Energy Trends in Selected Manufacturing Sectors:

Opportunities and Challenges for Environmentally Preferable Energy Outcomes

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3.12 Shipbuilding and Ship Repair

3.12.1 Base Case Scenario

Recent Sector Trends Informing the Base Case

Number of facilities: ↓
Value of shipments: ↑
Electricity intensity: ↓

Major fuel sources: Electricity, petroleum, natural gas

Current economic and energy intensity data are summarized in Table 56 on page 3-97.

Situation Assessment

The shipbuilding and ship repair industry (NAICS 336611) consists of 346 facilities that build and repair ships, barges, and other large commercial and military vessels, as well as facilities that manufacture offshore oil and gas well drilling and production platforms.[295] Most shipyards were built prior to World War II, with layout changes made piecemeal through the years. Facilities that are common to most shipyards include drydocks, shipbuilding positions, piers and berthing positions, workshops, work areas, and warehouses. The shipbuilding and ship repair industry participates in EPA's Sector Strategies Program.

Although recent economic indicators have been positive for the shipbuilding and ship repair industry, the sector faces some considerable economic challenges. Value added and value of shipments increased from 1997 to 2004 (see Table 56).[296] However, the long-term economic outlook for the industry may be less favorable. The sector is heavily dependent on military contracts and fairly uncompetitive in the global market of commercial shipbuilding, representing less than one percent of the global new construction market for commercial vessels.[297]

Electricity purchases represent 75 to 80 percent of the sector's energy costs, and purchased fuels represent the sector's remaining energy budget, with no major switching trends (i.e., from electricity toward fuels) evident from 1998 to 2004.[298] As Census Bureau data from the *Annual Survey of Manufacturers* do not provide the annual amount of energy produced from purchased fuels, it is not possible to calculate the total energy intensity of the shipbuilding industry, though it is possible to calculate electric intensity (kWh/dollar value of shipments), which fell by almost 10 percent from 1998 to 2004.[299] There is substantial regional variation in the sector's energy profile. For example, yards in the Northeast have higher fuel usage due to facility heating requirements. Regional differences in electricity and fuel costs may affect the cost-benefit calculations for energy efficiency improvement projects.

Energy-intensive processes for shipbuilding and ship repair include welding (electric arc welding is most common), forging, abrasive blasting, and application of marine coatings. The greatest energy-related environmental improvement opportunities are related to equipment replacement and/or retrofits to increase the energy efficiency of compressed air systems, HVAC systems, lighting, and motors.[300]

Table 56 summarizes current economic trend and energy intensity data originally presented in Chapter 2.

Table 56: Current economic and energy data for the shipbuilding and ship repair industry[pppp]

Economic Production Trends				
	Annual Change in Value Added 1997-2004	Annual Change in Value Added 2000-2004	Annual Change in Value of Shipments 1997-2004	Annual Change in Value of Shipments 2000-2004
	2.7%	5.4%	1.8%	2.4%
Energy Intensity in 2002				
	Energy Consumption per Dollar of Value Added (thousand Btu)	Energy Consumption per Dollar Value of Shipments (thousand Btu)	Energy Cost per Dollar of Value Added (share)	Energy Cost per Dollar Value of Shipments (share)
	NA	NA	1.2%	0.8%

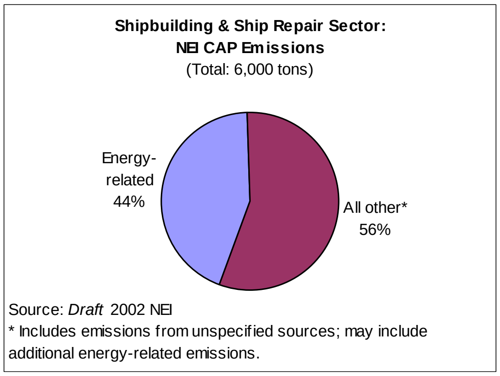
Expected Future Trends

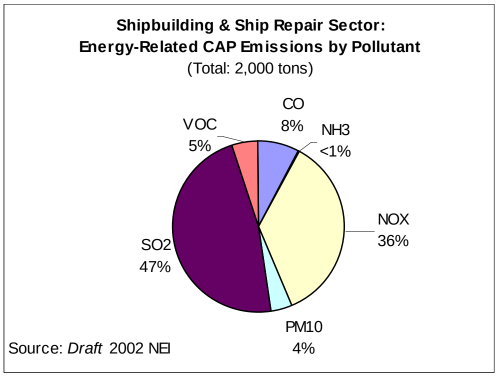
Economic pressures on the shipbuilding industry are expected to play a dominant role in sector energy use. Energy expenses represent a substantial fraction of production costs and, though the industry has not historically taken a strategic approach to energy management, increasing costs for electricity and fuels has driven growing consideration of energy issues, particularly in areas with high electric rates.[301] Efforts to control energy costs are likely to drive incremental efficiency improvement, but capital constraints are likely to limit the extent of major capital improvements. Purchased electricity will continue to meet the majority of the sector's energy requirements.

Increased VOC regulation has the potential to increase energy requirements for pollution control systems. In addition, increased regulation of stormwater discharges could increase energy requirements for water treatment.

Environmental Implications

Figure 28: Shipbuilding and ship repair sector: energy-related CAP emissions





pppp MECS does not provide energy consumption data for this sector.

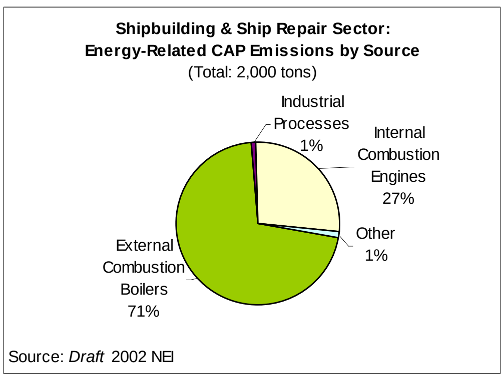
Figure 28 compares NEI data on energy-related CAP emissions with total CAP emissions for the shipbuilding and ship repair industry. Onsite energy-related CAP emissions are small compared with other sectors considered in this analysis—approximately 2,000 tons per year compared with more than 700,000 tons per year for the chemical manufacturing industry.

Effects of Energy-Related CAP Emissions

SO_2 and NO_x emissions contribute to respiratory illness and may cause lung damage. Emissions also contribute to acid rain, ground-level ozone, and reduced visibility.

It is important to note that NEI data attribute emissions to the generating source rather than the purchasing entity. Given the sector's reliance on purchased electricity, NEI data underestimate the industry's energy-related CAP emissions. According to NEI data shown in Figure 29, 63 percent of energy-related emissions are from residual oil consumption and 25 percent are from distillate oil consumption. Figure 28 shows that use of these fuels contributes to high fractions of sulfur dioxide and nitrogen oxide emissions, with those two pollutants comprising 83 percent of total CAP emissions.

Figure 29: Shipbuilding and ship repair sector: CAP emissions by source category and fuel usage



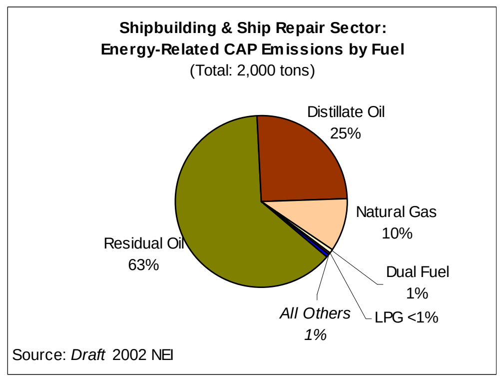


Figure 29 presents NEI data on the sources of energy-related CAP emissions shown in Figure 28, by source category and fuel usage. According to NEI data, the primary opportunities for reducing energy-related CAP emissions lie with reductions in petroleum-based fuel consumption and increased efficiency for external combustion boilers and internal combustion engines. Economic pressures on the industry could lead to reductions in petroleum consumption, which would decrease energy-related CAP emissions at the facility level, particularly sulfur dioxide and nitrogen oxides. Given the sector's dependence on purchased electricity, a portion of the sector's energy-related environmental footprint is linked to trends in electric generation, with most energy-related emissions impacts occurring at the utility level.

As there are no energy consumption projections for the shipbuilding and ship repair industry in AEO 2006, we do not report carbon dioxide emissions projections for this sector.

3.12.2 Best Case Scenario

Opportunities

Table 57 contains a brief assessment of five primary opportunities for improving environmental performance with respect to sector energy consumption, including potential barriers to implementing such opportunities.

Table 57: Opportunity assessment for the shipbuilding and ship repair industry

Opportunity	Ranking	Assessment (including potential barriers)
Cleaner fuels	Low	Due to the sector's dependence on purchased electricity, the environmental impact of energy inputs will follow national trends for electric generation. There may be some opportunity for clean fuels improvement through increased use of renewable energy, either at the facility level or in electric generation, but cost considerations limit the magnitude of this opportunity.
Increased CHP	Low	The sector shows little opportunity for CHP.
Equipment retrofit/ replacement	High	Equipment replacement and retrofits offer opportunities for energy efficiency improvement, particularly in the areas of compressed air systems, air handling equipment, lighting, HVAC, and motors. In the forging process, gas-fired heating can be replaced with induction heating (uses a high-frequency electric current), which has lower operational costs and requires lower energy inputs. The industry's limited capital and competing capital demands are the primary barriers to equipment-related opportunities. Industry representatives note that less capital-intensive opportunities such as facility lighting upgrades may be relatively easier to approve.[302]
Process improvement	High	Process improvements may offer opportunities for energy efficiency improvement and also may improve product quality and reduce operating costs. For example, energy-related environmental impacts from welding processes may be reduced through use of alternative energy sources, automation/robotics, and reduced post-weld processing.[303] In forging processes, improved efficiency of press changeovers to reduce idle running time will also save energy.[304] A technical barrier to increased welding automation/robotics is the highly customized nature of most welding operations in U.S. shipyards, where there are relatively few repetitive production processes.
R&D	Low	Given the capital constraints and long-term economic forecast for the shipbuilding industry, low levels of investment in R&D of new technologies are expected. The Welding Industry Vision Workgroup did set forth R&D needs and challenges with respect to welding processes.

Optimal Future Trends

As no energy use projections are available for the shipbuilding industry, it is not possible to compare a business-as-usual energy scenario with an optimal energy scenario. However, a preferred energy management strategy for the shipbuilding industry would primarily involve faster replacement rates of existing equipment with energy-efficient equipment and increased adoption of process improvements.

Environmental Implications

Given the shipbuilding industry's dependence on purchased power, the majority of environmental benefits (in terms of decreased CAP and carbon emissions) from increased energy efficiency in the shipbuilding industry would occur outside the facility at the utility level from reductions in purchased electricity. Due to the magnitude of energy losses from fossil fuel fired electric power generation, efficiency gains at the site level could have a magnified impact on energy-related emissions at the utility level, depending on the energy sources employed by local electric power generators.

Replacing fossil fuel-fired equipment with electric-powered equipment (as in the case of induction heating in forging operations) would shift energy-related emissions from the facility to the utility level. Though electric-powered equipment may be more efficient, fossil fuel-fired electric power generation is associated with substantial energy losses that could offset efficiency gains in terms of energy-related emissions. Such outcomes would depend on local variations in electric power supply.

3.12.3 Other Reference Materials Consulted

U.S. Department of Transportation, Maritime Administration. *Report on Survey of U.S. Shipbuilding and Repair Facilities*.

MetalPass.com. *Welding Industry Vision Workshop Result*. Internet source. Available at http://www.metalpass.com/metaldoc/paper.aspx?docID=122.

U.S. Environmental Protection Agency. *National Emissions Inventory*. 2002.