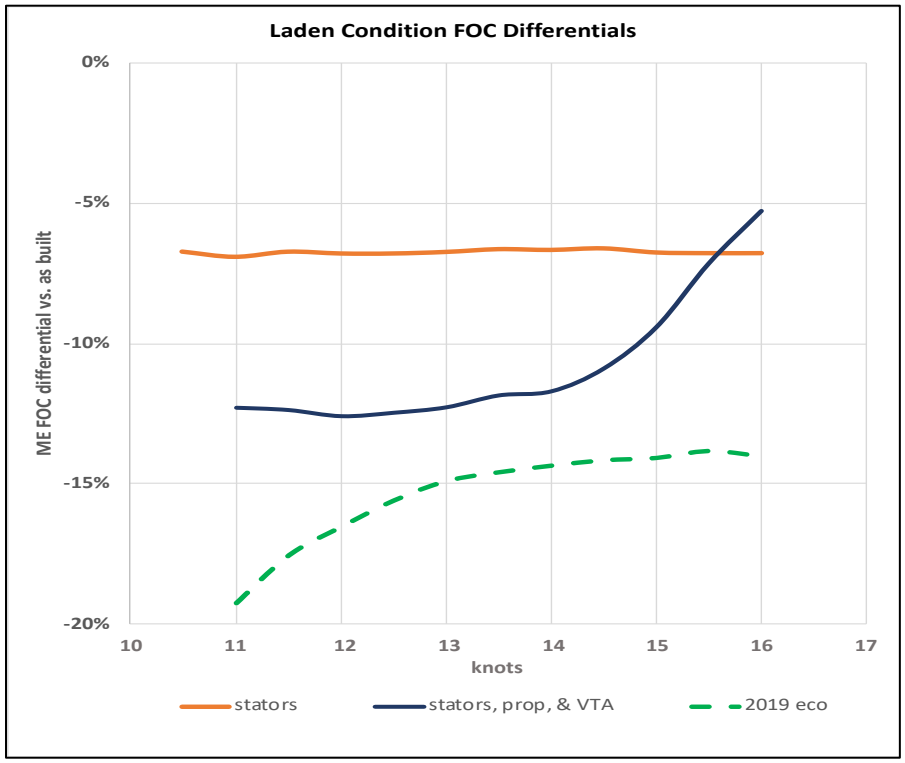
Example: MD Retrofit Recommendations

In this case study an owner asked MD to evaluate the potential gains from retrofitting a 2007-built VLCC. The ship's next special survey is scheduled to take place in two years, but the owner is considering accelerating the schedule in light of anticipated poor market conditions over the next year and attractive pricing from repair yards. The owner believes that oil majors will charter the ship if it was competitive with a modern eco-ship.

The owner provided necessary details on the hull, engine, and propeller for MD's GreenScreen evaluation. MD's database of engine tuning and retrofit costs provided the baseline for the performance evaluation.

The below chart shows the reduction in fuel consumption (relative to the baseline 2007 as built configuration) achieved with selected retrofit options, as calculated by GreenScreen. (The chart shows the results only for the laden condition; a similar analysis was performed for ballast conditions.) The dashed green line shows the relative fuel consumption of a modern eco VLCC.

The chart makes clear that substantial reductions in fuel consumption and CO2 emissions can be achieved by the most aggressive retrofitting option. The retrofit reduces the competitive disadvantage of the 2007-built ship relative to its eco competition by 75% between 11 knots and 13 knots. Although the retrofit reduces fuel consumption at all speeds, the gains are smallest at 16 knots. Tracking the vessel's trading patterns over the past five years showed that it was reported to have maintained 16 knots for more than one day just 2% of time.



From a financial perspective the choice between investing in stators vs. the stators/prop/VTA package will depend on the cost of each option as well as the likelihood that future market conditions (including

charter rates, carbon price, and bunker price) are such that the owner and charterer will choose to slowsteam or not. MD's evaluation considers the full range of market conditions and the likelihood associated with those conditions.

The table below shows the retrofit/upgrade options considered for the 2007-built VLCC and the initial GreenScreen performance evaluation. The cost of the retrofits includes both equipment and yard costs as well as the offhire opportunity cost associated with the retrofit installation. The rightmost columns show two measures of effectiveness of the retrofit: the reduction in main engine fuel consumption and reduction in annual bunker spending relative to the initial investment.

Retrofit	Total Cost (single ship basis) $mm	% reduction in FOC (12-14 knots)		$/year fuel savings in per $mm invested
		Laden	Ballast	Laden/Ballast avg.
Stators	**0.9**	**6.7**	**6.7**	**284,000**
New prop	0.9	3.3	4.0	138,000
VTA tuning	0.8	2.9	2.9	134,000
Stators, VTA & Prop	**2.4**	**11.6**	**12.0**	**173,000**

The GreenScreen performance evaluation shows that the stators are the lowest cost and single most important contributor to fuel savings but that a larger investment combining the stators with engine tuning and propeller optimization offers nearly double the savings. The next step in the GreenScreen process is to assess the most profitable and least risky option for the owner.

The owner indicated that the ship will likely continue to operate in the AG/Far East trade. We assume that the ship will operate in the AG/East trade, a 13,200 nm roundtrip voyage, 6,600 nm laden and in ballast legs. Port and offhire days are 4 days/voyage and 15 days/year respectively.

To confirm the robustness of the recommendations under a wide range of market conditions, we use Low, Base, and High scenarios for voyage revenues and for VLSFO prices – a total of nine market scenarios. These benchmarks are at the 25%, 50%, and 75% percentile of historical voyage revenues and compliant fuel prices respectively from 2000Q1 to 2020Q2.[1] The historical frequency of falling into these bins is summarized below.

Probability		Voyage Revenue ($mm)			Total
		1.5	2.2	3.0	
Bunker Price (USD/tonne)	180	13%	11%	1%	
	310	12%	26%	11%	
	470	0%	12%	13%	
Total					100%

[1] Observed voyage revenues are multiplied by Marsoft's fleet utilization index to account for variation in demand. HSFO bunker prices are used from 2000 to 2019. VLSFO bunker prices are used from 2020.

For the purposes of the forward-looking financial analysis we increased the weighting on the low oil price scenarios, to be more in line with OPEC's market-share focused strategy.

- Not surprisingly, the MD GreenScreen analysis confirms that the stators are an attractive retrofit, with a positive NPV in all market scenarios, an expected payback period of 2.5 years and an IRR of 42%. This is consistent with the adoption by leading owners of the stator retrofit.

- The incremental investment in engine tuning and propeller optimization, fails to meet the risk/return standards – given the pre-MD parameters of the transaction. The incremental 5% reduction in fuel consumption and CO2 emissions cannot be achieved without getting better terms for the owner.

MD is able to provide a package that reduced the initial cost of the investment to $2.2 million and generate incremental revenue from carbon credit sales totaling $0.3 million over five years.[2] Furthermore the owner's bank provided debt finance for a portion of the investment. This combination of deal enhancements shifted the financial performance of the larger deal to meet the owner's requirements and gain a further 5% reduction in CO2 emissions.

[2] At a carbon credit price of $15/tonne.