# Understanding Implications of Conventional Energy on Renewable Energy Development in China



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#### ABSTRACT

This paper gives out a framework on why China's energy policy is comparatively conservative in replacing conventional energy to renewable energy. Internally, the Chinese government prefers to building up a harmonious society and is cautious in policy making. China's application of Export-Oriented Industrialization strategy since its opening up in 1978, resulting in that China's GDP growth was highly dependent on exports, especially the manufacturing exports. In this process, a great amount of energy (coal as the primary energy source in China) is demanded. Externally, world capitalist economic center is moving to the East Asia, capital expansion reaches China. World capitalist characteristics like profit chasing and market expansion involved China to be an investments destination and world factory. China's position as a semi-periphery in the world capitalist economic system makes China's pace on replacing conventional energy to renewable energy cannot be independently increased by the Chinese government.

Keywords: China, conventional energy, renewable energy, Export-Oriented Industrialization, World System Theory

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## **1. Introduction**

#### **1.1 Background**

China is large geographically with 9.6 million square kilometers, ranking the fourth largest countries by area in the world (the third largest countries by area is the United States with 9.8 million square kilometers) (Mattyasovszky, M., 2018). And China is also huge in population. According to the latest United Nations estimates, the current population of China is 1,414,128,117 as of May 2, 2018, which is equivalent to 18.54% of the total world population. On one hand, under the circumstances of globalization and climate change, China and its development mode attract worldwide attentions. Because any new changes especially new policies within China will impact inevitably the whole world. On the other hand, due to the size and complexity of Chinese language, it is not easy for people outside of China to understand its developing logic and Chinese government's developing policies.

People are curious about China's development mode and path. Since China's economic reform and opening up in 1978, it is developing at a pace that attracts global attentions. This paper is conducted to understand China's energy development after China's implementation of economic reform after 1978 until now. From 1979 to 2016, China's annual real GDP averaged 9.6% and 2017 at 6.8% (Morrision, W. M., 2018). If we look into the most recent achievements, we could refer to achievements made during the 12<sup>th</sup> Five-Year Plan (2011-2015) in China. From 2011 to 2015, China's average GDP growth of 7.8% is much higher than the global average rate of 2.5% (Xinhua, 2015). China continues to be in the first place in the world in manufacture and trade sectors. Meanwhile, China witnesses the change from exporting only products like clothes, shoes to also high technical products like high-speed trains (Xinhua, 2015). In improving people's living standard, China is the first developing country finished the task of reducing the population living in poverty by

2015 deadline to meet the Millennium Development Goals (Xinhua, 2015). China One Belt One Road, by bringing countries in Asia, Europe and Africa, initiates to promote infrastructure construction, financial cooperation and cultural exchange in these regions (Xinhua, 2015).

However, behind the extraordinary achievements, energy is a sustainable topic for development in China. Energy, which contributes as engine to support the quick development, becomes an inevitable focus not only in China but also at the global level. Along with China's continuing economic growth, energy consumption increases greatly in China. Today, China is known as the biggest energy-consuming and producing country in the world (Du, 2016). Details are explained in the following Figure 1 and Figure 2.

As in figure 1, China has contributed to 55% of total energy consumption in the world since 2000. Specifically, China consumes 83% of coal, 47% of oil, 50% of non-fossil fuel and 16% of naturally gas comparing to the global consumption growth in each named type of energy sources.



Figure 1: The Growths in Energy Consumption of the World and China, 2000-2014

Source: the author has modified the table based on Du,W. (2016) calculations, from BP Statistics, 2015.

In China, there are five types of energy sources, namely, coal, oil, gas, nuclear and renewables mainly used in sectors like transport, industry, building and others (Dong, K. Y. et al., 2016). As in figure 2, China energy production in total fluctuates but with steady-increase trend from about 1% to about 35% among year 1950-2000, and then

grows sharply from about 35% to about 89% among year 2000-2014. Figure 2 also presents that coal is the main source for Chinese energy production. Oil ranks in the second place as the energy source, but is not comparable to coal in proportion. Natural gas and hydro contribute almost the same portion, ranking in the third and fourth place as energy sources. Wind and nuclear sources are displayed in the same table with a small portion, which is almost invisible comparing to coal since year 2000.

Accompanying with the quick development, China becomes also the world's biggest emitter. Specifically, China is responsible for 29% of global emission in 2015 (Pidcock, R. 2016). Emissions trigger severe pollutions in China and also likely to have global consequences. Air pollution that is mainly caused by application of conventional fuels as energy source attracts the international community attention under the circumstances of global climate change. As the second largest economy in the world with a huge population, China is essential to impact the whole world if any halt in meteoric rise in CO<sub>2</sub> emissions since the early 2000s (Pidcock, R. 2016). To give a better view of China polluting problem, the author puts details about emissions of CO<sub>2</sub> from the global perspective in Figure 3. The author extracts a Chinese map on February 10, 2018 to show PM 2.5 air pollution concentration in Figure 4. Although the Chinese government in 2014 has declared a "war on pollution" (Chen, X. W., 2017), we could tell from the map that air pollution is still severe. Figure 2: China's Total Primary Energy Production by Source



Source: the author has extracted the table from Key China Energy Statistics 2016.

As in Figure 3, the graphic on the left shows  $CO_2$  emission trend from the biggest emitters in the world including China 1960-2020.



Figure 3: Territorial emissions from biggest emitters; Global emissions by fuel type;

Source: Pidcock, R. (2016) original from Le Quéré, C. et al. (2016).

Comparing to USA, the biggest economy in the world, China is showing a meteoric rise trend since year 2000 and overtakes USA totally and towards a sharply rise. On contrary, both USA and EU are showing slow-decrease trends since 2000. India, a developing country as China, is showing a steady rising trend in emission but not comparable to China in amount and extent. The graphic on the right displays the global emissions by fuel type 1960-2020. Coal and oil are the largest two fuel types that give out  $CO_2$  and for a long time they keep emitting at almost the same level and keeps rising at the same pace. After year 2004, coal is the largest fuel type that gives out  $CO_2$  and this trend will keep growing.



Figure 4: PM<sub>2.5</sub> Air pollution concentration in China on February 10, 2018

Source: Extracted from Berkeley earth map showing air pollution status in China Feb. 10, 2018.

In order to address the pollution problem that make millions of people die prematurely and position itself as a leader in fighting against climate change, the Chinese government is seeking to move away from conventional energy sources like coal and other fossil fuels to renewable energy such as wind, hydroelectric, bioenergy and solar (Dong, K. Y., et al., 2016). In this way, China can simultaneously ease the rising concern on the energy security. (Pashley, A., 2016). Therefore, Chinese development mode is always a concern at a global level and its plan for development always becomes an international focus. When it released its 13th Five-Year Plan (2016-2020) for economic and social development on March 17, 2016, China attracted the international community attention again. The 13th Five-Year Plan outlines a plan that its economy should be gradually driven towards service-oriented, varied and less carbon-intensive rather than one that is heavily dependent on resources (Chinadialogue, 2016). The 13th Five Year Plan also concludes an energy consumption target. That is, at the end of 2020, the non-fossil fuels consumption should rise to 15% of primary energy consumption, comparing to 12% stated in the 12th Five Year Plan (2010-2015). And coal consumption is planned to decrease from 64% at the end of year 2015 to 58% at the end of year 2020 (13th Five-Year Plan).

#### **1.2 Problem Formulation**

From the above percentage, the author observes that although the Chinese government has made great progress in GDP growth and development in many sectors. And it is promoting using renewable energy instead of conventional energy. However, it seems the Chinese government is cautious to cut down the consumption of fossil energy, especially the coal consumption in China. Why China's energy policy is comparatively conservative in replacing conventional energy to renewable energy? In this paper, the author conducts a research on challenges for China to replace the conventional energy fuels to renewable energy. And the author, at the same time, tries to give readers a framework of understanding the challenges and containments China is facing to develop renewable energy.

### 1.3 Objective

Objective of this paper is to give out a framework of understanding why Chinese energy policy is comparatively conservative in replacing conventional energy to renewable energy comparing to other sectors. The author is trying to interpret Chinese energy policy to give readers a point of view to look at the challenges and containments that the Chinese government is facing.

## 2. Methodology

In this second part, methods and approaches applied to conduct this paper are discussed. Before diving into methods, the author would like to repeat this paper's research question: Why China's energy policy is comparatively conservative in replacing conventional energy to renewable energy?

#### 2.1 Choice of Theories

Firstly, a literature-based method was used to introduce the background---energy consumption and production status and energy structure in China.

To answer this research question and build up a framework to understand the problem, the author looked back briefly to the Chinese history to give an overview of the current communist government's logic to Chinese development. Then the author chose the theory of export-oriented industrialization and world system theory separately as internal and external factors to understand the current sources of problem after 1980s. Overall, the author looked into the challenges and constraints that the Chinese government was facing and tried to probe suggestions and solutions to the problem.

These theories were chosen because, firstly, China is a large developing country in the world. All kinds of policies were made and modified by the Chinese government to build up the new China since 1949. The author assumed that the Chinese government's attitude or policy to energy was based on historical consequences and current practical problems they meet in the new-China-build-up process. And the current Chinese developing mode imbedded inevitably consequences too. From related literatures about China development, the author got the clue that both China in Mao-era (1949-1976) and in the following Deng Xiaoping-era focused on industrialization, but with different developing strategies. China, led by Deng Xiaoping, has opened up since 1978 and has exported a lot of products out of China to

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the whole world. And China is also well known as the factory center of the world. Made-in-China labels on the products are easily found around the whole world markets. Export-Oriented Industrialization has the features that countries applied with this strategy focus on production and export-led economic growth. Therefore, the theory of **export-oriented industrialization** was chosen to probe the internal causes of this paper's problem.

Secondly, China is not an isolated entity in the world even when it was almost a closed economy in the Mao-era. Its connection with the outside world becomes closer than before especially after its opening up. The world after World War II has been dominated by the world capitalist economy. World system theory explains the dynamics of the world capitalist economy as a "total social system" (Martínez-Vela, C. A., 2001, p.1). Every state is an element constituting itself within this system (Sorinel, C., 2010). China, in this case, is not an exception. Besides, world system is a cyclical system. Its world economic center moves cyclically around the world as time moves on, specifically, from South Europe to West Europe in 17 and 18 centuries and then to the United States in 19 century and later to the East Asia. Trade, production and investment move and expand accordingly around the world. China started to become a producing center in the 1980s. Trade, production and investment increased greatly after China's the opening up. Therefore, the **world system theory** was applied to find the external effects on China's energy problem in this paper.

#### 2.2 Choice of Data

Corresponding to the theoretical analysis, the author collected data on China's special economic zones, free trade zones to exhibit the communist government's cautiousness in policy making and testing steps to get a ride on the world cyclical economics to drive its domestic economic growth.

And then data on China's Foreign Direct Investment inflow and outflow was illustrated to show that China was involved in the world cyclical economics as a semiperipheral region. Furthermore, percentages of FDI utilized in manufacturing industry and China's global manufacturing output by value were cited from relevant articles to give readers a picture of China being world factory.

All the above data implied that energy should be an engine to support this developing mode, but it did not show directly to readers. In order to connect them, the author chose manufacturing as an intermediate to look into energy status in China. Therefore, firstly, China's dependency on the foreign markets was illustrated by data on exports share of GDP growth, which verifying that China's economic growth dependent on exports to large extend. Secondly, China's total exports and exports of manufacturing goods were presented to show that China's export growths were highly driven by exporting manufactured goods. Thirdly and logically, China's total energy consumption, coal consumption, energy consumption in manufacturing and coal consumption in manufacturing was collected from China Statistical Yearbook to show the increasing amount of energy consumption that export-oriented growth mode had resulted in. Because of time limit, these quantitative data was mostly collected from online journals, books and relevant articles in the fields of renewable energy development and conventional energy especially coal industrial history in China.

#### 2.3 Empirical analysis on Coal and Wind Power in China

To address the problem comprehensively, the author gives two empirical examples of coal and wind power following the data analysis part. Coal was chosen because it was the most important conventional fuel source in China. Coal status in China, on the one hand, reflected the main barriers to the development of the renewable energy.

And wind power was selected as a case because wind power was a type of renewable energy source. Chinese wind power players like Goldwind and Envision now share more than 44 percent of the Chinese market (Deign, J., 2018). China plans to increase its non-fossil fuel of primary energy consumption from 12 percent to 15 percent by 2020. Containments or challenges wind power faces in China, on the other hand, slow down the process of replacement from the conventional energy to renewable energy.

#### 2.4 Thesis Structure

For the thesis structure please refer to Figure 5.



Figure 5: Thesis Structure

## **3. Theories**

#### **3.1 Export-Oriented Industrialization (EOI)**

#### **3.1.1** Overview on EOI theory itself

To give readers better understanding EOI in China, the author explained generally the EOI theory itself and its evolution stages in the following part and then combined with China case.

"Export-Oriented Industrialization (EOI)" is a trade and economic policy for development. In order to speed up the industrialization process of the country, this kind of policy is designed to promote exporting a nation's comparative-advantaged goods. Other than exporting goods to other nations, this EOI-strategy implies also that a nation needs to stand the foreign competitions by giving access to other countries its domestic markets (Krainara, C., 2007). In 1950s and 1960s, Germany and Japan initiated the export-oriented-growth strategy. In the 1970s and 1980s, the four East Asian Tigers, namely, South Korea, Taiwai, Hong Kong and Singapore adopted this strategy too. This kind of strategy was also followed by South East Asian countries like Thailand, Malaysia and Indonesia (Palley, T. I., 2011).

As time flies, instead of staying constant, this development model has developed to match the changes of the global circumstances and the internal country conditions.

According to Palley (2011), there are four stages to describe the evolution of this model. The first stage was led by Germany and Japan from 1945-1970. Both countries had their own domestic industrial base and benefited from exporting their goods by an under-valued exchange rate.

The second stage was in the period 1970-1985 with the four East Asian tigers as the example. In this stage, an under-valued exchange rate was not enough for the

development. Countries experiencing this stage acquired more foreign technology. As technology was becoming more movable, it was possible to make more growth to these countries.

The third stage can be extracted from the Mexico's experience of beginning the trade liberalization in 1986. Countries in this stage started to build themselves into producing platforms for other countries bringing with technology and capital. The strategy in this stage was changed from accumulating their own industrial capacity to integrating into the global economy, making using of an undervalued exchange rate and saving money by suppressing wages and social standards. In this case, they would be more competitive to attract multi-national corporations to invest directly at their sites. In 1994, North American free trade area (US, Canada and Mexico) was created. It represented the new strategy in this stage.

Additionally, this stage of export-oriented growth leads to the modern corporate globalization (Palley, T.I., 2011). And it starts the era that developing countries, international corporations and developed countries become partners. They together claiming to create a global market but in fact they were creating a global production zone. That means, the corporations could produce products in global platforms and then export back to developed countries. WTO established in 1996 is a good example of this stage to unify developed and developing countries and is a global extension of North American free trade area mode. China was admitted into the WTO in 2001.

The fourth stage can be explained by showing China's example. It is characterized with a strategy with asymmetric global involvement. That means, Chinese government promotes exports but at the same time maintain great tariffs on imports. Exchange rate is managed by controlling capitals. Technology accumulates through joint-ventures, multi-national acquisitions. And multi-national corporations also change their strategy in the case of China. They are now willing to license, source from other producers and joint-venture which reducing their capital investment and

increasing the possibility to get future profits from China's huge market (Palley, T. I. 2011).

#### 3.1.2 EOI in China

Before 1979 and traced back to 1949, the Chinese socialist government won the the revolution. And the first-generation revolutionary leaders like Mao Zedong, Zhou Enlai perceived that the root of China's backwardness was the lack of industrialization, especially the heavy advanced industries. At that time, China was an agrarian and almost closed economy with 71.3% of its labor force in traditional agriculture (Lin, J.Y, 2015). Starting in 1953, Chinese Communist leaders implemented Five-Year Plan to accelerate the process of building modern advanced industries. It adopted Soviet-style central planning policies to make the economic development (Peng, W., 2009). However, Chinese firms in this period, comparing to firms in high-income countries, were not feasible in an open competitive market. The Chinese government intervened in resources allocations and labor market planning. China was a planned market with suppressed interest rates, prices distortions to make sure low price input in industries. Economic efficiency was low and the growth before 1979 was driven mainly by the great inputs. China was an almost closed and planned economy, and household consumption was only 2.3 % per year (Lin, J. Y., 2015).

Under the blockage of western nations, and relationship with the Soviet Unions deteriorated, China tried to be energy independent when building up the new advanced industry. China has plentiful coal resources. Other alternatives like oil and gas is not as much as coal (Peng, W., 2009). Naturally, coal was chosen to develop its economy (Reuters, 2011). But in this period, China's annual coal production was only 32.4 million metric tons comparing to coal output at 618 million metric tons in 1978. The Mao-era China was characterized "protection" (Karunaratne, N. D., 1980, p. 219) in developing industries by applying import substituting strategy (Karunaratne, N. D., 1980). This strategy did not meet the goals of industrialization. The reason why Mao-

era China applied a protective developing strategy can be partly explained by China's "century of humiliation" (Schiavenza, M., 2013, parapraph 2) experiences in the history. "Century of humiliation" brief history thus will be mentioned in detail in later part of this paper.

Then China began to adopt export-oriented growth in the mid-1980s, inspired by the success of its East Asian neighbors like the South Korea, Hong Kong, Taiwan and Singapore. This is the era that Deng Xiaoping was in power and the Chinese government launched experiment with capitalist reform in 1978 (Reuters, 2011). In contrast to "protection" characterized in import substitution strategy, the export-led growth was imbedded with belief of "promotion" (Karunaraten, N. D., 1980, p. 218).

In this period, China's export-led growth model was guided specifically by two theories. The first one was the gradient theory (Xia, 1982), which was written into the government's seventh five-year plan for the period 1986-1990 (State Council 1986). The gradient theory, representing a version of the flying geese theory, divides China into three regions and gives different levels of priority of development. In specific, the eastern coastal region starts economic development first, then the central region follows the step and at last the western region keeps up. The second theory guiding the export-led growth is the great international circulation (Wang, 1988). It promotes processing trade as China's long-term national strategy of economic development (Yang, Y., 2011). Guangdong province by the mid-1980s already started this processing trade.

Business enterprise, involved in the processing trade, imported all or parts of the raw and supplementary materials, parts and components, accessories, and packaging materials from abroad. After they processed or assembled the products, they reexported them to the foreign parts, which were responsible to sell the finished products. In this process, they only charged the foreign parts a processing fee (HKTDC Research, 2015). Generally, according to Karunaraten, the export-oriented growth's promotional actions for manufacturing industries may include improving financial and credit institutions, building more infrastructure facilities, compensating external economies investing on other industries, and providing subsidies with training of labor. And free trade zones can be a vehicle to implement the export-led growth (Karunaraten, 1980).

Under the wave of export-oriented growth model around the world and inspiration by the Mexico's template for a new model of export-led growth as North American Free Trade Agreement in 1994, the WTO established in 1996. Inspired by the four Asian Tigers, China realized that only the processing trade was not enough to maintain the development of Chinese industries. China was in a greater need for foreign technologies. WTO gives a platform for multinational corporations to set up low-cost production centers in the developing countries. China's admission to WTO in 2001 raises the opportunity for China's further application of the export-led growth strategy. However, China, at the same time, became a production center for the whole world and became dependent on multinational corporations in exports although it benefits from this round for the job creation and technology transfer. According to Matthew Johnston (2016), China depends highly on foreign-owned firms, which compose 50.4% of Chinese exports and if joint ventures are included, then the figure is as high as 76.7% (Johnston, M., 2016). But China's model is more successful than the Mexico' model partly because it makes use of import tariffs, control strictly the capitals and manages to adopt foreign technology to build its own domestic technological infrastructure (Johnston, M., 2016).

The Chinese government applied the export-led growth means, at the same time, energy sector has to be developed accordingly to keep up with the speed of economic growth. Pollution and natural environment deteriorated quickly in China in this period and until now.

#### **3.2 World System Theory**

#### 3.2.1 World System Theory overview and Wallerstein's model

Like the EOI theoretical part, the author displayed an overview of the World System Theory itself and its four categories according Wallersterin's model. In this way, readers could perceive easily China's position in this world system and then understand better its interaction within the system.

The modern world system can be traced back to around 1500. It initiated from the then feudal Western Europe with crisis (Lechner, F., 2001). Later, the Western Europe saw the light to get out of the long-term crisis when technology was innovated and new market associations were formed. They were soon more efficient to produce products and they had passions to reach out to other parts of the world for long-distance trade. The Western Europe became the European core after they accumulated amounts of wealth through trading with other regions. On the way to wealth accumulation, a strong military and a multi-way of transportation were two factors that enabled the process (Lechner, F., 2001).

Throughout the sixteenth century, Europeans had developed a mode that all labors were divided geographically and professionally. They kept their positions as the core with capital-intensive production and other peripheral regions resulted in supplying them with low-skill labor and raw materials (Lechner, F., 2001).

Between the peripheral regions and the core regions, there were regions served as the semi-periphery (Lechner, F., 2001). They moderated the unequal relationship between the European core and the non-European periphery. The hierarchical structure was consequent on this unequal development. And the states also played a role in monopolizing the producers in the core and protect the mode of developing capitalist economy. However, no single state could dominate the system, although some states had more advanced technology and military strength which could be with a

hegemonic influence. Because the world system was a system in which all the states are destined to compete. They involved in the exploitation of others to reshape the world in their point of view. The world now, from a holistic point of view, was seeking profits by exchanging in a market that all the labor and goods were exhibited as commodities. And this accumulation process seems endless (Lechner, F., 2001).

In the twentieth century, the world-system touched the boundary geographically by soaking capitalist markets and state system to all regions. In this period, the United States rose as the number one super power with comparative economic and political strength (Lechner, F., 2001). After the Cold War, its power was weakened.

Some peripheral countries tried to move their economic status forward in the system and some newly independent states and communist regimes tested the boundaries of the core control. However, this did not change the fact that unequal economic development continued and the system was still intact.

In the twentieth century before 1968, the world is soaked in the hope, which originated from nineteenth century, which all personal rights should be equal and economy should be improved for all within the states. But after 1968, the influence of this demand was diminished. Development through the century, the world system now faces a period of transition according to Wallerstein. The exploitation has reached geographically limits. Expansion of new markets works not any more to kindle the path to continuing economic growth and avoiding future crisis and contraction. It now steps into a period that the core regions are struggling for the economic decline and the former periphery countries are getting power and make challenges to the current core under the circumstances that the former hegemonic power diminishes and ideology is not unified on a globally level (Lehner, F., 2001).

Figure 6: The world system model according to Wallerstein



Source: Elwell, F.W., 2013.

To illustrate clearer about Wallerstein's proposition about world four categories, core, semi-periphery, periphery and external (see Figure 6), the author in the following part will describe them separately.

Wallerstein proposes that each type has a relative position in the world economy with certain internal political and economic characteristics (Summary of Wallerstein on World System Theory).

#### a. The core

The core states focus on higher-technical and capital concentrated production. They have comparatively advanced technologies and usually have strong militaries or central governments to permit the local producers to get control over international business and to extract capital surpluses from international trade. They benefit most from the capitalist world economy by importing raw materials and low-skill labors from periphery or semi-periphery and exporting value-added finished products to semi-periphery and periphery.

#### b. The Periphery

The peripheral areas lack strong central governments or are weak in militaries. Labors in these peripheral areas are practiced in coercive way. They are under unequal trade relations with the core by exporting cheap raw materials and are dependent on the core. The capital surplus is extracted by the core through these unequal trade relations. Labor systems in these areas are designed not only for internal labor markets but also for the whole capitalist world economy, which is different from the core. They export also low-skilled labor to the core to assist the value-added producing process. The imbalanced development makes the core get much wealthier and the periphery more exploited. In this way, the core keeps the advantage to control over the periphery and maintain these unequal trade relations.

#### c. The Semi-Periphery

The core and the periphery are two extreme regions in the world system. Between them, there are the semi-peripheries. Those core countries that are in decline will fall into these semi-peripheral positions. And those peripheries that are improving their status and getting progress in the world system will also move into this semiperipheral status. Semi-peripheries are less dependent on the core than the peripheries. They have more varied economies and stronger states than the peripheries but not strong enough to compete with the core.

Figure 7: Wallerstein's World System Theory Model



Wallerstein's World System Theory Model

Source: Moyeer, K. 2016.

As the Figure 7 illustrated, the semi-peripheries often serve as buffer between the core and the peripheries (Lehner, 2001). They are not as dominant as the core in the international trade but still import cheap raw materials and labors from the peripheries. However, they do not benefit from the trade to the same degree as the core. The semiperipheries are, at the same time, also exploited by the core. It is a circle for the semiperipheries that they exploited the peripheries too and get wealthier than the peripheries and then spend the wealthy on the high profit products from the core.

#### d. External Areas

Other than above three categories in the world system, there are areas that are not involved in the system. They maintain their own economic system and products are mainly produced for their internal markets. The international commerce has limited influence to their economy. And they managed to stay outside the world economy. Figure 8: The Overview of Global Regions with Core, Periphery and Semi-periphery



Source: Shaji, 2016.

Figure 8 presents the overview of global regions with core, peripheral and semiperipheral characteristics. After developed for the first centuries, the world system comprises Northwest Europe as the core. Mediterranean Europe serves as the semiperiphery. Eastern Europe and Western part of globe including small parts of Asia works as periphery (Lechner, 2001). Time moves on to the end of the twentieth century, the core regions are enlarged to the rich industrialized countries, including Japan in Asia. The semi-peripheries are the states that are independent long time ago. The recently independent colonial countries which are still poor compromise generally the periphery (Lechner, F. 2001).

#### 3.2.2 Interaction between China and the world system

The core Western Europe headed by Britain industrialized through centuries and continued into the first half of 19 century (SparkNotes Editors, n.d.). Their improved producing efficiency and motivations to accumulate wealthier by trading promoted them to exploit other regions for markets and more raw material sources for production (SparkNotes Editors, n.d). The first Opium War between the Great Britain and Qing-dynasty China was trigged by forced trade in 1840. After Qing government was defeated in the first opium war, Qing government was signed "Treaty of Nanking" in 1842 (Huang, L. B., 2016). In this treaty, Hong Kong was ceded to Britain as a colony and five ports in China was forced open for trade, namely, Canton (Guangzhou), Amoy (Xiamen), Foochow-fu (Fuzhou), Ningbo and Shanghai (article II, Treaty of Nanjing (Nanking), 1842). Moreover Chinese customs was forced to give British rights for participate the import tax rate (Huang, L. B., 2016).

The first opium war defeat began an era in China known as the "century of humiliation" (Schiavenza, M., 2013, parapraph 2).until Mao Zedong proclaimed the founding of the People's Republic of China in 1949.

China then was a periphery from the perspective of world system theory and struggled to change the status with or without consciousness in the world system. Following words can partly verifying its peripheral status and Chinese elites like Mao Zedong's willingness to make a change.

"Long the world's pre-eminent civilization, China fell behind the superior technology of the West over the centuries, an imbalance that finally came to a head with the loss in the Opium Wars. This begun the most tumultuous century in the country's—or *any* country's—history, one that featured an incessant series of wars, occupations, and revolutions and one that did not end until the victory of the Communist Party in China's 1945-49 civil war.( Schiavenza, M., 2013, parapraph 3)"

Referring back to the Export-Oriented theory part, the author has already stated that Mao-era China was almost a closed economy and started to focus on industrial development, especially the heavy industries. Because Chinese elites like Mao Zedong and Zhou Enlai perceived that China's backwardness was due to the lack of industrialization. But Mao-era China failed to meet the advanced industrial development goals.

When Deng Xiaoping came into power in China after 1976, he promoted to test capitalist reform economically and directed China to the export-led growth strategy. The world capitalist was expanding geographically and were eager to relocate capitals and production. It was searching for new markets to get more profits and probing new raw material sources and cheap labors world widely. China's developing mode just meets the requirement of the world capitalist. In other words, China needs foreign markets and capitals to drive its domestic economic growth. And world capitalist needs China's huge markets to relocate its capitals and productions and also raw materials for further production. China's admission to WTO in 2001 means China was totally integrated into the world cyclic economy.

China, on the one hand, has to compete to move up in the world system and tries to be less exploited by the core. On the other hand, it has to expand like the core countries to explore raw materials from peripheral countries to produce and export products. China earns small portion of profits with the competitive advantage of cheap labor. China is resulted in becoming "factory of the world" (Chen, X. G., 2007, p. 2). As long as the holistic world is seeking profits by exchange labor and goods in a market and this accumulation process is endless ((Lechner, F., 2001), China will be in a passive position even if it makes only domestic reforms.

#### **3.3 Brief Sum up and supplement to Theoretical Discussion**

China, being proud of its pre-eminent civilization, did not feel it had fallen behind until it was defeated by the Great Britain in the first opium war in 1840. The war opens an era of China's "century of humiliation" (Schiavenza, M., 2013, parapraph 2). In author's opinion, the war was a conflict between industrial expansion and agrarian culture resistant. But because the industrialized core countries like the Great Britain had strong military and advanced technologies, China became a periphery and was exploited at some extend. In 1949, the communist elite Mao Zedong proclaimed the founding of the People's Republic of China, which ended the humiliation from Chinese point of view. It was a struggle to get rid of the core countries' control. Therefore, the first generation communist government has a burden on shoulder that it should develop China into an advanced industrial nation. Due to the historical warrelated experiences with western countries, China turned its back to capitalism in order to diminish the capitalist influence with the essence to get rid of control from the core countries. China took a Soviet-style central planning instead to develop its economy in this period. Coal was an ample resource in China and then it was chosen as a resource to develop new China. But this developing mode did not meet the industrialization goals. Deng Xiaoping, after Mao died in 1976, started to promote the capitalist reform economically, which caused severe debates among the elites. Therefore, export-oriented growth strategy was tested step by step through dividing China into three regions with different development priorities under the guide of gradient theory. The Chinese government promoted economic development by integrating into the international trade. It tried to transform China from a selfsufficient economy to an export-oriented economy. Special economic zones were playfields to implement this strategy in the first steps. The central government decentralized to give power to the local governments in these zones to attract foreign investments. Chinese policy directed China towards producing products for the world

rather than only for its own domestic market. Increase in exports, trade and foreign investment stimulated the growth in energy and resource consumption accordingly.

World capitalist is continuing moving on exploiting new markets and raw materials to relocate capitals and production. As a cyclical economics, world system's economic center was in Europe in 17, 18 centuries and then moved from the Europe to the United States in 19 century and later to the East Asia. Now China's opening-up decision meets the requirement of world capital expansion. In other words, China needs foreign markets and capitals to drive its economic development. World capital needs China to be a destination for raw materials, cheap labors, producing platform and the huge market to continue its accumulation process. China's application to the WTO in 1995 and its admission to it in 2001 could be perceived as a miniature of this fit. China becomes a semi-periphery, exporting low-value added products to the core countries or just processing the products earning processing fees and importing raw materials from peripheral countries for export production. China becomes inevitable a producing center for the whole world. Energy supporting manufacturing goods for exports had to keep up.

## 4. Analysis

#### 4.1 Historical point of view

According to Professor Kjeld Erik Brødsgaard, if you want to understand China, you have to understand the Chinese Communist Party (18: 42, Institute of Chinese Studies Delhi, 2018). The current China is recognized internationally as a new China since the Chinese Communist Party ruled China in 1949. The author here based on Kjeld's words further saying that, if you want to understand the Chinese Communist Party's logic on development policy making, you have to understand the history of China. To make readers easier to get the overview of Chinese history and to better illustrate the background of this paper, the author shows the timeline of world cultures through including Europe and America.

Figure 9: Timeline of World Cultures



#### Source: Fercility, (2018)

China is one of the world's four ancient civilizations. In the history, China was mainly ruled by the richest family, which was called dynasty. The first well-documented contact between Europe and China was Marco Polo's travel to China in 13<sup>th</sup> Century, which was equivalent to the Yuan dynasty (1279-1368) in China. Silk Road Foundation commented that: "Marco Polo traveled in great deal in China. He was amazed with China's enormous power, great wealth, and complex social structure. China under the Yuan dynasty was a huge empire whose internal economy dwarfed that of Europe." (Silk Road Foundation). The last dynasty in China is Qing dynasty (1644-1912). The first Opium War between the Great Britain and Qing-dynasty China,

was trigged by forced trade in 1840, and later resulted China being a semi-colonial semi-feudal country.

Since China's defeat in the Opium War (1839-42), this mysterious "traditional" and "despotic" civilization became the "sick man of East Asia" and had never been able to compete with the "Western modernity". For some scholars, the milestone of modern history began for the historical-cultural China when the Europeans banged on its door. As Fitzgerald's metaphor goes, "to the amazement of all, within and without, the great structure...suddenly collapsed, leaving the surprised Europeans still holding the door handle" (Fizgeral in Cumings, 1996: 29)

Throughout the entire 20<sup>th</sup> century China was perhaps the only country in the world that had been in constant revolutionary transformations in the midst of great external and internal turbulences: The Republican Revolution of 1911 (ended the rule of the Qing Dynasty) , the May 4<sup>th</sup> Movement (1919), the Anti-Japanese War (1937-1945) (the Second World War), the Civil War (1927-1950) (Nationalists and Communists ensued for decades), the Korean War (China entered the war in 1950), the Cold War (1947-1991), the Vietnam War (1955-1975, China supported North Vietnamese army), the Cultural Revolution (1966-1976).(Li, X., 2010)

Since the founding of the People's Republic of China in 1949, which is a Communist era. China in this era is usually called new China. To the western world especially the Americans, it is the "loss of China" (Li, X., 2010). Their wishful thinking about the imminent transformation of China into a democratic, capitalist and Christian nation evaporated into air. China under Mao took a socialist development path emphasizing human resources, common prosperity, economic equality and balanced development, and social and political mobilization. (Li, X., 2010) The socialist China at that time was under the pressure of US-led economic blockage and trade embargo and had a harsh relationship with Soviet Union in order to maintain its independent development. By the late 1970s, the Chinese state has improved its relations with the West and then it implemented the opening-up policy to interact with Western powers.

Experienced "century of humiliation" (Schiavenza, M., 2013, parapraph 2)" since Opium War in 1840 and turbulences throughout the entire 20 centuries, Chinese people dreamed more a harmonious and steady society. The current communist party, winning the civil war and starting to build up the new China, bared on their shoulder that China has to be as eminent again as it was in the history. This could be verified from the current Chinese president Xi Jinping's slogan--- "realizing the great rejuvenation of the Chinese nation." (Wang, Zh., 2016). But China experienced turmoil like the failed economic policy "The Great Leap Forward" (Cienciala, A. M, 1996, Chapter 10) and the followed "The Great Culture Revolution" (Cienciala, A. M, 1996, Chapter 10) in the beginning years of new China build up during Mao-era. It laid down the premise of the Chinese government's cautiousness in policy making.

When Deng Xiaoping led the economic reform and applied the export-led growth strategy to drive the economic development in China, he met barriers from inside the party too. Therefore, opening up was made step by step by setting special economic zones (Figure 10) as a test of the export-led growth strategy.

The Chinese government, after transitioning towards open door policy and exportoriented growth, takes steps decentralizing of government resources to promote economic development. It established the first range of Special Economic Zones in 1979-80 to attract foreign investment, namely Shenzhen, Zhuhai, Shantou in Guangdong and Xiamen in Fujian province, and then Hainan in 1985 (Crane, B.& et al., 2018). These zones are set up under local management, customs and administrative procedures separation with less political intervention from Beijing (Crane, B. & et al., 2018).

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Figure 10: China Five Special Economic Zones



Source: Crane, B. & et al. (2018).

1979-1984, the average economic development rate in these zones was 23.17%, which is 2.42 times greater than the national average development rate (Li, W.B. & et al, 2015). The moderate successful experiment of special economic zones consolidates the confidence to leaders as Deng Xiaoping and Chinese elites to promote further socialist market economy and the opening up policy.

Figure 11: China Free Trade Zones



Source: Shira, D., (2017).

Currently, there are also 11 free trade zones (FTZs) in China (Figure 11). They are a specific type of economic zones, where Customs does not intervene directly in

imported, handled, manufactured and exported goods (Shira, D., 2017). As the following map shows, Shanghai was inaugurated in 2013 as the first-generation FTZ. And then Guangdong, Fujian and Tianjin in 2015 follow as the second-generation FTZs. In 2016, the government announced plan for seven more FTZs that are mainly locates inland China. These seven newly announced FTZs as Chongqing, Liaoning, Henan, Hubei, Shaanxi, Sichuan and Zhejiang are the government's long-term plans to develop inland and support One Belt, One Road initiative (Shira, D., 2017).

In this way, China has cautiously got a ride on the world economic cycle to drive its domestic economic development. Trade, investment and exports increase dramatically. In the same logic, the Chinese government is cautious in making the energy policy according to the energy facts. Coal status will be discussed in detail in the later part to reflect the problems the Chinese government is facing.

#### **4.2** China GDP growth, exports, manufacturing and energy

After China's opening up, the experiments of setting special economic zones, admission to WTO and opening more free trade zones, China was highly involved in world cyclical economics and acting being a semi-periphery. It received Foreign Direct Investments (FDI) (Appendix 3) and manufactured goods for exports. FDI in manufacturing industry represented 63.2 per cent of total utilized FDI in China during the period 1997- 2008 and reached US\$ 49.89 billion in 2008 (Liu, K.& Daly K. J., 2011). And according to Table 1, exports of manufactured goods constituted 94.55% of China's total exports in 2008. The portion remained almost the same as the exports increased steadily from 1980-2002 and soared dramatically afterwards to 2008.

Alongside the exports increasing after the opening up, China's exports share in GDP grew accordingly. Table 2 illustrated China's exports share in GDP from 1978 to 2016. In 1978, the exports constituted only 4.5% of the total GDP. This portion increased steadily afterwards to the highest point 38.5 % in 2007 though with

fluctuations in 1989, in 1992 and in 1996. Exports share in GDP dropped suddenly to 31.65% and 20.26% respectively in 2008 and 2009 and then arises to 26.17% in 2010 and then decreased slowly afterwards. The number showed 18.61% in 2016. But the portion of exports in GDP still weighted heavily.



Table 1: China's Total Exports and Exports of Manufactured Goods (unit: 100m USD)

Generally, numbers in Table 3 demonstrated that China's total energy consumption rose progressively though out the period. Coal was the main energy source, which constitutes more than 92% of total energy consumption each year in the period. In the total energy consumption, around 56.97% was used by the manufacturing sector in 2015. And this percentage remained the almost the same or even more from year 1997-2004.

In these total energy consumption in manufacturing, coal attributed largely as the energy source. Specifically, 73.27% of energy used in manufacturing sector was supplied by coal consumption in 2015. And this percentage kept almost the same in the period.

Source: Liu, K. & Daly, K., (2011) according to China Statistical Yearbook, 1996-2009.



Table 2: Share of Exports in Gross Domestic Product (GDP) from 1978 to 2016 (%)

Source: the author recreated this graphic according to numbers extracted from Zhu, A. D. & Kotz, D. M. (2010) and Statista.

Table 3: China's Total Energy Consumption and Energy Consumption in Manufacturing, China's total Coal Consumption and Coal Consumption in Manufacturing 1997-2015 (unit: 10000 tons of SCE)



Source: China Statistical Yearbook, 1998-2017.

#### 4.2.1 China Being the World factory

Addition to the above energy consumption in manufacturing for exports, the following numbers showed that China was the world factory. In 1990 it produced less than 3% of global manufacturing output by value; its share now is nearly a quarter. China produces about 80% of the world's air-conditioners, 70% of its mobile phones and 60% of its shoes (The Economist, 2015). Here the author did not find the relevant energy consumption data because of time limit, but according to the above manufacturing and energy consumption data, we could get a clue indirectly that energy consumption especially the coal consumption has increased largely.

# 4.3 Conventional Energy and Renewable Energy General Status in China

#### 4.3.1 Coal in China

Table 3 in the above discussion revealed that coal was an important source of energy in China. At the same time, coal was a type of fossil energy, which could represent the conventional energy. In this part, the author would like to look into the coal status in China to understand the challenges and containments the government faces.

Table 4: China Energy Consumption Structure by Fuel Types 1965-2015



Source: Dong, K. Y., Sun, R. J., Li, H., & Jiang, H. D. (2017).

Table 4 described China's energy consumption structure by fuel types 1965-2015. In general, coal was China's main sources for energy. It comprised around 86% of the total energy consumptions in 1965. Over 50 years' small fluctuating development, coal remained still as the most important source for energy in 2015, which constitutes around 65% of the total energy structure. Comparing the energy structure 2015 to that in 1965, the overall energy structure was rebalanced through cutting coal consumptions and enlarging consumptions of oil, gas and more renewable energy. Table 5: Coal consumptions in Industry (Unit: 10000tons)

**	1000	400.	• • • •				
Year	1990	1995	2000	2005	2010	2014	2015
Total Coal	10552	137676.	135689.	243375.	349008.	411613.	397014.
Consumptio	3	5	7	4	3	5	1
ns							
Coal	81090.	117570.	121806.	224766.	329728.	390497.	375650
consumption	9	7	7	1	5	4	
s in Industry							
Percentage	76.85	85.40%	89.77%	92.35%	94.48%	94.87%	94.62%
	%						

Source: the author calculated the percentage according to numbers in coal balance sheet in China Statistical Yearbook 2017.

The author calculated the percentage of coal consumptions in industry of the total coal consumptions according to coal balance sheet in China Statistical Yearbook 2017 and displayed them in Table 5. It showed that 76.85% of total coal consumptions went to the industrial consumptions in 1990. Five years later, this percentage rose to 85.40 in 1995. And it went on growing according to every five-year statistics. In specific, the percentage was 89.77 in 2000, 92.35 in 2005, 94.48 in 2010 and 94.62 in 2015. The exception of this trend is the number in 2014---the coal consumptions in industry were 94.87%, which was higher than the number showed in 2015. In other words, after 2014, the industrial coal consumptions declined a little.

Table 6 included two types of information. On the left, it was a Chinese map that illustrated coal mines (the grey spots), coal-fired power plants (the black spots) and planned and approved coal-fired plants (the blue spots) national wide in China 2012.

Table 6: Coal Mines and Coal-fired Power Plants in China in 2012; Employment in Coal Mining andCoal Washing 1998-2016 (Unit: 10 thousand persons)



Source: Limited Water for Vast Coal Reserves in China, 2015 (left) and Bie, F., (2017) from CEIC database (right).

According to Bjx.com.cn (2015), there were 1221 coal-fired power companies in China in 2014, which were scatted intensively almost all provinces in China. And there were around 12000 coal mines totally (China Coal Industry Net, 2012.), among which around 11000 were active (Göß, S., 2016).

The main coal producing provinces in China are Shanxi, Inner Mongolia, Shaanxi, Anhui, Heilongjiang, Xinjiang, Shandong, Henan and Guizhou (Bai, X.F. & et al., 2017). Shanxi, Inner Mongolia, Shananxi are the largest three coal producing provinces in China. From the Chinese map for these provinces, main coal producing provinces covers a large area of the whole China arranging from the Northwest, North, Northeast, middle part, Southwest and Middle east part (Anhui province).

On the right, the graphic showed the number of people that were employed in the coal mining and coal washing in China 1998-2016. Overall, there were almost 50 million people employed in this sector in this period. Specifically, the least employments were less than 40 million in year 2001, 2002 and 2003. And the most employment was more than 50 million in 2013.

#### 4.3.2 Current status of wind power in China

To address the problem comprehensively, the conventional energy status in China, on the one hand, was the main reason of the problem. Containments or challenges renewable power faces in China, on the other hand, slow down the process of replacement from the conventional energy to renewable energy. The author chose to display wind power status in China. As wind energy is also developing at a rapid pace in China currently. Chinese wind power players like Goldwind and Envision now share more than 44 percent of the Chinese market (Deign, J., 2018). China plans to increase its non-fossil fuel of primary energy consumption from 12 percent to 15 percent by 2020. Wind power was also an import source of renewable energy.

According to Zhen-Yu Zhao et al. (2016), First, technically, Chinese wind power companies has not grasped the core technologies in manufacturing, operating, maintaining wind power equipment and connecting wind power grid. Specifically, China has to purchase blade coating materials from foreign companies and also has been dependent on importing parts with high R&D difficulties. Besides, China lacks the key technologies of large capacity turbines, the capabilities to design those wind turbines and adequate experience of maintenance and trouble shooting, although leading companies are increasing research efforts (Zhao, Zh. Y., 2016).

According to interviews made by Zhen-Yu Zhao et al (2016), the long period of R&D wind power equipment, inadequate research funding from the Chinese government and squeezed price margin because of fierce competition in international wind market resulted in Chinese wind developers buying drawings from foreign peers, purchasing production licenses and developing jointly with foreign companies. Though buying drawing has quicken the domestic cycle of R&D, China's poor R&D capability still leads to poor transforming of introduced technology, which affects the quality of equipment (Zhao, Zh. Y. et al, 2016).

Second, China's central government and local governments' different purposes of governing caused the overcapacity of wind power. Chinese central government stimulates strong supporting policies to wind power development, but the local governments are usually centered on short-term revenues from the wind power industry. The stimulus policies from the central government give rooms to profits (according to Zhen-Yu Zhao's research, the gross profit margin of Goldwind in 2007 reached 29%) and attracted kinds of domestic players. Wind turbine suppliers increased from 30 in 2008 to 43 in 2009. In order to get orders for further profits, manufacturers expanded their scale of production. This caused fierce competition and then resulted in that wind turbine suppliers declined from 43 in 2009 to 29 in 2011 (Zhao, Zh. Y., 2016). Local governments, aiming in remain tax revenue, encourages the wind developers to buy from local manufacturers. In the purpose of get approval of wind power projects, the wind developers usually choose the local manufactures. Thus the local manufactures are promoted irrationally to produce more products.

Another problem caused by local governments' irrational guidance is small capacity wind power projects' difficulties in connecting to the grid. Until August 2011, the central government had authorized the provincial governments the right to approve wind projects with an installed capacity under 50 MW (Zhao, Z. Y., 2016). To faster the approval process and avoid the complicated approval process in the central government, the wind project developers usually control its project size under 50 MW. Therefore, 93% of the small capacity wind projects are approved by the local governments (Zhao, Z. Y., 2016). But the local governments usually do not have a feasible plan to coordinate between the local grid development and wind power farm constructions.

## **5.** Conclusion

The objective of this paper is to give out a framework of understanding why Chinese energy policy is comparatively conservative in replacing conventional energy to renewable energy.

Since China's opening up after 1978, its GDP growth averaged 9.6% and 2017 at 6.8%. China has made great progress in manufacture, trade and high-tech products like high-speed train. And China has also improved people' living standard greatly. But alongside the quick development, its conventional energy consumption and energy structure rise pollution problem. And to large extend its CO<sub>2</sub> emission impacts the climate change and is worried by international communities. China's 13<sup>th</sup> Five-Year Plan (2016-2020) for economic and social development on march 17, 2016, also concludes an energy consumption target, that is to cut down the coal consumption from 64% at the end of year 2015 to 58% at the end of year 2020 and to raise non-fossil fuel consumption to 15% from 12 %.

This paper formulated a research question according to the situation: "Why China's energy policy is comparatively conservative in replacing conventional energy to renewable energy?" To look for answer to this research question, the author searched for internal and external causes to the problem by applying Export-Oriented Industrialization and World System Theory. Besides, a brief Chinese historical review was also added as a supplement to find the answer.

As to the internal causes to this problem, the author found that the current Chinese government's cautiousness in policy making rooted in its failure to fulfill its radical economic policy "The Great Leap Forward", which was followed by the turmoil "Culture Revolution" in the beginning years of the new China build up during Maoera. Baring on shoulders to rejuvenate China, the Chinese elites considered avoiding turbulence and trying to maintain a harmonious society when they made policies. In this period, coal, with an ample natural reserve, was selected as a resource to develop its economy and it became the primary energy source in the Chinese energy structure. Export-led growth strategy, which was promoted since Deng xiaoping's era, resulted in that China became a world producing platform and investment destination and Chinese GDP growth was highly dependent on manufacturing exports and foreign markets. Energy was highly demanded in this process. Coal, as the primary fuel source, was largely woven in the Chinese life. There were around 11000 active coal mines intensively scatted across the whole country and nearly 50 million people were employed in coal mining and coal washing. Meanwhile, wind power, as the renewable energy source, were still facing challenges like technical problem and local governments' irrational guidance for short-term revenue and not well coordinating with the central government resulting in that the wind power's difficulties to connect to the local grid.

As to the external causes, the author applied world system theory to find the answer. World capitalist is a cyclical economy and its world economic center has been moving around the world from the Europe to the United States and then to the East Asia as time goes on. China's export-oriented strategy met the requirement of world capitalist economy's characteristics like chasing for profits, markets and capital expansion. China becomes the capital-receiving country and involved as a semiperiphery to provide low-value added processing trade after it embraces the export-led growth mode. And China was transformed gradually to be the world factory. China's economic development was highly dependent on the foreign markets and manufacturing exports. Energy consumption, therefore, was not possible to be cut down fast as long as the profit accumulation process continues on world widely.

The Chinese government has already realized the problem. From the analysis part and other articles, we could get a clue that the Chinese government is, strategically, redirecting its economic development mode from export oriented to service oriented. They are moving investments out to other part of world like African countries. And they initiate also the One Belt One Road strategy to relocate capital and investments as well as to develop new trade routes in the region.

In the energy sector, they stimulate the renewable energy projects, promoting to upgrade coal-consuming efficiency and rebalance the energy structure by introducing more renewable energy and other fossil fuel energy.

Because of time limit, this paper gives out only a macro perspective to understand and interpret the problem. The conventional energy in this paper was only represented by the coal status and the renewable energy was exemplified by just wind power. Future researches on China's detailed coal sector reforms in different provinces could be done. Besides, other types of fossil fuel like oil and gas and other renewable energy type like water energy and solar energy development could also be included in the researches

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## 7. Appendix

Country	FDI Inflows			I	FDI Outflow	S
	Year 2000	2010	2015	2000	2010	2015
China	407	1147	1356	9	688	1276

China Foreign Direct Investments (Unit: 100 million USD)

Source: China Statistical Yearbook 2017