

2 How Many Phones? How Much Waste?

Over the past decade, cell phones have been transformed from a gadget for the wealthy into a necessity for mainstream consumers. As shown in Table 2.1, the growth in the use of cell phones has been truly dramatic. In 1985, there were 340,000 cell phone subscribers in the US. By 1990, that number had risen to 5.3 million, and in 2001 the number of subscribers exceeded 128 million.¹ In 2000, 73 million cell phones were sold in the US.² Despite this remarkable growth, however, US cell phone use lags behind that of other industrialized countries. At the end of 2001, one billion phones were in use worldwide,³ with about 400 million sold globally.⁴

Table 2.1 US Cell Phone Subscribers, 1985 to 2001

Year	Number of Subscribers (millions)
1985	0.34
1990	5.3
1991	7.6
1992	11.0
1993	16.0
1994	24.1
1995	33.8
1996	44.0
1997	55.3
1998	69.2
1999	86.0
2000	109.5
2001	128.7

Source: Cellular Telecommunications and Internet Association

To give an idea of the amount of waste generated by cell phones, this chapter provides information on the numbers of phones in use and their length of life, annual sales, and penetration rates. The goal is not to predict waste generation in a particular year, as this can vary considerably depending on economic conditions. Instead, we will make rough estimates of the average amount of waste these products may generate, and of the size of the stockpile of retired phones in storage that will eventually enter the waste stream.

Forecasting is always difficult and is particularly problematic when technological change is involved. It is difficult to predict the new technologies that might be developed or the degree to which consumers will accept them. As a starting point, INFORM arrived at some conservative estimates based on existing technologies and current trends – for example, the types of cell phones in use today and patterns in their use over the past decade.

These estimates do not take into account the possibility that, within the next three years, disposable cell phones will become widely used or that cell phones will substantially increase in weight because

of added functions (such as data and photo transmission). Such changes could substantially increase the amount of waste generated by cell phones and similar products (see chapter 7 for a look at some of the new applications for cell phones that could become common in future years).

As noted in the previous chapter, cell phones are frequently replaced when they are still in good working order, whether because the user travels abroad, changes service provider, or simply wants a different product. These phones are often referred to as “obsolete,” despite the fact that devices of the same make and model often

remain in widespread use. Nor are they properly described as “discarded,” since most replaced phones do not immediately enter the waste stream.

In place of either of these terms, this report uses the word “retired” to refer to phones that have been taken out of service. Most of these products are stored away in drawers, closets, and basements, and will enter the waste stream at a later date. Any phone for which the owner is not paying a service subscription is considered retired.

According to INFORM’s conservative estimates:

- By 2005, about 200 million cell phones will be in use in the US.
- By 2005, about 130 million phones will be retired each year in the US.
- By 2005, over 500 million phones will be stockpiled in the US – that is, stored and destined to enter the waste stream at some later date.

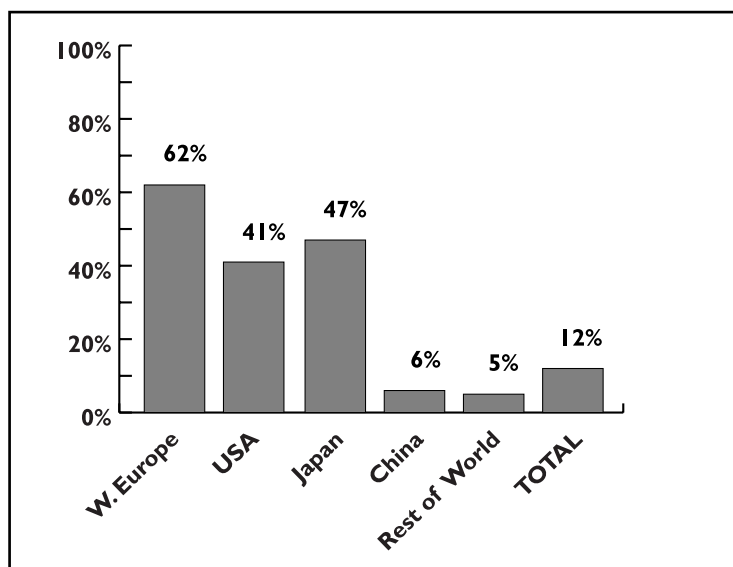
Cell Phone Penetration

Because of inconsistent data and variations in the definition of terms used to describe cell phone use, it is important to clarify some additional terms used in this report:*

- **Subscribers** is the total number of subscriptions for cell phone service. Thus, an individual with one cell phone subscription for work and a different subscription for personal use would count as two subscribers.
- **Penetration** measures subscribers as a percentage of the total population. Because an individual may have more than one subscription, penetration can exceed 100 percent. Penetration does not measure the percentage of the population that uses cell phones but rather the total number of phones in use as a percentage of population.

Figure 2.1 compares estimates of cell phone penetration in the US and other parts of the world, based on a detailed study conducted in 2000 at the Research Centre of Bornholm (Denmark).⁵ This study concluded that

Figure 2.1 Worldwide Cell Phone Penetration, as of year-end 2000



Source: Carl. H. Marcussen, Research Centre of Bornholm, Denmark.

the theoretical maximum percentage of a nation’s population that would ever become cell phone users is 75 to 80 percent. In some countries, however, such as Japan, Finland, and Norway, penetration will exceed 100 percent within the next few years.⁶

As of the end of 2000, according to the Bornholm study, the highest cell phone penetration in Western Europe was about 75 percent, in Finland, Iceland, and Austria, followed by about 72 percent in Norway and Italy. The average for Western Europe was estimated at 62 percent, compared to only 41 percent in the US. This indicates that there is considerable potential for growth in cell phone use in the US. (It should be noted that while the US lags in cell phone

* Data in Table 2.1, Table 2.2, and Figure 2.1 is based on these definitions.

use, it leads the world in the percentage of the population that uses a computer and accesses the Internet.⁷⁾

Estimating Cell Phone Penetration and Numbers of Phones in Use

The US population is expected to reach 294 million by 2005, up from 281 million in 2000.* If cell phone penetration in the US reaches 75 percent, comparable to the highest levels in Western Europe, there will be 220 million cell phones in use in this country by 2005. If it reaches 100 percent (meaning more people using multiple phones), the number of phones in use will be 294 million. We can take this as the extreme upper limit for cell phone penetration in the US.

A reasonable lower limit might be based on a cell phone penetration of 50 percent, slightly higher than the actual number for 2000, or 147 million cell phones in use in 2005. As shown in Table 2.2, the estimated number of phones in use in 2005, based on different penetration rates, ranges from roughly 150 to 300 million. A conservative estimate would be 200 million.

Estimating Cell Phone Sales and Numbers of Phones Retired

Table 2.3 shows the estimates of cell phone sales in the US made by Gartner Dataquest, a technology consulting firm. Estimated sales for 2004 are 152 million, with cumulative sales of 720 million from 1995 to 2004. These figures are consistent with the subscriber estimates discussed above.

When estimating the number of retired cell phones, an important factor is the average economic life of a phone. This is the age at which the owner chooses to replace it, which may be shorter than the phone's technical life. Worldwide, the average economic life of a cell phone is currently about 1.5 years, down from about three years in 1995. In the US, the eco-

Table 2.2 Estimated Cell Phones in Use in the US, 2005*

Penetration (%)	Phones in Use/ Subscribers (millions)
50	147
55	162
60	176
65	191
70	206
75	220
100	294

*Figures based on a total population of 294 million.
Source: INFORM, Inc.

Table 2.3 US Cell Phone Sales, 1995 to 2004

Year	Cell Phone Shipments/Year (millions of units)
1995	14.5
1996	16.6
1997	22.2
1998	30.6
1999	49.3
2000	72.9
2001	100.1
2002	122.3
2003	140.0
2004	151.9
TOTAL	720.4

Source: INFORM, Inc. Calculations are based on Gartner Dataquest, "Mobile Terminals: North America, 1995 through 2004," August 7, 2000.

* Projections based on the 2000 census are not yet available. This estimate is based on the 1990 census projections, which were adjusted upward using the actual population figure for 2000 from the 2000 census.

nomic life of a cell phone is the same as the world average. In poorer countries like China, where people cannot afford to replace phones as often, it is 2.5 years. In Japan, cell phones have an economic life of only one year, despite that nation's weak economy.⁸

Table 2.4 Estimated Number of Cell Phones Retired Per Year in the US

PHONE LIFE (YEARS)	NUMBER RETIRED PER YEAR (MILLIONS)					
	Per 300 million in use	Per 220 million in use	Per 200 million in use	Per 175 million in use	Per 160 million in use	Per 150 million in use
1.0	300	220	200	175	160	150
1.5	200	147	133	117	107	100
2.0	150	110	100	88	80	75

Source: INFORM, Inc.

Table 2.4 shows the estimated number of cell phones retired per year in the US given different lengths of phone life. Assuming 200 million phones in use and an economic life of 1.5 years, the number retired would be about 130 million per year.

Stockpiled Cell Phones

According to INFORM's estimates, the US stockpile of retired cell phones could exceed 500 million by the end of 2005. This assumes that over 700 million phones will be retired in the US by 2005,* of which about 75 percent will be placed in storage.

There is no good data on the disposition of retired phones. However, research and pilot electronics collection projects indicate that most retired phones are stored. For example, the European ECTEL project (described in chapter 5) found that only 14 percent of cell phones wind up in landfills,⁹ and in Minnesota's electronics collection project (described in chapter 4), very few phones were brought to the collection sites. According to the Silicon Valley Toxics Coalition, about 75 percent of all the computers sold in the US have been stockpiled.¹⁰ On the basis of such evidence, INFORM concludes that the number of stored phones is about 75 percent of the number retired.

How Much Waste?

Cell phone weight has decreased dramatically. According to a study published by the government of Canada, the weight of the typical phone dropped from 10.5 ounces in the early 1990s to 7.7 ounces by the end of the decade.¹¹

Weights provided by cell phone manufacturers generally refer to the handset plus batteries. According to INFORM's own measurements of a sampling of typical phones in use today, the combined weight of these

* Stockpile of phones retired based on estimates of cumulative sales up to 2005.

components ranges from 3.45 to 10.15 ounces. In addition, however, the adapter often weighs more than the handset and batteries combined. Since each phone comes with its own adapter, which generally cannot be used with other makes and models, this device can add substantially to the waste generated by discarded cell phones.

Given these weights, the average retired phone — including the handset, batteries, and adapter — will generate about one pound of waste. Thus, the 130 million phones that, according to INFORM's estimates, will be retired each year by 2005 will, along with their adapters, weigh 130 million pounds, or 65,000 tons. Moreover, significant additional waste will be generated by replacement batteries and accessories such as car chargers, headsets, carrying cases, and extra face plates and adapters, most of which are designed for specific models of cell phone.

Wireless Waste in Perspective

Reliable data on the amount of waste generated by electronic equipment in the US does not exist. In its report entitled *Municipal Solid Waste in the United States: 1999 Facts and Figures*, the US Environmental Protection Agency included, for the first time, a separate subcategory for consumer electronics. At the same time, however, the agency acknowledged the problem of unavailable data. Previously, consumer electronics were grouped under the heading "miscellaneous durables," which also included such products as dishes and luggage.

According to the EPA's data, the US generated 230 million tons of municipal solid waste in 1999.¹² In the new subcategory of consumer electronics, the EPA reported that 1.8 million tons of waste were generated, or under 1 percent of municipal solid waste.¹³ Also in 1999, a study performed in Minnesota on the composition of that state's waste stream concluded that 2 percent was electronic products.¹⁴ The European Union estimates that electrical and electronic equipment accounts for 4 percent of municipal solid waste.¹⁵ Given the disparities among these estimates, more work is clearly needed to define consumer electronics and collect reliable data on the amount of waste generated by these products.

Of course, no single product accounts for a large portion of the waste stream, and cell phones are only a small subcategory of electronic waste. Thus, the 65,000 tons of cell phone waste that, according to INFORM's estimates, will be generated in 2005 are far less than one-tenth of 1 percent of the 240 million tons of municipal solid waste projected for that year.¹⁶ Moreover, the waste generated by cell phones and other wireless products is dwarfed by the amount generated by wired computer equipment. For example, it is estimated that over 20 million computers are retired each year¹⁷ — products that, once discarded, will generate over 400,000 tons of waste.*

It is important to recognize that these estimates are based on current technologies and current patterns of use, which could change very rapidly. For example, in a recent interview, Nokia's vice president in charge of design predicted that "within a few years having just one cell phone will seem as odd to most people as owning a single pair of shoes."¹⁸ Today, cell phones in the US are primarily used for voice communication. New applications based on data and image transmission could greatly increase the amount of waste generated, since the devices would likely be heavier than current models and users might buy different devices for different functions. The proliferation of accessories and backup power supplies (discussed in chapter 6) likewise carries the potential for increased waste.

* This figure is based on a weighted average of 42 pounds: 50 pounds per PC and 7.5 pounds per laptop. See H. Scott Matthews *et al.*, "Disposition and End-of-Life Options for Personal Computers," Green Design Initiative Technical Report No. 97-10, Carnegie Mellon University, Pittsburgh, July 7, 1997.

Conceivably, the waste stream from cell phones and other wireless electronic devices, including pocket computers, pagers, personal digital assistants, e-books, medical monitors, and locator devices, will reach hundreds of thousands of tons per year. At the same time, the waste generated by computers may decrease considerably. Apple's new iMac desktop computer weighs only 21 pounds, compared to 50 pounds for traditional computers with cathode-ray tube monitors. If this represents a trend toward much lighter computers, the waste from wireless products could eventually exceed the waste from wired computers. Contributing to this scenario is the prospect of disposable cell phones and new applications leading to wireless devices that are as yet unknown.