UNDERSTANDING CHINA’s NEED TO FOCUS ON ITS RENEWABLE ENERGY EXPANSION PROGRAMME AND THE RELATIONSHIP TO ITS CLIMATE CHANGE POLICY

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Abstract

China is concerned with the need to increased energy production due to ongoing industrial development and an expanding middle class. The government in its 12th Five Year Plan is focusing on moving to an era of clean energy and advanced energy efficient technology not primarily to address climate change but rather to ensure that its vast energy requirements are procured from other sources rather than continuing to rely on finite sources of energy such as coal, oil and gas.

1.1 Introduction

China’s central government is undertaking a number of innovations in an attempt to reduce its reliance on fossil fuels for its vast energy needs. The 12th Five Year Plan for National Economic and Social Development 2011 to 2015, states China aims to lower its reliance on fossil fuels and move to energy saving technology. The plan envisages that by 2020 the percentage of non-fossil fuel energy will be increased to 15 per cent of China’s total primary energy consumption with carbon dioxide (CO2) emissions lowered to 40 to 45 per cent per unit of the Gross Domestic Product (GDP) as was recorded in 2005.

China’s energy consumption rate is rapidly increasing consuming 48.2 per cent of world coal resources in 2010 which accounts for nearly two thirds of global consumption. Its primary energy output was equal to 3.18 billion tons of standard coal making China the largest...
consumer of energy in the world. From a global perspective this high reliance on fossil fuels added to the increasing CO2 emissions which reached 394.36 parts per million (ppm) in December 2012; the highest figure on record. The effect of China’s greenhouse gas emissions are detrimental to human health with the Organization for Economic Co-operation and Development (OECD) reporting that China as the largest emitter of greenhouse gases in the world and of atmospheric particulate matter is causing unacceptably high levels in most Chinese cities.

China is dependent on the importation of coal and petroleum to fire its industrial sector. In 2011 China consumed 96.66 thousand trillion British Thermal Units (BTU), compared to the United States which consumed 97.88 thousand trillion BTU’s. In 2011 China expanded its electricity transmission lines throughout the country to reach 179,000 kms. The effect of such expansion British Petroleum’s World Energy Review states that based on China’s coal reserves and consumption in 2010, its coal reserves are likely be exhausted in 35 years so a pro-active move towards renewable energy is necessary.

The Chinese governments’ 2012 White Paper does not demonstrate concern over climate change and global warming rather it states the government intends to increase coal production. China will build 14 large coal mining bases in the next 5 years with large power stations to be constructed in Boha Rim, Yangtze River Delta and Pearl River Delta. It plans

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7  ‘China in the 2010’s Rebalancing Growth and Strengthening Social Safety Nets’ OECD contribution to the China Development Forum (20-22 March 2010) Beijing 11

8  Bloomberg ‘China’s Energy Consumption rises at Fastest Pace in 4 years’ (22 February 2012) <http://www.bloomberg.com/news/2012-02-22/china-energy-consumption-rises-at-fastest-pace-in-four-years.html>; it is acknowledged here that on a per capita basis China consumes far less energy than the US with a population that is 4 times greater than the US.


10  “BP Statistical Review of World Energy’ 2011


to remove outdated equipment and shut small thermal power units that are high greenhouse
gas emitters and large consumers of coal as some are very old and less than 25 per cent as
efficient as similar plants operating in Britain.

It is difficult to ascertain just how many coal mines operate in China because many are small
and uneconomical often closing down after short operational periods. Local coal production
is concentrated mainly in northern China because as it is not difficult to access and is cleaner
whereas in the south coal tends to be high in sulphur and ash. According to Chinese
regulations, coal-fired power plants of less than 135MW are prohibited in areas covered by
large grids. All new coal fired power generating units are required to install dust removing,
desulfurization and deniguration facilities.

Assessment of China’s renewable energy goals

China’s White Paper states that ‘China’s development must follow a path featuring high tech
content, low consumption of resources, less environmental pollution, satisfactory economic
returns as well as security. It is moving towards the objective of economical, clean and secure
development’. It envisages that primary energy consumption and installed generating
capacity will be reduced by 11.4 per cent and 15 per cent respectively by the end of 2015 as a

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14 Ben Wester ‘China’s coal fired power stations amongst the worst in the world’ the Sunday Times (23 September 2009)


result of internal clean energy programmes. These objectives need to be realized due to China’s escalating energy consumption. For example in 2010, China’s Electricity Council reported that total electricity consumption was 4.19 trillion kilowatt hours (kWh) (4,190,000 kilowatts), a rise of 8.12 per cent from the previous year. The manufacturing and industrial sectors increased consumption by 15.44 per cent to 3.09 trillion kWh in the same year. This is not surprising as in 2010 and 2011 China’s GDP averaged 9.2 per cent and 8.2 per cent respectively. The Chinese government recognizes that energy consumption has grown too quickly in recent years resulting in a strain on energy supplies because 70 per cent is utilized by the industrial sector.

The White Paper reports an up scaling of renewable energy consumption with the installed capacity of wind power reached 47 million kW., photovoltaic power 3 million kW. and solar water 200 million sq. metres in 2011. The goal of China’s National Energy Administration is that by the end of 2015 its renewable energy programme will produce 478 million Mt. of coal equivalent accounting for 9.5 per cent of its energy consumption. This means that 1.4 per cent of the energy mix during the period 2011 to 2015 will be up 11.4 per cent from the 9.6 per cent figure achieved during the previous five years. It also intends to reduce energy


consumption per unit of GDP by 16 per cent and lower its CO2 emissions per unit of GDP by 17 per cent in the next five years.  

**Climate Change Policy**

The National Development and Reform Commission (NRDC) overseas renewable energy policy. As part of its mandate is the National Leading Group Office for Climate Change, Energy Conservation and Emissions Reduction the problem of rising greenhouse gas emissions is recognized. It released this statement on energy and climate change but makes it clear that rapid economic development, eliminating poverty and at the same time lowering greenhouse gas emissions in compatible targets.

‘As a developing country with a large population, a relatively low level of economic development, a complex climate and a fragile co-environment, China is vulnerable to the adverse effects of climate change, which has brought substantial threats to the natural ecosystems as well as the economic and social development of the country. These threats are particularly pressing in the field of agriculture and livestock breeding, forestry, natural ecosystems and water resources and in coastal and eco fragile zones. Therefore China’s priority task at present is to adapt itself to climate change. The multiple pressures of developing the economy, eliminating poverty and mitigating the emissions of greenhouse gases constitute difficulties for China in its efforts to cope with climate change since the country is undergoing rapid economic development.’

In the past, China as a developing country, has not been held responsible for the current level of greenhouse gas emissions which is attributable to the western world. It has not been required to undertake a greenhouse gas emission reduction target under the Kyoto Protocol 2008 to 2012 and is still not required to do so before 2020. Change is on its way however when at COP-17 held in Durban in 2012 the participants observed that China and other developing nations who are emitting large volumes of greenhouse gases should have emission

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targets imposed on them. As a result the Chinese government has agreed to be part of a post 2020 climate change framework convention following the termination of the Kyoto Protocol, with the rider that the principle of ‘common but differentiated responsibility’ is to be built into any agreement.  

### Renewable energy regulatory framework and challenges

Essentially China’s policy on renewable energy falls into three categories 1) first level policies which provide general directions and guidance on the development of renewable energy, 2) second level policies which specify goals and development plans 3) third level policies which are made up of specific incentives and managerial guidelines. These polices emanate from the various levels of government.

By 2015 the government states it will achieve an installation of 90 GWP. (global warming potential) of wind power, 280 GWP. of hydroelectric power, 10 GWP. of solar power and 1.3 MWP. of biomass. The chart below gives a historical and future overview of China’s energy development targets:

<table>
<thead>
<tr>
<th>Type of renewable energy</th>
<th>2006 achieved</th>
<th>2009 achieved</th>
<th>2020 likely target</th>
<th>2020 proposed target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>130 GWP</td>
<td>197 GWP</td>
<td>300 GWP</td>
<td>300 GWP</td>
</tr>
<tr>
<td>Wind</td>
<td>2.6 GWP</td>
<td>25.8 GWP</td>
<td>30 GWP</td>
<td>150 GWP</td>
</tr>
<tr>
<td>Solar PV</td>
<td>0.08 GWP</td>
<td>0.4 GWP</td>
<td>1.8 GWP</td>
<td>20 GWP</td>
</tr>
<tr>
<td>Solar hot water</td>
<td>100 million m2</td>
<td>2 million m2</td>
<td>300 million m2</td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>2 GWP</td>
<td>3.2 GWP</td>
<td>30 GWP</td>
<td>30 GWP</td>
</tr>
</tbody>
</table>

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On a global basis the move to renewable energy has increased substantially over the past decade. The Renewable Energy Network, REN21, states that renewables comprised one quarter of global power capacity from all sources in 2009 and delivered 18 per cent of global electricity supplies. On an annual basis global solar photovoltaic (PV) power has grown by an average of 60 per cent over the past 10 years, wind power capacity has grown by about 27 per cent, solar hot water by 19 per cent and ethanol production by 20 per cent. REN21 reports that more than 100 countries have enacted policies promoting renewable energy in the past three years. The target share of energy or electricity from renewables will be in the 15 to 25 per cent range by 2020. Based on these figures China is not aiming for a remarkable change in its energy base but is following world trends in renewable energy production.

China’s renewable energy programme focuses on wind, solar hydropower and biomass. Sun Yucai, the Vice President of China’s Electricity Council states that in 2011 China attained 27.5 per cent of its total installed electricity generation capacity from hydropower, nuclear, wind, solar and biomass, an increase of 0.9 per cent from 2010. This breaks down into 230 million kW from hydro power, which is 21.8 per cent of the total output, 12.57 million kW from nuclear power and 45 million kW from wind power. The Deputy Director of the National Commission on Population, Resources and Environment in China states that the government intends to spend AU$473.1 billion on clean energy investments in the next five years which will result in 20 per cent of its total energy demand being met by solar and wind power.

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40 Du Juan ‘China Sets up First Renewable Energy Think Tank’ China Daily (24 February 2012)

In February 2012 China established its first national think tank on renewable energy in the form of the China National Renewable Energy Centre (CNREC).\(^{42}\) The National Energy Administration and the National Development and Reform Commission support this new Centre. Its role is to undertake research and develop programs and policies in relation to renewable energy and draft industry standards.\(^{43}\) It will also be involved in international cooperation programmes and has entered into the Sino-Danish Renewable Energy Programme which aims to develop renewable energy technology and the capacity of authorities to ensure the rapid development of renewable energy in China.\(^{44}\)

China introduced the *Law of the People’s Republic of China on Energy Conservation* in 1987.\(^{45}\) Article 1 mandates energy saving throughout society in order to improve energy efficiency and protect the environment. Article 3 mandates ‘the tightened control over the use of energy and adopting measures which are technologically feasible, economically rational and acceptable to the environment and community, reduction of the volume of energy consumed, the loss of energy and the discharge of pollutants and prevention of waste energy at each stage of production through consumption of energy in order to use energy efficiently and rationally.’ The construction of industrial projects which use backward technologies using excessive energy consumption and producing excessive energy waste is prohibited.\(^{46}\) Article 7 not only requires individuals to save energy but to inform on those that do not maintain the law. Backward industries are targeted under article 11 with the relevant agency required to publish a list of industries that fall into this category.\(^{47}\) The Law also promotes research and development in encouraging energy saving.\(^{48}\) This Law now has taken on a renewed impetus due to the growth of appliance ownership in China. The China Energy Group reports that the market for appliances currently involves 600 million people with the

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\(^{42}\) China National Renewable Energy Centre (22 March 2012) [http://www.cnrec.org.cn/english/aboutcnrec/overview.]

\(^{43}\) China National Renewable Energy Centre (22 March 2012) [http://www.cnrec.org.cn/english/aboutcnrec/overview.]

\(^{44}\) China National Renewable Energy Centre (22 March 2012) [http://www.cnrec.org.cn/english/aboutcnrec/overview.]


\(^{46}\) Article 13 *Energy Saving Law* 1997

\(^{47}\) Article 17 *Energy Saving Law* 1997

\(^{48}\) Chapter 4 *Energy Saving Law* 1997
rural market comprised of around 700 million people 10 to 20 years behind urban markets but which will escalate as the country continues to develop.\textsuperscript{49} Another key initiative was the Top 1000 Enterprises Energy Conservation Action Program introduced in 2006 the purpose of which was to save 1000 million tons of coal equivalent (tce) of energy over the 2006 to 2010 period. It focused on 1008 key nine energy supply and consuming industrial sectors which used 0.18 million tce in 2004. \textsuperscript{50}

In December 2005 the Chinese government promulgated the \textit{Renewable Energy Law (REL)} amended in 2009. It contains provisions that govern feed in tariffs; grid feed in requirements along with cost sharing mechanisms and supporting the rural use of renewable energy. Its purpose and method of implementation is set out in article 4 which states:

\textit{The State shall regard the development and utilization of renewable energy as an area of priority area in energy development, and promote the establishment and development of renewable energy market through setting the target for the total volume of the development and utilization of renewable energy and adopting corresponding measures. The State shall encourage economic entities of various ownership to participate in the development and utilization of renewable energy, and protect the legitimate rights and interests of the developers and users of renewable energy according to law.}

Amendments to this \textit{Law} in December 2009 relate to the Mandatory Connection Policy. The 2005 REL had introduced a ‘\textit{mandatory connection}’ policy, whereby grid companies were under an obligation to connect and buy all renewable energy that the grid was capable of absorbing. The original article 14 read: ‘\textit{The enterprises of power network ... shall purchase all of the network quantity of electric charge of the projects of electricity generation through incorporating renewable energy in [the] power network within the coverage of the power network, and provide network services for the electricity generation with renewable energy.’ However not all of the renewable power mandated has been connected to the grid as evidenced by the fact that though China has doubled its wind capacity each year for the past

\textsuperscript{49} China Energy Group \textit{‘Appliance Standard and Labelling’} (26 March 2012) \textless \url{http://china.lbl.gov/research/appliance-standards-and-labeling}\textgreater .

\textsuperscript{50} Zhong Xiang Zhang \textit{‘Is it Fair to Treat China as a Christmas Tree to hang Everybody’s Complaints? Putting its Own Energy Saving into Perspective’} February 2009 SSRN 1285618
four years only 30 per cent of that figure was actually fed into the grid. 51 This was due to companies lacking the infrastructure to connect all renewable power to the grid and the lack of incentives to encourage investment in infrastructure. 52 For this reason, article 14 of the REL was amended in 2009 to provide that the State will safeguard the ‘full purchase of the electricity generated from renewable energy’, giving powers to the competent department of energy along with the State Council to ‘determine the percentage of the electricity generated from renewable energy that shall be attained in the term of the plan in the total amount of electricity generated’ and ‘formulate the detailed measures for priority dispatch and full purchase of the electricity generated from renewable energy by grid enterprises’. Thus, the State created a new obligation for grid companies, facing stricter requirements and targets. This new requirement is enforceable under article 29 which imposes a penalty in the form of compensation for non-compliance. Compensation is paid to grid companies for producing renewable energy because it is more expensive to generate than that produced through by coal. A surcharge has been introduced on consumers of electricity which grid companies are permitted to collect. The end user surcharge goes to the Renewable Energy Development Fund with the grid company gaining compensation from the fund for the additional cost entailed in purchasing renewable energy and its integration into the grid. The fund is also used to provide finance for other renewable energy projects particularly in the poorer parts of China. Provisions on the Administration of Renewable Energy Power Generation 2006 covers producers of power not covered by grid regulations. Related Regulations are Measures on the Supervision and Administration of Grid Enterprises in Fully Purchase of Renewable Energy Power 2007 and Measures on Supervision and Administration of Grid Enterprises in Fully Purchase of Renewable Energy Power 2007. Measures for the Evaluation of the Demonstration Projects of Buildings Constructed with Renewable Energy was passed in 2006 the purpose of which is stated in Article 1 as to ‘promote scientific and impartial management of the demonstration projects of buildings constructed with renewable energy’ as well as ensuring the projects are safe and satisfactory.


52 Sara Schuman Greenlaw ‘China renews its commitment to renewable energy’ China 12 February 2010 <http://www.greenlaw.org.cn/enblog/?p=2279#more-2279>.
China’s main five power generation groups each have differing objectives in the renewable energy field. China Huaneng is the largest in Asia and second in the world, China Guodian plans to increase hydro and wind to 21.6 per cent of its current output in the next five years.\textsuperscript{53} China Datang intends to invest Renminbi (RMB) 100 billion in a thermoelectricity power station. China Huadian has reached 25 per cent of it capacity in renewable energy and China Power Investment has focused on decreasing coal power generation from 61 per cent to 48 per cent in 2010.\textsuperscript{54}

**Nuclear energy**

Though nuclear energy is not strictly renewable due to the fact that the residue from its use requires difficult and lengthy periods of disposal in order for the radioactivity to diminish it deserves a mention in this article because of China’s plan to substantially increase this form of energy.\textsuperscript{55} Currently only 1.8 per cent of China’s total energy comes from nuclear energy. Mainland China has fifteen nuclear reactors in operation with a capacity of 12.54 million kW.\textsuperscript{56} Twenty six nuclear reactors are currently under construction with a capacity of million 29.24 kW.\textsuperscript{57} ‘This is reflective of China’ nuclear programme which began in 1970\textsuperscript{58} and accelerated in 2005 under the National Development and Reform Commissions’ Tenth Economic Plan 2001 to 2005.\textsuperscript{59} In its 12th Five Year Plan, China foreshadows a four-fold expansion of the country's nuclear power generation capacity from 10 GW which is less than


2% of its current electricity generation, to 40 GW by 2015.\textsuperscript{60} This means that China is building 40 per cent of the 64 nuclear reactors currently being constructed around the world.

**Hydro power**

In 2010 China accounted for more than 60 per cent of global growth in hydropower. \textsuperscript{61} The current capacity of hydro power in China at the end of 2011 was estimated to be 230 gW, with a further 55 gW under construction. \textsuperscript{62} This represents 22 per cent of the total of renewable energy produced in China. The government considers that its exploitable hydropower resources are 542 million kW, with less than 30 per cent currently utilized. It plans to increase hydropower by half of the existing output so that by 2020 installed capacity will reach 290 million kW by 2015. \textsuperscript{63}

The Three Gorges Dam in China is currently the largest hydro power project in the world. It has a massive barrier across the Yangtze River creating a reservoir almost the length of Britain. It is driven by 26 giant turbines generates about 18,200 mW of power a year. \textsuperscript{64} Though it involved the displacement of millions of people and the flooding of hundreds of towns its past history explains to a certain extent why the Chinese government chose to go ahead with the dam. The ecology in the Three Gorges Dam area is weak. It lies in the upper reaches of the Yangtze River and has an important influence on the middle and lower reaches of the Yangtze River which affects the nation as a whole. \textsuperscript{65} Professor Cao states that the Three Gorges Dam Area was once an area covered by thick forest and was resplendent in wild animals and plants, rich in rainfall.\textsuperscript{66} Overtime the area became more and more densely

\textsuperscript{60}Krista Mahr ‘China’s Nuclear Energy Ambitions: Big Bold and Unstoppable Electric’ (14 January 2011) (<http://ecocentric.blogs.time.com/2011/01/14/china%E2%80%99s-nuclear-ambitions-b >).

\textsuperscript{61}BP Statistical Review of World Energy’ 2011 5.

\textsuperscript{62}David Stanway ‘China Urges Hydropower developers to head the environment’ Reuters (17 January 2012) <http://www.reuters.com/article/2012/01/17/china-hydropower-idUSL3E8CH2AC20120117>.


\textsuperscript{64}Jonathan Watts, ‘China warns of urgent problems facing Three Gorge’s Dam’ Guardian (20 May 2011)


populated so that by the time the Republic of China was founded ecological issues in the area were severe. By 1980 forest coverage had been reduced to 10 per cent of the original area and the production of steel changed the area into an industrial zone.  

The dam is not without a number of problems. Soil erosion is severe as about 140 tons of soil enters the rivers in the region annually which directly threatens the Dam.  Though the main benefit of the Dam apart from providing hydro energy is to prevent floods, Cao argues that the negative effects are greater water pollution in the area as the water moves more slowly and loses its self-decontamination ability.  The other problem is that 183 major sewage exits were submerged when the dam was flooded.  The geological structure of the area is complicated, prone to landslides and mud rock flows.  Cao argues that the dam will result in landslides and the collapse of dangerous rocks caused by changing water levels.  

In 2011 the State Council acknowledged that the Dam was causing geological, human and ecological problems and having a negative impact on downstream river transport and water supplies.  It is suffering from algae and pollution which is not being flushed away due to the 1.5 mile barrier. There is a serious lack of drinking water due to the contaminated water in the dam which affects thousands of people.  It recognized other problems such as earth tremors


73 Jonathan Watts, ‘China warns of urgent problems facing Three Gorge’s Dam’ Guardian (20 May 2011)  

74 Jonathan Watts, ‘China warns of urgent problems facing Three Gorge’s Dam’ Guardian (20 May 2011)
as it is built over an earthquake prone area, susceptible to landslides. The problem is now so serious that the government considers that hundreds of thousands of nearby residents may need to be moved away from the Dam. The other problem is that water levels in Hubei and Wuhan have seen long stretches of water close to shipping due to the shallow flow of the river. Power generation is that when droughts occur the water level falls and optimum power generation is detrimentally affected.

There are plans to build four new hydro-electric power plants on the Jinsha River which will ultimately generate 190 billion kW. However there are internal concerns over this type of development. The Ministry of the Environment in China has expressed its concern over plans to build a hydro power plant called the Xianoanhai plant on the Yangtze River. The Ministry argues that it will reduce the size of a protected nature reserve which has already been reduced to build the Jinsha hydro power plant. The director of the Institute of Public Environmental Affairs, Ma Jun points out that this is the last freshwater wildlife reserve left on the Yangtze and the project is detrimental to its survival. Bossard, of International Rivers, states that the rapid expansion of hydropower projects can result in huge risks when built in seismically active regions. He reports that a senior official in the Ministry of Environmental Protection considers that hydropower could cause more severe pollution than coal fired power plants because of the ecological impact and geological hazards.

**Solar Power**

75 Jonathan Watts, ‘China warns of urgent problems facing Three Gorge’s Dam’ *Guardian* (20 May 2011)

76 Jonathan Watts, ‘China warns of urgent problems facing Three Gorge’s Dam’ *Guardian* (20 May 2011)


78 David Stanway ‘China Urges Hydropower developers to head the environment’ *Reuters* (17 January 2012) <http://www.reuters.com/article/2012/01/17/china-hydropower-idUSL3E8CH2AC20120117.>


80 David Stanway ‘China Urges Hydropower developers to head the environment’ *Reuters* (17 January 2012) <http://www.reuters.com/article/2012/01/17/china-hydropower-idUSL3E8CH2AC20120117.>


China’s climate facilitates the capture of vast amounts of solar energy. The government plans to build large on grid photovoltaic power stations in Qinghai and Gansu provinces, the Xinjiang Uygur and Inner Mongolia autonomous regions because these areas can facilitate the creation of abundant amounts of solar energy. The White Paper outlines a plan to increase solar energy by 21 million kW. by 2015 comprised of a total solar heat area of 400 million sq. m. Solar hot water use will also be intensified in the country, small cities and towns.

Surprisingly, though China produces the largest number of solar panels globally it accounts for less than 0.01 per cent of the domestic energy market in China. Through what is called the Golden Sun Program which commenced in July 2009, the Chinese government provides generous solar PV subsidies amounting to 50 per cent of capital costs for building solar PV panels over 50 kW. as well as 70 per cent capital cost subsidies for off grid projects. The government is also investing in research and development of solar energy storage and the development of thinner silicon wafers. The growth of solar PV manufacturing in China has been staggering. Worldwide its market share in 2009 was: Sutech Power 7 per cent, Nigho Solar electric 2 per cent, Trina 4 per cent, Ja Solar 5 per cent Baoding Yingli 5 per cent. The inclusion of Taiwan companies, Motech which produces 3 per cent, E-ton Solar 2 per cent, and Gintech 3 per cent brings the total to about 49 per cent globally.

Suntech, Trina Solar and Yingli Green Energy have large operations in the United States. Suntech has been praised for the quality of its panels and was awarded the Top Brand PV seal.

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83 The output from solar power is dependent on the size of the panels which is usually about 1 kW. or 1.5 kW. some are as big as 10 kW. On average a 1 kW. system will produce about 4 kW. hours a day Solar Choice (20 November 2012) <http://www.solarchoice.net.au/blog/how-much-energy-will-my-solar-cells-produce/>.


There has been antagonism between the United States Commerce Department which imposed duties on China’s solar cells and panel importers because US solar companies argued that Chinese companies have been receiving subsidies of 2.8 per cent to 4.73 per cent from the Chinese government and therefore the amount levied on Chinese imports is justified because the US solar market is suffering because of price competition. The result is that the US Department of Commerce ruled that tariffs ranging from 24 to 36 per cent are placed on imports from China. The duty on Suntech is severe at 36 per cent. As Shobert points out, this reaction questions whether the US is embracing protectionism rather than competition. A lawsuit has also been filed against China by the German company Solar World which argues that China has breached World Trade Organization (WTO) export rules by illegally subsidizing its domestic solar industry. Reduced state and competitive prices from Chinese companies along with a glut in solar panels has resulted in a downturn in income for companies such as Phoenix Solar AG (PS4) and bankruptcy for Eriangen’s Solar Millennium and Solon.

China’s solar power internally is not very advanced. In March 2012 Zhang Guobao, the former head of China’s National Energy Administration, stated that China’s internal solar power market was inadequate producing only 2.2 kW of power compared to wind which totalled 450 million kW. The reason for this is that solar is too expensive costing 1.15 Yuan (0.18 U.S. dollars) per kW. hour compared to wind which costs 0.57 Yuan per kW. hour.

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92 Benjamin A Shobert ‘US risks emotion on China’s clean energy’ Asia Times (5 April 2012)
94 Diane Kardwell, Keith Bradshaw ‘US will place duties on Chinese solar Panels’ New York Times (10 October 2012)
95 Benjamin A Shobert ‘US risks emotion on China’s clean energy’ Asia Times (5 April 2012)
However China's National Development and Reform Commission (NDRC) is aggressively promoting the expansion of China's solar market. Some excellent projects have been initiated in China such as the sale of renewable energy to poor people in north-eastern China. Called the Renewable Energy Development Project, 400,000 solar home systems were installed in the homes of herders who are able to move them along with their herds to new pastures. The province of Gansu which is a large desert province is becoming the largest area of solar farms in China. A massive solar farm is planned in Jiangsu Province in Xuzhou city covering 700 sq. miles with a capacity of 20 mW. When fully operational it will have an annual power generation of 26,000,000 kW. hours saving 7,500 tonnes of coal each year and reducing emissions of carbon dioxide, sulphur dioxide and nitrogen dioxide by 20,000 tonnes 150 tonnes and 50 tonnes respectively.

China has a national long term national goal of introducing a goal of 150 million square metres of solar hot water by 2010 and 300 million square meters by 2012 so that a quarter of Chinese houses will have solar hot water.

**Wind power**

Wind power is proving to be a very popular form of renewable energy as by the mid 2008’s a combination of 70 countries produced 100,000 mW. of electricity. In 2010 global wind power grew by 22.7 per cent with China and the United States accounting for about 70 per cent of that growth. The Energy Research Institute (ERI) of the National Development and Reform Commission released the China Wind Energy Development Roadmap 2050 in October 2011 which states that the annual new installed wind capacity will be 15 gW. per year until the year 2020, 20 gW. from 2020 to 2030. Its proportion of the world’s annual newly installed capacity reached 49 per cent in 2010.

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104 ‘China Wind Energy Development Roadmap 2050’ (October 201) 7.
The largest potential wind farm areas are East Inner Mongolia, West Inner Mongolia, Xinjiang, Gansu, Hebei, Jilin, Jiangsu provinces. The Energy Research Institution states that wind power will need centralised development and long distance transmission. Mengzi grid in western Inner Mongolia contributes 10 terraWatt hours (tWh) which satisfied 9 per cent of regional power demand in 2010. Overall wind power is currently mostly land based and will continue to be so until 2021 to 2030 when offshore wind power has been further developed.

Deciding where to establish effective wind farms requires in depth feasibility studies. Ordinary wind power production is concentrated in the north western, north eastern and northern areas so that by 2015 it expect to generate a total of 100 kW. A slope of greater than 4 per cent, and water bodies, wetlands, marshes, nature reserves, national parks, 3km. buffer zones around cities, farmland and desert areas are unsuitable for wind power. The ERI considers the most suitable areas for the development of wind farms is northern China. Here not only are wind resources abundant, it is more sparsely populated and the economy is less developed. Therefore building and maintaining these installations will provide employment, boost local economies and encourage energy intensive industry to relocate to the north of China.

Increasingly off shore wind farms are being built. The Global Offshore Wind farm database reports that to date the United Kingdom leads the world in output with 2679.200 mW. annually, Denmark 8744.800 mW. and China 509.5000 mW. By 2015 China intends to

105 ‘China Wind Energy Development Roadmap 2050’ (October 2011) 1.
106 ‘China Wind Energy Development Roadmap 2050’ (October 2011) 19.
107 ‘China Wind Energy Development Roadmap 2050’ (October 2011) 7.
109 China Wind Energy Development Roadmap 2050’ (October 2011) 1.
110 China Wind Energy Development Roadmap 2050’ (October 2011) 27.
111 ‘China Wind Energy Development Roadmap 2050’ (October 2011) 27’
produce 500 kW of wind power offshore. 113 The most suitable areas identified for the development of off shore wind farms are the Taiwan Strait area and areas near Fujian, southern Zhejiang, Guangdong and Guangxi because of the frequency of summer typhoons and tropical summer monsoon activity. 114 China’s Meteorological Administration states that the potential for offshore wind power is up to 750 gW. which is three times the capacity of on shore farms. 115

China’s first operational coastal wind farm called the Donghai Bridge Offshore Wind Power Demonstration Project has been developed off Jiangsu province near Shanghai. 116 It is situated 8 to 13 kms. off the Nanhuizui coastline in about 10 metres of water. 117 34 turbines called Snovel SL3000 produced by the Snovel Wind Group Company operate commercially. 118 The total output of this project is 102 mW. and currently has an annual output of about 268 gWh. which can supply 200,000 households. 119 The electricity is relayed by submarine cable to the mainland to connect into the grid with the power produced sold to East China Power. 120 However as with all renewable energy projects, it is costly with this one estimated to be around US$3.6 billion /RMB 23 billion. 121 This project is a Clean


114 ‘China Wind Energy Development Roadmap 2050’ (October 2011) 15.


116 ‘China Wind Energy Development Roadmap 2050’ (October 2011) 15.


Development Project (CDM) approved by the CDM Board of the United Nations.\textsuperscript{122} The other party is Carbon Resource Management United Kingdom who are not contributing to the project financially but are voluntarily participants in the project and are not gaining Certified Emission Reduction Units. \textsuperscript{123} The project has been assessed to estimate the emission reductions that will be attained over the period of the project as shown below.

Period | Annual estimation of emission reductions (tCO2e)
--- | ---
2009 | 246,058
2010 | 246,058
2011 | 246,058
2012 | 246,058
2013 | 246,058
2014 | 246,058
2015 | 246,058

Total estimated reductions = 1,722,406 \textsuperscript{124}

Another major offshore wind farm project is the Lingang project in Jiangsu which will be completed by 2014. This project undertaken by Sinovel will have 6mW of turbines off the coast of Shanghai and is said to be the largest commercial offshore project in the world. \textsuperscript{125}

\textbf{Geothermal Renewable Energy}

The managing director of China renewable Energy Society (CRES), Li Yuanpu states that it plans to supply heating equal to 350 million sq. metres from geothermal energy in the next five years with a market size of around 70 billion Yuan (US$10.8 million). \textsuperscript{126} He also advises there are 3000 to 10000 metres deep reserves in the earth that would provide 860

\textsuperscript{122} ‘\textit{United Nations Shanghai Donghai Bridge Project}’ (26 March 2012) <http://cdm.unfccc.int/Projects/DB/BVQI1241775289.97/view>.

\textsuperscript{123} Department for the Environment Food and Rural Affairs UK government Article 12 Kyoto Protocol to the united nations framework convention on climate change Written approval of voluntary participation from UK (27 November 2008) <http://cdm.unfccc.int/filestorage/9/H/U/9HUJGETR6P38Y1COQWL420SZIXN7DV/a%20Approval.PDF?u018bTfnczMWIDAk1Y9S_FGw9v03vMB_9Bi>.

\textsuperscript{124} ‘\textit{United Nations Shanghai Donghai Bridge Project}’ (26 March 2012) <http://cdm.unfccc.int/Projects/DB/BVQI1241775289.97/view>.


\textsuperscript{126}
trillion tons of standard coal e amounting to 260,000 times China’s annual energy composition.\textsuperscript{127} China currently has 12 major geothermal energy basins with reserves equal to 853 billion tons of coal equivalent (e) and as a result can cut annual CO2 emissions by 1.3 billion tons.\textsuperscript{128} The government aims to produce 1.7 per cent of primary energy from geothermal sources by 2015 which is said to be equal to 69 million tons of coal equivalent.\textsuperscript{129}

**Biomass: energy and fuel production**

The Chinese government is encouraging the development of biomass production use and an increase in the use of ethanol fuel to three million tons by 2015. Biomass energy would replace petroleum oil through bio ethanol bio diesel and biomass to liquid fuels. It would also provide gasification and power generation and replace coal where small boilers and stoves are used.\textsuperscript{130} The development target envisaged by Liu is that by 2020 China will produce 30 gW. of biomass power, 44 billion m3 of biogas, 10 million tons of biomass ethanol, 2 million tons of biomass diesel and 50 million tons of biomass briquette.\textsuperscript{131} Ethanol can be produced from cassava, sweet Sorghum and cellulose and bio diesel from waste food oil and Jatrpha.\textsuperscript{132}

Wing Zinhui of Tsinghua University argues that the country is lagging behind other countries in terms of biomass energy investment and has failed to make any breakthrough in biomass energy technology. Such criticism is valid as China can produce large quantities of non-grain


\textsuperscript{130} Wu Chuangzhi ‘Research and Development on Biomass energy in China’ undated Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences.

\textsuperscript{131} Wu Chuangzhi ‘Research and Development on Biomass energy in China’ undated) Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences.

\textsuperscript{132} Wu Chuangzhi ‘Research and Development on Biomass energy in China’ undated Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences; Jatropha are succulent plants.
plant biomass which can be grown on marginal land as a result of its grain industry which generates about 700 million tons of straw annually.  

In rural China, biomass produced electricity production has great potential due to the availability of straw produced from grain farming. In 2000 the primary energy consumption rate of biomass was 10 per cent and in rural areas the consumption was 22 per cent of the total. However at that time biomass was not converted into modern energy carriers, rather the use of wood and agriculture residue was used by the Chinese people for cooking and heating in rural areas. Rural areas produce crop residues from corn stover, rice straw, along with processing residues in the form of rice husks, corn cobs and bagasse, which in 2000 was 750 million tonnes said to be equivalent to 40 per cent of all electricity generated from coal.

Biogas projects in China are not new. They were instigated in the late 1970’s utilizing animal waste in large and medium size animal farms because of the chronic shortage of energy in rural areas. Technology has continued to improve with the introduction of anaerobic contact digesters which since the 1990’s have increased due to the perceived environmental benefits. Thermochemical gasification of crop residue is used to convert waste into biogas. For example the Shandong Energy Research Institute has created a down draft fixed bed gasifier system that can convert corn stalks, sorghum, cotton, soybean and woody wastes into gas which is provided to local households.


Dragon Power has emerged as a major player in the biomass energy area and accounts for about 60 per cent of the biomass market with power generation expanding to about one million kW in 2011. Its subsidiaries, China Construction Bank and National Bioenergy, are providing RMB 28 billion for the construction of 100 biomass power plants for the period 2010 to 2015 which will have a capacity of three million KW. To date this company has established 19 biomass power plants which control 60 per cent of China’s biomass market.

There are a number of CDM projects awaiting approval under the auspices of the Kyoto Protocol. For example, the Biomass Generation Project in Shenyang County Jiangsu province is worth US$36,279,895 and is currently in the planning process under the control of the CDM board. This project will have an installed capacity of 25 Mw. and an energy generated amount of 126,500,000 mWh. annually. Its purpose is to reduce coal consumption thus alleviating power shortages and coal supply pressures and increasing the income of local farmers from the by-products of cotton production.

**Conclusion**

China, with a population of over 1.3 billion, will see energy demand continue to increase due to industrial expansion and a growing middle class with western style consumption patterns. It has to create other sources of power apart from fossil fuels which are finite and improve atmospheric conditions. The renewable energy targets discussed in this article though impressive are still insufficient these issues. Critical to the success of renewable energy targets being met is the need for the government to increase renewable energy targets in comparison to energy demands. It is no use building coal fired power stations, undertaking large coal mining projects unless the ratio of coal to renewables decreases. Though Martinot and Junfeng predict that China can meet its renewable energy target by 2020 with renewables


reaching 400 gW, which is triple the 135 gW. In 2006 this is not enough. The problems with nuclear energy and hydro cannot be cured so that focus on wind and solar is critical in a country that continues to develop and demand more and more power. The unsustainable release of greenhouse gas emissions underlies energy production and China can no longer ignore the fact that global warming is increasing and the need for the countries on this planet to take mitigating initiatives to combat the problem.