We create new value chains and cooperations for a future proof economy

Petrus Postma, co-founder

www.nflux.nl

Future proof economy
The Estonian Hydrogen Value Proposition

Step 1

Urgency

Why a hydrogen value chain?

- Oil and gas companies face increasing CO_2 taxes
- The energy sector is moving away from fossil fuels
- The prices of solar and wind energy are decreasing
- Energy systems are changing
- Countries and businesses join in that transition.

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Saudi Arabia takes steps to lead the $700B global hydrogen market

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BP sets ambition for net zero by 2050, fundamentally changing organisation to deliver

Release date: 12 February 2020

EIB 2020: When ambition becomes transformation

By European Investment Bank 13 Oct 2020

The European Investment Bank took a bold step when it announced in November last year that it would end funding for fossil fuel projects, alongside a slew of ambitious targets. This year has been about putting in place the roadmap for its transformation

The EIB promised last year to step up its commitment to the climate — by the end of 2021, it will end the financing of fossil fuel projects; over the next 10 years, the EIB Group plans to trigger investments of more than €1tr in climate protection and environmental sustainability; and at the same time, the EIB will increase the proportion of such investments in its portfolio from 25% to more than 50% by 2025.

And, by the end of this year, it will have fully aligned all its financing activities with the principles and goals of the Paris Agreement.

It is doing all this amid the economic and health crises created by Covid-19.

Step 2

Opportunity

EU investing heavily in Hydrogen

EXHIBIT 27: REVENUES AND EMPLOYMENT IN THE HYDROGEN ECONOMY, 2030

2030 hydrogen vision

Estimation of industry size

EU and global market potential taken from hydrogen vision

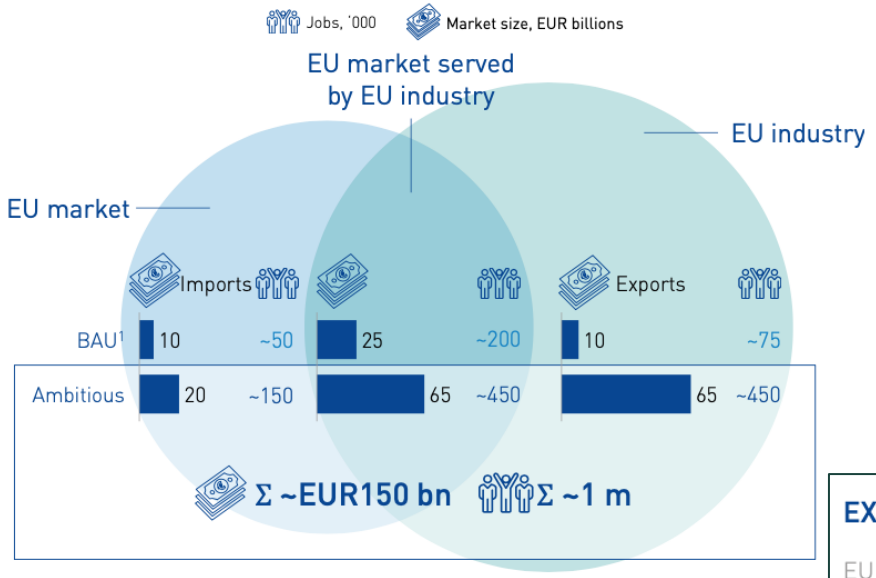
"Fair share" of EU industry on domestic and worldwide market derived from industry statistics and industry interviews

Revenue and jobs multipliers estimated from EU input-output models

Ambitious scenario

Fair domestic market share for EU players (between 60% and 90% depending on the step in the value chain)

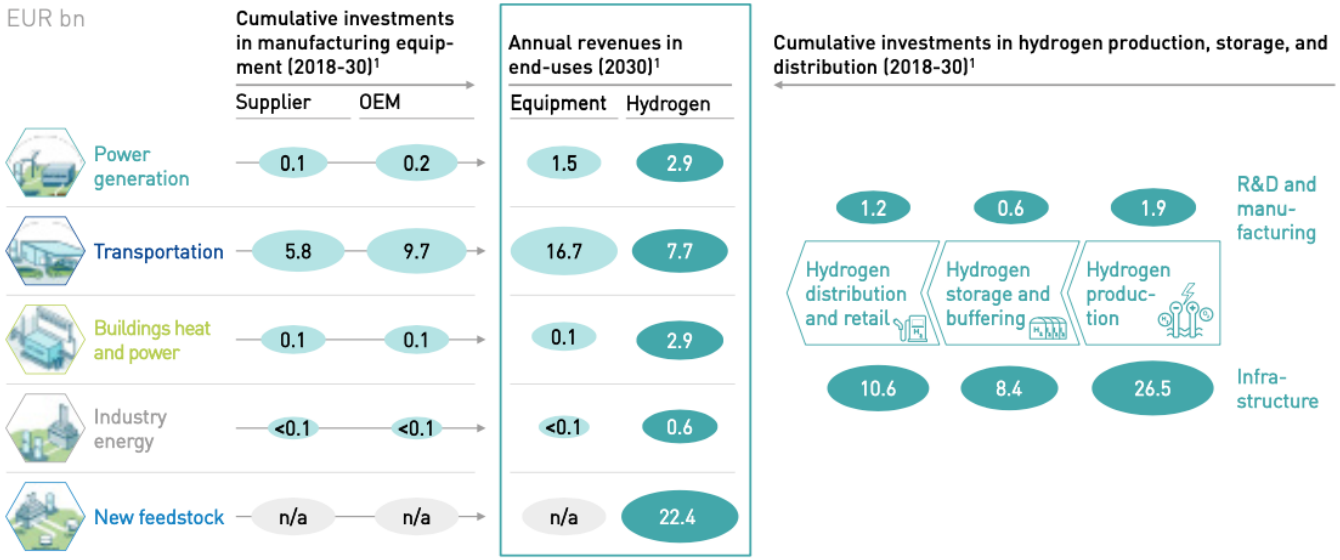
Fair market share for EU players in RoW (between 10% and 25% depending on the step in the value chain)



1 Business-as-usual scenario

European Hydrogen Roadmap

EXHIBIT 26: INVESTMENTS OF EUR 65 BILLION REQUIRED UNTIL 2030 ALONG THE VALUE CHAIN



1 Including investments/revenues in aftermarket services and new business models (assumption: 8% of investment/revenue)

Co-Funding

Fund	Description
Estonian subsidy scheme	Granting a € 5.000.000, - subsidy to a partnership of companies willing to invest in a H_2 pilot project. Can grant another € 50.000.000, - to successful pilot projects.
IPCEI	Supports innovative projects involving more than one Member State (e.g. Latvia); project can be aided up to 100% of the funding gap on the basis of a large set of eligible costs.
ECH2A	Aims to install 40GW of electrolyser capacity by 2030 in Europe, as stated in the European H_2 Strategy.
Innovation Fund	Funding programme for the demonstration of innovative low-carbon technologies; €10 billion to invest up to 2030.
Cohesion Fund	Aims to reduce economic and social disparities within the EU and to promote sustainable development, e.a. use of renewable energy.
European Regional Development Fund	Aims to reduce economic and social disparities within the EU and focuses on investments in several key priority areas, e.g. R&D and low-carbon economy.
Horizon Europe	Running from 2021-2027. Investing about 150M yearly in H_2 projects.
Ocean Fund	European Investment Bank fund investing in companies that build resilience in coastal ecosystems.
FuelEU Maritime	Aims to increase the use of sustainable alternative fuels in European shipping and ports.

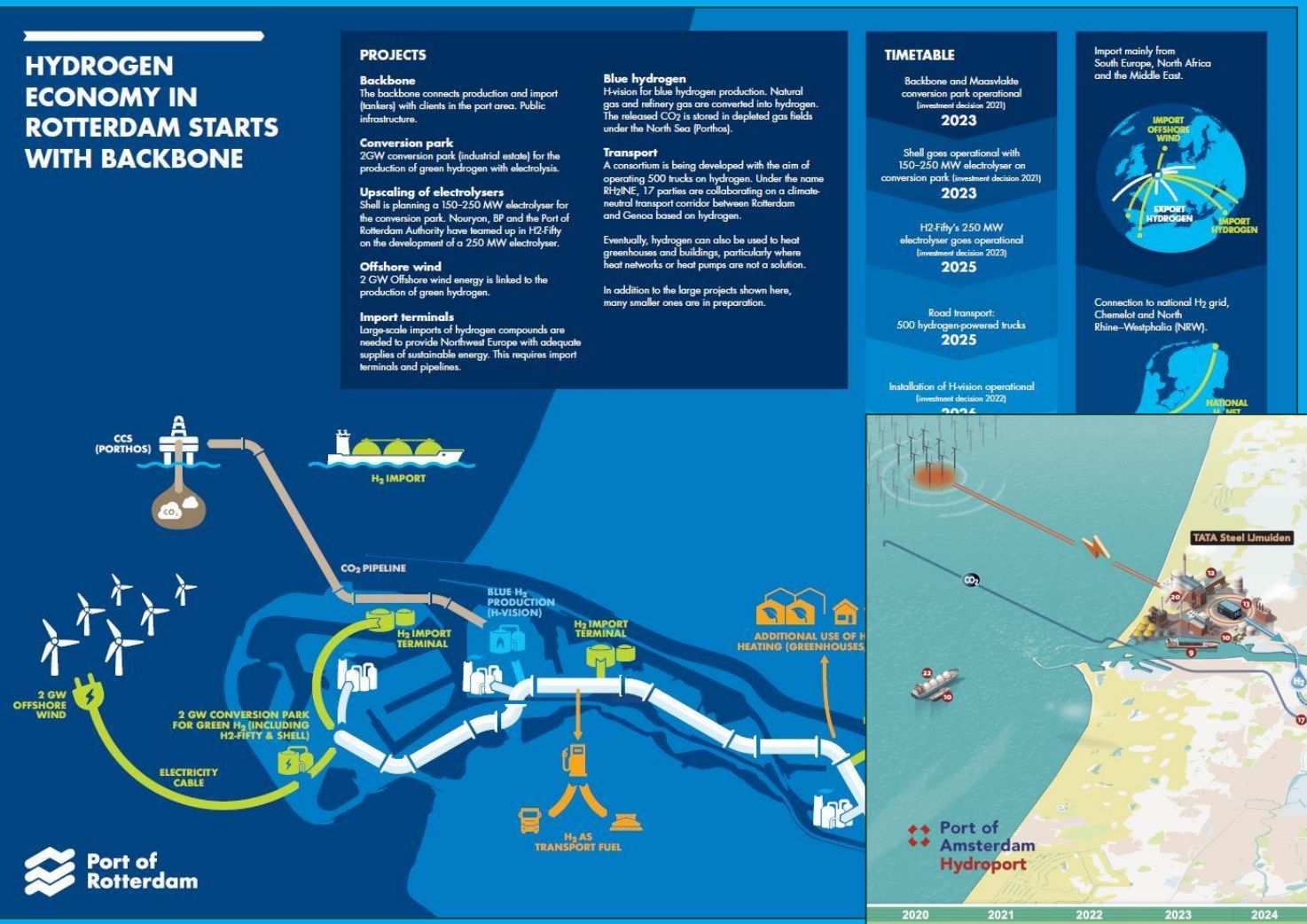
4. Opschalen van waterstof en groene elektronen in industrie – 338 miljoen euro

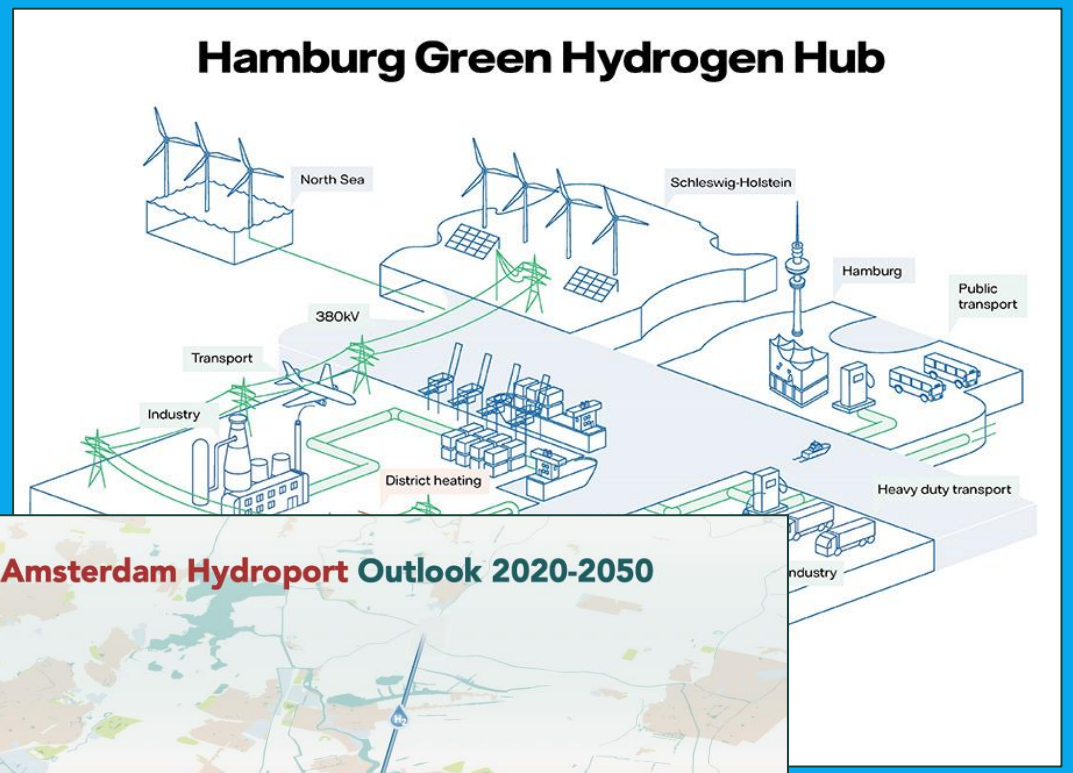
Het voorstel Groenvermogen is gedeeltelijk toegewezen (338 miljoen euro) en is gericht op de opschaling van waterstof en toepassing van groene elektronen in energie-intensieve industrieën. Het betreft een integrale aanpak van bedrijven, overheden en kennisinstellingen in deze sector waaronder een breed samenhangend onderzoeks- en innovatieprogramma en een onderwijsagenda. Het ontwikkelen kan bovendien sterk bijdragen aan de klimaatopgave.

De publieke investeringen moeten een krachtig en flexibel waterstofecosysteem creëren dat de basis vormt voor de opschaling van waterstof en elektrochemie. Industriële clusters waar hiervoor kansen liggen, zijn Noord-Nederland, Amsterdam, Rotterdam/Moerdijk, Zeeland, Arnhem, Brainport Eindhoven en Limburg (Chemelot).

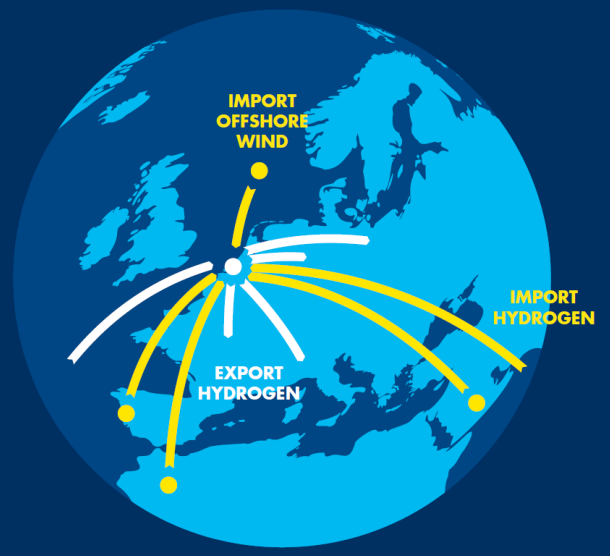
Meer onderzoek en innovaties zijn nodig om groene waterstof uiteindelijk efficiënt en goedkoper te kunnen toepassen. Zo ontstaan ook interessante verdienmodellen voor Nederland zowel in een mogelijke rol als producent of internationale distributeur.

EU Ports investing heavily in Hydrogen





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.

3×

DUTCH ENERGY CONSUMPTION FLOWS THROUGH THE PORT OF ROTTERDAM

20 Mt

TOTAL HYDROGEN FLOW IN ROTTERDAM IN 2050

200 GW

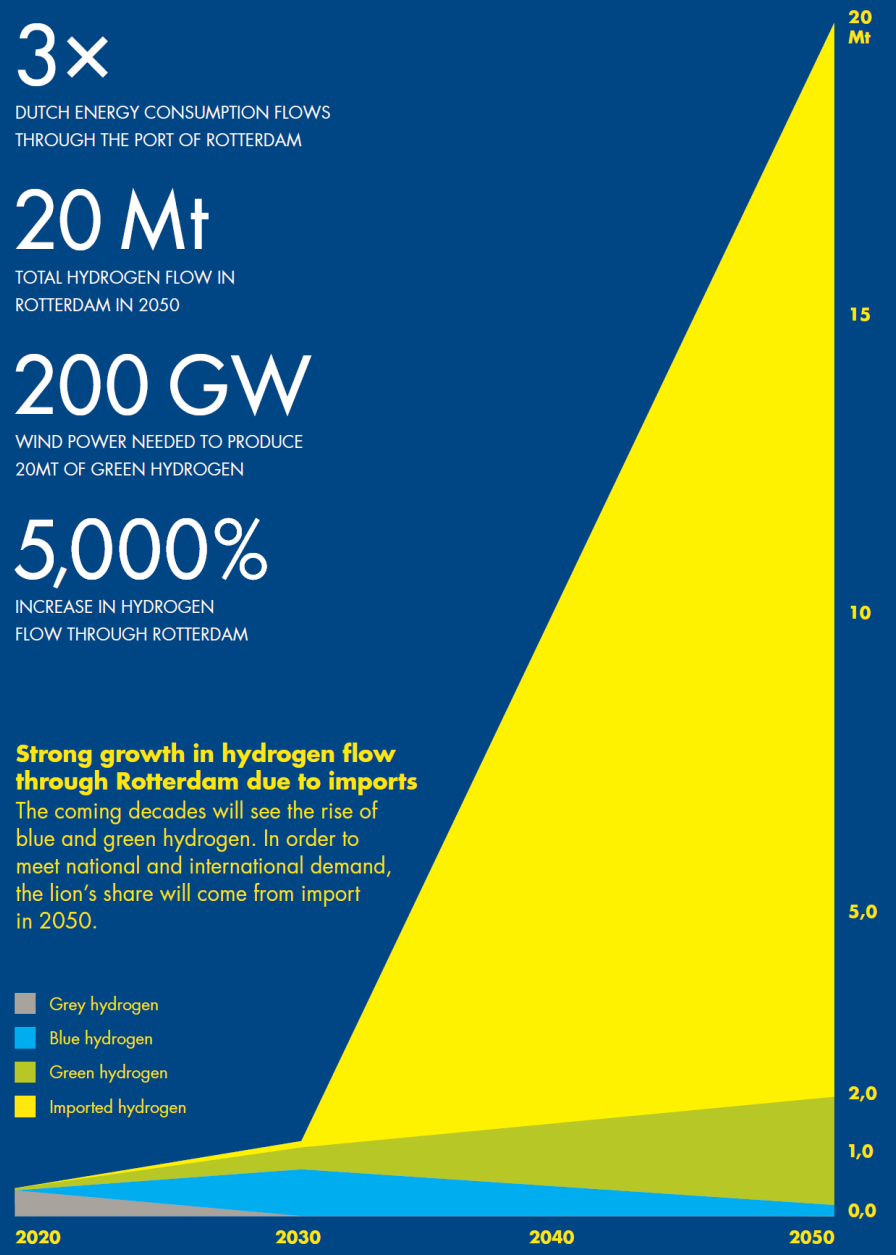
WIND POWER NEEDED TO PRODUCE 20MT OF GREEN HYDROGEN

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.



Step 3

Value Chain

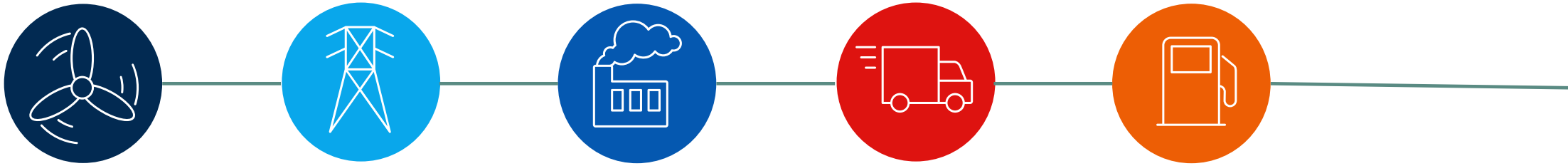
Hydrogen Value Chain

Directly at sea or on land in the harbor

Electrolysis

Hydrogen (or a carrier) is transported to the users

Hydrogen Transportation



Electricity Production

Through wind and solar

Conversion to Carrier

Hydrogen conversion to different types of carriers

Use Cases

Hydrogen in its many forms is used for different use cases

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Hydrogen Carriers

Green Hydrogen

Methanol

Methanol is a possible carrier for hydrogen, which is created by mixing green CO_2 with hydrogen. Methanol can be used as a biofuel, which is a direct potential use case.

LOHC

Hydrogen can be stored and transported by Liquid Organic Hydrogen Carriers (LOHC) based on a two-step cycle: (1) loading of hydrogen (hydrogenation) into the LOHC molecule (hydrogen is covalently bound to the LOHC) and (2) unloading of hydrogen (dehydrogenation) after transport and storage.

Ammonia

After adding nitrogen to hydrogen, ammonia is created. Ammonia as an end product can be used as a fertilizer which is a potential use case. When ammonia is merely used as a carrier, the ammonia must be cracked back to hydrogen.

SAF

Sustainable Aviation Fuels (SAF) are a clean substitute for fossil jet fuels. Rather than being refined from petroleum, SAF is produced from sustainable resources such as biomass and hydrogen combined with green CO_2.

Liquid H_2

Liquid hydrogen is stored under atmospheric pressure and a temperature of -253°C. The benefit of liquid H_2 is that it doesn't need cracking or dehydro-genation like ammonia or LOHC. This will therefore ultimately leave the best quality hydrogen with the least potential loss of hydrogen volumes.

Potential Use Cases

Transportation

H_2 can be used as a direct energy carrier or as a component of advanced fuels.

Heating for buildings

When green hydrogen is available in abundance, this becomes a viable option.

Industry

As the marginal price of natural gas is still low, hydrogen as a feedstock for Estonian Industry is a pathway for the future.

Export

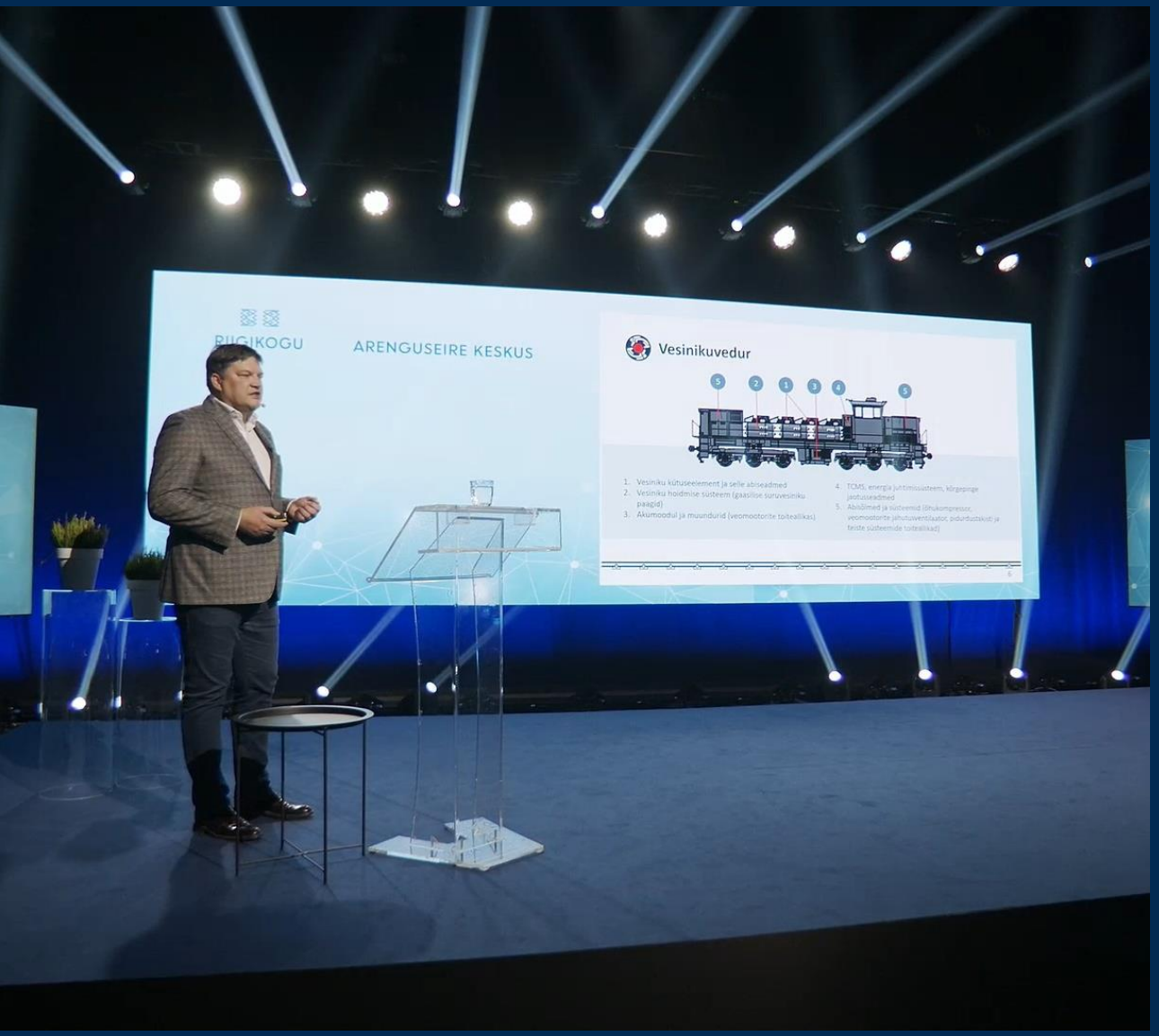
Estonia, when using its full potential for green energy production, might become an important player in the new H_2 economy.

Energy Storage

Using hydrogen as a buffer for the electricity grid might become a realistic option in the future.

Step 4

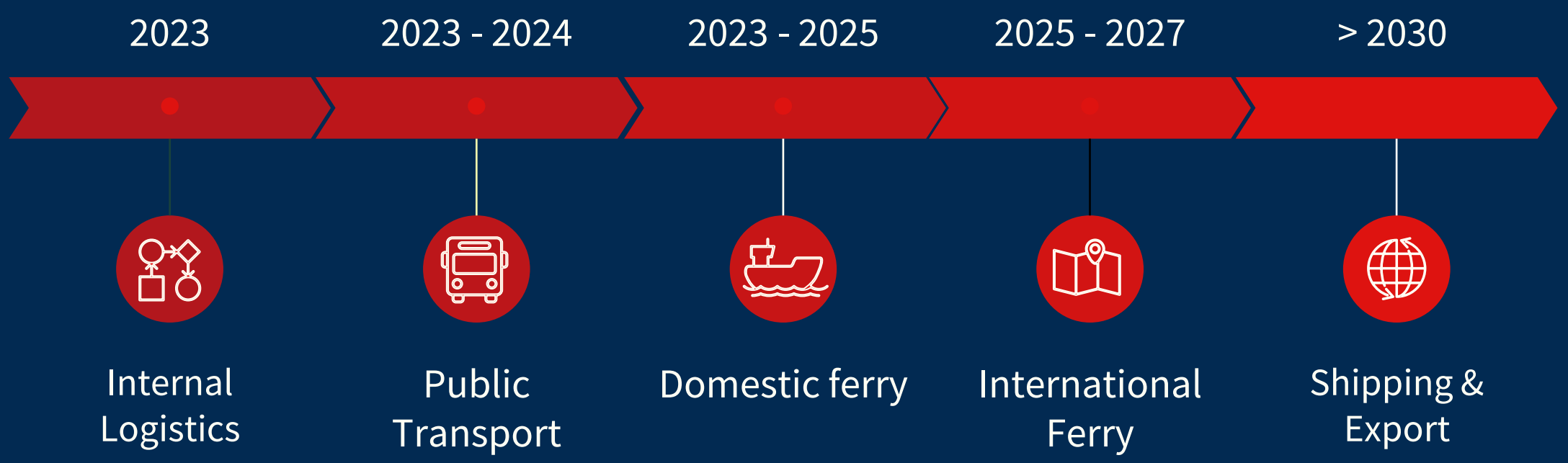
Strategy



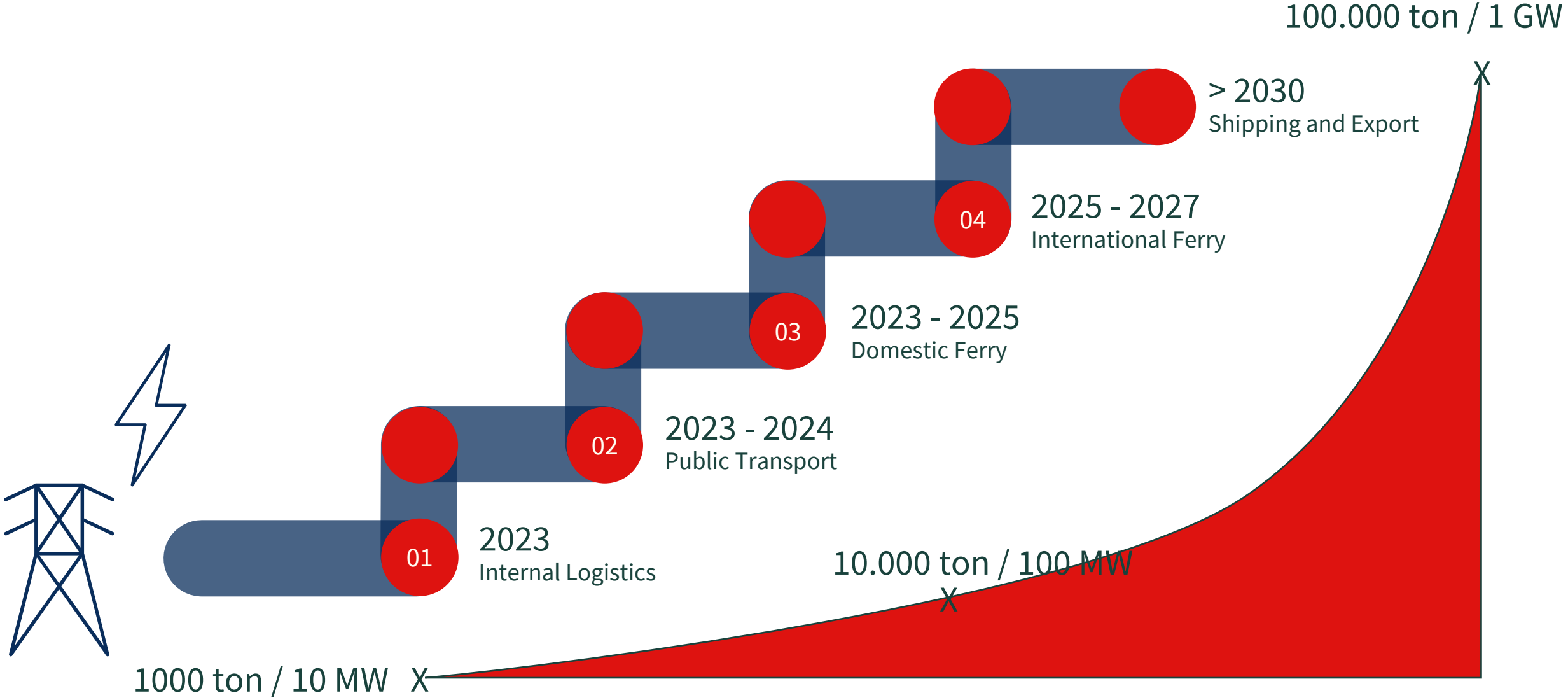
Dynamics in Estonia around Hydrogen

- Companies are presenting plans, like Operail with their hydrogen train.
- New government has expressed a need to invest in hydrogen.
- Most parties are willing to contribute to a new hydrogen value chain but are not really ambitious (yet); or waiting for available infra and removal of market barriers.
- Municipalities are willing to support (Tartu plans, Keila vision, Hiiumaa, Ida-Virumaa)

Stepping Stones of the Ecosystem



H_2 Production Capacity Scale-Up



Challenges to address

Efficient energy use

Converting green energy to hydrogen is energy intensive. When converting electricity to hydrogen there is a loss of approximately 30%. This is the same when turning it back to electricity. Therefore, where possible, processes (in the port) should be electrified and where necessary, hydrogen solutions should be implemented.

Green energy production

Until now, there are many plans for green energy production scale-up in Estonia. These plans range from offshore wind farms to large solar PV plants. Unfortunately, the bulk of planned energy production will be realized after 2030. To produce hydrogen with green energy, much is still to be done.

Lowering CAPEX cost with subsidies

Investing in hydrogen technologies and infrastructure requires high initial capital investments (CAPEX). These investments influence the price of hydrogen largely, while the operating costs are of less influence. Therefore, available subsidies are of big importance in starting up the hydrogen value chain.

International collaboration

The biggest European ports already have hydrogen strategies in place, these will be the first movers. By working together closely with these frontrunners, Estonia can ensure a place in the hydrogen market and good offset opportunities. It can also learn from the best practices in realizing a hydrogen economy.

Future proof economy
The Estonian Value Proposition

Add a value proposition to the Estonian economy

Get the knowledge in and the hydrogen derived products out

Be among the first movers to acquire investments and subsidies

Use your green carbon in an economic way

Reach Carbon Neutrality as a result

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REPÚBLICA PORTUGUESA

PORTUGAL NATIONAL HYDROGEN STRATEGY (EN-H_2)

A new ally for the energy transition in Portugal

GLOBAL OPPORTUNITIES

JAPAN, THE NEW HYDROGEN NATION

Feb 04, 2020 08:22 | Hanna Makino, Swiss Business Hub Japan

Japan was the first country to adopt a "Basic Hydrogen Strategy" and pla
become a “hydrogen society”. The nationwide hydrogen market is expecte
56-fold to JPY 408.5 billion (approx. CHF 3,7 billion) by 2030, providing exc
business opportunities.