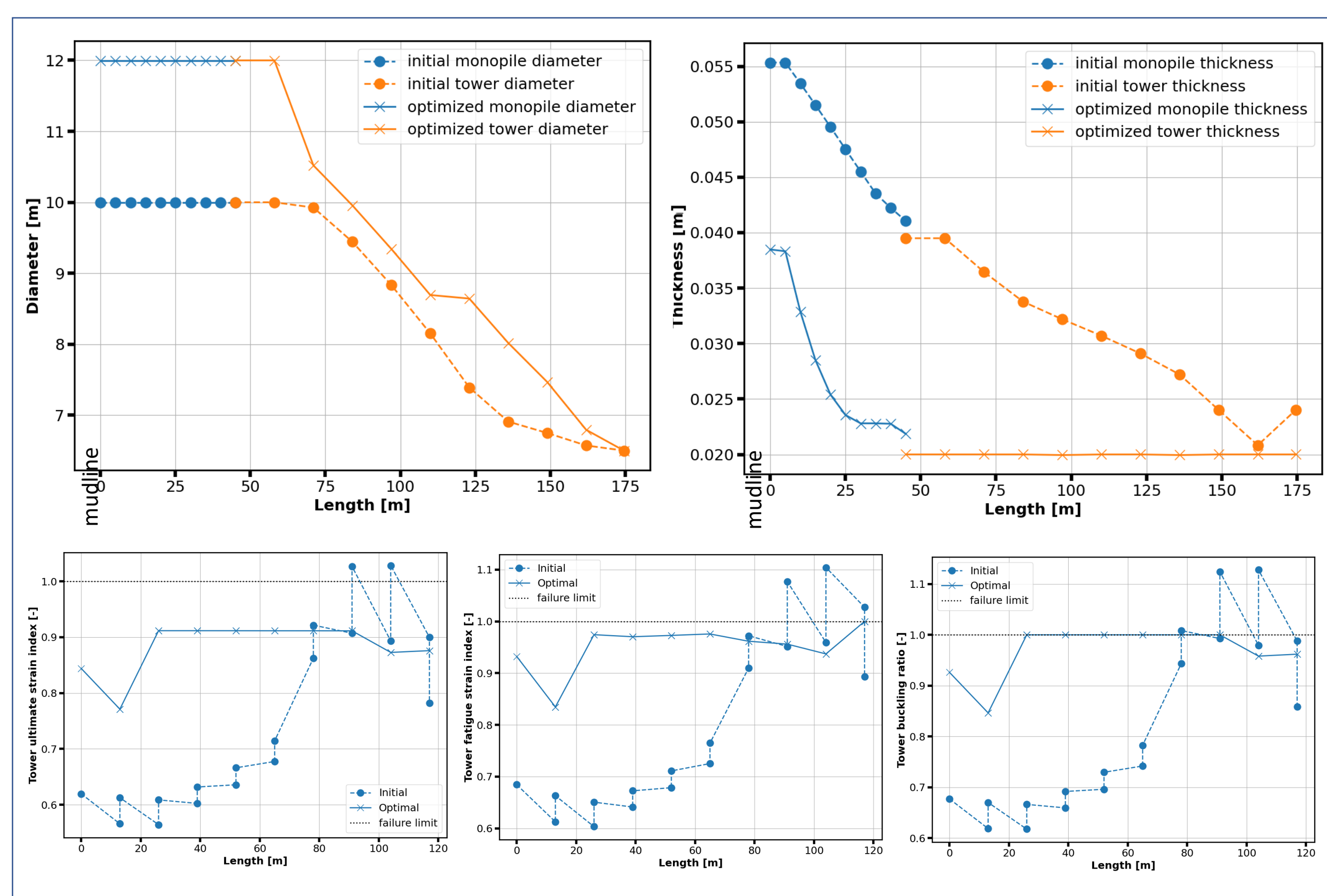


Optimization of support structure

The presented work explores the potential for support structure weight reduction, by enabling extended design space and accurate lifetime design load estimation in the design process. This example involves substructure of the ReaLCoE size, while utilizing general open data of the IEA-15MW-RWT, representing parametric variations around the ReaLCoE support structure design. DTU's SubstructOpt integrated design optimization framework is utilized to optimize the design of the support structure of the IEA-15MW-RWT for both the fixed (at the mudline) and floating offshore configurations. The OpenMDAO-based optimizer utilizes HAWC2 static aero-hydro-servo-elastic solver to optimize the structure, minimizing total mass within ultimate, fatigue and buckling failure constraints. The load evaluation relies on a surrogate model tuned on full time-domain HAWC2 design load basis simulations. With extended design space and accurate lifetime design load estimations which are calculated at every design iteration, the total mass of the monopile and tower can be reduced by overall increasing the diameter and reducing the wall thickness.

Fixed support: monopile and tower geometry and failure ratio



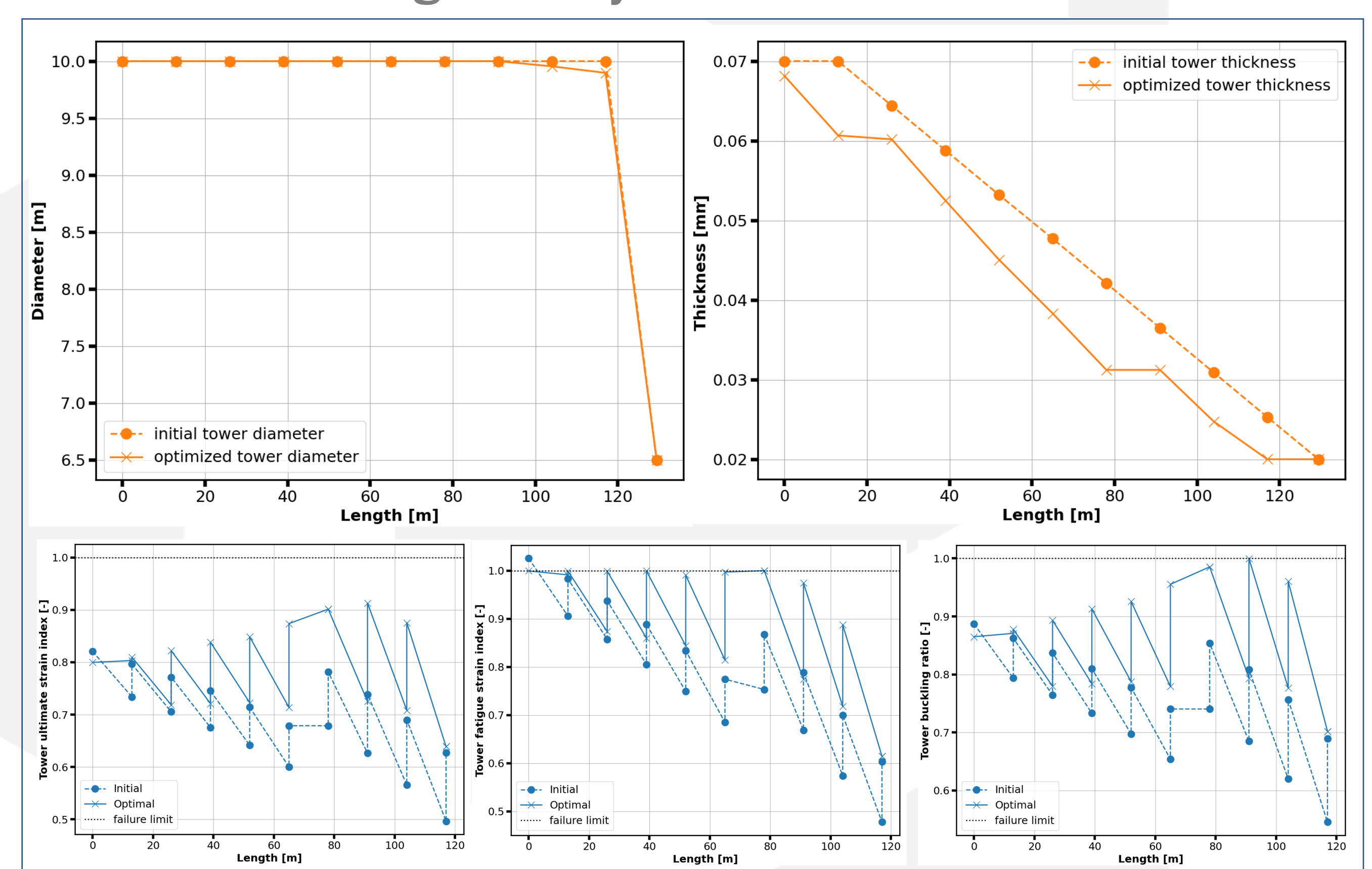
Fixed support structure optimization

With extended design space and non-frozen load input, the total mass of the monopile and tower can be reduced by 30%, by overall increasing the diameter and reducing the wall thickness, while the lowest system natural frequency is reduced by 1.3%. Extending the possibilities for larger monopile and tower diameters beyond 10m enables considerable mass reductions.

Floating support structure optimization

With extended design space and non-frozen load input, the total mass of the tower can be reduced by 13%, by overall reducing the wall thickness, while the lowest system natural frequency is reduced by 3.1%. The maximum tower diameter is here constrained to 10m due to the floater interface compatibility, but including the floater design in the process could enable further mass reductions.

Floating support: tower geometry and failure ratio



Source

1. Gaertner, Evan, et al. "IEA Wind TCP Task 37: Definition of the IEA 15-Megawatt Offshore Reference Wind Turbine." Osti Oai (U.S. Department of Energy Office of Scientific and Technical Information), Office of Scientific and Technical Information (OSTI), 2020, <https://doi.org/10.2172/1603478>.
2. Allen, C. K., et al. "Definition of the UMaine VoltturnUS-S Reference Platform Developed for the IEA Wind 15-Megawatt Offshore Reference Wind Turbine." Osti Oai (U.S. Department of Energy Office of Scientific and Technical Information), Office of Scientific and Technical Information (OSTI), 2020, <https://doi.org/10.2172/1660012>.
3. Antariksh Dicholkar, Thanasis Barlas, Alan W.H. Lio, David Verelst and Liselotte Ulvgård "Impact of reduced generator mass on fixed-bottom and floating offshore wind turbine design." TORQUE 2026, to appear.

ReaLCoE's vision is to unleash the full potential of offshore wind energy
 €35/MWh LCoE Goal, +12MW WEC Capacity, ~32 mio € Total Budget, 42 month project duration



Join the ReaLCoE community!

Further information about the ReaLCoE Programme can be found on our website: ReaLCoE.eu