WHAT IS THE ROLE OF RENEWABLE ENERGY RESOURCES IN TERMS OF STATE'S ACTS SEEKING POWER OR SECURITY IN INTERNATIONAL ORDER FOR CHINA?

The Graduate School of Economics and Social Sciences
of
İhsan Doğramacı Bilkent University

By

Furkan Vefa KURT

In partial fulfilments of the Requirements for the Degree of

MASTER OF ARTS IN ENERGY ECONOMICS, POLICY & SECURITY

Graduate Program in

Energy Economics, Policy and Security

İhsan Doğramacı Bilkent University

Ankara

February, 2021

FURKAN VEFA KURT

WHAT IS THE ROLE OF RENEWABLE ENERGY

Bilkent University 2021

Dedicated to My Family

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Energy Economics, Policy & Security.

Supervisor: Prof. Dr. M. Hakan Berument

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Examining Committee Member: Assoc. Prof. Pınar İpek

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Examining Committee Member: Assoc. Prof. Serdar Ş. Güner

Approval of Graduate School of Economics and Social Sciences:

Director: Prof. Dr. Refet S. Gürkaynak

ABSTRACT

What is the role of renewable energy resources in terms of state's acts seeking power or security in international order for China?

KURT, Furkan Vefa

M.A. Program in Energy Economics, Policy and Security

Supervisor: Prof. Dr. M. Hakan Berument

February, 2021

This thesis focuses on renewable energy development in China to examine how China has increased renewable energy production and consumption. Government role in renewable development, supporting policies, and the process of energy transition through the increasing importance of renewable energy resources in the world energy market and China are presented. Chinese renewable firms are also assessed in terms of their roles in renewable energy and related sectors. The findings of the study are discussed according to the basic arguments of realism for future research on whether China's energy transition increases its power and expands its capabilities in global scale.

Key Words: Renewable energy, energy transition, global energy market, China, power struggle, security.

ÖZET

Çin için uluslararası düzende güç veya güvenlik arayan devlet eylemleri açısından yenilenebilir enerji kaynaklarının rolü nedir?

Yüksek Lisans, Enerji Ekonomisi ve Enerji Güvenliği Politikaları Programı

KURT, Furkan Vefa

Tez Danışmanı: Prof. Dr. Hakan Berument

Şubat, 2021

Bu tez Çin'de yenilenebilir enerjinin gelişimine odaklanarak Çin'in yenilenebilir enerji üretimi ve tüketimini nasıl artırdığını incelemektedir. Dünya enerji pazarında ve Çin'de yenilenebilir enerji kaynaklarının gelişminde devletin rolü ve bu kaynakların enerji geçiş sürecindeki önemi tanımlanmıştır. Ayrıca, Çin şirketlerinin yenilenebilir enerji sektörü ve ilgili sektörlerdeki rolü değerlendirilmiştir. Araştırmanın bulguları, realist kuramın temel argümanlarına göre Çin'in enerji geçiş sürecinin Çin'in gücünü ve küresel ölçekte kabiliyetlerini artırıyor mu sorusunu ileride araştırmak üzere tartışılmıştır.

Key Words: Yenilenebilir enerji, enerji geçişi, küresel enerji pazarı, Çin, güç mücadelesi, güvenlik.

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My friends have been always supportive for me. I am very thankful to them for their encouragement and help. They are enabling me to take my steps more solidly. They motivates me for my studies all the time and have trust in me to keep continuing. I am very grateful for their support, encouragement, and companionship.

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CHAPTER ONE: Introduction

Introduction

The 21st century is facing a purposive energy transition with certain global scale necessities based on environmental challenges, such as climate change and global warming. Therefore, energy transition has been an important issue in energy politics; and debated be collectively action at global level to deal with the potential challenges in the future. In fact, renewable energy is increasing its share in total for $150 billion for solar and $100 billion for wind in the world with more countries adopting it. Conventional resources, such as oil have been losing its place to renewables. Further, the damage from fossil energy resources forces nations to adopt certain policies, mainly focusing on decreasing the shares of fossils, in energy consumption. In addition, energy efficiency can be reached through renewable energy deployment and enhanced renewable technologies, and innovations. Hence, renewable energy resources are encouraged both domestically and internationally by various non-state actors and states.

China is one of the most important countries in terms of energy transition towards renewables and efficiency. Chinese investments in renewable energy resources are far ahead from other countries. For example, Chinese investments peaked by 2012, with $54.2 billion of investment, which was higher than any other country and accounted for 29% of total investments in the G-20 countries (Aklin, Urpelainen, 2018). Moreover, Chinese overseas investments in energy sector allow China to interact with various countries in different regions. As the biggest polluter, China is the most committed country in the world to renewable energy policies for green economy and energy efficiency. Thus, China not only reduces its CO2 emissions through renewables but also expands its presence in energy related sectors in different regions. Indeed, Chinese massive manufacturing capabilities enables the country to export its renewable equipment to other nations.

Accordingly, this thesis questions the role of renewable energy resources in China's energy policy within the context of power politics in international relations. My research questions are (i) What is the role of renewable energy resources in China's energy policy? (ii) How can we examine China's focus on renewable energy resources in terms of a state's acts seeking power or security in international order? In light of my findings for the first question, I consider two arguments from realist school to do future research for the second question. In other words, the first research question provides the necessary background for a basic theoretical discussion to consider initial arguments about the second research question. Thus, future research is needed to give a full explanation for the second research question.

The plan of my thesis is as follows; Chapter 2 presents the rising importance of renewables in terms of its share in the world energy demand and energy production as well as its role in energy transition. Former energy transitions and current transition are described given the definition of energy transition in Chapter 2. Further, I investigate the role of state in promoting renewable energy. Chapter 2 concludes with China's energy outlook based on primary energy supplies, and primary energy consumption. In Chapter 3, I focus on the role of state and China's energy transition within the context of China's state-led energy policy and particularly its renewable energy legislations. In the conclusion chapter, I summarize my findings and consider future research questions to explain sufficiently China's focus on renewable energy resources in terms of a state's acts seeking power or security in international order.

CHAPTER TWO – The Rising Importance of Renewables in Energy Transition

2.1. What is Energy Transition?

Energy transition is defined by International Renewable Energy Agency (IRENA) (n.d.) as a way directed toward transformation of global energy sector from fossil-oriented to zero-carbon by the second half of the 21st century. "An energy transition is a long-term, multidimensional and fundamental transformation of the energy sector in a specific techno-institutional context with involvement in a broad range of technologies, and organizational and institutional structures (Graaf, et al, 2016, p. 297-301)." Main motivation is to decrease energy-related CO2 emissions to tackle the climate change or limit it to some extent. Urgent action on a global scale is necessary for decarbonisation of the energy sector (IRENA, n.d.) Similarly, United Nations Environmental Programme (2016), International Energy Agency (2015), and Renewable Energy Policy Network for the 21st Century (2016) have emphasized the necessity of renewable energy development and global energy transformation, transition from fossils to low-carbon, sustainable energy forms, to create an era of sustainability in terms of energy resources, in struggle against climate change.[1] Besides the on-going energy transition of the 21st century, there are former transitions in the history of world energy politics which demonstrate the process of energy transition.

Energy transition began when wood and biomass were replaced by coal (Graaf et al, 2016). Following this early transition, oil replaced coal to some extent as coal still

[1] IEA (International Energy Agency). World Energy Outlook 2015: Executive Summary; OECD/IEA: Paris, France, 2015. Available online: https://www.iea.org/Textbase/npsum/WEO2015SUM.pdf

has a large share in some countries' energy pie. Oil has advantage over coal in terms of its higher level of energy, efficiency, and abundance when it was first discovered in 1859 (Harford, 2019).[2] Therefore, "transition to oil is the second socio-technical transition" (Graaf, et al, 2016, p. 297-301)." However, there is a big difference between transition from wood to coal and coal to oil as the second one did not replace former energy resource entirely. Coal is still the second energy resource accounting for 25% of total energy supply in the world, mostly for electricity production (Graaf, et al, 2016). Past transformations were accompanied by major changes in technologies, industrial structures, practices of consumers, and expansion in energy demand both in terms of local and global changes (Graaf, et al, 2016). Similarly, energy transition of the 21st century differs from past transitions in terms of alarming conditions that forces humanity to change their energy supply and demand patterns given the environmental challenges, and degradation caused by devastating results of energy resources' excessive use.

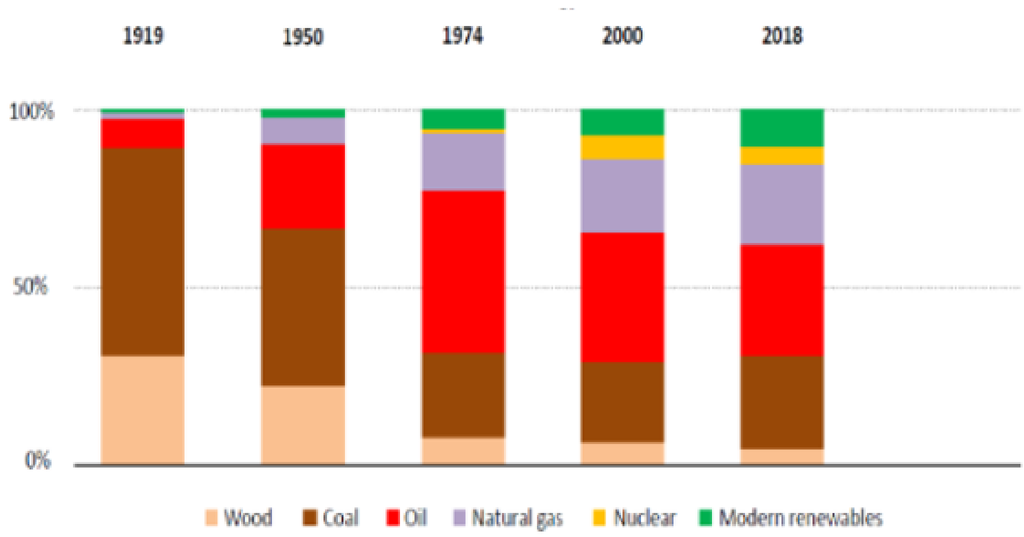
Ongoing energy transitions are shaped by a direction towards renewable energy resources and higher levels of energy efficiency, away from fossil fuel and nuclear-based energy sources (Graaf, et al, 2016). Electricity sector is on the most advanced level, which is followed by heating and transportation sectors through the major shifts in essential energy porters and energy technologies, which are wind turbines, solar PV modules, biogas plants, smart grids, fuel cells, and electric vehicles, accompanied by new approaches in products, services, business models, and regulations in accordance with the route of transition (Graaf, et al, 2016).

[2] Harford, T. (2019). Petrol Nasıl Bu Kadar Önemli Oldu: Bağımlılığın Tarihi. BBC News.

2.2. Increasing Share of Renewable Energy Resources in World Energy Demand

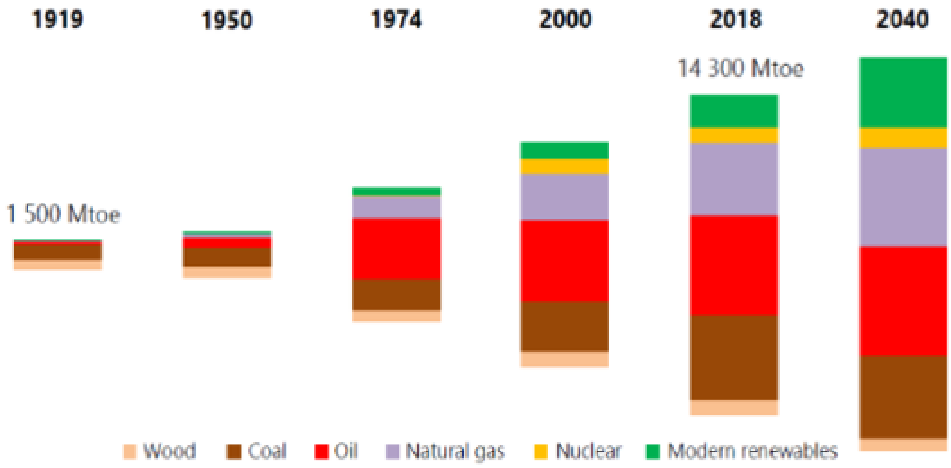
Renewable energy share has an increasing trend in terms of its share in world energy demand, while the energy demand has been growing largely. International Energy Agency (2020) demonstrates that renewable energy consumption is increasing and showing an increasing trend which is expected to remain in the following years as shown in the graphic (Fig. 1 and 2). Different supply sources and role of technology in energy transition and ongoing importance of oil and gas in the transition period are two major observations in the graphic.

Figure 1: Historical Transition in Energy Demand by Resource, (1919-2018) (Global Energy Demand)



Source: IEA, World Energy Outlook, 2019.

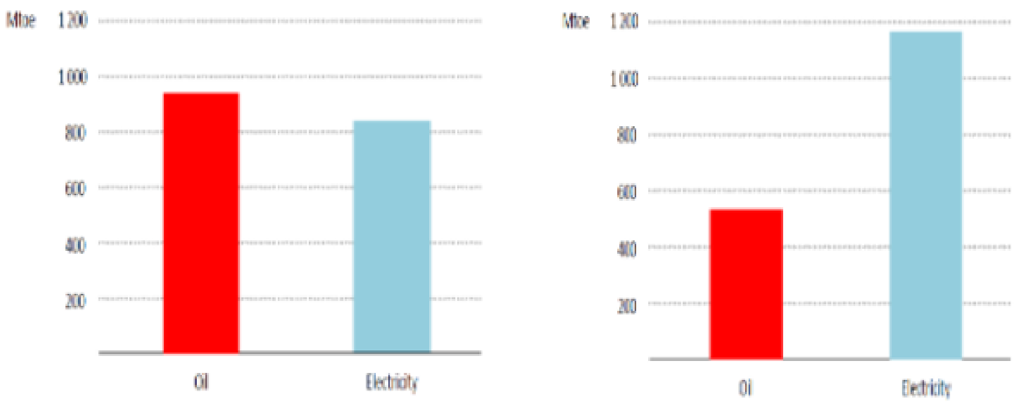
Figure 2: Growing Demand for Energy by Resource, (1919, 2040) (Global Energy Demand in the Stated Policies Scenario)



Source: IEA, World Energy Outlook, 2019.

One driver for these developments is environmental concerns that leads policy debates to achieve green economy through renewable energy since it is the best option to reduce CO2 emissions (Graaf et al, 2016). In this respect, share of CO2 emitting energy resources have to be decreased and replaced by cleaner resources. IRENA (n.d) states that 90% of the required carbon reductions can be achieved through renewable energy and energy efficiency. The second driver for growing share of renewable energy is the increase in demand for electricity, which is labelled as “electrification”. For example, when consumers needed more energy in the past, they traditionally turned to oil. In the future, consumers’ demand for electricity will be more than oil demand (Fig. 3).

Figure 3: Electrification in Global Energy Demand (2000-2018, 2018-2040), (Oil, Electricity)

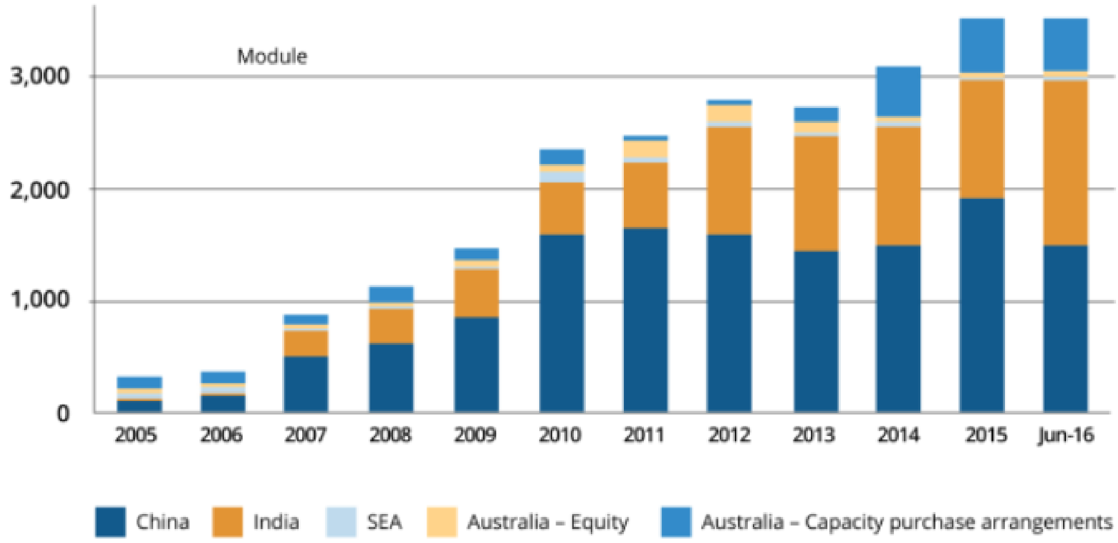


Source: IEA, World Energy Outlook, 2019.

Another necessity for renewable energy is energy poverty since 2 billion people have no access to modern energy resources (Graaf et al, 2016). In other words, energy security of people cannot be provided in some places of the world through investments in and trade of fossil fuels. Hence, energy transition is mandatory to meet the demand of people who do not have access to it.

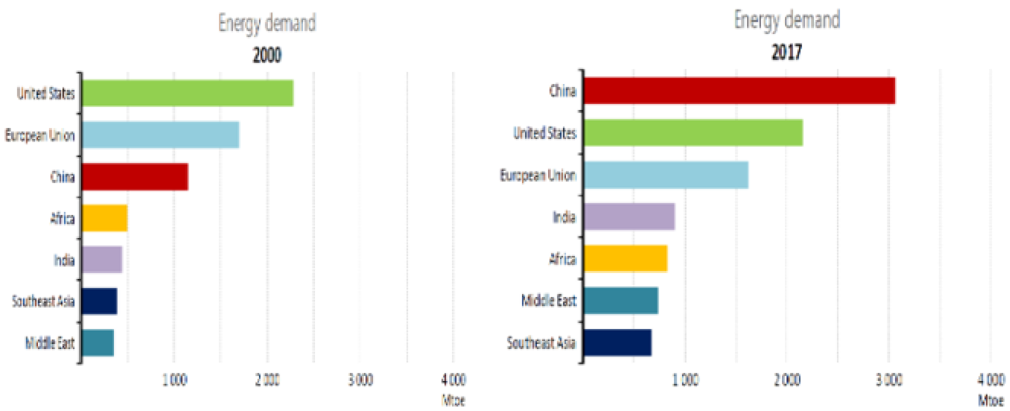
Moreover, there are expected economic benefits from the increasing usage of renewable energy resources in the economy. For example, renewable energy market is growing rapidly as wind energy reached $100 billion, and solar energy reached $150 billion by 2012 (Ang, Steenblik, 2015). Transition to renewable energy provides also more job opportunities for unemployed people while enabling economic growth at the same time. Thus, some countries such as China, India, South East Asian countries, and Australia show more tendency to invest in renewables especially after 2010 (Fig. 4). One reason for this tendency for countries like China and India and mostly in South East Asia is the shift in energy demand by countries and regions (Fig. 5 and 6).

Figure 4: CLP's Renewable Energy Portfolio Share (2005-2016), (China, India, SEA, Australia), (MW)



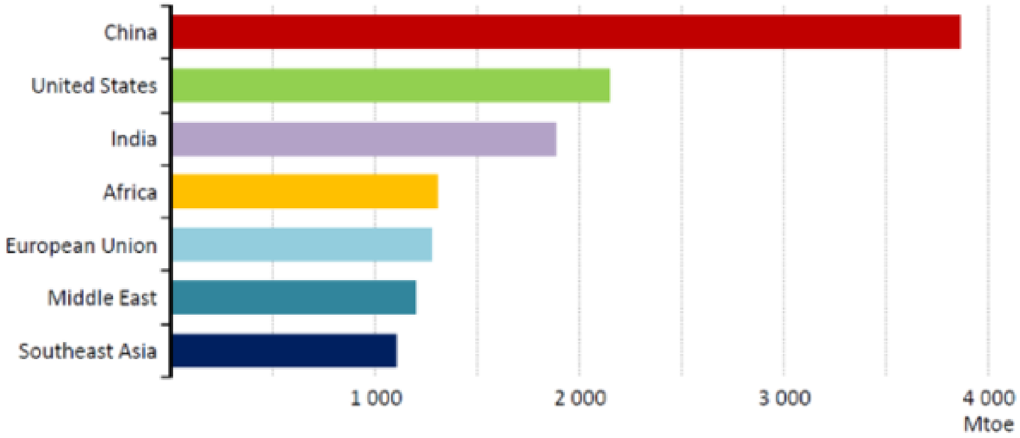
Source: CLP Holdings, Corporate Presentation, 2016.

Figure 5: Shift in Energy Demand by Countries, Regions (2000-2017), (Mtoe)



Source: IEA, World Energy Outlook, 2018.

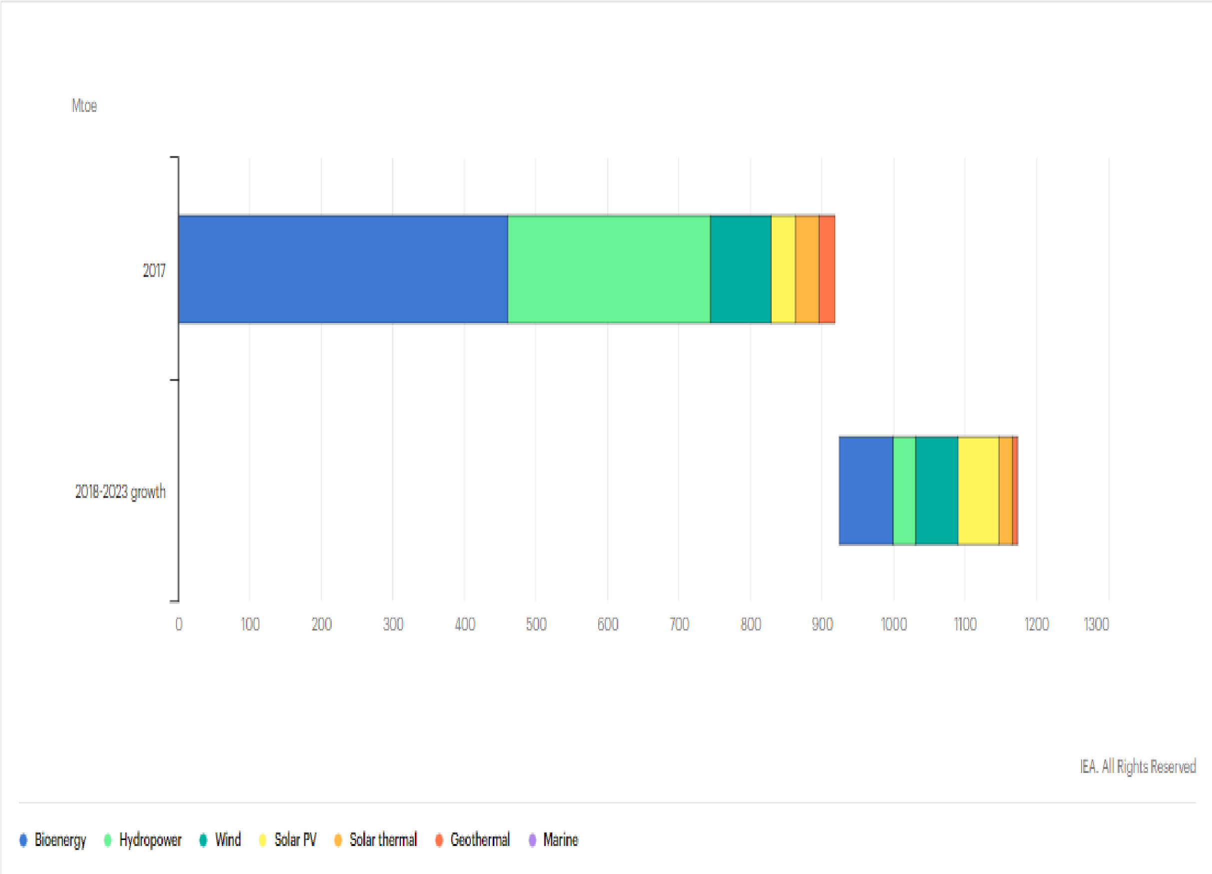
Figure 6: Shift in Energy Demand by Countries, Regions (Mtoe), (Energy Demand in 2040)



Source: IEA, World Energy Outlook, 2018.

The new disputes in World Trade Organization (WTO) has appeared to be about renewable energy since 2010 that indicates the emerging political and economic sensitivity for clean and renewable energy market (Graaf, et al 2016). For example, one dispute arose from export controls, when China put export restrictions on a group of rare elements with high-value inputs in downstream manufacturing (including clean energy products) and nine minerals (Graaf et al, 2016). Moreover, renewable energy consumption enlarges its share in the different sectors of technology and further expansion is expected (Fig. 7).

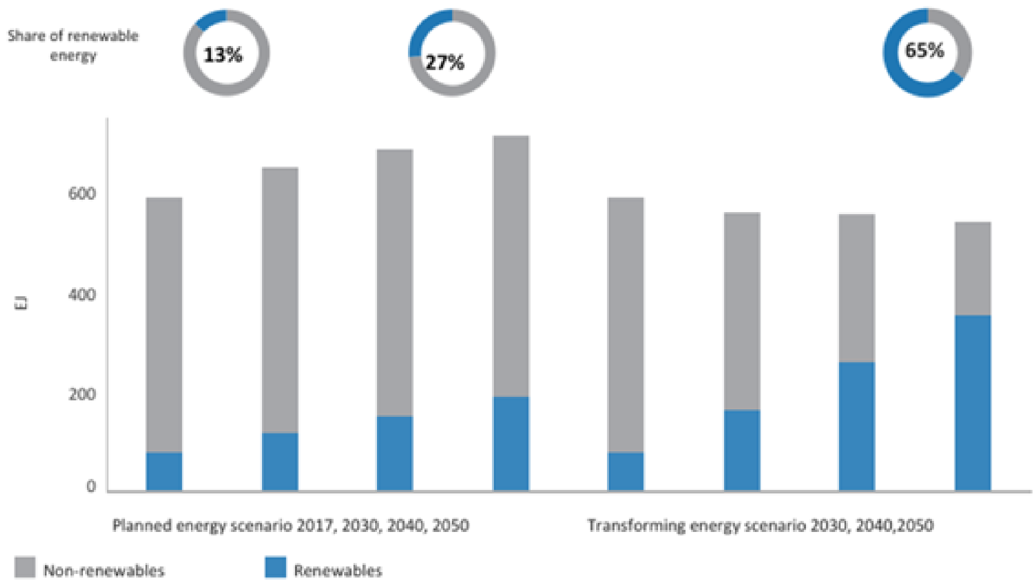
Figure 7: Renewable Energy Consumption by Technology – 2017 Compared to 2018-2023 Growth, (Global)



Source: IEA, Renewable Energy Consumption by Technology, 2020.

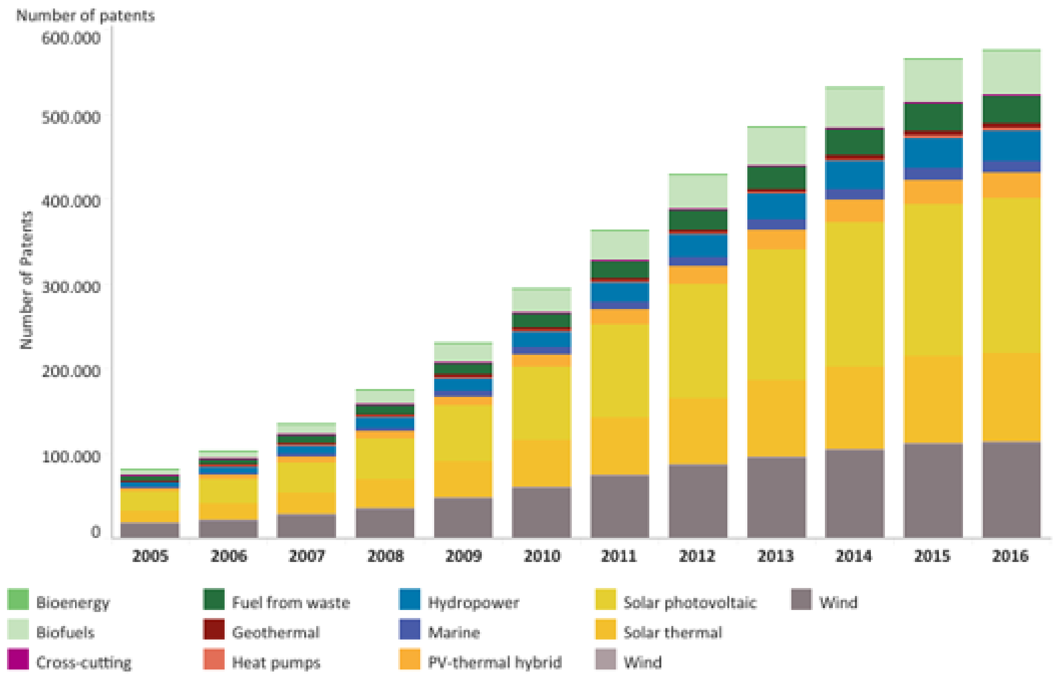
In short, depending on different countries' energy transition scenarios it is expected that share of renewables will enlarge in the next decades. For example, according to the IRENA 2020 report, the share of renewables in world total primary energy supply under planned energy scenario will increase from 13% in 2017 to 27% in 2050, while under transforming scenario the share of renewables in world total primary energy supply can reach to 65% in 2050 (Fig. 8).

Figure 8: Country Roadmaps to Renewable Energy in Total Primary Energy Supply Globally, (Planned Scenario – Transforming Scenario by 2050)



Source: IRENA, Global Renewables Outlook, 2020.

Figure 9: IRENA Renewable Energy Patents Time Series, Renewable Energy Patents Evolution, (By Resource, 2005-2016)



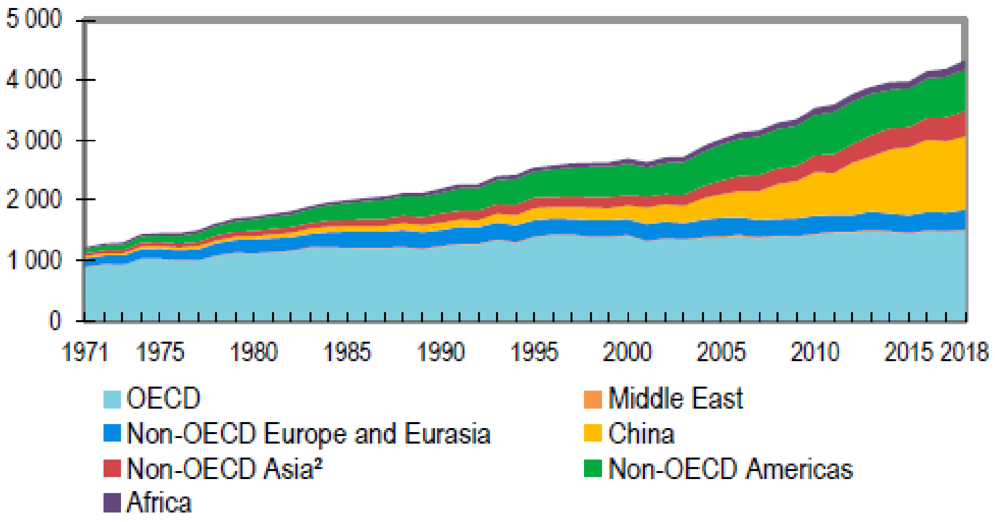
Source: IRENA INSPIRE, 2020.

Transition occurs in different areas but some of them show more developing trends such as wind and solar (Fig. 9). On the other hand, increasing acceleration in other areas can be observed as well.

2.2.1. Electricity Production from Renewable Energy Resources: Hydro, Wind, and Solar PV

International Energy Agency shows the ongoing importance of hydroelectricity production by regions and countries (Fig. 10). However, although China is the largest hydroelectricity producer in the world with 28.5%, the share of hydro in total domestic electricity generation is relatively lower with 17.2% in China (Fig. 11 and 12).

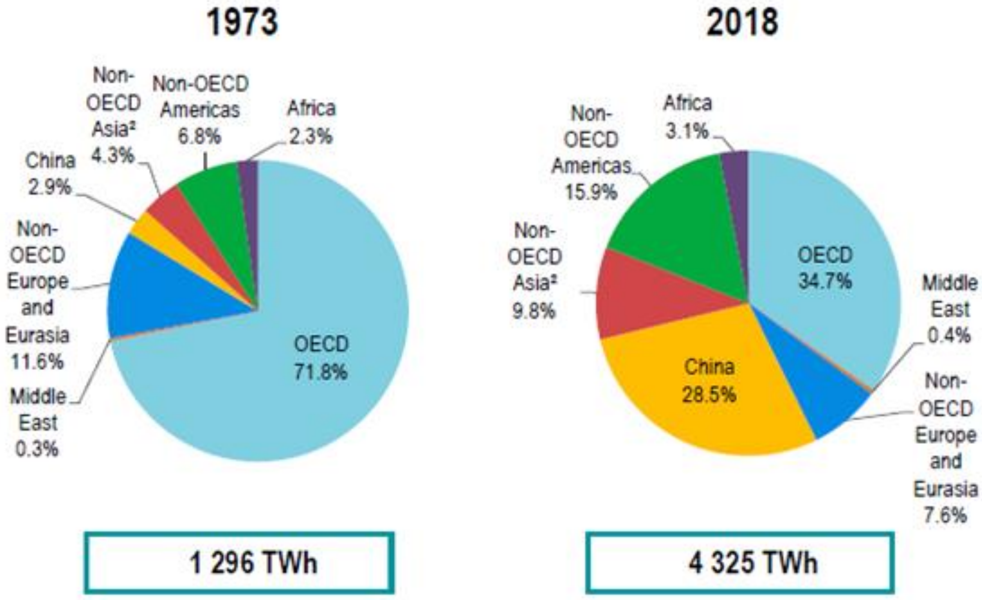
Figure 10: World Hydroelectricity Production from 1971 to 2018 by Region, (TWh).



Source: IEA, Key World Energy Statistics, 2020.

China's success in hydroelectricity can be observed from the graphic with excessive increase in its share in the overall production rate. Figure 11 shows China's share in the global hydroelectricity production.

Figure 11: 1973 and 2018 Regional Shares of Hydroelectricity Production, (Percentage), (TWh)



Source: IEA, Key World Energy Statistics, 2020.

Figure 12: Producers of Hydroelectricity (Producers –TWh, Net Installed Capacity – GW, Top Ten Producers, 2018)

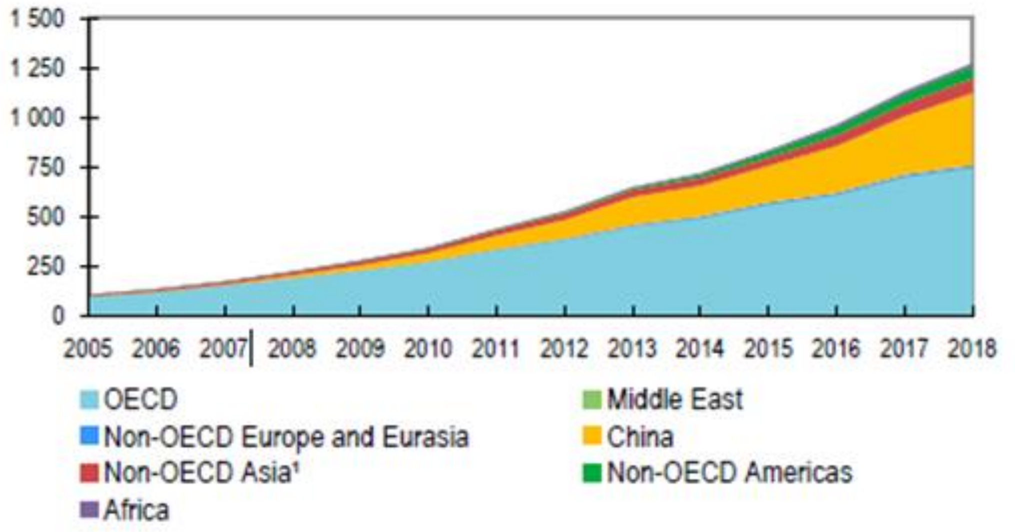
Producers	TWh	% of world total
People's Rep. of China	1 232	28.5
Brazil	389	9.0
Canada	386	8.9
United States	317	7.3
Russian Federation	193	4.5
India	151	3.5
Norway	140	3.2
Japan	88	2.0
Viet Nam	84	1.9
France	71	1.6
Rest of the world	1 274	29.6
World	**4 325**	**100.0**

Net installed capacity	GW
People's Rep. of China	352
Brazil	105
United States	103
Canada	81
Russian Federation	51
Japan	50
India	49
Norway	33
Turkey	28
France	26
Rest of the world	414
World	**1 293**

Country (top ten producers)	% of hydro in total domestic electricity generation
Norway	95.0
Brazil	64.7
Canada	59.0
Viet Nam	34.9
Russian Federation	17.3
People's Rep. of China	17.2
France	12.1
India	9.6
Japan	8.4
United States	7.1
Rest of the world[2]	15.6
World	**16.2**

Source: IEA, Key World Energy Statistics, 2020.

Figure 13: World Wind Electricity Production from 2005 to 2018 by Region, (TWh)

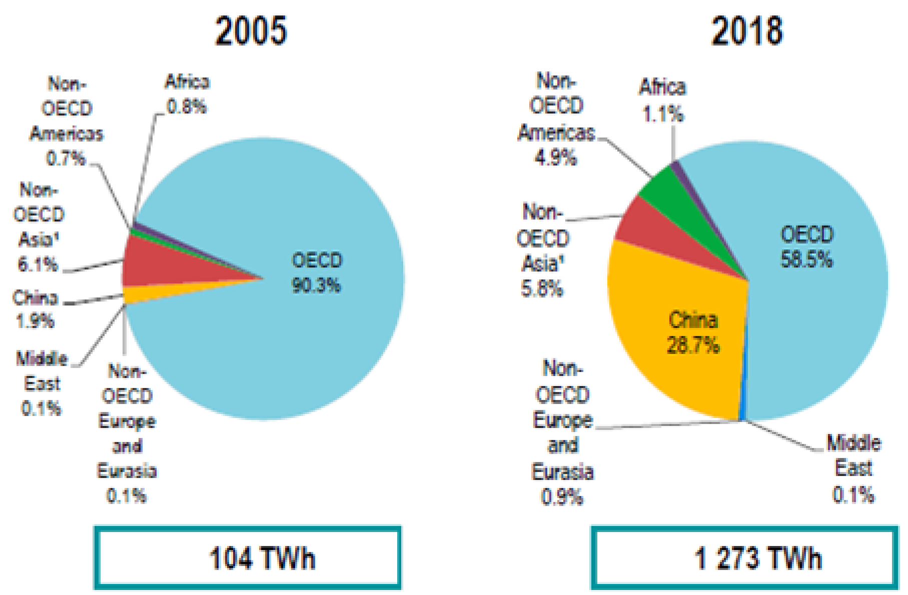


Source: IEA, Key World Energy Statistics, 2020.

In terms of wind electricity production, we observe again China's increasing share through years (Fig. 13). Figure 14 shows percentages of the mentioned actors. In 2018, China had 28,7% of wind electricity production as a single country which accounted more than the total of Middle East, Non-OECD Americas, Non-OECD Europe and Eurasia, non-OECD Asia, and Africa regions (Fig. 14). In Figure 15, China's leading share among top producers of wind electricity with 28.7% share and the largest installed capacity of 184.3 GW are evident. However, the share of wind in total domestic electricity generation is higher in other countries, such as African, OECD countries, and non-OECD countries. Because China has higher amount of total electricity consumption in which electricity generation from wind is only 5.1% in total domestic electricity generation in 2018 (Fig. 15).

Nevertheless, while China has the highest levels of energy supply, it has also the highest capability of producing energy from renewables compared to other large economics and major states in international system (Fig. 16). As we can observe from Figure 16, although coal receives the highest share in Chinese energy production, China has the largest share of renewables compared to other countries such as the US, India, Russia, and Japan. Furthermore, in terms of solar PV electricity production, China again shows excessive development rate (Fig.17). In the overall development, largest expansion in renewable energy production is accomplished by China as well (Fig. 11, 14 and 18).

Figure 14: 2005 and 2018 Regional Shares of Wind Electricity Production, (Percentage), (TWh)



Source: IEA, Key World Energy Statistics, 2020.

Figure 15: Producers of Wind Electricity, (Producers –TWh, Net Installed Capacity – GW, Top Ten Producers, 2018)

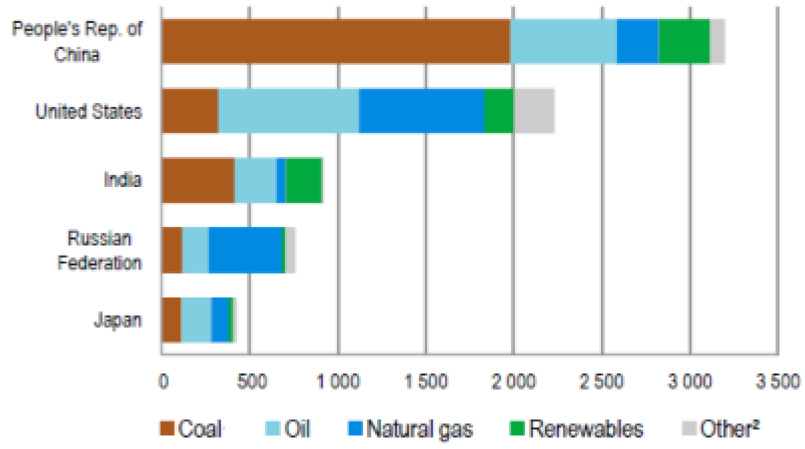
Producers	TWh	% of world total
People's Rep. of China	366	28.7
United States	276	21.7
Germany	110	8.6
India	64	5.0
United Kingdom	57	4.5
Spain	51	4.0
Brazil	48	3.8
Canada	33	2.6
France	29	2.2
Turkey	20	1.6
Rest of the world	220	17.3
World	**1 273**	**100.0**

Net installed capacity	GW
People's Rep. of China	184.3
United States	94.5
Germany	58.8
India	35.3
Spain	23.4
United Kingdom	21.8
France	14.9
Brazil	14.4
Canada	12.8
Italy	10.2
Rest of the world	92.4
World	**562.9**

Country (top ten producers)	% of wind in total domestic electricity generation
Spain	18.5
Germany	17.1
United Kingdom	17.1
Brazil	8.1
Turkey	6.5
United States	6.2
People's Rep. of China	5.1
Canada	5.1
France	4.9
India	4.1
Rest of the world[1]	2.5
World	**4.8**

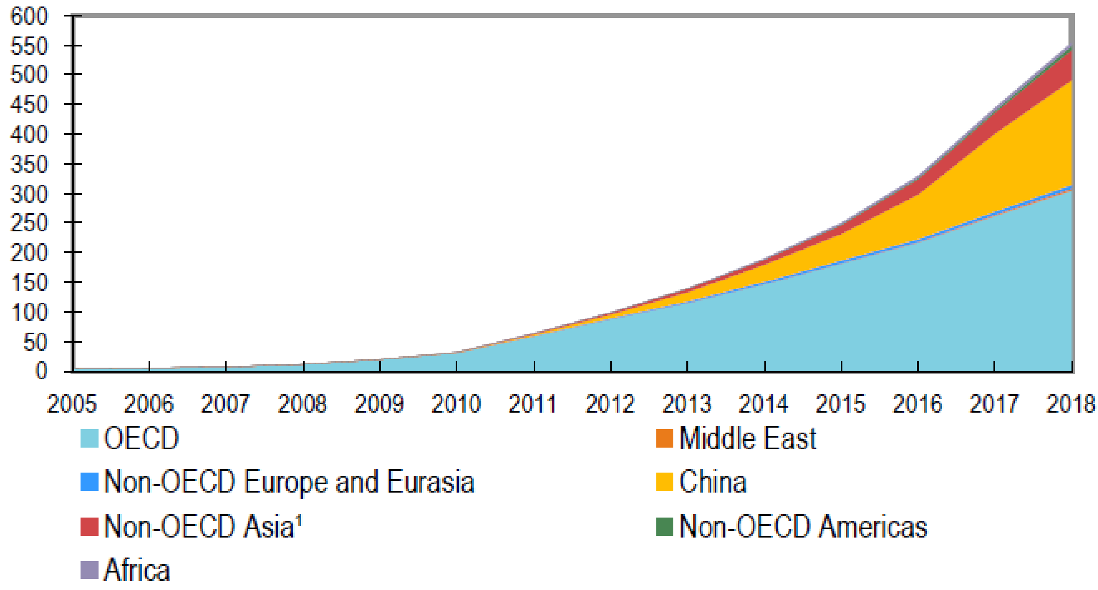
Source: IEA, Key World Energy Statistic, 2020.

Figure 16: Total Energy Supply by Energy Source (Mtoe), (China, United States, India, Russian Federation, Japan), 2018



Source: IEA, Key Energy Statistics, 2020.

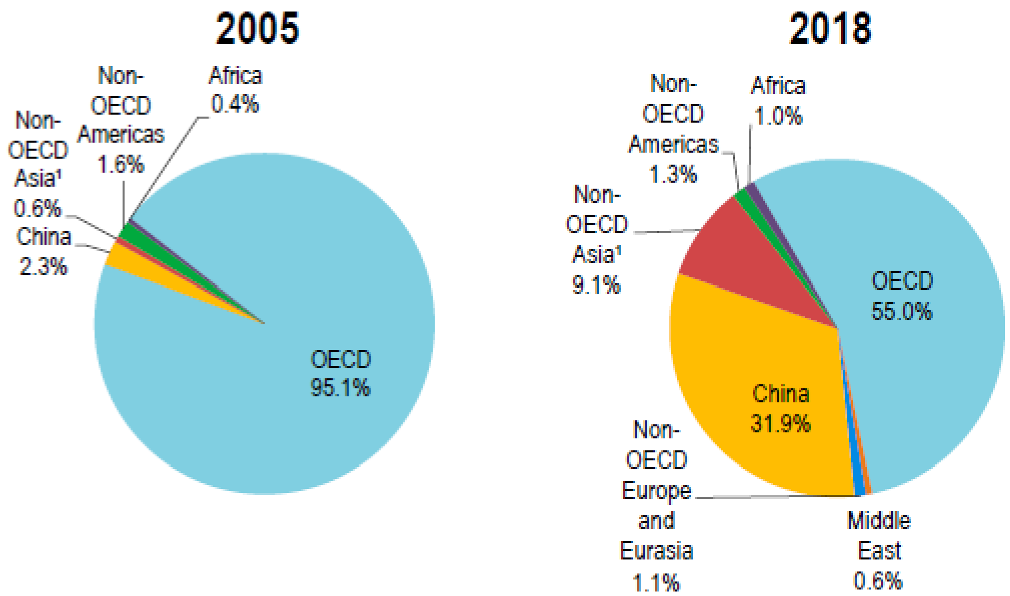
Figure 17: World Solar PV Electricity Production from 2005 to 2018 by Region, (TWh)



Source: IEA, Key World Energy Statistics, 2020.

When we look at the solar PV electricity production by years, we observe that after the OECD, China has become the second largest solar PV electricity producer in the world as a single country, followed by non-OECD Asia (Fig. 17). It is important to note that most of the increase has been after 2010. Figure 18 shows change in the shares of regions and China in solar PV electricity production in 2005 and 2018. China has 31.9% share in 2018 which rose from 2.3% in 2005.

Figure 18: 2005 and 2018 Regional Shares of Solar PV Electricity Production, (Percentage)



Source: IEA, Key World Energy Statistics, 2020.

In Figure 19 we see once again that China's leading shares in terms of top solar PV electricity producers with 31.9%, largest installed capacity with 175.1 GW are evident. However, the share of solar PV in total domestic electricity generation is higher in other countries such as Italy, Germany, and Japan. Because China has higher amount of total electricity consumption in which electricity generation from solar PV is only 2.5% in total domestic electricity generation in 2018 (Fig. 19).

Figure 19: Producers of Solar PV Electricity, (Producers –TWh, Net Installed Capacity – GW, Top Ten Producers, 2018)

Producers	TWh	% of world total
People's Rep. of China	177	31.9
United States	81	14.7
Japan	63	11.3
Germany	46	8.3
India	40	7.2
Italy	23	4.1
United Kingdom	13	2.3
France	11	1.9
Australia	10	1.8
Korea	9	1.7
Rest of the world	81	14.8
World	**554**	**100.0**

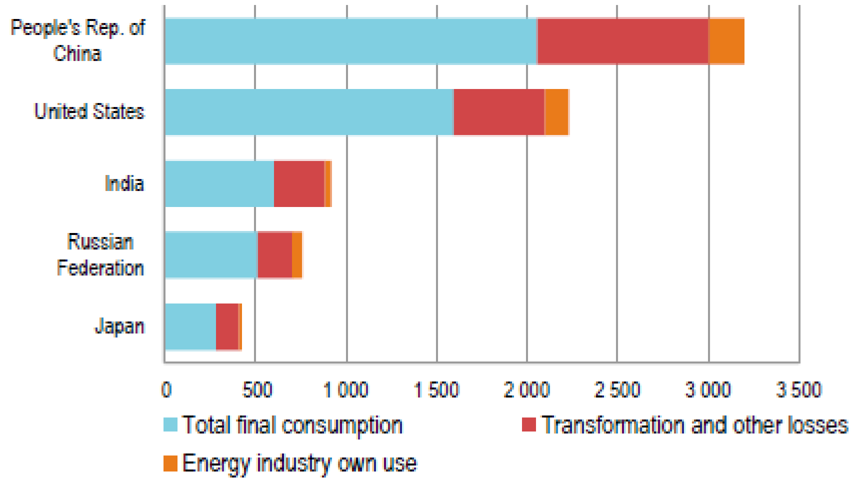
Net installed capacity	GW
People's Rep. of China	175.1
United States	62.5
Japan	56.2
Germany	45.2
India	28.3
Italy	20.1
United Kingdom	13.1
Australia	11.0
France	9.6
Korea	8.1
Rest of the world	66.4
World	**495.4**

Country (top ten producers)	% of solar PV in total domestic electricity generation
Italy	7.8
Germany	7.1
Japan	5.9
United Kingdom	3.9
Australia	3.8
India	2.5
People's Rep. of China	2.5
United States	1.8
France	1.8
Korea	1.6
Rest of the world[1]	0.9
World	**2.1**

Source: IEA, Key World Energy Statistics, 2020.

Furthermore, China has the highest level of total energy supply (TES) and the consumption level (Fig. 20). Besides huge energy supply of China, the country has the highest share of overall renewable energy production as shown in Figure 16.

Figure 20: Top Five Countries by Total Energy Supply (TES), (China, United States, India, Russian Federation, Japan), (Mtoe)

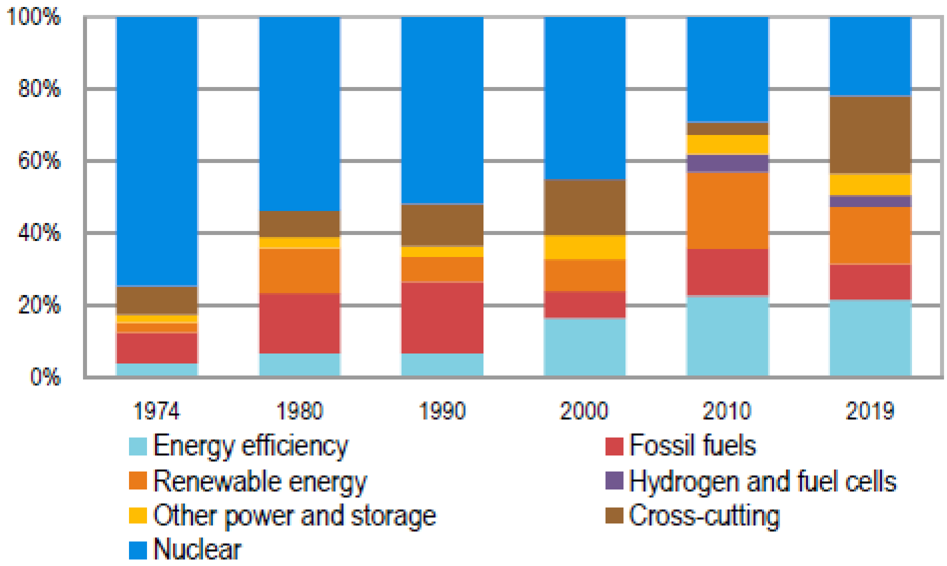


Source: IEA, Key World Energy Statistics, 2020.

Although coal receives the highest share in Chinese energy production, China has the largest share of renewables when compared to other countries. Therefore, with the commitment mentioned above and large investments in renewables, China aims to decrease its CO2 emissions and CO2 emitting energy resource shares through expanding its renewable energy resources and energy efficiency. However, these commitments should be in global scale. Indeed, in line with the increasing demand for renewable energy resources, there have been significant global efforts in research, design, and development (RD&D) to boost technological advancement and to reduce costs further in energy transition. Figure 21 shows change in total public energy RD&D budget allocations by technology and years. Especially after 1990s, energy efficiency share is increased as well as shares of renewables in the graphic. Thus, transition towards renewables and energy efficiency has been accelerated after 2000s given challenges for diversification of energy resources, reducing CO2 emissions and tackling climate change. Furthermore, these attempts succeed to some extent as the share of fossil fuels decrease through years.

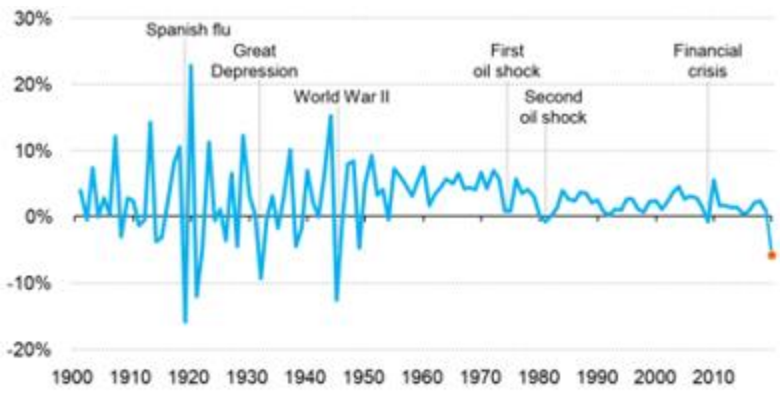
It is also important to note that energy efficiency has an effect on the decrease in total energy demand and supply in energy market before the sudden fall in energy demand during the Covid19 pandemic (Fig. 22). For example, the shock to energy demand in 2020 is set to be the largest in 70 years. In the IEA's estimate, global energy demand declines by 6%, a fall seven times greater than the 2009 financial crisis.

Figure 21: IEA Total Public Energy RD&D Budget by Technology, (1974-2019)



Source: IEA, Key World Energy Statistics, 2020.

Figure 22: Covid Impact on Energy Demand, (1900-2020)



Source: IEA, Global Energy Review, 2020.

2.2.2. Renewable Energy Technology and Future Scenarios for Renewable Energy

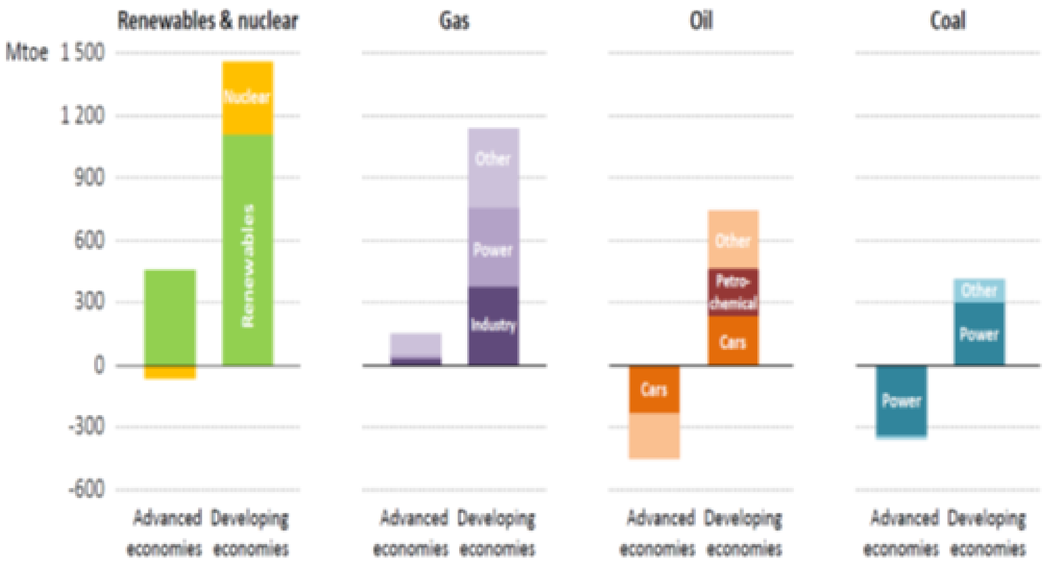
In the previous section, I showed in detail demand for renewable energy in transition and especially increasing share of wind and solar PV in electricity generation. When we look at the change in global energy demand for 2017 and 2040 by different energy supply sources, we observe that the highest increase in demand would be for renewables and demand by developing countries would be larger given their need for economic growth and consequent increase in energy demand (Fig. 23). For example, in terms of wind energy, both onshore and offshore, installed capacity enlarged extensively in global scale as well according to IRENA 2020 report (Fig. 24).[3] A major reason for this trend is change in technology and declining costs of electricity production from renewable energy resources, particularly wind and solar. IRENA (2014) report indicates that cost-competitiveness of renewable power generation technologies has reached to unprecedented levels.[4] Figure 25 demonstrates declining

[3] International Renewable Energy Agency (IRENA) (2020). Renewable Energy Insights Technologies. Installed Capacity Trends.

[4] International Renewable Energy Agency (IRENA) (2014). Renewable Power Generation Costs in 2014.

costs production from renewable energy resources, particularly for wind with approximately 70% reduction and solar with 90% reduction in solar PV- crystalline based on levelised cost of electricity. In fact, IRENA highlights the expected growth in renewable energy capacity for especially power generation for the future.[5]

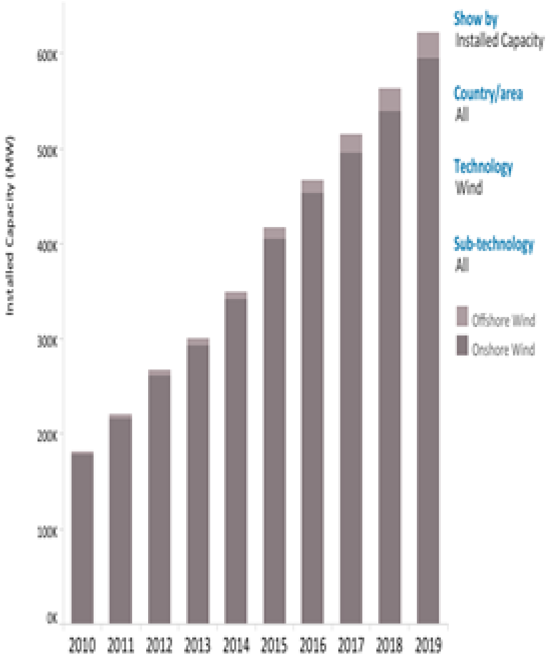
Figure 23: Change in Global Energy Demand, 2017-2040, (Mtoe)



Source: IEA, World Energy Outlook, 2019.

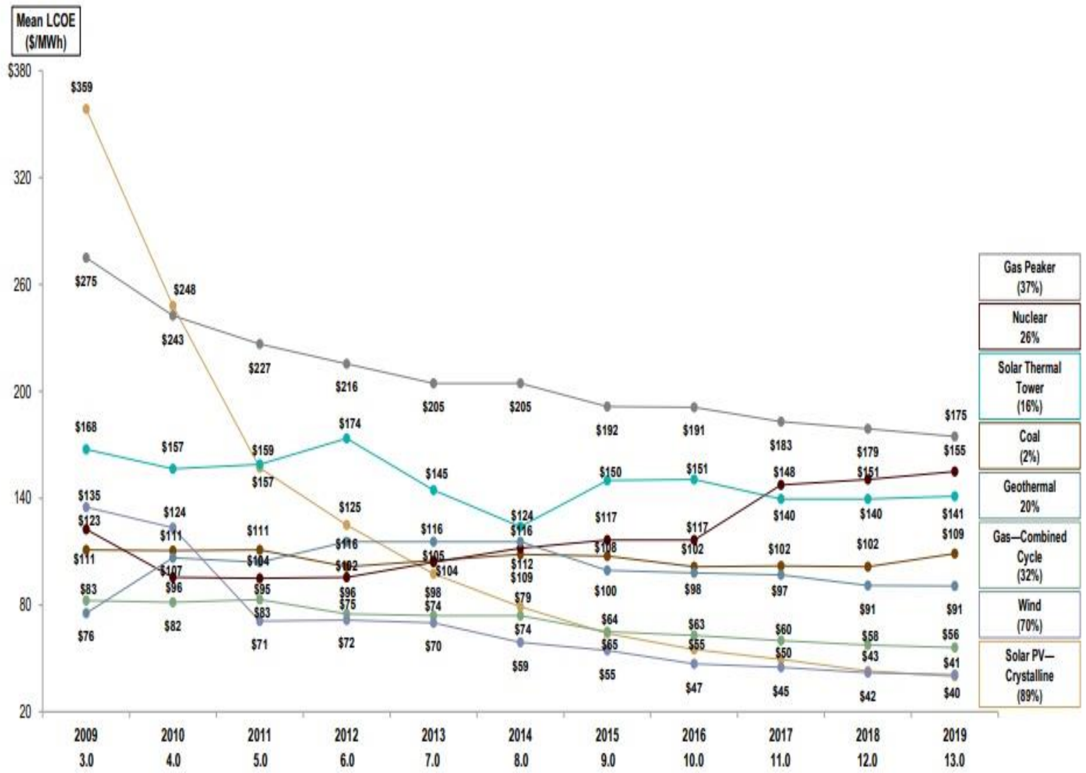
[5] International Renewable Energy Agency. (IRENA). (2014). Renewable Energy Prospect: China.

Figure 24: Installed Capacity of Onshore and Offshore Wind Globally, (2010-2019), (MW)



Source: IRENA, Global Renewables Outlook, 2020.

Figure 25: Levelized Cost of Energy Comparison – Historical Utility-Scale Generation Comparison, (2009-2020)[6]



Source: LAZARD, Levelized Cost of Energy Analysis, 2020.

[6] The Levelized Cost of Electricity (LCOE) is the discounted lifetime cost of building and operating a generation asset, expressed as a cost per unit of electricity generated (USD/MWh). It covers all relevant costs faced by the generator, including pre-development, capital, operating, fuel and financing costs. This is sometimes called a life-cycle cost.

2.3. The Role of State in Energy Policy: Different Policies to Promote Renewable Energy Resources

In the previous section, I demonstrated the rising importance of renewable energy resources in world energy demand and particularly in total domestic electricity generation that highlighted China as a leading country in terms of dominant shares as the top producer with the largest installed capacity in hydro, wind, and solar PV. In this section, I will look at the role of state in energy policy so that I can question further and discuss China’s focus on renewable energy resources in terms of a state’s acts seeking power or security in international order in my conclusion chapter.

States’ energy policies are shaped mostly by energy security, accessibility to energy, affordability of the resources, infrastructural needs, demand and supply requirements. Government subsidies, can be provided directly or indirectly such as fiscal subsidies, tax incentives for innovation, price control measures, demand assurance and compulsory allocation for renewables (Zhang et al, 2014). Political connections of firms with the government are also effective in receiving support and political background is also significant in obtaining various types of funding such as bank loans (Li, et al, 2008). However, efficiency of companies also matters for the government whether to support a firm or not (Yu et al, 2015).

There are several motivations for states to support renewable energy production. Public good argument is one example which is about “levelling the playing field for renewable energy” (Graaf et al, 2016, p. 183-191). Negative externalities of fossil fuels consist the first part of the public good argument because of local environmental pollution, public health losses, or global climate change. In this respect, governments try to earn the support of their citizens through convincing them with such arguments. Once the government have the support of their people, they began to invest in renewables while promising them to deal with those negative externalities from fossils and to deal with global scale environmental issues. Moreover, governments show their support for private technology and project developers which underinvest in renewable energy as they disregard wider social benefits (Graaf et al, 2016). In other words, governments provide support for such private actors both for the good of the society and for these private actors' interest seeking incentives at the same time.

According to Graaf et al (2016) development and deployment of renewable energy rest on two premises. First one is "government support for the emerging industry, technology, domestic ecosystem based on productivity and growth" (Graaf et al, 2016, p. 183-191). Renewable energy technologies should be demanded within the country and outside of the country. Through that demand, technology can be transferred to other countries in terms of exports which benefits the GDP. Technology can be also used within the country to increase the welfare and living standards of the people. In that respect, governments can have the ability to gain support from their citizens as they improve the welfare, and also make other countries dependent on their own technological production, own exports. To achieve technological development, governments have to provide their support to firms when there is a demand or need, in terms of patents, new technologies, and investments (Graaf et al, 2016). Government support has to be higher than fossil fuel support to make renewables more attractive for the firms and investors and to increase competitiveness of renewables. Moreover, firms should be able to get in the market easily that requires absence of a monopolistic structure as more actors in the market brings more competitiveness with larger options.

Therefore, mechanisms such as subsidies, tax breaks, and regulatory support have been used to expand renewable energy technology deployment, and increase learning, know-how while helping to economies of scale and decreasing costs of renewable energy to close the cost gap between renewables and non-renewable resources (Graaf et al, 2016). There are also pro-renewables trade policies, such as import tariffs, import duty reductions, export quotas, and export subsidies (Graaf et al, 2016). Through these mechanisms, investors, industry, and firms manage to obtain more advantageous conditions in their commitment for renewables with smaller costs, and enhanced technologies. In short, higher levels of competitiveness of renewables are targeted against those of fossil fuels that would enable private actors in the energy sector to invest more in renewables.

Second premise rests on the government ability to choose the winners in the market and decide which firm or renewable energy sector (i.e. wind, solar PV, biofuels) deserves government support (Graaf et al, 2016). In this respect, firms are dependent on governments in terms of the received amount of support which can be in funds or various different forms. Furthermore, governments can make their own investments to boost a certain sector if firms choose not invest in a certain sector. Thus, a rising sector can be well chosen by the governments when firms operate oppositely with the policies of governments.

By 2015, more than 140 countries established national policies to support renewable energy and energy efficiency (Graaf et al, 2016). “Wind and solar received the highest attention in these policies, and other renewable sub-sectors such as biofuels, biomass, geothermal and hydropower, energy storage, and R&D in batteries also received an important level of attention (Graaf et al, 2016, p. 183-191).” China is an example for these government actions. “The 12th Five Year Plan of Chinese government elevated investments on alternative, environmentally friendly, and energy efficient technologies to the level of ‘strategic emerging industries’ (Graaf et al, 2016, p. 185).” Through this decision of the government, renewables supported by the banks and funded in accordance with the needs of the sector. As a result of these policies, investments in renewable energy sector was observed. For example, China has the 3/5 of the solar panel production of the world and 95% of it is exported (Graaf et al, 2016). China both has the ability to develop new technologies with cost advantages and to enlarge its renewable energy share in the total energy production and consumption of the country.

The state-led mechanisms in increasing the share of renewable energy resources also cause trade-related tensions between countries mainly about local content requirements (LCRs), and feed in tariffs (Fit) (Graaf et al, 2016, p. 191-193). US-China dispute is one example in which China was accused of allowing its own manufacturers to sell wind turbines in international markets at lower prices than their competitors (Graaf et al, 2016). Another example from China is about excessive government subsidies for Chinese manufactured equipment (Graaf et al, 2016). These subsidies caused oversupply of Chinese manufactures which caused 30% fall in the price of solar panels that hurt other solar panel manufacturers in the US and Europe.

2.4. China’s Energy Outlook and Energy Policy

I will conclude this chapter by presenting China’s energy outlook in detail to underline the role of renewable energy resources, which has been already demonstrated in section 2.2. as part of the increasing trends for renewable electricity production in world energy demand. The descriptive statistics in this section would help me to examine the motivations behind China’s focus on renewable energy resources in terms of a state’s acts seeking power or security in international order that will be discussed in the conclusion chapter.

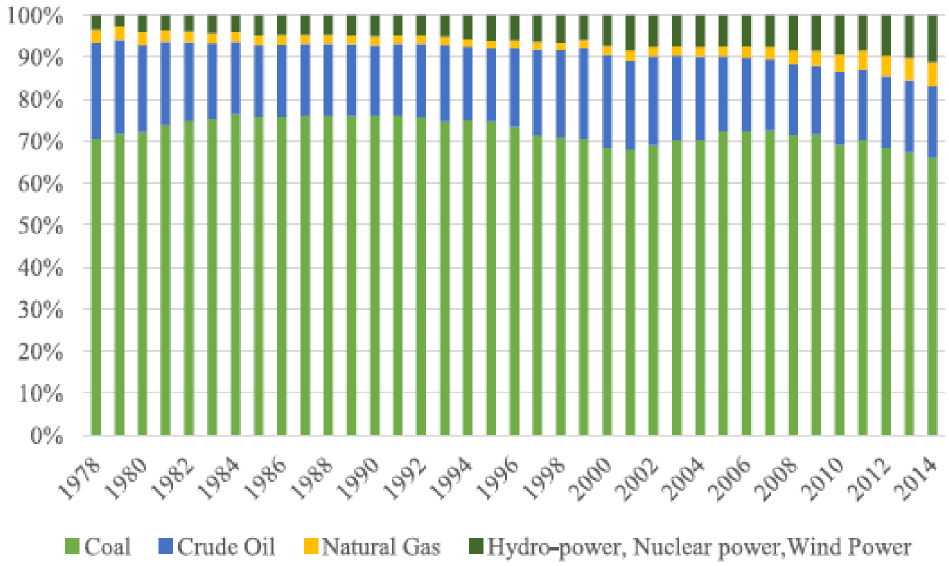
2.4.1. China’s Primary Energy supplies, Energy Imports by Countries and Primary Energy Consumption

China has been changing its primary energy consumption and production patterns towards more usage of renewables and more energy efficient resources. In 2018, Chinese government enacted financial regulatory reforms with the ambition to reduce high coal government debt levels, and eliminate air pollution from the industrial sector. Diversification energy supplies are also another motivation for the government. Furthermore, import dependency creates insecurities in terms of disruptions in energy flows. Renewable energy maximizes the energy security. Renewable energy resources also increase the power seeking policies. In accordance with these developments, China pursues expansion through enlarged renewable energy shares in the total national energy.

Figure 26 shows the primary energy consumption of China from 1978 to 2014. The data provided shows the increasing trend of renewables. However, Figure 26 includes nuclear power together with hydro power and wind power, while solar PV is not specified. What is striking in China’s energy consumption is that coal constitutes more than 60% in total primary energy consumption in 2014. When we look at Figure 27, we can observe China’s total primary energy demand by volume (Mtce) between 1990 and 2015. As of 2019, in Figure 28, China’s total primary energy consumption by fuel type is demonstrated where the share of coal is 58%, petroleum and other liquids 20%, hydroelectricity 8%, natural gas 8%, nuclear 2% and other renewable sources 5%. China’s efforts to increase renewables in its energy consumption have been continuing. For example, 60 GW of hydropower is planned to be installed in the south western region also with photo voltaic (PV) projects in the southern and eastern regions of the country as well as wind in the coastal regions which are going to increase the share of renewables in energy consumption further (Ji, Zhangd, 2019).

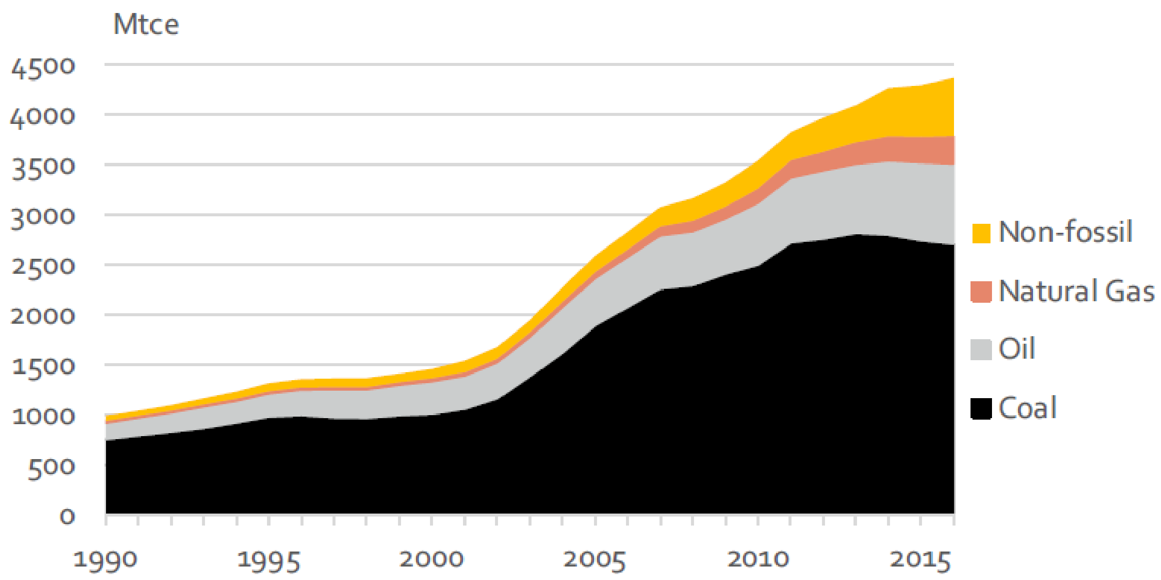
Furthermore, China is dependent on oil imports from different regions, mainly the Middle East, and Africa (see Figure 29). In terms of natural gas, China has both pipeline routes and LNG imports for its natural gas consumption which also involve with energy issues of the country (see Figure 30).

Figure 26: China's Primary Energy Consumption Composition, (1978-2014)



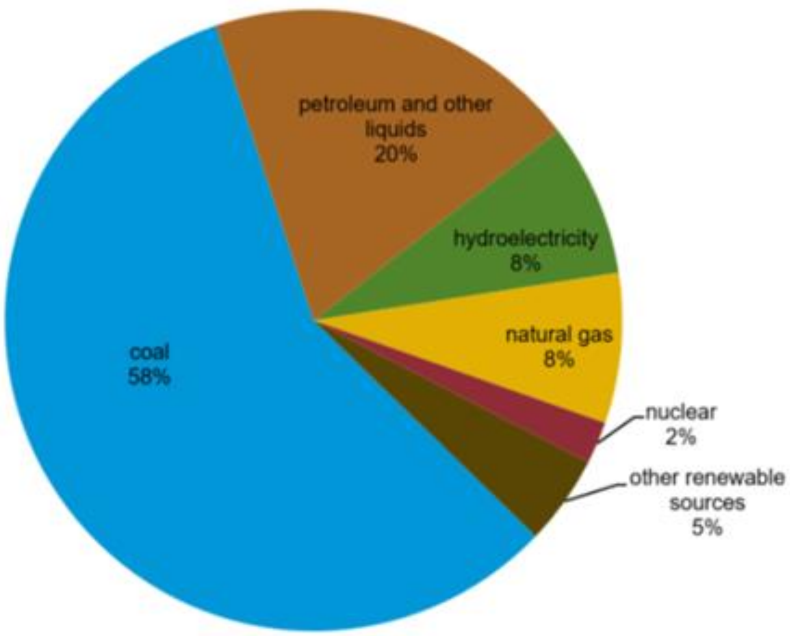
Source: NBSC, China Statistical Yearbook, 2014.

Figure 27: China's Total Primary Energy Demand, (1990-2015)



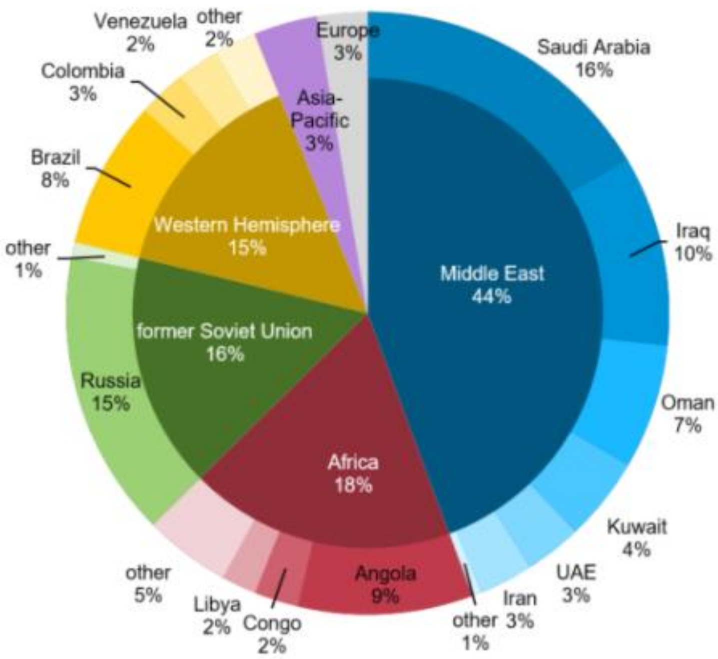
Source: NBSC, China Statistical Yearbook, 2018.

Figure 28: China Total Primary Energy Consumption by Fuel Type, 2019



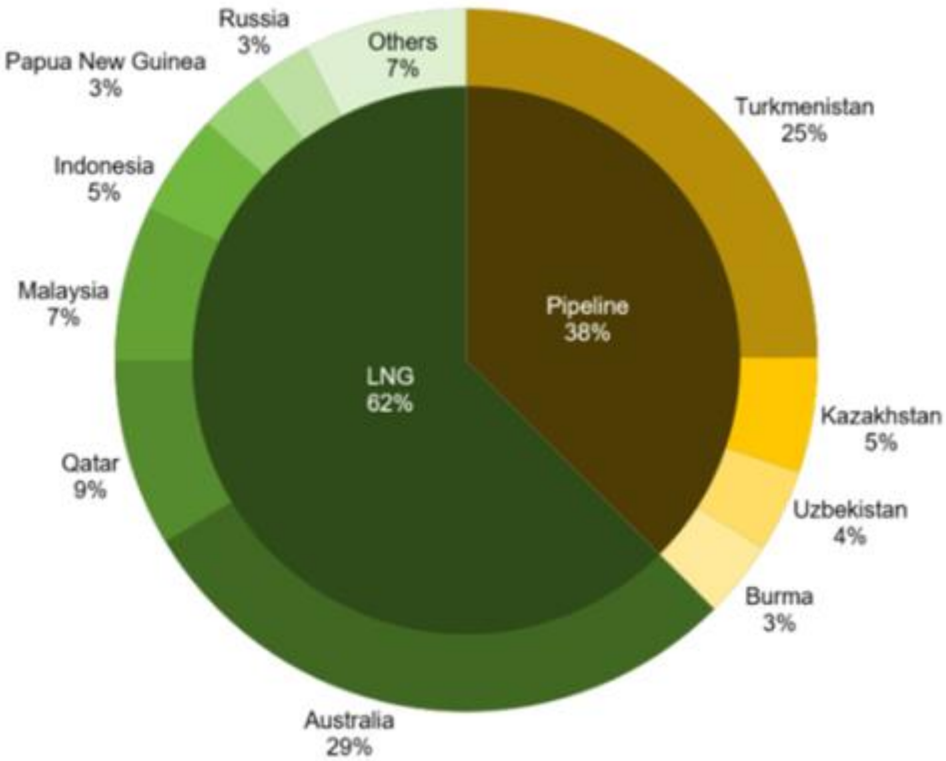
Source: BP Statistical of World Energy, 2020.

Figure 29: China's Crude Oil Imports by Countries and Regions, 2019



Source: FACTS Global Energy Services, China Oil Monthly, February 2020.

Figure 30: China's National Gas Imports by Countries, (Pipeline – LNG), 2019



Source: Global Trade Tracker, 2019.

China imports oil and gas from different regions and countries. Hence, with the motivation to decrease CO2 emissions, China's focus on renewable energy resources has increased.

2.4.2. Renewable Energy in China's Energy Policy

Renewable energy development was seen first during 1950s before the open-up policies in China. There were 41 tidal power stations built in coastal locations such as Guandong, Zhejiang, and Fujan between 1958 and 1960 (Fang, 2011). Similarly, in the mid-1980s, two single crystalline silicon solar cell production lines were built, while the first grid-connected wind farm was built in 1989 in Xinjiang (Han, Li, 2009, 2003). However, renewable energy and related policies to increase its share in energy production was first mentioned in 1991 in the Eight Five Year Plan (Peidong et al, 2009. For example, in 1995, the China Electric Power Act was introduced under the Five Year Plan that supported renewable energy consumption with more than 70.000 biogas stations, 7 million household biogas pools (Fang, 2011).

On the other hand, in 1990, renewables cannot be seen in Chinese electricity generation and this condition continued for 15 years (Aklin, Urpealinen, 2018). However, in 2005 with Renewable Energy Law, extensive increase in renewables achieved and within five years, there was 1.7% contribution from renewables. Coal dependency required energy diversification in China and transition to renewables was a great option since the policy goals to reduce CO2 emissions, increase energy efficiency with minimal losses, and to deal environmental issues.

Furthermore, fossil energy fuels are proven to decrease Chinese GDP with unpredictable price fluctuations. China's real GDP drops for 0.5% when oil prices increase for 10% (Awerbuch, Sauter, 2006). Therefore, more stable energy market for China can be achieved through renewables without a significant dependence on oil imports or fossil resources.

During mid-2000s, policymakers started to support pro-renewable policies with two major initiatives: (i) Renewable Energy Promotion Law for standards of renewable energy and (ii) "dual system" named for limited privatization approaches (Cherni, Kentish, 2007). Accordingly, in 2004, Chinese government stated that 10 GW of capacity from non- hydroelectric renewables goal could be achieved by 2010; while the target was achieved with higher capacity of 36 GW from non-hydro renewable resources in 2010 (Aklin, Urpelainen, 2007). However, renewable energy resources were still underexploited with significant potential for renewable energy system development (Mathiesen, Liu et al, 2011, 2011). Thus, between 2011 and 2015, China made large investments, $286 billion to renewable energy development and $376 billion to energy conservation policies to achieve its goals (Nicholas, He, 2014). The government efforts to increase the share of renewable energy resources peaked through investments. As mentioned above, $54.2 billion of investment was made in 2012, which was higher than any other country, and this amount of investment in China accounted for 29% of total investments among the G-20 countries in that year (Aklin, Urpelainen, 2018). Wind investments represented 60% and followed by solar with 30% in these investments in China (Aklin, Urpelainen, 2018). Similarly, McCrone, Moslener, d'Estais, Grüning, and Emmerich (2020) state that $59.6 billion invested in renewable energy in 2012 made China the biggest investor in renewable energy market in the world.[7]

[7] McCrone, A. Moslener, U. d'Estais, F. Grüning, C. Emmerich, M. (2020). Global Trends in Renewable Energy Investment Report. (116).

Hence, in 2012, renewables contributed 136 GW and in 2014, more than 90% of the non-hydroelectric capacity was from solar and wind (Aklin, Urpelainen, 2018). With huge investments, government aids, and public support, China received so much energy from renewables following these developments and advanced in energy efficiency when compared with rest of the world. China is still relying on coal but in the long-term renewables have the potential to replace most the share of coal. Currently, wind investment alone represents the sum of solar and wind in the United States. Renewable capacity in 2010 was 36 GW which is three times higher than the targeted goal (Aklin, Urpelainen, 2018).

In short, China has become the largest investor in renewable energy development with US$62.0, US$87.8, and US$102.9 billion in 2013, 2014, and 2015, respectively, while the total investment in the world was US$286 billion in 2015 (REN21, 2016 and Buckley, Nicholas, 2017). [8][9] For example, in terms of solar panel production and as a consumer of solar power China has obtained the leading place in 2013 by installing 12.9 GW of new solar capacity (REN21, 2014).[10] In 2015, China invested US$103 billion in renewable energy sector which accounted for two and half times the amount invested by the United States (Buckley, Nicholas, 2017). Therefore, with excessive investments in renewable energy sector in China, 136 GWH of electricity capacity to be produced from renewables was achieved as of 2013 (Aklin, Urpelainen, 2018). In fact, in the same year wind, biomass, and solar capacity had

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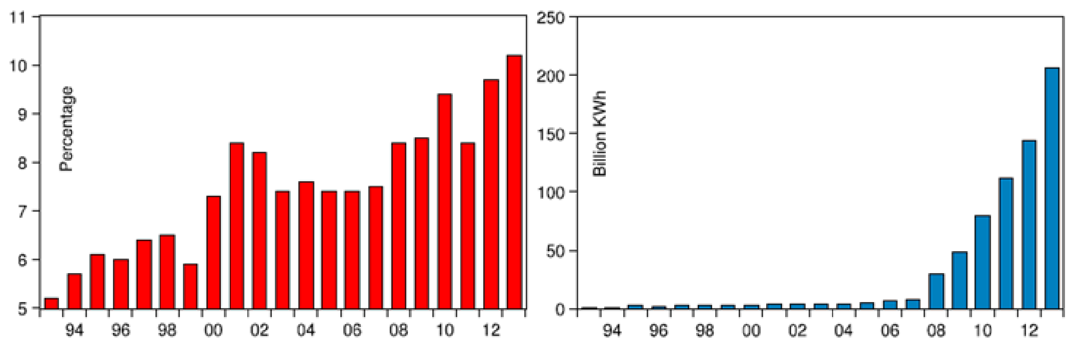
[8] Buckley, T. Nicholas, Simon. 2017. Chına’s Global Renewable Energy Expansion. How the World’s Second Biggest National Economy is Positioned to Lead the World in Clean-Power Investment. Institute for Energy Economics and Financial Analysis.
[9] Renewable Energy Policy Network for the 21st Century (REN21), 2016. Renewables 2016 Global Status Report. Available from: ⟨http://www.ren21.net/status-of-renewables/global-status-report/⟩.
[10] REN21. 2014. Renewables 2014 Global Status Report (Paris: REN21 Secretariat).

reached around 120 GW, and with that amount, China passed the capacity of the United States and Germany (Aklin, Urpelainen, 2018).

For example, China's installed energy capacity from hydro, solar, and wind in total accounted for 19.6%, 22.4%, and 23.9% of total capacity of electricity generation in 2013, 2014, and 2015, respectively (CEC, 2014).[11][12] "Renewable energy generation proportion has increased more than 10% from 1980 to 2012 in China (National Bureau of Statistic, 2013)." "By the end of 2015, China hosted more than 25% of the world's non-hydro renewable capacity, being 63.1% and 117.0% higher than the United States and Germany, respectively (Yang et al, 2016)."[13] Figure 31 compares the levels of renewable energy with and without hydro by years.

Figure 31: Renewable Energy Development in China (Hydro, Non-Hydro), (Billion KWh)



Source: Qi and Zhangd, 2019.

[11] China Electricity Council (CEC) 2014. Power Statistics Basic Data List in 2013. Available from: ⟨http://www.cec.org.cn/guihuayutongji/tongjxinxi/niandushuju/2015-03-06/134849.html⟩. China Electricity Council
[12] China Electricity Council. (CEC) 2016. Power Statistics Basic Data List in 2015. Available from: ⟨http://www.cec.org.cn/guihuayutongji/tongjxinxi/niandushuju/2016-09 22/158761.html⟩.
[13] Yang, J. X. Hu, H. Tan, T. Li, J. (2016). China's Renewable Energy Goals by 2050.Enrionmental Development. 20, 83-90.

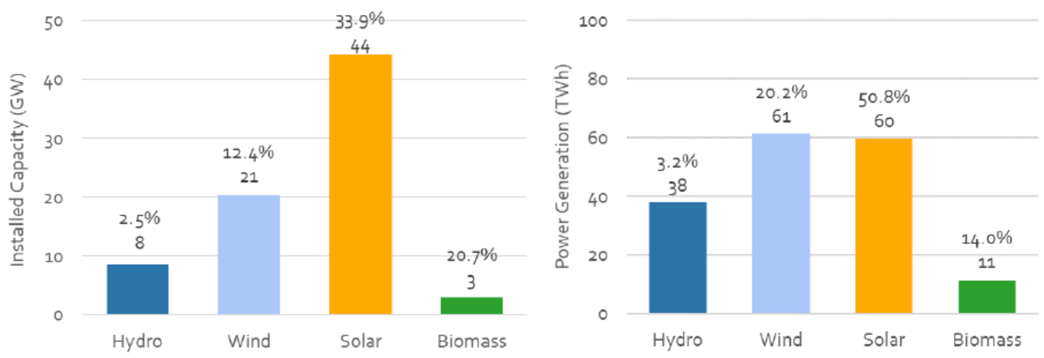
Ji and Zhangd (2019)[14] investigate the most recent, the 13th Five Year Plan of China, which aims further renewable energy developments to upgrade country's energy infrastructure in the 13th Five Year Plan of China various improvements were describes such as cleaner air in big cities compared with five years ago, less coal consumption, enormous deployment of renewable energy power market reforms, emission trading schemes, and mandatory consumption targets for renewable energy are some of these improvements (NDRC, 2019).[15]

Currently, China's energy pattern demonstrates slowing growth and higher levels of energy efficiency (NDRC, 2019). Renewables brought higher efficiency levels when compared with former energy patterns. Therefore, larger shares of produced energy can be used and slow-down in energy growth is an expected result. In 2018, in Chinese GDP growth was 6.6% growth in Chinese GDP was seen which is the lowest since 1990, while primary energy consumption reached to 4.640 Mtce (136 billion GJ) (NDRC, 2019). Furthermore, increase in energy efficiency was indicated through decline in energy consumption which decreased by 3.1% in 2018. Furthermore, increase in energy efficiency was indicated through decline in energy consumption which decreased by 3.1% in 2018. There is also gradual decrease in coal share in the overall energy market given diversified energy resources (NDRC, 2019). "The investment of newly added coal-fired power plants decreased by more than 60% and energy efficiency improved by 6% that led decreasing energy investments (NDRC, 2019)." In short, China is capable of using its energy more efficiently.

[14] Ji, Qiang & Zhang, Dayong. (2019) ow much does financial development contribute to renewable energy growth and upgrading of energy structure in China? Energy Policy https://doi.org/10.1016/j.enpol.2018.12.047.
[15] Energy Research Institute of Academy of Macroeconomic Research/NDRC. 2019. China Renewable Energy Outlook 2019. China National Renewable Energy Centre

Another important development in 2018 was decrease in residential use of coal (NDRC, 2019). In terms of non-fossil use, 14.3% of energy consumption was from non-fossils in 2018 which shows China is able to meet its renewable targets (NDRC, 2019). Intensity of carbon and main pollutant emissions intensity of production continued their decline and air became cleaner in most of the Chinese cities (NDRC, 2019). Figure 32 shows the recent renewable energy developments from 2018. Through these developments in renewable energy, China has an important capability to produce energy efficiently. Besides renewable deployment, China managed to reduce the costs for renewable energy in the past 20 years (NDRC, 2019). For further development, economic growth is the main policy of China for 2050 objectives (NDRC, 2050).

Figure 32: 2018 Incremental Installed Renewable Capacity (left), 2018 Incremental Renewable Power Generation (right), (China), (GW-TWH)



Source: NDRC, 2019.

More support for not only for renewable resources of hydropower, solar, and wind but also new nuclear projects are on the agenda. For example, the planned instalment of 60 GW of hydropower in the south western region, construction of a new national energy demonstration zone in Ningxia, increasing the progress in the distributed photo voltaic (PV) projects in the eastern and southern regions, and focusing on the wind power projects in coastal areas of the country were highlighted. The general objective for energy sector in the the 13th Five Year Plan of China is stated as to reshape the energy structure, optimize the supply of energy, build clean and low-carbon energy sources, and defend national energy security (Ji, Zhangd, 2019). Indeed, “regulation, legislation, and the generally favourable policy environment are all important factors in China’s upgrading of the energy structure (Liu, 2019).”

Among various regulations, launch of the Renewable Energy Law (REL) is another important milestone in China’s focus on increasing share of renewable energy resources in energy production and consumption in China (Zhang et al. 2016). Series of incentives, supports for renewable energy were used to boost the renewable energy with the Law (Shen, Luo, 2015). Furthermore, some of the firms received more support from the government in terms of loans, and funds depending on their closeness with the government (Li et al, 2008). Thus, more Chinese companies had the tendency to make their ties closer with the government which in turn enabled more centralized renewable energy development in China through governmental decisions and actions (Yu et al, 2015). It should be also noted that despite these “successful” policies, there are still millions of people who live without access to electricity and these policies are aiming to eliminate insufficient access to energy resources and provide supply to the growing demand for energy in China (Aklin, Urpelainen, 2018). Wang, Zhang, Ji, and Shi (2020) states that Chinese renewable energy development differs from region to region because already developed locations are more advanced in economic foundation, institutions, technological development that enables potential energy security, environmental protection, and renewable energy deployment better.[16]

China Renewable Energy Outlook 2019 investigates the announced scenarios and also focuses on below 2C scenario of the global warming conditions to assess Chinese commitment to the Paris Agreement (NDRC, 2019). Thus, the 14th Five Year Plan is expected to generate more committed results in the renewable energy development. For example, NDRC (2019) gave some policy recommendations stating that in the 14th Five Year Plan energy transition should be accelerated with ambitious targets for reduction in CO2 emissions, cost decreases in renewable energy deployments, establishment of renewable energy supporting policies, minimizing the damage from fossil fuels, less coal use in electricity production, avoiding new coal power plans and inefficient coal uses for the period between 2021-2025 (NDRC, 2019).

Lastly, when we look at China's future goals in its energy policy Yang, Hu, Tan, and Li (2016) examined particularly the ambitious targets set for 2050. For example, China's plan is to reach between 16%-%26 by 2030, and between 60%-86% by 2050 for the share of renewable resources in total electricity generation (Yang et al, 2018). Another study by the World Wildlife Fund reports that the share of renewables could amount for 80% of China's power by 2050 (Chandler et al, 2014).[17] Similarly, the study by Energy Research Institute of National Development and Reform Commission (2014) reveals that 62% of Chinese energy and 86% electricity can be

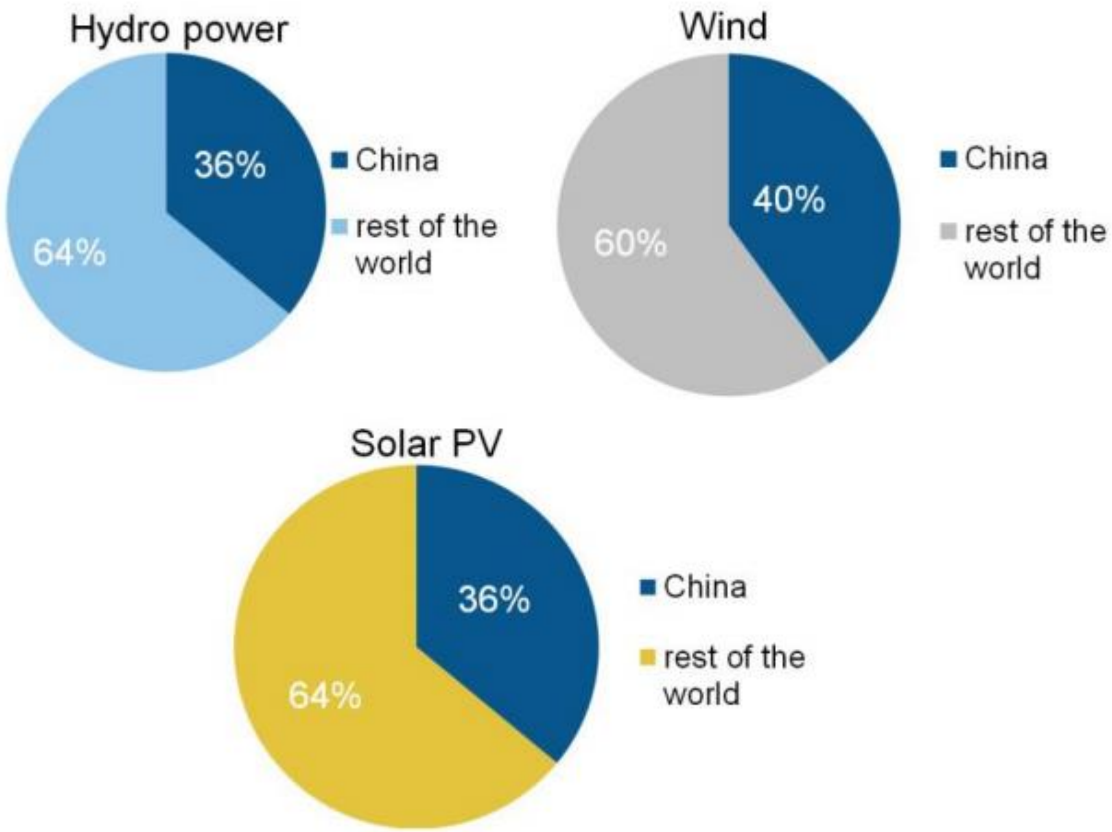
[16] Wang, Y. Zhang, D. Ji, Q. Shi, X. 2020. Regional Renewable Energy Development in China: A Multidimensional Assessment
[17] Chandler, W., Chen, S., Gwin, H., Lin, R., Wang, Y., 2014. China's Future Generation. Assessing the Maximum Potential for Renewable Power Sources in China to 2050. The World Wildlife Fund, Beijing.

obtained from renewables by 2050.[18] Furthermore, Zao, Xhang, Wei (2020) argue that renewable energy and oil can be easily substituted for each other. According to the authors' assessment at some point in the future, rather close or far, oil prices will show an excessive increasing trend when compared with today's fluctuations. Therefore, in the long term, renewable energy is going to be a better substitute to diversify depleting energy resources such as oil. As a result, renewable energy will play both the role of an important energy resource and a diverse source to enhance energy security of China by lessening energy dependency from imports.

There are other studies which indicate Chinese accomplishments as well. In short we can summarize the share of hydro power, solar PV, and wind energy in global renewable capacity growth between 2015-2021 compared with the rest of the world (Fig. 33).

[18] Energy Research Institute of National Development and Reform Commission, ERINDRC, 2015. China 2050 High Renewable Energy Penetration Scenario and Roadmap Study. Beijing.

Figure 33: China's Share of Global Renewable Capacity Growth, 2015-2021, (Hydro, Wind, Solar PV)



Source: IEA, World Energy Outlook, 2016.

2.4.3. Major Reasons for China's Focus on Increasing Renewable Energy Resources

When we look at the major reasons for China's focus on increasing renewable energy resources, one can argue that there were domestic reasons and external pressures that have shaped China's energy policy. First, one turning point was the energy plan of 2012, namely "China's Energy Policy." In this energy plan the Chinese government emphasized clearly the importance of renewable energy developments and support for the industry with multiple and clean procurement of energy because of the imminent conditions about the environmental degradation, climate change, and sustainable development (Aklin, Urpelainen, 2018). Although Chinese government has supported renewable energy development with documents dating back to 2002, international pressure was growing to make China adopt low-carbon growth policies in accordance with the Paris Agreement (Aklin, Urpelainen, 2018). In this regard, Chen (2018) argues that enlarging the share of non-fossil fuels in the total energy is the best way to tackle climate change and reduce CO2 emissions for clean economic growth.[19]

Second, another necessity to increase renewable energy in China's energy market is derived from coal dependency that causes poor air quality especially in the major highly populated cities (Cherni, Kentish, 2007). Poor air quality is an ongoing problem for China not only in urban locations but also for agricultural and forestry growth (Wu, 2003). For example, in 1990s environmental damage accounted for 7 percent of China's GDP (Aklin, Urpelainen, 2018). Thus, renewable energy policies have been aiming to increase competitive advantage of the industry to enlarge the share of renewables and investments, while they also help to reduce CO2 emissions and lead improvements in deteriorating environmental conditions (Liu, D. Liu, M. Xu, E. Pang, B. Guo, X. Xiao, Niu, D. (2018).[20] Similarly, Zhang et al (2017) argue that in the long term, renewable energy development can enable China to find solutions for energy shortages, low efficiency issues, high emission levels, and environmental impacts of conventional fossil fuel energy.[21]

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[19] Chen, Y. 2018. Factors Influencing Renewable Energy Consumption in China: An Empirical Analysis Based on Provincial Panel Data. J Clean Prod; 174:605–15.

[20] Liu, D. Liu, M. Xu, E. Pang, B. Guo, X. Xiao, Niu, D. (2018). "Comprehensive Effectiveness Assessment of Renewable Energy Generation Policy: A Partial Energy Policy Equilibrium Analysis in China." 115:330–341. doi: 10.1016/j.enpol.2018.01.018.

[21] Zhang, D. Wang, J. Lin, Y. Si, Y. Huang, C. Yang, J. Huang, B. Li, W. 2017. Present Situation and Future Prospect of Renewable Energy in China. Renew Sustain Energy Rev;76:865–71.

Moreover, high government and public support, and less opposition for renewable energy investments by vested interest groups in fossil based energy sectors than those in industrialized countries made China a better place for those investments (Aklin, Urpelainen, 2018). For example, Chen, Cheng, and Urpelainen (2014) conducted a survey that showed urban middle class support for renewable energy developments.[22]

Third, according to the data of the US Energy Information Administration (2018)[23], China surpassed the United States in oil imports by becoming the largest oil importer in the world. Hence, with increased dependence, potential vulnerability, and volatility in prices, renewable energy appears to be an important alternative for China(Zhao, Zhang, Wei, 2020).[24] For example, when the international oil price increases, Chinese cost of oil imports increases accordingly and this condition makes renewable energy more competitive because of its fiscal advantages when compared with traditional fossil energy (Zhao, Zhang, Wei, 2020). Awerbuch and Sauter (2006) find out that the cost of price increase and 10% rise in oil prices leads to a decline in Chinese GDP for 0.5% in terms of real GDP.[25] Thus, increase in oil prices in the past has also encouraged the development of renewable energy industry through the substitution effect in China's energy market (Zhao, Zhang, Wei, 2020).

In this regard, Matthews and Tan (2014) (2015) argue that biggest motivation of China to invest excessively in renewable energy is the energy security of the

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[22] Chen, Dingding & Cheng, Chao-Yo & Urpelainen, Johannes. (2015). Support for Renewable Energy in China: A Survey Experiment with Internet Users. Journal of Cleaner Production. 112. 10.1016/j.jclepro.2015.08.109.

[23] Energy Information Administration. (2018) China Surpassed the United States as The World's Largest Crude Oil Importer in 2017.

[24] Zhao, Y. Zhang, Y. Wei, W. (2020). Quantifying International Oil Price Shocks on Renewable Energy Development in China.

[25] Awerbuch, S., and R. Sauter. 2006. "Exploiting the Oil–GDP Energy Policy Effect to Support Renewables Deployment." 34 (17): 2805–2819. doi: 10.1016/j.enpol.2005.04.020.

country.[26][27] Similarly, Yang et al. (2016) show that the period between 2020 and 2030 would be transition and transformation process for China's energy systems. After this period, it is expected that one of the primary energy sources would become renewable energy resources amounting 1.4 billion TCE, 25% of primary energy consumption, and by 2050, fossil fuels would be replaced by dominant share of renewable energy accounting for 2.6 billion TCE, 40% of primary energy. In terms of renewable electricity, 60% of total share would be supplied, while distributed renewable energy should be able to meet more than 20% of end users (Yang et al, 2016).

Moreover, Zao, Xhang, Wei (2020) argue that renewable energy and oil can be easily substituted for each other. They emphasize that China's growing competitiveness in renewable energy is important to overcome costs resulting from fluctuations in the oil prices, which might not continue similarly in the future because of the limitations on the amount of oil resources. Although in the short term decreasing oil prices weakens the benefits of investments on renewable energy, in the long term, clean energy is not a preference but a must because of challenges in environmental degradation and climate change in China. Thus, Zao, Xhang, Wei (2020) concludes that renewable energy is going to be a better substitute to diversify depleting energy resources such as oil especially in the long term. Further, the authors recommend that when international oil prices are falling, which is not conducive to the development of renewable energy industry in China, the government should actively adopt policies to offset this negative effect.

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[26] Mathews, J.A. Tan, H. 2014. China's Renewable Energy Revolution: What is Driving It? Asia-Pac. J. 12, 1–8.
[27] Mathews, J.A. Tan, H. 2015. The Greening of China's Black Electric Power System? Insights from 2014 data. Asia-Pac. J. 13, 1–8.

Fourth, economic benefits including technological advancement aiming to increase particularly the share of non-hydro renewable energy resources are another reason for China's focus on renewables in its energy policy. Fang (2011) finds out that there is a positive correlation between total renewable energy consumption and GDP, GDP per capita, per capita annual income of rural households, per capita annual income of urban households. For example, Figure 36 shows that renewable energy consumption increases rapidly in terms of million tons of coal equivalent (Mtce). On the other hand, Figure 34 presents the share of renewables in terms of percentage values. There is rapid increase in both GDP and share of renewables in China's overall energy consumption. Thus, it is argued that decrease of fossil resources in the overall energy consumption and their replacement by renewables contribute to economic growth. Renewable energy consumption increases rapidly in terms of million tons of coal equivalent (Mtce). Furthermore, renewable energy consumption and GDP are positively correlated and interconnected with each other. There is rapid increment in both GDP and share of renewables in the overall energy consumption (Fig. 35). Hence, decrease of fossil resources in the overall resources, which is replaced by renewables, brings economic growth.

Sebri and Ben-Salha (2014) also emphasizes the positive relationship between renewable energy consumption and growth rate. [28] Zhang and Ren (2015) find out similar results that there is a mutual relationship between renewable energy consumption and economic growth in certain provinces of China such as Shandong.[29] Lin et al (2016) find out that GDP and renewable electricity

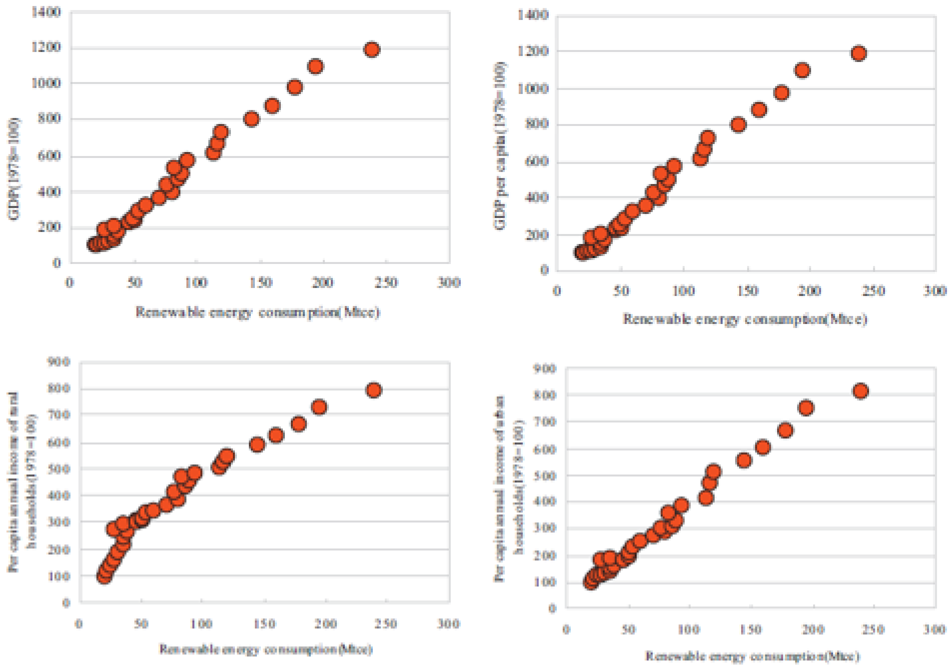
[28] Sebri M, Ben-Salha O. 2014. On the Causal Dynamics between Economic Growth, Renewable Energy Consumption, CO2 Emissions and Trade Openness: Fresh Evidence from BRICS Countries. Renew Sustain Energy Rev. 39:14–23.
[29] Zhang Z, Ren. X, (2015). Causal Relationship Between Energy Consumption and Economic Growth.

consumption have positive relationship in the long run.[30] Chen (2018) asserts that economic development also has positive impact on renewable energy consumption based on the research on 30 provinces in China.[31] Chen (2018) also reaches a conclusion that underlines positive correlatıon between exports and renewable energy development.[32] An example to those exports can be given from solar PV panel production and by 2012, top 10 PV producers in the world consisted of seven China-based producers (Huang, Negro, 2016).[33]

Moreover, in 2014 employment in renewable energy industry in China accounted for 2.6 million of employments directly or indirectly (REN21, 2014). In 2016 employment in renewable sector continued to increase accounting 3.5 million jobs in China out of total 8.1 million jobs in the same sector in the world according to the International Energy Agency (2016).[34] One reason for these developments in China is the role of political elites in a centralized government system who pursue energy security and high growth rates through investments in renewable energy (Aklin, Urpelainen, 2018). In short, economic benefits, such as economic growth, exports, and employment are also important driving force for China's focus on increasing renewable energy resources in its energy market.

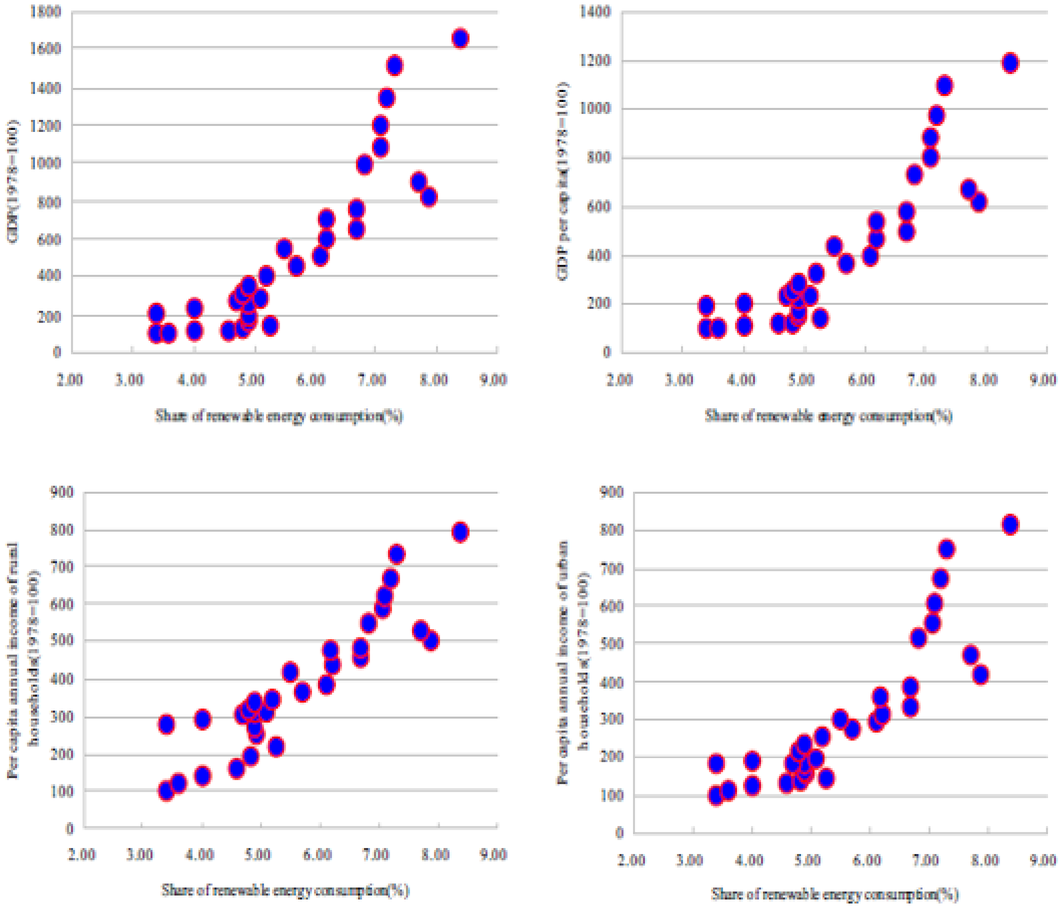
[30] Lin B, Omoju OE, Ju Okonkwo. 2016. Factors Influencing Renewable Electricity Consumption in China. Renew Sustain Energy Rev. 55:687–96
[31] Chen, Y. 2018. Factors Influencing Renewable Energy Consumption in China: An Empirical Analysis Based on Provincial Panel Data. J Clean Prod.
[32] Chen, Y. 2018. Factors Influencing Renewable Energy Consumption in China: An Empirical Analysis Based on Provincial Panel Data. J Clean Prod
[33] Huang, P, Negro, SO. Hekkert, MP. Bi, K. 2016. How China Became a Leader in Solar PV: An Innovation System Analysis. Renew Sustain Energy Rev;64:777–89.
[34] International Energy Agency (IEA). 2016. World Energy Outlook

Figure 34: Renewable Energy Consumption in China and its Relation with Chinese GDP, (Mtce)



Source: Fang, 2011.

Figure 35: Economic Welfare vs. Renewable Energy Consumption for China from 1978 to 2008, (GDP, Share of Renewable Energy Consumption).



Source: Fang, 2011.

2.4.4. China's Dominantly Large Firms in Renewable Energy Sector and Other Renewable Energy Related Sectors in the World

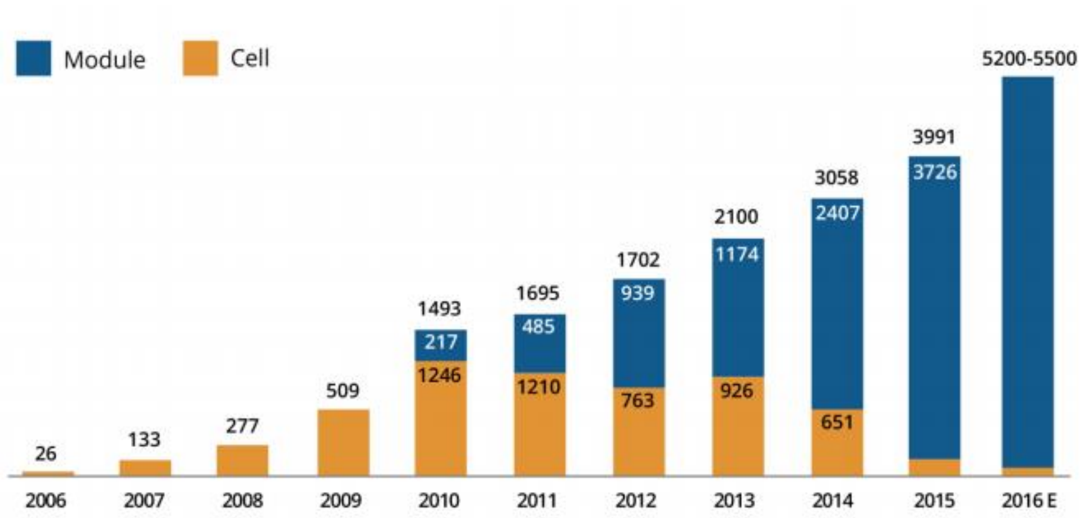
China shows unprecedented developments in its energy structure with its leading place in 12.9 GW of new solar capacity and solar modules (REN21 2014). Two largest PV manufacturers were Chinese firms, Yingli and Trina Solar SA solar while Jinko Solar are also placed in the top ten firms of the solar PV manufacturing in the same list (Aklin, Urpelainen, 2018).

In 2012, nine out of top-15 solar panel producers and four out of top ten producers in wind tribunes were from China, which accounted for 30 percent and almost 17 percent of global market share in solar panels and wind tribunes, respectively (REN21, 2014). In 2016, world's six largest solar-module manufacturing firms consisted of five Chinese firms (Buckley, Nicholas, 2017). Yingli and Trine Solar were the leading ones while other two Chinese companies, as mentioned, JA Solar and Jinko Solar, ranked in the top ten solar panel producers in the world (Aklin, Urpelainen, 2018).

For example, JA Solar ranks at the top six solar module manufacturers in the world (Buckley, Nicholas, 2017). Silicon wafer, cells and modules are other manufacturing areas of the company in a more competitive environment with decreasing costs (Fig. 39). "JA Solar has a global module manufacturing capacity of 5.5GW per year with a cumulative shipment of 17.5GW. Since 2010 the company has focused increasingly on sales outside of China, and in 2015, 57% of revenues were generated from overseas customers (Buckley, Nicholas, 2017, p. 23-24)." Figure 36 shows the development of the company. JinkoSolar is another Chinese renewable energy company with 16 overseas subsidiaries and has manufacturing plants in Malaysia, South Africa, and Portugal in addition to those within China (Buckley, Nicholas, 2017). In Chile, Mexico, Brazil, South Africa, Italy, China, JinkoSolar owns the highest market share (Buckley, Nicholas, 2017). Some of the downstream solar PV generation projects in China are owned by the company with the capacity of 1.3 GW (Buckley, Nicholas, 2017). Furthermore, Jinko has renewable energy development operations in Latin America for overseas downstream generation project opportunities (Buckley, Nicholas, 2017). Figure 37 shows the development in

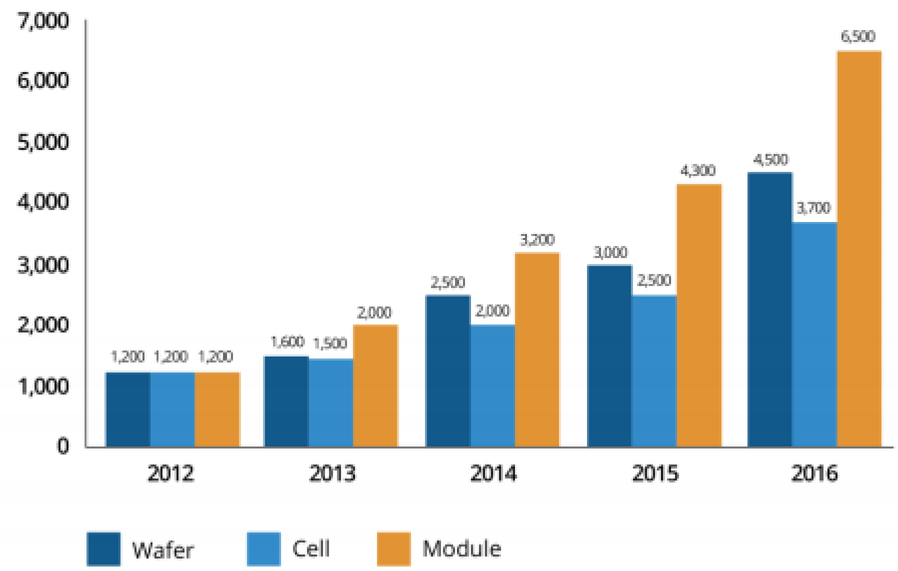
JinkoSolar's manufacturing capacity through years in wafer, cell, and module with more competitive costs of cell and pack (Fig. 38).

Figure 36: JA Solar Annual Module and Cell Production, (2006-2016), (Modules, and Cells), (MW)



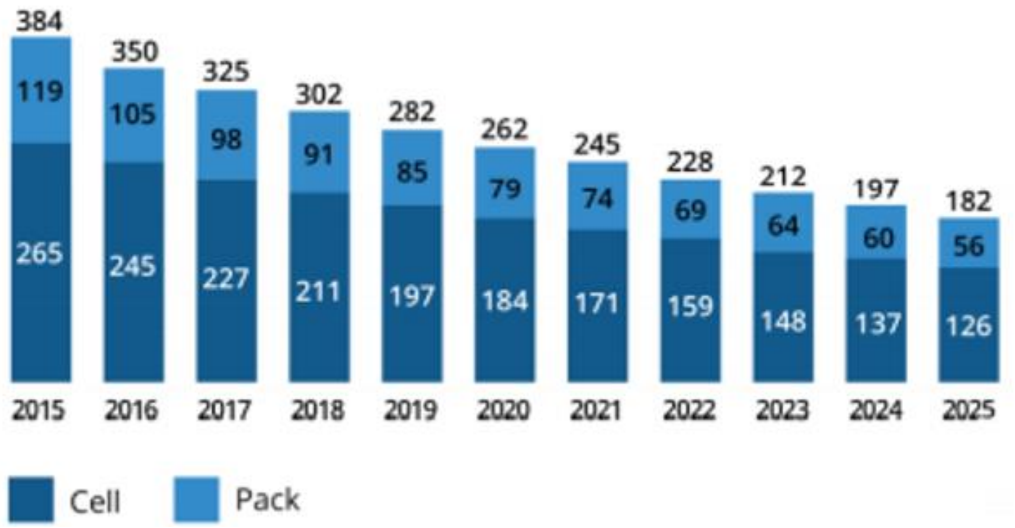
Source: Buckley and Nicholas, 2017.

Figure 37: JinkoSolar Manufacturing Capacity, (2012-2016), (MW).



Source: Buckley and Nicholas, 2017.

Figure 38: Forecast Decline in Ion Battery Costs, (Global), ($/kWh)



Source: Buckley and Nicholas, 2017.

Furthermore, China's commitment to increasing share of renewable energy production has been apparent, when China National Building Materials (CNBM) built a US$1.6 billion, 1.5 GW thin-film solar module facility to challenge US and its First Solar company (Buckley, Nicholas, 2017). Similarly, Goldwind, a Chinese company, surpassed Vestas in 2015 with the motivation to become the largest wind-turbine manufacturer in the world (Buckley, Nicholas, 2017). With domestic-oriented companies of the Goldwind such as United Power, Ming Yang, Envision, and CSIC, five of the top-ten wind-turbine manufacturing firms in the world are owned by China (Buckley, Nicholas, 2017).

In addition to large firms in solar PV and wind tribunes manufacturing firms, there are large state owned and private firms in China's utility sector. For example, State Grid Corporation of China (SGCC) is the largest electricity utility company in the world with over 1.9 million employees and more than 1 billion customers and operations across countries, such as Australia, Brazil, and Portugal. (Buckley, Nicholas, 2017). The SGCC's annual sales accounting US$ 330 billion from electricity generation (Buckley, Nicholas, 2017) are larger than combined revenues of Boeing and Apple, which makes the SGCC rank second in terms of revenues in the 2016 Global Fortune List.[35] "China Three Gorges Corporation (CTGC) is another state-owned power company and the largest clean energy group in China (Buckley, Nicholas, 2017). The largest hydro-electric facility of the world with 22.5 GW was commissioned by the CTGC in 2012 and the project is 20 times larger than the Hoover Dam's 1.35 GW capacity (Buckley, Nicholas, 2017). The CTGC reached 60 GW of electricity capacity in 2016 and with PowerChina, two companies dominate global investments in hydro-power and construction of hydro-power dams (Buckley, Nicholas 2017).

China has been paying attention to production of lithium for some time in light of the global recognition of electric vehicles (EV) which challenged the hegemony of internal-combustion engines. For example, Tianqi Lithium has become the largest lithium ion manufacturer worldwide after the acquisition of Talison Lithium in 2012 and Galaxy's Jiangsu processing facility in 2015. The Tianqi Lithium continued its market expansion by spending US$ 2.5 billion in 2016 to obtain a 25% minority share of SQM of Chile, which was the world's fourth-largest lithium firm (Buckley, Nicholas, 2017). Further, although Tesla seems to be the most recognized EV company, two biggest challengers (BYD and CATL) in terms of global lithium ion battery and EV leadership are based on China (Buckley, Nicholas, 2017).

In line with the growing market for EV accompanied with the rising demand for batteries, rare-element mining and processing sector has been also increasingly important for energy market and related industries in the world economy. Chinese

[35] Fortune. 2016. Global 500.

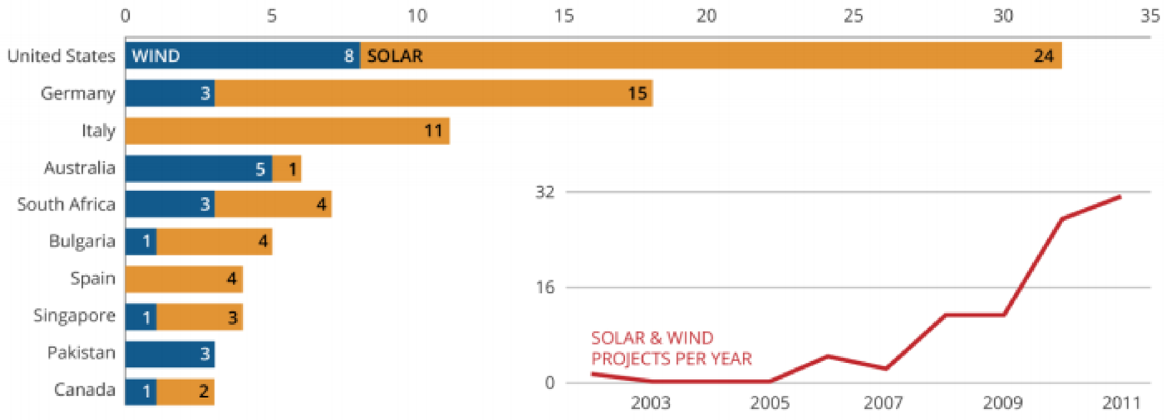
enterprises control 90% and 72%, respectively of the rare-element mining and processing sector. The rise of Chinese dominance in these critical sectors has been observed when the American firm, Molycrop US collapsed financially in 2015 (Buckley, Nicholas, 2017). Further, in 2010, China imposed export quotas for 35%, which accounts for 95% of the global supply, on rare earth elements that are used in high-technology equipment for clean energy products. These elements are found scarcely that caused fourfold rise in prices of rare earth elements in 2010 and another twofold increase in 2011 (Graaf et al, 2016). China argued that quotas are formed to decrease domestic downstream costs for its own manufacturers and to keep those resources in domestic market (Graaf et al, 2016).

Moreover, Chine-led large trans-national infrastructure projects, such as “One Belt, One Road,” “the Silk Road Fund,” “the China-Pakistan Economic Corridor,” and the “Bangladesh-China-India-Mynamar (BCIM) Economic Corridor,” provide opportunities for Chinese renewable energy firms’ market expansion overseas (Buckley, Nicholas, 2017). For example, in 2015, China’s State Power Investment Corporation (SPIC) bought Pacific Hydro of Australia for A$3 billion and the deal provided Pacific Hydro’s winds and hydro generation assets in Australia, Chile, and Brazil to SPIC’s energy portfolio, which has established over 100GW of capacity located across 25 countries (Buckley, Nicholas, 2017). Similarly, Brazil, Mexico, Argentina, and Chile are very advantageous locations for Chinese companies’ renewable energy investments across Latin America (Buckley, Nicholas, 2017). For example, in Argentinian renewable energy auctions in 2016, wining wind projects and three quarters of the solar bids at least, involved Chinese capital and technology, while various US and European companies consider Argentina too risky for renewable energy investments (Koop, 2016).[36]

In addition to Asia and Latin America regions, some of the hotspots for Chinese renewables investment are Texas, California, and New Jersey where pro-renewable energy policies are supported (Buckley, Nicholas, 2017). In Sub-Saharan Africa between 2010 and 2015, main contractor Chinese companies were responsible for 30% of newly added generation capacities (IEA, 2016).[37] For example, there are wind energy, solar PV energy, and bioenergy investments by Chinese firms in South Africa and Ethiopia. JinkoSolar has invested in a solar PV factory in Kenya, and Ghana, which has an annual capacity of 120 MW (megawatts) (Buckley, Nicholas, 2017). Figure 39 shows China's overseas investments in renewables between 2003 and 2011. The number of investments in various countries such as the United States, Germany, Australia, and Italy is also a demonstrator of success in terms of China's goal to enlarge its renewable energy capacities.

[36] Koop, F. 2016. China's Impressive Stake in Latin America's Renewables. China Dialogue. Accessed through: https://chinadialogue.net/en/energy/9419-china-s-impressive-stake-in-latin-america-s-renewables/
[37] International Energy Agency (IEA). 2016. Boosting the Power Sector in Sub-Saharan Africa: Chinese Involvement.

Figure 39: China's Overseas Investments in Renewables, 2003-2011, (Wind and Solar)



Source: World Resources Institute, 2013.

In summary, this chapter has demonstrated the growing role of renewable energy resources in the on-going energy transition in the world as well as the role of state in boosting renewable energy investments and production through different incentive mechanisms. Within this context, I looked at the Chine's energy outlook as well as Chinese government's energy policy for renewable energy resources historically. Figure 33 above, indicates the considerable role of renewable energy resources in China by demonstrating China's share in global renewable capacity growth in hydro power, solar PV, and wind energy compared with the rest of the world between 2015 and 2021.

I identified major reasons for China's focus on increasing share of renewable energy resources in energy consumption that highlighted external pressures for climate change given Paris Agreement for reducing CO2 emissions and domestic reasons such as reducing coal in electricity generation given environmental pollution, poor air quality in large urban areas, China's energy security given its dependence on imported oil and gas resources and need for diversification of energy supply sources, and economic benefits from increasing renewable investments and production in domestic and overseas energy market. Lastly, I presented the dominant role of Chinese state owned and private companies in renewable energy sector and other renewable energy related sectors in the world.

In the next chapter, I will examine China’s energy security and the role of state in China’s increasing renewable energy capability so that I can make a basic theoretical discussion to consider initial realist arguments to assess China’s acts in maximizing security and seeking power in the conclusion.

CHAPTER THREE – The Role of Renewables in China's Energy Security

3.1. China's Energy Security: Avoiding Oil Import Dependency and Vulnerability

Energy security is one of the major concerns of states as they are dependent on flows of energy with minimal disruptions. The International Energy Agency defines energy security as "the uninterrupted availability of energy sources at an affordable price (IEA, 2020).[38] Uncertainty due to anarchy in international system would encourage states to avoid disruptions especially those that might stem from geopolitical disputes, civil conflicts in oil and gas supplier countries or regional wars, and to maximize their energy security. Thus, a realist analysis of China's energy security and/or to enhance its power relations regarding energy resources in international order would be helpful.

The existence of anarchy forces states to secure themselves without depending on other variables. In this respect, China has to allocate its capacities in accordance with their most important policies regarding its energy security, while it can aim also to shape the international arena in its favour through controlling international production and exchange mechanisms in the energy market (O'Brien, Williams, 2003). Especially major powers have the capability to do so and China is one of the few major powers in the international system. China has a significant production capability in energy within its borders which decreases its dependence on other countries and secure itself from disruptions of energy imports. Risks of disruptions can be minimized further through decreasing dependence on imports of energy

[38] IEA. 'What is Energy Security?' https://www.iea.org/topics/energy-security

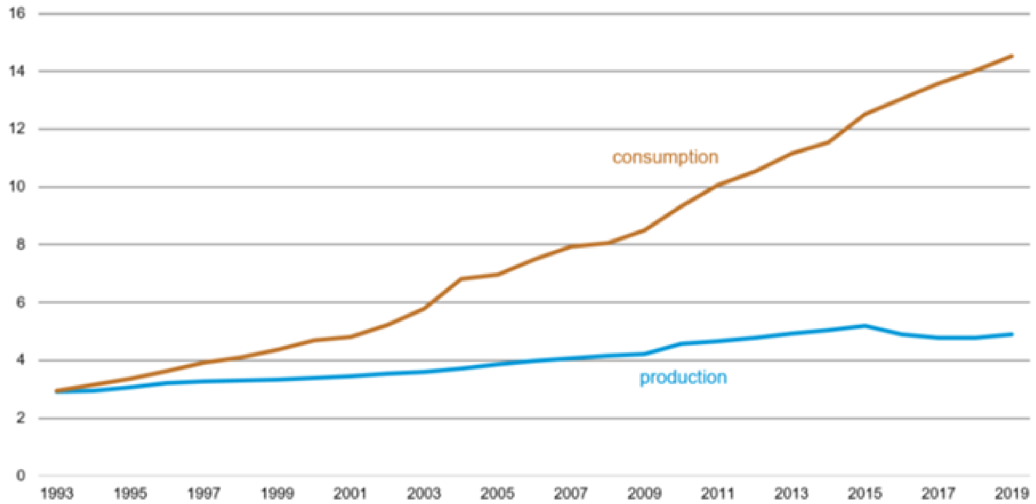
supply sources such as oil and natural gas. Therefore, with larger share of renewable energy deployment, China makes itself less dependent and more secure by producing its own energy within its own borders. Influence in global energy market is another variable for assessing the level of power. a China has. China's market capabilities in domestic and overseas energy markets can provide wealth and growth to the state.

China's energy security is an evolving area of research because of the changes in its market structure. In a time period less than two decades, China has become the world's biggest net oil importer in 2017 (Moe, Midford, 2013). However, in terms of security Chinese' dependency on overseas energy supplies is not devastating as the country has considerable capability of domestic production (Moe, Midford, 2013). China's domestic oil production was 4 million barrels per day (mb/d) in 2013 that to give an idea in terms of military security this amount of production is four times higher than the oil which enabled US to wage two wars, in Iraq, and Afghanistan (Moe, Midford, 2013). Therefore, one can argue that China has capability to defend itself to some extent. This ability of China decreases its vulnerability to disruptions in global energy flow at least strictly in security or defence fields. Moreover, China's domestic coal production with abundant coal reserves, 70% of the world, provide secure domestic energy supply (Moe, Midford, 2013).

Despite the availability of large domestic coal reserves and some domestic oil production in the Chinese energy market, the country is still vulnerable to the fluctuating oil prices and disruptions in oil supplies in terms of economic growth and domestic stability (Moe, Midford, 2013) given its ongoing demand for imported oil and gas resources. Production stays low while consumption increases relatively (Fig.

40). Therefore, the government has been making the Five Year Plans (2001-2005, 2006, 2010, 2011-2015, 2016-2021) to overcome challenges in China's energy security. In these plans, the Chinese government specify energy related policy targets and some tools which are energy mix in favour of China, overseas equity oil production, more state owned tanker fleet, construction of cross-border pipelines, a strategic petroleum reserve (SPR), expanded refinery capacity, future and long-term contracts, participation in constabulary tasks overseas, and diversifying its energy sources and routes.

Figure 40: China's Petroleum and Other Liquids Production and Consumption, 1933-2019, (Million Barrels per Day)



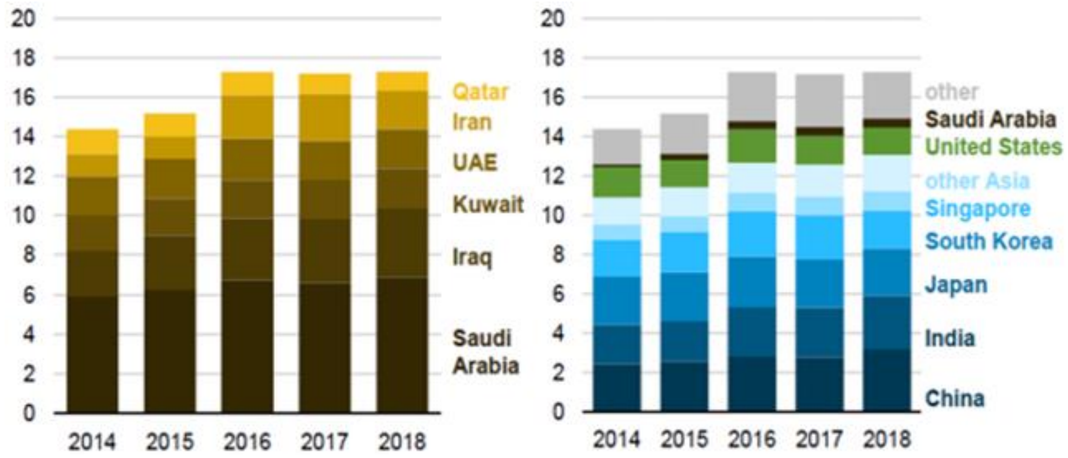
Source: US Energy Information Administration, Short-Term Energy Outlook, August 2020.

Furthermore, Chinese imported energy is dependent on the stability of different regions and countries. As the Middle East is the major region for Chinese imports, the Strait of Hormuz is very crucial. After the Strait of Hormuz, the Strait of Malacca is the route for Chinese imports (Fig. 41). Moreover, China is the largest importer of the oil that is exported from the Middle East (see Figure 42). Hence, any disruption in the energy flow might be very devastating for China as the country is much more dependent than other countries. Therefore, vulnerability in such potential occasions has to be decreased along with dependence.

Figure 41: Chokepoints for Crude Oil and Petroleum Liquids Transportation

Source: Salahuddin, 2013.

Figure 42: Volume of Crude Oil and Condensate Transported through the Strait of Hormuz, by Origin (left), by Destination (right), (2014-2018)



Source: US Energy Information Administration, 2018.

For example, regarding security of China's oil demand the national oil companies (NOCs), play an important role. The Chinese NOCs are very active in many countries for upstream projects; and there are 50 Chinese NOCs out of 131 NOCS listed in the world (Moe, Midford, 2013). "In 2009, the Chinese NOCs spent $147.59 billion for merger and acquisition (M&A) in oil and gas sector that accounted for 12% of global total M&A in December 2010 (Moe, Midford, 2013). Further, Chinese NOCs including China's national offshore oil company (CNOOC) receive loans with very low interest rates, gain diplomatic support, and benefit from Chinese diplomacy. China pursues a policy to provide economic and diplomatic support for its companies that operate in natural resource rich countries with authoritarian regimes (Moe, Midford, 2013). China provides such regimes arms; and overlooks human rights abuses and environmentally polluting projects in order to advance its crude oil production interests.

China has been also applying hedging strategies to minimize risks in its overseas energy investments (Moe, Midford, 2013). Hedging strategies can be made for short and long terms. For example, establishing closer ties with international organizations, such as participating in the UN missions, and complying with environmental treaties, such as the Paris Agreement can be considered long term cooperative initiatives. China has been also following short-term strategies, such as safeguards to ensure minimum risks in case of a supply disruption, high prices, and instability in international oil market (Moe, Midford, 2013). In addition to state-led hedging strategies, the NOCs follow also some hedging mechanisms including setting domestic oil product prices and taxes, approving NOC investments and credits in favour of companies, developing overall planning, and granting exploration licence (Moe, Midford, 2013). Although NOCs get involved with Five Year Plans, they cope with losses in downstream processes as the prices are set by the government. In some occasions, NOCs pressurize Chinese government to increase downstream oil prices in accordance with their profit-oriented policies. If the government does not comply, NOCs tend to sell their oil in the international market.

In short, the NOCs' interests are not determining government interest. It can be said that the Chinese government has the upper hand by imposing certain hedging strategies according to its own agenda on the NOCs through the state's control on appointment of NOC directors, setting up party groups with the NOCs, which operate as lawmakers, regulators, and law enforcers (Moe, Midford, 2013). Further, the Chinese government forces NOCs to operate in certain locations of the world, where other private energy companies find it too risky to operate. So, the Chinese NOCs sometimes have the potential to be monopoly player in such countries.

China seems to be confident about its energy security despite geopolitical crisis sometimes in major oil producing countries. For example, China supported sanctions for four rounds in UNSC against Iran although Iran is an important crude oil supplier for China (Moe, Midford, 2013). Nevertheless, sanctions on Iran caused prices to go up for Iranian imports to China when compared with other Middle East countries. Thus, China’s energy security continues to be under threat in case of any potential disruptions in the crude oil seaborne transportation besides price fluctuations given China’s import dependency in oil.

Another example for Chinese government’s tools to enhance energy security, which is specified in the Five Year Plans, is using the state owned tanker fleet. The Chinese NOCs’ and private companies overseas production is transported by the state-owned tanker fleet. This fleet also enables China to avoid high insurance premium (Moe, Midford, 2013). Further, China secures its crude oil and natural gas imports from potential war time risks by pipeline supplies and from peacetime risks by seaborne supplies (Moe, Midford, 2013).

In other words, not only market conditions but also strategical considerations mostly shape China’s overseas energy investments as shown in the crude oil sector. Thus, the Chinese state has been explicitly involved in securing crude oil investments and production overseas which in turn contributes not only to maximize energy security but demonstrates China’s willingness and capability to influence to an extent world energy market and geopolitics associated with these supplier countries.

While the role of Chinese NOCs in overseas investments for crude oil production has been important, one can argue that the Chinese energy policy has been committed to the ambition of decreasing oil import volumes, and minimizing vulnerability to price fluctuations in the international oil markets. For example, despite 50% oil imported in China in 2009, the oil imports share in total oil demand decreased to 17% in 2010 that amount is expected to decrease to 9% in 2030, which accounts for the 22% of total world energy demand (Moe, Midford, 2013).

Consequently, China's focus on increasing the share of renewable energy resources in its energy consumption has been put at the centre of its energy security policy gradually. In the next section, I will present the process for China's renewable energy policy making to understand in detail how it has shaped the Chinese state's capability in maximizing security and/or seeking power in the international order.

3.2. The Role of State in China's Increasing Renewable Energy Capability

Administrative Department is one of the responsible bodies of the government for renewable energy along with the National Energy Administration (NEA), and National Development and Reform Commission (NDRC), which are responsible for setting medium and long term targets by establishing utilization plans and publishing guidelines for renewable energy development in China (Moe, Midford, 2013). Many ministries and government departments are also involved in the policy making process such as Ministry of Environmental Protection (MEP) and Ministry of Science and Technology (MOST) (Moe, Midford, 2013). Although National Energy Administration (NEA) is the central authority, approval of other bodies is necessary for practical actions. Thus, the complexity of renewable energy policy making through these different bureaucratic units creates a collective action problem to transform the energy structure into a greener and cleaner one.

Nevertheless, one can argue that Chinese state has been influential and successful in terms of achieving the policy targets especially in the last decade. Chinese government initially encouraged and supported electricity generation from renewables and clean energy resources with the “Electricity Law of the People’s Republic of China,” which was enacted in 1995 (Moe, Midford, 2013). However, further action was necessary. In 1997, the “Law of the People’s Republic of China on Energy Conservation” was adopted with the purpose of the state to show its approval for efforts to develop methane, spreading the application of the technologies for further utilization of renewable energy resources such as biomass, solar power, wind power, small scale hydropower generation (Moe, Midford, 2013). Compared with the 1995 policies, this policy was much more detailed to provide guidance. Following the 1997 Law, in 2005, the Renewable Energy Law (REL) was adopted setting an overall target for renewable energy production, mandate compulsory grid connections, introducing feed-in-tariff (FiT), establishing a cost sharing mechanism for electricity generation from renewable energy, and establishing a special renewable energy promotion fund (Moe, Midford, 2013). In fact, after the adoption of REL, rapid development in renewable energy has been observed in China (see Chapter 2, Figure 31).

Moreover, the Chinese government intervened into renewable energy market development through price setting since its early stages. Especially at the first stages of the renewable energy transition, main challenge was the high prices and low competitiveness of the renewables compared to other energy resources. Wind-generated electricity wholesale price was set based on the prices of the wind project building that emerge from a government-organized tendering process. Onshore wind power generation price was determined through concession bidding to Fit from 2003 to 2009; and different wind power generation price was prices were set according to local wind resources in various locations (Moe, Midford, 2013).

Wind offshore power generation prices, on the other hand, set by concession bidding in auctions (Moe, Midford, 2013). Biomass subsidies were too low in some regions of China and determined through subsidies to feed-in-tariff, concession bidding (Moe, Midford, 2013). Solar PV received different type of subsidy with government pricing and concession bidding to feed in tariff in some provinces of China and again, different PV power prices were seen in accordance with the local solar resources (Moe, Midford, 2013). Oceanic power is another resource but government has no pricing besides its guidelines and encouragements.

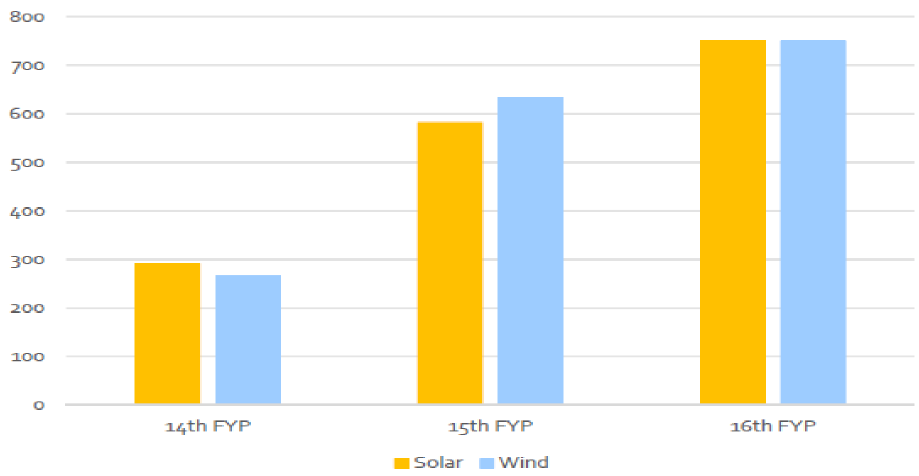
The Chinese government also supported R&D development to increase the competitiveness of renewables. For example, wind power, solar energy, biomass received the priority in R&D spending with shares of 40%, 32%, 25% of total renewable investments, respectively (Moe, Midford, 2013). In short, every target that was set in MITPRED, EFYPRED, TFYPRED was reached farther than planned ones both in terms of the time and the amount of resource. For example, especially between the 11th Five Year Plan and the 12th Five Year Plan, technological development and market breakthroughs in wind power were achieved. In fact, MITPRED 2020 targets were already achieved in 2010 (Moe, Midford, 2013). As the industry developed, 95% of the solar PV modules exported to Europe and the United States (Moe, Midford, 2013). The increasing exports in renewable energy market have demonstrated not only the excessive capacity of Chinese manufacturers but also the growing influence of China by expanding its share in the global renewable energy market.

Lastly, when we look at the next 14th Five-Year Plan, we observe more accelerated commitment for renewables (NDRC, 2019). Elimination of subsidies is aimed to boost competitiveness of renewables both in domestic and in overseas markets. For example, competitiveness of wind and solar are almost same with the coal (NDRC, 2019). China is capable of achieving 19% non-fossil energy in the 14 th Five-Year Plan for the years between 2021 and 2025 (NDRC, 2019). Electrification from renewables rather than coal is targeted to provide more reduction in CO2 emissions with larger share of clean energy in the overall market. In short, Chinese government considers increasing share and competiveness of renewable energy and energy efficiency as a major goal for both the demand and supply side to enhance economic growth (NDRC, 2019).

According to the study of NDRC (2019), Chinese GDP increases 4.2 times in real terms to RMB 380 trillion, and obtain 78% of urbanisation in 2050 (NDRC, 2019). Primary energy consumption is expected to be stabilized to 6 bilion tce after 2030s and coal consumption can be restricted to 1 billion tons of coal (714 billion tce) by 2050 (NDRC, 2019). Furthermore, with more diversified energy resources through renewables, significant decrease in dependency on imported oil is also targeted. Non-fossil energy is expected to be the 2/3 of the total primary energy consumption (NDRC, 2019). Non-fossil energy can have the capability of accounting for 42% by 2035 and 65% by 2050 of the total energy share (NDRC, 2019). Between 2018 and 2050, CO2 emissions is planned to go down to 200 billion tons in total and less than 2500 million tons in 2050 with an electrification rate above 60% (NDRC, 2019). "Electricity is assumed to be decarbonised with 78% non-fossil electricity by 2035 and 91% in 2050 (NDRC, 2019)."

Consequently, one can argue that the Chinese government has been influential by designing more planned policies for renewable energy development to maximize its energy security. Figure 43, for example, summarizes how the Chinese state's focus on increasing renewable energy resources in energy security has been planned and achieved. In the concluding chapter, I will examine the major motivations in China's renewable energy policy together with China's energy outlook and its dominantly large firms in renewable energy sector and other renewable energy related sectors in the world, which were described in Chapter 2. In my examination of China's major motivations, I will consider and discuss two basic arguments from realist school.

Figure 43: Wind and Solar Installations under by Five-Year Plans of China, (14th, 15th, 16th Plans)



Source: NDRC, China Renewable Energy Outlook, 2019.

CHAPTER FOUR: Conclusion: China's Motivations in the Renewable Energy Development: Maximizing Security and/or Seeking Power?

In this thesis I focused largely on the role of renewable energy resources in China's energy policy. In this section, I consider my second research question, which is how we can examine China's focus on renewable energy resources in terms of a state's acts seeking power or security in international order, in light of my findings for the first question to have a basic theoretical discussion so that I can develop my future research. In other words, future research is needed to give a full explanation for the second research question.

I facilitate two basic arguments based on realist school of international relations to assess China's motivations in the renewable energy development. The first argument is that China's energy policy and focus on renewables is largely driven by internatl balancing acts to maximize its security in the existing international order through reducing energy imports and seeking self-sufficiency in the domestic energy sector. The second argument is that China's energy policy and focus on renewables is largely driven by external balancing acts against the United States to maximize China's power in world energy politics.

In realist theory states are accepted as rational, purposive, and unitary actors while focusing on their own security (O'Brien, Williams, 2003). Economic rationalists are sub-group of realist thinking who argue that gains from trade are unequally distributed based on the power relations of countries. In this respect, I assume energy security is essential for a state's security so that its related acts can be examined through offensive or defensive power relations in world energy politics in the given international order.

Within this framework, my findings in Chapter 3 about the domestic reasons and external pressure for reducing China's CO2 emissions highlight in general that China enlarges its energy production as well as its economic capabilities in accordance with the motivation of self-sufficiency and green economy. Since 2012 the "China's Energy Policy" emphasized clearly the importance of renewable energy developments and support for the industry with because of the imminent conditions about the environmental degradation, climate change, and sustainable development in China (Aklin, Urpelainen, 2018). In this regard, China's coal dependency that causes poor air quality especially in the major highly populated cities (Cherni, Kentish, 2007) has been complementary to Chinese efforts in increasing the share of renewables in energy consumption. Further, renewable energy appears to be an important alternative for China given its increased dependence, potential vulnerability, and volatility in crude oil prices (Zhao, Zhang, Wei, 2020).[39] For example, increase in oil prices in the past has also encouraged the development of renewable energy industry through the substitution effect in China's energy market (Zhao, Zhang, Wei, 2020). Thus, these domestic and external forces have been shaping China's motivation of self-sufficiency and green economy that can be considered as China's internal balancing acts to maximize its security in the existing international order.

Moreover, by time China has become more capable of exporting its technology, innovation, and know-how in renewable energy sector to other countries that contributed to its GDP growth and capability to create more employment for its very large population. However, not only economic benefits but also more diversified

[39] Zhao, Y. Zhang, Y. Wei, W. (2020). Quantifying International Oil Price Shocks on Renewable Energy Development in China.

energy resources and less dependency on energy supply imports through larger share of domestic energy production, seems to underline China's internal balancing acts to maximize its energy security with minimal potential vulnerability to disruptions in the flow of imported energy resources.

On the other hand, influence in the renewable energy market through the relative power of states is another indicator of power. Therefore, winners and losers in the renewable energy market development can trigger further conflicts in energy transition in the world energy politics. Indeed, the Chinese state-led mechanisms in increasing the share of renewable energy resources have been causing trade-related tensions between countries. For example, the US has accused China allowing its own manufacturers to sell wind turbines in international markets at lower prices than their competitors (Graaf et al, 2016). Similarly, China's excessive government subsidies, which were described in the previous section in this chapter, for Chinese manufactured equipment caused caused 30% fall in the price of solar panels that hurt other solar panel manufacturers in the US and Europe (Graaf et al, 2016). Therefore, the growing importance of China's dominantly large firms in renewable energy sector and other renewable energy related sectors in the world can be considered as China's external balancing acts against the United States to maximize China's power in world energy politics.

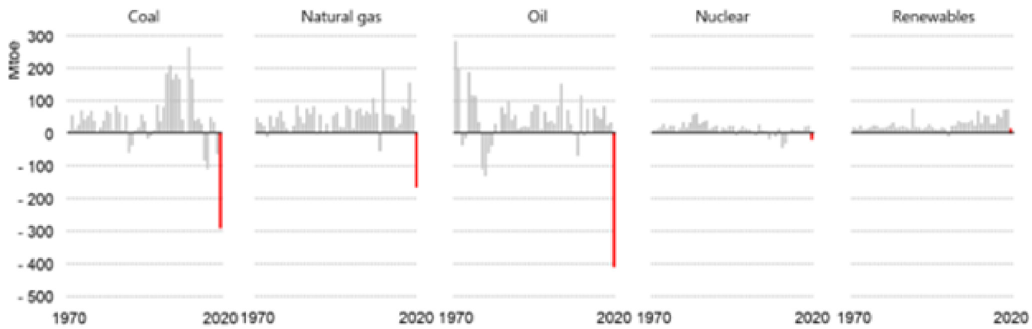
For example, as I demonstrated in Chapter 3, nine out of top-15 solar panel producers and four out of top ten producers in wind tribunes were from China, which accounted for 30 percent and almost 17 percent of global market share in solar panels and wind tribunes, respectively in 2012 (REN21, 2014). In 2016, world's six largest solar-module manufacturing firms consisted of five Chinese firms (Buckley, Nicholas, 2017). China aims to use its capabilities in renewable energy through investments in various regions of the world, such as Sub-Saharan Africa and Latin America. Similarly, China's large transnational infrastructure projects, such as "One Belt, One Road," "the Silk Road Fund," "the China- Pakistan Economic Corridor," and the "Bangladesh-China-India-Mynamar (BCIM) Economic Corridor," provide opportunities for Chinese renewable energy firms' market expansion overseas (Buckley, Nicholas, 2017). China's overseas investments show the intention to influence others by mergers and acquisitions of foreign firms not only in solar PV and wind tribune manufacturing but also in rare-element mining and processing sectors given its importance for energy market such as lithium batteries and related industries in the world economy. For example, as I mentioned in Chapter 3, Chinese enterprises control 90% and 72%, respectively of the rare-element mining and processing sectors. Further, China imposes export quotas on rare elements that creates a trade dispute since 95% of the global supply of rare elements is from China (Graaf et al, 2016).

Thus, one can argue that China increases its presence in the overseas renewable energy market also as external balancing act in light of the offensive realist argument, which focuses on expansionist policies for a state to become more advantageous than others (Mearsheimer, 2007). The examples above seem to support the argument that renewable energy policies of China can be considered as expansionist. Consequently, I would argue that one can explain China's major motivations in expanding its role both domestically and globally in renewable energy development largely as internal balancing acts to maximize China's security in the existing international order through reducing energy imports and seeking self-sufficiency in the domestic energy sector. However, China's state-led energy policy and its focus on renewables can be considered to an extent as external balancing acts to maximize China’s power in world energy politics.

Future Research

In light of my findings for the first question, I considered two arguments from realist school to do future research seeking a plausible answer to the second research question. The world is facing a pandemic which changes the global balance and interactions of states in unprecedented levels. The effects of the pandemic need to be researched further given slowdown in the world economy which is accompanied by sharp decline in energy demand. In other words, the pandemic might reshape developments not only in the renewable energy market in the world but overall in different energy markets. For example, the crude oil market has experienced a very sharp decline that is followed by similar sharp decline in coal demand (See Figure 44). Similarly, the so-called “oil-price wars” which had started before the breakout of the pandemic between Russia and Saudi Arabia can have geopolitical consequences for energy crude oil import dependent states’ internal and/or external balancing acts in the world energy politics. Thus, my future research can develop hypothesis to test related arguments of the realist school to explain sufficiently the China’s role in maximizing its security and/or power within the context of the consequences of the sharp decline in energy demand and considerably lower fossil energy prices in the world due to the on-going COVID19 pandemic.

Figure 44: Fossil Fuels Limitations (2020)



Source: IEA, Global Energy Review, 2020.

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