UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: April 12, 2004

TO : Janet Buyer, ESFS

THROUGH: Gregory B. Rodgers, Ph.D., AED, EC GBR

FROM : Mary F. Donaldson, EC

SUBJECT : Portable Generators

Introduction

Most carbon monoxide-related deaths from engine driven tools in the U.S. are associated with the improper use of portable generators. This report presents an overview of the market for portable generators and includes information about manufacturers, production, units in use and types of generators preferred by consumers.[1]

The Electric Power Research Institute (EPRI) breaks down portable generators into the following components which are mounted onto a metal chassis (1):

- internal combustion engine,
- AC alternator,
- starting and regulating controls,
- electric power outlets,
- safety devices such as ground fault circuit interrupters and circuit breakers.
- starter

Generators may be categorized by power output. According to *Consumer Reports,* small generators produce 3.0 to 4 kilowatts (kW); mid-sized units, 4.5 to 7 kW; and large units around 10kW (8). Both commercial users and consumers purchase generators. While the markets are not clearly differentiated, consumers overwhelmingly purchase light duty lower cost models.

Portable generators run on gasoline, diesel, natural gas, or liquid propane (LP). A few models use multiple fuel sources (8). Consumers generally purchase gasoline-powered units. A market study report by Frost & Sullivan indicated that only 2 percent of light duty portable generators run on fuels other than gasoline (12).

[1] It should be noted that this memo reflects the analysis of CPSC staff, has not been reviewed or approved by, and may not necessarily reflect the views of the Commission.

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Portable generators sold in the U.S. produce 60Hz current. The production of 60 Hz power requires generators to operate at 1800 revolutions per minute (rpm) or multiples thereof. Portable, light duty generators are often powered by 3600 rpm, air cooled, twin cylinder lawn mower engines (2). These high rpm air-cooled engines have relatively short product lives, providing about 500 hours of use. When used for emergency backup purposes, these light duty units usually remain operational for about 5 to 7 years (1, 12). Units designed for longer service include liquid-cooled 1800 rpm gasoline generators that may provide up to 10,000 operating hours. Similar diesel powered units may provide 30,000 hours of use (2). However, because of their price, these units typically are not purchased by consumers.

Suppliers and Shipments

Generator suppliers are part of the non-road engine and equipment industry. The companies in this market are foreign, domestic, multi-national, and joint ventures, and include both small and large businesses (5). Most generator suppliers are equipment assemblers, i.e. they assemble purchased components to produce a generator set. The largest suppliers of generators also manufacture their own engines.

In the course of this study, we identified more than 40 U.S. suppliers of portable generators in the under 15 kW output range – the range most commonly used by consumers. These firms are listed in Table 1 at the end of this report, along with the electrical output ratings and price ranges, where known. Most firms identified sell their generators nationwide. However, Frost and Sullivan indicated that there are some small assemblers that operate in regional markets (12). Three firms dominate this market – Briggs and Stratton (27 percent), Coleman (18 percent), and Honda (13 percent) – producing about 60 percent of generator sales revenues in 2002 (11, 12).

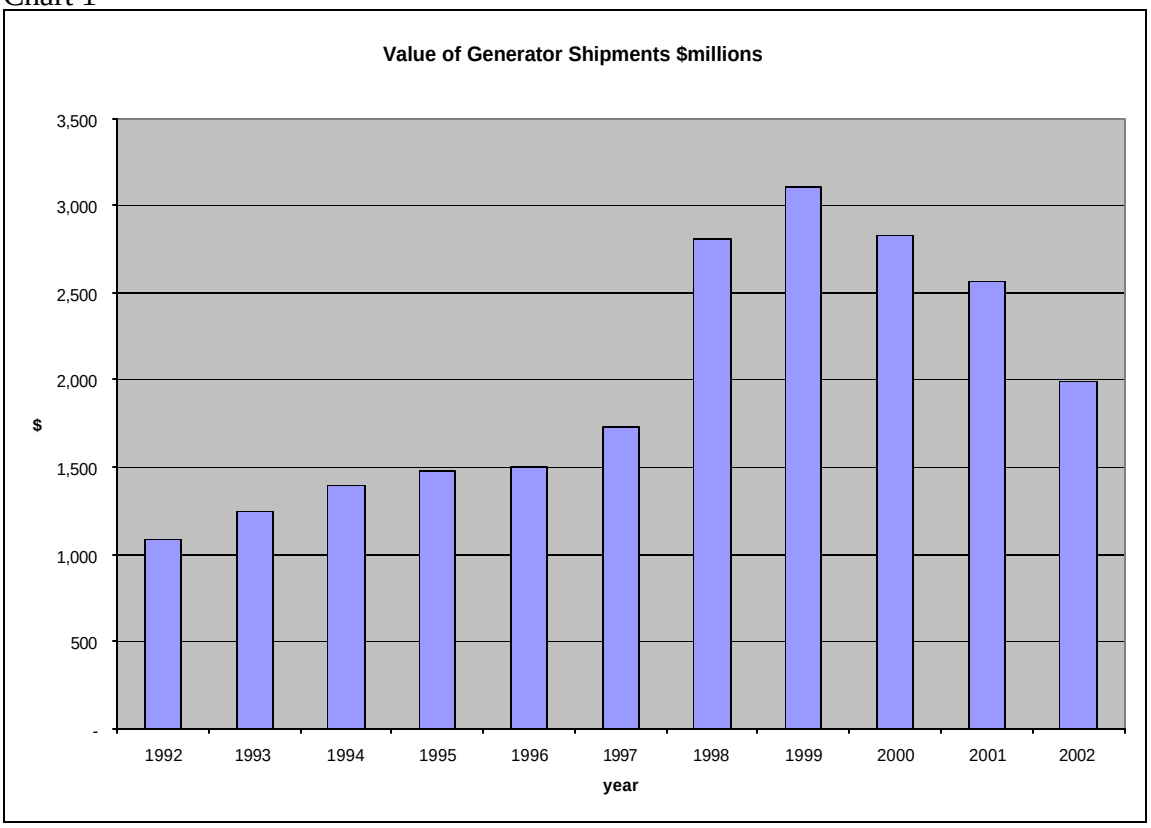
More than half of portable generators are sold through standard mass market retail channels. This includes hardware stores, discount retailers and home centers. Equipment dealerships having exclusive relationships with manufacturers account for about one quarter of sales. Direct and internet sales account for the remainder (12). Generators are also rented from equipment rental companies.

The U.S. Bureau of the Census reports generator shipments in terms of shipment valuation and units, categorized by power output and engine fuel type. Due to disclosure restrictions, no data was reported in the specific subcategory of interest in this report: gasoline-powered generators under 15 kW output. Complete "value of shipment" data is available for combined categories of generators, including portable and fixed generators, with power output ranging from below 5kW to over 100kW. Chart 1 shows this information graphically. As can be seen in the chart, 1999 was a peak year for generator shipments. This can be attributed to demand fueled by concerns about power grid failure and infrastructure sabotage leading up to the Year 2000 (1, 3, 13). In 2002, manufacturers shipped about $2 billion worth (FOB plant[1]) of

[1] FOB means free-on-board. FOB plant is the price paid for goods at factory loading dock and does not include shipping charges.

gasoline and diesel driven generator sets. It should be noted that most of these shipments are of commercial and industrial generators.

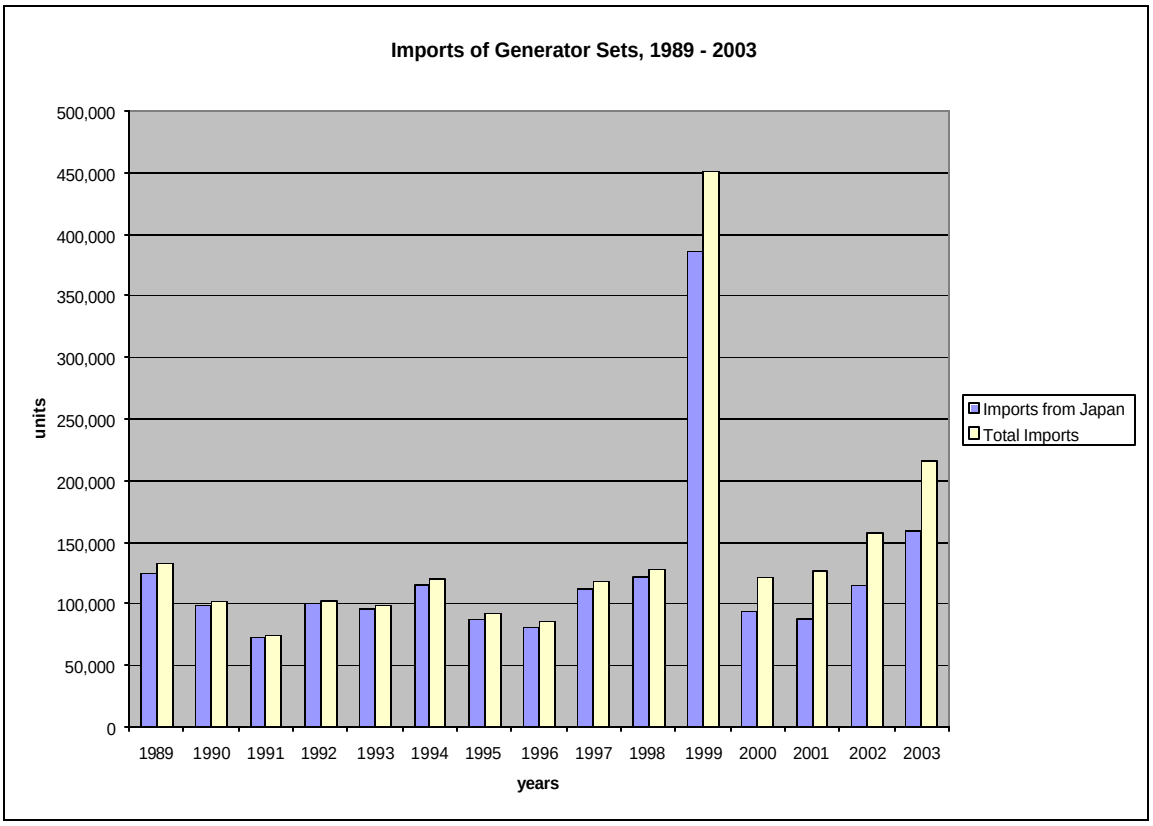
Chart 1



Source: Current Industrial Reports: Motors and Generators: 1992 to 2002, U.S. Bureau of the Census.

Imports of generator sets are illustrated in Chart 2. Imports had a value of $127 million in 2002 and exports were valued at about $72 million. Imports from Japan constitute the largest percentage of imports of generator sets of all sizes. Close to three-quarters of imports have been from Japan since 2000, down from 96 percent in 1997. Reflecting the surge in U.S. demand for generators in 1999, 451,000 generators were imported, and 86 percent of those were from Japan. (See Chart 2.)

Chart 2



Source: United States International Trade Commission.

Trade Associations

Generator manufacturers also produce other types of outdoor equipment such as lawn mowers and other lawn and garden equipment. Many are members of the Outdoor Power Equipment Institute, an association of mostly lawn care equipment manufacturers. There is also the Electrical Generating Systems Association (EGSA), an association of large on-site electrical generator manufacturers. Many EGSA members also manufacture small portable generators. Many engine manufacturers that also produce generators are members of the Engine Manufacturers Association.

Prices

A review of the marketplace revealed a large price range for portable generators. Prices ranged from as low as $399 for a small 1,000 watt output generator from Troy-Bilt to $4,900 for an 11,000 watt generator from Honda. On a kW-output basis prices range from about $100 to as much as $1000 per kW. An article in *Consumer Reports* in November 2003 showed a price

range of $400 to $3,000 for consumer-use generators (8). The most popular generator prices are in the $500 to $800 range (13). According to a study by Frost and Sullivan, in 2002, average retail prices of light duty portable units were about $723 with a range of about $500 to $1500 (12).

Sales

Based on the Frost & Sullivan study, about 357,000 light duty portable generators were sold in the U.S. in 2002. Of these, an estimated 57 percent or about 203,000 units (representing about $150 million in retail sales) were purchased for use by homeowners. This is down from the peak year for generator shipments in 1999, when about 733,000 units of light duty generators were shipped in the U.S., with perhaps 418,000 for use by homeowners. Table 2 shows estimates of light duty portable generators sales to homeowners, based on Frost & Sullivan's 57 percent estimated rate of sales to homeowners from 2002 (12).

Table: 2: Estimated homeowner purchases of light duty portable generators, 1999 to 2002

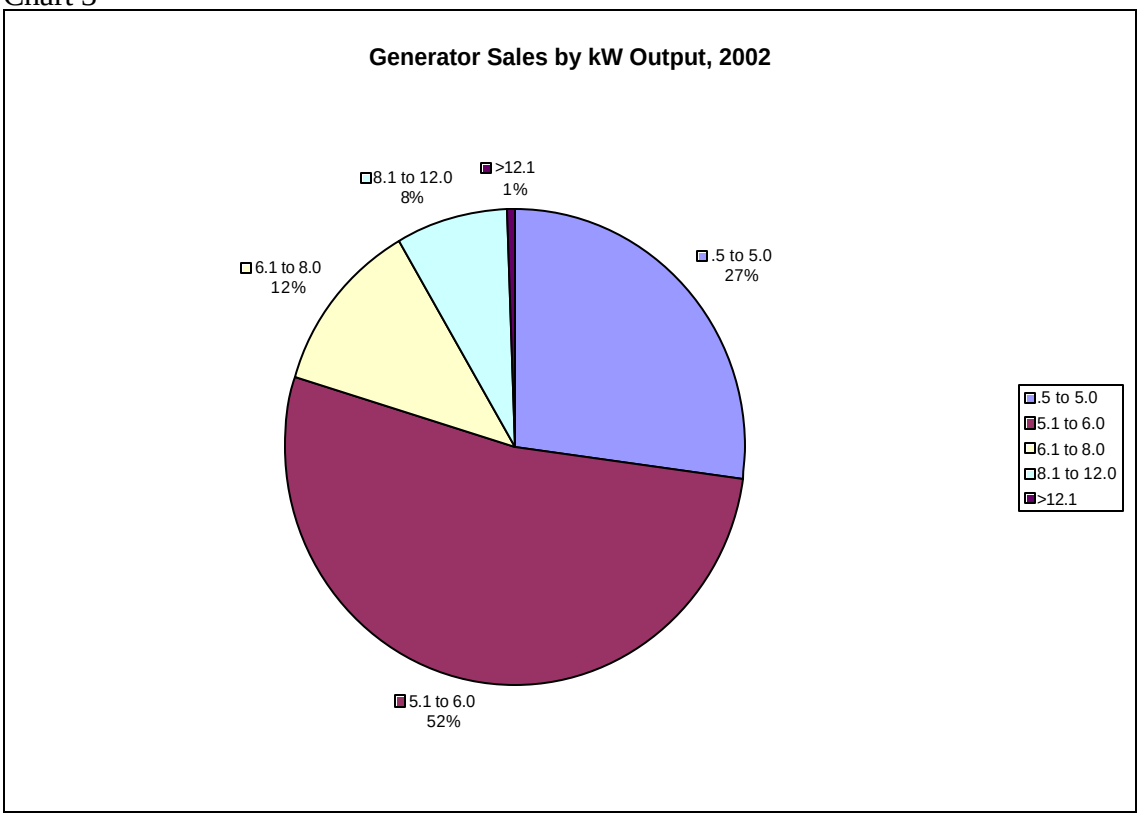
Year	**Total U.S. Sales**	**Sales to Homeowners**
1999	733,000	418,000
2000	288,000	164,000
2001	342,000	195,000
2002	357,000	203,000

Source: Frost & Sullivan

Consumer demand for generators may be attributed to reactions to events such as power outages caused by weather-related disasters, grid failures, and rolling blackouts as well as fear of outages prompted by security-related concerns (3, 9,12). The large spike in generator sales in 1999 was reportedly a response to fear leading up to the Year 2000 (1, 3 ,13). Increased reliance on power for home office functions has also been linked to generator demand (6). Because weather-related events prompt many sales of generators, the summer and fall tropical storm seasons result in the highest unit sales, according to Briggs and Stratton's annual report (11).

According to a study by Frost & Sullivan, homeowners are the largest end users of light duty portable power generators, with the most popular size being 5 to 6kw of output, accounting for about 52 percent of light duty sales. According to EPRI, most residential generators operate in the 3 to 10 kW range (1). Chart 3 below illustrates the breakdown by kW output and percentage of sales.

Chart 3



Source: Frost and Sullivan

Number in Use

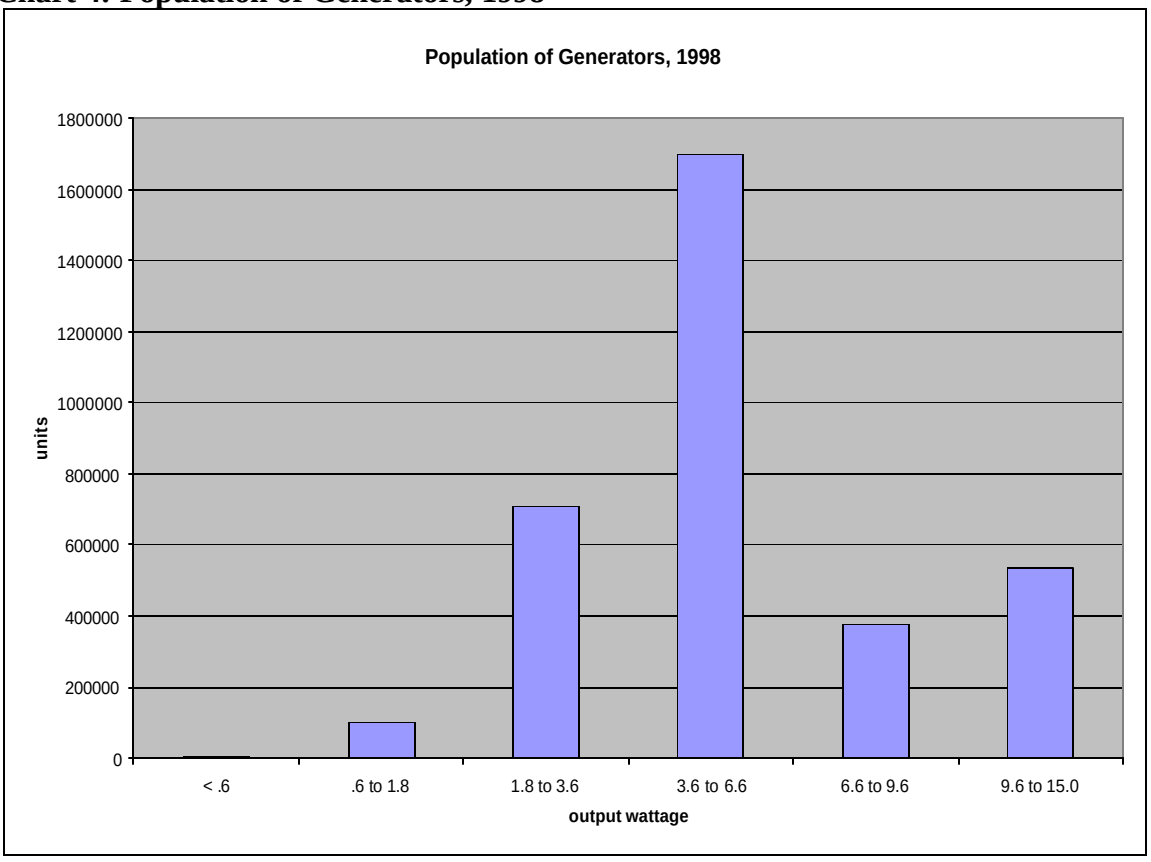
The U.S. Environmental Protection Agency (EPA), in its work on emissions of non-road engines, developed estimates of the population of gasoline powered generators for 1998 for all end users. EPA categorized generators by engine type and horsepower as opposed to kW output. The population of generators in terms of kilowatt output may be roughly estimated by multiplying the horsepower rating by a nominal conversion factor of about 0.6[2]. Table 3 presents the EPA population figures along with this conversion. Chart 4 illustrates the population of generators by power output, converted as described (4).

[2] Because of energy losses, applying the direct conversion of 1 horsepower = .746 kw does not equate to the generator ratings observed in the marketplace, so the conversion of 1 hp = .6 was chosen as more reflective of the marketplace.

Table 3: Estimated Population of Generators under 25 hp, 1998, all end users

Engine Type	1hp=.6kW	Estimated population, all users	% of generators
2-stroke, 0-1 hp	0 to .6	4,052	0.12
2-stroke, 1-3 hp	.6 to 1.8	100,577	2.94
4-stroke, 3-6 hp	1.8 to 3.6	707,572	20.66
4-stroke, 6-11 hp	3.6 to 6.6	1,699,093	49.61
4-stroke, 11-16 hp	6.6 to 9.6	375,830	10.97
4-stroke, 16-25 hp	9.6 to 15.0	537,782	15.70
		3,424,906	100.00

Chart 4: Population of Generators, 1998



Using CPSC's product population model with estimates of historical sales, and assuming an average product life of about 6 years, we estimate that about 1 million portable generators are

in use in US households. This is about one-third of the generators reported by EPA in 1998, suggesting that most of the generators at that time were not being used by consumers.

Using EPA's figures and applying the conversion factor described above, about half of the generators in use under 25 horsepower operate in the 3.6 to 6.6 kW as of 1998. By way of comparison, Frost & Sullivan estimated that about half of the light duty portable generators sold in 2002 were in the 5.1 to 6.0 output range, with 5.5 kW being the most popular size in this range (4, 12).

Table 1: Manufacturers and Suppliers of Portable Electric Generators

Manufacturer/Model	Output Rating	Price Range
American Honda	.700 to 11kW	$700 to $4,900
Baldor Pow'r Gard Powerchief	1.3 to 11 kW	$692 to
Briggs & Stratton	.9 to 10kW	$450 to $1970
Vanguard Generators (Briggs & Stratton)	2kw to 10kw	$610 to $2484
Coleman Powermate (Premium, Premium Plus & Professional)	1.1 to 12kW	$400 to $2150
Craftsman	3 to 5.6kW	$450 to $750
Deere & Co. (John Deere)	2.5 to 6.0kW	$800 to $1800
DEK generators	2 to 6kW	$1,000 to $2,700
DeVilbiss		
DeWalt (Black & Decker)	2.9 to 7kW	
Eastern Tools & Equipment Generators (ETQ)	2.5 to 6.5KW	$420 to $2800
Generac Portables (Briggs & Stratton)	.9 to 10kW	
Gillette Gen-Pro	3.0 to 15kW	To $4703
Groban		
HawkPower	1.3 to 6.7kW	$634 to $2460
Husqvarna	6.55kW	$1300
Ingersoll-Rand	5.0 to 7.25 kW	
Kawasaki (Powerpartner)	.45 to 6kW	
Kosika generators		
Lister-Petter		
Mahle, Inc.		
Makita	1.3 to 12 kW	$800 to $3,115
Master	3.0 to 10kW	$799 to $3,899
Mitsubishi	1.1 to 6.7 kW	$575 to $2,139
Multiquip (MQ)	2.2 to 9.7 kW	
NAC	4.3 to 7.0kW	$1569 to $2300
New Holland North America		
Northstar (Northern Tool and Equipment Company)	2.7 to 15kW	

Onan Portable Generators Sets (Cummins)	2.5 to 6.0kW	
Porter-Cable (commercial)	3.5 to 10kW	
Pramac (Power Gard)	5kw, 7.5kw	$524 to $2500
Robin America (Subaru)	1.3 kW to 13.0 kW	$660 to $3,300
SDMO Generators	.9 to 9KW	
Stow (Multiquip)	2.9 to 4.5 kW	
Trillium International		
Troy-Bilt	1.0kW to 7.5kW	$399 to $1099
Tsurami (construction)	2.5 to 5.0kW	$1200 to $2300
Voltmaster	3.0 to 15kW	$435 to $3,600
Walbro Engine Management		
Wheelhouse	4.0 to 5.5kW	$650 to $750
WINCO	3.0 to 15kW	$886 to $4,362
Winpower	2.5 to 15kW	$668 to $4,360
Yamaha	1 to 12 kW	$600 to $3,800
Yanmar (Diesel)		
Wacker	3.7 to 9.7kW	$1,390 to $3,332
Westerbeke (marine applications)		

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