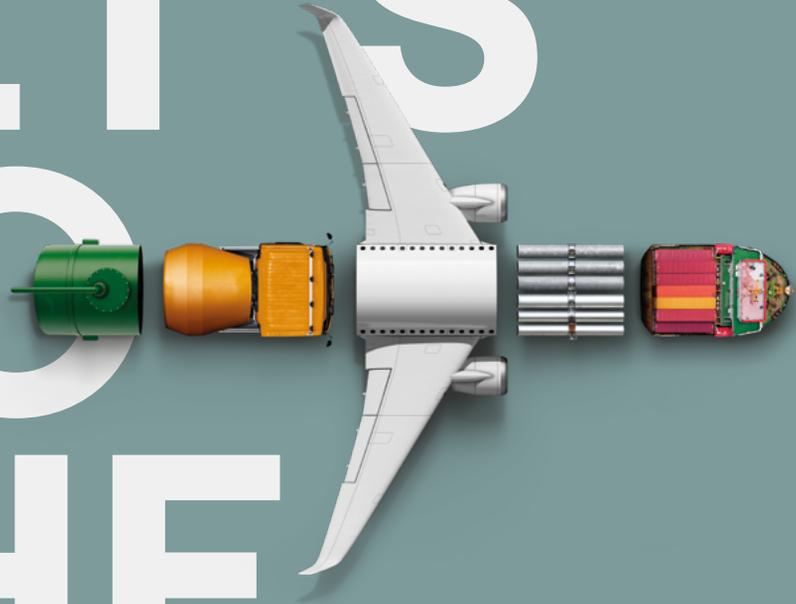


LET'S DO THE HARD PART



→ **DECARBONIZING THE
ENERGY-INTENSIVE INDUSTRIES**

For years, we've talked about the challenge of reducing carbon emissions in the most energy-intensive industries and in long-distance transportation. Now it's time to change the conversation and start scaling the proven solutions we have at hand.

Let's do the hard part of decarbonization.

TOPSOE

THE NOW OF DECARBONIZATION



REDUCING THE CARBON FOOTPRINT OF ENERGY-INTENSIVE INDUSTRIES

A rapid shift from fossil fuel dependency to low-carbon alternatives is essential to combat climate change. A crucial step in this transition is the transformation of the energy sector through scaling renewable energy sources for direct electrification whenever possible. Yet, many energy-intensive industries, as well as long-distance transportation, cannot be easily electrified.

Topsoe's technologies and solutions pioneer the transformation of renewable electricity and biomass into green and renewable fuels, and enable the production of low-carbon fuels based on natural gas with carbon capture (CCUS). These are the feasible pathways for decarbonizing industries where renewable electricity is not a viable source of direct energy, and a meaningful step towards reaching global targets of net zero by 2050.

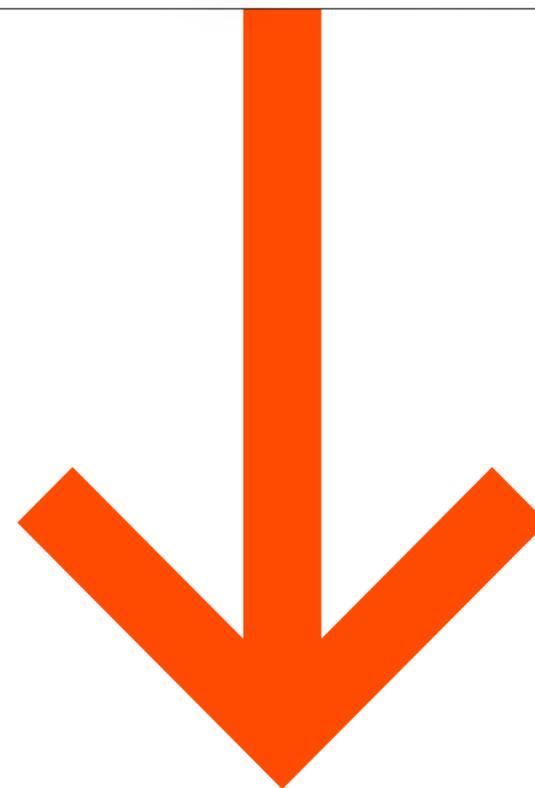
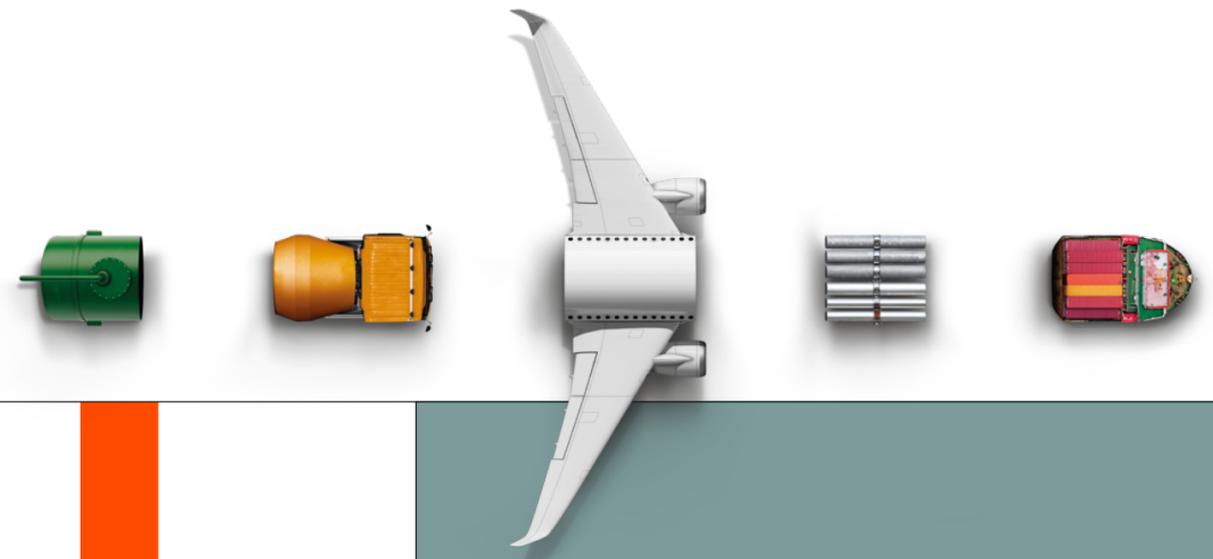
TACKLING THE HARD CHALLENGES IN ENERGY-INTENSIVE INDUSTRIES AND LONG-DISTANCE TRANSPORTATION

Energy-intensive industries – including steel, cement, chemicals and long-distance transportation – are often referred to as “hard-to-abate.” But hard doesn't mean impossible. Instead, it's a matter of investing in the right energy transition technologies to de-risk, implement at scale and drive down cost.

Energy-intensive industries and long-distance transportation account for approximately 30% of global carbon emissions. Addressing the carbon emissions of these sectors is not only our duty, it's also essential to reach net zero by 2050. But the road to net zero will not be paved by any single idea or technology.

Like most global challenges, the energy transition will be realized through an energy system that is equitable, sustainable and scalable.

Tripling the supply of renewable energy will be the cornerstone of such a system. But more is needed. Even in a scenario where we achieve net zero by 2050, it's estimated that a little more than half of the total energy consumption will be electricity. For the remaining portion, we need fuels with low carbon intensity (CI). Topsoe technologies deliver these with high efficiency, enabling industries to reduce their climate impact and overcome some of their most pressing challenges.



A FLIGHT PATH FOR NET ZERO AVIATION

Aviation alone accounted for 2% of global carbon emissions in 2022. A strong reliance on carbon-intensive jet fuel, long aircraft-engine lifespans, and the essential role of aviation in global connectivity and trade require a significant effort to reduce emissions. The good news? The technology exists to ramp up production of Sustainable Aviation Fuels (SAF), which can help reduce Greenhouse Gas (GHG) emissions in aviation. In 2022, global SAF production is estimated to have been between 300 and 450 million liters, covering less than 0.15% of the total jet fuel demand.

WE'RE THE HOW OF DECARBONIZATION

DELIVERING SOLUTIONS TO RESHAPE HOW WE PRODUCE AND MOVE AROUND

At Topsoe, we invest heavily in technology for the energy transition. We're determined and committed to helping our customers reach their carbon reduction ambitions by providing solutions – based on decades of experience and innovation – that are essential for their decarbonization journey.

THE PROMISE OF POWER-TO-X

Power-to-X (PtX) is the bridge between the world's most carbon-intensive industries and a net zero future. Despite its massive potential, PtX is, at least on the surface, quite a simple idea. As a term, it covers a family of processes that use an electrolyzer to convert renewable power (P) into green hydrogen, the base reactant that can be transformed into a whole spectrum of versatile energy carriers (X). These include eMethanol, eAmmonia and eSAF, as well as other fuels that can be used across industries. By changing the form of renewable energy from electricity to molecules, we make it a better fit for decarbonizing industries that cannot be electrified directly.

At Topsoe, we've leveraged over 80 years of scientific knowledge and innovation to deliver PtX offerings that bring adaptable, tested and proven solutions to the market. We're one of a few companies that has the full PtX value proposition. At the heart of our PtX solutions is our Solid Oxide Electrolyzer Cells (SOEC), which offers up to 30% higher efficiency than conventional electrolysis technology.

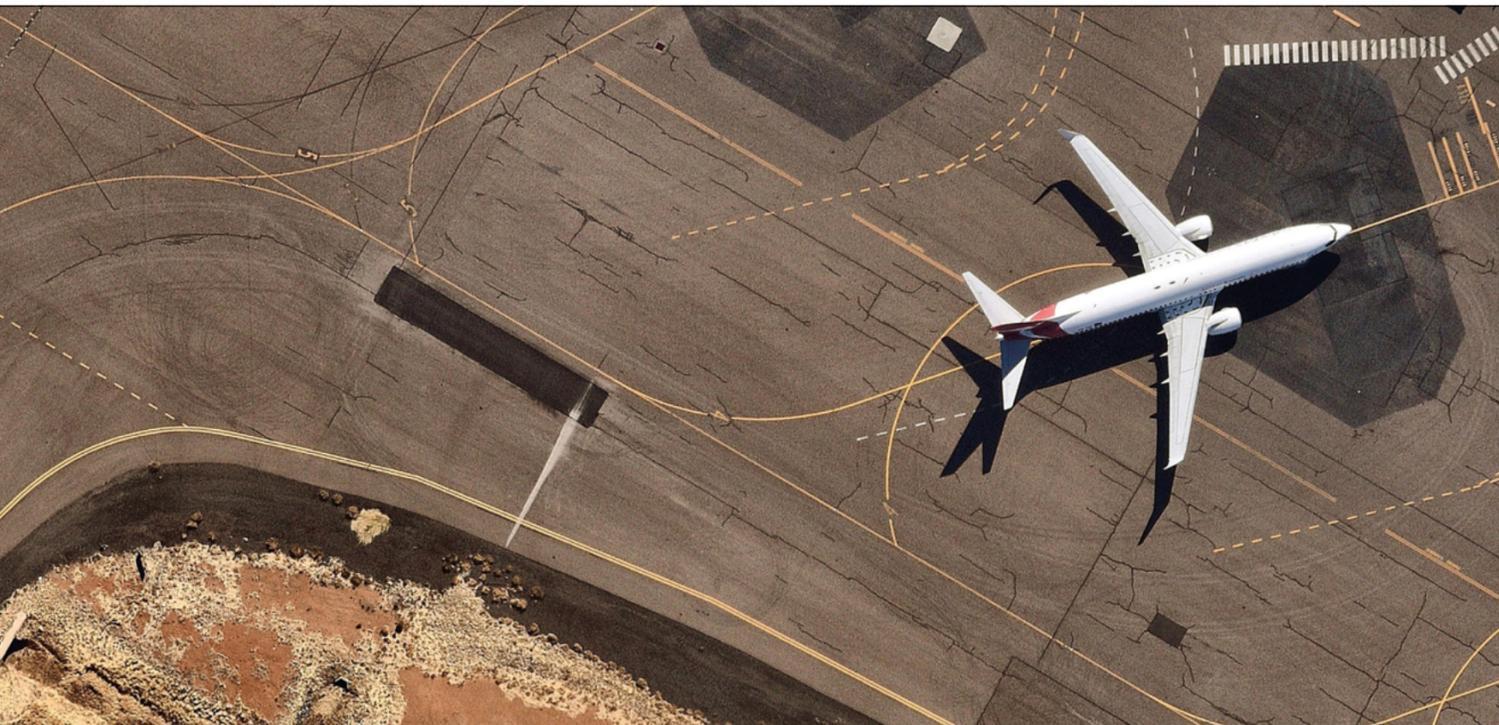
GOING LOW-CARBON – MUCH LOWER

As we develop, mature and test technologies using renewable energy, low-carbon fuels play a pivotal role in the journey toward decarbonization. Low-carbon technologies are available, proven and scalable, and can help transform hard-to-abate sectors, such as shipping. Also known as blue hydrogen, low-carbon hydrogen is produced by combining traditional hydrogen production methods with carbon capture. The hydrogen can then be transformed into low-carbon ammonia or methanol.

Low-carbon solutions have a lower carbon footprint than conventional solutions. With strict controls to ensure the lowest possible upstream emissions and safe and permanent storage of CO₂ underground, low-carbon hydrogen, ammonia and methanol contribute to reducing carbon emissions. Topsoe takes a pioneering role in developing technologies that generate hydrogen with minimal carbon emissions.



THE WAY FORWARD FOR TRANSPORTATION



SUSTAINABLE AVIATION FUELS

Sustainable Aviation Fuels (SAF) play a crucial role in mitigating the aviation industry's emissions, contributing to a more environmentally responsible future for air travel.

SAF can help reduce aviation industry's GHG emissions by up to 85% compared to conventional jet fuel and 100% for e-jet fuels. SAF is fully compatible with existing aircraft and fueling infrastructure, and can be implemented within existing structures.

SAF is therefore an environmentally and logistically favorable alternative fuel source for the aviation sector.

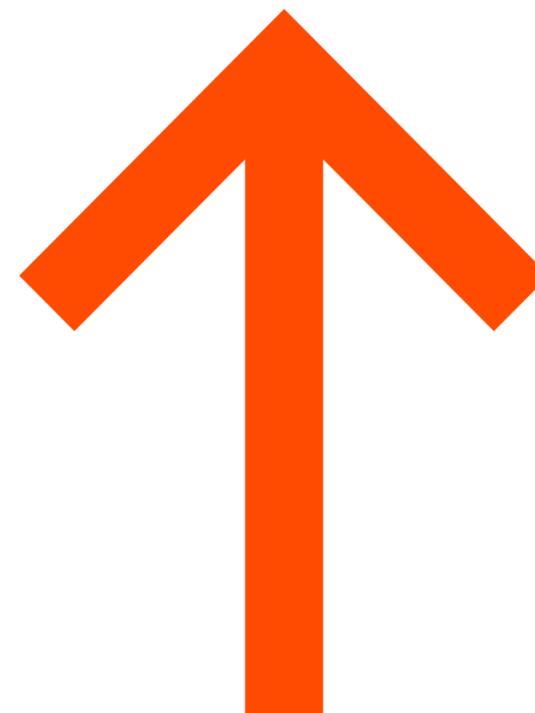
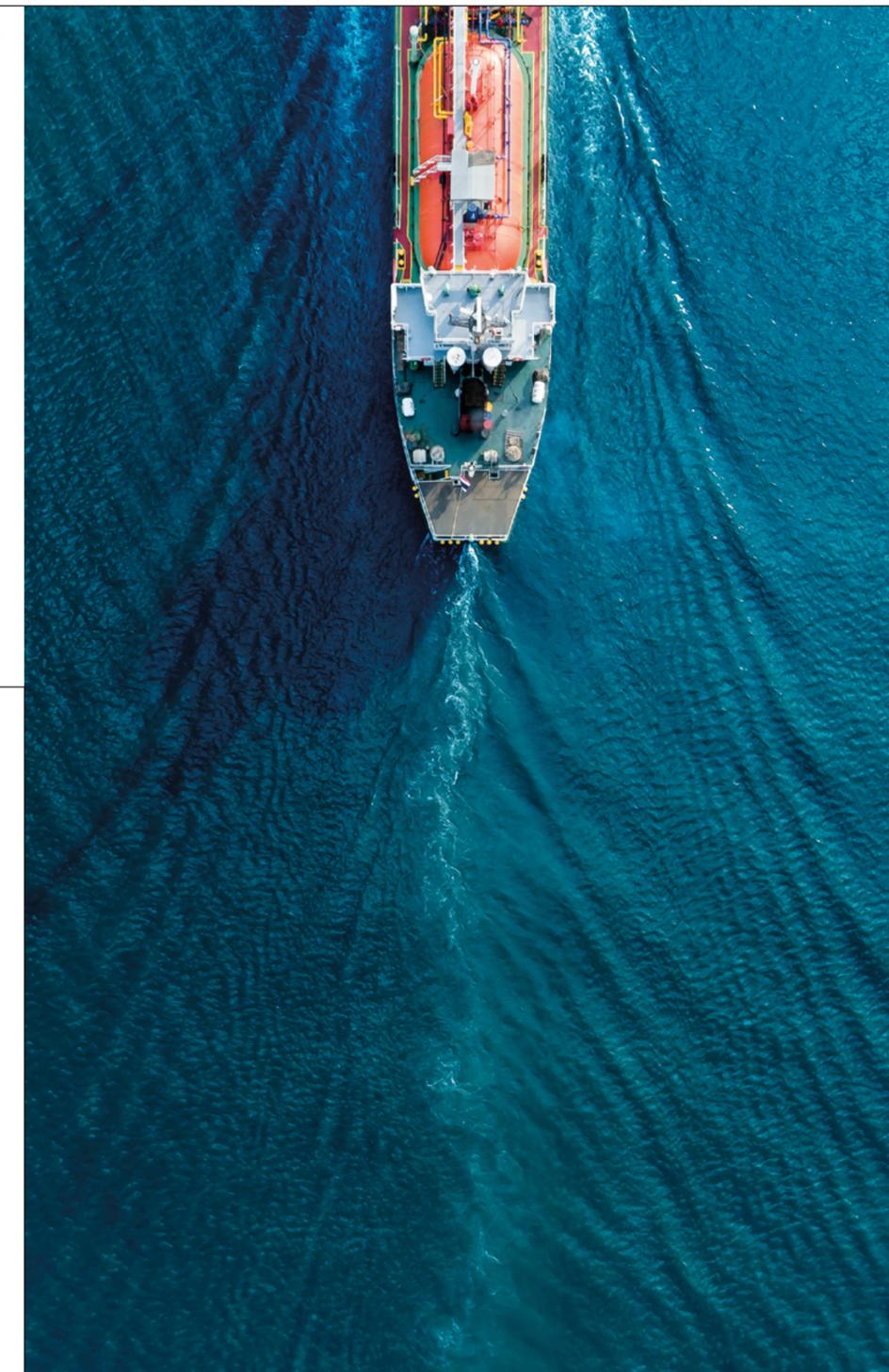
Topsoe has a range of proven technologies ready to help our customers produce SAF with several already commercially advanced production routes, including the production of renewable fuels from waste oils and fats, and e-fuels from green hydrogen, CO₂ and renewable electricity.

E-FUELS FOR SHIPPING

Shipping vessels emit roughly 1 billion tons of CO₂ globally – almost 3% of the total energy-related CO₂ emissions annually. The need for a more sustainable fuel source is evident. Both methanol and ammonia, produced using renewable energy and electrolysis, have the potential to play a significant role in shipping. Due to their high energy densities, they can be easily stored and used today with existing infrastructure.

For the transportation sectors specifically, Topsoe has the solutions needed to produce e-fuels by producing green hydrogen via electrolysis. We can then convert the hydrogen to either ammonia or methanol for shipping through our leading technology.

Approx. **one-third** of all SAF and renewable diesel produced globally goes through Topsoe technology.

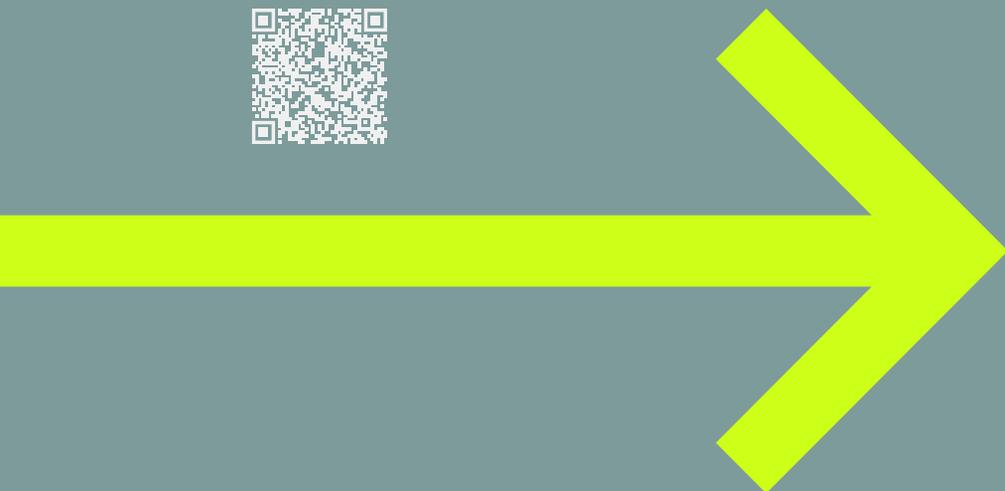


READY TO DECARBONIZE?

The global fight against climate change requires partnerships, innovation and an all-hands-on-deck approach. Now is our chance to work together to focus on the how and the now of decarbonization – and scale up the solutions we already have, fast.

MEET US AT COP28

www.topsoe.com/COP28



TOPSOE

ABOUT TOPSOE

Topsoe is a leading global provider of technology and solutions for the energy transition. We combat climate change by helping our customers and partners achieve their decarbonization and emission reduction goals.

Based on decades of scientific research and innovation, we offer world-leading solutions for transforming renewable resources into fuels and chemicals for a sustainable world, and for efficient and low-carbon fuel production and clean air.

We were founded in 1940 and are headquartered in Denmark, with over 2,800 employees serving customers all around the globe.

To learn more, visit www.topsoe.com

