



THRUST

Creating a zero-emission waterborne business case ... TODAY

Merriam-Webster Dictionary

1. A forward or upward push;
2. A movement (as by a group of people) in a specified direction

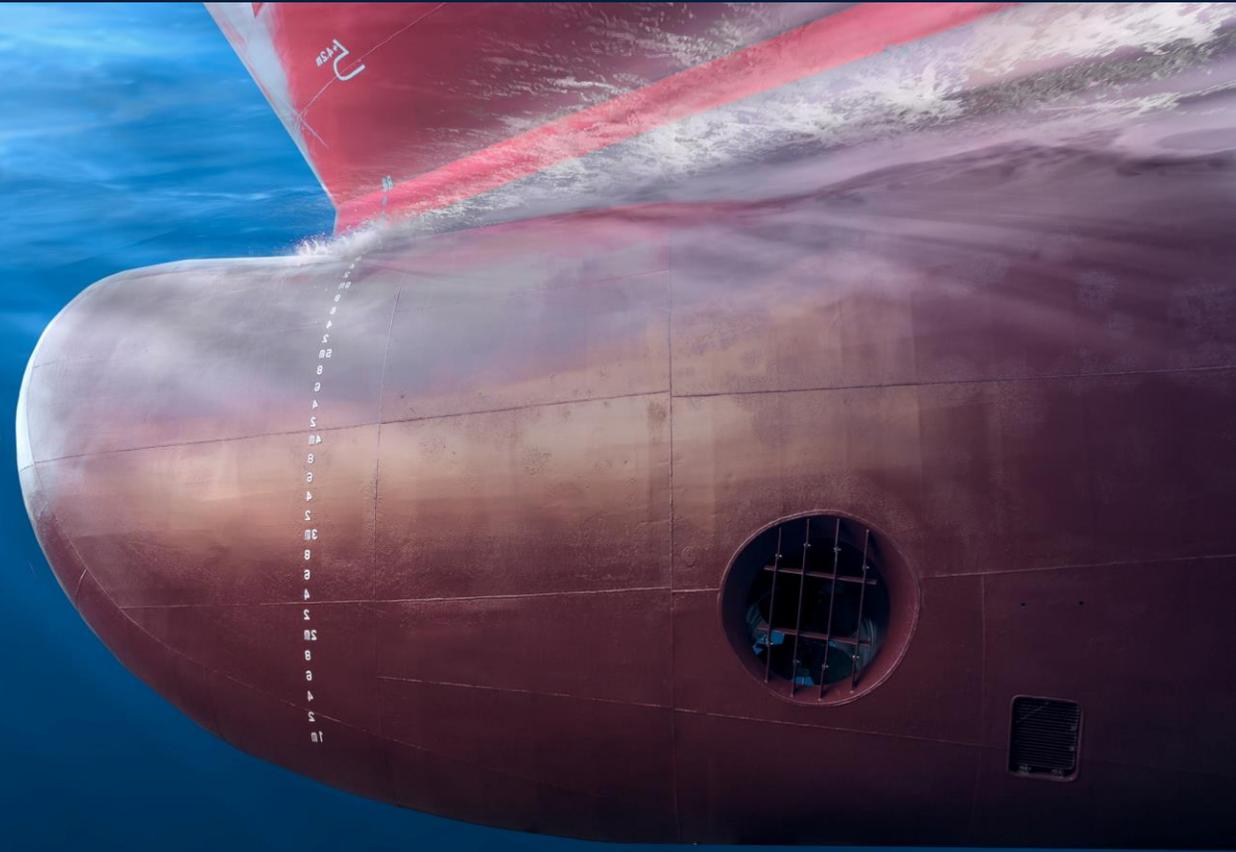
Acronym: Towards Hydrogen-based Renewables Used for Ship Transportation

THRUST is an initiative by:

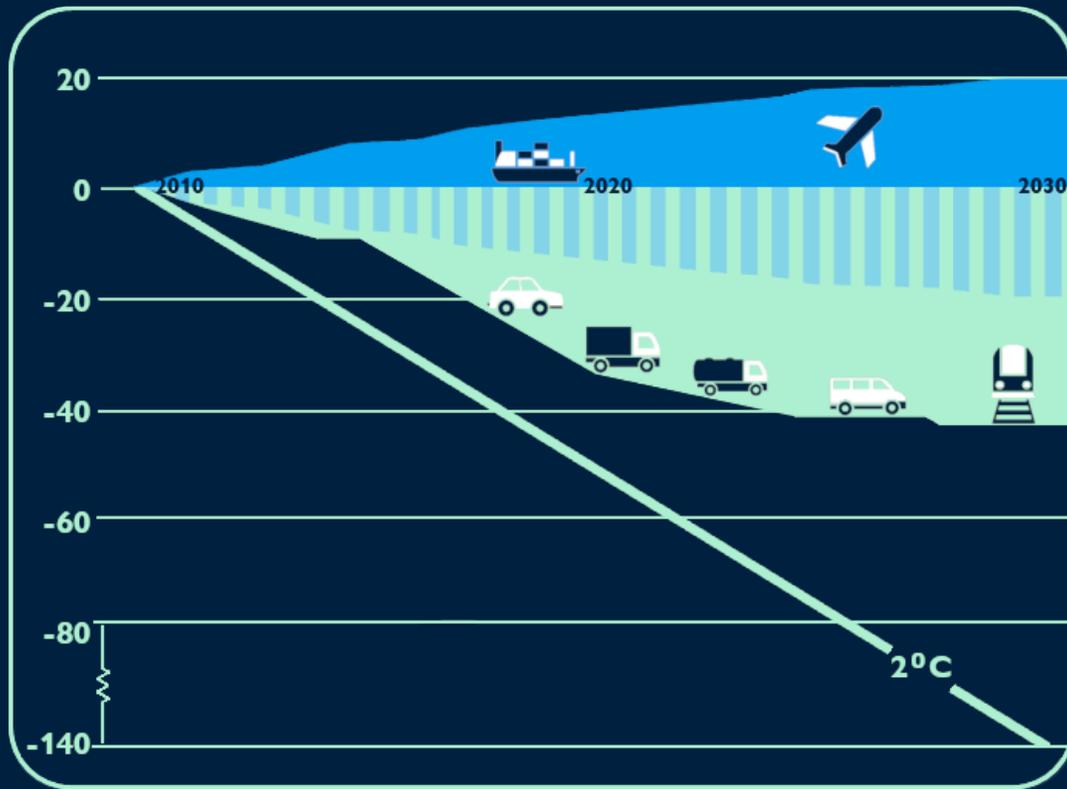


A zero-emission business case will accelerate the transition

1. Background – Why, Who, How
2. Creating a business case
3. Case study – the North Sea



The impact of fossil fuel consumption of the maritime transport industry has a significant and rising impact on global warming ...



Fossil fuel consumption (MTOE*)

📦 Emitting 1 billion tonnes of CO₂ /year

📦 IMO ambition:

*“Reduce the total annual GHG emissions **by at least 50% by 2050** compared to 2008, while, at the same time, pursuing efforts towards **phasing them out entirely.**”***

📦 Phasing out entirely can only be achieved by using 100% renewables

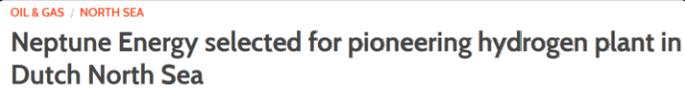
*MTOE = Million Tonnes Oil Equivalent

**IMO = International Maritime Organization



Momentum technologies & government plans building up but...

Hydrogen as key technology



Public perception & political will



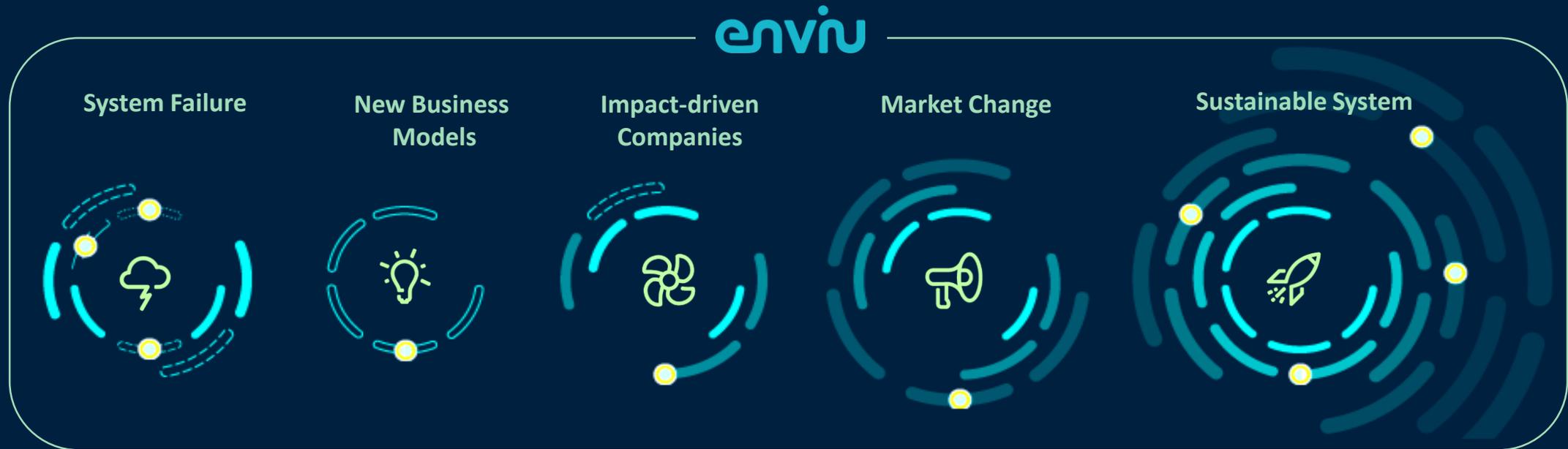
How about the urgency....!?



Creating business opportunities is crucial to accelerate the required transition



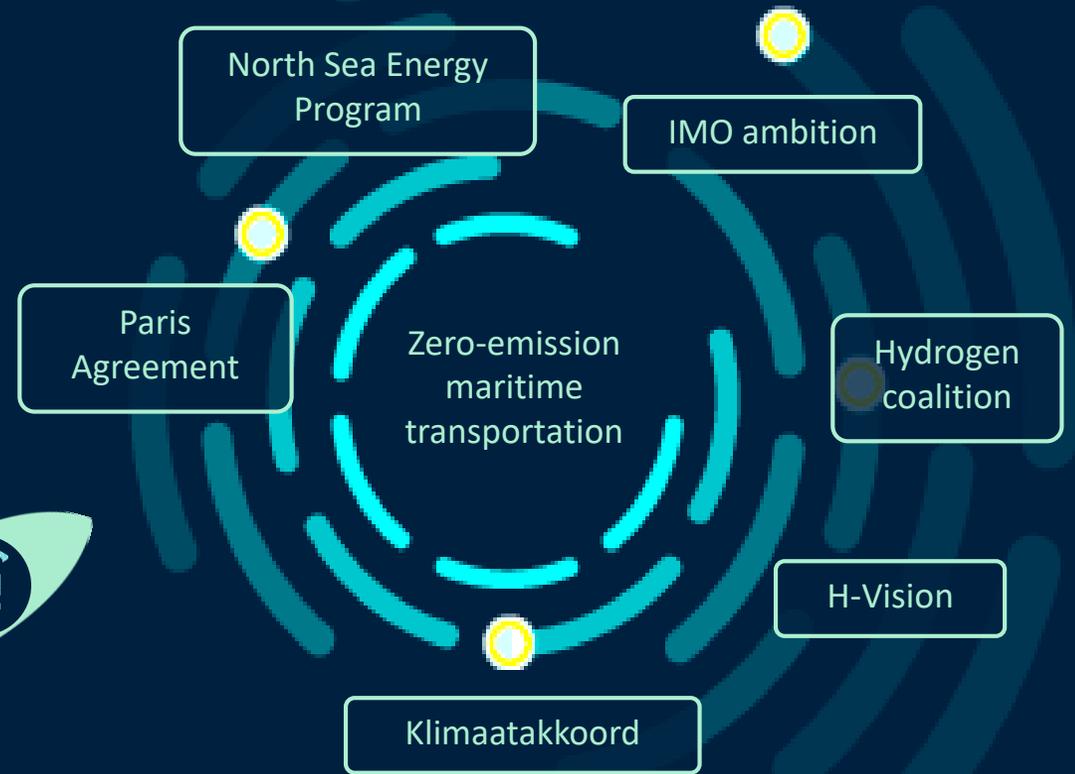
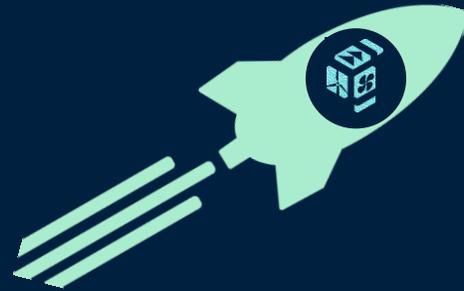
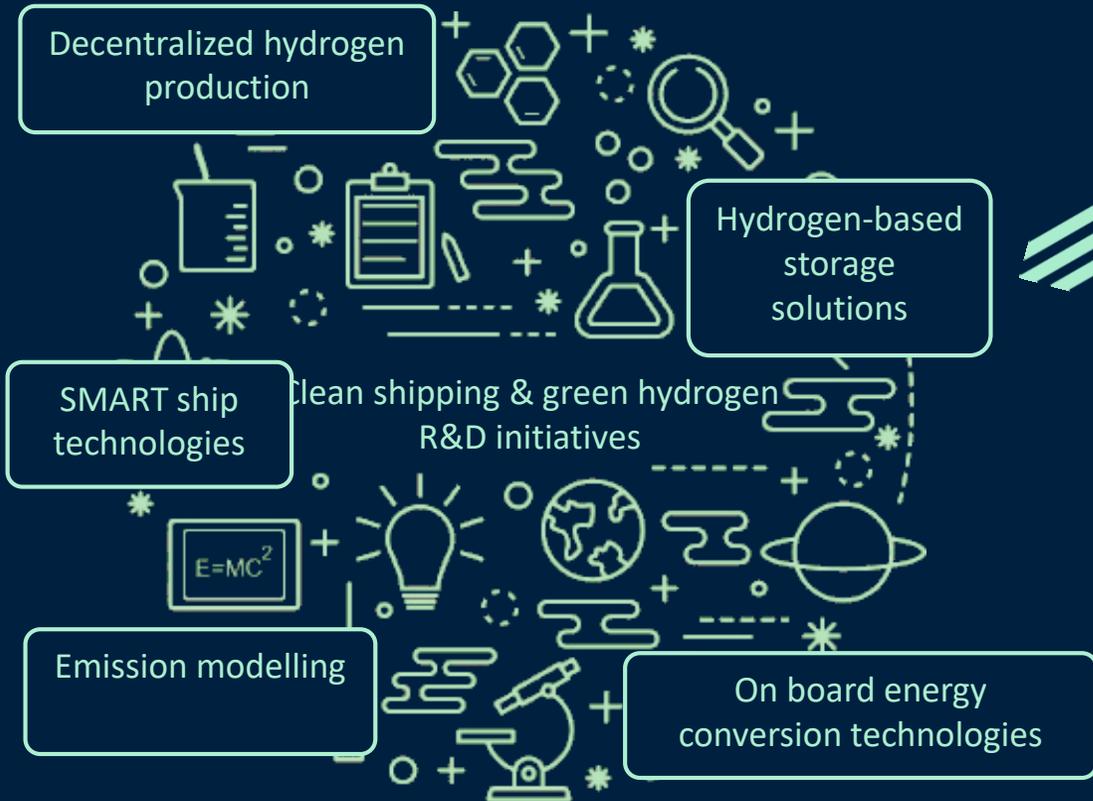
Enviu runs programs to build world changing companies in a variety of sectors that need change



THRUST is a program initiated to accelerate the transition to zero harmful emission shipping



Acceleration of technologies and business concepts towards market entry



Role:

-  **Outsider**
-  **Integrator**
-  **Business case builder**

Why us:

-  **System-thinking**
-  **Cross sectoral**
-  **Technical & commercial**



To achieve a zero-emission waterborne value chain...

We innovate & experiment



We pilot & demonstrate



We build & scale



We collaborate

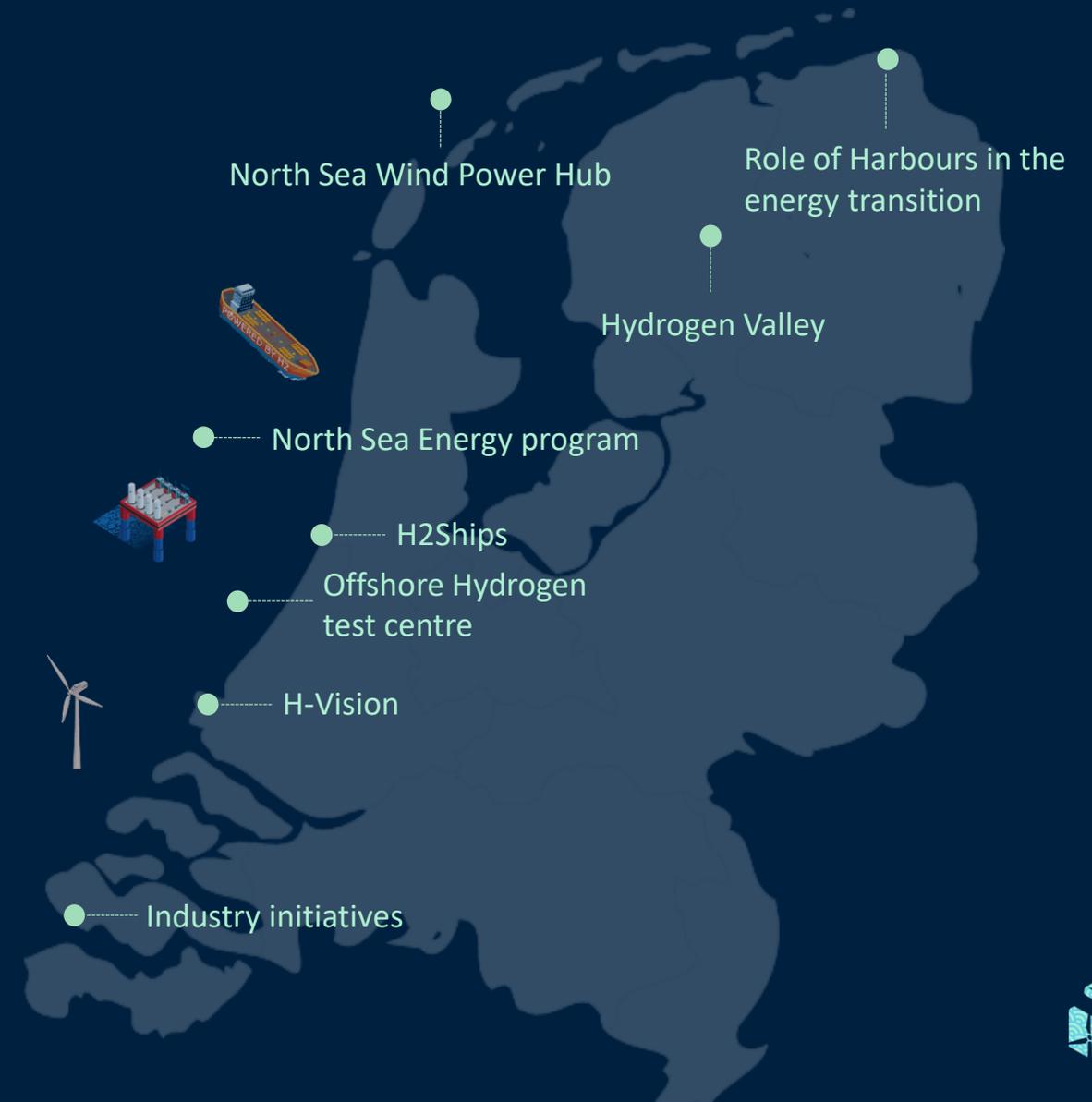


Create a business case by ... 1/5) Breaking down silos

 Initiatives

 Sectors

 Business Models

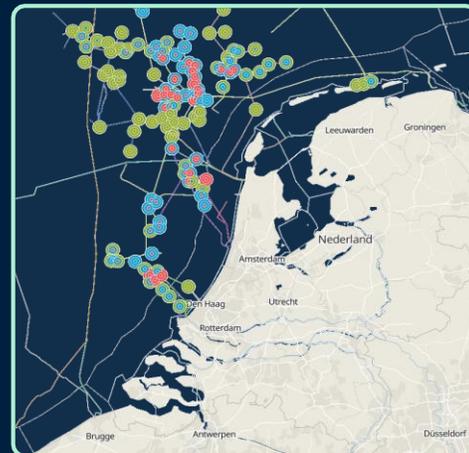


Creating a business case by ... 2/5) Scouting the right location

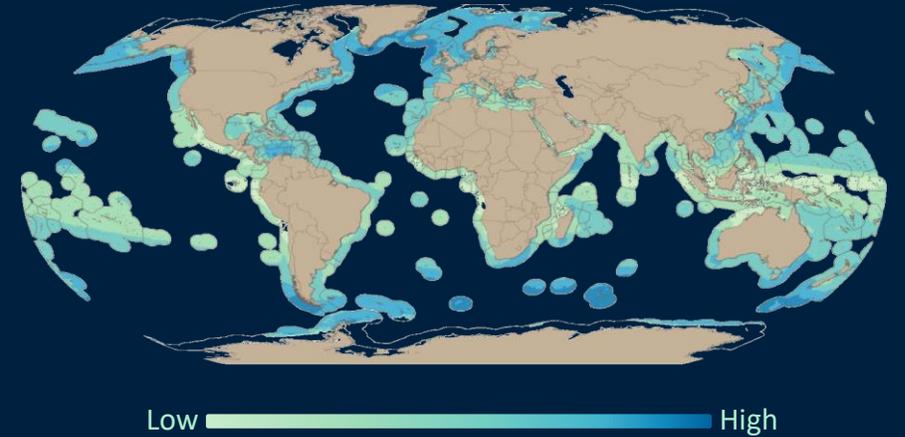
 Renewable energy generation

 Existing & future infrastructure

 Maritime sector



Wind energy potential in shallow waters



Maritime traffic on world oceans

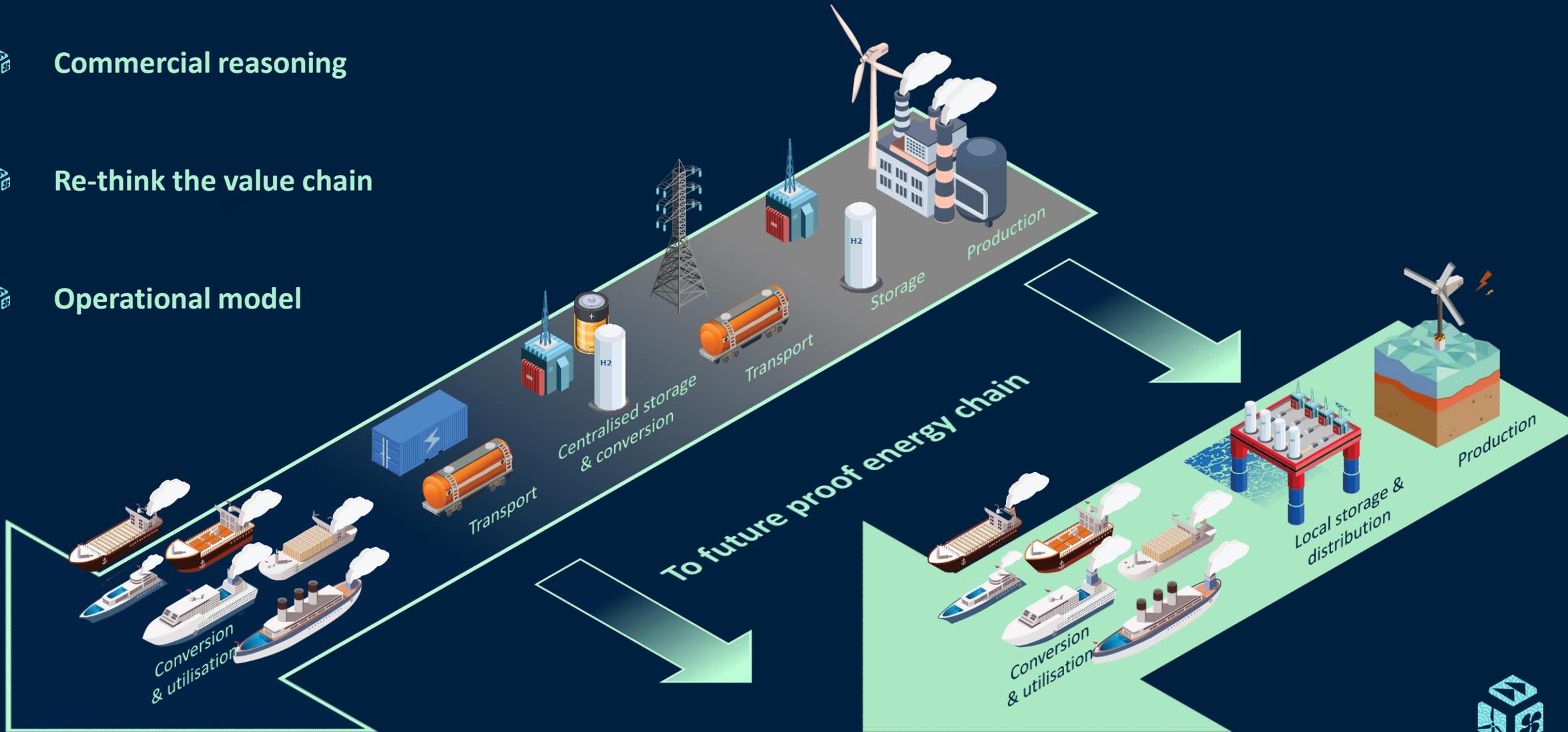


Create a business case by ... 3/5) Rethinking the value-chain

Commercial reasoning

Re-think the value chain

Operational model



Create a business case by ... 4/5) Matching technologies & operational profiles

- Technologies exist and are maturing
- Location and operating profile part of puzzle
- One-size does not fit all



- | | |
|---------------------------|-------------------------|
| — H2 compressed (700 bar) | — H2 liquified (-253°C) |
| — H2-Fuel | — Silicon Fuel |
| — MOFs | — Graphene |
| — NH3 | — Formic Acid |
| — LOHC | — Methanol |
| — Ethanol | — Gasoline |
| — Diesel | — LNG |



Create a business case by ... 5/5) Financing short & long-term



Mixed sources



Together is more



Need to start

Steps	Expected results	Timing	Contribution & financing of activities
1. Pre Feasibility	<ul style="list-style-type: none"> MoU consortium Project Core team established High level scope & financing 	Now-10/2019	<ul style="list-style-type: none"> active role of all consortium members
	<ul style="list-style-type: none"> Clear view SWOT 	12/2019	<ul style="list-style-type: none"> cash & in-kind active role of all consortium members
2. Concept Feasibility	<ul style="list-style-type: none"> Off-shore energy landscape Potential hydrogen uptake by Maritime sector 	12/2019	<ul style="list-style-type: none"> cash & in-kind active role of all consortium members MIT Cooperation (35%, max. 350 k €)
	<ul style="list-style-type: none"> Agreement on business concept Go / No Go -> Pilot Feasibility 	Q2 2020	<ul style="list-style-type: none"> member in cash & in-kind Subsidies & Grants
3. Pilot Feasibility	<ul style="list-style-type: none"> Pilot location defined Confirmation Pilot partners Financial plan 	Q4 2020	<ul style="list-style-type: none"> Subsidies and incentives – e.g. DEI+ Remaining gap covered by consortium
4. Pilot	<ul style="list-style-type: none"> Agreement business activities Pilot completed, operations 	2021 and beyond	<ul style="list-style-type: none"> EU-Grant & National subsidies, e.g. Innovation Fund, DEI+ Fund raising for scale-up
5. Commercialisation	<ul style="list-style-type: none"> Market Entry 	After pilot	<ul style="list-style-type: none"> Revolving investment return on initial investments Improved business case and operational break-even Commercial Investments + incentives



Business Case Example

Profile			
Type of vessels	• crew and equipment transfer, survey		
Power output	• 1+ MW	speed (max) : 20 (23) Knots - speed (surveying) : 8 knots	
Fuel Capacity	• < 5000 Liter	current fuel : MGO – alternative Fuel : Green Ammonia/Hydrogen	
Operational Modes	• Shore <-> Windfarm	• Inter site	Surveying / idle
Range	• 20-30 NM	• 5-15 NM	0-10 NM
Operational chain efficiency gain / loss vs. BAU	• Ammonia : + 20-25%	• Liquefied H2 / LOHC : + 5-10%	Gaseous H2 : - 10 -15%



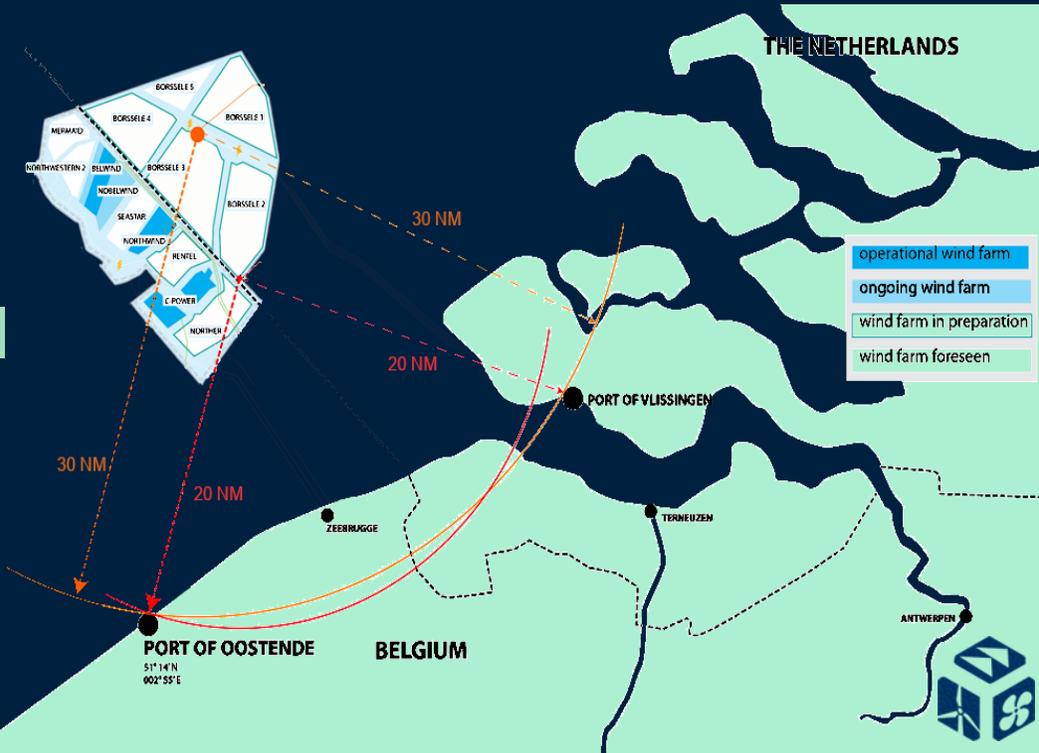
Starting Points Pilot

- | | |
|---|--------------|
| • Proven Technology / Reliability : Uptime of > 99% | must |
| • Fuel / Energy capacity fits operational profile | must |
| • Ship layout and efficiency is not reduced by more than 5% | must |
| • Energy delivered is 100% renewable | must |
| • Renewable energy has been locally generated | nice to have |
| • Increase of ship availability | bonus |
| • Generation of energy on board | bonus |

Well to wave efficiency > 35%

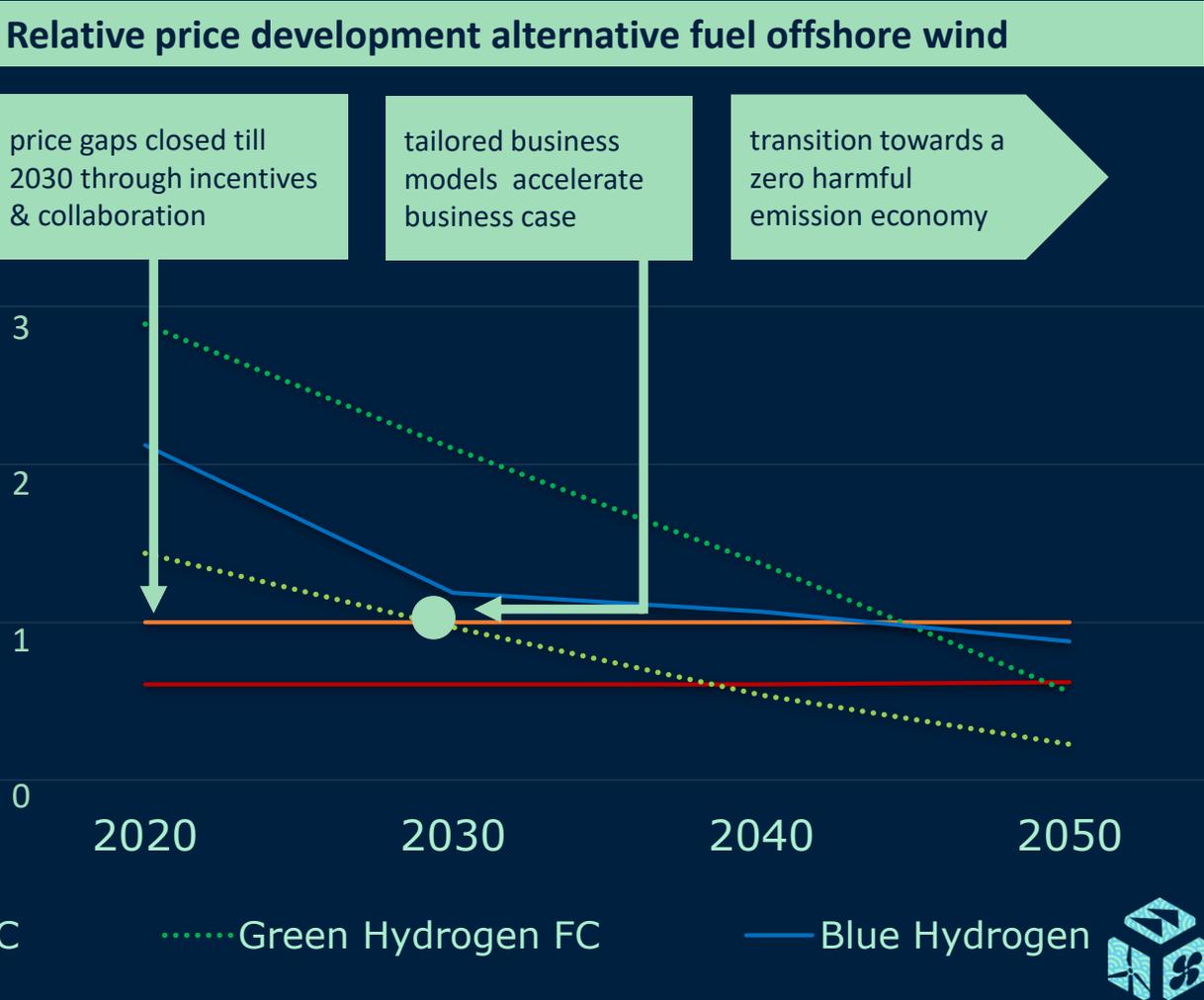


Location : Borssele I - V



Capitalising the operational sweet spots makes a subsidy-free business case possible by 2030

- 📦 **Today** : Large scale pilots feasible through price incentives & subsidies
- 📦 **Until 2030** : Tech. solutions tested, scaled and cross-sectorally integrated
- 📦 **Beyond 2030** : A right cocktail of solutions accelerates a non-subsidised business case by five to ten years
- 📦 **License to grow**: Project participants are positioned ahead of the bunch on route towards a profitable zero emission economy



Join us if you have the ambition to:

1. Create **real impact** by proving that zero-emission business models can work already today
2. Create a new sustainable industry on the North Sea, setting the pace for **maritime decarbonisation globally**
3. Invest in a future we can be proud of - **re-shaping the oil & gas, maritime & offshore industries** - maximising the benefits of our geographic location and technological expertise





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Let's create THRUST together



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