

Running head: RENEWABLE ENERGIES: ANALYSIS OF STRENGTHS AND LIMITATIONS  
AND THEIR APPLICATION IN CHINA AND IN THE USA

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Renewable Energies: Analysis of Strengths and Limitations  
and their Application in China and in the USA

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## Table of contents

Introduction.....	3
1. Renewable Energies: Strengths and Limitations .....	4
Biomass Energy .....	4
Geothermal Energy .....	4
Hydropower Energy .....	4
Solar Energy.....	5
Wind Power Energy .....	5
Transition from Fossil Fuels to Renewable Energy Sources .....	6
2. Application in China .....	8
From Then to Now.....	8
China’s Projects .....	10
Paris Climate Agreement .....	11
3. Use of Renewable Energies in the USA .....	13
Brief History of Energy Use in the United States .....	13
Today’s Situation and some Data .....	13
Conclusion .....	15
References.....	16

## Introduction

When it comes to renewable energies, there are many misconceptions, even if the argument is widely debated nowadays. In fact, resources sometimes called green energy or eco-friendly, have many names and a bit of controversy. What are the real benefits that come from them? Are they a real solution? What are their strengths and limits?

Renewable energy could be summarized as form of technology that produces and stores energy and electricity from sustainable resources. There are many advantages involving eco-friendly energy. Although, its strengths can differ from a long-term resource to another, overall drawbacks and positive aspects present similarities.

# 1. Renewable energies: Strength and Limitations

## 1.1 Biomass Energy

Biomass energy is the result of organic waste product burning. Heat generated from combustion, move turbines that then produce and store electricity. As all the other sustainable sources, it is renewable and eco-friendly because guarantees a balance between burnt carbon which is released in the atmosphere to be absorbed again by a crop. In addition, it is also abundant if forests and woods are well managed. Its limits, on the contrary of other renewable sources, are just phew. It is, in fact, expensive and requires huge spaces in order to be applied.

## 1.2 Geothermal Energy

Geothermal energy is the use of heat coming from within the earth. Its warmth can be of various temperature and is what determines its use. Moderate to low heat geothermal energy involves hot water extraction, often used to heat houses, whereas dry steam extraction, which is the higher temperature form, could be used to heat bigger areas. Differently from wind energy, which depends on the weather, geothermal power is stable, its power plant can be detected and analysed precisely. On the other hand, like wind power, it requires a specific location in order to be applied and its construction costs are extremely high.

## 1.3 Hydropower Energy

Hydropower is probably one of the oldest energy forms used by humankind. Long before obtaining the name of “Green energy” hydropower was adopted in mills to spin the wheel. Nowadays hydropower, also called Hydroelectric power, as the name suggests it is used to produce electric energy, using two different ways. The first method involves dams and water storage, the second is without dams. Its difference is determined by its use. The firsts one is used in large-scale production, whereas the second one is involved in the small-scale production. As Geothermal energy, it is reliable and efficient, especially if there are reservoirs in the facilities. In addition,

water storage guarantees flexibility. However, dams have enormous consequences over local communities and environment, such as some fish species threatened by turbines.

#### 1.4 Solar Energy

Solar energy comes from sun rays. It is obtained from two different methods. The most wide-spread is photovoltaic panels where electricity is produced by cells that absorb photons. The second one is called concentrating solar power. As the name suggests solar power heat is concentrated over mirrors, that then sent to receivers. The latter is particularly useful on large-scale implants. Solar energy is not only renewable, Nasa claimed that sun will shine for the next 6.5 billion years, but it is also eco-friendly if the manufacturing process is not taken into consideration, because of nitrogen trifluoride, a sulphur substance which is far more polluting than carbon dioxide. But on the other hand, its energy capability is strong and effective, leading to less pollution in long-term and so fewer diseases.

#### 1.5 Wind Power Energy

Wind power is the result of electricity produced by turbines moved by wind. There are two types of turbines, they could be horizontal or vertical oriented. They are usually situated in wind farms or in offshore position in bodies of water when their energy capability is over 100 kilowatts, when their capability is under 100 kilowatts usually they are used by privates. One of its major advantages in addition to renewability and sustainability, similarly to solar power, is the help to public health. In fact, as a not pollutant energy form, there are no toxic element involved in the process. However, this particular energy form has its own way to damage the environment, for example in 2012, 573.000 birds got killed. Never the less wind farms are usually far from demanding areas, the issue can be addressed only with transportation leading to pollution in any case.

## 1.6 Transition from Fossil Fuels to Renewable Energy Sources.

Fossil fuels are still our main sources of energy, despite the on growing conversations about climate change. It was estimated that, in 2017, “the burning of fossil fuels around the world” would emit the highest levels of carbon dioxide ever recorded, up to 37 billion tones (The Guardian, 2017). The consequences of such pollution are the reason many scientists support the use of renewable energy sources instead of fossil fuels.

A transition from traditional energy sources to renewables is actually underway, albeit slowly. This seems to be proven by the number of cities across the world that are slowly working towards being entirely powered by renewable sources. As a matter of fact, The Guardian reported that since 2015 “the number of cities [...] predominantly powered by clean energy had more than doubled”. This “commitment and ambition” to no longer rely on fossil fuels do not only help the environment but are necessary to prove to governments that it is an achievable goal.

Indeed, it is very likely that this transition could already be possible on a global scale, thanks to developments on scientific fields. Scientists have been working for years on making these technologies more accessible to people in their daily lives. For example, MIT researchers have worked towards making transparent solar cells, as an article from Energy Futures reports. These solar cells could be used on windows and potentially revolutionize the usage of solar power. According to the article, positioning these solar cells to coat windows “in a skyscraper could provide more than a quarter of the building’s energy needs without changing its look”.

There are many reasons why governments should invest in these renewable technologies. One of them being the possible positive effects on jobs. According to the International Renewable Energy Agency, “the renewable energy sector encompasses a broad range of occupations and skills requirements”. Therefore, there are some positions in the sector that would require a specific set of

skills, which could slow down the transition from fossil fuels to renewables, but it could also possibly lead to job opportunities for those who can teach those needed skills. Additionally, renewable energies also bring in jobs in the area of transport, installation, and maintenance. According to IRENA, “solar PV employment grew by 12% in 2016” and new installations for wind power “resulted in a 7% increase in global employment”. Ultimately, clean energy wouldn’t risk an increase in unemployment.

Another factor to consider is that the cost of renewable energy has been constantly falling, which would make the transition easier. The costs of producing onshore wind electricity and solar electricity have dropped respectively of 23% and 73% since 2010 (Forbes, 2018). Costs are even expected to keep dropping over the next years. As a matter of fact, IRENA director-general, Adnan Amin, has said that “these cost declines across technologies are unprecedented and representative of the degree to which renewable energy is disrupting the global energy system”.

However, before investing in renewable energies there are some possible negative aspects to consider. The biggest expenses in renewable energies are from installing the technology rather than its maintenance (Union of Concerned Scientists, 2017). This is a factor that should not be overlooked because, in an economy mostly focused on the present and short-term goals, an energy source that is profitable on the long term might not look appealing. Clean energy could also have problems in the global markets, because not only it is a new type of technology and sector, but it would also have to “compete with wealthier industries that benefit from existing infrastructure, expertise, and policy” (UCS, 2017).

Finally, renewable energy sources can also have a negative impact on flora and fauna, which seems to not be discussed often. Energy sources such solar and wind do not affect the environment with the release of carbon dioxide like fossil fuels do, but they can disturb the local habitat and solar farms specifically might alter the growth of the vegetation. Solar panels can be potentially even

more damaging since their construction involves toxic chemicals which can induce “health risk” and “environmental hazards” (Sciencing, 2018).

## 2. Application in China

### 2.1 From Then to Now

This chapter will examine the use of renewable energies in China.

China is the major country in electricity production from renewable energies sources.

In February 2005 was enacted the Renewable Energy Law and was put into effect on 1<sup>st</sup> January 2016. This law was promulgated to promote the development and utilization of renewable energies (R.E.), improve the energy structure, diversify energy supplies, safeguard energy security, protect the environment and realize the sustainable development of economy and society<sup>1</sup>. Furthermore it defines the general conditions for R.E. to become a more important energy source in China. It covers all modern forms of R.E., i.e. wind, solar, water, biomass, geothermal and ocean energy. Renewable energy becomes the preferential area for energy development under this law.

In August 2007 the State Council released the National Medium-and Long Term for Science and Technology Development (MLP), in which was explained why was so important to invest on R.E.

*Our country is currently suffering from sharp discrepancies between energy supply and demand, an irrational energy structure, and low energy efficiency, with predominantly coal-based primary energy consumption, resulting in severe environmental pollution. Over the next 15 years, meeting*

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<sup>1</sup> NPC. The renewable energy law of the People's Republic of China, in 14<sup>th</sup> session. Beijing: Standing Committee of the National People's Congress (NPC) of the People's Republic of China; 2005



*the fast-growing demand for energy and for its clean and utilization constitutes a major challenge for the development of energy- related science and technology not.*<sup>2</sup>

Up to 2013 China saw R.E. as a source of energy security and not as a way to reduce the level of pollution. In fact, according to the article “Smog Wars: China’s Pollution in the Spotlight”, Chinese government denied existence of the pollution and moreover the media couldn’t discuss the pollution openly. The journalist Tyler Roney had to use the word fog and not smog to explain the grey and brown haze that smelled of ash and grounded flights. Other two state-media asserted that air pollution had many benefits, in fact they were convinced that smog made Chinese people more united, equal, aware and humours.

Only from 2013 China realized pollution as a risk. In September 2013 China’s Action Plan for the Prevention and Control of Air Pollution issued by China State Council illustrated the government’s aim to increase the use of R.E. and reduce in this way the level of pollution.

On March 4, 2014 the Chinese premier, Li Keqiang declared war against pollution. Another step forward in war on pollution was the launch of a \$8.13 billion environmental protection fund to decrease pollution.

In February 2016 Beijing was arranging the entrance of a new standard for vehicle emissions, to plan facing the smog, before the Winter Olympics in 2022. This was applied due to car and truck pollution estimated as around one-third of Beijing’s smog.

As The New York Times article reports, four years after that statement China is winning, with significant improvements in Chinese people’s health.

In the last decade China has built an increasing number of clean energy research centres, with cutting-edge research in areas from photovoltaics to CO<sub>2</sub> capture and use.

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<sup>2</sup> State Council, Guojia Zhongchangqi Kexue he Jishu Fazhan Guihua Gangyao (2006–20 Nian) [National medium-and long-term program for science and technology development (2006–20)], February 9, 2006, <[http://www.gov.cn/jrzq/2006-02/09/content\\_183787.htm](http://www.gov.cn/jrzq/2006-02/09/content_183787.htm)>. Subsequent MLP quotations are from this source.

The United Nations Environment Programme estimates that China invested \$103 billion (£77 billion) in renewable energy in 2015, more than one-third of the world's total.

The country alone installed more solar panels than any other nation, in 2016 the solar capacity leaped from 43 GW to 77 GW; after that China announced a new five-year plan for solar panels: it aims to reach 110 GW of solar panel by 2020.

Despite China is nowadays the global leader in solar, a decade ago, the country was not so developed.

Thanks to the laws promulgated to reduce pollution, in 2015, China dominated in renewable energies overseas, as showed a study by the Institute for Energy Economics and Financial Analysis (IEEFA).

## 2.2 China's Projects

On May 2014 were enacted the Airborne Pollution Yangtze River Delta and the Pearl River Delta to reduce coal use by 2017.

Thanks to the laws promulgated to reduce pollution, in 2015, China dominated in renewable energies overseas, as showed a study by the Institute for Energy Economics and Financial Analysis (IEEFA). In fact, China has effectuated big investments in different countries:

- In Australia, China Light & Power struck a \$1.1bn deal, buying power from wind and solar farms.
- In Chile, Tianqi Lithium spent \$2.5bn acquiring a 25% stake of a lithium miner and processor.
- In Germany, Beijing Enterprises Holdings Ltd spend \$1.6bn on a Waste to Energy development<sup>3</sup>.

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<sup>3</sup> Slezak, M. (2017, January 6). China cementing global dominance of renewable energy and technology. In *The Guardian*. Retrieved from:

China now owned:

- Five of the world's six largest solar-module manufacturing firms
- The largest wind-turbine manufacturer
- The world's largest lithium ion manufacturer
- The world's largest electricity utility

It has programmed other various ambitious renewable energy project, six of them are:

- Longtan Hydropower Station, Guangxi

Situated on the Hongshui River, the dam for the Longtan Hydropower Station stands just over 216 meters tall. The power station has a capacity of more than 6,000 megawatts (MW).

- Solar road, Jinan

The city of Jinan, in the eastern province of Shandong, is home to a "solar expressway" covering 5,875 square meters.

- Donghai Bridge Wind Farm

China's Donghai Bridge Wind Farm is located in the East China Sea. It has a capacity of just over 100 MW and comprises 34 turbines.

- Three Gorges Dam, Hubei

A vast hydropower facility, the Three Gorges Dam stands roughly 181 meters tall and has a length of around 2,335 meters, according to the United States Geological Survey.

- Panda Power Plant, Shanxi

With an install capacity of 100 MW and it could produce 3.2 billion kilowatt hours of green electricity over 25 years, representing an equivalent saving of 1.056 million tons of coal.

· Shenzhen's electric buses, Guangdong

One of China's major cities where there are electric buses<sup>4</sup>.

### 2.3 Paris Climate Agreement

China's presence in wind power globally is also on the rise. The journey is a clear contrast to the US one, which in 2017 withdrew from the Paris climate agreement. This last one is a deal that joins together all the world's nation with the purpose of tackling climate change for the first time in history. An evaluation of progress will be made by the end of 2018, with further reviews every five years.

Another deal was the Kyoto Protocol of 1997 set emission cutting targets for a handful of developed countries, but the US retreat and others failed to comply.

A similar situation happened last year when the USA decided to pull out from the Paris climate agreement.

In conclusion, although China is the principal energy producer and consumer, renewable sources provide just a little percentage of its need of electricity, for this reason China has to invest more in renewable energy. Furthermore, the supplies of oil, coal and gas are finite and subject to geopolitical tension, while renewable energies can be built and used wherever there is sufficient water, wind and sun.

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<sup>4</sup> Frangoul, A. (2018, January 22). Here are six of China's ambitious, mind-boggling, renewable energy projects. In *CNBC*. Retrieved from: <https://www.cnbc.com/2018/01/22/here-are-six-of-chinas-ambitious-mind-boggling-renewable-energy-projects>

### 3. Use of Renewable Energies in the USA

#### 3.1 Brief History of Energy Use in the United States.

In the United States, the sources of renewable energy have always been wood and water. In 1700 the first coal mines were inaugurated and 100 years later drilling began in search of oil and natural gas. In 1950 the first nuclear power stations were opened and they were very successful until about the 80s when accidents such as those of Chernobyl and Three Mile Island occurred. Not only nuclear power plants lost importance due to accidents, but also because of the radioactive waste they produced. The fossil fuel is thus marketed and, even today is in a dominant position.

What made the industrialization of the United States possible is fossil fuels. The first hints of industrialization, however, were present only around the sources of energy. Places far from gas, oil and coal continued to benefit from water and wood until better transport systems were built. It is only in the last 10 years that the nation has paid serious attention to renewable energy: until 1970 renewable energies produced less than 10% of power consumption. Nowadays there are two problems concerning the fossil fuels: high price and quality. The price of fossil fuels is not only high but is above all variable and non-predictable. The reason for this lies in the fact that in the mid-1700s new methods had been found that were quicker and more effective for mining coals, allowing high-quality coal to be extracted because it was close to the earth's surface.

#### 3.2 Today's Situation and some Data.

It is a fact that fossil fuels are sources rich in carbon which, once burned, goes into the atmosphere in the form of carbon dioxide. From this, it follows the atmospheric pollution that is so much discussed nowadays. Humans have accelerated the production process of carbon monoxide by a million times compared to what is naturally produced. For this reason, governments around the world are mobilizing to reduce the release of carbon monoxide, trying to use the renewable energies available in the best possible way. Although the facilities that use renewable energy are still very

expensive, they are slowly falling in price. It is important to note that the more renewable energies are used, the more projects related to them fall in price, becoming more accessible. In this way, they can also be integrated into buildings and vehicles. As reported by the geologist Hobart M. King, the energy consumption taken from renewable energy in the United States amounts to about 9%. Most of this percentage is represented by energy sources such as biomass and hydroelectricity. From the mid-nineties until today, the use of clean energy has increased by 6%. The nation exploits above all the power of the wind to produce clean energy: for example, it is possible to find wind power plants in Texas, California, Indiana and Oregon. Solar and geothermal energy also grew during the last twenty years, by 55% and 27%, respectively. The costs of geothermal energy projects are generally high, but to this day they are competing with the costs of fossil fuels.

According to King's predictions, even if America came out of the Paris agreement, renewable energy will have a bright future because the consequences of air pollution are something that can not be overlooked. For example, different geothermal, hydroelectric and solar plants can be built in the west of the United States. A clear example of the desire for change comes from South American entrepreneur and inventor Elon Musk (he created Tesla electric cars) who, during the National Governors Association meeting in July 2017, said the following word:

If you wanted to power the entire United States with solar panels, it would take a fairly small corner of Nevada or Texas or Utah; you only need 100 miles from 100 solar panels to power the entire United States. The batteries you need to store the energy, so you have 24/7 power, is 1 mile by 1 mile. One square-mile.

It is a reality that renewable energy can change the future of the United States and the world. On the other hand, it is equally important that prominent people like Elon Musk are urging the government to invest more and better in clean energy.

## Conclusion

In conclusion, it is clear that the situation of renewable energy is evolving. It has been demonstrated how today more benefits outnumber disadvantages. In the last decade a shift from fossil fuels use to green energies has started and will be likely to continue in the future. Positive aspects coming from that transition are related to the drop of project prices regarding sustainable energy. On the other hand, fossil fuel energies cost is quickly increasing, whereas their availability is getting more and more scarce. Those two events are leading to enormous changes in the perception of renewable energy. In fact, their spread is likely to improve in the future as well as research and innovation creating new possibilities to increase their technology.

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