1 THE MOS MEMORY MARKET

OVERVIEW

Memory 1997 provides detailed coverage of the recents trends associated with DRAM, SRAM, EPROM, and flash memory IC devices. Market direction and technology inclinations for each product segment are covered in separate sections. Details of the ROM and EEPROM markets are referenced in this section.

The memory market is often looked upon to introduce new and innovative devices. Demands from customers for more sophisticated and technically advanced systems necessitate that new IC products enter the market. When new products are introduced to the marketplace, existing IC components are pushed further along the product lifecycle. Figure 1-1 provides ICE's view of where several memory ICs will be located in the 1997 product lifecycle.

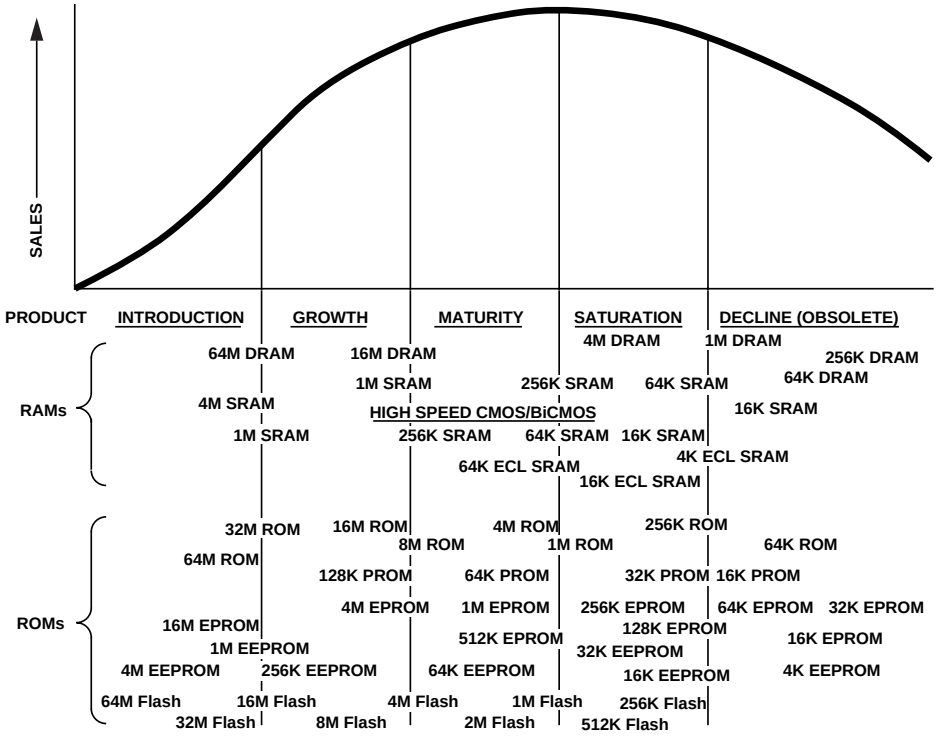
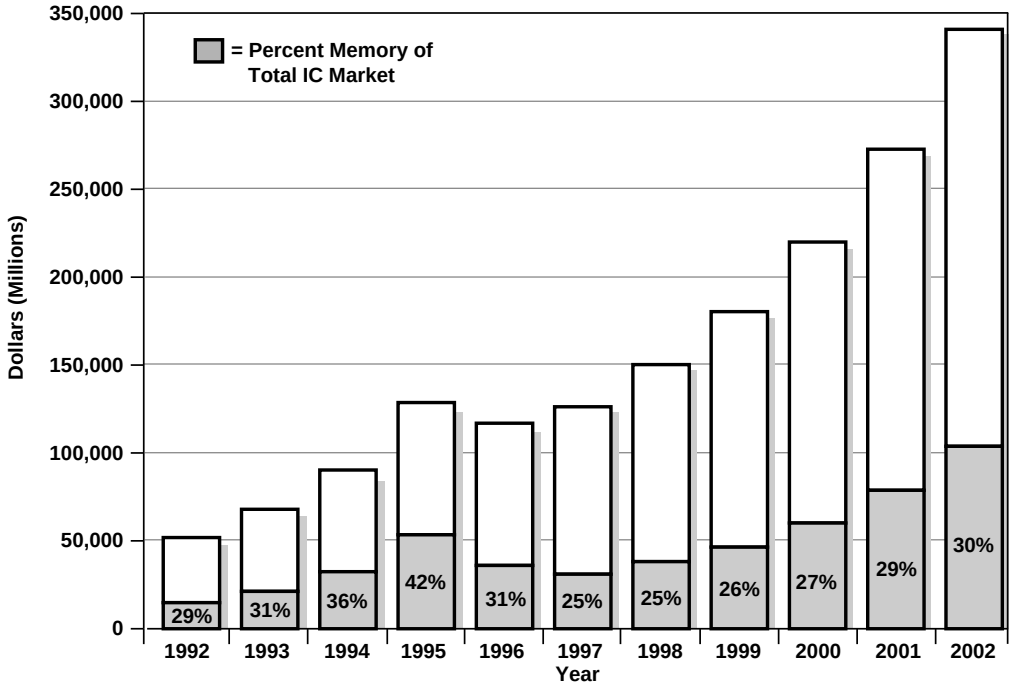


Figure 1-1. Memory Product Lifecycle (1997)

Figure 1-2 shows the worldwide MOS memory and IC markets through 2002. In 1996, MOS memory devices accounted for 31 percent of the IC market. This was down significantly from 1995 when MOS memory devices accounted for 42 percent of the total IC market, the highest level in semiconductor history. In 1997, the memory portion of the overall IC market is forecast to decrease to 25 percent. In fact, the memory market will likely remain less than one-third of the total IC market through the year 2002, which is a dramatic shift from market conditions during the first half of the 1990's.



WW IC Market ($M)	51,875	67,950	90,295	128,680	116,920	126,275	150,265	180,320	219,990	272,790	340,985
WW Memory Market ($M)	14,840	21,260	32,455	53,460	36,015	31,030	38,185	46,430	60,145	78,770	103,790
Other IC Market ($M)	37,035	46,690	57,845	75,220	80,905	95,245	112,080	133,960	159,845	194,020	237,195
Percent Memory of IC Market	29%	31%	36%	42%	31%	25%	25%	26%	27%	29%	30%

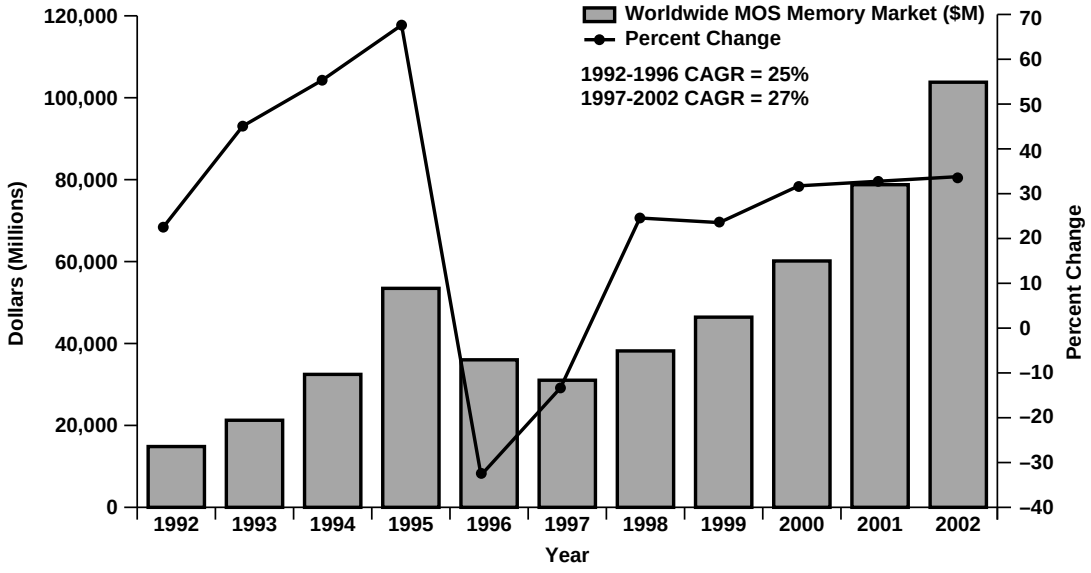
Source: ICE, "Memory 1997" 18909F

Figure 1-2. MOS Memory Percent of Total Worldwide IC Market ($M)

Despite the fact that the memory IC market is forecast to be a smaller percentage of the total IC market through the year 2002, the memory IC market is expected to grow at a better annual rate between 1997 and 2002 than it did between 1992 and 1996 (Figure 1-3).

It is interesting to note just how great an impact the MOS memory market has on the overall IC market. Figure 1-4 shows the percent increase/decrease in the IC market during the past two years and the forecast for 1997. With 30 percent growth, the IC market (not including memory

ICs) was extremely good in 1995 ($75.2 billion). However, when the MOS memory segment was factored in, the overall growth of the IC market increased 13 additional percentage points to 43 percent, or $128.7 billion!



MOS Memory Market ($M)	14,840	21,260	32,455	53,460	36,015	31,030	38,185	46,430	60,145	78,770	103,790
Percent Change	21	43	53	65	–33	–14	23	22	30	31	32

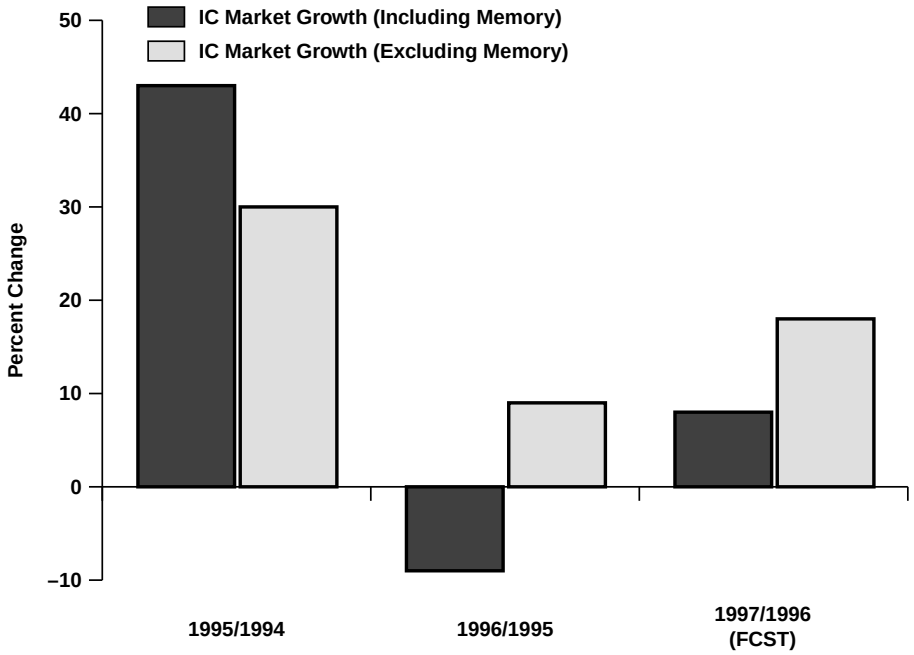
Source: ICE, "Memory 1997" 18903F

Figure 1-3. 1992-2002 MOS Memory Market CAGR

A similar impact was felt in 1996 when the total IC market was $116.9 billion. This represented a decrease of nine percent from the previous year. However, if the memory segment of this figure is excluded, the IC market actually witnessed eight percent growth in 1996.

Figure 1-5 provides a complete review of the MOS memory and IC markets for the years 1992-2002. Following three straight years of better than 40 percent growth (1993, 43%; 1994, 53%; 1995, 65%), the 1996 MOS memory market experienced the “correction year” that was anticipated for some time.

As will be discussed later, a great amount of new wafer fab capacity led to greatly reduced average selling prices for memory products. This, in turn, led to the -33 percent reduction in the size of the 1996 MOS memory market. Excess wafer fab capacity is forecast to remain through 1997, which will likely keep the memory market surpressed.



Year	1995	1996	1997
IC Market ($M) (Including Memory)	128,680	116,920	126,275
IC Market ($M) (Excluding Memory)	75,220	80,905	95,245

Source: ICE, "Memory 1997" 22424

Figure 1-4. Effects of Memory Market on Total IC Market

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
WW IC Market ($M)	51,875	67,950	90,295	128,680	116,920	126,275	150,265	180,320	219,990	272,790	340,985
WW MOS Memory Market ($M)	14,840	21,260	32,455	53,460	36,015	31,030	38,185	46,430	60,145	78,770	103,790
WW Memory Percent Change	21%	43%	53%	65%	–33%	–14%	23%	22%	30%	31%	32%
Percent Memory of Total IC	29%	31%	36%	42%	31%	25%	25%	26%	27%	29%	30%
DRAM ($M)	8,525	13,140	23,420	40,835	25,130	21,485	27,750	34,605	46,080	61,890	82,870
SRAM ($M)	2,890	3,295	3,755	6,075	4,745	3,500	3,955	4,510	5,275	6,015	6,915
EPROM ($M)	1,250	1,350	1,390	1,385	1,105	815	695	580	500	420	375
Flash ($M)	270	740	865	1,860	2,610	3,000	3,585	4,530	6,050	8,175	11,280
ROM ($M)	1,225	1,625	1,890	1,965	1,340	1,100	970	870	775	680	610
EEPROM ($M)	480	700	720	885	920	975	1,090	1,210	1,355	1,490	1,650
Other Memory ($M)	200	410	415	455	165	155	140	125	110	100	90
Total MOS Memory ($M)	14,840	21,260	32,455	53,460	36,015	31,030	38,185	46,430	60,145	78,770	103,790

Source: ICE, "Memory 1997" 18914H

Figure 1-5. MOS Memory Market Forecast

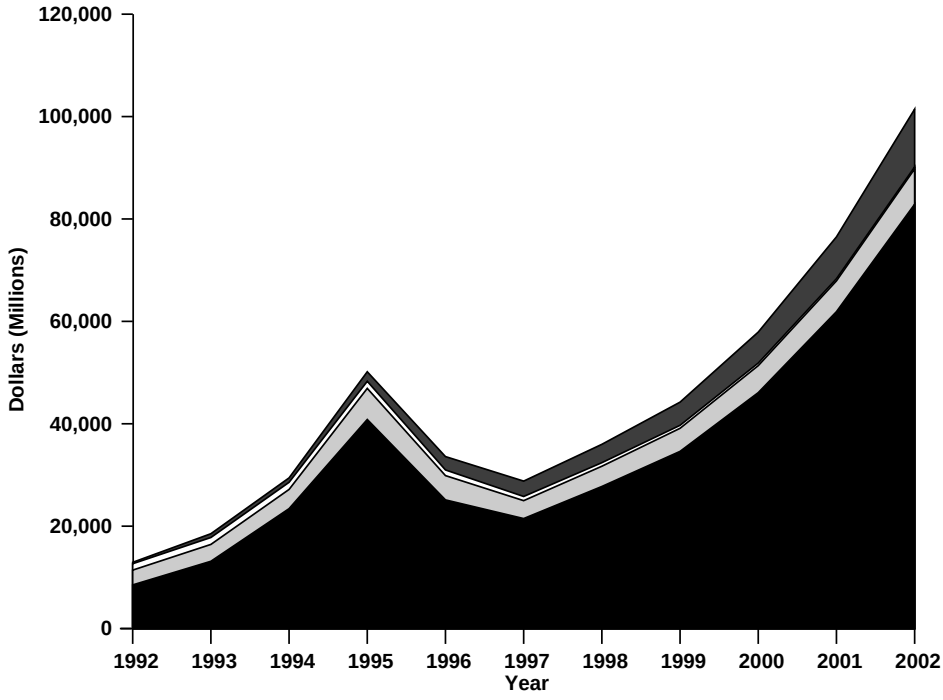
Despite a one or two-year period of "slower" market growth, ICE shows in Figure 1-6 that the 10-year average annual growth rate of the MOS memory market looks bright. Only ROMs, EPROMs, and the "other memory" (i.e., FIFOs, etc.) categories are shown experiencing declining markets through the year 2002.

DRAM	26%
SRAM	9%
EPROM	–11%
FLASH	45%
ROM	–7%
EEPROM	13%
Other Memory	–8%
Total Memory	21%

Source: ICE, "Memory 1997" 22425

Figure 1-6. Ten Year Average Annual Growth Rates (1992-2002)

In terms of dollar volume, DRAMs make up the majority of MOS memory sales and are forecast to be the dominant memory product through the year 2002 (Figure 1-7). In fact, ICE forecasts that in the year 2002, 80 percent of the MOS memory market will be attributed to DRAM sales as shown in Figure 1-8.



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
DRAM ($M)	8,525	13,140	23,420	40,835	25,130	21,485	27,750	34,605	46,080	61,890	82,870
SRAM ($M)	2,890	3,295	3,755	6,075	4,745	3,500	3,955	4,510	5,275	6,015	6,915
EPROM ($M)	1,250	1,350	1,390	1,385	1,105	815	695	580	500	420	375
Flash ($M)	270	740	865	1,860	2,610	3,000	3,585	4,530	6,050	8,175	11,280

Source: ICE, "Memory 1997" 18902E

Figure 1-7. Dollar Volume of MOS Memory Product Segments

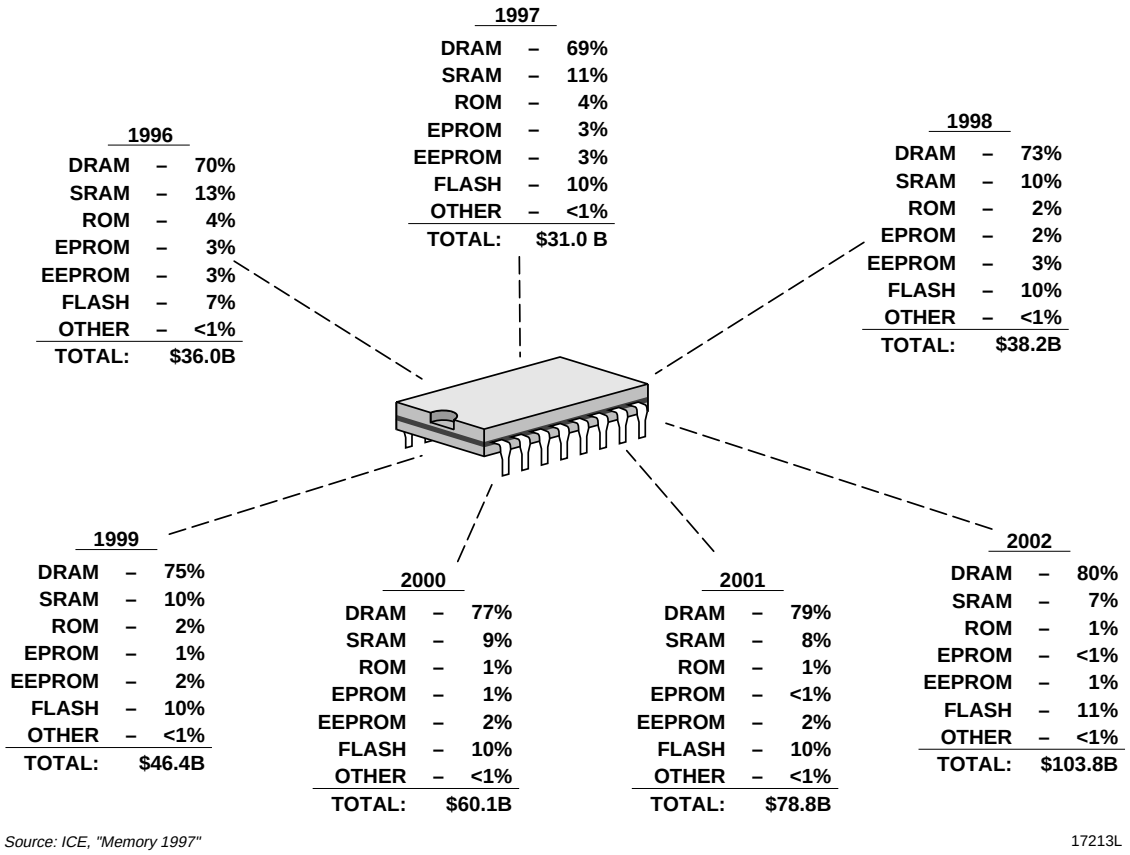
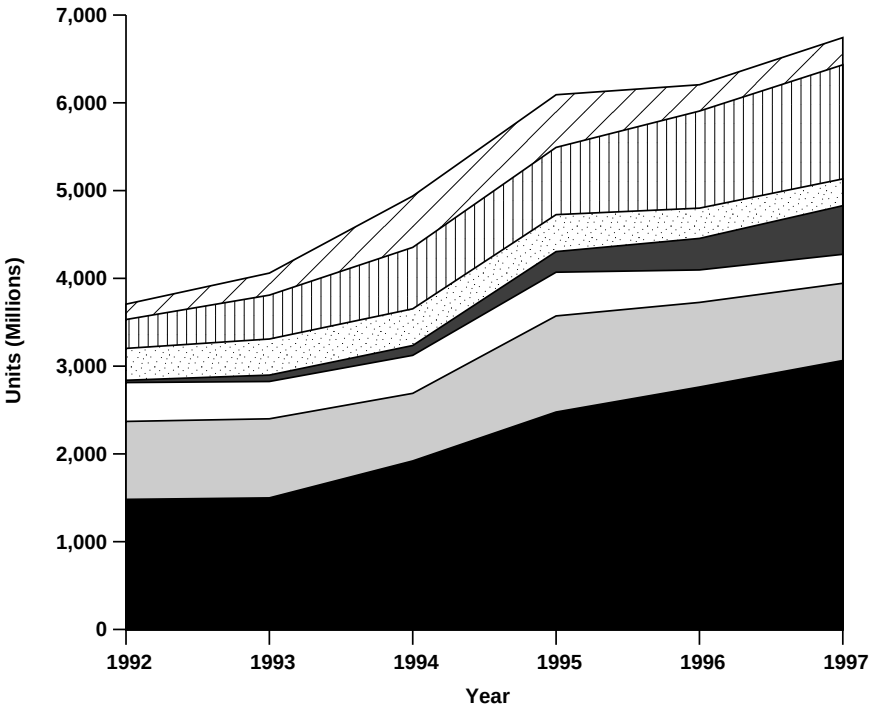


Figure 1-8. MOS Memory Product Marketshare

Flash memory sales accounted for three percent of the MOS memory market in 1995 and seven percent in 1996. Beginning in 1997 and lasting through at least the year 2002, the flash memory market is forecast to represent a double-digit percentage of the total MOS memory market. Meanwhile, as a percent of the total memory market, the SRAM, ROM, EPROM, and EEPROM markets will remain flat or decline over the next five years.

MOS memory unit shipments are also dominated by DRAMs as displayed in Figure 1-9. Note how DRAM unit shipments continued upward even though this particular market tumbled almost 40 percent in 1996.

Although DRAM unit demand remained strong, not all categories experienced an uptick in shipments in 1996. SRAMs, EPROMs, and ROMs each suffered through a decline in shipments in 1996. All three categories are forecast to experience additional shipment declines in 1997. Figure 1-10 provides an overview of the complete unit shipment forecast for MOS memory devices. Additional unit shipment detail is found in each product section.



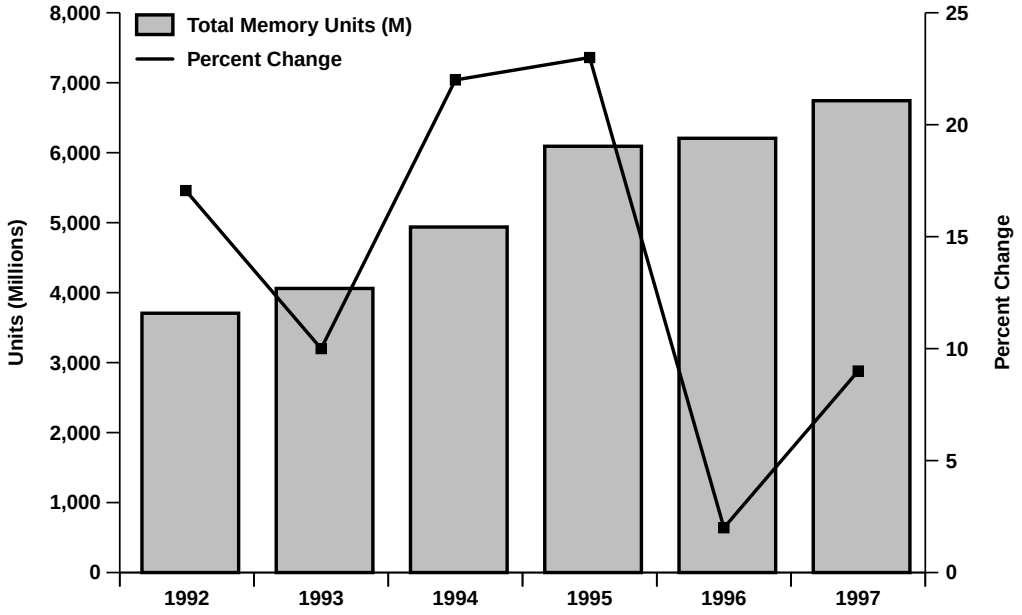
	1992	1993	1994	1995	1996	1997
DRAM (M)	1,482	1,499	1,920	2,477	2,762	3,064
SRAM (M)	888	901	770	1,095	964	880
EPROM (M)	443	425	433	498	370	330
Flash (M)	26	73	112	235	359	554
ROM (M)	363	411	418	421	345	305
EEPROM (M)	329	500	700	766	1,106	1,300
Other Memory	175	251	585	600	300	310
Total Memory Units (M)	3,706	4,060	4,938	6,092	6,206	6,743

Source: ICE, "Memory 1997" 22426

Figure 1-9. MOS Memory Unit Shipments by Product

A brief review of regional MOS memory consumption is shown in Figure 1-11. Driven by sales of new computers and upgrades to existing computer systems, the North America region led the world in the consumption of memory ICs in 1995 and in 1996. Furthermore, it is forecast to remain the leading consuming region in 1997.

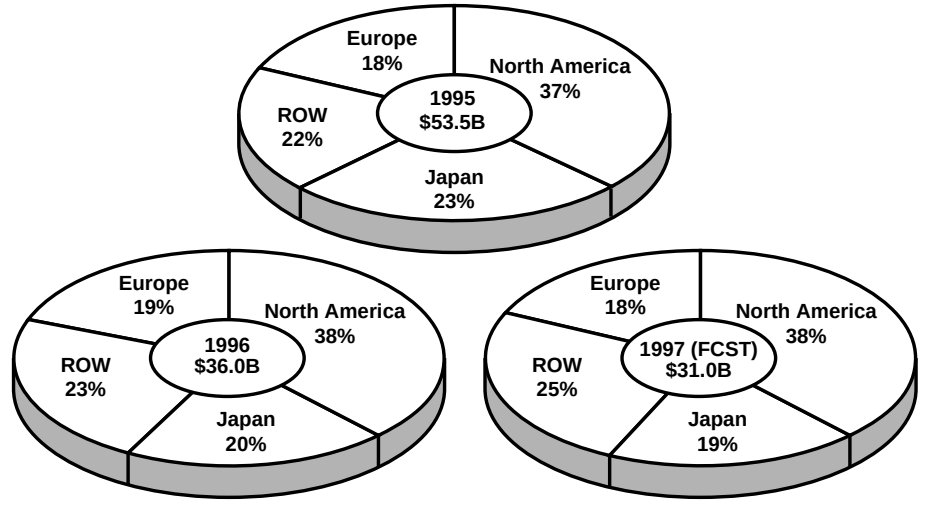
The ROW region (Korea, Taiwan, et al), increased its share of memory IC consumption during the past few years. For many years, the ROW was primarily a consumer of memory ICs that were installed in various electronic systems then shipped abroad. More recently, however, the ROW's consumption of memory ICs has been to meet the growing domestic demand created by a maturing market-driven economy. Strong local economies in this region (along with greater disposable income) will only lead to further consumption of MOS memory devices in the ROW region in the coming years.



Total Memory Units (M)	3,706	4,060	4,938	6,092	6,206	6,743
Percent Change	17	10	22	23	2	9

Source: ICE, "Memory 1997" 22427

Figure 1-10. Total MOS Memory Unit Shipments



Source: ICE, "Memory 1997" 18912J

Figure 1-11. MOS Memory Consumption by Region

Figure 1-12 leaves no doubt that the Japanese companies remain the largest producer of MOS memory devices, although the ROW region remains a keen competitor. With numerous huge, new DRAM fabs slated to come on line in 1997 and 1998, Korea, Taiwan, and other countries in the ROW region will likely make further in-roads into Japan's dominance of memory IC production.

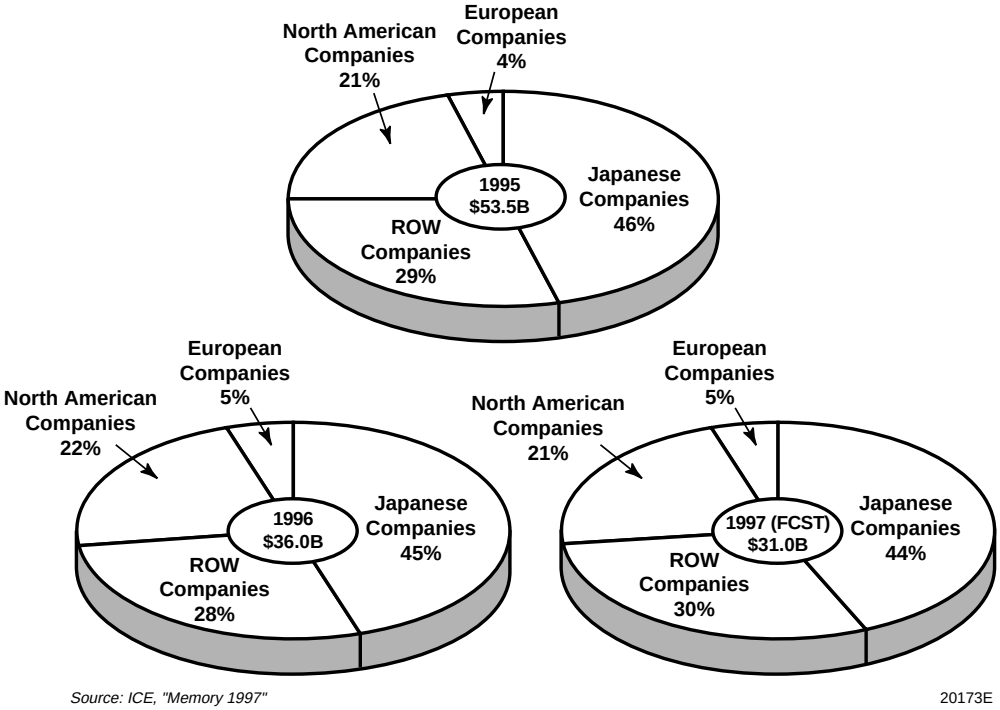


Figure 1-12. MOS Memory Production

Regional production for each MOS memory segment is shown for 1996 in Figure 1-13. In 1996, Japanese firms supplied the biggest portion of DRAMs, SRAMs (the two largest memory markets), and ROMs. However, as shown in Figure 1-14, ROW firms continued to gain additional marketshare in each of the product segments (DRAM and SRAM) where Japan dominated.

North American companies maintained their recent 10-15 percent marketshare in the DRAM segment, while dominating the EPROM, EEPROM, and fast-growing flash memory markets. SGS-Thomson, the world's leading EPROM manufacturer, was the source of Europe's strong showing in the EPROM market and was also a contributor to the flash memory market.

Listed in Figure 1-15 are marketshare figures for the top five worldwide MOS memory suppliers in 1995 and 1996. Together, the five firms accounted for approximately half of all MOS memory sales during the past two years.

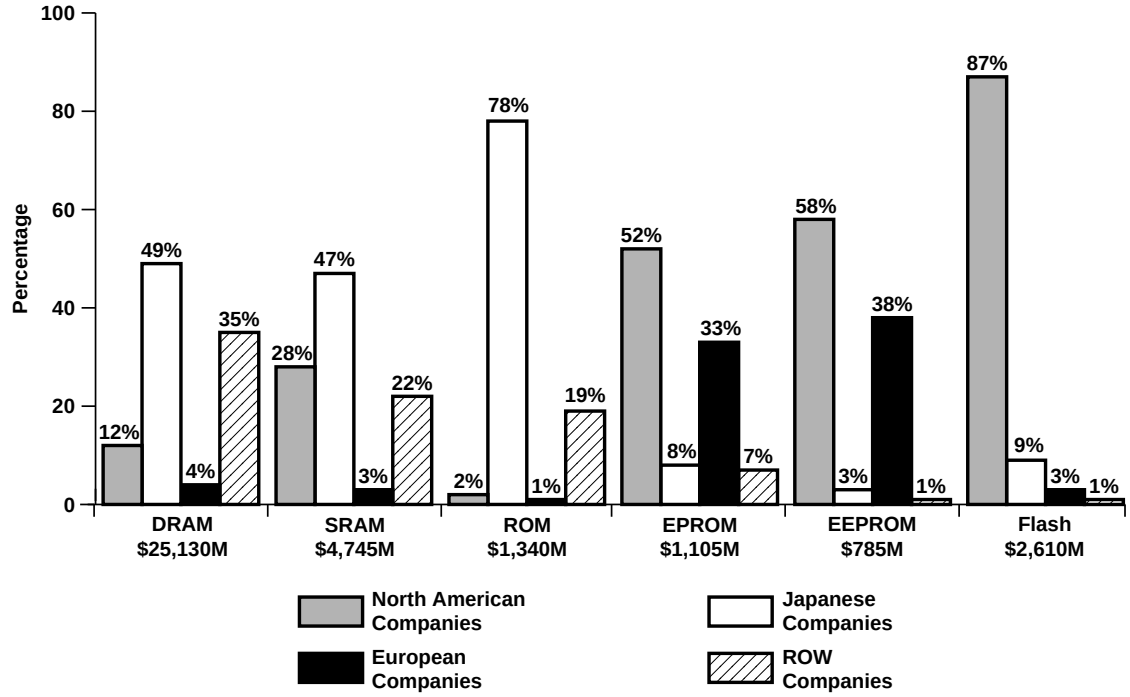


Figure 1-13. 1996 MOS Memory Production by Product Segment ($M)

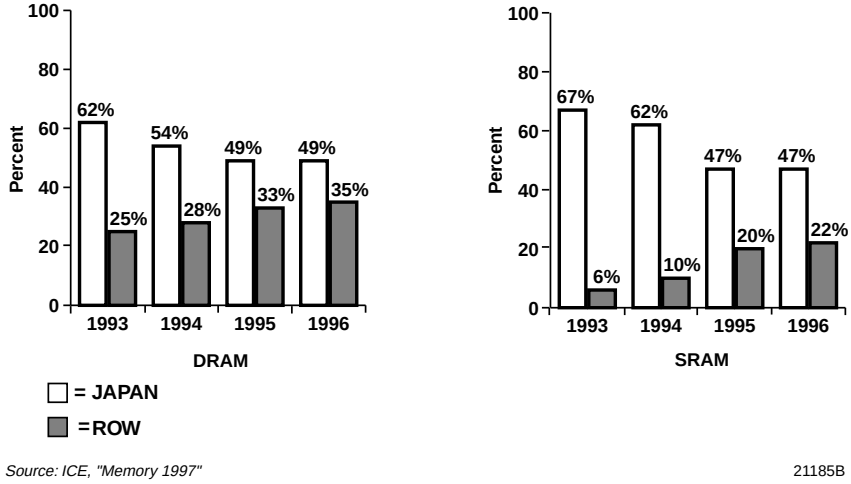


Figure 1-14. ROW (Korea) Muscles Production from Japan

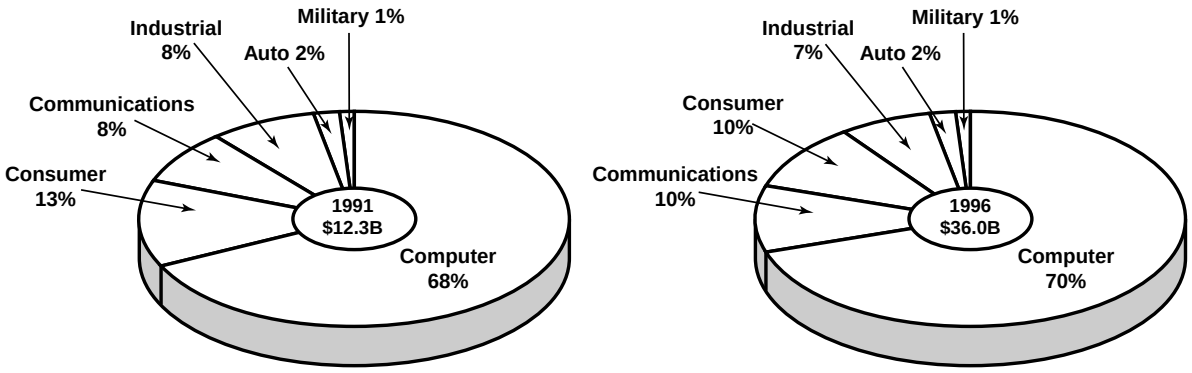
Samsung continued to set the pace as the leading supplier of MOS memory devices in 1996. In fact, it increased its marketshare in 1996. NEC, Toshiba, and Hitachi, three leading Japanese IC suppliers, maintained their leading positions. New to the top memory IC supplier list in 1996 was Korea's Hyundai. Its 1996 memory sales were solely from DRAM devices.

Rank	1995			1996		
	Company	Sales ($M)	Marketshare (%)	Company	Sales ($M)	Marketshare (%)
1	Samsung	7,545	14	Samsung	5,428	15
2	NEC	5,630	11	NEC	4,180	12
3	Hitachi	5,028	9	Hitachi	3,360	9
4	Toshiba	4,535	8	Toshiba	2,885	8
5	TI	3,555	7	Hyundai	2,300	6
Other	—	27,172	50	—	17,862	49
Total	—	53,465	100	—	36,015	100

Source: ICE, "Memory 1997" 14495R

Figure 1-15. Total MOS Memory Market Leaders

In Figure 1-16, ICE shows the memory IC usage by system type. Over the course of five years, end-use applications for memory devices changed very little while the market tripled in size.

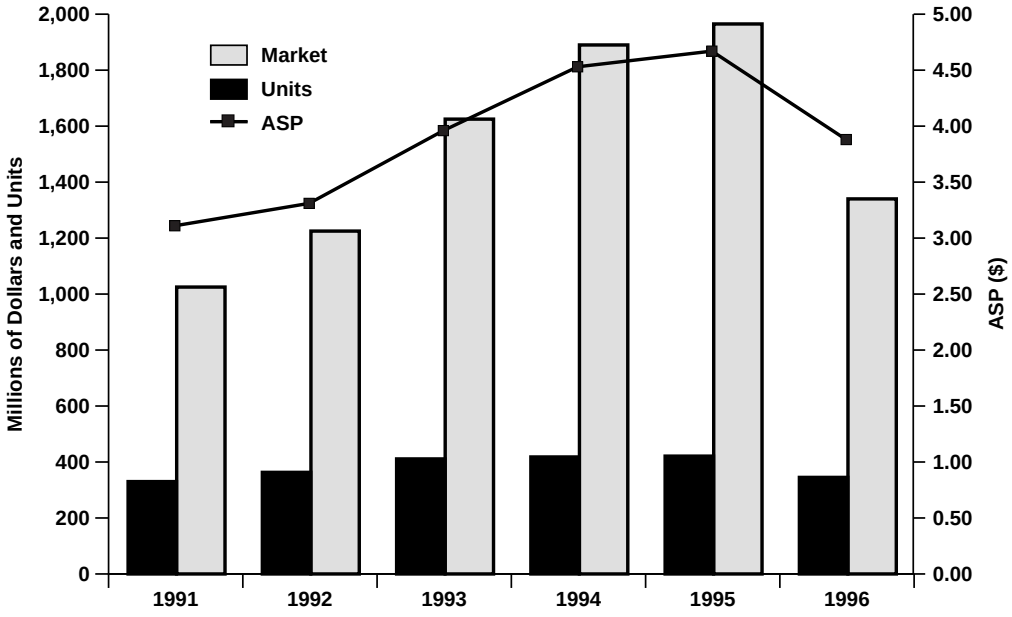


Source: WSTS/ICE, "Memory 1997" 21759A

Figure 1-16. Memory IC Usage by System Type

THE ROM MARKET

Read-only memories (ROMs) represent the least expensive type of semiconductor memory. They are used primarily for storing data in electronic equipment such as laser printer fonts, dictionary data in word processors, and sound-source data in electronic musical instruments. ROMs are also used extensively in video game software. The ROM market grew well through the first half of the 1990's, coinciding closely with a jump in PC sales and other consumer-oriented electronic systems (Figure 1-17).



Market ($M)	1,025	1,225	1,625	1,890	1,965	1,340
Units (M)	330	363	411	418	421	345
ASP ($)	3.11	3.37	3.96	4.53	4.67	3.88

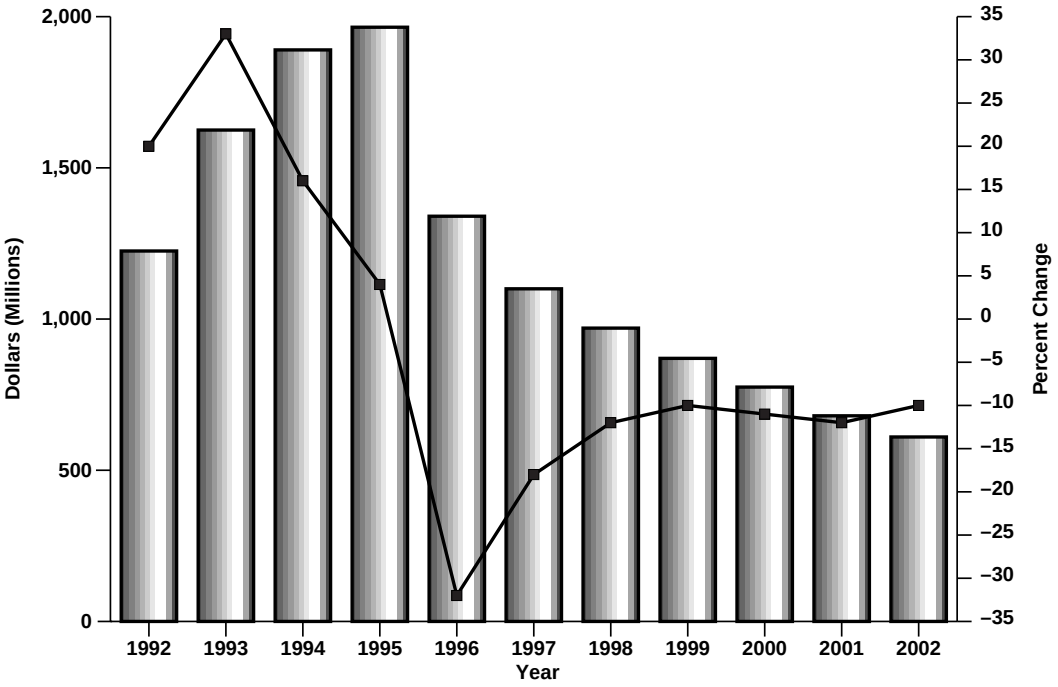
Source: WSTS/ICE, "Memory 1997" 20607B

Figure 1-17. ROM Market History

However, as shown in Figure 1-18, the ROM market declined significantly (-32 percent) in 1996. Among the reasons for the 32 percent decline in 1996 were the weak Japanese yen measured against the dollar (109 yen to the dollar in 1996 versus 94 yen to the dollar in 1995). Since the ROM market is largely dominated by Japanese manufacturers and end users, it is closely tied to fluctuations in the yen.

Another factor contributing to the ROM market decline is the fact that one of the biggest end users of these devices—video games—is moving toward CD-ROM-based machines. Additionally, other memory products that afford greater functionality have become relatively cost competitive with ROMs. As shown, ICE believes that the ROM market will continue to decline through the year 2002.

Following several years of unit growth, ROM shipments also declined sharply (-18 percent) in 1996 as shown in Figure 1-19. ICE anticipates this downward trend of ROM unit shipments to continue during the next five years as well.

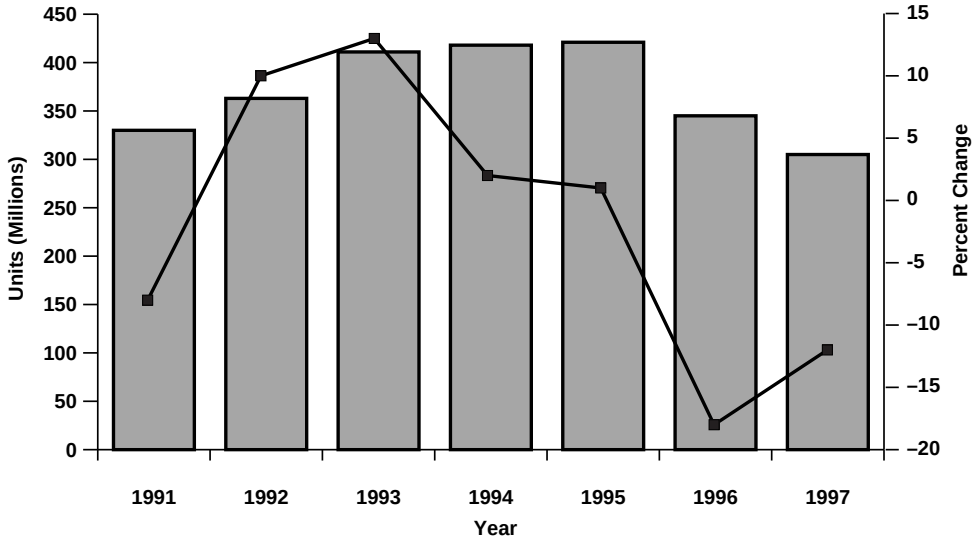


ROM Market ($M)	1,225	1,625	1,890	1,965	1,340	1,100	970	870	775	680	610
Percent Change	20	33	16	4	–32	–18	–12	–10	–11	–12	–10

Source: WSTS/ICE, "Memory 1997"

20348F

Figure 1-18. The ROM Market



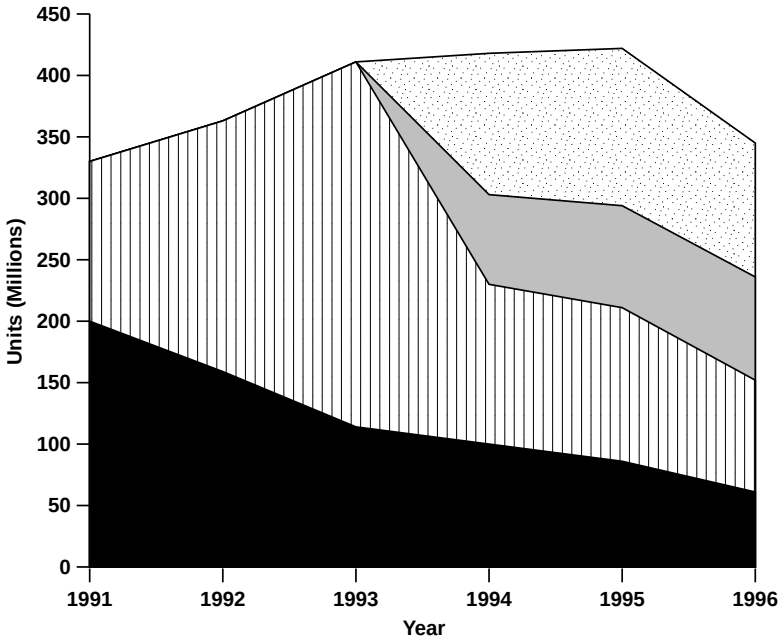
Total Units (M)	330	363	411	418	421	345	305
Percent Change	–8	10	13	2	1	–18	–12

Source: WSTS/ICE, "Memory 1997"

20608A

Figure 1-19. ROM Unit Shipments

Of the ROM units that continue to ship, more and more are high-density devices. Figure 1-20 shows the trend toward high-density ROM devices. Most manufacturers kept their ROM production at the 4Mbit level. However, companies such as Sharp, NEC, and Macronix developed mask ROMs at and above the 32Mbit density.



≤2M	200	159	114	100	86	61
4M	130*	204*	297*	130	124	91
8M	—	—	—	73	83	84
≥8M	—	—	—	115	128	109
Total Units (M)	330	363	411	418	421	345

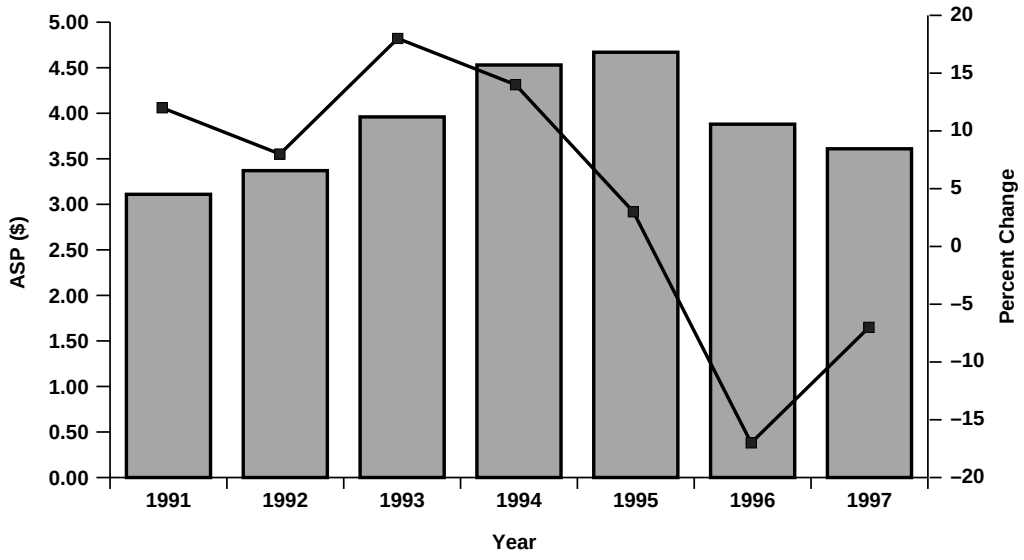
*** Includes ≥4M densities.**

Source: WSTS/ICE, "Memory 1997" 20609A

Figure 1-20. ROM Unit Shipments by Density

Through the first half of the decade, the average selling price (ASP) for ROM devices increased mostly due to the transition to higher density devices (Figure 1-21). Although the ROM ASP declined in 1996, a smaller ROM market moving toward higher densities may force ASPs to trend upward in the second half of the decade.

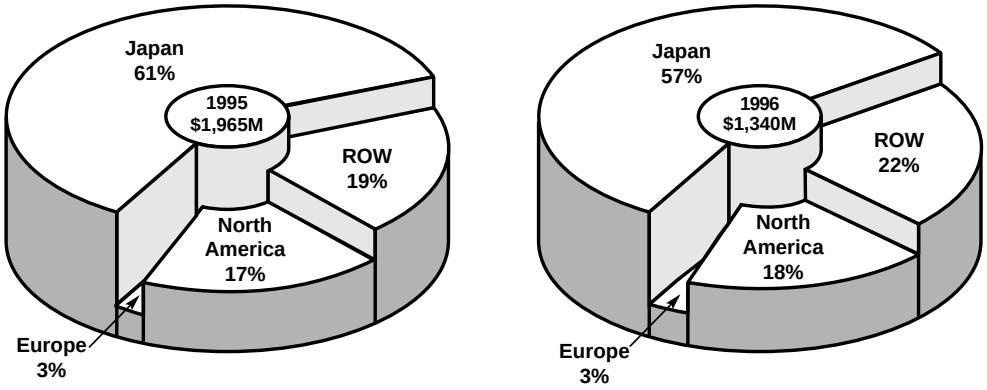
ROM consumption by geographic region is shown in Figure 1-22. Despite marketshare gains made by vendors in the ROW region, Japanese IC makers continued to hold a tight grip as the leading suppliers of ROM ICs (Figure 1-23). Together, Sharp and NEC held about half of the ROM market in 1995 and 1996. A few notes of activity from selected ROM suppliers are shown below.



Total ASP ($)	3.11	3.37	3.96	4.53	4.67	3.88	3.61
Percent Change	12	8	18	14	3	–17	–7

Source: WSTS/ICE, "Memory 1997" 20610A

Figure 1-21. ROM ASPs



Source: WSTS/ICE, "Memory 1997" 16790M

Figure 1-22. ROM Market by Region

Sharp

Sharp remained the leading ROM supplier in 1996 and continued to bolster its portfolio of 3V, high-denisty ROMs. Additionally, it concluded that there was demand for 64Mbit ROM devices and began mass producing these in 3Q96 using its 0.4µm process technology.

Rank	1995			1996		
	Company	Sales ($M)	Marketshare (%)	Company	Sales ($M)	Marketshare (%)
1	Sharp	500	25	Sharp	375	28
2	NEC	400	20	NEC	280	21
3	Samsung	230	12	Macronix	204	15
4	Toshiba	255	13	Toshiba	170	13
5	Hitachi	245	13	Hitachi	160	12
Other	—	335	17	—	151	11
Total	—	1,965	100	—	1,340	100

Source: ICE, "Memory 1997" 14496T

Figure 1-23. ROM Market Leaders

Sharp targeted the 32-bit embedded applications market when it introduced two ROMs (1Mbit x 32 and 2Mbit x 16) in late 1996. Designed especially for 32-bit embedded systems, Sharp expects its new 3V devices to be a popular choice in applications such as font storage in laser and ink-jet printers where cost is critical and performance demands are high. Sharp believes its new devices will help reduce overall parts count, eliminate some system overhead, and improve overall system performance.

NEC

In 4Q96, NEC began taking orders for high-speed 32Mbit mask ROMs that operate at 3V. Targeting office and game machine program and fixed-data storage applications, the devices were initially priced at $27.50. Initial shipments were to begin at the rate of 350,000 units per month.

Macronix

Based on its proprietary Flat ROM cell technology, Macronix developed and now offers a ROM family ranging from 4Mbits to 16Mbits. The devices are manufactured using a 0.8µm process technology. The company is eager to move to the 32Mbit density for its ROM products. At this level, the devices will be manufactured using 0.6µm design rules.

American Microsystems Inc. (AMI)

Although not a leading ROM supplier, AMI unveiled two high-speed (45ns and 70ns) 1Mbit devices targeted for disk drive applications. Initial versions operated at 5V, but the company plans to introduce parts based on 3.3V technology in 1997.

Siemens

An interesting ROM development targeting the multimedia market is the Record-On-Silicon (ROS) device from Siemens. With a 50-percent reduction in die area compared with conventional ROM, the company claims the ROS could halve the cost of conventional ROM and push into markets for non-semiconductor storage, such as compact disks and photographic film. A 64Mbit version of the device is planned for introduction in 1997.

Fujitsu

In recent years, a few ROM suppliers announced intentions to withdraw from the mask ROM business. Fujitsu, for example, cancelled development efforts of its 32Mbit and other next-generation ROM devices and stopped producing and shipping its line of 16Mbit-and-smaller products in 1996.

THE EEPROM MARKET

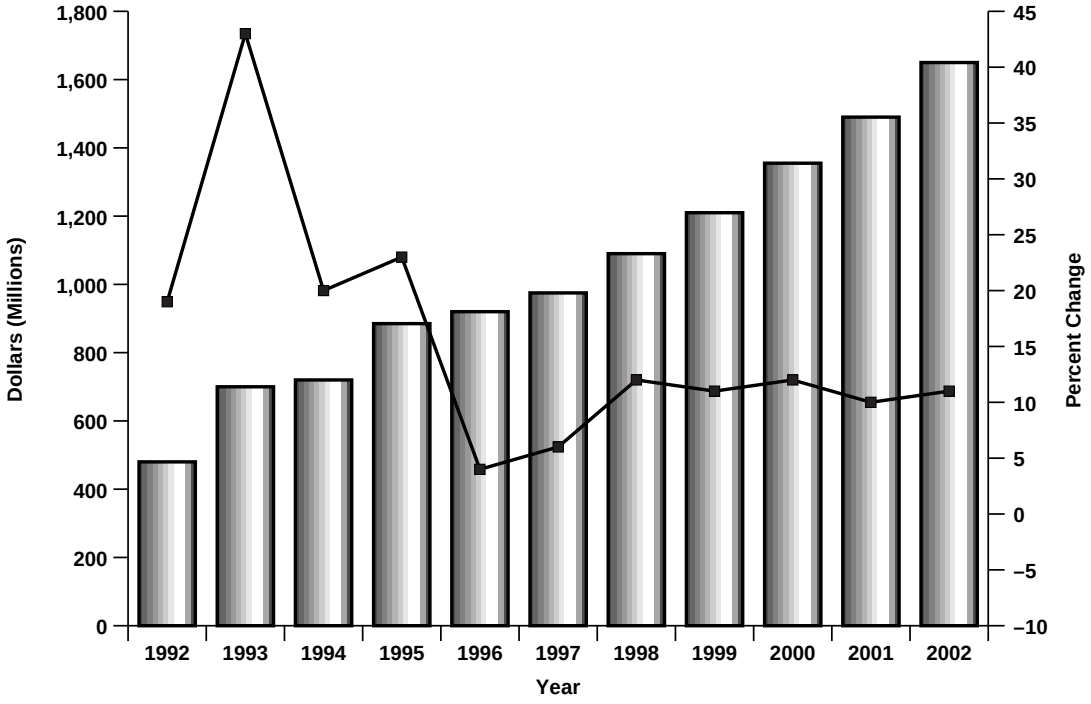
EEPROMs (electrically erasable programmable read only memories) offer users excellent capabilities and performance. Two key advantages of using EEPROMs include in-system reprogrammability and small, bit by bit erasure capability.

The EEPROM market forecast through the year 2002 is shown in Figure 1-24. In 1996, the EEPROM market was up four percent after posting two years of 20-plus percent growth. ICE forecasts that through the year 2002, the EEPROM market will average 11 percent growth per year.

EEPROM consumption by region is shown in Figure 1-25. Due in part to military use, North America was the largest regional market for EEPROMs in 1996.

EEPROMs are available in either a serial or parallel version. Parallel devices are generally faster, offer high endurance and reliability, but also cost more than their serial counterparts. Parallel EEPROMs are found mostly in the military market. Serial EEPROMs, though generally less dense and slower than parallel devices, are much cheaper and used in more of the “commodity” applications.

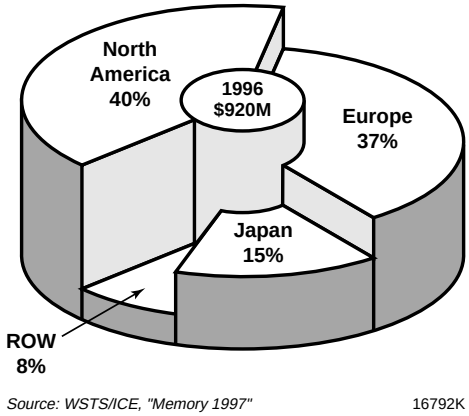
ICE estimates that serial EEPROMs accounted for 92 percent of the $885 million EEPROM market in 1996 (Figure 1-26). With few exceptions, the largest serial EEPROM density shipping in volume was the 64Kbit device. Companies such as Atmel, Xicor, and SGS-Thomson supplied the large majority of these devices.



EEPROM Market ($M)	480	700	720	885	920	975	1,090	1,210	1,355	1,490	1,650
Percent Change	19	43	20	23	4	6	12	11	12	10	11

Source: ICE, "Memory 1997" 20347E

Figure 1-24. EEPROM Market Growth



Source: WSTS/ICE, "Memory 1997" 16792K

Figure 1-25. 1996 EEPROM Market

Until late in 1996, designers who needed more than 64Kbit of EEPROM had to use two or more smaller serial EEPROMs connected in parallel. However, in 4Q96, SGS-Thomson pushed serial densities to a new level with the introduction of its 128Kbit and 256Kbit devices.

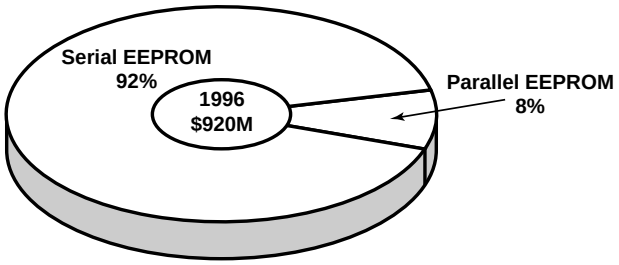


Figure 1-26. 1996 EEPROM Market by Type

The largest parallel EEPROMs built in volume during 1996 were 1Mbit devices. They were used extensively, although not exclusively, in military applications. Parallel EEPROMs are of particular interest in the military because they offer more flexibility than other kinds of solid-state memory.

Parallel EEPROMs can be found in military applications such as flight controllers, vehicle control systems, field communications equipment, secure radios, command and control systems, radar, and guidance subsystems. The lightness, ruggedness, and fast performance of parallel EEPROMs make them well suited for harsh environments.

Consumer-oriented applications represented the largest end-use of serial EEPROMs in 1996 (Figure 1-27). Led by low-voltage parts, EEPROM suppliers in 1996 found a healthy and vibrant business in rapidly growing portable consumer and industrial applications.

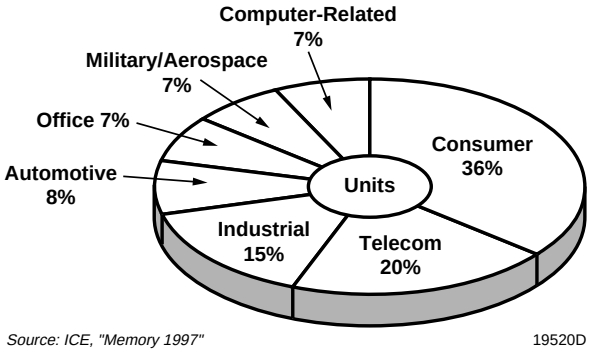


Figure 1-27. Serial EEPROM Applications

Small density serial EEPROMs were used extensively in portable, battery-powered devices including pagers, modems, and cellular and cordless phones. They have also showed up in parameter and configuration setups in disk drives, printers, and industrial data-acquisition applications. In automotive applications, EEPROMs are used in air bags, antilock braking systems, and car radios.

Newer EEPROM applications include satellite communication boxes and monitors and sense-detect functions in memory modules. Suppliers are also excited about the potential of EEPROMs in the smart-card market.

Most leading manufacturers have begun to offer their devices in low-voltage versions. SGS-Thomson's Eagle Range serial EEPROM family, for example, supports operation as low as 1.8V and its next generation will support 1V operation. In 3Q96, Atmel introduced the first 3V 1Mbit parallel EEPROM.

Innovative features have been added to EEPROMs by many manufacturers. In 1996, Xicor introduced Block Lock protection on two of its EEPROMs. By allowing a user to partition its device with 25, 50, or 100 percent write protection, Block Lock allows the combination of alterable data with secured data.

Several vendors agree that EEPROM technology is facing increased competition from flash memory. However, flash memory remains a mass-storage technology and is virtually unavailable (and not as cost effective) in densities under 1Mbit. EEPROMs, on the other hand, are mainly used for storing small amounts of data that are frequently changed.

Leading EEPROM suppliers are shown in Figure 1-28. Atmel, SGS-Thomson, and Xicor continued to make strides in the market. For these and other companies that manufacture them, the EEPROM business should remain reasonably healthy and stable through 2002.

Rank	1995			1996		
	Company	Sales ($M)	Marketshare (%)	Company	Sales ($M)	Marketshare (%)
1	SGS-Thomson	167	19	SGS-Thomson	280	30
2	Atmel	154	17	Atmel	180	20
3	Xicor	100	11	Xicor	115	12
4	Microchip	85	10	Microchip	109	12
5	National	64	7	National	70	8
6	Siemens	53	6	Siemens	66	7
Other		262	30	—	100	11
Total		885	100	—	920	100

Source: ICE, "Memory 1997" 14498R

Figure 1-28. EEPROM Market Leaders

SGS-Thomson

To meet a growing need, SGS-Thomson developed its "Super Flash" device, a part that combines non-volatile flash technology and full-featured EEPROM functionality. A key benefit of a combined EEPROM/flash chip, compared with the common technique of simulating EEPROM in flash memory, is that the host controller can read the flash memory while an EEPROM write cycle is in progress. SGS-Thomson plans to introduce the part in 1997.

Atmel

Atmel unveiled its line of in-system programmable (ISP) EEPROM-based serial memories that provide an alternative approach to programming 3.3V SRAM-based field programmable gate arrays. The devices are designed to compete against and replace existing one-time-programmable (OTP) EPROM solutions that must be physically removed in order to reprogram FPGA configuration code. Atmel believes its ISP EEPROM will save time and afford greater flexibility in the pre-production stage of the FPGA product life when code is still evolving.

Xicor

Xicor introduced its family (4Kbit, 8Kbit, and 64Kbit) of serial peripheral interface (SPI) EEPROMs that features 5MHz speed (Figure 1-29). The chips are targeted for use in mobile wireless systems and also include the company's Block Lock and partitioned memory architecture. It is specified to operate from a battery power source over the range of 2.5V to 5.5V.

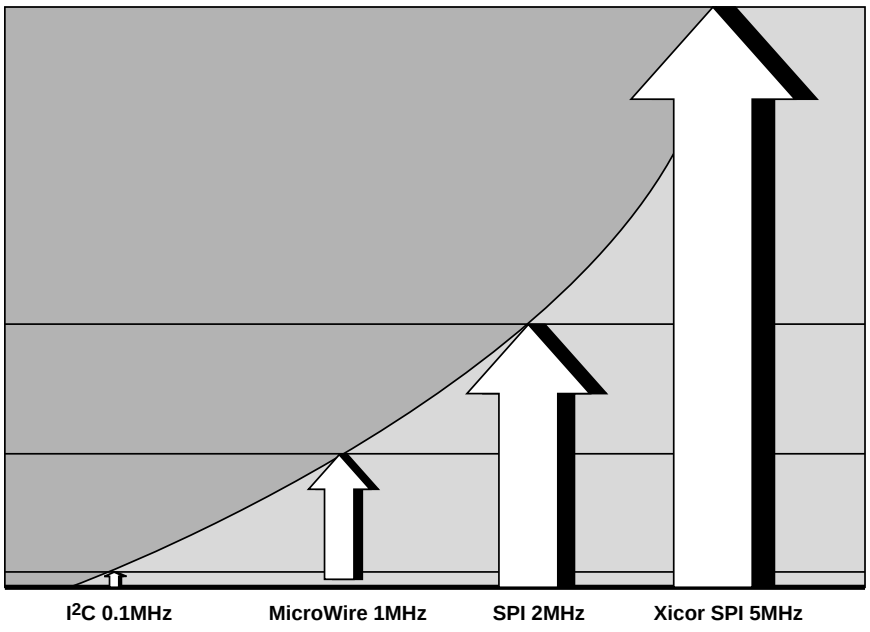


Figure 1-29. Xicor Speeds SPI EEPROMs

The company also announced that Yamaha (Japan) signed on to manufacture its EEPROMs under the Xicor brand name and that both companies would cooperate in process technology development.

Hitachi

Hitachi introduced 64Kbit and 256Kbit EEPROMs that can operate from voltages as low as 2.2V. The low voltage will help designers implement systems that can use unregulated portable power supplies and will provide a power savings of about 20 percent compared to devices that operate at 2.7V. Samples of the 64Kbit devices were delivered in April 1997 (volume 3Q97), while the 256Kbit part was slated for volume production in 2Q97. Pricing in volume quantities was set at $5.00 for the 64Kbit device and $10.00 for the 256Kbit product.