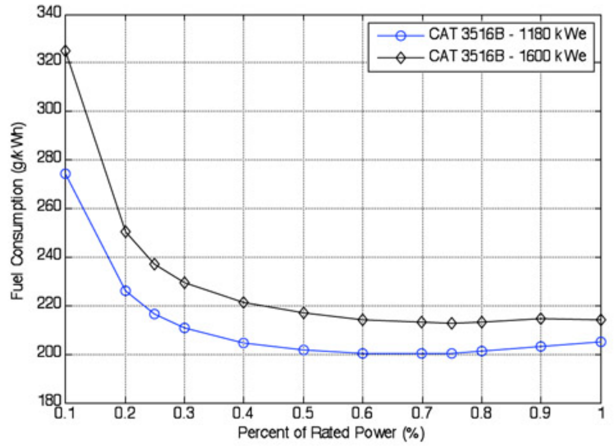
# Electrical Load Distribution and its Impact on Annual Fuel Consumption




To facilitate the development of technologies for improving the fuel efficiency ships, a study was performed to quantify the annual fuel consumption associated with each of the major electrical loads. For a test system, a 100 m class passenger vessel was selected. While different ships may have somewhat different distributions, this particular choice has the richness of applications to make it an interesting example for analysis.

As a first step in the analysis, power distributions associated with various vessel operating modes were compiled. By combining these load distributions with an assumed annual percentage of time spent in each mode, a relative account of the fuel consumption for key electrical loads was produced. The figure shows the results of this analysis. While this was done for a hypothetical ship, a similar assessment can be made for an operating ship for which operational data are available.

**Discussion of Results**

Since the energy and power for the entire ship's electrical load is produced from diesel generator sets, each electrical load has a direct impact on the fuel economy of the overall system. As shown in the figure above, these electrical loads can be broken down into the following categories: propulsion loads, winch loads, thruster loads, HVAC, clean power M-G set, cooling plant loads, 230V and 120V feeder, distribution board, and other miscellaneous loads.

These results highlight prioritized targets for improving the vessel's fuel economy. As expected, propulsion loads represent the largest annual fuel consumption at over 2800 m3, or $2.4 million per year based upon $850/m3, and should be one of the first targeted loads. Second to the propulsion load is HVAC. The HVAC load, found by summing both the Cooling Plant and HVAC values in the figure, accounts for 15% of the annual fuel consumption. Thus, a 10% savings on the HVAC demand alone yields over $58,000, while a 10% savings on propulsion loads yields nearly $240,000 per year. Commensurate with fuel savings is the beneficial reduction in generated emissions from the diesel generator sets.

This demonstrates that the greatest impact of fuel savings will come from technologies that augment the efficiency of the ship's propulsion and HVAC systems. Improved granularity of the prime movers, waste heat recovery, supplemental energy from renewables could offer sufficient energy savings with a reasonable return on the initial capital costs. HVAC architectures for marine vessels remain conventional; and, there are significant opportunities for efficiency upgrade using approaches that are a major departure from conventional practice. UT is researching these opportunities in an ongoing marine ship efficiency study