
ANALYZING THE SHIP DISPOSAL OPTIONS

Chapters Two through Five examined the option of long-term storage and the three ship-disposal options: domestic recycling, overseas recycling, and reefing. This chapter reports on our comparative analysis of these four options and points the way toward the most cost-effective and environmentally sound course of action.

REMOVAL OF THE OVERSEAS RECYCLING OPTION

Congress recently considered legislation that would have directed the Navy and MARAD to renew foreign recycling. The initiative failed but may come up again in the future. We concluded that despite the favorable cost of the overseas recycling option for ship disposal, the number and breadth of the impediments it involves make its reliable implementation unlikely without congressional action. And even then, overseas recycling might face insurmountable problems under international law should the Basel Convention decide to regulate the ship recycling practice. It is our conclusion that neither the Navy nor MARAD should attempt to restart the overseas recycling of U.S. government ships until and unless Congress resolves the impediments and directs such a program.

COMPARATIVE ANALYSIS OF REMAINING THREE OPTIONS

Table 6.1 summarizes the cost estimates for the remaining three options: long-term storage, domestic recycling, and reefing. The long-term storage option assumes that the fleet will be maintained for 100 years. The recycling and reefing options anticipate 20-year programs to dispose of the entire inventory of 358 inactive ships.

Long-Term Storage

Long-term—i.e., 100 years—of storage will cost about \$4.9 billion in undiscounted FY00 dollars, or about \$1.2 billion discounted. The undiscounted cost

Table 6.1
Summary of Cost Estimates for Domestic Disposal Options

Option	Undis-counted Baseline	Undis-counted Range	Discounted Baseline	Average Annual Budget			
				Navy		MARAD	
Long-term storage	\$4.9B	\$3.8–\$7.7B	\$1.2B	\$20M–\$25M		\$25M–\$34M	
				Without Title Transfers	With Title Transfers	Without Title Transfers	With Title Transfers
Domestic recycling	\$1.9B	\$0.7–\$3.6B	\$1.4B	\$42M	\$28M	\$52M	\$66M
Reefing	\$0.5B	\$0.3–\$0.8B	\$0.4B	\$11M	\$8M	\$14M	\$17M

could be reduced to about \$4.3 billion if all ships were stored at MARAD facilities. The average annual budget impact should be \$50 million. As Chapter Two indicates, the accuracy of the cost estimates depends on the performance of three variables: the aging factor, costs associated with dry docking, and the interval between dry dock inspections. Figure 6.1 displays the sensitivities associated with these variables. It shows that each variable is somewhat sensitive, with the aging factor being the most sensitive. Should the aging factor increase

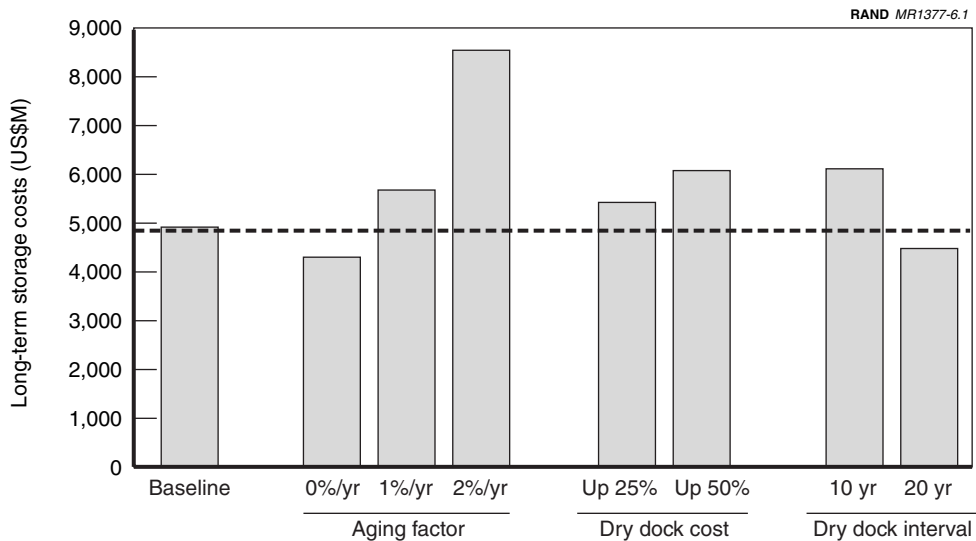


Figure 6.1—Sensitivities Within Long-Term Storage Costs

from the 0.5 percent per year used in the baseline case to 2 percent per year, the total costs could double. Dry dock costs and intervals may be somewhat less sensitive. Nevertheless, as Chapter Two notes, if a series of spills or increased corrosion problems were to cause fleetwide dry-dock intervals to decrease from 15 years to some shorter period of time, costs could rise.

Domestic Recycling

We estimate the total cost of the domestic recycling option to be about \$1.9 billion in constant FY00 undiscounted dollars, or \$1.4 billion in discounted dollars. While the number of ship titles each agency holds does not affect this total, it does affect the separate agency budgets. As title now stands, the Navy annual budget for this option would average \$42 million, and MARAD's would average \$52 million. If the Navy transfers to MARAD title to the 47 amphibious warfare and auxiliary ships in the 358 ship inventory, the average Navy inactive fleet budget will fall to about \$28 million while MARAD's rises to about \$66 million (see Chapter Three, Figures 3.4 and 3.5). The accuracy of these cost estimates depends on three variables: cost factors associated with dismantling the ships, cost savings from learning to be more efficient in the actual recycling process, and the potential to produce cost-offsetting revenues.

In addition, the accuracy of these estimates is sensitive to the value of four variables in the cost model. To account for complexity differences between the different ship classes, we adopted the ship complexity trend we used for the reefing option. This trend has a ± 16 percent error band. The labor costs we used are from PSNS and the SDP contractors; the average value of these data has a ± 30 percent error band. The learning curve for the heavy industry market is generally 95 percent; however, the range could be anywhere from 90 to 100 percent. Finally, scrap prices for ship recyclables vary greatly. To assess this sensitivity, we allowed for a ± 50 percent variation.

Dismantling costs include a great deal of manual labor, and the manual labor cost factor is among the most sensitive elements in the domestic recycling cost estimate. The Navy SDP contractors report that about half the cost of recycling a ship is in the dismantling phase, which is highly labor intensive. We believe better estimates will be possible as data on different classes of ships become available from the SDP.

Climbing the learning curve and discovering efficiencies could produce cost savings. A domestic recycling program should focus on providing a reliable, steady supply of ships to each contractor, perhaps sorted by ship type, to maximize efficiency gains. Each contractor may have different efficiency drivers, so the U.S. government will need to pay close attention if learning beyond the 95 percent learning curve used in our analysis is to be achieved.

Should PSNS’s experience of having learning efficiencies overcome by a growth in environmental costs be seen by other recyclers, then there may be no cost savings from learning. We coupled the ±46 percent starting point error with both 95 percent and 0 learning to produce, respectively, a minimum and a maximum cost estimate for the domestic recycling option.

Scrap prices, as noted above (and as detailed in Appendix D and discussed in Chapter Three), can be quite volatile. However, fluctuations in scrap steel prices have relatively little impact on the cost estimate for this option.

Figure 6.2 illustrates all of the sensitivities for the domestic recycling costs. The range of the total program cost for this option is very large. As a result, we believe that should this option be selected, the U.S. government will need to place long-term contracts with experienced ship recycling firms that are carefully monitored for progress and cost containment.

Reefing

Reefing is the least expensive domestic disposal option. Our baseline estimate for a 20-year reefing program is based on a 95 percent learning curve and a best fit to the available data for ship complexity and labor costs. For these conditions, our cost estimate is \$500 million in constant FY00 undiscounted dollars, or \$370 million discounted. Our best-case estimate is based on a 90 percent learning curve and the lower end of both the complexity error band (-16 per-

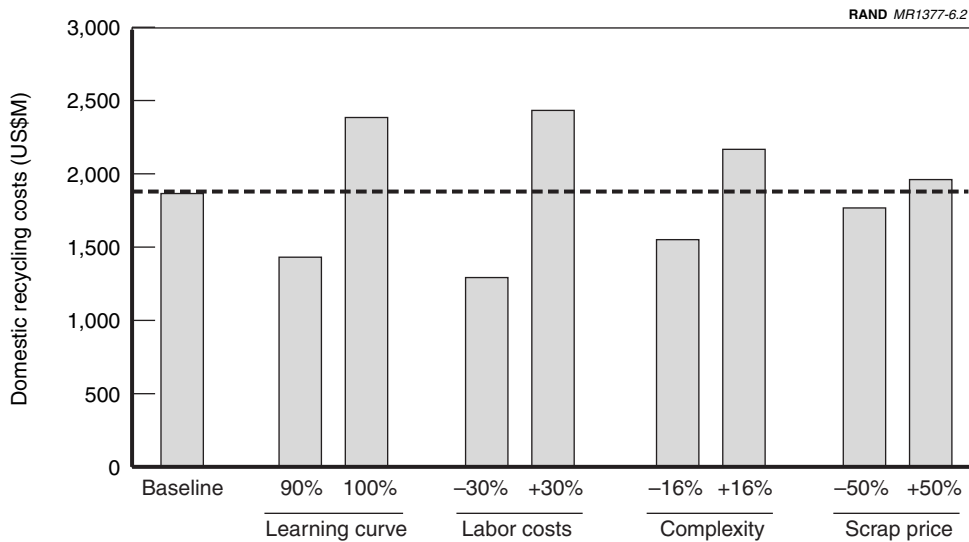


Figure 6.2—Sensitivities Within Domestic Recycling Costs

cent) and the labor cost error band (-30 percent). For these conditions, we arrive at \$320 million in constant FY00 undiscounted dollars, or \$240 million discounted. Our worst-case estimate is based on a flat learning curve and the upper end of both the complexity and the labor cost error envelopes. It is \$760 million in constant FY00 undiscounted dollars, or \$560 million discounted.

As with the domestic recycling option, each agency’s annual inactive fleet budget will depend on the number of ship titles the agency holds. As the titles now stand, the Navy’s annual budget for this option would average \$11 million, and MARAD’s would average \$14 million. With title transfer to MARAD of the Navy’s 47 auxiliary and amphibious warfare ships, the Navy’s annual budget would average \$8 million, MARAD’s about \$17 million. Our cost estimates include ship storage equaling about one-third of the total cost. If the ship storage expense is already in the existing agency budgets (we have not seen them), the actual budget increase required to implement the reefing option could be one-third less than the figures given.

As was also the case for domestic recycling, the learning curve has an important effect on reefing program cost. Figure 6.3 illustrates the range of costs based on our baseline, best-case, and worst-case costs and the sensitivity of the baseline to learning curves of 90 and 100 percent. For comparison, the figure also includes the cost to prepare all 358 ships for sinking exercises (SINKEX) at the average cost (reported to us by the Navy) of \$75 per ton.

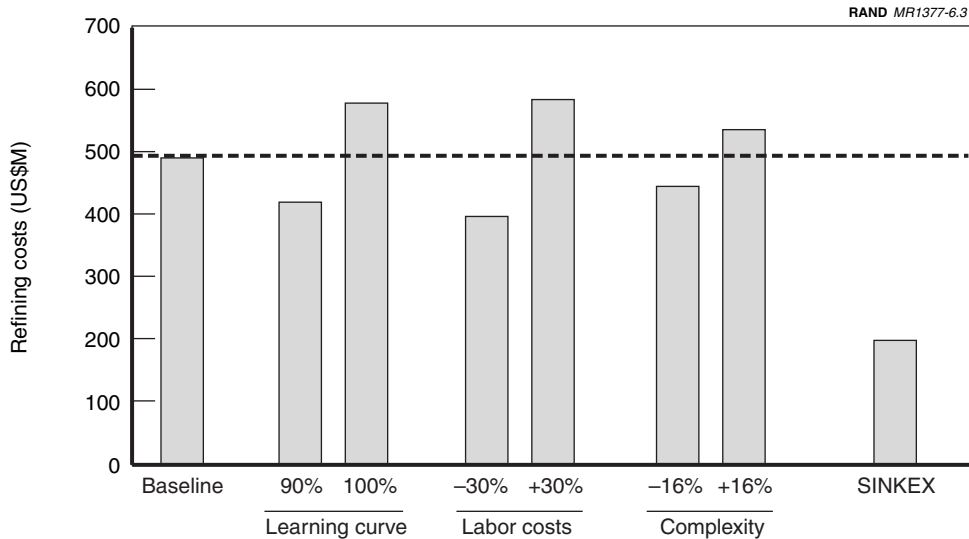


Figure 6.3—Sensitivities Within Reefing Costs

Reefing shares some learning experience sensitivities with domestic recycling, in this case with regard to the expectation that contractors will grow more efficient in preparing ships for reefing. However, because the reefing option is limited to 20 years and is based on a fairly extensive database of historic reefing preparation costs, it lacks the extreme sensitivity to variations in cost factors seen for the other options, variations that might explode and inflate the overall cost of those options much beyond our predictions. What could add to the predicted program cost for reefing is more-demanding new standards for reef preparation.

Reefing brings with it the potential for additional economic offsets in the form of benefits to communities: increased revenues from recreational diving, sport fishing, improved commercial fishing, and similar endeavors that prosper when reefing takes place in adjacent waters. As Chapter Five makes clear, there are two estimates for gross revenues from reefing: revenue per ship site and revenue per ship. Which estimate to use depends on whether ships are reefed singly or in groups. Nevertheless, the two estimates bound the possible outcomes. The average gross revenue per reef site is estimated at \$2.7 million per year or \$1.9 million per ship per year. Revenues accruing from taxes to state, federal, and local governments would build each year as the program proceeds, ultimately reaching between \$68 and \$170 million per year and continuing at that rate to the end of the reef system's lifetime. The growing tax revenue from the program would offset the program's total undiscounted average cost by as early as the twelfth year.

For the reefing option to succeed, a coordinated Navy-MARAD program will be needed. Given the demand for ships to use in reefing that is evident from the our surveys, there is likely to be strong competition for ships if a reefing program is announced. A way to ensure that the ships are equitably distributed will be needed. Also, one or both agencies will need a management program to handle expenditures and other details.

CONCLUSIONS

We did not attempt to identify the best solution for every individual ship in the 358-ship inventory. Our cost estimating techniques are accurate only for the aggregate of all 358 ships. Some ships, notably several in the MARAD inventory, are in very poor condition and may not be suitable for anything other than cautious and prompt recycling. Others may be unsuitable for one of the options because of size, military considerations, or some other specific issue. We therefore anticipate that a comprehensive program of disposal for all 358 ships will be some combination of domestic recycling, reefing, and intermediate storage.

The cost estimates for the reefing option are grounded in a sound set of cost data from other entities that have used reefing to dispose of unwanted vessels. Moreover, reefing is the only one of the options that has the potential to create revenue to the government (in the form of taxes from businesses associated with reef usage) beyond the ship-disposal costs the government will incur.

RECOMMENDATIONS

The Navy and MARAD should exploit the experience with the Navy's ongoing Ship Disposal Program to dispose of those inactive ships in the inventory that are in poor condition. This will reduce the current risk of sinking or some other environmentally notable incident. At the same time, both agencies should begin discussions between themselves and with the Environmental Protection Agency and coastal authorities aimed at developing standards and a program that will establish reefing as a viable course of action for disposal of as many of the 358 ships as possible. The goal should be to dispose of the current fleet by 2020 or earlier, as that conforms to a reasonable pace easily within the capacity of the available industrial base. Finally, no matter which option or combination of options is chosen, the Navy and MARAD should consider storing all of their inactive ships in MARAD facilities pending their disposal. That way they can take advantage of MARAD's lower annual storage costs.