

Technologies That Will Shift the GLOBAL BALANCE OF POWER in the Next 20 Years

By Vivek Wadhwa

Governments, businesses, and economists have all been caught off guard by the geopolitical shifts that happened with the crash of oil prices and the slowdown of China's economy. Most believe that the price of oil will recover and that China will continue its rise. They are mistaken. Instead of worrying about the rise of China, we need to fear its fall. Also, while oil prices may oscillate over the next four or five years, the fossil-fuel industry is headed the way of the dinosaur. The global balance of power will shift as a result.

LED light bulbs, improved heating and cooling systems,

and software systems in automobiles have gradually been increasing fuel efficiency over the past decades. But the big shock to the energy industry came with fracking, a new set of techniques and technologies for extracting more hydrocarbons from the ground. Though there are concerns about environmental damage, these techniques increased the output of oil and gas, caused the usurpation of old-line coal-fired power plants, and dramatically reduced America's dependence on foreign oil.

The next shock will come from clean energy. Solar and wind are now advancing on exponential curves. Every two years, solar installation rates are doubling, and photovoltaic-module costs are falling by about 20 percent. Even without the subsidies that governments are phasing out, present costs of solar installations

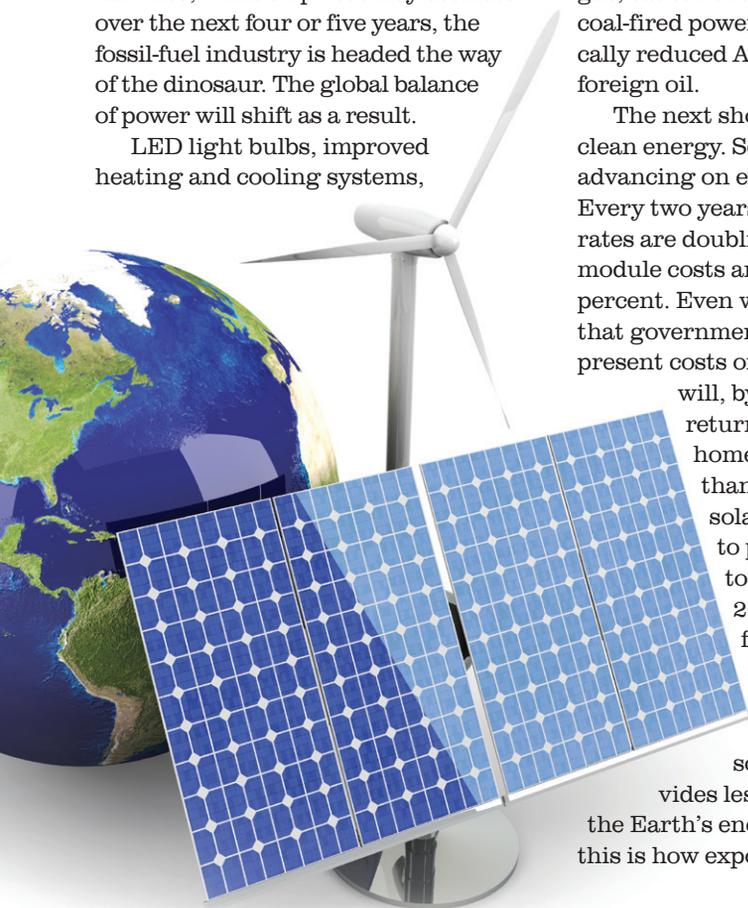
will, by 2022, halve, reducing returns on investments in homes nationwide to less than four years. By 2030, solar power will be able to provide 100 percent of today's energy needs; by 2035, it will seem almost free, just as cell-phone calls are today.

This seems hard to believe, given that solar production provides less than one percent of the Earth's energy needs today, but this is how exponential technologies

advance. They double in performance every year or two, and their prices fall. Given that California already generates more than five percent of its electricity from utility-scale solar, it is not hard to fathom what the impact of another few doublings would be: the imminent extinction of the fossil-fuel industry. Exponential technologies are deceptive because they move very slowly at first, but one percent becomes two percent, which becomes four, eight, and sixteen—you get the idea. As futurist Ray Kurzweil says, "When an exponential technology is at one percent, you are halfway to 100 percent," and that is where solar and wind energies are now.

Anyone tracking the exponential growth of fracking and the gradual advances that were being made in conservation and fuel efficiency should have been able to predict, years ago, that by 2015, the price of oil would drop dramatically. It wasn't surprising that relatively small changes in supply and demand caused massive disruptions to global oil prices; that is how markets work. They cause commodities futures and stock prices to fall dramatically when slowdowns occur.

This is also what is happening to China's markets. The growth of China's largest industry, manufacturing, has stalled, causing ripple effects throughout China's economy. For decades, manufacturing was flooding into China from the U.S. and Europe and fueling its growth. Then a combination of rising labor and shipping costs and automation began



to change the economics of Chinese manufacturing. Now, robots are about to tip the balance further.

Foxconn had announced in August 2011 that it would replace one million workers with robots. This didn't occur because the robots then couldn't work alongside human workers to do sophisticated circuit board assembly. However, a newer generation of robots such as ABB's Yumi and Rethink Robotics' Sawyer can do that. They are dextrous enough to thread a needle and cost as much as a car does.

China is aware of the advances in robotics and plans to take the lead in replacing humans with robots. Guangdong province is constructing the world's first "zero-labor factory," with 1,000 robots which do the jobs of 2,000 humans. It sees this as a solution to increasing labor costs.

The problem for China is that its robots are no more productive than their counterparts in the West are. They all work 24 hours, 7 days a week without complaining or joining labor unions. They cost the same and consume the same amount of energy. Given the long shipping times and high transportation costs, it no longer makes sense to send raw materials across the oceans to China to have them assembled into finished goods and shipped to the West. Manufacturing can once again become a local industry.

It will take many years for Western companies to learn the intricacies of robotic manufacturing, build automated factories, train workers, and deal with the logistical challenges of supply chains being in China; but these are surmountable problems. What is now a trickle of manufacturing returning to the West will, within five to seven years, become a flood.

After this, another technology revolution will begin: digital manufacturing.

In conventional manufacturing, parts are produced by humans using power-driven machine tools such as saws, lathes, milling machines, and drill presses to physically remove material to obtain the shape desired. In digital manufacturing, parts are produced by melting successive layers of materials based on 3D models—adding materials rather than subtracting them. The 3D printers that produce these items use powered metal, droplets of plastic, and other materials much like the toner

cartridges that go into laser printers. 3D printers can already create physical mechanical devices, medical implants, jewelry, and even clothing; but these are slow, messy, and cumbersome—similar to how the first generations of inkjet printers were. This will change.

By the early 2020s, we will have elegant, low-priced printers for our homes that can print toys and household goods. Businesses will use 3D printers to do small-scale production of previously labor-intensive crafts and goods. Late in the next decade, we will be 3D-printing buildings and electronics. These will eventually be as fast as today's laser printers are. Don't be surprised if, by 2030, the industrial robots go on strike, waving placards saying "Stop the 3D printers: they are taking our jobs away!"

The geopolitical implications of these changes are exciting and worrisome. America will reinvent itself just

as does every 30-40 years. It is, after all, leading the technology boom. As we are already witnessing, Russia and China will stir up regional unrest to distract their restive populations; oil producers such as Venezuela will go bankrupt; the Middle East will become a cauldron of instability. Countries that have invested in educating their populations, built strong consumer economies, and have democratic institutions that can deal with social change will benefit because their people will have had their basic needs met and can figure out how to take advantage of the advances in technology. **N**

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