Powering progress: China’s clean energy revolution

Jun Ying

In a recent report, New Energy Finance predicts that China’s clean energy industry will outstrip the ambitious targets set by the country’s National Development and Reform Commission (NDRC), but will require around 50% more investment than forecast. ***Jun Ying*** *provides a summary of the latest findings.*

Solar energy being deployed in China WANG SICHENG, BEIJING JIKE NEW TECHNOLOGY CO

Between 2000 and 2004 China’s energy consumption rose by 46.7%, and is set to keep on rising. With a GDP growth rate averaging 8.5% per annum over the past 10 years, national energy demand is due to increase from 1423 Mtoe (million tonnes of oil equivalent) in 2004 to 2100 Mtoe by 2020 (see Figure 1). In meeting this demand China will have to overcome three key challenges - an overdependence on coal, a lack of domestic sources of oil, and appaling environmental problems.

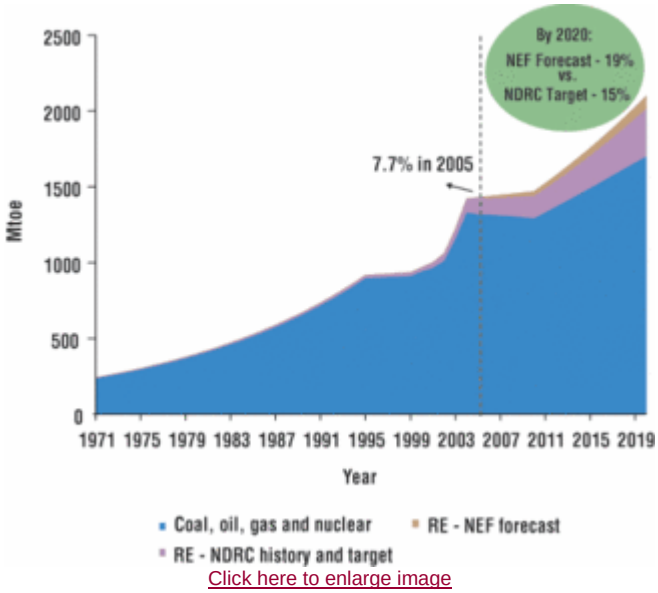

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Figure 1. *Chinese energy demand and renewable energy supply - history, target and forecast (1971-2020) Source: NDRC (history and target); IEA; New Energy Finance (forecast) Note: Renewables excluding traditional biomass*

In response to these challenges the Chinese government has embarked on a very substantial clean energy drive. In terms of power production, China is already the world's largest producer of renewable electricity (including large hydro), with 120 GW of power generation capacity installed by 2005, or 25% of the country's total installed capacity (see Table 1). In addition, it is already the third-largest manufacturer of bioethanol.

TABLE 1. China's 2005 renewable energy capacity, and 2020 target vs. forecast by sector. Source: New Energy Finance

	2005 Capacity	2020 NDRC Target	2020 NEF Forecast
Large hydro (GW)	80.0	225	225
Mini-hydro (GW)	35.0	75.0	76.8
Solar PV (MW)	70.0	2	5.3
Solar water heating (million m^2)	80.0	300	292
Wind (GW)	1.3	30.0	54.0
Biomass power (GW)	2.3	20.0	27.0
Biogas (billion m^3)	8	40	40
Biomass solid fuel (m tonnes)	n/a	50.0	50.0
Bioethanol (billion litres)	1.4	17.8	16.8
Biodiesel (billion litres)	0.2	6.0	10.9
Geothermal power generation (MW)	45.0	250	206
Geothermal direct use (Mtce)	1.1	8.0	6.6
Marine (GW)	0.001 (in 2000)	3.0 ~ 5.0	3.0

Note: n/a – not available.

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In 2005, Vice Premier Zeng Peiyan announced that the government wanted 15% of the country's primary energy use to come from renewable sources by 2020, compared with 7.7% in 2005. In January 2006, the Renewable Energy Law came into force, lending substantial support to the government's aims. The legislation was intended to establish the foundations for large-scale investment by creating a financial and regulatory environment where more of the risks would be borne by state-controlled utilities and private investors could be sure of reasonable returns. The National Development and Reform Commission (NDRC) claimed that reaching that target would require more than US$179 billion of capital expenditure investment over 15 years - an average of nearly $12 billion per year.

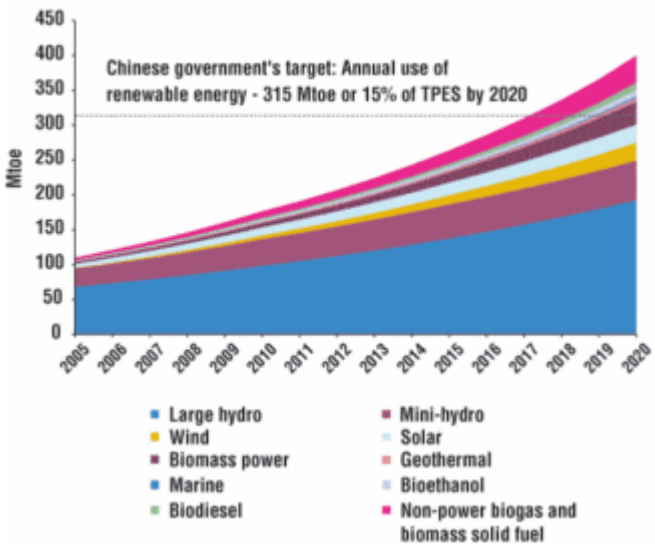

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Figure 2. *Chinese renewable energy supply forecast by sector (2006-2020) Source: NDRC; New Energy Finance (Forecast) Note: Coal equivalent calculation for power generation in China (1 GWh = 3.5 x 10^{-4}Mtce or 2.45 x 10^{-4}Mtoe)*

According to forecasts, by 2020 renewable energy from hydro, wind, solar, bioenergy, geothermal and marine will provide 399 Mtoe, accounting for 19% of the nation's projected total requirement (see Figures 1 and 2 and Table 1). Biofuels production is targeted to reach 27.7 billion litres, meeting 9.1% of the country's transport fuel requirements. New Energy Finance estimates that this will require total investment of $267 billion over the next 15 years, about 50% more than the figure estimated by the NDRC. Of this, $60 billion will be spent on new wind capacity, $41.1 billion on solar PV and thermal installations, $98.1 billion on large and mini-hydro, $32.1 billion on biomass power generation, $16.8 billion on biofuels and $19 billion on renewable energy from other sources (see Figure 3).

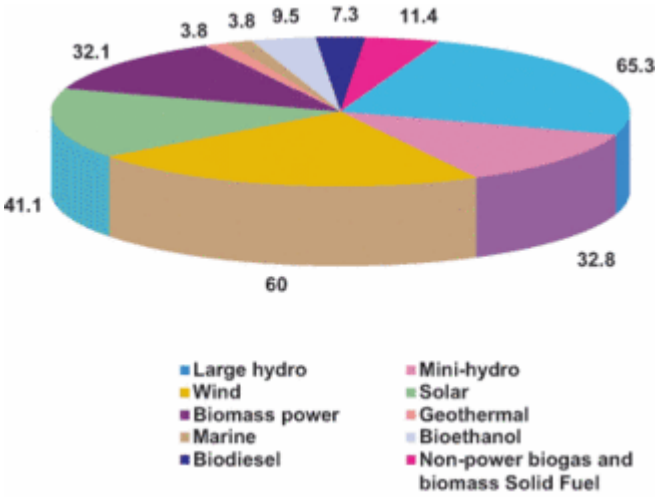

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Figure 3. *Chinese renewable energy investment forecast by sector (2006-2020) Source: New Energy Finance (forecast) Note: Compares to NDRC total of $179bn; $bn real at 2005 prices*

China's strategy is more than a drive to build renewable energy generation and biofuels production capacity. The government is determined that, in solving China's short-term energy and environmental problems, it will not end up dependent on foreign technology and suppliers. It is therefore co-ordinating efforts to ensure that a domestic equipment industry is being built, encouraging the creation of competitive local suppliers and the acquisition of overseas technologies. It has also identified areas where China can become a supplier of renewable energy and low-carbon technology to the rest of the world, taking advantage of the country's growing low-cost / high-skill industrial base and exploiting the fast-growing demand for clean energy technologies in the developed world.

China's clean energy revolution will not be without risks. While China's rapid economic growth looks set to continue, it has yet to escape from a cycle of boom and bust. The country's power supply has oscillated between surplus and shortage. Basic power sector reform and the connection of regional grids into a national power network remain to be completed. China's unpredictable approach to free market economics creates further challenges: state-owned power suppliers have won contracts with loss-making bids, and the sudden replacement of long-term power supply agreements with short-term bidding in 2002 caused substantial losses for overseas investors who had been promised guaranteed returns. Suppliers of equipment and technology will be worried by China's poor record on the protection of intellectual property, while the biggest potential barrier to investment in renewable energy generation projects in China is the lack of fixed, long-term feed-in tariffs.

Building integrated photovoltaics on a new building in Shenzhen WANG SICHENG, BEIJING JIKE NEW TECHNOLOGY CO

Despite these caveats, however, no serious clean energy investor can ignore the Chinese market. China's drive for clean energy is not a cynical response to concerns about the country's growing environmental footprint. Nor is it a marginal initiative, expected to make only a minor contribution to meeting the country's exploding energy needs. It is a core part of China's energy strategy - offering a significant contribution to rising energy demand while at the same time weaning China off its dependence on fossil fuel imports and addressing the country's very substantial environmental problems. China's commitment to renewable energy and low-carbon technology is broad, deep and irreversible.

Assuming the absence of dramatic shocks or policy U-turns - hopefully not too rash an assumption, despite China's history - there now follows a summary of how New Energy Finance expects various sectors of China's energy industry to develop.

'Clean' coal
Coal accounts for over 70% of China's electricity generation capacity, and there is no prospect of weaning the country off it in the short or medium term. Any attempt to shift China to cleaner energy provision must have cleaner coal at its heart. There are a number of national initiatives, with significant support of multilateral institutions, focusing on a range of clean coal options from advanced combustion, such as Integrated Gasification Combined Cycle (IGCC) and Supercritical Fluidized Bed Combustion (SFBC), to carbon capture and storage. Owners of these technologies are effectively engaged in a game of poker, with technology transfer as table stakes and the world's largest market for coal-fired power plant as the prize.

Carbon capture and storage (CCS)
With coal such an integral part of China's energy future, CCS technology offers great promise. It is, however, still not commercially viable. China is primarily focused on technology transfer and has initiated a number of CCS projects based on multilateral agreements. It is one of the founding members of the Carbon Sequestration Leadership Forum (CSLF) and has integrated the development of CCS technologies into its National Science and Technology plan.

Nuclear power
By early 2007, China's 10th and 11th nuclear reactors will have come on line, bringing capacity to 8.6 GW. By 2020 China plans to have invested $50 billion on 30 more reactors, increasing nuclear capacity to 40 GW. Despite the scale of this programme, nuclear power is still expected to meet only 4% of total demand at that time. China is currently selecting suppliers, with Westinghouse (recently sold to Toshiba), Russia's AtomStroyExport and France's Areva among those in the running. Once again the Chinese government is making technology transfer a large part of the purchase decision. China is a world leader in the design of next-generation pebble bed reactors, but these will not be commercially available for gigawatt-scale reactors before 2020.

Energy efficiency
The Chinese government, as part of its 11th National Five Year Plan (2006-2010), has committed itself to restricting the country's energy consumption to twice the level of 2000, while achieving a GDP four times that of 2000 by 2020. Energy efficiency and conservation measures will play a key role in enabling China to achieve this target. The government is encouraging consumers to cut down the level of energy usage by means of demand-side management programmes and has implemented a stand-alone Energy Conservation Law. There has been a recent surge in investments in the energy efficiency sector and China also has a strong base in producing energy efficient equipment.

Wind power
At the end of 2005, China had just 1.3 GW of installed wind capacity, leaving it in eighth place globally and far behind India, which had 4.4 GW. The NDRC recently raised its target from 4 GW to 5 GW by 2010 and from 20 GW to 30 GW by 2020. New Energy Finance estimates that China will beat these targets, with 9.7 GW in 2010 and 54 GW by 2020 (see Table 1). In addition, a powerful local megawatt-scale turbine and subassembly manufacturing base looks set to emerge that will remain largely focused on the domestic market for the next few years, but will compete globally in the decade leading up to 2020.

Transporting coal on the Yangtze. China's over reliance on coal for power is leading to massive environmental problems SXC PHOTO LIBRARY

Solar heating and photovoltaics
China has 80% of the world market share in solar passive heating, but very little installed photovoltaic (PV) capacity - despite a strong module export industry. It is already a global manufacturing powerhouse for cells and modules, but is currently dependent on feedstock imports. This is likely to change by 2015, due to intense investment in silicon refining capacity in 2006-2012, and the country will become a net exporter of every element in the PV value chain by 2020. PV installations will increase as domestic production reduces prices. We expect the country will surpass its 2010 target of 300 MW, with a total of 384 MW, and will easily outstrip its 2020 target of 2 GW, with a total of 5.3 GW. This will require total investment of $41.1 billion in domestic solar thermal and PV installations over the next 15 years. A further $24.5 billion will be invested by Chinese and overseas companies to build the PV supply chain, with most of the production exported by 2020.

Hydro
As the world's largest generator of hydropower, China had 115 GW of capacity in place at the end of 2005. The majority of this, 80 GW (69.6%), is from large hydropower stations, but 35 GW (30.4%) is generated by 'mini-hydro' (power stations below 50 MW). New Energy Finance expects the hydro sector to remain the largest provider of renewable energy in China, almost exactly hitting the NDRC target of 300 GW by 2020. Much of the new capacity will continue to come from large projects but development of mini-hydro will continue. There may be opportunities for CDM finance, but otherwise this looks like being a domestic Chinese industry.

Biomass
In 2005, China had 2.3 GW of biomass power generation capacity in place, much of it providing combined heat and power. There is likely to be rapid growth in the short term as municipal waste-to-energy and landfill gas projects are pushed through, supported in some cases by Kyoto CDM finance. The production of gas from biodigestion is also expected to grow strongly. New Energy Finance forecasts capacity of 27 GW in 2020, surpassing the 20 GW NDRC target.

Geothermal
China's high-temperature geothermal resources are mainly concentrated in Tibet and Yunnan Province. The target for installed power generation capacity by 2010 is 75-100 MW, which looks tiny compared to other renewable sources. Geothermal heating, in contrast, has seen rapid growth and is expected to increase to 24 million square meters by 2010.

Marine energy
China is among the world's leaders in marine energy, with a number of pilot projects in operation, and a nascent equipment supply chain. Although we expect to see the sector grow substantially from a fairly modest base, by 2020 it will still only provide 8.6 TWh of power with 3 GW capacity.

Bioethanol
China is already the world's third largest producer of bioethanol, producing 1.36 billion litres in 2005. Continuing efforts to grow the industry have led us to forecast production of 16.8 billion litres per year by 2020. Over the short and medium term, most growth will be in traditional, i.e. non-cellulosic, bioethanol. Once cellulosic technology is proven, new capacity will be built rapidly and traditional production to be retrofitted to take advantage of the cheaper, more abundant feedstock.

Biodiesel
Chinese biodiesel production is at a very early stage of development. The government has only recently decided to actively support the industry, trialing non-traditional biodiesel crops such as jatropha. The greatest opportunities stem, however, from the $20-25 billion being invested in coal-to-oil plants. The Fischer-Tropsch process used in the plants can also produce synthetic diesel from gasified biomass. New Energy Finance envisages biodiesel production will hit 10.9 billion litres per year by 2020, of which just under half will be produced through the Fischer-Tropsch process.

Hydrogen and fuel cells
Between 2001 and 2005, the Chinese Ministry of Science and Technology approved $165 million for research and development of advanced hybrid-electric drive and fuel cell vehicles. Chinese investment in fuel cell research is focused on building local technology capabilities and on high-profile demonstration projects. The triple challenges of technology, cost and infrastructure development mean that large-scale deployment of fuel cell or hydrogen-powered applications in the period to 2020 is unlikely. China's fuel cell industry will largely represent an opportunity for overseas fuel cell companies to reduce costs through offshore manufacturing.

China is a world leader in small hydro power,

Venture capital and technology investment
The VC community is developing rapidly, with a number of companies focusing substantially or entirely on opportunities in clean energy. More than 60 of China's 200 business incubators have worked on creating renewable energy or low-carbon technology companies. However, overseas investors will find it difficult to establish themselves unless they develop local contacts and knowledge.

Public markets
China's public markets have had a bumpy ride. An initial period from 1989 to 1993 when prices could hardly be said to be set by the market was followed by the Asian crash in 1997, then a period of stagnation and a freeze on new share issues. Although the Shenzhen and Shanghai markets are now operating as real exchanges, with increasing liquidity, and are open once again for IPOs, foreign investors have been sceptical of the risk-return balance offered by the Chinese markets, and are looking instead at the healthy pipeline of potential IPO candidates seeking a listing overseas. The volume of investment required by China's clean energy industry will be such that it will have either to relax its QFII restrictions on foreign investment in Chinese companies, or watch companies go overseas.

CDM and carbon finance
China is a signatory to the Kyoto Protocol, although as a non-Annex I country it has no obligation to limit its own carbon emissions. It is eligible to participate in the CDM mechanism of Kyoto, and after a slow start has become the largest producer of CDM credits. This looks set to continue, with energy projects qualifying in wind, waste-to-energy, mini-hydro and energy efficiency. However, in addition to the usual carbon market risks - volatility, delivery, liquidity and execution - in China there are added risks. The government is suspicious of overseas companies profiting from arbitrage opportunities between creation and compliance values of credits, and it views its carbon reduction activities to date as part of its post-Kyoto negotiating strategy. It has already implemented *post-facto* regulations at least once to invalidate sales of credits to overseas agents. There is also significant counter-party risk, with experience from other industries showing that contracts with well-connected Chinese companies can be hard to enforce. We expect that China will be a source of CDM credits worth up to $2 billion in the period to 2012 from renewable energy alone, but the watchword is *caveat emptor* (buyer beware).

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The information and opinions contained in this article are taken from Interesting Times - Clean Energy Investment Opportunities in China, an in-depth look at the opportunities and challenges facing the Western investor. The report contains an up-do-date review of the policy and investment environment, proprietary growth forecasts for each sector of the Chinese clean energy industry, analysis of opportunities in wind, solar, biofuels and other sectors, and a look at the strategies being followed by key players.

For more information, or to buy a copy of the report, please contact Jun Ying