

CHINA IN THE RENEWABLE ENERGY RACE

Sarmiza Pencea*

Abstract

For over three decades Chinese economy grew annually by an average of almost 10%, driven by huge investments in industrialization, urbanization and infrastructure networks and by large exports of price-competitive goods.

The downside of China's accelerated development is its insatiable hunger for energy – China also became the world's largest energy consumer - and for natural resources, which, on the one hand contributes to depleting faster the global stocks of non-renewables and, on the other hand, it dangerously increases pollution.

Keywords: renewable energy, Chinese economy, catching up

JEL Classification: O53, Q20

1. Briefly on Chinese Catching Up and Its Costs

For over three decades Chinese economy grew annually by an average of almost 10%, driven by huge investments in industrialization, urbanization and infrastructure networks and by large exports of price-competitive goods. Hundreds of millions of people were pulled out of poverty, the living standards improved visibly and China re-positioned itself in the world economy. The strength of its economic status was tested and proven by the swift way in which it managed to overcome the global economic crisis of 2008-2010, which devastated other economies. In fact, in the aftermath of the crisis, the Chinese economy seems to be stronger, with its position in the world greatly improved.

Thus, in 2010 China became the second largest economy in the world by its GDP at official exchange rate and, according to forecasts, it is going to surpass the US in a time span of maximum 15 to 20 years. At present, China is also the world's no.1 industrial producer, the no.1 exporter and the second largest importer worldwide. It is also ranked first in a number of international markets, as the largest producer, the largest consumer, or both (see Table no.1). At the same time, China's foreign exchange reserves amount to the staggering level of USD 3 045 billion¹ (March, 2011), the largest ever worldwide.

* Sarmiza Pencea is at the Institute of World Economy in Bucharest.

¹ <http://www.chinability.com/Reserves.htm>

Table no. 1: China's positioning in some international markets*

International market	World producers ranking	World consumers ranking	World exporters ranking	World importers ranking
Coal	1 st	1 st		2 nd
Steel	1 st	1 st	2 nd	1 st
Electricity	2 nd	2 nd		
Oil	5 th	3 rd	33 rd	4 th
Natural gas	9 th	9 th	32 nd	27 th
Textiles and clothing	1 st	1 st	1 st	
Consumer appliances	1 st			
Cars	1 st	1 st		
Semiconductors	1 st			
Sulfuric acid	1 st			
Fertilizers	1 st			
Ammonia	1 st			
Dyes	1 st			
Synthetic fibres	1 st			
Paper and cardboard	1 st			
Construction materials	1 st	1 st		
Cement	1 st	1 st		
Plate glass	1 st	1 st		
Construction ceramics	1 st	1 st		
Sanitary ceramics	1 st	1 st		

Sources: www.chinaknowledge.com, www.digitivity.com, www.ciafactbook.org
<http://www.issb.co.uk/global.html> ; * **Note:** this is a non exhaustive listing

The downside of China's accelerated development is its insatiable hunger for energy – *China also became the world's largest energy consumer*² - and for natural resources, which, on the one hand contributes to depleting faster the global stocks of non-renewables and, on the other hand, it dangerously increases pollution. (Notice that

² Lam, Cory – *12th Five Year Plan Hailed as "Greenest FYP in China's History"*, China Briefing, 5.04.2011, www.china-briefing.com

most of the example industries from Table no.1, in which China excels, are both energy-intensive and highly polluting industries).

From the point of view of its requirements for natural resources, it was calculated that, if it were to opt for the traditional western economic model and get its 1.3 billion population live by American standards, China would need more planets Earth for the necessary inputs.

At the same time, it is well-documented that rapid development took its toll on China, and the country became one of the most polluted countries in the world, contributing heavily to the green-house effect, the global warming, the severe damage of soil and the poisoning of the planetary ocean (see Box no. 1). Both these factors, the insufficiency of resources, energy included, and the negative impact on the environment, indicate that development in the longer run is unsustainable unless China, and the other countries as well, change course, switching to an entirely different development model, based on renewable, non-polluting energy resources and technologies.

Box. No.1: China's Pollution in Facts and Figures

- *China is the greatest green-house gas polluter in the world;*
- *At present, China operates two new coal-fired power plants every week;*
- *Only 1% of city dwellers in China breathe safe air according to EU standards;*
- *If China would keep its present growth rate without improving its energetic efficiency, in 2030 it could throw into the atmosphere a quantity of carbon dioxide equal to that emitted by the rest of the world;*
- *If carbon dioxide emissions per head in China become equal to those in the US, then the total global emissions would triple, with catastrophic consequences;*
- *Out of the world's 20 most polluted towns, 16 are in China;*
- *In China there is one third of the whole garbage produced by mankind; One third of the Chinese territory is affected by acid rains and one quarter is a desert;*
- *Almost 100 towns suffer from landslides due to the excessive use of the water table;*
- *80% of Chinese rivers are heavily polluted and 50% of the population drink polluted water;*
- *Yearly, Yangtse river discharges into the ocean 1 billion tonnes of untreated residual waters;*
- *Environmental damage made cancer the leading cause of death in China.*

Sources: Kahn, Joseph; Yardley, Jim - *As China Roars Pollution Reaches Deadly Extremes*, www.nytimes.com; Wolf, Martin - *China Challenges the Whole World*, www.ft.com ; *China's Carbon Dragon. Growing China's Economy while Cutting Planet Warming Emissions*, www.csmonitor.com; *More Details about China*, <http://arthurthinks.wordpress.com>

2. Changing the Course: The New Focus on Renewable Energy

2.1 The structure of Chinese energy consumption

Chinese energy consumption is currently dominated by coal, which accounts for over 70% of China's total primary energy consumption and for almost 43% of the world total. China is the greatest consumer of coal globally, with industry - which accounts for almost 47 % of the national GDP – the greatest energy-consumer among sectors. To be able to meet its huge energy needs, the country became not only *the largest producer*, but also *the second largest importer of coal in the world*.

Besides coal, China is also a considerable producer and a major importer of oil - which is its second most important primary energy source. The country ranks the 5th and, respectively, the 3rd in global oil production and imports.

As shown in Table no. 2, coal and oil meet the bulk of Chinese demand for energy, while natural gas and nuclear power have only marginal shares in the total energy consumption. Within the total energy consumption structure, a more significant share, of 6.6%, is taken by hydropower, which is the third most important energy source for this country. Globally, China is the largest consumer of hydropower, accounting for over 18% of the world hydropower consumption.³

Table no. 2: Comparative Structure of Primary Energy Consumption, by Major Countries (% , 2008)

COUNTRY	OIL	GAS	COAL	NUCLEA R POWER	HYDRO POWER	TOTAL PRIMARY ENERGY CONSUMPTIO N
USA	38.5	26.0	24.6	8.4	2.5	100
CHINA	18.8	3.7	70,2	0,7	6,6	100
RUSIA	19.0	55,3	14,8	5,4	5,5	100
JAPAN	43,7	16,6	25,4	11,2	3,1	100
GERMANY	38.0	23.7	26.0	10.8	1.5	100
FRANCE	35,8	15,5	4.6	38.6	5,5	100
UK	37.2	40.0	16.7	5.6	0,5	100
AUSTRALI A	35.9	17.9	43.4	-	2,8	100

SOURCE: BP 2009 World Energy Statistical Data

³ BP Statistical Review of World Energy 2010

2.2 The new focus on renewable energy

Over the past few years, *China has emerged as a global leader in renewable energy*, its remarkable rise showing a strong commitment by the government to diversify energy sources, alleviate pollution, reduce imports and boost the country's energetic security.

In China, energy was identified as a strategic sector, and, as a consequence, a host of new *policies and regulations* were adopted with the purpose of encouraging energy efficiency and an increased deployment of renewable energy. Also, more than two decades of *investments in science and technology* focussed on the energy sector, aiming at making the country an innovator, as well as a low-cost manufacturer of cutting-edge technologies.⁴ The combination of policy incentives and investments has encouraged major advances in the development of renewable energy, especially wind and solar power.

Recently, investments in the sector expanded very swiftly and, in just a few years, China managed to surpass the US and become *the no.1 investor in clean energy, worldwide*. (See Table no. 3 and Table no. 4). It is significant and worth noticing that in 2009, when China outran the US for the first time, the total amount of Chinese investments was almost double that of the US. It is also worth mentioning that, additional to other funding, over the last two years, an important amount of the financial stimulus package earmarked for curbing the impact of the global crisis was used by the Chinese central and local governments for clean energy investments. This helped keeping the pace of investments high, giving a significant boost to the renewable energy sector, and, at the same time, it created a significant number of jobs and it generated growth.

Table no. 3: The Top 10 Countries, by Five -Year Growth in Investment

Country	Investment Growth 2005-2009
1. TURKEY	178%
2. BRAZIL	148%
3. CHINA	127%
4. UNITED KINGDOM	127%
5. ITALY	111%
6. USA	103%
7. FRANCE	98%
8. INDONESIA	95%
9. MEXICO	92%
10. REST OF EU27	87%

Source: G-20 Clean Energy Factbook, *Who's Winning the Clean Energy Race?* Growth, Competition and Opportunity in the World's Largest Economies, the PEW Charitable Trust, 2010

⁴ World Watch – *Renewable Energy and Energy Efficiency in China*, 2010, www.worldwatch.org

Table no. 4: Top 10 in Clean Energy Investments, 2009

Country	Clean Energy Investments (bn. USD)
1. CHINA	34,6
2. USA	18.6
3. UNITED KINGDOM	11.2
4. REST OF EU27	10.8
5. SPAIN	10.4
6. BRAZIL	7.4
7. GERMANY	4.3
8. CANADA	3.3
9. ITALY	2.6
10. INDIA	2.3

Source: G-20 Clean Energy Factbook, Who's Winning the Clean Energy Race? Growth, Competition and Opportunity in the World's Largest Economies, the PEW Charitable Trust, 2010

At present, due to its huge investments, *China is already topping the world in production of compact fluorescent light bulbs, solar water heaters, solar photovoltaic (PV) cells and wind turbines* and is one of the most rapid countries in terms of installing renewable energy generation capacities.⁵ Having built a strong manufacturing base and export markets, China is striving now to meet domestic demand by installing substantial new clean energy capacities. Its best results can be already seen in wind and solar power.

2.2.1 Wind Power

China has the largest wind resources in the world, one quarter of them on land and three-quarters off-shore.⁶ Researchers from Harvard and Tsinghua universities have found that *China could meet all its electricity demands from wind power through 2030.*⁷ Therefore, Chinese leaders identified *wind power as a key growth component* of the country's economy.

The total wind power installed capacity increased from only 1.3 GW in 2005, to 12 GW in 2008, 26 GW in 2009 and 41.8 GW in 2010, when *China became the largest wind energy provider worldwide.* According to the Global Wind Energy Council, the

⁵ Bradsher, Keith – *China Leading Global Race to Make Clean Energy*, www.nytimes.com

⁶ www.wikipedia.org

⁷ Ecogeek.org – *China Could Replace Coal with Wind*, 31.01.2010

development of wind energy in China, in terms of scale and rhythm is absolutely unparalleled in the world.⁸

Presently, there are *80 wind farms operating in China, all on shore*. The construction of the first off-shore wind farm, consisting of 34 wind turbines, was started and completed in 2009 to provide electricity to the 2010 Shanghai World Expo.

In **Table no. 3**, hereunder, a comparative image of the world most important wind power producer countries, is presented. In 2009, China managed catching up Germany and both countries ranked first, with 16.1% of the total world installed capacity, each. A year later, China increased its wind power generation capacity by 62% to a total of 41,8 GW, surpassing Germany and becoming sole leader.

Table no. 3: Cumulative Installed Wind Turbine Capacity (GW)

COUNTRY	2009 (GW)	2009/2008 CHANGE	2009 SHARE OF TOTAL WORLD
US	35.2	39.3%	22.0%
EUROPE, of which:	76.6	16.0%	47.8%
- GERMANY	25.8	7.9%	16.1%
- SPAIN	18.8	13.5%	11.7%
- FRANCE	4.8	30.1%	3.0%
- UK	4.3	33.0%	2.7%
CHINA	25.8 (41,8 in 2010)	113,3%	16,1% (22% in 2010)
INDIA	10.8	12.1%	6.8%
TOTAL ASIA PACIFIC	42.0	59.0%	26.3%
TOTAL WORLD	160.1	31.0%	100%

SOURCE: BP Statistical Review of World Energy, June, 2010; Copsey, Tom; Isabel, Hilton - Greening China. Outlook for European SMEs, Spring 2011

To encourage local wind turbine manufacturers, China implemented policies to stimulate joint-ventures and technology transfers, mandated the use of locally made wind turbines and subsidized wind energy R&D. As a result, the *number of local specialized companies increased to over 80* (from only 6, in 2004)⁹ and *their market share increased to least 50%* of the domestic market, which was previously dominated by

⁸ www.wikipedia.org

⁹ Xinhua – *China Speed in Clean Energy Business*, 13.12.2009

foreign companies.¹⁰ Furthermore, *in 2009, China became the largest wind turbine manufacturer in the world, over-passing Denmark, Germany, Spain and the USA.*¹¹ Also, *three of China's wind turbine producers - Sinovel, Goldwind and Dongfang - are now in the top 10 globally.*¹²

Multinational companies respond to the rapid development of the wind power sector and market in China, building locally big state-of-the-art factories. For instance, in 2010, Vestas of Denmark has erected in NE China *the world's biggest wind turbine manufacturing complex*, where it transferred the technology to build the latest electronic controls and generators.¹³

2.2.2 Solar power

China has rich solar resources across most of its territory. More than 96% of its land receives over 1 050Kwh of solar radiation per square meter, and two thirds of its surface receives 2 200 sunshine hours a year.¹⁴

In solar power, just like in the case of wind power, China first focussed on developing manufacturing capacities for equipment and on gaining market share in foreign markets. In the home market, developments were quite divergent: while wind power farms expanded in China quicker than anywhere else, solar power generation lagged behind and only recently it was paid more attention. That is why, when speaking about manufacturing and exports of solar power generation equipment, we find China on top of world leaders, but when we look at the locally installed capacity, we discover that the country still has a long way to go, as PV installed capacity still account for less than 2% of the world total.

Solar energy can be used either directly, for water heating (solar water heating - SWH), or to generate electricity and store it in batteries for later use (solar photovoltaic/PV cells and panels). *China is the largest manufacturer in the world, of both solar water heating (SWH) and solar PV equipment.*¹⁵

In SWH, China cumulates nearly two thirds of global capacity, and production goes substantially to its home market, where more than 10% of the households rely on sun to heat their water. At this level of consumption, China is not only the world leading manufacturer, but also the *world leading user of SWH systems*.

¹⁰ UNEP – *Renewable Energy in China*, www.unep.org

¹¹ Bradsher, Keith – *China Leading Global Race to Make Clean Energy*, www.nytimes.com

¹² Martinot, Eric;Jungfeng, Li – *China's Latest Leap: Renewable Energy Policy Update for China*, 21 July 2010, www.martinot.info, www.ren21.net

¹³ Martinot, Eric; Jungfeng, Li – *China's Latest Leap: Renewable Energy Policy Update for China*, 21 July 2010, www.martinot.info, www.ren21.net

¹⁴ World Watch – *Renewable Energy and Energy Efficiency in China*, 2010, www.worldwatch.org

¹⁵ Bradsher, Keith – *China Leading Global Race to Make Clean Energy*, www.nytimes.com

As for solar PV, in 2009 China produced 45% of the entire global volume¹⁶, mainly for export. With 95% to even 99% of its yearly production sold to foreign markets, it's no wonder China became, besides the leading solar PV producer, *the largest exporter of solar PV in the world*, too. The pace of development in solar PV production and export was very swift in this country. It is undoubtedly impressive to note that, *in only one decade, China went from making just 1% of PV cells for solar panels, to being the world's leading producer and capturing 40% global market share*.¹⁷ For 2011, Chinese firms are expected to make more than half of the solar panels manufactured globally, and 80% of the solar hot-water units.¹⁸

Chinese solar PV exports go mainly to Europe and the US. In the following table (Table no. 4), the top destinations of the Chinese solar PV exports are presented, and also a comparison of Chinese and American exports to the same markets, which reveals the strength of Chinese competitiveness in solar PV.

Table no. 4: Top 10 Destinations of Chinese Solar Panels Exports

RANK	MARKET	Solar PV 2009 Export Value (USD billion)	2009/2008 Change IN Chinese Exports (%)	Chinese Solar PV Exports as compared to US Solar PV Exports (%)
1.	GERMANY	3.77	+20.5%	608.9% higher
2.	NETHERLANDS	1.57	+158.7%	35 000 % higher
3.	ITALY	0.85	+21.8%	1074 % higher
4.	BELGIUM	0.55	+37.7%	771% higher
5.	USA	0.44	+54.0%	
6.	S. KOREA	0.41	- 14.7%	2371.5% higher
7.	SPAIN	0.34	- 91.8%	4505% higher
8.	JAPAN	0.28	-1.6%	703.2% higher
9.	FRANCE	0.28	+45.8%	340.6% higher
10.	AUSTRALIA	0.21	+ 281.2%	6460% higher

SOURCE: Workman, Daniel – China Versus US, Solar Panel Sales by Country, Suite 101, 5.12.2010

¹⁶ Idem

¹⁷ Richardson, Michael – China's Green Ambition, US Sees Red, Yale Global, 5.01.2011, <http://yaleglobal.yale.edu>

¹⁸ Idem

3. Planning for the Future

The five year plan (FYP) remains a key policy instrument for the Chinese economy. The recently concluded 11th FYP targeted 10% renewable energy by 2010 and 15% by 2020, a 20% reduction in energy intensity (energy per GDP unit) and a 10% reduction in pollutants over the 2006-2010 time frame. The 2010 targets were broadly achieved (See Table no. 5)

Table no. 5: Key Energy and Climate Goals and Indicators, 2006-2020

INDICATORS	11 TH FYP 2006 - 2010 (target)	11 TH FYP 2006 - 2010 (actual)	12 TH FYP 2011 - 2015 (target)	13 TH FYP 2016 -2020 (target)
Energy intensity (% reduction in 5 years)	20%	19.1%	16%	NOT SET
Carbon intensity (% reduction in 5 years)	NOT SET		17%	40 - 45% vs. 2005
New energy (% of primary energy)	10%	9.6%	11.4%	15%

SURSA: Delivering Low Carbon Growth. A Guide to China's 12th Five Year Plan, The Climate Group, HSBC Climate Change Centre of Excellence, 2011

The 12th five year plan just launched in March 2011 is considered “the greenest in China's history”. It stresses on the importance and urgency to create “a green China” building on the success of the previous FYP and setting ambitious targets for the next five years. On the non fossil and renewable energy question, the targeted growth in installed capacity by the end of 2015 is to increase nuclear power four-fold, to 40GW, to add 63 GW new hydroelectric capacity, to more than double the current level of wind capacity by adding new 48 GW, while solar power is expected to reach 5 GW installed capacity. At the same time, the share of coal within the energy mix is planned to fall from 72%, to 63%.¹⁹

To help meeting these targets, the New Energy Industry Development Plan 2011-2020 provides for governmental investments in renewable energy of Euro 220-330 billion over 10 years, with amounts of Euro 170 billion earmarked for wind

¹⁹ Hannon, Alison; Liu, Ying; Walker, Jim; Wu, Changhua - Delivering Low Carbon Growth. A Guide to China's 12th Five Year Plan, The Climate Group, HSBC Climate Change Centre of Excellence, 2011

power and Euro 22 billion for solar energy. This package is part of an overall investment of Euro 550 billion in non-fossil energy, which additionally includes nuclear and hydropower.

From all its actions of the last decade and plans for the next decade, it is obvious that China understood that its future economic development, its energetic security and its competitiveness in the international markets will increasingly and vitally depend on the way it behaves and acts in the renewable energy race, and, as such, it makes every effort to gain competitive advantage in this field. China aims at mastering and dominating renewable energy technologies and markets and, to this end, it makes huge efforts to get in the forefront, to position itself as an undisputable leader, pacesetter and creator of new technologies. *“These efforts to dominate renewable energy technologies raise the prospect that the West may someday trade its dependence on oil from the Middle East, for a reliance on solar panels, wind turbines and other gear manufactured in China.”*²⁰

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