PROCEEDINGS OF THE
INTERNATIONAL CARBON NEUTRALITY TRAINEESHIP PROGRAM
Volume.02, Number.1, 2024, 136-140

The Impact of Emerging Technologies Mainly on the IoT on Carbon Neutrality

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Abstract

Climate change is the most important issue facing humanity. In recent years, one extreme weather event after another and global warming triggered by greenhouse gas emissions from fossil energy consumption have put the world on the cusp of another energy revolution. The development and utilization of renewable and clean energy constitute the third energy revolution. In this context, it is urgent to propose "carbon neutrality". Carbon neutrality is an significant strategy and goal, through the form of afforestation, energy conservation and emission reduction, offset its own carbon dioxide emissions, to achieve carbon dioxide "zero emissions" can help mitigate the adverse effects of climate change, protect the health and diversity of the ecosystem. At the same time, carbon neutrality is also a global goal, and through collective action, countries can collectively mitigate the adverse effects of climate change on global society and economy. The Internet of Things can play an important role in achieving carbon neutrality, and IoT systems are like a "digital skin" for our planet. Using sensors to effectively monitor, analyze and manage CO_2 emissions, cloud applications to share data and improve energy efficiency, and AI modeling to predict carbon footprints are all effective ways to achieve carbon neutrality. By educating researchers about carbon-neutral policies and integrating IoT technologies, we can more effectively reduce carbon emissions and drive environmental sustainability.

Keywords: Carbon neutrality; Internet of Things; GHG emissions; climate change.

1. Introduction

Scientists have shown over decades of research that human activity is causing climate change. After the Industrial Revolution, human economic activities emitted huge quantities of greenhouse gases into the Earth's atmosphere. Rising concentrations of greenhouse gases in the atmosphere are already having a major impact on the Earth's climate system. Carbon neutrality is urgently needed. Carbon neutrality refers to offsetting the generated carbon dioxide (CO_2) through carbon capture, storage, and conversion within a certain period, to achieve "zero emission" of greenhouse gases. The Paris Agreement aims to limit global warming to 1.5 °C above the pre-industrial levels. To achieve IPCC's

objective, carbon neutral target must be realized globally by the middle of the 21st century [1]. However, "Emissions Gap Report 2019" released by the United Nations Environment Programmer (UNEP) presents that there still exists a big gap between countries' targets to reduce carbon emissions and 1.5 °C goal [2][3].

In the face of the challenges of environmental governance and achieving carbon neutrality, this paper aims to explore the different forms of applications of IoT technology and how these can work together to form a comprehensive carbon neutral solution. In the process of carbon neutrality, how to make full use of IoT technologies to achieve accurate monitoring and management of carbon emissions has become a key issue.

Today, with the Internet of Everything, everything is tightly connected through the threads of the Internet of Things. The introduction of IoT technologies can not only improve the efficiency of carbon neutrality, but also reduce the cost of implementing carbon neutrality strategies. With real-time monitoring and intelligent decision-making, companies and governments can better formulate carbon management strategies, reduce unnecessary carbon emissions, and promote sustainable development.

This article will explain in the next chapter the criteria on which the convergence of IoT and carbon neutrality is based. Next, we delve into different forms of IoT applications. These are three short chapters on sensor applications, cloud applications, and AI modeling. We will explain the comparison between the research results of this article and existing literature, delve into the connotation of the recommended methods in these literatures, summarize the main findings of the research, propose the future development direction of the Internet of Things in the field of carbon neutrality, and reflect on the shortcomings of current technology. Provide scientific and practical solutions to achieve climate neutrality goal.

2. Methods

The Internet of Things (IoT, Internet of Things) is also called "sensor network", which is the general name of "sensor network" in the world; It refers to objects by loading various information sensing devices. The advent of the IoT concept has broken the previous conventional thinking. Considering the previous elements. A definition for a connected object could be: "Sensor(s) and/or actuator(s) carrying out a specific function and that are able to communicate with other equipment. It is part of an infrastructure allowing the transport, storage, processing, and access to the generated data by users or other systems." A definition for a connected object could be: "Sensor(s) and/or actuator(s) carrying out a specific function and that are able to communicate with other equipment. It is part of an infrastructure allowing the transport, storage, processing, and access to the generated data by users or other systems." Then, a definition for the IoT would be: "Group of infrastructures interconnecting connected objects and allowing their management, data mining and the access to the data they generate. [4]" IoT technology has played a huge role in tackling carbon neutrality.

This paper refers to papers from Z-library, IEEE, ScienceDirect, and other databases on the application of the Internet of Things to carbon neutrality. Greenhouse gas emissions and climate change affect carbon neutrality standards. Each module of the article considers relevance and science, and references articles published in the recent past. By comparing the existing techniques by referring to several literature, we can discover the shortcomings of the existing techniques and have more novel ideas.

The Internet of Things technology still has shortcomings in the management of carbon neutrality, and the management of carbon neutrality requires us to have a more detailed grasp of the current situation of the earth, and most of the applications of the Internet of Things are implemented in some areas, and there is no large-scale coverage. For example, remote areas, rural areas, and uninhabited areas are mostly not monitored because IoT application technology is not mature enough and the energy consumption and cost of trying to cover these areas is too high. This is just for land areas, and for the wider ocean it is difficult to keep abreast of ocean conditions with current technology. There is still more room for IoT technology to grow, and here are a few directions in which it could govern carbon neutrality.

2.1. Sensor monitoring, analysis, and management of environmental data

When it comes to the Internet of Things, many people's first thought is sensors. Sensors are a technology that

people working in the IoT industry cannot do without. In agriculture-related majors at my school, many teachers and students use sensors to monitor the temperature and humidity of the environment in which fruits and vegetables are grown, and to understand the growing conditions of fruits and vegetables. The status data of the growing environment of fruits and vegetables can be seen briefly through the IoT network. Monitoring environmental data with sensors is a very good option. The sensor transmits the collected data to the data processing part or the monitoring center via wired or wireless communication. By setting thresholds or criteria for sensors, early warnings and prompts for abnormal or excessive data can alert the relevant personnel to take timely measures.

The combination of modern environmental monitoring and the Internet of Things and other technologies. Therefore, modern methods of environment monitoring are known as SEM systems, due to use of IoT, AI and wireless sensors [5]. The WSNs provide the connectivity of the data, captured by employing sensors and IoT devices, used to record, monitor, and control various environmental conditions, such as water quality, temperature, air quality, etc. A smart environment system can be easily understood [6]. For carbon-neutral governance, accurate environmental data obtained by sensors is an important reference for responding to environmental changes.

2.2. Cloud applications improve energy efficiency and reduce carbon emissions.

Cloud computing and Internet of Things (IoT) are two very different technologies that are both already part of our life. Their adoption and use are expected to be more and more pervasive, making them important components of the Future Internet. A novel paradigm where Cloud and IoT are merged together is foreseen as disruptive and as an enabler of a large number of application scenarios [7].

Green cloud computing is also one of the emerging technologies. The benefits of green cloud computing are focused mainly on energy saving and carbon-footprint reduction. However, the development of green cloud computing is closely related to the evolution of green data centers, because the data centers are the core of the cloud computing. According to Koomey [8], the energy consumed by data centers in 2010 represented 1.3% of the total consumption. Now, cloud computing environments and MapReduce [9] have evolved separately to address the need to process large data sets. Cloud computing environments leverage virtualization to increase utilization and decrease power consumption through virtual machine (VM) consolidation. The benefits of cloud computing adoption for small and medium enterprises in terms of reducing energy consumption and carbon emissions were analyzed by Williams. [10]. The results indicated that the carbon footprint of the ICT sector could be reduced by 1.7% if 80% of enterprises use cloud computing [11][12].

Cloud computing is a neoteric model that integrates existing technologies to improve resource usage efficiency. Results using these technologies vary, but cloud computing currently faces issues such as immature software design and virtual machine technology. This is also a major challenge in combining cloud applications with carbon neutrality.

AI measurement and carbon reduction

AI-based solutions have clear advantages over traditional manual measurement methods. It can more quickly, reliably, and accurately determine the full carbon footprint of any given organization, and its powerful forecasting and data analysis capabilities can help decision-makers make more correct decisions. Google, for example, has partnered with the ElectricityMap platform to use AI systems to display clean power production around the world in real time and aggregate carbon footprint data across countries. On top of that, Google has managed to significantly reduce carbon emissions by matching its energy consumption plans to the availability of low-carbon electricity from the grid.

Regarding the specific paths and action strategies for enterprises to use AI to reduce carbon emissions, the answer given in the book , 《Reduce Carbon and Costs with the answer is given in the Power of AI》 ,wrote by Charlotte Degot and her team that is “Companies can use AI-powered data engineering to automatically track emissions throughout their carbon footprint. Predictive AI can forecast future emissions across a company’s carbon footprint, in relation to current reduction efforts, new carbon reduction methodologies, and future demand. As a result, the company can set, adjust, and achieve reduction targets more accurately. By providing detailed insight into every aspect of the value chain, prescriptive AI and optimization can improve efficiency in production, transportation, and elsewhere, thereby reducing carbon emissions and cutting costs” [13].

Specific paths and action strategies for companies to use AI to reduce carbon emissions can be expanded and applied in the process of governing carbon neutrality. Leveraging AI to address climate change challenges will not only help human society successfully transition from high-carbon to low-carbon and net-zero carbon, but also drive

companies to find ways to succeed in a low-carbon world and achieve a win-win situation for economic development and social benefits, he added.

3. Results

We are now facing a more serious environmental crisis. The impact of environmental damage can grow exponentially, eventually causing unacceptable disasters. In the face of such dilemmas, long-term, effective strategies are particularly important. Changing the current state of the environment through technology is certainly an excellent solution.

Sensor detection of environmental data, cloud applications and AI prediction are among the technological changes aimed at improving the efficiency of work and resource allocation. They are helpers in managing carbon neutrality, but after that, formal action is more important. The fact that technology can ease our lives does not mean we can sit back and relax. Instead, we should be more concerned about the irreversible damage to the environment that over-development may cause, or the consequences of exacerbating climate change.

Different regions have different levels of development. Developing carbon neutrality is not the highest priority option for underdeveloped and developing countries compared to developing industry and manufacturing. These countries do not have the level of education and science and technology to support them in achieving this goal. Carbon neutrality goal. Promoting the process of carbon neutrality requires the collaboration of all countries in the world. The application of IoT technologies is not only the interconnection of things, but also the interconnection of countries. Novel technologies and environmental protection concepts should be embraced by more countries.

Science and technology are advancing at a rapid pace. New history may be made every day, and human civilization will advance further.AI and cloud applications, once the stuff of science fiction movies, are gradually becoming reality. The Internet of Things (IoT) is envisioned to grow rapidly due the proliferation of communication technology, the availability of the devices, and computational systems [14]. Green and low carbon are major trends in the future development of various industries. Industrial transformation is a priority. The existing industrial system will undergo tremendous changes, and this change is an opportunity to lead to green environmental protection.

4. Discussion

The theme of the 21st century is peace and development. This is an age where people and things are connected. Compared to carbon neutral global emission reduction research, technological innovation and global emission reduction research have grown faster, indicating that technological innovation is increasingly valued. Therefore, there will be more research on technological innovation in the future, including energy technology, emission reduction technology, optimization technology and measurement technology. Moreover, individual technologies are currently far from sufficient to achieve carbon neutrality goals. From a technical point of view, future research will be diverse and interdisciplinary [15].

Comparing this paper with the existing literature, the difference is that this paper considers the impact of more non-technical factors on the governance of carbon neutrality based on IoT combined with carbon neutrality. What is lacking is more professional technical research and innovation. suggestion. At the same time, the approach of promoting carbon neutrality through IoT mentioned in this paper has been intensively studied in the existing literature. At the same time, the concept of this paper is closer to the existing literature.

In my opinion, there are several directions of development for the three technologies mentioned in this paper: sensors, cloud applications and artificial intelligence. For sensors, it is a good choice to use new materials, structures, and processes to improve the sensitivity, stability, and lifetime of the sensor, as well as to reduce the cost and difficulty of maintaining the sensor. For cloud applications, updating software design and virtual machine technology is very important. For AI technology, it is significant to have AI learn more about carbon neutrality and formulate strategies and plans. These technological advancements are a huge challenge and opportunity for IoT technology and carbon neutrality. Seizing opportunities for technological advancement can clear roadblocks for the future.

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