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DISPLAYS

FINE-TUNING: JAPANESE COMPANIES ARE FOCUSING ON HIGH-RESOLUTION COLOR SCREENS

JAPAN'S LIQUID-CRYSTAL GOLD RUSH

It's lapping rivals and investing heavily in active-matrix technology

In Japan, yearend parties are known as *bonenkai*—literally, "forgetting the year that's past." Recession-weary electronics managers in Tokyo would like to do just that. So in their *bonenkai* speeches last month, company presidents waxed poetic over their brightest hope for the future: liquid-crystal displays for computers and consumer electronics. NEC Corp. even set up some screens behind the banquet table, and President Tadahiro Sekimoto repeatedly urged guests to "take a nice long look."

Sekimoto and his colleagues in Japan's electronics industry have good reason to dote on LCDs: The market is nearly all theirs. To be sure, overseas rivals offer beguiling visions of better technology. But in the U. S. and Europe, where promising ideas are approaching production, no one seems willing to match Japanese investments. And for now, competitors in Korea and Taiwan have barely begun to produce notebook-size screens. As a result, Japanese companies control 95% of the world market for LCDs and are selling the latest generation of dazzling color displays as fast as they can crank them out. "At least for the next few years, they'll be in firm control," predicts Steve Myers, an electronics analyst at Jardine Fleming.

That's welcome news for the Japanese, who are in the process of elevating LCDs from a niche product to a linchpin in their electronics strategy for the rest of the 1990s. Since their commercialization in the early 1970s, the somewhat fuzzy "passive matrix" LCDs used in calculators and in some small TVs have been a low-profit item at best. Second-generation "active matrix" LCDs, though larger, sharper, and more colorful, have been expensive to make, in part because they were so hard to manufacture that until recently more than half came off the line with defects.

ACTIVE MARKET. With mind-boggling speed, however, the screenmakers are bounding over manufacturing hurdles, raising yields, cutting production costs, and making active-matrix LCDs better—sharper still and faster in handling full-motion video. Thanks in part to such improvements, these advanced LCDs are becoming key components in portable computers, camcorders, handheld organizers, video games, and virtual-reality devices. Such screens are already making good money for industry leader

Sharp Corp., and several other players may be in the black soon. So the companies are on an investment spree. Over the next four years, NEC and Sharp plan to pump nearly $1 billion each into new production lines. Hitachi, Toshiba, and Sanyo will also spend large sums, enticed by projections that the market will quadruple, to at least $15 billion by the end of the decade.

The active-matrix business is benefiting most at the moment from booming sales of notebook and laptop computers. Personal-computer makers are willing to pay $1,500 apiece for the screens--double the price of passive-matrix displays--because of their higher performance. In first-generation screens, a picture is created by applying voltages to rows and columns of liquid crystals. In active-matrix LCDs, by contrast, each picture element, or pixel, is switched on and off by its own transistor. In a technique derived from chipmaking, several hundred thousand electronic elements are printed on a sheet of chemically treated glass, producing an electronic mesh, or "active matrix." The drawback is that manufacturing complexity increases with size, so that screens larger than 17 inches diagonally are impractical.

PLASMA AND TUBES

U.S. and European contenders have been counting on these weaknesses to be Japan's undoing. Rather than use the same technology, they're exploring other varieties of displays that may be cheaper and easier to make. And the upstarts' creativity is impressive. Texas Instruments Inc. now can pack 442,000 microscopic mirrors onto a sliver of silicon that could serve as a projector for high-definition television. Motif Inc., a joint venture of Motorola Inc. and In Focus Systems Inc. in Wilsonville, Ore., has pioneered "active addressing," which can give passive-matrix LCDs more control over pixels to achieve nearly active-matrix resolution for a fraction of the cost. It will begin shipping samples soon. Photonics Imaging of Northwood, Ohio, has built a flat-panel display illuminated by gas plasma that measures 30 inches diagonally--far larger than any LCD can achieve. Tektronix Inc. in Beaverton, Ore., is lowering costs by combining aspects of LCDs and plasma displays. France's Pixel International, meanwhile, has developed a six- inch color screen made of thousands of tiny vacuum tubes--each like the cathode ray tube in today's TV screens.

The Pentagon's Advanced Research Projects Agency is aiding the U.S. effort with grants of $85 million this year. It has committed $25 million to help OIS Optical Imaging Systems Inc. in Troy, Mich., build a $100 million LCD plant. Another $20 million will go to the U.S. Display Consortium, a group of electronics companies that includes American Telephone & Telegraph Co. and Xerox Corp. Rockwell International and Honeywell are helping Kopin Corp. in Taunton, Mass., bring LCD goggles for virtual reality to the consumer market.

U.S. Display Consortium President Peter Mills even argues that U.S. producers may leapfrog the Japanese. "For the first time in any industry," he says, "Japan has borne the investment burden in the first generation of equipment and materials." Mills argues that other display companies can thus build on what the Japanese have learned--without limiting themselves to active-matrix technology. "We're not burdened by a $3 billion investment in one technology," he says.

In the meantime, Americans are big suppliers to Japan. Corning Inc. sells 70% of the glass used in active-matrix screens. Applied Materials Inc. builds some of the best equipment to deposit thin-film transistors. Toshiba Corp.'s computer displays are made in a joint venture with IBM. And Motif sells its chips for active addressing to a unit of Sanyo Electric Co.

Still, the Japanese have a huge head start. While Pixel and Motif prepare their first screen shipments, Sharp expects $1.5 billion in LCD revenues in the year ending in March. And for Japan, practice is making perfect. In less than two years, NEC engineers have cut the number of photographic production steps from 12 to 6. On a new line in Kagoshima, they will soon produce four panels instead of two from each sheet of glass. NEC has also raised production yields--the share of good screens in each batch--from 50% two years ago to nearly 80% today, a gain many analysts hadn't expected to see for years. Costs are falling, too, as production and testing gear is standardized. "The LCD industry is at a turning point," says Zenzo Tajima, active-matrix products manager at Hitachi Ltd.

BLOODBATH

Now, the Japanese are trying to cement their lead with relentless improvement in screens. Fujitsu Ltd. and Sharp have shown LCD prototypes that can be viewed from a wide angle, like TV screens. Sharp and Casio Computer Co. have begun to replace glass with lighter and more durable plastics. Vertical integration--something U.S. companies lack--adds urgency to their efforts. Toshiba Corp. and NEC use fancy color screens to boost sales of their notebook computers. And Sharp has sold half a million ViewCam video recorders, which have a built-in four-inch LCD screen.

The Japanese could still suffer setbacks if new entrants accelerate the fall in prices, which producers expect to decline gradually to $1,000 over the next few years. Or market growth might not meet expectations: "Who will buy all of these expensive screens?" asks David E. Mentley, director of display-industry research at Stanford Resources Inc. in San Jose, Calif. He sees a possible "bloodbath in the next two to three years."

Sharp and the others are betting he's wrong--and that if he isn't, they will have the prowess to survive. As for the challenge from exotic new displays, they plan to make whatever catches on. They already have crossed one chasm of technology, from picture tubes to liquid crystals. After that, what's another leap or two?