Fishing Vessel Energy Audit Project

To provide vessel owners with practical measures to save fuel, the Alaska Fisheries Development Foundation (AFDF) partnered with Alaska Longline Fishermen's Association (ALFA), Alaska SeaGrant, Nunatak Energetics, and Navis Energy Management Solutions to conduct energy audits and collect data from Alaskan fishing vessels between 2012 and 2017. The information below is provided to help vessel owners identify operational and equipment solutions to improve fuel efficiency tailored to their specific needs.

Hybrid fishing vessels

Troll, longline, and gillnet fishing vessels which spend many hours with their main engine at idle while working the fishing gear are good candidates for a growing number of hybrid drive options. Diesel engines are most efficient when producing 50-80% of their rated HP such as when transiting to and from the fishing grounds. Diesel engines are much less efficient at low power loads such as when a vessel is at idle or moving at 2-3 knots hauling fishing gear. Hybrid drives allow propulsion power to be delivered from multiple sources. With a hybrid drive a vessel could operate with its main engine shut off and propulsion power provided by an auxiliary engine or battery bank. Typical longline, troll and gill net vessels use less than 35 hp (26 kW) for propulsion and deck hydraulics while fishing.

Figure 1 Example of a hybrid drive

Equipment

For fishing vessels that have gen-sets there are several options for configuring a hybrid drive. Transfluid (www.transfluid.us) makes an intermediate clutch that installs between the main engine and the existing transmission. The intermediate clutch has mounting points for one to four power transmission inputs (PTI) or power take offs (PTO). One possible hybrid drive configuration consists of an electric motor mounted on a PTI point and a hydraulic pump on the PTO point. This would allow the main engine to be shut off when in fishing mode, and the gen set to provide both propulsion and hydraulic power. Another hybrid drive option is to install a shaft generator. Shaft generators are essentially an electric motor built around a section of the propeller shaft and can be installed directly on the existing propeller shaft or as a new intermediate shaft. Similar to a PTI, when the vessel is fishing, the main engine can be shut off and the gen-set used to provide power to the shaft generator for propulsion. The speed of an AC electric motor is related to the frequency supplied (Hz). Under both hybrid options using AC motors, the speed of the motor would be controlled by a variable frequency drive (VFD) controller which would speed up or slow down the electric motor based on throttle inputs.

Fuel savings and benefits

Hybrid drives offer some interesting benefits. One benefit is that fuel and engine maintenance costs would decrease. Gen-sets typically have lower maintenance and rebuild costs, and would burn less fuel than the main engine as the gen-set would be more optimally loaded. Another benefit is redundant propulsion. The ability to finely control the electric motor's RPM may also eliminate the need for shifting and the associated cavitation sounds thought to attract sperm whales to longline vessels. Some electric motors also have the ability to generate electricity when powered by an outside source. These "motor/generators" could supply AC loads for refrigeration when the main engine is being used, thus allowing the gen-set to be shut down when the vessel is transiting to the fishing grounds.

Exactly how much fuel could be saved using a hybrid propulsion system depends on the fishery, vessel operating procedures, and design details. Based on recorded hydraulic, electric and propulsion loads, as well as several assumptions about the performance of a hybrid system, a freeze troll vessel with an auxiliary generator could reduce its fuel consumption by approximately 30% with a hybrid drive.

What about an all electric fishing vessel?

Battery power is best suited for applications with predictable charging intervals and relatively short trips. Installing enough battery storage to support a multi-day fishing trip is prohibitively expensive despite falling lithium ion battery costs. Batteries still cost $700-1000/kWh of storage. For a fishing vessel that needs 20 hp (15 kW) for propulsion, hydraulics and electric loads when fishing, $10 to $15 thousand worth of batteries are required per hour of electric operation. The charging system needed for the battery bank would add several thousand dollars to the cost.

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This publication is supported in part by funds from NOAA Award # NA15NMF4270275. The statements, findings, conclusions and recommendations are those of the authors and do not necessarily reflect the views of NOAA or the Dept. of Commerce.