

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,200

Open access books available

169,000

International authors and editors

185M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Chapter

The State of Renewable Energy in China and Way Forward in New Scenario Policies

*Daniel Adu, Ransford O. Darko, Boamah Kofi Baah
and Agnes Abbey*

Abstract

China has a huge undeveloped potential in the field of renewable energy and represents the highest nation in hydropower both in installation and generation worldwide with which contributes greatly in their energy supply and helps in elimination energy demand situation in the country to direct the energy system toward the area of sustainably, clean, and quality energy supply for its safety in the country. The manuscript discusses the current renewable energy systems in China, the potentials for various renewable energy sources, and way forward. It also discusses the expected state of renewable energy in the next four decades in China and the various strategic development techniques. The current renewable energy situations, both demand and supply situations, have been discussed. Summary of the approaches for new development by the various energy sectors in the country as well as support of the government in renewable energies has been analyzed.

Keywords: renewable energy, potential, energy consumption, hydropower, wind power, solar power

1. Introduction

With the advent of renewable energy and high investment risk, the main financial support areas of R & D activities for commercial applications are REPG [1], among the significant financial support for the Chinese government's special funds for renewable energy, for the development of renewable energy-related activities, including resource exploration, and the development of standards, as well as the development of the project [2]. A small number of specific regulations were allotted for the special fund. For example, the Operation Views on Promoting the Development of Wind Power Generation Industry in 2006 was released by NDRC and MOF. It specified that the government would select several competent wind turbine and component manufacturers in which the R&D and testing of new products could be supported by the Renewable Energy Development Special Fund [3]. In the same way, appropriate laws and regulations also specified that the R&D of new products, as well as site industrialization of key technologies in the solar power industry, will be

supported by a portion of the special fund [4, 5]. In addition to the special funds for the development of renewable energy, the government of China has as well provided R&D funds for renewable energy through the following plans and programs, for example, The National Basic Research Program of China (“973” Program), The “Five-year Plans,” and The National Natural Science Fund and The National High Technology Research and Development Program of China (“863” Program), [6]. Similarly, Liu et al., on the other hand, have divided China’s current renewable energy policy into several categories, including development planning, industry guidance and technical support, cost sharing, price incentives, legal responsibility, and promotion [7].

2. China’s energy structure (supply and demand)

China’s energy demand is currently led by industrial sector, but there will be a drastic change in future. While total energy demand will remain as present in 2050, the structure will change. There will be a rise in the transport and building sectors energy consumption, while the industrial sector consumption will be reduced. Based on the policy report, the final energy demand is expected to reach 3397 Mtce by the year 2050 [8]. This rising demand can be resolved through renewable sources. This is true for both scenarios; nevertheless, the electrification and share of renewable energy are great in the Below 2°C Scenario. Here, 54% of energy demand will be electrical energy in 2050 in the scenario compared to 37% in the Stated Policies Scenario. Industrial area fossil energy use is mainly substituted by electricity. China is on the path to a greener and more diversified energy supply. The higher dependence on coal is removed and substituted with nonfossil energy sources. In both scenarios, the energy demand will peak around 2030, and by 2050 the Below 2°C Scenario will have an energy demand of 3202 Mtce [8]. **Figure 1** shows the main energy installed capacity and peak demand in China by regions. **Figure 2(a, b)** shows the final energy demand (Mtce) in 2050 in the two scenarios compared with today, by sector and fuel type. There was an increase in total energy production from 627.7 million tce to 3600 between 1978 and 2014, with the consumption also rising by 5.69 times during the same period, attainment of 4260 million tce in 2014. **Figure 3** shows China’s Primary Energy Consumption between 2010 and 2016. **Figure 4** compares the energy consumption by source in China between 2010 and 2016 [8].

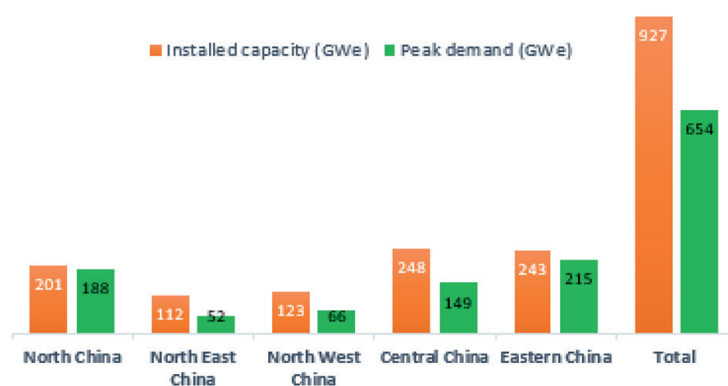


Figure 1.
The main energy installed capacity and peak demand in China by regions.

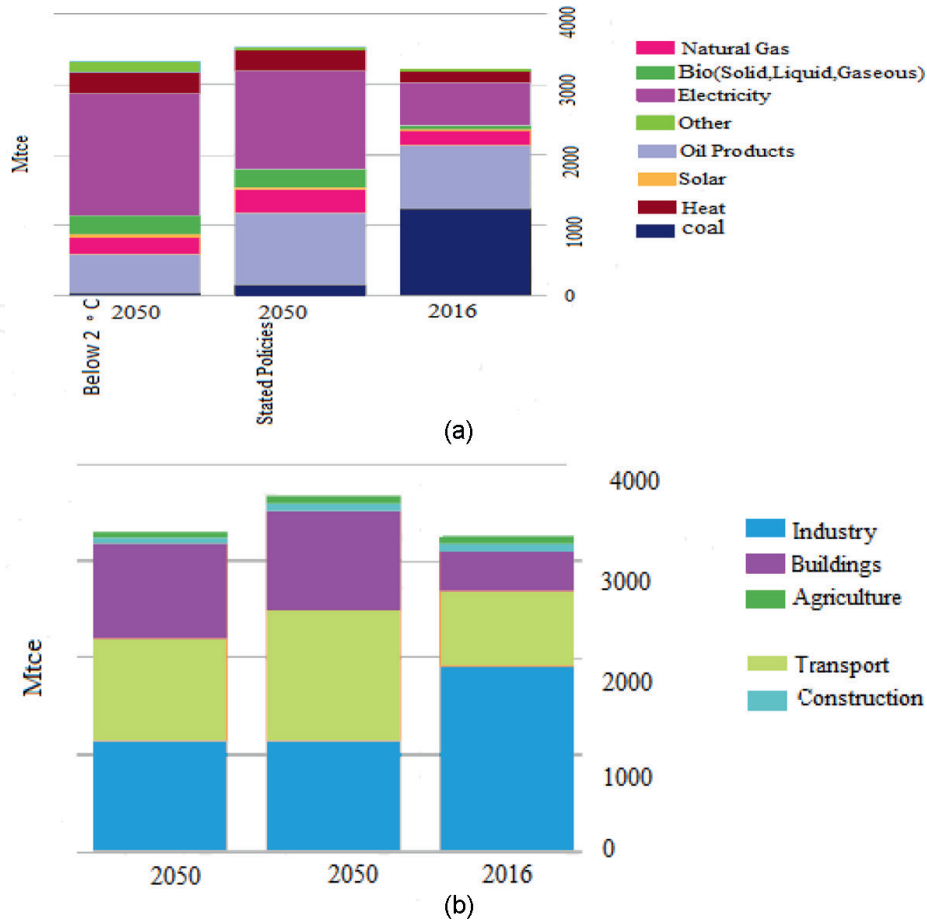


Figure 2. Final energy demand (Mtce) in 2050 in the two scenarios compared with today, by sector and fuel type.

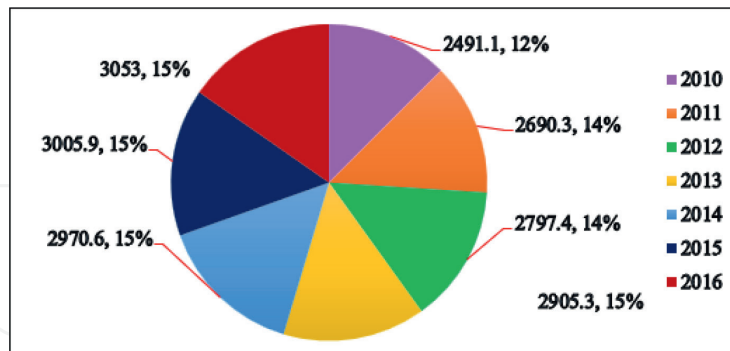


Figure 3. China's Primary Energy Consumption between 2010 and 2016. * Primary energy comprises commercially traded fuels, including modern renewables used to generate electricity. Notes: Oil consumption is measured in million tonnes; other fuels are measured in million tonnes of oil equivalent.

As stated by Li Fulong, consumption of coal during the first half of 2017 was about 1.83 billion metric tons making 59.8% of the total energy. There was a rise of 3% in natural gas and nonfossil fuels mix to 29%. Based on the energy sector's 5-year plan for 2016–2020, China targets to bring down the country's share of coal energy mix down to less than 58%. China's total energy consumption is expected to reach 5 billion tons by 2020, bringing about an annual increase of approximately 2.5% between 2016 and 2020. As stated by the plan, there will be an increase in the share of nonfossil fuels to over 15% with the share of natural gas also reaching 10% [9].

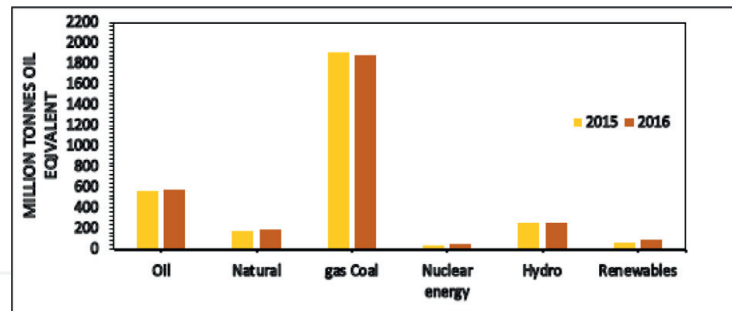


Figure 4. China's Primary Energy Consumption by fuel type between 2010 and 2016. * Primary energy comprises commercially traded fuels, including modern renewables used to generate electricity. Notes: Oil consumption is measured in million tonnes; other fuels are measured in million tonnes of oil equivalent.

3. Current situation of renewable energy resources in China

As stated by the 13th Five-Year Plan of China (between 2015 and 2020), energy from nonfossil was expected to constitute 15% of the entire main energy consumption during 2020. Based on the statistics of China's energy council, China's national total electricity consumption as on October 2017 was 513.0 billion kWh, an increase of 5.0% over the same period in 2016. The primary industry consumption was 8.4 billion kWh of electricity, an increase of 3.6%; the secondary industry consumption also was 365 billion kWh of electricity, an increase of 3.0%; tertiary industry consumption was 70.8 billion kWh of electricity, an increase of 12.4%; and urban and rural resident's consumption was 68.8 billion kWh of electricity, an increase of 8.7%. All increased during the same time in 2016. The national installed capacity also reached 1.67 billion kW, and thus, 6000 kW and over power plants, an increase of 7.3% compared to 2016. Thus, hydropower was 300 million kW, thermal power was 1.08 billion kW, nuclear power was 35.82 million kW, and wind power was 160 million kW [10]. On the side of generation, the hydropower generation capacity reached 923.4 billion kWh within the first 10 months of 2017, an increase of 2.2% compared to the same time in 2016. Others like thermal power generation capacity reached 3799.3 billion kWh, an increase of 5.4%, nuclear power generation reached 203.6 billion kWh, an increase of 18.4, and wind power generating capacity reached 239.7 billion kilowatts, an increase of 25.3%. **Figures 3 and 4** show the power production and installed capacity in the country as at the end of October 2017 with the year-on-year change in % [11] (**Figures 5 and 6**). **Figure 7** shows Electricity Generation from Renewables in China by source, 2008–2015.

According to China's electricity council, power system in China is still subjugated by coal; nevertheless, the 2016 additional installed capacity of solar power of 77 GW and wind power and solar power total of up to 149 GW brought about the higher portion of renewable installed capacity. Wind turbines generated 241 TWh of electricity in 2016, thus, an increase of 30% on that of 2015. Solar power generation also adds up by 72% with an increase in generation of 66TWh in 2016. Nuclear power stations also saw growth in 2016 compared to 2015 with a generation of additional 24% electricity reaching 213 TWh [13]. **Figure 8** shows the installed power generating capacity in China together with the additions in 2016, while **Figure 9** shows year-on-year growth in power production as **Figure 10** shows the energy generation mix in the country 2016.

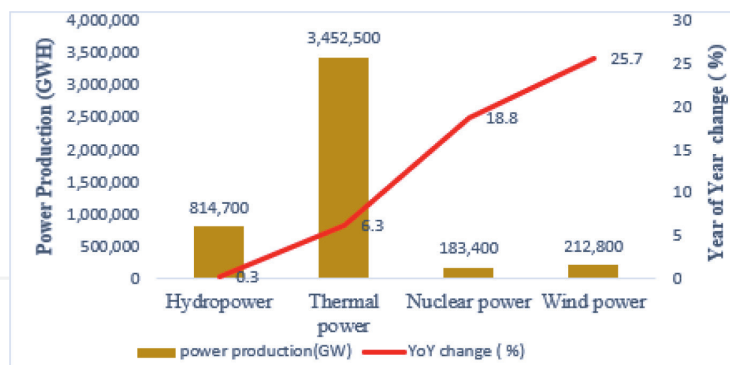


Figure 5. Power production from renewables in China 2017. *Thermal includes coal, gas, oil, and biomass.

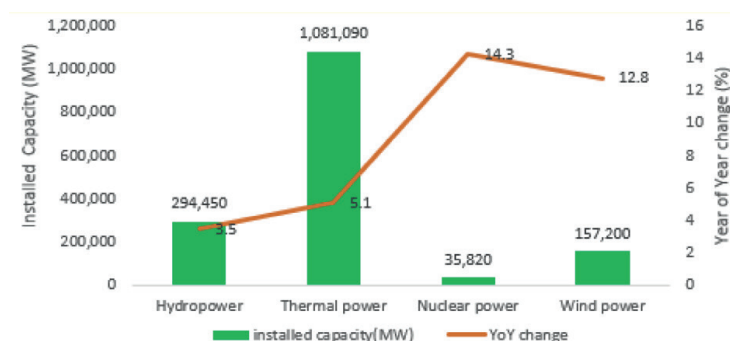


Figure 6. Renewable energy installed capacity in China 2017. *Thermal includes coal, gas, oil, and biomass.

4. Renewable energy potential

China has a huge undeveloped potential in the field of renewable energy, and the government has recently been aware of these resources and begun to take steps to take advantage of that potential. A study has shown that the country will be able to meet the emerging new demand if all the targets set by the government are achieved as it will yield new renewable energy generation capacity of 362 GW [15].

4.1 Hydropower

China leads globally in the field of hydropower installment capacity and generation. The country in 2016 saw growth in its overall installed hydro capacity of about 11.74 GW making a total of 330 GW [16]. China is the leading country of hydropower development in the world with the world's leader in hydropower scale and project capacity development, with the largest hydropower station in the world's situated along the Yangtze River. China had 117 GW of installed capacity in 2005 with the aforementioned of 300 GW by 2030. According to World Watch Institute, China has hydropower potential capacity of 500 GW [17]. The strong water resources in China are mainly in the western underdeveloped and along the east coast where electricity demand increases. Most of China's water resources are in Sichuan, Tibet, and Yunnan, where the Yangtze River begin in Tibet and flows through Sichuan; the Pearl began in Yunnan [18]. China has greatly made a perfect use of the various most important channels in the country for hydroelectric development. **Figure 3** shows The Three

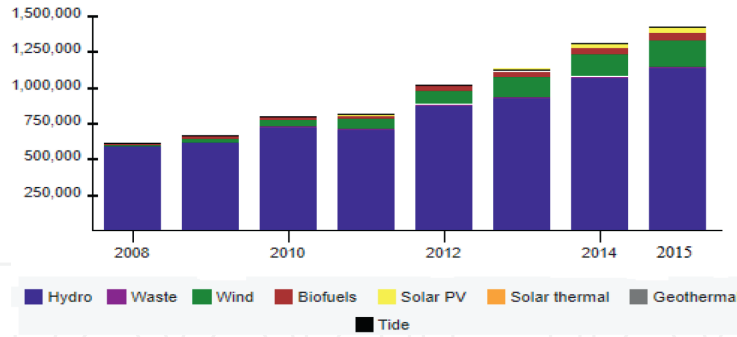


Figure 7. Electricity Generation from Renewables in China by source, 2008–2015 (GWh) [12].

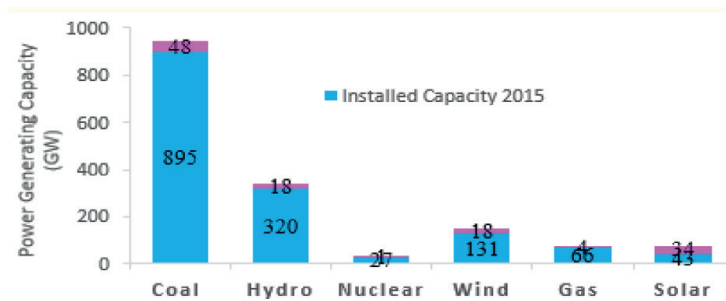


Figure 8. The installed power generating capacity in China together with the additions in 2016 in GW [13].

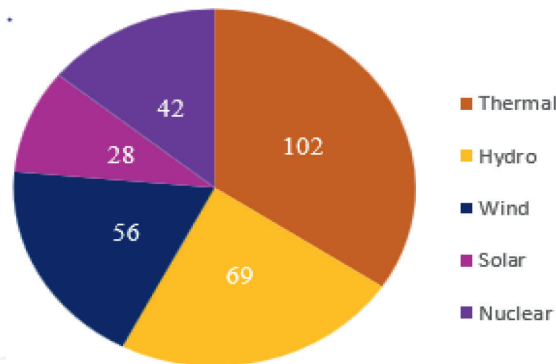


Figure 9. Year-on-year growth in power production (TWh) [13].

Gorges Dam, while **Figure 4** shows the largest hydroelectric plants in China with their generation and installed capacity (**Figure 11**) [19].

4.2 Wind

With hydropower, wind power has a great opportunity to become a major source of renewable energy in China. The Chinese government has developed a potential power generation capacity for the development of China’s wind power market, with its ability to increase its planned capacity by 2020 to generate 30 GW. China experienced a significant increase in energy from the wind farm throughout the country. [20]. The wind power industry in China has succeeded in rapid growth due to government intervention. China is a world leader in wind power generation, with the largest installed capacity of any nation [21] and continued rapid growth in new wind

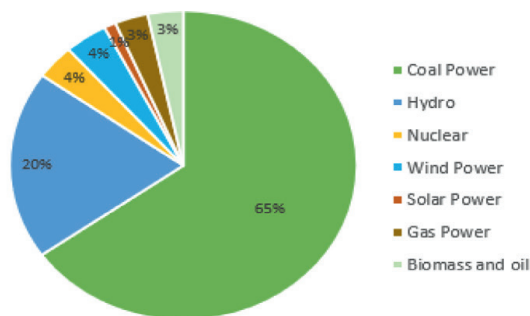


Figure 10.
 China's electricity mix in 2016 in TWh [14].

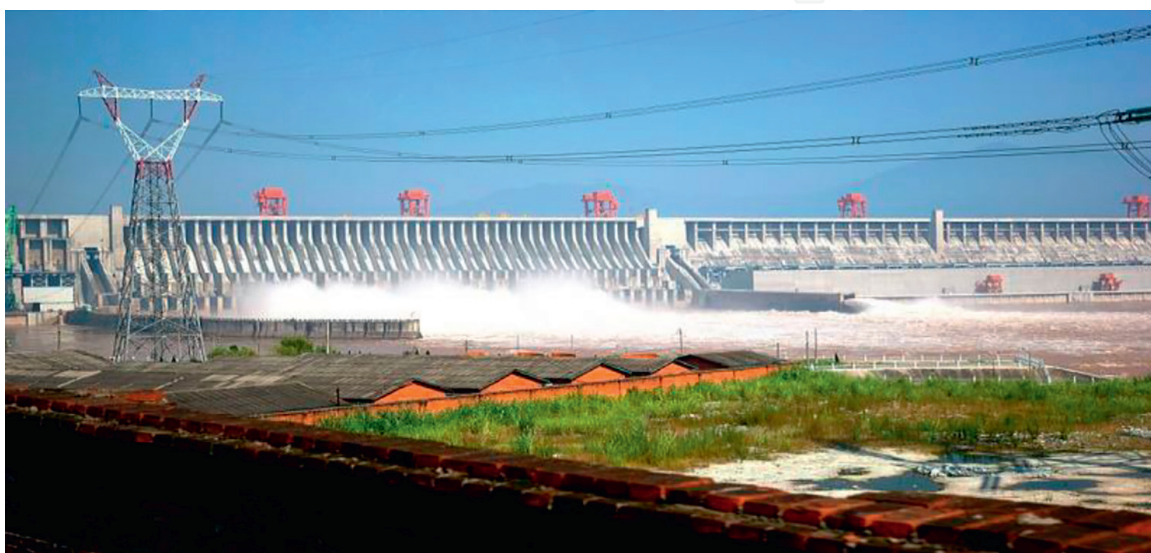


Figure 11.
 The Three Gorges Dam.

facilities. [22]. In 2016, the country added 19.3 GW of wind power generation capacity [23] reaching a total capacity of 149 GW, [12] with an electricity generation of 241 TWh representing 4% of national total electricity consumption. China's projection is to attain 250 GW of wind capacity by 2020 as part of government's promise to produce 15% of all electricity from renewable resources. [24]. The status of the base has been included in the policy and market with the development of tax incentives. In 2004, the Commission carried out a "wind power concession" for a 20-year work cycle to lessen the in-grid wind power tariff through the establishment of wind farms with high capacity [25]. Prior to 2006, the Commission agreed to construction of five large wind farms, all of having no less than 100 (MW) capacity [25]. As shown **Figure 12**. When the law of renewable energy was put into effect in 2006, the grid company was obliged to sign a grid connection agreement with the wind power generating company and purchase the full amount of the wind power generated by it [25]. **Table 1** shows wind power installed capacity (MW) and generation (GWh) in China 2007–2016.

4.3 Biomass power

Biomass is a multistep process of producing synthetic hydrocarbon fuels made from biomass that can be converted to both solid and liquid and gaseous fuels through



Figure 12.
Small wind turbines and solar power panels as well as wind farm in China.

chemical and biological processes [26]. Biomass is anticipated to contribute roughly between 15% and 50% of the world's primary energy consumption by the year 2050 [27]. Biomass in China is a larger energy source than most would think because of the huge rural population. Eighty percent of biomass energy is located in rural China with the principal source being crop residue [28]. Approximately 4 billion tons of crop residues and wood fuels are burnt using stoves in the western rural areas [29]. The Chinese government is making great strides to develop rural renewable energy, because biomass is a good already established one, and they are considering further development and efficiency gains in the use of traditional biomass. The government has begun to promote the development of biomass energy to achieve multiple projects at the national level. They participated in the planting and reforestation program in Wuhan, Guangdong Province. Over the past 14 years, the region has grown to 170.600 hectares with an increase in coverage from 31.5% to 49.4%, almost 20% of the increase in [29] and 62.8% increase in annual production capacity, and the increase can be repeated in other parts of the country. Due to the abundant domestic biomass resources, the biomass energy industry in China is rapidly developing [30].

4.4 Solar

China is leading globally in terms of solar PVs installation since 2013 and leading the world's largest market for both photovoltaics and solar thermal energy. It increased its total PV capacity to 77.4 GW [31] and was the first country to pass 100 GW of cumulative installed PV capacity in 2017. [32] China currently has six factories that produce no less than 2 GW/year each of monocrystalline, polycrystalline, and noncrystalline photovoltaic cells. They comprise LDK Solar Co, Wuxi Suntech Solar Energy Co., Ltd. 50 MW/year of solar, Yunnan Semi-Conductor Parts Plant 2 MW/year of mono-crystalline cells, the Baoding Yingli Solar Energy Modules Plant, 6 MW/year of polycrystalline cells and modules, the Shanghai Jiaoda Guofei Solar Energy Battery Factory 1 MW/year of modules, and the Shanghai PV Science and Technology Co., Ltd. 5 MW/year of modules [32]. **Figure 13** shows SolarGIS-Solar-map-China-Mainlands.

Some of the technologies used as solar collectors and photovoltaic modules include the following: Molten Salt Storage Technology, the process uses inorganic

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Capacity (MW)	12,200	16,000	31,100	62,700	75,000	91,424	114,763	129,700	149,000
Production (GWh)	3675	5710	14,800	26,900	44,622	74,100	103,000	134,900	153,400

Table 1.
Wind power installed capacity (MW) and generation (GWh) in China 2007–2016[24].

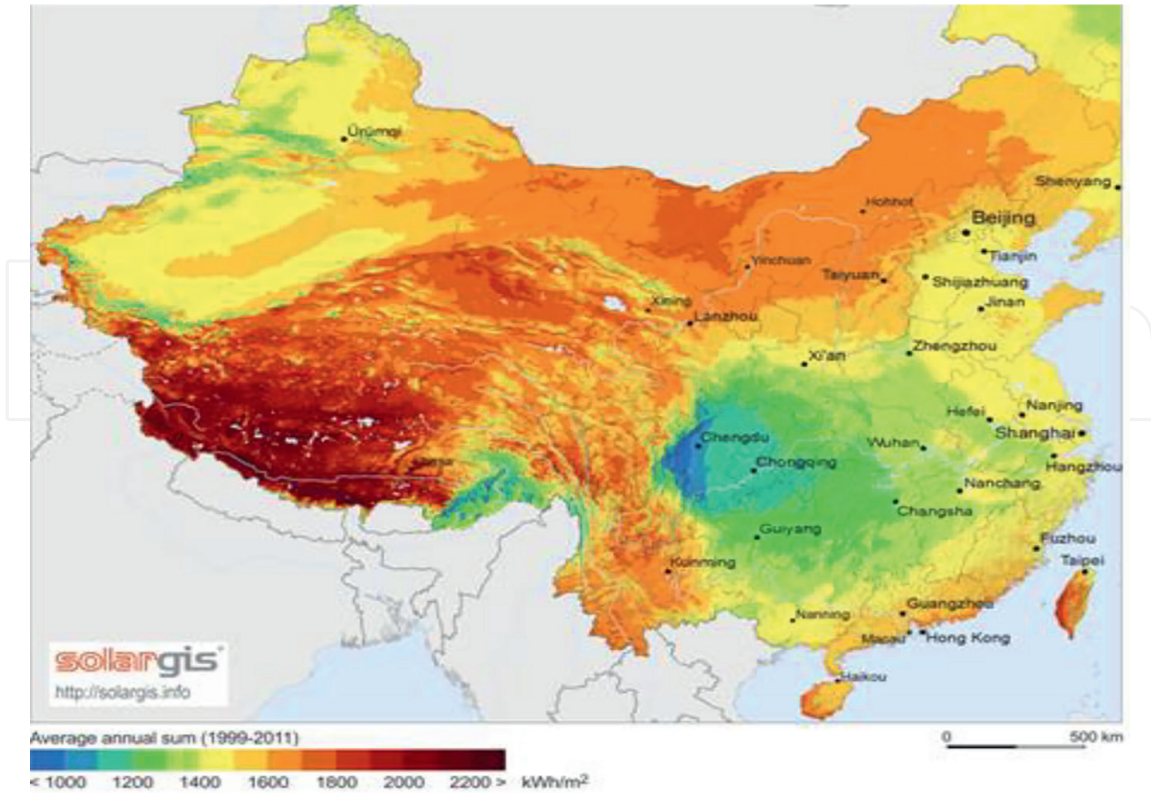


Figure 13.
SolarGIS-Solar-map-China-Mainlands.

TARGET FOR RENEWABLE POWER GENERATION BY 2020 (GW)

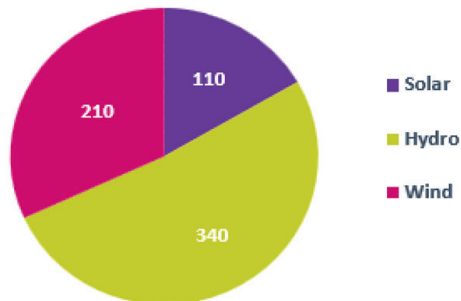


Figure 14.
Target for renewable energy generation by 2020 (GW).

salts to transfer energy generated by solar PV systems into solar thermal using heat transfer fluid rather than oils as some storage system have; and Solar Panel with Built-In Battery: with this application, the rechargeable battery is built into the solar panel itself, rather than operating as two stand-alone systems. According to scientists, conjoining the two into one system could lower costs by 25% compared to existing products.

5. Perspectives of renewable energy development in China

Studies are currently being conducted on other renewable energy sources, such as energy marine current energy, wave energy, ocean thermal energy, and salinity

	Solar	Wind	Biomass	Hydro	Nuclear	Gas	Coal
2010	0	30	0	216	0	36	655
2016	77	149	0	332	34	67	945
2025	340	336	25	400	86	145	1061
2030	469	429	33	440	111	173	1089
2035	600	515	41	471	135	199	1096
2040	739	593	49	493	145	219	1087

Table 2.
China's new policies scenario capacity by technology (GW).

gradient energy, not forgetting tidal energy. Nevertheless, they are hardly ever being used for commercial power generation due to high cost, poor dependability, low efficacy, poor stability, and small size [33, 34]. The total accessible reserve of ocean energy resources in China is anticipated to be about 1000 GW with great potential for exploitation [35]. **Figure 14** shows the Target for Renewable Energy Generation by 2020 and **Table 2** also shows China's New Policies Scenario Installed Capacity by Technology [36].

5.1 Switching to a cleaner source of power

A good distribution and policy support helps to make renewables cheaper, and solar PVs turn out to be the cheapest form of energy generation in China.

Installed low-carbon capacity, led by hydropower, wind, and solar PV, raises quickly and constitutes 60% of total capacity by 2040. Average solar PV projects in China become cheaper than both new and existing gas-fired power plants around 2020 and cheaper than new coal-fired capacity and onshore wind by 2030 [37].

There was a rise of 1.3% in China's energy consumption in 2016. Increase during these 2 years (2015 and 2016) has been the lowest aside 1997–1998. In spite of this, China continues to be the world's largest growth market for energy within 16th successive years. Renewable power (without hydro) increased by 14.1% in 2016, beneath the 10-year average, but the largest rise on record (53 Mtce). The wind gave over half of renewables growth, while solar energy contributed almost a third despite accounting for only 18% of the total [2]. According to China's energy agency, the country will cultivate \$361 billion into renewable power generation by 2020 which will create over 13 million jobs in the sector. This is containing in the National Energy Administration (NEA) blueprint document which outlines their agenda for national energy sector development throughout their 5-year 2016 to 2020 period. The NEA also mentions that renewable power installed capacity including wind, hydro, solar, and nuclear power will constitute about half of new electricity generation by 2020 [38]. **Figure 15** shows China's Primary Energy Consumption by a source in the new portfolio (**Figure 16**).

Based on IRENA the global roadmap, renewable energy portion in China's energy mix is anticipated to reach 17% by 2030 comparable to 13% in 2010. This analysis, however, displays that the country can convincingly achieve modern renewables to 26%. China can save over USD 200 billion a year by 2030, helping in the improvement of health and reducing CO₂ emissions [39]. Under the high renewable energy

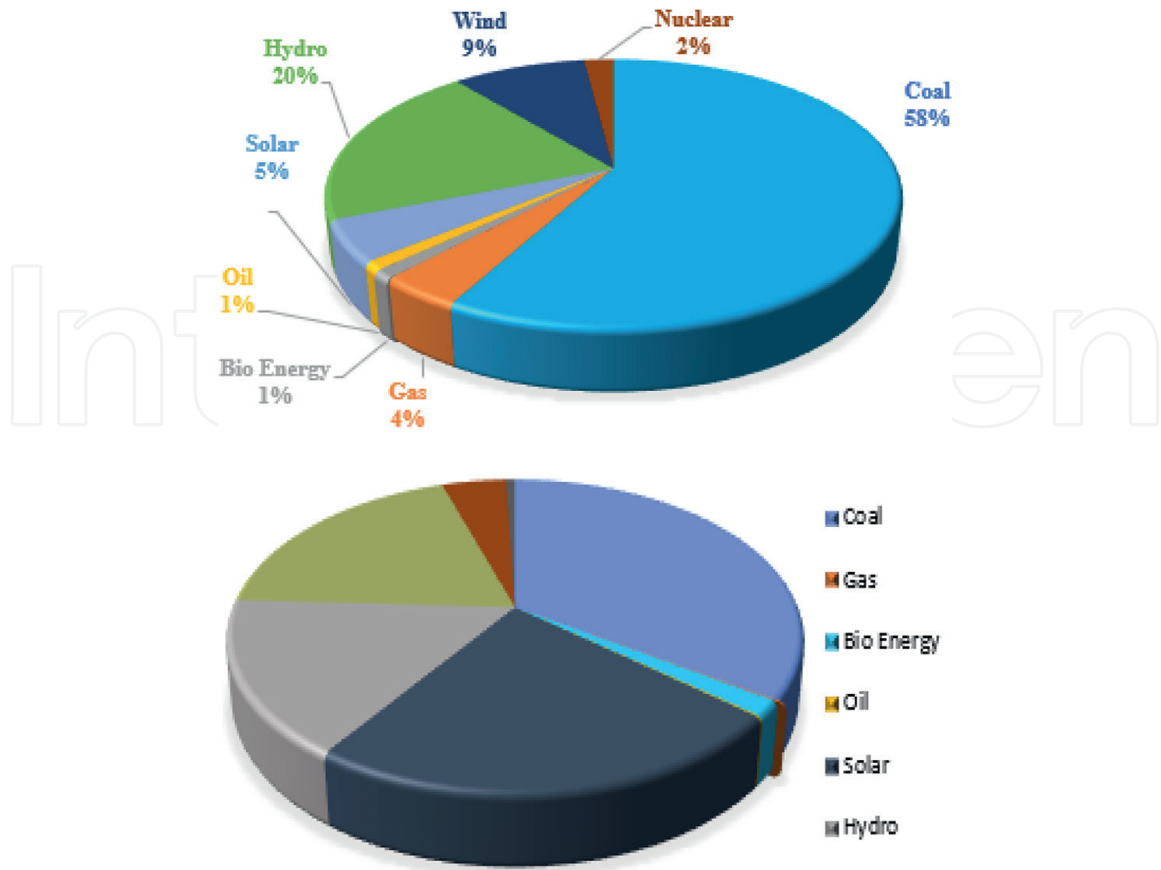


Figure 15. Installed power generation capacity in China in the New Policies Scenario 2040 of a total of 3188GW.

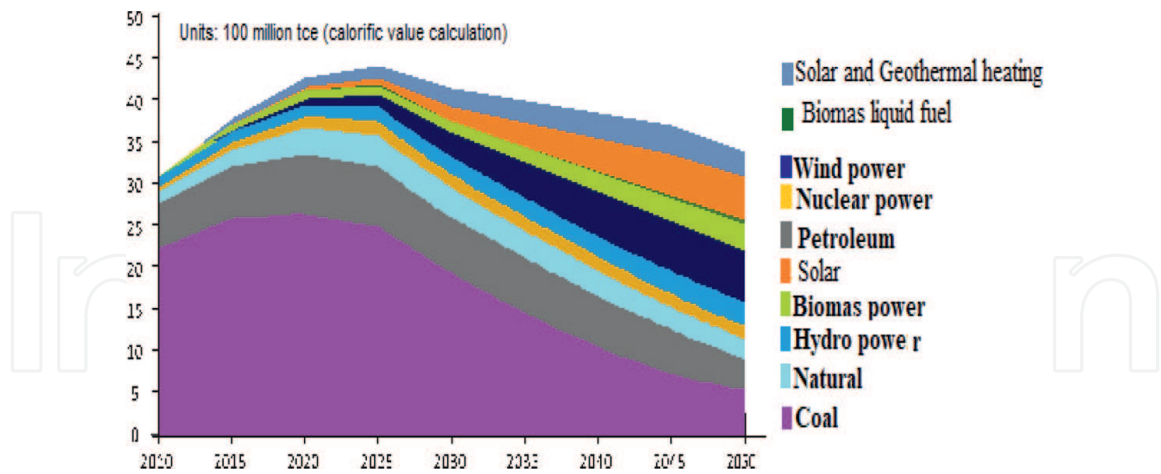


Figure 16. China's primary energy consumption.

penetration scenario, total power generation in China will be 15.2 trillion kWh in 2050. This consist of 1038 kW coal, 466 kW natural gas, 649 kW nuclear, 2187 kW hydro, 5350 kW wind, and 4130 kW of solar. All these energy resources were in billions. This, therefore, constitutes total of 85.8% of renewable energy power generation and 91% of nonfossil energy [40].

Power generation capacity (GWe)	2020				2030				2050			
	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4
Hydropower	310	340	370	350	403	430	453	400	440	510	530	530
Wind power	50	100	150	200	120	180	300	400	300	500	800	1000
Solar power	5	20	30	80	50	100	200	450	500	800	1000	1300
Geothermal power	0.08	0.08	0.08	0.5	0.5	0.5	0.5	5	1.5	1.5	1.5	50
Biomass power	15	20	30	30	20	20	20	35	10	10	10	35
Ocean power	0.04	0.04	0.04	0.1	1	1	1	1	10	10	10	10
Biogas	34.6	34.6	34.6	34.6	62.9	62.9	62.9	61	78.6	78.6	78.6	108
Biomass briquette	7.1	14.3	21.4	25	14.3	21.4	35.7	25	21.4	35.7	57.1	40
Geothermal	10.3	10.3	10.3	50	20.5	20.5	20.5	100	41	41	41	200
Ethanol/biodiesel	16.4	24.2	31.1		44.4	77.9	101.1	56.6	77.9	134.9	168.6	193
Total renewables (billion tce)	0.51	0.61	0.73	0.86	0.73	0.89	1.1	1.4	1.14	1.54	1.93	2.6
Total energy consumption (billion-tce)	4	4	4	4.6	4.5	4.5	4.5	5.5	5	5	5	5.8
Share of renewables (%)	12.7	15.3	18.2	18	16.3	19.8	24.4	25	22.8	30.8	38.5	45

a G1-G3 are quoted from [15].

b tce stands for a ton of standard coal equivalent. *c* China's Energy Development Strategy Action Plan for 2014–2020 released on November 19, 2014.

Table 3.
 China's renewable energy development goals by 2050a.

6. China's renewable energy goals by 2050

China has turned out to be the world leader in renewable energy and made a great investment. According to [41] report, China promised US\$286 billion for the development of renewable energy as well as US\$376 billion for energy conservation projects in 2011–2015. According to [42] report, the total investment of the world in 2015 was US\$286 billion with China contributing 102.9 billion in 2015 as the world's largest investor in the renewable energy development. China hosted over 25% of the world's non-hydro renewable capacity as at the end of 2015, being 63.1 and 117.0% higher than the United States and Germany, correspondingly [43]. In 2006, China enacted the Renewable Energy Law and Pricing Law that implemented tax reduction, financial support, subsidy policies, and measures for renewable energy applications. [37].

Summary of the renewable energy targets by the Research Committee of China has been tabulated in **Table 3** (G1–G3) considering three cases comprising 2020, 2030, and 2050. The high uptake scenario would be a challenge to achieve. Nevertheless, there is a possibility of achieving it in realistic for China to achieve 45% of their energy from renewables to increase the country's total energy consumption of 5.8 billion tce by 2050 (G4 in **Table 3**) [44].

7. Conclusions

This manuscript has discussed the various renewable resource potentials in China. It was revealed that hydroelectric power has the highest installed and development potential in the country with its development in most of the cities and provinces in the country. Other resources such as wind, solar, and biomass were also observed to have a great potential in the country which are yet to be developed. The various techniques to eliminate coal and fossil fuel use to overcome pollution and emission control by the government have also been discussed. This collaboration will continue to lead and guide the world toward further green development and make massive green supports for the welfare of people. The various Development Strategic Action Plan for and Instantaneous of renewable energy targets by the various Research Committees in the country have also been analyzed and suggested appropriate solutions for achievement.

Acknowledgements

The authors would like to express their gratitude to Mrs. Joyce Adu, Mrs. Joyce Oppong, Dr. Asare Bediako, Sam Adu-Kumi Jnr., and Majeed Usman Koranteg for their proof reading and correction. This work was supported by the Special Funds of the National Social Science fund of China, grant number 18VSI038.

Conflict of interest

The authors have complied with ethical requirements: submission implies that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent of the publisher. The authors have no conflict of interest to declare.

Thank you for your consideration of the work.

IntechOpen

Author details

Daniel Adu^{1*}, Ransford O. Darko^{2*}, Boamah Kofi Baah³ and Agnes Abbey⁴

1 School of Management Science & Engineering, Jiangsu University, Zhenjiang, China


2 Department of Agricultural University, University of Cape Coast, Ghana

3 University of Professional Studies, Accra Ghana

4 Department of Renewable Energy, Cape Coast Technical University, Cape Coast, Ghana

*Address all correspondence to: adudaniel39@yahoo.com and chiefrodark@yahoo.com

IntechOpen

© 2022 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] Ouyang XL, Lin BQ. Levelized cost of electricity (LCOE) of renewable energies and required subsidies in China. *Energy Policy*. 2014;**70**:64e73
- [2] Ministry of Finance. National Development and Reform Commission, National Energy Administration (MOF/NDRC/NEA), Tentative procedures for the management of collecting and using renewable energy development special fund. January 2012
- [3] National Development and Reform Commission. Ministry of Finance (NDRC/MOF), implementation opinions on promoting the development of wind power generation industry. 2006.
- [4] Ministry of Finance (MOF). Tentative procedures for the management of special fund on the industrialization of wind power generating equipment. 2008.
- [5] Ministry of Finance. Ministry of Science and Technology, National Energy Administration (MOF/MOST/NEA), Notice on Implementing the Golden Sun Demonstration Project, July 2009
- [6] Zhao ZY, Zuo J, Fan LL, Zillante G. Impacts of renewable energy regulations on the structure of power generation in China: a critical analysis. *Renewable Energy*. 2011;**36**(1):24e30
- [7] Liu LQ, Liu CX, Wang JS. Deliberating on renewable and sustainable energy policies in China. *Renewable and Sustainable Energy Reviews*. 2013;**17**:191e198
- [8] BP Statistical Review of World Energy. June 2017. Available from: <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review-2017/bp-statistical-review-of-world-energy-2017-full-report.pdf>. [Accessed: 20 November 2017]
- [9] Li F. China's energy structure continues to optimize. Available from: http://www.chinadaily.com.cn/business/2017-07/22/content_30211808.htm Accessed 20 December 2017
- [10] BP. BP Statistical Review of China. London: BP; 2016
- [11] CEC Sector Development and Environment and Resources Beijing, PR China. Available from: web@cec.org.cn
- [12] IEA – Report. 2015. Available from: www.iea.org. Retrieved 2017-09-23.
- [13] China Energy Portal. Tracking China's transition to sustainable energy. February 27, 2017
- [14] CEC. National Power Industry Statistical Bulletin Data List. Beijing, PR China: Planning and Development Department; 2016
- [15] Zhang J, Adu D, et al. Review on China's renewable energy and future Projections. *International Journal of Smart Grid and Clean Energy*. 2018;**7**(3):361-366
- [16] IHA. Key Trends in Hydropower. Chancery House, St Nicholas Way, Sutton, London: Central Office; 2017
- [17] Thompson R. China: Clean and Renewable Energy Report to. 2010
- [18] Yang JX. Hydropower: A Viable Solution for China's Energy Future? 2007. World Watch Institute. Available from: <http://www.worldwatch.org/node/4908>

- [19] Dams in China. Wikipedia.org. Available from: http://en.wikipedia.org/wiki/Category:Dams_in_China
- [20] Renewable Energy in China: Grid Connected Wind Power. National Renewable Energy Lab. Available from: <http://www.nrel.gov/docs/fy04osti/35789.pdf>
- [21] Gang W. Wind matters: China's role in the future of wind (PDF). Goldwind. 28 October 2015. Retrieved 8 February 2016.
- [22] China's new wind power capacity hits record high - Xinhua — English.news.cn. Available from: news.xinhuanet.com. Retrieved 2016-02-08
- [23] Xinhua, China's wind power capacity continues to grow. Available from: <http://www.globaltimes.cn/content/1030911.shtml/> [dead link accessed 24/06/2017]
- [24] Daniel C. Climate Wire, China blows past the U.S. in wind power. Scientific American. Retrieved from: 2016-02-08
- [25] Gow D. Wind power becomes Europe's fastest growing energy source. Tuesday February 3, 2009. Gardian.co.uk. Available from: <http://www.guardian.co.uk/environment/2009/feb/03/wind-power-eu>
- [26] Wind Electricity Installed Capacity. International Energy Statistics. Energy Information Administration (EIA)
- [27] Nicholas S, He J. How China became a climate leader. 2014. Available from: Eco Business <http://www.eco-business.com/opinion/how-china-became-climate-leader/>. Accessed 20/09/2017
- [28] REN21. Renewables 2016 global status report. Renewable energy policy network for the 21st Century. 2016
- [29] Blauvelt, E. Biomass in China. World Energy Discussion. Jan 14, 2008. Available from: <http://worldenergydiscussion.blogspot.com/2008/01/biomass-in-china.html>
- [30] Nature Editorial. Trend watch renewable boom. Nature. 2016b;534:157
- [31] Zhang D et al. Present situation and future prospect of renewable energy in China. Renewable and Sustainable Energy Reviews. 2017;76:865-871
- [32] China is adding solar power at a record pace. Available from: Bloomberg.com. 19 July 2017. Retrieved 1 August 2017
- [33] World Watch Institute. Solar energy booming in China. Available from: worldwatch@worldwatch.org 1400 16th St. NW, Ste. 430, Washington, DC 20036, access November 22, 2017
- [34] Zhang D, Li W, Lin Y. Wave energy in China: Current status and perspectives. Renewable Energy. 2009;34:2089-2092
- [35] Liu T, Xu G, Cai P, Tian L, Huang Q. Development forecast of renewable energy power generation in China and its influence on the GHG control strategy of the country. Renewable Energy. 2011;36:1284-1292
- [36] NRDC White Paper – Improving China's existing renewable energy legal framework; lessons from the International and Domestic Experience, Natural Resources Defense Council. October 2010
- [37] Jin Yang X, Hu H, et al. China's renewable energy goals by 2050. Environmental Development. 2016;20:83-90 ISSN 2211-4645
- [38] IEA. World Energy Outlook 2017. Available from: <https://www.iea.org/weo/china/>. Accessed 20 December 2017

[39] Wang S, Yuan P, Li D, Jiao Y. An overview of ocean renewable energy in China. *Renewable and Sustainable Energy Reviews*. 2011;**15**:91-111

[40] Here's how much money China is throwing at renewable energy. Available from: <http://fortune.com>. Retrieve 10 November 2017

[41] IRENA. *Renewable Energy Prospects. China: International Renewable Energy Agency*; 2017

[42] Energy Research Institute. *China 2050 high renewable energy penetration scenario and roadmap study National Development and Reform Commission*. 2015

[43] Kumar A, Kumar K, Kaushik N, Sharma S, Mishra S. Renewable energy in India: Current status and future potentials. *Renewable and Sustainable Energy Reviews*. 2010;**14**:2434-2442

[44] Nicholas S, He J. How China became a climate leader. 2014. Available from: <http://www.eco-business.com/opinion/how-china-became-climate-leader/>. Eco Business