The Race to Make the World Flat

You know you want this TV—and soon you'll be able to afford it! Manufacturing advances are bringing the cost of flat panels way down.

BY STUART F. BROWN

If the wall of your den cries out for a big, beautiful flat-screen TV, but there's no way you can justify forking over the $4,000 it would cost to buy, say, the 42-inch Samsung shown above, stay tuned. Driven by the stampede of computer makers into consumer electronics and by fast-forward technology evolution in the factory, flat-screen TVs are on a path to get a whole lot cheaper soon.

So-called plasma displays like the one in that hot-selling Samsung are the king of the hill in flat-screen technology today. They're thin and light enough to be hung on walls or hidden in picture frames. Despite drawbacks like "burn-in" (watch a war obsessively and that little CNN logo at the corner of your picture could become permanent) and poorer image quality than ordinary picture tubes, plasma displays have caught on as they've come down radically in price—some 45% in the past two years.

But the hottest technology in flat screens is a bigger sibling of the humble little liquid-crystal-display panels that let you watch DVDs on your notebook PC and see caller ID on your cellphone. The arms makers of the PC revolution—the companies that build the machines for making computer chips—are searching for new places to grow and have latched onto LCD TVs as the answer. There's a reason: The science behind making LCD TVs is a close cousin of the science behind turning out Pentiums.

So it's no surprise that the firm pressing hardest is Applied

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TVs WILL HATCH inside this $10 million, 66-ton flat-panel maker from Applied Materials.

Materials, the $5-billion-a-year leader in high-end semiconductor manufacturing equipment. A plethora of other chipmaking-equipment companies are chasing the LCD market too, and the rivalry of all these players is helping to bring down flat-panel prices. Explains Ross Young, president of DisplaySearch, an Austin firm that tracks the flat-panel world: "As panel sizes go up, equipment costs are rising much less because of growing competition between suppliers, who are hungry because the market for chipmaking equipment is slow."

Today most of the action in LCD TVs is still in small units—like the 17-inch combination TV/PC display Michael Dell is holding on the cover of this magazine (expected price: $699). Such screens are fine for the bedroom or kitchen or a tabletop somewhere. But to lay claim to the wall of the den—and the profits that beckon there—a screen must be at least twice that large.

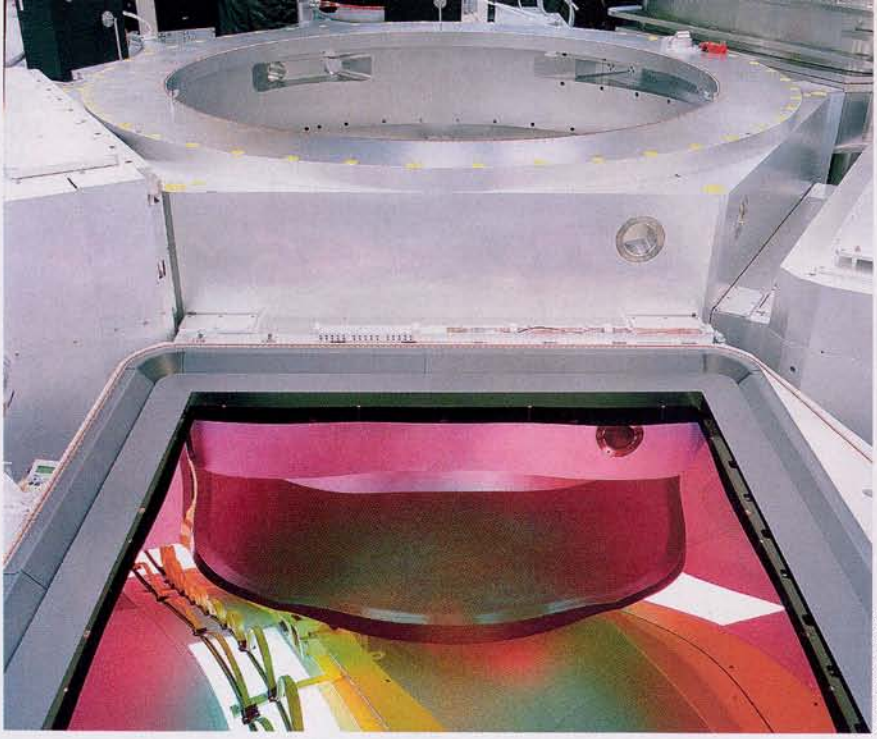
Now a Super Bowl–worthy technology competition for the couch-potato market is breaking out as LCD TVs start to rival plasma TVs. "The 30- to 40-inch range will be a battle zone," says Jonas Tanenbaum, senior marketing manager for flat-panel displays at Samsung Electronics America, which sells both kinds. "Plasma wins hands down for value right now. But LCD prices will drop way down."

Today the price gap is dramatic: Samsung charges $9,000 for a 40-inch LCD, while plasma costs less than half that. If those prices paralyze you, you may feel more acquisitive in 2006. That's when Charles Annis, director of flat-panel equipment research at DisplaySearch, sees LCD and plasma-screen prices reaching parity—and when a 30-inch flat panel set should drop to $1,000, and 42-inch screens will sell for about $2,000.

The fact that LCDs are even being considered as boob-

tube killers is astounding to people who follow the industry. Manufacturers less than a decade ago were still struggling to get good at making LCDs big enough for laptops. They've succeeded so well that something like 38 million LCDs are going into notebooks worldwide this year, and another 53 million into desktop PCs, where flat screens are replacing bulky CRTs at a rapid rate. Now, fueled by U.S. innovations, the vast Asian manufacturing industry that has grown up to make LCDs is perfecting production methods that should soon put big LCD TVs into millions of homes.

To consumer-electronics companies and computer makers, those homes are a luscious target. The average U.S. household has 2.75 TVs—almost all the bulky picture-tube kind. This year only about 650,000 flat-panel TVs were shipped in the U.S., vs. 27 million picture-tube TVs. But by 2007 flat panels are expected to account for well over 20% of the TV market (see chart).



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AS BIG AS A BED, a mirrorlike glass sheet (foreground) will get coated with 24 million transistors to yield six LCD TVs.

An LCD TV can be built thin enough to hang on the wall because it forms images differently from regular picture tubes. The LCD screen is an exotic high-tech sandwich that squeezes tuner circuitry, color filters, polarizers, liquid-crystal material, and a fluorescent backlight into an assembly less than an inch thick. Its heart is the so-called transistor array—millions of thin-film transistors, each too small to see, precisely positioned across a sheet of clear glass itself no thicker than a fingernail.

Although an LCD panel might not remind you in any way of a computer chip, they actually have a lot in common. Both are produced in clean-room facilities, or fabs; making a flat-screen display takes several weeks and scores of steps—the process is almost as long and painstaking as making a Pentium. Compared with the transistors in a Pentium, though, those in an LCD are gigantic. They can be big because there's only so much information in a television signal; many LCD displays handle even HDTV images with ease. The transistors in the screen work in teams of three, with each team responsible for a color picture element, or pixel. Think of pixels as teeny-weeny shutters that blink open and shut as often as hundreds of times a second to let through light on command—that's how Lou Dobbs or Homer Simpson comes to life on your screen. The shutter effect is achieved thanks to liquid crystal, magical stuff sandwiched in the screen that changes the amount of light it lets through when the transistors zap it with voltage.

Because the newest, biggest LCD TVs bring the highest profit margins, makers are pushing hard to get ever larger ones into production. Ten years ago the state-of-the-art machines for laying down transistor arrays could work with sheets of glass measuring 16 by 20 inches, about the size of a pillowcase. The latest machines can handle sheets of glass bigger than a queen-sized bed—enough to make six 37-inch TV panels at once.

Bunny-suited workers could be seen recently clambering on one of these big units, a chemical-vapor-deposition machine, in the clean-room assembly area at Applied Materials. Ascending a scaffold to give a visitor a top-down view, Wendell Blonigan, the burly president of Applied Materials' LCD equipment business, points to a huge metal ring at the heart of the machine. "It was made on the largest forging press in the U.S.," he boasts.

The machine represents the sixth generation of ever larger systems Applied Materials has built to help LCD fabs vie for greater economies of scale. It looks like a space station, with high-vacuum work chambers the size of compact cars radiating like spokes from the central ring. Within those chambers, the machine applies thin-film layers at high temperatures to build up transistors on the glass. The central ring is inhabited by a robot; when each step is done, it gently transfers the 20-pound sheets of glass from one chamber to the next. Each of these systems costs $10 million and needs an entire Boeing 747 freighter to deliver it to the customer.

Those 747s all fly to Asia. Sharp, LG Philips LCD, and Samsung are the top makers of LCDs, and four Taiwanese companies are solely devoted to producing them: AU Optronics, Chi Mei Optoelectronics, Quanta Display, and Hann Star. Those might not be household names, but computer makers have them on their speed dial. Who says the world isn't flat? F

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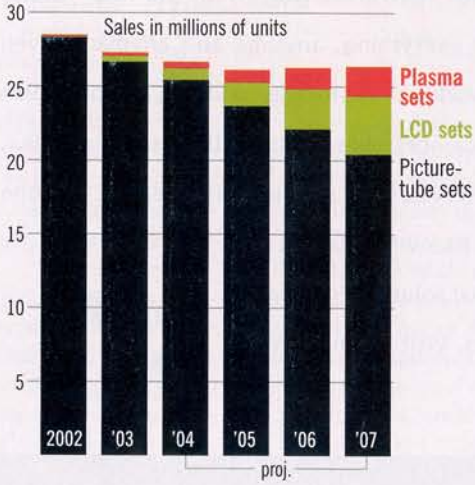
THIN EDGE OF THE WEDGE

Flat-panel TVs, especially the LCD kind, will carve out a growing chunk of U.S. TV sales.



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