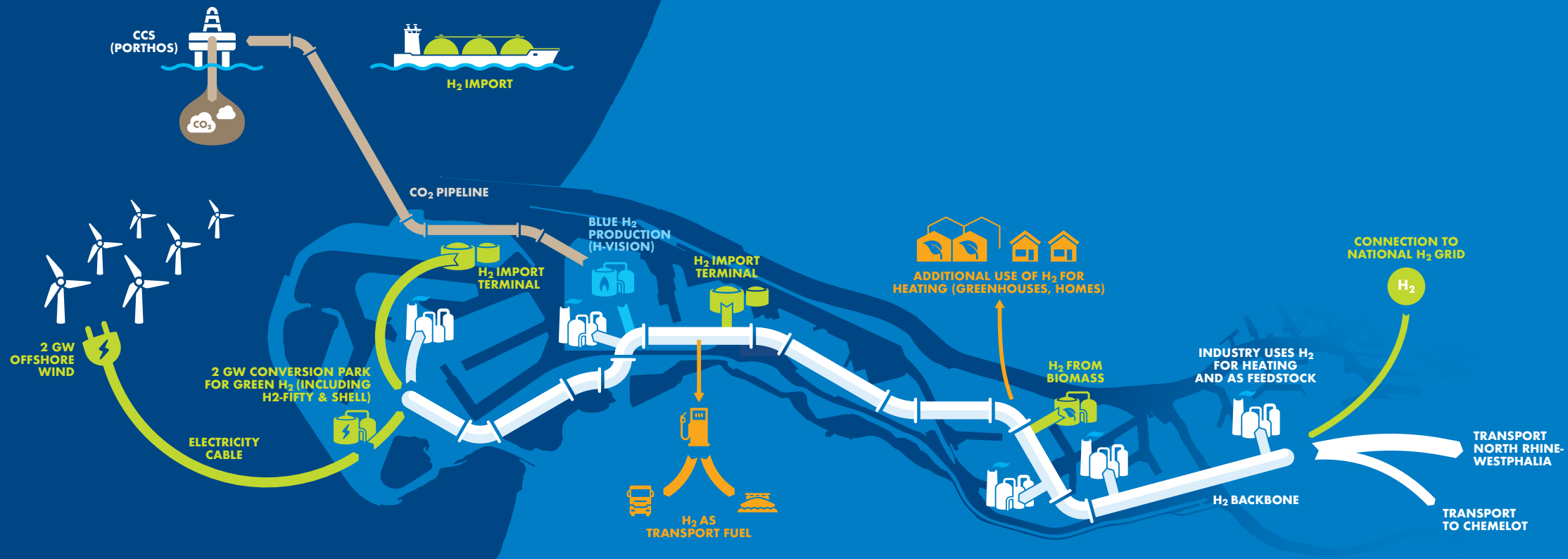
HYDROGEN ECONOMY IN ROTTERDAM STARTS WITH BACKBONE

Hydrogen system
The port of Rotterdam will have a hydrogen system that combines production and use, particularly in industry, but also imports and transit flows of hydrogen to other parts of the Netherlands and Northwest Europe. The Port Authority and Gasunie are working on an initiative to have a backbone for hydrogen running through the port as early as 2023.

This main transport pipeline will supply companies with hydrogen produced at conversion parks in the port. The backbone will be connected to Gasunie's national infrastructure throughout the Netherlands and to corridors leading to industrial areas in Chemelot in Limburg, and North Rhine-Westphalia. In time, there are also plans for a terminal to facilitate imports of hydrogen.

Earning power
This will give Rotterdam a leading infrastructure in the field of hydrogen that will stimulate market development. In addition to making an important contribution to the national climate targets, a hydrogen system of this kind will also boost the earning power of the port complex, whilst maintaining the important role of the port for the Dutch economy in the future.



Port of Rotterdam

KEY HYDROGEN PROJECTS

Backbone
Access to this main transport pipeline through the port will be open for suppliers and purchasers of hydrogen. The backbone will transport both green and blue hydrogen. It is expected to go into operation in 2023.

Conversion park
The first conversion park for hydrogen production will open on the Maasvlakte in 2023. Hydrogen is produced centrally here and transported to companies through the backbone.

Import terminal
The Port Authority has teamed up with a range of partners to launch a research project for the establishment of a hydrogen terminal in the port. The terminal is expected to be operational by 2030.

Upscaling of electrolysers
Hydrogen is produced with electrolysers at the conversion park. Shell is planning to start operations with a 150–250 MW electrolyser here in 2023. Nouryon, BP and the Port of Rotterdam Authority are working together in the H2-Fifty project on the development of a 250 MW electrolyser for 2025.

Blue hydrogen
The H-vision consortium is developing installations for the large-scale production of blue hydrogen in the electricity sector and as a substitute for natural gas in the petrochemical industry. The CO_2 released during production is stored and/or used in greenhouses.

Transport
A consortium is being set up with the aim of having 500 hydrogen-powered trucks by 2025. Under the name RH_2INE, seventeen parties are collaborating on a climate-neutral transport corridor between Rotterdam and Genoa based on hydrogen.

Grey, blue and green
Hydrogen has to be produced. This is already being done in the port of Rotterdam on the basis of natural gas. However, CO_2 is released during the production of this *grey hydrogen*.

Low-carbon production can be achieved by capturing and storing the CO_2 below the seabed in depleted gas fields. CO_2 can also be used in greenhouses as a growth accelerator. This is known as *blue hydrogen*.

A third option is carbon-free *green hydrogen*, which is produced by electrolysing water using green power, for example from offshore wind farms. No CO_2 is released and combustion does not emit any greenhouse gases either.

Key role
Hydrogen will play a key role in the new energy system. In addition to its increasing role in the process industry as a substitute for natural gas to generate high temperatures, hydrogen is becoming a major factor in the sustainable chemical industry and the production of bio- and synthetic fuels.

Hydrogen is also developing into an important energy carrier in air and sea transport, and in heavy road haulage, but it will also find its way into heat supplies for greenhouses and homes.

INTERNATIONAL HUB

Connection to national H_2 grid, Chemelot and North Rhine–Westphalia (NRW).

Packing and unpacking

In order to supply industry and other sectors with adequate supplies of green hydrogen, a huge amount of electricity from wind farms is required, as well as a major increase in electrolyser capacity. A number of projects have been launched to initiate the developments required in these areas. Blue hydrogen is a possibility in the short term and it is seen as leading the way for green hydrogen. Given the way demand is developing, import will initially be needed from the Middle East, North Africa and Southern Europe. Hydrogen can be liquefied on site in these areas or 'packaged' in other substances and transported to Rotterdam by tanker. Upon arrival in the port of Rotterdam, the hydrogen is 'unpacked' so that it can be used as feedstock or fuel. Last year, the International Energy Agency called for ports with sizeable industrial parks to be developed into the new nerve centres for hydrogen. The robust supply and transit facilities, in combination with large-scale use, can further market development.

Connection to the hinterland

The backbone through the port of Rotterdam will be connected to Gasunie's national infrastructure throughout the Netherlands and, through corridors, to industrial areas in Chemelot (Limburg) and North Rhine-Westphalia. With its facilities for imports, production, application, handling and transshipment, Rotterdam is being transformed into an international hub for hydrogen. A hydrogen hub of this kind in Rotterdam delivers all kinds of benefits. The large-scale use of hydrogen in industry can significantly reduce carbon emissions. With a hydrogen system of this kind, the port will also maintain its position as an international leader and the driver of the national economy.

THE ENERGY PORT OF NORTHWEST EUROPE

Rotterdam hub

Almost three times the total energy consumption of the Netherlands is delivered to Rotterdam every year. That equates to 13 percent of the European Union's total energy needs. At present, this is mostly crude oil. Most of it is transported to Germany and the rest of Europe. The remainder is processed by industry in Rotterdam, mainly into feedstock for the chemical industry and fuels for the Dutch and international markets.

This means that Rotterdam is Northwest Europe's energy port. This port function will continue in the future but the energy flow will change. It will consist primarily of hydrogen. Domestic demand is expected to increase sharply. The annual requirement is now 0.4 million tonnes (Mt) annnuallly in Rotterdam and 0.8 Mt nationwide. This will rise to almost 14 Mt by 2050. Approximately half of this energy — 7 Mt — will pass through Rotterdam. Demand from Germany could increase by a further 8 Mt and 5 Mt from other Northwest European countries.

As a result, the flow of hydrogen, with Rotterdam as the hub, could be as high as 20 Mt by 2050: that is an increase of five thousand percent. So imports of hydrogen will be needed. The Dutch section of the North Sea now has 1 GW of wind energy. This could rise to 60-70 GW by 2050. To produce 20 Mt of green hydrogen, 200 GW of installed wind capacity would be needed. Most of the hydrogen flow through Rotterdam will therefore have to come from imports.

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DUTCH ENERGY CONSUMPTION FLOWS THROUGH THE PORT OF ROTTERDAM

20 Mt

TOTAL HYDROGEN FLOW IN ROTTERDAM IN 2050

200 GW

WIND POWER NEEDED TO PRODUCE 20MT OF GREEN HYDROGEN

5,000%

INCREASE IN HYDROGEN FLOW THROUGH ROTTERDAM

Strong growth in hydrogen flow through Rotterdam due to imports

The coming decades will see the rise of blue and green hydrogen. In order to meet national and international demand, the lion's share will come from import in 2050.