Chapter 2: Industry Characterization

To accurately assess the potential impact of this emission control program, it is important to understand the nature of the affected industries. This chapter describes relevant background information related to each of the categories of engines and vehicles subject to this proposal. For each engine category, descriptions of the supply and demand sides of the markets are provided. Additionally, industry organization and historical market trends data are discussed.

2.1 CI Marine Engines and Recreational Boats

This section gives a general characterization of the segments of the marine industry that may be affected by the regulation. The emission control program may affect diesel marine engines and recreational boats that contain these engines. We therefore focus on the compression-ignition (CI) diesel marine engine manufacturing and recreational boat building industries. Information is also provided for several spark-ignition vessel categories, even though they are not directly affected by this rule (spark-ignition engines and vessels are the subject of a separate proposed rulemaking regarding evaporative emissions; See 67 FR 53050, August 14, 2002). This industry characterization was developed in part under contract with ICF Consulting[1] as well as independent analyses conducted by EPA through interaction with the industry and other sources.[2,3,4]

2.1.1 The Supply Side

This section describes the types of recreational boats that may contain CI marine engines, the inputs used to manufacture both boats and engines, and the costs associated with boat and engine production.

2.1.1.1 Product Types

Diesel engines are primarily available in inboard marine configurations and are most commonly found in inboard cruisers and inboard runabouts. The National Marine Manufacturers Association estimates that 18 percent of all inboard boats are equipped with diesel engines, with the dominant application being cruisers.[5] Diesel engines are also available in sterndrive configurations on a limited basis, and in the past, a small number of outboard boats contained diesel engines as well (currently there are no outboard diesel engines being manufactured). Descriptions of these boat types, taken from the Economic Impact Analysis of the Proposed Boat Manufacturing NESHAP, are provided here[6]:

- **Inboard runabouts** are mid-sized boats powered by an attached engine located inside the hull at the middle or rear of the boat, with a prop shaft running through the bottom of the boat. Most inboard runabouts are tournament ski boats.
- **Inboard cruisers** are large boats with cabins. Almost all cruisers are equipped with two inboard engines.

- **Sterndrives** are mid-sized boats powered by an attached inboard engine combined with a drive unit that is located on the transom at the stern (rear) of the boat. Sterndrives are also known as inboard/outboards or I/Os.
- **Outboards** are small to medium-sized boats powered by a self-contained detachable engine and propulsion system, which is attached to the transom. This category of boats includes most runabouts, bass boats, utility boats, offshore fishing boats, and pontoons.

Larger boats are powered exclusively by diesel inboard engines. These boats are generally 40 feet or greater in length. Recreational boats in ports with access to the ocean (e.g. Seattle) can be 80 to 100 feet or longer. The larger boats typically require twin inboard diesel engines with 2,000 total horsepower or more. Recreational diesel marine engines are generally produced by domestic companies that have been long-standing players in the marine diesel engine market. The three companies that tend to dominate the market are Caterpillar, Cummins, and Detroit Diesel (see Section 2.1.3.2 for details about these companies). Nearly 75 percent of diesel engines sales for recreational vessels in 2000 can be attributed to these three companies.

Sterndrive boats equipped with diesel engines account for less than 1 to 2 percent of the market. A minority of mid-sized boat owners insist on diesel powered sterndrive engines for their boats. Diesel marine sterndrive systems generally power the same types of boats as their gasoline counterparts, which tend to be 15 to 30 feet in length. Customers that choose a diesel sterndrive marine engine are generally seeking three main advantages over gasoline sterndrive marine engines. First, diesel fumes are much less ignitable and explosive that gasoline fumes. Second, diesel powered craft have a greater range than gasoline powered craft with similar fuel capacity. Lastly, diesel engines tend to be more reliable and tend to run more hours between major overhauls than gasoline engines. This last point is particularly important to boat owners who operate their boats higher than the average.

One major disadvantage of diesel sterndrive engines is their cost relative to comparably powered gasoline sterndrive engines. For example, a 40 foot twin cabin cruiser with twin gasoline sterndrive engines costs $238,000. For twin diesel sterndrive engines, the price increases by approximately $50,000. The fact that the diesel engine is more expensive, coupled with the fact that diesel fuel is often less available than gasoline in the U.S., has resulted in limited domestic demand for recreational diesel sterndrive marine engines.

2.1.1.2 Primary Inputs

The primary inputs used to produce marine engines and recreational boats, can be divided into four major categories: capital, labor, energy, and materials. Capital refers to the type of equipment used in production where the type of capital depends upon the good being produced. The same is true for labor, as different skills are required for the production of boats relative to engines. Energy refers to the electricity, natural gas, or other power sources used to operate production equipment and plants at which boats and engines are manufactured. Material inputs are what differ the most across the production of these end products. The remainder of this section focuses on the different materials used to produce CI marine engines and recreational boats.

Some of the main materials used to produce CI marine engines include fluid power pumps, motors, and transmissions; fluid power cylinders, filters, valves, hoses, and their assemblies; metal bolts, nuts, screws, washers, and tanks; iron, steel, and nonmetal forgings and castings; steel bars, plates, piston rings, and other steel shapes and forms; gears, gaskets, and fabricated plastic products; engine electrical equipment such as spark plugs, generators, and starters; and rubber and plastic hosing and belting. All of these inputs are used in conjunction with energy, capital, and skilled labor to manufacture engines.

Main inputs used in the production of recreational boats include marine engines, plastic and aluminum fuel tanks, and rubber fuel hoses. However, these are but a few of the materials used in boat manufacturing. Others include marine metal hardware, such as propellers, castings, screws, washers, and rivets; metal forgings, castings, and other steel forms; aluminum and aluminum-base alloy sheet, plate, foil, rod, bars, and pipes; fiberglass, lumber, plywood, canvas products, and carpeting; plastic rods, tubes, and shapes; and paints, varnishes and lacquers.

2.1.1.3 Costs of Production

The historical production costs of marine engines and recreational boats are divided into the primary input categories of labor, materials, and capital expenditures. Table 2.1-1 presents the value of shipments (VOS), production costs, and production costs as a share of the VOS for the other engine equipment manufacturing industry (which includes marine engine manufacturing). Table 2.1-2 shows the same figures for the boat manufacturing industry. The other engine equipment manufacturing industry is identified by Standard Industrial Classification (SIC) code 3519 and the North American Industrial Classification System (NAICS) code 333618. The SIC code and the NAICS code for the boat building industry are 3732 and 336612.

For both engine manufacturing and boat building, the average share of the cost of materials and total capital expenditures is similar. The cost of materials represents an average of 57 to 58 percent of the VOS for both industries and average share of capital expenditures for both industries is approximately 2 to 3 percent. Another trend evident for both industries is that the cost shares of materials and payroll tended to be higher in the earlier part of the 1990s than in the late 1990s. Payroll, which includes the costs associated with employee wages and benefits, differs slightly across the industries. For the boat manufacturing industry, payroll represents an average of 20 percent of VOS while for engine manufacturing, it is equal to an average share of 14 percent of its shipment value.

Also notable in these tables is that the average VOS for the engine manufacturing industry, over $16 billion, is about three times the average VOS for the boat manufacturing industry. It is important to keep in mind that the data in Table 2.1-1 include other engine equipment manufacturing and does not represent marine engine manufacturing exclusively. Likewise, the figures in Table 2.1-2 for boat manufacturing include vessels that are not powered by CI engines, such as outboards, jet skis, personal water craft, and boats that are not motorized, such as canoes and kayaks.

Table 2.1-1
Value of Shipments and Production Costs for the SIC and NAICS Codes that Include Recreational Boat Engine Manufacturers*, 1992 - 1999 [7,8,9,10,11,12,13]

		Value of Shipments	Payroll		Cost of Materials		Total Capital Expenditures	
Year	Industry Code	($$10^6$)	($$10^6$)	% of VOS	($$10^6$)	% of VOS	($$10^6$)	% of VOS
1992	SIC 3519	$11,827	$2,072	18%	$6,996	59%	$461	4%
1993	SIC 3519	$12,600	$1,900	15%	$7,545	60%	$371	3%
1994	SIC 3519	$15,308	$2,162	14%	$8,977	59%	$406	3%
1995	SIC 3519	$16,642	$2,238	13%	$9,940	60%	$499	3%
1996	SIC 3519	$17,286	$2,237	13%	$9,905	57%	$528	3%
1997	NAICS 333618	$19,011	$2,374	12%	$10,539	55%	$631	3%
1998	NAICS 333618	$20,312	$2,471	12%	$11,963	59%	$682	3%
1999	NAICS 333618	$22,389	$2,652	12%	$12,474	56%	$786	4%
	Average	$16,922	$2,263	14%	$9,792	58%	$545	3%

* Value of Shipments, Payroll, Cost of Materials, and Total Capital Expenditures are in nominal U.S. dollars

Table 2.1-2
Value of Shipments, and Production Costs for the SIC and NAICS Codes that Include Recreational Boat Manufacturers*, 1992 - 1999 [14,15,16,17,18,19,20]

		Value of Shipments	Payroll		Cost of Materials		Total Capital Expenditures	
Year	Industry Code	($$10^6$)	($$10^6$)	% of VOS	($$10^6$)	% of VOS	($$10^6$)	% of VOS
1992	SIC 3732	$4,599	$1,006	22%	$2,609	57%	$63	1%
1993	SIC 3732	$4,975	$1,033	21%	$2,919	59%	$83	2%
1994	SIC 3732	$5,334	$1,081	20%	$3,075	58%	$90	2%
1995	SIC 3732	$5,597	$1,105	20%	$3,218	57%	$89	2%
1996	SIC 3732	$5,823	$1,177	20%	$3,396	58%	$109	2%
1997	NAICS 336612	$5,607	$1,030	18%	$3,237	58%	$122	2%
1998	NAICS 336612	$5,939	$1,114	19%	$3,202	54%	$263	4%
1999	NAICS 336612	$7,463	$1,361	18%	$4,099	55%	$231	3%
	Average	$5,667	$1,113	20%	$3,219	57%	$131	2%

* Value of Shipments, Payroll, Cost of Materials, and Total Capital Expenditures are in nominal U.S. dollars

Looking specifically at the engine manufacturing industry, we see that the share of payroll steadily declined over the 1992 - 1999 time period. In 1992, payroll represented 18 percent of the VOS but by 1995, it was down to 13 percent. Labor costs fell to 12 percent of the VOS in 1997 and remained at this lower share value through 1999. A declining trend is also evident for the share of payroll for the boat manufacturing industry, however it was more recently that the share of labor costs fell. In 1992, labor costs were equal to 22 percent of the boat manufacturing industry's VOS. It dropped to 20 percent from 1994 to 1996 and most recently was equal to 18 to 19 percent in the late 1990s.

2.1.1.4 Recreational Boat Production Practices

Based on information supplied by a variety of recreational boat builders, the following discussion provides a description of the general production practices used in this sector of the marine industry.

Engines are usually purchased from factory authorized distribution centers. The boat builder provides the specifications to the distributor who helps match an engine for a particular application. It is the boat builders responsibility to fit the engine into their vessel design. The reason for this is that sales directly to boat builders are a very small part of engine manufacturers' total engine sales. These engines are not generally interchangeable from one design to the next. Each recreational boat builder has their own designs. In general, a boat builder will design one or two molds that are intended to last 5-8 years. Very few changes are tolerated in the molds because of the costs of building and retooling these molds.

Recreational vessels are designed for speed and therefore typically operate in a planing mode. To enable the vessel to be pushed onto the surface of the water where it will subsequently operate, recreational vessels are constructed of lighter materials and use engines with high power density (power/weight). The tradeoff on the engine side is less durability, and these engines are typically warranted for fewer hours of operation. Fortunately, this limitation typically corresponds with actual recreational vessel use. With regard to design, these vessels are more likely to be serially produced. They are generally made out of light-weight fiberglass. This material, however, minimizes the ability to incorporate purchaser preferences, not only because many features are designed into the fiberglass molds, but also because these vessels are very sensitive to any changes in their vertical or horizontal centers of gravity. Consequently, optional features are generally confined to details in the living quarters, and engine choice is very limited or is not offered at all.

Based on information supplied by a variety of recreational boat builders, fuel tanks for recreational boats are usually purchased from fuel tank manufacturers. However, some boat builders construct their own fuel tanks. The boat builder provides the specifications to the fuel tank manufacturer who helps match the fuel tank for a particular application. It is the boat builder's responsibility to install the fuel tank and connections into their vessel design. For vessels designed to be used with small outboard engines, the boat builder may not install a fuel tank; therefore, the end user would use a portable fuel tank with a connection to the engine.

2.1.2 The Demand Side

The information provided in this section addresses the various options consumers have available regarding recreational marine vessels and the engines used to power them. Some of the engine-powered recreational boats available to consumers include inboards, sterndrives, outboards, personal water craft, and jet boats.

2.1.2.1 Uses and Consumers

Recreational boats are used for a number of water-related pastimes including fishing, waterskiing, cruising, vacationing, relaxing on the water, sunning, and a host of other activities. Runabouts are commonly used for waterskiing, tubing, and wakeboarding. Larger cruisers and yachts can be used for extended trips because they may be equipped with cabins for cooking and sleeping. Fishing boats can vary in size depending on whether they are used for offshore sport fishing or local lake fishing. Other boats, such as personal water craft, sailboats, canoes, and rowboats can be used for cruising along the water.

According to the National Marine Manufacturers Association (NMMA), there are currently close to 70 million people participating in recreational boating. In the late 1990s, this figure was closer to 80 million, but the recent economic downturn has led consumers to engage in fewer leisure activities. From Table 2.1-3, we can see that outboard boats are the most common boat type, followed further behind by inboard and sterndrive boats. The number of inboards and sterndrives owned in the U.S. are roughly equivalent over the 1997 to 2001 time period.

Table 2.1-3
Recreational Boating Population Estimates (10^3)*, 1997 - 2001 [21,22]

	1997	1998	1999	2000	2001
People participating in recreational boating	78,406	74,847	73,208	72,269	69,486
All boats in use	16,230	16,824	16,790	16,991	16,999
Outboard boats owned	8,125	8,300	8,211	8,288	8,342
Inboard boats owned	1,587	1,609	1,635	1,660	1,678
Sterndrive boats owned	1,582	1,673	1,665	1,709	1,743
Personal water craft	1,000	1,100	1,096	1,078	1,631

* These in-use figures are based on the actual state and Coast Guard registrations. Population estimates are rounded to the nearest thousandths.

The type of boat purchased by a consumer and the type of engine it is equipped with are affected by the recreational activity the consumer plans to engage in, the size of the boat being purchased, and other consumer preferences. For example, if a larger inboard cruiser is selected for purchase, the consumer will likely opt for a diesel engine. Diesel engines are, in general, more expensive, but have a longer life span than gasoline engines. In addition, diesel engines are available at much higher power ratings. However, if the consumer prefers a smaller fishing boat with an outboard engine configuration, it will be equipped with a gasoline engine.

Generally speaking, recreational boats are considered final goods while the engines that power them are intermediate goods. As discussed in Section 2.1.1.4, boat builders purchase engines from distribution centers and then use these engines as inputs to the production of boats. Boat builders may provide their own engine designs to engine manufacturers so that the engines will properly fit into the boat builders' specific models.

2.1.2.2 Substitution Possibilities

Consumers can substitute across different boat types but may be limited by the water-related activities they want to engage in. Runabouts and cruisers are available in different engine configurations and different engine types. Consumers will first evaluate the purpose for which they'd like to buy a boat and will then consider the various types of boats that will suit their preferences. If consumers choose to purchase either sterndrive or inboard boats, they have both diesel and gasoline engines available to them. Outboards, on the other hand, are only available with gasoline engines.

Consumers may be interested in engaging in water-related activities, but may instead consider purchasing non-motorized boats. For example, consumers who are like to float out on the water or engage in lake fishing may choose to purchase a sailboat, row boat, or canoe. These non-motorized boating options do not allow the consumer to participate in the same set of water-related activities as would the purchase of a motorized boat, but they may be considered substitutes for less intensive water-related past times.

2.1.3 Industry Organization

It is important to gain an understanding of how the recreational marine vessel and CI marine engine industries may be affected by the emissions control program. One way to determine how increased costs might affect the market is to examine the organization of each industry. This section provides data to measure the competitive nature of the boat building and marine engine industries and lists the manufacturers of recreational boats, marine engines, and marine fuel tanks.

2.1.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and Herfindahl-Hirschman indices (HHI) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices for the six digit NAICS code level for the year 1997, the most recent year available. Tables 2.1-4 and 2.1-5 provide the four- and eight-firm concentration ratios (CR4 and CR8, respectively) and the Herfindahl-Hirschman indices for the other engine equipment manufacturing and boat building industries (the other engine equipment manufacturing industry includes manufacturers of marine engines). These industries are represented by NAICS codes 333618 and 336612, respectively. Concentration ratios are provided in percentage terms while HHI are based on a scale formulated by the Department of Justice.

Table 2.1-4
Measures of Market Concentration for the NAICS Code that Includes Recreational Boat Engine Manufacturers, 1997 [23]

Description	CR4	CR8	HHI	VOS ($\$10^6$)	Number of Companies
NAICS 333618	55.8	76.0	1019.1	$19,011.09	245

Table 2.1-5
Measures of Market Concentration for the NAICS Code that Includes Recreational Boat Manufacturers, 1997 [24]

Description	CR4	CR8	HHI	VOS ($\$10^6$)	Number of Companies
NAICS 336612	41.4	48.9	644.5	$5,607.30	984

The criteria for evaluating the HHI are based on the 1992 Department of Justice Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries have more ability to influence market prices. Based on these criteria, the marine vessel industry can be modeled as perfectly competitive for the purposes of the economic impact analysis. The other engine equipment manufacturing industry is slightly more concentrated, with higher CRs and an HHI value just over 1,000. However, it is reasonable to assume that the marine engine manufacturing industry is perfectly competitive for the economic analysis.

2.1.3.2 CI Marine Engine and Recreational Boat Manufacturers

We have determined that there are at least 16 companies that manufacture CI marine engines for recreational vessels. Nearly 75 percent of diesel engines sales for recreational vessels in 2000 can be attributed to three large companies. Six of the identified companies are considered small businesses as defined by the Small Business Administration SBA) size standard for NAICS code 333618 (less than 1000 employees). Based on sales estimates for 2000, these six companies represent less than 5 percent of recreational marine diesel engine sales. Table 2.1-6 provides a list of the diesel engine manufacturers identified to date by EPA.

Table 2.1-6
Annual Sales for Recreational Diesel Marine Engine Manufacturers Identified by EPA, 2000/2001 [25,26,27]

Companies with greater than 1,000 employees	Annual Sales[a] ($10^6)	Companies with less than 1,000 employees	Annual Sales[a] ($10^6)
Caterpillar, Inc. (Engines Div.)[b]	**$2,176.0**	Alaska Diesel Electric/Lugger	$9.2
Cummins Engine Company, Inc.	**$6,600.0**	American Diesel Corporation	$5.0
Detroit Diesel Engines	**$2,358.7**	Daytona Marine	$2.9
Isotta Fraschini	NA[c]	Marine Power, Inc.	$7.0
Deere & Company	$13,137.0	Peninsular Diesel Engines, Inc.	NA[c]
Marine Corporation of America	NA[c]	Westerbeke Corporation	$29.1
Mercruiser	$68.6		
MTU Aero Engine Components	$7.9		
Volvo Penta	$275.0		
Yanmar Diesel America Corporation	$18.9		

[a] Annual sales of listed companies include revenues received from the sale of all products sold by these companies, not just revenues received from the sales of diesel marine engines.
[b] Companies in **bold** dominate the diesel engine market for recreational vehicles.
[c] NA means Not Available.

Less precise information is available about recreational boat builders than is available about engine manufacturers. Several sources were used, including trade associations, business directories, and Internet sites when identifying entities that build and/or sell recreational boats. We have also worked with an independent contractor to assist in the characterization of this segment of the industry. Finally, we have also obtained a list of nearly 1,700 boat builders known to the U.S. Coast Guard to produce boats using recreational gasoline and diesel engines. At least 1,200 of these companies install gasoline-fueled engines and would therefore be subject to the proposed evaporative emission standards. More that 90 percent of the companies identified to date would be considered small businesses as defined by SBA size standards for NAICS code 336612 (less than 500 employees). Table 2.1-7 provides a sample of recreational boat manufacturers known to EPA.

Table 2.1-7
Annual Sales and Employment for a Sample of Recreational Boat Manufacturers Identified by EPA, 2000/2001 [28,29,30]

Company	Annual Sales[a] ($$10^6$)	Employment
Bayliner Marine Corporation	$450.0	2,500
Beneteau USA Limited	$1.7	10
Boston Whaler, Inc.	$6.0	600
Brunswick Marine Group	$483.0	2,900
Carver Boat Corporation	$149.8	1,300
Catalina Yachts	$35.0	250
Correct Craft, Inc.	$35.0	250
Crestliner, Inc.	$50.0	350
Fiberglass Unlimited	$1.0	16
Fountain Powerboats, Inc.	$57.5	390
Four Winns, Inc. LLC	$46.6	500
Genmar Industries	$869.0	6,500
Glastron Boats	$58.0	650
Godfrey Marine	$51.4	550
Grady-White Boats, Inc.	$55.0	500
Hood Yacht Systems	NA[b]	NA[b]
Lowe Boats	$43.8	380
Lund Boat Company	$60.4	525
Magnum Marine Corporation	$6.9	60
Mariah Boats, Inc.	$31.7	275
MasterCraft Boat Company	$87.0	500
Morgan Marine	$37.1	400
Ocean Yachts, Inc.	$14.6	150
Old Town Canoe Company	$11.5	100
Palmer Johnson, Inc.	$23.0	200
Porta-Bote International	$3.6	32
Regal Marine Industries, Inc.	$85.0	700
S2 Yachts, Inc.	$78.0	600
Sabre Corporation	$18.4	160
Sea Ark Boats, Inc.	$6.0	100
Seaswirl Boats, Inc.	$28.8	250
Skeeter Boats, Inc.	$45.0	200
Smoker-Craft Boats, Inc.	$52.0	400
Sport-Craft Boats, Inc.	$23.0	200
Sunbird Boat Company, Inc.	$28.8	250
Tracker Marine, LLP	$57.0	2,400

[a] Annual sales of listed companies include revenues received from the sale of all products sold by these companies, not just revenues received from the sales of recreational boats.
[b] NA means Not Available.

2.1.4 Markets

This section examines select historical market statistics for inboard and sterndrive boats and engines. It presents domestic quantities, values, and unit prices for both boat types as well as shipment data for inboard and sterndrive engines. Also presented are quantities and values of exports and imports of both inboard and sterndrive boats and engines. The section concludes with the current trends of the marine industry. EPA focuses on these two boat configurations because they are available with diesel engines.

2.1.4.1 Quantity and Price Data

Quantities of shipments produced domestically, real values of shipments, and unit price data are presented in Tables 2.1-8 through 2.1-10 for inboard runabouts, inboard cruisers, and sterndrive boats equipped with SI and CI engines (disaggregated data were not available by engine type). Real unit price data are calculated by simply dividing real value of shipments by the quantity of shipments produced. Also provided are domestic shipment data for inboard and sterndrive engines in Table 2.1-11 (price data were not available). While a fraction of inboard boats are equipped with diesel engines (approximately 18 percent), recall that only 1 to 2 percent of sterndrive boats contain diesel engines and that sterndrives with diesel engines are more expensive than those operating with SI engines. Also note that virtually all diesel engines in inboard boats are placed in cruisers. Only 1 to 2 percent of inboard runabouts contain CI engines. Because these three boat categories may contain diesel engines, their market data are discussed here.

An overall examination of the data for all three boat types shows that the quantity of shipments, real value of shipments, and real unit values all increased over the 1980 to 2000 time period. Comparing across these boat types shows that the average annual growth rates are highest for quantities and shipment values for inboard runabouts (9.5 percent for the quantity of shipments and close to 12 percent for the real value of shipments). The average growth rates for these same variables are lowest for sterndrive boats (the quantity of shipments grew at an average annual rate of under 4 percent and the average annual growth rate for the value of shipments was 5 percent). Also notable is that the unit price of inboard runabouts increased, on average, at a lower rate than for inboard cruisers and sterndrives. Though the average annual growth rates are positive across the variables presented, there is definite evidence of dips in the quantity of shipments and real value of shipments for inboard cruisers, and in all three variables for sterndrive boats. These trends are not existent for inboard runabouts. Before examining the historical data presented for inboard cruisers and sterndrives, a closer examination at inboard runabouts is warranted.

Table 2.1-8
Recreational Inboard Runabout Boats - Domestic Quantity of Shipments, Value of Shipments, and Unit Values, 1980 - 2000 (1996$) [31,32]

Year	Quantity of Shipments (units)	Real Value of Shipments ($$10^3$)	Real Unit Value ($)
1980	2,900	$52,226	$18,009
1981	2,950	$55,860	$18,935
1982	3,200	$63,030	$19,697
1983	3,900	$71,217	$18,261
1984	4,500	$84,727	$18,828
1985	4,500	$92,238	$20,497
1986	5,300	$113,964	$21,503
1987	6,600	$137,669	$20,859
1988	7,400	$163,263	$22,063
1989	9,100	$215,846	$23,719
1990	7,500	$152,414	$20,322
1991	6,200	$129,380	$20,868
1992	6,400	$126,358	$19,743
1993	6,800	$141,809	$20,854
1994	7,200	$148,725	$20,656
1995	6,900	$150,673	$21,837
1996	6,000	$126,234	$21,039
1997	6,100	$133,733	$21,923
1998	6,900	$155,707	$22,566
1999	12,100	$293,742	$24,276
2000	13,600	$342,465	$25,181
Avg. Annual Growth Rate	9.5%	11.9%	1.9%

Of the three boat types presented here, domestic shipments and the real value of domestic shipments grew at a higher annual rate, on average, for inboard runabouts. In 1980, just under 3,000 inboard runabouts were being manufactured and distributed in the U.S. The real value of these boats (in 1996 dollars) was over $52 million, with the average inboard runabout equal to a real value of $18,000. By 1990, both the quantity of shipments and the real value of shipments more than doubled. Unit prices increased, but only by 12 percent. In 2000, quantity of shipments, shipment values, and unit values hit their peak. U.S. shipments of inboard runabouts were equal to 13,600, real value of shipments equaled over $342 million, and the real value was just over $25,000.

Table 2.1-9
Recreational Inboard Cruiser Boats - Domestic Quantity of Shipments, Value of Shipments, and Unit Values, 1980 - 2000 (1996$) [33,34]

Year	Quantity of Shipments (units)	Real Value of Shipments ($$10^3$)	Real Unit Value ($)
1980	5,300	$802,253	$151,368
1981	5,450	$861,890	$158,145
1982	5,125	$854,167	$166,667
1983	7,485	$1,060,700	$141,710
1984	10,780	$1,604,094	$148,803
1985	12,200	$1,811,865	$148,514
1986	12,700	$1,894,840	$149,200
1987	13,100	$2,135,718	$163,032
1988	13,500	$2,355,750	$174,500
1989	12,300	$2,299,952	$186,988
1990	7,500	$1,589,672	$211,956
1991	3,600	$742,680	$206,300
1992	3,550	$675,032	$190,150
1993	3,375	$696,830	$206,468
1994	4,200	$927,793	$220,903
1995	5,460	$1,193,367	$218,565
1996	5,350	$1,215,268	$227,153
1997	6,300	$1,636,375	$259,742
1998	6,600	$1,631,720	$247,230
1999	7,000	$1,713,733	$244,819
2000	8,000	$2,123,768	$265,471
Avg. Annual Growth Rate	5.0%	7.9%	3.1%

Inboard cruisers are larger boats and hence have higher value of shipments and average unit value measures. An examination of Table 2.1-9 shows that this market has grown over the 1980 to 2000 time period. Evidence of growth in this market can be seen by examining the average annual growth rates. The real average price of an inboard cruiser was equal to slightly more than $151,000 in 1980, but by the year 2000, prices reached a peak of $265,471 (a net price increase of 75 percent). Real shipment values also showed a large increase starting at $802 million in 1980 and rising to over $2.1 billion in 2000. The reason for the large price increase is evident because the rise in the quantity of shipments from 1980 to 2000 was not as dramatic as the rise in the real value of shipments. The net increase in the quantity of shipments for the 1980 to 2000 time period was 50 percent.

During the mid to late 1980s, the quantity and real shipment values of inboard cruisers steadily increased to reach their peak. In 1983, 7,485 inboard cruisers were manufactured with a total real value of $1.6 billion. By 1988, shipments rose to 13,500 and the real value of shipments exceeded $2.35 billion. The average value of this boat type in this same year was

$174,500. This surge in the market for inboard cruisers was followed by a large decline in the quantities and values of shipments. By 1993, the domestic quantity of inboard cruisers fell to its lowest level at 3,375 and real value of shipments was close to its lowest level at just under $700 million.

Table 2.1-10
Recreational Sterndrive Boats - Domestic Quantity of Shipments, Value of Shipments, and Unit Values, 1980 - 2000 (1996$) [35,36]

Year	Quantity of Shipments (units)	Real Value of Shipments ($$10^3$)	Real Unit Value ($)
1980	56,000	$1,080,702	$19,298
1981	51,000	$1,052,492	$20,637
1982	55,000	$1,039,167	$18,894
1983	79,000	$1,412,841	$17,884
1984	108,000	$2,031,008	$18,806
1985	115,000	$2,247,784	$19,546
1986	120,000	$2,481,280	$20,677
1987	144,000	$3,141,231	$21,814
1988	148,000	$3,230,840	$21,830
1989	133,000	$2,836,265	$21,325
1990	97,000	$2,062,421	$21,262
1991	73,000	$1,436,559	$20,553
1992	75,000	$1,347,147	$19,251
1993	75,000	$1,322,872	$17,580
1994	90,000	$1,738,313	$17,271
1995	93,000	$1,827,867	$18,920
1996	64,500	$1,925,248	$19,138
1997	92,000	$2,027,969	$29,264
1998	91,000	$2,046,755	$21,829
1999	79,600	$1,956,644	$22,063
2000	78,400	$2,106,395	$24,122
Avg. Annual Growth Rate	3.7%	5.0%	2.0%

The annual domestic quantities of sterndrive boat shipments far exceed the quantities of inboard runabouts and inboard cruisers combined. They are mostly equipped with gasoline engines and are in a similar price range as inboard runabouts. A closer examination of Table 2.1-10 shows that this market peaked and dipped during the same years as the inboard cruiser market. This general expansion of the market for recreational boats in the late 80s was due to higher economic growth for the U.S. In 1988, shipments of sterndrives were equal to 148,000 (an 87 percent increase over the year 1983 quantity) and shipment values were equal to over $3.2 billion (a 128 percent increase in the real shipment value in 1983). Also notable is that though unit values of sterndrives are far less than those for inboard cruisers, the real value of shipments are very close for these boat types (approximately $2.1 billion in the year 2000). The value of the market for inboard runabouts is far smaller at a value of $342 million in 2000.

Table 2.1-11 below provides the quantity of shipments of inboard and sterndrive engines combined. These data also combine gasoline and diesel engines. What is clear from this table is that the shipment quantities tend to reflect the peaks and dips seen in the data for sterndrives and inboard cruisers. Domestic engine shipments rose to their highest value in 1988 at a total of 211,900. They then fell over the remainder of the 1980s and early 1990s to quantities in the low 90 thousands. In the mid 1990s there was a slight rise in engine shipments to a total of 120,000 but in the year 2000, the quantity fell to just over 105,000.

Table 2.1-11
U.S. Shipments of Inboard and Sterndrive Engines, 1980 - 2001 [37]

Year	Quantity of Shipments	Year	Quantity of Shipments
1980	87,750	1991	92,400
1981	81,500	1992	94,600
1982	85,650	1993	94,700
1983	104,125	1994	114,000
1984	148,000	1995	120,000
1985	155,000	1996	120,000
1986	161,900	1997	116,100
1987	210,800	1998	104,500
1988	211,900	1999	108,500
1989	190,700	2000	110,400
1990	134,100	2001	105,800

2.1.4.2 Foreign Trade

Tables 2.1-12 and 2.1-13 present trade data for inboard and sterndrive boats. Over the 1992 to 2000 time frame, import values of these boat types grew. A large increase in the value of inboard cruiser imports was evident from 1999 to 2000. Though they initially are larger, export values for these boat types do not show the same rising trend. For both boat types, export values dipped in the early 1990s and then steadily rose through the remainder of the decade. Inboard export value never recovered to its 1992 level, but sterndrive exports did. In fact, the 2000 value of sterndrive exports exceeded its value in 1992.

Further comparisons can be made between exports and imports of each boat type. As the data in these tables show, inboard import values exceeded their export values during the latter half of the 1990s. This was not always the case, as prior to 1996, export values were greater. In 1992, the value of inboard imports was only equal to 16 percent of the value of exports but by 1995, they caught up to exports and equaled 92 percent of inboard export values. In 2000, inboard exports were equal to a fraction of their imports (37 percent).

Table 2.1-12
Import Values[a] (10^3) of Inboard and Sterndrive Boats, 1992 - 2000 [38,39]

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Inboard Runabouts	8,957	16,781	21,069	56,199	135,800	221,497	301,226	348,107	303,910
Inboard Cruisers[b]	32,859	87,997	113,858	143,620	142,007	90,184	113,173	151,170	220,214
Inboards Total	41,816	104,778	134,927	199,819	277,807	311,681	414,399	499,277	524,124
Sterndrive Runabouts	10,900	7,965	9,479	15,224	12,090	11,637	22,494	27,894	30,139
Sterndrive Cruisers[c]	10,976	10,302	18,042	14,779	15,955	15,414	42,599	53,653	70,725
Sterndrives Total	21,876	18,267	27,521	30,003	28,045	27,051	65,093	81,547	100,864

[a] Import values are in nominal U.S. dollars.
[b] Data for inboard cruisers are for those over 24 feet in length.
[c] Data for sterndrive cruisers are for those over 20 feet in length.

Table 2.1-13
U.S. Export Values* (10^3) of Inboard and Sterndrive Boats, 1992 - 2000 [40,41]

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Inboards	261,474	184,673	163,284	217,443	189,825	222,976	213,111	197,260	198,257
Sterndrives	189,463	127,382	135,229	186,230	191,327	199,364	198,675	236,326	198,349

* Export values are in nominal U.S. dollars.

In the case of sterndrives, import values remained below the value of sterndrive exports over the 1992 to 2000 time period. In 1992, imports were equal to approximately 12 percent of export values. The value of imports did approach exports through the decade and by 2000, they were equal to about 50 percent of the value of exports. What is notable is a large jump in the value of sterndrive import values between the years 1997 and 1998. Imports rose from approximately $27 million to over $65 million in the span of this year. Sterndrive export values generally increased through the year 1999 when they hit their peak at $236 million, however in the year 2000, they fell to just below $200 million. Still, export values for sterndrives were twice the value of their imports in this year.

Tables 2.1-14 and 2.1-15 present foreign trade data for inboard diesel and sterndrive engines. Import data for inboard diesel engines were disaggregated by varying ranges of horsepower (ranging from less than 150 to over 1000 horsepower) while inboard export data are only available for diesel engines below 200 horsepower. Sterndrive engine data were not available in disaggregated form. An examination of Table 2.1-14 shows that the total import value of inboard diesel engines declined and rose over the 1990s. In the early part of the 1990s, imports of inboard diesel engines steadily declined in value, but then rose dramatically in 1995. This anomalous year was followed by a decline in import value which remained relatively constant until it again rose in 2000. For sterndrive engines, import values grew dramatically in the beginning of the 1990s as well. They then dipped during the mid 1990s only to rise again at the end of the decade to its highest value.

Though Table 2.1-14 only provides inboard import data for diesels, it is clear that the value of these engine imports exceed the value of sterndrive engine imports. We can infer that fewer sterndrive engines were imported relative to inboard engines. Note however, that inboard engines may also be used for boats with sterndrive engine configurations, which may partially explain why the import values for inboard engines are much higher.

Export data for the various types of inboard diesel engines were not available, therefore we are unable to make direct comparisons across the total import and export values of these engines. Some comparison can be made between the import values of inboard diesel engines below or equal to 150 horsepower and export values of inboard diesel engines under 200 horsepower since these generally refer to the same set of engines. A comparison of the these values shows roughly equal values of imports and exports of this engine type in the 1990s. Overall, export values are slightly higher. Sterndrive engine import and export values can be directly compared as these measures represent all foreign trade of this engine type to and from the U.S. From these tables, we can see that export values of sterndrive engines far exceeded import values in the beginning of the 1990s. However the value of imports for this engine type approached its export value by 1995. For the latter half of the 1990s, export values remained higher but the difference between export and import values remained smaller.

Table 2.1-14
U.S. Import Values* ($\$10^3$) of Inboard Diesel Engines and Sterndrive Engines, 1992 - 2000 [42,43]

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Inboard Diesels									
≤ 150HP	17,270	14,230	10,104	8,765	10,050	6,933	9,244	13,992	15,084
150-199HP	4,901	4,983	5,384	5,539	5,701	7,915	6,528	6,114	6,916
200-312HP	9,035	9,805	9,153	10,721	7,102	8,851	10,355	13,032	8,756
313-499HP	4,910	4,288	7,625	7,796	7,634	9,624	15,609	21,332	38,506
500-999HP	5,365	5,994	8,418	14,257	15,174	13,494	9,808	10,836	12,725
≥ 1000HP	72,606	40,611	18,577	24,680	39,965	31,486	33,777	29,002	43,698
Inboard Total	114,087	79,911	59,261	293,878	85,626	78,303	85,321	94,308	125,685
Sterndrive Engines									
Total	3,221	5,947	19,045	25,401	21,586	15,457	17,525	25,434	43,489

* Import values are in nominal U.S. dollars.

Table 2.1-15
U.S. Export Values* ($$10^3$) of Diesel Inboard
Engines Under 200 HP and Sterndrive Engines, 1992 - 2000 [44,45]

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Inboard Engines	11,174	11,332	8,962	15,263	13,976	20,201	18,665	19,123	23,543
Sterndrive Engines	25,186	24,164	25,024	28,386	26,980	23,734	17,089	24,430	30,427

* Export values are in nominal U.S. dollars.

2.2 Large SI Engines and Industrial Equipment

This section gives a general characterization of the Large SI industry. Large SI engines are nonroad spark-ignition engines that have rated power higher than 25 horsepower (19 kW) and that are not recreational engines or marine propulsion engines. They are typically derivatives of automotive engines, but use less advanced technology and operate on LPG and CNG as well as gasoline. Large SI engines are used in a wide variety of commercial uses. Because it is not practical to present detailed information on all of these applications in this section, we focus primarily on forklifts. This is reasonable because they are the dominant application for Large SI engines. Also, as explained in greater detail in Section 9.7 of Chapter 9, the detailed economic impact analysis performed for this sector focuses on forklifts. Other information presented in this section describes some general characteristics of the Large SI sector.

2.2.1 The Supply Side

This section provides a description of the types of industrial equipment that may contain Large SI engines, the major inputs used to manufacture this equipment, and the costs of production.

2.2.1.1 Product Types and Populations

Large SI engines are used in a wide variety of applications, including forklifts, generators, pumps, leaf blowers, sprayers, compressors, other material handling equipment, and agricultural production. Table 6.2.2-1 in Chapter 6 presents our estimates of the 2000 U.S. population of the various Large SI equipment applications. We estimated populations of engine and equipment models using historical sales information adjusted according to survival and scrappage rates.

A 1996 study of the forklift market estimated that there were 491,321 engine-powered forklifts in use in the United States in 1996 (Classes 4, 5, and 6; see below for an explanation of these classes).[46] That study estimated that 80 percent of this population used LPG (commonly referred to as propane because propane is its primary constituent), with the rest running on either gasoline or diesel fuel. If that 20 percent of that population are split evenly between gasoline and diesel fuels, as we estimate, this means that the number of spark-ignition forklifts in 1996 was about 442,000, or that about 90 percent of all forklifts were spark-ignition. As noted in Table 6.2.2.1, we estimate that about 95 percent of those spark-ignition forklifts are run LPG or CNG, with the rest being run on gasoline. The high percentage of propane systems for forklifts can be largely attributed to expenses related to maintaining fuel supplies. LPG cylinders can be readily exchanged with minimal infrastructure cost. Installing and maintaining underground tanks for storing gasoline has always been a significant expense, which has become increasingly costly due to the new requirements for replacing underground tanks.

With regard to non-forklift applications, the split between LPG and gasoline is not as clear. Large SI engines today are typically sold without fuel systems, which makes it difficult to assess the distribution of engine sales by fuel type. Also, engines are often retrofitted for a different fuel after the initial sale, making it still more difficult to estimate the prevalence of the different fuels. Natural gas, a third option, is less common in Large SI engines even though natural gas and LPG fuel systems are very similar. Natural gas supply systems typically offer the advantage of pipeline service, but the cost of installing high-pressure refueling equipment is an obstacle to increased use of natural gas.   Table 6.6.2.1 contains our estimates of the use of LPG and CNG for non-forklift applications; the rest are estimated to use gasoline. We estimate 100 percent LPG/CNG use for oil field equipment, gas compressors, and refrigeration/AC. For construction, general industrial, and other nonroad equipment, there may be a mix of central and noncentral fueling; we therefore believe that estimating an even mix of LPG and gasoline for these engines is most appropriate.

We estimate very low or no LPG/CNG use for agricultural and lawncare equipment. Lawn and garden equipment is usually not centrally fueled and therefore operates almost exclusively on gasoline, which is more readily available. Agriculture equipment is predominantly powered by diesel engines. Most agriculture operators have storage tanks for diesel fuel. Those who use spark-ignition engines in addition to, or instead of, the diesel models, would likely invest in gasoline storage tanks as well, resulting in little or no use of LPG or natural gas for those applications. An estimated distribution of fuel types for the individual applications are listed in Table 6.2.2-1.

Large SI engines also vary considerably by size. Most of these engines are smaller than 100 horsepower, with the lower limit of the engine category at 25 horsepower. On an annual sales basis, 34 percent of Large SI engines are less than 50 horsepower, and 80 percent are less than 100 horsepower. Only about 20 percent are larger than 100 horsepower, with the largest about 250 horsepower.

2.2.1.2 Engine Design and Operation

Most engines operate at a wide variety of speeds and loads, such that operation at rated power (full-speed and full-load) is rare. To take into account the effect of operating at idle and partial load conditions, a load factor indicates the degree to which average engine operation is scaled back from full power. For example, at a 0.3 (or 30 percent) load factor, an engine rated at 100 hp would be producing an average of 30 hp over the course of normal operation. For many nonroad applications, this can vary widely (and quickly) between 0 and 100 percent of full power. Table 6.2.2-1 shows the load factors that apply to each nonroad equipment application.

Table 6.2.2-1 also shows annual operating hours that apply to the various applications. These figures represent the operating levels that apply through the median lifetime of equipment.

2.2.1.3 Liquid-Cooled , Automotive-Derived Engines

The majority of Large SI engines are industrial versions of automotive engines and are liquid-cooled. However, in the absence of emission standards there has been only limited transfer of emission-control technology from automotive to industrial engines, and most of these are equipped with only very basic emission control technology if any.

Producing an industrial version of an automotive engine typically involves fitting a common engine block with less expensive systems and components appropriate for nonroad use. Manufacturers remove most of the sophisticated systems in place for the high-performance, low-emission automotive engines to be able to produce the industrial engine at a lower cost. For example, while cars have used electronic fuel systems for many years, almost all industrial Large SI engines still rely on mechanical fuel systems. Chapter 3 describes the baseline and projected engine technologies in greater detail.

2.2.1.4 Air-Cooled Engines

Some manufacturers produce Large SI engines exclusively for industrial use. Most of these are air-cooled. Air-cooled engines with less than one liter total displacement are typically very similar to the engines used in lawn and garden applications. Total sales of air-cooled engines over one liter have been about 9,000 per year, 85 percent of which are rated under 50 hp. While these engines can use the same emission-control technologies as water-cooled engines, they have unique constraints on how well they control emissions. Air-cooling doesn't cool the engine block as uniformly as water-cooling. This uneven heating can lead to cylinder-to-cylinder variations that make it difficult to optimize fuel and air intake variables consistently. Uneven heating can also distort cylinders to the point that piston rings don't consistently seal the combustion chamber. Finally, the limited cooling capacity requires that air-cooled engines stay at fuel-rich conditions when operating near full power.

While air-cooled engines account for about 9 percent of Large SI engine sales, their use is concentrated in a few specialized applications. Almost all of these are portable (non-motive) applications with engine operation at constant speeds (the speed setting may be adjustable, but operation at any given time is at a single speed). Many applications, such as concrete saws and chippers, expose the engine to high concentrations of ambient particles that may reduce an engine's lifetime. These particles could also form deposits on radiators, making water-cooling less effective.

2.2.1.5 Forklift Truck Manufacturing

As noted above, forklifts are the most common application of Large SI engines. Forklifts are self-propelled trucks equipped with platforms that can be raised and lowered. These trucks are used for lifting, stacking, retrieving, and transporting materials and are typically powered by either LPG, gasoline, diesel, or an electric motor. It is estimated that 80 percent of the forklift trucks in these classes operate on LPG.[47] The industry classifies forklifts in six categories, and the types of forklifts with Large SI engines are those classified as Class 4, 5, and 6. They represent those forklift truck classes that may be affected by the emissions control program. Descriptions of Class 4, 5, and 6 forklifts are as follows[48]:

- **Class 4**. Internal Combustion (IC) Engine Trucks - fork, counterbalanced, cushion tire, rider trucks;
- **Class 5**. IC Engine Trucks - fork, counterbalanced, pneumatic tire, rider trucks; and
- **Class 6**. Electric and IC Engine Tractors - sit down rider, draw bar pull.

The major difference between Class 4 and Class 5 forklifts is the type of tire installed. Pneumatic tires allow forklift trucks to be operated on varied terrain, while cushion tires are more suitable for flat floor surfaces. All of these forklifts allow for the operator to sit down, thus reducing operator fatigue or strain. Generally speaking, forklifts may differ in their design, maximum lift capacity, location of the lift operator, type of tires installed, and by the type of fuel used.

The costs of producing forklift trucks fall into three major categories: capital expenditures, labor costs, and the costs of materials. Capital expenditures include the manufacturer's costs of equipment and its installation; labor costs include the producer's costs associated with employees wages and benefits; and the costs of materials are the costs of tangible and intangible inputs such as internal combustion (IC) engines, steel for the truck frame, tires, rubber hosing and belting, counterbalances, and energy. Table 2.2-1 shows the historical production costs for the industrial truck, tractor, trailer, and stacker machinery manufacturing industry which includes forklift manufacturers. This industry is identified by Standard Industrial Code (SIC) 3537 and the North American Industrial Classification System (NAICS) Code 333924.

U.S. Department of Commerce statistics, set out in Table 2.2-1, show that the average value of shipments (VOS) for this industry over the 1992 to 1999 time period is equal to approximately $4.7 billion, with the highest value of shipments occurring in 1998. The cost of materials for this industry is equal to an average of almost $3 billion (64 percent of VOS). The average cost of labor is approximately $746 million (16 percent of VOS), while capital expenditures are equal to an average value of $93 million (2 percent of VOS). Examination of this data clearly shows that capital expenditures represent the smallest share of the value of shipments while the cost of materials represents the largest share.

Table 2.2-1
Value of Shipments (VOS) and Production Costs for the SIC and NAICS Codes that Include Forklift Manufacturers*, 1992 - 1999 [49,50,51,52,53,54,55]

		VOS	Payroll		Cost of Materials		Total Capital Expenditures	
Year	Industry Code	($$10^6$)	($$10^6$)	% of VOS	($$10^6$)	% of VOS	($$10^6$)	% of VOS
1992	SIC 3537	$2,754	$499	18%	$1,701	62%	$58	2%
1993	SIC 3537	$3,200	$592	19%	$1,984	62%	$43	1%
1994	SIC 3537	$4,054	$628	15%	$2,700	67%	$71	2%
1995	SIC 3537	$4,970	$723	15%	$3,251	65%	$94	2%
1996	SIC 3537	$4,866	$742	15%	$3,076	63%	$107	2%
1997	NAICS 333924	$5,538	$894	16%	$3,612	65%	$140	3%
1998	NAICS 333924	$6,248	$944	15%	$4,112	66%	$104	2%
1999	NAICS 333924	$5,597	$942	17%	$3,429	61%	$127	2%
	Average	$4,653	$746	16%	$2,983	64%	$93	2%

* Value of Shipments, Payroll, Cost of Materials, and Total Capital Expenditures are in nominal U.S. dollars.

2.2.2 The Demand Side

This section provides information about the uses and consumers of Large SI engines and forklift trucks. The various industrial sectors in which forklifts are used and the substitute products for forklifts are also discussed.

Generally speaking, industrial SI equipment is considered a final good while Large SI engines are referred to as intermediate goods. This is because the engines are manufactured to be used as inputs to the production of industrial SI equipment. Consumers in the marketplace demand industrial equipment which may contain Large SI engines, therefore their demand for Large SI engines is derived from their demand for industrial equipment.

Manufacturers of industrial equipment have three options to obtain the SI engines they use for equipment production. Their first options is to produce the SI engines used in their final products. The second option is to purchase a partially finished engine and add on the fuel system and perform the engine calibration in-house. The third options is to purchase a completed engine and “drop” it in their equipment without modification. When equipment companies purchase Large SI engines as an input to their production, they are considered the immediate consumers of Large SI engines. However, if equipment manufacturers choose to produce Large SI engines as inputs for their production of equipment, they have vertically integrated the production of a vital input, SI engines, into their overall production process. Though they consume the engines in the production of industrial equipment, they are, in this case, the suppliers of these engines via the final product.

In the case of forklifts, engines are commonly purchased from outside companies.

However, the design and assembly of these engines may be completed in-house (i.e., adding the fuel system and calibrating the engine). Sometimes the forklift manufacturer is the designer of the engines, but in other cases, the forklift manufacturer may rely on its parent company to work on engine design while it focuses exclusively on forklift production. This secondary arrangement is common in large companies which may contain a subsidiary producer of forklift trucks. Because engine designs may be specific, contractual arrangements may be made between engine manufacturers and forklift producers so as to keep the supply of engines consistent.

2.2.2.1 Uses of Forklifts

The main function of forklift trucks is to lift and transport materials. Class 4, 5, and 6 forklifts are used in indoor settings, such as warehouses and stock rooms or in some outdoor settings. Table 2.2-2 shows the population of forklift trucks by industry sector for the year 1995, the most recent year for which industry data is available. The manufacturing sector uses the largest share of forklifts followed next by wholesale trade. Together, these two industry sectors accounted for over 60 percent of the U.S. total forklift population in 1995. This estimate is based on industry shipments and allows for scrappage of older units.

Table 2.2-2
1995 Class 4, 5, and 6 Forklift Population by Industry Sector[56]

Industry Sector	Population	Percent Share (%)
Manufacturing	196,985	40.3%
Wholesale Trade	100,721	20.6%
Transportation, Communication, and Utilities	68,785	14.1%
Services	46,675	9.5%
Retail Trade	32,919	6.7%
Construction	29,497	6.0%
Other	13,757	2.8%
Total	489,339	100%

2.2.2.2 Substitution Possibilities for Forklifts

The most common substitute for Class 4, 5, and 6 IC engine forklifts are electric motor forklifts, which fall into Classes 1, 2, and 3. Descriptions of these forklifts are as follows[57]:

- **Class 1**. Electric Motor Rider Trucks;
- **Class 2**. Electric Motor Narrow Isle Trucks; and
- **Class 3**. Electric Motor Hand Trucks.

Electric-powered forklifts are also used for lifting, transporting, and stacking of materials, but they differ in design and lift capacity from Class 4, 5, and 6 lift trucks. Design differences may lead a consumer to choose one type of forklift over another. For example, narrow isle trucks are commonly found in warehouses that are designed to use less floor space and rely more on vertical stacking. Rider-type forklift trucks are used when significant amounts of material must be moved or where operator fatigue may be an issue. Hand trucks are used for lighter loads and are operated using a handle.[58] Generally, electric forklifts have lower material-handing capacity.

One advantage of Class 1, 2, and 3 forklifts is that they do not produce exhaust fumes while in operation, thus making them well suited to indoor operations. However, electric forklifts rely on batteries that must be recharged which may lead to times where forklifts are not available. Changing out spent batteries to reduce recharge time is not generally practical because these batteries are expensive (as much as $10,000 or more each) and can weigh 1,000 lbs. While electric forklifts can operate for about 8 hours on a charge, LPG forklifts can operate for about 12 hours before refueling. Consequently, electric forklifts may be a practical alternative only in some applications.

Aside from electric powered forklifts, other modes of transporting materials may be considered. For lighter loads, non-motorized hand pallet trucks and stacker machinery may be acceptable substitutes. They are less expensive but have low load capacities. These types of equipment also rely more heavily on manual labor.

2.2.2.3 Customer Concerns

As illustrated in Table 6.6.2.1, most Large SI engines are used in industrial applications. These industrial customers have historically been most concerned about the cost of the engine and equipment, and about reliability. In many cases, equipment users value uniform and familiar technology because these characteristics simplify engine maintenance. As described in Chapter 5, equipment users have largely ignored the potential for improving fuel economy when they make their purchase decisions. As a result most Large SI engines being sold today have relatively simple carburetor technology that is similar to automotive technology of the early 1960s.

Another user concern relates to emissions. A large number of these engines are operated indoors or in other areas with restricted airflow much of the time. For these applications, customers generally want engines with lower CO emissions. Consequently, most engines used in these applications are fueled with LPG or CNG. However, calibration or maintenance problems in the field can cause dangerously high CO levels in these engines. Occasionally customers purchase engines equipped with exhaust catalysts to protect operators from exposure to high emission levels.

2.2.3 Industry Organization

It is important to gain an understanding of how the Large SI equipment and engine industries may be affected by the emission control program. One way to determine how increase costs may affect the market is to examine the organization of each industry. This section provides data to measure the competitive nature of the forklift and Large SI engine industries and lists manufacturers of these equipment and engines. It should be noted that while forklift manufacturers will be affected by changing engine designs, only those companies that certify their engines with EPA will be directly regulated.

This section does not contain detailed information on non-forklift application. While these other sectors will be affected by the control program, it is not practical to report detailed information for each.

2.2.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and the Herfindahl-Hirschman index (HHI) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices for the six digit NAICS code level for the year 1997, the most recent year available. Table 2.2-3 provides the four- and eight-firm concentration ratios (CR4 and CR8, respectively), and the Herfindahl-Hirschman index for the industrial truck, tractor, trailer, and stacker machinery manufacturing industry, the industry that includes producers of forklifts. This industry is represented by NAICS code 333924. Concentration ratios are provided in percentage terms while HHI are based on a scale formulated by the Department of Justice.

The criteria for evaluating the HHI are based on the 1992 Department of Justice Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries have more ability to influence market prices. Based on these criteria, the industry that produces forklifts can be modeled as perfectly competitive for the purposes of the economic impact analysis, since their HHI is 503.

Table 2.2-3
Measures of Market Concentration for the NAICS Code that Includes Forklift Manufacturers, 1997 [59]

Description	CR4	CR8	HHI	VOS ($\$10^6$)	Number of Companies
NAICS 333924	38.5	52.3	503	$5,538.33	434

2.2.3.2 Large SI Engine and Forklift Manufacturers

Using data from Power Systems Research for the period 1994-96, we have identified seven principal manufacturers of Large SI engines. These are listed in Table 2.2-4, along with their average annual sales volume. This table shows that sales volumes are relatively evenly distributed among these seven manufacturers. The figures for "other" manufacturers presents aggregated data from four additional companies: Volkswagen, Westerbeke, Hercules, and Chrysler. While the market has changed over recent years, with some manufacturers dropping out of the market, General Motors, Mitsubishi Motors, Ford Power Products, and Nissan Industrial Engines continue to have roughly equal shares and represent between 60 and 70 percent of the annual sales of these engines in the United States.

Table 2.2-4
Engine Sales by Manufacturer (1994-1996)

Manufacturer	Average Annual Sales	Distribution
General Motors	19,500	19%
Mitsubishi Motors	15,600	15%
Ford Power Products	14,000	14%
Nissan Industrial Engines	13,800	13%
Wis-Con Total Power	12,100	12%
Toyota	11,800	12%
Mazda	8,200	8%
Other	7,200	6%
Total	102,300	100%

Source: Power Systems Research Database

The degree to which engine manufacturers offer integrated engine and equipment models is an important factor in determining how companies address the need to redesign their products. Companies that use their own engine models to produce equipment can coordinate the engine design changes with the appropriate changes in their equipment models. The principal integrated manufacturers (Nissan, Mitsubishi, and Toyota) all produce forklifts. About 40 percent of Large SI equipment sales are from integrated manufacturers.

Other forklift manufacturers have also been responsible for varying degrees of engine design. Engine design expertise among these companies is so prevalent that some forklift manufacturers may assume responsibility for certifying their engines, even though they buy the engines mostly assembled from other manufacturers.

EPA has identified at least fourteen forklift manufacturers that use Large SI engines. The majority of these companies produce Class 4 and 5 forklifts, though there are a handful that manufacture Class 6 forklifts. Table 2.2-5 provides a listing of the forklift manufacturers and their total annual sales (including sales abroad) for the most current year for which data were available (2000 or 2001). The table shows that the companies range in size based on their annual sales.

Table 2.2-5
Annual Sales for Forklift Manufacturing Companies, 2000/2001 [60,61,62,63]

Company	Annual Sales ($\$10^6$)
NACCO Materials Handling Group (owns Hyster and Yale)	$1,292
Clark Material Handling Company	$539
Mitsubishi Caterpillar Forklift America, Inc.	$172
Nissan Forklift Corporation, North America	$86
Toyota Industrial Equipment Manufacturing	$83
Hyundai Construction Equipment - Material Handling Division	$80
TCM Manufacturing USA	$50
Komatsu Forklift USA, Inc.	$30
Kalmar AC, Inc.	$27
Linde Lift Truck Corporation	$26
Drexel Industries, Inc.	$26
Tailift USA, Inc.	$10
Blue Giant	$9
Daewoo Heavy Industries America	$5

2.2.4 Markets

This section examines the historical market statistics for the forklift manufacturing industry. Historical data on the quantity of domestic shipments and some price data of IC engine forklifts are provided. The quantity and values of exports and imports of non-electric forklift trucks are presented as well.

2.2.4.1 Quantity and Price Data

Historical market data on the quantity of U.S. shipments of Class 4, 5, and 6 forklifts are provided in Table 2.2-6 and were obtained from the Industrial Truck Association Membership Handbook (2002). As this table shows, there has been an overall increasing trend in the quantity of forklifts produced in the U.S. with an overall net increase of 118 percent from 1980 to 2000 and an average increase of just under 7 percent per year. During the 1990s, shipments increased from almost 48,000 in 1990 to approximately 73,000 in 1995, but then dipped in 1996 to just above 60,000. Since 1996, the general increasing trend in the quantity of SI engine forklifts manufactured in the U.S. continued with a relatively small dip in 1999. For the purpose of this economic impact analysis, we used 65,000 forklifts as our baseline quantity of forklifts produced in 2000, based on production data for the past 10 years. For future year projections, we used the growth rates contained in our NONROAD model.

Table 2.2-6
U.S. Shipments of Internal Combustion
Class 4, 5, and 6 Forklifts, 1980 - 2000 [64]

Year	Quantity of Shipments	Year	Quantity of Shipments
1980	39,448	1991	38,406
1981	31,885	1992	46,183
1982	18,553	1993	48,947
1983	26,245	1994	65,027
1984	45,338	1995	72,685
1985	47,844	1996	60,287
1986	46,195	1997	64,946
1987	47,945	1998	80,554
1988	48,535	1999	74,994
1989	55,104	2000	85,993
1990	47,702	Average Annual Growth Rate = 6.7%	

Forklift truck prices can vary a great deal depending on their class, the manufacturer, the model type, and selected options. Pricing data on various Class 4 and 5 forklift models were obtained from the Handbook of New and Used Equipment Values - IC Lift Trucks (Equipment Watch, 2001). Current retail prices for various IC forklifts with no options for the year 2001 varied from a low of $17,000 up to well over $100,000 for high end models. However, most models were priced in the range of $25,000 to $50,000.

2.2.4.2 Foreign Trade

Export and import values and quantities for non-electric forklifts presented in Table 2.2-7 show increasing trends since 1989. Based on this information, the U.S. is a net importer of forklifts as its value and quantity of imports exceeds it value and quantity of exports. Note, however, that U.S. domestic production of forklifts far outweighs the quantity it imports. A closer examination of the export value and quantity data show that while U.S. exports generally increased over the 1989 to 2001 time period, there was a sharp decline in export quantity and value in 1996. Exports of forklifts went from a total value of $194.3 million in 1995 to about $91 million in 1996 (a similar decline is evident in the quantity of forklifts). Since 1996, both the value and quantity of exports has increased with a slight dip occurring in 2001. U.S. imports of forklifts has also shown a general increase in both value and quantity, however again, in 2001 a slight dip is evident.

The main importers of non-electric forklifts, related trucks, and parts of forklifts to the U.S. are Japan, Canada, and the United Kingdom and the main countries the U.S. exports its forklifts to are Canada, Mexico, and the United Kingdom.[65]

Table 2.2-7
Import and Export Quantities and Values* for Non-Electric Self-Propelled Forklift and Other Trucks, 1989 - 2001 [66]

Year	Export Value ($$10^6$)	Export Quantity	Import Value ($$10^6$)	Import Quantity
1989	$113	7,065	NA	NA
1990	$142	7,651	NA	NA
1991	$148	8,302	NA	NA
1992	$146	9,511	NA	NA
1993	$144	12,762	NA	NA
1994	$196	11,277	$301	19,496
1995	$194	10,131	$389	22,824
1996	$91	4,963	$375	19,214
1997	$146	8,670	$459	21,820
1998	$162	9,890	$611	29,251
1999	$150	11,526	$574	26,741
2000	$190	16,208	$612	30,751
2001	$168	12,768	$507	23,381
Average	$153	10,056	$294**	14,883**

[a] Values are in nominal dollars.
[b] Average is computed for the years 1994 through 2001.

2.3 Snowmobile Market

Snowmobiles are normally one or two passenger vehicles that are used to transverse over snow-covered terrain. They have a track in the rear similar to that of a bulldozer and runners (similar to skis) in the front for steering. Snowmobiles are used primarily for recreational purposes. However, a small number of them are produced and used for utility purposes, such as search and rescue operations. Annual sales of snowmobiles in the U. S. have varied dramatically over the years. Over 140.6 million units were sold in the U. S. in 2001.[67]

2.3.1 The Supply Side

This section provides a description of snowmobiles and their engines, the major inputs used to manufacture this equipment, and the costs of production.

2.3.1.1 Product Types

There are several types of snowmobiles on the market. Snowmobiles types range from children's models with very low horsepower to high-powered machines with engine sizes approaching 1000 displacement cc. Snowmobiles are designed to appeal to a variety of consumers including those who wish to cover rough mountainous terrain, those who seek speed, those who wish to tour the countryside and the novice snowmobiler. Snowmobiles are offered in one-seat and two-seat models and in luxury and low-cost varieties. Snowmobile manufacturers seek to appeal to a wide range of potential snowmobile riders. This section will describe a few of the components of the models on the market. There are a variety of engine options including two-stroke or four-stroke, air or water cooled, and various engine displacements. Options include electric start, reverse, specialized paints, and other items. For a more complete description of typical snowmobile attributes see Section 9.4.

2.3.1.2 Engine Design and Populations

The vast majority of snowmobiles sold in the U.S. are powered by two-stroke engines currently. Engine displacements range from 60 cc for an entry-level youth model to 998 cc for a high-performance model. Based upon PSR snowmobile production data, snowmobiles produced have been trending towards higher engine sizes with the average engine size increasing over 17 percent between the period 1990 and 2000. In 1996 over 44 percent of the snowmobiles produced had engine sizes less than 500 cc displacement. In 2000, this percentage had dropped to 23 percent. In general the larger the engine size, the more powerful for the 2-stroke engines that dominate the snowmobile market today. The average engine size in 2002 was 570 cc displacement.[68]

The number of models produced for a given engine size for the four major snowmobile manufacturers is shown in Table 2.3-1.

Table 2.3-1
Engine Displacement for Major Snowmobile Manufacturers in the U.S. Market in 2000[69]

Manufacturers	≤300cc	≤500cc	<700cc	700-1000cc
Arctic Cat, Inc.	852	14,233	41,253	8,317
Bombardier (Ski Doo)	2,638	23,507	20,017	11,973
Polaris Industries	2,533	21,585	34,067	14,276
Yamaha	0	10,615	16,483	6,085
Total	6,023	69,940	111,820	40,651

* Production data were taken from OELINK Database owned by Power Systems Research.

2.3.1.3 Two-Stroke vs Four-Stroke Cycle Engine Usage

The majority of snowmobiles are equipped with 2-stroke engines. For the 2003 models currently available for sale, nine 4-stroke models are available. Each of the manufacturers offers 4-stroke models in their current sales inventory. For more details see Section 9.4.

2.3.1.4 Production Costs of Snowmobiles

Production costs for snowmobiles are not readily available. In lieu of cost of production data for snowmobiles specifically, a discussion of the cost of production data for NAICS 366999 Other Transportation Equipment Manufacturing is presented. This category includes snowmobiles, ATVs, golf carts, and other miscellaneous transportation equipment. As Table 2.3-2 shows, the average value of shipments (VOS) for these industries over the 1992 to 2000 time period is equal to approximately 4.5 billion dollars, with the highest value of shipments occurring in 2000. The cost of materials for this industry is equal to an average of about 3 billion dollars (65 percent of VOS). The average cost of labor is approximately 549 million (12 percent of VOS), while capital expenditures are equal to an average value of 97 million (2 percent of VOS). Examination of these data clearly shows that capital expenditures and payroll represent the smallest shares of the value of shipments while the cost of materials represents the largest share.

Table 2.3-2
Value of Shipments (VOS) and Production Costs for the SIC and NAICS Codes that Includes Snowmobile Manufacturers, 1992 - 2000 [70,71,72,73,74]

		VOS	Payroll		Cost of Materials		New Capital Expenditures	
Year	Industry Code	($$10^6$)	($$10^6$)	% of VOS	($$10^6$)	% of VOS	($$10^6$)	% of VOS
1992	SIC 3799	3,087	449	15%	1,969	64%	62	2%
1993	SIC 3799	3,807	514	14%	2,422	64%	86	2%
1994	SIC 3799	3,947	469	12%	2,611	66%	98	2%
1995	SIC 3799	4,539	512	11%	3,056	67%	86	2%
1996	SIC 3799	5,179	570	11%	3,368	65%	103	2%
1997	NAICS 336999	4,437	496	11%	2,803	63%	97	2%
1998	NAICS 336999	5,033	578	11%	3,236	64%	122	2%
1999	NAICS 336999	5,645	643	11%	3,766	67%	106	2%
2000	NAICS 336999	6,245	714	11%	4,195	67%	117	2%
	Average	4,568	549	12%	3,047	65%	97	2%

* Value of Shipments, Payroll, Cost of Materials, and Total Capital Expenditures are in nominal U.S. dollars

2.3.2 The Demand Side

This section provides information on the uses of snowmobiles, various substitute products on the market, and information concerning consumers who purchase snowmobiles.

2.3.2.1 Uses of Snowmobiles

There are a variety of snowmobile types currently produced and tailored to a variety of riding styles. The majority of the overall snowmobile market is made up of high performance machines. These snowmobiles have fairly high powered engines and are very light, giving them good acceleration speed and handling. The performance sled come in several styles. Cross country sleds are designed for aggressive trail and cross country riding. Mountain sleds have longer tracks and wider runner stance for optimum performance in mountainous terrain. Finally, muscle sleds are designed for top speeds (in excess of 120 miles per hour) over flat terrain such as frozen lakes. Performance snowmobiles are generally designed for a single rider.

The second major style of snowmobile is designed for casual riding over groomed trails. These touring sleds are designed for one or two riders and tend to have lower powered engines than performance snowmobiles. The emphasis in this market segment is more on comfort and convenience. As such, these sled feature more comfortable rides than performance machines and tend to have features such as electric start, reverse, and electric warming hand grips.

The last and smallest segment of the snowmobile market is the utility sled segment. Utility snowmobiles are designed for pulling loads and for use in heavy snow. Thus the engines are designed more for producing torque at low engine speeds, which typically corresponds to a reduced maximum speed of the snowmobiles. Utility snowmobiles are common in search and rescue operations.

A typical snowmobile lasts thirteen years and travels approximately 17,000 miles over its lifetime. The average snowmobile is used 57 hours per year.[75]

2.3.2.2 Substitution Possibilities

A number of substitute products to snowmobiles exist. Consumers can substitute across off-road recreational vehicles. However, ATVs and off-highway vehicles may not be used safely in the snow. Snow coaches are a substitute motorized product. Consumers may be interested in engaging in outdoor activities, but may instead consider doing a non-motorized activity. For example, consumers who are interested in being outside in the snow may engage in skiing or sledding. Recreational indoor activity of many types are substitute possibilities for snowmobile riding.

2.3.2.3 Customer Demographics and Customer Concerns

Based upon ISMA data, the average snowmobile owner is 42 years old, and had an average annual income of $68,000 in 2001. The average snowmobile rider has 18 years experience in riding. The majority of snowmobile owners are married. Approximately 63 percent of riders trailer their snowmobiles to go riding.[76]

Good performance is very important to snowmobilers. This is especially true for the performance segment of the market, where high power and low weight are crucial for the enjoyment of the performance snowmobile enthusiast. The performance snowmobile segment is driven by a constant demand for more power and lower weight. In the touring segment of the market, performance in terms of power and weight is somewhat less important but still significant. In all snowmobile market segments, durability and reliability are very important to the customer.

The price of a snowmobile produced by the four major manufacturers currently ranges from about $3,700 for entry level models to around $12,000 for some high performance models. The average snowmobile price in 2001 was $6,360. Some of the high performance snowmobiles produced by the small manufacturers can approach $20,000, but this is an extremely small niche market. Since snowmobiles are a discretionary purchase, price is a factor in the consumers decision to purchase.

2.3.3 Industry Organization

Because there are costs associated with the emission control program, it is important to determine how the snowmobile industry may be affected. Industry organization is an important factor which affects how a market may react to regulatory costs. This section provides a description of the organization of the snowmobile industry.

2.3.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and the Herfindahl-Hirschman index (HHI) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices for the six digit NAICS code level for the year 1997, the most recent year available. Table 2.3-3 provides the four- and eight-firm concentration ratios (CR4 and CR8, respectively), and the Herfindahl-Hirschman index for the NAICS code 336999, Other Transportation Equipment Manufacturing, the industry category that includes producers of snowmobiles. Note that the concentration ratio is reported in percentage terms while the HHI is based on a scale developed by the Department of Justice. For this industry the CR4 was 50.7 percent and the CR8 was 75.3 percent.

The criteria for evaluating the HHI are based on the 1992 Department of Justice Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries have more ability to influence market prices. Based on these criteria, the NAICS category that includes firms that produce snowmobiles can be considered unconcentrated or more competitive.

Table 2.3-3
Measures of Market Concentration for the NAICS Code that Includes NAICS 336999 Manufacturers, 1997 [77]

Description	CR4	CR8	HHI	VOS ($\$10^6$)	Number of Companies
NAICS 336999	50.7	75.3	885.2	$4,436,67 9	349

However, it is important to recognize that four producers dominate the snowmobile industry or produce 99 percent of the worldwide snowmobiles produced and sold. This information suggests that snowmobile manufacturing is highly concentrated with four manufacturers dominating the market. However, when one considers firm behavior within the industry and the availability of numerous product substitutes, the picture alters somewhat. While snowmobile manufacturing is concentrated, snowmobiles represent a small fraction of total recreational products available in the market place.

Market structure is important to assessing the potential impacts of a regulation on an industry because it determines the behavior of producers and consumers within the industry. Economists often estimate concentration ratios for the subject market or industry to assess the competitiveness. More (less) concentrated markets are considered to be less (more) competitive. The extremes are defined by perfect competition (many buyers/seller with no influence over price) and monopoly (one seller with control over setting price). Between these two extremes are varying degrees of imperfect competition, or oligopoly, that depend upon different assumptions of strategic behavior among sellers within the market or industry. The competitiveness will depend upon the definition of the subject market or industry with those being more (less) broadly defined demonstrating more (less) competition. For example, the "snowmobile" market is dominated by four major producers and may be considered less competitive. However, there are likely to be many substitutes for snowmobiles when considering the broader "recreational vehicles" or "recreational activities" markets. These substitutes increase the competitive nature of the market or industry. In previous regulatory analysis, the Agency has modeled the imperfectly competitive nature of pharmaceuticals (product differentiation) and cement (regional barriers to entry) where there were commonly accepted and researched approaches. Rather than add uncertainy to model outcomes by speculating on the strategic interactions of producers here, we chose to model the markets as perfectly competitive. Generally speaking, this assumption will tend to understate the price and output changes associated with regulation and may overstate the profit loss of producers; however, the extent of the bias is unknown and direction may vary by producer.[78]

2.3.3.2 Snowmobile Manufacturers

Manufacturers of snowmobile were formerly classified under the SIC code 3799 and are now classified under NAICS code 336999, Other Transportation Equipment Manufacturing. The Small Business Administration (SBA) uses SIC/NAICS categories to classify businesses as large or small, depending on the number of employees or sales criteria. Snowmobile manufacturers have the NAICS sub-classification 3369993414 and must have fewer than 500 employees to be considered a small business by SBA. Snowmobile wholesale companies may also be impacted by this regulation. Wholesale dealers of snowmobiles are categorized as NAICS classification 421110 - Automobile and Other Motor Vehicle Wholesales, and are considered small business if they have fewer than 100 employees.

There are four major manufacturers of snowmobiles that account for almost the entire U.S. market. These manufacturers are Arctic Cat, Bombardier (Ski Doo), Polaris and Yamaha. Polaris is the largest snowmobile manufacturer by sales volume, followed by Arctic Cat, Bombardier, and Yamaha. There are less than five snowmobile manufacturers that combined make up significantly less than one percent of the U.S. snowmobile market. These snowmobile manufacturers specialize in high performance snowmobiles and other unique designs (such as stand-up snowmobiles).

Bombardier and Yamaha produce the engines used in the snowmobiles they sell. In contrast, Polaris and Arctic Cat purchase engines for the snowmobiles they sell. Arctic Cat typically purchases Suzuki engines, while Polaris purchases engines made by Fuji Corporation.

2.3.4 Snowmobile Retailers and Rental Firms

In contrast to the small number of manufacturers producing snowmobiles, there are over 1,500 registered snowmobile dealers in the United States according to ISMA data. Approximately the same number operate in Canada and Scandinavia. These firms typically do not sell snowmobiles exclusively, but also sell other recreational vehicle products such as ATVs and motorcycles. Snowmobile retailers are included in NAICS category 441229 - All Other Motor Vehicle Dealers, and are considered small business if annual sales revenues are less than $6.0 million. In additional to retailers, rental firms exist that purchase snowmobiles to rent to the occasional snowmobile rider. These firms are included in NAICS category 532292 - Recreational Goods Rental, and are considered small business if the firm experiences sales less than $6.0 million. Potentially, both retailers and rental firms may be impacted by the regulation to the extent that the price of the snowmobiles the firms sell or rent increase.

2.3.5 Markets

This section examines the historical market data for the snowmobile industry. Historical data on the quantity of domestic shipments and price data of snowmobiles are provided.

2.3.5.1 Quantity and Price Data

Historical market data on the quantity of snowmobiles sold in the U.S. are provided in Table 2.3-4. Data were obtained from ISMA.[79] As this table shows, there has been an overall increasing trend in the quantity of snowmobiles sold in the U.S. with an average annual increase of 6 percent from 1990 to 2001. However, annual sales declined in 1991 and 1998 through 2000. Sales of snowmobiles increased more than 76 percent between the years 1990 and 2001. Retail dollars sales increased, on average, by 11 percent annually from 1990 to 2001. Snowmobile retail dollars per unit have also increased, showing an annual average increase of 5 percent for the same period.

Table 2.3-4
U.S. Units Sold, Retail Dollars and Retail Dollars Per Unit
Snowmobiles, 1990 - 2001 [80]

Year	Unit Sales	% Change Unit Sales	Retail Dollars ($\$10^6$)	% Change Retail Dollars	Retail Dollars/ Unit	% Change Retail Dollars/Unit
1990	80,000	---	$300.0	---	$3,750	---
1991	78,000	(3%)	$323.7	8%	$4,150	11%
1992	81,946	5%	$356.0	10%	$4,344	5%
1993	87,809	7%	$403.9	13%	$4,600	6%
1994	114,057	30%	$558.9	38%	$4,900	7%
1995	148,207	30%	$791.3	42%	$5,339	9%
1996	168,509	14%	$905.2	14%	$5,372	1%
1997	170,325	1%	$1,005.8	11%	$5,905	10%
1998	162826	(4%)	$975.1	3%	$5,988	1%
1999	147867	(9%)	$882.8	9%	$5,970	0%
2000	136,601	(8%)	$821.0	7%	$6,000	1%
2001	140,629	3%	$894.4	9%	$6,360	6 %
11-year Annual Average	137,889	6%	$747	11%	$5,698	5%
Change 1990 to 2001		76%		198%		70%

*Dollar values and percent changes of dollar values presented are nominal values.

2.3.5.2 Foreign Trade

In general, export and import data are not available for the snowmobile market. Data for SIC 3799 are available from the International Trade Commission. These data are presented on Table 2.4-6, Import and Export Quantities and Values for ATVs, 1989-2001, in Section 2.4, All-Terrain Vehicles, below. However, SIC 3799 includes snowmobiles, ATVs, golf carts and other transportation equipment. Thus the trade data is not specific to snowmobiles. World wide sales data for snowmobiles are presented in Table 2.3-5. During 2000 approximately 40 percent of total worldwide production was produced by Bombardier and Yamaha, foreign companies with the remainder of 60 percent produced by Arctic Cat and Polaris, domestic manufacturers.

Table 2.3-5
Worldwide Production, Sales, and Inventories of Snowmobiles 1990 - 2001[81]

Year	Worldwide Production (10^3 units)	Worldwide Retail Sales (10^3 units)	Worldwide Inventory (10^3 units)
1990	174.9	163.4	55.5
1991	157.2	153.0	59.7
1992	116.3	150.0	27.9
1993	146.0	158.0	16.0
1994	185.0	181.0	18.6
1995	231.5	227.4	22.6
1996	260.9	252.3	31.1
1997	273.7	260.7	44.2
1998	270.7	257.9	56.9
1999	231.7	230.9	57.7
2000	205.0	208.3	54.4
2001	190.3	208.5	36.1

2.4 All-Terrain Vehicles

All Terrain Vehicles (ATVs) are normally one-passenger open vehicles that are used for recreational and other purposes requiring the ability to traverse over most types of terrain. Most modern ATVs have four-wheels, and have evolved from three-wheeled designs that were first introduced in the 1970s. According to data provided by the Motorcycle Industry Council (MIC), production of ATVs sold in the U.S. has averaged about 390,000 units between 1996 and 2001. However, ATV sales have increased during that time to more than 880,000 units in 2001. ATVs therefore constitute the largest single category of non-highway recreational vehicles, though it is difficult to calculate the total vehicle population at any given point in time since many states do not require registration of ATVs.

2.4.1 The Supply Side

This section provides a description of ATVs and their engines, the major inputs used to manufacture this equipment, and the costs of production.

2.4.1.1 Product Types

There are several types of ATVs on the market. This section will describe a few of the components of the models on the market. There are a variety of engine options including two-stroke or four-stroke, air or water cooled, and various engine displacements. Options also include 5-speed manual or automatic transmissions.

2.4.1.2 Engine Design and Populations

The majority of ATVs sold in the U.S. are powered by single-cylinder, four-stroke cycle engines of less than 40 horsepower, operating under a wide variety of operating conditions and load factors. Engine displacements range from 50cc for an entry-level youth model to 660cc for a high-performance adult model, but more than three-fourths of them fall in the 200-500cc range.

In the year 2000, ATV manufacturers used 225,246 engines between 200cc and 300cc displacement (see Table 2.4-1). Of the engines produced, 64 percent were less than 400cc displacement and 84 percent were less than 500cc displacement . Over the past four years, production of engines with greater than 500cc displacement has increased from approximately 5 percent in 1996 to 16 percent in 2000.

Table 2.4-1
Engine Displacement for Major ATV Manufacturers in the U.S. Market in 2000[82]

Manufacturers	<200cc	200 - 300cc	300 - 400cc	400 - 500cc	200 - 700cc
Arctic Cat, Inc.	0	14,758	4,896	10,869	0
Honda	2,429	119,661	7,561	65,933	13,583
Kawasaki Motors	0	44,169	6,780	0	0
Polaris Industries	0	21579	54,834	6,689	62,144
Suzuki	0	9,346	0	1,740	0
Yamaha	7,635	15,733	26,977	21,743	0
Total	10,064	225,246	101,048	106,980	75,727

2.4.1.3 Two-Stroke vs Four-Stroke Cycle Engine Usage

Approximately 80 percent of all ATVs produced for U.S. consumption use four-stroke cycle engines. Of the six major manufacturers, only Polaris, Suzuki and Yamaha used two-stroke cycle engines at all. The remainder of the two-stroke engines in ATVs sold in U.S. are found in entry-level or youth models, which are imported from the Far East or assembled in this country from imported parts. In general, two-stroke engines are less expensive to produce than four-stroke engines, thus providing a marketing advantage in the youth and entry-level categories. We estimate that two-strokes make up roughly twenty percent of the market when the imported youth models are included.

2.4.1.4 Production Costs of ATVs

As Table 2.4-2 shows, the average value of shipments (VOS) for this industry over the 1992 to 1999 time period is equal to approximately 4.6 billion dollars, with the highest value of shipments occurring in 1999. The cost of materials for this industry is equal to an average of about 3 billion dollars (65 percent of VOS). The average cost of labor is approximately 549 million (12 percent of VOS), while capital expenditures are equal to an average value of 97 million (2 percent of VOS). Examination of these data clearly shows that capital expenditures and payroll represent the smallest shares of the value of shipments while the cost of materials represents the largest share.

Table 2.4-2
Value of Shipments (VOS) and Production Costs for the SIC and NAICS Codes that Includes ATV Manufacturers, 1992 - 2000 [83,84,85,86,87]

		VOS	Payroll		Cost of Materials		New Capital Expenditures	
Year	Industry Code	($$10^6$)	($$10^6$)	% of VOS	($$10^6$)	% of VOS	($$10^6$)	% of VOS
1992	SIC 3799	3,087	449	15%	1,969	64%	62	2%
1993	SIC 3799	3,807	514	14%	2,422	64%	86	2%
1994	SIC 3799	3,947	469	12%	2,611	66%	98	2%
1995	SIC 3799	4,539	512	11%	3,056	67%	86	2%
1996	SIC 3799	5,179	570	11%	3,368	65%	103	2%
1997	NAICS 336999	4,437	496	11%	2,803	63%	97	2%
1998	NAICS 336999	5,033	578	11%	3,236	64%	122	2%
1999	NAICS 336999	5,645	643	11%	3,766	67%	106	2%
2000	NAICS 336999	6,245	714	11%	4,195	67%	117	2%
	Average	4,568	549	12%	3,047	65%	97	2%

* Value of Shipments, Payroll, Cost of Materials, and Total Capital Expenditures are in nominal U.S. dollars.

2.4.2 The Demand Side

This section provides information on the uses of ATVs, various substitute products on the market, and the consumers who purchase ATVs.

2.4.2.1 Uses of ATVs

As noted above, ATVs are used for recreational and other purposes. They are mainly used for, riding on trails. Examples of non-recreational uses are for hauling and towing on farms, ranches or in commercial applications. Some ATVs are sold with attachments that allow them to take on some of the functions of a garden tractor or snow blower. ATVs are also used for competitive purposes, although not to the same extent as off-highway motorcycles.

2.4.2.2 Alternate Uses of ATV Engines

Although a few ATV engine lines have been used in other applications, such as some smaller on- and off-highway motorcycles, manufacturers have stated that ATV engines are normally designed only for use in ATVs. ATV engines may share certain components with motorcycles, snowmobiles and Personal Water Craft (PWC), but many major components such as pistons, cylinders and crankcases differ within given engine displacement categories.

2.4.2.3 Substitution Possibilities

Consumers can substitute across off-road recreational vehicles. An off-highway motorcycle as a substitute would allow the consumer to enjoy the same off-road recreation that they would receive with an ATV. Consumers may be interested in engaging in outdoor activities, but may instead consider doing a non-motorized activity. For example, consumers who are interested in being outside may engage in hiking, running, or riding a bicycle. These non-motorized options would allow the consumer to participate in outdoor activity, hence they may be considered substitutes for less intensive off-highway pastime.

2.4.2.4 Customer Concerns

Except for the competitive segment of the market, performance seems to be somewhat less important to ATV purchasers than it is to purchasers of snowmobiles or off-highway motorcycles. Most youth models, which form a significant portion of the market, are normally equipped with governors or other speed-limiting devices. Performance can be important for some of the higher-end adult models, but handling is also an important consideration, particularly when riding in dense wooded areas. Durability and reliability are also important to the customer, but perhaps not as important as price.

The price of an ATV can range from about $1,200 for an entry-level youth model to around $7,000 or more for a large, high performance machine. ATVs, like other recreational vehicles, are basically discretionary purchases, although utility may enter into the equation more often than in the case of off-highway motorcycles or snowmobiles. Cost is an important factor, particularly in the youth or entry-level segments of the market, and significant cost increases could cause people to spend their discretionary funds in other areas.

2.4.3 Industry Organization

Because there are costs associated with the emission control program, it is important to determine how the ATV industry may be affected. Industry organization is an important factor which affects how a market may react to regulatory costs. This section provides a description of the organization of the motorcycle industry.

2.4.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and the Herfindahl-Hirschman index (HHI) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices for the six digit NAICS code level for the year 1997, the most recent year available. Table 2.4-3 provides the four- and eight-firm concentration ratios (CR4 and CR8, respectively), and the Herfindahl-Hirschman index for the NAICS code 336999l, Other Transportation Equipment Manufacturing, the industry category that includes producers of ATVs. Note that the concentration ratio is reported in percentage terms while the HHI is based on a scale developed by the Department of Justice. For this industry the CR4 was 50.7 percent and the CR8 was 75.3 percent.

The criteria for evaluating the HHI are based on the 1992 Department of Justice Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries have more ability to influence market prices. Based on these criteria, the NAICS category that includes firms that produce ATVs can be considered unconcentrated or more competitive.

Table 2.4-3
Measures of Market Concentration for the NAICS Code that Includes ATV Manufacturers, 1997 [88]

Description	CR4	CR8	HHI	VOS ($\$10^6$)	Number of Companies
NAICS 336999	50.7	75.3	885.2	$4,436,679	349

2.4.3.2 ATV Manufacturers

Manufacturers of ATVs were formerly classified under the Standard Industrial Classification (SIC)code 3799 and the North American Industrial Classification System (NAICS) code 336999, Other Transportation Equipment Manufacturing. These codes are used by the

Small Business Administration (SBA) uses SIC/NAICS categories to classify businesses as large or small, depending on the number of employees or sales criteria. ATV manufacturers have the NAICS sub-classification 3369993101 and must have fewer than 500 employees to be considered a small business by SBA. In addition to manufacturers, there are a number of importers of ATVs, classified under NAICS code 42111, the code that also includes importers of automobiles, trucks, motorcycles and motor homes. To be classified as a small business by SBA for this NAICS code, an importer must have fewer than 100 employees.

Using data including the Power Systems Research (PSR) Database, Dun & Bradstreet (D&B) Market Identifiers Online Database, and information from the MIC identified 16 manufacturers and 17 importers of ATVs. ATV producers and importers are listed in Table 2.4-4. Six large manufacturers, Honda, Polaris, Kawasaki, Yamaha, Suzuki, and Arctic Cat accounted for approximately 98 percent of all U.S. ATV production in calendar year 2000.

Four of the six major ATV manufacturers, Honda, Kawasaki, Yamaha and Suzuki, are primarily automobile and/or on-highway motorcycle manufacturers who also produce ATVs, off-highway motorcycles, snowmobiles, personal water craft (PWC) and other non-highway vehicles. Polaris and Arctic Cat manufacture snowmobile, in addition to producing ATVs. Polaris also produces on-highway motorcycles and Arctic Cat produces PWC.

The 10 other manufacturers account for the remaining two percent of U.S. production in 2000. Only three of these are non-U.S.-owned. Of these remaining producers, five are classified as large businesses, and five as small businesses. Bombardier is a large Canadian snowmobile manufacturer that has recently entered the ATV market. Cannondale is a large American bicycle manufacturer that has recently begun production of ATVs as well. Hyosung and Tai Ling are large Far Eastern manufacturers, who also manufacture motorcycles and motor scooters (in the case of Hyosung). Roadmaster/Flexible Flyer is primarily a large bicycle and toy manufacturer but it also produces youth ATVs that are sold in large discount stores.

There are also some 17 firms that import ATVs. Thirteen of these are U.S.-owned. Dun and Bradstreet data on the numbers of employees are available for four of these companies, and indicate that these are small businesses according to the SBA definition. Since none of these had more than 40 employees and two had less than 20 employees, it seems safe to assume that the others are also small businesses according to the SBA definition. The 17 importers and 5 small manufacturers either import completed ATVs or assemble them in this country from imported parts.

Table 2.4-4
ATV Manufacturers/Importers

Firm Name	Type
ATK	IMPORTER
COSMOPOLITAN MOTORS	IMPORTER
D.R.R. INC.	IMPORTER
E-TON DISTRIBUTION LP	IMPORTER
HOFFMAN GROUP INC.	IMPORTER
J & J SALES	IMPORTER
JEHM POWERSPORTS	IMPORTER
KASEA MOTORSPORTS	IMPORTER
MANCO PRODUCTS	IMPORTER
MOTORRAD OF NORTH AMERICA	IMPORTER
PANDA MOTORSPORTS	IMPORTER
POWERGROUP INTERNATIONAL ALPHASPORTS	IMPORTER
REINMECH MOTOR COMPANY, LTD	IMPORTER
TRANSNATIONAL OUTDOOR POWER LLC	IMPORTER
TWS-USA, INC	IMPORTER
ULTIMAX LCC	IMPORTER
UNITED MOTORS OF AMERICA, INC	IMPORTER
AMERICAN SUNDIRO	MANUFACTURER
ARCTIC CAT, INC.	MANUFACTURER
BOMBARDIER	MANUFACTURER
CANNONDALE CORP - BEDFORD	MANUFACTURER
HONDA AMERICAN MANUFACTURING	MANUFACTURER
HYOSUNG MOTORS AND MACHINERY	MANUFACTURER
INTERNATIONAL POWERCRAFT	MANUFACTURER
KAWASAKI MOTORS CORPORATION	MANUFACTURER
KEEN PERCEPTION INDUSTRIES	MANUFACTURER
MOSS	MANUFACTURER
PANDA MOTORSPORTS	MANUFACTURER
POLARIS INDUSTRIES	MANUFACTURER
ROADMASTER /FLEXIBLE FLYER	MANUFACTURER
SUZUKI	MANUFACTURER
TAI LING MOTOR COMPANY	MANUFACTURER
YAMAHA MOTOR MANUFACTURING CORP.	MANUFACTURER

2.4.3.3 Engine Manufacturers

Four of the major ATV producers, Honda, Kawasaki, Yamaha and Suzuki, manufacture both engine and equipment. In addition to producing engines for itself, Suzuki manufactures engines for Arctic Cat, and in fact owns a significant amount of Arctic Cat common stock. Hyosung Motors and Machinery and the Tai Ling Motor Company also use Suzuki engines in their ATVs. Although Polaris produces some of its own engines, a substantial number are supplied by Fuji Heavy Industries, primarily an auto and truck manufacturer, and its U.S. subsidiary, Robin Industries. Polaris owns a substantial amount of Robin common stock.

Other engine manufacturers include Rotax, a subsidiary of Bombardier Inc., a large Canadian company. Bombardier/Rotax also produces engines for a wide variety of other applications, including snowmobiles, motorcycles, ATVs, personal water craft (PWC), utility vehicles and aircraft. A few small ATV manufacturers use Briggs or Kohler utility engines, but these are covered by EPA’s Small Spark Ignition (SI) Engine regulations and are not included in this analysis.

2.4.4 Markets

This section examines the historical market data for the ATV industry. Historical data on the quantity of domestic shipments and price data of ATVs are provided. The quantity and values of imports and exports for ATVs are presented as well.

2.4.4.1 Quantity and Price Data

Historical market data on the quantity of ATVs sold in the U.S. are provided in Table 2.4-5. Data were obtained from the Motorcycle Industry Council (MIC). As this table shows, there has been an overall increasing trend in the quantity of ATVs sold in the U.S. with an average annual increase of 17 percent from 1990 to 2001. Sales of ATVs increased more than 600% between the years 1990 and 2001. Retail dollars increased, on average, by 22 percent from 1990 to 2001. This is due to the huge increase in production. Retail dollars per unit has also increased, showing an annual average increase of 5 percent for the same period. There was a steady rise of the retail dollars/unit over this time period.

Table 2.4-5
U.S. Units Sold, Retail Dollars and Retail Dollars Per Unit ATVs, 1990 - 2001 [89]

Year	Unit Sales	% Change Unit Sales	Retail Dollars ($$10^3$)	% Change Retail Dollars	Retail Dollars/ Unit	% Change Retail Dollars/Unit
1990	134,619		$393.20		$2,921	
1991	125,056	(7%)	$371.32	(5%)	$2,969	2%
1992	144,332	15%	$449.42	21%	$3,114	5%
1993	162,307	12%	$563.18	25%	$3,470	11%
1994	189,328	17%	$770.52	37%	$4,070	17%
1995	277,787	48%	$1,282.47	66%	$4,617	13%
1996	317,876	14%	$1,530.97	19%	$4,816	4%
1997	359,397	13%	$1,759.77	15%	$4,896	2%
1998	429,414	19%	$2,155.02	22%	$5,019	3%
1999	545,932	27%	$2,805.70	30%	$5,139	2%
2000	648,645	19%	$3,343.15	19%	$5,154	0.3%
2001	880,000	12%	$3,734.91	12%	$5,123	-0.6%
Annual Average	383,154	17%	$1,596.64	22%	$4,276	5%

2.4.4.2 Foreign Trade

Export and import values and quantities for ATVs are presented in Table 2.4-6. This table shows that the export values started out on in an increasing trend for the first three years. Then in 1992, export value dropped by 64 percent and fluctuated between $73 million and $95 million, with the exception of the year 1997. Import quantity decreased until 1992 then remained between 34 thousand and 45 thousand through 2001. The import value decreased each year from 1989 to 1993, it dropped again in 1995 and maintained an increasing trend from 1996 to 2001. The import quantity generally decreased from 1989 to 1993 and started a general rebounding trend. Note that the data presented relates to SIC 3799 and includes ATVs, snowmobiles, golf carts and other transportation equipment.

Table 2.4-6*
Import and Export Quantities and Values for ATVs, 1989 - 2001 [90]

Year	Export Value ($$10^3$)	Export Quantity (10^3)	Import Value ($$10^3$)	Import Quantity (10^3)
1989	$169,881	161	$223,425	2,548
1990	$196,344	95	$156,239	2,486
1991	$209,003	75	$50,877	2,838
1992	$134,356	35	$31,786	1,854
1993	$75,876	40	$9,907	8
1994	$72,787	45	$13,549	11
1995	$85,976	43	$7,351	17
1996	$92,806	42	$9,272	19
1997	$136,357	45	$13,478	41
1998	$85,742	34	$19,174	37
1999	$91,335	42	$32,755	113
2000	$94,783	40	$48,433	178
2001	$89,381	42	$89,786	156
Average	$118,048	56	$54,310	793

*Values shown relate to SIC 3799, which includes ATVs, snowmobiles, golf carts, and other transportation products.

2.5 Off-Highway Motorcycles

Off-highway motorcycles, commonly referred to as “dirt bikes,” are recreational vehicles designed specifically for use on unpaved surfaces. As such, they all have certain characteristics in common, such as a large amount of clearance between the fenders and the wheels, tires with aggressive knobby tread designs, and a lack of some of the equipment typically found on highway motorcycles (e.g., lights, horns, turn signals, and often mufflers). Thus they normally can not be licensed for on-highway use. There are a limited number of motorcycles, known as dual-purpose motorcycles, that can be used for both on- and off-highway purposes. These can be licensed for highway use, and so fall under the current highway motorcycle regulations, assuming that they are powered by engines of 50cc or larger displacement. Off-highway motorcycles are used for recreational riding, but substantial numbers are also used for competition purposes. Some in fact can be used for little else, e.g., machines that are designed for observed trials competition, which have no seats in the conventional sense of the term, and engine characteristics that are totally unlike those of most other motorcycles. Only a few thousand observed trials competition bikes are produced each year. Vehicles designed solely for competition are exempt from this rule. EPA's noise regulations also exempt any off-highway motorcycle that is designed and marketed solely for use in closed-course competition.

2.5.1 The Supply Side

This section provides a description of off-road motorcycles and engines, the major inputs used to manufacture this equipment, and the costs of production.

The motorcycle manufacturing process generally begins with the delivery of motorcycle engines and transmissions, from engine plants to the motorcycle assembly plant. At the plant, the engines and transmissions are matched to designated vehicles on the assembly line. Motorcycle engines are produced with 1 to 8 cylinders, with various configurations. Multi-cylinder engines are manufactured in three basic configurations: in-line, opposed, and V-type. Each of these refer to the position of one bank of cylinders in relation to the other. Motorcycles engines can be air or water cooled; 2-stroke or 4-stroke; carbureted or fuel-injected. Engines may be manufactured with variances in other design characteristics, including the number and placement of carburetors, cams, and valves.

2.5.1.1 Product Types and Populations

The number of off-highway motorcycles produced for sale in the U.S. averaged about 71,415 units between 1990 and 2001. As is the case with ATVs, off-highway motorcycle production increased considerably in later years, to more than 195,000 units in 2001 according to the Motorcycle Industry Council (MIC). Since many states do not require registration of off-highway motorcycles, it is difficult to estimate a total population of these vehicles operational at any given time.

As noted above, off-highway motorcycles can be used for recreational purposes or for competition. EPA defines vehicles that are "used solely for competition" as those with features (not easily removable from the vehicle) that would make the vehicle's use in other recreational activities unsafe, impractical, or highly unlikely.

Certain types of off-highway motorcycles are designed and marketed for closed-course competition. These are commonly known as "motocross bikes." Some 12-14 percent of off-highway motorcycles produced from 1996 to 2000 were motocross bikes. Other sources have estimated motocross bikes to be closer to 30 percent of off-highway sales.[91] Other types of competition motorcycles are the observed trials machines mentioned above, which emphasize handling ability rather than speed, and the so-called "enduro bikes." Enduro bikes are designed for cross-country type racing, rather than closed-course competition. As such, they require some of the equipment normally found on non-racing machines, such as spark arresters (required by U.S. Forest Service regulations) and at least minimal lighting packages.

Whether for competition or recreational use, off-highway motorcycles are operated under transient conditions that include a wide variety of speeds and load factors.

2.5.1.2 Engine Design and Operation

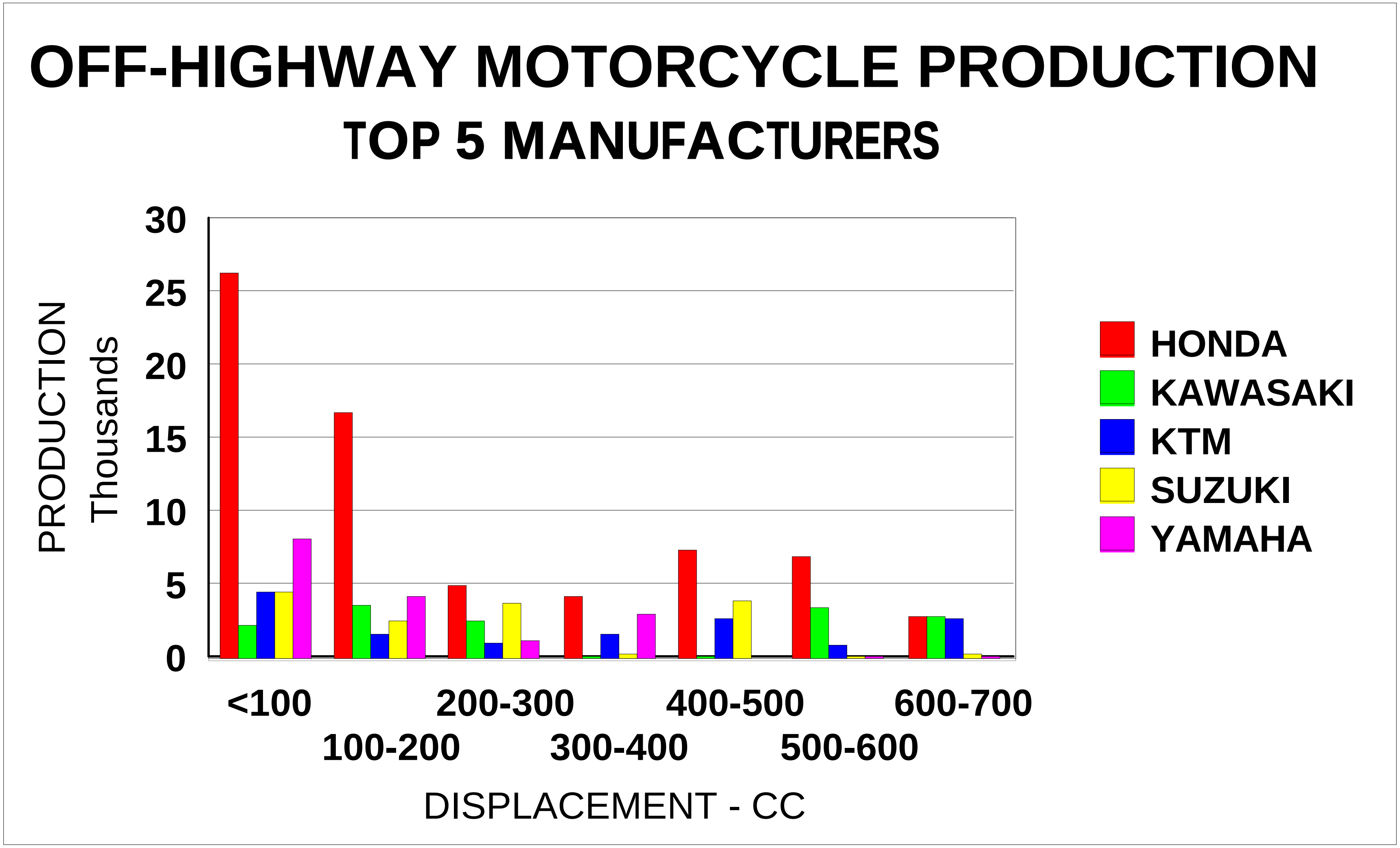
The off-road segment of the motorcycle market is dominated by vehicles with relatively small engines. Off-highway motorcycle engines have traditionally been about two-thirds smaller and less powerful than those used in on-highway cycles. In 1990 and 1998, approximately 88 percent of the off-highway motorcycles in use had an engine displacement less than 350cc. See Table 2.5-1.

Table 2.5-1
Quantities of Off-road Motorcycles By Engine Displacement
1990 and 1998 [92]

Engine Displacement	1990 Number of Motorcycles	1990 % of Total	1998 Number of Motorcycles	1998 % of Total
Under 125cc	306,000	40.8	367,200	30.7
125-349cc	346,500	46.2	680,500	56.9
350-499cc	30,000	4.0	34,700	2.9
450-749cc	67,500	9.0	113,600	9.5
Total	750,000	100	1,196,000	100

In the year 2000, about 68 percent of the models produced were less than 300cc displacement, and half of these were 100cc or less. Percentages by engine displacement for the top five producers are approximately the same as for the industry as a whole. The distribution of engine sizes for these producers tends to be somewhat skewed, with a larger fraction of off-highway motorcycles falling into the lower displacement ranges (see Figure 2.5-1). Unlike on-highway motorcycles, our contractor found no off-highway engines larger than 700cc are currently produced.

Figure 2.5-1 [93]



2.5.1.3 Two-Stroke vs Four-Stroke Cycle Engine Usage

Based on the PSR database, slightly more than half of the off-highway motorcycles produced for sale in the United States are powered by four-stroke cycle engines. However, estimates from the Motorcycle Industry Council (MIC) place the percentage of two-stroke sales at more than 60 percent. The percentage of two-strokes varies considerably by manufacturer. Honda, which accounts for more than 45 percent of this production, is predominantly a four-stroke manufacturer. Four-strokes comprise about two-thirds of its production. For Yamaha, the percentage is about 57 percent. The remainder of the foreign and domestic producers manufacture more two-stroke engines than four-strokes. For the other top-five producers, KTM, Kawasaki, and Suzuki, the percentage of two-stroke engines varies from 58 to 72 percent, and can be even higher (up to 100 percent) for some of the remaining manufacturers.

Two-stroke engines are normally used in two primary applications: (1) racing machines, because they tend to have a higher power-to-weight ratio than four-stroke engines (this is important for competition, especially in the smaller displacement classes), and (2) youth model or entry-level motorcycles, because two-strokes are cheaper to produce than four-strokes. Since youth or entry-level motorcycles also tend to have smaller displacement engines, the higher power-to-weight ratio of the two-stroke tends to provide slightly better performance. However, there has been a growing tendency in recent years for manufacturers to bring out more new four-stroke engines, particularly in the higher displacement ranges. This is also true in their competition lines.

2.5.1.4 Use of Engines in Other Applications

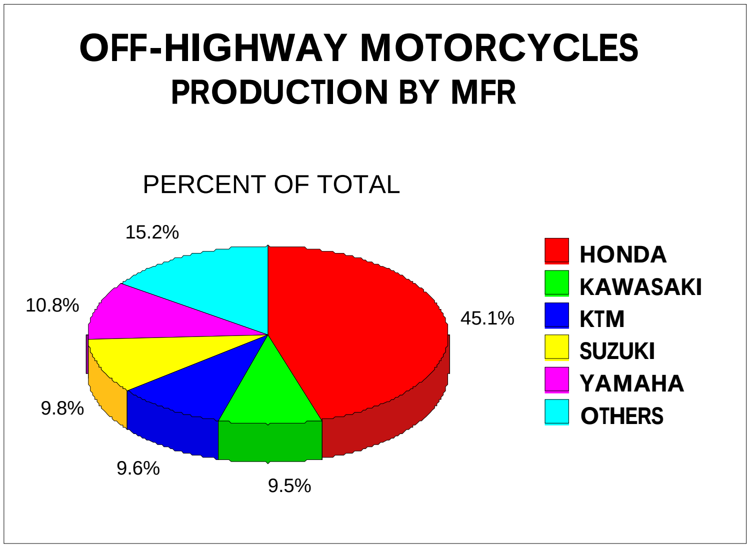
Only a few engine lines, primarily among the top five producers, are used in both off-highway and on-highway motorcycles. Part of the reason for this is because over half of the off-highway bikes use two-stroke engines, whereas almost no two-stroke engines are found in on-highway motorcycles. Also, as noted above, off-highway motorcycles generally have much smaller displacement engines than their on-highway counterparts. Off-highway motorcycle engines are closer in terms of engine size to ATV engines. However, ATVs also use predominantly four-stroke engines and these are not as likely to be highly-tuned for performance as are many off-highway motorcycle engines.

2.5.1.5 Off-Road Motorcycle Manufacturers

Motorcycle manufacturers are classified under the Standard Industrial Classification (SIC) code 3751 and under the North American Industry Classification System (NAICS) code 336991, Motorcycle, Bicycle and Parts Manufacturers. Motorcycle manufacturers have the subcode 3369913, which includes manufacturers of scooters, mopeds, and sidecars. To be classified as a small business by the Small Business Administration (SBA) size standards, the manufacturer must have fewer than 500 employees. Motorcycle importers are classified by subcode 4211101, which also includes automobile importers, and has an SBA size cutoff of 100 employees to be considered a small business.

Twenty five companies manufacture off-highway motorcycles. The five largest manufacturers, Honda, Kawasaki, Yamaha, Suzuki, and KTM. accounted for approximately 85 percent of all production sold in the U.S. in calendar year 2000. These companies manufacture automobiles and/or on-highway motorcycles, motorscooters, ATVs, Personal Water Crafts (PWC), as well as off-highway motorcycles. Honda is by far the largest producer of off-highway motorcycles, with over 45 percent of the total production for sale in the U.S. Figure 2.5-2 shows the market shares for the top five and the other producers, and Table 2.5-2 presents a list of the manufacturers of off-highway motorcycles.[94]

Figure 2.5-2



Source: ICF Consulting, Docket A-2000-01, Document II-A-84.

Of the 25 firms that manufacture off-highway motorcycles for the U.S. market, six are U.S. manufacturers. With the exception of Cannondale, which is primarily a bicycle manufacturer, all of these companies produce only motorcycles. Italy has five manufacturers. One of these, Cagiva, is mainly a producer of on-highway motorcycles. Piaggio is primarily a motorscooter manufacturer; Betamotor makes motorscooters and trials bikes. Lem and Polini manufacture youth motorcycles. Spanish manufacturers of off-highway motorcycles that are imported to the U.S. include Gas Gas Motos, primarily an observed trials bike manufacturer, and Montesa, which is owned by Honda. Other manufacturing companies whose products are imported into the U.S. market are also found in Austria, Belarus, Ireland, Korea, Sweden, Taiwan, and the United Kingdom. KTM, an Austrian company with a U.S. branch, is one of the five major producers for the U.S. market.

The 20 other manufacturers accounted for the remaining 15 percent of production for sale in the U.S. Six of these firms, accounting for approximately 3 percent of total production for the U.S. market, are located in this country. Dun and Bradstreet employee data are available for four of the six U.S. manufacturers, indicating that these are small businesses according to the SBA definition.

Our contractor has also identified 16 off-highway motorcycle importers. Eight of these are U.S.-owned. Dun and Bradstreet data are available for five of the eight U.S. importers, indicating that they are small businesses though it seems likely that all eight are small businesses.

Table 2.5-2
U.S. Off-Highway Motorcycle Manufacturers/Importers [95]

Firm Name	Type
ACTION POLINI	IMPORTER
BETA USA	IMPORTER
CODY RACING PRODUCTS	IMPORTER
COSMOPOLITAN MOTORS INC.	IMPORTER
CRE IMPORTS/E-LINE ACCESSORIES	IMPORTER
GAS GAS NORTH AMERICA	IMPORTER
HUSQVARNA USA	IMPORTER
KASEA MOTORSPORTS	IMPORTER
KTM SPORTMOTORCYCLE USA, INC.	IMPORTER
MIDWEST MOTOR VEHICLES, INC.	IMPORTER
TRANSNATIONAL OUTDOOR POWER, LLC	IMPORTER
TRYALS SHOP	IMPORTER
TWS-USA INC.	IMPORTER
U.S. MONTESA	IMPORTER
UNITED MOTORS OF AMERICA	IMPORTER
VOR MOTORCYCLES USA	IMPORTER
AMERICAN DIRT BIKE INC. (U.S.)	MANUFACTURER
ATK MOTORCYCLES (U.S.)	MANUFACTURER
BETAMOTOR SPA (ITALY)	MANUFACTURER
CAGIVA MOTORCYCLE SPA (ITALY)	MANUFACTURER
CANNONDALE CORP - BEDFORD (U.S.)	MANUFACTURER
CCM MOTORCYCLES LTD (U.K.)	MANUFACTURER
COBRA MOTORCYCLE MFG. (U.S.)	MANUFACTURER
GAS GAS MOTOS SPA (SPAIN)	MANUFACTURER
HM MOTORCYCLES (U.S.)	MANUFACTURER
HONDA MOTORCYCLES (JAPAN)	MANUFACTURER
HUSABERG MOTOR AB (SWEDEN)	MANUFACTURER
HYOSUNG MOTORS AND MACHINERY (KOREA)	MANUFACTURER
KAWASAKI HEAVY INDUSTRIES (JAPAN)	MANUFACTURER
KTM SPORT MOTORCYCLE AG (AUSTRIA)	MANUFACTURER
LEM MOTOR SAS (ITALY)	MANUFACTURER
MADFAST MOTORCYCLES (IRELAND)	MANUFACTURER
MINSK MOTOVELOZAVOD (BELARUS)	MANUFACTURER
MONTESA-HONDA ESPANA, SA (SPAIN)	MANUFACTURER
PIAGGIO GROUP (ITALY)	MANUFACTURER

POLINI (ITALY)	MANUFACTURER
REV! MOTORCYCLES (U.S.)	MANUFACTURER
SUZUKI (JAPAN)	MANUFACTURER
TAI LING MOTOR COMPANY LTD. (TAIWAN)	MANUFACTURER
VOR MOTORI (ITALY)	MANUFACTURER
YAMAHA MOTOR COMPANY LTD. (JAPAN)	MANUFACTURER

2.5.1.6 Engine Manufacturers

For the majority of off-highway motorcycles, the vehicle manufacturer is also the engine manufacturer. However, a few motorcycle manufacturers use engines produced by other firms. ATK Motorcycles and CCM Motorcycles Ltd. use Bombardier/Rotax engines, while the Tai Ling Motor Company uses Suzuki engines. The Spanish manufacturer, Gas Gas Motos, noted primarily for its observed trials machines, produces some of its own engines and buys others from Cagiva, a large Italian manufacturer. One U.S. manufacturer, Rokon, markets a low-production trail motorcycle resembling a large motorscooter. This vehicle type is intended for hunters and fishermen. Rokon uses industrial-type engines made by Honda and other manufacturers which are regulated under the EPA Small SI regulations. Therefore, Rokon is not included here.

As Table 2.5-3 shows the average value of shipments (VOS) for this industry over the 1992 to 1999 time period is equal to approximately 2.8 billion dollars, with the highest value of shipments occurring in 1998. The cost of materials for this industry is equal to an average of almost 1.6 billion dollars (57 percent of VOS). The average cost of labor is approximately 347 million (19 percent of VOS), while capital expenditures are equal to an average value of 26.7 million (1 percent of VOS). Examination of this data clearly shows that capital expenditures represent the smallest share of the value of shipments while the cost of materials represents the largest share.

Table 2.5-3
Value of Shipments (VOS) and Production Costs for the SIC and NAICS Codes that Include Off-Highway Motorcycle Manufacturers, 1992 - 1999 [96,97,98,99]

		VOS	Payroll		Cost of Materials		Total Capital Expenditures	
Year	Industry Code	($$10^6$)	($$10^6$)	% of VOS	($$10^6$)	% of VOS	($$10^6$)	% of VOS
1992	SIC 3751	1,878.9	301.7	16%	1,146.2	61%	10.6	1%
1993	SIC 3751	1,878.3	409.3	22%	1,362.0	73%	13.0	1%
1994	SIC 3537	2,632.1	482.6	18%	1,488.6	57%	14.2	1%
1995	SIC 3537	2,832.9	502.6	18%	1,541.6	54%	15.4	1%
1996	SIC 3537	3,094.0	565.1	18%	1,673.9	54%	17.9	1%
1997	NAICS 336991	3,382.6	662.3	20%	1,802.3	53%	19.5	1%
1998	NAICS 336991	3,343.8	620.3	19%	1,740.7	52%	9.6	0
1999	NAICS 336991	3,066.1	576.1	19%	1,611.3	53%	7.2	0
	Average	2,776.8	347.1	19%	1,559.1	57%	26.7	1%

* Value of Shipments, Payroll, Cost of Materials, and Total Capital Expenditures are in nominal U.S. dollars

2.5.2 The Demand Side

This section provides information on the uses of off-highway motorcycles, the various substitute products on the market, and the consumers who purchase off-highway motorcycles.

2.5.2.1 Uses of Off-Highway Motorcycles

Motorcycles are used for a for a variety of purposes, including recreation, touring, commuting, and on- and off-road racing. There are generally three motorcycle model types, on-highway, dual(both on highway and off-highway), and off-highway. On-highway motorcycles are certified by the manufacture as being in compliance with the Federal Motor Vehicle Safety Standards (FMVSS), and are designed for use on public roads. On-highway motorcycles include scooters, but excludes mopeds (limited speed motor-driven cycles under 50cc, with or without fully operative pedals). Dual motorcycles are certified by the manufacturer as being in compliance with FMVSS, and are designed with the capability for use on public roads, as well as off-highway recreational use. Off-highway motorcycles are not certified by the manufacturer to be in compliance with FMVSS for on-highway use. This category includes competition motorcycles. Table 2.5-4 show that off-highway motorcycles represents nearly 15% of the total population in 1998 and nearly 18% in 1998.

Table 2.5-4
Estimated Population By Model Type
1990 and 1998 [100]

MODEL TYPE	1990 NUMBER OF MOTORCYCLES	1998 NUMBER OF MOTORCYCLES
On-Highway	3,650,000 (72.3%)	4,809,000 (73%)
Dual	660,000 (13%)	565,000 (8.6%)
Off-Highway	750,000 (14.8%)	1,196,000 (18.2%)
Total	5,060,000 (100%)	6,570,000 (100%)

2.5.2.2 Substitution Possibilities

Consumers can substitute across off-road recreational vehicles. As a substitute, an ATV would allow the consumer to enjoy the same off-road recreation that they would receive with an off-highway motorcycle. Consumers may be interested in engaging in outdoor activities, but may instead consider doing a non-motorized activity. For example, consumers who are interested in being outside may engaging in hiking, running, or riding a bicycle. These non-motorized options will also allow the consumer to participate in outdoor activity, but they may be considered substitutes for less intensive off-highway past times. Indeed, any type of recreational activity may be viewed as a substitute for off-highway motorcycle usage.

2.5.3 Industry Organization

Because there are costs associated with the emission control program, it is important to determine how the off-highway motorcycle industry may be affected. Industry organization is an important factor which affects how an industry may react to regulatory costs. This section provides a description of the organization of the motorcycle industry.

2.5.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and the Herfindahl-Hirschman index (HHI) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices for the six digit NAICS code level for the year 1997, the most recent year available. Table 2.5-5 provides the four- and eight-firm concentration ratios (CR4 and CR8, respectively), and the Herfindahl-Hirschman index for the Motorcycle, Bicycle, and Parts Manufacturing industry, the industry that includes producers of off-highway motorcycles. This industry is represented by NAICS code 336991. For this industry the CR4 was 67.5 percent and the CR8 was 76.7 percent.

The criteria for evaluating the HHI are based on the 1992 Department of Justice Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries have more ability to influence market prices. Though the HHI measure for this industry is high, we have chosen to model is as a perfectly competitive market. We have made this choice based on the number of recreational substitute available for off-highway motorcycles.

Table 2.5-5
Measures of Market Concentration for the
NAICS Code that Includes Off-Highway Motorcycle Manufacturers, 1997 [101]

Description	CR4	CR8	HHI	VOS ($\$10^6$)	Number of Companies
NAICS 336991	67.5	76.7	2,036.5	$3,382,689	373

2.5.3.2 Motorcycle Manufacturers

As mentioned above, motorcycles are included under Standard Industrial Classification (SIC) 3751. The U.S. motorcycle industry is relatively small compared to other industries such as the automobile industry. There are over 40 U.S. firms (Table 2.5-2) engaged in the manufacture and/or distribution of off-highway motorcycles. Six of these firms accounted for 90 percent of the new motorcycle units produced in the United States in 2000. Table 2.5-6 shows the ranking and market share for the major producers in the industry for 1999 and 2000.

Table 2.5-6
Motorcycle Manufacturers by Market Share 1999-2000 [102]

BRAND	1999 RANK	1999 MARKET SHARE	2000 RANK	2000 MARKET SHARE
Honda	2	24.1%	1	25.0%
Harley-Davidson	1	25.5%	2	23.0%
Yamaha	3	17.8%	3	19.3%
Suzuki	5	10.8%	4	11.2%
Kawasaki	4	11.8%	5	10.2%
BMW	6	1.9%	6	1.7%
All Others	--	8.1%	--	9.6%

In the off-highway segment, the top five manufacturers were Honda , Kawasaki, KTM, Suzuki, and Yamaha. Table 2.5-7 shows the market share among the major producers. U.S. off-highway motorcycle production by the top five firms steadily rose over the 1996 to 2000 time period, with a slight dip in 1999.

Table 2.5-7
Off-Highway Motorcycle Units Manufactured by the Top Five Firms 1996-1999 [103]

Company	1996	1997	1998	1999	2000	1996-2000 TOTAL	1996-2000 MARKET SHARE
Honda	45,694	51,281	56,678	53,706	68,924	276,283	48.0%
Suzuki	17,022	19,200	18,694	10,617	11,039	76,572	13.3%
Yamaha	23,862	29,231	25,230	26,079	20,406	124,808	21.7%
Kawasaki	12,687	12,147	13,249	12,885	14,560	66,528	11.5%
KTM	2,778	3,146	3,783	7,236	14,747	31,690	5.5%
Total	102,043	116,005	117,634	110,523	129, 676	575,881	100%

2.5.3.3 Small Businesses

The motorcycle companies listed in Table 2.5-2 can be grouped into small and large business categories using the Small Business Administration (SBA) general size standard definitions for NAICS codes. The SBA defines a small business in terms of the employment or annual sales of the owning entity and these thresholds vary by industry. Based on the size standard for NAICS 336991, several of the motorcycle producers are considered small businesses.

2.5.4 Markets

This section examines the historical market statistics for the off-highway motorcycle manufacturing industry. Historical data on the quantity of domestic shipments and price data of off-highway motorcycles are provided. The quantity and values of imports and exports for motorcycles are presented as well.

2.5.4.1 Quantity and Price Data

Historical market data on the quantity of U.S. unit sales of off-highway motorcycles are provided in Table 2.5-8. Data were obtained from the Motorcycle Industry Council (MIC). As this table shows, there has been an overall increasing trend in the quantity of off-highway motorcycles sold in the U.S. with an overall net increase of 290 percent and the retail value of off-highway motorcycle increased by nearly 40 percent from 1990 to 2000.

Table 2.5-8
U.S. Units Sold, Retail Dollars and
Retail Dollars Per Unit Off-Highway Motorcycles, 1990 - 2001 [104]

Year	Unit Sales	Retail Dollars	Retail Dollars/Unit
1990	39,221	$63,745,225	$1,625
1991	37,363	$63,670,177	$1,704
1992	39,345	$68,038,926	$1,729
1993	39,863	$75,033,960	$1,882
1994	40,991	$84,844,505	$2,070
1995	40,791	$94,125,405	$2,308
1996	45,266	$111,001,200	$2,452
1997	49,168	$119,041,853	$2,421
1998	59,930	$133,062,004	$2,220
1999	77,875	$170,303,959	$2,187
2000	120,501	$279,984,888	$2,324
2001	195,250	$334,983,201	$2,253

* Values are in nominal dollars.

2.5.4.2 Foreign Trade

Export and import values and quantities for off -highway motorcycle are presented in Table 2.2-9. These data show increasing trends for export and import values since 1989. Note these data reflect imports and exports for SIC 3751, motorcycles, bicycles, and parts.

Table 2.5-9
Import and Export Quantities and Values for Off-Highway Motorcycles, 1989 - 2001[105]

Year	Export Value (1,000 Dollars)	Export Quantity (1,000 Dollars)	Import Value (1,000 Dollars)	Import Quantity (1,000 Units)
1989	$244,722	$319	$1,325,309	32,829
1990	$419,911	$480	$1,216,239	37,164
1991	$615,439	$796	$1,370,364	40,850
1992	$671,331	$846	$1,574,380	37,823
1993	$702,831	$1,053	$1,758,664	42,767
1994	$711,053	$739	$1,800,564	40,322
1995	$850,229	$721	$2,178,559	43,937
1996	$906,040	$626	$2,046,358	41,868
1997	$976,494	$692	$2,117,154	48,622
1998	$918,277	$662	$2,445,434	45,565
1999	$738,152	$823	$2,993,162	43,008
2000	$798,357	$673	$3,898,859	37,846
2001	$967,947	$480	$3,895,486	26,592
Average	$732,368	$685	$2,201,579	39,938

* Values are in nominal dollars and reflect values for SIC 3751 Motorcycles, Bicycles, and Parts.

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