



MACIEJ M. SOKOŁOWSKI

University of Warsaw

## China, energy, policy, evolution, revolution: Questions and answers

---

### Abstract

China develops very fast and country's economy grows rapidly. Among many statistics one may find energy industry. As enormous economy needs vast amounts of energy, the power sector is a key-factor for its development. A scale of energy needs has influenced the installed capacity which is counted in hundreds of gigawatts. And this does not mean that nothing more will be installed. Quite the contrary, China still builds new power units. In the future, this trend will continue. Nevertheless, there are indications that the Chinese energy sector is no longer the same as before. China installs more and more renewable energy sources and develops its nuclear programme. On the other hand, the country's conventional energy sector (mainly coal sources) is still large. This results in a high-scale CO<sub>2</sub> emissions, giving China title of "the biggest CO<sub>2</sub> emitter in the world." Mentioned dichotomy makes it necessary to analyze the energy policy of China and evaluate it in terms of recent changes that could be called "evolutionary," or "revolutionary" for Chinese energy sector.

*Keywords:* China, energy policy, CO<sub>2</sub>, renewable energy sources, nuclear programme, 12th Five-Year Plan

## To begin

China develops rapidly. The country grows what has its reflection in many statistics. Among them one may find energy sector. This part of Chinese economy is becoming an increasingly important factor of the country's development. Obviously, every economy needs energy. Given the scale, it is difficult to consider China in the category of "every economy." Chinese economy needs huge amounts of energy. Since 2011 China has become the largest power generator in the world, overtaking the former leader – the United States (EIA, 2014).<sup>1</sup> Apart from electricity generation, China leads in terms of various energy data. Some of them can be qualified as the country's strengths (e.g. renewable capacity), some of them are its weaknesses (CO<sub>2</sub> emissions). These two examples are different points on the energy axis of the Chinese economy. Nevertheless, they show the extremes of the Chinese energy sector as well as they highlight its chances and drawbacks.

Naturally, the challenges of the energy sector of China are not only linked with renewable energy and CO<sub>2</sub> emissions, but they are much more complex. Apart from transport, CO<sub>2</sub> emissions come from electricity sector with its coal sources. This trig-

---

<sup>1</sup> According to BP, Chinese power generation of 2011 was 4713 TWh, what represents a 12% increase compared to 2010. At the same time, the United States produced "only" 4302,4 TWh. In 2013, the difference between these two largest world producers of electricity was even greater. China generated 5361,6 TWh, the United States 4260,4 TWh. Furthermore, by achieving this result China reached 23,2% of the whole electricity produced in the world, surpassing North America (5180,8 TWh in total), as well as Europe together with Eurasia (5324,1 TWh in total), *BP Energy Outlook 2035: Country Insights China*, BP, [http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country\\_insights\\_China\\_2035.pdf](http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country_insights_China_2035.pdf) [access date: 29.09.2015],

gers a discussion on energy efficiency as well as on low-emission sources. These circumstances give a field for comments on nuclear energy.

A picture of the Chinese energy sector seen in this light seems to be diverse. What bind it is the energy policy of China. In this context, the paper is aimed at analyzing the basic conditions of the Chinese energy sector with main elements of the energy mix of China. In my research, I delve into Chinese strategic plans and juxtapose them with the structure of the country's energy sector. My comments cover the renewable energy, nuclear sources, as well as coal industry and CO<sub>2</sub> emissions. In conclusion I try to answer the question on the nature of Chinese energy policy, i.e. whether China has entered the evolutionary or rather revolutionary road in terms of shaping its energy sector.

### **China's energy mix**

**E**nergy mix of China is a fossil fuel mix. This is confirmed by the official statistics of the Chinese government as well as external studies, e.g. the U.S. Energy Information Administration (EIA). For the purposes of this analysis, let me use the first one.

According to the National Bureau of Statistics of China total energy production in China (2013) provided in tones of standard coal equivalent (SCE) is based on coal (75,6%).<sup>2</sup> Together with crude oil (8,9%) and natural gas (4,6%) it gives fossil fuels a significant advantage over renewable energy sources (hydro-

---

<sup>2</sup> 9-1 *Total Production of Energy and Its Composition*, China Statistical Yearbook 2014, <http://www.stats.gov.cn/tjsj/ndsj/2014/indexeh.htm> [access date: 29.09.2015].

and wind power) and nuclear sources. These two groups in total reach 10,9%.<sup>3</sup>

In comparison to 1978, which is a base-level for the statistics, production of energy from coal has increased by 5,3%. The share of energy produced in nuclear and renewable sources has tripled (3,1% in 1978 – 10,9% in 2013). What is worth noticing is a large decrease in the energy use of crude oil. In late 1970s it reached more than one fifth of total energy production (22,7%). Finally, over the years, the usage of natural gas slightly increased (2,9% in 1978).<sup>4</sup>

With respect to total consumption of energy, as the National Bureau of Statistics of China provides energy produced from coal reach 66% (2013).<sup>5</sup> In contrast to production, the energy consumption from crude oil accounts for a larger share (18,4%). Other elements of the energy mix, i.e. natural gas and nuclear together with renewable sources accordingly reach 5,8% and 9,8% which is a result quite similar to statistics on production. Compared to data from 1978, consumption of energy from coal and crude oil has dropped (70,7% and 22,7% in 1978), whereas in terms of natural gas, nuclear and renewable sources has grown (3,2 and 3,4).<sup>6</sup>

Regarding a structure of Chinese power sector, as the National Bureau of Statistics of China presents, an installed capacity of power sources in China reached 1257 GW in 2013.<sup>7</sup> Development in this area is impressive. In 2000, the installed capacity was at the

---

<sup>3</sup> Ibidem.

<sup>4</sup> Ibidem.

<sup>5</sup> 9–2 *Total Consumption of Energy and Its Composition*, China Statistical Yearbook 2014, <http://www.stats.gov.cn/tjsj/ndsj/2014/indexeh.htm> [access date: 29.09.2015].

<sup>6</sup> Ibidem

<sup>7</sup> 9–15 *Installed Capacity of Power Generation*, China Statistical Yearbook 2014, <http://www.stats.gov.cn/tjsj/ndsj/2014/indexeh.htm> [access date: 29.09.2015].

level of 319 GW. Nowadays, it is four times larger. The annual rate of the new sources in the system is also extraordinary. Each year China builds tens of gigawatts of new power units. Between 2012–2013 this rate exceeded 100 GW in one year.<sup>8</sup> According to the National Energy Administration of China, at the end of 2014, the national electricity sector reached almost 1320 GW. Divided into source, it goes as follows: coal 820 GW, hydropower 300 GW, wind 90 GW, natural gas 50 GW, solar 30 GW, nuclear 20 GW, biomass and waste 9.2 GW.<sup>9</sup>

### **Central plans for energy sector**

China adopted an institution of a five-year central plan from the Soviet Union. The 1st Five-Year Plan was formally launched in 1953 after the Chinese economy recovered from the shock waves of war<sup>10</sup>. Nowadays, the institution of a central plan is still an important instrument of Chinese policy in terms of economy and its sectors. Naturally, its character, likewise the character of Chinese economy, has changed. Plans indicate main goals and highlight way to achieve them.

An increasing importance of energy for the Chinese economy and the needs for improvement of the environment influence China's strategic plans. An ongoing debate on the quality of environment raises attention to issues related to the energy and climate. Modern Chinese five-year plans reflect these needs. The last two plans (11th and 12th) are of particular importance. An-

---

<sup>8</sup> Ibidem.

<sup>9</sup> *China's installed electricity capacity by the end of 2014*, China Daily, [http://www.chinadaily.com.cn/business/chinadata/2015-02/13/content\\_19582590.htm](http://www.chinadaily.com.cn/business/chinadata/2015-02/13/content_19582590.htm) [access date: 29.09.2015].

<sup>10</sup> A. Eckstein, *China's Economic Revolution*, New York 1977, p. 111.

gang Hu describes them as a “turn to green development,” as almost 30% (11th) and 45% (12th) of their indicators were related to green development, “and the particular prominence was given to environmental objectives.”<sup>11</sup> Van Someren and van Someren-Wang in their comparison of 11th and 12th Five-Year Plan evaluate three groups of themes: economical, ecological, and social. The energy issues are gathered in the second of them. Within them in 11th Five-Year Plan they find: “reduction of energy use per GDP” and “reduction of major discharge pollutants.”<sup>12</sup> The 12th Five-Year Plan is more comprehensive in this regard, as it include “more mandatory green targets and green development indicators for keeping officials accountable” as well as “energy saving, promote renewables.”<sup>13</sup>

A clear example of this approach is, the 12th Five-Year Plan (2011–2015).<sup>14</sup> Among its provisions one may find principles that highlight in very simple way the new approach of Chinese government towards the development of the energy sector. This includes “the importance of building a resource-saving and environment-friendly society” with a use of energy saving, reducing greenhouse emissions and actively tackling global climate change.<sup>15</sup> To do so China “should develop circular economy and low carbon technologies.”<sup>16</sup>

---

<sup>11</sup> A. Hu, *China: Innovative Green Development*, Heidelberg 2014, pp. 108–109.

<sup>12</sup> T. C.R. van Someren, S. van Someren-Wang, *Green China: Sustainable Growth in East and West*, London 2012, p. 83.

<sup>13</sup> *Ibidem*.

<sup>14</sup> *12th Five-Year Plan*, <http://www.britishchamber.cn/sites/default/files/full-translation-5-yr-plan-2011-2015.doc> [access date: 30.09.2015].

<sup>15</sup> *Ibidem*, p. 3.

<sup>16</sup> *Ibidem*.

I consider that this quotation indicates a change in the approach to energy and the environment in China.<sup>17</sup> Not only should the development of the energy sector enable the stable, uninterrupted and cheap energy production that serves the needs of the Chinese economy, but also must lead to the achievement of the environmental and climate goals.<sup>18</sup> Chinese government has decided to improve energy efficiency and reduce emission. These go together with changes in the structure of energy consumption, strengthening the pricing mechanism and environmental taxation. Additionally, these need enforcing the related laws, regulations, and standards.<sup>19</sup>

It is worth noting that China has introduced into its system specific environmental targets and linked with them goals, mainly set as a percentage value. What is important is that some of them has a binding nature and some of them are just an approximation (“forecast”). Among them, the Chinese government assumed energy-related goals. These are: “increase of non-fossil fuel usage in primary energy consumption (%)”, “decrease in energy consumption per unit of GDP (%)”, “decrease in CO<sub>2</sub> emissions per unit of GDP (%)”. All three have a binding character. In terms of non-fossil fuel, China has to reach 3,1% growth, from 8,3% in 2010 to 11,4 at the end of 2015. Goals linked with energy efficiency and CO<sub>2</sub> emissions do not have such a point of reference. Although, the Chinese government has planned relatively high goals, i.e. 16% decrease in energy consumption per unit of GDP, and 17% decrease in CO<sub>2</sub> emissions per unit of GDP. Apart from them,

---

<sup>17</sup> M.M. Sokołowski, *Developments of the Energy Policy of China: A Long March not a Short Run*, [in:] *Socio-Economic Relations between Europe and Asia in the 21st Century*, M. Sitek, M. Łęski (eds) Józefów 2014, p. 158.

<sup>18</sup> *Ibidem*.

<sup>19</sup> *12th Five-Year Plan*, *op.cit.*, p. 5.

one may notice 2015-goal of “total decrease in emissions of major pollutants (%)” This goal is divided into “Chemical Oxygen Demand (COD)” with 8% decrease, “Sulphur Dioxide (SO<sub>2</sub>),” also 8% decrease, as well as a 10% drop in emissions of “Ammonia Nitrogen” and “Nitrous Oxides.” The 12th Five-Year Plan has assumed building “the new energy industry.” As its core elements Chinese government has chosen “the development of new-generation nuclear energy and solar energy utilization, photovoltaic and photo-thermal power generation, and wind power technological equipment, intelligent power grids and biomass energy.”<sup>20</sup> Seen in this light, China has planned to conduct ambitious projects on numerous fields: nuclear energy (“industrial bases for new-generation nuclear power equipment”), renewable energy sources (“large wind power generating sets and parts, new assemblies of efficient solar power generation and heat utilization, biomass energy conversion and utilization technologies”), and grid infrastructure (“intelligent power grid equipment”).<sup>21</sup> Naturally, the development of renewable energy sources includes actions in the field of hydro sector. That traditionally developed sub-sector of power industry includes further steps in terms of large-scale installations as well as medium and small units.<sup>22</sup>

Finally, I observe that Chinese energy policy with its “new model” is closely related to “the new material industry.” Energy efficiency is their common denominator, as China wants to develop new, advanced functional materials.<sup>23</sup> Similarly, “the new energy automobile industry,” aimed at “the development of plug-in hybrid electric vehicles, pure electric vehicles and fuel cell auto-

---

<sup>20</sup> *Ibidem.*, p. 9.

<sup>21</sup> *Ibidem.*, p. 10.

<sup>22</sup> M.M. Sokółowski, *op.cit.*, p. 159.

<sup>23</sup> *Ibidem.*



mobile technologies,<sup>24</sup> clearly shows its close relationship with the energy sector.<sup>25</sup>

Seen in this light, let me present some further remarks on mentioned branches of energy sector, i.e. renewable energy sources as well as nuclear units. According to Chinese 12th Five-Year Plan they role in the energy sector has to increase, as China wants to fulfill its low-emission goals.

## **China and renewable energy generation**

China is a world's leader in renewable energy development. It is related to many different dimensions, but two of them are significantly important: number of manufactured installations and installed capacity.<sup>26</sup> Data from China's renewable energy sector are really impressive. In 2013, China installed more new renewable energy than Europe and the rest of the Asia Pacific region.<sup>27</sup> In 2013, Chinese PV capacity reached 13 GW. It was almost one-third of global capacity added that year by China.<sup>28</sup> In 2015, the capacity of PV has grown more than twice. According to the Chinese National Energy Administration the total solar power capacity amounted to 35,78 GW.<sup>29</sup> On the other hand, as the pace of

---

<sup>24</sup> *12th Five-Year Plan*, op.cit., pp. 9–10.

<sup>25</sup> M.M. Sokołowski, op.cit.

<sup>26</sup> *Ibidem*.

<sup>27</sup> *Renewable energy prospects: China*, IRENA, [http://irena.org/remap/IRENA\\_REmap\\_China\\_report\\_2014.pdf](http://irena.org/remap/IRENA_REmap_China_report_2014.pdf) [access date: 30.09.2015].

<sup>28</sup> *The first decade: 2004–2014*, REN21, p. 11, [http://www.ren21.net/Portals/0/documents/activities/Topical%20Reports/REN21\\_10yr.pdf](http://www.ren21.net/Portals/0/documents/activities/Topical%20Reports/REN21_10yr.pdf) [access date: 30.09.2015].

<sup>29</sup> *China Added 7.73 GW of Solar Capacity in H1 – Energy Regulator*, Reuters, <http://www.reuters.com/article/2015/07/28/china-solar-idUSB9N0W501420150728/> [access date: 30.09.2015].

renewable electricity capacity accelerates, the Chinese grid has been unable to absorb the new generation adequately. It delayed solar PV connection or left idle those solar farms that cannot be satisfactorily integrated into the grid.<sup>30</sup>

Mentioned PV capacity can be divided into large solar power plants of the nominal capacity of 30,07 GW and the combined capacity of 5,71 GW of the distributed generation.<sup>31</sup> Moreover, in eight Chinese regions solar capacity exceeded 1 GW (as of the end of June 2015). These are: Gansu province (5,78 GW), Xinjiang Uygur autonomous region 5,7 GW, Qinghai province 4,7 GW, Inner Mongolia autonomous region 4,03 GW, Jiangsu province 3,02 GW, Ningxia Hui autonomous region 2,39 GW, Hebei province 1,6 GW, and Zhejiang province 1.43 GW.<sup>32</sup> What should be mentioned is that solar PV is the largest employer within the renewable sector, with 2,5 million jobs, most of which are concentrated in China (due to its undisputed lead in manufacturing as well as a rapidly expanding domestic market).<sup>33</sup>

---

<sup>30</sup> Clover I., Shaw V., *China idled 9% of its solar capacity in H1 2015*, NEA reports, PV Magazine, [http://www.pv-magazine.com/news/details/beitrag/china-idled-9-of-its-solar-capacity-in-h1-2015--nea-reports\\_100020373/#ix-zz3nnvqIfTE](http://www.pv-magazine.com/news/details/beitrag/china-idled-9-of-its-solar-capacity-in-h1-2015--nea-reports_100020373/#ix-zz3nnvqIfTE) [access date: 30.09.2015].

<sup>31</sup> M. Mancheva, *China Nears 35.8 GW of Installed PV with over 7.7 GW of H1 Additions*, SeeNews Renewables 28.07.2015, <http://renewables.seenews.com/news/china-nears-35-8-gw-of-installed-pv-with-over-7-7-gw-of-h1-additions-486013> [access date: 30.09.2015].

<sup>32</sup> Mancheva M., *China Nears 35.8 GW of Installed PV with over 7.7 GW of H1 Additions*, SeeNews Renewables 28.07.2015, <http://renewables.seenews.com/news/china-nears-35-8-gw-of-installed-pv-with-over-7-7-gw-of-h1-additions-486013> [access date: 30.09.2015].

<sup>33</sup> *Renewables 2015 Global Status Report*, REN 21 2015, p. 36, [http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015\\_Onlinebook\\_low1.pdf](http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf) [access date: 30.09.2015].

With respect to the Chinese wind industry in 2014, China broke a record installing almost extra 20 GW. This made it possible to reach more than 96 GW of total installed capacity in wind power (7% of country's total power capacity, producing 2,78% of all electricity generated).<sup>34</sup> Behind China, in 2014 the US added 4,7 GW of new onshore wind capacity (for comparison in 2013 it was just 764 MW) and reached 64,2GW of wind power installed.<sup>35</sup> As the China's National Energy Administration (NEA) presented, in June 2015 the country's large-scale wind power capacity has reached almost 105 GW, which is 26,8% more than a year back.<sup>36</sup>

Apart from wind energy, China develops hydropower on a large scale.<sup>37</sup> The economically exploitable hydropower potential in China is estimated to be 402 GW, in comparison to approximately 280 GW installed until now, with an average 20 GW added annually.<sup>38</sup> It is confirmed by the data from 2014. At the end of that year, the Chinese hydropower capacity reached 282 GW with extra 21,850 MW (with 600 MW of pumped storage) added to the mix.<sup>39</sup>

---

<sup>34</sup> 2014年风电产业监测情况 [2014 Wind Power Industry Monitoring], NEA, [http://www.nea.gov.cn/2015-02/12/c\\_133989991.htm](http://www.nea.gov.cn/2015-02/12/c_133989991.htm) [access date: 30.09.2015].

<sup>35</sup> *China's wind power capacity now bigger than UK's total electricity supply*, Business Green, <http://www.businessgreen.com/bg/news/2391764/chinas-wind-power-capacity-now-bigger-than-uks-total-energy-supply> [access date: 30.09.2015].

<sup>36</sup> The data do not include plants with capacities lower than 6 MW. See Mancheva M., *Large wind capacity in China nears 105 GW at end-June 2015*, SeeNews Renewables, <http://renewables.seenews.com/news/large-wind-capacity-in-china-nears-105-gw-at-end-june-2015-484453>.

<sup>37</sup> M.M. Sokółowski, op.cit., p. 163.

<sup>38</sup> *The first decade: 2004–2014*, p. 26.

<sup>39</sup> *China*, International Hydropower Association, <https://www.hydropower.org/country-profiles/china> [access date: 30.09.2015].

Chinese investments in clean energy, including renewables and energy efficiency reached a record level of \$89,5 billion in 2014 (32% growth).<sup>40</sup> The United States with “just” \$51.8 billion (8% growth) took second place. In 2014, China invested \$40 billion in solar sector, up 45% on the previous year.<sup>41</sup> A decade ago, China made just 5% of the world’s solar PV modules, whereas now China makes two thirds of them.<sup>42</sup> Moreover, China also produces more wind turbines (large and small) than any other country.<sup>43</sup> With respect to export of Chinese wind turbines, according to a survey and statistical data of Chinese Wind Energy Association on China’s wind power installations, China received orders for 305 wind turbines totaling 494 MW from overseas buyers during the first half of 2015, what represented substantially more than the number of units during the same period in 2014.<sup>44</sup>

Presented circumstances show that renewable energy sources are becoming increasingly important for Chinese energy policy. Due to environmental concerns China needs low-emission sources. Thereby, besides renewables China intensively develops nuclear units.

---

<sup>40</sup> E. Crooks, *China extends lead over US as top green energy backer*, Financial Times, <http://www.ft.com/cms/s/0/8209e816-97de-11e4-b4be-00144feabdc0.html#axzz3TMabpKaf> [access date: 30.09.2015].

<sup>41</sup> *Global Trends in Renewable Energy Investment 2015*, Frankfurt School-UNEP Centre/BNEF 2015, p. 14, [http://apps.unep.org/publications/pmtdocuments/-Global\\_trends\\_in\\_renewable\\_energy\\_investment\\_2015-201515028nefvisual8-mediumres.pdf.pdf](http://apps.unep.org/publications/pmtdocuments/-Global_trends_in_renewable_energy_investment_2015-201515028nefvisual8-mediumres.pdf.pdf) [access date: 30.09.2015].

<sup>42</sup> *Renewables 2015 Global Status Report*, op.cit., p. 29.

<sup>43</sup> Ibidem.

<sup>44</sup> L. Yuanyuan, *China’s Wind Turbine Orders Total 494 MW in First Half of 2015*, Renewableenergyworld.com <http://www.renewableenergyworld.com/articles/2015/09/china-s-wind-turbine-orders-total-494-mw-in-first-half-of-2015.html> [access date: 30.09.2015].

## China and nuclear energy

China started its actions in the area of nuclear energy in 1960s.<sup>45</sup> These were first plans and programmes and until 1970s nothing significant had happened.<sup>46</sup> Then, in 1970 a clear signal for development of Chinese nuclear energy sector was given. It was Chinese prime minister Zhou Enlai who delivered a speech on the nuclear power plants.<sup>47</sup> As he said “[n]uclear power should not only be used for weapons. It should also be used to serve China’s economic development.”<sup>48</sup> Enlai’s declaration resulted in an acceleration of Chinese nuclear efforts.<sup>49</sup> Few years later, in 1985, the construction of China’s first nuclear power plant (Qinshan Nuclear Power Company) started.<sup>50</sup>

In 1990s, China managed to open only one nuclear power plant. It was Daya Bay, equipped with two pressurized water reactors (PWR).<sup>51</sup> Further development of nuclear energy in 1990s was driven by the 9th Five-Year Plan (1996-2000). This Plan covered construction of four nuclear power projects of eight reactors with an installed capacity of 6600 MW (Yuming, 2002). These

---

<sup>45</sup> B.K. Sovacool, S.V. Valentine, *The National Politics of Nuclear Power: Economics, Security, and Governance*, New York 2012, p. 197.

<sup>46</sup> M.M. Sokółowski, op.cit., p. 164.

<sup>47</sup> S. Cappellano-Sarver, *Naval Implications of China’s Nuclear Power Development*, [in] *China’s Future Nuclear Submarine Force*, A. Erickson et al. (eds), Annapolis 2007.p. 118.

<sup>48</sup> W. Zhihong, *The nuclear option*, China Daily, from [http://www.chinadaily.com.cn/bw/2008-10/20/content\\_7119381.htm](http://www.chinadaily.com.cn/bw/2008-10/20/content_7119381.htm) [access date: 30.09.2015].

<sup>49</sup> M.M. Sokółowski, op.cit., pp. 164–165.

<sup>50</sup> X. Cheng, *Nuclear power in China and first AP1000 nuclear power projects*, <http://www.iaea.org/NuclearPower/Downloadable/Meetings/2013/2013-02-11-02-14-TM-INIG/22.cheng.pdf> [access date: 30.09.2015].

<sup>51</sup> M.M. Sokółowski, op.cit., p. 165.

projects (Qingshang Phase 2, Qingshan Phase 3, Lingao, and Tianwan nuclear power plants) were expected to be fully operational during the 10th Five-Year Plan (2001-2005).<sup>52</sup> Next central plan, i.e. 11th Five-Year Plan (2006-2010) called for acceleration of construction of nuclear power projects.<sup>53</sup> As the part of the Plan sites for additional forty-nine nuclear power plants were identified. They accounted for a total generating capacity ranging from 47-52 GW.<sup>54</sup> In the following years Chinese government planned even more significant development of the nuclear generating.<sup>55</sup> Projections for nuclear power covered 70-80 GW installed by 2020, 200 GW by 2030 and 400-500 GW by 2050.<sup>56</sup>

However, in 2011, after the Fukushima accident the Chinese government suspended its actions in the field of the nuclear programme.<sup>57</sup> This was aimed at carrying out “comprehensive safety checks of all nuclear projects, including those under construction (with an immediate halt required on any not satisfactory),” as WNA notices.<sup>58</sup> Nevertheless, in October 2012, the Chinese government decided to install 60 GW of nuclear power by 2020. The policy “has moved from ‘moderate development’ of nuclear pow-

---

<sup>52</sup> Ibidem.

<sup>53</sup> H. Weiping, *Introduction to the 11th Five-Year Plan on Energy Development*, <http://www.uschinaogf.org/forum8/monday/2-hu%20weipingndrc%20topic-11%20five-year%20plan%20english.pdf> [access date: 30.09.2015].

<sup>54</sup> A.C. Kadak, *Nuclear Power: “Made in China”*, p. 4, [http://web.mit.edu/pebble-bed/papers1\\_files/Made%20in%20China.pdf](http://web.mit.edu/pebble-bed/papers1_files/Made%20in%20China.pdf) [access date: 30.09.2015].

<sup>55</sup> M.M. Sokółowski, op.cit.

<sup>56</sup> *Nuclear power in China*, WNA. from <http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/China--Nuclear-Power/> [access date: 30.09.2015].

<sup>57</sup> M.M. Sokółowski, op.cit., p. 166.

<sup>58</sup> *Nuclear power in China*, op.cit.

er to ‘positive development’ in 2004, and in 2011–12 to ‘steady development with safety’.<sup>59</sup>

Actions taken by China clearly shows that policy went in the direction of the latter (i.e. steady development).<sup>60</sup> Seen in this light, in 2014 September, NEA announced that China’s goal has been to become a world leader in nuclear power by 2020.<sup>61</sup>

### **China, coal and CO<sub>2</sub> emissions**

In spite of including many points on low-emission energy sources, the 12th Five-Year Plan is related in many ways to traditional energy sources. This concerns development of coal mines and restructuring the coal industry (coal enterprise groups and coal mine enterprises), or exploration of oil and natural gas (with shale gas and coal-bed gas), as well as construction of large coal-fired power plants near coal industry sites.<sup>62</sup>

According to the World Energy Council (WEC) China alone accounts for half of the world coal consumption,<sup>63</sup> what makes that China is number one in these terms. Country’s coal consumption in 2013 was almost three times higher than it was in

---

<sup>59</sup> Ibidem.

<sup>60</sup> M.M. Sokołowski, op.cit.

<sup>61</sup> S. Chen, *China plans to be world leader in nuclear power by 2020*, South China Morning Post, <http://www.scmp.com/news/china/article/1591984/china-plans-be-world-leader-nuclear-power-2020?page=all> [access date: 30.09.2015].

<sup>62</sup> M.M. Sokołowski, op.cit., pp. 156–157.

<sup>63</sup> *World Energy Issues Monitor*, World Energy Council, p. 25, <https://www.worldenergy.org/wp-content/uploads/2015/01/2015-World-Energy-Issues-Monitor.pdf> [access date: 30.09.2015].

2000.<sup>64</sup> Interestingly, in September 2015 the Chinese government in the China Statistical Abstract 2015 presented a revision to China's historical coal consumption and production. Between 2000 and 2013 the energy-content-based coal consumption was up to 14% higher than previously reported, similarly the coal production was up to 7% higher.<sup>65</sup> Apart from these data, China altered information on the total primary energy consumption and production, which were also higher than previously reported-up to 11% and 7% in some years.<sup>66</sup> Moreover, as EIA indicates, China is the world's top coal producer and importer since the early 1980s.<sup>67</sup> Furthermore, EIA links rising coal production in China with the fact that China became the world's largest energy producer.<sup>68</sup> Coal production rose 9% in 2013 from 2012, and it reached nearly 4,4 billion tons.<sup>69</sup>

Recalled circumstances, especially these related to mentioned revision of coal-data, means that China might have been emitting far more greenhouse gas than it is believed. Even without counting those data, the available reports shows that emissions in China pose a huge challenge. China leads worldwide, being the biggest energy-related CO<sub>2</sub> emitter that in 2007 overtook the US's position in total annual CO<sub>2</sub> emissions.<sup>70</sup> In 2013 China pro-

---

<sup>64</sup> *China*, EIA, <http://www.eia.gov/beta/international/analysis.cfm?iso=CHN> [access date: 30.09.2015].

<sup>65</sup> *Recent statistical revisions suggest higher historical coal consumption in China*, EIA, <http://www.eia.gov/todayinenergy/detail.cfm?id=22952#> [access date: 30.09.2015].

<sup>66</sup> *Ibidem*.

<sup>67</sup> *China*, EIA, *op.cit.*

<sup>68</sup> *Ibidem*.

<sup>69</sup> *Ibidem*

<sup>70</sup> W.J.W. Botzen, J.M. Gowdy, J.C.J.M. van den Bergh, *Cumulative CO<sub>2</sub> emissions: shifting international responsibilities for climate debt* "Climate policy" 2008, no. 8 (6), p. 570.



duced 10,3 billion tonnes of CO<sub>2</sub> what was 29% share in global CO<sub>2</sub> emissions.<sup>71</sup> Compared to 2012, in 2013 China increased its CO<sub>2</sub> emissions by 4,2%.<sup>72</sup> On the one hand, according to statistics it was lower than the annual increases of about 10% over the last decade, but on the other, higher than the increase of 3,4% in 2012.<sup>73</sup> Nevertheless, the mentioned revision concerning coal data disrupts the final shape of the Chinese energy sector.

Although, it is unjustified to say that China does not take any action to change this image. This is confirmed by moves in the field of the renewable energy and the nuclear sources. It is also expressed in the Chinese energy policy. 12th Five-Year Plan included massive reductions in energy consumption intensity and carbon dioxide emissions. This was to be done by decreasing the growth of industries with high energy consumption, and increasing the energy efficiency, revising the energy consumption structure, and development of the use of non-fossil energy resources, as well as establishment and improvement of the emissions monitoring, with building a carbon emission trading market.<sup>74</sup>

---

<sup>71</sup> For comparison, the United States produced 5,3 billion tonnes, and the European Union 3,7 billion tonnes of CO<sub>2</sub>, *Trends in global CO<sub>2</sub> emissions: 2014 report*, Emissions Database for Global Atmospheric Research, p. 4, [http://edgar.jrc.ec.europa.eu/news\\_docs/jrc-2014-trends-in-global-co2-emissions-2014-report-93171.pdf](http://edgar.jrc.ec.europa.eu/news_docs/jrc-2014-trends-in-global-co2-emissions-2014-report-93171.pdf) PBL [access date: 30.09.2015].

<sup>72</sup> *Ibidem*.

<sup>73</sup> *Ibidem*.

<sup>74</sup> *12th Five-Year Plan*, *op.cit.*, pp. 29–30. Apart from it the 12th Five-Year Plan covers many others steps in the field of climate change. As stated there China “must carry out comprehensive adjustments to the composition of the industrial and resource structures, save energy and improve energy efficiency and increase forest carbon sinks, amongst several other measures. We must significantly reduce the intensity of our energy consumption and CO<sub>2</sub> emissions, as well as effectively regulate greenhouse gas (GHG) emissions. We must rationally regulate our total energy consumption levels, carry out serious manage-

Moreover, the 12 Five-Year Plan addressed the Chinese willingness to join in international efforts for climate protection. China declared its active participation in the international climate negotiations, as well as its openness to develop cooperation in scientific research and to support developing countries in confronting the challenges of climate change.<sup>75</sup>

### To sum up

An analysis of the historical and current data of electricity demand makes it possible to conclude that the Chinese installed capacity will grow over the next decades. The problem is to determine the size of this growth. According to EIA, by 2040 China will reach 2265 GW of power installed.<sup>76</sup> The World Nuclear Association predicts that in 2020 China will have about 1600 GW of power installed, and 2000 GW in 2025.<sup>77</sup> On the other hand, Bloomberg New Energy Finance forecasts that by 2030 China's

---

ment of resource usage, accelerate the formulation of resource development plans, clarify total regulatory targets and define a workable mechanism. We will promote the planting of trees and forestation to increase the national forest-cover area to 12,5 million hectares. We will accelerate research, development and application of low carbon technologies and regulate GHG emitting sectors such as industry, construction, transportation and agriculture. We will look into creating low carbon product standardisation, labelling and authentication systems, establish an effective system for calculating GHG emission statistics and gradually create a carbon emissions trading system. We will advance low carbon pilot projects." Ibidem, p. 30.

<sup>75</sup> M.M. Sokółowski, *op.cit.*, p. 161.

<sup>76</sup> *China*, EIA, *op.cit.*

<sup>77</sup> *Nuclear power in China*, *op.cit.*

total electricity generation capacity will amount to approximately 2700 GW.<sup>78</sup>

The question is how will the structure of Chinese energy mix look like? It is very probable that coal will remain the dominant position as a fuel source. BP indicates that its share drops from 77% today to 59% in 2035, but the share of renewable energy sources will increase from 3% to 12%.<sup>79</sup> Seen in this light, IRENA also predicts a rise of renewables in China. This includes an increase to 16% by 2030.<sup>80</sup> The renewable share can be even higher. As IRENA admits the share of renewables can quadruple to 26% with technologies currently available, what would make China the world's largest user of renewable energy, accounting for about 20% of global use.<sup>81</sup> IRENA forecasts that in 2030, under the business-as-usual scenario, 30% of China's electricity will come from renewable what in comparison to current situation is a 10% increase.<sup>82</sup> Also BNEF draws a very "green" scenario of the development of the Chinese renewable energy sector. According to BNEF in 2030 installed renewable capacity will be equal to coal capacity.<sup>83</sup> In this scenario, renewables will contribute to more than half of new capacity growth, increasing from 27% to 44% in 2030, while coal-fired power generation capacity will decrease from 67% in 2012 to 44% in 2030.<sup>84</sup>

---

<sup>78</sup> *The future of China's power sector: Executive summary*, BNEF, <http://bnef.com/InsightDownload/8694/pdf/> [access date: 30.09.2015].

<sup>79</sup> *BP Energy Outlook 2035: Country Insights China*, BP, [http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country\\_insights\\_China\\_2035.pdf](http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country_insights_China_2035.pdf) [access date: 30.09.2015].

<sup>80</sup> *Renewable energy prospects: China*, op.cit., p. 2

<sup>81</sup> Ibidem.

<sup>82</sup> Ibidem, pp. 1–2

<sup>83</sup> M.M. Sokolowski, op.cit., p. 164.

<sup>84</sup> *The future of China's power sector*, op.cit.

Nevertheless, as presented in the title of this paper, does Chinese energy policy enter the phase of an evolution or a revolution? Are conducted actions and implemented steps rather slight changes in the energy mix or significant moves towards totally new energy sector? Will China achieve its energy goals or will it fail in this field? How will the 13th Five-Year Plan look like? These are just a few questions that may be risen in the discussion on the Chinese energy policy. On the basis of my research, I can give following answers.

Firstly, in terms of shares of each energy sources China rather evolves its energy mix. As the country has an enormous energy sector it is not an easy thing to resign from one type of source and replace it with another one. Although, when it comes to each, specific branch of energy, especially the renewables, with respect to conducted investments and power installed China reaches revolutionary development. The progress in terms of new capacity installed is significant.

However, the low-emission sources are just a minor part of the Chinese energy mix, where conventional energy, in particular, coal power sources prevail. Thereby, CO<sub>2</sub> emissions in China are at a very high level, and even the impressive development of renewables together with nuclear power will not change this situation in a short run.<sup>85</sup>

Secondly, the information coming from the Chinese government and country's energy sector rather shows that China will achieve its energy goals. However, some undermine the Chinese statistics as being discussable and not always reflecting the reality. On the other hand, the last example of revision of the coal-data shows that China pays more attention to the matter of the statistics reliability.

---

<sup>85</sup> M.M. Sokolowski, *op.cit.*, p. 167.

Thirdly, many factors prove that the next central plan will be even more progressive than the 12th Five-Year Plan. I notice that the growing eco-awareness of Chinese society and will of Chinese people to live in a cleaner environment, noted by the government and local authorities as well as and Chinese companies, may be its background. Thereby, China is likely to intensify efforts on national energy and climate agenda.<sup>86</sup>

### Bibliography

- 12th Five-Year Plan*, <http://www.britishchamber.cn/sites/default/files/full-translation-5-yr-plan-2011-2015.doc> [access date: 30.09.2015].
- 2014年风电产业监测情况 [2014 Wind Power Industry Monitoring], NEA, [http://www.nea.gov.cn/2015-02/12/c\\_133989991.htm](http://www.nea.gov.cn/2015-02/12/c_133989991.htm) [access date: 30.09.2015].
- 9–1 *Total Production of Energy and Its Composition*, China Statistical Yearbook 2014, <http://www.stats.gov.cn/tjsj/ndsj/2014/indexeh.htm> [access date: 29.09.2015].
- 9–15 *Installed Capacity of Power Generation*, China Statistical Yearbook 2014, <http://www.stats.gov.cn/tjsj/ndsj/2014/indexeh.htm> [access date: 29.09.2015].
- 9–2 *Total Consumption of Energy and Its Composition*, China Statistical Yearbook 2014, <http://www.stats.gov.cn/tjsj/ndsj/2014/indexeh.htm> [access date: 29.09.2015].
- Botzen W.J.W., Gowdy J.M., Bergh J.C.J.M. van den, *Cumulative CO<sub>2</sub> emissions: shifting international responsibilities for climate debt* “Climate policy” 2008, no. 8 (6).
- BP Energy Outlook 2035: Country Insights China*, BP, [http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country\\_insights\\_China\\_2035.pdf](http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country_insights_China_2035.pdf) [access date: 29.09.2015],

---

<sup>86</sup> *Ibidem*, pp. 166–167.

- BP Energy Outlook 2035: Country Insights China*, BP, [http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country\\_insights\\_China\\_2035.pdf](http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/Country_insights_China_2035.pdf) [access date: 30.09.2015].
- Cappellano-Sarver S., *Naval Implications of China's Nuclear Power Development*, [in] *China's Future Nuclear Submarine Force*, A. Erickson et al. (eds), Annapolis 2007.
- Chen S., *China plans to be world leader in nuclear power by 2020*, South China Morning Post, <http://www.scmp.com/news/china/article/1591984/china-plans-be-world-leader-nuclear-power-2020?page=all> [access date: 30.09.2015].
- Cheng X., *Nuclear power in China and first AP1000 nuclear power projects*, <http://www.iaea.org/NuclearPower/Downloadable/Meetings/2013/2013-02-11-02-14-TM-INIG/22.cheng.pdf> [access date: 30.09.2015].
- China Added 7.73 GW of Solar Capacity in H1 – Energy Regulator*, Reuters, <http://www.reuters.com/article/2015/07/28/china-solar-idUSB9N0W501420150728/> [access date: 30.09.2015].
- China*, EIA, <http://www.eia.gov/beta/international/analysis.cfm?iso=CHN> [access date: 30.09.2015].
- China*, International Hydropower Association, <https://www.hydropower.org/country-profiles/china> [access date: 30.09.2015].
- China's installed electricity capacity by the end of 2014*, China Daily, [http://www.chinadaily.com.cn/business/chinadata/2015-02/13/content\\_19582590.htm](http://www.chinadaily.com.cn/business/chinadata/2015-02/13/content_19582590.htm)
- China's wind power capacity now bigger than UK's total electricity supply*, Business Green, <http://www.businessgreen.com/bg/news/2391764/chinas-wind-power-capacity-now-bigger-than-uks-total-energy-supply> [access date: 30.09.2015].
- Clover I., Shaw V., *China idled 9% of its solar capacity in H1 2015, NEA reports*, PV Magazine, [http://www.pv-magazine.com/news/details/beitrag/china-idled-9-of-its-solar-capacity-in-h1-2015--nea-reports\\_100020373/#ixzz3nnvqIfTE](http://www.pv-magazine.com/news/details/beitrag/china-idled-9-of-its-solar-capacity-in-h1-2015--nea-reports_100020373/#ixzz3nnvqIfTE) [access date: 30.09.2015].
- Crooks E., *China extends lead over US as top green energy backer*, Financial Times, <http://www.ft.com/cms/s/0/8209e816-97de-11e4-b4be-00144feabd0c.html#axzz3TMabpKaf> [access date: 30.09.2015].
- Eckstein A., *China's Economic Revolution*, New York 1977.

- Global Trends in Renewable Energy Investment 2015*, Frankfurt School-UNEP Centre/BNEF 2015, [http://apps.unep.org/publications/pmtdocuments/Global\\_trends\\_in\\_renewable\\_energy\\_investment\\_2015-201515028nefvisual8-mediumres.pdf.pdf](http://apps.unep.org/publications/pmtdocuments/Global_trends_in_renewable_energy_investment_2015-201515028nefvisual8-mediumres.pdf.pdf) [access date: 30.09.2015].
- Hu A., *China: Innovative Green Development*, Heidelberg 2014.
- Kadak A.C., *Nuclear Power: "Made in China,"* [http://web.mit.edu/pebble-bed/papers1\\_files/Made%20in%20China.pdf](http://web.mit.edu/pebble-bed/papers1_files/Made%20in%20China.pdf) [access date: 30.09.2015].
- Mancheva M., *China Nears 35.8 GW of Installed PV with over 7.7 GW of H1 Additions*, SeeNews Renewables 28.07.2015, <http://renewables.seenews.com/news/china-nears-35-8-gw-of-installed-pv-with-over-7-7-gw-of-h1-additions-486013> [access date: 30.09.2015].
- Mancheva M., *China Nears 35.8 GW of Installed PV with over 7.7 GW of H1 Additions*, SeeNews Renewables 28.07.2015, <http://renewables.seenews.com/news/china-nears-35-8-gw-of-installed-pv-with-over-7-7-gw-of-h1-additions-486013> [access date: 30.09.2015].
- Mancheva M., *Large wind capacity in China nears 105 GW at end-June 2015*, SeeNews Renewables, <http://renewables.seenews.com/news/large-wind-capacity-in-china-nears-105-gw-at-end-june-2015-484453>.
- Nuclear power in China*, WNA. from <http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/China--Nuclear-Power/> [access date: 30.09.2015].
- Recent statistical revisions suggest higher historical coal consumption in China*, EIA, <http://www.eia.gov/todayinenergy/detail.cfm?id=22952#> [access date: 30.09.2015].
- Renewable energy prospects: China*, IRENA, [http://irena.org/remap/IRENA\\_REmap\\_China\\_report\\_2014.pdf](http://irena.org/remap/IRENA_REmap_China_report_2014.pdf) [access date: 30.09.2015].
- Renewables 2015 Global Status Report*, REN 21 2015, [http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015\\_Onlinebook\\_low1.pdf](http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf) [access date: 30.09.2015].
- Sokołowski M.M., *Developments of the Energy Policy of China: A Long March not a Short Run*, [in:] *Socio-Economic Relations between Europe and Asia in the 21st Century*, M. Sitek, M. Łęski (eds) Józefów 2014.
- Someren, T.C.R. van, Someren-Wang S. van, *Green China: Sustainable Growth in East and West*, London 2012.

Sovacool B.K., Valentine S.V., *The National Politics of Nuclear Power: Economics, Security, and Governance*, New York 2012.

*The first decade: 2004-2014*, REN21, [http://www.ren21.net/Portals/0/documents/activities/Topical%20Reports/REN21\\_10yr.pdf](http://www.ren21.net/Portals/0/documents/activities/Topical%20Reports/REN21_10yr.pdf) [access date: 30.09.2015].

*The future of China's power sector: Executive summary*, BNEF, <http://bnef.com/InsightDownload/8694/pdf/> [access date: 30.09.2015].

*Trends in global CO<sub>2</sub> emissions: 2014 report*, Emissions Database for Global Atmospheric Research, [http://edgar.jrc.ec.europa.eu/news\\_docs/jrc-2014-trends-in-global-co2-emissions-2014-report-93171.pdf](http://edgar.jrc.ec.europa.eu/news_docs/jrc-2014-trends-in-global-co2-emissions-2014-report-93171.pdf) PBL [access date: 30.09.2015].

Weiping H., *Introduction to the 11th Five-Year Plan on Energy Development*, <http://www.uschinaogf.org/forum8/monday/2-hu%20weipingndrc%20topic-11%20five-year%20plan%20english.pdf> [access date: 30.09.2015].

*World Energy Issues Monitor*, World Energy Council, <https://www.worldenergy.org/wp-content/uploads/2015/01/2015-World-Energy-Issues-Monitor.pdf> [access date: 30.09.2015].

Yuanyuan L., *China's Wind Turbine Orders Total 494 MW in First Half of 2015*, Renewableenergyworld.com <http://www.renewableenergyworld.com/articles/2015/09/china-s-wind-turbine-orders-total-494-mw-in-first-half-of-2015.html> [access date: 30.09.2015].

Zhihong W., *The nuclear option*, China Daily, from [http://www.chinadaily.com.cn/bw/2008-10/20/content\\_7119381.htm](http://www.chinadaily.com.cn/bw/2008-10/20/content_7119381.htm) [access date: 30.09.2015].