

ZeroNorth

Predicting fuel consumption: solving a long-standing industry challenge central to driving shipping's decarbonisation

Predicting and accurately measuring marine fuel consumption is one of the most important tasks that crew, owners, operators and charterers have to complete for every vessel travelling the world's oceans.

It carries such a focus because fuel costs are by far the largest operational expenditure for any vessel. These costs are only set to mount in the near future, as new, low carbon fuels come onto the market. This is why voyage and vessel optimisation has become an increasingly important topic and pursuit for owners and operators. Realising a 5-10% fuel saving – and an associated cut in emissions – in the near term with digital technologies is a key commercial priority.

Given the importance of voyage optimisation in driving decarbonisation, the accuracy of fuel consumption models are essential. However, predicting and understanding how much fuel a vessel is using at any given time in a myriad of conditions is not an easy task. Historically, captains had to print out and bring their fuel tables on board. Of course, over the years technology and theoretical modelling has significantly evolved to create fuel consumption tables and speed curves that estimate the amount of fuel that a vessel should consume under certain conditions. Given the imperative to optimise voyages and vessels, it is crucial that we understand the accuracy and applicability of fuel consumption models to serve this purpose, and therefore to support shipping's decarbonisation challenge.

Fuel tables are generated from an underlying mathematical model that considers a huge range of parameters, such as the deadweight tonnage of a vessel, its width, engine type, draught and power. Fuel tables serve an important operational purpose and will continue to be an important part of crew reporting. However, we also have the opportunity to further evolve fuel tables, which, as an industry, we must work together to seize to fully enhance voyage optimisation.

New digital technologies give us the capability to properly use the underlying mathematical model, in turn unlocking more precise fuel consumption predictions, delivering deeper knowledge and insight.

That's why in May of 2021, maritime technology company, ZeroNorth convened a range of organisations spanning ship owners and operators, fuel consumption model providers and voyage optimisation software companies in several roundtable workshop with the aim to set and agree on **an industry-wide methodology for fuel table benchmarking**.

This briefing document examines the output from the workshop, explores what this means for an industry that has an ever-tightening requirement to optimise, and outlines the exciting next steps in the development of this new benchmark.

Convening across the sector

To create an industry-wide methodology for fuel table benchmarking, it was vital to bring together the sector's leading voices and minds to ensure truly multilateral input. This approach marries other similar initiatives to standardise processes across the sector – including some of the programmes being run under the International Maritime Organisation's GloMEEP energy efficiency project.

In early 2021, ZeroNorth therefore set out to convene a series of workshops, with participants from organisations, including representatives from GreenSteam, I4, Cargill, UltraBulk, Western Bulk, Maersk Tankers Digital, Lloyd's Register, Bearing, Propulsion Dynamics and A.P. Møller – Maersk.

These companies include some of the biggest players in their fields. Together, they are a representative cross section of ship owner, class society, software company, and fuel consumption provider interests. The output of the collaborative workshops therefore takes advantage of expertise spanning decades in vessel and voyage optimisation.

The participants met over the course of several sessions with the aim to discuss and build the benchmark.

Building a benchmark based on real world conditions

When creating a benchmark to assess the accuracy of fuel tables, the first step was to agree the parameters that should be included in the mathematical calculation.

Currently fuel tables are normally established during vessel sea trials, either at the newbuild stage or after a scheduled dry-docking. By being based on data gathered during such a brief period of time, fuel tables do not account for the huge range of operational and sea scenarios a vessel might encounter over its lifespan, not to mention changing cargo, trade patterns, routes or equipment. That is why additional information from noon reports and during scheduled drydocking helps update the tables based on the vessel's current condition. However, there is not a benchmark that enables us to measure a fuel consumption model's accuracy, and therefore potential for optimisation.

The breakthrough that this new benchmark enables is that it measures accuracy by comparing fuel model predictions with real world operational observations — gathered from noon reports and sensor data — ensuring that a fuel model is measured against conditions which occur in the real world, and not just theoretically.

By adopting a standard methodology to incorporate this real-world information, we will be able to unlock greater consistency and transparency between different fuel models and organisations.

The new benchmark will allow owners to understand the accuracy of fuel tables for a vessel or on a fleet-wide basis.

Specifically, participants in the workshop agreed to create a tier-based system with a set of standard guidelines to help the industry to benchmark fuel tables. The agreed benchmark uses two primary metrics:

- 1. Accuracy, which is a percentage measure of the mean absolute error that a fuel model has, and;**
- 2. Bias, which is a percentage measure of the mean error that a fuel model has.**

Initially launching for testing with a fully scoped out Tier 1, and a soon-to-be-finalised Tier 2, the tier system will allow end users to decide the level of depth and detail of fuel table analysis that they want to deploy on the path to vessel optimisation.

The benchmarking guidelines with Tier 1 are focused around creating a simple overview of the overall performance of a vessel's fuel tables, within different vessel and sea conditions. It provides easy-to-understand feedback on the performance and limitations of the models that owners and operators are already using.

The benchmark report card for each fuel table will span a number of factors. This includes a global figure for accuracy and bias, as defined above, but also accuracy and bias for fuel models based on three key factors: speed, weather and cargo condition. These factors are broken down further into three speeds (low, medium and high); two broad weather conditions (good and bad, based on the Beaufort scale); and for when the vessel is either laden or in ballast.

At a glance, end users can see the performance of their fuel models either granularly across these factors, or holistically in one global average.

There are many potential operational uses for this information. For example, when it comes to evaluating total fuel consumption on a voyage level, owners and operators can simply use the global accuracy and bias figures to gain an instant understanding of the accuracy of their fuel tables.

However, in more nuanced applications, such as where a fuel table is used to simulate possible route and speed scenarios, end users might choose to use evaluate the performance of their fuel tables by using an average of accuracy and bias across the speed and weather subset information.

The high level of flexibility of the Tier 1 benchmark makes it an excellent starting point for end users to assess the accuracy of their fuel tables. In the future, the Tier 2 model will add in other factors such as additional uncertainty measures to allow for a greater depth of statistical analysis, and for subset information to be based on data factors, such as quantiles and clustering of information.

Next steps

After a successful series of workshops, the next step is to implement, test and scale this benchmark with end users. The participating organisations will work to understand and develop the real-world applications of the fuel table benchmarking, particularly with respect to how this impacts software that can provide vessel or voyage optimisation.

By creating a standard benchmark for fuel table measurement, the companies involved have laid an extremely strong foundation for vessel optimisation. By basing decisions on the reality that a vessel faces, we will be able to more authoritatively improve revenue and cut emissions.

All organisations that have collaborated in this workshop have committed to transparently share results and update the standard as required, jointly launching an exciting new phase for marine voyage optimisation.