• Question 2.6: New impacts that are not yet scientifically known are being addressed (Paper C3-10924). What other new impacts are being addressed that are not yet scientifically known? What assessment methods and studies are being used and explained to stakeholders?

In the marine environment where interconnections and electrical connections with offshore wind farms are being developed, potential temporary impacts are related to noise generated by the works, possible release of contaminants, modification of the substrate (seabed) and turbidity (Figure 1).
The potential permanent impacts are related to electric and magnetic fields, temperature and the reef effect. These are subject to many uncertainties, although scientific knowledge is progressing. Disturbance depends on the location of the electric cable: in the water column (dynamic cable for floating wind farm connections for producers), on the seabed (laid and protected cable) and in the seabed sediment (buried cable).

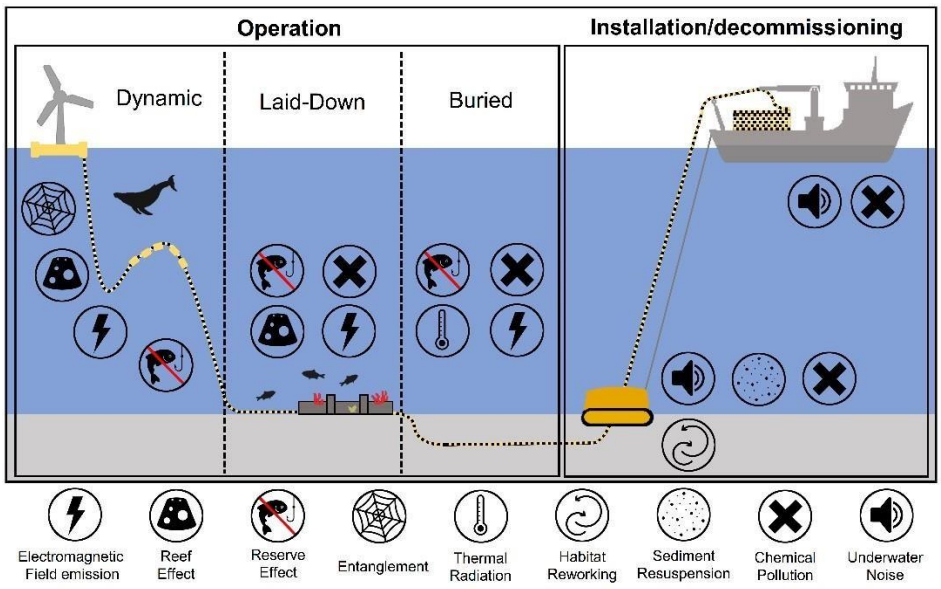

Figure 1 : Diagram of the potential effects caused by different types of SPC immersion (Dynamic, Laid-Down and Buried) during their operation and installation/ decommissioning phases [1].

In 2019, a summary of knowledge has been highlighted that the ecological impacts of submarine power cables relate to the classic environmental issues inherent in any artificial structure installed on the seabed with a modification of the natural substratum, for which there is a generally significant scientific hindsight, as well as to more novel issues related to the passage of electric current in the cables (electromagnetic fields; heating), which received much less attention until the 2000s [2]. No impacts were found to be high.

The impacts considered negligible are : the modification of the temperature in the vicinity of the cable on the organisms and ecosystems considered, mainly because of the very localised

nature of this effect, and as long as the sediment is permeable ; the modification of the nature of the bottom, turbidity, hydro-sedimentary dynamics, seawater and sediment chemistry.

The impact considered to be medium with a medium degree of uncertainty is modification of the electromagnetic field with respect to sensitive migratory species and elasmobranchs for a cable not embedded in water. In the case of a dynamic cable, the level of uncertainty is considered high.

During the construction phase (between two and four months), the impact of the reworking of the substrate on benthic organisms (benthos) is considered to be low because the majority of benthic habitats and species recover relatively easily. Indeed, the soft bottoms are populated by resilient invertebrate species with a short life cycle. However, some benthic species and habitats are more vulnerable because of their low resilience, such as *Posidonia* meadows, and because they support essential ecological functions (e.g. nursery areas, where juveniles of a fish species feed and grow). These areas must be avoided.
During this phase, the uncertainties (considered to be medium) concern the impact of anthropogenic noise on the benthos and on fish species.

Effects from the restriction of uses (reserve effect) and the creation of artificial structures (reef effect) above the cable are also likely to have impacts. However, in contrast to those described above, these could potentially lead to an improvement in the ecosystem by accommodating a greater diversity of species. The reserve effect would result in a reduction in the removal of marine species and associated effects on habitats and the reef effect is likely to alter the composition of the benthic community in the vicinity of the power cable compared to the baseline. These two potentially positive impacts are considered to be medium with a medium degree of uncertainty.

Uncertainties are heightening the perceptions of risk [3]. Each research that are lowering risk decrease uncertainty so there is a need to inform stakeholders in the consenting processes for marine renewable energy development.
The more standardized methodologies will be developed, the more comparisons between projects and natural habitats will be possible. This will give more confidence in measurements. For now, before and after electric cable installation ecological assessment are done (like on benthic communities on soft or rocky substrates, sediment quality…). That is an important step. The bigger one, is to do long term ecological assessment in cooperation with academic researchers.

[1] B. Taormina, J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, A. Carlier, “A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions” (Renewable and Sustainable Energy Reviews, 96, p. 380–391, 2018).

[2] J. Alemany, C. Vogel, A. Carlier, ‘Synthèse des connaissances sur les impacts des câbles électriques sous-marins : phase de travaux et d’exploitation – Etude du compartiment benthique et des ressources halieutiques’, (rapport IFREMER, 2019).

[3] Copping A. E., Freeman M. C., Gorton A. M. & Hemery L. G. (2020b) Risk retirement-decreasing uncertainty and informing consenting processes for marine renewable energy development. Journal of Marine Science and Engineering, Vol. 8, pp. 1-22, https://doi.org/10.3390/jmse8030172