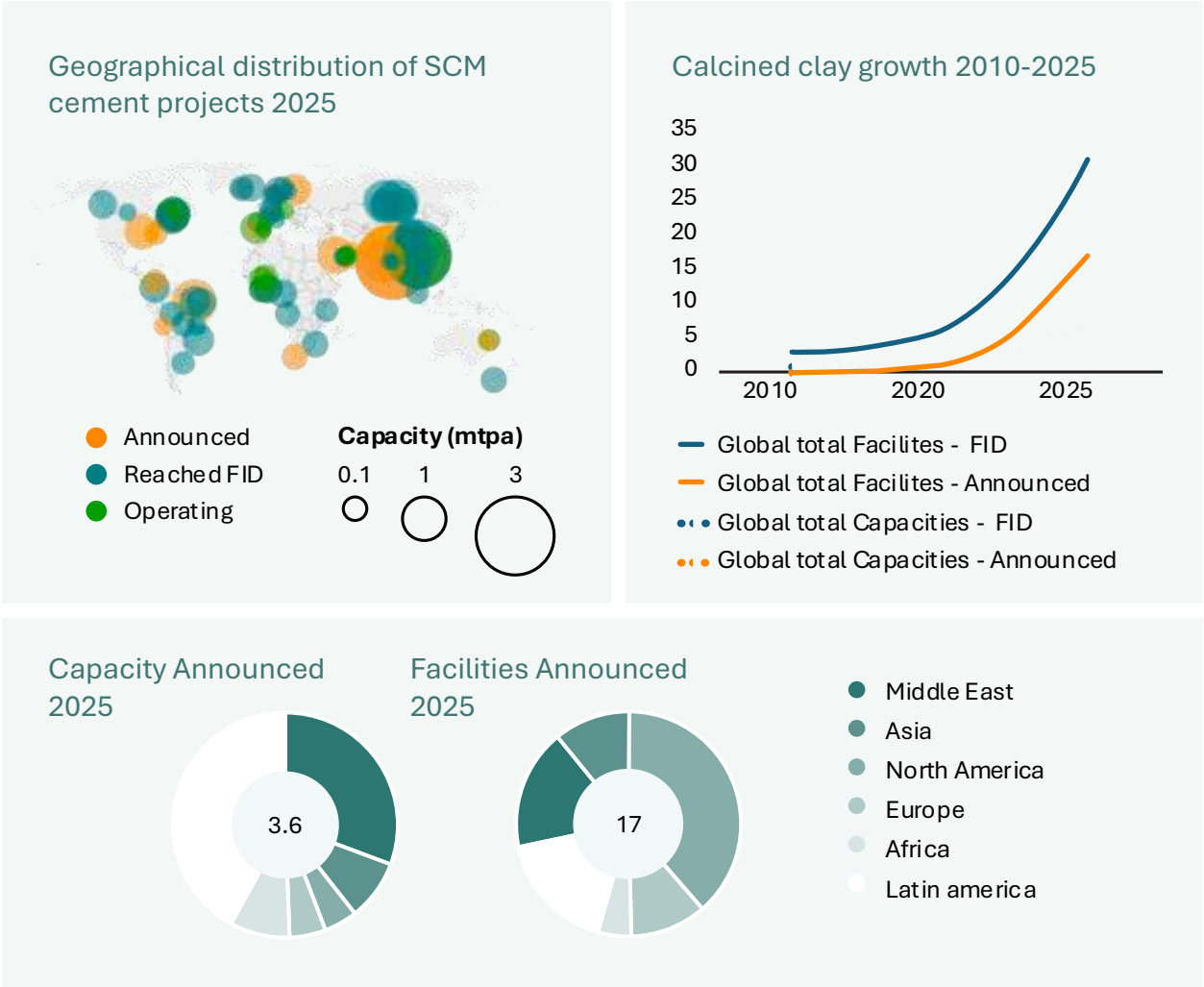
Supplementary Cementitious Materials (SCMs) can replace a significant portion of emissions-intensive clinker in cement production. SCMs include materials such as fly ash, blast furnace slag, limestone and pozzolans, all of which can reduce both emissions and costs. The key challenge is finding the right mix of SCMs to lower the clinker rate as far as possible while maintaining strength and durability. Calcined clay is rapidly emerging as a scalable option in these SCM blends, helping to achieve deeper emissions cuts.

Ordinary Portland Cement (OPC) typically contains more than 95% clinker, which accounts for almost 90% of production emissions. SCMs are already used widely, bringing clinker rates down to around 75%. Innovative SCM combinations can reduce this further. Developers report being able to reduce clinker ratio to as low as 30-35%, which is a 65-75% reduction versus OPC, and a 50-67% reduction compared to ‘traditional’ cement mixes.

SCMs are often cheaper than clinker, particularly for importing countries and can be easily blended, with minimal plant modifications. Given the current high costs of Carbon Capture and Storage (CCS), SCMs offer a practical route to eliminating a substantial share of emissions upfront, reducing what will need to be captured later.

They enable fast and clean growth at lower costs. SCMs are a cost-effective way to decarbonise existing cement production and expand production more rapidly without a jump in CO₂ emissions, while relying on local resources – particularly valuable for fast-growing economies. There has been a global surge in SCM deployment, including in calcined clay, across Europe, the US, and especially the New Industrial Sunbelt (data for China are not yet available).

However, inertia is delaying adoption. The biggest factor delaying wider adoption is institutional inertia in the construction value chain: technical norms and building codes often take years to recognise new blends. In addition, although investment amounts are relatively limited, access to affordable capital – especially in EMDEs – is also important.



Developers emphasise that **SCMs can enable faster, cleaner growth in developing economies at a lower cost**, but industry standards need to adapt more rapidly to innovation



“Ghana imports clinker, adding ~25% logistical costs and macro-economic risk. **LC3¹ can be produced using local materials, is cheaper, and can reduce clinker rates to 35%** (we are currently close to 40%). Despite industry inertia, we aim for LC3-35 to become the African standard and have already inspired several African nations.”

CBI | Ghana



“We see huge interest for our proprietary ACT² mix in Africa and India. **Reducing the clinker rate to 25% is a compelling value proposition as it allows for three times as much production from one clinker kiln without additional CO₂ emissions** – enabling faster capacity expansion with a smaller investment (and lower emissions).”

Ecocem | France



“**The most efficient solution is partial clinker substitution using widely available, reactive, high-performing materials** to produce cement as good as – or better than – traditional formulations. Our cement has just over 50% clinker, as slow evolution of EN³ standards currently prevents going below 50%, despite being technically viable.”

Vicat | France



1. Limestone-Calced Clay Cement (LC3) is a low-carbon blended cement that replaces part of the energy- and carbon-intensive clinker (the main component of conventional Portland cement) with a combination of calcined clay and limestone; 2. ACT is a next-generation, scalable cement / binder technology developed by Ecocem aimed at drastically reducing CO₂ emissions relative to conventional Portland cement and common cement formulations; 3. These are the primary European standards for cement. Sources: MPP Global Project Tracker, MPP analysis

In aluminium, complementary ‘last-mile’ technologies are helping producers get closer to zero emissions

Clean power remains the biggest lever

Electricity accounts for the majority of emissions in aluminium production, so the first priority is switching to renewables. Most existing smelters are seeking to do this through renewable PPAs, physical or virtual. China Hongqiao, one of the world’s largest producers, adopted a bolder strategy by relocating 60% of its smelting capacity from Shandong to Yunnan, a province rich in hydro and solar power. There it has commissioned a 2 Mtpa high-efficiency smelter, with another planned. This 4 Mtpa of low-carbon capacity is the equivalent to all North American production. In addition, they have installed 2 GW of solar PV in Shandong, with a further 2 GW in development.

China Hongqiao Group: “The capability and the speed of delivery of renewable energy projects in China is one of the advantages we have.”

‘Last-mile technologies’: alumina production step

While smelting accounts for most of the CO₂ footprint, alumina refining – an earlier stage in the chain – also holds some abatement potential as it still relies heavily on fossil-based steam. Mature low-carbon options exist, such as biomass and electric boilers, but such projects are currently limited in the pipeline.

Brazil’s Hydro Alunorte demonstrates how a series of levers can be used to achieve one of the world’s lowest emissions intensities. It has replaced coal and fuel oil with natural gas, and then with biomass and electric boilers powered by renewables. Alcoa’s Poços de Caldas is following a similar route.

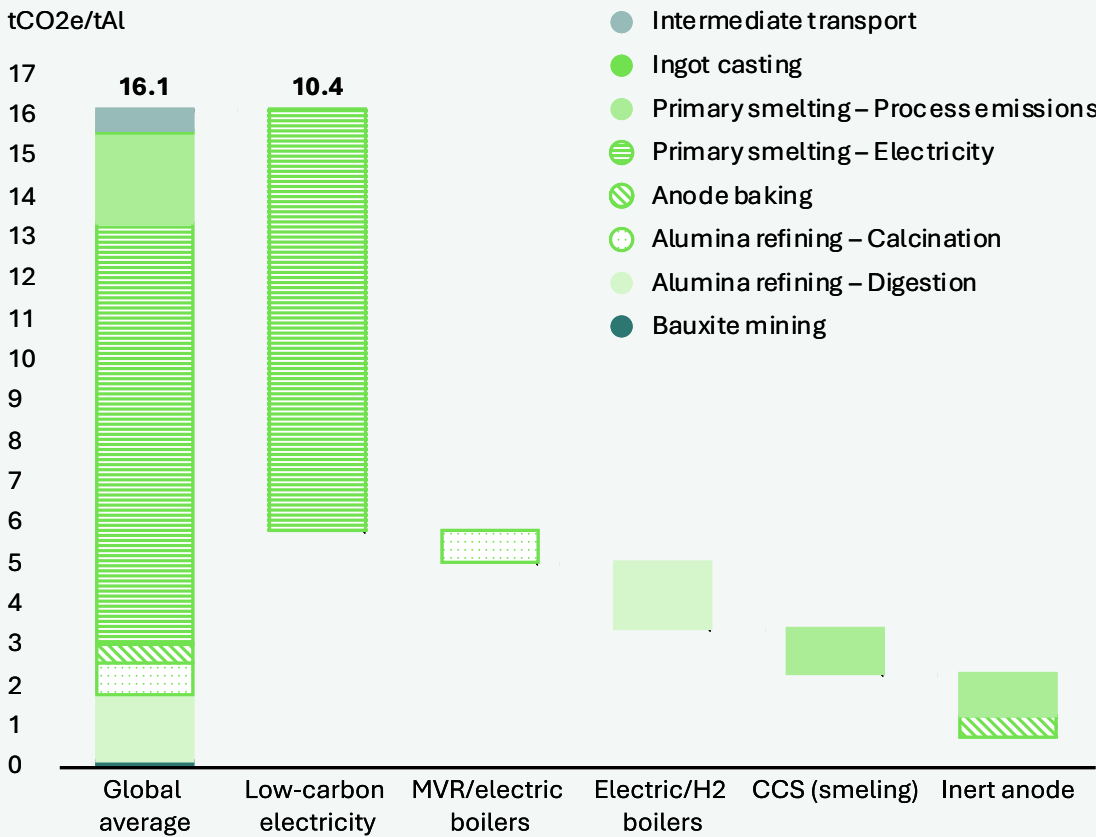
‘Last-mile technologies’: remaining aluminium smelter emissions

For smelters already powered by clean electricity (around 25-30% of global capacity), remaining emissions come from the carbon anodes used in electrolysis. No commercial solutions exist to this challenge yet, though inert anode and CO₂-capture technologies exist at research and demonstration scale. For example, the Arctial project in Finland aims to demonstrate fully decarbonised aluminium production.

Aluminium producers can still progress other elements. For example, Aluminium Dunkerque in France is demonstrating how – once their electricity is decarbonised – leading primary producers can take steps to abate residual emissions while breakthrough technologies mature. The company has installed a new recycling furnace, has deployed AI-based energy efficiency and flexibility measures, and is pioneering a project to capture process CO₂ from its potlines. Meanwhile it is working with its alumina suppliers to reduce scope 3 emissions. Aluminium Dunkerque is also planning to expand the site in the next 10 - 15 years when inert anode technology is expected to be commercially available.

Aluminium Dunkerque: “We are not in a low-cost producing region due to the price of energy and workforce. So, we need to build more on one of the strategic advantages we do have, which is sustainability.”

Primary aluminium emission intensity by decarbonisation lever (tCO₂e/tAl)



China has emerged as the clear leader in clean industry development, while the 'new industrial sunbelt' region and Europe are set to capture the next wave of opportunity if they act now

China is positioning itself as the world's clean industry leader and has the most financed and operating plants. Of the 144 projects that have reached Financial Investment Decision (FID), 54 are in China. Financing its 148-strong pipeline would multiply its successful projects more than threefold and even this is likely an underestimation as public disclosure ahead of construction is often limited.

Europe has roughly 65% of China's financed projects at 35. The 'new industrial sunbelt' region and the US have 19 and 18 projects passed FID, respectively.

The countries poised to benefit

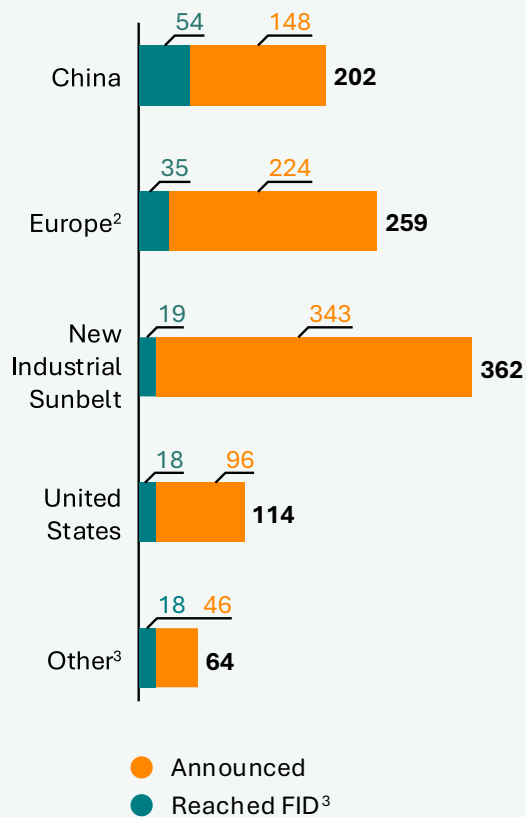
In terms of remaining investment opportunity, the 'new industrial sunbelt' stands out in both absolute and relative terms, with 343 projects in the pipeline – 19 times its current financed projects.

Australia and India lead this region with 53 total projects each. They are tied for the third-largest pipeline in the world. India represents the largest pipeline among EMDEs.

Europe also has significant growth potential, with 224 projects waiting to be unlocked – over six times its current financed projects.

The US has 96 projects lined up – over five times its financed projects.

Pipeline by region, number of projects



Top 20 countries by total project count

Country	Total	Announced
China	202	148
United States	114	96
Australia	53	52
India	53	47
Spain	43	39
Brazil	41	37
Canada	40	30
France	39	35
Norway	31	23
Egypt	29	29
Chile	28	28
Oman	21	20
Sweden	19	15
Finland	18	17
United Kingdom	18	17
Portugal	16	15
Morocco	14	14
Jordan	14	14
Netherlands	14	11
Denmark	13	13

Non-EMDE in the new industrial sunbelt¹
 EMDE in the new industrial sunbelt

With more than 200 projects in development and 54 already unlocked, China recognises the strategic value in forging ahead, while others risk falling behind

China is moving fast. It has already unlocked 54 projects with a capacity of ~21 Mtpa – including 14 of the 21 ammonia projects and 14 of the 18 methanol projects that have reached FID globally. The country has recently picked up its pace, accounting for ~60% of FIDs in the past two years, including 12 of the 19 new FIDs recorded this year.

The announced pipeline consists of 148 additional projects, representing an estimated \$150 billion investment potential. Public disclosure of progress ahead of construction is often limited, meaning the known pipeline almost certainly underestimates actual progress.

A key driver is China’s highly competitive energy capacity. Its renewables build-out is unprecedented, particularly in solar – with 360 GW installed in 2024, and 212 GW more in the first half of 2025 at highly competitive costs. Green hydrogen and its derivatives offer an attractive way to convert China’s low-cost power potential into value-added, exportable clean products. This is especially true in regions with vast and complementary renewables potential and high risk of price curtailment if this power were added to the grid, such as Inner Mongolia , Gansu and Qinghai.

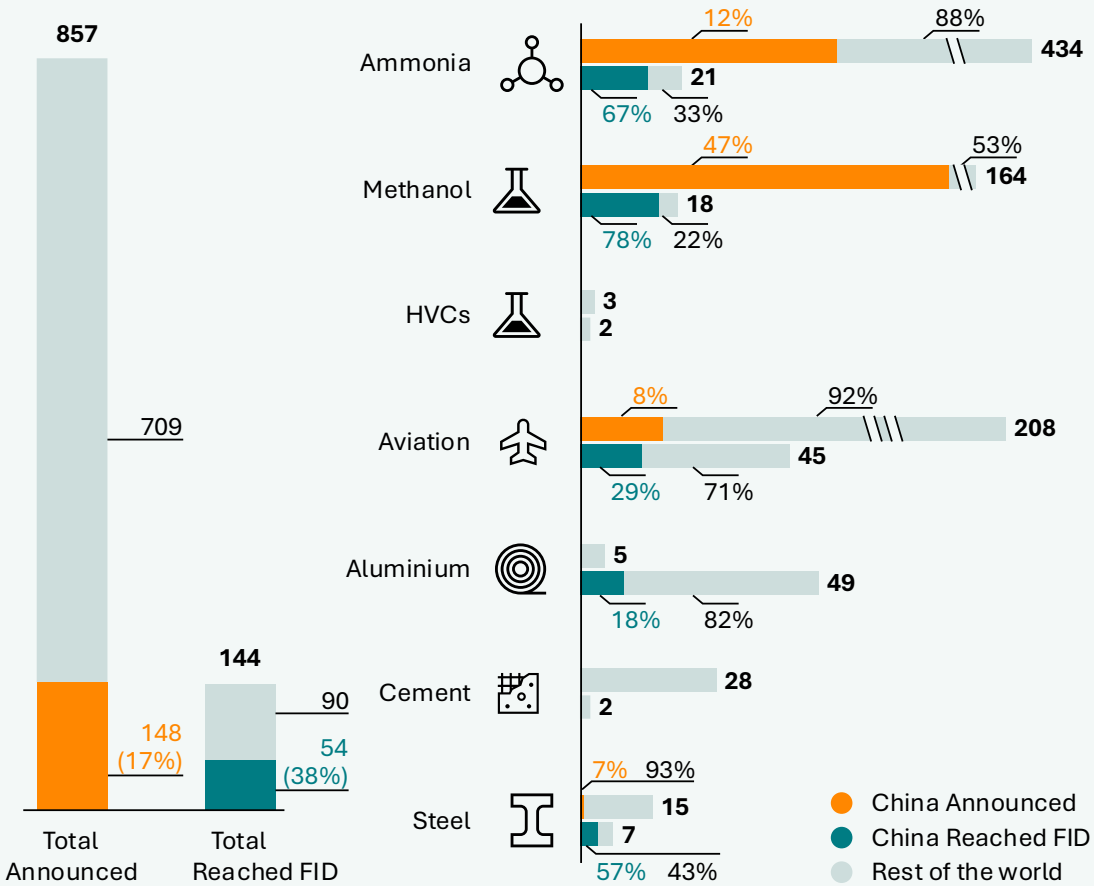
China combines plentiful resources with clear policy to deliver at scale. The government is focused on enabling clean exports and meeting its ‘dual carbon’ goals of peak emissions by 2030 and carbon neutrality by 2060. For example, clean methanol is being promoted domestically as a low-carbon fuel, with blending in taxis, buses, and official fleets.

Developers benefit from large balance sheets, integrated supply chains and cost discipline, allowing them to take strategic bets and deliver large projects at speed and low cost. Many are expanding across the value chain – from renewables to clean fuels, chemicals and batteries – capturing value through vertical integration.

China’s progress shows that industrial decarbonisation is possible at pace and scale. The warning for other regions is clear – wait and you risk losing your share of the next industrial opportunity.

LONGi: “We identified this opportunity back in 2018: as renewable – especially solar – costs would decrease, we expected an outbreak of installations, which could not all be absorbed by the grid. For abundant clean power, hydrogen production is a logical choice, and we believe methanol is the most promising application.”

Number of projects in China compared to the rest of the world¹



1. The availability and transparency of publicly accessible information in China can vary significantly across sectors. There were no Chinese projects in our poised list, due to the relatively lower visibility into the Chinese project pipeline as well as the relatively higher speed of execution in region. Source: MPP Global Project Tracker

The 70 projects identified as ‘poised’ for financing (outside China) are in **renewables-rich ‘sunbelt’ regions and countries with favourable policy landscapes**

The analysis has identified 70 projects ‘poised’ to secure financing. Their Final Investment Decision (FID) now often depends on securing additional volumes of offtake, which in turn requires effective and predictable implementation of announced policies incentivising demand, and on securing permits and access to critical infrastructure (for example, grid connections).

Most projects are in ammonia (37) or aviation (20). Geographically, a large proportion lie in the ‘new industrial sunbelt’ - 30 projects, or 43%, with the majority of those in EMDEs. The remainder are spread across Europe (22) and North America (18). No projects in China are included, due to limited public disclosure.

Together, these projects represent about 50 Mtpa of clean production capacity and \$142 billion in potential investment, with high feasibility of reaching FID providing critical enablers are met.

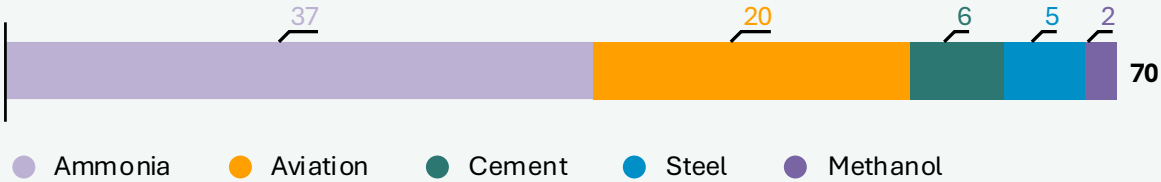
Governments have a critical role in driving demand and capturing early market share

With the clean industrial transition under way, early movers stand to gain the most. Developers are pragmatic about where they locate and finance their projects. The best-performing regions combine strong renewable energy potential, secure feedstock access, efficient logistics and, crucially, supportive government policy. Governments therefore have significant influence over the share of clean industry investment they attract.

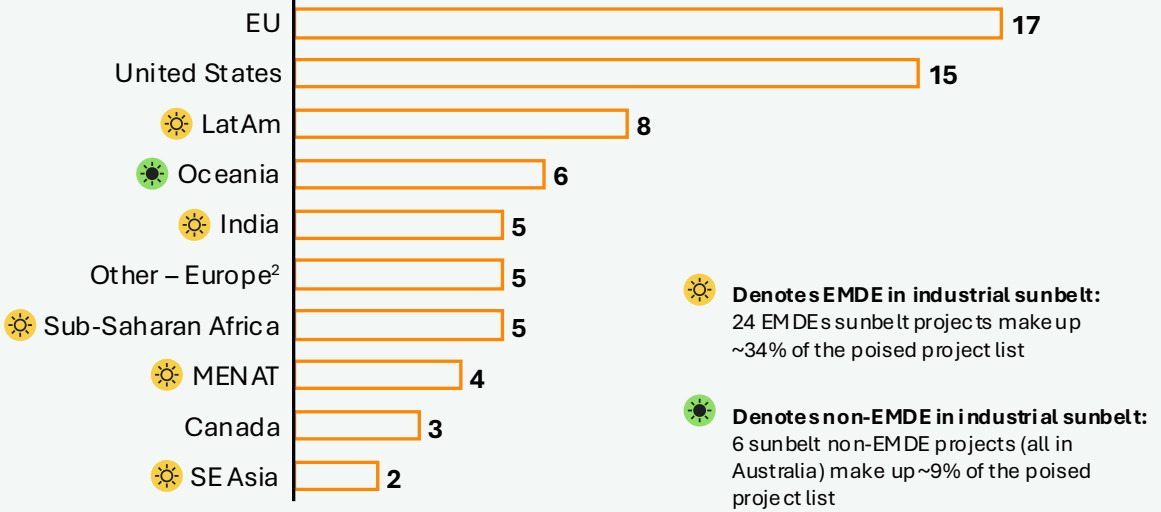
Infinium: “US policy pullbacks have not impacted our scale and expansion but have drawn us to accelerate in other regions. It used to be a no-brainer that e-SAF development was most attractive in the US, but changes are beginning to level the playing field globally. Besides the US we are now also developing in Northern Europe, South America, and the Middle East.”

Norsk e-Fuel: “Progress on our most advanced project in Mosjøen has been delayed pending necessary updates to the grid infrastructure. We decided to advance three other promising locations in Sweden and Finland and have since then increased our focus on our ‘pipeline strategy’, where we develop multiple projects at the same time while leveraging synergies e.g., on supply and offtake.”

70 poised projects by sector, excluding China¹ (# projects)



70 poised projects by region, excluding China¹ (# projects)



¹The Other – Europe designation for Category 1 projects includes Iceland, Norway, and the United Kingdom. Source: MPP Global Project Tracker

The ‘new industrial sunbelt’ can turn its abundant renewables capacity into a \$1.2 trillion opportunity for clean growth and resilience

The ‘new industrial sunbelt’ spans countries from Latin America to Africa, the Middle East and Asia Pacific to Australia — a diverse group united by exceptional renewable energy potential and a shared exposure to climate risk.

Many of these regions possess solar, wind, hydro or geothermal resources far exceeding their projected 2040 electricity demand: by factors of four to six times demand in East and Southeast Asia¹, 10 to 15 times in South America², 30 to 45 times in MENA and Australia³, and up to 1,000 times demand in Sub-Saharan Africa⁴ when theoretical solar potential is included. Harnessing this capacity for clean industrial production could unlock an estimated \$1.17 trillion in investment, including \$900 billion across emerging and developing economies.

Developing domestic and export-oriented clean industries offers multiple dividends for these regions:

- Economic and social gains from converting renewable power into new clean products to serve domestic and export markets, with associated investment and jobs
- Energy and food security thanks to reduced exposure to fossil fuel price volatility and supply chain disruptions
- Improved climate resilience by avoiding further emissions growth as economies industrialise

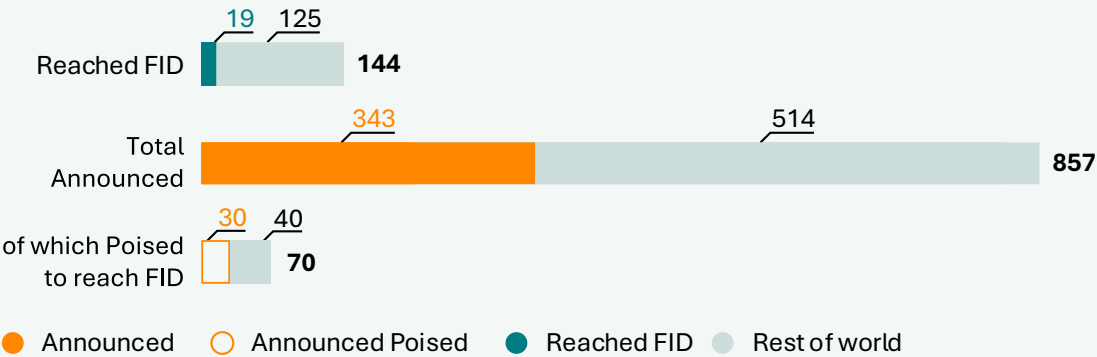
For EMDEs, this represents a chance to grow their economies without repeating the fossil fuel path that will exacerbate the climate impacts that these regions are so exposed to.

At the same time, underdeveloped grids and infrastructure remain constraints. Addressing them in tandem with industrial investment is critical: renewable power expansion and clean-industry deployment should happen hand in hand, enabling a rapid yet just transition. The cost of capital can be prohibitively high in these countries, meaning financial de-risking is critical, and access to concessional capital can be a powerful lever.

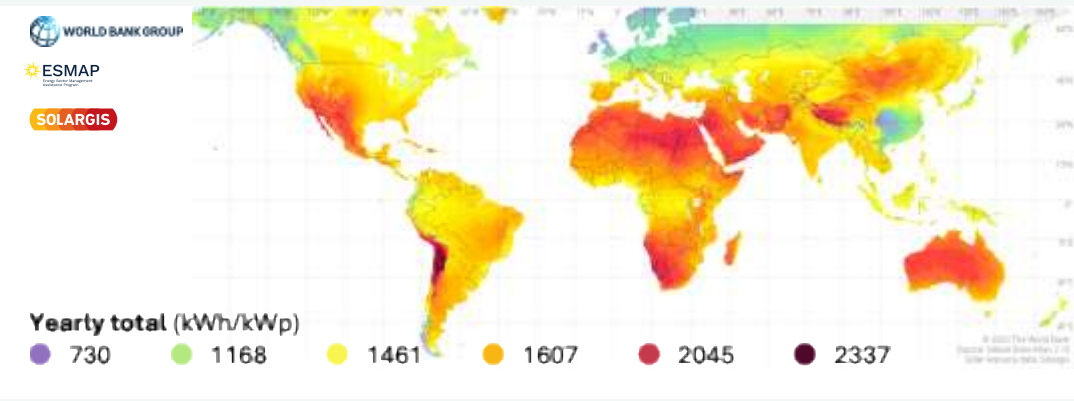
Atome: “Fertilisers in Latin America are predominantly imported. This is expensive, exposes agriculture-focused economies to macro-economic shocks and has even led to bankruptcies in the region since the Russia-Ukraine war.”

Atome: “Paraguay has surplus renewable power potential. While power demand in the Mercosur region is relatively small, fertiliser need is huge. Transforming power into molecules [such as hydrogen to produce ammonia] can build a new industry and create jobs in Paraguay, while shielding the region against macro-economic shocks.”

Number of projects in New Industrial Sunbelt vs Rest of World



Long term average of photovoltaic power potentials¹



1. NREL. (n.d.). *SE Asia cost of energy: Findings*; IEA. (2024). *Southeast Asia Energy Outlook 2024: Executive summary*; 2. Azevedo, S. S. P. de et al. (2020). Assessment of offshore wind power potential along the Brazilian coast. *Energies*, 13(10), 2557; Balza, L. et al. (2015). *Lights on? Energy needs in Latin America and the Caribbean to 2040*; 3. World Bank Group, ESMAP, & Solargis. (n.d.). *Global Solar Atlas: Middle East & North Africa*; DTU Wind Energy, World Bank Group, & ESMAP. (n.d.). *Global Wind Atlas: Middle East & North Africa*; IEA. (2025). *The future of electricity in the Middle East and North Africa*; BECRC. (2021). *Annual report 2020–2021*; Roberts, M. et al. (2019). *How much rooftop solar can be installed in Australia? Report for the Clean Energy Finance Corporation*. AEMO. (2024). *2024 Electricity Statement of Opportunities*; 4. IRENA. (2021, March). *The renewable energy transition in Africa: Powering access, resilience and prosperity*. Map 1 source: Solargis (n.d.), *Photovoltaic Electricity Potential*

Clean industry leaders and supportive policies have made Europe home to the second-largest project pipeline - creating major potential for industrial competitiveness and economic resilience

Europe has a significant pipeline of 224 announced projects, of which 22 are identified as ‘poised’ to reach FID. However, despite having the skills, technology and capital, it is struggling to move the pipeline from planning to construction. Of 19 FIDs in the past year, only three were in Europe.

Europe's fossil-based industry is struggling. Most European industrial plants are more than 30 years old, compared to an average asset age in Asia of under 15 years. This ageing infrastructure leads to higher maintenance costs, lower energy efficiency and greater emissions intensity, compounded by Europe's relatively high electricity and gas prices. Excluding hydro-based aluminium, Europe is consistently among the least competitive regions for fossil-based commodities such as steel, ammonia, methanol and aluminium. In addition, Europe's exposure to fossil fuel imports drives significant cost volatility.

Clean industry development provides an opportunity to reset this. By replacing old plants with modern, efficient clean production facilities, Europe can reclaim technology leadership and industrial competitiveness, strengthen its energy security, and position itself for leadership in global clean trade.

Europe's clean energy resources are uneven and countries with good renewable energy potential such as the Nordics and Spain hold a disproportionately large share of the mature pipeline of clean industrial plants.

To unlock long-term competitiveness, European production centres should maximise the continent's renewable resources and build clean trade relationships with third countries – where European players can invest and deploy technology – to help develop new and resilient industrial value chains.

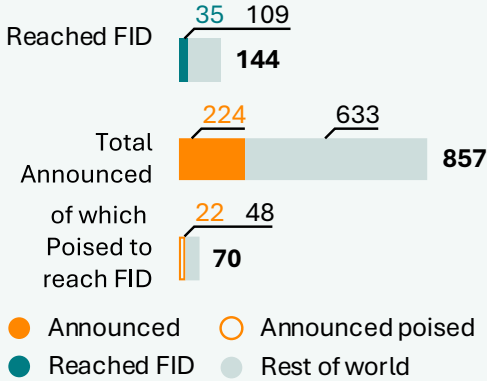
Building on the strong foundation of the EU Emissions Trading System (ETS) and financial support schemes, the most critical component to unlocking investment is policy that drives demand for clean commodities. Europe must:

- Uphold existing policies, such as the SAF blending mandate under RefuelEU,
- Effectively implement announced policies, such as REDIII and CBAM, and
- Introduce new demand creation policy, for example, for materials sectors (steel, cement, aluminium).

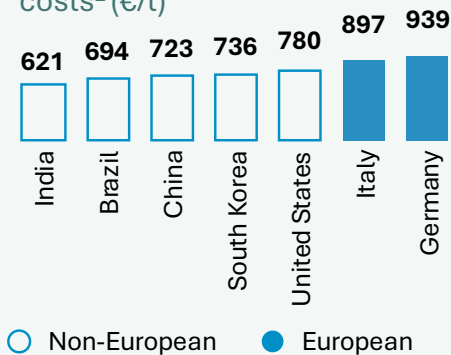
Stegra: “Building a new greenfield plant means that it is also highly efficient. Many steel plants in Europe have been around for 80 – 90 years with a lot of investments going into old assets. These have grown organically, and logistical flows are not the most effective.”

Norsk: “These SAF projects provide an independent energy supply that is critical to Europe, especially for liquid energy carriers. It's a drop-in fuel that can use existing infrastructure, including for military applications. It creates jobs, often in remote regions, and climate-positive investment flows.”

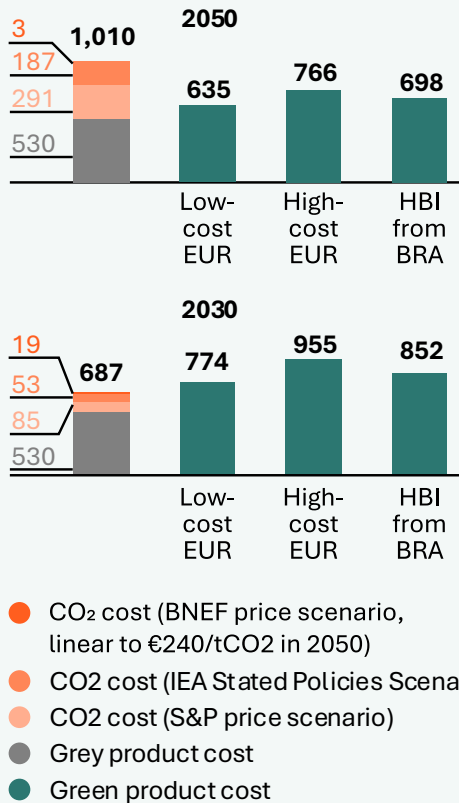
Number of projects in Europe¹ compared to rest of world



BF-BOF steel production costs² (€/t)



Evolution of green steel production costs under different CO₂ scenarios (€/t)



Notes: 1. In this context, Europe includes countries from EU27, EFTA and the UK. 2. Average production cost of BF-BOF steel in 2021 from TransitionZero. 3. Based on primary MPP research on EU lead markets

View from the ground

Insights from developers on what
can unlock investment



Project developers are proving that clean industry can be bankable, **and showing what it takes to get there**

- **Interviews with project developers from across the world** – working on projects that are operational, passed FID, or gearing up for FID – **provide us with a unique view from inside the industrial transition.** They explain their strategic rationale for pursuing these projects, the economic fundamentals they rely on, where the most persistent barriers lie and how they can be overcome.
- **Their insights confirm that clean industry is no longer a vision for the future but an emerging growth opportunity now.** Across sectors, progress depends on stimulating demand through effective and predictable implementation of announced policies and on securing permits and access to critical infrastructure, such as grid connections.
- **Together, these lessons point to practical steps that governments, investors and industry can take to accelerate the shift from plans to plants.**

Developers say **countries are turning to clean industry to boost energy security, competitiveness and climate resilience**

Clean industry delivers local dividends – jobs, investment and stronger communities ...

“Our SAF production helps restore degraded land and provides socioeconomic benefits to local communities: we provide ten thousand direct jobs, and are developing 20% of the land with family farming, medium- and smallholders.” **Acelen**

“There are strong socio-economic benefits for the Boden region, with 4,700 direct and indirect jobs and a positive GDP impact.” **Stegra**

“It is also a significant investment in the economy of the Netherlands. For example, we started from 100 jobs and will triple that to 300 jobs.” **Neste**

“We divert waste from landfills and incineration plants, a well-established European Union regulatory target. Also, these types of projects provide significant jobs.” **Repsol**

... as well as broader macro-economic benefits

“Fertilisers in Latin America are predominantly imported. This is expensive, exposes agriculture-focused economies to macro-economic shocks and has even led to bankruptcies in the region since the Russia-Ukraine war. Paraguay has surplus renewable power potential. While power demand in the Mercosur region is relatively well covered, fertiliser need is huge. Transforming power into molecules [such as hydrogen to produce ammonia] can have a significant development impact, such as building a new industry and creating jobs in Paraguay, while shielding the region against macro-economic shocks.” **Atome**

“And critically, we are building a European industry competence in a critical sector that is also needed for security and defense – in a clean way.” **Stegra**

“Recent geopolitical developments have underscored the importance of building core capabilities within Europe's borders, making the Rotterdam expansion strategically relevant.” **Neste**

“Producing SAF improves energy independence. It also boosts local economies and provides a high-value application for waste.” **Velocys**

Clean industry is a strategic choice for long-term growth **and the business case is strengthening fast**

Developers see clean industry as a strategic, profit-driven opportunity that can strengthen competitiveness and open new export markets

“Local OEM demand combined with global policies provide the basis for a strong market for low-carbon steel, also in South-East Asia. Given competitive HBI production costs, we believe our integrated approach can boost clean steel value chains in the region.”

Meranti

“For us, moving into clean fuels is a strategic and profit-driven decision. As ammonia is easier to produce at scale, it is the most likely solution for the huge quantities of green shipping fuel that will be needed. However, it is a specialty product that is difficult to handle. If we can build confidence with authorities and become a key player, we believe margins can be a lot healthier than in the traditional fuels space.” **Itochu**

“We see green hydrogen as the next wave of business opportunity, with large scale associated markets that can be unlocked: AI, electrolysis, wind turbines, BESS, will be integrated together to produce green molecules efficiently.” **Envision**

Conviction, vision and demand analysis must translate into robust financial projections to take a Financial Investment Decision

“We have a passion for decarbonisation, but projects won’t get built unless they make economic sense. Our business case needs to provide economic returns to asset managers at the same level and risk profile as LNG.” **First Ammonia**

“To get internal sign-off on the investment, our teams considered more than 400 scenarios to stress-test the business case, covering fuel price volatility, regulatory shifts, and demand changes.” **OMV Petrom**

“Financial institutions are not used to the bio-economy. To build investor confidence, we needed to provide evidence that the risks could be managed and the project would be commercially viable.” **Acelen**

Developing a bankable project begins with identifying willing-to-pay buyers, **driven by clear demand signals from policy**

Projects need to be underpinned by credible market demand

“A long-term vision is necessary but it needs to be accompanied with deep market insight and execution. It’s important for us to understand customer types, geographies and pricing. With the EU for example, with laws mounting from 2028, there is a clear demand pocket.” **Envision**

“We see two first demand categories emerging in Europe. First, from bulk carriers, for whom it is easy to put an ammonia tank on the deck. Secondly, from container carriers and car carriers, as their cargo is so valuable that the relative impact on end prices is extremely low.” **Itochu**

“We found offtakers for 60% of our volume through 20 contracts.” **Stegra**

“We moved forward once the technology reached commercial readiness and market and investment demand began to build. Strong interest from strategic investors, driven by voluntary demand, reinforced our expectation that mandated demand would follow [for example in California, the EU, Japan.]” **Infinium**

Clear and consistent demand-side policies are essential to provide predictability to developers and investors

“Public infrastructure projects require low-carbon cement, and we’re expecting more green procurement criteria in construction regulation.” **Holcim**

“Mandates and regulation are critical, and we need clarity. Unclear regulation is a huge burden for smaller developers.” **Repsol**

“The most critical elements to put in place are clear regulations, a single global standard for ‘green’ and a credible global book and claim system.” **First Ammonia**

“Clear, short-term regulation is critical for the industry to develop. We run the risk that governments wait for industries to develop, while industries need offtakers and offtakers wait for clarity from regulators.” **Envision**



Successful projects rely on proven technologies, but **cultivating and proving project integration skills is critical for success**

Generally, the technology required is already proven – sometimes developers demonstrate specific components or applications

“Gasification technology is well proven. We worked tirelessly to improve efficiency from 90% to 98%. Our pilot test in June was very successful, and provided practical operating data that that was critical to take FID.” **LONGi**

“Electrolysers have been clearly demonstrated and bunkering technology is nothing new. However, an ammonia bunkering vessel is less demonstrated, which is why we decided to build that first.” **Itochu**

“We ran commercially for over 6,000 hours and saw a marked improvement in perceived investability after that.” **Velocys**

“While SAF technology and production have existed for some time, today’s approaches can face limitations to scale. Our Pathfinder facility demonstrated Infinium’s ability to commercialise a next-generation e-Fuel technology, showcasing both its integration and potential. That success built investor confidence and helped accelerate the final investment decision for the Roadrunner project.” **Infinium**

Successful integration of the different technology pieces – from design to delivery – is the key concern for developers and investors

“The technology is not new, but we had to integrate it into our existing operations. Coordination is a complex part, also in execution: we had 10-15 operators, and at some point we had 700 contract workers on site next to the existing crew. Properly coordinating this so that everything fits – and will actually work in practice – together is a mammoth task.” **Neste**

“For these types of projects, delivering on the integration is your main IP as a developer. Demonstrating you can do this with a first project will enable rapid scaling thereafter.” **Velocys**

“Technology and delivery integration is critical and highly complex. While each technology element is proven separately, combining their operations at scale is untested and requires detailed design work and external expertise. During procurement, we engaged with many companies to understand their offerings and capabilities. We actively steer the process to ensure we have competent suppliers acting within their area of expertise. With a variety of partners, it takes time to manage the delivery interfaces, but this allows us to retain control over the process.” **OMV Petrom**

Cross-value chain collaboration is key: partnerships are often critical, but some players go beyond and pursue a vertical integration route

Strong partnerships are important, especially with offtakers, technology suppliers, finance, and public authorities

“From the start, we brought together a carefully selected, strategic and complementary group of owners: renewable energy, electrolyser and CO2 technology leaders, engineers, developers, financiers and aviation experts. Each partner since then adds new unique capabilities, strengthening our company as we grow.” **Norsk e-Fuel**

“We formed deep partnerships across the value chain to minimise the risk of one supply contract failing. And we invested in early dialogue and ongoing coordination with local stakeholders.” **Stegra**

“In Lianyungang we work very closely with local government, with a local agricultural feedstock aggregator and with the port group.” **LONGi**

There are examples of value-chain integration; this provides an opportunity to reduce risk and increase upside

“We are developing a total renewable solution value chain: wind turbines, electrolysers, and ammonia production coupled with energy storage. We believe this integrated approach is needed to develop the market, rather than wait for a market to develop.” **Envision**

“We are broadening our role across the value chain from renewables to our green hydrogen subsidiary in 2021 and our green methanol subsidiary in 2022.” **LONGi**

“The fact that an integrated company like Repsol is leading such a project reduces the offtaking risk: we could use the methanol for our own demand, but we retain the option to sell externally if market conditions are favourable.” **Repsol**

Project finance requires comprehensive de-risking; **developers with access to their own strategic capital can boost their returns** by retaining more risk

Project finance generally requires full business case de-risking to get a project to Financial Investment Decision

“We had to de-risk and control the full business case. First, we addressed the technology risk using hydropower and decades-old electrolyser technology. Then, we had to contract all our cost inputs and offtake: despite the huge market size – and price competitiveness – we needed to secure our full offtake volume with Yara. On top of that, advanced financial structuring with an element of concessional funding was needed across the full cap stack.” **Atome**

“We secured seven-year offtake contracts (unheard of in commodity markets). We had to contract all our suppliers before we knew exactly which technology we needed, as well as securing our iron ore long term. We needed an incredibly solid view on CapEx and OpEx to demonstrate bankability.” **Stegra**

“We need fixed and predictable revenues and costs: long-term offtake agreements, long-term feedstock agreements, controlled pricing.” **First Ammonia**

Financially established players can retain some early risk to escape the ‘chicken-and-egg problem’ and reduce cost of capital

“We didn't start to sell until the construction phase when we were able to turn vision into reality and gain credibility, resulting in better prices. It is far more challenging for smaller developers where on the one hand, offtakers are adopting a wait and see for the actual plant and on the other, funders want offtake contracts.” **Envision**

“A single majority shareholder with management involvement allows us to move decisively.” **China Hongqiao Group**

“As a large, global business with the Finnish state as a significant shareholder, we have been able to secure investment across our portfolio of renewable fuel projects rather than having to do this on a project by project basis. We have leveraged green debt instruments across four eligible Neste assets.” **Neste**



Agility is essential: **diversification and modular design can reduce risk and boost upside**, and flexibility to pivot remains critical

Developers hedge their bets where they can and often use modular designs for faster deployment and optionality to easily add capacity

"We plan to sell to the shipping sector, but the fact that there are other demand markets limits the downside for us." **Itochu**

"Our portfolio strategy means we want to get 250kt online until 2032 and have multiple potential locations in Northern Europe to deliver this from. Our feedstock and offtake contracts are designed to be flexible and can be adapted to different project locations." **Norsk e-fuels**

"A modular ramp-up strategy allows us to gradually scale up green hydrogen and benefit from lower hydrogen production costs over time. The initial use of natural gas enables us to develop the project at speed, while still being able to benefit from expected hydrogen cost improvements in the future." **Meranti**

"A more modular design allows us to lower the initial required CapEx outlay, reducing perceived investment risk." **Velocys**

Resilience is important, as several projects have pivoted significantly to get where they are today

"We planned to develop in Germany but the Russia-Ukraine war spiked power prices. We moved to Texas given its excess wind power and green hydrogen tax credits policy. However, this policy took two years to roll out and we had to wait for clarity under the Trump administration. This project is happening now, but we will also develop elsewhere, for example, Northern Europe, South America, and Asia – where we have government interest." **First Ammonia**

"We originally planned for both the DRI and EAF to be in Thailand but needed competitive natural gas. With HBI production in Oman the business case works, and this type of split model makes a lot of sense. We are now exploring the same for our phase 2 projects in Australia and Indonesia." **Meranti**

"While we were fundraising, a project using the same FT pathway failed, forcing us to switch to a proven gasification technology and reduce our capital outlay. We used smaller reactors, moved our supply chain from self-manufacturing to a strategic partnership with Morimatsu, and increased recycling and efficiency. We managed to reduce our cost of capital significantly." **Velocys**

Developers see **clear first-mover advantages** and plan to scale after their first projects are successful

Aim is to get on the learning curve, establish relationships with scarce tech & feedstock providers, and improve investability of next projects

"It's not easy to develop in an industry that doesn't exist yet. However, you get invaluable early learnings and you build important relationships with suppliers, customers, and financiers." **First Ammonia**

"While others wait, we are developing knowledge on a complex and multidisciplinary process and establishing key partnerships." **LONGi**

"We want to prove the technology early and get the integration to work, removing first-of-a-kind project risk perception. We're building EPC and tech provider relationships, and can work alongside regulation." **Velocys**

"We believe strongly in first-mover advantages: access to public funding, establishing partnerships with limited tech providers and feedstock suppliers, and getting on the learning curve to develop a blueprint that will increase our scalability." **Norsk e-Fuel**

Developers do not see projects as a one-off, but have concrete plans to scale

- "We will develop multiple bunkering locations simultaneously, to develop a global ammonia bunkering system. Locations and sequencing are market driven, and we currently have tangible plans for Singapore, Europe, the Suez Canal, the Panama Canal and Japan." **Itochu**
- "We aim to replicate our current project; we have concrete plans to develop up to five identical hubs and have formal investor interest for this." **Acelen**
- "We have 50+ CCUS projects in development worldwide, of which 11 flagship projects. 7 European projects have been awarded grants from the EU Innovation Fund; these are planned to be operational by 2030." **Holcim**
- "We will strongly leverage our learnings for expansion. We will likely split the value chain, to become a supplier of green iron for the established steel industry –and therefore an enabler for steel plant decarbonization. We are already laying the groundwork for future projects in Portugal, Brazil, and Canada." **Stegra**

From plans to plants

Clean industry case studies



Clean industry: dawn of a new era **introducing case studies from around the world**

ALUMINIUM | China Hongqiao Group | Yunnan Hongtai and Honghe | China

CEMENT | Heidelberg - Brevik CCS | Norway

CEMENT | Holcim | OLYMPUS | Greece

AMMONIA | Envision | Chifeng | China

AMMONIA | First Ammonia | Victoria Renewable | USA

AMMONIA | Itochu | Singapore

AMMONIA | Atome | Villeta | Paraguay

METHANOL | LONGi | Jiangsu Lianyungang | China

METHANOL | Repsol | Ecoplanta | Spain

STEEL | Stegra Boden | Sweden

STEEL | Meranti Green Steel | Oman and Thailand

AVIATION | Neste renewables refinery | The Netherlands

AVIATION | OMV Petrom | Petrobrazil | Romania

AVIATION | Infinium | Roadrunner | USA

AVIATION | Norsk e-Fuel | Rauma | Finland

AVIATION | Acelen Renewables | Mataripe Biorefining | Brazil

AVIATION | Velocys | Altalto | UK

ALUMINIUM | Aluminium Dunkerque | France

ALUMINIUM | Hydro Alunorte | Brazil

CEMENT | Ecocem ACT Dunkerque | France

CEMENT | Vicat Argilor | France -

CEMENT | CBI Ghana LC3 | Ghana

China Hongqiao Group | Yunnan Hongtai and Honghe | China



Aluminium

Repowering primary aluminium with renewable electricity



Customers

Automotive, construction, packaging, electronics

With close to 6.5 Mtpa of primary smelting capacity, China Hongqiao Group is one of the world's largest aluminium producers. Since 2019, the company has been pursuing an ambitious relocation strategy from coal-based Shandong to renewable-rich Yunnan Province to decarbonise its operations. As of 2025, China Hongqiao has already relocated 2 Mtpa of primary capacity (Yunnan Hongtai) and is underway to open an additional 2 Mtpa by 2026 (Yunnan Honghe), representing more than 60% of its capacity.

The grid in Yunnan is famously clean, with more than 90% powered by renewables, especially hydroelectricity. Taking a step further, China Hongqiao has commissioned 2 GW of solar PV capacity to complement the Yunnan grid in 2025, with an additional 2 GW currently under development. Relocating smelting capacity is allowing the company to refresh the technology and introduce the highly energy-efficient 600kA Plus electrolysis cells.



5 MtCO₂eq

GHG emissions already reduced annually



4 Mt

Primary aluminium produced annually



4 GW

solar capacity under development in Yunnan



Project insights

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ADDED VALUE With China's 45 Mtpa cap on primary aluminium production, China Hongqiao is seeking growth from downstream value-added products and recycled aluminium. The company is reducing its carbon intensity and investing downstream activities in the value chain.

EFFICIENCY The company's average smelter age is now under 10 years. The two new smelters will have energy consumption levels below 12.4 MWh/t, among the lowest globally. Production will be delivered to customers as hot molten metal to save energy.

INNOVATION China Hongqiao continues to explore new technologies. For example, it is developing a 500 MW molten salt energy storage facility with magnetic levitation pump technology and engages in R&D partnerships.

DELIVERY PACE China Hongqiao's expertise and working culture has enabled a delivery of the projects in record time. The example, the first 2 GW solar project was completed under two years.

Milestones



2019

Yunnan Hongtai smelter groundbreaking ceremony



2020

First metal produced from Yunnan Hongtai



2025

First aluminium production from Yunnan Honghe



2026

Continuing commissioning of Yunnan Honghe

Heidelberg | Brevik CCS | Norway



Cement

Carbon Capture and Storage (CCS) on Brevik cement works



\$400m

Project investment (retrofit and capture system)



Customers

Construction, architects, ready-mix, precast, masonry

Brevik CCS is the world's first full-scale carbon capture retrofit in cement, capturing 400,000 tonnes of CO₂ annually. Developed by Heidelberg Materials and the Norwegian government, it proves that deep decarbonisation in one of the most emissions-intensive industries is achievable.

The project has been in development for 20 years, reflecting the complexity of pioneering CCS in cement. It integrates a custom-engineered capture system into an existing plant, liquefying CO₂ for offshore geological storage. It's part of Norway's Longship CCS initiative and is registering strong customer interest in its 2025 production of evoZero, the world's first carbon captured near-zero cement.

Brevik's success shows that CCS in cement is technically viable, commercially attractive and scalable. It also highlights how public-private partnerships and persistent innovation can unlock climate solutions in heavy industry.



400 kt CO₂

Will capture 400,000 tonnes of CO₂ annually



1.2 Mt

Cement produced annually



400

Employees and external partners at peak construction

Project insights

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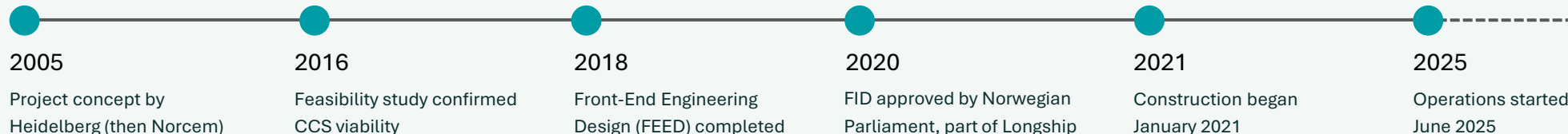
TECHNOLOGY Brevik is the first cement plant to integrate full-scale CCS as a retrofit. The CO₂ is captured with amine-based solvent, liquefied at -26°C, and shipped for permanent geological storage 2,600 metres below the seabed.

ECONOMIC Brevik CCS investment of €400m is focused on retrofitting capture technology. About 80% of the funding was provided by the Norwegian government through its Longship programme, which also covers the transport and storage infrastructure.

PARTNERSHIPS Strong public-private partnership between Heidelberg Materials and the Norwegian government was essential. Inclusion in Norway's Longship CCS program provided access to shared transport and storage infrastructure.

MARKET Heidelberg Materials commercialises Brevik CCS cement under the evoZero brand. It can be physically delivered to customers or virtually to other European countries through a multi-site mass-balancing approach verified by a third party.

Milestones



ANNOUNCED | CEMENT

Holcim | OLYMPUS | Greece

**Cement**

Carbon Capture and Storage (CCS) on Milaki plant

**€400m**

Project investment (incl. €125m from EU Innovation Fund)

**Customers**

Construction, export-oriented markets incl. oil well cement

OLYMPUS is one of Southern Europe's most advanced CCS projects, designed to capture one million tonnes of CO₂ annually from Holcim's Milaki cement plant and store it offshore in the Prinos depleted oil field. The project uses a combination of oxyfuel and cryogenic technologies and benefits from a deep-sea port terminal, enabling direct source-to-sink CO₂ shipping.

Unlike cluster-based CCS models, OLYMPUS pioneers a standalone configuration, which simplifies logistics but increases infrastructure costs. The plant is also unique in its export orientation, producing specialised cement for oil and gas drilling and serving a growing low-carbon demand in Greece.

**1 Mt CO₂**

Annual capture capacity

**2 Mt**

Near-zero cement produced annually

**15 to 20**

Years (estimated) lifetime of CO₂ storage

Project insights

[READ FULL CASE STUDY ►](#)

REGULATION Greece lacks a domestic legal framework for CO₂ sequestration. Holcim is working with partners to build one, drawing on models from Northern Europe. Offshore storage permitting is a key challenge.

INVESTMENT Despite grant from EU Innovation Fund, inflation has increased CAPEX by 30–40%, creating a gap in the business case. Holcim is exploring Carbon Dioxide Removal credits and Carbon Contracts for Difference (CCfDs) to hedge CO₂ price volatility.

FUTURE OPTIONS As the CO₂ storage site has a limited lifespan (15–20 years), Holcim is already exploring CO₂ utilisation options such as e-methanol production, and CO₂ export to other EU or to non-EU countries like Egypt. These alternatives strongly depend on future EU regulations.

MARKET Milaki's position in regional exports and its production of oil well cement position is quite unique. Demand for low-carbon materials is rising in Greece, supported by public infrastructure projects and new Green Public Procurement criteria.

Milestones



2021

Project announced



2023

Received €125m EU Innovation Fund grant



2025

Official groundbreaking ceremony



2029

Aim to be operational





Envision | Chifeng | China



Ammonia

Ammonia production powered by renewable energy



\$1.5bn

Project investment



Customers

Signed offtake agreements

Envision Chifeng Green Hydrogen Net Zero Industrial Park in China is challenging the idea that great ammonia is a premium product with a high price. As the world's largest green ammonia plant, it is determined to make the green hydrogen economically competitive with fossil fuels without relying on subsidies or regulations.

An integrated solution developed by Envision allows the company to implement this vision. This 100% off-grid facility is powered by renewable energy, wind and solar, and capable of producing 320,000 tonnes of green ammonia annually.

The project became fully operational in July 2025 thanks to a combination of this bold vision with a continuous improvement mindset: a commitment to relentlessly reducing costs across all project parts, including renewable energy generators, electrolyzers and ammonia reactors.



730 ktCO₂eq/t

Estimated GHG emissions avoided annually



320 kt

Carbon-free ammonia produced annually



Project insights

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INVESTMENT Rather than waiting for signed offtake and financing agreements, Envision took a bold step by investing its own capital early, backing its belief in the concept and trust that it would be able to deliver.

INTEGRATION Technology integration remains a challenge for FOAK projects. Extensive piloting allowed Envision to cut costs and develop an efficient integrated solution, securing their position in the developing market.

CREDIBILITY Once the construction started, customer and partner relationship building became easier. Potential customers were invited to visit the site on multiple occasions to witness tangible progress. Offtake agreements were signed during the construction phase.

MODULARITY Modularity of the developed solutions allows Envision to scale-up their existing production facility and consider new locations in close proximity to target markets.

Milestones



2022

Project idea initiated, land acquired



2023

Construction of pilot project started



2024

Pilot commissioned. FID made for Phase 1



2025

Phase 1 production project commissioned

ANNOUNCED | AMMONIA

First Ammonia | Victoria Renewable | USA



Ammonia

Ammonia production powered by renewable energy



Customers

Offtake agreements signed with European companies that buy chemicals

First Ammonia combines pragmatism and ambition, recognising that large-scale decarbonisation will only succeed if clean fuels can be produced competitively. Ammonia is already a globally traded commodity vital for fertilisers and industrial chemicals, and it could also serve as a future fuel for shipping and energy storage. This versatility makes it uniquely positioned to drive a clean fuels transition.

Policy frameworks introduced in Europe and the U.S. reinforced this opportunity, enabling lower production costs for ammonia. The project in Victoria, Texas – with an electrolyser capacity of around 300 MW, producing around 250,000 tonnes per year – was designed to strike a balance between economies of scale and bankability.



575 ktCO₂eq

Estimated GHG emissions avoided annually



250 kt

Carbon-free ammonia produced annually

Project insights

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TECHNOLOGY First ammonia is partnering with Topsoe to deploy their Solid Oxide Electrolysis Cell (SOEC) technology - based on efficiency considerations. Being an early SOEC adopter is perceived to carry additional technological risks. A technology partner who understands this and can provide certain performance guarantees is crucial to getting a First-of-a-Kind project financed.

FINANCING Without legacy capital, securing early-stage capital required visionary backers who were willing to commit before the market had fully formed.

REGULATION Policy creates markets. Without strong regulation and incentives, clean fuels will not reach scale. It is also essential to have the capacity to tolerate policy uncertainty and be flexible enough to adapt to a changing landscape.

SCALE First Ammonia has found the optimal production scale, balancing economics and bankability. The modular design allows production to be expanded, and the developed blueprint can be replicated in other locations.

Milestones



2016

Development team started collaboration with Topsoe



2020

Company predecessor enters into a global development JV with Topsoe



2022

First Ammonia founded as a company



2025

FEED completed



2026

Expected financial close

ANNOUNCED | AMMONIA

Itochu | Singapore



Ammonia

Ammonia production and bunkering ecosystem development



Customers

Container line operators

In choosing Singapore for its ammonia bunkering initiative, ITOCHU is linking the world's busiest port with one of shipping's most promising clean fuels. The project is showing how early engagement with regulators, suppliers and shipyards can build confidence in an unfamiliar fuel, offering lessons for others as green ammonia markets expand worldwide.

Itochu recognises the benefits of becoming a first mover in the ammonia bunkering market, viewing ammonia as a more scalable fuelling solution than methanol. While the company has already placed an order for an ammonia bunkering vessel and is actively working together with the Singapore port authorities, it is also implementing an ammonia production strategy. Itochu is planning to develop two production projects, one in India and one in Indonesia. In the future, the company also plans to start operating in the Suez and Panama canals and develop local production capacities.



300kt

Planned green ammonia production in India

Project insights

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REGULATION Uncertainty surrounding definitions, certification and subsidy mechanisms related to clean shipping fuels remain. This poses a risk to investment and planning.

TECHNOLOGY Ammonia engines and ammonia vessels are emerging technologies. To improve their perception and enable scaling, the efficiency and safety of the developed solutions must be demonstrated.

CREDIBILITY Being a first mover provides valuable experience and the ability to build partnerships, creating market entry barriers for competitors. Demonstrated performance creates credibility, required to influence market legislation and secure grants.

PARTNERSHIPS Without partners, developing a global supply chain for clean ammonia is impossible. Early engagement is essential for success. Itochu has been in discussions with port authorities, shipbuilders, container line operators, and other relevant parties.

Milestones



2023

Strategy shift towards ammonia bunkering



2025

Order placed for a 5,000 m³ bunkering vessel



2025

Expecting FIDs for pilot ammonia production project in Indonesia (55 ktpa) and project in India (300 ktpa)



2025



2027

Indonesia project planned to be commissioned



2029

India project planned to be commissioned



ANNOUNCED | AMMONIA



Atome | Villeta | Paraguay

Ammonia
Ammonia production for CAN fertiliser

€630m
Project Finance

Customers
100% offtake agreement with Yara

Atome's flagship project, the Villeta plant, is pioneering the production of low-carbon calcium ammonium nitrate (CAN) fertiliser made using green ammonia. By harnessing Paraguay's abundant hydropower, Atome can ensure price and supply stability, reduce reliance on imported fertilisers and create high-quality jobs.

The facility's location on the Paraguay River enables efficient logistics across Mercosur's major food producing regions – including western Brazil, northern Argentina, and Uruguay – which are currently dependent on fertiliser imports. It also provides a direct export route to Europe. Atome chose to produce CAN fertiliser for its existing market application as well as increasing demand from buyers looking to secure and decarbonise their food supply chain, such as global food companies like PepsiCo, who can command a green premium. The offtake agreement with Yara, a globally leading fertiliser company, de-risked the project for lenders and demonstrated commercial viability. Concessional capital from the Green Climate Fund, Inter-American Development Bank (IDB), and the International Finance Corporation (IFC) helped strengthen the debt structure. Equity financing, anchored by Hy24, is currently being formulated.

260 kt
Low-carbon Calcium Ammonia Nitrate (CAN) made annually

~90 kt
Carbon-free ammonia produced annually for this CAN production



project visualisation

Project insights

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OFFTAKE Securing long-term buyers is essential to unlocking investment. Offtake agreement is the cornerstone of the project finance, allowing to de-risk the project for lenders.

RESILIENCE Infrastructure projects inevitably face delays. Macroeconomic conditions, commodity cycles and shifting ESG sentiment can have a dramatic impact on financing; projects must be structured to ride out the storm.

LEADERSHIP Villeta demonstrates the value of combining international expertise with strong local leadership. Navigating financial cycles, regulatory barriers and stakeholder management requires a team able to adapt quickly and maintain investor confidence amid changing conditions.

EDUCATION From financiers to off-takers, every stakeholder needed to understand the project's value proposition. While farmers may face higher initial costs, the impact on consumers is minimal, and communicating this clearly will help build support.

Milestones





LONGi | Jiangsu Lianyungang | China



Methanol

Bio-methanol production



Customers

Signed a long-term offtake agreement with an international shipping company

As one of the world's leading solar suppliers, LONGi has transformed the way electricity is generated worldwide. Originally founded as a solar technology company, LONGi was one of the first to recognise the potential applications of abundant renewable energy supply.

Leveraging its established biomass gasification expertise and connecting local farming communities with Chinese renewable energy potential, the company is now developing scalable green methanol production technologies. The facility at Lianyungang city in China will process 800 kt of biomass feedstock per year and produce 180 kt of bio-methanol, targeting the growing market for clean shipping fuels.



800 kt

agricultural residues (wheat straw, rice straw, forestry/wood waste) processed annually



180 kt

Bio-methanol produced annually



Project insights

[READ FULL CASE STUDY ►](#)

ECONOMICS Renewable fuels will only scale if they are commercially viable; climate benefits are important, but secondary to cost competitiveness.

TECHNOLOGY Though the individual technologies are well tested, integrating them into a system can be challenging.

FEEDSTOCK The production of bio-methanol requires robust supply chains and infrastructure for feedstock, with aggregation across multiple suppliers. As the Chinese agricultural sector is highly fragmented, individual farmers form the backbone of the supply chain.

PARTNERSHIPS Partnerships with authorities, financial institutions, farmers, industry and technology partners initiated at the early stages are crucial to driving the project forward.

Milestones



2021

Established a LONGi Hydrogen subsidiary



2022

Formed a green methanol BU, piloted fluidised bed gasification



2023

Pilot successfully completed, ISCC certification obtained



2024

Signed long-term purchase agreement with shipping co



2025

Reached Final Investment Decision, started construction



2028

Expected to be fully operational



Repsol | Ecoplanta | Spain



Methanol

Municipal Solid Waste-based methanol production



\$800m

Project investment, including €106M from the EU Innovation Fund



Partners

Enerkem as the key technology partner

Repsol's Ecoplanta project in Tarragona reached final investment decision (FID) in January 2025 and will pioneer the commercial-scale production of renewable fuels and circular chemical products. Methanol is produced using gasification technology supplied by Enerkem. The plant will process residual municipal solid waste (MSW) that would otherwise be landfilled or incinerated. Given Spain's current 50% landfilling rate, feedstock is readily available. The facility's modular design reflects careful consideration of optimising scale versus feedstock availability.

Ecoplanta's dual-product capability demonstrates its sophisticated market positioning. The methanol produced can serve two distinct market segments: chemicals and fuels. Although the current priority is biofuels, driven by the EU Renewable Energy Directive and upcoming International Maritime Organization (IMO) shipping regulations, the ability to switch between these applications provides commercial resilience. This allows the facility to respond to evolving market dynamics and regulatory frameworks in both sectors.



400 kt

municipal solid waste per year used in methanol production



240 kt

Renewable and circular methanol produced annually



340

Direct, indirect and induced jobs, in addition to 2,800 jobs during construction



Project insights

[READ FULL CASE STUDY ►](#)

INTEGRATION Being both producer and offtaker, Repsol demonstrates how vertical integration improves bankability and commercial resilience.

PARTNERSHIPS Strategic partnerships don't need to be financial. An operational role for Enerkem added capability without diluting control.

FINANCE Internal financing has allowed to accelerate project development, allowing to reach within a short timeframe. Proceeding without fully detailed engineering holds risk but saves costs and time.

MODULARITY Modular design of the production facility allows to balance risk and opportunity. The plant will have two production lines, mitigating feedstock availability risk and allowing for scalability.

Milestones



2021

Project announced



2022

Awarded EU Innovation Fund grant; Repsol became a shareholder in Enerkem



2025

Reached FID



2029

Expected commissioning



Stegra | Boden | Sweden



Steel

Green hydrogen-based iron and steel production



€6.5bn

Project investment, including



Customers

Automotive, equipment manufacturers, steel-makers

Stegra is Europe's first greenfield steel mill in 50 years and the world's first large-scale plant for near-zero-emission steel. Located in Boden, Sweden, the site integrates green hydrogen production, DRI, and electric arc furnace steelmaking – all on one site. The plant will produce 2.1 Mtpa of DRI and 2.5 Mtpa of steel in Phase One, with plans to scale to 5 Mtpa by 2030 in Phase Two.

Stegra's innovation lies not only in technology integration but also in its commercial model: securing long-term offtake agreements with premium automotive and industrial customers, enabling bankable financing. The project is backed by a strong founding vision from Vargas and builds on Sweden's HYBRIT pilot success.



700 MW

Hydrogen electrolysis capacity



2.5 Mt

Annual H₂-based steel production (phase 1)



4,700

Direct jobs and indirect jobs

Project insights

[READ FULL CASE STUDY ►](#)

REGULATION Early engagement and good relations with local and regional authorities enabled smooth permitting. The project is expected to have a positive impact on Swedish GDP and regional development.

SCALABILITY Stegra's model sets a precedent for future green steel projects, with potential replication in Portugal, Brazil, and Canada. Despite Boden being an integrated site, the company sees itself as a future supplier of a green iron to the established industry.

DEMAND Stegra engaged with potential green steel offtakers early in its development. By September 2025, the company had secured binding agreements with major companies such as BMW, Volvo Group, IKEA and Microsoft, including a price premium.

FINANCE Stegra Boden raised €6.5 billion for its project, with two-thirds as debt. Offtake agreements contracted over the past years acted as revenue guarantees, similar to PPAs in renewables.

Milestones



2020

Company founded as H2 Green Steel



2022

Construction started (permit approved)



2023

Environmental permit approved



2024

H2 Green Steel rebranded to Stegra, Key financing decision reached



2026

Phase 1 production start-up

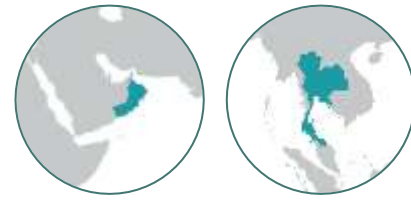


2030

Phase 2 expansion to 5 Mtpa

ANNOUNCED | STEEL

Meranti Green Steel | Oman and Thailand



Steel
Low-carbon iron & scrap processed in Electric Arc Furnace

\$3bn
Project investment, incl. both HBI and EAF plants

Customers
Automotive, equipment manufacturers, steelmakers

As the first cross-border green steel initiative in Asia-Pacific (APAC), Meranti Green Steel is pioneering a new industrial model that decouples ironmaking and steelmaking across Oman and Thailand. This innovative approach enables Meranti to leverage regional advantages in energy sourcing and market access, positioning the company at the forefront of the clean steel transition.

The project responds to growing demand from automotive and manufacturing sectors for low-carbon steel, as well as tightening climate policies such as the EU's Carbon Border Adjustment Mechanism (CBAM). Meranti's business model is built on producing Hot Briquetted Iron (HBI) in Oman using natural gas and 25% green hydrogen, with a clear roadmap to full transition to green hydrogen over time. Besides exports mainly to Europe, the HBI, a transportable form of reduced iron, will feed a newly built Electric Arc Furnace (EAF) in Thailand powered by 100% renewable electricity, alongside recycled steel scrap.

3 MtCO₂eq
GHG emissions avoided annually

2.5 Mt
HBI and EAF steel produced annually



©artist impression based on engineering layout

Project insights

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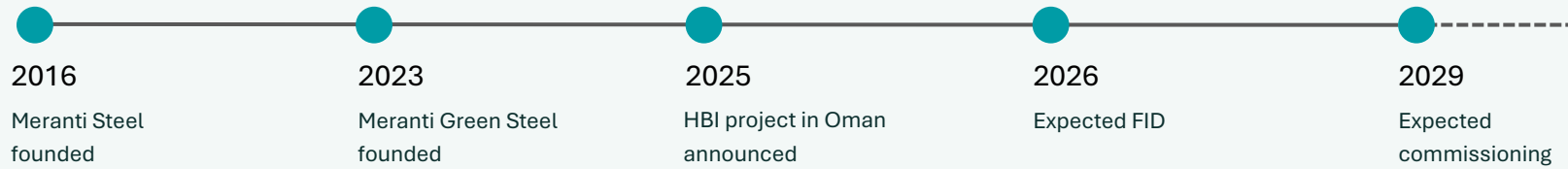
DEMAND Meranti Green Steel sensed market traction for green HBI and low-carbon steel, underpinned by climate policies and corporate commitments. The company already secured half of its output as offtake agreements, an essential step to demonstrate bankability.

BUSINESS MODEL The project was originally designed to be fully integrated in Thailand. Meranti Green Steel decided to decouple ironmaking, with its DRI/HBI plant in Oman where energy is cheaper and outlook for green hydrogen development is strong.

PARTNERSHIPS Establishing such a cross-regional value chain requires strong stakeholder alignment. To progress its project, Meranti has been working closely with key partners, such as Omani and Thai authorities, customers and ore suppliers.

FINANCE Despite a fully bankable case, Meranti is raising additional equity to reach FID stage. The fit of equity partners is critical to ensure strategic alignment to become a green steel leader in APAC with 7-8 Mtpa production by 2035.

Milestones





Neste renewables refinery | The Netherlands



Aviation

SAF production



€2.5bn

Project investment



Customers

Offtake agreements with many airlines across the globe

Neste began researching and developing renewable fuels in the 1990s, when renewable energy was far from mainstream and regulatory frameworks or support mechanisms were virtually non-existing. The company had a strong belief in the market potential and in the inevitability of the transition to renewable fuels.

Having developed its own technology to turn renewable oils and fats into premium-quality renewable fuels, Neste was well-positioned when the market started to emerge. The company accelerated its investments and launched commercial production of renewable diesel in Porvoo, Finland, in 2007. New facilities in Singapore followed in 2010 and its Rotterdam facility opened in 2011. The company is now expanding its refinery in Rotterdam and will more than double the current SAF production capability there.



Up to 80%

GHG emission reduction over the fuel's life cycle compared to using fossil jet fuel



500 kt

Current SAF annual production capability; in 2027, the SAF production capability will reach 1,200kt



300

Jobs created

Project insights

[READ FULL CASE STUDY ►](#)

VISION Developing and deploying own technologies created a strong first-mover advantage. Experience and expertise developed in one region could be transferred across geographies.

REGULATION Mandates for sustainable aviation fuel (SAF) remain a powerful driver of demand for renewable fuels. Investment into new production capacity is highly capital intensive and needs long term demand certainty. Mandates create a viable market and drive the acceleration of SAF production and demand.

DIVERSIFICATION A diversified raw materials pool, global sourcing and pre-treatment expertise support the growth of renewable fuels production as well as cost efficiency. These capabilities can be replicated across locations.

EDUCATION Project execution requires close collaboration and knowledge sharing with technology partners and regulators, but this is also crucial with other external stakeholders. Educating potential customers is especially important, as highlighting the emissions reduction benefits and ease of use of SAF in existing aircraft can accelerate stakeholder confidence and adoption of SAF.

Milestones



2011

Rotterdam renewables refinery opened



2021

SAF modification of the Rotterdam refinery announced



2022

Final investment decision for SAF modification and for refinery expansion



2025

SAF production started at Rotterdam refinery



2027

Rotterdam expansion expected to start production



OMV Petrom | Petrobrazî | Romania

**Aviation**

SAF production

**€750m**

Project investment

**Customers**Regional airlines;
continuing collaboration
with existing clients

OMV Petrom is positioning Romania at the forefront of aviation decarbonisation. At its Petrobrazî refinery, construction is underway on a new facility that will produce Sustainable Aviation Fuel (SAF) at commercial scale. By moving early, the company aims to secure a foothold in a market that is set to expand rapidly.

The goal is to become the first mover in the region's SAF market, offering a reliable supply to airlines that need to comply with EU decarbonisation targets, while reinforcing the company's role as an energy leader. The ambition aligns with the EU ReFuelEU Aviation mandate, which will require 70% of jet fuel to be SAF by 2050. Support from existing customers and an increasing European regulatory push for decarbonised aviation are accelerating this vision. OMV Petrom is not only responding to regulation, but also actively shaping a market that is still in its formative stage.

Project insights[READ FULL CASE STUDY ►](#)

PRUDENCE Early action on feedstock, using existing infrastructure and building local partnerships secures customers and policy alignment.

PLANNING Running hundreds of demand, price and regulatory scenarios enabled OMV Petrom to prepare for a volatile market landscape and ensure that investment decisions were robust against multiple potential futures.

FEEDSTOCK Control over pretreatment and feedstock supply provides resilience against volatility and enables the company to experiment with more advanced and unconventional waste inputs.

PARTNERSHIPS Collaborating with engineering firms, technology providers and refineries across Europe helped to compensate for the limited operational data available on new technologies such as PEM electrolyzers.

Milestones**2024**Financial Investment
Decision taken**2025**

Construction started

**2028**Commercial operations
target



Infinium | Roadrunner | USA



Aviation

SAF production



Customers

Offtake agreements with American Airlines and IAG

Infinium was founded in 2020 to commercialise ultra-low carbon fuels. Building on more than a decade of technological development, the company secured early backing from strategic investors including Amazon, Mitsubishi and AP Ventures.

The first commissioned project, Pathfinder, was the world's first integrated e-SAF plant, establishing a blueprint for engineering design, financing and offtake models. Using CO₂ from a local midstream gas company and powered by renewable energy, the Roadrunner facility will produce 23,000 tonnes of e-SAF and other e-fuels annually for use in the US and UK.

Infinium's design philosophy is based on replication. Its projects are structured in modular "train" configurations, enabling future plants to be deployed quickly and cost-effectively. The company is already exploring opportunities in regions with abundant renewable energy and CO₂ supply, including Norway, South America and the Middle East.



23 kt

e-SAF and other e-fuels produced annually



Project insights

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PACE Pathfinder showed the value of moving early at a small scale, to prove concept, establish credibility and build market confidence. All lessons are now embedded in Roadrunner.

CONTRACTING Commercial agreements are as important as technology. Structuring contracts to balance risk, ensure reliability and facilitate financing is key to any pioneering project.

RESILIENCE A hands-on approach and a willingness to adapt across the design, engineering and deployment phases are key to the success of complex, one-of-a-kind facilities. Furthermore, keeping up to date and being adaptable in a rapidly changing regulatory environment helps to ensure that projects remain financially and operationally sustainable.

PARTNERSHIPS Early engagement with strategic investors, resilient off-takers, local authorities and suppliers is crucial to project success.

Milestones



2020

Infinium founded



2021

Pathfinder project developed as first integrated e-SAF facility



2023



2023

Pathfinder project commissioned



2025

Roadrunner project reached FID and construction starts



Norsk e-Fuel | Rauma | Finland



Aviation

SAF production



Customers

Offtake flexibility for Norwegian Air Shuttle, Boeing, Cargolux

Norsk e-Fuel was founded with the vision of industrialising power-to-liquid (PtL) technology to deliver large-scale sustainable aviation fuel (e-SAF) production. e-SAF is produced using fossil-free power, water and carbon dioxide captured via a point of source capture or direct air capture. Producing e-SAF locally ensures Europe's energy security, generates jobs and investments.

The company is pursuing a portfolio of four projects across the Nordics, with the ambition to produce 250kt annually in 2032. This strategy is designed to spread risk, accelerate learning and ensure momentum in the event a particular project faces setbacks.

Rauma project is designed to produce around 80,000 tonnes of e-fuels (of which up to 80% will be e-SAF) each year. The project marks the company's first expansion beyond Norway and is set to become a flagship for Europe's aviation decarbonisation drive.



60 kt

Estimated e-SAF produced annually; total production capacity is 75-80 kt of e-fuels



Project insights

[READ FULL CASE STUDY ►](#)

DIVERSIFICATION Developing multiple sites in parallel ensures that setbacks in one project do not stall overall progress. Planning, communication and the optimal time buffer between sites are crucial so that lessons learnt can be passed on to the next project.

PARTNERSHIPS Active support from municipalities and ports can speed up permitting and bolster public trust. The company's shareholder group provides credibility and technical expertise.

FINANCE Developing First-of-a-Kind projects requires novel financing solutions. Separating the plants out as Special Purpose Vehicles (SPVs) has allowed for equity investment and debt raising at the company level, spreading risk, but highlights the need for innovative funding mechanisms and supportive policy to level the playing field for smaller developer.

FLEXIBILITY Location-agnostic offtake agreements and a flexible CO₂ strategy reduce exposure to single suppliers or sites, making projects more investable.

Milestones



2024

Project announced



2025

Pre-FEED stage



2026

Expected to complete FEED



2027

Targeting to reach FID

ANNOUNCED | AVIATION

Acelen Renewables | Mataripe Biorefining | Brazil



 **Aviation**
SAF production

 **€3bn**
Investment fully funded by Mubadala Capital

 **Customers**
Positioned to serve markets with SAF mandates

Harnessing Brazil's potential for sustainable growth, Acelen Renewables is transforming Brazil's degraded lands into productive ecosystems for renewable fuel production. They are proving that a little-known, native, resilient macaúba fruit oilseed can fuel the future of aviation, building the first integrated and large-scale project to turn macaúba into jet fuel.

Acelen Renewables was launched in 2023 with a clear mission: to rehabilitate Brazil's vast degraded areas to create a new source of energy. Acelen saw the opportunity to develop macaúba, a hardy native tree, as a feedstock for sustainable aviation fuel (SAF). Macaúba thrives on degraded land – it grows on poor soils, requires little water and does not compete with food crops – so it offers a way to contribute to decarbonising aviation without posing a threat to food security.

With an investment of around US\$3 billion, backed by Mubadala Capital and leveraging the Mataripe industrial hub, the project pioneers the use of macaúba to produce 1.3bn liters of renewables fuels annually, including SAF and HVO, while also creating new economic opportunities, improving energy security and delivering social benefits.

 **~1Mt**
Renewable fuels produced annually (SAF and HVO)



Project insights

[READ FULL CASE STUDY ▶](#)

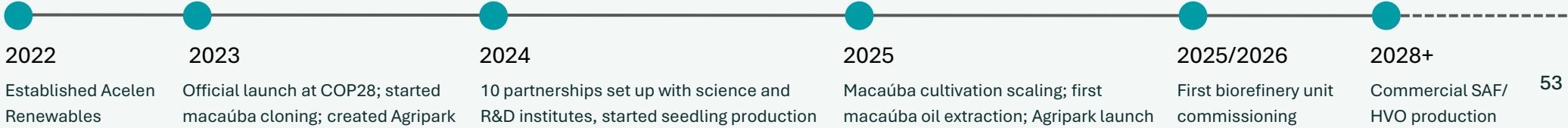
SOCIETY The launched community inclusion programme has demonstrated that a technical project can benefit local communities, by providing new income, training, and knowledge transfer.

INNOVATION Developing its own innovation centre alongside partnerships with universities, research centres and technology companies such as Honeywell have been critical for improving seedlings and ensuring the fuel meets international standards.

EXPORT Access to developed markets provides financial resilience. Both Europe and the US have clear mandates for sustainable aviation fuel (SAF), which provides clarity for demand.

LEADERSHIP By pioneering macaúba as a SAF feedstock, Acelen Renewables is building international recognition and setting foundations for global benchmarks for quality, traceability and social responsibility.

Milestones



Velocys | Altalto | UK



Aviation

SAF production

Velocys has been at the forefront of Sustainable Aviation Fuel (SAF) development for over two decades. Its UK-based Altalto project is designed to deliver second-generation SAF, which is projected to dominate supply by 2050. With regulations and decarbonisation strategies driving strong market growth, first-generation SAF cannot meet demand alone due to finite feedstock supply. One way to produce second-generation SAF is through the Fischer-Tropsch (FT) process, which can utilise a much broader range of non-food feedstock waste materials. Besides directing this feedstock to a higher-value application, SAF production also brings greater long-term economic and climate benefits.

Drawing on lessons from its initial basis of design, the company has shifted to a modular approach that reduces costs, minimises integration risks and strengthens the business case. Design optimisation and continuous development resulted in a significant reduction in capex costs at the small-scale demo stage. The Altalto project is linking proven FT technology to abundant waste feedstocks and reducing risk to demonstrate that SAF can be both bankable and socially beneficial.

100 ktCO₂eq

GHG emissions avoided annually



23 kt

SAF produced annually



©Velocys Altalto project visualisation

Project insights

[READ FULL CASE STUDY ▶](#)

AGILITY It's wise to start small, test the solutions thoroughly, and scale up gradually. A modular design reduces risk and improves investability.

FLEXIBILITY The current landscape is full of uncertainties relating to legislation, infrastructure, logistics and market dynamics. A foundation for long-term resilience is provided by flexibility in technology, geography and financing.

INTEGRATION A combination of different technologies within one project poses technical challenges. Owning the integration of the front end avoids costly commissioning errors. Leveraging external expertise of EPC contractors and technology providers is essential.

Milestones



2020

Developing the technology and the production model



2025

Market reach and investment bridging; received planning consent; received Advanced Fuels Fund (AFF) grant.



2026

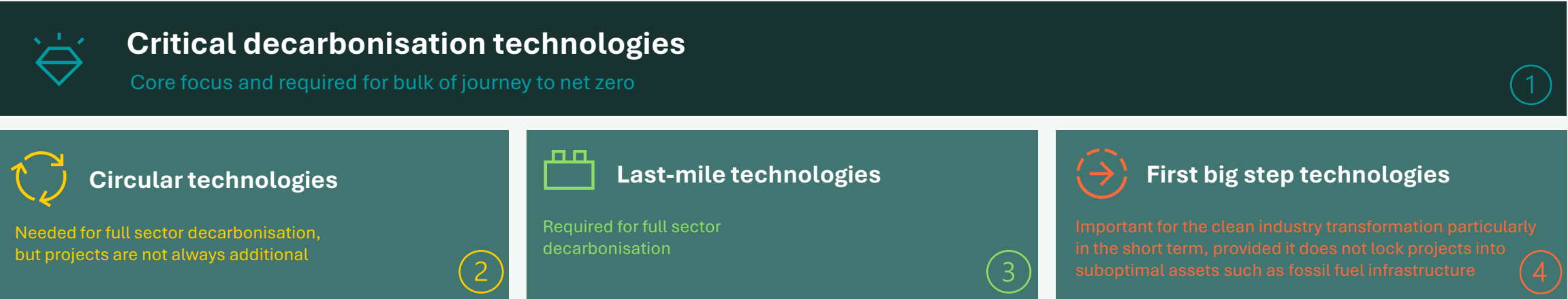
Expected to complete FEED



2030

Targeting to start operations

We have set more explicit and consistent requirements for projects in our ‘critical decarbonisation’ pipeline; at the same time, **we want to recognise the broader progress that is happening.**



The following case studies **show significant progress** in categories 2, 3 or 4:

- **CBI Ghana LC3 | Ghana**
- **Vicat Argilor | France**
- **Ecocem ACT Dunkerque | France**
- **Aluminium Dunkerque | France**
- **Hydro Alunorte | Brazil**



Aluminium Dunkerque | France



Aluminium

Low-carbon primary smelter



€300 m

Estimated for full-scale carbon capture



Customers

Automotive, construction, packaging, electronics

Aluminium Dunkerque is one of Europe's most advanced aluminium producers, operating with one of the lowest carbon footprints globally. The site is undergoing a multi-phase transformation to further reduce emissions and future-proof operations. Its roadmap includes:

- Operational efficiency and energy upgrades (2022–2026)
- Carbon capture deployment (2026–2035)
- Expansion with inert anode technology (post-2035)

The company has already achieved <4 tCO₂e per tonne of aluminium for its entire production considered as today's low-carbon benchmark. It is already integrating recycled content, investing in AI and big data to improve process efficiency, and recently secured clean electricity through long-term PPAs with EDF (nuclear) and Engie (renewables).



4 tCO₂eq/t

Aluminium GHG emissions intensity vs >11t global average



285 kt

Primary aluminium produced annually



750

Total jobs

Project insights

[READ FULL CASE STUDY ►](#)

TECHNOLOGY For aluminium smelters, moving beyond clean electricity is technically challenging. Aluminium Dunkerque is investigating different options including recycling, capture of process CO₂ and, in the longer term, expansion with inert anodes.

POWER Aluminium Dunkerque is working continuously to ensure reliable supply of clean and affordable power. This effort culminated in 2025 when the company secured a long-term agreement with EDF and Engie covering 100% of its needs.

DEMAND There is growing market traction for low-carbon aluminium, especially from automakers. With an intensity of 4 tCO₂eq/tAl, Aluminium Dunkerque is well positioned and even experienced its first market bid for aluminium below 3 tCO₂eq/tAl.

PARTNERSHIPS Establishing a CO₂ value chain is a complex and lengthy process. For its carbon capture project, Aluminium Dunkerque collaborates with local partners to ensure stakeholder alignment and effective delivery of the CO₂ infrastructure.

Milestones



2023

Announced carbon capture project consortium



2025

Commissioned new recycling furnace in May



2025

Secured 10-year nuclear and renewable PPA



2030

Expected commissioning of carbon capture project



2035

Capacity expansion on inert anode technology



2040

OPERATIONAL | ALUMINIUM

Hydro Alunorte | Brazil



Alumina
Low-carbon refinery



€260m
Investment for fuel switch and electric boilers



Customers
Primary aluminium producers, incl. Hydro's own smelters

Hydro Alunorte, the world's largest alumina refinery outside China, is leading the way in pragmatic industrial decarbonisation. Located in Brazil, the site is implementing a multi-phase strategy to reduce emissions while maintaining and even improving competitiveness. Its roadmap includes:

- Fuel switch from oil to natural gas
- Electrification with high-efficiency electric boilers
- Biomass integration using local açai kernel waste
- Electric calcination pilot and deployment (2030–2040)

The site has already cut 700,000 tonnes of CO₂ annually through fuel switching and secured long-term renewable PPAs covering 60% of its power demand. Hydro Alunorte is demonstrating how incremental, cost-effective steps can deliver deep emissions cuts today while preparing for full transformation by 2040.



1.1 MtCO₂eq
GHG emissions avoided annually since 2021



6.3 Mt
Alumina produced annually



12,000
Jobs created globally (across Hydro group)



Project insights

[READ FULL CASE STUDY ►](#)

TECHNOLOGY Hydro Alunorte is deploying proven, commercially available technologies including off-the-shelf electric boilers. The site has also retrofitted existing coal boilers to co-fire waste biomass. The company is preparing for electric calcination by 2040.

POWER Brazil's grid is more than 90% renewable, offering a structural advantage for electrification. Hydro Alunorte has secured two important PPAs (solar and wind) covering 60% of its power demand. This ensures access to clean, affordable electricity.

DEMAND Decarbonisation strategy is designed to be financially viable without future carbon pricing or charging a premium. Projects such as fuel switching and biomass have attractive economics, maintaining Alunorte in the 1st quartile of the global cost curve.

PARTNERSHIPS Hydro is advocating for the inclusion of alumina in the EU CBAM. This would reward early movers like Alunorte and discourage new coal-based refineries. The company also benefits from local tax agreements that support environmental initiatives.

Milestones



FINAL INVESTMENT DECISION | CEMENT

Ecocem Dunkerque | France

**Cement**

ACT formulation

**€50m**Project investment incl.
€3.6m public grant**Customers**Construction, architects,
ready-mix, precast,
masonry

Ecocem Dunkirk is the first commercial-scale facility deploying ACT technology, which replaces most clinker with blast furnace slag, limestone, and a proprietary mineral admixture. This innovation reduces CO₂ emissions by up to 70%, without compromising cost or performance. ACT is the result of more than 10 years of R&D and is designed as a drop-in solution for existing construction practices, enabling rapid market adoption.

The Dunkirk facility will be strategically located in a Regional Aid Zone with access to robust port infrastructure and proximity to major construction markets in Northern France and Paris, as well as export hubs. The plant will initially produce 300,000 Mtpa with plans for four additional plants to scale up to 1.9 Mtpa by 2029. ACT is already certified under ASTM C1157 in the US, has obtained a European Technical Assessment, and is undergoing national certification in France. Regulatory updates across Europe are expected to further facilitate market access by 2026.

**-70%**GHG intensity
compared to
conventional cement**300 kt**ACT cement
produced annually**1.9 Mt**Expected annual
production by 2030

Project insights

[READ FULL CASE STUDY ►](#)

ECONOMIC Because of its formulation and relatively simple production method, Ecocem will be able to sell ACT cement at market price without charging a premium. This has been a strong argument for potential customers to explore offtake.

SCALABILITY Beyond France and 1.9 Mtpa of expected capacity by 2030, Ecocem is exploring international partnerships to scale ACT globally such as India and Africa. It also started collaboration with Titan Group in Greece to develop a bespoke ACT formulation.

FINANCE The €50m project is entirely financed with debt, a quite rare financing structure for a first-of-a-kind facility as this one. Ecocem strong balance sheet, 22 years of profitability record and future market access gave sufficient confidence to the banks.

STANDARDS Ecocem worked with standard authorities to ensure market access. ACT has now obtained European Technical Assessment and is undergoing certification in France. EU cement norms are expected to include ACT by end of 2026.

Milestones



2022

ACT technology
announced

2023

ACT pilot in Normandy
ETA obtained

2024

ACT use demo project
in London

2025

Dunkerque plant
started construction

2026

ACT delivery on
the market

2030

Expansion to 1.9
Mtpa in France

CBI Ghana LC3 | Ghana



Cement

Activated clay-based low-carbon cement production



\$80m

Project investment (with 50:50 debt-equity ratio)



Customers

Construction, architects, ready-mix, precast, masonry

As the world's largest flash calciner to enter operation, CBI Ghana is spearheading the shift to calcined clay-based cement in Africa. The project responds to both economic and environmental imperatives, addressing high clinker import costs and the need for sustainable building materials. The company intends to use the clay in LC3 formulations, a type of cement blend that typically contains 50-60% clinker, 20-30% activated clay and 15-20% limestone. To enable this project, the company had to break through regulatory and market challenges, particularly the absence of a dedicated LC3 standard in Ghana.

CBI Ghana's flash calciner is an industrial furnace that rapidly heats, dehydrates (or 'calcines') and cools locally-sourced clay in a matter of seconds to create a pure and highly reactive activated clay. Activated clay is a highly promising Supplementary Cementitious Material (SCM) as it is widely available and provides strong concrete performance.



381 ktCO₂eq

GHG emissions avoided annually



400 kt

Activated clay produced annually



300

Jobs created during construction phase

Project insights

[READ FULL CASE STUDY ►](#)

ECONOMIC The cost of cement and clinker in Africa is particularly high due to high import dependence. This is partly because the continent does not have as many good quality limestone deposits required to produce clinker.

CARBON MARKET Activated clay is not yet recognised in international carbon markets that are supporting projects such as reforestation or clean cookstove. Receiving minimal carbon credits would greatly support the uptake of activated clay projects in Africa.

MARKET Due to the lack of infrastructure and housing in Ghana, cement demand is poised for significant growth. Locally-sourced clay is a great opportunity to meet this growing demand without adding expensive clinker imports.

STANDARDS Initially, Ghana cement standard did not allow the use of activated clay. CBI Ghana worked in collaboration with the national standard authority to develop a LC3 standard. Ghana has now the lowest authorised clinker content for LC3 cement of 35%.

Milestones



2016

Company founded



2019

Started grinding station based on imported clinker



2022

Signed EPC flash calciner contract



2024

Ghana's GS PAS 5:2024 LC3 standard adopted



2025

Calcined clay production started

Vicat Argilor | France



Cement

Activated clay-based low-carbon cement production



€60m

Project investment (incl. €13 m public grant)



Customers

Construction, architects, ready-mix, precast, masonry

As the first European industrial-scale flash calciner to enter operation, Vicat's Argilor facility is pioneering the shift to lower-carbon cement that helps meet France's RE2020 building regulations. The company noticed supportive market signals, with customers requesting lower-carbon alternatives in early 2022. Nowadays, every single tender they receive includes a decarbonization approach.

Its industrial-scale flash calciner is an industrial furnace that rapidly heats, dehydrates (or 'calcines') and cools clay in a matter of seconds to create a pure and highly reactive activated clay. Activated clay is a highly promising Supplementary Cementitious Material (SCM) as it is widely available and provides good concrete performance.



50 ktCO₂eq

GHG emissions avoided annually



120 kt

Activated clay produced annually



Project insights

[READ FULL CASE STUDY ►](#)

REGULATION The French RE2020 building regulation sets maximum limits on embedded carbon emissions in new buildings, incrementally promoting the use of low-carbon materials and a decarbonised construction industry.

REGULATION Vicat cites the Carbon Border Adjustment Mechanism (CBAM) as a powerful tool for leveling the playing field between EU producers and foreign competitors. However, CBAM must be watertight to be effective to avoid fraud risks.

INVESTMENT Vicat received a public grant of around €13m from the French Agency for the environment (France 2030 mechanism).

STANDARDS Slow evolution of the EN cement standards prevents putting less than 50% clinker into limestone activated clay cements, while it is technically viable.

Milestones



2021

Project first announced



2021

Received public funding from ADEME



2022

Started construction



2024

Started production

Appendix

The Global Project Tracker: methodology and updates

New data provide the most detailed and robust view yet of the global pipeline of commercial-scale clean industry projects, reflecting refined thresholds, tighter technology parameters and expanded data coverage in key emerging regions. To further enhance our insights, we also conducted interviews with 20+ project developers between July and September 2025.

Overview of key data improvements and notes on methodological update

Refined project eligibility thresholds	Eligibility criteria for category 1 projects continue to be applied across all sectors, focusing on <i>commercial-scale</i> projects with a minimum capacity of 0.1 Mtpa for all sectors other than Aviation with 0.01 Mtpa. Demonstration projects are included <i>only</i> where there is clear evidence of commercial ambition or scale-up potential, while pilot and R&D projects are excluded. This ensures the database captures projects with tangible near-term market and decarbonisation impact.
Tighter technology categorisation	Technology classification has been more rigorously tested, with <i>Category 1: Critical Decarbonisation Technologies</i> defined as solutions capable of achieving 70–80% emissions reduction compared with conventional processes. The framework applies stricter boundaries on what qualifies as a “critical decarbonisation” project, emphasising verified key low-carbon technologies with concrete planning and progress. Projects that do not meet the more rigorous criteria fall into the newly added categories 2-4.
Enhanced data sources and coverage	Data has improved significantly due to the inclusion of new verified global sources, especially from additional research on China. Regional project insights from Brazil, MENAT, Australia and India, have improved visibility into rapidly growing key regions. These additions enhance regional balance and provide a more complete picture of global deployment momentum.
Inclusion of Category 2-4 projects	Additional <i>Category 2-4</i> projects have allowed a broader examination of progress beyond the <i>Category 1: Critical decarbonisation</i> , investigating the diverse technologies required to drive industrial decarbonisation progress across value chains

Developer interviews	As a complementary source of information, we conducted interviews with 20+ developers between July and September 2025
FID timing	Our FID timeline counts from November each year to October the next year. For example, this past year’s FIDS captured so far run from November 2024 to October 2025.



1. For additional information on key data sources, methodologies, and set thresholds for each sector, please refer to the Global Project Tracker at tracker.missionpossiblepartnership.org
2. We reserve the right to make data adjustments within 30 days of the publication

Detailed methodology and definitions

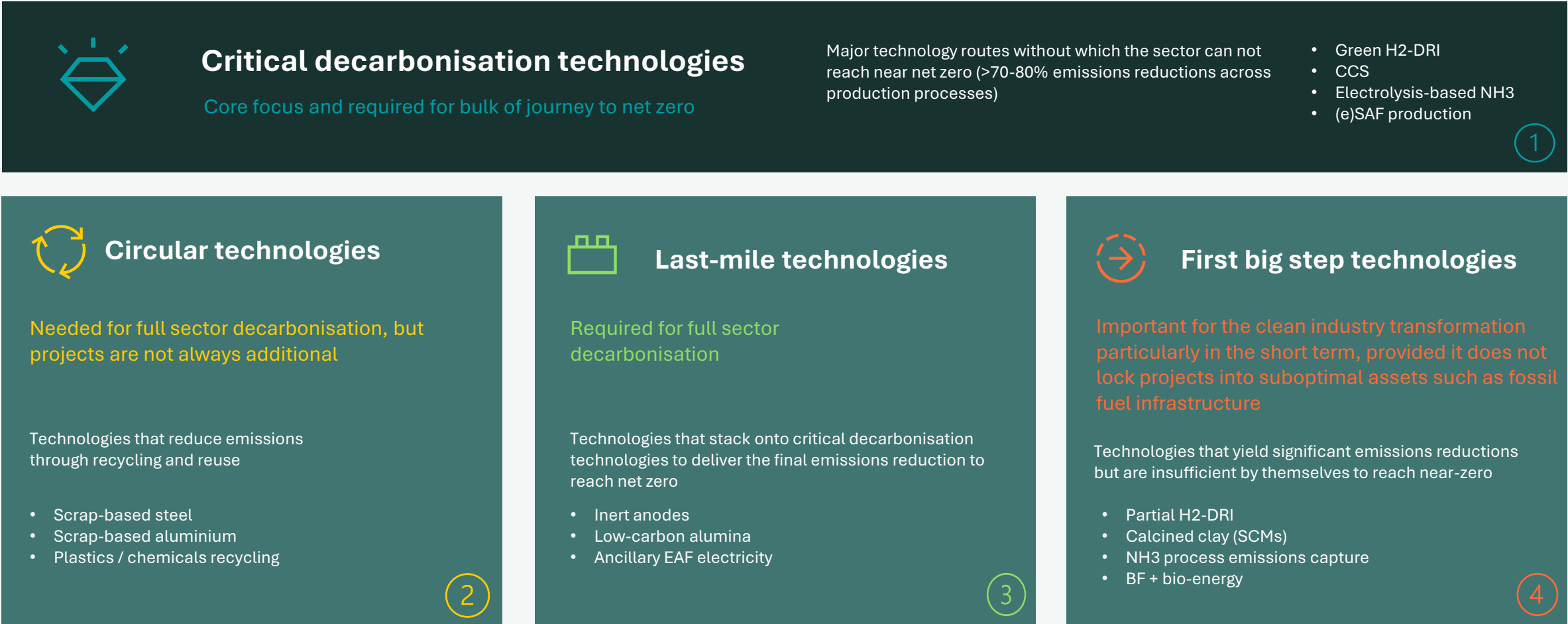
The data for this edition of the Global Project Tracker follows updated methodology across all projects and sectors, with the following criteria in the scope of **Category 1: Critical Decarbonisation projects**:

Sector	Data sources	In-scope products	In-scope Category 1: Critical Decarbonisation technologies ¹	Commercial-scale capacity threshold ²
Ammonia	Ammonia Energy Association (AEA), Primary Research	Ammonia	100% Biomass, Electrolysis, Electrolysis (ALK), Electrolysis (Other), Electrolysis (PEM), Electrolysis (Pressurized Alkaline Electrolysis), Electrolysis (SOEC), Grey H2 + CCS(ATR), Grey H2 + CCS(Gasification +process + flu gas capture), Grey H2 + CCS (Other), Grey H2 + CCS(Partial Oxidation), Grey H2 + CCS(SMR flu gas + process emissions capture)	0.1 Mtpa
Methanol	Methanol Institute (MI), Primary Research	Methanol	CCS (Natural Gas), Electrolysis + CO ₂ (biogenic / non-biogenic), Electrolysis + Gasification (Biomass), Electrolysis + Gasification (Residual waste), Gas reforming (Biomethane), Gasification (Biomass), Gasification (Residual waste)	0.1 Mtpa
High Value Chemicals	Systemiq research, IEA, The Global Partners for Plastics Circularity	Ethylene ³	Bio-ethanol dehydration	0.1 Mtpa
Aviation ⁴	Atoma Research, Primary research, Argus media	SAF	Ethanol-to-Kerosene (AtJ)-BtL, Ethanol-to-Kerosene (AtJ)-PtL, Ethanol-to-Kerosene (AtJ)-PtL/BtL, Fischer-Tropsch Synthesis-BtL, Fischer-Tropsch Synthesis-PtL, Fischer-Tropsch Synthesis-PtL/BtL, Hydrothermal Liquefaction-PtL/BtL, Methanol-to-Kerosene-BtL, Methanol-to-Kerosene-PtL, Methanol-to-Kerosene-PtL/BtL, Pyrolysis-BtL, HEFA-BtL	0.01 Mtpa
Aluminium	Primary research, historic data from International Aluminium Institute (IAI)	Primary Aluminium	100% clean electricity ⁵	0.1 Mtpa
Cement	Primary Research, historic data from LeadIT	Cement	Traditional production + CCS	0.1 Mtpa
Steel	Primary Research, historic data from LeadIT	Primary Steel, Iron	Green H2 Direct Reduction, NG/COG-DR (with concrete plans to transition to H2)	0.1 Mtpa



1. Includes Category 1 technologies for each sector for which commercial scale projects have attained in-scope pipeline status definitions, 2. For each sector, only projects above the set capacity threshold were included. This Includes commercial-scale plants, and demo projects with noted commercial ambition were included on a case-by-case basis (pilot and R&D level projects are excluded where identified); 3. Category 1 HVC technologies only include projects that produce ethylene; 4. Aviation technology categories adjusted to broadly align with ASTM pathways as well as Power to Liquid (PtL), Biomass-to-Liquid (BtL) and Power Biomass to Liquid (PBtL) categorization. Instances of reported SAF and HVO/ Diesel assume a 15% volume attributed to SAF. 5. Assumes fully decarbonized smelting of primary aluminum, does not include projects without ties to specific smelters, decarbonization of other processes for aluminum and alumina

We have set tighter parameters to identifying clean industrial projects as near-zero production, while **new categories recognise complementary approaches that are driving broader moves** towards clean industry across sectors.



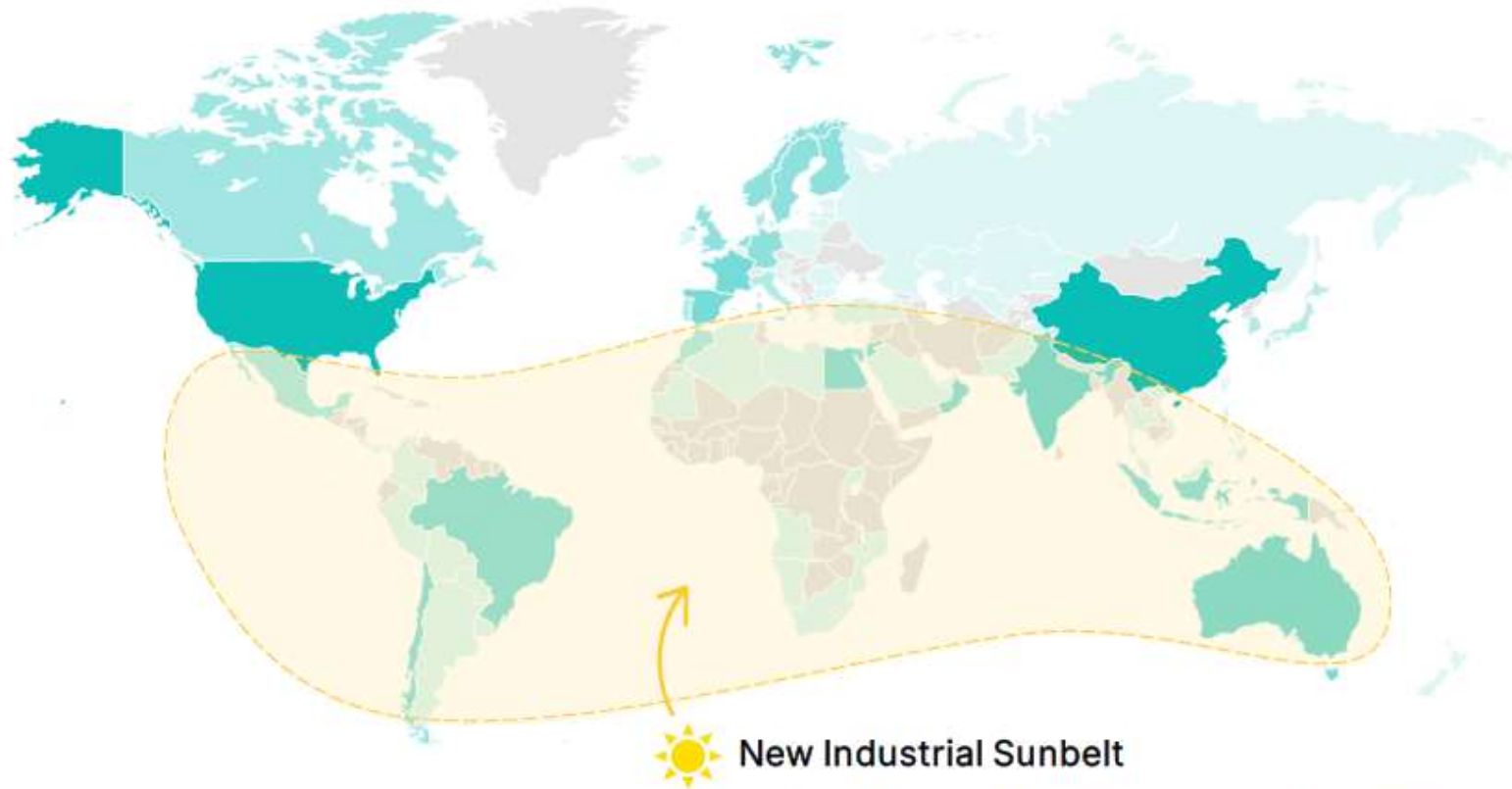
Back-up: tech routes per category

	Circular technologies	First big steps technologies	Last-mile reduction technologies
Ammonia		Ethane cracking + CCUS (byproduct) Grey H2 + CCS(SMR / gasification only process emissions capture) Grey H2 + CCU(SMR / gasification only process emissions capture) Methane pyrolysis (carbon black byproduct) Partial biomass	
Methanol		CCU + H2 (non-renewable) / ETL CCUS (Natural Gas) Gas reforming (Biomethane + Natural gas)	
High Value Chemicals	Chemical recycling Mechanical recycling Pyrolysis Depolymerisation Gasification	H2 fuelled cracker E-Cracker CCU Green MTO EOL: Biological Treatment EOL: Landfill gas upgrading EOL: Landfill gas to power EOL: Biocovers EOL: WtE + CCS	H2 –fuelled cracker CCS CCU (EOR)
Aviation		HEFA-BtL (Coconut oil feedstock)	
Aluminium	Scrap-based secondary production	100% clean electricity ¹ Captive coal with plans for hydro Partial clean electricity	Bioenergy for anode production Inert anodes Low-carbon alumina
Cement		Alternative Binder Chemistries Alternative Fuels Conventional SCMs SCM: Calcined clay Traditional production + CCUS ²	
Steel	Scrap-based secondary production Standalone EAF	BF + CCUS (<80% capture) NG/COG-DR (with concrete plans to transition to H2) NG/COG-DR (with no concrete plans to transition to H2) Traditional production + CCUS	BF + Bio H2 Production



Refers to the Rio Tinto Arvida AP60 extension and legacy projects 2. Usually cases are CCU or unclear how the captured carbon will be utilised

The 'New Industrial Sunbelt': Regions, including many EMDEs, that can capitalise on abundant low-cost clean energy to realise the available opportunity



Countries with an abundance of natural resource to produce renewable energy, competitive labour markets and good fundamentals to deliver plentiful clean hydrogen at lower costs. A fifth of all clean industry investments to date have flowed into new industrial sunbelt countries.

Glossary

Term	Definition
Final Investment Decision	The project stage at which a formal commitment is made by the company's senior management and project stakeholders to proceed from the planning stage to the construction phase. FID marks the point at which the necessary resources are allocated to the implementation of the project.
Electrolyser	An electrochemical device that performs electrolysis, which is the process of splitting water into hydrogen and oxygen using an electric current. Water electrolyzers differ in terms of the technologies applied, dynamics, efficiency, cost and required materials.
Biomass gasification	A thermochemical process that converts organic feedstock, such as wood or agricultural waste, into a mixture of hydrogen and carbon monoxide. This synthesized gas can then be catalytically transformed into liquid fuels through a Fischer-Tropsch process.
Waste-to-fuel	A production pathway that enables municipal solid waste to be converted into liquid fuel. This process involves a gasification step for the solid feedstock, followed by a Fischer–Tropsch reaction.
Power-to-liquid	An e-SAF production pathway that uses renewable hydrogen and captured carbon dioxide. The hydrogen is then used to convert the carbon dioxide into carbon monoxide, which is necessary for future production steps.
Fischer-Tropsch	A catalytic method of converting syngas — a mixture of carbon monoxide and hydrogen — into liquid hydrocarbons, such as synthetic fuels and chemicals. FT enables the conversion of hydrogen and carbon monoxide from various sources into aviation fuel.

Term	Definition
Blue ammonia	Ammonia which is produced using fossil feedstock. The generated carbon dioxide (CO ₂) is captured and stored or utilised.
Green ammonia	Ammonia produced without the use of fossil fuels. The most mature production technology is electrified Haber-Bosch, which uses electrolytic hydrogen and nitrogen captured from the air.
HEFA	A process that converts pre-treated bio-feedstock into aviation fuel and biodiesel. The primary feedstocks are waste fats, oils and grease. Although it is the most widely adopted SAF technology today, its potential is constrained by the limited availability of the currently used feedstocks, so alternative sources are being researched.
NH₃	Chemical formula of ammonia, which can be used, for example, in fertiliser, chemical, energy, and transport sectors.
H₂-DRI	Process for producing green iron by directly reducing iron ore into iron using hydrogen instead of the natural gas or coal typically used in conventional processes. Using hydrogen avoids the synthesis of carbon dioxide during the process.
Feedstock / bio-feedstock	Feedstock is a raw, unprocessed material used in the production process. Bio-feedstock is a material of biological origin. Wood waste, for example, is a bio-feedstock, which can be used for sustainable aviation fuel production.



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