# Task 6.8: Summary and Evaluation of Environmental Impacts, Risk and Safety, and Economic Aspects of Ballast Water Treatment Methods

## Executive Summary

An environmental economic assessment ideally can be used to evaluate different policy and/or technological options and helps to select the most cost effective solutions.

In the case of ballast water treatment systems the evaluation should consider the following:

- Benefits: reduction of / stopping undesired migration of species. It is assumed that a high "kill rate" of zooplankton, phytoplankton and bacteria gives a high level of protection.
- Costs: input of additional resources (investment in treatment system, energy, chemicals, manpower).
- Costs: (some) additional burden to the environment due to the use of additional equipment and additional risks (due to chemical use, pollution, etc.).

The "benefit-side" of the MARTOB project on ballast water treatment is a special case. Normally, the benefits are somehow well described in terms of, for example, reduction of emissions (and ambient concentrations). It is in such cases relatively easy to compare the effectiveness of different technologies. In the ballast water project however, the problem partly had to be defined, which makes the evaluation particularly difficult. The biological effectiveness of the different treatment systems had to be defined first and measured afterwards. The performance standard adopted by IMO means that all systems at least must pass this standard.

As from the large scale tests and also the laboratory tests no decisive conclusion could be drawn on the effectiveness of certain technologies (in terms of the IMO adopted standard), the obtained results do not allow for a "normal" cost-effectiveness assessment. Too little or no results are available to compare effectiveness of different technologies with the costs thereof. The only conclusion that can be drawn from the large scale (and laboratory) tests is that the technologies somehow and under certain circumstances are (or can be) effective. We has been assumed in the analyses that all technologies are or have the potential to be effective.

Sensitivity analysis of the calculated results shows that the operational costs per $m^3$ treated ballast water hardly changes if the number of trips or the amount of cubic metres ballast water to be treated per trip varies greatly. The total costs per treated $m^3$ ballast water declines as the number of trips increases due to spread evenly the same capital costs over an increased number of cubic metres per year.

Some negative environmental impact is inevitable, and this is mainly a result of energy use. The trade-off is between biological effectiveness as a positive impact and negative impacts on climate control and acidification. However, the negative impact of the treatment systems on climate control is much less than the impact of energy use for the entire ship. Many ships use more than 100,000 kg of marine diesel every day or 500,000 kg per 5-day trip, which is 100 times higher than the most energy consuming system.

An environmental economic analysis must rely highly on the biological effectiveness of the treatment systems. Weighing one against the other is a matter of a balance between the money to invest in treatment systems and the negative environmental and biological impacts of not treating ballast water.