The Trend of Climate Change and Development of Green Finance[1]

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Abstract: *Global carbon emissions continue to rise, nearly the staggering 40 billion tons per year. The global average temperature has already increased by about 1.5°C compared to pre-industrial levels, highlighting the growing severity of climate warming. The world must stand firm and work together to tackle the issue of carbon emissions.*

After a thorough analysis of the economic costs of low-carbon transition, we find that even if environmental costs are all internalized, the global economy may still can handle. Furthermore, the orderly replacement of traditional coal-fired power with renewable energy sources offers the potential to fundamentally address the issue of rising global carbon emissions at a reasonable cost. This provides strong support and economic feasibility for a low-carbon transition. More optimistically, with technological progress, the cost of new energy is expected to decline, presenting a brighter future for the transition.

Based on this, it is recommended to expand investments in renewable energy, promote the orderly replacement of coal-fired power plants with solar, wind, and hydropower installations year by year and enable the power generation system to transition from fossil fuels to renewable energy. Additionally, to increase the absorptive capacity of new energy, it's imperative to strengthen investment in energy storage facilities, necessary for the more efficient use of renewable energy.

In today's discussion, much has already been covered about renewable energy. Now, I would like to add some background information on this issue to help us gain a more comprehensive understanding of the topic.

I. Accelerated Carbon Emissions Sound the Alarm for Global Climate Warming

In figure 1, the red line illustrates the continuous human carbon emissions over the past 170 years, while the blue line describes the changes in carbon dioxide (CO_2) concentration in the atmosphere. The data shows that the concentration of CO_2 has risen from 285 ppm (parts per million) 170 years ago to the current level of about 417 ppm, in line with the process of global industrial modernization. Over these 170 years of industrialization, the world has cumulatively emitted approximately 1.8 trillion tons of CO_2, with an average annual emission of about 10.5 billion tons.

The current situation is increasingly dire. Global CO_2 emissions have now reached a staggering 40 billion tons per year, and this number continues to rise. The flow of this CO_2 is alarming: part of it enters the

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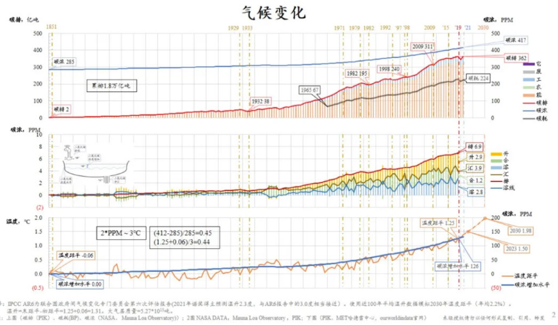
oceans, causing ocean acidification; another portion remains in the atmosphere, leading to the continued rise in CO2 concentration; only a small fraction is absorbed by green plants through photosynthesis. Since this absorption is far from sufficient to offset the growth in emissions, CO2 continues to accumulate in the atmosphere, further accelerating global climate warming.

Figure 1 Climate Change



Looking back over the past 170 years, the global temperature has already risen by approximately 1.5°C. If we allow this trend to continue, by 2030, the global temperature rise could hit the 2.0°C warning threshold. Although the international community is working together to limit the temperature increase to within 1.5°C, and ideally to keep it from exceeding 2°C, the reality is that a 1.5°C rise is already a certainty, and a 2°C rise may become a harsh reality in the near future. This situation is nothing short of extremely grave.

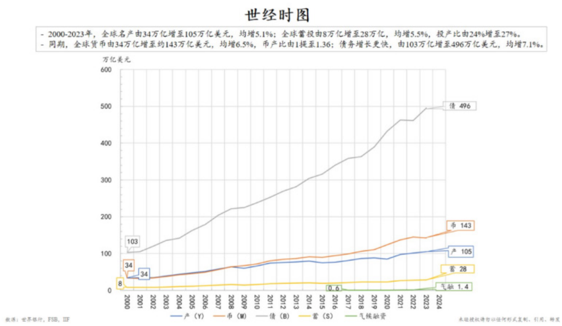
Many may still have a limited understanding of the deeper causes of global warming. They might think that, since the Earth has experienced more extreme climate fluctuations in its history, the warming is merely small and insignificant. Some may even optimistically believe that, just like in the past, the Earth's climate will naturally revert to colder conditions.

However, the reality is far from that simple. The current changes in temperature are not only becoming more pronounced, but the driving forces behind them have fundamentally changed. In contrast to the past, where climate fluctuations were primarily driven by changes in the Earth's orbit leading to ice ages, today's climate warming is mainly driven by human activities—specifically, the massive emissions of greenhouse gases. This human-induced climate change is not only different from the natural transitions of the past, but it also carries an irreversible severity.

II. The Economic Feasibility of a Low-Carbon Transition

Therefore, the world must stand firm in its commitment to addressing carbon emissions. From the perspective of global economic resilience, as shown in Figure 2, since 2000—over nearly a quarter of a century—global GDP has grown from $34 trillion to $105 trillion. This provides the scale of the global economy. Currently, climate financing stands at approximately $1.4 trillion per year. However, this amount will likely continue to grow as it serves and relies on sectors like renewable energy.

Figure 2 Time Series Line Figure of the World Economy(2000-2024)



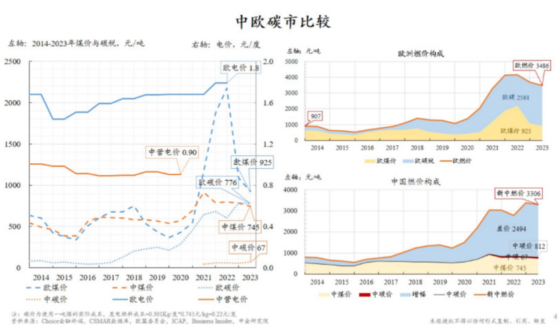
Global electricity consumption is around 28 trillion kilowatt-hours annually, with an average cost of about $0.15 per kilowatt-hour. Based on this, the total global electricity cost per year is approximately $4.2 trillion, which accounts for roughly 4% of global output ($105 trillion). If we consider other non-electric energy consumption, energy costs could double to around $8 trillion. Even so, this is not an overwhelming burden for the global economy—it could be handled.

I believe this point should be emphasized in international discussions: adjusting the energy structure from fossil fuels to renewable energy may have an economic impact of around 10% on the global economy, but this impact will not occur all at once. Instead, it will gradually increase to 10% over time.

During this process, we can accelerate adjustments to minimize the scale of the impact or to reduce the negative effects once they peak, keeping them within a manageable range. Therefore, it is crucial to invest real money now to solve the problem.

One of the key methods to control carbon emissions is to internalize the environmental costs, which can be achieved through carbon markets and carbon trading. As Figure 3 clearly shows, the current price of carbon in the EU (represented by the blue line) has risen to over 70 euros per ton, equivalent to nearly 700 yuan, and has been steadily increasing since 2014. The carbon trading mechanism is playing an increasingly important role in the EU. China has also launched its own carbon trading process, but the current carbon price is still relatively low compared to Europe, only about one-tenth of the European level. This indicates that there is room to further improve the operation and efficiency of China's carbon trading mechanism.

Figure 3 Comparison of China and EU Carbon Markets (2014-2023)



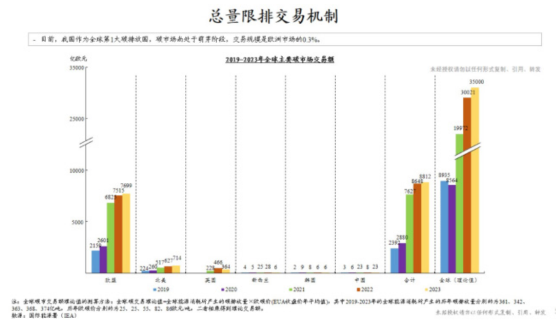
Considering that the EU will implement the Carbon Border Adjustment Mechanism (CBAM) in the future—requiring goods exported to Europe to calculate their carbon costs based on EU carbon prices—companies that fail to meet the required carbon cost may have to pay additional fees, or they might be barred from entering the EU market. This could have a significant impact. Therefore, we need to focus now on the full fuel cost, including a reasonable carbon emission price.

Take coal as an example. Coal itself has a base price, but the carbon emissions generated by burning coal must also include a carbon cost. Burning one ton of coal emits roughly four tons of CO2, so the carbon cost of each ton of coal is calculated by multiplying the carbon market price per ton of CO2 emissions by four.

Taking China's current market price of 67 yuan per ton of carbon emissions as an example, the carbon cost per ton of coal is around 280 yuan. This means that if the base price of coal is 700 yuan, adding the carbon cost would increase the total price by about 40%. If we use the European carbon price as a reference, the increase would be even more significant. A rough estimate suggests that once the carbon cost is factored in, the price of coal fuel could surge to over 3,000 yuan per ton.

Through a well-functioning carbon price trading market and mechanism, the external impacts of carbon emissions can be converted into internal costs that must be borne by the parties involved in the transaction.This would incentivize reduced carbon emissions and promote green, low-carbon development.

Figure 4 Cap-and-Trade Mechanism (2019-2023)



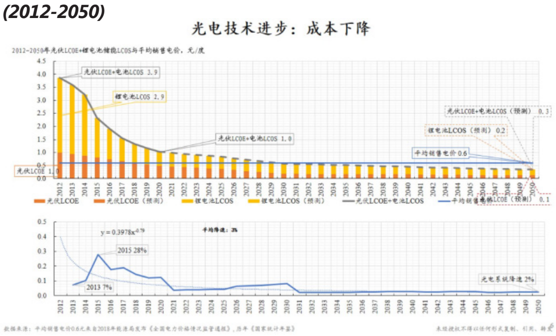
Currently, the EU is showing the most proactive stance in carbon emission trading. Based on its carbon price and corresponding emission levels, the size of the EU's carbon trading market is estimated to be between 700 billion and 800 billion euros. If we expand this view globally and use the EU carbon price as a benchmark to calculate the costs associated with all emissions, the total carbon cost could reach approximately 3.5 trillion euros.

However, it is important to note that this figure still accounts for less than 4% of global GDP, which is $105 trillion. Even if all external costs were internalized, the global economic system could potentially bear this additional cost. From a sustainable development perspective, this is also a responsibility we must shoulder.

III. Energy System Transformation Will Address the Carbon Emission

Internalizing the cost of carbon emissions will inevitably prompt energy users across society to adjust and absorb the additional cost pressure. The fundamental solution lies in the transformation of the energy system, driven by technological advancements and a continuous reduction in application costs. In fact, we have already witnessed a significant decline in relevant costs, particularly in photovoltaic (PV) power generation and chemical energy storage unit costs. As technology improves and economies of scale expand, these costs will continue to fall.

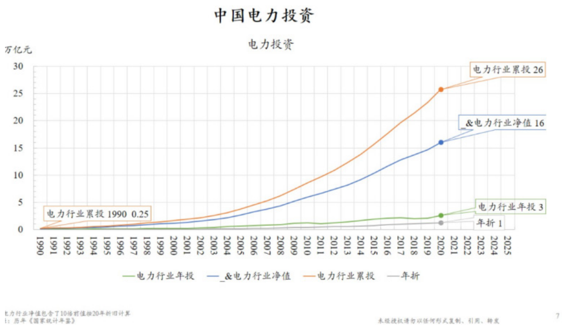
Figure 5 Advances in Photovoltaic Technology: Cost Reduction (2012-2050)



As shown in Figure 6, both energy demand and supply have been increasing along with economic development. Data on electricity investments show that since 1990, annual investments in China's power system—along with cumulative investment, depreciation, and net value—have continued to rise.

As seen in Figure 7, the installed capacity of renewable energy in China has already surpassed that of thermal power, taking up half of the total installed capacity. However, in terms of actual power generation, renewable energy has not yet overtaken thermal power, due to the unique physical characteristics of different energy types.

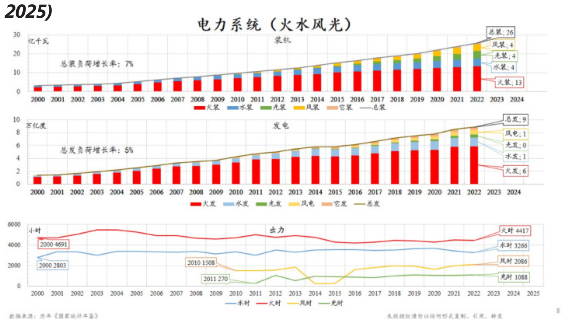
Figure 6 China's Electricity Investments (1990-2025)



Specifically, the average annual generation time for various types of energy follows a "1234" pattern: PV power averages about 1,000 hours per year, wind power around 2,000 hours, hydropower about 3,000 hours, and thermal power around 4,000 hours.

It's important to note that this ratio does not reflect the superiority of thermal or wind power over PV power but merely reveals their inherent physical properties, similar to physical constants. The product of generation hours and installed capacity often determines the share of each energy type in actual power generation. Therefore, while renewable energy has gained an advantage in installed capacity, its share in actual power generation still needs to improve.

Figure 7 The Power System (Thermal, Hydro, Wind, Solar)(2000-2025)



Our core strategy is to gradually phase out thermal power plants as they reach the end of their service life and replace them with new renewable energy installations. This will drive the transition of the power generation system from being fossil fuel-dominated to renewable energy-dominated. As shown in Figure 8, we base our predictions on systematic annual data.

In our forecast, the priority is to meet annual electricity