

Technology



Reconnaissance

PETMAN by Boston Dynamics will be upgraded into the Atlas. The new bot will walk like a human, use its hands for support, and be able to squeeze through narrow passages. Cost: Not yet for sale.



Defusing Bombs

iRobot's battle-tested PackBot can search caves and tunnels and find or neutralize roadside bombs. Cost: \$100,000.

Surgery

The da Vinci Si boasts a high-def, 3D vision system. Robotic arms are manipulated from an ergonomic surgeon's console. Cost: \$1 million.

Rise of the Machines (Again)

▶ U.S. companies chase the fast-growing market for service bots

▶ "In the health care field, you have clearly seen a revolution"

In 1961, just after America's Sputnik moment, the world's first industrial robot debuted at a **General Motors** assembly plant in Trenton, N.J. A company called **Unimation** had created the machine, a hulk with a four-ton arm that could work with heated die castings and perform welding. The company's founder, an American engineer named Joseph Engelberger, now considered the father of modern robotics, hoped to revolutionize U.S. manufacturing. Yet by the late 1980s overseas rivals had blown past Unimation, as well as much of the U.S. robotics industry. "The U.S. is nearly out of the industrial robot busi-

ness," a U.S. Commerce Dept. national security assessment warned in 1991.

Five decades after Unimation's debut, just as President Barack Obama has declared another Sputnik moment to spur U.S. competitiveness, the nation's robotics industry is enjoying a revival. When global robotics executives gather in Chicago from Mar. 21-24 for Automate 2011, their annual industry convention, a healthy delegation of U.S. companies will be strutting their stuff alongside Germans, Japanese, and South Koreans.

True, big multinationals such as Swiss-based **ABB** and **Fanuc** of Japan still dominate the global market for in-

dustrial, or manufacturing, robots, now worth \$12 billion, according to the Frankfurt-based International Federation of Robotics (IFR). But leadership of the larger and faster-growing market for service robots, a sector IFR pegs at \$13 billion worldwide, is up for grabs. This business encompasses robotic applications for industries such as defense, space, health care, business logistics, and consumer products, among other markets. And U.S. companies clustered in Boston, Pittsburgh, and Silicon Valley are very much in contention.

The service bot market is expected to double in size by 2013, and of the 200 or so top companies, nearly 70 are in the U.S., twice as many as are in Germany or Japan, according to IFR. "We are world leaders in service robots," says Colin Angle, chief executive officer of Bedford (Mass.)-based **iRobot**, which makes the Roomba and Scooba floor cleaning machines and the PackBot, a robot that can search caves and help with bomb-disposal missions.

Big defense budgets during the 2000s financed the deployment of thousands of robots, including unmanned aerial



Ship Maintenance
Chariot Robotics' Envirobot removes coatings and corrosion from the hulls and decks of ships, as well as large steel containers. Cost: \$1 million

Hospital Transport
Aethon's automated robotic system, called the TUG, is used by 100-plus hospitals to transport meds, equipment, and meals. Cost: Not available.



MEDICAL

Housecleaning
iRobot's Scooba preps, washes, scrubs, and squeegees floors. Sensors guide it around furniture and pets and then to a docking station. Cost: \$499.



CONSUMER



MILITARY

Ground Transport
This gear-carrying robot, BigDog, was a YouTube sensation in 2008. A souped-up version called the Legged Squad Support System has received \$32 million in funding from the Defense Dept. Cost: Not yet for sale.

and underwater vehicles, to Iraq and Afghanistan and helped revive the industry. (The Roomba is derived from iRobot research in mine-detection bots financed by the military.) The Pentagon's fascination with robots hasn't waned.

In 2010, the Defense Advanced Research Projects Agency (Darpa) budgeted \$23 million on three in-house programs heavily focused on robotics, funding projects including the development of a creepy-looking quadrupedal pack robot from **Boston Dynamics** called the Legged Squad Support System (LS3). On Feb. 23, Darpa awarded the Waltham (Mass.) company \$1.6 million to begin work on a prototype human-like robot called the Atlas that can walk upright and use its hands for balance to squeeze through narrow passages on surveillance or emergency rescue missions.

The other funded robot design, the cat-like Cheetah, will be able to clock speeds up to 40 mph to check out, say, enemy positions, says Boston Dynamics President Marc Raibert. Robotic cheetahs may seem indulgent in these austere times, but Raibert says the mechanics and software needed to develop the fast

cats will pay off militarily and be useful in civilian applications such as emergency response and fire-fighting. "Progress is just dollars away," he says.

Last decade's big increases in computing power and falling prices for laser scanners, motion sensors, software, chips, and other electronic components have made all manner of robots far more intelligent and flexible. That, plus a steady flow of \$1.2 billion in venture capital from 2000 to 2010, according to the National Venture Capital Assn., opened the arena to new players. "Something like a laser scanner five years ago would cost double" what it does today, says Aldo Zini, president and chief executive of Pittsburgh-based **Aethon**, founded in 2001. Backed by venture funds including **Trident Capital** and **Pacific Venture Group**, Aethon

"The U.S. is nearly out of the robotics business," the Commerce Dept. warned in a 1991 report

now makes a mobile robot called the TUG that automates the movement of medications, equipment, and meals in more than 100 hospitals.

In the operating room, the da Vinci robotic surgical system developed by **Intuit Surgical** in Sunnyvale, Calif., allows surgeons to view their patients from a high-def, 3D camera and (ideally) make more precise incisions by manipulating robotic arms. That can mean less invasive surgery and quicker recovery. "In the health care field, you have clearly seen a revolution," says Henrik I. Christensen, the chairman of robotics at Georgia Institute of Technology's College of Computing.

What could mess up the comeback? Christensen and others worry that the European Union, Japan, and South Korea, all of which have sophisticated robotics industries, are spending big on research to undercut the current U.S. advantage in service robots. (To inspire future engineers, South Korea is building a \$607 million robot-theme amusement park slated to open in Incheon in 2014.) "That's a big potential threat in the future," says Mitch Rosen-



Dubai can't
break its
building habit
page 44 ▶

berg, vice-president for marketing at **Kiva Systems**, which makes mobile robots designed to move goods and fulfill orders at e-tailers.

Government funding matters, but there is one unique advantage that may give U.S. tech companies an edge over foreign rivals, says Thomas Kalil, a deputy director with the White House Office of Science and Technology Policy. "The U.S. companies have a lot of experience creating ecosystems with third-party developers," says Kalil, who points to Apple's success with the iPhone. Kalil thinks free software developed by **Microsoft** and **Willow Garage** for robotic applications will accelerate innovation in the field. Willow Garage gives away a robot operating system to researchers and encourages them to develop applications for it. (It also sells a mobile research robot.) That openness, plus U.S. expertise in software and deep capital markets, says Kalil, gives American companies an edge.

—Brian Bremner

The bottom line U.S. robotic companies have regained their strength, but face tough Asian and European rivals in the service robot market.

Enterprise

Did We Mention How Great Our Servers Are?

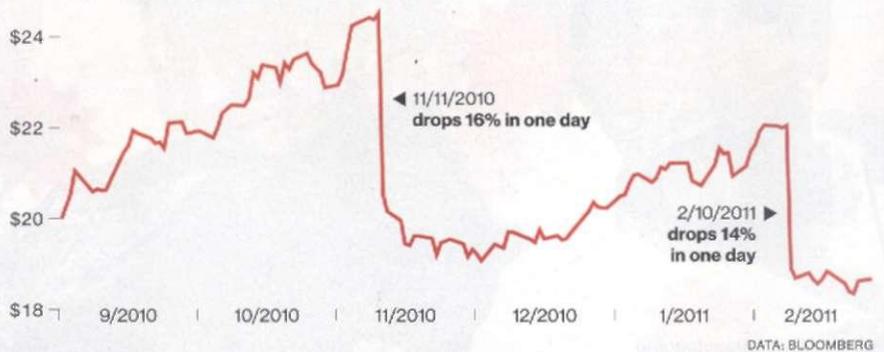
- ▶ As its stock languishes, Cisco bets on server sales
- ▶ It's facing the most competition in networking gear "in a decade"

During an otherwise dour earnings call with Wall Street analysts on Feb. 10, **Cisco Systems** executives uttered the phrase "data center" 29 times. It was, in part, an effort to keep attention on server sales, which are growing fast as corporations and phone carriers build massive data centers to handle increased Internet traffic. Sales of Cisco's Unified Computing System servers, introduced in early 2009, were up 700 percent last quarter and are on pace to hit \$650 million this year. "The data center evolution is playing out as we anticipated," said Chief Executive John T. Chambers.

The trouble is that \$650 million is just 1.5 percent of Cisco's expected rev-

Cisco's Twin Peaks

The company's stock price has plummeted after each of the last two quarters.



enues of \$43.7 billion this year, and it is facing unfamiliar pressures in the other 98.5 percent. Once known for its spookily consistent ability to deliver a penny more in earnings per share than Wall Street forecast, Cisco has missed expectations three quarters in a row. After twice coming up short on revenues, profit margins fell to 62 percent last quarter, below the company's guidance of around 64 percent. It also has been losing share in some key markets, including cable set-top boxes and its mainstay router business. Spooked by un-Cisco-like uncertainties, investors drove the stock down 14 percent after the earnings call, and it has yet to recover.

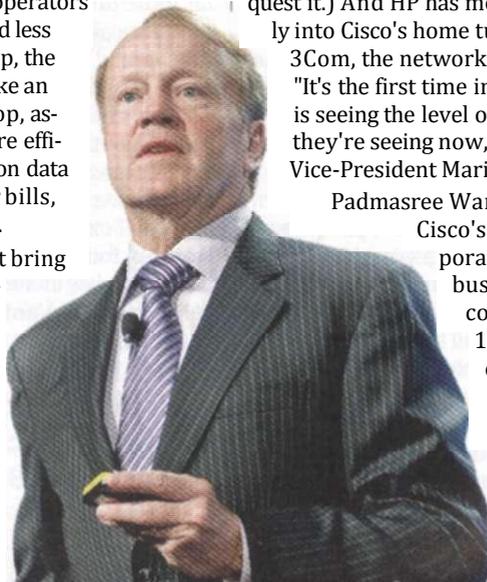
Cisco sees the \$50 billion server market as one of its most promising growth opportunities. Its UCS servers are part of Cisco's so-called network-centric approach to building data centers. Cisco says pairing the UCS with the company's line of Nexus switches will let data center operators get by with one-third less gear. (With this setup, the network becomes like an omniscient traffic cop, assigning tasks far more efficiently.) That saves on data center space, power bills, and operating costs.

But servers won't bring relief to Cisco shareholders any time soon. Cisco had less than one percent of the server market in the fourth quarter, according to researcher Gartner.

And the company is paying a surprisingly high price for admission into the market. Analysts say Cisco has given away many servers to win traction with customers used to buying them from **Hewlett-Packard**, **IBM**, and **Dell**. That's one reason for the decline in profit margins in the recent quarter. It's also the reason for some competitors' taunts: "We don't typically give away many servers because ye don't have to," says Forrest Norrod, general manager of Dell's Data Center Solutions unit. Cisco spokesman Lee Davis says Cisco loans UCS servers, but not permanently.

Cisco's move into servers has turned HP and Dell—and to some extent, IBM—from partners into competitors. The trio used to sell billions of dollars of Cisco's networking gear each year as part of their big corporate contracts. Now that Cisco is a rival, all three are pushing alternatives. (IBM's consulting arm continues to sell Cisco gear to customers who request it.) And HP has moved aggressively into Cisco's home turf by acquiring 3Com, the networking gear maker. "It's the first time in a decade [Cisco] is seeing the level of competition they're seeing now," says HP Senior Vice-President Marius Haas.

Padmasree Warrior, who runs Cisco's massive corporate technology business, says the company gained 1,000 new UCS customers in the fourth quarter, nearly tripling the number from the previous quar-



ter. While most have been small or mid-sized companies, she says accounts with large corporations—where most profits lie—are now picking up. Cisco is known for having one of the most aggressive, effective sales and marketing teams. It has 740 salespeople and a growing number of resellers devoted to servers. “There are a lot of doubters out there, but they’ve done a good job,” says Jere Brown, CEO of **Data Dimension Americas**, a large technology distributor.

Gaining share in servers, which have margins roughly half what Cisco is used to, is not an end in itself. Chambers’s intent is to use servers as an entry point to persuade customers to also buy its networking and storage products, as well as consulting services. Stephanie Carullo, senior vice-president of data center sales, urges patience. “We’ve been in this for 18 months, not 45 years” like some of Cisco’s competitors. “I think it’s not a bad achievement.” —Peter Burrows

The bottom line Networking king Cisco is trying to dominate data centers by aggressively marketing servers and offering loaners to customers.



Social Networking

Dueling Your Facebook Friends for a New Job

- ▶ Job site BranchOut is like “Hot or Not” for business contacts
- ▶ “Most of us do not want to relive middle school over and over again”

Research shows that the larger and more diverse your web of contacts, the more luck you’ll have in the job market. **LinkedIn**, the sober networking site for professionals, has 90 million members. **Facebook** has nearly six times as many, but its users tend to post party photos and off-the-cuff quips that can turn the world’s largest social network into a career killer. **BranchOut**, a career-minded website that launched in July, wants to mine the middle ground.

Users join BranchOut by linking their Facebook account to the site. BranchOut automatically creates profiles by pulling in education and work history and nothing else—from the network. (It can also grab resume info from LinkedIn.) The profiles are accessible only to members, who can search among friends to see who has worked at a specific company. They can also view 3 mil-

lion job listings. BranchOut has about 400,000 active monthly users, according to AppData.

To entice more people, and to get social acquaintances to think about each other as business contacts, BranchOut recently debuted a new feature called SocialScore. Founder Rick Marini calls it the business version of “Hot or Not,” the notorious online game that asks players to decide which of two people is better looking. When BranchOut’s users start playing, they’re shown two randomly selected Facebook friends, and then asked to choose which they’d rather work with. The winner is notified, and BranchOut keeps score. “It’s fun and ego-driven and addictive,” says Marini. (Was that you or your colleague who just shuddered?)

SocialScore is not just for fun. “The data we can collect is gold for recruiters,” Marini says. Ideally, it provides a realistic, crowd-sourced assessment of a candidate that headhunters might find hard to come by on their own. Since SocialScore’s launch on Feb. 17, Marini says about 20,000 people have voted 700,000 times. Soon, BranchOut will match up people by job title. Then it will be able to rank, say, software engineers by popularity. Marini will sell these lists to recruiters at a price he has yet to determine.

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Number of times that libraries can lend e-books from HarperCollins, under a new licensing restriction the publisher announced on Feb. 25. After a license expires the library will have to repurchase the e-book.

DATA: HARPERCOLLINS

Technology

Will recruiters find the information credible? "It would make a difference to have the validation of your peers," says Carlos Gil, the founder of Jobs-DirectUSA, an online job board. Ethan Beard, the Facebook executive who

\$6
MILLION

Amount raised
by BranchOut
from investors
including Accel
Partners

oversees partnerships with sites like BranchOut, says that, generally, "you get the ultimate source of truth from friends." Marini, who sold the social media site Tickle to **Monster Worldwide** for \$100 million in 2004, isn't the first to bring ratings to the office; the site Cubeduel uses data from LinkedIn profiles to let colleagues rank one another. Marini is the first to put together a business based on the idea, and has raised \$6 million from a group of investors led by venture capital firm Accel Partners.

Rating colleagues is "a pretty mixed proposition," says Lee Rainie, director of the Pew Internet & American Life Project. "It makes social relationships more complex and more interesting--and more fraught." Zeynep Tufekci, a University of Maryland professor who studies the social impact of technology, is also skeptical of the value: "Most of us do not want to relive middle school over and over again."

Marini is mindful of these concerns. "This is not mean-spirited," he says. The loser of each face-off is never notified--only the winner is told the battle results. "It's all about the positive."

Tony Wright, the co-founder of Cubeduel, says that even if some people are discomfited now, workplace rankings are an inevitability. "Eventually, whether it's us or them or another company, there will be someone keeping score." —*Susan Berfield*

The bottom line BranchOut's job-seekers rank one another based on Facebook profiles. The company plans to sell the rankings to recruiters.

Cable

Coming Soon to Your Screen: T-Commerce

- ▶ Cable operators are ramping up interactive sales during shows
- ▶ "With two clicks of your remote control, this stuff is in your mailbox"

Consumers may hate the banners, crawls, and logos that clutter the bottom of their TV screens, but they're about to see a lot more of it. **Comcast, Time Warner, Cox Communications**, and other U.S. cable and satellite providers this year are introducing technologies that let them blast viewers with interactive pop-up ads flogging DVD boxed sets of *Gossip Girl*, mutual fund prospectuses, and myriad other products.

Cable companies have created a consortium called **Canoe Ventures**, which is retrofitting millions of digital cable

boxes with software that lets advertisers send on-screen pitches. Bravo, USA, History, and about a dozen other channels have signed up for the service.

Rovi, the leading provider of on-screen program guides, has developed its own T-commerce technology and signed up major networks including NBC and Fox. **Samsung**, **Sony**, and other television makers plan to offer similar services on Web-connected TVs. And satellite operators **Dish Network** and **DirectTV** are creating their own systems, which should be available late this year.

Adopting so-called T-commerce could create a windfall for cable companies. "We're pretty sure we're going to see a massive increase in responses to ads," says Canoe Ventures' Chief Executive Officer David Verklin. "With two clicks of your remote control, this stuff is in your mailbox five days later." Researcher In-Stat estimates that as much as 3 percent of viewers will click the buy button, making T-commerce sales potentially worth about \$1.5 billion annually.

True, T-commerce efforts to date haven't been huge successes. **Tivo** boxes deliver interactive pop-ups, though so far they've been used mostly as a way for viewers to request brochures or other information. **British Sky Broadcasting** has had T-commerce for a decade, but most of the \$325 million in annual revenue comes from gamblers placing bets on sporting events, according to In-Stat.

U.S. media companies think they'll be successful this time around because Americans are now accustomed to online shopping. And Canoe's offering, with 30 million households by year-end, has the scale they need to make the effort worthwhile. Five companies including **Honda**, **Kimberly-Clark**, and **Fidelity Investments** have signed up with Canoe to test the system with everything from free samples to polling. Ultimately, users may get targeted pitches tailored to their viewing habits, though that could take years, says Michael Fitzsimmons, CEO of **Delivery Agent**, which is working with T-commerce systems to provide billing. "The optimal time for presenting sales offers," he says, "is for shows you're watching or about to watch." 

—Cliff Edwards

The bottom line TV viewers can expect more product pitches interrupting shows as cable operators roll out new systems for pop-up, interactive ads.

Innovator



Michael Lefenfeld



The chemist has designed a safe, cheap compound to power fuel cells. Starting later this year it will be used in electric bikes and phone chargers

Shortly after Michael Lefenfeld graduated from Washington University in St. Louis in 2002, his grandfather asked him to solve a problem. "He wanted something that he could take to the bathroom with him and drop in the toilet ... an air freshener of sorts," says Lefenfeld, who majored in chemical engineering. "I started thinking about how to volatilize a fragrant oil off the surface of toilet bowl water."

Lefenfeld hired James Dye, a chemist at Michigan State University, to help with the project. In 2004 the pair patented the world's first process for producing air-stable alkali metals. These compounds are normally highly reactive; they combust when exposed to most liquids and vapors. Lefenfeld and Dye found a way to keep them from burning in air, a feat they quickly realized had plenty of non-bathroom uses. That year they founded the Manhattan company SiGNa Chemistry.

Most of SiGNa's business is in selling

alkalis to chemical companies that use them in oil refining, drug development, and more. For the past three years Lefenfeld, now 30, has focused on adapting them for fuel cells. SiGNa makes a sodium silicide powder that, when mixed with water, releases hydrogen gas that many fuel cells use to create an electrical charge. SiGNa's powder is nontoxic and can be triggered by almost any water—salt or fresh—or even urine. Lefenfeld says it can efficiently power anything that uses three kilowatts or less, from laptops to lawn mowers.

This summer the California company Pedego will start selling an electric bicycle that includes a refillable SiGNa fuel cartridge to extend the range of its lithium battery from 20 to 100 miles. In October, the Swedish fuel cell company myFC plans to begin selling a brick-size cell phone charger that will run on SiGNa "PowerPukks." Each aluminum puck, about the size of its hockey namesake, is enough to provide 10 hours of juice for a typical smartphone. The charger will cost around \$200, and each puck will run about \$2.50. SiGNa supplies the fuel and builds custom canisters for both Pedego and myFC.

John Kopasz, a chemist at Argonne National Laboratory, says the advantage of SiGNa's fuel is that "you don't have to supply heat," and "the starting materials are relatively cheap." The downside is that its powder is not regenerable, so it's not a contender in the race to power hydrogen-fueled cars.

Still, Lefenfeld says there are plenty of uses beyond bikes and smartphones. SiGNa currently is using a U.S. Agency for International Development grant to produce mobile power units for disaster relief areas. And the invention solved his grandfather's problem: The "plop and drop" tablet "made the bathroom smell really, really nice," says Lefenfeld.

—Ira Boudway

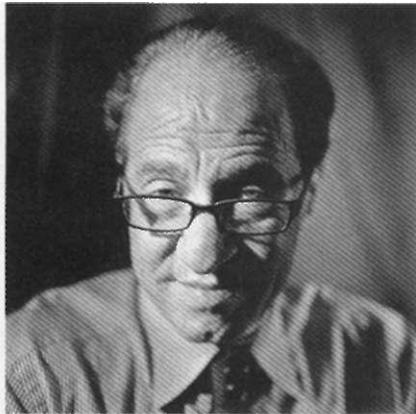
Request ▶ His grandfather asked for a toilet-activated air freshener

Invention ▶ Air-stable alkali metals with a variety of industrial uses

Market ▶ Could be used to power laptops and lawn mowers

Charlie Rose talks to Ray Kurzweil

“These technologies ... will be 1,000 times more powerful in 10 years”



The author, inventor, and futurist says accelerating technology will soon bring us immortality—and all the energy the earth requires

I'm interested in this notion of a coming singularity-computers surpassing humans-and your obsession with immortality. What led you there?

I really started with this exploration of where technology is headed and the tremendous power of exponential growth. So where radical life extension comes from is the observation that biology is a set of software processes. We have software running in our bodies. It's out of date. It evolved thousands of years ago. Our approach so far to health and medicine has been hit-or-miss. We find treatments accidentally. Here's something that lowers blood pressure. We don't know why it works. Now we're actually gaining access to that software, understanding how it works. These technologies will double in power every year. They'll be 1,000 times more powerful in 10 years, a million times more powerful in 20 years. What I'm looking forward to is the tipping point where we're adding more time than is going by in terms of life expectancy. The sands of time will start running in rather than running out within a couple decades.

What about this idea of humans merging with technology?

There are already people putting computers in their bodies and brains. Parkinson's patients, deaf people with cochlear implants, computerized pancreases. Ultimately we'll do it non-invasively because another exponential progression is that they're getting smaller and smaller. You know, this [holding up a smartphone] was the size of a building when I was a student. And it will be the size of a blood cell one day-and much more powerful. We'll be able to send very powerful devices into our bodies that will keep us healthy, extend our thinking. This might as well be in my body and brain because it's part of who I am.

What do we really mean by artificial intelligence?

Well, it means machines performing functions that used to require human intelligence, and the list of those tasks is getting broader and broader. In the early '80s, I predicted that a computer would take the world's chess championship by '98. In '97, Deep Blue defeated Kasparov. People immediately said, "Well, chess isn't really such a creative game." And there's something to that. I mean, chess is the kind of game you would expect a logical machine to be able to perform. People also said at that time that computers would never master the subtleties of language, metaphors, irony, puns, similes. [IBM's *Jeopardy!*-playing] Watson is a powerful demonstration, handling pretty subtle forms of language. Watson not only had to understand a little query, it had to understand the hundreds of thousands of pages of natural language documents that were dumped into it.

Some people fear AI. What do you say to them?

There's a movement to ban these technologies, which is actually based on my writings. I don't agree, because I don't think it would work. There are things we can do about it, and we can have ethical standards to keep this technolo-

gy safe. We can have rapid response systems like we have for software viruses. It's far from perfect, but nobody's taken the Internet down for even a second, so it's a pretty robust system. Technology is a double-edged sword. It always has been. I mean, fire kept us warm but also was used as a weapon of destruction.

These are powerful tools. But it's not like the conceptions that you see in science fiction movies where there's the evil machines. I mean, look at it today. We have lots of humans empowered and enhanced by our machines. And we still have conflict between different groups of humans, all of whom have machines.

What's the driving idea that excites you the most?

I think it's the unification of all these different fields being powered by information technology. We've seen its impact on politics just in the last few weeks. Social networks started three revolutions.

It's that exponential growth concept again. Where else does it take us?

Solar power actually is doubling every two years and has been for 20 years. Regardless of all the political debates, the actual output in watts has been doubling every two years. It's eight doublings away from meeting 100 percent of our energy needs. So when I presented this to the Prime Minister of Israel, he said, "But do we have enough sunlight to do this with?" I said, "Actually, we have 10,000 times more than we need." After we double eight more times and can meet all of our energy needs with solar, we'll be using one part in 10,000 of the sunlight that falls on the earth. So, we're actually awash in resources. If you look at how these exponentially growing technologies are being applied, there's a lot more resources and opportunity to overcome these problems. ©



Watch Charlie Rose on Bloomberg TV weeknights at 8 p.m. and 10 p.m.