

# Sustainability of Carbon Ferries

*M.C.B Dam<sup>1</sup>, N.B. Nielsen<sup>2</sup>*

<sup>1</sup>DTU Management Engineering, Technical University of Denmark

<sup>2</sup>DTU Management Engineering, Technical University of Denmark,

The main purpose of this study was to analyse the sustainability of carbon fibre reinforced polymer (CFRP) ferries in Denmark. Sustainability of the composite shipbuilding industry has been determined by an interdisciplinary approach combining life cycle thinking with strategic models and methods.

A comparative Life Cycle Assessment (LCA) analysis was made to assess the environmental impacts from a high speed catamaran ferry build in carbon fibre reinforced polymer versus a high speed catamaran ferry build in aluminium. Both catamaran ferries were capable of operating the same route between Harstad and Tromsø in Norway and were built in accordance to the high speed craft code. The hulls of the CFRP ferries were built in 2009–10 by a Danish shipyard Tuco Marine Group which has been the focus company in this case study.

The results showed that the operation stage had the biggest environmental impacts mainly caused by the extensive fuel consumption of both ferries. A comparison between the construction stages of each ferry was made to see which processes and materials accounted for the largest impacts during production. A number of limitations and assumption was made especially for the aluminium modelling.

It was found that a lightweight CFRP ferry could be beneficial for the environment, the economy and the society. However, it depended on the specific route and ferry and whether the extra investment needed for buying a CFRP ferry was offset by the lower fuel consumption and maintenance costs during the lifetime of the ferry. Furthermore it was found that environmental break-even occurred after 3 month while economic occurred after 4 years.

Porter's Five Forces and PEST analysis were used and supplemented with the results obtained in the LCA study. The strategic analysis showed that market potential and perspectives of a CFRP ferry in Denmark do exist, but under different conditions than the Norwegian high speed ferries. The main competitive parameters in the industry were identified to be cost, trust, time, and references, and their influence on a sustainable development were discussed.

The interdisciplinary approach made it possible to focus on patterns of sustainability, where the LCA gave a quantitative measure of alternatives. The LCA could not be used in the search for potential markets for a CFRP ferry, here the PEST analysis were of help. The interdisciplinary approach could be used for actors considering being more sustainable, and the approach could assist in finding and prioritizing areas of focus.