Ørsted

The power of American green hydrogen

How the rising star of Power-to-X can make U.S. industries sustainable

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Beyond decarbonizing hard-to-electrify sectors, we see investing in green hydrogen as a chance to boost America's industries, infrastructure, and workforce.

Melissa Peterson
Head of P2X Americas
Ørsted

The last 29%: decarbonizing the U.S. economy with green hydrogen

The United States has greater historical emissions than any other country on earth[1]. This makes the U.S. a priority area for accelerating the energy transition – a global push to reduce greenhouse gas (GHG) emissions by improving energy systems.

Following two decades of advancement in energy technology and policy, the costs of building wind and solar farms at scale have fallen significantly. For the United States, this has meant remarkable growth in clean energy. From 2010 to 2021, the share of wind and solar energy powering the U.S. electrical grid rose by more than 400%[2].

While these gains are valuable, renewable electricity alone cannot decarbonize[i] the U.S. The power sector represents just 25% of U.S. GHG emissions, with transportation, heavy industry, and buildings accounting for another 64%[3]. By decarbonizing the power sector and electrifying these other industries to the greatest possible extent, the U.S. could reduce its emissions by 71%[4]. But that would still leave 29% of national emissions untouched.

This elusive 29% comes from sectors like steelmaking, petrochemicals[ii], shipping, and aviation, for which direct electrification is either technically unfeasible or prohibitively expensive. For these 'hard-to-electrify' sectors, it will be difficult to achieve decarbonization without turning to an alternative solution: green hydrogen.

An opportunity to transform the U.S. economy

As a feedstock or fuel, hydrogen alone emits no carbon dioxide. When produced using zero-emissions wind or solar energy, hydrogen's inputs and outputs are fully renewable, creating what is called 'green hydrogen'. With no emissions from production or use, green hydrogen has the potential to decarbonize even the most fossil fuel dependent processes.

This idea is foundational to Ørsted's Power-to-X (P2X) business, and the reason we're leveraging our renewable power portfolio to produce green hydrogen and e-fuels[iii]. In March 2022, we formally entered the U.S. P2X market with a landmark agreement to develop a P2X facility on the Gulf Coast powered by Ørsted renewable energy. This represents a major step in realizing our company vision of creating a world that runs entirely on green energy.

From experience, we know that developing and scaling a new industry comes with many unknowns and requires considerable investments – which we are prepared to make. Beyond decarbonizing hard-to-electrify sectors, we see investing in the U.S. green hydrogen industry as a chance to create American jobs and deliver economic value to communities nationwide.

To achieve the best results, rapid decarbonization will need to occur within the next decade[5]. We believe green hydrogen and e-fuels will be critical to this journey, and the time to start is now. In this white paper, Ørsted puts forth a vision for the applications and decarbonization potential of green hydrogen and P2X technologies in the United States.

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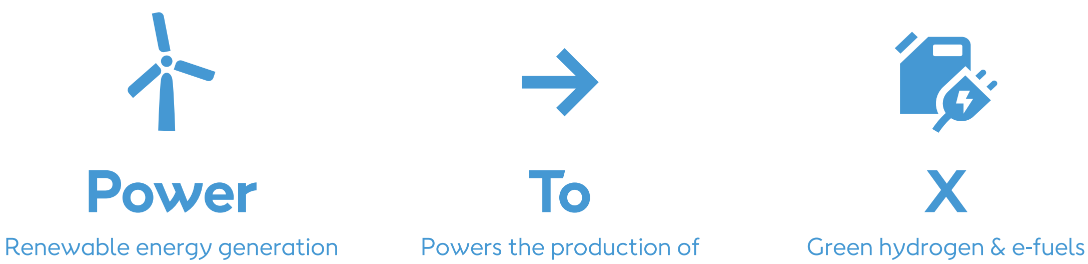
[i] To reduce or eliminate GHG emissions, especially carbon dioxide (CO_2).
[ii] An industry that manufactures chemical products using petroleum, a fossil fuel source.
[iii] A type of synthetic fuel produced using green hydrogen.

Today's hydrogen is brown and gray. Tomorrow's could be green.

Hydrogen gas has traditionally been derived from fossil fuels, which release harmful emissions into the atmosphere. The emerging green hydrogen industry is looking to change that, providing a renewably powered alternative.

Figure 1



What is P2X?

Power-to-X (P2X) is the umbrella term for turning electricity into something else. In this white paper, the 'X' refers to green hydrogen and e-fuels.

A snapshot of hydrogen today

Hydrogen is commonly used as a feedstock for heavy industries, including petrochemicals, manufacturing, and power. It can be extracted from many sources, such as coal, natural gas, biomass, and water.

As of 2021, 96% of hydrogen produced was derived from coal and natural gas[6], representing 6% of global natural gas use and 2% of global coal consumption[7]. When coal is used as feedstock, the result is called brown hydrogen; with natural gas, it is gray hydrogen (see Figure 2). Because both coal and natural gas emit GHG when processed, neither brown nor gray hydrogen can be considered renewable.

How hydrogen fuel becomes green

Green hydrogen – also called 'renewable hydrogen' – is produced by using clean energy to power electrolysis. This chemical process uses an electrolyzer[iv] powered by renewable electricity to split water into hydrogen and oxygen molecules. Because only clean energy is used as feedstock (e.g., wind, solar), the resulting green hydrogen has a zero-emissions profile in both production and use.

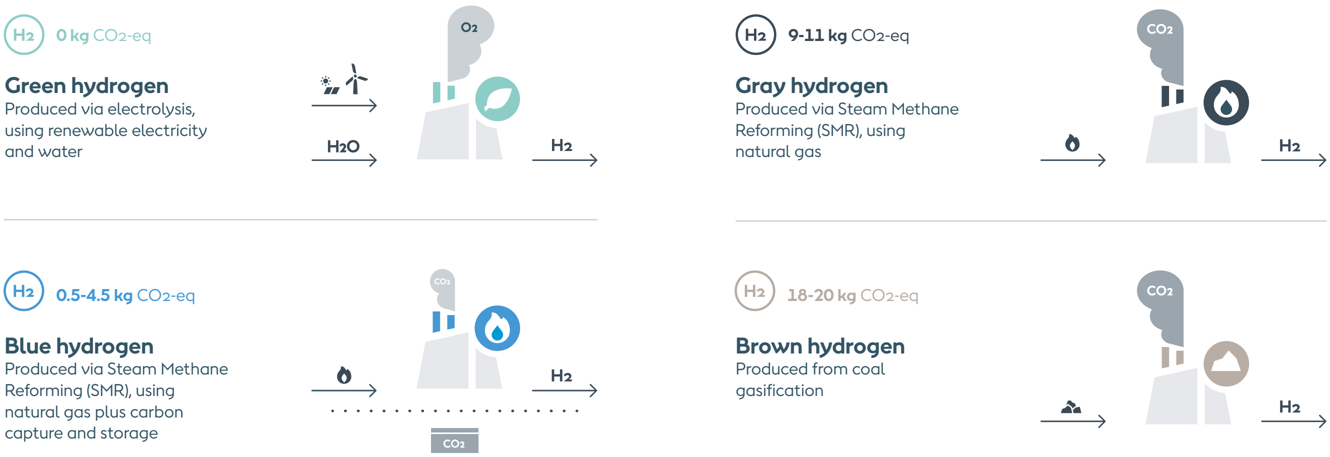
3%
Hydrogen's share of global final energy demand[7]

While it represents less than 1% of total hydrogen production today[6], renewable hydrogen production is growing significantly. This is thanks to parallel increases in demand for clean hydrogen and decreases in the cost of renewable electricity.

[iv] Electrolyzers are devices that split water into oxygen and hydrogen molecules in a process called electrolysis.

H2RES is Ørsted's first renewable hydrogen project in operation, producing up to ~1,000 kg of green hydrogen per day.

Figure 2



1 The colors of hydrogen refer to the method of production. Regardless of the color, the resulting H_2 molecule is always chemically the same.
2. Other colors of hydrogen include pink (produced from nuclear energy) and turquoise (produced via methane pyrolysis). Hydrogen made from solar energy is also sometimes referred to as yellow hydrogen.

Transforming green hydrogen into e-fuels

Green hydrogen can also form the base of e-fuels, a type of synthetic fuel. Given their distinct chemical profile, e-fuels can provide a simpler solution than green hydrogen for certain applications in sectors like heavy industry and transportation.

Primary types of e-fuels

E-methanol
Traditional methanol production combines hydrogen with carbon extracted from fossil fuels, a process that adds CO_2 to the atmosphere. By contrast, when green hydrogen is instead synthesized with captured biogenic carbon (see Figure 3), the resulting e-methanol is carbon negative.

When used as a fuel, e-methanol releases captured carbon back into the atmosphere. This offers a net-neutral carbon solution that can replace conventional methanol used for petrochemical products and other applications.

E-kerosene
Green hydrogen and biogenic carbon can also be synthesized to produce e-kerosene. This is being developed as a sustainable aviation fuel to replace the conventional oil-based kerosene currently used in the aviation industry.

E-ammonia
When nitrogen – the most abundant element in our atmosphere – is combined with hydrogen, it becomes ammonia. Ammonia production accounts for ~36% of global hydrogen demand[8], and is primarily used to create agricultural fertilizers.

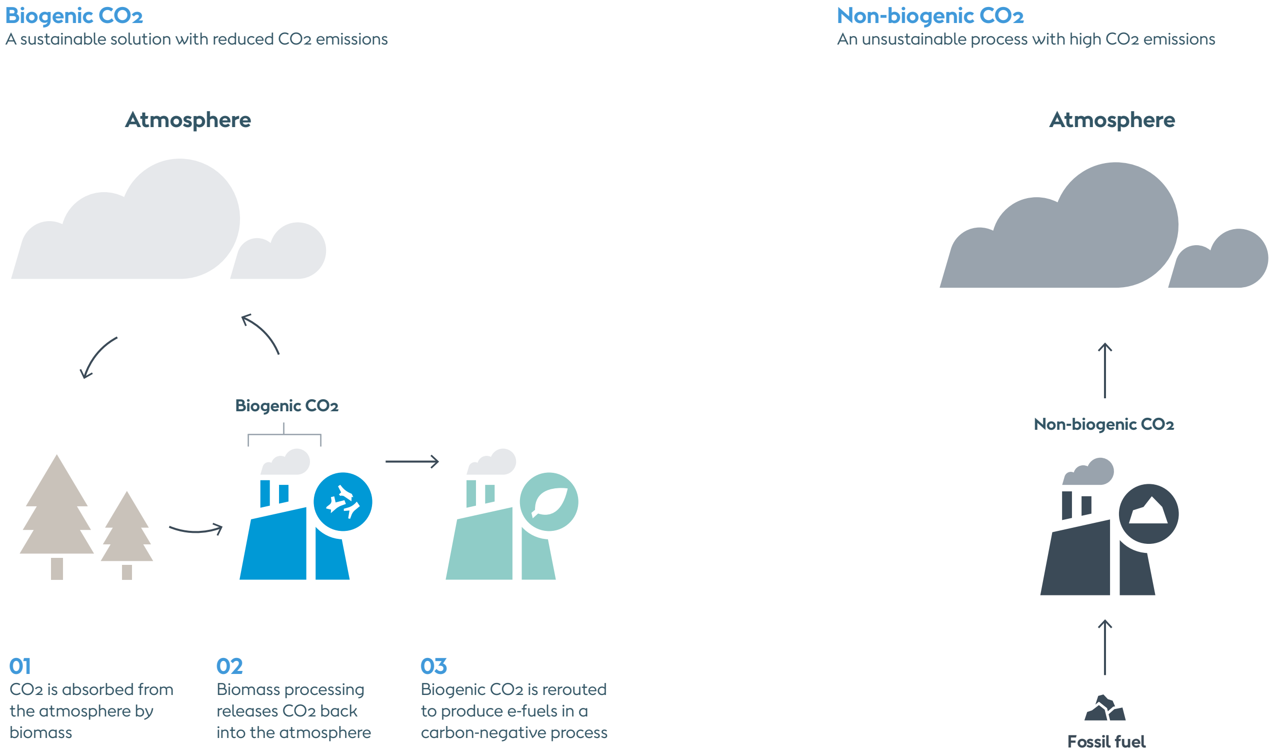
When nitrogen is synthesized with green hydrogen, e-ammonia can be produced. E-ammonia is a zero-carbon fuel that can replace traditional ammonia in fertilizer, provide green fuel for ships, or act as an energy carrier for hydrogen.

Ørsted's Permian Energy Center is a solar and storage project located in Andrews County, Texas that generates 420 MW of solar power.

Thanks to their varied chemical structures, e-fuels can be stored and transported differently than green hydrogen, offering more flexibility. E-fuels can also serve as drop-in fuels[v], providing an immediate replacement to their fossil fuel-based counterparts in many applications.

[v] Fuels that can be dropped in as an immediate replacement without requiring changes to existing infrastructure, equipment, or technology (e.g., e-methanol).

Figure 3



What is biogenic carbon?

Some e-fuels, such as e-methanol and e-kerosene, release carbon when used. For their use to be truly carbon-neutral, these fuels must be produced through carbon negative processes which remove carbon from the atmosphere.

To achieve this, the carbon should be sustainably sourced, via methods like capturing carbon of biogenic origin[vi]. This type of carbon, called biogenic carbon, can be pulled from the natural carbon cycle during the processing of bio-based materials. Processing typically requires the combustion or biological conversion of biomass.

Examples of biogenic carbon materials

Wood
Chips, pellets, charcoal, hog fuel, firewood

Agricultural residue
Straw, corn husks, livestock manure

Solid waste[vii]
Paper, cardboard, food waste

Biofuels
Bioethanol, biodiesel

When biomass is burned, the same carbon that was absorbed during the natural lifecycle of the organic materials returns to the atmosphere. When P2X technologies capture and redirect biogenic carbon to produce e-fuels, those e-fuels are carbon negative.

What does all this mean for businesses?

For companies in hard-to-electrify sectors, using renewable energy to create green hydrogen and e-fuels presents a chance to achieve net-zero carbon solutions. Green hydrogen can be used by a wide variety of industries, and e-fuels, its flexible derivatives, offer even more sectors a path to decarbonization. This makes P2X a strong solution for lowering or eliminating GHG emissions in areas where electrification alone is insufficient.

[vi] Substances of biogenic origin are produced by living organisms (e.g., plants) or biological processes.
[vii] Only the biogenic components of solid waste.

Hydrogen demand is growing — and these industries stand to benefit

Hydrogen demand reaches new heights

In 2021, the global demand for hydrogen hit 94 million metric tons. While current demand is dominated by petrochemicals, future demand is expected to cross industries. By 2030, the International Energy Agency (IEA) has projected global demand reaching up to 180 million metric tons of hydrogen[8]. This number accounts for growth in existing industries and sectors that will begin using hydrogen for new applications.

Figure 4

The growing demand for green hydrogen[8]

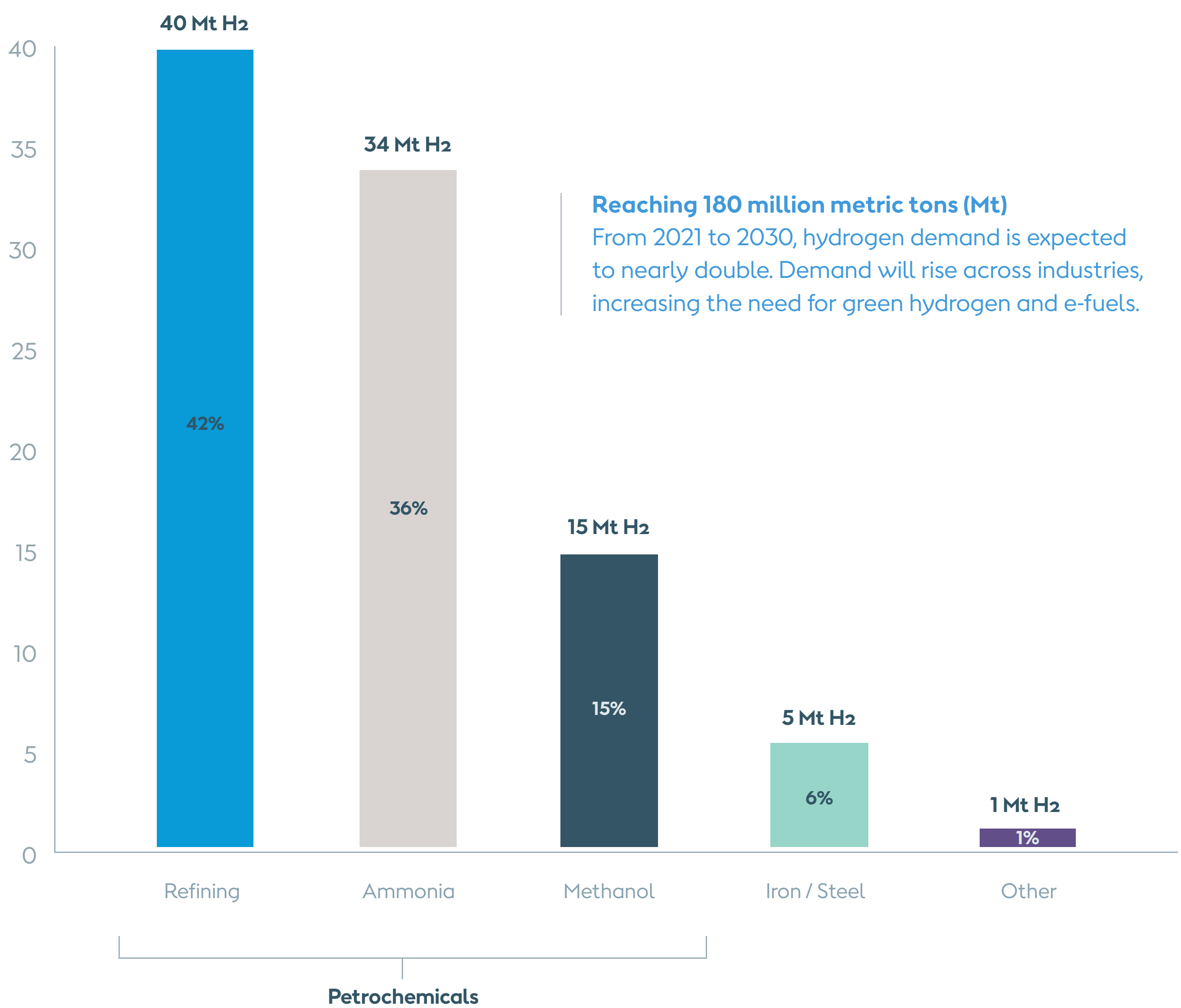
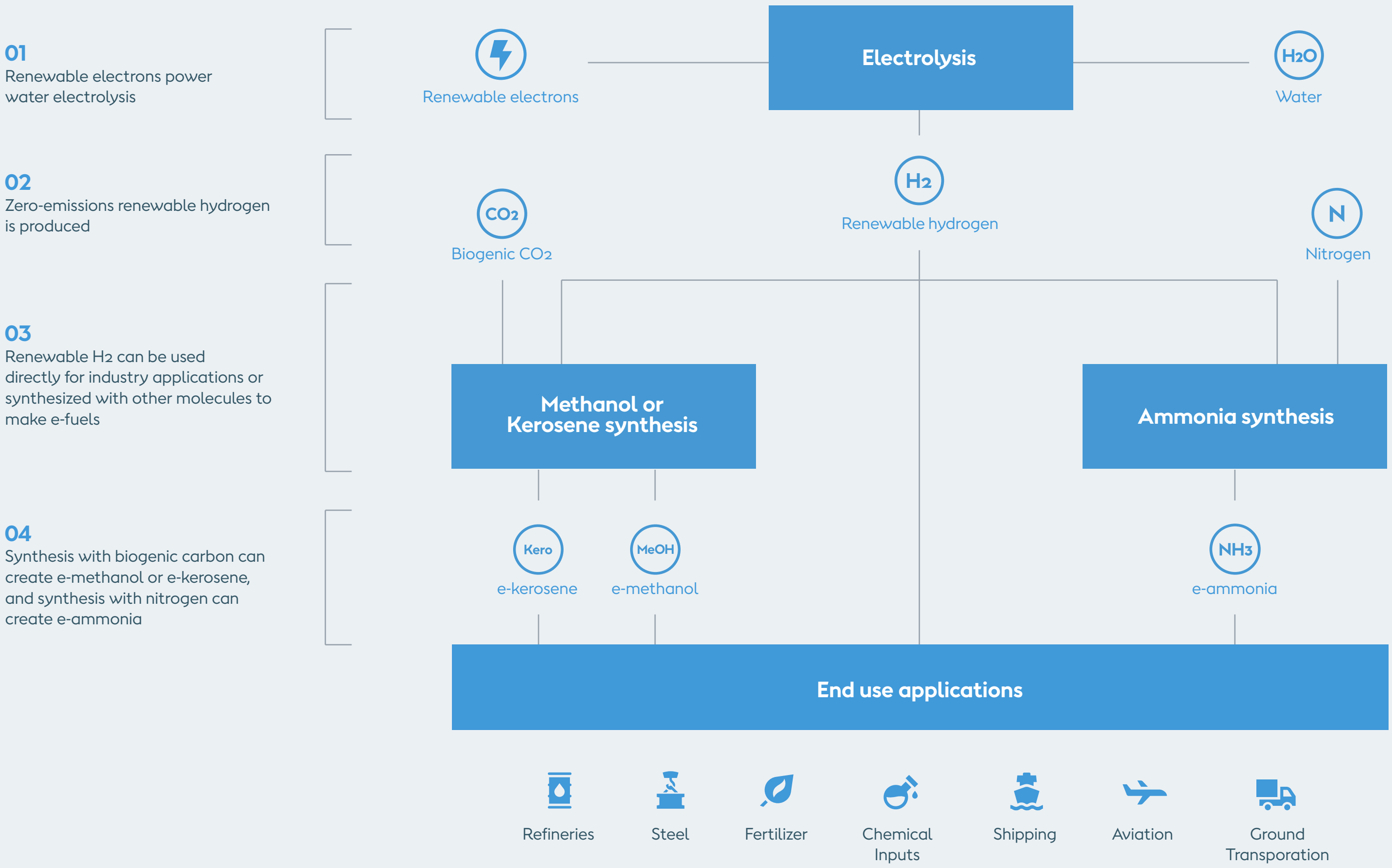


Figure 5



3 key industries for green hydrogen

① Petrochemicals | 5.8% of global GHG emissions[9]

Petrochemical processes dominate global hydrogen consumption, driven by petroleum refining, ammonia production, and methanol production.

- **Petroleum refining**
  Refining accounts for more than 40% (~39.8 million metric tons) of hydrogen demand[8]. Of that hydrogen, over 90% is used for hydrotreating and hydrocracking, processes which reduce the amount of sulfur in finished products and increase fuel yield[10]. Gray hydrogen feedstock purchased for these processes can be directly replaced with renewable hydrogen to reduce GHG emissions from refining.

- **Ammonia production**
  Among petrochemical products, ammonia production leads hydrogen demand with ~33.8 million metric tons of annual demand[8]. Ammonia is most frequently used on an industrial scale as an agricultural fertilizer. It is also a common feedstock for refrigerant gas and the manufacturing of plastics and other chemical byproducts. E-ammonia can replace conventional ammonia in each of these applications, eliminating all CO_2 emissions from production.

- **Methanol production**
  Methanol production is the second largest market for hydrogen among petrochemical products, reaching ~14.6 million metric tons of annual hydrogen demand[8]. Methanol is a foundational compound for a variety of products, from chemicals like formaldehyde to everyday goods like plastics and synthetic fabrics. E-methanol could be substituted for all of these applications, offering a net-zero carbon alternative.

② Steel | 7.2% of global GHG emissions[9]

Iron and steel represent ~5.2 million metric tons of annual hydrogen demand[8]. While this is a smaller share than that of petrochemicals, the stakes are just as high, given that steelmaking is extremely emissions-intensive. Producing a single ton of steel using fossil fuels like coal or natural gas creates ~1.85 metric tons of CO_2 emissions[11].

The most common method for producing primary steel today is through the blast furnace-basic oxygen furnace (BF-BOF) method. Manufacturers could most efficiently reduce GHG emissions[viii] by switching from BF-BOF to the direct reduction of iron-electric arc furnace (DRI-EAF). This process uses hydrogen as feedstock.

Green hydrogen can be blended into the DRI-EAF process with minimal changes to equipment, helping remove GHG emissions from steel production. Demand for green hydrogen is expected to grow exponentially as the industry shifts toward hydrogen-based DRI. As of March 2022, nearly 60 green steel projects have been announced, representing seven of the ten largest steel-producing countries[12].

③ Transportation | 16.2% of global GHG emissions[9]

The transportation sector has already started decarbonizing thanks to widespread use of electric vehicles (EVs). While the EV market has provided efficient light- and medium-duty vehicles (e.g., cars, vans), heavy-duty transportation, including ships, planes, and trucks, remains challenging to electrify. P2X offers a solution to vehicles providing long-haul services, with possibilities for both green hydrogen and e-fuels.

- **Marine**
  The global shipping industry produces ~1 billion metric tons of CO_2 emissions annually, with fossil fuels providing 99% of the sector's final energy demand[13]. By replacing fossil fuels with clean energy, ~80% of shipping's carbon emissions could be cut by 2050[14].

  While several industry players are developing green hydrogen-fueled ships[15], hydrogen's low volumetric energy density makes it best suited to short-sea shipping. This means that e-fuels with high volumetric energy density that maximize energy storage space – like e-methanol or e-ammonia – are the ticket to long-haul, international shipping.

  Maersk, a global leader in shipping, has already announced the construction of 19 methanol-fueled cargo ships designed to decarbonize its operations. These ships will consume ~750,000 metric tons of e-methanol per year[16].

  While the deployment of e-ammonia as a marine fuel is slightly behind that of e-methanol, e-ammonia provides a carbon-free alternative to conventional marine fuels. Familiarity with the production and handling of ammonia, as well as existing distribution and bunkering infrastructure for marine vessels, will ease the transition to e-ammonia.

- **Aviation**
  Aviation accounts for 2.4% of global emissions from fossil fuels – and the sector's overall climate impact goes well beyond CO_2 emissions. With each flight, condensation trails (known as contrails) from planes are left behind in the atmosphere, helping trap radiation between the sun and earth[17].

  Replacing fossil-based kerosene with e-kerosene created from renewable hydrogen can reduce both the sector's net GHG emissions and the impact of contrails. This is because e-kerosene contains fewer of the particles and chemicals that produce the soot that forms contrails[18]. The essential technologies for using e-kerosene in aviation already exist, and deployment will advance with technical scale-ups and relevant regulations.

- **Ground transportation**
  Medium- and heavy-duty trucks represent 26% of transportation-related GHG emissions in the U.S. – more than twice the combined emissions of American ships and planes[19]. For long-haul trucks, the possibility of using direct electrification to reduce emissions is complicated by range limitations and long battery recharging times.

  One possible solution is to transform trucks into fuel cell electric vehicles (FCEV), a type of zero-emissions vehicle powered by green hydrogen. FCEV infrastructure is already available and expanding. California leads the U.S. market, serving over 8,000 FCEV via 47 public retail hydrogen refueling stations, with another 55 under construction or being planned as of mid-2021[20]. Expanded hydrogen refueling infrastructure and greater numbers of FCEV-type trucks could unlock the decarbonization of long-haul trucking, substantially lowering emissions in this hard-to-electrify sector.

[viii] In the short-term, green hydrogen could also be used as a reductant in blast furnaces, partially replacing coke.

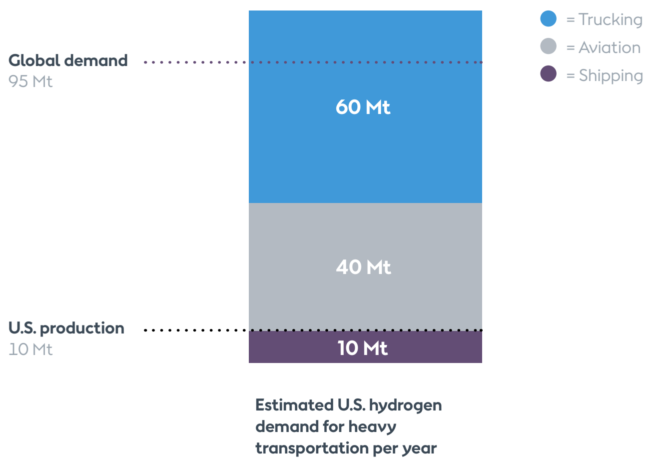
What about hydrogen exports?

Based on projects under development, the global export market for hydrogen is estimated to reach ~12 million metric tons annually by 2030. Of that, a projected 1.1 million metric tons will come from North America[21]. Projected exports from the U.S. will represent only a fraction of national production, as high domestic consumption is expected to lead the American hydrogen market[22].

Most export projects will use ammonia as a hydrogen carrier. This is due to ammonia's higher volumetric energy density, developed procedures for safe handling, and a wealth of existing infrastructure for storage and transportation. In addition to the applications detailed above, the export market will also drive demand for increased e-ammonia production.

Figure 6

Estimating new hydrogen demand for transportation



How much potential new demand is there for green hydrogen? Let's look at one hard-to-electrify sector: transportation. Based on an Ørsted analysis, switching all U.S. shipping, aviation, and trucking to green hydrogen and e-fuels would require over 110 million metric tons of hydrogen per year. That's over 10 times the current U.S. production of hydrogen, and more than today's entire global demand!

Crystal Steel Fabricators, located in Caroline County, Maryland, is constructing wind turbine foundations for Ørsted's Mid-Atlantic projects.

Green hydrogen represents a strong solution for decarbonizing long-haul trucking, a particularly hard-to-electrify sector of transportation.

Ørsted's Amazon Wind Farm in Scurry County, Texas generates 253 MW of onshore power.

Why the U.S. is ready for green hydrogen

The U.S. is poised to become a global leader in the green hydrogen industry. Many factors contribute to this, including regulatory incentives, existing transportation, export, and distribution infrastructure, and a qualified workforce.

Favorable legislation and regulatory incentives

A recently updated regulatory framework has put the U.S. in the global spotlight as a frontrunner in the hydrogen economy. In 2021, the P2X industry garnered strong support from the Biden-Harris Administration and the United States Congress with the passage of the Bipartisan Infrastructure Law (BIL)[ix]. The BIL sent a strong signal that growing the hydrogen economy is a national priority.

This signal was compounded by the Inflation Reduction Act (IRA), which was signed into law in August 2022. This legislation boosts green hydrogen's ability to replace fossil fuels in the United States by making it cost-competitive with gray hydrogen. Through the IRA's Hydrogen Production Tax Credit (PTC), green hydrogen producers can receive up to $3 per kilogram if labor, wage, and domestic content provisions are satisfied. This incentive unlocks an immense market of buyers and sellers in the domestic green hydrogen economy.

While the PTC is technology-neutral[x], the metrics used for measuring emissions favor the cleanest form of hydrogen: green hydrogen. Producers of green hydrogen will receive the largest portion of the tax credit, as the process emits no CO_2. This is a key distinction from blue hydrogen, the production of which still releases CO_2 into the atmosphere.

> The IRA boosts green hydrogen's ability to replace fossil fuels in the U.S. by making it cost-competitive with gray hydrogen. Through the Hydrogen Production Tax Credit (PTC), green hydrogen producers can receive up to $3 per kilogram of green hydrogen, unlocking an immense market of domestic buyers and sellers.

Strong new and existing infrastructure

The U.S. produces 10 million metric tons of hydrogen per year[24]. From transport logistics, to processing, to fuel safety, Americans already have the foundational infrastructure and knowledge to further scale up green hydrogen production and distribution.

Legislation is also supporting the development of new infrastructure, such as the BIL's Regional Clean Hydrogen Hubs program. Run by the Department of Energy (DOE), this program provides $7 billion to build 6-10 regional hydrogen hubs across the United States. Hubs must prove that their hydrogen production technology works and provide commercially viable plans that include fuel offtakers and a community benefits plan[xi]. By prioritizing hubs with a sound business strategy, the government is underlining its commitment to an economically robust, self-sustaining hydrogen economy with strong infrastructure.

> **$7 billion**
> DOE funds for building 6-10 regional hydrogen hubs across America

A qualified workforce with transferable skills

As the world's largest producer of oil and natural gas, the United States is home to an immense amount of expertise and experience. Technical, commercial, and strategic skills from legacy energy and industrial sectors can be directly applied to the P2X industry. This means that a qualified workforce for the new jobs created by green hydrogen and e-fuels expansion can be found domestically.

[ix] Also known as the Infrastructure Investment and Jobs Act (IIJA).
[x] Not favoring any one color of hydrogen (See Page 5, Figure 2).[25]
[xi] The hub selection process notably requires a community benefits plan, which must thoughtfully and meaningfully embrace the goals of the Justice40 Initiative. This initiative seeks to have 40% of benefits from certain federal investments flow to marginalized or disadvantaged communities overburdened by pollution.

What the U.S. electrical grid gains from green hydrogen

A greater supply of renewable energy

Renewable energy is the common backbone of both electrification and green hydrogen – two key routes to decarbonization. This means that decarbonizing the U.S. economy will require clean energy to be affordable and abundant enough to serve both purposes.

One way to do this is via additionality. Additionality means building clean energy facilities individually dedicated to producing electricity *either* for the grid *or* for green hydrogen and e-fuels. This ensures that clean energy for direct electrification is not diverted to hydrogen production (and vice versa), while keeping the overall supply of green energy growing.

Our Amazon Wind Farm in Scurry County, Texas generates 253 MW of onshore power.

Reliable energy, whenever it's needed

The grid should not be impacted by the energy demand for green hydrogen, as the electrolyzers pulling power from the grid have a flexible load. Electrolyzers can be ramped up or down in reaction to regional electricity demand. This is a highly beneficial feature for the grid during times of high demand or extreme weather events.

Here's how it works. When electricity demand is low and supply is high, electrolyzers can increase production to help avoid energy curtailment[xii], while storing any excess hydrogen produced. When electricity demand is high and supply is low, electrolyzers can decrease production to avoid straining the grid or spikes in electricity prices. Stored hydrogen can then fill any distribution gaps related to its end use, limiting the impact of grid disruptions.

A long-term solution for seasonality

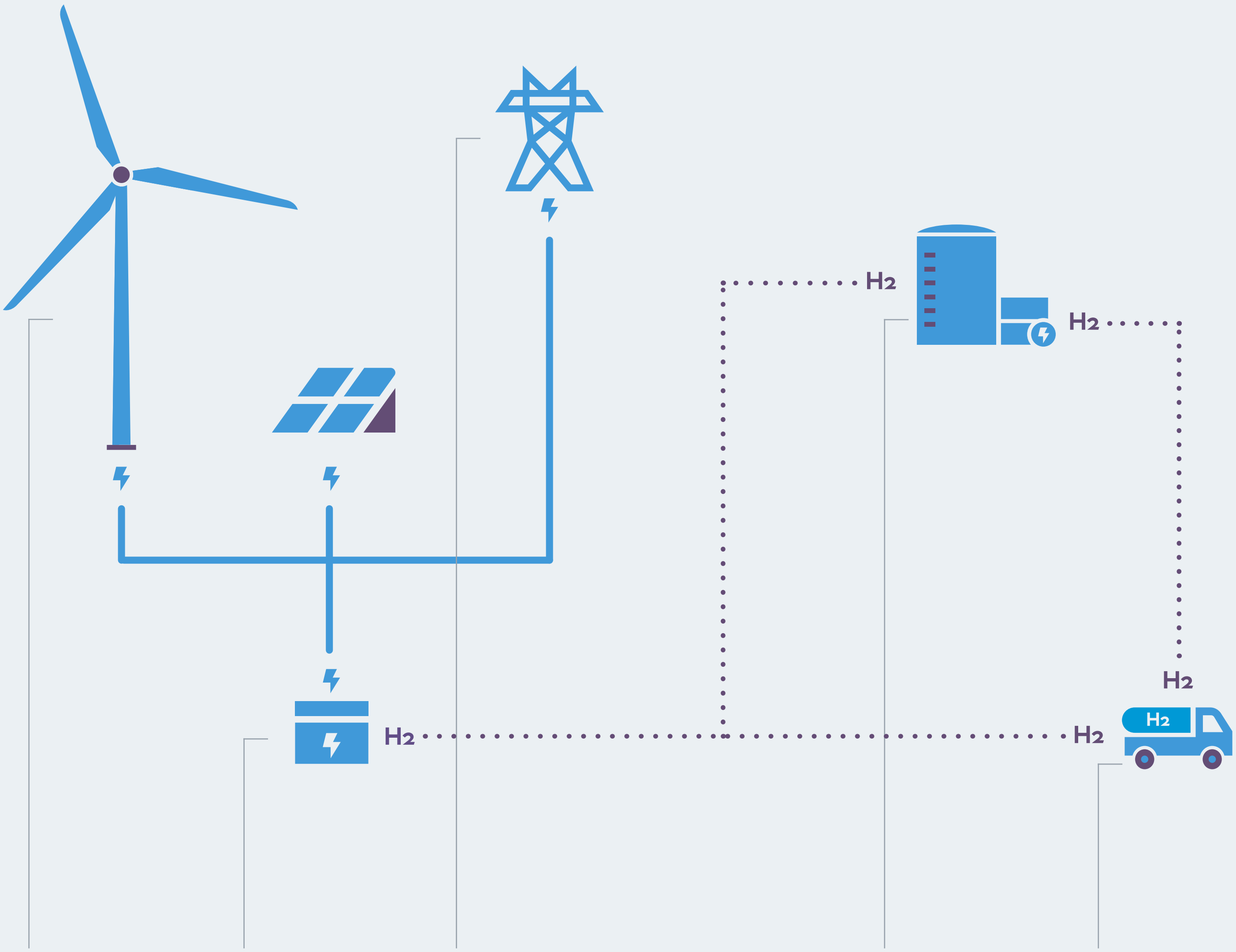
While electric battery storage systems can store energy for short periods of time, long-term energy storage remains a technical and economic challenge. Hydrogen could offer a solution by working as a storage mechanism. Excess clean energy can be stored as hydrogen in tanks or underground salt caverns, then later extracted and used to procure energy.

However, this should be considered a secondary use for hydrogen until renewable electricity represents a greater part of the U.S. energy mix and seasonal storage becomes essential. Priority should be given to funneling green hydrogen into hard-to-electrify sectors, while heating and power generation can benefit from direct electrification.

[xii] When energy output is deliberately reduced to balance energy supply.

Figure 7

Green hydrogen and the U.S. electrical grid



Wind / solar
Renewable electricity is transmitted to the grid or directly to electrolyzers.

Electrolyzer
An electrolyzer can ramp up or down hydrogen production, pulling more or less electricity from its power source.

Electrical grid
Electricity is routed through the grid to electrolyzers not directly tied to wind/solar generation.

Storage
Hydrogen not immediately routed for distribution can be stored for later use.

Distribution
Hydrogen fuel is transported for end use or further e-fuel synthesis.

Electricity
Transmission of electricity between energy producers and consumers.

H_2
Renewable hydrogen
Distribution of hydrogen fuel through pipelines from production to end uses.

Developing a powerhouse U.S. industry while meeting climate targets

U.S. targets for GHG reduction and hydrogen

The United States is targeting net zero[xiii] by 2050, starting with a 50-52% reduction in GHG emissions by 2030, compared to 2005 levels. Getting there will require an ambitious, well-rounded strategy that includes direct electrification, renewable hydrogen, and e-fuels. This will ensure that the hard-to-electrify sectors discussed in this paper have a practical route to decarbonization that matches the country's climate targets.

Recent legislation and policies aim to bulk up the domestic supply of green hydrogen. This is crucial to supporting U.S. decarbonization goals – without legislation like the IRA, the U.S. may have achieved only a 24%-35% reduction in GHG emissions by 2030[26]. Documents like the DOE's National Clean Hydrogen Strategy and Roadmap detail how hydrogen will contribute to national decarbonization and propose pathways to increased production. The final goal is to produce 50 million metric tons of clean hydrogen in the U.S. annually by 2050.

Becoming a global leader in P2X

National climate targets and supporting legislation have prepared the ground for the U.S. to become a global leader in P2X. This is bolstered by a favorable combination of economic, technical, and market conditions, including:

- Falling costs for P2X technology through economies of scale
- A sixfold increase in electrolyzer manufacturing capacity[27]
- Widespread availability of low-cost renewable energy
- Domestic demand to support a robust green hydrogen industry
- Existing infrastructure and relevant workforce skills

Of course, successfully scaling up green hydrogen in time for 2030 will require effort from policymakers, investors, renewable energy producers, and industrial consumers and suppliers. For our part, Ørsted is committed to being a trusted partner in renewables, supporting the development and deployment of green hydrogen and e-fuels. We see the U.S. as primed to launch a robust P2X industry, leading the way on decarbonization – and we're prepared to help.

50 million
America's clean hydrogen production goal for 2050 (in metric tons)

H2RES is Ørsted's first renewable hydrogen project in operation. The facility will produce up to ~1,000 kg of green hydrogen daily.

[xiii] Cutting GHG emissions to as close to zero as possible, with any remaining emissions reabsorbed from the atmosphere.

Make Ørsted your partner in decarbonization

Formerly a fossil fuel company, Ørsted is now one of the world's most sustainable energy companies[xiv]. Our business transformation is a story of successful innovation, steep learning curves, and difficult strategic choices that have led to long-term gains. This is the expertise we're applying to the green hydrogen economy with our P2X business.

We're investing ~$50 billion in developing clean energy between 2020-2027, and have committed to building 50 GW of installed renewable energy capacity by 2030[28]. After pioneering the offshore wind industry, we diversified into onshore wind and solar markets, adding to our competencies in vertically integrated renewable energy infrastructure.

Across the U.S., Ørsted has more than 5 GW of land-based capacity for wind, solar, storage technologies, and e-fuels, and another 5 GW of offshore wind under development.

Our experience building and operating large-scale renewable energy assets and developing P2X projects worldwide will enable us to successfully deliver P2X products in the United States.

Figure 8

Our ambition: 50 GW by 2030

Gross installed capacity, GW

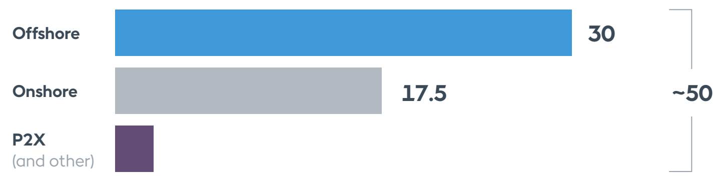
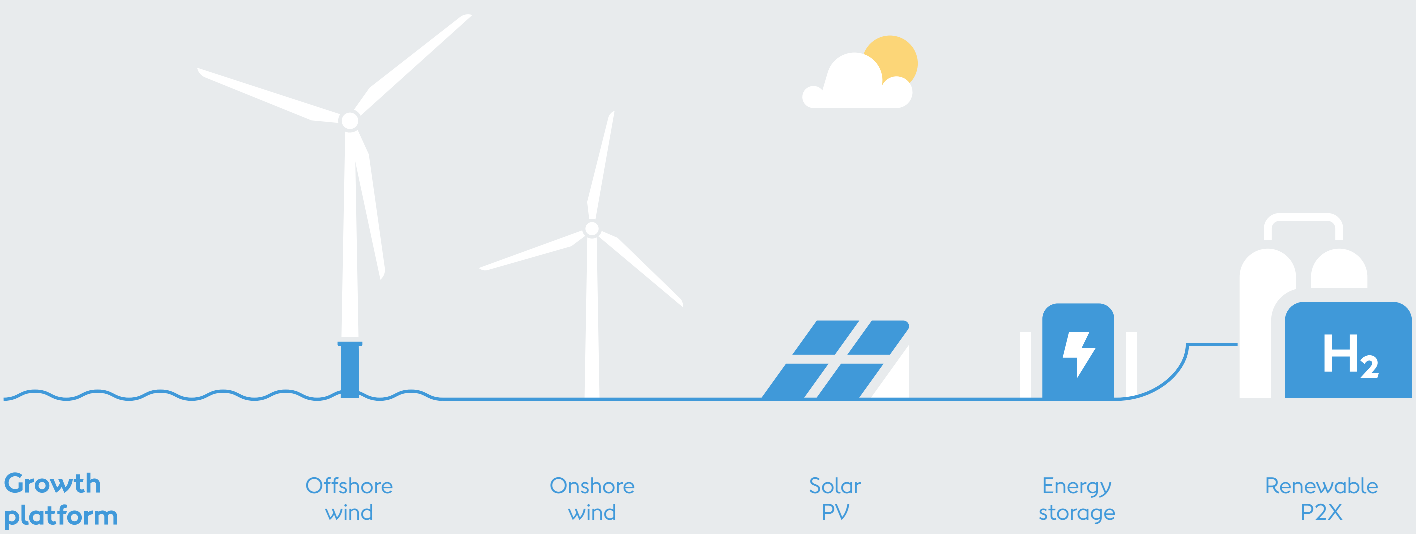


Figure 9



[xiv] Ørsted is the first energy company to have its science-based net-zero emissions target approved by the Science Based Targets Initiative (SBTi).

P2X portfolio highlights

HSRES is Ørsted's 2 MW hydrogen electrolysis plant. It will provide green hydrogen for ground transportation.

Gulf Coast e-Methanol (U.S.)

As its entry into the U.S. P2X market, Ørsted signed a landmark agreement to provide e-methanol to Maersk, a leading integrated container logistics company. Ørsted will develop a P2X facility on the Gulf Coast to produce ~300,000 metric tons of e-methanol per year. This will fuel Maersk's newly ordered fleet of 19 methanol-powered vessels.

Our facility will be powered by ~1.2 GW of new renewable energy from Ørsted's wind and solar farms. The biogenic carbon needed to produce e-methanol will be extracted through carbon capture. Project commissioning is planned for the mid-2020s, making it by far the world's most ambitious project for large-scale e-methanol production.

FlagshipONE (Sweden)

In Sweden, we're developing a 70 MW green fuels project to supply 50,000 metric tons of e-methanol per year to the marine industry by 2025. FlagshipONE is Europe's largest e-methanol facility with an FID, with onsite construction starting in Spring 2023. E-methanol will be produced using renewable electricity and biogenic carbon captured from a co-located heat and power plant, Hörneborgsverket. FlagshipONE will also use steam, process water, and cooling water from the plant. Excess heat from e-methanol production will be delivered to Övik Energi and integrated into the district heating supply.

Green Fuels for Denmark (Denmark)

The Green Fuels for Denmark project brings together leading Danish companies in developing industrial-scale production of renewable hydrogen and sustainable e-fuels for marine, air, and ground transportation. By combining supply- and consumer-side actors, the project seeks to first develop 10 MW of electrolyzer capacity by 2025. This will be scaled up to 250 MW, including e-fuel production, then 1.3 GW when the project is completed. The required electricity will come from offshore wind farms off the coast of Bornholm in the Baltic Sea. Much of the green hydrogen produced will be combined with sustainably sourced carbon to generate 250,000 metric tons of e-kerosene and e-methanol per year.

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About Ørsted

The Ørsted vision is a world that runs entirely on green energy. Ørsted develops, constructs, and operates offshore and onshore wind farms, solar farms, energy storage facilities, renewable hydrogen and green fuels facilities, and bioenergy plants. Ørsted is recognized on the CDP Climate Change A List as a global leader on climate action and was the first energy company in the world to have its science-based net-zero emissions target validated by the Science Based Targets initiative (SBTi). Headquartered in Denmark, Ørsted employs approx. 8,000 people. Ørsted's shares are listed on Nasdaq Copenhagen (Orsted). In 2022, the group's revenue was DKK 132.3 billion (EUR 17.8 billion). Visit orsted.com or follow us on Facebook, LinkedIn, Instagram, and Twitter.

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