Title：Climate Change Solutions: Multi-Dimensional Strategies and Global Actions

Climate change has led to serious problems such as increasing greenhouse effect, water scarcity and ecosystem imbalance. Since the industrial revolution, the greenhouse gases produced by human activities have far exceeded the threshold of the Earth's self-purification capacity (Fig.1), leading to a continuous rise in global temperature.[1] For example, the summer of 2023 saw many places in the Northern Hemisphere break all-time high temperature records, while the high incidence of extreme cold wave events confirms the disruption of the climate system.[2] The greenhouse effect is due to the interaction of greenhouse gases on the earth to the sunlight, which produces a series of environmental effects, resulting in the increasing temperature of the earth. The most obvious feeling brought to human beings is that it is getting hotter and hotter in summer and colder and colder in winter.[3] Without systemic measures, the risks of sea level rise, agricultural yield reduction and virus recovery will be further exacerbated in the future[4]. This paper proposes solutions from four dimensions: technology, policy, society and ecology.

Figure 1 The harm caused by environmental pollution (Source: Vision China)

The response to this global crisis needs to move away from a fragmented governance mindset. The complexity of the climate system is such that it is difficult for a single policy or technology to achieve a fundamental reversal. In the Emissions Gap Report 2023, the United Nations Environment Programme (UNEP) clearly states that a 45% cut in carbon emissions must be achieved by 2030 if temperature rise is to be limited to 1.5°C, which requires simultaneous changes in the energy system, policy frameworks, social behaviors and ecosystems[5]. Based on this, this paper constructs a solution framework from the four dimensions of technology, system, society and nature to solve the climate dilemma through cross-disciplinary collaboration. This paper proposes solutions from four dimensions: technology, policy, society and ecology.

Accelerating research and development of new energy technologies and optimizing the energy mix. The fossil energy system on which the industrial revolution depended is no longer sustainable. According to the International Energy Agency (IEA) statistics, in 2022, the proportion of global fossil energy consumption is still as high as 80%, and its carbon emissions account for 89% of the global total (Fig.2). Cracking this dilemma needs a two-track approach: on the one hand, through technological innovation to reduce the cost of renewable energy. For example, Germany since 2000 to start the "Energy Transformation Program", cumulative investment of more than 50 billion euros in research and development of photovoltaic and wind energy technology, to promote renewable energy power generation from 6% to 46%[6], its solar cell conversion efficiency exceeded 24%, becoming the global benchmark. On the other hand, improving energy utilization efficiency is equally critical. Tesla's Megapack energy storage system deployed in South Australia, by storing excess wind power and regulating peak and valley power usage, has made 60% of the state's electricity regenerative, with an annual carbon dioxide emission reduction of 2 million tons. Such cases show that technology iteration and system optimization are the core drivers of energy transformation.

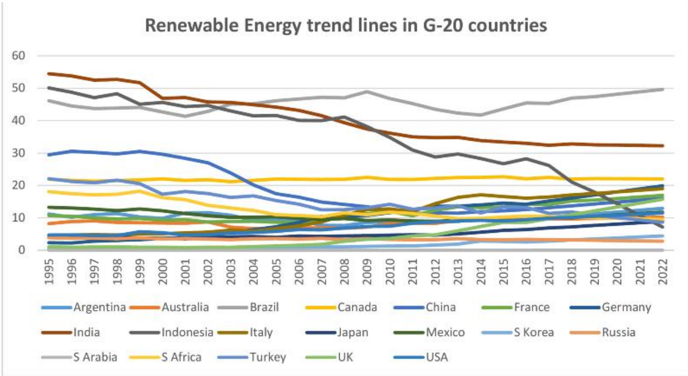

Figure 2 The trend of renewable energy in G20 nations.[7]

Expanding ecological restoration and building carbon sink networks. Natural ecosystems are the Earth's most economical carbon traps. Research by the Chinese Academy of Sciences shows that China's “Three North Protective Forests” project has reforested a total of 32 million hectares, sequestering 450 million tons of carbon and reducing the frequency of sandstorms and dust storms in the region by 40 per cent. Marine ecological restoration also has great potential: Indonesia, through the restoration of 2,000 hectares of mangrove forests, has achieved an annual carbon sequestration of 500,000 tons, equivalent to the emissions of 50,000 cars. According to the World Wide Fund for Nature (WWF), if 30% of the world's marine and terrestrial ecosystems were protected, 37% of carbon emissions could be offset (Fig.3). Therefore, ecological restoration needs to go beyond single tree planting and build a three-dimensional “forest-wetland-ocean” network of carbon sinks, supplemented by satellite remote sensing monitoring technology, to ensure that the effectiveness of restoration is quantifiable and sustainable.

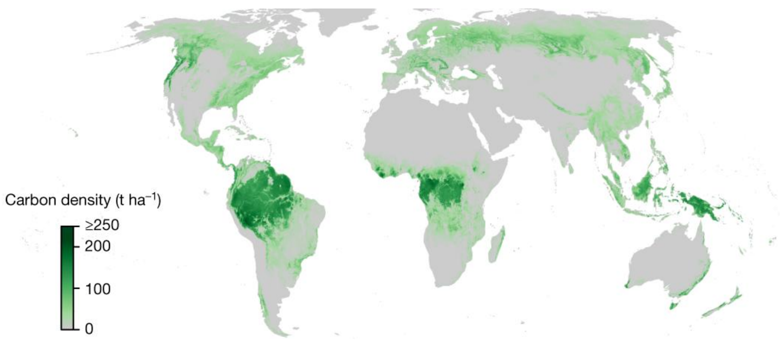

Figure 3 Map of carbon stocks in terrestrial trees.[8]

In conclusion, climate change is an urgent global issue that requires the world to work together to maintain environmental security and safeguard our planet.

References

[1] M. Bourquin, H. Peter, G. Michoud, S. B. Busi, T. J. Kohler, A. L. Robison, M. Styllas, L. Ezzat, A. U. Geers, M. Huss, S. Fodelianakis, M. Styllas, M. Schön, M. Tolosano, V. de Staercke, T. J. Kohler, T. J. Battin and T. The Vanishing Glaciers Field, *Nature Communications* **2025**, *16*, 1264.

[2] D. Raimi, E. Campbell, R. Newell, B. Prest, S. Villanueva and J. Wingenroth, *Resources for the Future: Washington, DC, USA* **2022**, 1723-1742.

[3] Y. Xiong, J. Liu and J. Kim, *Building and Environment* **2019**, *165*, 106393.

[4] N. C. Lo, F. S. M. Bezerra, D. G. Colley, F. M. Fleming, M. Homeida, N. Kabatereine, F. M. Kabole, C. H. King, M. A. Mafe, N. Midzi, F. Mutapi, J. R. Mwanga, R. M. R. Ramzy, F. Satrija, J. R. Stothard, M. S. Traoré, J. P. Webster, J. Utzinger, X.-N. Zhou, A. Danso-Appiah, P. Eusebi, E. S. Loker, C. O. Obonyo, R. Quansah, S. Liang, M. Vaillant, M. H. Murad, P. Hagan and A. Garba, *The Lancet Infectious Diseases* **2022**, *22*, e327-e335.

[5] B. H. Desai, *Yearbook of International Environmental Law* **2020**, *31*, 319-325.

[6] E. Lohmüller, S. Lohmüller, P. Saint-Cast, J. Greulich, S. Glunz and R. Preu in *Review and Highlights of More Than 30 Years Research on Ever Improving Technology for PERC Solar Cells at Fraunhofer Ise*, *Vol.* Accepted, **2024**.

[7] S. Han, D. Peng, Y. Guo, M. U. Aslam and R. Xu, *Scientific Reports* **2025**, *15*, 2236.

[8] L. Mo, C. M. Zohner, P. B. and T. W. Crowther, *Nature* **2023**, *624*, 92-101.

Statement of using AI

I used artificial intelligence techniques to search and categorize the relevant literature, but all the information was personally collected and organized by myself through Google Scholar.