

Energy transformation and sustainable development: Enlightenment from China's energy plan

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Abstract. The world's energy development is in an era of great change. Since the Industrial Revolution, the large-scale development and utilization of fossil energy has effectively promoted the progress of human civilization, but it has also brought about prominent problems such as resource scarcity, environmental pollution, and climate change. At present, accelerating energy reform and transformation has become an inevitable choice for countries around the world to solve difficulties and achieve sustainable development. As a practitioner of global energy transformation, China is demonstrating its responsibility and leading role and actively contributing to China's solutions. This article summarizes China's energy-saving measures, uses cluster analysis to compare China's energy data with other countries, affirms China's role in leading the world's low-carbon wave, and provides suggestions for the energy-saving development of other countries.

1 Introduction

Since the 21st century, energy issues have become a major concern for countries around the world. Practice shows that over-exploitation of fossil energy is not advisable. Facing the severe challenges existing between the world's energy supply, energy environment and energy efficiency, countries urgently need to open up and explore the path to sustainable development.

Energy issues have always been on the radar of all countries around the world, and the economic recession caused by the epidemic has spread to the energy field along with the economy. A survey found that global energy demand fell by approximately 4.5% in 2020, which was the most severe recession since the end of World War II [1]. This was due to the sharp drop in energy demand due to blockade policies implemented in response to the epidemic around the world. Equally shocking is the fact that the carbon intensity of the energy structure (i.e. the average carbon emissions per unit of energy used) fell by 1.8%, one of the largest declines since the war [2].

Such trends appear to be in line with expectations of countries around the world transitioning to zero emissions: strong growth in renewable energy and the replacement of

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coal. However, wind and solar power generation has “more than doubled” in the past five years, but has actually had little impact on total coal power generation [3]. In other words, even if the world’s carbon dioxide emissions have decreased in recent years, this reduction may only be temporary as the global economy recovers and countries gradually lift lockdowns. To this end, if we want to truly fully implement the green economy, both producers and consumers, as well as enterprises and governments, should respond accordingly.

The COVID-19 epidemic is a crisis that the whole world and China need to face together. China has taken unprecedented epidemic prevention and control measures, but at the same time, most countries around the world are still in the first two stages of the epidemic: dealing with the health crisis, and preventing economic collapse and avoiding serious harm to vulnerable groups [4].

Scholars generally believe that when responding to the epidemic, we must keep in mind the lessons brought by the financial crisis: the economic recovery after the crisis did not pay enough attention to sustainable development, and many countries quickly resumed fiscal austerity [5]. If some countries’ short-term economic stimulus measures focus mainly on traditional industries and infrastructure and still increase fossil fuel consumption, it may lead to pollution and high-carbon development in the coming decades [4].

Due to different national conditions, the methods of choice are also different: countries with land resources or natural resources will choose to vigorously develop emerging industries, countries with relatively scarce resources will encourage people to adjust their consumption structure through financial subsidies and financial support; developed countries will directly Industrial development is promoted through financial investment (such as the establishment of special funds), while developing countries are more likely to adjust taxes and fees.

China’s industrial scale and its technological strength, strategy and execution capabilities will lead to China’s choices having a huge impact on the world. In 2015, Chinese President Xi Jinping proposed the initiative to build a global energy internet at the United Nations Development Summit, advocating the establishment of a new energy supply system focusing on clean energy development and electric energy supply [6]. The core concept of the Global Energy Internet is clean development, and the way to achieve it is “two substitutions”, that is, implementing clean substitution in energy development and implementing electric energy substitution in energy consumption.

There is no doubt that as a major change and innovation in the energy field, the Global Energy Internet concept proposed by China points out the direction for the world’s energy transformation and future development [7]. Over the past eight years, the initiative has received widespread praise and positive response from the international community. It has been included in the United Nations 2030 Agenda, making China’s contribution to promoting the world’s energy transformation, coping with climate change, and achieving sustainable human development [8].

2 Primary energy consumption of the world

We calculated and enumerated the primary energy consumption of different countries over a ten-year period (Table 1).

Judging from the final average annual growth rate, among the selected countries, India, Turkey and Iran have similar data to China.

Table 1. the energy consumption of different countries [9].

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	average annual growth rate
China	112.5	117.1	121.4	124.8	126.5	128.6	132.8	137.6	142.1	145.5	3.8%
Belarus	1.1	1.2	1.1	1.1	1	1	1	1.1	1.2	1	0.3%
the United States	92.1	89.6	92	93	92	92.1	92.3	95.6	95	87.9	0.5%
the United Kingdom	8.9	8.5	8.1	8	8	7.9	7.9	7.9	7.7	6.7	-1.2%
Japan	20	19.9	19.7	19.2	18.9	18.7	18.9	18.8	18.4	17.7	-0.8%
Russian Federation	28.9	29	28.9	28.7	28.2	28.8	29	30.1	29	29.9	1.1%
India	23.8	25	26	27.8	28.7	30	31.1	33.1	33.9	32	4.7%
Germany	13.2	13.4	13.7	13.1	13.4	13.6	13.8	13.4	13.1	12.1	-0.1%
Turkey	4.8	5.1	5.1	5.2	5.7	6	6.4	6.3	6.5	6.3	4.3%
Canada	13.8	13.8	14.1	14.2	14.3	14.1	14.2	14.4	14.5	13.6	1%
France	10.2	10.2	10.3	9.9	10	9.8	9.7	9.8	9.6	8.7	-0.7%
Iran	9.1	9.2	9.6	10	10	10.4	10.8	11.4	12	12.1	3.4%
South Korea	11.3	11.4	11.5	11.8	12	12.2	12.2	12.4	12.2	11.8	2.1%

Although these countries are geographically different, their main fuel types are also different. (Oil is the main fuel in Africa, Europe and the Americas. Natural gas dominates in the CIS and the Middle East. Coal is the main fuel in the Asia-Pacific region.) But what these countries have in common is that they all have high energy needs, and they are also developing country.

During the process of collecting data, we found that the world's total primary energy consumption fell by 4.5% last year, which was the first decline in energy consumption since 2009. The decline was mainly due to a fall in oil consumption (down 9.7%), which accounted for nearly three-quarters of the total decline. Consumption fell for all fuels except renewables (up 9.7%) and hydropower (up 1.0%). Consumption fell in all regions, with the largest declines occurring in North America (down 8.0%) and Europe (down 7.8%). The Asia-Pacific region saw the lowest decline (down 1.6%), driven by growth in China (up 2.1%)[9]. China is the only major country with an increase in energy consumption in 2020.

If divided by energy type, oil still accounts for the largest share (31.2%) of the energy structure. Coal was the second largest fuel in 2020, accounting for 27.2% of total primary energy consumption. But at the same time, the share of renewable energy rose to 5.7%, it is really a record high [10].

What role does China play in the world energy transformation stage?

In recent years, under China's initiative, many countries around the world have introduced clean development policies and accelerated investment and construction of clean

energy projects. More than a dozen countries, including Belgium and Sweden, have phased out all coal-fired power plants. 26 EU member states have pledged not to build new coal-fired power stations after 2020[9]. The Netherlands, Norway, the United Kingdom, France and other countries have announced timetables for banning the sale of fuel vehicles. Investment in renewable energy reached US\$280 billion, exceeding US\$250 billion for five consecutive years, which is three times the investment in fossil energy power generation [10].

At present, China has established “One Belt, One Road” energy partnerships with 30 countries, and has carried out close cooperation in the fields of energy trade, investment, production capacity, equipment, technology, standards and other fields [11].

In addition, China has also established a regional energy cooperation platform with ASEAN, the Arab League, the African Union, and Central and Eastern Europe, and established the East Asia Summit Clean Energy Forum, which is committed to promoting technological innovation, cooperation and training [12]. China’s successful experience in actively participating in global energy governance, building a global energy Internet, and promoting “Belt and Road” energy cooperation shows that promoting high-quality opening up and upholding the concept of mutually beneficial and double-win cooperation have always been important ways to stabilize international energy cooperation.

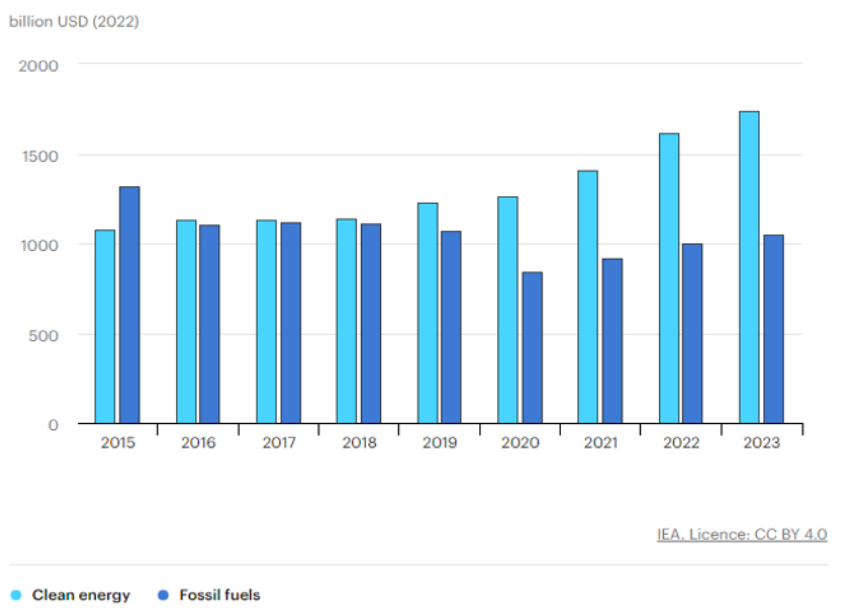


Fig. 1. Global energy investment in clean energy and in fossil fuels, 2015-2023[9].

Investment in clean energy technologies is significantly outpacing spending on fossil fuels as affordability and security concerns triggered by the global energy crisis strengthen the momentum behind more sustainable options, according to the IEA World Energy Investment 2023 report (Figure 1). Annual clean energy investment is expected to rise by 24% between 2021 and 2023, driven by renewables and electric vehicles, compared with a 15% rise in fossil fuel investment over the same period. But more than 90% of this increase comes from advanced economies and China, presenting a serious risk of new dividing lines in global energy if clean energy transitions don’t pick up elsewhere [9].

We summarized the proportion of renewable energy consumption in different regions in 2020 (Figure 2).

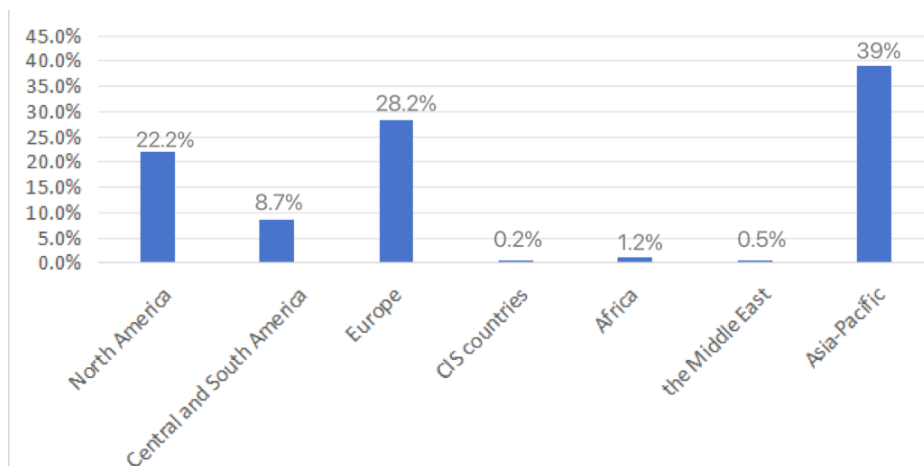


Fig. 2. The proportion of renewable energy consumption in different regions-2020 [12].

Judging from specific data, China is the country with the largest increase in renewable energy in the world in 2020 (1.0 exajoules), followed by the United States (0.4 exajoules). Over the past five years, renewable energy generation has accounted for about 60% of global power generation growth, with wind and solar power more than doubling.

What is certain is that developed countries need to make greater progress in energy efficiency. Therefore, China should learn from the successful cases of developed countries to contribute to the development of low-carbon energy in the world.

Recently, the International Energy Agency, the International Renewable Energy Agency, the United Nations Statistics Division, the World Bank and other international organizations jointly released the “Tracking Sustainable Development Goal 7: Energy Progress Report”. The report summarizes global energy consumption from four aspects: electricity penetration, clean cooking, energy efficiency and renewable energy. The report believes that China has made the largest contribution to the reduction of global energy consumption, with a contribution rate of more than 35%, higher than the 13% of the United States and 8% of India. The report also affirmed China’s great achievements in clean energy, popularization of electricity and improving people’s lives.

3 Findings and suggestions

We believe that the reduction in carbon dioxide emissions from 2020 to now is caused by two factors. One is the decline in energy demand due to the impact of the epidemic, and the other is that countries around the world are actively adjusting their energy structures. At present, the world has made great progress in the fields of electricity popularization and industrial energy efficiency, especially the advancement of renewable energy. The experience of some countries, including China, sends a positive signal: if appropriate methods and policies are adopted, countries around the world can achieve achievements in clean energy, popularization of electricity, and improvement of people’s lives.

Thanks to China’s progress since 2010, global renewable energy consumption has grown rapidly. In 2015, China’s contribution to global renewable energy consumption reached 30%. Among them, 50% of global solar energy consumption comes from China, followed by the United States and Germany, with 10% and 7% respectively. Since 2010, China has promoted natural gas, liquefied petroleum gas, biogas and electricity on a large scale. The use rate of biomass fuel has dropped by 6% every year, which has driven the increase in the penetration rate of clean energy in Asia.

Therefore, we can try to make some recommendations for the energy transition for other countries:

For developing countries, the first is to actively develop renewable energy technologies: such as researching more reliable energy storage technologies, actively developing clean energy such as solar energy and wind energy, and reducing the proportion of fossil fuel applications.

Secondly, the developing countries need to stimulate investment in energy by public and private financial institutions and actively seek international help.

For developed countries, they need actively use already perfected technical means and let the development of science and technology drive the implementation of emission reduction measures.

The government should provide financial support for energy technology training, research, and innovation, and pass legislation to protect the energy ecosystem.

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