DMEC Dutch Marine Energy Centre

Environmental impact tools

Why do we need environmental impact tools?

> **For marine energy technologies to be truly sustainable, they should have no significant impact on the environment. However, any structure extracting energy from the environment will have some level of impact. Hence, any technology that is moving to the operational environment (i.e. the water) is required to obtain specific permits and licences based on environmental legislation.**

Today, demands in legislation and permits are not straightforward and are open to different interpretations. The main problem is the absence of a generally agreed set of standards and analytic methodologies to assess and evaluate environmental impact of marine energy technologies. Basically, it is not known which data/evidence a technology developer should deliver in order to prove that the environmental impact of the technology is within acceptable limits.

The knowledge base regarding environmental impact of marine energy technologies is fragmented. Therefore, active collaboration and knowledge transfer from academia to the end users (i.e. technology developers as well as the political bodies responsible for evaluating new technologies) is needed.

The DMEC approach

Within DMEC we are developing a set of tools intended to identify and quantify environmental effects. Some tools are primarily intended to **transfer existing knowledge** regarding the environmental impact of marine energy technologies into operational frameworks. Other tools develop **new knowledge** in specific areas where the current level of science is insufficient to assess and mitigate effects.

Translate existing knowledge

To evaluate the environmental impact of a certain technology, three aspects should be assessed:

I. The environmental **stressors**, i.e. factors that can impose stress on the environment. This can comprise effects of structures, effect of moving parts, effects on water chemistry (including effect on the distribution of fresh water and salt water), electromagnetic effects and noise effects;
II. The environmental **receptors**, or the components of the ecosystem that are subjected to impacts. This can involve effects on the physical environment, effects on groups of organisms (invertebrates, fish, mammals, birds) and effects on ecological interactions. Effects can be either near-field (e.g. the direct impact of turbines on passing fish or marine mammals), or they can be far-field (e.g. effects on exchange volumes of water, affecting the tidal movement in semi-enclosed systems or effects such as blocking of major migratory routes).
III. **Cumulative effects.** Generally impacts on the environment always have to be evaluated against other human activities in the field.

Many of these processes and elements have been researched extensively. The main challenge is to apply existing knowledge to develop a generally agreed balance between sufficient safeguards against environmental damage vs. degrees of freedom to research and develop marine energy technologies.

Develop new knowledge

Although marine energy is 'clean' in the sense that it does not emit greenhouse gasses, there are still environmental risks that need to be addressed. Fundamental knowledge gaps can lead to environmental target setting by authorities based on worst-case scenarios. These often indicate unrealistically high impacts, and consequently may lead to a refusal of permits.

One issue is the behaviour of fish in the vicinity of moving objects, such as turbines. Currently models are used that assume fish to be totally passive. In reality, many fish can react to various environmental cues, affecting the probability that they are hit by turbine blades. We are developing technologies that can observe and quantify fish behaviour in the vicinity of turbines in the field. Fish can also react to sound. Research has been conducted on extreme noise pollution, such as that resulting from pile driving. However, the effect of sustained (additional) noise in a relatively noisy environment is unknown.

Together with all actors involved, we will fill the knowledge gaps linked to environmental impacts, aiming to develop standardised methods to be used in permitting and licensing of marine energy technologies. The ultimate aim is to develop procedures that enable new technologies to reach the market, while optimally safeguarding the environment.

Which DMEC-partner can do what?

NIOZ
NIOZ conducts fundamental research on seas, oceans and estuaries. Typically, their marine energy research relates to the assessment and quantification of environmental effects. NIOZ has extensive facilities for in situ measurements and field observations.

Wageningen Marine Research
Wageningen Marine Research (WMR) is an applied marine research institute, with a focus on marine, brackish and freshwater ecosystems. WMR has extensive experience in environmental impact studies, generally with a focus on fish, birds and marine mammals. In collaboration with DMEC, WMR developed the DIDSON camera. This is a tool that allows observation of fish behaviour in turbid conditions, such as seen in the vicinity of a tidal turbine.

TNO
TNO is an independent research organisation. TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society in a sustainable way. The Acoustics and Sonar Group has extensive experience in measurement and mitigation of underwater noise, and develops tools for environmental impact studies regarding underwater sound.

Deltares
Deltares is an applied research institute focussing on water and subsoil. Deltares develops numerical tools to assess environmental impacts, focusing strongly on the link between physics (water flow, sediment movement), water quality (nutrients, turbidity, pollutants) and ecology (e.g. primary production; habitat formation). To support the development of numerical tools, Deltares has large-scale test facilities.

What can DMEC do?

Whether you are a technology developer or a policymaker, DMEC assists in finding the answers to your questions regarding environmental impacts of marine energy. We have a comprehensive overview of the available relevant knowledge. Because environmental issues are often complex, a multi-disciplinary approach is required. We assist in setting-up the right partnership of academia and knowledge experts. In this way, we support knowledge transfer and assist the development of standards for permitting and licensing of marine energy technologies. We also facilitate in developing new knowledge, for issues where knowledge gaps prove to be a barrier for implementation, licensing and permits.

Last but not least we can assist developers of marine energy technology with the process of obtaining permits based on a generally accepted set of metrics.