ARGUS HYDROGEN AND FUTURE FUELS

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LAST UPDATED: OCTOBER 2023

The most up-to-date Argus Hydrogen and Future Fuels methodology is available on www.argusmedia.com
**Argus Hydrogen and Future Fuels**

Argus Hydrogen and Future fuels includes modelled costs for hydrogen produced at newly constructed facilities using several industry standard production paths.

For each technology a standard project is modelled using assumed capital and other costs, adjusted for each location based on risk and tax rates that vary by country.

Those costs, summarised below are reviewed periodically and are subject to change from time to time as national taxation and fiscal policies change.

To those capital costs is added operating costs and the variable cost per kilogram of hydrogen. Assumptions used in determining fixed and variable costs are described below and are updated semi-annually, subject to market consultation.

**Currency and unit**

Prices are published in US dollars per kilogram and in the local currencies for Australia, Canada, China, Europe, India, Japan and South Korea. Currency conversions are made using an average exchange rate during the week before publication. Hydrogen and ammonia prices can be converted to energy terms using the Argus Direct platform. Argus assumes a lower heating value of 33.33kWh/kg for hydrogen conversions and 5.17kWh/kg for ammonia.

**Capex/no-capex hydrogen costs**

For each location and technology, two sets of hydrogen costs are published, one including capex and another excluding capex, allowing for clear comparisons of fixed and variable costs between locations and technologies.

**Fixed cost summary**

<table>
<thead>
<tr>
<th></th>
<th>Capex ($/kW)</th>
<th>Fixed cost ($/t H2, plant lifetime)</th>
<th>Capex ($/kg H2, actual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALK electrolysis</td>
<td>967</td>
<td>Grid/diurnal, offshore wind</td>
<td>1.11-1.18</td>
</tr>
<tr>
<td>PEM electrolysis</td>
<td>1,700</td>
<td>599</td>
<td>1.76-2.31</td>
</tr>
<tr>
<td>ATR + CCS</td>
<td>369</td>
<td>0.73-1.12</td>
<td></td>
</tr>
<tr>
<td>SMR</td>
<td>151</td>
<td>0.30-0.46</td>
<td></td>
</tr>
<tr>
<td>SMR + CCS</td>
<td>271</td>
<td>0.53-0.82</td>
<td></td>
</tr>
<tr>
<td>Coal gasification</td>
<td>388</td>
<td>1.13-1.43</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Argus publishes hydrogen prices including and excluding capex, allowing for specific capex assumptions on a $/kg of hydrogen basis to be calculated for each technology and location. Ranges of those figures are shown here and vary depending on country risk and tax rates.*

**Green (No-C)**

Green (or No-C) hydrogen is produced using renewable electricity, either generated as part of an integrated hydrogen and electricity project or purchased from the grid with an accompanying guarantee of origin.

**Electrolyser assumptions**

Two technologies are modelled — ALK and PEM — for which capital, operating and other costs vary by location. Both assume a 100MW plant design capacity, operating and other costs of 3.5pc of capital expense per year and a plant lifetime of 25 years. A capacity factor of 70pc is assumed for grid-connected and diurnal installations and a capacity factor of 60pc is assumed for offshore wind-powered projects.

ALK installations are assumed to require 58MWh of electricity per tonne of hydrogen and PEM installations 54MWh/t.

**Electricity prices**

Where available, Argus has used levelised cost of electricity figures from the International Renewable Energy Agency (Irena) for the cost of off-grid power. In some cases Argus makes an estimate of the cost based in part on Irena data.

European grid electricity prices are the Argus month-ahead base load price for the named country. See the Argus European Electricity methodology.

**Green (No-C) hydrogen cost assumptions**

<table>
<thead>
<tr>
<th>Location</th>
<th>Technology</th>
<th>Electricity source</th>
<th>Electricity cost source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>PEM</td>
<td>Offshore wind</td>
<td>Irena</td>
</tr>
<tr>
<td>Netherlands</td>
<td>PEM</td>
<td>Offshore wind</td>
<td>Irena</td>
</tr>
<tr>
<td>UK</td>
<td>PEM</td>
<td>Offshore wind</td>
<td>Irena</td>
</tr>
<tr>
<td>Germany</td>
<td>PEM</td>
<td>Offshore wind</td>
<td>Irena</td>
</tr>
<tr>
<td>France</td>
<td>PEM</td>
<td>Offshore wind</td>
<td>Argus estimate</td>
</tr>
<tr>
<td>Spain</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Irena</td>
</tr>
<tr>
<td>Spain</td>
<td>ALK</td>
<td>Grid + GOC + 24.6pc fees</td>
<td>Market</td>
</tr>
<tr>
<td>Americas</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
</tr>
<tr>
<td>US west coast</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
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<td>Canada</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
</tr>
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<td>Brazil</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Irena</td>
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<tr>
<td>Chile</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Irena</td>
</tr>
<tr>
<td>Middle East and Africa</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
</tr>
<tr>
<td>Oman</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
</tr>
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<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
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<tr>
<td>Saudi Arabia</td>
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<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
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<tr>
<td>South Africa</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Argus estimate</td>
</tr>
<tr>
<td>Asia</td>
<td>PEM</td>
<td>Offshore wind</td>
<td>Irena</td>
</tr>
<tr>
<td>Japan</td>
<td>PEM</td>
<td>Offshore wind</td>
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<td>PEM</td>
<td>Offshore wind</td>
<td>Irena</td>
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<tr>
<td>China</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Irena</td>
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<td>PEM</td>
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<td>Irena</td>
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<tr>
<td>Vietnam</td>
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<td>Offshore wind</td>
<td>Argus estimate</td>
</tr>
<tr>
<td>India</td>
<td>PEM</td>
<td>Onshore wind + solar</td>
<td>Irena</td>
</tr>
</tbody>
</table>
Guarantees of origin
Guarantee of origin prices for the current calendar year are added to the price of electricity, where specified. UK calculations use renewable guarantee of origin (Rego) prices and calculations for EU countries use guarantee of origin (GOO) prices. The specific Rego or GOO price used is the lowest of the relevant published unsubscribed Rego or GOO price assessments.

See the Argus European Electricity methodology.

Grid fees
Grid fees are added to the cost of electricity for projects connected to the power grid. Fees are expressed as a percent of the wholesale power price and are reviewed semi-annually.

Yellow (baseline)
Yellow (or baseline) hydrogen is produced using grid electricity without any guarantee of origin.

Electrolyser assumptions
Two technologies are modelled — ALK and PEM — for which capital, operating and other costs vary by location. Both assume a 100MW plant design capacity, operating and other costs of 3.5pc of capital expense per year and a plant lifetime of 25 years. A capacity factor of 70pc is assumed for grid-connected and diurnal installations and a capacity factor of 60pc is assumed for offshore wind-powered projects.

ALK installations are assumed to require 58MWh of electricity per tonne of hydrogen and PEM installations 54MWh/t.

Electrical prices
Europe
The Argus month-ahead base load price for the named country. See the Argus European Electricity methodology.

US
To produce a price for every hour in the calendar month, Argus averages peak and off peak price assessments as described below.

West coast: the Argus month-ahead off peak and peak price assessments for the NP15 market area. Peak is 06:00-22:00 on business days, off peak is all other hours.

Midwest: the Argus month-ahead off peak and peak price assessments for the northern Illinois market area. Peak is 07:00-23:00 on business days, off peak is all other hours.

East coast: the Argus month-ahead off peak and peak price assessments for the PJM West market area. Peak is 07:00-23:00 on business days, off peak is all other hours.

See the Argus US Electricity methodology.

Japan
The day-ahead base load price on the Japan Electric Power Exchange (JEPX) for the Tokyo market area.

Grey (baseline), Blue (Low-C and BAT+)
Argus publishes the cost of hydrogen produced using steam methane reforming (SMR) and autothermal reforming (ATR) processes, with or without carbon capture and storage (CCS) and with natural gas drawn from the local market, priced at regulated tariffs or bought at international market prices.

Two technologies are modelled — SMR and ATR — for which capital, operating and other costs vary by location. Argus also publishes costs excluding capex for existing SMR plants where a CCS system has been retrofitted. All assume 60,000 t/yr plant design capacity and a capacity factor of 90pc.

Assumptions per tonne of hydrogen produced

SMR without CCS
• 9t of CO2 is released
• 3.4t of natural gas is required, including gas consumed as fuel
• 6.64t of water is consumed

SMR with CCS
• 1t of CO2 is released
• 8.59t of CO2 is captured and stored
• 3.74t of natural gas is required, including gas consumed as fuel
• 4.68t of water is consumed
• CO2 transport and storage is assumed to cost $20/t

SMR with CCS retrofit
• 2.9t of CO2 is released
• 7.5t of CO2 is captured and stored
• 3.74t of natural gas is required, including gas consumed as fuel
• 4.68t of water is consumed
• CO2 transport and storage is assumed to cost $20/t
ATR with CCS
• 0.6t of CO2 is released
• 9.84t of CO2 is captured and stored
• 3.81t of natural gas is required, including gas consumed as fuel
• 2.28MWh of electricity is consumed
• 25.27t of water is consumed
• CO2 transport and storage is assumed to cost $20/t

Natural gas prices
Natural gas prices are converted at a fixed 48.62mn Btu/t

Europe

Netherlands: TTF day-ahead
UK: NBP day-ahead
Germany: Germany VTP (Trading Hub Europe) day-ahead
Spain: PVB front-month
France: PEG day-ahead.

See the Argus European Natural Gas methodology

North America

US Gulf coast: Henry Hub day-ahead index
Canada: Alliance ATP day-ahead index

See the Argus Natural Gas Americas methodology

Asia

Japan: LNG des northeast Asia (ANEA) first half month forward
South Korea: LNG des northeast Asia (ANEA) first half month forward
Australia: AEMO Victoria, prompt
Qatar: the higher of the published LNG fob Middle East (Asia-Pacific bound) ARV and LNG fob Middle East (Europe bound) ARV prompt prices less 5pc to account for liquefaction costs
UAE: the higher of the published LNG fob Middle East (Asia-Pacific bound) ARV and LNG fob Middle East (Europe bound) ARV prompt prices less 5pc to account for liquefaction costs

See the Argus LNG Daily methodology

Russia
Gas prices are the regional maximums for industrial consumers as set by the Federal Tariff Service of the Russian Federation

Russia west: Orenburg region
Russia east: Tyumenskaya region

Trinidad and Tobago
LNG fob Trinidad and Tobago first half month forward. See the Argus LNG Daily methodology

CO2
Hydrogen producers are assumed to purchase allowances or pay CO2 taxes for unabated CO2 emissions.

EU and UK: CO2 costs are the Argus assessments of EU ETS and UK ETS spot prices. See the Argus European Emissions Markets methodology.
Japan: the Tax for Climate Mitigation, imposed by the Ministry of the Environment is added to the gas price
South Korea: the price of credits in the Korea ETS (K-ETS) scheme
Canada: priced as per the Greenhouse Gas Pollution Pricing Act

Electricity prices

Europe
The Argus month-ahead base load price for the named country. See the Argus European Electricity methodology.

Russia
The weighted average day-ahead wholesale auction price from Russian state wholesale power market trading platform operator ATS.

Japan
The day-ahead base load price on the Japan Electric Power Exchange (JEPX) for the Tokyo market area.

South Korea
The Kepco tariff for high-voltage electricity consumers.

Qatar
The Qatar General Electricity and Water Corporation (KAHRAMAA) tariff for industrial electricity consumers

UAE
The Dubai Electricity and Water Authority (DEWA) tariff for industrial electricity consumers

Australia
The average Australian Energy Market Operator (AEMO) Victoria spot price

Canada
The average Alberta Electric System Operator (AESO) daily pool price

Trinidad and Tobago
Trinidad and Tobago Electricity Commission (TTEC) tariff for very large industrial consumers

US
To produce a price of electricity for every day in the calendar month, Argus averages peak and off peak price assessments as described below.

Gulf coast: the Argus day-ahead off peak and peak price assessments for the Entergy market area. Peak is 07:00-23:00 on business days, off peak is all other hours. See the Argus US Electricity methodology.
Argus publishes the cost of hydrogen produced using coal gasification with carbon capture and storage (CCS) and with coal purchased at international market prices.

Capital, operating and other costs vary by location. All assume 250,000 t/yr plant design capacity and a capacity factor of 90pc.

**Assumptions per tonne of hydrogen produced**

- 1.5t of CO2 is released
- 17.7t CO2 captured and stored
- 11.43t of 5,500 kcal/kg coal is consumed
- 1.36MWh/t of electricity is consumed
- 12.17t of water is consumed
- CO2 transport and storage is assumed to cost $20/t

**Coal**

Prices are the latest available

**Australia**

- fob Newcastle 6,000kcal/kg NAR
- fob Newcastle 5,500kcal/kg NAR

**China**

- cfr south China 5,500 kcal/kg NAR
- ddp Shanghai 3,800 kcal/kg NAR

**South Africa**

- fob Richards Bay 6,000 kcal/kg NAR
- fob Richards Bay 4,800 kcal/kg NAR

**Indonesia**

- fob Indonesia 5,800 kcal/kg GAR (5,500 kcal/kg NAR)
- fob Indonesia 4,200 kcal/kg GAR (3,800 kcal/kg NAR)

**Russia**

- fob Black Sea 6,000 kcal/kg NAR

See the Argus Coal Daily International methodology

**US**

- fob Hampton Roads terminals 6,000 kcal/kg NAR

See the Argus Coal Daily methodology

**Electricity**

**Australia**: the average Australian Energy Market Operator (AEMO) Victoria spot price

**China**: State Grid Corporation of China monthly tariff

**South Africa**: The tariff for Eskom direct customers

**Indonesia**: National Electricity Company PLN quarterly industrial tariff

**Regional technology averages - hydrogen**

Argus also publishes regional average hydrogen costs grouped by production technology.

Each price is an average of the listed published costs, converted to US dollars per tonne.

**Northwest Europe**

- Baseline: Netherlands, UK and Germany SMR (no CCS)
- BAT +: Netherlands, UK and Germany SMR + CCS
- Low-C: Netherlands, UK and Germany ATR + CCS
- No-C: Netherlands, UK and Germany PEM (offshore wind)

**North America**

- Baseline: US Gulf coast and Canada SMR (no CCS)
- BAT +: US Gulf coast and Canada SMR + CCS
- Low-C: US Gulf coast and Canada ATR + CCS
- No-C: US West coast PEM (wind and solar) and Canada PEM (offshore wind)

**Northeast Asia**

- Baseline: Japan and South Korea SMR (no CCS)
- BAT +: Japan and South Korea SMR + CCS
- Low-C: Japan and South Korea ATR + CCS
- No-C: Japan, South Korea PEM (offshore wind) and China PEM (wind and solar)

**Middle East**

- Baseline: UAE and Qatar SMR (no CCS)
- BAT +: UAE and Qatar SMR + CCS
- Low-C: UAE and Qatar ATR + CCS
- No-C: UAE, Saudi Arabia and Oman PEM (wind and solar)

**Exporter**

- Baseline: Australia, UAE, Qatar, US Gulf coast SMR (no CCS)
- BAT +: Australia, UAE, Qatar and US Gulf coast SMR + CCS
- Low-C: Australia, UAE, Qatar and US Gulf coast ATR + CCS
- No-C: US West coast, Chile, Namibia, Australia, Oman and Saudi Arabia PEM (wind and solar)

Russia

The weighted-average day-ahead wholesale auction price from Russian state wholesale power market trading platform operator ATS.

**Russia west**: Orenburg region

US

To produce a price for every hour in the calendar month, Argus averages peak and off peak price assessments as described below.

**East coast**: the Argus month-ahead off peak and peak price assessments for the PJM West market area. Peak is 07:00-23:00 on business days, off peak is all other hours.

See the Argus US Electricity methodology
Decarbonisation spreads
Argus also publishes the difference between lower- and higher-carbon intensity production costs.

Regional
Deltas are published showing the $/kg difference between No-C and BAT + costs, between Low-C and BAT + costs, and between BAT + and baseline costs for each of the regions described above.

National
Deltas are published in $/kg and €/kg.

France: No-C to baseline
Germany: No-C to BAT +
Netherlands: No-C to baseline

Complete list of hydrogen prices

Africa and Mideast Gulf
Namibia
no-C diurnal + PEM

Oman
no-C diurnal + PEM

Qatar
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C diurnal + PEM

Saudi Arabia
no-C diurnal + PEM

South Africa
BAT + coal gasification 4800 NAR
BAT + coal gasification 6000 NAR
no-C diurnal + PEM

UAE
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C diurnal + PEM

Americas
Brazil
no-C diurnal + PEM

Canada
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C offshore wind + PEM

AsiaPacific
Australia
baseline SMR
BAT + coal gasification 5500 NAR
BAT + coal gasification 6000 NAR
BAT + SMR + CCS
low-C ATR + CCS
no-C diurnal + PEM

Chile
no-C diurnal + PEM

Trinidad
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS

US east coast
BAT + coal gasification
baseline grid + ALK
baseline grid + PEM

US Gulf coast
BAT + SMR + CCS
low-C ATR + CCS
baseline SMR

US midwest
baseline grid + ALK
baseline grid + PEM

US west coast
no-C diurnal + PEM
baseline grid + ALK
baseline grid + PEM

Asia

China
BAT + coal gasification 3800 NAR
BAT + coal gasification 5500 NAR
no-C diurnal + PEM

India
no-C diurnal + PEM

Indonesia
BAT + coal gasification 3800 NAR
BAT + coal gasification 5500 NAR

Japan
baseline grid + ALK
baseline grid + PEM
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C offshore wind + PEM

South Korea
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C offshore wind + PEM

Vietnam
no-C offshore wind + PEM

Europe
France
baseline grid + ALK
baseline grid + PEM
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C grid + GOO + ALK
no-C offshore wind + PEM

Germany
baseline grid + ALK
baseline grid + PEM
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C grid + GOO + ALK
no-C offshore wind + PEM

Netherlands
baseline grid + ALK
baseline grid + PEM
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C grid + GOO + ALK
no-C offshore wind + PEM

Spain
baseline grid + ALK
baseline grid + PEM
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C grid + GOO + ALK
no-C offshore wind + PEM

UK
baseline grid + ALK
baseline grid + PEM
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
no-C grid + GOO + ALK
no-C offshore wind + PEM

Russia
BAT + coal gasification 6000 NAR

Russia east
baseline grid + ALK
baseline grid + PEM
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS

Russia west
baseline SMR
BAT + SMR + CCS
low-C ATR + CCS
Argus Hydrogen and Future Fuels includes modelled costs for ammonia produced at newly constructed facilities using hydrogen as a feedstock. Costs for future hydrogen production are calculated in the same way as those for spot production and assume the same fixed costs but incorporate forward price assessments for gas, electricity and CO2 emissions allowances.

Forward hydrogen costs are published for:

### Europe
- **Netherlands**
  - baseline SMR years 1-3
  - BAT+ SMR + CCS years 1-3
  - low-C ATR + CCS years 1-3
- **France**
  - baseline SMR year 1
  - BAT+ SMR + CCS year 1
  - low-C ATR + CCS year 1

### Germany
- **baseline SMR year 1-3**
- **baseline SMR year 1-3**
- **low-C ATR + CCS year 1-3**

### Spain
- **baseline SMR year 1**
- **BAT+ SMR + CCS year 1**
- **low-C ATR + CCS year 1**

### UK
- **baseline SMR year 1-2**
- **BAT+ SMR + CCS year 1-2**
- **low-C ATR + CCS year 1-2**

### Ammonia
Argus Hydrogen and Future Fuels includes modelled costs for ammonia produced at newly constructed facilities using hydrogen as a feedstock.

Modelled ammonia production costs are differentiated by location and by the cost of hydrogen production. Hydrogen costs are modelled as described above.

### Timing
Costs are calculated and published electronically each week, on Tuesday, and appear in the weekly print edition of Argus Hydrogen and Future fuels.

### Currency and unit
Prices are published in US dollars per tonne and in the local currencies for Australia, Canada, China, Europe, India, Japan and South Korea. Currency conversions are made using an average exchange rate during the week before publication.

### Blue/grey ammonia assumptions
Blue and grey ammonia is produced using fossil fuels — blue ammonia involves the capture and storage of CO2 and grey ammonia does not.
- Ammonia:Hydrogen ratio 5.85:1
- Capacity: 351,000t/yr of ammonia production (gas projects), 1.463mn t/yr of ammonia production (coal projects)
- Plant lifetime: 25 years
- Capacity factor: 90pc
- Water consumption: 1.6t/t of ammonia
- No off-site heat or power consumption is assumed

### Green ammonia assumptions
- Ammonia:Hydrogen ratio 5.85:1
- Capacity: 474,500t/yr of ammonia production
- Plant lifetime: 25 years
- Capacity factor: 90pc
- Water consumption: 1.6t/t of ammonia
- Electricity consumption: 1.05MWh/t of ammonia

### Fixed cost summary

<table>
<thead>
<tr>
<th>Capex ($/t NH3, actual)</th>
<th>PEM electrolysis</th>
<th>offshore wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>366-492</td>
<td>382-445</td>
<td></td>
</tr>
<tr>
<td>191-301</td>
<td>118-188</td>
<td></td>
</tr>
<tr>
<td>157-249</td>
<td>256-327</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Argus publishes ammonia prices including and excluding capex, allowing for specific capex assumptions on a $/t of ammonia basis to be calculated for each technology and location. Ranges of those figures are shown here and vary depending on country risk and tax rates*

### Regional technology averages - ammonia
Argus also publishes regional average ammonia costs grouped by production technology.

Each price is an average of the listed published costs, converted to US dollars per tonne.

### Northwest Europe
- Baseline: Netherlands, UK and Germany SMR (no CCS)
- BAT+: Netherlands, UK and Germany SMR + CCS
- Low-C: Netherlands, UK and Germany ATR + CCS
- No-C: Netherlands, UK and Germany PEM (offshore wind)

### North America
- Baseline: US Gulf coast and Canada SMR (no CCS)
- BAT+: US Gulf coast and Canada SMR + CCS
- Low-C: US Gulf coast and Canada ATR + CCS
- No-C: US West coast PEM (wind and solar) and Canada PEM (offshore wind)

### Northeast Asia
- Baseline: Japan and South Korea SMR (no CCS)
- BAT+: Japan and South Korea SMR + CCS
- Low-C: Japan and South Korea ATR + CCS
- No-C: Japan, South Korea PEM (offshore wind) and China PEM (wind and solar)

### Middle East
- Baseline: UAE and Qatar SMR (no CCS)
- BAT+: UAE and Qatar SMR + CCS
- Low-C: UAE and Qatar ATR + CCS
- No-C: UAE, Qatar, Saudi Arabia and Oman PEM (wind and solar)
### Exporter
- **Baseline:** Australia, UAE, Qatar, US Gulf coast SMR (no CCS)
- **BAT+:** Australia, UAE, Qatar and US Gulf coast SMR + CCS
- **Low-C:** Australia, UAE, Qatar and US Gulf coast ATR + CCS
- **No-C:** US West coast, Chile, Namibia, Australia, Oman and Saudi Arabia PEM (wind and solar)

### Decarbonisation spreads
Argus also publishes the difference between lower- and higher-carbon intensity production costs. Deltas are published showing the difference between No-C and BAT+ costs, between Low-C and BAT+ costs, and between BAT+ and baseline costs for each of the regions described above.

### Complete list of ammonia prices

<table>
<thead>
<tr>
<th>Region</th>
<th>Baseline Cost</th>
<th>BAT+ Cost</th>
<th>Low-C Cost</th>
<th>No-C Cost</th>
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<td><strong>Africa and Mideast Gulf</strong></td>
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<td>BAT+ SMR + CCS</td>
<td>low-C ATR + CCS</td>
<td>no-C diurnal + PEM</td>
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<tr>
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<td><strong>UK</strong></td>
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### Direct Reduced Iron
Argus Hydrogen and Future Fuels includes weekly averages of calculated production costs for Direct Reduced Iron (DRI).

**Prices are published for**
- Natural Gas DRI
- DRI spread – No-C hydrogen (renewables + PEM) vs natural gas northwest Europe
- DRI spread – BAT+ hydrogen (SMR + CCS) vs natural gas northwest Europe

See the Argus Ferrous Markets methodology.