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Argus Hydrogen and Future Fuels

Market news, analysis and prices

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EDITORIAL: A gear change in funding and the project approval process is needed for the EU to deliver on its ambitious production targets

CONTENTS

Speed limits

The European Commission last week boldly claimed that its system for subsidising renewable hydrogen production would, in contrast to the production tax credits provided by the US Inflation Reduction Act (IRA), be "cost-effective, fast and administratively light". But making good on this promise will require the EU to vastly improve on previous efforts to support the nascent hydrogen economy, while funding will need to be lifted substantially for subsidised volumes to make a meaningful contribution to domestic production targets.

The commission envisages that the European hydrogen bank — first announced in September last year — will hold auctions where successful bidders "will receive a fixed premium for each 1kg of renewable hydrogen produced over a period of 10 years". It will launch an €800mn pilot this autumn, with the commission saying this "will be followed by further auctions or other forms of support for hydrogen production" to cover "the EU domestic part of the hydrogen bank" — something that suggests the scheme could eventually also be used to secure imports.

While details are still sparse, the selective auction system could help ensure that subsidies are only granted to projects that would otherwise not materialise. This could indeed make the EU's system more cost-effective than the IRA's broad sweep, under which all projects will be supported as long as they meet the necessary requirements related to lifecycle greenhouse gas emissions and other factors, such as labour conditions.

But the real task will be to achieve cost-effectiveness without sacrificing speed — and the EU's track record on this is not particularly promising. The commission itself has acknowledged that its focus on directing funding to the right projects has at times slowed progress on key initiatives for low-carbon hydrogen projects. "We have a responsibility to the taxpayer — it is a lot of money and we need to get the assessment right," EU executive vice-president for competition Margrethe Vestager said in July last year after the commission approved a first wave of hydrogen projects for state aid under the Important Project of Common European Interest (IPCEI) scheme. "We can move faster, but there's a limit."

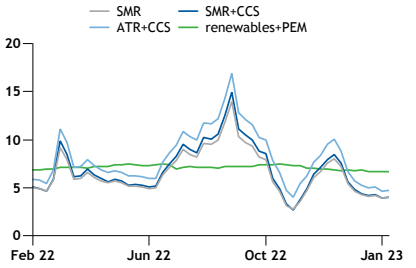
European project developers have repeatedly complained about how long waiting times for IPCEI approvals have prevented them from taking final investment decisions. The commission says it is taking these complaints to heart and vowed last week to make it easier for developers to access funding, partly through temporary changes to state aid regulations.

For the auction system to truly boost the EU's production, it will also need to be backed up with ample funds in the coming years. The €800mn is a start, but a small one. The initial sum could subsidise just 292,000t if the US' maximum support of $3/kg, or €2.74/kg, is to be matched. This would equate to 29,200t/yr over the envisaged 10-year period — a fraction of the 10mn t/yr of domestic renewable hydrogen that the EU is targeting by 2030. And even the €3bn that has so far been earmarked for the hydrogen bank in the longer term would only suffice for 110,000 t/yr, or just over 1pc of the 2030 target.

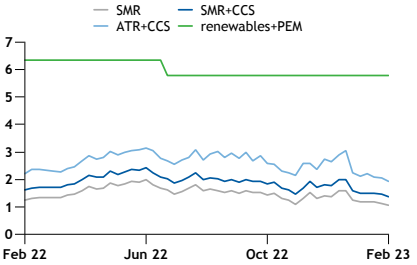
In any event, launching the auctions will be contingent on the EU finalising a legal definition of what counts as renewable hydrogen. The bloc is now more than a year behind schedule with this — another signal that pledges from Brussels to move faster should be taken with a grain of salt.

HYDROGEN PRICES

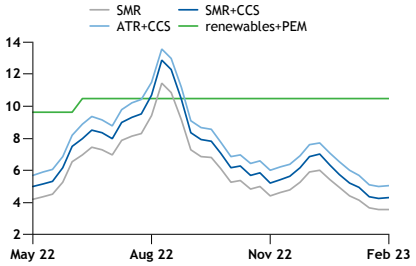
Northwest Europe average cost €/kg



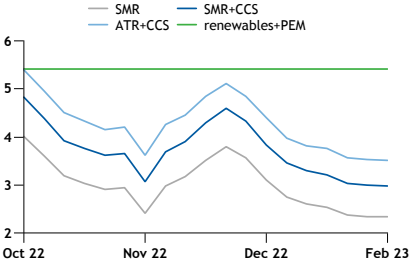
North America average cost $/kg



Northeast Asia average cost $/kg



Exporter average cost $/kg



Regional hydrogen cost markers — 7 Feb

	Process	Incl. capex $/kg	Incl. capex ± 31 Jan	Excl. capex $/kg	Excl. capex ± 31 Jan
Baseline					
Northwest Europe	SMR	4.36	+0.12	4.08	+0.13
North America	SMR	1.05	-0.08	0.77	-0.07
Northeast Asia	SMR	3.57	+0.03	3.27	+0.03
Middle East	SMR	3.17	+0.02	2.87	+0.02
BAT+					
Northwest Europe	SMR+CCS	4.34	+0.08	3.83	+0.09
North America	SMR+CCS	1.37	-0.08	0.85	-0.08
Northeast Asia	SMR+CCS	4.29	+0.03	3.76	+0.03
Middle East	SMR+CCS	3.90	+0.02	3.38	+0.03
Low-C					
Northwest Europe	ATR+CCS	5.14	+0.10	4.44	+0.10
North America	ATR+CCS	1.93	-0.13	1.22	-0.14
Northeast Asia	ATR+CCS	5.02	+0.02	4.30	+0.02
Middle East	ATR+CCS	4.46	+0.03	3.74	+0.02
No-C					
Northwest Europe	Island renewable+PEM	7.23	nc	5.32	nc
North America	Island renewable+PEM	5.78	nc	3.90	nc
Northeast Asia	Island renewable+PEM	10.48	nc	8.57	nc
Middle East	Island renewable+PEM	5.55	nc	3.69	nc
Exporter					
Exporter baseline	SMR	2.33	nc	2.04	nc
Exporter BAT+	SMR+CCS	2.98	-0.01	2.46	nc
Exporter low-C	ATR+CCS	3.51	-0.02	2.80	-0.02
Exporter no-C	Island renewable+PEM	5.41	nc	3.45	nc

Argus hydrogen taxonomy

	Purity	Pressure	tCO2e/tH2
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

CO2e emissions on a gate-to-gate basis

Pump prices, 70MPa — 3 Feb

	Unit	Price	± 6 Jan
Japan			
Eneos	¥/kg	1,650.00	nc
Iwatani	¥/kg	1,210.00	nc
Germany			
H2Mobility	€/kg	12.85	nc

MARKET DEVELOPMENTS

India's H2 plans suffer blow from Adani crisis

A collapse in the share price of group companies triggered the cancellation and raises doubts about the firm's green hydrogen plans

In a setback to India's ambitious renewable hydrogen plans, embattled conglomerate Adani on 2 February cancelled a 200bn rupee ($2.5bn) share sale, despite securing enough interest to proceed.

Adani said on 1 February it had surpassed subscription targets for its share sale, which included around $620mn earmarked to fund green hydrogen plans. But it announced later that day that it had nevertheless decided to cancel the sale, following a collapse in share prices of its group companies sparked by a report from US investment firm Hindenburg Research accusing it of market manipulation and accounting fraud. Adani said "unprecedented" market circumstances had led it to cancel the follow-on public offer (FPO). While shares in Adani Enterprises, and its gas, power and green energy arms slumped, the company has denied Hindenburg's allegations and has threatened legal action.

Adani has been gearing up to play a key role in India's ambitious plans for renewable hydrogen production, which had been off to a strong start this year when the government last month announced an initial outlay of 197.44bn rupees ($2.38bn) for its National Green Hydrogen Mission. New Delhi wants to build 5mn t/yr of green hydrogen production capacity by 2030 and has set a longer-term target of 10mn t/yr "with growth of export markets and international partnerships". Adani's green energy arm, Adani New Industries (Anil), in January laid out plans to build 3mn t/yr of green hydrogen production capacity over 10 years, with a planned initial investment of $50bn in this sector. Anil said it would develop an end-to-end integrated ecosystem for the production of low-cost green hydrogen and its derivatives, including manufacture of equipment such as wind and solar modules as well as electrolysers.

French energy firm TotalEnergies had last year announced plans to buy a stake in Anil, with a view to producing 1mn t/yr of green hydrogen by 2030. TotalEnergies bought a 20pc stake in Adani Green Energy in 2021, as well as a 50pc stake in the Indian firm's solar power assets, for a total cost of $2.5bn. But the French company last week played down its exposure to Adani through those investments, and its 37pc stake in Adani Total Gas, which together account for just 2.4pc of its employed capital.

Progress elsewhere

While the Adani crisis rocked India, there were some signs of progress for other companies pursuing plans to build up renewable hydrogen production capacity in the country.

Renewables company Greenko Energy announced last week that it placed an order for 140MW electrolysis equipment from Belgian manufacturer John Cockerill for what it says will be the country's first green ammonia plant. Greenko ordered 28 units of 5MW alkaline electrolysers for use in a 300 t/d, or 110,000 t/yr, green ammonia plant in Una in Himachal Pradesh, northern India, which it is jointly developing with John Cockerill. The equipment is due to be delivered in March 2024 and the plant slated for commissioning in June next year.

The order builds on last year's partnership between the two companies to jointly develop Indian hydrogen plants and a 2 GW/yr electrolyser factory in Kakinada, Andhra Pradesh. It is the first large-scale order of electrolysis equipment from an Indian company and indicates tangible progress on project plans.

Meanwhile, the south Indian state of Kerala announced plans to set up two renewable hydrogen hubs, in Kochi and Thiruvananthapuram, over the next two years. It has earmarked 2.2bn rupees ($26.7mn) that will be used for "viability gap funding, grant and equity support" for the hubs.

MARKET DEVELOPMENTS

Stakeholders weigh in on US hydrogen credit rollout

Feedback centred on the question of how qualified facilities will be defined and how lifetime emissions will be calculated, writes Emmeline Willey

Stakeholders across the hydrogen value chain have sent feedback to the US Treasury Department as they seek to shape its guidance on the Inflation Reduction Act's production tax credit.

The bill was signed into law last year and is set to grant production tax credits of up to $3/kg for clean hydrogen, but the Treasury has yet to finalise the exact guidelines and the timeline remains uncertain. The Treasury in November requested comments from stakeholders and the large number of comments submitted "probably is not helping them get through it", hydrogen firm Plug Power's chief executive, Andy Marsh, said in late January.

While Marsh expects the guidelines to be released late in the second quarter, he says the Treasury's decisions will not be the end of the story. "There will always be back and forth with Treasury" even once the rules are written, he says.

Stakeholders that submitted comments homed in on the question of how qualified facilities will be defined and how lifetime emissions will be calculated.

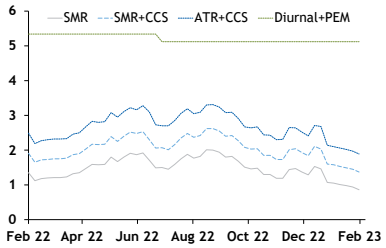
Plug suggested that individual electrolyser modules at the same site should each qualify as a clean hydrogen production facility to which the credit may be applied. It additionally requested that chlor-alkali by-product hydrogen purification sites should be eligible, which could allow the company to obtain credits for the hydrogen by-product it receives from the waste-stream of one of its partners, chemical manufacturer Olin.

Oil and gas industry group American Petroleum Institute called for unrelated process trains at the same facility to separately be eligible for either the production tax credit or the '45Q' tax credit for carbon capture and storage, which was not envisaged under the initial bill. The group also demanded that the credits should not be developed to meet the US' proposed Clean Hydrogen Production Standard — which has also yet to be finalised — arguing that it was never intended to serve as a regulatory standard.

H2 tax credit under IRA

CO2 emissions kg per kg of H2	Maximum credit $/kg
up to 0.45	3.00
0.45-1.5	1.00
1.5-2.5	0.75
2.5-4.0	0.60

US H2 costs incl. capex $/kg



Decision time

Comments submitted also focused on the question of how closely hydrogen production will have to match with zero-emissions electricity generation, mirroring discussions in Europe that have contributed to the EU's definition of renewable hydrogen being severely delayed.

Environmental groups Earthjustice, Sierra Club and League of Conservation Voters urged the Department of Energy (DOE) to enforce strict time-matching requirements, so only hydrogen produced from zero-emission electricity generated nearby in the same hour would qualify for the credit. The groups urged the DOE not to allow producers to qualify with unbundled renewable energy credits or book-and-claim systems. But Plug argued that "unobtainable" time-matching standards would "irreparably stifle the development of clean hydrogen production facilities" and recommended conformity with existing frameworks like California's Low Carbon Fuel Standard, which requires matching over nine-month periods.

The environmental groups did not restrict their demands to the time-matching question. They also requested that when captured CO2 is used in enhanced oil recovery, the DOE should include the resulting oil combustion emissions in its well-to-gate analysis of a hydrogen plant.

With developers counting on the credit to make their projects viable, many will likely wait on Treasury guidance before making final investment decisions. If Marsh's prediction plays out, the Treasury's decision this summer will have the potential to tint the US' future hydrogen economy green — or blue — depending on the fine print.

NEWS

Norwegian CCS sites		
Project	**Companies**	**Capacity** *mn t/yr*
Errai	Neptune Energy, Horisont Energi	4-8
Luna	Wintershall Dea	TBC
Northern Lights	Equinor, Shell, TotalEnergies	5
Polaris	Horisont Energi	100*
Sleipner	Equinor, ExxonMobil, Lotos Norge, Kufpec Norway	1
Smeaheia	Equinor	20

**overall capacity in mn t, not mn t/yr*

Equinor, Var Energi exit Barents Blue H2, CCS project

Norway's state-controlled Equinor and independent Var Energi have pulled out of the planned Barents Blue blue ammonia project and linked carbon capture and storage (CCS) development in northern Norway. They will be replaced in the former by Spanish fertiliser producer Fertiberia.

The agreement between Equinor, Var Energi and operator Horisont Energi expired on 31 January. Horisont is now in co-operating with Fertiberia, aiming at a full Barents Blue partnership from 1 April and a 50pc share for each company.

Equinor and Var Energi have also pulled out of the planned Polaris CO2 storage site, linked to Barents Blue. Polaris, in the Barents Sea off northern Norway, will store the carbon captured during the ammonia production process. The site's potential capacity of 100mn t means it could permanently store CO2 from other sources. Horisont says it will "invite new partners into the Polaris CO2 storage licence, including a qualified operator", and that it will file a development plan with a new licence group. Norway's petroleum and economy ministry awarded a CO2 storage licence to Polaris in April 2022.

Var Energi is still seeking "a comprehensive gas export solution" for Barents Sea resources. "Development of the proven [gas] resources in the region, including Goliat, Alke and Lupa, will require an export solution with greater capacity than what we deem realistic within the scope of the project," the firm says.

Equinor says it remains positive about exploring "gas supply solutions from Hammerfest LNG to the Barents Blue project following the changes in the partnership".

Barents Blue won a grant of 482mn Norwegian kroner ($48.5mn) under the EU's Important Projects of Common European Interest scheme and the funding is unaffected by the changes in the consortium, Horisont says. According to Fertiberia, the project will be largest clean ammonia production plant in Europe. It will produce 1mn t/yr of blue ammonia when it comes on line — something previously targeted for 2026.

By Georgia Gratton and Aidan Lea

RWE orders 200MW electrolyser, urges EU decision

German utility RWE has placed an order for 200MW of electrolysis equipment from Linde Engineering, despite still waiting for an EU decision on state aid funding, saying it needed to move ahead to be able to stick to its timeline.

RWE plans to launch the first 100MW plant at its planned hydrogen site in Lingen, Lower Saxony, in 2024, followed by another of the same size in 2025.

Approval by the EU commission for state aid funding from the German government is still pending, but "production of electrolyser stack modules of this size takes several months and must be ordered well in advance", RWE says. The company's 2024 and 2025 project deadlines would be "impossible to meet if there were further delay", it adds. The electrolyser order does not imply a final investment decision, the firm says, adding it is "all the more important for RWE to receive the notification [from the EU] soon".

The electrolysers will come from UK-based manufacturer ITM, which has a partnership with legacy industrial gas supplier Linde. RWE preselected Linde and ITM to provide the equipment for its Get H2 project in December 2021, but has now signed contracts for the order. The plants are the largest proton exchange membrane electolysers under execution worldwide, ITM says, and this will be the first deployment of 10MW standard module skids that ITM and Linde Engineering have jointly developed to target large-scale installations.

By Aidan Lea

NEWS

Asia-Pacific leads in H2 refuelling station additions

Hydrogen refuelling station additions in Asia-Pacific far outpaced those in other regions last year, German certification firm TUV Sud has said, based on data from consulting company LBST.

Of 130 hydrogen refuelling stations opened last year, 73 were in Asia-Pacific, TUV Sud says. South Korea accounted for the bulk of the increase, adding 45 outlets. The use of hydrogen in road transport is a key pillar of South Korea's decarbonisation aims, partly because of its relatively limited potential for renewable power generation and the difficulties associated with importing electricity.

South Korea's additions last year were on par with the 45 new stations opened across all of Europe. But additions in Europe were still higher "than ever before", according to TUV Sud.

H2 refuelling stations, selected countries	
South Korea	149
China	138
Germany	105
France	44
UK	17
Netherlands	17
Switzerland	14

— TUV Sud

The overall number of refuelling stations in Asia-Pacific grew to 455 by the end of 2022. The rapid increase in South Korea lifted its number of stations to 149, but Japan still leads with 165. China has 138, although TUV Sud cautions that "the more challenging information access there [is] somewhat limiting reliability".

Europe had 254 stations by the end of 2022, with Germany accounting for more than 40pc of them. The EU is pursuing ambitious targets for building out its hydrogen refuelling network in the coming years, although exact targets are yet to be finalised. In what could be a boost to the plans, French firms TotalEnergies and Air Liquide said last week that they will jointly seek to add 100 stations in France, Germany and the Benelux countries in the coming years. The companies will focus on supply for heavy-duty vehicles and plan to set a up a joint venture this year that will procure hydrogen from the market and distribute it to customers. Consensus has grown that long-haul heavy-duty trucks will be the main use case for hydrogen in road transport.

North America had 89 stations operational at the end of 2022 following 11 new openings, but only 19 were outside California, TUV Sud says. Hydrogen refuelling stations now exist in 37 countries, with Columbia, Cyprus and Israel the most recent additions, it says.

By Stefan Krumpelmann

Namibian green ammonia offtake deals surpass 1mn t/yr

The planned Hyphen hydrogen project in Namibia has signed two further offtake deals, taking the total for the project to over 1mn t/yr of green ammonia.

The German-UK joint venture signed a non-binding initial agreement for 500,000 t/yr with an unnamed major chemical company, and another for 250,000 t/yr with South Korean hydrogen producer Approtium.

The deals follow Hyphen's agreement to supply Germany utility RWE with 300,000 t/yr from 2027, which was signed late last year.

Hyphen plans to produce 1mn t/yr by 2027 to decarbonise energy in Namibia and southern Africa region and increase production to 2mn t/yr by 2029 for export, it said. The scale of the project has increased from the previously announced 700,000 t/yr by 2027 and 1.7mn t/yr second phase.

"Although Hyphen's primary focus is the supply of hydrogen into Europe, and Germany in particular, South Korea is expected to emerge as a key market in the green hydrogen sector, in which Approtium will be a major player," Hyphen chief executive Marco Raffinetti said.

Hyphen is one of at least seven hydrogen projects planned in Namibia, where the government is striving to attract investors.

By Aidan Lea

NEWS

South Korea enlists state-owned firms for H2 ramp-up

South Korea's trade, industry and energy ministry has tasked state-owned gas firm Kogas with developing infrastructure for liquefied hydrogen imports, while state-owned oil company KNOC will oversee infrastructure for ammonia imports and distribution.

Responsibilities will be split between the two to ensure investments are not duplicated and that the cost of the build-out is minimised, the ministry says.

Kogas will be in charge of establishing infrastructure to enable up to 100,000 t/yr of liquefied hydrogen imports by 2029, drawing on its experience in developing LNG import facilities, the ministry says. An initial concept design for the liquefied hydrogen import terminal is to be developed this year, while specifications for ordering liquefied hydrogen tankers will also be established.

KNOC is to ensure that South Korea can import up to 800,000 t/yr of ammonia by 2026, rising to 4mn t/yr by 2030 and 10mn t/yr by 2036. Import facilities are to be developed close to coal-fired power plants as South Korea sees ammonia co-firing as a key pillar of bringing down its emissions.

The ministry also envisages an ammonia cracking facility being set up to supply hydrogen for co-firing at power plants that currently run on gas imported as LNG. The site should be able to produce 50,000 t/yr of hydrogen from ammonia by 2027 and 300,000 t/yr by 2035, the ministry says. This would correspond to over 290,000t/yr of ammonia in the first phase and 1.75mn t/yr by 2035.

The country's power generation companies will have to ensure that hydrogen co-firing technology is available by 2026 by carrying out research and development and demonstration projects.

While co-firing will play a major role in efforts to decarbonise, Seoul recently sharply downgraded targets for hydrogen and ammonia use in power generation, citing feasibility of technology and construction of fuel supply infrastructure. The adjustments suggest that Motie is now taking a much more conservative view on how quickly such technology and infrastructure can be developed.

By Stefan Krumpelmann

Linde plans $1.8bn H2 complex at Texas site

Industrial gas firm Linde will invest $1.8bn to build and operate an on-site complex to provide blue hydrogen to Dutch fertilizer firm OCI's planned ammonia plant in Texas. Linde's facility will supply low-carbon hydrogen and nitrogen to OCI's 1.1mn t/yr blue ammonia plant in Beaumont, on the US Gulf coast. OCI began construction of the plant in autumn last year.

To meet increased demand from companies seeking to lower their carbon footprints, Linde says it will also connect its new facility to its network in the Gulf region to supply low-carbon hydrogen and "atmospheric and rare gases" to new and existing customers.

Linde will produce hydrogen from natural gas with autothermal reforming outfitted with carbon capture technology, which it says should let it sequester more than 1.7mn t/yr of carbon emissions. The blue ammonia plant will produce 70pc less CO2 compared with conventional ammonia production, OCI says.

OCI expects to invest less than $1bn in the project, which is due to come on line in the first quarter of 2025 and could have its capacity doubled to 2.2mn t/yr in the future. The location in Beaumont grants it access to domestic customers, as well as export markets in Europe and Asia, the company says. OCI says it expects the plant will benefit from the US' '45Q' carbon capture credit.

By Emmeline Willey

ANALYSIS

Chile to hit industrial scale green H2 from 2024

Industrial-scale projects are expected to start to come on stream from the end of 2024, writes Emily Russell

Chile is advancing the development of its green hydrogen sector, with at least 46 projects under way, of which five are in operation, four are under construction and the rest are mainly at the feasibility or prefeasibility stage, according to hydrogen association H2 Chile.

H2 Chile's inventory, which is based on publicly available information, indicates that industrial-scale projects will start to come on stream from the end of 2024 and build up steam towards the end of the decade.

Among the frontrunners, Chilean company HIF's $51mn Haru Oni project in the far-south Magallanes region produced its first e-fuel from green hydrogen in December 2022 in a trial phase. The first industrial-scale phase of the development is expected to produce 75mn litres/yr of e-fuels from green hydrogen in the second half of 2025.

"In the current stage, it is critical not only to test projects' technical and economic feasibility, but for each project to incorporate a comprehensive vision and address its [social] contribution to the area where it will operate," H2 Chile executive director Marcos Kulka says.

The country is conducting a public consultation into how to balance economic opportunities with environmental and community concerns regarding green hydrogen, which will be incorporated into a 2023-50 action plan to be published later this year.

Chile's hydrogen strategy envisages the country having 25GW of electrolysis in operation or under development by 2030 — one of the most ambitious targets globally — and producing hydrogen at less than $1.50/kg. And the government has taken some steps to support the near-term capacity build-out, such as awarding $50mn in co-financing to six green hydrogen projects with a combined capacity of 45,000 t/yr that must be operating by December 2025. It has also issued a tender offering public land and obtained $750mn in funding from the InterAmerican Development Bank and World Bank for green hydrogen development.

"This is a concrete sign of state support," Kulka says. "But many more synergies are needed for the industry to take off with the intensity required to meet the country's carbon neutrality goals and create a new productive [economic] sector that brings sophistication and growth to our economy." Regulations are needed to govern the safety of installations, human capital development, shared infrastructure and the costs of connecting green hydrogen projects to the grid, according to Kulka.

Chile financing for H2 projects

Developer	Name	Electrolysis MW	H2 t/yr	Finance $mn
Enel Green Power	Faro del Sur	240	25,000	16.9
Linde	HyPro Aconcagua	20	300	2.4
Engie	HyEx	26	3,300	9.5
Air Liquide	Amer	80	*	11.8
GNL Quintero	Bahia Quintero	10	430	5.7
CAP	H2V CAP	20	1,550	3.6

**60,000t/yr of e-methanol from renewable energy, green hydrogen and CO2 capture from a fixed source*

— Corfo

North and south

Nine projects are proposed for the Antofagasta region in the north and 12 in Magallanes, where solar and wind power, respectively, offer especially competitive conditions to lower green hydrogen production costs and where the government is developing hydrogen hubs.

Major projects include French firm Total Eren's H2 development in Magallanes, which will use 10GW of wind capacity to feed 8GW of electrolysis capacity for green ammonia production that is expected to commence in 2027. In Antofagasta, compatriot Engie is completing studies for the 26MW Hyex pilot electrolysis plant to produce green ammonia from 2025. The aim is to kick off industrial-scale operations of 2GW in 2030.

In other regions, projects are targeting domestic offtake rather than exports. Among them is the Bibio region in the south of the country, where Chilean steelmaker CAP seeks to install 20MW of electrolysis capacity to produce 1,550 t/yr of hydrogen for green steel production.

IN BRIEF

ITM to cut costs following 'unacceptable' results

UK electrolyser company ITM has outlined a 12-month plan to rectify what chief executive Dennis Schulz called "an unacceptable set of results". ITM in January issued a profit warning for the whole financial year, after it suffered production delays and was forced to scale back its expansion plans last year. Schulz's priorities include trimming staff costs by 30pc, slimming ITM's product offering to about a fifth of its current size and speeding up manufacturing and product testing. ITM also plans to review the future of Motive Fuels, its mobility-focused joint venture with trading firm Vitol.

Uniper eyes green ammonia from India's Greenko

German state-owned utility Uniper has signed an initial agreement to exclusively negotiate offtake for green ammonia from the first phase of Indian firm Greenko's production facility in Andhra Pradesh state. Uniper is set to buy 250,000 t/yr of ammonia from Greenko's plant in the city of Kakinada, the firms say. They will negotiate pricing, supply and the tenure structure under the heads of terms of the initial agreement. The deal would mark India's first green ammonia export agreement, Greenko says. Greenko's multi-phase project could reach 1mn t/yr of output capacity by 2027.

Neom green ammonia plant capital costs rise 70pc

Capital costs for the planned Neom green ammonia plant in Saudi Arabia have risen by 70pc to $8.5bn, one of the partners has said, because of changes to the way the project is financed and inflationary pressures. US-based industrial gas firm Air Products' chief executive, Seifi Ghasemi, says the company, with Saudi renewables firm Acwa Power and the PIF sovereign wealth fund, decided to raise the share of third-party financing and to invest more up front to reduce long-term operating costs. The partners now aim to build their own transmission lines and other infrastructure for the project to reduce dependence on others. They had said the 1.2mn t/yr project would cost $5bn when it was announced in 2020.

New pipeline to carry Danish H2 to Germany from 2027

A new pipeline in the Baltic Sea could carry renewable hydrogen from Denmark to northeast Germany from 2027, according to plans unveiled by German gas system operator Gascade. The 140km pipeline is intended to transport hydrogen produced from offshore wind farms around the Danish island of Bornholm to Lubmin on Germany's Baltic coast and could reach a capacity of 10GW in the 2030s, Gascade says. In Lubmin, the pipeline could link to the Flow hydrogen network that is jointly planned by several German gas grid operators. The Flow project envisages 1,100km of hydrogen pipelines stretching from Lubmin to the German-Czech border and as far south as Stuttgart.

Oman's Hydrom extends land bid submission deadline

Oman's state-owned hydrogen company Hydrom has extended the bid submission deadline for its first licensing round, in which two 320km^2 plots of land in Duqm are on offer for development of renewable hydrogen projects. The deadline was pushed back by one month, with bidders now expected to submit their proposals by 15 March, instead of 15 February. The reason for the extension was not disclosed. Around 50 companies purchased pre-qualification documents to participate in this first auction round, Hydrom's executive director, Firas Ali al-Abduwani, said in January, in line with Oman's expectations. The bid evaluation will now begin in March and the winners will be announced in April.

COMPLETE HYDROGEN PRODUCTION COSTS

No-C Hydrogen									7 Feb
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Price	Price in $/kg	± 31 Jan	Price	Price in $/kg	± 31 Jan
Netherlands	Wind + PEM	Green	€/kg	5.85	6.35	nc	4.11	4.46	nc
Netherlands	Grid + GOO + ALK	Green	€/kg	11.72	12.71	+0.36	10.66	11.56	+0.35
UK	Wind + PEM	Green	£/kg	4.97	6.05	nc	3.44	4.19	nc
UK	Grid + GOO + ALK	Green	£/kg	13.22	16.08	+0.68	12.30	14.96	+0.69
Germany	Wind + PEM	Green	€/kg	6.98	7.57	nc	5.21	5.65	nc
Germany	Grid + GOO + ALK	Green	€/kg	12.26	13.30	+0.78	11.19	12.14	+0.78
France	Wind + PEM	Green	€/kg	7.17	7.78	nc	5.40	5.86	nc
France	Grid + GOO + ALK	Green	€/kg	14.85	16.11	+0.64	13.79	14.96	+0.65
Spain	Diurnal + PEM	Green	€/kg	4.66	5.05	nc	2.90	3.15	nc
Spain	Grid + GOO + ALK	Green	€/kg	10.67	11.57	+0.54	9.57	10.38	+0.54
US west coast	Diurnal + PEM	Green	$/kg	5.12	5.12	nc	3.29	3.29	nc
Canada	Wind + PEM	Green	C$/kg	8.60	6.43	nc	6.03	4.51	nc
Oman	Diurnal + PEM	Green	$/kg	5.45	5.45	nc	3.53	3.53	nc
Saudi Arabia	Diurnal + PEM	Green	$/kg	5.53	5.53	nc	3.61	3.61	nc
UAE	Diurnal + PEM	Green	$/kg	5.61	5.61	nc	3.83	3.83	nc
Qatar	Diurnal + PEM	Green	$/kg	5.59	5.59	nc	3.77	3.77	nc
Namibia	Diurnal + PEM	Green	$/kg	5.94	5.94	nc	3.61	3.61	nc
South Africa	Diurnal + PEM	Green	$/kg	5.90	5.90	nc	3.72	3.72	nc
Japan	Wind + PEM	Green	¥/kg	1,801	13.80	nc	1,548	11.86	nc
China	Diurnal + PEM	Green	Yn/kg	31.98	4.73	nc	19.27	2.85	nc
India	Diurnal + PEM	Green	Rs/kg	406.03	4.94	nc	241.65	2.94	nc
South Korea	Wind + PEM	Green	W/kg	16,019	12.92	nc	13,626	10.99	nc
Vietnam	Wind + PEM	Green	$/kg	7.86	7.86	nc	5.75	5.75	nc
Australia	Diurnal + PEM	Green	A$/kg	7.19	5.03	nc	4.55	3.18	nc
Brazil	Diurnal + PEM	Green	$/kg	5.41	5.41	nc	3.23	3.23	nc
Chile	Diurnal + PEM	Green	$/kg	5.40	5.40	nc	3.48	3.48	nc

Low-C hydrogen									7 Feb
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Price	Price in $/kg	± 31 Jan	Price	Price in $/kg	± 31 Jan
Netherlands	ATR + CCS	Blue	€/kg	4.74	5.14	+0.08	4.10	4.45	+0.09
UK	ATR + CCS	Blue	£/kg	4.23	5.14	+0.08	3.67	4.46	+0.08
Germany	ATR + CCS	Blue	€/kg	4.79	5.20	+0.09	4.14	4.49	+0.09
Spain	ATR + CCS	Blue	€/kg	4.57	4.96	+0.16	3.88	4.21	+0.17
France	ATR + CCS	Blue	€/kg	4.69	5.09	+0.14	4.04	4.38	+0.13
US Gulf Coast	ATR + CCS	Blue	$/kg	1.89	1.89	-0.08	1.19	1.19	-0.08
Canada	ATR + CCS	Blue	C$/kg	2.62	1.96	-0.19	1.67	1.25	-0.19
Japan	ATR + CCS	Blue	¥/kg	677	5.19	nc	583	4.47	nc
South Korea	ATR + CCS	Blue	W/kg	6,001	4.84	+0.03	5,108	4.12	+0.03
Australia	ATR + CCS	Blue	A$/kg	4.63	3.24	-0.06	3.62	2.53	-0.05
Trinidad	ATR + CCS	Blue	$/kg	4.52	4.52	+0.05	3.46	3.46	+0.05
Qatar	ATR + CCS	Blue	$/kg	4.38	4.38	+0.02	3.66	3.66	+0.02
UAE	ATR + CCS	Blue	$/kg	4.53	4.53	+0.03	3.81	3.81	+0.02
Russia west	ATR + CCS	Blue	$/kg	1.86	1.86	-0.02	1.05	1.05	-0.01
Russia east	ATR + CCS	Blue	$/kg	1.74	1.74	-0.01	0.92	0.92	-0.01

COMPLETE HYDROGEN PRODUCTION COSTS

BAT+ hydrogen									7 Feb
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Price	Price in $/kg	± 31 Jan	Price	Price in $/kg	± 31 Jan
Netherlands	SMR + CCS	Blue	€/kg	4.06	4.40	+0.08	3.59	3.89	+0.08
UK	SMR + CCS	Blue	£/kg	3.50	4.26	+0.06	3.09	3.76	+0.06
Germany	SMR + CCS	Blue	€/kg	4.08	4.43	+0.06	3.61	3.91	+0.06
Spain	SMR + CCS	Blue	€/kg	3.91	4.24	+0.14	3.40	3.69	+0.14
France	SMR + CCS	Blue	€/kg	3.87	4.20	+0.11	3.40	3.69	+0.12
US Gulf Coast	SMR + CCS	Blue	$/kg	1.37	1.37	-0.08	0.86	0.86	-0.08
Canada	SMR + CCS	Blue	C$/kg	1.82	1.36	-0.08	1.12	0.84	-0.08
Japan	SMR + CCS	Blue	¥/kg	562	4.31	+0.03	493	3.78	+0.03
South Korea	SMR + CCS	Blue	W/kg	5,294	4.27	+0.03	4,637	3.74	+0.03
Australia	SMR + CCS	Blue	A$/kg	3.93	2.75	+0.01	3.19	2.23	+0.02
Trinidad	SMR + CCS	Blue	$/kg	3.99	3.99	+0.06	3.21	3.21	+0.06
Qatar	SMR + CCS	Blue	$/kg	3.90	3.90	+0.02	3.38	3.38	+0.03
UAE	SMR + CCS	Blue	$/kg	3.90	3.90	+0.02	3.38	3.38	+0.03
Russia west	SMR + CCS	Blue	$/kg	1.33	1.33	nc	0.73	0.73	nc
Russia east	SMR + CCS	Blue	$/kg	1.21	1.21	-0.01	0.61	0.61	-0.01

BAT+ hydrogen						7 Feb
					Excl. capex	
	Process	Legacy colour	Unit	Price	Price in $/kg	± 31 Jan
Netherlands	SMR + CCS retrofit	Blue	€/kg	3.73	4.05	+0.09
UK	SMR + CCS retrofit	Blue	£/kg	3.21	3.90	+0.08
Germany	SMR + CCS retrofit	Blue	€/kg	3.75	4.07	+0.07
Spain	SMR + CCS retrofit	Blue	€/kg	3.55	3.85	+0.15
France	SMR + CCS retrofit	Blue	€/kg	3.55	3.85	+0.13
US Gulf Coast	SMR + CCS retrofit	Blue	$/kg	0.83	0.83	-0.08
Canada	SMR + CCS retrofit	Blue	C$/kg	1.22	0.91	-0.08
Japan	SMR + CCS retrofit	Blue	¥/kg	491	3.76	+0.03
South Korea	SMR + CCS retrofit	Blue	W/kg	4,637	3.74	+0.03
Australia	SMR + CCS retrofit	Blue	A$/kg	3.16	2.21	+0.02
Trinidad	SMR + CCS retrofit	Blue	$/kg	3.19	3.19	+0.06
Qatar	SMR + CCS retrofit	Blue	$/kg	3.35	3.35	+0.02
UAE	SMR + CCS retrofit	Blue	$/kg	3.35	3.35	+0.02
Russia west	SMR + CCS retrofit	Blue	$/kg	0.70	0.70	-0.01
Russia east	SMR + CCS retrofit	Blue	$/kg	0.59	0.59	nc

BAT+ hydrogen										*7 Feb*
					Incl. capex			Excl. capex		
	Process	kcal/kg NAR	Legacy colour	Unit	Price	Price in $/kg	± 31 Jan	Price	Price in $/kg	± 31 Jan
Australia	Coal gasification + CCS	5,500	Blue	A$/kg	4.55	3.18	-0.08	3.47	2.43	-0.09
Australia	Coal gasification + CCS	6,000	Blue	A$/kg	6.78	4.74	-0.60	5.71	3.99	-0.60
China	Coal gasification + CCS	3,800	Blue	Yn/kg	24.00	3.55	-0.09	18.80	2.78	-0.10
China	Coal gasification + CCS	5,500	Blue	Yn/kg	24.20	3.58	-0.03	19.00	2.81	-0.03
Indonesia	Coal gasification + CCS	5,500	Blue	$/kg	3.38	3.38	-0.04	2.55	2.55	-0.04
Indonesia	Coal gasification + CCS	3,800	Blue	$/kg	3.13	3.13	-0.04	2.30	2.30	-0.03
South Africa	Coal gasification + CCS	4,800	Blue	$/kg	3.29	3.29	-0.06	2.29	2.29	-0.06
South Africa	Coal gasification + CCS	6,000	Blue	$/kg	3.54	3.54	+0.03	2.54	2.54	+0.03
Russia West	Coal gasification + CCS	6,000	Blue	$/kg	2.76	2.76	+0.05	1.90	1.90	+0.04
US east coast	Coal gasification + CCS	6,000	Blue	$/kg	3.31	3.31	-0.15	2.57	2.57	-0.16

COMPLETE HYDROGEN PRODUCTION COSTS

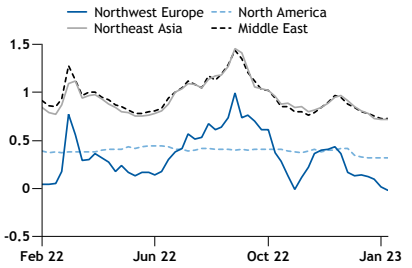
Baseline hydrogen									7 Feb
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Price	Price in $/kg	± 31 Jan	Price	Price in $/kg	± 31 Jan
Netherlands	SMR	Grey	€/kg	4.07	4.41	+0.11	3.81	4.13	+0.12
UK	SMR	Grey	£/kg	3.43	4.17	+0.13	3.20	3.89	+0.13
Germany	SMR	Grey	€/kg	4.09	4.44	+0.11	3.83	4.15	+0.11
Spain	SMR	Grey	€/kg	3.93	4.26	+0.19	3.64	3.95	+0.18
France	SMR	Grey	€/kg	3.91	4.24	+0.16	3.64	3.95	+0.16
US Gulf coast	SMR	Grey	$/kg	0.86	0.86	-0.08	0.58	0.58	-0.07
Canada	SMR	Grey	C$/kg	1.66	1.24	-0.08	1.27	0.95	-0.08
Japan	SMR	Grey	¥/kg	462	3.54	+0.03	423	3.24	+0.03
South Korea	SMR	Grey	W/kg	4,451	3.59	+0.02	4,091	3.30	+0.03
Australia	SMR	Grey	A$/kg	3.03	2.12	+0.02	2.62	1.83	+0.02
Trinidad	SMR	Grey	$/kg	3.15	3.15	+0.05	2.72	2.72	+0.05
Qatar	SMR	Grey	$/kg	3.17	3.17	+0.02	2.87	2.87	+0.02
UAE	SMR	Grey	$/kg	3.16	3.16	+0.02	2.87	2.87	+0.02
Russia west	SMR	Grey	$/kg	0.79	0.79	-0.01	0.46	0.46	nc
Russia east	SMR	Grey	$/kg	0.69	0.69	nc	0.35	0.35	-0.01

Baseline hydrogen									7 Feb
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Price	Price in $/kg	± 31 Jan	Price	Price in $/kg	± 31 Jan
Netherlands	Grid + ALK	Yellow	€/kg	11.30	12.26	+0.40	10.25	11.12	+0.40
Netherlands	Grid + PEM	Yellow	€/kg	11.64	12.62	+0.37	9.96	10.80	+0.37
UK	Grid + ALK	Yellow	£/kg	12.83	15.61	+0.70	11.91	14.49	+0.70
UK	Grid + PEM	Yellow	£/kg	12.92	15.72	+0.64	11.45	13.93	+0.64
Germany	Grid + ALK	Yellow	€/kg	11.86	12.86	+0.83	10.79	11.70	+0.83
Germany	Grid + PEM	Yellow	€/kg	12.16	13.19	+0.77	10.46	11.34	+0.77
France	Grid + ALK	Yellow	€/kg	14.45	15.67	+0.69	13.38	14.51	+0.69
France	Grid + PEM	Yellow	€/kg	14.57	15.80	+0.64	12.87	13.96	+0.65
Spain	Grid + ALK	Yellow	€/kg	10.26	11.13	+0.59	9.16	9.94	+0.59
Spain	Grid + PEM	Yellow	€/kg	10.70	11.60	+0.55	8.94	9.70	+0.55
US west coast	Grid + ALK	Yellow	$/kg	7.23	7.23	-5.02	6.08	6.08	-5.02
US west coast	Grid + PEM	Yellow	$/kg	7.94	7.94	-4.67	6.11	6.11	-4.67
US Midwest	Grid + ALK	Yellow	$/kg	4.78	4.78	-1.13	3.63	3.63	-1.13
US Midwest	Grid + PEM	Yellow	$/kg	5.66	5.66	-1.05	3.82	3.82	-1.06
US east coast	Grid + ALK	Yellow	$/kg	5.18	5.18	-1.28	4.03	4.03	-1.28
US east coast	Grid + PEM	Yellow	$/kg	6.03	6.03	-1.19	4.20	4.20	-1.19
Japan	Grid + ALK	Yellow	¥/kg	1,882	14.42	-0.85	1,728	13.24	-0.86
Japan	Grid + PEM	Yellow	¥/kg	1,911	14.64	-0.80	1,668	12.78	-0.79

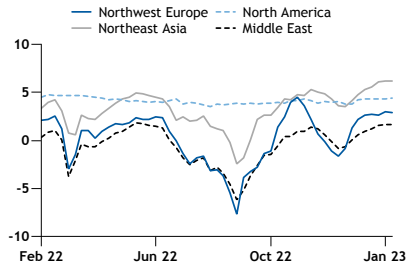
COMPLETE HYDROGEN PRODUCTION COSTS

Decarbonisation spreads				*7 Feb*
	Incl. capex		Excl. capex	
	$/kg	± 31 Jan	$/kg	± 31 Jan
Northwest Europe				
No-C to BAT+	2.89	-0.08	1.49	-0.09
BAT+ to baseline	-0.02	-0.04	-0.25	-0.04
North America				
No-C to BAT+	4.41	+0.08	3.05	+0.08
BAT+ to baseline	0.32	nc	0.08	-0.01
Northeast Asia				
No-C to BAT+	6.19	-0.03	4.81	-0.03
BAT+ to baseline	0.72	nc	0.49	nc
Middle East				
No-C to BAT+	1.65	-0.02	0.31	-0.03
BAT+ to baseline	0.73	nc	0.51	+0.01
Net exporter				
No-C to BAT+	2.43	+0.01	0.99	nc
BAT+ to baseline	0.65	-0.01	0.42	nc

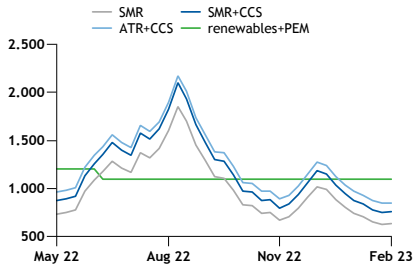
Decarb spread BAT+ to baseline *$/kg*



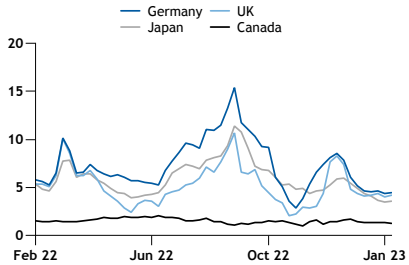
Decarb spread No-C to BAT+ *$/kg*



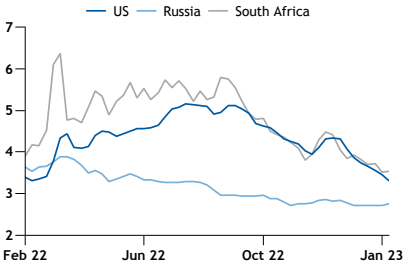
Middle East average cost *$/kg*



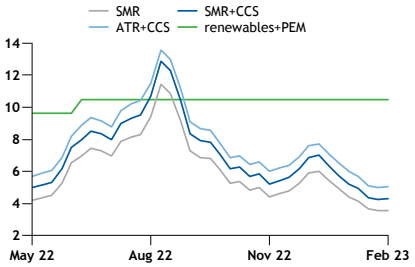
SMR H2 costs *$/kg*



Coal H2 costs NAR 6,000 *$/kg*



Northeast Asia average cost *$/kg*



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 Feb*
		Incl. capex		Excl. capex	
	Process	$/t	± 31 Jan	$/t	± 31 Jan
Baseline					
Northwest Europe	SMR	868	+22	752	+22
North America	SMR	302	-14	187	-13
Northeast Asia	SMR	718	+4	600	+6
Middle East	SMR	630	+3	517	+3
BAT+					
Northwest Europe	SMR+CCS	864	+14	710	+15
North America	SMR+CCS	356	-14	201	-14
Northeast Asia	SMR+CCS	842	+5	684	+6
Middle East	SMR+CCS	756	+4	604	+5
Low-C					
Northwest Europe	ATR+CCS	1,001	+18	814	+18
North America	ATR+CCS	452	-23	264	-24
Northeast Asia	ATR+CCS	966	+2	775	+3
Middle East	ATR+CCS	851	+5	665	+3
No-C					
Northwest Europe	Island renewable+PEM	1,458	nc	1,056	nc
North America	Island renewable+PEM	1,173	nc	782	nc
Northeast Asia	Island renewable+PEM	2,050	nc	1,648	nc
Middle East	Island renewable+PEM	1,095	nc	705	nc
Exporter					
Exporter baseline	SMR	505	-2	391	-1
Exporter BAT+	SMR+CCS	617	-1	464	nc
Exporter low-C	ATR+CCS	708	-4	521	-4
Exporter no-C	Island renewable+PEM	1,081	nc	671	nc

COMPLETE AMMONIA PRODUCTION COSTS

No-C ammonia										*7 Feb*
				Incl. capex			Excl. capex			
	Process	Legacy colour	Unit	Price	Price in $/t	± 31 Jan	Price	Price in $/t	± 31 Jan	
Netherlands	Wind + PEM	Green	€/t	1,196	1,297	nc	830	900	nc	
UK	Wind + PEM	Green	£/t	1,003	1,220	nc	681	828	nc	
Germany	Wind + PEM	Green	€/t	1,395	1,513	nc	1,023	1,110	nc	
France	Wind + PEM	Green	€/t	1,441	1,563	nc	1,069	1,159	nc	
Spain	Diurnal + PEM	Green	€/t	938	1,017	nc	574	623	nc	
US west coast	Diurnal + PEM	Green	$/t	1,040	1,040	nc	663	663	nc	
Canada	Wind + PEM	Green	C$/t	1,745	1,305	nc	1,205	901	nc	
Oman	Diurnal + PEM	Green	$/t	1,077	1,077	nc	674	674	nc	
Saudi Arabia	Diurnal + PEM	Green	$/t	1,090	1,090	nc	688	688	nc	
UAE	Diurnal + PEM	Green	$/t	1,108	1,108	nc	734	734	nc	
Qatar	Diurnal + PEM	Green	$/t	1,104	1,104	nc	725	725	nc	
Namibia	Diurnal + PEM	Green	$/t	1,189	1,189	nc	687	687	nc	
South Africa	Diurnal + PEM	Green	$/t	1,171	1,171	nc	706	706	nc	
Japan	Wind + PEM	Green	¥/t	350,411	2,685	nc	297,164	2,277	nc	
China	Diurnal + PEM	Green	Yn/t	6,315	934	nc	3,685	545	nc	
India	Diurnal + PEM	Green	Rs/t	80,056	974	nc	45,699	556	nc	
South Korea	Wind + PEM	Green	W/t	3,138,050	2,531	nc	2,632,193	2,123	nc	
Vietnam	Wind + PEM	Green	$/t	1,547	1,547	nc	1,093	1,093	nc	
Australia	Diurnal + PEM	Green	A$/t	1,470	1,028	nc	925	647	nc	
Brazil	Diurnal + PEM	Green	$/t	1,076	1,076	nc	614	614	nc	
Chile	Diurnal + PEM	Green	$/t	1,063	1,063	nc	664	664	nc	

Low-C ammonia										*7 Feb*
				Incl. capex			Excl. capex			
	Process	Legacy colour	Unit	Price	Price in $/t	± 31 Jan	Price	Price in $/t	± 31 Jan	
Netherlands	ATR + CCS	Blue	€/t	927	1,005	+13	758	822	+15	
UK	ATR + CCS	Blue	£/t	810	986	+14	663	807	+13	
Germany	ATR + CCS	Blue	€/t	927	1,005	+16	752	816	+16	
Spain	ATR + CCS	Blue	€/t	887	962	+28	703	763	+29	
France	ATR + CCS	Blue	€/t	915	992	+23	741	804	+22	
US Gulf Coast	ATR + CCS	Blue	$/t	446	446	-14	260	260	-14	
Canada	ATR + CCS	Blue	C$/t	611	457	-32	358	268	-33	
Japan	ATR + CCS	Blue	¥/t	129,463	992	nc	104,406	800	nc	
South Korea	ATR + CCS	Blue	W/t	1,165,455	940	+5	929,885	750	+6	
Australia	ATR + CCS	Blue	A$/t	977	683	-11	706	494	-9	
Trinidad	ATR + CCS	Blue	$/t	902	902	+8	617	617	+8	
Qatar	ATR + CCS	Blue	$/t	840	840	+4	653	653	+3	
UAE	ATR + CCS	Blue	$/t	861	861	+5	677	677	+4	
Russia west	ATR + CCS	Blue	$/t	417	417	-3	202	202	-2	
Russia east	ATR + CCS	Blue	$/t	396	396	-2	180	180	-2	

COMPLETE AMMONIA PRODUCTION COSTS

BAT+ ammonia *7 Feb*

				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Price	Price in $/t	± 31 Jan	Price	Price in $/t	± 31 Jan
Netherlands	SMR + CCS	Blue	€/t	810	879	+14	670	727	+14
UK	SMR + CCS	Blue	£/t	686	835	+10	566	688	+11
Germany	SMR + CCS	Blue	€/t	805	873	+10	661	717	+11
Spain	SMR + CCS	Blue	€/t	774	839	+24	621	674	+24
France	SMR + CCS	Blue	€/t	774	840	+18	632	686	+20
US Gulf Coast	SMR + CCS	Blue	$/t	357	357	-14	204	204	-14
Canada	SMR + CCS	Blue	C$/t	473	354	-14	265	198	-14
Japan	SMR + CCS	Blue	¥/t	109,756	841	+5	89,006	682	+5
South Korea	SMR + CCS	Blue	W/t	1,045,190	843	+5	849,295	685	+6
Australia	SMR + CCS	Blue	A$/t	858	600	+2	633	443	+4
Trinidad	SMR + CCS	Blue	$/t	812	812	+11	575	575	+10
Qatar	SMR + CCS	Blue	$/t	758	758	+4	605	605	+5
UAE	SMR + CCS	Blue	$/t	753	753	+3	603	603	+5
Russia west	SMR + CCS	Blue	$/t	326	326	nc	147	147	nc
Russia east	SMR + CCS	Blue	$/t	305	305	-2	127	127	-2

BAT+ ammonia *7 Feb*

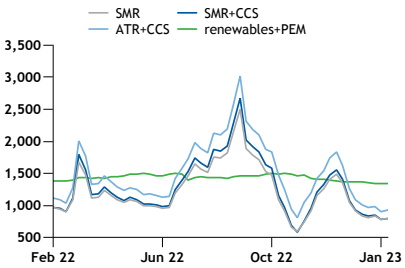
					Incl. capex			Excl. capex		
	Process	kcal/kg NAR	Legacy colour	Unit	Price	Price in $/t	± 31 Jan	Price	Price in $/t	± 31 Jan
Australia	Coal gasification + CCS	5,500	Blue	A$/t	875	612	-14	632	442	-16
Australia	Coal gasification + CCS	6,000	Blue	A$/t	1,257	879	-102	1,014	709	-103
China	Coal gasification + CCS	3,800	Blue	Yn/t	4,469	661	-15	3,299	488	-17
China	Coal gasification + CCS	5,500	Blue	Yn/t	4,503	666	-5	3,333	493	-5
Indonesia	Coal gasification + CCS	5,500	Blue	$/t	633	633	-7	447	447	-6
Indonesia	Coal gasification + CCS	3,800	Blue	$/t	590	590	-7	404	404	-5
South Africa	Coal gasification + CCS	4,800	Blue	$/t	629	629	-10	402	402	-11
South Africa	Coal gasification + CCS	6,000	Blue	$/t	672	672	+6	445	445	+5
Russia West	Coal gasification + CCS	6,000	Blue	$/t	531	531	+9	337	337	+6
US east coast	Coal gasification + CCS	6,000	Blue	$/t	631	631	-26	465	465	-27

Baseline ammonia *7 Feb*

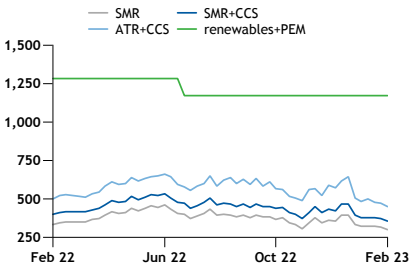
				Incl. capex			Excl. capex		
	Process	Legacy colour	Unit	Price	Price in $/t	± 31 Jan	Price	Price in $/t	± 31 Jan
Netherlands	SMR	Grey	€/t	812	881	+19	708	768	+21
UK	SMR	Grey	£/t	674	820	+22	584	710	+22
Germany	SMR	Grey	€/t	807	875	+19	699	758	+19
Spain	SMR	Grey	€/t	776	842	+33	662	718	+30
France	SMR	Grey	€/t	781	847	+27	674	731	+27
US Gulf coast	SMR	Grey	$/t	270	270	-14	156	156	-12
Canada	SMR	Grey	C$/t	445	333	-14	290	217	-14
Japan	SMR	Grey	¥/t	92,660	710	+5	76,999	590	+6
South Korea	SMR	Grey	W/t	900,128	726	+3	755,066	609	+5
Australia	SMR	Grey	A$/t	704	492	+3	535	374	+3
Trinidad	SMR	Grey	$/t	668	668	+9	491	491	+9
Qatar	SMR	Grey	$/t	633	633	+3	518	518	+4
UAE	SMR	Grey	$/t	626	626	+3	516	516	+3
Russia west	SMR	Grey	$/t	234	234	-1	101	101	nc
Russia east	SMR	Grey	$/t	217	217	nc	83	83	-1

COMPLETE AMMONIA PRODUCTION COSTS

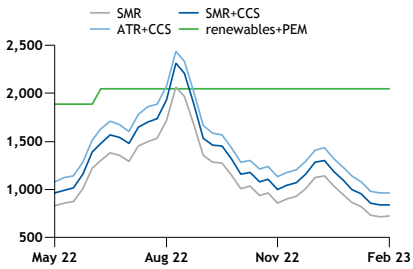
NW Europe ammonia average $/t



North America ammonia average $/t



Northeast Asia ammonia average $/t



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