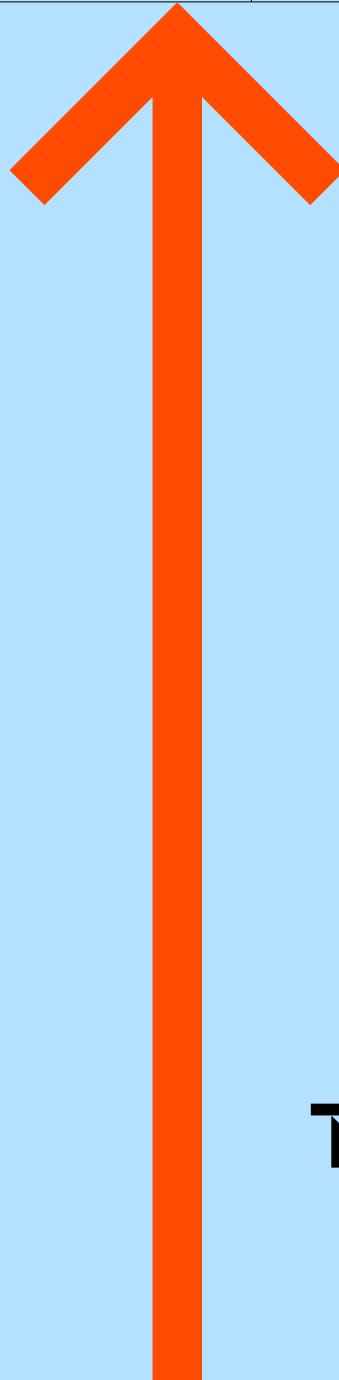


Blue hydrogen

GROUNDBREAKING
SOLUTIONS FOR
HYDROGEN PRODUCTION
AT SCALE



Explore how you can massively decarbonize at scale, now.

TOPSOE

What if we said you could dramatically decarbonize your business, today? Well, you can. Blue hydrogen can be produced at mega scale, leveraging existing natural gas infrastructure to minimize time and money spent on decarbonization. The case for blue hydrogen is clear. With guidance from Topsoe, you can scale up production and bring down emissions.

BRING ON NET ZERO: ULTRA-LOW CARBON NATURAL GAS IS HERE

THE ENERGY TRANSITION IS NOW

Making the transition to a net zero economy is imperative – for your business and the planet. And this isn't just an idea for the future. The transition to sustainable energy technologies is already in full flow. The wait-to-see-what-happens-next time is over. The activate-the-vital-energy-transition time is now.

BLUE IS HERE

Transform natural gas resources into clean profit. Blue hydrogen is produced by combining traditional hydrogen production methods with carbon capture.

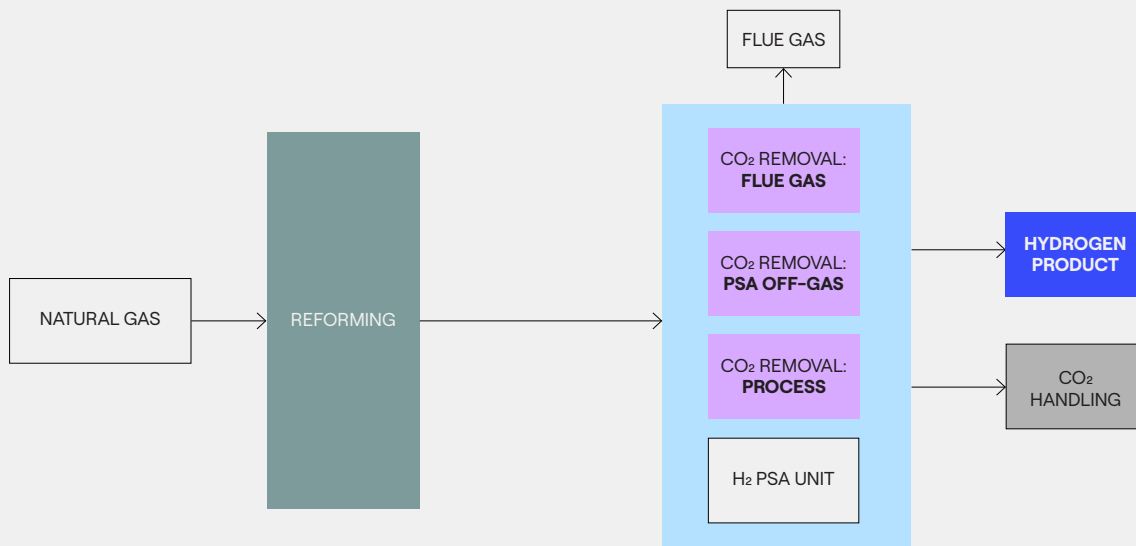
There are different types of carbon capture technologies available. CO₂ can be removed from the flue gas side, process side, and/or hydrogen PSA off-gas. The optimal choice of this technology mainly depends on the selection of the reforming process.

We deliver an integrated blue hydrogen solution comprising hydrogen production and carbon capture. In close dialogue with you, we select the most suitable combination of technologies based on specific project drivers.



BLUE HYDROGEN

TOPSOE OFFERS ONE SINGLE LICENSE FOR ALL STEPS IN A BLUE HYDROGEN FACILITY



● Integrated CO₂ Removal Technology: Sub-licensed

- CO₂ is formed in the process side together with the Hydrogen product. This portion of the CO₂ can be captured before or after the PSA
- CO₂ is also formed on the flue gas side, where natural gas is burned together with PSA off-gas to generate heat for the process

DIFFERENT SHADES OF BLUE?

Although definitions vary, most key industry stakeholders agree that blue hydrogen must have >90–95% CO₂ recovery. Topsoe's contribution to this process significantly exceeds this, with up to 99%+ carbon recovery.

HYDROGEN IS ALREADY HAPPENING

Due to its huge importance in reaching a net zero economy, demand for blue hydrogen is growing significantly.

By now, most companies, countries, and regions have published clear hydrogen strategies. The message is clear among them all: hydrogen will play a massive role in their future energy mix.

For this reason, the number of global projects is growing at a rapid rate.

CAPTURE THE MOMENT

To capitalize on this demand, prospective blue hydrogen producers should move at speed and with care. Choosing the right technology will ensure genuinely effective decarbonization.

Since there is the need for hydrogen for so many different sectors and industries, the benefits of scaling up are clear. With 3–5 times larger single-line capacities than alternatives, our customers can capture economies of scale and minimize levelized cost of hydrogen (LCOH).

We offer unique and proven technologies for production of ultra-low carbon intensity blue hydrogen. Our integrated blue hydrogen solutions reduce up to 99%+ of all CO₂ emissions from the reforming process.

MORE BUSINESS

LESS CARBON.

NATURAL GAS,

FUTURE READY.

**A LOW-CARBON FUTURE
– POWERED BY NATURAL GAS**

As the world switches to lower-carbon energy sources, blue hydrogen is ready to meet the challenge of decarbonizing natural gas resources in an economically attractive way.

Blue hydrogen will be vital for reaching a net zero economy. That's because it can be used in its pure form for production of chemicals and fuels, as well as for fuel substitutions in difficult-to-decarbonize sectors such as cement, steel, refining, and petrochemicals.



BE READY FOR REGULATION

There are already several regulatory frameworks designed to reduce CO₂ emissions. For example, the EU Emission Trading System (ETS) directive drives CO₂ reductions by setting a cap on the total CO₂ emission allowance for each company and by reducing this cap figure over time. The pace of this annual cap reduction is set to increase significantly.

Meanwhile the US administration has proposed a hydrogen production tax credit (PTC) which incentivizes hydrogen production with the lowest carbon intensity (CI).

Specific states such as California and British Columbia have legislation that encourages the use of low-CI transport fuels, where the lower the CI of hydrogen, the more Low Carbon Fuel Standard (LCFS) credits it would generate. Wherever your operations are in the world, future-proof your business by adopting the technology that can help reduce your carbon footprint significantly and meet targets.

DECARBONIZE AT SCALE

Leverage the largest possible single-line capacity to produce clean hydrogen at large scale. In doing so, you'll reduce the levelized cost of the hydrogen you produce.

Our customers are already benefiting from economies of scale. With more than 300 years of operational experience, our SynCOR™ blue hydrogen technology is by far the most mature technology in the market.

The levelized cost of blue hydrogen is minimized as the single-line production capacities increase. With single-line capacities up to 720 mmscfd (800,000 Nm³/hr), our blue solutions capture far more economy of scale than alternatives.



THE **B BROADEST RANGE
OF TECHNOLOGIES,
CARBON CAPTURE
INTEGRATED.**



Whether you are planning to produce blue hydrogen at large scale or in smaller, flexible units, we have the right solution for you. Our technologies lead the industry in efficiency and cost-effectiveness.

FULLY INTEGRATED SOLUTIONS

Get the full blue hydrogen production solution: reforming and CO₂ capture in one single-point license.

We collaborate with carbon capture technology providers. Superior integration of these technologies ensures an industry-leading 99%+ scope 1 emissions reduction in the Topsoe process.

With our blue hydrogen offering, you get basic engineering, technology license, catalysts, proprietary hardware, technical service, and comprehensive performance guarantees.

THE WIDEST PORTFOLIO OF REFORMING TECHNOLOGIES

There are many hydrogen technologies with their own benefits and challenges when it comes to producing blue hydrogen using carbon capture.

The best choice of technology ultimately depends on achieving certain CO₂ emissions reductions as cost-effectively as possible. We will consult with you to meet these objectives in the best way for your business.

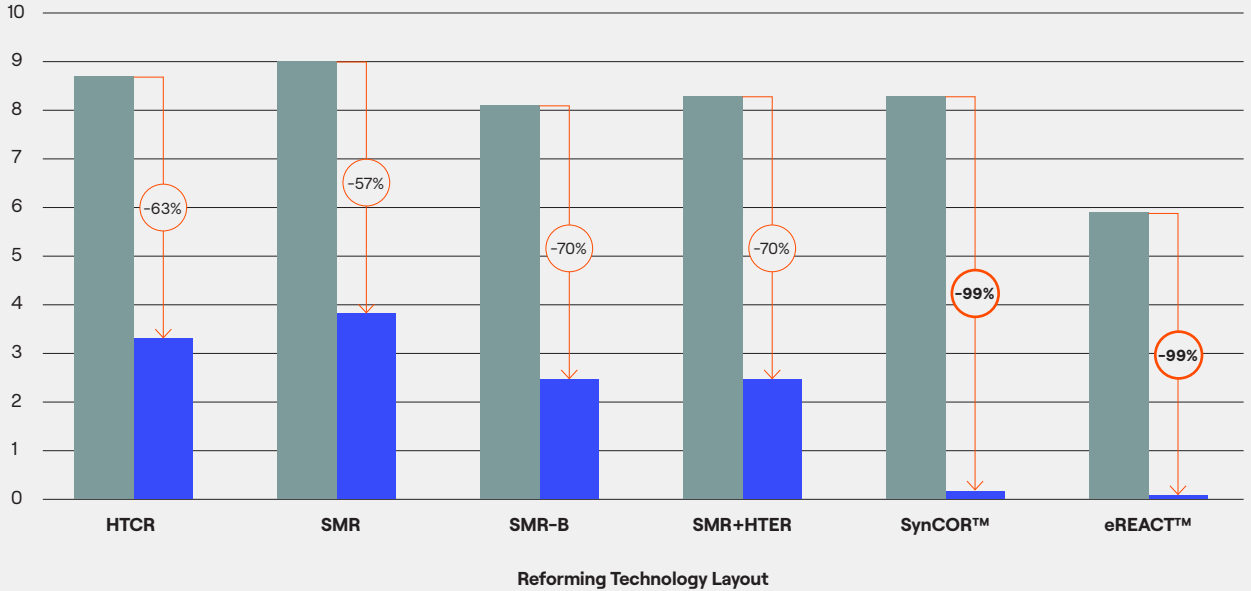


COMPARISON OF BLUE HYDROGEN TECHNOLOGIES

WITH SynCOR™ AND eREACT™ YOU CAN ACHIEVE 99%+ CARBON INTENSITY REDUCTION

Carbon intensity

(kg CO₂ emitted/kg H₂ produced)



- Carbon intensity (no CO₂ capture)
- Carbon intensity (with process CO₂ capture - without flue gas capture)

- CO₂ capture is easier from the process gas or PSA off-gas, rather than flue gas due to higher partial pressure
- In SynCOR™ Blue Hydrogen technology, it is possible to achieve a CI lower than 0.1 kgCO₂/kgH₂ without the need of flue gas CO₂ capture
- In eREACT™ the achievable CI is even lower

AIM HIGH, GO LOW-CARBON

Take the lowest energy route to ultra-low carbon intensity hydrogen. Carbon intensity is now widely considered the most effective way to measure the success of a blue hydrogen technology in terms of carbon emissions reductions and Topsoe's solutions have incredibly low CI.

With options for all production capacities, we offer the broadest and most optimal selection of technologies to produce blue hydrogen today.

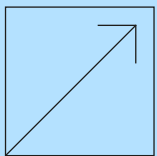
TRUE BLUE

Aim high to secure low-carbon intensity hydrogen. With up to 99%+ CO₂ removal capabilities, our blue hydrogen solutions lead the industry for decarbonization.

We have the best understanding of hydrogen reforming technologies and integration with carbon capture, so we can work with you to find the right solution for your current infrastructure and project needs.

That's how we help our customers achieve the most profitable and sustainable operations.

At Topsoe, we believe in a tailor-made approach in partnership with you. That's why we have different solutions for every project requirement. Below are just two of our best-in-class technologies.



SynCOR™

Meet what we like to call the 'workhorse of the future'. SynCOR™ is a next-generation technology which is well-proven and far exceeds any other in the category. It's especially suitable for production at very large capacities and with high carbon capture requirements.

Reap the rewards of economy of scale: Among all blue hydrogen technologies, SynCOR™ has the lowest levelized cost due to lower CAPEX and OPEX.

SynCOR™ also has a reduced steam throughput which significantly reduces the sizes of equipment and piping and enables single-line capacities up to 720 mmscfd (800,000 Nm³/hr) – that is 3-5 times larger than alternatives.



eREACT™ hydrogen

Welcome to the future of steam methane reforming (SMR). Powered by electricity, eREACT™ hydrogen is a technology that – especially as renewable energy scales up and becomes cheaper – will certainly play a huge role in hydrogen production.

It can reduce the size of a traditional steam methane reformer from a 30-meter-long, six-story building to a unit 100 times smaller. Put that together with the outstanding energy efficiency and zero flue gas emissions, it makes the technology extremely commercially attractive.

BUILDING A LOW-CARBON WORLD THROUGH UNDERSTANDING AND EXPERTISE

INVEST WITH CONFIDENCE

Every third hydrogen molecule is produced using Topsoe solutions. Future-proof your business by working with the worlds largest hydrogen technology licensor and maximize both your potential and resources.

With a proven track record and advanced analytical competencies, we ensure the scalability and economic feasibility of your blue hydrogen projects.





SECURE THE FULL VALUE CHAIN

We offer fully integrated end-to-end solutions. Our unique combination of R&D, process design, technologies, and catalysts equip you with everything you need to make blue hydrogen happen for your organization. All under one single-point license.

UNRIVALED UNDERSTANDING

When you partner with us, you benefit from unparalleled knowledge. With the broadest toolbox of hydrogen technologies and the broadest overview of all available technologies, our tech-agnostic approach will ensure that the optimal solution is applied to your project. And, whether you would like to revamp your current operations or build new, we are ready and able to support you through that process.

HERE FOR HOW, READY NOW

By perfecting chemistry for a better world, we enable you to succeed in the transition towards renewable energy. It's not just a dream: we have the proven solutions and references to make your decarbonization ambitions become a reality. And it can happen today.

LET'S START TODAY

Get in touch with our team to discuss your options. [Just click here.](#)

Founded in 1940, Topsoe is a global leader in developing solutions for a decarbonized world, supplying technology, catalysts, and services for worldwide energy transition.

Our mission is to combat climate change by helping our partners and customers achieve their decarbonization and emission-reduction targets, including those in challenging sectors: aviation, shipping, and production of crucial raw materials. From low-carbon or zero-carbon chemicals, to renewable fuels and plastic upcycling, we are uniquely positioned to aid humanity in realizing a sustainable future.

Topsoe is headquartered in Denmark, with 2,100 employees serving customers all around the globe. To learn more, visit [topsoe.com](https://www.topsoe.com)



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