STEP CHANGE IN INSTALLING WINDFARMS

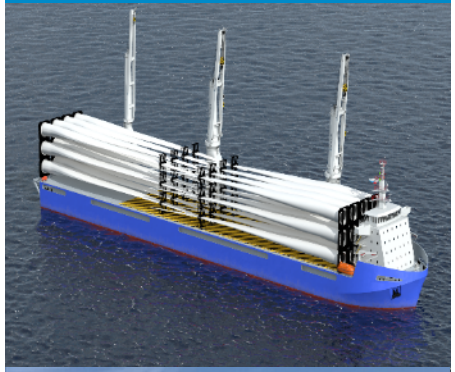
WINDFARM INSTALLATION VESSEL (**WIV**), AN INTEGRATED SOLUTION FOR LARGE OFFSHORE WINDFARMS - SLASHING INSTALLATION TIME, COSTS AND EMISSIONS

JUNE, 2021

Huisman
Equipped for impact

HUISMAN

PRESENCE IN OFFSHORE WIND

Port	Transportation	Installation MPs	Installation WTGs
	 		

offering: cranes, wind tools, motion compensated solutions, digitalisation & robotics and world wide service

Huisman

Wind Turbine Shuttle

Wind Turbine Shuttle (WTS)

- Designed a decade ago (2009)
- Fast sailing SWATH vessel
- 3D motion compensation technology

- WTG is assembled in harbour
- Able to transport and install two complete WTG's (**Max. 10MW**)

Picking up WTGs in harbour

CHALLENGES AHEAD

CALL FOR STEP CHANGE IN INSTALLING WINDFARMS

- ✓ **Amount of offshore WTG's** to be installed is growing exponentially
- ✓ WTG's and foundations are **increasing in size**
  - ✓ Growing mass WTG components, hub height & length of blades
  - ✓ Growing length and mass of monopiles
- ✓ **Floating wind** expected to ramp up to ~1GW by 2025 and ~30GW by 2035
- ✓ **Workability** current installation vessels
- ✓ **Reducing CO_2** footprint
- ✓ Limited capable **Marshall ports**
- ✓ Current offshore **safety challenges**

Link to movie:
https://vimeo.com/563687512/6792b555c5

Nacelle installation

- View on top of tower
- Tower movement caused by waves on monopile

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New cost effective installation vessel: Windfarm Installation Vessel (WIV)

- Able to install monopiles & WTG's on bottom fixed and floating foundations
- High workability (>90%)
- Increased safety during operations
- Feeder vessels sail directly from manufacturers sites to WIV (port independent)

Installation of 120-150 WTG's + foundations (~2GW) per year

>50% CO_2 reduction per windfarm installation

>30% cost reduction per windfarm installation

WINDFARM INSTALLATION VESSEL

AN INTEGRATED APPROACH TO WINDFARM INSTALLATION

‘Floating Factory’ for windfarms

- A large stable semi-submersible vessel
- Dynamic positioning
- Methanol fueled

- For WTGs up to 20MW

- Dedicated installation tower with manipulators and 3D motion compensated trolleys (no swinging crane hooks)

- 3,000t, 3D motion compensated, knuckle boom crane for loading WTG components from feeder vessels

Link to animation:
https://vimeo.com/555065079/95dc41c104

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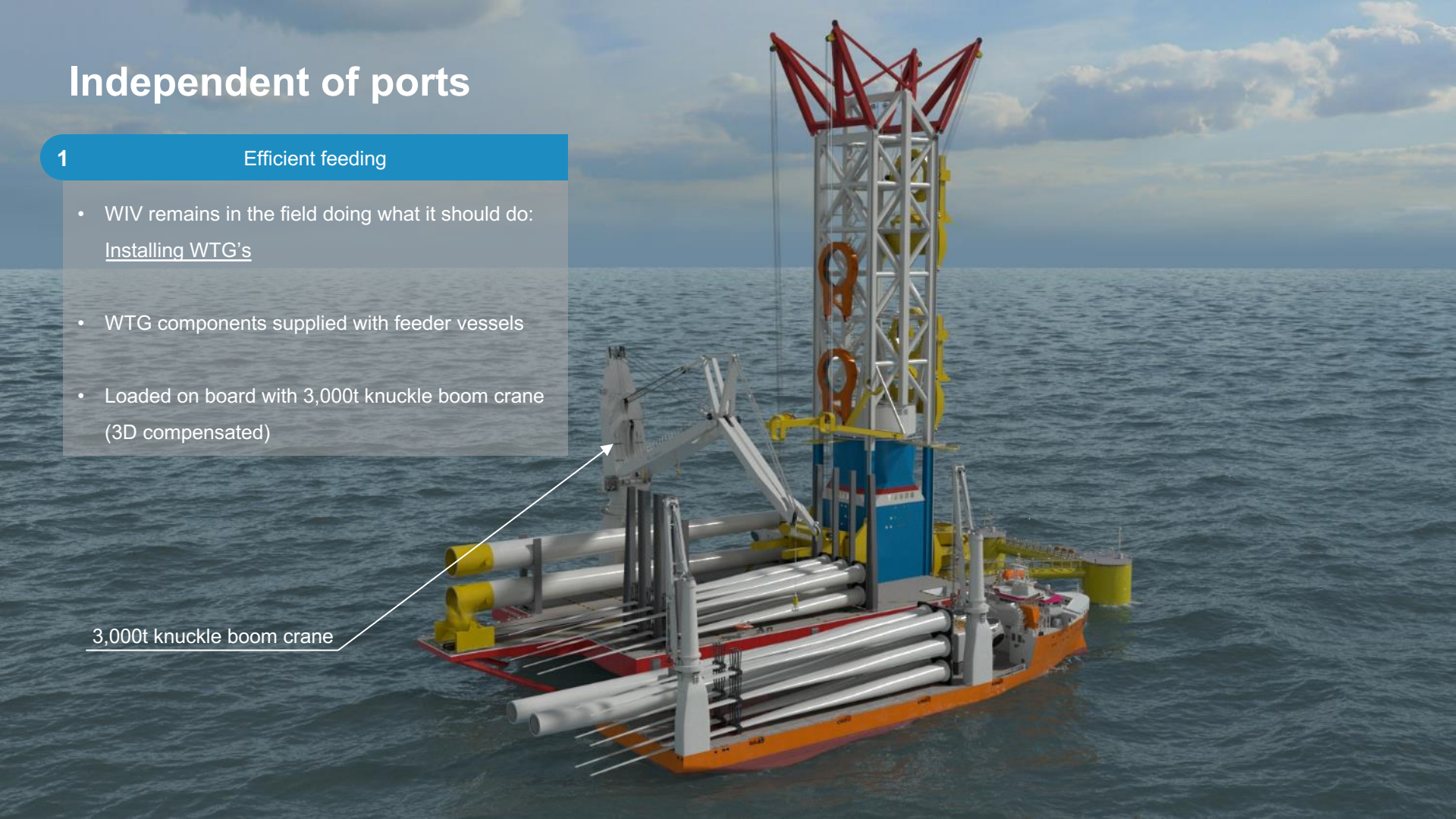
Independent of ports

1 Efficient feeding

- WIV remains in the field doing what it should do: Installing WTG's
- WTG components supplied with feeder vessels
- Loaded on board with 3,000t knuckle boom crane (3D compensated)



Highly efficient on board assembly of new generation WTG’s

2 Offline on board WTG assembly

- Dedicated rotating assembly & installation tower
- Outfitted with manipulators and trolleys for safe handling WTG components (no swinging crane hooks)
- Four workstations for assembling and installing WTG’s simultaneously

Height above deck: 180m

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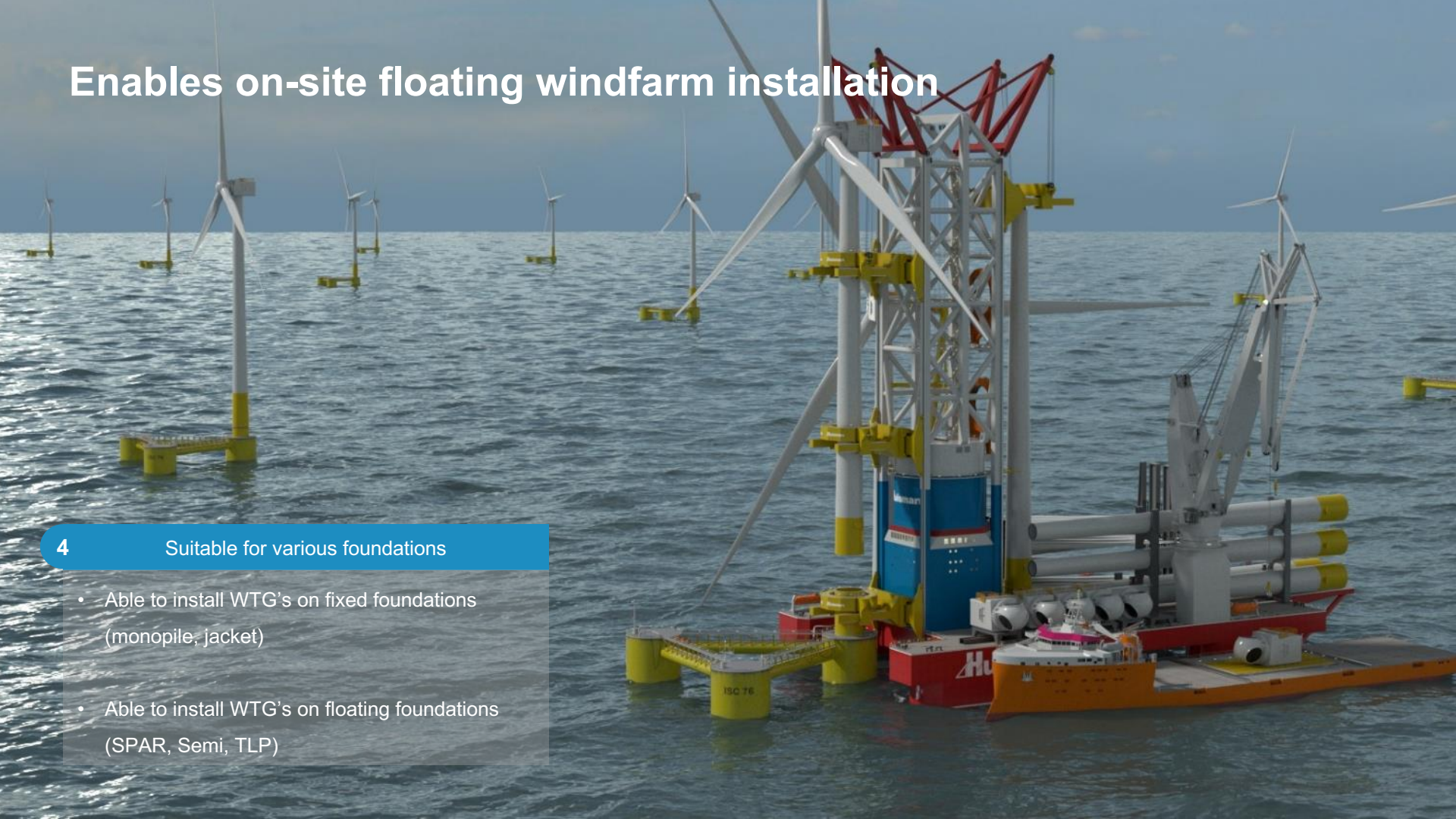
Safe and efficient installation of WTG’s

3 Motion compensated WTG installation

- Dedicated slip joint connection between foundation and WTG
- Two trolleys compensated the WTG
- One trolley clamps onto the foundation
- Installs on **<u>average 1 WTG per day</u>**

Enables on-site floating windfarm installation



4 Suitable for various foundations

- Able to install WTG’s on fixed foundations (monopile, jacket)
- Able to install WTG’s on floating foundations (SPAR, Semi, TLP)

And the other way around…

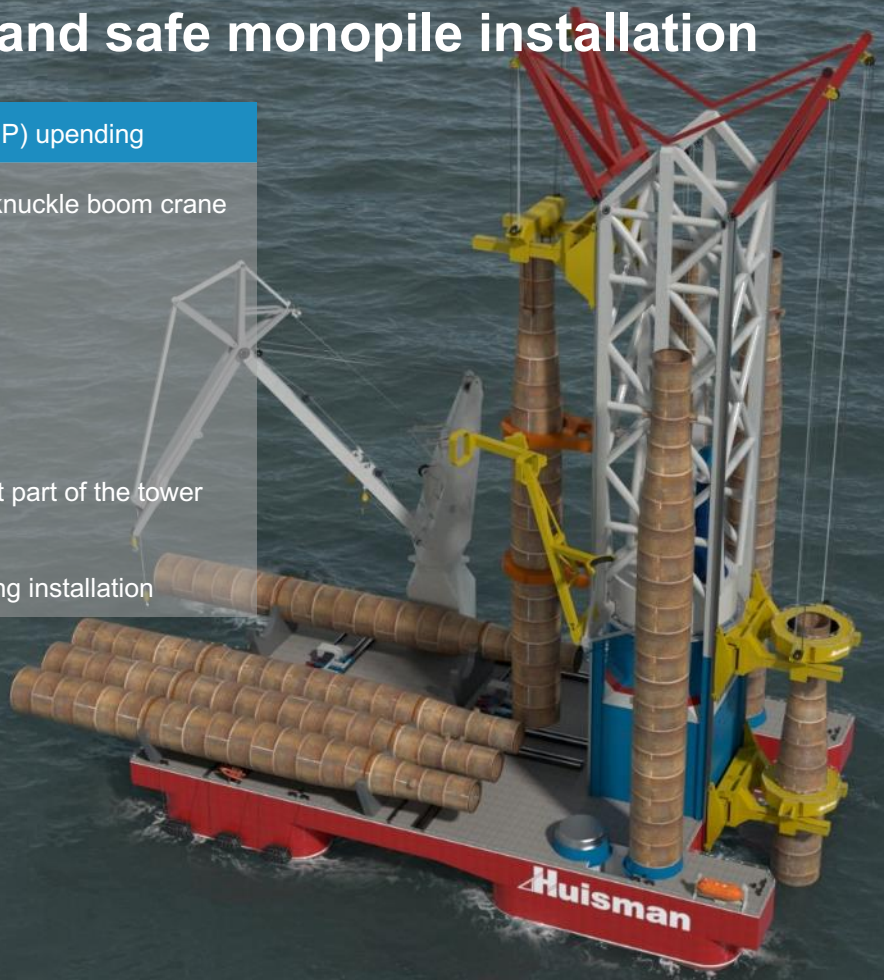
5 On-site WTG major component exchange

- With the reverse process a WTG can be taken back on board
- Once on board, major component exchange can be done safely and efficient

Enables fast and safe monopile installation

6 Offline monopile (MP) upending

- MP loading with 3,000t knuckle boom crane (3D compensated)
- Transport of 11 MP's (vertical and horizontal)
- Upending MP's at the aft part of the tower
- Full control of MP's during installation



7 Monopile (MP) installation

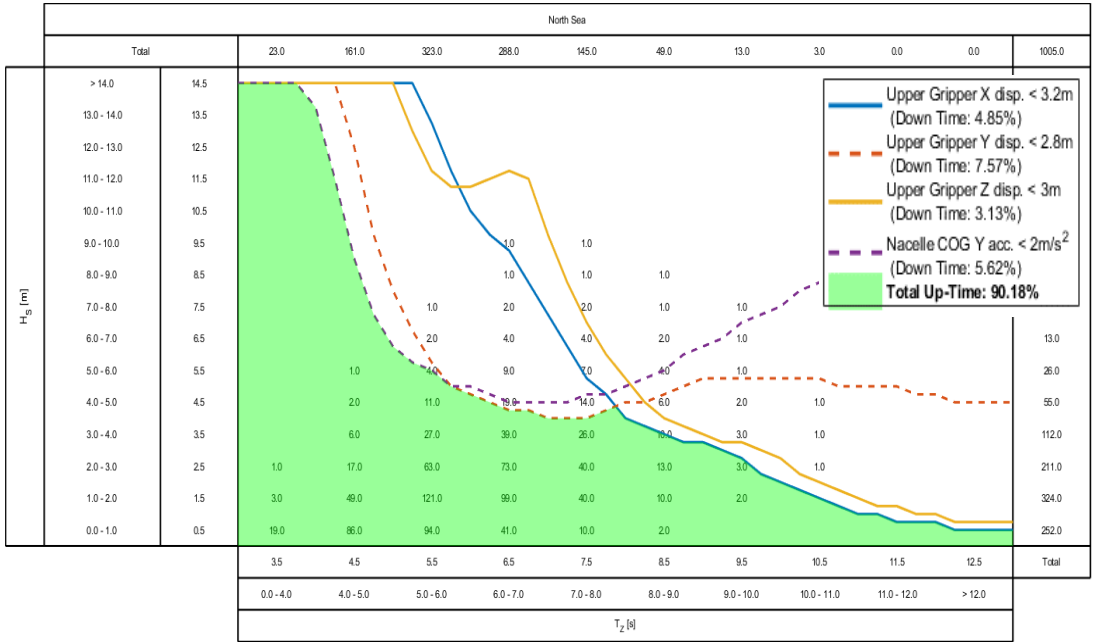
- Installing MP's at the front part of the tower with motion compensation
- Installs on **average 2 MP's per day**

WINDFARM INSTALLATION VESSEL

HIGH WORKABILITY → HIGH PREDICTABILITY

- ✓ WIV average year around **workability of 94% in North Sea**

  (all headings)



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Proven Huisman technologies

Rope luffing boom crane

Capacity 1000mt
Wire rope Ø109mm x 6000m

Motion Compensated Gripper

Max. dimensions pile Ø12m x 120m
Max. mass 2500mt

World's largest slew bearing

Slew bearing Ø30m

Line up tool J-lay tower

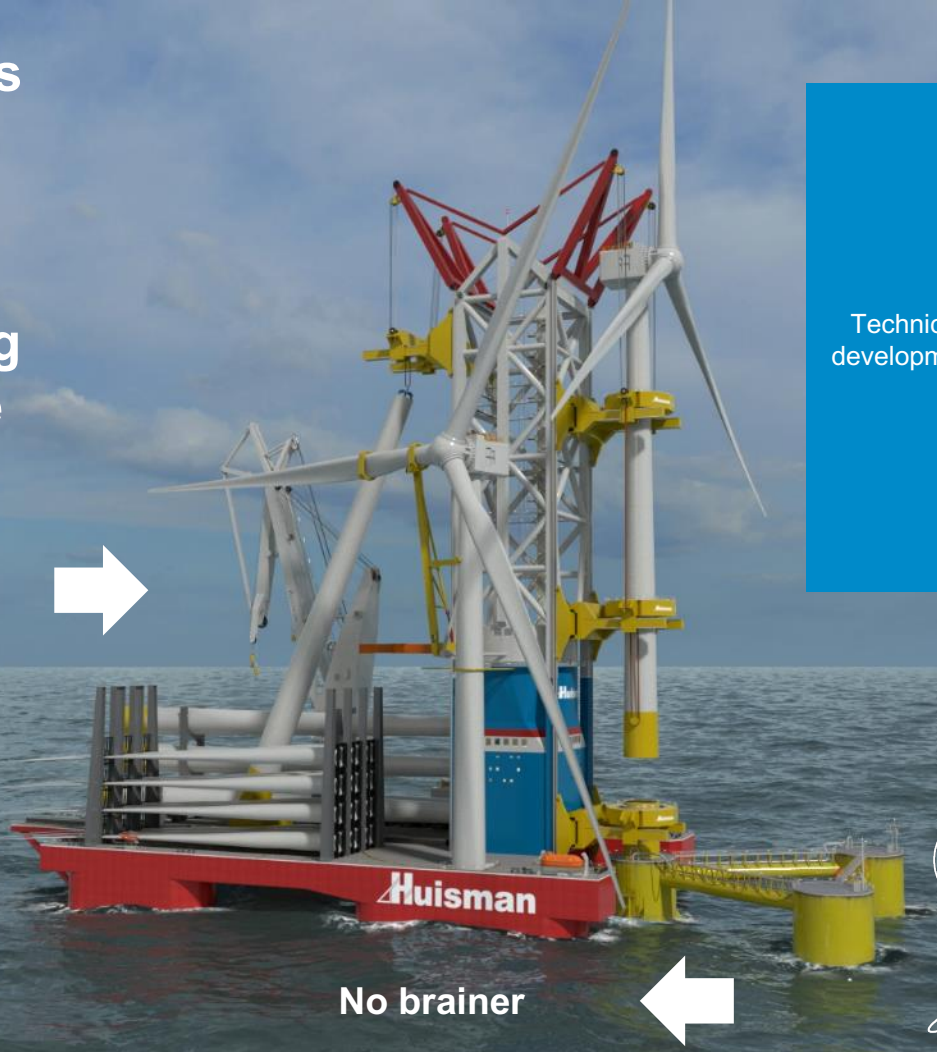
Capacity 70mt

No rocket science

Current status

Understanding the challenge

+



No brainer

Technical development

Offshore wind developer

Supply chain

Potential WIV owner

Lower LCOE

Lower CO_2 emissions

Increased safety

Equipped for impact.