

EXECUTIVE SUMMARY

***The China Greentech Report 2011* is the culmination of an open source, commercial collaboration of over 100 of the world's leading technology companies, entrepreneurs, investors, NGOs and policy advisors who participated in the China Greentech Initiative's 2010 Partner Program. These organizations commit their expertise, time and funding to the China Greentech Initiative to address the many on-going opportunities and challenges facing those seeking to accelerate China's complex, rapidly-changing greentech markets.**

This Report builds upon the first edition of *The China Greentech Report*, which the China Greentech Initiative launched at the World Economic Forum in Dalian, China in 2009. With over 50,000 copies downloaded, the 2009 edition is commonly referred to as the primer by which to understand China's greentech markets. This edition provides an updated view on the world's fastest growing sector in the world's fastest growing market, with a focus on three main themes:

- Why China is emerging as a global greentech leader
- How each of the six sectors on which the China Greentech Initiative focused in 2010 are evolving
- What prioritized greentech opportunities exist within each of these sectors

This Report summarizes the detailed proprietary analysis provided to the China Greentech Initiative's partners and advisors who participated in the 2010 Partner Program. This Report should be viewed as a complement to the 2009 edition. Whereas the 2009 edition focused on defining the China greentech landscape and solutions, the 2011 Report provides deeper analysis on some of the most important greentech opportunities in China today.

Defining China's Greentech Markets

The term greentech refers to technologies, products and services that deliver benefits to users of equal or greater value than those of conventional alternatives, while limiting the impact on the natural environment as well as maximizing the efficient and sustainable use of energy, water and other resources. In this Report, the China Greentech Initiative focuses on six greentech sectors: Cleaner Conventional Energy, Renewable Energy, Electric Power Infrastructure, Green Building, Cleaner Transportation, and Clean Water.

The China Greentech Report 2011 Market Map									
Energy Supply				Resource Use			Other Markets		
Sectors	Cleaner Conventional Energy	Renewable Energy	Electric Power Infrastructure	Green Building	Cleaner Transportation	Cleaner Industry	Clean Water	Waste Management	Sustainable Forestry and Agriculture
Segments	Cleaner Coal	Solar Power	Transmission	Optimized Design	Cleaner Road	Optimized Design	Water Extraction	Waste Collection	Sustainable Forest Management
	Cleaner Oil	Wind Power	Distribution	Sustainable Materials	Cleaner Rail	Sustainable Materials	Water Treatment	Waste Recycling	Sustainable Land Management
	Cleaner Gas	Bioenergy	Energy Storage	Energy Efficiency	Cleaner Air	Efficient Processing	Water Distribution	Energy from Waste Recovery	Sustainable Farming Communities
	Nuclear Power	Hydropower	Demand Management	Water Efficiency	Cleaner Waterway		Water Use	Waste Treatment	Optimized Crops
		Wave Power	Supply Flexibility				Wastewater Treatment	Sustainable Waste Disposal	
	Geothermal Energy								

Legend

- Sectors covered in the Report
- Primary focus
- Secondary focus
- Limited or no focus

Source: China Greentech Initiative analysis

China's Evolving Greentech Markets

Within just a few years, China has emerged as a global greentech leader. As we predicted in *The China Greentech Report 2009*, China is now a greentech leader by a number of indicators, but more importantly, China stands at the center of almost every greentech market. No greentech investor or company can ignore China. Here are five reasons why:

■ Astonishing Growth in China's Greentech Markets

Propelled by China's economic expansion and ambitious policies, greentech markets in China have grown swiftly, showing no signs of slowing. In the last two years China's greentech markets have advanced across every sector, from wind and solar power to emissions control and wastewater treatment. For example, by the end of 2010 China had become the world's largest investor in clean energy at RMB 354 billion (US\$54.4 billion),¹ installed 44.7 GW of wind power,² and built 8,358 kilometers of high-speed rail.³ The 12th Five-Year Plan (2011-2015) and other policies will propel further expansion in coming years.

■ Urgent Needs Drive Greentech Growth

Government policies respond pragmatically to China's urgent needs in energy security, food and water supply, and pollution. The scale of the country's energy- and environmental-related needs is just as immense as everything else in today's rapidly-growing China. Consider some of the most pressing needs pushing China ahead on greentech policies and spending: China imports over 50% of its oil, per capita water supply is only one quarter of the world average and decreasing, and indoor and outdoor air pollution cause up to 1.3 million deaths per year.⁴ In each area, significant change and implementation of new solutions are essential to prevent major negative consequences for China and its people.

1. Pew Charitable Trusts, *Who's Winning the Clean Energy Race?* (Washington, D.C.: Pew Charitable Trusts, 2011)

2. "China adds 18.9 GW of new wind power capacity in 2010," Global Wind Energy Council, Apr. 6, 2011, www.gwec.net

3. "统计局:中国铁路营业里程世界第二 高铁排榜首。" [Bureau of Statistics: China's Rail World's Second Longest, High-Speed Rail Number One] Chinanews, Mar. 4, 2011, www.news.163.com

4. "China Energy Data, Statistics, and Analysis," U.S. Energy Information Administration, www.eia.doe.gov, accessed on Nov. 2010; Wang, J. et al., *Climate Change and China's Agricultural Sector: An Overview Of Impacts, Adaptation and Mitigation* (Switzerland: International Centre for Trade and Sustainable Development, 2010); "Environment problems pose health risk for China: Lancet," *The Independent*, Mar. 26, 2010, www.independent.co.uk

- **Continuing Urbanization and the Growth of Eco-Cities**
Immense resource demands brought about by China's continuing historic urbanization compel policymakers to make existing cities more sustainable and establish new eco-city projects. China's population shift from rural to urban areas represents the largest migration in human history. In 1980, a mere 20% of the population was urban, but by 2010 this rate had risen to 47% with no signs of slowing.⁵ However, this has occurred without emphasis on sustainability. Policymakers recognize that achieving national goals on energy efficiency and carbon emissions will depend upon the progress made by cities, reflected in China's growing number of eco-cities and policies for building and heating efficiency. For example, cutting carbon emissions of existing eco-cities by 20% would equal 32 million tons of carbon annually, equivalent to the emissions of New Zealand.⁶
- **China Becoming a Player in International Energy and Environmental Issues**
As China's energy demands and greentech policies have expanded, so has its role on the international stage. China's energy demands and environmental impact are vast and growing, with two distinct forces combining to expand China's international role. First, rising energy demand may triple by 2035, giving China a greater stake in the world energy and resource economy.⁷ This has profound effects on geopolitics, world commodity markets and international business. Second, China's greentech market growth has helped change China's image from that of a laggard on the environment to a position of leadership in many instances.
- **Seeking to Capture Domestic and Global Greentech Markets**
China's industrial policy promotes the domestic greentech industry to ensure China's energy security. National industrial policy is a central driver of China's greentech markets. The country's booming greentech markets represent a huge social and technological shift, and have real potential to solve serious energy and environmental problems. Because of the scale of China's energy needs, the government has made it a priority to ensure the country and its businesses capture these new markets. One of the ways they are doing this is by emphasizing domestic research capabilities: R&D spending rose by 20% annually between 1995 and 2005 and China is now home to some of the world's largest greentech manufacturing companies.⁸

While these five reasons apply to all of China's greentech markets, the specifics differ within each greentech sector. For each of the China Greentech Initiative's six sectors we reviewed recent major developments and summarized the key findings of specific Opportunity Assessments completed during 2010.

5. Goldman Sachs, *Hukou Reform: A Mid To Long Term Goal, Picking Up Pace* (U.S.: Goldman Sachs, 2011)

6. China Greentech Initiative analysis

7. International Energy Agency, *2010 World Energy Outlook* (Paris, France: International Energy Agency, 2010)

8. Steinfeld, Edward S., *Playing Our Game: Why China's Rise Doesn't Threaten the West* (U. S.: Oxford University Press, 2010)

Cleaner Conventional Energy

China's energy and environmental problems cannot be solved without Cleaner Conventional Energy. The government has implemented a range of policies within the last 18 months to encourage the development of greentech solutions.

Cleaner Conventional Energy—energy derived from fossil fuels in ways that minimize their negative impact on the natural environment—is a focal point for government and industry. Achieving government targets for reducing carbon intensity by 40-45% by 2020 will require dramatic increases in natural gas and nuclear power consumption as well as an emphasis on cleaner coal. The government established the National Energy Commission (NEC) in 2010 to overcome competing interests and ensure the development of a cohesive energy policy, and continued to push for the consolidation of the coal industry to improve efficiency, safety and enforcement of regulations. On emissions, China is set to adopt policies that would bring the country's coal plants in line with other countries. Pricing reforms have fallen behind expectations, but are expected to move forward again during the 12th Five-Year Plan period.

The China Greentech Initiative developed three in-depth Opportunity Assessments for the Cleaner Conventional Energy sector in 2010:

- **Potential for Wide-Scale Adoption of IGCC and CCS Technologies**
Integrated gasification combined cycle (IGCC) and carbon capture and sequestration (CCS) have the potential to revolutionize power generation in China, but their potential remains largely unfulfilled. IGCC and CCS technologies are well-suited to China's environmental imperatives, geology, and large coal plant market; both technologies can play a role in reducing the long-term impact of China's power plant construction boom of the last decade. That said, the country faces a paradox: high initial costs and technology gaps mire IGCC and CCS in the demonstration project phase; however, China is the ideal place for development given its low cost and rapid infrastructure expansion. For example, IGCC costs in China could be more than 60% less than in developed countries.⁹ China will likely expand slowly from demonstration projects in the next decade, favoring incremental gains over large-scale technology adoption.
- **Strong Future for De-SO_x and De-NO_x, but Fly Ash Recycling and Utilization Lags**
After the rollout of post-combustion desulfurization (De-SO_x) over the last five years, China will promote new regulations and investments during the 12th Five-Year Plan period for denitrification (De-NO_x) as well as fly ash recycling and utilization. In China's push to improve air quality over the last five years, coal power plant De-SO_x regulations have been relatively successful, with Chinese equipment suppliers capturing the market. China is now encouraging De-NO_x technologies with a 10% emissions reduction target and a potential tariff. Lessons learned from the De-SO_x experience will likely help improve enforcement. Fly ash recycling continues to lag, but extraction of valuable minerals increases financial incentives.
- **Potential for Carbon Pricing in China**
Pricing carbon continues to attract hot policy debate in China. As its galloping economy brings skyrocketing energy use and greenhouse gas (GHG) emissions to the fore, China recognizes the need to address growing energy and environmental hazards. One carbon pricing option—a carbon tax—is being carefully considered, but despite indications that China could adopt a tax, perhaps as soon as 2012, many challenges remain. Such a tax could take years to put into place, and fundamental implementation questions are unresolved, such as tax neutrality, revenue management, and incentives for greentech solutions.

Reducing carbon intensity by 40-45% by 2020 will require dramatic increases in consumption of natural gas and cleaner coal.

9. Angell, Christopher, et al., "The Role of IGCC in China: Past, Present, and Future," Saistrip, May 2010, www.saistrip2010.webatu.com; IPCC, *Carbon Dioxide Capture and Storage* (U.K.: Cambridge University Press, 2005, 443)

Renewable Energy

Government policies and investment have transformed China into one of the world's leading adopters and manufacturers of Renewable Energy technology.

Ambitious renewable energy targets and strategic government investment have helped China become a world leader in renewable energy manufacturing and power generation. In 2010, China surpassed the U.S. to become the world's largest wind power producer with 44.7 GW of installed capacity.¹⁰ China renewable energy manufacturers produce more solar photovoltaic panels and wind turbines than any other country. By 2020, installed capacity of wind, solar and biomass power is targeted to more than quadruple, from less than 50 GW in 2010 to more than 200 GW in 2020. Given China's installation track record, combined with reassessments of nuclear energy in the wake of the disaster in Japan, these targets are probably conservative.

The China Greentech Initiative developed three in-depth Opportunity Assessments for the Renewable Energy sector in 2010:

Installed capacity of wind, solar and biomass is targeted to more than quadruple by 2020.

- **China's Domestic Solar Market Emerges**

China plans to boost solar capacity 20-fold by 2020, from 800 MW in 2010 to more than 20 GW, including more development in western China, with technologies beyond the crystalline silicon (c-Si PV) solutions China has favored so far. Already the world leader in solar panel manufacturing, China is poised to enter a new phase: developing domestic solar power generation capacity. In early concession rounds, western regions have been favored for large-scale projects using primarily domestically-produced crystalline silicon PV panels. As technology and power generation costs decline, it is likely that China will install a mix of solar technologies to achieve its 2015 and 2020 solar power generation targets. China is reconsidering its energy targets in the wake of Japan's nuclear crisis, which may increase solar power targets further to 10 GW by 2015 and 30 GW by 2020.¹¹

- **China's Wind Market Heads to Sea**

As a new government priority, China's offshore wind market is poised for takeoff; however, since offshore wind is more than twice as expensive to develop than China's still abundant onshore resources, the market represents a paradox for investors. China's offshore wind market only began in 2009 with the construction of its first offshore wind farm near Shanghai, but government targets call for swift growth to 30 GW by 2020.¹² Offshore wind capital costs in China are expected to be at least double onshore costs, yet the first concession round held in 2010 for four projects totaling 1 GW resulted in low bid prices—insufficient, it appears, for profitable ownership. These projects may be subsequently awarded higher tariffs by the government to ensure profitable operation, just as with early onshore wind farms. Given policy and technical uncertainties, the current market does not suit risk-averse developers. For foreign equipment and service providers, the market may be favorable, but due to pricing constraints there may be limited opportunities for foreign turbine manufacturers.

- **Distributed Renewable Energy (DRE) Leadership and Potential**

China is a leading player in DRE with significant capacity in small hydropower, household biogas digesters and rooftop solar water heating. However, without grid improvements, more cost-effective energy storage and subsidies, promising DRE technologies will not reach their full potential. China's push for rural electrification in previous decades promoted DRE technologies for the first time. China's small hydro capacity, at 55 GW, is the largest in the world and supplies 50% of China's rural electricity. Solar hot water heaters are also prevalent in China, covering more than 145 million square meters and accounting for more than 80% of the world's solar water heating capacity.¹³ Most development has been government funded and driven, although private financing models have been used successfully in wealthier urban areas for distributed rooftop solar.

10. "China has highest wind power capacity: report," Reuters, Jan. 13, 2011, www.reuters.com

11. Li Yuchuan, "China May Double Photovoltaic Capacity to 10 GW by 2015," *China Securities Journal*, Mar. 30, 2011, www.cs.com.cn

12. World Bank, *China: Meeting the Challenges of Offshore and Large-Scale Wind Power: Strategic Guidance* (Washington, D.C.: Asia Sustainable and Alternative Energy Program, World Bank, 2010), 16)

13. REN21, *Renewables 2010 Global Status Report* (Paris, France: REN21 Secretariat, 2010)

Electric Power Infrastructure

State Grid's ambitious plan to invest RMB 3.45 trillion (US\$ 530 billion) to build a strong and smart grid by 2020 ensures that China will be one of the world's largest smart grid markets in the years to come; however, the industry's monopolistic structure poses challenges for market entrants.

China's overstretched electricity grid faces a daunting challenge: efficiently powering the nation's staggering economic growth as the energy mix diversifies. Ambitious renewable energy and energy efficiency targets, as well as growth projections for electricity demand, require a more advanced grid than exists today. State Grid, the world's largest utility and provider of 80% of China's electricity, released its Smart Grid Plan in 2009, which provides a roadmap through 2020 that ensures China remains one of the world's largest smart grid markets. China's 2010 smart grid market was already the largest in the world at RMB 47.5 billion (US\$ 7.3 billion).¹⁴ Smart grid solution providers, however, must prepare for difficult market conditions, where low-cost solutions and strong relationships with local grid companies define success.

The China Greentech Initiative developed three in-depth Opportunity Assessments for the Electric Power Infrastructure sector in 2010:

■ State Grid's Smart Grid Plan

Distribution and consumption are the best opportunities for private solution providers in the State Grid's Smart Grid Plan. State Grid's Smart Grid Plan could abate 1.65 billion metric tons of carbon emissions per year, the equivalent of Russia's 2009 total carbon emissions. Investments in distribution are planned at RMB 119 billion (US\$ 18 billion) while consumption targets RMB 89 billion (US\$ 14 billion), together over half the smart grid investment total, with these sectors relatively open to private involvement.¹⁵ Private firms seeking to promote their smart grid products and services must engage deeply with both central and local levels of State Grid.

■ Connecting Intermittent Power to the Grid

State Grid has largely addressed problems with wind farm connections, but still cannot absorb intermittent energy in some regions, requiring new solutions such as UHV construction to transport power elsewhere. Despite huge growth in new wind installations since 2008, nearly 100% of all completed wind farms are now connected to the grid, compared to only two-thirds in 2008.¹⁶ The problem has shifted to excess intermittent supply, because the windiest regions cannot absorb significant power fluctuations without posing problems for grid stability and reliability. New UHV power lines will partially address the problem by shifting power elsewhere; by 2015 China will invest RMB 500 billion (US\$ 77 billion) to construct 40,000 kilometers of UHV transmission lines.¹⁷ Management and forecasting tools that maintain grid stability are also needed, such as active and reactive power flow control and low-voltage ride-through (LVRT) technology.

■ Technology Preferences in China's Smart Meter Market

Although China will roll out 50 to 60 million Automatic Meter Reader (AMR) meters in 2011, and more sophisticated Advanced Meter Infrastructure (AMI) is yet to come, the meter market is currently only open to a handful of incumbents. China's smart meter roll-out of 500 million meters before 2015 poses a paradox for solution providers: implementing low-cost AMR now means that the country could require another round of new, more sophisticated AMI meters as early as 2015.¹⁸ China's meter market is restricted to a handful of players already present, however, and no change seems likely in the near future. Grid companies rely on suppliers with low prices, a quality track record, local after-sale customer service, and relationships with internal grid company departments.

At RMB 47.5 billion (US\$ 7.3 billion), China's 2010 smart grid market was the largest in the world.

14. "Top 10 Countries for Smart Grid Investment," Zpryme Research and Consulting, Nov. 9, 2010, www.gereports.com

15. 国家电网, "国家电网智能化规划总报告," State Grid, "State Grid Smart Grid Plan Final Report" Feb. 2010

16. Shu Yinbiao, "12th Five-Year Electricity and Energy Sector Transition Development," State Grid (presentation given at the 2020 Energy & Economy Development Forum, China, Oct. 31, 2010)

17. Bai, Jim and Aizhu Chen, "China top grid firm says to further develop UHV tech," Reuters, Jan. 28, 2011, www.reuters.com

18. Li, Min and Wendy Wang, *Electronic Equipment & Services* (Hong Kong: Yuanta, 2010); China Greentech Initiative analysis

Green Building

China's Green Building market has more than doubled every year since 2005, but remains only a fraction of its potential size. Numerous challenges impede growth, yet companies with a nuanced understanding of this complex, rapidly growing market can position themselves to become future industry leaders.

Given the pace and scale of urbanization, China needs to improve building efficiency to meet energy and environmental goals. Green buildings can play a substantial role: if all of China's existing buildings were green, it would mean energy savings equal to half of the total electricity generated in China in 2007.¹⁹ Although the economics of green building are favorable in China, builders are reluctant to pursue green building projects due to misaligned incentives between developers, owners and tenants. Though enforcement may be improving for building energy codes, it lags in other areas. Despite these and many other challenges there are still attractive opportunities for foreign and domestic companies.

The China Greentech Initiative developed three in-depth Opportunity Assessments for the Green Building sector in 2010:

- **Expanding the Building Energy Efficiency Retrofit Market through ESCOs**
The market for building energy efficiency retrofits is expanding rapidly, as are government efficiency targets for existing buildings, yet current policies are insufficient, subsidies are still small, and ESCO solutions vary widely by market segment. Energy Services Companies (ESCOs) provide energy efficiency solutions to customers on a risk-reward basis over a specified payback period and have great potential to improve energy efficiency, but their near-term potential in China is unclear. Over the last five years the building energy efficiency retrofit market has experienced a 40% compound annual growth rate as government policies support growth.²⁰ The most important policies affecting ESCOs are targets for urban heating in northern China and energy management of large public buildings; however, progress is uneven and subsidies for ESCOs are too small to make a meaningful difference.
- **Accelerating Green Building Materials Adoption through Supply Chain Practices**
Incomplete industry standards and metrics, poor enforcement of regulations, and supply chain practices that ignore the environment define China's fledgling green building materials supply chain. Despite rising green building demand in China, green building materials currently represent only 5% of the total market. Building code enforcement is uneven, giving developers little incentive to source legitimate green building materials. Building materials suppliers may certify materials with authorities without necessarily complying with requirements. Nevertheless, environmental criteria in sourcing and value-chain partnerships offer opportunities for stakeholders to move the entire market forward.
- **Rapidly Improving Market for Sustainable Indoor Environment Solutions**
Indoor air quality (IAQ), thermal efficiency and energy efficiency solutions have considerable potential in the Sustainable Indoor Environment (SIE) market. SIE, which affects human health and productivity as well as the environment, is influenced by a number of factors, including IAQ, thermal efficiency and energy efficiency. SIE solutions such as air purification, floor heating and energy efficient lighting technologies, represent markets that are relatively well-developed or are improving quickly. China's interior fit-out market, for example, reached RMB 1.85 trillion (US\$ 285 billion) in 2009, consisting of 180,000 companies with a total of 14 million employees.²¹ A major challenge for SIE is weak enforcement of existing standards. Other issues include lack of motivation, design process difficulties, lack of reliable products and services, and low market awareness. Better enforcement and integrated solutions are needed for the SIE market to develop further.

19. "Total Electricity Net Generation (Billion Kilowatthours) – China," U.S. Energy Information Administration, Nov. 2010, <http://www.eia.doe.gov/>, accessed on Mar. 17, 2011

20. Energy Committee of China Energy Conservation Association, *Annual Report on China Energy Service Industry (Beijing, China: EMCA, 2009)*

21. Zhang Zhonglin, "Development of Chinese Building Decoration Market," China Building Decoration Association (presentation on press release of carpenter exhibition, Beijing, China, 2008)

If all of China's existing buildings were green, it would mean energy savings equal to half of the total electricity generated in China in 2007.

Cleaner Transportation

To address growing problems with traffic congestion, energy efficiency, emissions and energy security, China is pursuing diverse Cleaner Transportation solutions ranging from alternative fuels to electric vehicles.

Rapid growth of China's transportation sector has led to major issues, including increased vehicle emissions, oil use and road congestion. In 2010, 18 million vehicles were sold in China, making it the world's largest automobile market.²² Although China has already far exceeded the high-speed rail accomplishments of many developed countries, the government has ambitious plans to expand the industry further. Government, industry and private investors are making sizable investments in the early-stage development for electric vehicles, batteries and alternative fuels; however, the government's aggressive targets may prove unrealistic.

The China Greentech Initiative developed four in-depth Opportunity Assessments for the Cleaner Transportation sector in 2010:

■ China's Emerging Electric Vehicle (EV) Ecosystem

While growth prospects for China's EV market are substantial, the nascent market faces major challenges, including inadequate charging infrastructure and high battery costs. The government has set ambitious growth targets for the EV market, aiming to have 5 million EVs on the road by 2020; however, the industry faces many hurdles.²³ Government-led pilot programs are the main near-term market driver, supported by a new EV development plan and charging standards. Technology constraints, high battery costs and the lack of charging infrastructure in pilot cities all pose major barriers. Unlike in more developed countries, low-speed EVs may serve as a bridge for the eventual commercialization of high-speed electric vehicles.

■ Electric Vehicle Battery Market Evolution

Over 60 Chinese battery makers have set their sights on EVs, and while technical challenges abound, government support and industry optimism remain strong. Even as lithium-ion battery manufacturers vie for a share of China's early-stage EV battery market, few orders from automakers and numerous technical challenges await the victors. Major obstacles include weak R&D capabilities, lack of automated production methods and difficulties in vehicle integration. Government and investor funds continue to flow into the sector, suggesting optimism that these barriers can be overcome.

■ Alternative Fuels for Road Transportation

Ethanol, natural gas and methanol are the three most widely adopted alternative transportation fuels in China today; however, breakthroughs are needed in feedstock supply, technology development, infrastructure rollout and user acceptance to progress further. The government continues to promote a full spectrum of alternative fuels, yet they account for only 3% of the current market. Ethanol, natural gas and methanol have developed rapidly over the past five years, but still face major development challenges, including feedstock, technology, infrastructure and user acceptance. Other alternative fuels appear less promising, at least in the near term.

■ Rapid Growth in Cleaner Rail

Rapid economic development and urbanization intensify China's need for greater rail capacity, and the government is responding to the challenge. In response to the mounting need for more long-distance freight and passenger capabilities, China has embarked on a major expansion of its already extensive rail network. Metropolitan systems are also undergoing a makeover as subway and light rail coverage expands dramatically. By the end of 2010, China's rail network reached 91,000 km, making it the second largest in the world, with plans to grow to 120,000 km by 2020. China is also home to the world's largest high-speed rail network, with 8,000 kilometers constructed by 2010, and 16,000 kilometers planned for 2015—equivalent to the world's total to date.²⁴

With 18 million vehicles sold in 2010, China is the world's largest automobile market by volume.

22. Patti, Waldmeir, "China car sales stay in the fast lane," *Financial Times*, Jan. 4, 2011, www.ft.com; China Greentech Initiative analysis. Note: Figures discussed here include on-road passenger vehicles such as cars, minivans and SUVs, and commercial vehicles such as buses and trucks.

23. "节能与新能源汽车产业规划" 征求意见稿全文, "[Energy-saving and New Energy Vehicle Industry Plan" Draft for Public Comment Full Text] Netease Auto, Sep. 21, 2010, <http://auto.163.com>

24. Note: This figure includes rail lines with operating speeds over 200 km/h. "统计局:中国铁路营业里程世界第二 高铁排榜首," [Bureau of Statistics: China's Rail World's Second Longest, High-Speed Rail Number One] *Chinanews*, Mar. 4, 2011, www.news.163.com

Clean Water

Given the critical importance of water to China, the government has made Clean Water a major priority, including investing in wastewater treatment, improving water efficiency, and ensuring adequate water supply.

Water pollution and scarcity due to weak enforcement, drought and over-use are some of the biggest problems facing China today. In 2009, 270 million people in rural China had no access to safe drinking water and more than 4.5 million people were short of water in northern China due to the severe drought.²⁵ The government is responding to these problems with new policies and major investment projects: China has tripled the number of municipal wastewater plants, initiated the controversial South-to-North diversion project, and planned desalination projects near urban areas. Between 2010 and 2020, RMB 4 trillion (US\$ 615 billion) will be invested in water infrastructure improvements.²⁶ Better enforcement of existing water laws and new regulations to increase efficiency are also government priorities, but the scale of the problem is so large that even these laudable policies will not suffice.

The China Greentech Initiative developed three in-depth Opportunity Assessments for the Clean Water sector in 2010:

RMB 4 trillion (US\$ 615 billion) will be invested in water infrastructure improvements between 2010 and 2020.

- **Private Sector Opportunities in the Municipal Wastewater Treatment Market**
As China shifts investment in wastewater treatment to lower-tier cities in the South and Southwest, opportunities exist for private participation in build-operate-transfer (BOT) and operation and maintenance (O&M) models, though low cost solutions and inefficient operation remain the norm. China has rapidly boosted municipal wastewater treatment rates since 2007. The urban wastewater treatment ratio steadily grew from 34% in 2000 to 70% in 2010.²⁷ Pricing is still set locally, with no obvious national trends. Private participation can bring needed expertise to the sector, which is plagued by inefficient public operation, but most regions still focus on low-cost solutions. BOT and O&M models are the most promising areas for private sector involvement.
- **Private Sector Participation in Water Utilities**
Despite market reforms and willingness of private domestic and foreign companies to participate in China's water sector, implementation proves to be a challenge. The private sector has only contributed 10-20% of recent water infrastructure financing. Though many private companies have formed partnerships with local water utilities, just 10% of sector investment in 2008 came from the private sector. Only a few regions support such investment, while others strongly oppose private involvement. Wastewater treatment is the main area of participation, as opposed to water supply. Public-private partnerships (PPPs) have had mixed results, with private investors facing multiple problems including limited market knowledge, scarce financing, intense competition and demanding municipal customers.
- **Wastewater Treatment Plant Lifecycle Cost and Profit Analysis**
Municipal wastewater treatment plants have grown rapidly in China, but often at the expense of operational efficiency. Build-operate-transfer (BOT) contracts lead to higher operating efficiency and better long-term performance. BOT municipal wastewater treatment plants appear to have lower operating costs and higher net profits than alternative investment models. Investors have generally only agreed to BOT contracts where they were able to negotiate favorable revenue terms and ensure profitable long-term operational performance versus public-operated plants. Electricity is the largest area with operations improvement potential: BOT plants use up to 50% less electricity than other types of plants. Other revenue and cost improvement opportunities can also be pursued to improve plant performance.

25. "China To Invest CNY90 Billion For Waste Water Treatment," *China CSR*, Dec. 4, 2009, www.chinacsr.com; "Millions at risk in China drought," *BBC*, Aug. 23, 2009, www.news.bbc.co.uk

26. "中共中央 国务院关于加快水利改革发展的决定," [Central People's Government of the People's Republic of China, Decision on accelerating water reform and development] Jan. 31, 2011; Lu, Ting, "China's Investment Momentum: RMB 4 Trillion for Water Projects," *Chinastakes*, Jan. 31, 2011, www.chinastakes.com

27. China market overview: Waste water treatment (Beijing, China: Yatsen Associates Co., Ltd., 2009, 3)

Looking Forward

Opportunities to grow China's greentech markets abound.

Driven by strong government support that addresses urgent national needs, China's greentech markets have grown with astonishing speed. Though rapid continued urbanization puts incredible stress on resources, this same force could drive the growth of eco-cities when married with sustainable development. As the ambitious targets outlined in the 12th Five-Year Plan reveal, China plans to magnify previous growth, catapulting China onto the global energy and environment stage in a leading role. Seeking to capitalize on the experience gained in its sizable greentech markets, China's industrial policies aim to increase Chinese leadership at home and abroad.

China's emergence as a global greentech leader translates into opportunity, but not always directly. As China's greentech markets have grown, they have also become more complex, and growth does not always translate directly to opportunity for the private sector or foreign participants: some of the greatest opportunities are often the most surprising ones, profitable niches overlooked in the big headlines.

To explore in detail China's greentech market developments as well as sector-specific analyses, we invite you to turn to the respective chapters in this Report.

Some of the greatest opportunities in China's market are often the most surprising ones.
