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Argus *Hydrogen and Future Fuels*

Market news, analysis and prices

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What role for clean H2 in South Korea?

Plans for a cleaner grid may leave no future for ammonia co-firing, and recent events will reinforce resolve to reduce import reliance, writes Stefan Krumpelmann

For a while, imports of clean hydrogen and derivatives were expected to take centre stage in South Korea's energy future. But a change in government and war in the Middle East have shifted the focus to domestic clean energy generation, and hydrogen imports could be sidelined to a supporting role.

South Korea in 2021 set a target of using 3.9mn t/yr of hydrogen by 2030. Roughly half of this was to be imported from regions with abundant potential for low-cost production. Imports were expected to rise to 22.9mn t/yr by 2050, accounting for over 80pc of supply by then. Hydrogen and derivatives were expected to be used widely across industry, power generation and transport.

While these targets have not been abandoned officially, the 2030 goals are far out of reach and policy objectives have changed.

After taking office last year, the government of President Lee Jae Myung increased the country's 2030 renewable power capacity target to 100GW from 80GW previously. The existing figure stands at 37GW.

The government also announced plans for an accelerated phase-out of coal-fired power, with direct implications for hydrogen and derivatives. Seoul called off a second round of its clean hydrogen power generation bidding market, as the coal phase-out decision effectively rules out long-term ammonia co-firing.

War in the Middle East has provided fresh impetus for a government drive to strengthen domestic energy output — South Korea relies heavily on imported fossil fuels, including oil and LNG from the Mideast Gulf.

"It is time to establish a new energy security system capable of drastically reducing dependence on imports by expanding domestic production," the ministry of climate, energy and environment said on 7 April. The government now says it aims to reach the 100GW renewables target for 2030 "ahead of schedule".

The ministry's statement focused primarily on increased electrification, including a "complete transformation" of the national power grid. But it also referenced support for hydrogen production using renewable and nuclear power, hydrogen consumption in steelmaking and adoption of hydrogen-powered vehicles.

An imminent relaunch of the clean hydrogen power generation bidding market's second round may be focused exclusively on co-firing domestically produced hydrogen with natural gas, industry participants say, although the government has yet to finalise the exact plans. Participants in the mechanism previously looked primarily to cheaper supply from abroad, including ammonia produced from natural gas with carbon capture and storage (CCS) in the Middle East.

Even before the war started, delays in renewable and CCS-based hydrogen projects globally cast doubts over import plans. And with the government encouraging domestic output, major firms like Hyundai have advanced ambitious plans for renewable hydrogen production and development of in-house technologies.

Imports will arguably still have a role, however, given cost advantages and investments already made. Renewable ammonia from elsewhere in Asia could be a particularly attractive proposition. Engineering firm Samsung C&T signed a binding $3bn deal last month for renewable ammonia supply from India's Reliance — possibly to replace volumes from a delayed Saudi CCS-based project destined for co-firing by utility Kospo. And in February, Lotte Fine Chemical received a first renewable ammonia cargo from China's Envision Energy.

South Korea H2 targets (from 2021)

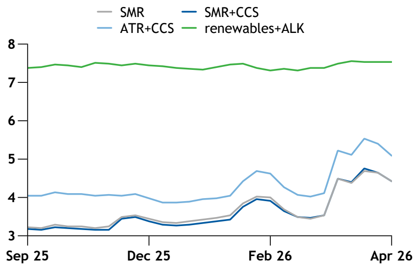
	Domestic production	Imports
2030	940,000 t/yr conventional/unabated; 750,000 t/yr CCS-based; 250,000 t/yr renewable	1.96mn t/yr renewable
2050	3mn t/yr renewable; 2mn t/yr CCS-based	22.9mn t/yr renewable

— government

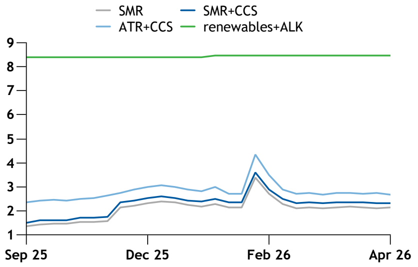
CONTENTS

HYDROGEN COSTS

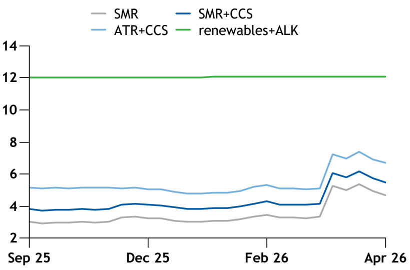
Northwest Europe average cost €/kg



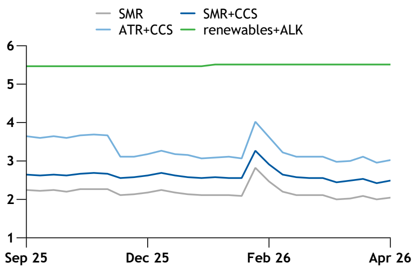
North America average cost $/kg



Northeast Asia average cost $/kg



Exporter average cost $/kg



Regional hydrogen cost markers — 7 Apr

			Incl. capex		Excl. capex	
	Process	Unit	Cost	± 31 Mar	Cost	± 31 Mar
Baseline						
Northwest Europe	SMR	€/kg	4.42	-0.22	3.57	-0.21
Northwest Europe	SMR	$/kg	5.10	-0.24	4.12	-0.24
North America	SMR	$/kg	2.13	+0.01	1.07	+0.01
Northeast Asia	SMR	$/kg	4.68	-0.24	3.71	-0.23
BAT+						
Northwest Europe	SMR+CCS	€/kg	4.43	-0.22	3.46	-0.24
Northwest Europe	SMR+CCS	$/kg	5.11	-0.25	4.00	-0.26
North America	SMR+CCS	$/kg	2.31	-0.01	1.11	-0.02
Northeast Asia	SMR+CCS	$/kg	5.49	-0.24	4.40	-0.23
Low-C						
Northwest Europe	ATR+CCS	€/kg	5.10	-0.29	4.03	-0.28
Northwest Europe	ATR+CCS	$/kg	5.89	-0.32	4.65	-0.31
North America	ATR+CCS	$/kg	2.66	-0.10	1.32	-0.10
Northeast Asia	ATR+CCS	$/kg	6.68	-0.23	5.44	-0.23
No-C						
Northwest Europe	Island renewable+PEM	€/kg	7.53	-0.01	6.13	-0.02
Northwest Europe	Island renewable+PEM	$/kg	8.69	nc	7.08	nc
North America	Island renewable+PEM	$/kg	8.47	nc	6.68	nc
Northeast Asia	Island renewable+PEM	$/kg	12.07	nc	10.49	nc
Exporter						
Exporter baseline	SMR	$/kg	2.05	+0.06	1.26	+0.10
Exporter BAT+	SMR+CCS	$/kg	2.50	+0.07	1.61	+0.10
Exporter low-C	ATR+CCS	$/kg	3.02	+0.06	2.00	+0.08
Exporter no-C	Island renewable+PEM	$/kg	5.52	nc	3.49	nc

Argus hydrogen taxonomy

	Purity	Pressure	tCO_2e/tH_2
Baseline	99.9%	30 bar	<11.3, >8.0
BAT+	99.9%	30 bar	<2.88, >1
Low-C	99.9%	30 bar	<1, >0.5
No-C	99.99%	30 bar	<0.01

CO_2e emissions on a gate-to-gate basis

Pump prices, 70MPa — 2 Apr

	Unit	Price		± 2 Mar
Japan				
Iwatani	¥/kg	1,650.00		nc
		Low	High	
Eneos	¥/kg	2,200.00	2,750.00	nc
Germany				
		Low	High	
H2Mobility (stations with conventional H2 supply)	€/kg	15.05	19.25	nc
H2Mobility (stations with "green" H2 supply)	€/kg	13.00	18.25	-0.01

MARKET DEVELOPMENTS

Canada e-fuel plants need tax credit tweaks: Developer

The developer says clean hydrogen project cancellations should free up funding for e-fuels, writes Chingis Idrissov

Toronto-headquartered project developer StormFisher has asked the Canadian government to extend the country's clean hydrogen investment tax credit (ITC) to cover e-methanol, e-methane and synthetic aviation fuel (e-SAF) production, arguing that Ottawa has the budgetary scope to do so.

The clean hydrogen ITC in its current form covers capital expenditure (capex) on hydrogen production equipment at rates of 15pc, 25pc or 40pc, depending on the carbon intensity. Developers can also claim a separate 15pc credit on capex for an ammonia synthesis plant, but no equivalent credit exists for any other hydrogen derivative, including e-fuels. StormFisher is asking for that same 15pc rate to be extended to e-fuel synthesis equipment.

The firm says it could be "difficult to achieve the required profitability" for its planned 72,000 t/yr e-methanol plant in Varennes, Quebec, based on "expected sales prices", which is why it has proposed the amendment.

The plant will use a 100MW electrolysis plant operated by Hydro-Quebec and 100,000 t/yr of biogenic CO_2 from a neighbouring ethanol plant and landfill sites. Total additional investment to complete the electrolyser and the e-methanol plant is estimated at around C$650mn ($468mn), with construction due to start in 2027 and first production in 2028.

For StormFisher, the credit extension would be worth around C$94mn. The Varennes plant would add C$54.9mn a year to Canadian GDP and generate C$5.5mn annually in federal tax revenues, as well as C$5mn for Quebec, StormFisher says. This is enough for the government to recoup the C$94mn credit within 18 years, against a planned 24-year plant life, the firm says.

The developer identified five other active Canadian e-fuel projects that would also benefit (*see table*). Some of the other developers provided StormFisher with information on their capital cost expectations. Based on these, the total cost of extending the tax credits could amount to C$379mn, assuming that 100pc of capital investments qualify, StormFisher says.

Clean H2 investment tax credit (ITC)

H2 carbon intensity in kg of CO2e/kg	
<0.75	40pc
=>0.75, <2	25pc
=>2, <4	15pc

— Canadian government

PBO's cost estimates for clean H2 ITC

Fiscal year	Cost *C$mn*
2023-24	133
2024-25	403
2025-26	920
2026-27	1,970
2027-28	2,312

— Parliamentary Budget Office (PBO) 2024

The money's there

StormFisher argues that the government can afford this. Ottawa put the cost of the clean hydrogen ITC at C$5.7bn over 2023-28 and said it anticipated that many projects would withdraw. Drawing on data from the Canadian Hydrogen Association, the report puts the likely spend at around C$2.8bn once cancelled and stalled projects are stripped out. This leaves around C$2.7bn to spare, roughly seven times the maximum cost of the amendment. The main driver of that gap is the contraction of Canada's hydrogen project pipeline — Newfoundland and Labrador pulled public land access from three wind-based hydrogen projects totalling nearly 2GW of planned electrolyser capacity, and the total shortfall against earlier announcements now tops 2.1GW, StormFisher says.

If all six e-fuel projects go ahead, the government would also face up to C$1.3bn in ITC claims on the electrolyser and hydrogen plant equipment at those sites under existing rules, regardless of whether the amendment is adopted. But StormFisher notes that some of that bill, particularly from TES Canada's e-methane project in Quebec, was probably already baked into the government's original ITC budget so the net extra cost could be lower.

The case for the amendment also rests on shipping demand. The EU's FuelEU Maritime regulation and the IMO's proposed net-zero framework are expected to drive demand for low-carbon methanol. StormFisher cited DNV's tracker showing more than 450 methanol-capable ships are already in operation or on order globally, against 48 ammonia-capable ships and 47 hydrogen-capable ships.

E-fuel projects under development

Developer	Location	E-fuel type
StormFisher	Varennes, Quebec	E-methanol
TES Canada	Shawinigan, Quebec	E-methane
Greenfield Global	Varennes, Quebec	E-methanol
Nova Sustainable Fuels	Goldboro, Nova Scotia	Bio/e-SAF, renewable methanol
Elemental Clean Fuels	BC/ Alberta	E-methanol, e-methane
Teralta Hydrogen Solutions	Brandon, Manitoba	E-methane

— StormFisher & Gougeon EP March 2026 report, Argus

NEWS

Greece plans 1pc green H2 transport quota for 2030

Greece's government has proposed a 1pc quota for renewable fuels of non-biological origin (RFNBOs) in road transport for 2030, according to a draft law released for consultation.

The proposal aligns with the EU's revised renewable energy directive (RED III), which requires member states to ensure that RFNBOs make up at least 1pc of road transport fuels by 2030. The draft allows for the quota to be met through the so-called 'refinery route', meaning refiners can replace fossil hydrogen with renewable hydrogen for fuel production. It would also introduce a minimum 1.2pc RFNBO quota for the maritime sector in 2030, and apply a multiplier of two for RFNBO use in road transport and of 1.5 for the maritime and aviation sectors.

Unlike some other countries, Greece's proposal does not include a phase-in of quotas before 2030s or a trajectory with increasing quotas throughout the 2030s. Nor does Greece's proposal set specific penalties for non-compliance. Instead, fines would be decided by the ministry on a case-by-case basis.

The government's consultation runs until 14 April.

The bill also states that 42pc of all industrial hydrogen use should be renewable by 2030, rising to 60pc by 2035, in line with RED III requirements. But like most EU member states, Greece has not set company-specific obligations or defined mechanisms to reach this target.

Greece's hydrogen demand was nearly 350,000t in 2024, according to data from the European Hydrogen Observatory. Almost 330,000t of this was used in refineries and most of this would fall under the transport targets. The remainder was primarily for ammonia production.

Some renewable hydrogen projects are under development in Greece, including Motor Oil Hellas' under-construction 50MW electrolyser at the Corinth refinery, a 100MW electrolysis project in Lamia planned by a German joint venture, and a Helleniq Hydrogen plant in the north of the Macedonia region.

Greek gas transmission system operator Desfa last week opened a tender for the environmental impact assessment of its planned hydrogen pipeline. The H2dria pipeline would run 570km and connect production units with demand mainly in the Athens, Corinth and Thessaloniki industrial areas, and would link up with a planned hydrogen pipeline in Bulgaria, Desfa says.

By Pamela Machado

Proposed H2dria pipeline

— Desfa

Canadian project selects Plug for 275MW electrolysers

Germany's Hy2gen has selected US firm Plug Power to supply 275MW of electrolyser capacity for its Courant renewable ammonium nitrate project in Canada.

Plug will provide front-end engineering design services and support "electrolyser integration, plant configuration and performance optimisation", the US firm says. Plug will provide its GenEco proton exchange membrane electrolysers for the project. The deal with Hy2gen is one of Plug's "largest electrolyser project awards" so far, it says.

Hy2gen is planning to make around 480,000 t/yr of ammonium nitrate using 307MW of hydropower from utility Hydro-Quebec. The ammonium nitrate will be supplied to local offtakers for manufacturing explosives. Hy2gen aims to take a final investment decision on the project next year and to commission the plant by 2030.

Plug is also developing its own renewable hydrogen projects, but has scaled back plans for new plants. The firm recently sold a site in New York state that was earmarked for a 120MW electrolysis plant to a data centre developer.

By Stefan Krumpelmann

NEWS

Chilean firm advances 420,000 t/yr e-methanol plant

Antofagasta, Chile

Chilean chemical producer NorQuim has submitted an environmental impact assessment for a 420,000 t/yr e-methanol plant in Chile's Antofagasta region.

The facility will form part of an industrial complex that will also include a plant producing lithium and copper mining inputs, such as soda ash, calcium chloride and lime. Chilean mining companies currently import these products, NorQuim says.

NorQuim plans to invest \$1.2bn in the e-methanol plant and \$900mn in the inputs plant. Construction is due to start in 2028, and the complex is expected to be complete by 2035. The environmental impact assessment for the mining inputs plant is expected to be submitted in mid-April, NorQuim says.

Producing 420,000 t/yr of e-methanol would require about 80,000 t/yr of renewable hydrogen. This suggests that the plant would have to draw on some 1GW of electrolysis capacity.

NorQuim says it intends to use mainly biogenic CO_2 from the adjacent inputs plant for e-methanol production. The company was not immediately available to comment further on the exact origin of the CO_2.

Potential target markets for e-methanol are the shipping and aviation sectors, NorQuim says.

By Pamela Machado

Spain finalises hydrogen bank subsidies

Spain has finalised subsidies for a third project under the auction-as-a-service (AAAS) mechanism of the second European Hydrogen Bank round, while another project appears to have dropped out of the process.

The ecological transition ministry has issued a resolution approving €93.6mn (\$107.9mn) in operating subsidies for developer AccionaPlug — a joint venture between Spanish renewables firm Acciona and US hydrogen company Plug Power. AccionaPlug will receive €2.53/kg of hydrogen over a 10-year period for 3,700 t/yr of output at its 25MW H2 Valley Navarra project, in northeast Spain. This is the highest successful submission across both hydrogen bank rounds.

A document from the ministry's energy saving and diversification institute suggests that developer Hy4Greenvillafranca did not submit its application on time and will forfeit the support. The institute had not replied to *Argus'* request for confirmation by the time of publication. Hy4Greenvillafranca would have received €20.5mn in total, based on a bid of €1.50/kg.

The two projects were invited for grant negotiations in November after Dutch Power2X withdrew its application to receive nearly €246mn.

Two other projects previously already agreed to subsidies under Spain's AAAS. Smartenergy accepted support for its 100MW Orange.bat project, and Elyse Energy will get funding for the 60MW eM-Numancia e-methanol plant. Projects are required to start operations within the next five years to receive the support.

Madrid initially earmarked €400mn for the second hydrogen bank round under the AAAS scheme, but will only disburse €220mn. AccionaPlug's bid was the highest submitted by any of the 36 Spanish projects that participated in the second hydrogen bank auction, EU data indicate. This suggests that no further projects can be called up to replace Hy2Greenvillafranca. All Spanish projects that submitted eligible bids and did not withdraw their application have now been selected for subsidies either from the EU pot or the Spanish budget.

Spain set aside €440.5mn for the third hydrogen bank round under the AAAS scheme. The round closed in February, but winners have yet to be announced.

By Pamela Machado

Projects supported under Spanish AAAS

Project	Developer	Vol *t/yr*	Subsidy *€/kg*	Aid *€mn*
eM-Numancia	Elyse Energy	6,360	0.69	43.9
Orange.bat	Smartenergy	11,960	0.69	82.5
H2 Valley Navarra	AccionaPlug	3,700	2.53	93.6

— Eological transition ministry

NEWS

Lhyfe trims hydrogen pipeline to focus on key projects

French hydrogen developer Lhyfe has scaled back its project pipeline and now has around 1.5GW of electrolysis capacity at an advanced development stage or beyond, down from more than 4.6GW at the end of 2024.

The revised pipeline represents about €4.5bn ($5.1bn) of potential investment, according to the company's 2025 results.

Projects in operation, under construction or at the awarded or tender-ready stages total 353MW of capacity — roughly 200MW less than at the end of 2024.

Lhyfe says it is prioritising investment in "the most mature European projects" and those "best aligned with concrete market developments and regulatory progress". Priority sectors include industry in the UK and mobility and refining in the EU. The firm has halted work on some projects over the past year, including a 600MW plant in Sweden and a 100MW project in western France.

The company plans to take a final investment decision (FID) on the 100MW Green Horizon project in Le Havre in early 2027. It previously targeted an FID in 2026 after securing a €149mn French government subsidy last year.

Lhyfe reported €10mn in revenue for 2025, nearly double the €5.1mn in 2024. But it still incurred a net loss of €51mn, well up from the €29.2mn a year earlier.

Its current operations centre on small-scale plants with 21MW of combined electrolysis capacity serving mobility and industrial users in France, Germany and the Netherlands. The company expects to commission an additional 15MW of electrolysis capacity across two French sites in 2026.

By Pamela Machado

Lhyfe hydrogen project pipeline *MW*

Project stage	End 2025	End 2024
In operation	21	22
Under construction	17	33
Awarded stage	10	10
Tender ready stage	305	510
Advanced development	1,100	4,100

— Lhyfe

Egyptian, Chinese firms team up on green H2, NH3

Four companies have signed a preliminary agreement to develop a renewable hydrogen plant in Alexandria, Egypt, to feed ammonia and fertiliser production.

Construction firm Orascom and Hong Kong-listed Chinese developer UEG Green Hydrogen will lead feasibility studies for 500MW of wind and solar generation and the hydrogen production plant. Egyptian producers Abu Qir and Alexfert plan to use the output for their existing ammonia and fertilizer sites in Alexandria.

The firms are targeting 480 t/d, or roughly 175,000 t/yr, of renewable ammonia, compliant with the EU's renewable fuels of non-biological origin (RFNBO) rules. This would require around 85 t/d of hydrogen, or around 31,000 t/yr.

The agreement sets a framework for co-operation while the partners conduct technical, commercial and regulatory assessments. Definitive agreements will follow subject to the outcomes of these, the firms say.

The deal follows a December 2024 plan by Abu Qir to source 50 t/d of renewable hydrogen to raise capacity at one ammonia plant and partly replace natural gas at two others. Abu Qir cited supply security, emissions reduction and compliance with the EU carbon border adjustment mechanism as key drivers.

Abu Qir holds a 45pc stake in North Abu Qir Agricultural Nutrients, which is developing a 2,400 t/d ammonium nitrate plant adjacent to Abu Qir's fertiliser complex in Alexandria. North Abu Qir Agricultural Nutrients signed several preliminary agreements with international firms for renewable hydrogen supply, but no further announcements have followed.

Egypt has one of the largest project pipelines for production of renewable hydrogen and derivatives. But there has been little tangible progress recently, with industry participants citing numerous hurdles for development, including a lack of suitable electricity transmission infrastructure.

By Chingis Idrissov

Alexandria, Egypt

ANALYSIS

Biogenic H2 debate holds back German RFNBO quotas

Bayernoil says a 'refinery route' for biogenic hydrogen makes sense while not enough RFNBO hydrogen is available, others say it would be a waste of resources, writes Stefan Krumpelmann

German hydrogen industry participants are increasingly frustrated by delays to the country's revised law on trimming greenhouse gas (GHG) emissions in the transport sector. Policy makers have yet to make decisions on numerous contentious questions, including whether or not biogenic hydrogen used in refineries should count towards GHG quotas.

Germany's lower house of parliament, the Bundestag, was due to discuss and vote on the government's proposed law in late March, which would have paved the way for implementation. But the vote was postponed and implementation will now happen no earlier than May — even though the law is supposed to apply retroactively from the start of 2026.

Industry participants say several sticking points remain, including the level of sub-quotas for renewable fuels of non-biological origin (RFNBOs) and a potential separate GHG quota for the maritime sector.

Biogenic hydrogen — made, for example, from biomass or biogas — also remains a hotly debated topic. As it is not an RFNBO, biogenic hydrogen cannot count towards the sub-quotas. And while it can be used towards wider GHG quotas, this is only the case for supply made available directly to the transport sector. Biogenic hydrogen used as an intermediate product in refineries cannot generate certificates, under the government's proposal from December.

For some industry participants, this exclusion is a major shortcoming that the Bundestag should rectify in a final text. South German refiner Bayernoil in particular has advocated strongly in favour of opening the so-called 'refinery route' for biogenic hydrogen.

Bayernoil, which produces biogas and uses some to make biomethane for refining, argues that wider adoption of biogenic hydrogen will be needed in a transition phase during which not enough RFNBO-compliant hydrogen is available. Biogenic hydrogen could be much cheaper to produce than RFNBOs and allowing the refinery route could provide new offtake opportunities, the firm says.

As with RFNBOs, using biogenic hydrogen in refineries would arguably be the most cost-efficient deployment option and there is no reason why this should be excluded, Bayernoil says. In terms of overall transport sector emissions and the logic of the EU's revised renewable energy directive (RED III), it is irrelevant at which point of the value chain emissions reductions are achieved, the refiner argues.

Germany's planned H2 sub-quotas*

Year	Government draft %†
2026	0.1
2027	0.1
2028	0.5
2029	0.5
2030	1.2
2031	1.2
2032	1.5
2033	1.5
2034	2.5
2035	2.5
2036	4.0
2037	5.0
2038	6.0
2039	7.0
2040	8.0

**measured as share of overall fuel supplied to the road transport sector;*
†Germany's upper house of parliament, the Bundesrat, has proposed higher quotas for 2030-34 and the final decision rests with the lower house of parliament, the Bundestag

— government draft bill

Bio degrading?

But others — including some developers of electrolysis projects and numerous environmental groups — have argued strongly in favour of excluding biogenic hydrogen from the refinery route. They note that biogas, and especially biomethane that is made through further processing, is still scarce. Making biogenic hydrogen is a highly inefficient use of whatever little is available, they say.

Moreover, wider adoption of biogenic hydrogen in refineries could hamper the ramp-up of electrolytic hydrogen, opponents argue. There is a risk that opting for a cheaper short-term solution could hinder development of technologies that are needed in the long term, according to think-tank Agora Energiewende. However, Bayernoil argues that such concerns are addressed through the separate RFNBO sub-quota that specifically supports development of electrolysis projects.

Policymakers in the Bundestag will have to make a final call on which path to take for biogenic hydrogen. The upper house, the Bundesrat, left the government's text unchanged on this, although its committees recommended urging the government to investigate the benefits and risks of unlocking the refinery route for biogenic hydrogen.

INTERVIEW

H2-readiness still critical for US turbine buyers: MHI

Engineering firm Mitsubishi Heavy Industries (MHI) has pledged to reach net-zero emissions by 2040, one of the most aggressive targets in heavy industry. Argus spoke with senior general manager Shin Gomi about how the company is balancing these commitments with the surge in US demand for fast, firm power and why hydrogen-ready turbines are critical for this. Edited highlights follow:

In the US, nearly all new large-load power requests are focused on natural gas. How do you reconcile that with Mitsubishi's commitments to net-zero?
From Mitsubishi's perspective, the path forward is not eliminating fossil assets, but decarbonising them over time. For coal, that means carbon capture systems or co-firing ammonia. For natural gas, it means transitioning toward hydrogen co-firing and eventually 100pc hydrogen use. So even though today's demand, especially in the US, is overwhelmingly for gas, that does not contradict the energy transition pathway. These same assets can become net-zero thermal plants through ammonia, hydrogen or CO_2 capture.

Are your US-bound gas turbines H2-ready and are customers interested in this?
Yes. Every turbine we sell today is H2-ready. That is now a baseline requirement, not a separate product line. Customers absolutely have not abandoned net-zero targets. Most still have 2040–50 climate commitments, and they ask us explicitly to ensure compliance with today's emission standards, and readiness for tomorrow's requirements, whatever those may be. Right now, customers are chasing demand first — particularly from data centres — but they want to know that they have options if hydrogen becomes available in the future. Green hydrogen production technology is evolving, and I think it will start to make a lot of economical sense, too.

'Every turbine we sell today is H2-ready. That is now a baseline requirement, not a separate product line. Customers absolutely have not abandoned net-zero targets'

Where do you expect your turbines to be deployed in the US by 2029-30?
Demand is nationwide. Data-centre construction will drive deployment wherever substations are already stressed. Ageing coal plants being retired will also require replacement capacity in the same locations. Electrification of transport and industry will also add load across regions. The west coast is already feeling this. Wherever renewables dominate, you need fast-ramping turbines to stabilise the grid. Wherever you have 24/7 data-centre demand, you need base-load reliability.

What is the status of hydrogen deployment today?
It was our ambition to create these hydrogen power hubs around salt caverns that can act as large-scale hydrogen storage. Starting with Utah, it was our original intention to build combined-cycle hydrogen-based power plants near these formations. Similar geology exists across the US, and we still believe hydrogen hubs will emerge around these formations. Progress has slowed, but the underlying strategy has not changed. In Japan, development is further along. At our Takasago Hydrogen Park, we run a 600MW power plant specifically to validate hydrogen-firing technology. We are producing hydrogen onsite using several pathways and inject it into the gas turbines to validate performance, materials, and cost.

'Renewables are growing, but balancing them requires zero-carbon thermal power. That is why Japan is pushing hydrogen and ammonia co-firing so aggressively'

Where is hydrogen adoption happening the fastest right now?
Japan is moving steadily because it has no choice — it is resource-constrained and must diversify. Renewables are growing, but balancing them requires zero-carbon thermal power. That is why Japan is pushing hydrogen and ammonia co-firing so aggressively. Asia more broadly is in a coal-to-gas transition first. Hydrogen comes later. Europe had strong momentum, but high energy prices have slowed adoption.

IN BRIEF

Newfoundland and Labrador, Canada

Pattern lets Canada wind-to-H2 land reservation expire

US developer Pattern Energy has allowed a land reservation for a planned wind-powered renewable hydrogen and ammonia facility in Canada's Newfoundland and Labrador province to lapse, as it shifts focus to a wind-only project. Pattern did not request an extension to the reservation, which expired on 31 March, provincial energy and mines minister Lloyd Parrott says. The province issued the allocation letter in April 2024. Pattern said late last year that it would refocus on a wind farm designed to supply the domestic grid. Subsidiary Argentia Renewables withdrew an environmental assessment application for a project targeting renewable hydrogen and ammonia production for export using about 300MW of wind power. The province terminated land reservations for three other projects earlier this year, citing a lack of progress and developers' failure to pay land fees.

EU confirms 1Q26 CBAM certificate price

The European Commission on Tuesday confirmed the carbon border adjustment mechanism (CBAM) certificate price for the first quarter of 2026 at €75.36/t of CO_2 equivalent (CO_2e). The price was calculated using a weighted average of EU emissions trading system (ETS) auction clearing prices over the quarter. The commission will apply the same methodology to calculate certificate prices for the remaining quarters of 2026, but prices will shift to a weekly average auction-based calculation from 2027. Some companies have been proxy-hedging their CBAM position through EU ETS allowances (EUAs) in the secondary market to cover their exposure to price volatility, because CBAM certificates will not be in circulation until February 2027. Proxy-hedging demand for spot or front-year EUAs was stronger early in the quarter, dropping closer to the end of the quarter when there was more clarity on the level at which the quarterly CBAM price would be set.

Half of EU H2 mechanism suppliers get multiple offers

Half of all suppliers who submitted their offers under the EU's Hydrogen Mechanism received expressions of interest from at least three potential offtakers, the European Commission says. Nearly 90pc of suppliers received an expression of interest from at least one potential offtaker. The mechanism received 265 supply inputs and "created 273 unique offtaker supplier combinations", the commission says. Negotiations between suppliers and buyers will carry on without the commission's involvement, the commission has said previously. The platform covers renewable hydrogen and derivatives such as ammonia, synthetic methanol and hydrogen-based aviation fuels, and aims to facilitate hydrogen trading, gather market information and increase the engagement of financial institutions in the hydrogen sector.

Toyota eyes equal stake in Daimler-Volvo fuel cell JV

Toyota Motor has signed a non-binding initial agreement to join Daimler Truck and Volvo Group as an equal shareholder in their fuel cell joint venture Cellcentric, the firms say. Toyota will take its stake through a capital increase, giving all three companies equal shares. Toyota and Cellcentric plan to jointly develop and produce unit cells and supporting components for fuel cell stacks. Cellcentric will act as their joint "centre of competence" for heavy-duty and off-road applications, the firms say. The agreement requires board and regulatory approval before it becomes binding. Daimler Truck and Volvo set up Cellcentric in 2021 to develop and make proton exchange membrane fuel cell systems for heavy-duty trucks and other applications where battery-electric technology may be less practical. Cellcentric sells its products to both parent firms and third-party customers.

IN BRIEF

Dutch hydrogen tech companies complete merger

The merger of Dutch hydrogen technology companies Battolyser and VDL Hydrogen Systems has created a new electrolyser manufacturer — Alquion. The new company says it will commercialise alkaline electrolysers that can be switched on or off easily and "without any loss of performance". The Flexolyser electrolyser offers flexibility to be integrated into renewables projects and manage intermittency. In high operating conditions, the system will use surplus power to make hydrogen and inject it into a pipeline or storage unit. In low operating conditions, it can be turned off and supply stored or hydrogen imported. The two firms first announced co-operation plans in July 2025. Alquion aims to take a final investment decision next month on a 0.5MW demonstration plant for an unnamed industrial customer and is preparing to produce a 5-10MW system. Battolyser previously focused on manufacturing electrolysers that would also function as battery storage systems.

Belgium launches subsurface H2 exploration programme

The Belgian government is launching a national programme for exploration of subsurface natural hydrogen resources. The government will make €1.5mn available for a first phase that will be led by the Geological Survey of Belgium and is expected to run for two years, climate minister Jean-Luc Crucke says. The first steps will involve mapping the subsurface potential, identifying promising areas and potentially laying the foundation for production, Crucke says. The minister acknowledges that "there are still many uncertainties", but says subsurface hydrogen "could permanently change our energy and industrial model" if large volumes are discovered and can be produced. Large subsurface hydrogen potential has been reported across various regions in France. Initial analyses indicate that a large field in northern France could extend into Belgium, Crucke says.

Australian firm taps Linde for CCS-based NH3 plant study

Australian developer NH3 Clean Energy has appointed Linde Engineering to carry out a front-end engineering design (Feed) study for its 1.3mn t/yr carbon capture-based ammonia project in Western Australia, with the firms also assessing potential post-Feed development options. The WAH2 project is to be developed in two phases. Each will provide NH3 capacity of 650,000 t/yr and total investment was expected to exceed A$3.2bn ($2.2bn) as of February 2025. NH3 Clean Energy aims to take a final investment decision by the end of 2026, with first production in 2029. Feed studies began in August 2025. NH3 Clean Energy says it is also discussing business models to advance the project with Linde, and that it is looking for the "opportunity to reduce capital requirements" to reduce exposure to construction risk and leverage Linde's operational experience. NH3 Clean Energy says it would retain ownership of the business and control over ammonia sales under any of the chosen models.

Hynfra picks Topsoe for Jordan green ammonia plant study

Danish technology firm Topsoe has signed a front-end engineering and design (Feed) agreement with Polish developer Hynfra for a 100,000 t/yr renewable ammonia plant at Jordan's port of Aqaba. Hynfra expects to take a final investment decision in 2027, with start-up targeted for 2030. Output is intended for international fertiliser markets. The project will be powered by a 550MW solar farm. Hynfra is developing the project with Emirati firm Fidelity Group through their Jordan Green Ammonia joint venture, which signed a land use agreement with the Aqaba Special Economic Zone Authority in September 2024. Hynfra sees project capital expenditure of $1bn and total costs at $1.5bn–1.6bn.

Hynfra's renewable ammonia projects

Location	NH3 capacity *t/yr*	Renewable cap. *MW*	Capex *$bn*
Aqaba, Jordan	100,000	550	1.0
Kavala, Greece	100,000	800	1.0
Nouakchott, Mauritania	100,000	260	1.5
Duqm, Oman	400,000	2,600	4.0
Egypt	400,000 (phase 1: 100,000)	1,960	4.0
Andhra Pradesh, India	2mn (phase 1: 100,000)	Grid	na

— Hynfra, Argus

COMPLETE HYDROGEN PRODUCTION COSTS

No-C Hydrogen									7 Apr
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Netherlands Terneuzen	Wind + ALK	Green	€/kg	7.16	8.27	nc	5.85	6.76	nc
Netherlands	Grid + PPA + ALK	Green	€/kg	7.54	8.71	+0.06	5.52	6.38	+0.06
UK Harwich	Wind + ALK	Green	£/kg	5.22	6.90	nc	4.05	5.35	nc
UK	Grid + PPA + ALK	Green	£/kg	6.95	9.20	-0.13	5.13	6.78	-0.13
Germany Bremen	Wind + ALK	Green	€/kg	7.50	8.66	nc	6.13	7.08	nc
Germany	Grid + PPA + ALK	Green	€/kg	6.52	7.52	+0.03	4.50	5.20	+0.04
France Sete	Wind + ALK	Green	€/kg	7.91	9.13	nc	6.41	7.40	nc
France	Grid + PPA + ALK	Green	€/kg	6.32	7.29	+0.02	4.03	4.65	+0.02
Spain Teruel	Diurnal + ALK	Green	€/kg	4.98	5.75	nc	3.11	3.60	nc
Spain	Grid + PPA + ALK	Green	€/kg	5.14	5.94	-0.01	3.33	3.85	-0.01
Italy	Grid + PPA + ALK	Green	€/kg	7.70	8.89	nc	5.22	6.03	+0.01
Portugal	Grid + PPA + ALK	Green	€/kg	5.27	6.08	-0.01	3.51	4.05	-0.01
US Wilbarger	Diurnal + ALK	Green	$/kg	6.87	6.87	nc	4.86	4.86	nc
Canada Newfoundland	Wind + ALK	Green	C$/kg	14.02	10.07	nc	11.83	8.49	nc
Oman Duqm	Diurnal + ALK	Green	$/kg	3.91	3.91	nc	2.56	2.56	nc
Saudi Arabia Tabuk	Diurnal + ALK	Green	$/kg	3.71	3.71	nc	2.34	2.34	nc
UAE Abu Dhabi	Diurnal + ALK	Green	$/kg	5.10	5.10	nc	3.45	3.45	nc
Qatar Mesaleed	Diurnal + ALK	Green	$/kg	5.84	5.84	nc	4.25	4.25	nc
Namibia Walvis Bay	Diurnal + ALK	Green	$/kg	7.88	7.88	nc	4.01	4.01	nc
South Africa Coega	Diurnal + ALK	Green	$/kg	7.27	7.27	nc	4.88	4.88	nc
Japan Fukushima	Wind + ALK	Green	¥/kg	2,052	12.88	nc	1,725	10.82	nc
China Jilin	Diurnal + ALK	Green	Yn/kg	22.29	3.24	nc	16.96	2.46	nc
India Kutch	Diurnal + ALK	Green	Rs/kg	339.86	3.65	nc	264.42	2.84	nc
South Korea Ulsan	Wind + ALK	Green	W/kg	30,383	20.10	nc	27,480	18.18	nc
Vietnam Phu Yen	Wind + ALK	Green	$/kg	9.34	9.34	nc	7.86	7.86	nc
Australia Burrup	Diurnal + ALK	Green	A$/kg	9.10	6.28	nc	6.18	4.27	nc
Brazil Piaui	Diurnal + ALK	Green	$/kg	4.94	4.94	nc	2.88	2.88	nc
Chile Mejillones	Diurnal + ALK	Green	$/kg	4.50	4.50	nc	2.93	2.93	nc

Low-C hydrogen									7 Apr
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Netherlands	ATR + CCS	Blue	€/kg	5.27	6.08	-0.28	4.18	4.83	-0.27
UK	ATR + CCS	Blue	£/kg	4.48	5.93	-0.31	3.56	4.70	-0.31
Germany	ATR + CCS	Blue	€/kg	5.06	5.84	-0.31	4.12	4.76	-0.30
Spain	ATR + CCS	Blue	€/kg	4.88	5.63	-0.31	3.72	4.30	-0.30
France	ATR + CCS	Blue	€/kg	4.98	5.75	-0.38	3.77	4.35	-0.38
US Gulf coast	ATR + CCS	Blue	$/kg	2.89	2.89	+0.01	1.53	1.53	+0.01
Canada	ATR + CCS	Blue	C$/kg	3.40	2.44	-0.20	1.54	1.11	-0.20
Japan	ATR + CCS	Blue	¥/kg	1,086	6.81	-0.19	889	5.58	-0.18
South Korea	ATR + CCS	Blue	W/kg	9,895	6.55	-0.27	8,024	5.31	-0.27
Australia	ATR + CCS	Blue	A$/kg	5.46	3.77	+0.15	3.59	2.48	+0.16
Trinidad	ATR + CCS	Blue	$/kg	5.70	5.70	-0.16	3.91	3.91	-0.16
Russia west	ATR + CCS	Blue	$/kg	2.65	2.65	nc	1.26	1.26	+0.01
Russia east	ATR + CCS	Blue	$/kg	2.56	2.56	+0.01	1.17	1.17	+0.01
Saudi-Arabia	ATR + CCS	Blue	$/kg	2.39	2.39	nc	1.27	1.27	nc

COMPLETE HYDROGEN PRODUCTION COSTS

BAT+ hydrogen — 7 Apr

	Process	Legacy colour	Unit	Incl. capex			Excl. capex		
				Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Netherlands	SMR + CCS	Blue	€/kg	4.48	5.17	-0.23	3.52	4.06	-0.23
UK	SMR + CCS	Blue	£/kg	3.72	4.91	-0.24	2.89	3.83	-0.23
Germany	SMR + CCS	Blue	€/kg	4.35	5.02	-0.25	3.51	4.06	-0.25
Spain	SMR + CCS	Blue	€/kg	4.37	5.04	-0.26	3.34	3.86	-0.26
France	SMR + CCS	Blue	€/kg	4.45	5.14	-0.28	3.38	3.90	-0.28
US Gulf coast	SMR + CCS	Blue	$/kg	2.38	2.38	+0.01	1.18	1.18	+0.02
Canada	SMR + CCS	Blue	C$/kg	3.11	2.23	-0.04	1.46	1.05	-0.04
Japan	SMR + CCS	Blue	¥/kg	879	5.52	-0.23	704	4.42	-0.23
South Korea	SMR + CCS	Blue	W/kg	8,268	5.47	-0.25	6,608	4.37	-0.25
Australia	SMR + CCS	Blue	A$/kg	4.61	3.18	+0.18	2.95	2.04	+0.19
Trinidad	SMR + CCS	Blue	$/kg	4.93	4.93	-0.14	3.34	3.34	-0.14
Russia west	SMR + CCS	Blue	$/kg	2.17	2.17	nc	0.93	0.93	nc
Russia east	SMR + CCS	Blue	$/kg	2.11	2.11	nc	0.87	0.87	nc
Saudi-Arabia	SMR + CCS	Blue	$/kg	1.93	1.93	nc	208	208	nc

BAT+ hydrogen — 7 Apr

	Process	Legacy colour	Unit	Excl. capex		
				Cost	Cost in $/kg	± 31 Mar
Netherlands	SMR + CCS retrofit	Blue	€/kg	3.55	4.10	-0.22
UK	SMR + CCS retrofit	Blue	£/kg	2.88	3.81	-0.23
Germany	SMR + CCS retrofit	Blue	€/kg	3.55	4.09	-0.25
Spain	SMR + CCS retrofit	Blue	€/kg	3.37	3.89	-0.26
France	SMR + CCS retrofit	Blue	€/kg	3.41	3.93	-0.28
US Gulf coast	SMR + CCS retrofit	Blue	$/kg	1.12	1.12	+0.02
Canada	SMR + CCS retrofit	Blue	C$/kg	1.54	1.11	-0.03
Japan	SMR + CCS retrofit	Blue	¥/kg	677	4.25	-0.23
South Korea	SMR + CCS retrofit	Blue	W/kg	6,374	4.22	-0.24
Australia	SMR + CCS retrofit	Blue	A$/kg	2.81	1.94	+0.18
Trinidad	SMR + CCS retrofit	Blue	$/kg	3.24	3.24	-0.15
Russia west	SMR + CCS retrofit	Blue	$/kg	0.87	0.87	nc
Russia east	SMR + CCS retrofit	Blue	$/kg	0.81	0.81	nc

BAT+ hydrogen — 7 Apr

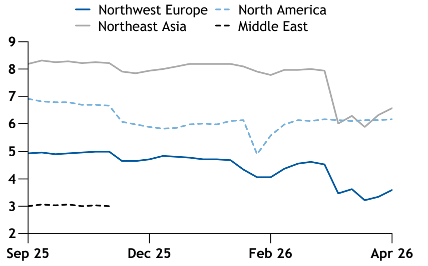
	Process	kcal/kg NAR	Legacy colour	Unit	Incl. capex			Excl. capex		
					Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Australia	Coal gasification + CCS	5,500	Blue	A$/kg	5.98	4.13	nc	3.69	2.55	nc
Australia	Coal gasification + CCS	6,000	Blue	A$/kg	6.66	4.59	-0.02	4.36	3.01	-0.01
China	Coal gasification + CCS	3,800	Blue	Yn/kg	26.83	3.90	+0.03	18.84	2.74	+0.03
China	Coal gasification + CCS	5,500	Blue	Yn/kg	25.44	3.70	-0.01	17.45	2.53	-0.02
Indonesia	Coal gasification + CCS	5,500	Blue	$/kg	3.68	3.68	+0.01	2.45	2.45	+0.02
Indonesia	Coal gasification + CCS	3,800	Blue	$/kg	3.66	3.66	nc	2.43	2.43	nc
South Africa	Coal gasification + CCS	4,800	Blue	$/kg	5.00	5.00	-0.01	2.69	2.69	-0.01
South Africa	Coal gasification + CCS	6,000	Blue	$/kg	5.14	5.14	+0.02	2.83	2.83	+0.01
Russia west	Coal gasification + CCS	6,000	Blue	$/kg	3.56	3.56	+0.03	1.85	1.85	+0.03
US east coast	Coal gasification + CCS	6,000	Blue	$/kg	4.15	4.15	-0.01	2.48	2.48	-0.01

COMPLETE HYDROGEN PRODUCTION COSTS

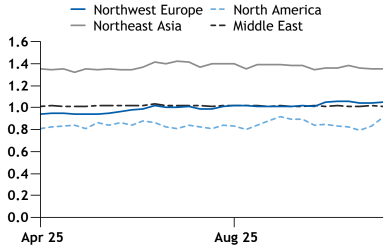
Baseline hydrogen						7 Apr			
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Netherlands	SMR	Grey	€/kg	4.47	5.16	-0.22	3.61	4.17	-0.22
UK	SMR	Grey	£/kg	3.54	4.68	-0.21	2.81	3.72	-0.20
Germany	SMR	Grey	€/kg	4.35	5.03	-0.24	3.62	4.17	-0.25
Spain	SMR	Grey	€/kg	4.35	5.02	-0.25	3.44	3.97	-0.25
France	SMR	Grey	€/kg	4.43	5.11	-0.27	3.47	4.01	-0.27
US Gulf coast	SMR	Grey	$/kg	1.97	1.97	+0.02	0.90	0.90	+0.02
Canada	SMR	Grey	C$/kg	3.20	2.30	+0.01	1.74	1.25	+0.01
Japan	SMR	Grey	¥/kg	745	4.67	-0.23	589	3.70	-0.23
South Korea	SMR	Grey	W/kg	7,093	4.69	-0.25	5,619	3.72	-0.24
Australia	SMR	Grey	A$/kg	3.83	2.64	+0.18	2.36	1.63	+0.18
Trinidad	SMR	Grey	$/kg	4.34	4.34	-0.14	2.93	2.93	-0.14
Russia west	SMR	Grey	$/kg	1.76	1.76	+0.01	0.66	0.66	nc
Russia east	SMR	Grey	$/kg	1.70	1.70	+0.01	0.60	0.60	nc
Saudi-Arabia	SMR	Grey	$/kg	1.54	1.54	nc	0.66	0.66	nc

Hydrogen decarbonisation spreads				7 Apr
	Incl. capex		Excl. capex	
	$/kg	± 31 Mar	$/kg	± 31 Mar
Northwest Europe				
No-C to BAT+	3.58	+0.25	3.08	+0.26
Low-C to BAT+	0.78	-0.07	0.65	-0.05
BAT+ to baseline	0.01	-0.01	-0.12	-0.02
North America				
No-C to BAT+	6.16	+0.01	5.57	+0.02
Low-C to BAT+	0.35	-0.09	0.21	-0.08
BAT+ to baseline	0.18	-0.02	0.04	-0.03
Northeast Asia				
No-C to BAT+	6.58	+0.24	6.09	+0.23
Low-C to BAT+	1.19	+0.01	1.04	nc
BAT+ to baseline	0.81	nc	0.69	nc
Net exporter				
No-C to BAT+	3.02	-0.07	1.88	-0.10
Low-C to BAT+	0.52	-0.01	0.39	-0.02
BAT+ to baseline	0.45	+0.01	0.35	nc

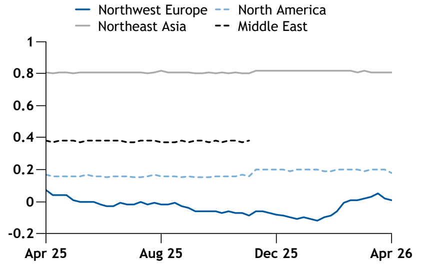
Decarb spread No-C to BAT+ *$/kg*



Decarb spread Low-C to BAT+ *$/kg*



Decarb spread BAT+ to baseline *$/kg*



COMPLETE HYDROGEN PRODUCTION COSTS

Decarbonisation spreads relevant for subsidy mechanisms								7 Apr
		Incl. capex			Excl. capex			
	Unit	Spread	Spread in $/kg	± 31 Mar	Spread	Spread in $/kg	± 31 Mar	
France								
No-C to Baseline[1]	€/kg	3.48	4.02	+0.27	2.94	3.39	+0.27	
Germany								
No-C to BAT+[2]	€/kg	3.15	3.64	+0.25	2.62	3.02	+0.25	
Netherlands								
No-C to baseline[3]	€/kg	2.69	3.11	+0.23	2.24	2.59	+0.23	

Differentials between the costs of renewable and natural gas-based hydrogen are used in subsidy mechanisms to establish the cost of switching to supply with a lower emissions intensity. The spreads above are relevant for the following:

1 France's planned operational support scheme for renewable hydrogen plants

2 Future supply to Thyssenkrupp's direct reduced iron plant in Duisburg

3 Operational support granted to selected projects in Dutch subsidy scheme

Low-C hydrogen forward									7 Apr
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Netherlands									
2027	ATR + CCS	Blue	€/kg	4.72	5.45	-0.24	3.63	4.19	-0.24
2028	ATR + CCS	Blue	€/kg	4.02	4.64	-0.10	2.93	3.38	-0.11
2029	ATR + CCS	Blue	€/kg	3.74	4.32	-0.01	2.66	3.07	-0.01
UK									
2027	ATR + CCS	Blue	£/kg	4.01	5.30	-0.23	3.08	4.08	-0.23
2028	ATR + CCS	Blue	£/kg	3.43	4.54	-0.09	2.50	3.31	-0.09
Germany									
2027	ATR + CCS	Blue	€/kg	4.60	5.31	-0.23	3.08	4.23	-0.23
2028	ATR + CCS	Blue	€/kg	3.90	4.50	-0.10	3.66	3.42	-0.10
2029	ATR + CCS	Blue	€/kg	3.62	4.18	-0.01	2.96	3.10	-0.01
France									
2027	ATR + CCS	Blue	€/kg	4.59	5.30	-0.23	3.38	3.90	-0.23
Spain									
2027	ATR + CCS	Blue	€/kg	4.52	5.22	-0.23	3.37	3.89	-0.23

BAT+ hydrogen forward									7 Apr
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Netherlands									
2027	SMR + CCS	Blue	€/kg	3.98	4.60	-0.19	3.02	3.49	-0.19
2028	SMR + CCS	Blue	€/kg	3.41	3.93	-0.09	2.44	2.82	-0.09
2029	SMR + CCS	Blue	€/kg	3.18	3.67	-0.01	2.22	2.56	nc
UK									
2027	SMR + CCS	Blue	£/kg	3.33	4.41	-0.18	2.51	3.32	-0.18
2028	SMR + CCS	Blue	£/kg	2.86	3.78	-0.06	2.04	2.69	-0.07
Germany									
2027	SMR + CCS	Blue	€/kg	3.91	4.51	-0.20	3.08	3.55	-0.20
2028	SMR + CCS	Blue	€/kg	3.33	3.85	-0.08	2.50	2.89	-0.08
2029	SMR + CCS	Blue	€/kg	3.10	3.58	-0.01	2.27	2.62	-0.01
France									
2027	SMR + CCS	Blue	€/kg	4.01	4.63	-0.20	2.94	3.39	-0.20
Spain									
2027	SMR + CCS	Blue	€/kg	3.95	4.56	-0.20	2.92	3.38	-0.19

COMPLETE HYDROGEN PRODUCTION COSTS

Baseline hydrogen forward									7 Apr
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/kg	± 31 Mar	Cost	Cost in $/kg	± 31 Mar
Netherlands									
2027	SMR	Grey	€/kg	3.98	4.60	-0.18	3.13	3.61	-0.19
2028	SMR	Grey	€/kg	3.42	3.95	-0.08	2.57	2.96	-0.08
2029	SMR	Grey	€/kg	3.21	3.71	+0.01	2.36	2.72	nc
UK									
2027	SMR	Grey	£/kg	3.20	4.23	-0.15	2.47	3.26	-0.16
2028	SMR	Grey	£/kg	2.74	3.62	-0.03	2.01	2.65	-0.04
Germany									
2027	SMR	Grey	€/kg	3.93	4.53	-0.19	3.19	3.68	-0.19
2028	SMR	Grey	€/kg	3.36	3.88	-0.08	2.63	3.03	-0.08
2029	SMR	Grey	€/kg	3.15	3.64	+0.01	2.41	2.79	+0.01
France									
2027	SMR	Grey	€/kg	4.00	4.62	-0.18	3.05	3.52	-0.18
Spain									
2027	SMR	Grey	€/kg	3.94	4.55	-0.19	3.03	3.50	-0.19

Direct-reduction iron costs (27 Mar)		*$/t*
Specification	**Cost**	**±**
Natural gas DRI, ex-works NW Europe	467.07	-17.10
DRI spread No-C hydrogen (renewables+ALK) vs natural gas NW Europe	360.46	+9.83
DRI spread BAT+ hydrogen (SMR+CCS) vs natural gas NW Europe	174.28	+33.61

Renewable hydrogen certificate revenue (RH2CR)				*7 Apr*
	€/kg	**± 31 Mar**	**$/kg**	**± 31 Mar**
Germany RH2CR from GHG reduction obligations	8.36	-0.17	9.65	-0.18

In Germany, companies can generate tradeable certificated by delivering renewable hydrogen or derivatives to road fuel markets. They can then sell these certificates to parties that are obliged to meet certain greenhouse gas (GHG) emission reduction targets. The RH2CRs represent the revenue suppliers can generate from selling the certificates for each kg of hydrogen they produce. Calculations are based on hydrogen's lower heating value of 120 MJ/kg and assume a 70pc reduction in GHG emissions compared with the fossil fuel comparator of 94.1 of CO2 equivalent/MJ.

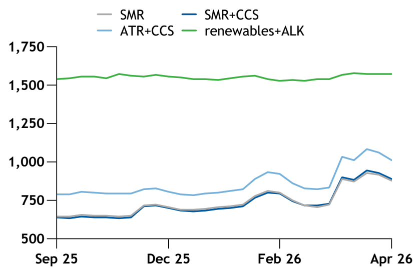
COMPLETE AMMONIA PRODUCTION COSTS

Argus liquid ammonia taxonomy (for calculated costs)	
	tCO2e/tNH3
Baseline	<1.93, >1.37
BAT+	<0.49, >0.17
Low-C	<0.17, >0.09
No-C	<0.01

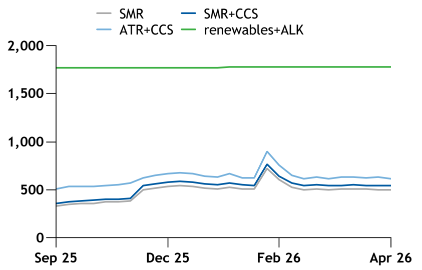
CO2e emissions on a gate-to-gate basis; purity >99.5pc; temperature -33°C

Regional ammonia cost markers						7 Apr
			Incl. capex		Excl. capex	
	Process	Unit	Cost	± 31 Mar	Cost	± 31 Mar
Baseline						
Northwest Europe	SMR	€/t	880	-39	665	-39
Northwest Europe	SMR	$/t	1,016	-43	768	-43
North America	SMR	$/t	502	+2	235	+2
Northeast Asia	SMR	$/t	937	-42	691	-42
BAT+						
Northwest Europe	SMR+CCS	€/t	887	-40	650	-40
Northwest Europe	SMR+CCS	$/t	1,024	-44	750	-45
North America	SMR+CCS	$/t	540	-2	244	-3
Northeast Asia	SMR+CCS	$/t	1,087	-42	815	-42
Low-C						
Northwest Europe	ATR+CCS	€/t	1,011	-51	746	-51
Northwest Europe	ATR+CCS	$/t	1,167	-56	862	-56
North America	ATR+CCS	$/t	612	-15	281	-16
Northeast Asia	ATR+CCS	$/t	1,302	-41	998	-41
No-C						
Northwest Europe	Island renewable+PEM	€/t	1,571	-4	1,246	-3
Northwest Europe	Island renewable+PEM	$/t	1,814	nc	1,439	nc
North America	Island renewable+PEM	$/t	1,782	nc	1,367	nc
Northeast Asia	Island renewable+PEM	$/t	2,423	nc	2,070	nc
Exporter						
Exporter baseline	SMR	$/t	481	+11	231	+11
Exporter BAT+	SMR+CCS	$/t	566	+11	290	+11
Exporter low-C	ATR+CCS	$/t	666	+9	358	+10
Exporter no-C	Island renewable+PEM	$/t	1,171	nc	712	nc

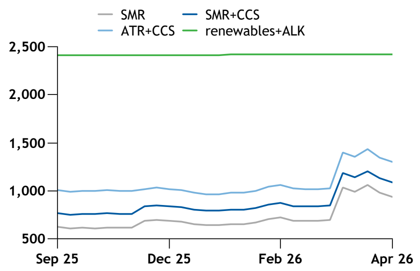
NW Europe ammonia average €/t



North America ammonia average $/t



Northeast Asia ammonia average $/t



COMPLETE AMMONIA PRODUCTION COSTS

No-C ammonia									7 Apr
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/t	± 31 Mar	Cost	Cost in $/t	± 31 Mar
Netherlands Terneuzen	Wind + ALK	Green	€/t	1,509	1,742	nc	1,200	1,386	nc
UK Harwich	Wind + ALK	Green	£/t	1,092	1,444	nc	818	1,081	nc
Germany Bremen	Wind + ALK	Green	€/t	1,553	1,793	nc	1,244	1,437	nc
France Sete	Wind + ALK	Green	€/t	1,652	1,908	nc	1,295	1,496	nc
Spain Teruel	Diurnal + ALK	Green	€/t	1,062	1,227	nc	646	745	nc
US Wilbarger	Diurnal + ALK	Green	$/t	1,480	1,480	nc	1,025	1,025	nc
Canada Newfoundland	Wind + ALK	Green	C$/t	2,903	2,084	nc	2,381	1,709	nc
Oman Duqm	Diurnal + ALK	Green	$/t	803	803	nc	518	518	nc
Saudi Arabia Tabuk	Diurnal + ALK	Green	$/t	763	763	nc	469	469	nc
UAE Abu Dhabi	Diurnal + ALK	Green	$/t	1,030	1,030	nc	688	688	nc
Qatar Mesaleed	Diurnal + ALK	Green	$/t	1,170	1,170	nc	844	844	nc
Namibia Walvis Bay	Diurnal + ALK	Green	$/t	1,746	1,746	nc	811	811	nc
South Africa Coega	Diurnal + ALK	Green	$/t	1,583	1,583	nc	980	980	nc
Japan Fukushima	Wind + ALK	Green	¥/t	412,718	2,590	nc	340,538	2,137	nc
China Jilin	Diurnal + ALK	Green	Yn/t	4,635	673	nc	3,411	495	nc
India Kutch	Diurnal + ALK	Green	Rs/t	69,361	746	nc	52,619	566	nc
South Korea Ulsan	Wind + ALK	Green	W/t	6,055,490	4,006	nc	5,406,023	3,577	nc
Vietnam Phu Yen	Wind + ALK	Green	$/t	1,916	1,916	nc	1,553	1,553	nc
Australia Burrup	Diurnal + ALK	Green	A$/t	1,821	1,257	nc	1,231	849	nc
Brazil Piaui	Diurnal + ALK	Green	$/t	1,094	1,094	nc	589	589	nc
Chile Mejillones	Diurnal + ALK	Green	$/t	975	975	nc	600	600	nc

Low-C ammonia									7 Apr
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Cost	Cost in $/t	± 31 Mar	Cost	Cost in $/t	± 31 Mar
Netherlands	ATR + CCS	Blue	€/t	1,041	1,202	-48	774	894	-48
UK	ATR + CCS	Blue	£/t	881	1,166	-53	654	865	-54
Germany	ATR + CCS	Blue	€/t	990	1,143	-54	760	878	-53
Spain	ATR + CCS	Blue	€/t	978	1,129	-54	694	802	-53
France	ATR + CCS	Blue	€/t	1,002	1,157	-65	705	814	-65
US Gulf coast	ATR + CCS	Blue	$/t	653	653	+1	319	319	+1
Canada	ATR + CCS	Blue	C$/t	794	570	-33	339	243	-33
Japan	ATR + CCS	Blue	¥/t	210,750	1,322	-34	162,385	1,019	-34
South Korea	ATR + CCS	Blue	W/t	1,936,116	1,281	-48	1,476,663	977	-48
Australia	ATR + CCS	Blue	A$/t	1,163	803	+28	704	486	+28
Trinidad	ATR + CCS	Blue	$/t	1,169	1,169	-28	730	730	-28
Russia west	ATR + CCS	Blue	$/t	597	597	nc	255	255	nc
Russia east	ATR + CCS	Blue	$/t	582	582	+1	240	240	+2
Saudia-Arabia	ATR + CCS	Blue	$/t	543	543	nc	268	268	nc

Low-Carbon Ammonia benchmarks			7 Apr
	Unit	Cost	± 31 Mar
JKLAB CFR Ulsan, South Korea, incl. US 45Q tax credit	$/t	686.74	+5.34
JKLAB CFR Ulsan, South Korea, excl. US 45Q tax credit	$/t	822.74	+5.34
JKLAB CFR Niihama, Japan, differential	$/t	-0.11	+0.19
EULAB CFR ARA, incl. 45Q US tax credit	$/t	599.27	+3.22
EULAB CFR ARA, excl. 45Q US tax credit	$/t	735.27	+3.22

The low-carbon ammonia benchmarks include the US Gulf coast Low-C ATR+CCS ammonia production cost (with and without the US' 45Q tax credit for carbon sequestration) and freight costs. Freight costs are for delivery to Ulsan, South Korea, for JKLAB and to Amsterdam-Rotterdam-Antwerp (ARA) for EULAB. For JKLAB, the Niihama differential reflects the cost difference for delivery to Niihama in Japan, rather than to Ulsan.

COMPLETE AMMONIA PRODUCTION COSTS

BAT+ ammonia				Incl. capex			Excl. capex		7 Apr
	Process	Legacy colour	Unit	Cost	Cost in $/t	± 31 Mar	Cost	Cost in $/t	± 31 Mar
Netherlands	SMR + CCS	Blue	€/t	898	1,037	-41	660	762	-41
UK	SMR + CCS	Blue	£/t	744	984	-41	540	715	-41
Germany	SMR + CCS	Blue	€/t	861	994	-44	655	756	-44
Spain	SMR + CCS	Blue	€/t	879	1,015	-45	625	722	-45
France	SMR + CCS	Blue	€/t	900	1,039	-49	634	732	-49
US Gulf coast	SMR + CCS	Blue	$/t	555	555	+2	257	257	+3
Canada	SMR + CCS	Blue	C$/t	730	524	-7	322	231	-8
Japan	SMR + CCS	Blue	¥/t	173,647	1,090	-40	130,364	818	-40
South Korea	SMR + CCS	Blue	W/t	1,637,986	1,084	-43	1,226,813	812	-43
Australia	SMR + CCS	Blue	A$/t	999	690	+32	588	406	+32
Trinidad	SMR + CCS	Blue	$/t	1,020	1,020	-25	626	626	-25
Russia west	SMR + CCS	Blue	$/t	503	503	nc	197	197	nc
Russia east	SMR + CCS	Blue	$/t	493	493	+1	187	187	+1
Saudia-Arabia	SMR + CCS	Blue	$/t	454	454	nc	208	208	nc

BAT+ ammonia					Incl. capex			Excl. capex		7 Apr
	Process	kcal/kg NAR	Legacy colour	Unit	Cost	Cost in $/t	± 31 Mar	Cost	Cost in $/t	± 31 Mar
Australia	Coal gasification + CCS	5,500	Blue	A$/t	1,313	906	nc	720	497	nc
Australia	Coal gasification + CCS	6,000	Blue	A$/t	1,431	988	-2	838	578	-3
China	Coal gasification + CCS	3,800	Blue	Yn/t	5,567	809	+5	3,501	509	+6
China	Coal gasification + CCS	5,500	Blue	Yn/t	5,322	773	-3	3,256	473	-3
Indonesia	Coal gasification + CCS	5,500	Blue	$/t	775	775	+3	456	456	+3
Indonesia	Coal gasification + CCS	3,800	Blue	$/t	771	771	nc	453	453	+1
South Africa	Coal gasification + CCS	4,800	Blue	$/t	1,105	1,105	nc	509	509	-1
South Africa	Coal gasification + CCS	6,000	Blue	$/t	1,128	1,128	+2	532	532	+2
Russia west	Coal gasification + CCS	6,000	Blue	$/t	797	797	+6	355	355	+5
US east coast	Coal gasification + CCS	6,000	Blue	$/t	919	919	-2	488	488	-2

Baseline ammonia				Incl. capex			Excl. capex		7 Apr
	Process	Legacy colour	Unit	Cost	Cost in $/t	± 31 Mar	Cost	Cost in $/t	± 31 Mar
Netherlands	SMR	Grey	€/t	891	1,029	-39	675	780	-39
UK	SMR	Grey	£/t	708	937	-36	524	693	-36
Germany	SMR	Grey	€/t	858	990	-43	671	775	-42
Spain	SMR	Grey	€/t	870	1,005	-44	641	740	-43
France	SMR	Grey	€/t	890	1,028	-47	649	750	-47
US Gulf coast	SMR	Grey	$/t	475	475	+2	205	205	+3
Canada	SMR	Grey	C$/t	738	530	+2	369	265	+2
Japan	SMR	Grey	¥/t	148,926	935	-40	109,750	689	-40
South Korea	SMR	Grey	W/t	1,421,337	940	-43	1,049,180	694	-43
Australia	SMR	Grey	A$/t	853	588	+32	480	332	+32
Trinidad	SMR	Grey	$/t	909	909	-25	553	553	-25
Russia west	SMR	Grey	$/t	425	425	+1	148	148	+1
Russia east	SMR	Grey	$/t	414	414	nc	137	137	+1
Saudi-Arabia	SMR	Grey	$/t	381	381	nc	158	158	nc

COMPLETE AMMONIA PRODUCTION COSTS

Ammonia decarbonisation spreads				7 Apr
	Incl. capex		Excl. capex	
	$/t	± 31 Mar	$/t	± 31 Mar
Northwest Europe				
No-C to BAT+	790	+44	689	+45
Low-C to BAT+	143	-12	112	-11
BAT+ to baseline	8	-1	-18	-2
North America				
No-C to BAT+	1,242	+2	1,123	+3
Low-C to BAT+	72	-13	37	-13
BAT+ to baseline	38	-4	9	-5
Northeast Asia				
No-C to BAT+	1,336	+42	1,255	+42
Low-C to BAT+	215	+1	183	+1
BAT+ to baseline	150	nc	124	nc
Net exporter				
No-C to BAT+	605	-11	422	-11
Low-C to BAT+	100	-2	68	-1
BAT+ to baseline	85	nc	59	nc

E-SAF PRODUCTION COSTS

No-C e-SAF								7 Apr
			Incl. capex			Excl. capex		
	Process	Unit	Cost	Cost in $/t	± 31 Mar	Cost	Cost in $/t	± 31 Mar
Netherlands	PPA+ALK FT	€/t	9,122.14	10,533.65	+25.85	6,088.41	7,030.50	+25.85

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