

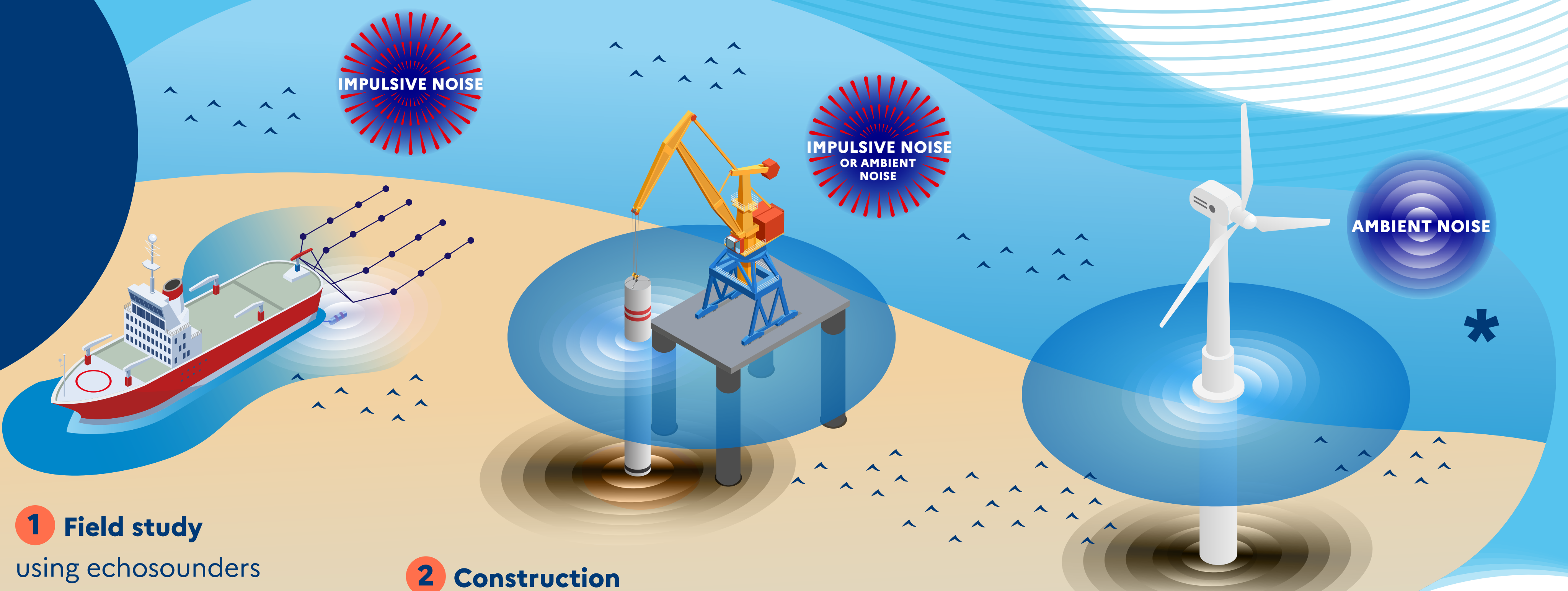
GOUVERNEMENT

Liberté  
Égalité  
Fraternité

# UNDERWATER NOISE

## FROM OFFSHORE WIND TURBINES

### SOURCES

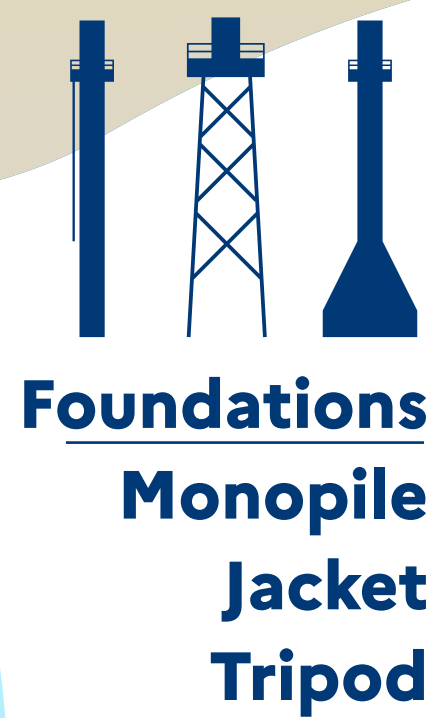


\* Also applicable to floating wind turbines

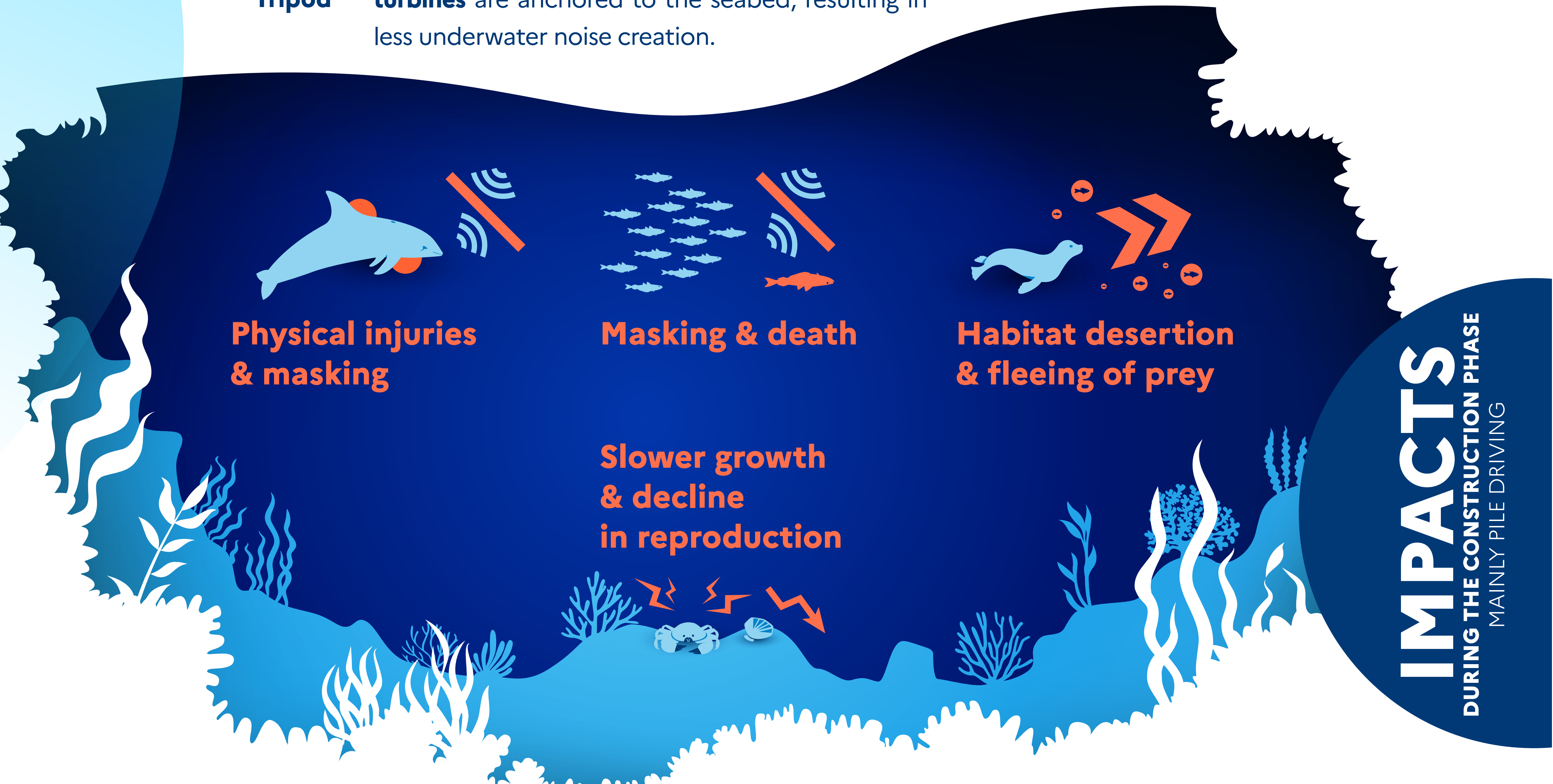
**1 Field study**  
using echosounders or air guns.

**2 Construction**  
**Monopile** and **jacket** foundations are made by **pile driving** into loose substrates using a hydraulic hammer, or by **drilling** in the case of rocky seabeds. The **tripod** foundation, which is less noisy, is simply placed on the surface of the seabed. Other works (setting up of cables – preparing the substrate) can also create noise. **Floating wind turbines** are anchored to the seabed, resulting in less underwater noise creation.

**3 Operational**  
The vibrations created by operating the wind turbine are spread via the mast into the water. The noise generated depends on the type of foundation, the wind speed and the power of the turbine.



**Foundations**  
**Monopile**  
**Jacket**  
**Tripod**



**Physical injuries & masking**

**Masking & death**

**Habitat desertion & fleeing of prey**

**Slower growth & decline in reproduction**

**IMPACTS**  
DURING THE CONSTRUCTION PHASE  
MAINLY PILE DRIVING

The impact is amplified depending on how close the individual is to the noise source.

# SOLUTIONS

**Vibratory driving**  
 Consists in driving piles using an oscillation/vibration technique. Reduces pile-driving time but remains noisier than drilling.

**Bubble curtain**  
 Air is injected into perforated pipes, as it escapes it forms a cloud of bubbles that attenuate sound waves.

**Hydro Sound Damper**  
 A net fitted with many air-filled elements, which is less affected by currents than bubble curtains, is placed around the noise source.

**Cofferdam**  
 A double steel wall, isolated inside by an air space and bubble curtain, is used to confine the noise source (pile being driven).

**Acoustic resonator (AdBm technique)**  
 The noise source (pile being driven) is confined by a circular shield made up of many blocks that resonate together.



## MOBILISATION OF STAKEHOLDERS

In France, wind power planning, integrated in the Multiannual Energy Programme, builds upon the **sea basin strategy documents** that were approved in autumn 2019. In this framework, the consideration of **landscape and biodiversity criteria** is a government priority. Moreover, in early 2021 an **"ECUME" workgroup** was assigned the task of determining the cumulative effects of such projects on marine biodiversity.

On an international level, several countries have imposed national **impact reduction measures** during the phase of setting up offshore wind turbine worksites (see the non-exhaustive table below). Germany and the United States have also implemented regulatory requirements regarding **threshold noise limits not to be exceeded** together with mandatory noise attenuation measures during this phase.

Impact reduction measures	France	Germany	United Kingdom	Netherlands	United States
Starting works gradually to avoid individuals being too close (Soft Start)	✓	✓	✓	✓	✓
Observation of marine mammals	✓	✓	✓	✓	✓
Passive acoustic monitoring	✓	✓	✓	✓	✓
Spatial and temporal planning of worksites	✓	✓	✓	✓	✓
Marine mammal deterrent devices	✓	✓	✓	✓	✓

Currently being developed!

The **SubSea Quieter®** is a noise and turbidity confinement system suitable for wind turbine facilities that is based on an innovative multi-layer membrane. It provides a good cost/benefit ratio, is very simple to use and is more effective than bubble curtains even in difficult conditions (currents, swell ...). It will be used during port infrastructure works planned for 2022 in the framework of a European LIFE project and on a first offshore wind farm in 2024.

