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Highly reputed and flourishing

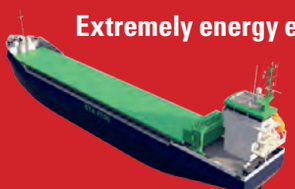
DUTCH YACHT BUILDING SPECIAL

Fleets of foiling ships?

Research to tackle the challenges

ÈTA 6700

Extremely energy efficient



Headed for the open sea

Fishing vessel Z-98 Windroos

ENERGY LABEL FOR SUPERYACHTS

While each yacht is unique, their use turns out to be quite similar

Bound to be launched in November this year during METSTRADE and The Superyacht Forum, the Yacht Environmental Transparency Index (YETI) is in a crucial fleet review testing phase for arriving at a YETI 1.0 version. YETI will not only enable rewarding serious efforts of reducing environmental impact, but it will also define a new arena for the yachting sector to compete on in delivering the most environmentally friendly operating yachts for their clients.

It started with a Christmas card in 2018, that Bram Jongepier from Dutch superyachtbuilder Feadship sent to his peers in the yachting industry with the request to help finding "YETI": the Yacht Environmental Transparency Index. The responses were very enthusiastic, which led to a meeting in March 2019 at the Feadship-De Voogt offices to discuss this YETI idea.
Jongepier shared his challenges as a designer to showcase clients how much better a new concept design would be compared to the status quo. Great concepts mostly ended up being judged by their economic cost alone. Unfortunately, there was no reference for the ecological side that could indicate the benefits versus costs and as such, help make a more informed decision. The attendees confirmed that the yachting sector needs a standardised way of comparing yachts on their environmental credentials.

Collaborative approach

A Joint Industry Project (JIP) for developing YETI was agreed upon and would be organised through the new collaborative platform Water Revolution Foundation. This Foundation had been founded just a few months before with the main mission to tackle the environmental impact and drive sustainability in the global yachting sector.
The YETI JIP team is international and consists of eleven major yacht builders, four naval architects, one marina and refit facility

Photo: YETI intends to be indifferent to a yacht's size or top speed; it rewards its efficiency (photo Jeff Brown).

and three Dutch research and knowledge institutes. They are: Abeking & Rasmussen, Baglietto, Benetti, Damen Yachting, De Voogt Naval Architects, Delft University of Technology, Dykstra Naval Architects, Feadship, Fincantieri Yachts, Heesen Yachts, Lateral, Lürssen Yachts, MARIN, MB92, Oceanco, Royal Huisman, Sanlorenzo, TNO and Vitruvius.

Life Cycle Assessment approach

Like Water Revolution Foundation's Yacht Assessment Tool, YETI is based on the principle of Life Cycle Assessment (LCA). This approach takes into consideration the:

- Upstream process: impact from raw materials extraction, transportation and manufacturing;
- Core process: impact from the construction phase;
- Downstream process: impact from the operational phase, including maintenance and spare parts, as well as end-of-life.

LCA is being promoted as a leading approach for the yachting sector to ensure that the choices made to reduce environmental impact are indeed leading to an overall environmental improvement. Only optimising the operational phase is not enough and could lead to just moving impact from one phase to another without really tackling it. YETI will therefore be under continuous development, and is likely to come with updates over time, working towards covering the entire life cycle.

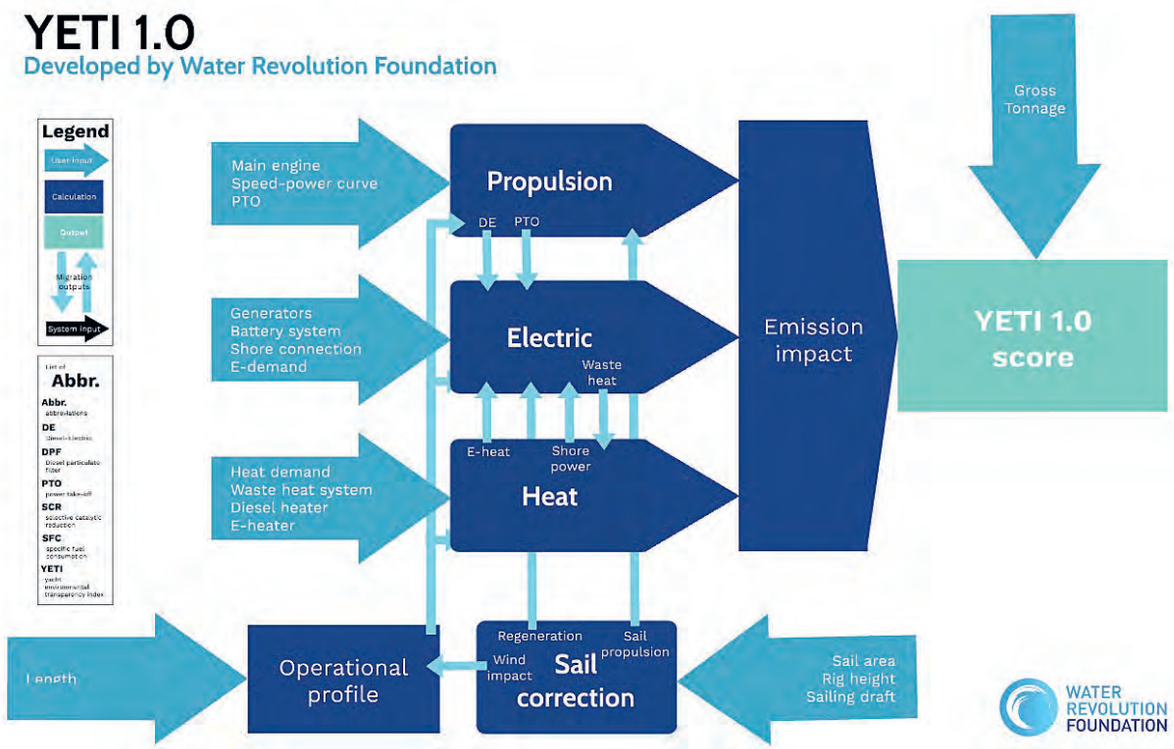
Operational profile

The first version of YETI focuses on the operational phase, reflecting yachts' long lifespan and fairly well available and verifiable data. To make a realistic assumption on the lifetime impact of a yacht, one needs to know how a yacht is actually being used. This is not always in line with how it has been designed. In fact, while each yacht is so unique, their use turned out to be quite similar. We proved this through analysing a large quantity of AIS data (automatic identification system, compulsory on all large yachts). Out of almost 300 years of operational data from 109 yachts, a standardised, parametric operational profile was determined with time and speed distribution, where speed was found to be related to waterline length. As expected, yachts tend to spend little time at speed (only ten per cent) and spend most of their time in port (56 per cent) and at anchor (34 per cent). The use of an operational profile is the main difference with the Energy Efficiency Design Index (EEDI) approach, which only looks at a single sailing condition.

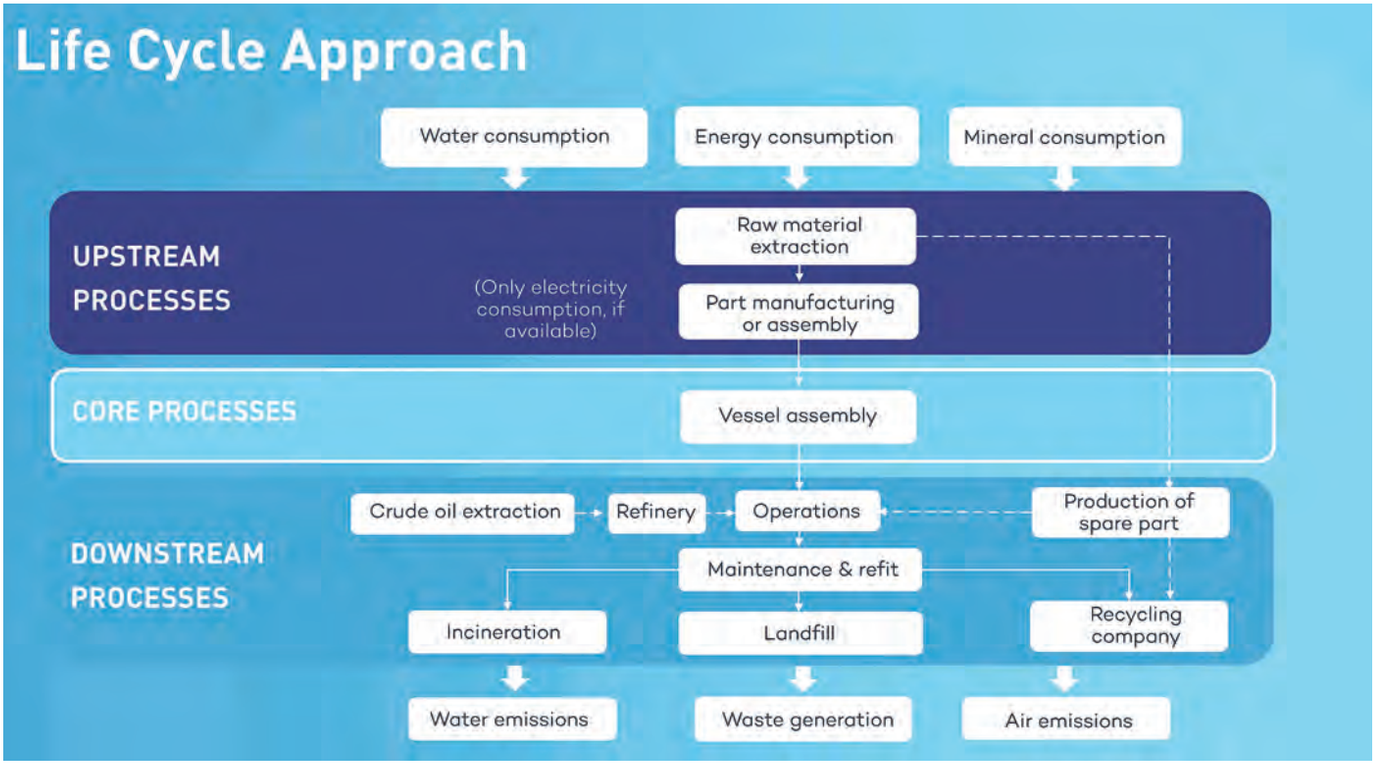
> Yachts spend ninety per cent of their time in port and at anchor

Propulsion

The propulsive energy is determined by combining the speed-power curve of the yacht (validated by sea trials) with the operational profile. A standard sea margin of fifteen per cent is added to represent



YETI 1.0 flow chart (by Vino Peeten).



Scheme for the Life Cyle Approach.

fouling and weather resistance. This energy demand is supplied by the main engines or generators (user input, choice between diesel direct or diesel electric), which returns fuel use, urea use and emissions when combined with factory engine data, validated by bench tests.

The effect of sails has been integrated using a mathematical representation of average wind power, using the EEDI methodology for wind-assisted ships. This resulted in a sailing yacht dividing the time at main cruising speed partially in motor sailing condition, partially sail-only and partially motor-only.

YETI allows for the comparison of the overall environmental impact of displacement yachts, fast yachts and sailing yachts, with most common powering systems such as diesel direct, diesel electric and hybrids.

Hotel power

The objective, transparent determination of hotel power, has proven to be very difficult. Yards and designers use different methods and experiences to size the generators on board. This topic is being addressed within the YETI JIP, and is expected to result in a standardised, simplified load balance. Currently, the YETI 1.0 calculator works with the unvalidated user input of electric hotel power, heat hotel power and condition dependent loads like stabilisers, navigation/steering equipment and manoeuvring thrusters.

Similar to the propulsion power demand, the hotel power is combined with the standardised operational profile to yield generator fuel use, urea use and emissions.

Energy efficient options

The aim of YETI is to recognise yachts with reduced environmental impact due to their general design (such as good naval architecture or systems) or additional technical features in the power supply system. The options currently incorporated in the YETI tool are:

- Main engine PTO (so called hybrid propulsion, allowing the main engine to provide hotel power instead of the generators);
- Underwater exhaust (NO_x emissions are partially absorbed by sea water);
- SCR (selective catalytic reduction, Tier III exhaust cleaning system);
- DPF (diesel particulate filter, exhaust soot reduction technology);
- Solar cells;
- Battery banks (functioning as peak shaver or cycling on generators);
- Waste heat recovery (providing heating energy to various systems).

These options allow for higher overall tank-to-wake efficiency and/or fewer emissions, resulting in less environmental impact in a yacht's operational phase.

Shore power

Since yachts spend a lot of their time in port, the use of shore power and the average energy mix of the local grids of the most visited marinas, have been considered as well. Clean shore power will therefore be important. However, not all ports have sufficient shore power in the first place, depending on the required hotel power demand. To provide a realistic value for the availability of shore power, a survey was conducted among yacht captains and marinas. This has resulted in an exponential function describing the probability that shore power is available, which is used in the YETI tooling.

Impact

The use of fuel, urea and shore power, including their upstream impacts as well as downstream emissions coming from the exhaust, determine the environmental impact of the yacht's operation. To quantify and totalise these, standardised specific impact values are used based on the international ReCiPe method, from the ecoinvent database and expressed in ecopoints. When combined with the consumption and emission values of the yacht, the total impact is calculated. At the same time, the user gains insight in which factors create most impact, main engine or generator, CO_2 or NO_X, etc.

Overall scoring and ranking

The process described above will yield a single value of the impact of a yacht. A logical result is that the impact of a larger yacht will be higher than that of a smaller yacht, which leads to the effect that the best yacht is no yacht at all. To make YETI independent of size, the functional unit of gross tonnage (GT) is being considered. This would mean that a large yacht to which much attention is given to reduce environmental impact will indeed have a better score than a small yacht, which was not designed to be environmentally friendly. The use of GT as a functional unit is currently being verified by the JIP in a fleet review this summer, in which as many yachts as possible are being reviewed using the YETI 1.0 calculator.

The analysis of the results will show whether GT is fit to be used as a functional unit.

As soon as the functional unit is validated, a ranking system can be designed, for example using a five-star rating scale. The aim is to have this work completed before the end of 2021. Stay tuned!

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