# Improving the Global Atmosphere and Maintaining Atmospheric Balance by Empowering Power Stations with AI

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Abstract: Global climate change constitutes a considerable contemporary challenge confronting humanity. The atmospheric composition is a key factor influencing global climate, and the equilibrium of atmospheric composition is critical to the stability of the Earth's ecosystems. In view of this, this paper innovatively proposes the construction of a Global Atmosphere- Energy Smart Coordination System (GAESCS), which aims to comprehensively cover and monitor the global atmospheric composition in real time, and maintain the atmospheric balance to improve the climate. At present, the central position of electricity in production and life is unshakeable, but there is a contradiction between various types of power generation in terms of efficiency and pollution. Thermal power generation has a high conversion rate but is highly polluting, while wind and hydropower are clean but inefficient and unstable in supply. This system designed for research can accurately calculate the average household power consumption and air composition concentration in each region of the world. This system through intelligently schedules the work of each power station to maximize the advantages of each power plant and minimize atmospheric pollution. GAESCS can also provide new ideas to crack the dilemma of energy production and environmental protection, and help global climate governance and sustainable development.

## 1 INTRODUCTION

Global climate change has become a serious challenge to human society, and it has also triggered a series of ecological problems, such as the greenhouse effect, sea-level rise, and frequent extreme weather events. Its core mechanism is closely related to the dynamics of atmospheric composition. The atmospheric composition, as the pivotal element of the Earth's climate system, plays an important role in global climate regulation. Its small changes can have a significant impact on the global climate. Maintaining the stability and balance of atmospheric composition is therefore crucial to mitigating global climate change and protecting the Earth's ecosystem.

Among the many challenges in addressing climate change, the energy utilization patterns are undoubtedly one of the key factors. Electric power is the main form of energy for production and life in modern societies. It has a direct impact on the quality of the atmospheric environment due to the quality of its production methods. At present, thermal power generation, hydroelectric power generation, wind power generation, nuclear power generation, and other methods of power production coexist. However, each method of power generation has its own limitations. Thermal power generation has a high conversion rate and is widely used globally, but its high energy loss and pollution levels make it one of the main sources of greenhouse gas emissions. While wind and hydroelectric power generation. Although they are clean and non-polluting, have low conversion efficiencies and are highly restricted by natural conditions, making it difficult to meet global electricity demand on their own. In this contradictory energy pattern, how to rationally allocate the work of each power plant and fully leverage the advantages of each power generation method while minimizing atmospheric pollution has become an urgent issue.

This study proposes an innovative concept based on a paradigm shift in technology governance: the construction of a Global Atmospheric-Energy Smart Coordination System (GAESCS). The system aims to

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integrate high-precision atmospheric detection technology, a real-time pollutant monitoring network and artificial intelligence algorithms. For the intermittent problem of clean energy, it constructs a power prediction model based on meteorological prediction, together with the inter-regional power dispatch mechanism, to ensure the stability of the energy supply and the environmental friendliness of the dual objectives. The system will eventually form a closed-loop optimization model of ‘pollution emission-energy production-load demand’, which will maximize the comprehensive benefits of meeting the global power demand with minimal environmental costs.

This study try to break through the dilemma of limitation and lag in traditional environmental governance, and explores a systemic climate solution based on artificial intelligence. Through considering the global energy system and the atmospheric environment as an organic whole, the GAESCS system is expected to provide a new technological paradigm for addressing climate change and promote the transformation of human society into an environmentally intelligent and synergistic sustainable development model.

# 2 TRADITIONAL POWER GENERATION METHODS - AN EXAMPLE OF THE IMPACT OF COAL-BASED POWER GENERATION

In the global electricity production pattern, coal power generation occupies an extremely important position, accounting for as much as 41% of power generation.

Coal power generation has significant advantages in terms of energy efficiency, but its impact on the atmospheric environment should not be underestimated. Between 2014 and 2017, China's thermal power industry consumed between 41.66% and 46.49% of the country's total coal, and the consequent emissions of $SO_2$, NOx, and smog accounted for between 14.72% and 36.93% of the country's anthropogenic emissions, between 20.44% and 37.69%, and between 7.26% and 13.55% of the country's anthropogenic emissions, respectively. 37.69% and 7.26% to 13.55% respectively. Although thermal power still occupies a dominant position in China's energy structure, the air pollution problem behind its high efficiency needs to be solved (Cui,2021).Not only China, but also other countries.

India is the world's fifth-largest power-generating country. It has a generating capacity of about 210 GW, and the scale of power generation will continue to expand in the future. Currently, coal power generation accounts for as much as 66% of India's power generation, and coal power generation also occupies a major part of the country's new power generation capacity planning. According to relevant information, during the 12th Five-Year Plan period from 2012 to 2017, India planned to add 76 GW of coal power generation capacity, while in the 13th Five-Year Plan period from 2017 to 2022, it planned to add 93 GW of coal power generation capacity. In the 13th Five-Year Plan to be implemented between 2017 and 2022, an additional 93 GW of coal-fired power generation capacity is planned. The various types of emissions generated during the operation of coal-fired power plants have serious and wide-ranging impacts on human health, mainly in terms of triggering higher mortality and morbidity rates.

The impacts of coal-fired power plants on human health are severe and widespread. Back in December 2011, India had 111 coal-fired power plants in operation, with a total capacity of 121 GW. These coal-fired power plants consume a huge amount of coal - about 503 million ton - every year. This process generates a large number of pollutants, including about 580 ton per annum of particulate matter with a diameter of less than 2.5 $\mu$m, 2,100 ton per annum of sulfur dioxide (SO2), 2,000 ton per annum of nitrogen oxides (NOx), 1,100 ton per annum of carbon monoxide (CO), 100 ton per annum of volatile organic compounds (VOCs) and 665 million ton of carbon dioxide (CO2 ) per annum. emissions. The emission of these pollutants places a heavy burden on public health. It is estimated that between 2011 and 2012, there were between 80,000 and 115,000 premature deaths and over 20 million cases of asthma caused by exposure to total PM10 emissions from coal-fired power plants. The economic cost to the public and the government of such a serious health hazard is in the range of Rs. 16,000 to 23,000 crore, which translates to US$ 3.2 to 4.6 billion. The greatest health impacts from emissions from coal-fired power plants are concentrated in Delhi, Haryana, Maharashtra, Madhya Pradesh, Chhattisgarh, the Gangetic plains of India, and most of central and eastern India (Kone, 2017). This shows that traditional thermal coal power generation is quite serious in terms of atmospheric pollution, and as a result, human life and health are seriously endangered. Human beings have also been exploring and developing green power generation methods.

## 3 ADVANTAGES OF NEW GREEN POWER GENERATION - SOLAR, WIND AND WATER AS EXAMPLES

Compared with traditional thermal power generation, solar power generation does not need to rely on traditional fossil fuels such as coal and oil, and produces almost no carbon dioxide during the power generation process. These power generation methods greatly reduce the emission of air pollutants, greatly maintain the atmospheric balance, and reduce the incidence of illnesses caused by air pollution. As a source of energy, solar energy has significant advantages: first, solar energy resources are extremely abundant and sustainable, theoretically not facing the problem of depletion; second, the development of solar power generation can reduce the large-scale exploitation of the Earth's limited petroleum resources, and help to achieve the sustainable use of energy and environmental protection (Wu,2012).

Despite the significant benefits of green development, there are several limitations and shortcomings. Some green energy projects require large amounts of land resources. For example, large-scale solar power plants and wind farms need to install equipment over a wide area. It may have certain impacts on the local ecosystem, such as destroying wildlife habitats and affecting land use. In particular, in the field of hydropower development. Hydroelectricity is more specific in terms of siting requirements. Because of its dependence on the conversion of potential and kinetic energy of water flow, hydropower plants usually need to be built adjacent to important water systems. When planning a hydropower project, the stability of the runoff from the water system must be accurately assessed, and the carrying capacity of the surrounding ecosystem must be fully considered to ensure the long-term stable operation of the power station. The construction of large reservoir projects may bring many disturbances to the surrounding ecosystem. For example, changes in hydrological conditions can affect the habitat of aquatic organisms in the basin, and land inundation can destroy terrestrial vegetation communities and animal habitats. In addition, if the reservoir project fails to ensure adequate safety performance during the design and construction phases, in the event of force majeure natural disasters (e.g., powerful earthquakes, massive floods, etc.), it may face serious risks such as dam failure, which can be devastating to the safety of downstream residents' lives and property, as well as to the ecological integrity of the region. In addition, the production process of green energy devices may also generate a certain amount of environmental pollution, such as the manufacturing process of solar photovoltaic panels, which involves heavy metal pollution and other environmental issues. Furthermore, due to technological limitations, green power generation, such as solar and wind power, is also highly demanding of the natural environment, and the supply of these energy sources is dependent on weather conditions, which does not ensure a stable power output. Some green power generation has high initial investment costs. For example, the construction of large-scale solar power plants or wind farms requires significant capital investment for equipment procurement, installation and infrastructure development. According to relevant studies, the conversion efficiency of solar power is only 15-25%, and that of wind power is only 30-45%, while conventional power generation can maintain a stable 35-45%.

Therefore, the new green power generation cannot be widely promoted yet and cannot completely replace traditional power generation. This paper will also focus on the innovative idea of building a Global Atmosphere-Energy Smart Cooperative System, or GAESCS for short.

## 4 GAESCS DESIGN AND FUNCTIONS

GAESCS uses a multi-tier architecture design, including data acquisition layer, data processing layer, intelligent decision-making layer, and application service layer, as shown in Figure 1 (He,2025).

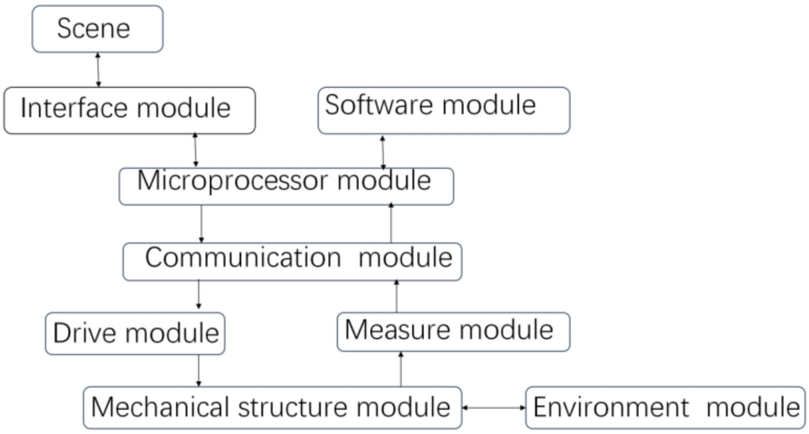


Figure 1: System structure block diagram.

The system will integrate data from multiple sources, including meteorological satellite data, ground sensor monitoring data and real-time monitoring of key parameters such as atmospheric composition (e.g., carbon dioxide, methane, water vapour, etc.), temperature, barometric pressure, wind speed and so on to build a global atmospheric information database. At the same time, the system will access the global power production database to obtain information on the type of power generation, installed capacity, operational status, emission data, etc., of each power station, and will be integrated with the global energy consumption data, including the consumption of electricity in various regions and industries. Specifically, the system will integrate low-orbit multiple satellites to ensure tight and seamless coverage across countries around the globe (Bai, 2024), ground-based sensor arrays and high-altitude detection platforms to form a three-dimensional observation network.

For example, hydroelectric power generation needs to be constructed over large river falls and also needs to operate during seasonal periods of high river flows. In order to be able to capture the right time to run on time. The author proposes that the water satellite can be used to collaborate as proposed by Liu Xinyu and others(Liu, Zhang and Shen et al,2025).

To easy for systematic analysis, assessment, and prediction of meteorological data and to be able to make decisions on the optimal solution. The author thinks that the three-dimensional visualization system which includes meteorology, satellites and radar for visualization and analysis by the National Oceanic and Atmospheric Administration (NOAA) of the United States (Rao, Zhu and Xu et al, 2023).

For the data processing of ground sensors and high-altitude detection platforms. GAESCS performs preliminary analysis on the raw data collected by the sensors to remove noise, fill in missing values, eliminate redundancy, and so on. Common preprocessing methods include data cleaning, data smoothing, data normalization, etc. Data cleaning is used to remove erroneous data and outliers; data smoothing reduces the effect of noise through filtering algorithms; and data normalization scales the data to a specific range to facilitate subsequent processing.

After data processing, the system will be based on real-time data and forecast results, the system will use intelligent algorithms i.e. C-IDSS system to optimize and schedule the work of each power station(Qin and Kang,1995). According to the power demand and atmospheric quality requirements of each region, the tasks of different power generation modes will be reasonably allocated, priority will be given to the use of clean energy for power generation, and efficient transmission and distribution of power will be realized through smart grid technology.

The application service layer provides users with various application functions and services. It includes visualization interfaces for displaying atmospheric monitoring data and energy production status, and decision support tools for energy management and climate governance. Users can access the system through web browsers or mobile applications for real-time information and decision support. The system provides real-time monitoring of global atmospheric composition and power production processes, detecting anomalies and alerting relevant personnel in a timely manner. At the same time, based on the real-time feedback data, it dynamically adjusts the scheduling program to ensure that the system is always in the best operating condition.

# 5 MECHANISMS OF THE SYSTEM'S CONTRIBUTION TO ATMOSPHERIC BALANCE AND CLIMATE IMPROVEMENT

## 5.1 Optimizing Energy Structure and Reducing Greenhouse Gas Emissions

By reasonably allocating the work of each power station, Priority will be given to the use of renewable energy, such as wind and water energy for power generation, and the reliance on high-pollution and high-emission thermal power generation will be reduced by reasonably allocating the work of each power station. The system will intelligently plan the layout of renewable energy power generation projects according to the resource endowment and energy demand of each region, and increase the proportion of renewable energy in the power supply, thereby directly reducing greenhouse gas emissions and mitigating the trend of rising greenhouse gas concentrations in the atmosphere.

## 5.2 Realize the Dynamic Balance of Atmospheric Components

The system is able to monitor changes in atmospheric composition concentration in real time, and when an abnormality in atmospheric composition is found in a certain region (e.g., carbon dioxide concentration is too high or too low), it will indirectly affect the emission and absorption of various atmospheric compositions by intelligently scheduling the power production process and adjusting the energy consumption structure. For example, increasing the proportion of clean energy power generation in high carbon emission areas reduces carbon emissions; in low carbon absorption areas, carbon sink capacity is enhanced through optimizing energy use and ecological construction

## 5.3 Promote Synergistic Global Climate Governance

The system will break national boundaries and geographical restrictions to achieve the sharing and collaborative management of global atmospheric and energy information. Countries can understand the global climate situation and energy development trend through the system platform, and formulate more scientific and reasonable climate policies and energy development strategies. At the same time, the system can promote international energy cooperation and technology exchanges to jointly address the challenges of climate change.

# 6 VALUE OF THE SYSTEM TO THE ENERGY SECTOR

## 6.1 Improve Energy Utilization Efficiency

Through the in-depth application of intelligent scheduling and optimization technology, accurate scheduling models and optimization algorithms are constructed based on the operating characteristics, energy consumption indexes, and power production demand of each power station. Real-time monitoring and analysis of the power plant operation data, dynamic adjustment of operating parameters and power generation strategy, to ensure the power plant is always in the high-efficiency zone. This can not only significantly reduce the waste caused by inefficient operation of equipment and energy conversion loss, but also optimize the power production process, improve the utilization efficiency of power generation equipment, and power generation quality. Thus realizing the all-around improvement of power production efficiency, providing strong support for the sustainable development of energy and power, which is of great academic and practical significance (Ren and Huang, 2005).

## 6.2 Promote Energy Transformation and Upgrading

Accelerating the development and utilization of renewable energy is a key path to promote the transformation of the energy structure in the direction of clean and low-carbon. Meanwhile, this system builds a solid data support system and accurate decision-making basis platform to innovate energy technology, can effectively stimulate the vitality of scientific and technological innovation in the field of energy, promote the continuous innovation of energy technology. And then enhance the efficiency of the use of energy and the ability of sustainable development, and help the global energy transition and the realization of the goal of sustainable development, for the construction of a clean, low-carbon, safe and efficient modern energy system to provide a strong impetus (Zhang and Wang, 2025).

### 6.3 Ensure Energy Security and Stable Supply

With the efficient operation of a real-time monitoring and intelligent scheduling system, it can achieve accurate control of energy supply dynamics. On the one hand, real-time monitoring can capture the subtle fluctuations in energy production, transmission and other links in a timely manner, and accurately locate potential risk points; on the other hand, intelligent scheduling is based on big data analysis and complex algorithms to quickly formulate coping strategies and rationally deploy energy resources to ensure that in the face of unexpected events such as extreme weather and equipment failure, the supply of energy does not appear to be a large gap or interruption. This process can not only effectively smooth out short-term fluctuations in energy supply, but also enhance the resilience of the energy supply system, provide a strong guarantee for the sound operation of the global energy network, enhance the stability and reliability of the energy system in a complex and volatile environment, and promote the sustainable and stable supply of energy.

## 7 CHALLENGES AND SHORTCOMINGS

However, there are some challenges and limitations to the implementation of GAESCS.

### 7.1 Technical Challenges

The system aims to deeply integrate cutting-edge technologies such as artificial intelligence, big data analysis, and satellite remote sensing to achieve the goal of efficient and accurate application. In the process of system construction and implementation, the dynamic characteristics of the current technological evolution need to be fully considered. Although the relevant technology has achieved significant results in theoretical research and practical application, it must be clear that its development and optimization process is still advancing, and has not yet reached the stage of complete maturity and stereotypes. Therefore, in the implementation of the system, it is very likely to encounter all kinds of complex and difficult technical bottlenecks. For example, there are potential technical challenges in the optimization of the adaptability of artificial intelligence algorithms, the improvement of the accuracy of big data analysis models, and the high-precision analysis of satellite remote sensing data, etc. It is necessary for the interdisciplinary team to collaborate in the research, and gradually overcome the problems through continuous R&D investment and innovation practice, in order to ensure the stable operation of the system and the achievement of the expected performance.

### 7.2 Data Quality and Availability

In today's complex technological environment, the accuracy and reliability of the data collected by the system become the key factors determining the performance and effectiveness of the system. At the application level, data quality is susceptible to a variety of factors that can compromise the integrity and accuracy of the data. For example, sensor failures can lead to biased or missing monitoring data, which cannot truly reflect the actual situation; errors in the data transmission process, such as signal interference and network delays, can also impede the accurate transmission of data, making it deviate from the original data. In addition, there are significant differences in the geographical availability of data, and some regions have limited access to data and a scarcity of data, which undoubtedly restricts the global coverage of the system to a certain extent, making it difficult for it to perform ideally in these data-weak regions, and affecting the overall applicability and universality of the system. It is thus clear that improving data quality is crucial to guaranteeing the effective operation of the system on a global scale.

### 7.3 Collaboration and Coordination

The implementation of GAESCS (the full name of GAESCS) involves a wide range of actors, including government agencies, research institutions, and energy companies. Efficient collaboration and coordination among these parties will play a key role in the success of GAESCS. However, it should not be overlooked that, based on their own functional positioning and interests, each subject upholds the goal to different degrees of difference, the interests and goals of the non-consistency of many obstacles to the coordination of work, so that the process of collaboration is faced with a complex dilemma. For example, the government focuses on macro-planning and social benefits, research institutes are committed to technological innovation and knowledge development, and energy companies focus on economic benefits and market competitiveness, which makes it easy for the three parties to have disagreements and contradictions in the allocation of resources, decision-making, and promotion of the project, thus affecting the overall effectiveness and quality of the implementation of GAESCS.

# 8 CONCLUSION

The Global Atmosphere-Energy Smart Coordination System proposed in this paper provides an innovative solution to address global climate change and sustainable energy development. By integrating global atmospheric monitoring and energy production scheduling functions, the system is able to achieve the goals of dynamic equilibrium maintenance of atmospheric structure and climate improvement. Although the system is still at the conceptual design stage, its potential value and significance should not be overlooked. In the future, with the continuous development and improvement of related technologies, this system is expected to become an important tool for global climate governance and sustainable energy development, creating a cleaner, more stable and sustainable home for mankind.

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