The future of circularity in maritime: innovation forecasts

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Future of… circularity

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Project Manager

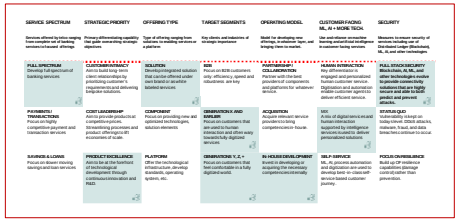
CIFS
Foresight Analyst

Expertise:

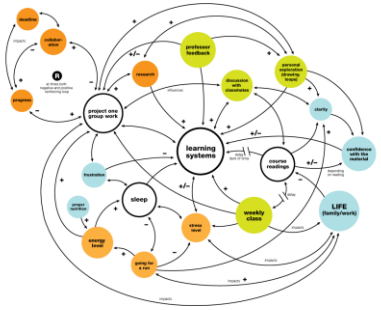
- Strategic foresight
- Sociology of science and technology (STS)
- Maritime & ocean economies
- Scenario-based strategizing
- Open innovation
- Business model innovation

applied foresight toolbox

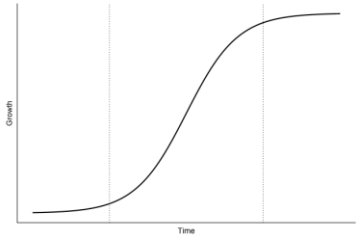
Backcasting



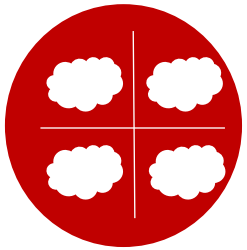
Strategy playboxes



Systems analysis

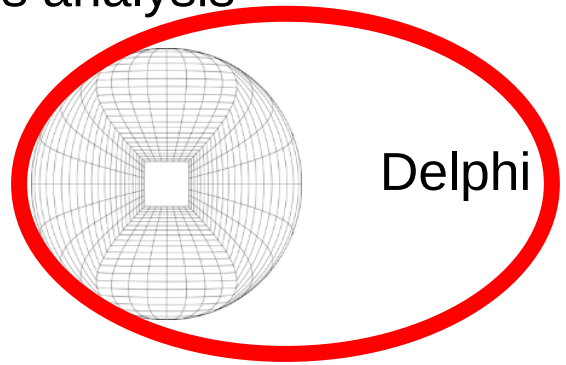


Technology forecasting



Scenarios

Wargaming

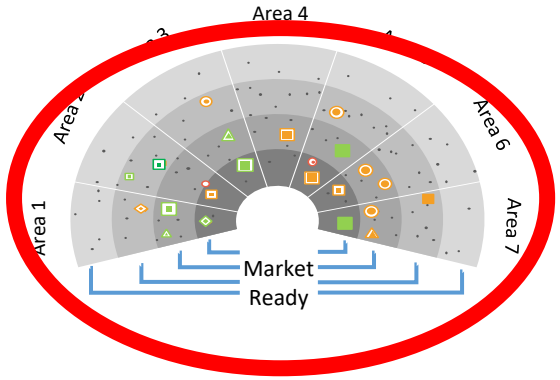


Delphi

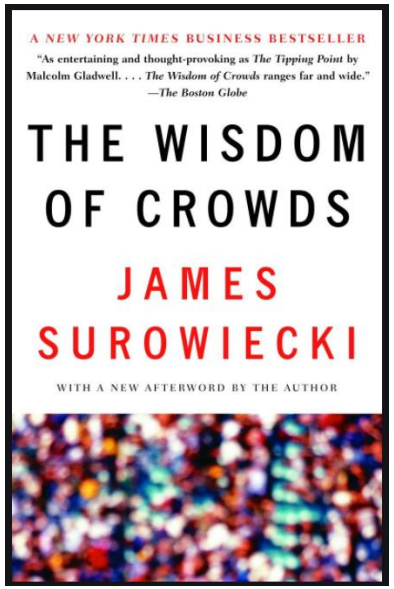
Technology roadmapping

Trend auditing

Foresight radars



Method: wisdom of the crowd

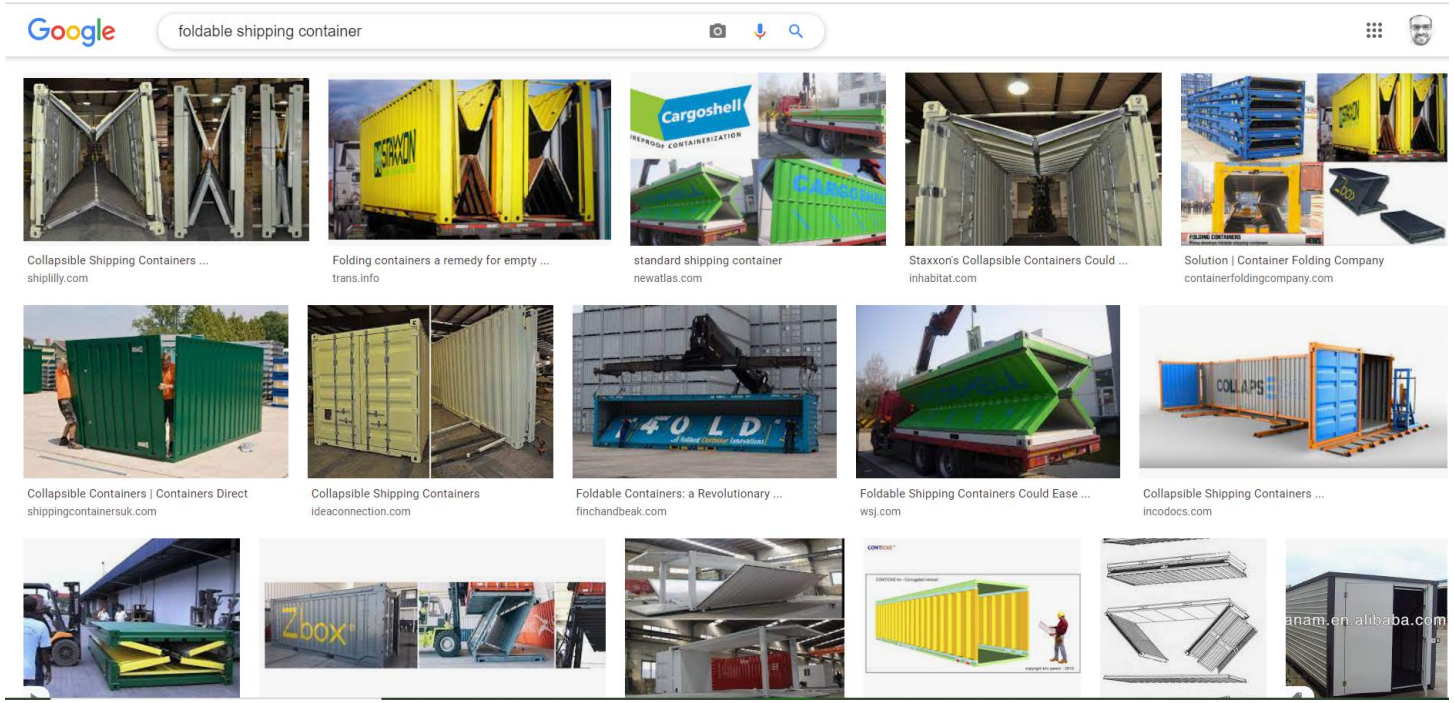


Paradoxically, the best way for a group to be smart is for each person in it to think and act as independently as possible

Innovation forecast prompting

"please estimate how many years from now, that accomplishing [task A] with/by [technology B] will become…"

- …an accepted practice.
- …commercially available.
- …a viable alternative.



Respondents’ estimations and opinions

3

1

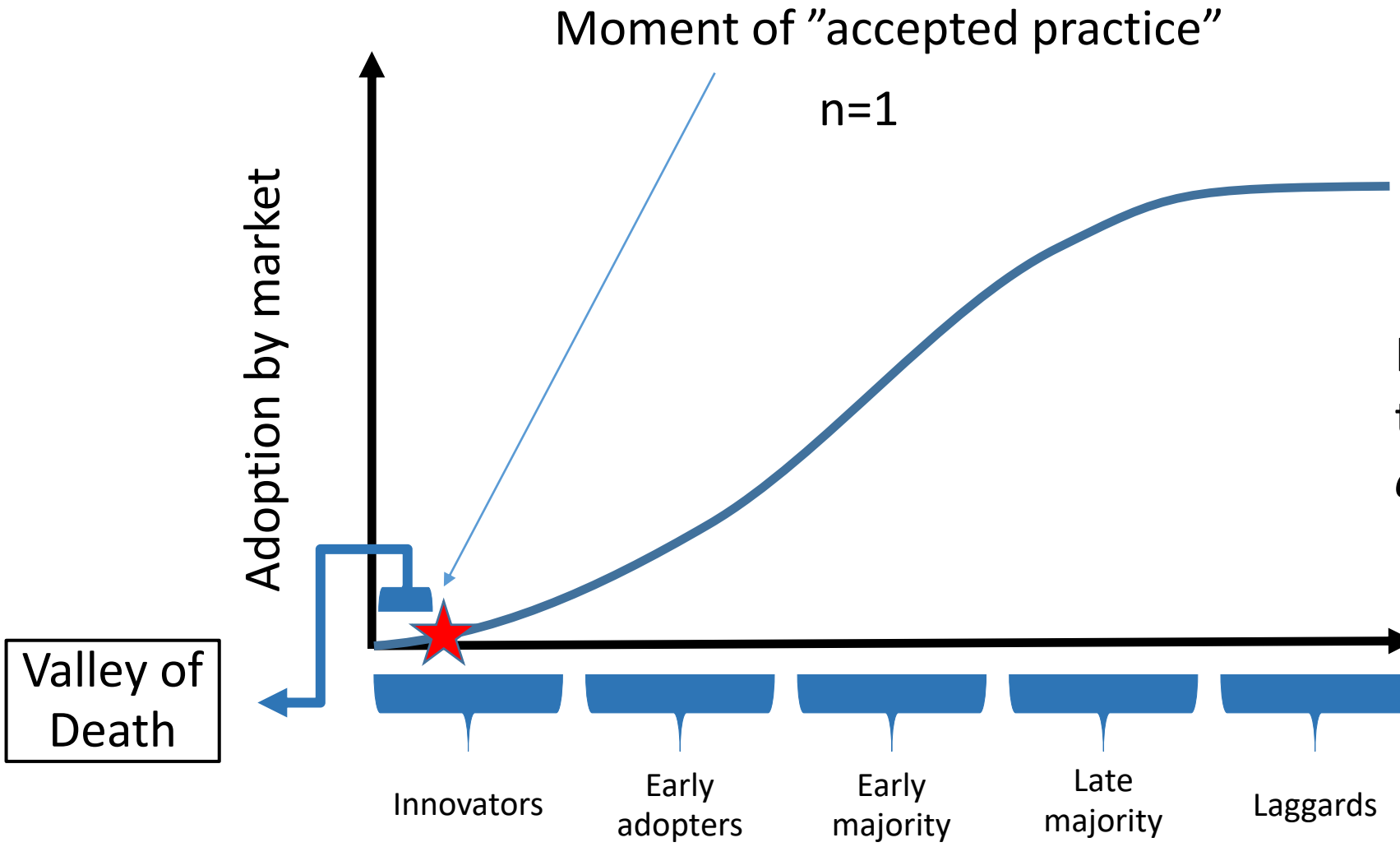
2

It’s already here

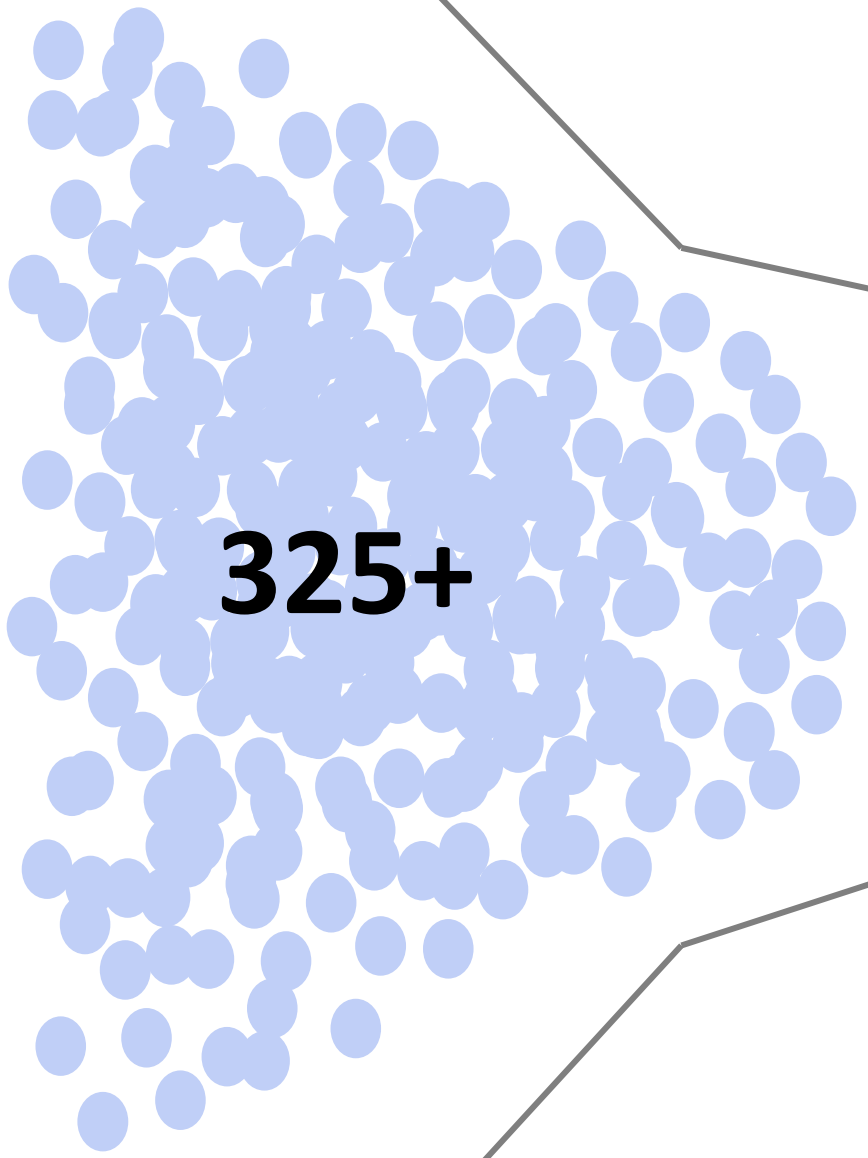
When it will happen

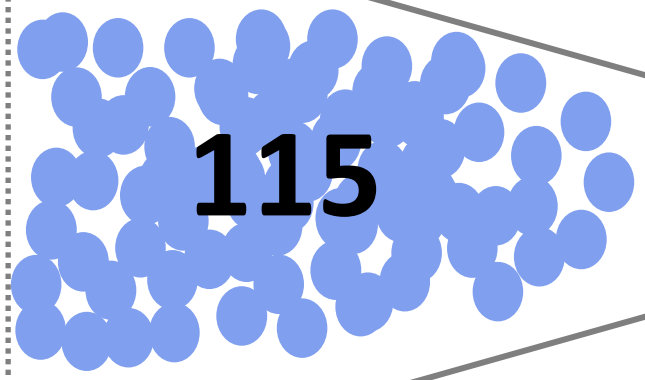
Never going to happen

Technology diffusion curve



Innovation forecasting: time to ***commercial availability***





ECOPRODIGI

PERISCOPE
reaping the potential of the oceans

PERISCOPE
entrepreneurial discovery

ous bird abatement

firms can lose up to 36% because of seagulls and Autonomous drones, fish farms, could be used n off

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3D printing of turbine blades

Transport of wind turbine blades can amount up to 20% of wind park development costs. 3D printing turbine blades on site on jack-up rigs would lower these costs

Read More

Wave-powered tsu warning

Combining tsunami detec renewable wave energy s could allow for more freq transmissions and lower t of manual battery replac

ps

ce of air between a ship's water could effectively p 'fly' through the water el efficiency and ssions

Read More

Fully electric fish farm

Fish farms, located far out to sea, could go fully electric by using wave energy, and use surplus power to charge the electric vessels that make voyages out to the farm

Read More

Container stacking

Heavy lifting drones able containers around at ports able to reduce crane mov make operation more effic cheaper

rm ssioning

years, 150 oil and gas ll be decommissioned nowledge base of best d risks would lead to safe practices

Read More

Turbine blade cleaning drones

Cleaning wind turbine blades is a necessary procedure which is currently done manually. Automated drones could perform this service 24/7 while reducing risks and costs

Read More

Autonomous service

An autonomous-unmanne can perform simple tasks both construction and ope increase a vessel's operati efficiency

y autonomous wind

utonomous wind farms adopt and move to ss would generate more more consistently than ed or floating-moored

Read More

Underwater data lasers

The development of lasers that could package and transmit data from seafloor to surface vessels would improve robotic applications for untethered exploratory voyages

Read More

Container lashing dro

Lashing containers is one o dangerous jobs in maritime can support the experts on these operations

d turbine nts

offshore wind turbines ing replacement of rts. On-site 3D printing, replacement of spares ve efficiency

Read More

Offshore container terminal

Increasing sizes of container ships will outgrow port facilities. Offshore container terminals would provide space for unlimited growth and flexibility for ships

Read More

Recharging at wind

Offshore wind turbines co electricity to recharge the equipped vessels that ser maintain them, reducing t requirements and emissic

ce hull laser

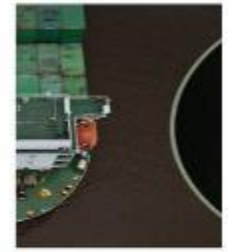
ships or sending divers ip hulls is time-expensive, and imprecise. Laser scanners would ability and efficiency

Read More

Offshore logistics hub

Co-locating a container terminal at an offshore wind energy park would be able to use excess electricity to desalinate water for hydrogen for powering feeder vessels

Read More



Digital vessel twinn

A delivered digital twin of built ship can be used to planned specifications wi avoid mistakes for rework physical inspections

rone charging

ion of subsea drone tforms at offshore wind

Solar-powered charging vessel

A network of autonomous solar-powered vessels could provide on

Lashing robots

Lashing and de-lashing o one of the most dangerous

ter laser pipe

nissioning of offshore oil m infrastructure is

Smart weather buoys

Online weather buoys could send real-time updates on weather and

Drones de-icing win turbines

ice build-up on wind turbi lowers electricity producti

ip inspection

regularly undergoing ctions. Using swarms of

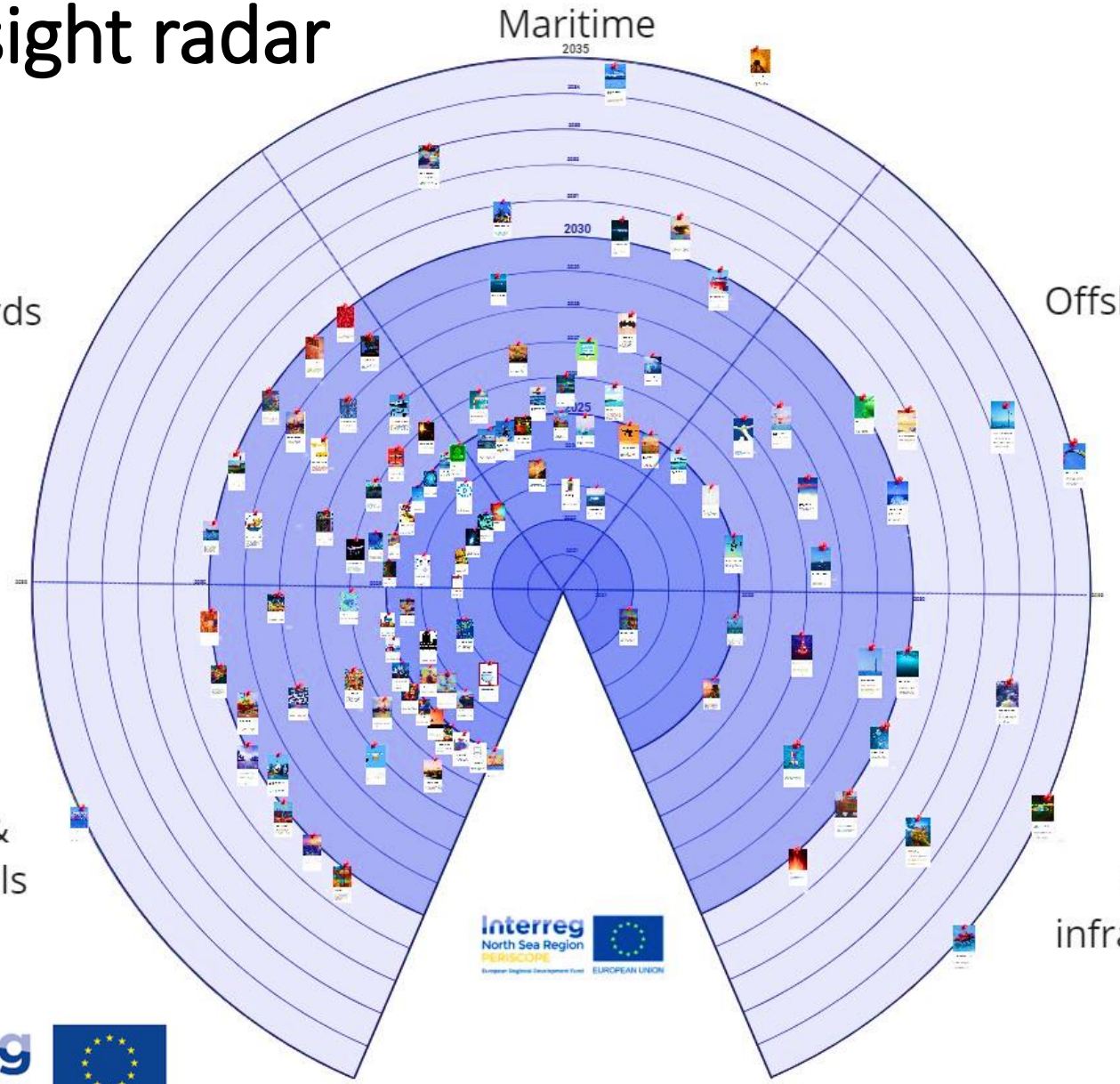
Subsea robotic maintenance

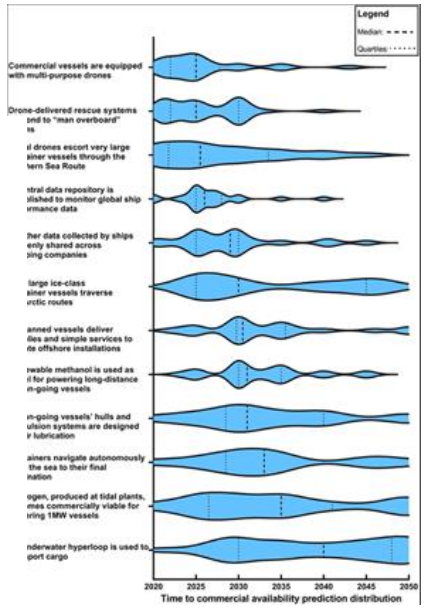
Offshore platforms need underwater maintenance on subsurface systems

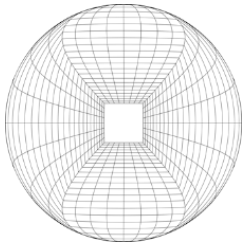
Offshore maintenan drones

Offshore platforms require inspection and maintenan

Maritime & offshore Foresight radar







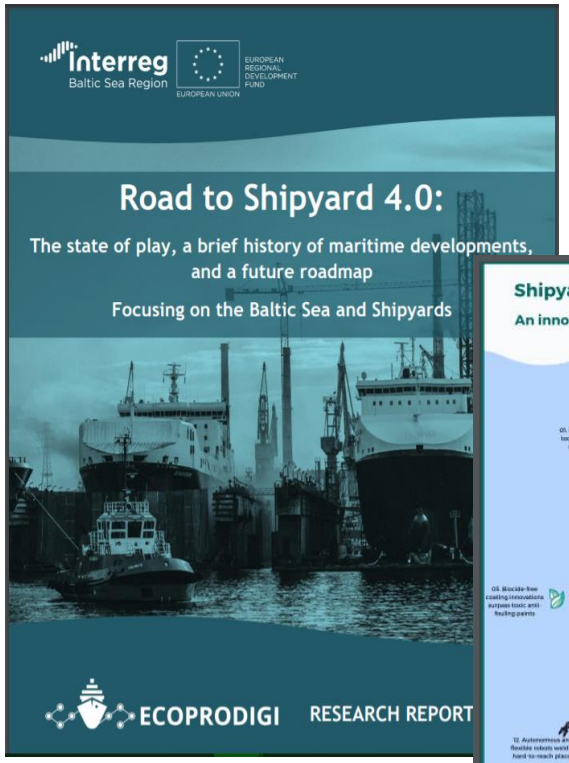
135+ Innovation concepts:
Technologies that will impact the maritime & offshore economies and when

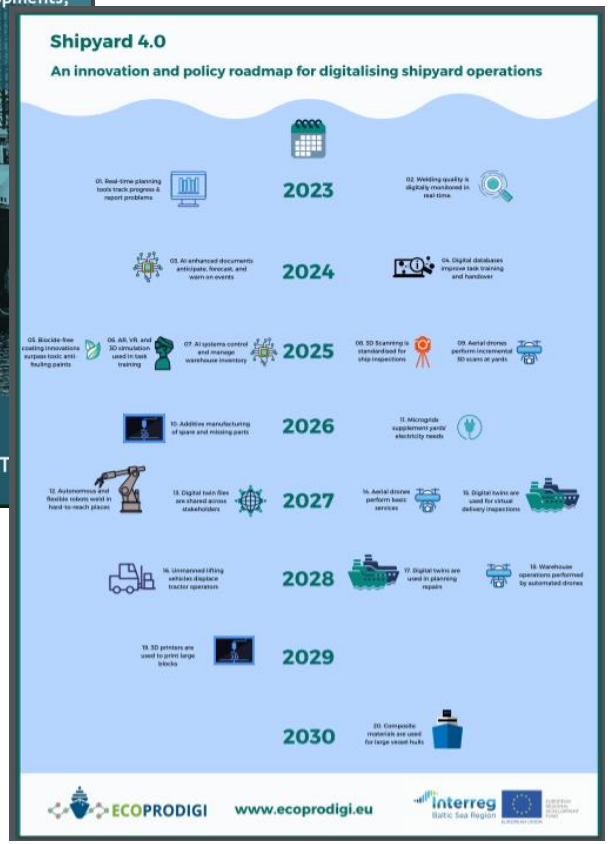
miro

Interreg North Sea Region European Regional Development Fund EUROPEAN UNION

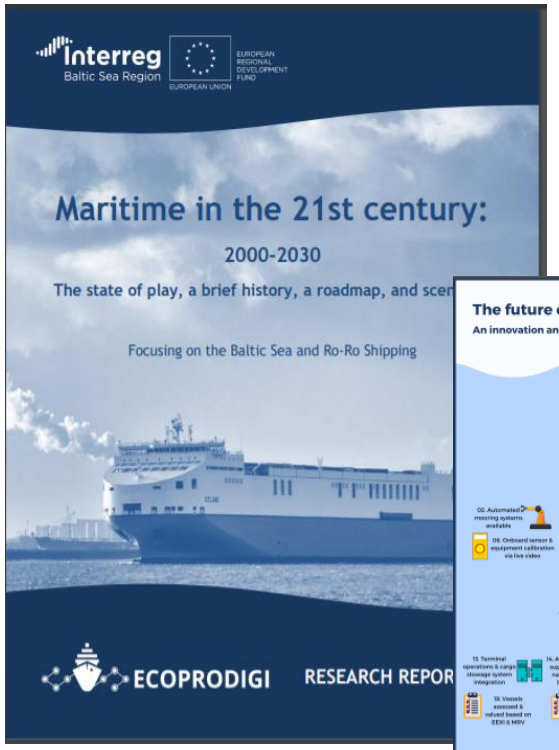
RUG

ROADMAP TO SHIPYARD 4.0





ROADMAP INTEGRATED SHIP OPERATIONS



ECOPRODIGI

RADAR THEMES

- Maritime
- Ports
- Shipyards
- Offshore wind
- Other infrastructure

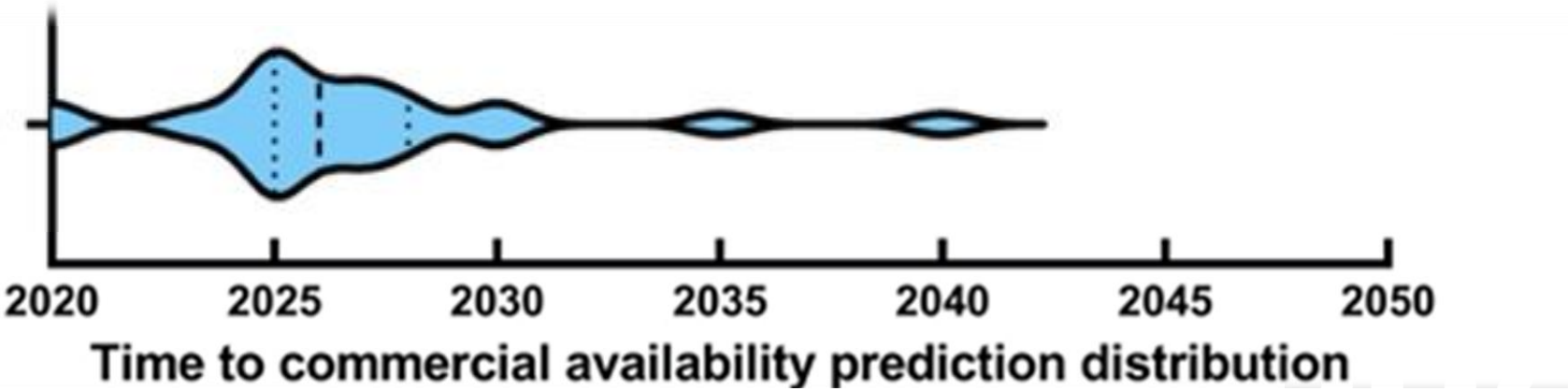
- Autonomous systems
- Circularity
- Construction
- Decomissioning
- Digitalization
- Drones and robotics
- Maintenance and repair
- Multi-use platforms
- Ocean energy
- Policy, standards, and regulations
- Process optimization

INTERNATIONAL MRV: CENTRALIZED DATA REPOSITORY FOR FLEET

Maritime transport emits around 940 million tonnes of CO2 annually and is responsible for about 2.5% of global greenhouse gas (GHG) emissions. Establishing a central data warehouse would require a standardization of the digital data file formats that national regulatory bodies can agree to. In turn, this can inform efforts to develop maritime carbon and emission trading schemes.

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2026	2025	July/2027	Dec/2031	8%	13%

A central data repository is established to monitor global ship performance data



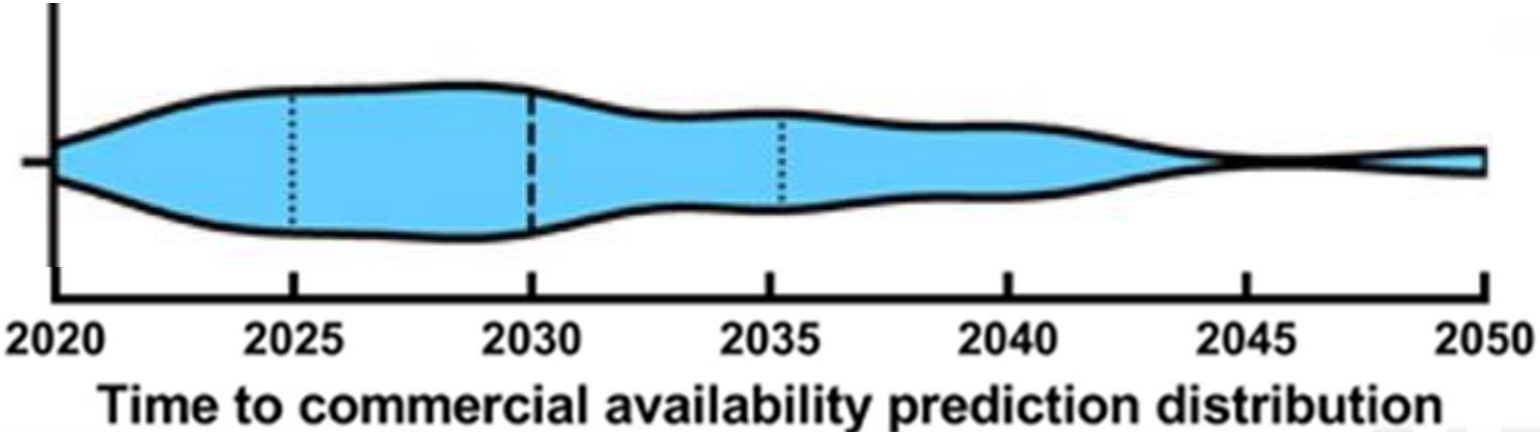
NOVEMBER, 2020

COMPOSITE BULK CARRIER HULL

Fires and explosions are the third largest cause of vessel casualties and have resulted in 112 large vessel losses during the past decade. A single loss could see damages in excess of $1bn. Although steel does not burn, it is a good conductor of heat and therefore spreads fire to adjacent compartments. Composite materials are of low density, low weight, high strength, are non-heat conductive, and highly resistant to corrosion and fire…

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2030	2030/2035	Jan/2032	Feb/2039	0%	0%

A large bulk carrier is built with a fire-proof composite hull

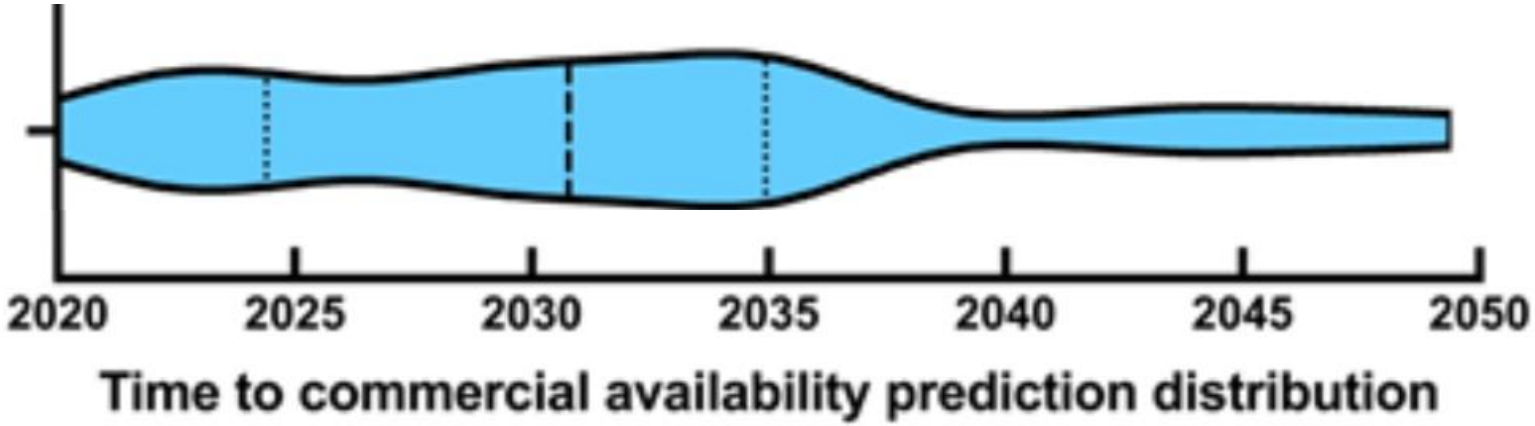


3D PRINTING TURBINE BLADES

Between 2020 and 2030, it has been forecasted that approximately 4,091 offshore turbines will be installed throughout all of Europe. [1] Counting the modern standard design of 3 blades each, we can anticipate that 12,273 turbine blades are needed. Transport of blades can amount to 20% of development costs…

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2031	2035	Jan/2033	Mar/2041	0%	10%

Turbine blades are 3D printed offshore at the sites of wind park development projects



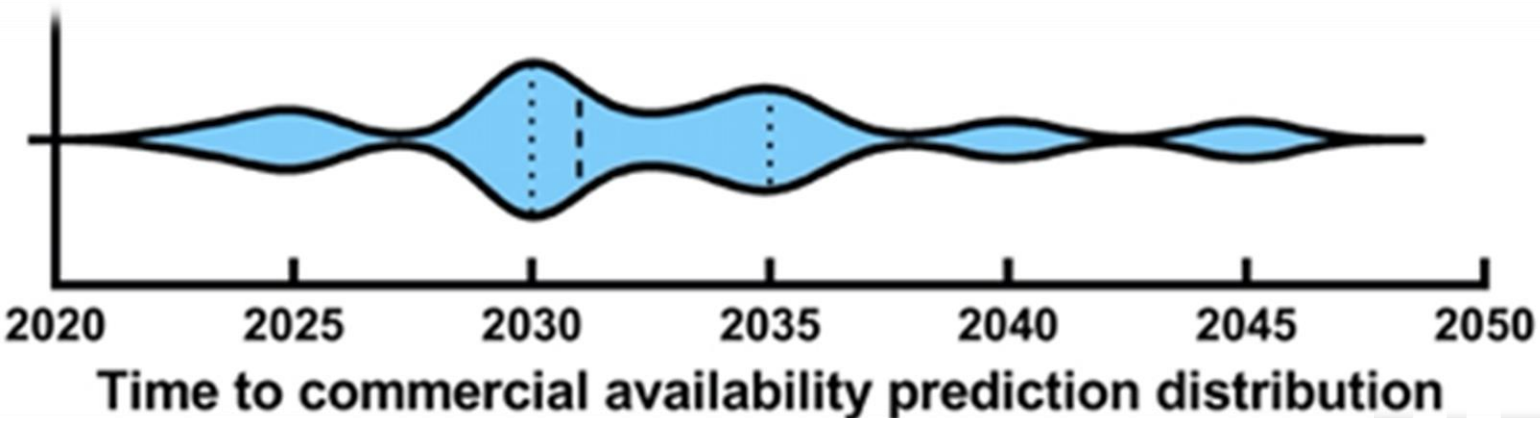
Time to commercial availability prediction distribution

RENEWABLE METHANOL TO POWER OCEAN GOING VESSELS

Ambitions for zero emission maritime operations by 2030 require new power sources. Renewable methanol is produced from an electrolysis process, powered from a renewable energy source. The process combines hydrogen with CO2 captured from the air or the emissions from an industry, making it carbon neutral.[1]…

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2031	2030	Jun/2033	Mar/2039	0%	0%

Renewable methanol is used as a fuel for powering long-distance ocean-going vessels

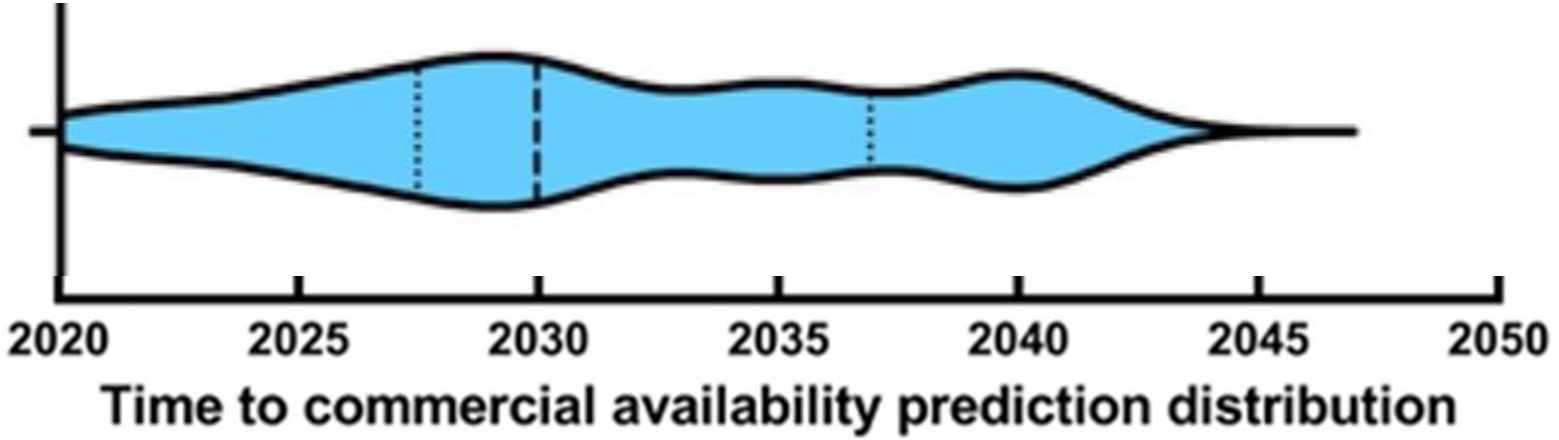


MICROGRIDS AT LARGE PORTS

Ports are the sites of major pollution, where large vessels continue to run their engines even while at berth, and heavy-lifting work is being performed by diesel-powered cranes. As the maritime industry explores ways to decarbonize, microgrids that at ports can play a supplementary role to existing electric grids with an enhanced energy storage systems…

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2030	2030 (2040)	Jul/2032	Aug/2038	0%	0%

Microgrids are retrofitted into large ports

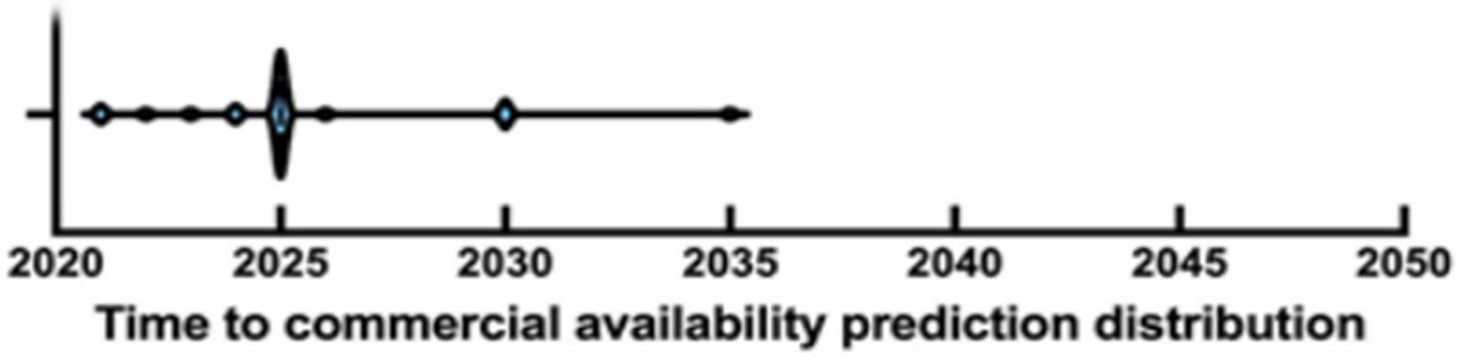


CONTRACTS THAT INCENTIVIZE MINIMUM TIME AT PORT

When at port, ships keep their auxiliary engines running for electricity, resulting in unnecessary emission of pollutants and over $18bn in fuel waste.[1] Estimates suggest that an eight-hour stay at port can emit 2.5 tonnes of pollutants.[2] Waiting time at ports increases when ships fail to arrive on schedule, causing systemic delays for other inbound vessels, trucks, and trains.[1] While penalties exist for late arrivals, there is little incentive for the port to process cargo faster...

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2025	2025	Apr/2026	Apr/2029	0%	0%

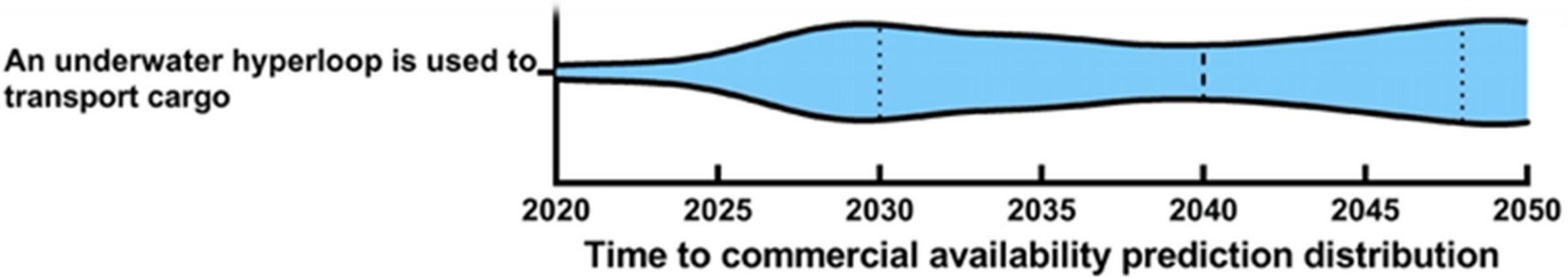
Contracts between ports and shipping companies are designed to minimize time at port



CARGO HYPERLOOP

Hyperloop proposes using magnetized tracks to move goods friction-free through a vacuum-sealed tunnel. The speeds in these systems are aiming to reach 1,000 kilometers per hour.[1,2,3] hyperloop runs on electricity, and when powered by renewable energy, will contribute to advancing the decarbonization of transport…

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2040	2050	Jul/2039	Aug/2048	0%	4%

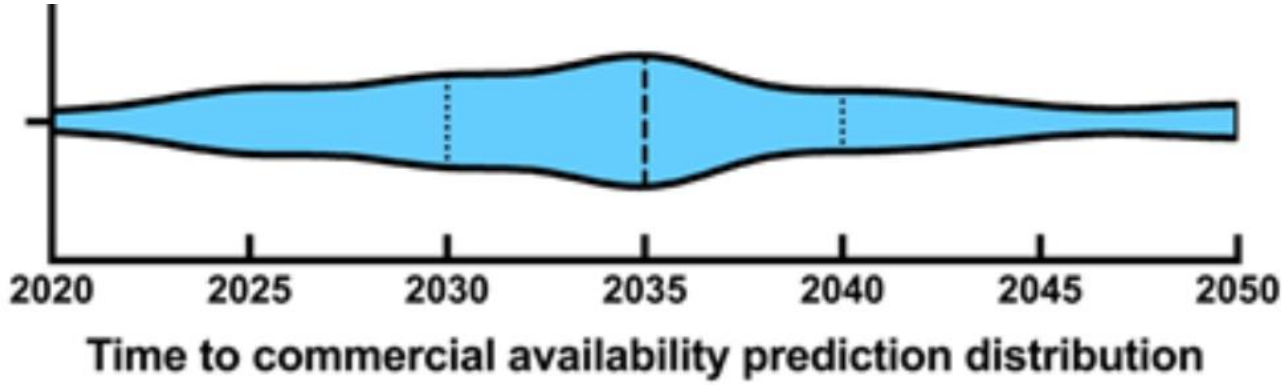


OFFSHORE WIND KITE FARMS

At higher altitudes, the wind blows stronger and more consistently. Whereas windmills have yet to exceed 200m in height, wind kites are reaching 800m in the air. To produce energy from wind kites, the rope is connected to a generator on the ground or surface of the water. The kite then deflates as a motor reels in the kite closer and the process is repeated…

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2035	2035	Mar/2035	Dec/2042	3%	14%

Offshore wind kite farms become a viable alternative to offshore windmills



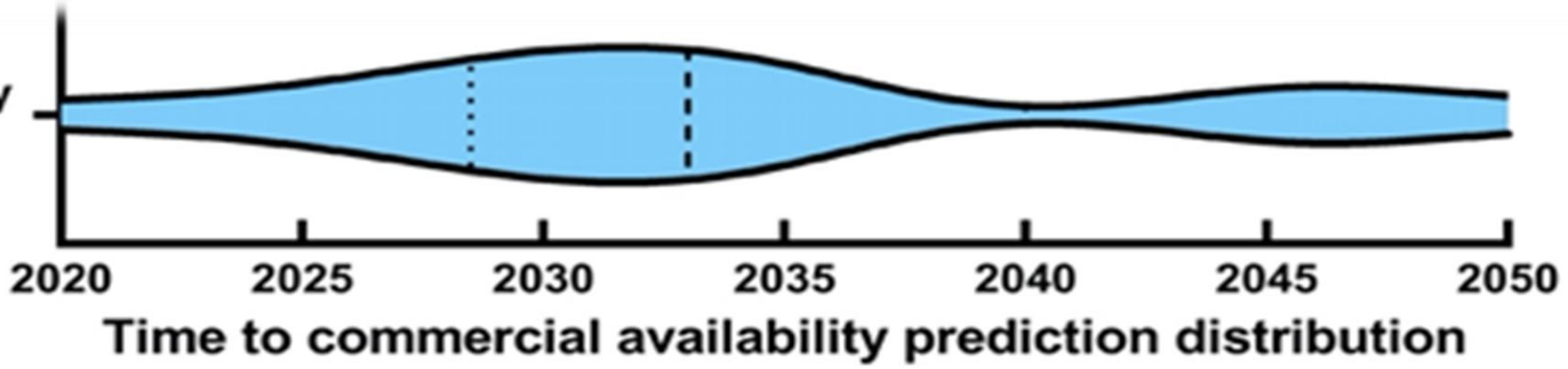
Time to commercial availability prediction distribution

AUTONOMOUS CONTAINERS

In 2019, the containerized shipping industry will have transported over 800 million TEU, generating earnings in excess of $25bn.[1] These containers arrive in ports on container ships, where they face an immediate bottleneck as they are unloaded…

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2033	2030	Aug/2034	Mar/2043	5%	32%

Containers navigate autonomously from the sea to their final destination



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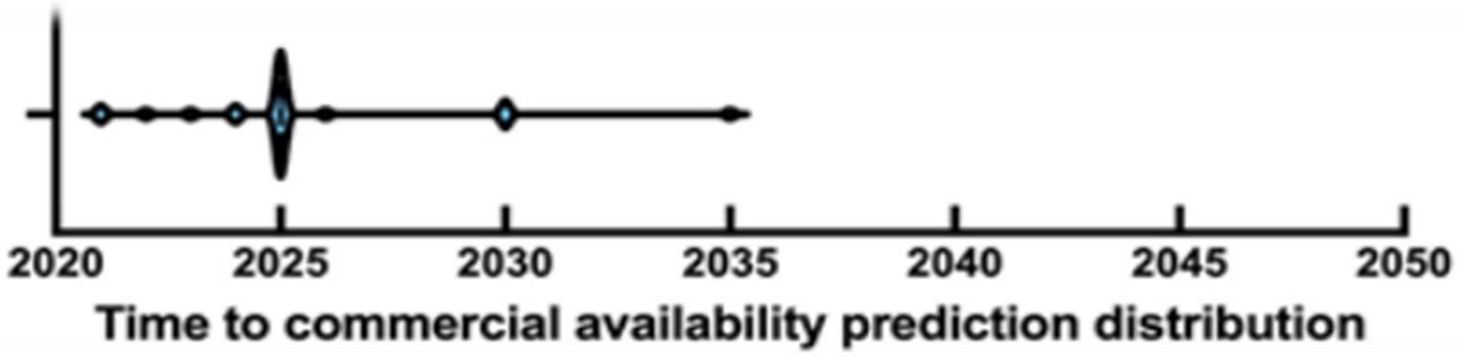
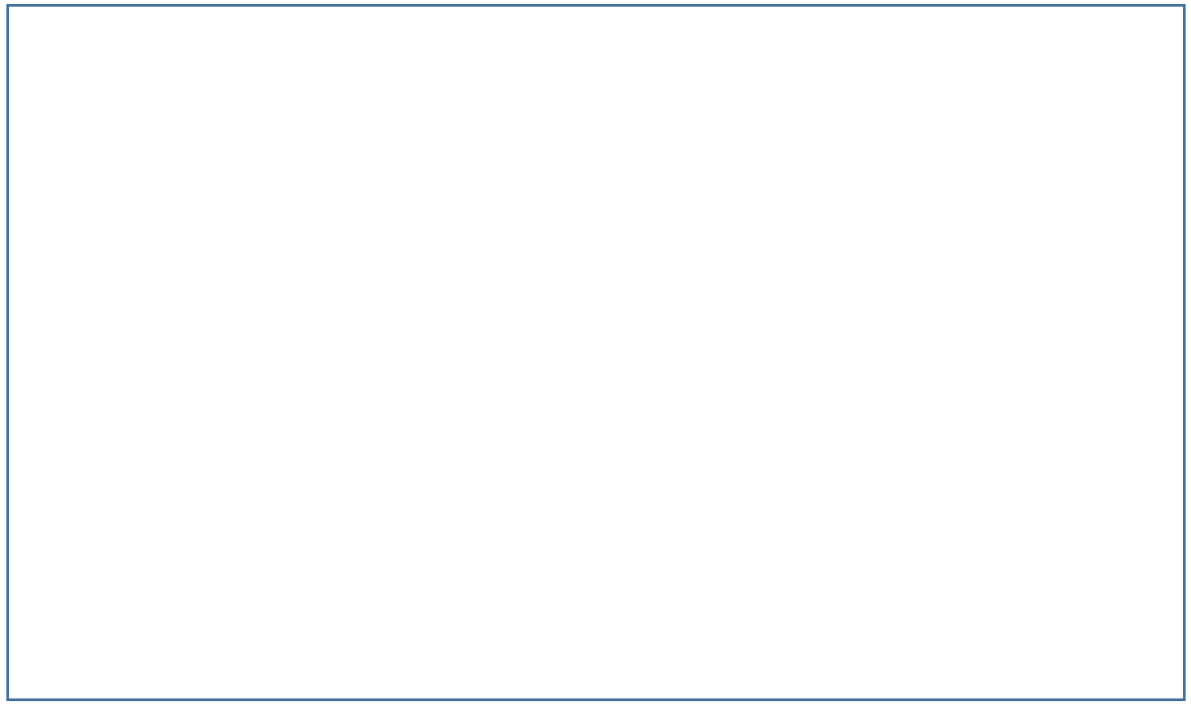
Contracts between ports and shipping companies are designed to minimize time at port



How many years from now, will we have a commercial vessel sailing on a molten salt thorium reactor??



DECEMBER, 2021

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A FEW WORDS OF CAUTION

1. Forecasts are not the end, but a beginning
2. Just becasue many believe it to be true, it does not make it so
3. Innovators and organizations need to preserve optionality
4. Innovations do not happen by themselves

Interreg
North Sea Region
PERISCOPE
European Regional Development Fund

EUROPEAN UNION

…to establish a permanent strategic foresight platform for blue growth

1

…catalyze innovation actions through an open entrepreneurial discovery process

2

…facilitate trans-regional collaboration on industrial development projects

3

Matthew Spaniol
matt@ruc.dk

Thank you

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When will it become accepted practice that wind turbine blades will be 3D printed offshore, at the sites of wind park development projects?

2022

Go to **www.menti.com** and use the code **1119 2467**

When will retrofitting kits for terminal tractors be commercially available?

2022

Go to **www.menti.com** and use the code **1119 2467**

When will 3D printing be automated - including material supply, removing products, and quality control?