

Research on the implementation path of event carbon neutrality

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Abstract. This essay explores the concept of activity-based carbon neutrality as a critical component in achieving carbon emission reduction targets. With the Chinese government's commitment to carbon sequestration by 2030 and carbon neutrality by 2060, activity-based carbon neutrality has gained prominence as a hot topic in environmental discussions. The essay emphasizes the significance of activity-based carbon neutrality in promoting public awareness and participation in carbon reduction efforts. It highlights the existing research gap in this field and stresses the need for exploring methodologies to achieve activity-based carbon neutrality. The essay outlines the accounting standards for activity-based carbon neutrality, focusing on large-scale events and offering practical examples of carbon emission reduction measures during the preparation, execution, and conclusion phases of activities. Additionally, it introduces carbon offsetting methods such as carbon quotas and carbon credits. The article also presents a specific case study of the "Six-Five Environment Day National Event" held in Liaoning Province, which successfully achieved carbon neutrality through various initiatives. Overall, the essay encourages further investigation into activity-based carbon neutrality to enhance overall carbon reduction efforts.

1. Background of Event Carbon Neutrality

Carbon neutrality refers to reducing greenhouse gas emissions to mitigate global warming. With the continuous introduction of national and governmental policies, carbon neutrality has become a hot topic, permeating various aspects of people's lives.

In September 2020, the Chinese government announced the "dual-carbon goal,"[3][8] striving to achieve carbon sequestration by 2030 and carbon neutrality by 2060, actively promoting the effective implementation of the Paris Agreement and participating in global climate governance. In the 2021 National People's Congress, the "dual-carbon goal" was reinforced in the State Council's progress report, with a call for orderly promotion of carbon sinks and carbon neutrality, implementation of carbon sink action plans, and the formal launch of China's first year of implementing the "dual-carbon goal." By the end of 2022, various ministries, the central government, and the State Council had collectively issued nearly a hundred policy statements on the "dual-carbon" goals, including "Comprehensive and Accurate Implementation of the New Development Concept of Carbon Neutrality" and "Action Plan for Carbon Neutrality by 2030." [2] In addition, local governments at all levels have formulated plans to promote carbon neutrality, including the "1+N"

policy plan. Some regions and large companies have also proposed specific action plans.

Among these, active carbon neutrality has become a crucial aspect of achieving China's carbon emission targets. As of 2023, the energy-intensive provinces of Shandong and Shanxi have successively released implementation plans for large-scale event carbon neutrality within their respective territories. These plans require event organizers to develop carbon neutrality implementation plans during the preparation stage of large-scale events, carry out emission reduction actions during the events, and calculate greenhouse gas emissions at the conclusion, taking offset measures to achieve carbon neutrality. In the future, carbon neutrality for small and medium-sized events will receive increased attention, with more local governments, industries, and enterprises participating in event carbon neutrality efforts, controlling and limiting carbon emissions during events, making it a trending issue.

Event carbon neutrality refers to reducing carbon emissions during events, including performances, sports events, conferences, forums, exhibitions, etc., excluding activities held within the regular business scope of venues such as theaters, concert halls, parks, and entertainment venues. Based on the number of participants, event carbon neutrality is classified into large-scale and small-medium-scale event carbon neutrality. Large-scale event carbon neutrality encompasses gatherings with a certain number of participants within a specific time and location, with the

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defined number varying by region (e.g., 1000 people in Beijing and 500 people in Shandong).

Event carbon neutrality holds significant educational and informative value. Compared to industrial carbon neutrality, it closely relates to people's daily lives, and advancing event carbon neutrality comprehensively can better raise public awareness of carbon neutrality.

Based on literature research, the existing studies in the field of carbon neutrality mainly focus on industrial production, leaving significant gaps in research on event carbon neutrality. Currently available information related to event carbon neutrality primarily centers on carbon emission accounting methods rather than methodologies for reducing emissions in events. Therefore, research on the implementation path of event carbon neutrality holds substantial research significance.

2. Standards for Calculating Event Carbon Neutrality

Currently, enterprises can follow carbon emission accounting standards such as the "Guidelines for the

Implementation of Large-scale Event Carbon Neutrality (Trial)" issued by the Ministry of Ecology and Environment in 2019, as well as local guidelines like the "Beijing Large-scale Event Carbon Neutrality Implementation Guidelines," "Shandong Province Large-scale Event Carbon Neutrality Implementation Plan (Draft for Comments)," and the "Large-scale Event Carbon Neutrality Evaluation Specification" (DB13T5560-2022) by the Hebei Provincial Market Supervision Administration.

According to the guidelines for large-scale event carbon neutrality in various regions, the calculation of greenhouse gas emissions should include all controllable and influenceable emissions during the event's holding phase. When conditions permit, emissions generated during the preparation and conclusion stages of the event should also be accounted for.

The methodology for calculating greenhouse gas emissions for large-scale events should be implemented according to the recommended accounting standards and technical specifications as listed in Table 1.

Table 1. Types of Emission, Emission Sources, Calculation Methods, and Emission Factors for Event Carbon Neutrality

Emission Type	Emission Source		Calculation Method	Emission Factor
Direct Greenhouse Gas Emissions	Fossil fuel combustion in fixed facilities	Includes fixed facilities within large-scale event venues and offices of personnel serving large-scale events, using fossil fuel combustion such as coal boilers, gas boilers, direct-fired machines, gas stoves, etc.	1. "Guidelines for Greenhouse Gas Accounting and Reporting (Trial) for Public Building Operation Units (Enterprises)" issued by the Office of the National Development and Reform Commission (NDRC) (Climate [2015] No. 1722).[1] 2. Refer to Formula (2) for fossil fuel combustion emissions in DB11/T1785-2020.	Emission factors for fossil fuels' lower heating value, carbon content per unit calorific value, and carbon oxidation rate can be obtained from the recommended values in Appendix A, Table A.1 of DB11/T1785-2020.
	Mobile fossil fuel combustion in movable facilities	Includes movable facilities serving large-scale events, such as official vehicles, staff commuting vehicles, etc.	Refer to Formula (2) for fossil fuel combustion emissions in DB11/T1786-2020.	Emission factors for fossil fuels' lower heating value, carbon content per unit calorific value, and carbon oxidation rate can be obtained from the recommended values in Appendix A, Table A.1 of DB11/T1786-2020.
Indirect Energy-related Greenhouse Gas Emissions	Emissions from venue and supporting facilities construction	Includes newly constructed facilities, renovated facilities, and temporary constructions serving large-scale events, such as buildings, offices, pavilions, enclosed stadiums, open stadiums, competition venues, open stands, roads, sidewalks, etc.	1. Building material production: Refer to Formula (6.2.1) for carbon emissions during the building material production stage in GB/T51366-2019.	The emission factor for building materials can be obtained from the default values in Table D.0.1 of Appendix D in GB/T51366-2019.[5]
			2. Building material transportation: Refer to Formula (6.3.1) for carbon emissions during the transportation of building materials in GB/T51366-2019.	The emission factor per unit weight transportation distance can be obtained from the default values in Table E.0.1 of Appendix E in GB/T51366-2019.
Indirect Energy-related Greenhouse Gas Emissions	Carbon dioxide emissions from purchased electricity and heat consumption	Includes facilities within large-scale event venues and offices of personnel serving large-scale events, consuming externally purchased electricity and heat, such as ventilation	1. "Guidelines for Greenhouse Gas Accounting and Reporting (Trial) for Public Building Operation Units (Enterprises)" issued by the Office of the National Development and Reform Commission (NDRC) (Climate	The emission factor for annual average grid electricity supply can be obtained from the recommended values in Appendix A, Table A.2 of DB11/T1785-2020.

		systems, air conditioning, lighting, printers, etc.	[2015] No. 1722).	The emission factor for heat supply can be obtained from the recommended values in Appendix A, Table A.2 of DB11/T1785-2020.
		Carbon dioxide emissions from purchased electricity consumption for electric vehicles and other movable facilities. Includes electric vehicles, such as official vehicles, staff commuting vehicles, etc.	1. "Guidelines for Greenhouse Gas Accounting and Reporting (Trial) for Land Transport Enterprises" issued by the Office of the National Development and Reform Commission (NDRC) (Climate [2015] No. 1722). 2. Refer to Formula (5) for emissions from purchased electricity consumption in DB11/T1786-2020.	The emission factor for annual average grid electricity supply can be obtained from the recommended values in Appendix A, Table A.2 of DB11/T1786-2020.
Other Indirect Greenhouse Gas Emissions	Transportation emissions	Transport activities generated by organizers and participants of large-scale events, including flights, high-speed trains, subways, taxis, private cars, etc.	1. "IPCC Guidelines for National Greenhouse Gas Inventories" published by the Intergovernmental Panel on Climate Change (IPCC) in 2006. 2. "Government Greenhouse Gas Conversion Factors for Company Reporting: Methodology" published by the UK Department for Business, Energy, and Industrial Strategy in 2021.	Emission factors for different modes of transportation can be obtained from the parameters in Attachment 5 of "Notice on Key Carbon Emission Unit Management and Carbon Emission Rights Trading Pilot Work in 2020" (Jinghuanfa [2020] No. 6) issued by the Beijing Municipal Ecology and Environment Bureau.
	Accommodation and catering emissions	Activities related to accommodation and catering for participants of large-scale events	1. "ISO 14064-1:2018 Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals." 2. "Government Greenhouse Gas Conversion Factors for Company Reporting: Methodology" published by the UK Department for Business, Energy, and Industrial Strategy in 2021.	Emission factors for accommodation can be referred to "Defra/DECC (2012) Government GHG Conversion Factors for Company Reporting." Emission factors for catering can be calculated from Chapter 3, Table 3-2 of "Carbon Emissions from Residents' Food Consumption: Influencing Factors and Reduction Strategies" in GB/T26157-2010.
	Implicit carbon emissions from large-scale event supplies	Purchased products, raw materials, and materials supplied to large-scale events	1. "ISO 14064-1:2018 Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals." 2. "Government Greenhouse Gas Conversion Factors for Company Reporting: Methodology" published by the UK Department for Business, Energy, and Industrial Strategy in 2021.	For accommodation emissions, refer to "Defra/DECC (2012) Government GHG Conversion Factors for Company Reporting."
	Emissions from Waste Treatment	Methane emissions from landfilling.	1. Refer to the "Guidelines for Provincial Greenhouse Gas Inventory Compilation (Trial)" issued by the Office of the National Development and Reform Commission (NDRC) in Climate [2011] No. 1041, which includes the "Guidelines for Provincial Greenhouse Gas Inventory Compilation (Trial)."	The solid waste landfill treatment rate, methane generation potential for various types of landfills, methane recovery amount, and oxidation factors can be obtained from the data sources or recommended values in Table 5.1-5.4 of the "Guidelines for Provincial Greenhouse Gas Inventory Compilation

				(Trial)" in Climate [2011] No. 1041.
	Emissions from Carbon Dioxide from Waste Incineration		Carbon content of waste, percentage of mineral carbon in the total carbon content, and combustion efficiency can be obtained from the corresponding emission factor's recommended values in Table 5.5 of the "Guidelines for Provincial Greenhouse Gas Inventory Compilation (Trial)" in Climate [2011] No. 1041.	

3. Implementation Path of Event Carbon Neutrality

3.1. Carbon Emission Reduction in Events

For event-based carbon neutrality, several large-scale events have already adopted various measures to reduce carbon emissions at each stage, providing new insights into achieving event carbon neutrality. According to the accounting standards for event carbon neutrality in various regions, the carbon accounting mainly consists of several stages, including event preparation, event hosting, and event conclusion.

This article will draw from existing cases to introduce the carbon emission reduction process during the stages of event preparation, hosting, and conclusion, providing relevant recommendations to achieve event carbon neutrality.

3.1.1. Event Preparation Stage

During the event preparation stage, companies should first estimate the greenhouse gas emissions generated by the event.

After estimating the greenhouse gas emissions, companies should propose emission reduction measures based on the event plan. According to the relevant carbon neutrality accounting standards, event emissions primarily include transportation emissions, accommodation and catering emissions, implicit emissions from event supplies, and emissions from waste treatment. Specific measures for the event preparation stage for the above four types of emissions are shown in Table 2.

Table 2. Emission Reduction Measures during Event Preparation Stage

Transportation Emissions:	Encourage attendees to use public transportation, new energy vehicles, bicycles, or other low-carbon means of transportation.
	Pre-assess the travel distance of attendees (and facilitate carpooling for nearby participants).
Accommodation and Catering Emissions:	Avoid using single-use plastic cutlery and opt for sustainable alternatives when ordering tableware.

	Choose local, low-carbon, and plant-based catering options whenever possible.
	Encourage VIP guests to bring their own personal items such as toothbrushes.
Emissions from Consumables:	Select energy-efficient and environmentally friendly venues for organizing the event.
	Opt for recyclable consumables and materials during procurement for event preparations.
	Utilize LED lighting systems and maximize natural light during venue setup.
Emissions from Waste Disposal:	Promote the use of renewable resources, such as renewable souvenirs and chairs.
	Set up different types of waste bins in advance for convenient waste sorting.
	Develop a plan for recyclable materials to reduce waste emissions.
	Plant green vegetation around the venue to absorb greenhouse gas emissions
	Establish or renovate wastewater recycling systems around the venue.

3.1.2. Event Implementation Stage

During the event implementation stage, the organizers should diligently execute the emission reduction plan developed during the event preparation stage and further improve the plan based on the actual circumstances of the event. The organizers should carry out actions to control greenhouse gas emissions according to the carbon neutrality implementation plan, ensuring the achievement of the expected emission reduction results.

For the event implementation stage, specific measures for energy conservation and emission reduction should be taken in the areas of transportation emissions, accommodation and catering emissions, emissions from consumables used during the event, and emissions generated from waste disposal. The specific measures to achieve carbon neutrality are shown in Table 3.

Table 3. Emission Reduction Measures during Event Implementation Stage

Transportation	Set up shuttle buses with designated routes based on participants' addresses to reduce
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Emissions	transportation emissions
	Rent new energy vehicles to replace traditional fuel-powered buses.
Accommodation and Catering Emissions	Promote the clean plate campaign and impose penalties for intentional waste behavior
	Use public water dispensers and provide reusable environmentally friendly water cups instead of plastic bottled water and disposable paper cups
	Reduce the provision of disposable amenities (e.g., toothbrushes, slippers)
	Optimize air conditioning temperature and use natural ventilation when unnecessary
Implicit Emissions from Event Supplies	Limit the use of paper banners and pull-up banners, and opt for electronic presentations in PPT format
	Choose electronic versions of conference materials during the event; refrain from using paper forms and documents and switch to electronic formats
	Use LED screens and manage electricity usage effectively, turning off when not in use
	Reasonably schedule meetings during daytime to reduce energy consumption.
	Opt for second-hand items for the event instead of purchasing new ones.
	Utilize electronic business cards and nameplates to save paper.
	Adopt facial recognition and ID verification, eliminating the need for printed badges.
Emissions from Waste Treatment:	Conduct water conservation education, encourage water recycling for toilet flushing, etc.
	Food waste and residue can be used as fertilizer
	Resell event equipment to increase utilization
	Organize paper recycling activities.

establishment of carbon sequestration forests. Below is a detailed explanation of carbon quotas, carbon credits, and establishing carbon sequestration forests.

3.2.1. Carbon Quotas

"Carbon quotas" refer to the "total amount of greenhouse gases (expressed in carbon dioxide equivalent) that an enterprise is permitted to emit into the atmosphere during a specific period as approved by the competent government department." In simpler terms, to alleviate the pressure of achieving the "peak carbon emissions" target by 2030, the government grants allowances for carbon emissions to key emitting entities to incentivize energy conservation, emission reduction, and promote the green and low-carbon transformation of industries[4].

For example, if the cost of energy conservation and emission reduction is low, Company A may choose to reduce emissions through energy conservation measures or other carbon sequestration methods. After fulfilling its obligations, the remaining "carbon quotas" can be traded in the carbon emission market for economic benefits. On the other hand, if the cost of energy conservation and emission reduction is high[7], and Company A cannot fully meet its carbon emission reduction obligations even after using all its "carbon quotas," it can enter the carbon market to purchase quotas from other companies, government departments, or individuals. Alternatively, Company A can develop its own CCER (China Certified Emission Reduction) projects to obtain "carbon credits" to offset a portion of the quotas (the offset ratio should not exceed 5% of the total quotas). In extreme cases, if Company A fails to offset its carbon emissions or fulfill its obligations within the validity period, it will face significant fines.

3.1.3. Event concluding stage

During the event concluding stage, the organizers consolidate the information on overall carbon emissions reduction during the event, quantifying specific emission reduction values. They calculate the actual greenhouse gas emissions produced based on the real carbon reduction achieved during the event and use it as a basis for carbon offsetting.

At the event concluding stage, the total carbon emission reduction is publicly disclosed to enhance the participants' sense of engagement and accomplishment. This disclosure also serves as a positive example and successful case for other event organizers[9].

3.2. Carbon Emission Offset for Events

In addition to reducing carbon emissions from events, event organizers can achieve carbon neutrality through carbon emission offset methods. The current offset methods include obtaining carbon quotas or carbon credits and establishing carbon sequestration forests.

Organizers determine suitable offset products based on the actual greenhouse gas emissions produced during the event. These offset products mainly fall into two categories: carbon quotas or carbon credit offset and

3.2.2. Carbon Credits

While "carbon quotas" are based on carbon emissions, "carbon credits" are based on carbon emission reductions.

"Carbon credits" refer to the reduction of carbon emissions achieved through enhanced energy efficiency, pollution reduction, or development reduction measures, which have been verified and confirmed by international organizations, independent third-party entities, or governments. These emission reductions can be entered into the carbon market for trading. Generally, carbon credits are registered and issued in the form of emission reduction projects. The specific differences between carbon quotas and carbon credits are illustrated in Table 4.

Table 4. Comparison of Carbon Quota and Carbon Credit Concepts

	Carbon Quota	Carbon Credit
Differences in Rights	Represents the permissible amount of greenhouse gas emissions.[6]	Represents the reduction in emissions.
Differences in Generation	Issued by the government to companies (either	after the actual emission reduction action takes place,

	paid or free), with a predetermined quantity. Generated	verified by professional institutions.
Differences in Trading	Purpose Meets the need for companies to fulfill their obligations at a lower cost.	Primarily used to fulfill corporate social responsibility requirements.
Differences in Trading Systems	Carbon Emission Trading System (ETS).	Carbon Emission Trading System and voluntary emission reduction system trading.

3.2.3. New Carbon Sink Afforestation (Carbon Sequestration Afforestation)

"New Carbon Sink Afforestation (Carbon Sequestration Afforestation)" refers to a special afforestation activity carried out on land with a determined baseline, with the primary purpose of increasing carbon sequestration. This afforestation and the growth process of the forest (trees) are subject to carbon sequestration measurement and monitoring. Compared to regular afforestation, carbon sequestration afforestation highlights the function of forests as carbon sinks, requiring specific technical requirements for carbon sequestration measurement and monitoring, while emphasizing the multiple benefits of forests. Only afforestation that adheres to the technical requirements of carbon sequestration afforestation and passes inspection and acceptance according to specified procedures, and undergoes carbon sequestration measurement and monitoring by qualified entities as per regulations, can be recognized as a carbon sink forest.

4. Specific Reference Cases

In May 2022, the National Main Venue Event for the 65th Environment Day, successfully organized by the Liaoning Provincial Government, served as an excellent model for activity-based carbon neutrality projects.

The event featured five parallel forums that extensively discussed various ecologically-related issues, showcasing environmental achievements, and summarizing successful experiences. Simultaneously, the organizing committee used public education to raise awareness about environmental protection and carbon neutrality. Through this event, they encouraged adopting low-carbon and eco-friendly lifestyles, fostering a societal atmosphere of collectively building a low-carbon and eco-friendly environment.

Throughout the entire event, the concept of simplicity, greenness, and low carbon was diligently upheld, ultimately achieving carbon neutrality for the National Main Venue Event for the Environment Day[10]. Proper planning was carried out during the preparation, execution, and conclusion stages of the event, employing internet promotion of low-carbon emission reduction concepts and using big data to calculate carbon emissions. Measures for successfully achieving carbon neutrality for this large-scale event are outlined in Table 5.

Table 5. Categorization of Specific Measures for Emission Reduction during the National Environment Day Event at the Hexi Corridor

Phase	Specific Measures	Emission Reduction Direction
Preparation Phase	Plan and budget for emissions related to fossil fuel combustion and transportation during the event, following the "Carbon Neutrality Emission Standards for Events."	Transportation emissions.
	Plan and budget for emissions related to accommodation, catering, and electricity and heat consumption during the event, following the "Carbon Neutrality Emission Standards for Events."	Accommodation and catering emissions.
Event Phase	Encourage participants to bring their own personal items, such as toothbrushes, and promote the practice of clean plate waste reduction.	Accommodation and catering emissions.
	Opt for electronic conference materials instead of printed versions to reduce emissions from conference consumables.	Emissions from disposable conference materials.
	Set up public drinking water facilities and provide reusable eco-friendly water bottles, eliminating plastic bottled water and disposable paper cups.	Emissions from disposable conference materials.
Event Conclusion Phase	Purchase "green electricity" to charge new energy vehicles during the event, achieving a carbon reduction of 1.63 tons of carbon dioxide equivalent.	Transportation emissions.
	Establish carbon-neutral forests in Zhanggutai, Zhanwu County, Fuxin City, Liaoning Province, to offset the carbon emissions from the event.	Creation of new carbon sink forests for offsetting.
	Liaoning Datang International Jinzhou Thermal Power Co., Ltd. voluntarily cancels 60 tons of national carbon emission quotas to offset part of the carbon emissions from this event.	Carbon quota offset.

The various measures implemented during the National Main Venue Event for the 65th Environment Day are highly instructive, and it is anticipated that more and more events will adopt a series of measures to achieve energy conservation and emission reduction in

the future. The initiative of activity-based carbon neutrality is expected to be effectively implemented.

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