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CHAPTER ELEVEN

ICTs and the Green Economy

US and Chinese Policy in the 21st Century

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The growing consensus around climate change has led many analysts to champion information technology as a foundation to a green economy. Reducing global warming and enhancing resource management are strong reasons to take the idea of a green economy seriously. Many countries today are aggressively pursuing green innovation strategies because of the potential social and economic benefits associated with harnessing clean energy. Much as information and communications technologies (ICTs) have underwritten globalization and reshaped industrial societies, they are transforming the structure and practices of green innovation. ICTs are no silver bullet, but they are very likely a major key to developing a clean energy economy. In this chapter we explore the policy implications of green innovation in the context of the two largest economies in the world, the U.S. and China. Looking critically at U.S. and Chinese economic policy, we consider the opportunities and challenges facing these two economic giants. We begin with U.S. policy in relation to the green economy, and then turn to Chinese policy. What should be the green economy strategies for the U.S. and China going forward? How can they work cooperatively to resolve the growing economic and political challenges around climate change?

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The Green Economy and U.S. Policy in the 21st Century

It has become increasingly clear that we are moving beyond the closed loop of industrial civilization. Aggressive attempts to curb ozone depleting chemicals and cut green house gas emissions have become commonplace in contemporary public policy discourse. Growing concern about climate change and the impact of carbon dioxide emissions has made green innovation and a green economy a central feature of international debate. At the policy level, the definition of a "green economy" remains in flux, but is linked to the elimination of fossil fuels and a long-term shift from highly polluting industrial industries to low-carbon, low-waste industries. This includes technological innovation, renewable energy generation (wind, solar, geothermal, and biomass) and energy conservation.

Many government programs around the world today focused on environmental sustainability are exploring technology initiatives for reducing green house gases. Denmark's *Action Plan for Green IT* established by the Ministry of Science, Technology, and Innovation, for example, and Japan's *Green IT Initiative* established by the Ministry of Economy, Trade, and Industry, provide strong models of cutting edge green innovation policy (Castro, 2009). Although there is no fixed definition of "Green ICTs," Green IT or Green Computing is often defined as the practice of using computers and telecommunications in a way that maximizes positive environmental benefit and minimizes environmental pollution (Worthington, 2009, p.16). This includes energy efficiency in ICT equipment and the use of recyclable materials in the production of ICT-related goods. In the U.S., two national agencies have each initiated green ICT-related measures, the U.S. Department of Energy (DOE)[1] and the U.S. Environmental Protection Agency (EPA).[2]

Technology may be essential to green innovation but strategic public policy is critical. Evidence from climate science points to the need for a large-scale coordinated response to climate change, including a broad portfolio of active technologies and regulatory management. Reducing global warming and enhancing resource management are strong reasons to take the idea of green ICTs and a green economy seriously (Castro, 2009). The limitations of past U.S. policy, however (particularly when compared to countries at the leading edge of green innovation) suggest that the U.S. has a long way to go. Consider the data: 85 percent of America's energy comes from fossil fuels (petroleum, coal, and natural gas). While America produces 10 percent of the world's oil, it consumes one quarter of the world's total supply. 70 percent of that oil is imported from abroad (with estimates of $475 billion on imported oil in 2008 alone). The hard reality is that America's high-tech society is built on top of a fossil fuel economy of oil, coal, and natural gas. With finite supplies of carbon energy and global warming concerns, this situation will have to change dramatically.

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While environmental policy in the U.S. has mainly focused on educating (and sometimes miseducating) the private sector about its environmental impact, what the U.S. has lacked most is a robust public policy for coordinating a coherent green strategy. The strength of countries at the leading edge of green innovation, for example, is anchored in their capacity to leverage government oversight in the rapid coordination of public-private partnerships. Lacking a coordinated and vigorous energy policy, the U.S. has not been as effective as other advanced industrial countries.

Challenges to the U.S. Economy

Where does the U.S. economy stand today? Over the past 20 years, structural weakness in the U.S. economy has become considerable. Masked by a succession of economic bubbles (the dotcom bubble, the low interest bubble, the real estate bubble, and most recently the subprime mortgage crisis), the U.S. economy has become structurally reliant on foreign capital to finance itself. Weak manufacturing has led to a massive trade deficit and a growing external debt. As American industrial production has shrank, domestic consumption has soared.

While the U.S. economy is heavily dependent on consumer spending, American consumers are now deeply in debt. Increasingly reliant on foreign creditors, the U.S. appears to be a global hegemon in decline. According to Goldman Sachs, the U.S. share of global gross domestic product fell to 27.7 percent in 2006 from 31 percent in 2000. Meanwhile, the share of global gross domestic product for the BRIC countries (Brazil, Russia, India, and China) rose to 11 percent from 7.8 percent (Gross, 2007). China alone accounts for 5.4 percent. In 2007 the BRICs' contribution to global growth was in fact greater than the U.S. Even adjusting for the differential power of currencies, growth in the U.S. has lagged behind global growth for the past 10 years.

The hard reality is that the American economy lacks the productive capacity to rejuvenate itself. Many now believe that the U.S. needs to develop a new economic engine. Van Jones (2008), for example, has proposed a "green new deal" to transform the U.S. around alternative energy. Insulating homes and businesses alone he suggests, could produce a service economy of low and medium-skill jobs that could help to revitalize the U.S.

A New Energy Paradigm: Renewing the U.S. Economy

The rising call for green economy jobs offers significant promise both in terms of innovation and mass employment. Beyond fossil fuels, the continental U.S. has enormous assets in renewable wind and solar energy. Underlying any strategy for renewable energy, however, is the issue of the storage and transmission. Most analysts agree

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that the transmission and distribution of electricity is a major key to developing a green economy. America's aging electricity grid, however, is in critical need of renewal. Changes to the U.S. electricity grid, for example, would likely mean introducing next generation digital technologies.

The difference between traditional grids and the potential of digital grids is considerable. While traditional grids simply distribute energy, next generation *Smart Grids* have the capacity for two-way energy transmission. A two-way power flow from distributed renewables like solar and wind, for example, would mean that consumers could sell excess electricity back to the grid. Directly connecting suppliers (utilities) to customers, while at the same time transforming this into a bi-directional relationship, would completely transform the U.S. energy infrastructure .

Using smart grids, U.S. energy production could become augmented by clusters of locally distributed energy resources (DER)[3]. Using a combination of advanced two-way technologies and applications, energy generation in the U.S. could look increasingly like the Internet. Policy related organizations like GridWise (2009) for example, argue that smart grids can transform the production, storage, and use of energy, just as the Internet revolutionized the production and use of information and communications. While DER systems are small-scale power-generation technologies (typically in the range of 3–10,000 kW), they can be combined to form dense clusters of networked energy. Since most forms of renewables (ocean tide, wind, solar) are inherently variable or intermittent, smart grids can balance sudden drops in electrical generation by adjusting storage or consumption itself. Linking consumers and producers into a single national energy network could have huge potential for green innovation.

U.S. Policy and the Green Economy

The recent rush of stimulus spending around the world includes significant investments in the green economy. Green innovation and the development of green technologies are seen by many policymakers as critical to the future prosperity of advanced economies. This is clearly the view of the Obama administration as well. The U.S. administration's stimulus bill has dedicated U.S.$71 billion to clean energy funding, with an additional U.S.$20 billion for loan guarantees and tax incentives to support clean energy projects. The administration has proposed investing in a *Unified National Smart Grid* linking all of the nation's local electrical networks that have been upgraded to smart grids. High-capacity transmission would span the country, providing linkages to local electric utilities and distantly located bulk power generation facilities.

Using advanced, high-voltage lines, America's Unified Smart Grid is envisioned as efficiently moving electricity across vast geographic distances with minimal loss-

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es. Long distance interconnections are not new (a 5 GW 800 KV system is currently being constructed along the southern provinces of China). What is new, however, is the network architecture of the Unified Smart Grid. The Unified Smart Grid would not simply be a collection of point-to-point interconnections between regional systems. Rather, it would be a two-way electrical transmission network, enabling access points to function as virtual power generators or Grid energy storage facilities. Smart grid applications, for example, would improve the ability of electricity producers and consumers to communicate with one another and make decisions about how and when to produce and consume energy. Smart-grid operators could move energy provided by wind or solar power plants from one side of the country to the other. Combining solar power from the South with wind power from the Northeast, the U.S. would be able to use its varied geography in a highly coordinated way.

Smart Grids not only introduce additional layers of advanced technology, they also bridge adjacent markets in architectural design, smart home appliances, wireless networks, auto production, and traditional utilities. At the most basic level, however, smart grids would mean a wider array of customized energy choices, commercial technologies and services, distributed intelligence, and clean power. Deploying a unified energy network would mean consumers could also become producers, collaborating together around open innovation. This could mean a new democratic platform for prosumer (producer-consumer) collaboration (von Hippel, 2005). Bauwens (2009), for example, argues that these networking systems underlie the gestation of new socioeconomic infrastructure in desperate need of a supportive institutional and governmental framework. Beyond the command-and-control systems characteristic of mass industrial society, the green economy would likely be coordinated by the collaborative logic of peer-to-peer networks.

Global Shift

Beyond the U.S. and other advanced economies, however, there is a global crisis looming around energy consumption in emerging economies. China is predicted to become the largest economy in the world by the middle of this century. While China and India only accounted for 10 percent of the world's energy consumption in 1990, and 19 percent in 2006, they are projected to account for 28 percent in 2030[4] (Energy Information Administration, 2009). As Victor and Yueh (2010) argue, the "era of growing demand for oil and other fossil fuels in the industrialized countries is over; most of the future growth in demand will come from the energy market countries, notably China and India (p. 62)." Rising demand for energy in develop-

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ing countries is putting unprecedented pressure on the global energy system. Beyond economic nationalism, there is a critical need for new collaborations in green policy and green innovation. Consider for example, the recent stimulus spending to rejuvenate the global economy:

> The problem is most obvious regarding the "green" part of the $2.5 trillion that is being spent globally to stimulate the world economy. The U.S. and China alone are spending $1.5 trillion, including a large fraction on energy projects. South Korea has devoted 85 percent of its stimulus package to green investments, promoting energy efficiency and low-emissions power plants. The British government has set aside hundreds of millions of pounds to support research and development in green industries. Coordination is needed, however, because the market for green-energy technology is global; ideas promoted in one country can quickly spread to the rest of the world through the marketplace. For example, U.S. spending on renewable sources of energy can invigorate U.S., Chinese, and European firms that supply solar cells and wind turbines, boosting all three economies at the same time. And Chinese spending on new power grids can benefit the Western companies, as well as the Chinese ones, that develop the requisite technology. (Victor and Yueh, p. 70)

The bottom line is that the green economy is different from other markets and will require political coordination at the highest levels. Part of the answer to this lies in commercial markets themselves—free competition should bring the best green technologies to the forefront. But beyond commercial markets, there is the need for coordination in public policy to underwrite green innovation and negotiate the frictions between competing nation-states. Although the growing list of energy consuming countries around the world is long, priority belongs to the world's largest economies, particularly the U.S. and China. Given their dominant roles as the world's largest energy consumers, the U.S. and China must play a significant role in nurturing the green economy. In order to appreciate the scope of this challenge, it is important to understand China's current economic trajectory.

The global economy today is still largely based on industrial production. For this reason, international trade in industrial products is still viewed as one of the major indicators of global GDP growth. As China continues to modernize and build consumer-driven markets, it is absorbing an increasing share of the world's energy and resources. Behind the story of China's unprecedented economic growth is an increasing consumption of natural resources, especially energy.

China has become one of the largest greenhouse gas emitters in the world today, and "energy consumption in China is expected to rise significantly as the country aims to quadruple its gross domestic product by 2020" (Jia, 2004, para. 5). Interestingly, China will likely surpass the U.S. in smart grid investments this year, investing $7.3 billion dollars in smart grid technology through stimulus loans, grants, and tax credits (compared to $7.1 billion by the U.S.) (Bhanoo, 2010). In order to cope with growing environmental problems and improve the sustainabil-

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ity of China's economic development, the Chinese government has introduced policies to support "environment construction." According to Liu Zhiquan, Deputy Director General of Department of Technology Standards, Ministry of Environmental Protection, China plans to invest 3.1 trillion Yuan (or $450 billion U.S.) in environmental protection, exceeding that of the U.S. and Japan (People's Daily Online, 2009, para. 5). As a developing country however, China is largely focused on industrialization.

For much of the 20th century, China did not substantially participate in the global economy. However, over the past 30 years the Chinese economy has undergone significant restructuring linked to commercial markets and privatization. Today, China has moved past Japan to become the world's second largest economy. In the last two decades China has overtaken the U.S. and Germany to become the world's largest exporter and it now has the world's largest foreign exchange reserves. The downside of all this economic growth is that China has also become the world's largest emitter of carbon (Mandelson, 2010).

The struggle between environmental degradation and environmental protection has been daunting for China. Early efforts at environmental protection in China can be traced to its 1972 delegation to the UN's Human Environment Conference[5] and to China's environmental protection conference in 1973. Under market liberalization, China has found the challenge of implementing environmental policy at the local level to be a major obstacle to managing environmental pollution. Over the past three decades, the rate of environmental pollution in China has significantly outpaced the country's capacity to deal with environmental protection (Economy, 2004). This is not to say that the Chinese government is taking no action on climate change. Unlike the market-based approach to environmental protection seen in the U.S., the Chinese government has been quite proactive in establishing a comprehensive national apparatus for promoting environmental protection and sustainable economic growth.

THE GREEN ECONOMY AND CHINA IN THE 21ST CENTURY

Today, the long-term policy trajectory of China is to gradually shift from "high-energy consumption" to "information processing" (Hu, 2007, para. 3). China's industrialization is only accelerating, however, and industrial development remains the foremost goal of Chinese economic policy (National Development and Reform Commission, 2006, para. 3). The good news is that Chinese policymakers are acutely aware of the need to employ information technologies in order to develop a "highly-efficient" and "low-cost" ICT infrastructure. Over the past two decades, a shift from industry to information has become a central feature of Chinese innovation policy. ICTs, it is suggested, have the long-term potential to replace mater-

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ial goods (dematerialization), and increase productivity and efficiency (Hilty, Seifert, & Treibert, 2005). However, the reality is that ICTs linked to globalization are boosting the production of material goods. Rather than dematerialization, what we are seeing is a third-order effect of ICTs. This suggests an underlying logic for the development of green ICT innovation that requires closer coupling to environmental protection.

There are at least four key areas of industry in which the use of IT is promoted to support Chinese industrial development. These industries include traditional industries (energy and manufacturing), agricultural industries, service industries, and industrial enterprises. Among these four areas of industry, the traditional industries are given the most attention by government because of their relative importance to China's current stage of industrialization (The State Council of China, 2008. para. 2). According to the State Council of China (2006, para. 4), energy and manufacturing are the two primary industries essential to China's long-term national development.

The problem, of course, is that China's industrialization is highly polluting. Heavily reliant on the consumption and exploitation of natural resources, the Chinese government is increasingly introducing policies to improve and even radically change their approach to economic development. Using ICTs to balance environmental protection with industrial growth is now viewed as being extremely important to China's future trajectory. The total investment in the IT sector of China's manufacturing industries, for example, grew from 28.4 billion Yuan ($4.1 billion US) in 2005 to 43.7 billion Yuan ($6.4 billion US) in 2008 (see Figure 1). Progress on the ground, however, is rather uneven due to variations in development across different regions of China.

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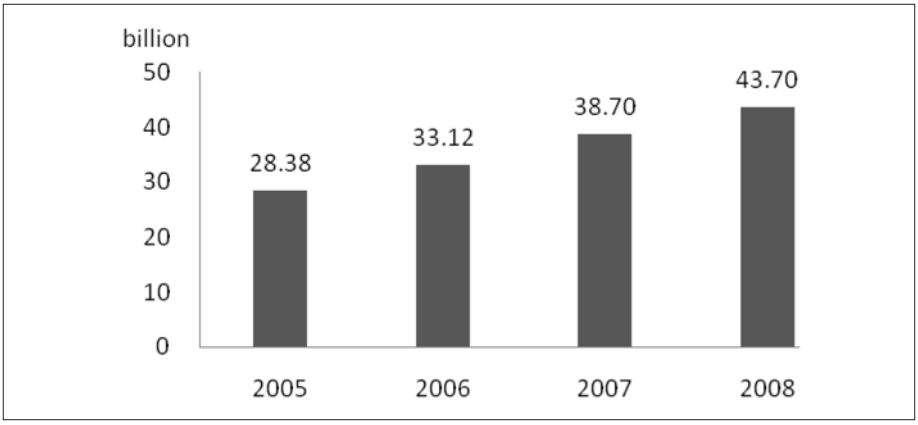

Figure 1. Growth of investment in IT sectors of China's manufacturing industries (2005–2008)
Source: Data from China's Manufacturing Industry Development Annual Report (CCID, 2009, para. 3)

Using ICTs to Manage and Control Industrial and Urban Pollution

Apart from industrial use in China, ICTs can also be widely adopted to measure and control the impact of industrial activities on the environment. As Rautenstrauch and Patig (2001) point out, one of the reasons industrial manufacturing is often seen as the cause of environmental damage is the lack of information in manufacturing industries for managing raw materials. If industrial manufacturers in China and elsewhere were to adopt specialized information systems to improve their industrial production processes, this could go a long way towards managing industrial pollution.

Rapid industrial and urban development over recent decades has left China's environment heavily damaged. Water, soil, forest, and minerals are all declining at a disconcerting rate (The World Bank Group, 2001). In response, the Chinese government has established a series of policies and regulations to control or restrain the impact of industrial pollution on the environment. Among these regulations, environmental monitoring systems and networks have been given particularly high priority. In addition, all environmental protection departments at the local level are required to construct their own advanced environmental monitoring systems to support timely decision-making. This includes environmental monitoring databases, in order to improve the capability for collecting and analyzing environmental data (Ministry of Environmental Protection, 2007, para. 3).

While the construction of China's environmental monitoring system has made good progress, one of the main obstacles to environmental protection in China is a marked disinterest from commercial enterprises on the ground. Short of econom-

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ic or other incentives, many enterprises in China show little or no interest in cooperating with local authorities on environmental protection. To reverse this situation, the Chinese government has set up electronic platforms for exchange of environmental activities among Chinese enterprises. In the process of "trade exchanges," a great deal of information is processed via the Internet, which has itself improved the efficiency of "green activities" in China. These electronic exchanges include the China Beijing Environment Exchange (CBEEX), the Shanghai Environment and Energy Exchange (SEEE) and the Tianjin Climate Exchange (TCE).

One of the key aims for establishing such electronic platforms is to encourage polluting enterprises to find ways to engage in energy-saving activities while gaining commercial benefits. Such activities could assist Chinese industries to significantly cut down their CO_2 emissions. In fact, the CBEEX has recently set up the China Carbon Neutral Alliance (CCNA), which is regarded as China's first carbon-neutral organization. In return for brand value, CCNA requires that any enterprise or organization that wishes to join its network establish a timetable for carbon emission reduction procedures (China Beijing Equity Exchange [CBEX], 2010).

From Traditional Industry to Information Industry

Compared to traditional industrial industries, information and knowledge processing could offer an important new pathway for promoting green innovation and a green economy in China. Arguably, raising the proportion of "information industries" in the Chinese economy will go some way towards helping to ease the pressure of economic growth on the natural environment. Since the early 1980s, the Chinese government has made significant efforts to encourage the development and innovation of China's information industry. As early as in 1982, the State Council founded a special group called the "Computer and LSI Leadership Group," in order to boost the development of the computing industry in China.

According to a report by the Ministry of Science and Technology (MST), the electronics and communication industries had already become critical to the Chinese economy by the end of 1999 (Lu, 2002, p. 51). Over the past 10 years, China's information industry has entered a boom period, during which the Chinese government has played a decisive role in promoting the development of ICTs. In 2002, for example, the State Council Informatization Office (SCIO) enacted policy to increase government procurement and adoption of software products or services provided by local ICT enterprises in order to boost the development of the software industry and expand the international software market in China (China Software Industry Association [CSIA], 2002). As a result of these efforts, a wide variety of sectors of information industry have proliferated in China. According to a report released by the Ministry of Industry and Information Technology, the total revenue of China's

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information industry increased from 1.88 trillion Yuan ($275 billion U.S.) in 2003 to 5.6 trillion Yuan ($820 billon U.S.) in 2007 (Shen & Huang, 2009, para. 2).

China's emerging green ICT industry

While developing a robust information industry in China goes some way towards fostering a green economy, ICTs are no "cure-all" for achieving environmental sustainability. Due to the fast growing use of information technologies and the increasing construction of China's information infrastructure, a new kind of environmental pollution has resulted. According to Yousif (2010), the impact of ICTs on the earth's climate and its dwindling resources is a growing concern. "Recent studies found that carbon dioxide (CO_2) emissions from data centres alone surpass emissions from many individual countries . . . This is in addition to the fact that much ICT equipment contains toxic substances such as lead and mercury, much of which enters the environment via the dumping of obsolete equipment" (para. 2). As one of the fastest growing segments of the Chinese economy, China is faced with an enormous problem in dealing with pollution related to ICTs (Brodkin, 2009; Chaize, 2008; Hasson, 2009)[6].

In response to the challenge of ICT related pollution, Green ICTs have become a significant area of interest in China. While still at an early stage of Green ICT development, the Chinese government has been active in embracing the concept of green technologies and engaging in the development of Green ICTs within relevant industries. While there is no formal policy to promote specific areas of Green ICTs, the Chinese government has been active in helping to facilitate platforms for business exchanges between enterprises that are interested in Green ICT cooperation. Most recently, the China Green Data Center Development and Practice Summit was held in Beijing in September 2009 under the support and direction of the Ministry of Industry and Information Technology (MIIT). In the summit, delegates from both leading enterprises and government exchanged ideas about the future development of China's Green ICT industry (Yong, 2009).

DISCUSSION: U.S. AND CHINESE POLICY IN THE 21ST CENTURY

Overall, much more needs to be done to develop clear and measurable policies to improve the performance of Green ICTs and reduce environmental pollution. The Chinese government has only recently begun to focus on policies stimulating research and development around green innovation. Beyond Green ICTs, China is investing heavily in renewable energy, including hydropower, wind, solar, biofuel, geothermal, and tidal energy. In fact, China's State Renewable Energy Medium- and Long-term Planning (SREMLP) has aimed at raising the share of China's

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renewable energy to 15 percent by 2020. China is now the world's largest maker of wind turbines, and the world's largest manufacturer of solar panels. At the same time, total power generation in China is on track to pass the U.S. by 2012, and most of the added capacity will still be from coal (Bradsher, 2010). Coal will represent two-thirds of China's energy capacity in 2020, and nuclear and hydropower will make up most of the rest.

The Need for Cooperation

It is becoming abundantly clear that countries around the world must now search for ways to cooperate on comprehensive solutions to climate change. One positive example of this needed cooperation is the recent agreement between the U.S. and China to work together on clean energy policy (DOE, 2009). This joint agreement represents a strong first step in bilateral relations on green policy, including several important initiatives for incubating green technologies. These initiatives include:

1. *A U.S.-China Clean Energy Research Center* facilitating joint research and development of clean energy technologies, as well as serving as a clearinghouse to help researchers in each country. Jointly supported by public and private funding, this research center includes an investment of $150 million over 5 years.
2. *An Electric Vehicles Initiative* building on the first-ever US-China Electric Vehicle Forum in September 2009, including joint standards development, demonstration projects, technical roadmapping and public education projects.
3. *An Energy Efficiency Action Plan* supporting improved energy efficiency in buildings, industrial facilities, and consumer appliances including energy efficient building codes and rating systems, testing procedures and performance metrics for consumer products. In addition, both countries agree to convene a new U.S.-China Energy Efficiency Forum to be held annually, rotating between the two countries.
4. *A Renewable Energy Partnership* developing roadmaps for wide-spread renewable energy deployment in both countries. The Partnership will also provide technical and analytical resources to states and regions in both countries to support renewable energy deployment and facilitate state-to-state and region-to-region partnerships, including a new U.S.-China Renewable Energy Forum that will be held annually, rotating between the two countries.

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5. *A cooperation program on cleaner uses of coal*, including large-scale carbon capture and storage (CCS) demonstration projects, bringing teams of U.S. and Chinese scientists and engineers together in developing clean coal and CCS technologies.
6. *A U.S.-China Shale Gas Resource Initiative* using experience gained in the U.S. to assess China's shale gas potential and promote environmentally-sustainable development of shale gas resources (including joint technical studies) in China.
7. *An Energy Cooperation Program (ECP)* leveraging private sector resources for project development work in China across a broad array of clean energy projects. This includes collaborative projects on renewable energy, smart grid, clean transportation, green building, clean coal, combined heat and power, and energy efficiency.

The strategic partnership on energy now forming between the U.S. and China is a promising start. Together, China and the U.S. are now the world's largest polluters. This suggests the need for a coordinated and vigorous energy policy. But an alliance between the U.S. and China is not enough. By 2050 the world's population is expected to reach nine billion, adding the equivalent of two Chinas to our current population. Nine billion people will need food, water, and other resources on a planet where human consumption is already negatively impacting the environment. The strategic planning necessary to move the global economy beyond fossil fuels remains elusive and will take leadership at the highest levels. As countries begin to search for ways to cooperate on comprehensive solutions to climate change, much more needs to be done to improve the performance of Green ICTs and reduce environmental pollution.

CONCLUSION

Managing sustainable economic growth and reducing environmental pollution are strong reasons to take the idea of a green economy seriously. Beyond economic nationalism, it is clear that the green economy necessitates a high degree of international cooperation. The rise of China and other emerging economies is a tectonic shift in the global order. Rising demand for energy in developing countries will be insurmountable without innovation in the global energy system. Beyond commercial markets, however, there is the need for coordination in policymaking to underwrite green innovation. Strategic public policy around green technologies is vital to reversing the negative impact of industrial production. Technology is no sil-

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ver bullet, but ICTs are very likely the underlying foundations for harnessing an expanding green economy.

NOTES

1. The DOE has established the DOE Data Center Energy Efficiency Program.
2. Established in 1992 by the EPA, ENERGY STAR is the U.S. standard for energy efficient electronic equipment. Originally developed for computer equipment, it now includes other electronic equipment such as heating and cooling systems, office equipment, home electronics, etc.
3. DER technologies consist primarily of energy generation and storage systems such as solar, wind, fuel cells, and microturbines placed at or near the point of use.
4. In contrast, the U.S. share of total world energy consumption was 21 percent in 2006 but will fall to 17 percent in 2030.
5. During which the delegation proposed a list of 10 principles, some of which were incorporated into the UN's declaration later. Two environmental incidents related to water reservoirs (one in Dalian and one in Beijing) sparked the state's initial environmental consciousness and the development of a series of instruments including establish formal institutions, establishing environmental laws and organizations, and organizing large-scale environmental programs throughout the 70s and 80s (Economy, 2004).
6. In response to this growing problem, Tencent, one of China's largest Internet companies, has developed a next generation Green Data Center to manage its business services (Bie, 2008).

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