



Chemistry Shapes the *Future*



Responsible Care®
OUR COMMITMENT TO SUSTAINABILITY

AICM 2022

Sustainable Development Report

AICM 2022 可持续发展报告



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About AICM

Introduction of AICM

AICM was founded in 1988, to jointly promote the harmonious and sustainable development of China's chemical industry. Today AICM represents nearly 70 major multinational companies in the chemical industry of China. Among the AICM members, 5 companies are among the World Top 10 Companies and 28 members stand among the World Top 50 Chemical Companies. Their businesses cover manufacturing, sales, transportation, distribution, and disposal of chemicals.

AICM's Major Contributions

To contribute to the development of a harmonious society and the sustainable growth of China's chemical industry, as the representation of the leading international chemical players in China, AICM is committed to:



1 Promoting Responsible Care[®] and other globally recognized chemical management principles among all stakeholders;

2 Advocating cost-effective, science and risk-based policies to policy makers;

3 Building up the contributive role of the chemical industry to the economy.

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About This Report

This is the fourth sustainable development report released by AICM. The report aims to identify the challenges and opportunities faced by chemical companies in the context of carbon neutrality and to make suggestions accordingly.

In this report, AICM will (1) summarize the work and achievements of chemical companies in the context of carbon neutrality; (2) analyze and summarize the challenges and opportunities faced by chemical companies at the current stage; and (3) advocate cost-effective and science-based policies to build up the contributive role of the chemical industry in achieving carbon neutrality in China.

This report will illustrate the main views of AICM members on the key issues and their suggestions for improvement.

Reporting Methods

The report consists of three sections.

1 Questionnaire survey of stakeholders: The major challenges and opportunities for the chemical industry in meeting carbon goals in China are summarized, and their impacts on companies are analyzed based on the results of a questionnaire survey of 26 companies, and public information and reports collected.

2 Interviews with the stakeholders: The interviewees' perspectives and suggestions on major challenges and opportunities are collected through these interviews.

3 In-depth analysis and summary of issues: The challenges and opportunities encountered by foreign chemical companies in the context of carbon neutrality are summarized through the analysis of survey results, public information, reports, and interview results, and reasonable and scientific suggestions are put forward accordingly.

Access to the Report

This report will be presented in simplified Chinese and English. The electronic version of the report can be obtained from the AICM official website. Meanwhile, AICM will send a hard copy of the report to each AICM member.

Statement from AICM Senior Management

AICM is committed to promoting the initiative of Responsible Care®. While continuously developing the international chemical industry platform and tailoring the resourceful databases for chemical MNCs, AICM also represents the member enterprises to actively share the international best practices to the chemical industry stakeholders. Policy makers are advocated to formulate various fields cost-effective science and risk-based policies to support chemical industry affairs. At the same time, as the representative of foreign-funded chemical enterprises in China, we are working together with the member enterprises to make contributions to the promotion of China's carbon neutrality and the sustainable development of China's chemical industry, so as to build a good social image of the chemical industry and do a good job in public publicity.

In 2020, China raised the carbon neutrality goal of "reaching the carbon peak by 2030 and achieving carbon neutrality by 2060", and the 2021 Report on The Work of The Government also required a solid promotion of carbon peak and carbon neutrality, China officially put the "carbon neutrality" into the top-level strategy layout. This brought great challenges and opportunities to the chemical industry. As an important pillar of the national economy, the chemical industry plays a key role in achieving sustainable development and has great potential in energy saving and carbon reduction. AICM believes that the green transformation of foreign chemical enterprises can drive the sustainable development of the whole industrial chain.

AICM's fourth Sustainable Development Report for foreign chemical companies in China is based on in-depth communication with senior management of AICM member companies to explore the issues that foreign chemical companies should be concerned about in

their low-carbon development in China. Our insights on energy management and energy structure optimization, production process improvement, carbon accounting and carbon market participation mechanism, value chain emission reduction measures and administration according to law were given, and feasible paths of how to seize the opportunities of sustainable development of chemical industry were discussed.

As a part of the efforts to adjust the industrial structure and promote a green, circular and low-carbon path, the chemical industry plays the role of initiator of downstream carbon emission reduction. The good development of chemical industry is inseparable from the efforts of enterprises and government. When planning the path to carbon neutrality, how to fully consider the particularity of the chemical industry, promote industry-leading technologies, guide enterprises to scientifically reduce emissions and promote the sustainable development of the chemical industry is the common challenges faced by administration and AICM. These require administration to formulate scientific policies and enterprises to efficiently achieve regulatory goals. In addition, there are many opportunities for chemical companies under China's carbon neutrality, which will help improve the image of the chemical industry, increase the demand for green products, and promote the sustainable development of the chemical industry.

The realization of carbon neutrality cannot be achieved without the joint efforts of administration and companies. AICM will continue to act as a bridge of communication between companies and policy makers, encourage our member companies to develop goals and strategies, help them overcome existing challenges and work together to create a carbon neutral future.



With the convening of 26th UN Climate Change Conference of the Parties (COP26), carbon neutrality has once again become the focus of social attention. Many countries and regions have set up goals, strategies and action plans for carbon neutrality. China proposed the goal of "achieving carbon dioxide peaking before 2030 and carbon neutrality before 2060" ("dual carbon" goals, in short) in 2020 and put it as one of the top priorities in 2021, reflecting its resolve to become carbon neutral. In this context, all industries and enterprises have actively formulated climate action goals and carried out a series of campaigns for transitioning to a clean energy-driven economy.

Background

01

1.1 Overall Progress towards Carbon Neutrality in China

The year 2021 marks the commencement of China's transition towards "carbon neutrality". The Central Economic Work Conference put "carbon dioxide peaking and carbon neutrality" as one of the primary tasks in 2021. To this end, a slew of supporting policies and programs were introduced to help transform and upgrade the industrial structure and energy production and consumption pattern, promote a green, circular, and low-carbon path, and achieve high-quality economic development.

January 2021	<ul style="list-style-type: none"> • <i>Measures for Administration of Carbon Emissions Trading (For Trial Implementation)</i>
March 2021	<ul style="list-style-type: none"> • <i>2021 Government Work Report</i> • <i>Outline of the 14th Five-Year Plan for National Economic and Social Development and the Long-Range Objectives Through the Year 2035</i>
October 2021	<ul style="list-style-type: none"> • <i>Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy</i> • <i>Notice of the State Council on Printing and Distributing the Action Plan for Carbon Dioxide Peaking Before 2030</i> • <i>Responding to Climate Change: China's Policies and Actions</i> • <i>China-US Joint Glasgow Declaration on Enhancing Climate Action in the 2020s</i> • <i>China's Achievements, New Goals and New Measures for Nationally Determined Contribution</i> • <i>China's Mid-Century Long-Term Low Greenhouse Gas Emissions Development Strategy</i>

In March 2021, China announced the *Outline of the 14th Five-Year Plan for National Economic and Social Development and the Long-Range Objectives through the Year 2035*, which put forward specific requirements for carbon dioxide peaking and carbon neutrality. Before the convening of COP26, China successively released two overarching documents on its "1+N" policy framework for carbon dioxide peaking and carbon neutrality. During the COP26 summit, China and the United States jointly issued the *China-US Joint Glasgow Declaration on Enhancing Climate Action in the 2020s*. The two sides pledged to accelerate action on climate change in the critical decade of the 2020s and work together to achieve the goals of the *Paris Agreement*. After the summit, China formally submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat two documents, including: *China's Achievements, New Goals and New Measures for Nationally Determined Contribution* and *China's Mid-Century Long-Term Low Greenhouse Gas Emissions Development Strategy*. These moves pronounced China's resolve to the international community to address climate change.

According to *China's Mid-Century Long-Term Low Greenhouse Gas Emissions Development Strategy*, China will make positive contributions to the global response to climate change in the following aspects:

Fostering a green, low-carbon and circular economic system
Building a clean, low-carbon, safe and efficient energy system
Establishing a low GHG emission industrial system
Impelling urban and rural construction in green and low-carbon manner
Forming a low-carbon comprehensive transportation system
Achieving a substantial reduction in non-carbon dioxide GHG emission
Implementing the Nature-Based Solutions
Inspiring low-emission technology innovation
Creating a new pattern of nationwide participation
Promoting the modernization of climate governance system and governance capacity



1.2 Progress towards Carbon Neutrality in China's Chemical Industry

The work towards "carbon dioxide peaking and carbon neutrality" in the chemical industry is of great significance to the national realization of the "dual carbon" goals. According to the energy statistics and environmental statistics of the National Bureau of Statistics, the total carbon emissions of the petrochemical and chemical industries in 2020 was 1.378 billion MtCO₂, accounting for about 13% of the country's total carbon emissions.

In order to implement the working guidance for carbon dioxide peaking and carbon neutrality, the governing bodies have issued a string of policies to promote the green and low-carbon transformation of energy-intensive industries such as the chemical industry.

October 2021	<ul style="list-style-type: none"> • <i>Several Opinions on Strict Energy Efficiency Constraints and Promote Energy Conservation and Carbon Reduction in Key Fields</i> • <i>2021-2025 Action Plan for Energy Conservation and Carbon Reduction in Petrochemical Industry</i>
January 2022	<ul style="list-style-type: none"> • <i>Notice on Printing and Distributing the Implementation Plan on Promoting Green Consumption</i>

The chemical industry has huge potential for energy saving and carbon reduction, of which energy efficiency standards are an important basis for energy saving and carbon reduction in the chemical industry as well as a favourable support for transformation and upgrading. By benchmarking the advanced energy efficiency values of domestic and foreign producers, departments can determine industry benchmarks and guide the chemical industry to improve energy efficiency in a scientific and orderly manner around the industry's energy efficiency performance, while promoting the industry's green and low-carbon energy transformation. In addition, the carbon pricing mechanism and green financial standard system are favourable grips to support the overall green and low-carbon transformation of society. Through the policy inclination to green and low-carbon chemical enterprises in terms of loan restrictions and debt issuance assessment, it will be conducive to accelerating the achievement of carbon neutrality by enterprises in local areas, bringing about a demonstration and leading role for the industry.

Combined with a number of policy documents, authorities will promote the green and low-carbon transformation of the chemical industry mainly from the following aspects:

Acceleration of the green and low-carbon transformation of energy



In 2021, many places in China issued announcements prohibiting the addition of high-energy-consuming production capacity such as steel, coking, and coal chemicals, refrained from approving energy-intensive and emission-intensive new projects in key areas, and emphasized the reduction of energy consumption in traditional energy-intensive and emission-intensive industries such as oil and coal. While controlling key emission sources, China promulgated a number of policies to vigorously support the development of renewable energy. In April 2021, the National Energy Administration issued the *Notice on Matters Concerning the Development and Construction of Wind Power and Photovoltaic Power Generation in 2021*, encouraging social capital to participate in clean energy investment and construction, such as photovoltaic, wind power and nuclear energy industries. In terms of energy innovation capacity building, China accelerated the tackling of key shortcomings in energy technology and equipment, and established a number of new energy technology innovation platforms focused on the development needs of new energy models and formats.

Energy Efficiency Improvement



Studies have shown that improving energy efficiency contributes up to 35% to achieving carbon neutrality, and is also the lowest-cost carbon reduction path. During the 14th Five-Year Plan period, China will vigorously step up the improvement of energy efficiency. On the one hand, it will promote the supply-side reform of energy-intensive industries, put forward binding goals for emission reduction to reduce production capacity, and speed up the transformation of energy-intensive and emission-intensive industries; on the other hand, it will promote the recycling and utilization of renewable resources, including the recycling of products in energy-intensive industries, such as scrap steel and plastics, as well as the waste heat recovery.

Launching supportive tools for carbon reduction



In November 2021, the central bank announced the launch of carbon reduction support tools to guide social capital to flow to green and low-carbon industries and promote carbon emission reduction.

The carbon reduction support tools focus on supporting the development of key areas such as clean energy, energy conservation and environmental protection, and carbon emission reduction technologies, and providing funds to financial institutions through a direct mechanism of “loan first and then borrowing” (i.e. financial institutions that have issued carbon emission reduction loans to key areas can apply for financial support from the People's Bank of China). In addition, the central bank has not stipulated the scale of carbon reduction support tools. The industry expects that the scale of carbon reduction support tools will exceed one trillion yuan by the end of 2022. It will help the industry speed up the construction of a clean energy system and achieve carbon dioxide peaking and carbon neutrality.

Strengthening the construction of market mechanism



As an important measure to achieve carbon dioxide peaking and carbon neutrality, the carbon trading market is of great significance. First, it can promote the transformation of energy-intensive and emission-intensive industries towards green and low-carbon ones, and accelerate the peaking of carbon emissions in emission-intensive industries. In the meanwhile, it releases price signals for carbon emission reduction, gives play to the market incentive mechanism, guides the flow of funds to green industries, and promotes innovation and breakthroughs in green and low-carbon technologies and cutting-edge technologies. Second, green carbon-reducing enterprises obtain proceeds by selling carbon emission rights, which means that the carbon trading market provides efficient investment and financing channels for enterprises to achieve carbon dioxide peaking and carbon neutrality. Third, the establishment of a national carbon offset mechanism helps increase market participation and activity, foster regional coordinated development, and achieve low-cost emission reductions.

1.3 Carbon Neutrality Ambition of AICM Members in China

Enterprises are one of the main players in achieving China's "dual carbon" goals. In accordance with domestic and foreign commitments on climate change and carbon dioxide emission reduction, AICM members actively respond and follow the trend. While conducting carbon emission information disclosure at the group level, many chemical companies set carbon goals to demonstrate to the society their ambition to address climate change.

According to our statistics of the respondents of AICM members, 63% of the companies conduct carbon verifications in China every year. All respondents of AICM members have set carbon goals or other sustainable development goals at the group level. More than 92% of them regard increasing investment in environmental protection, energy conservation and emission reduction as one of the tasks in China from the management level.

It is understood that the respondents of AICM members believe that carbon emission disclosure will help enhance the corporate green image and brand value, and promote the building of corporate carbon management capabilities. The group headquarters of most respondents manage the carbon emission data of all their regional branches/subsidiaries, and disclose them on a whole group basis, so as to track the progress towards carbon neutrality from the top level. Given the different energy resources in different regions, the groups will consider the carbon neutrality policies of each region. As a result, the expected dates of realization of carbon neutrality goals for companies are often earlier than the dates set by the country (for example, the year of achieving carbon neutrality set by most companies is 2050, which is earlier than the year of 2060, the goal of China), and thus companies will not set separate carbon goals for their individual regions.





Deep Insight

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In 2021, China carried out a number of measures aiming to solve the ecological and energy efficiency problems associated with rapid industrial development, so as to achieve the goal of comprehensive green transformation of economic and social development. With the continuous improvement of the top-level design, the realization path of "carbon neutrality" was gradually clarified. Chemical enterprises must make strategic transformations to meet the requirements of the times.

According to the survey, 92% of the respondents of AICM members considered that China's "dual carbon" goals and its introduction will have an impact on their business layout and investment in China. They argue that in light of the "dual carbon" goals, local governments put forward stricter requirements for their compliance with energy consumption and carbon emission regulations, implying certain policy risks in the future operation and development. On the other hand, they also see the development prospects of low-carbon projects in China under the "dual carbon" goals. As an important component and material of low-carbon technology, chemical products can effectively improve the operational efficiency of customers and help customers and the whole society to achieve carbon neutrality. The respondents of AICM members believe that the emerging new material market will bring new opportunities for the chemical industry.

Impact of the “dual carbon” goals on the company's business development



China's "dual carbon" goals bring the following challenges and opportunities to the respondents of AICM members:

Challenges

- Energy management improvement
 - Energy structure optimization
 - Production process improvement
 - Carbon emissions accounting and carbon trading market participation
 - Value chain management
 - Investment in other emission reduction measures
 - Administration by law
-

Opportunities

- Promoting sustainable development of the industry
 - Increasing demand for chemical products
 - Improving the image of chemical companies
-





2.1 Energy Management Improvement

Carbon emissions can be roughly divided into two categories according to the mechanism of generation which are energy-related emissions and emissions from industrial processes. The former is mainly carbon emissions caused by the direct combustion of fossil energy; the latter has nothing to do with energy consumption but refers to emissions from specific chemical reactions. According to the survey, the respondents of AICM members believe that energy-related emissions are the most important source of carbon emissions affecting corporate emissions, of which external energy procurement and the burning of fossil fuels in factories have the greatest impact.

In order to meet the policy requirements of regulation, AICM member companies have adopted a number of energy efficiency measures to reduce the overall energy consumption of the company. According to the survey, the respondents of AICM members believe that technical carbon emission reduction (reducing energy consumption through technology or equipment upgrades) is the most important emission reduction measure. In addition, they carry out managed carbon emission reduction by continuously optimizing their energy management systems, which is one of their major advantages in low-carbon management.

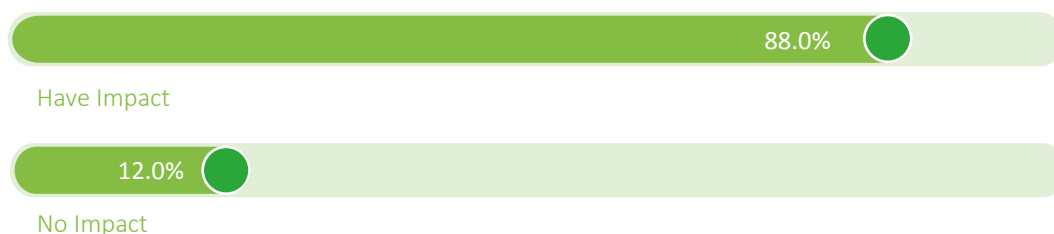
Main measures taken by the respondents of AICM members to reduce energy consumption through technology or equipment upgrades

- Shutting down or optimizing some installations and factories with high energy consumption;
- Building up energy recovery systems such as waste heat recovery systems to reduce waste of ineffective energy in the process;
- Adding frequency conversion equipment, LED lighting equipment, sensor coordinated equipment, etc. to improve the energy efficiency of process equipment;
- Improving the precision of energy management through information management systems such as the energy platform management system.

In recent years, under China's "dual carbon and dual control" policies ("dual control" means the control on total energy consumption and intensity), local governments have intensively issued a number of institutional documents, such as identifying chemical projects as pollution-intensive and emission-intensive projects and "dual carbon and dual control" implementation measures. However, the lack of systematic planning and management as well as the lack of synergy between policies and measures concerning green and low-carbon energy transformation, energy conservation, pollution reduction and carbon reduction have caused a huge pressure on some areas in implementing the "dual control" policy. With the trickling down of emission control indicators level by level, the important task of controlling energy consumption and emissions will eventually fall on each enterprise. Although AICM members already meet the industry's advanced energy consumption standards, the high energy consumption image of the chemical industry places additional constraints on new production capacity or power procurement. According to the survey, 88% of the respondents of AICM members believe that the pressure from indicators of local governments and industrial parks has an impact on the company's operations, which mainly includes:

- Local governments implement aggressive energy regulations, bringing environmental and safety risks to the company's operations;
- Unplanned production restrictions and shutdowns lead to large fluctuations in raw material supply and customer orders, which put enormous pressure on the company's entire supply chain;
- Chemical projects are usually defined as the pollution-intensive and emission-intensive projects, along with the regional energy consumption indicators, resulting in higher electricity costs in operation and restrictions on investment in new production capacity.

Impact of local government and industrial park targets



The carbon neutrality goal of a region is limited by the local industrial structure and energy structure. A comprehensive analysis of the internal and external environment and layout will be more helpful for formulating carbon and energy goals in a scientific way. The respondents of AICM members suggested:

- 1) Carry out peer benchmarking and formulate differentiated standards for enterprises in different industries while ensuring the diversity of industries in a region. Attention should be paid to the actual energy management level of enterprises. Reward advanced companies and punish backward ones, thereby promoting the sustainable development of the industry.
- 2) Based on the level of local resources, formulate a scientific realization path to achieve carbon neutrality. Break it down into different industries, set the industry's annual energy consumption indicators, and avoid unplanned production restrictions and shutdowns. Grant enterprises a certain amount of time and space to implement transformation measures to reduce the impact on their normal operation.



2.2 Energy Structure Optimization

In order to reduce energy-related emissions, it is an effective way for chemical companies to reduce carbon emissions by replacing traditional coal-fired power with renewable energy power, improving the energy efficiency management and control of the company, and propelling the development towards green production. According to the survey, the respondents of AICM members believe that optimizing the energy structure is the second most important measure in reducing carbon emissions.

At present, some chemical companies have begun to build and install renewable energy power generation systems on the site. This model not only reduces the cost of electricity for production and revitalizes the fixed assets of the enterprise, but also reduces the greenhouse gas emissions caused by energy consumption, thereby helping enterprises to build a clean, low-carbon, safe and efficient energy system. However, the development of renewable energy on-site has certain limitations. It is limited by the area of the site and difficulty to meet the demand of electricity for production through distributed photovoltaic projects. Therefore, the respondents of AICM members are exploring other ways to gradually purchased clean energy, such as signing Power Purchase Agreements for grid-connected generator sets that hold Energy Attribute Certificates (EACs), purchasing EACs, and investing in off-site renewable energy projects. Through these measures, enterprises could bind the environmental attributes of green power with their own energy consumption in order to reduce carbon emissions in the production process and accelerate the process of achieving carbon neutrality. The measures mainly involve the following aspects:

Main energy optimization measures taken by the respondents of AICM members

- Procurement of EACs (GEC, i-REC);
- Signing Power Purchase Agreements (PPAs) for grid-connected generator sets that hold EACs;
- Investment in on-site renewable energy projects;
- Investment in off-site renewable energy projects.

Although enterprises are increasingly aspiring for energy transition, the proportion of the respondents of AICM members that have actually adopted such measures is not high. In 2020, China's renewable energy power generation accounted for 29.5% of the total electricity consumption of the whole society. However, due to the spatial mismatch to a certain extent between natural resources and chemical operation sites across the country, enterprises have faced many difficulties in purchasing adequate local renewable energy. In addition, China's green power trading market is still immature with many regions still in the pilot stage, and enterprises are still in the process of exploring green power trading.

Some respondents of AICM members said that the governing departments have made it clear that new renewable energy is not included in the total energy consumption control, which has eased the burden on the regional total energy consumption, but there is still a lack of guidance on indicator compliance at the enterprise level. Many low-carbon measures such as purchasing renewable energy and purchasing green power certificates are not an effective way for enterprises to reduce the total volume and intensity of energy consumption. Moreover, the synergy mechanism between green power procurement and green power certificate procurement is still unclear, and there is a large price difference. These circumstances have hindered the implementation path of carbon neutrality for enterprises who have the will to reduce emissions but lack corresponding policies and mechanisms to support them.

The main challenges faced by the respondents of AICM members are as follows:

- The proportion of renewable energy projects in some regions is low, and there is a lack of renewable energy power suppliers;
- The green power trading market is still in the pilot stage, there is a lack of channels for enterprises to conduct green power trading in the project operation area;
- Enterprises lack of ways to reduce the total amount of energy at the enterprise level, for example, they cannot reduce the total amount of energy by purchasing clean energy.
- The green power certification mechanism is not adequate, there is a large price difference between green power procurement and green power certificate procurement.

China has already been at a high-speed stage of energy transformation where the supportive green power trading market and improved institutional mechanisms will help promote the low-carbon development of the whole society. The respondents of AICM members suggested to:

- 1) Accelerate the construction of the national green power trading market and break down existing barriers to cross-regional power trading, help enterprises plan and implement energy structure transformation and promote the green upgrade of corporate energy consumption.
- 2) Provide more policy support on the supply and consumption sides, and develop rational pricing mechanisms and trading rules to encourage companies to participate in green power trading market.
- 3) Improve the total energy consumption and intensity indicators for enterprises, evaluate the regulations of excluding renewable energy use from the total energy consumption and intensity, so as to encourage enterprises and industries to decarbonize and promote the regional development of renewable energy.
- 4) Improve the green power certification mechanism to comply with international standards, so as to ensure that the environmental attributes of green power used in China are recognized uniformly and universally.

EU Energy Management Mechanism ¹

In 2018, the EU passed the action *United in delivering the Energy Union and Climate Action - Setting the foundations for a successful clean energy transition*, which included Energy Efficiency Directive, the Renewable Energy Directive and three other interim agreements with the European Council. For energy efficiency, the EU set a goal of 32.5% improvement in energy efficiency by 2030 compared to "business as usual". This goal is mainly aimed at the level of the governing bodies which are required to reasonably set goals for different industries, implement energy distribution, and improve the efficiency and quality of energy utilization through the synergies of different industries.

The EU introduced the Guarantee of Origin (GO) as early as 2009. Its original purpose is to prove to end consumers of electricity the proportion of renewable energy in the purchased energy instead of serving as a standard to support member states in achieving their own energy goals. Based on the opening of the EU's electricity market, through the establishment of differentiated electricity prices and the GO trading market, many EU countries have phased out the subsidy mechanism by promoting the development of the market mechanism for renewable energy which fostered the increasement of renewable energy.

The EU also restricts the impact on climate change from the operation of enterprises through the Emissions Trading System (ETS) and product energy consumption specifications, thereby advancing the realization of its climate goals.

¹EUR-Lex- 52019DC0285- EN- EUR-Lex (europa.eu)

2.3 Production Process Improvement

Different from other industries, there are multiple steps that produce non-energy-related carbon dioxide emissions during the production process of chemical products. The main reason is that a large amount of carbon and nitrogen elements may exist in the raw materials. In the process of physical and chemical reactions, some substances without complete treatment may be transformed to or generate greenhouse gases which will be then directly emitted to the atmosphere, afflicting the natural environment to a certain extent, thereby accelerating global warming.

Some respondents of AICM members said that increasing the proportion of low-carbon raw materials is one of the important ways to achieve low-carbon development of chemical industry. For example, the use of light hydrocarbons and natural gas as raw materials for methanol and low-carbon olefins can further reduce production processes and carbon emissions. Additionally, the use of renewable biomass or recycled materials as raw materials to produce bulk chemicals and fine chemicals reduces the consumption and development of fossil-based raw materials, thereby promoting the green development of raw materials.

Main measures taken by the respondents of AICM members to improve the production process

- Replacement of fossil-based materials by bio-based materials;
- Recycling of carbon dioxide as a raw material of production;
- Development of product recycling solutions, where materials that are originally used as waste are sorted and returned to production as raw materials.

Through interviews, we learned that in some regions, the energy consumption of raw materials is counted in fuel combustion emissions in carbon accounting. As a matter of fact, generally only 20% of the energy consumption of raw materials lead to carbon emissions and the rest of the 80% are converted into products. As a result, some chemical companies show above-standard indicators in energy accounting and carbon accounting, and thus face more stringent policy requirements. In addition, the chemical industry often needs to use fossil-based materials as raw materials for its production. Although the Research and Development (R&D) of relevant low-carbon technologies has been carried out, the progress has been relatively slow and some green products lack market competitiveness.

Main challenges faced by the respondents of AICM members

The energy consumption of raw materials is included in the total energy consumption control;

- Products in the chemical industry are relatively complex, of which some products have stricter requirements on raw materials, making it difficult for enterprises to reduce carbon dioxide emissions from non-energy consumption in their production processes at this stage;
- The technology R&D investment for raw material optimization and operating cost is high, resulting in the lack of market competitiveness.

The energy and products involved in the chemical industry are complicated. More refined management is required to fully evaluate the energy efficiency and low-carbon performance of chemical companies. The respondents of AICM members show a strong willingness to participate in the communication with the governing institutions and provide them with technical support. They suggested:

- 1) Acceleration of the renewal of relevant system standards. In January 2022, the National Development and Reform Commission (NDRC), among other departments, proposed that the energy consumption of raw materials should not be included in the total energy consumption control. This is conducive to the development of enterprises with advanced energy efficiency. It is hoped that the governing bodies will consider the impact of this opinion on the carbon emission accounting of enterprises when updating energy efficiency indicators;
- 2) When formulating indicators and standards, it is recommended to fully consider the process and technical level of different chemical products, and improve the setting of advanced values for indicators.
- 3) Formulation of green and low-carbon product certification standards to strengthen the demand-side recognition of green products, and to promote the green transformation of chemical enterprises.

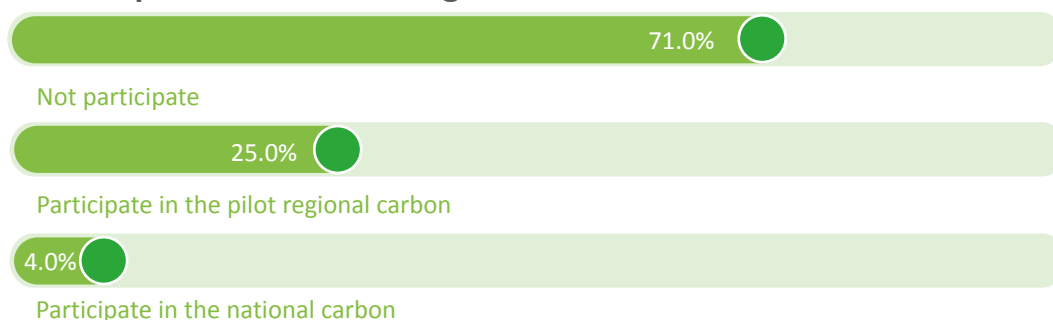


2.4 Carbon Emissions Accounting and Carbon Trading Market Participation

Carbon trading market and carbon tax are the two main carbon pricing tools in the world, of which carbon trading market is the policy tool currently adopted by China. The tool relies more on market conditions to reduce costs and ensure cost-effectiveness while reducing greenhouse gas emissions.

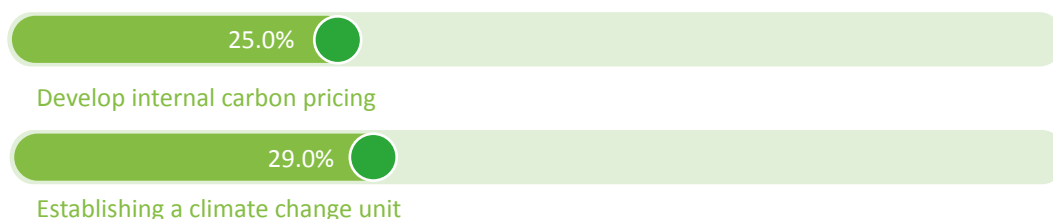
At the current stage, there are mainly two types of trading markets in China: one is the national carbon trading market that was launched since July 2021, the other are the pilot regional carbon trading markets that were launched successively in 2011. The national carbon trading market currently includes only key emission companies in the power generation industry, while in the pilot areas, due to different local laws, only part of the markets cover the petroleum and chemical industries. According to the survey, 4% of the respondents of AICM members are included in the national carbon trading market (the included companies have their own power plants and thus belong to the power industry) while 25% were included in the pilot regional carbon trading markets. With the gradually expanding coverage of China's carbon trading market, eight industries including petrochemical and chemical industries will gradually soon be included in the national carbon trading market, creating a huge impact on the chemical industry.

Participate in China Trading Market



In response to climate change, AICM member companies are actively adapting to the carbon trading market. According to the survey, 29% of the respondents of AICM members have set up special climate change response departments whose main responsibility include conducting carbon accounting, carbon trading, technical research and emission reduction activities, etc. Through centralized management of the company's carbon assets as well as the prevention and control of company's risk, they proactively respond to climate change risks. Moreover, some member companies have set up internal carbon prices to improve the internal operation of the company by assigning emission reduction cost indicators to key emission departments.

Management measures to address climate change



However, AICM member companies have raised concerns about the future carbon trading market. According to the survey, 58% of the respondents of AICM members are concerned about the insufficient allocation of carbon emission quota in the future. Some companies believe that the current carbon emission quota allocation plan based on historical emissions ignores the company's upfront investment in energy conservation and emission reduction, failing to reflect the company's technological advantages and thus sapping the company's drive to reduce emissions. In addition, China's carbon trading market is still in the preliminary stage, for example, the supporting mechanisms such as taxation are not yet adequate, the energy trading market and the carbon trading market have not been fully connected and the domestic carbon emissions trading is not recognized by overseas institutions. These challenges have undoubtedly increased the cost of carbon management for enterprises.

Main challenges faced by the respondents of AICM members

- The carbon emission rights allocation method adopted in some regions fails to take into account the production efficiency of enterprises and lacks incentives for enterprises to reduce emissions;
- Tax regulations have not kept pace with the carbon trading market reform process, which has hindered the settlement and invoicing of companies which results in higher costs;
- Emission reduction measures such as green certificates and green power have not been connected to the carbon trading market, thus the effectiveness of various measures on future carbon emissions compliance is unknown, implying risks in trading;
- Due to the differences between domestic and foreign standards, export-oriented enterprises often need to conduct multiple times of the carbon emission accounting according to different standards which increases the burden of the enterprises.

Carbon Emission Quota Allocation

Currently, there are two main carbon emission quota allocation methods worldwide:

- Industry benchmarking method refers to the setting of emission benchmark based on overall emission data of the industry before the issuing of quota based on the benchmark;
- Historical intensity method refers to the issuing of quota to enterprises according to the historical emission data of the enterprise combined with the emission reduction coefficient.

As for the chemical industry, the international carbon trading market mainly adopts the industry benchmarking method. In Europe and the United States, regulators take the arithmetic means of the emissions per ton of product from installations that produce the product or that are of the same level over the past five-year period as the historical intensity levels, which are then arranged in order from low to high and take the average of the top 10% quantile values as the benchmark of the installations of the same level. In this way, only the most advanced production facilities can receive full or even surplus emission allowances.

In some of China's pilot areas, due to the relatively late establishment of the carbon trading market, weak data base and complexity of products in the chemical industry, the historical intensity method is adopted for the time being.

Compared with the international carbon accounting standards and carbon trading market system, China started late in carbon management while its carbon trading market is still in the initial stage of development. According to their own challenges, the respondents of AICM members put forward the following suggestions for the future carbon trading market construction:

- 1) Formulation of a national carbon trading market development roadmap as soon as possible by taking into account the production efficiency of enterprises when designing indicators to reflect the advantages of advanced enterprises from the system as well as formulation a scientific competition mechanism;
- 2) Improvement of the supporting policies of the carbon trading market such as taxation, etc. to guide enterprises to correctly participate in market transactions;
- 3) Improvement of the trading coordination mechanism under the background of carbon neutrality to clarify the emission reduction benefits of each trading market (such as green certificates, green power and carbon emission reduction trading, etc.) and to provide scientific and effective emission reduction guidelines for enterprises;
- 4) Enhancement of international communication by fully considering the impact of carbon tariffs (EU carbon border adjustment mechanism)² on China's carbon trading market when optimizing standards and keeping up with international carbon accounting certification standards.

² The EU carbon border adjustment mechanism will require importers in the cement, electricity, fertiliser, aluminium, iron and steel sectors to pay for the emissions of their imports. The mechanism will take place in 2023 with the transitional period from 1 January 2023 to 31 December 2025. During this period, importers will report on a quarterly basis the embedded emissions corresponding to their imports of the previous quarter, detailing direct and indirect emissions and reporting any carbon price paid abroad instead of paying for the emissions. In the future, the EU will consider extending the scope of the sector.



2.5 Value Chain Emissions

Carbon neutrality means that companies not only need to focus on reducing carbon emissions from their own operations but also need to monitor and evaluate carbon emissions across the entire value chain from raw material extraction to disposal of end products. According to the survey, 58% of companies have disclosed or are planning to disclose carbon emissions information across indirect carbon emissions from upstream and downstream of the value chain, among which the main categories of indirect carbon emissions from upstream and downstream of the value chain disclosure are as follows:



- Purchased goods and services



- Production material



- Fuel and energy related activities (excluding direct and indirect emissions from operations that are owned or controlled by the reporting company)

- Upstream transportation and distribution

- Disposal of waste generated in operations

- Business travel

- Downstream transportation

- End-of-life treatment of sold products

Indirect carbon emissions from upstream and downstream of the value chain Disclosure

42.0%



No planned to disclose indirect carbon emissions from upstream and downstream of the value chain

58.0%



Planned or undertaken to disclose indirect carbon emissions from upstream and downstream of the value chain

According to AICM's survey, the amount of chemical industry's indirect carbon emissions from upstream and downstream of the value chain are often larger than those generated by its production. Based on this, the respondents of AICM members have successively carried out supplier management. For example, they urge suppliers to join relevant organizations, develop specialized economical and low-carbon logistics services, etc. At the same time, they also take actions to improve product efficiency, design low-carbon products, reduce energy consumption/loss during product use and gradually reduce carbon emissions in the indirect carbon emissions from upstream and downstream of the value chain through internal and external management.

Main measures taken by the respondents of AICM members to manage their value chain emissions

- Localized procurement of materials;
- Use efficient and clean means of transport for upstream and downstream cargo transportation;
- Reduce business travel and encourage online meetings;
- Reduce waste generation in the production process;
- Optimize product performance and reduce products' dependence on downstream energy consumption;
- Strengthen supplier communication and collaborate with suppliers to reduce carbon emissions;
- Urge suppliers to pass third-party audits to improve sustainability performance.

However, during the management process, members find it difficult to implement supplier management. On the one hand, China has not yet required the disclosure of carbon emissions in indirect carbon emissions from upstream and downstream of the value chain of enterprises, thus most enterprises lack a clear understanding of the emission boundaries of indirect carbon emissions from upstream and downstream of the value chain and cannot confirm the boundaries of management, on the other hand, as China's carbon accounting system is in its infancy, some regions have not yet required the disclosure of relevant data on carbon emissions, making it difficult to obtain upstream and downstream data causing a lack of basic data to support management decisions.

Moreover, the additional cost of emission reduction will be indirectly passed on to the price of purchased products or services, resulting in increased operating costs and green inflation of products. At present, the application of clean energy technology and the construction of supporting facilities are still at the initial stage. For example, during the process of logistics and transportation, the use of new energy vehicles or the reduction of road transportation can optimize the transportation structure to a certain extent but the current application of clean energy in freight vehicles is limited. Besides, hydrogen energy vehicles have higher operating costs, coupled with few hydrogen refueling stations, making it difficult to put them in use on a large scale. The market's recognition of green products is not high and the green inflation brought about by the additional investment of low-carbon products makes the products less competitive at the current stage which has a certain impact on the operation of enterprises.

Main challenges faced by the respondents of AICM members are as follows:

- The lack of corresponding domestic guidance and standards results in companies lacking a clear understanding of indirect carbon emissions from upstream and downstream of the value chain boundaries;
- As China's carbon accounting system in its infancy has not fully covered all industries and regions, it is difficult to obtain upstream and downstream data;
- The lack of relevant certification for low-carbon products makes it difficult for the market to accept the additional cost brought about by emission reduction requirements for suppliers which dampens companies' willingness to reduce emissions.

Some respondents of AICM members believe that establishing sound accounting standards and disclosing industry emission data will help companies improve their carbon emission accounting for the entire value chain. Furthermore, companies' assessment of the carbon footprint of products according to these standards will provide the governing departments with more complete basic data of products and thus building up the foundation for the launch of green and low-carbon products.

The respondents of AICM members suggested to:

- 1) Formulate emission accounting standards for indirect carbon emissions from upstream and downstream of the value chain in China to guide enterprises in managing the emission data of the value chain and further promote the carbon neutrality of the entire value chain of the chemical industry;
- 2) Establish an industry database to provide data support and endorsement for enterprises to calculate emissions in indirect carbon emissions from upstream and downstream of the value chain;
- 3) Formulate green and low-carbon product certification standards, strengthen the demand-side recognition of green products, and thus promote the green transformation of chemical enterprises.

2.6 Investment in Emission Reduction Projects outside of the Value Chain

Completing the optimization of the energy structure and building up a low-carbon energy supply system are the main methods to achieve carbon neutrality in the chemical industry. However, due to the industry's reliance on fossil-based raw materials, unavoidable carbon emissions are still generated during the production process which requires investment in additional emission reduction projects to offset these emissions.

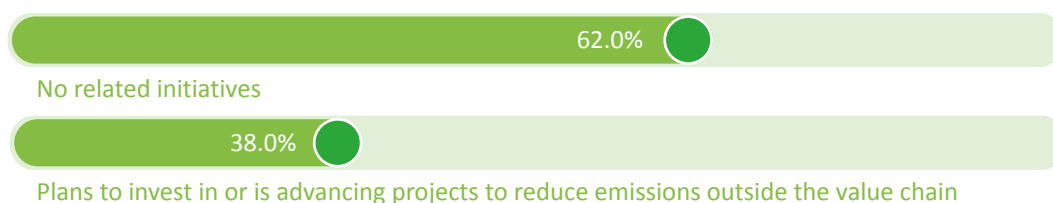
Faced with the pressure to reduce emissions, some AICM members have carried out basic research on carbon dioxide capture, utilization and storage applications. They believe that accompany with the "dual carbon" strategy, the utilization and storage technology of carbon dioxide has broad prospects and the accompanying chemical process with carbon dioxide used as raw material are also expected to develop rapidly, such as converting carbon dioxide to methanol. For other non-petrochemical or coal chemical companies, the respondents of AICM members have begun to focus on absorbing carbon dioxide emissions from their production activities through afforestation as a supplement for the path towards carbon neutrality.

According to the survey, 38% of AICM member companies have planned or are promoting investment in emission reduction projects outside of the value chain.

Major emission reduction projects invested by the respondents of AICM member companies outside the value chain

- Carbon elimination projects such as Carbon Capture and Storage (CCS);
- Carbon removal projects such as forests carbon sinks.

Carbon Emission reduction initiatives outside of the value chain



Despite a strong willingness to invest in emission reduction projects, the respondents of AICM member companies face some challenges. Some believe that the development of low-carbon technologies such as Carbon Capture and Storage is ineffective and the current operating costs are high. Besides, due to the immature carbon trading market in China, member companies do not understand the development process of carbon emission reduction projects and cannot confirm the investment benefits. Although more companies have relevant plans, they are still in the wait-and-see stage in practice.

- The development of low-carbon technologies has low effectiveness but high investment;
- Lack of relevant policies, standards and platforms to guide companies in translating the results of emission reduction measures into benefits;
- The current price of carbon in the Emissions Trading System is too low to incentivize investments in emissions reduction. It is also significantly lower than the levels seen in other major economies around the world.

Given the above challenges, AICM members hope that the governing institutions can provide corresponding institutional support:

- 1) Tilt the special funds and preferential tax policies towards scientific and technological innovation in green and low-carbon fields so as to encourage enterprises to develop low-carbon technologies.
- 2) Improve the emission reduction project trading system to provide clear and effective guidelines for enterprises to develop carbon emission reduction projects. In addition, strengthen collaboration with international agencies to ensure that the emission reduction projects have the same effect on a global scale.
- 3) An increase in carbon prices will be required to accelerate investments in emission reduction projects.



2.7 Administration by Law

In order to speed up the decisions and deployment concerning the green and low-carbon development, the governing departments have strengthened the prevention and control of the ecological environment source of energy-intensive and emission-intensive projects. This is a new round of supply-side structural reform in China and an important driving force for the green transformation of the pollution-intensive and emission-intensive industries.

The management of the pollution-intensive and emission-intensive projects has a significant impact on the operation of chemical industry who is a traditional energy consumer. In order to reduce the impact of environmental risks on operations, AICM member companies fully consider industrial policy orientation in terms of strategic layout, technology research and development, production capacity optimization, and operational efficiency improvement in the process of preparing future plans. They carry out multiple rounds of demonstration on the basis of the enterprise resource endowment to ensure that their energy efficiency meets the national standard.

However, due to the lack of an overall management mechanism for energy consumption indicators by the governing departments, some regions tend to suspend all new energy-intensive projects in response to the state's escalating dual control on energy consumption, taking the "one size fits all" approach to the pollution-intensive and emission-intensive projects. In order to meet the energy consumption indicators, they take compulsory measures to shut down key energy-consuming enterprises, distressing many enterprises.

Some respondents of AICM members said that the dual control on energy consumption is a systematic project, for which the governing departments should set boundaries along industrial lines and treat different industries accordingly. Since China has formulated energy efficiency pacesetting and benchmarking levels for energy-intensive enterprises, the governing departments should adhere to the systematic concepts of respecting for market laws, refining work requirements, intensifying responsibility implementation, promoting energy-saving and carbon-reducing technological transformations gradually and avoiding "one-size-fits-all" management and "campaign-style" carbon reduction when implementing the law. They should allow and encourage enterprises that meet the requirements of dual control to carry out production and operation by identifying the actual energy consumption level of enterprises, build pilot demonstration benchmarks for the industry while resolutely shut down and rectify disorderly, illegal and backward enterprises, so as to ensure the stability of the industrial and supply chain as well as the smooth operation of the economy and society.

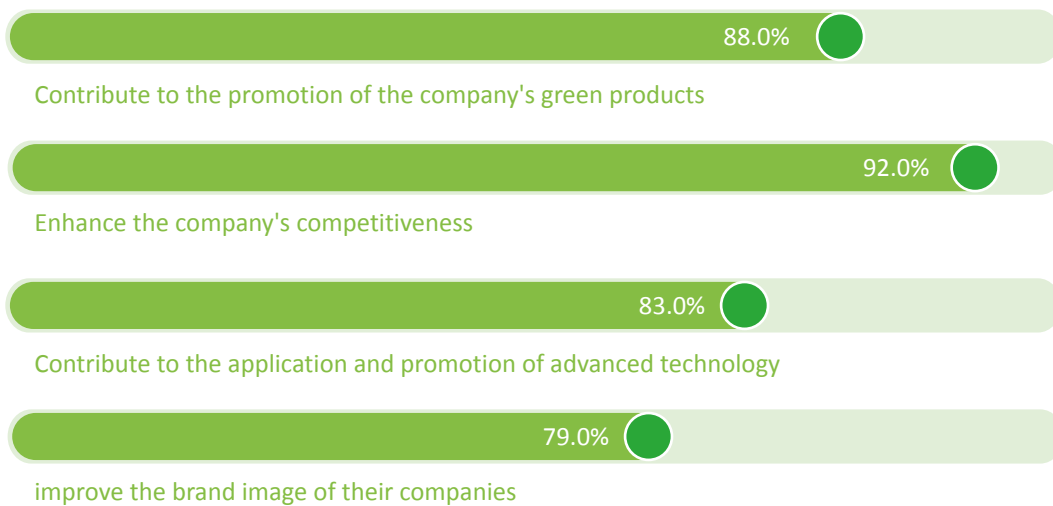
In addition, some respondents of AICM members hope that local governing institution will establish a cross-departmental working mechanism during the planning process to fully elaborate the synergies as well as systematically and comprehensively improve local regulations and standards. Moreover, they should clarify the policy basis for law enforcement and guide the compliance operation of enterprises under the background of "dual carbon" strategy to promote the scientific and effective realization of carbon neutrality locally.



2.8 Opportunities

In recent years, the concept of green development has taken root. Under the new trend of green development in the chemical industry, the demand for green low-carbon technology and green low-carbon products is growing rapidly. With a dual incentive of market demand and policies, the chemical industry will face new opportunities. Our survey shows that 92% of the respondents of AICM members view that China's "dual carbon" goals can usher in new opportunities for the chemical industry.

"Dual carbon" goals bring new opportunities for chemical industry



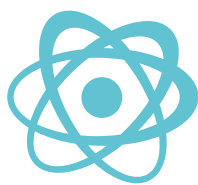
Improving the Image of the Chemical Industry



The chemical industry is often perceived as a pollution-intensive and emission-intensive industry. China's latest proposal of carbon neutrality will help the industry establish a new image of green development.

According to the survey, 79% of the member companies believe that the “dual carbon” goals will help improve the brand image of their companies. Respondents of AICM members agree that the development of a low-carbon chemical industry is an inevitable future trend and requirement. Currently, companies are increasingly viewing sustainability as one of the main drivers of growth and value. By rejecting the traditional pollution-intensive and emission-intensive mode of production, increasing investment in renewable energy projects, focusing on value chain emissions and so forth, companies will establish a good reputation for the industry.

Promoting Sustainable Development of the Industry



On the surface, the strategy of Carbon Peaking and Carbon Neutrality seems to set a cap on carbon emissions, and chemical companies are thus taking on the arduous responsibility to reduce carbon emissions. While in reality, the strategy is to create new opportunities for sustainable development in the chemical industry by setting carbon emission standards under certain constraints.

According to the survey, 83% of the respondents of AICM members view the “dual carbon” goals as a driving force for them to use and promote advanced technologies and 92% believe that the goals will improve their corporate competitiveness. The respondents of AICM members agree that the requirements on industry structure and technologies will benefit the companies with technological advantages in the early stages, and these requirements and regulations can raise the industry barriers to entry and eliminate the backward production capacity with pollution-intensive and emission-intensive in the industry. Meanwhile, with the chemical industry being a key link between raw materials and consumer goods, companies with a whole industry chain layout will have the opportunity to create higher value-added products, transforming their green concept into a competitive edge.

Increasing Demand for Products in the Chemical Industry



The chemical industry is a basic industry of the national economy and is related to the development of various industries. Green low-carbon chemical products are not only the “postcard” of chemical companies, but also can help the downstream industries and customers to reduce carbon emissions and achieve carbon neutrality.

According to the survey, 88% of the respondents of AICM members believe that the “dual carbon” goals are instrumental in promoting their green products. Some of the member companies interviewed state that following the campaign to raise awareness of carbon peaking and carbon neutrality, different emission reduction requirements for various industries are being released one after another, and customers are putting higher demands on both the products' carbon emissions and the usage efficiency. Chemical companies have hence been providing downstream customers with low carbon solutions and are working on multiple fronts such as architectural coatings, new energy materials, and catalysts to assist them in achieving their carbon neutrality goals. These emerging products have created a new blue ocean market and introduced new momentum for the green transformation of the chemical industry.



3 Conclusions

The period from 2021 to 2025 is key for China to achieve carbon peaking and carbon neutrality. During this period, various industries need to develop and improve their top-level design for carbon neutrality and confirm the pathway to achieving it, which requires not only companies to explore new directions of green and low-carbon development but also relevant authorities to align actions with companies and improve relevant institutional regulations, so as to ensure that carbon neutrality commitments at all levels be based on law and evidence.

AICM believes that AICM members' efforts will contribute to the carbon neutrality of China's chemical industry and bring some inspirations to the Chinese chemical industry, so that the public can truly understand the efforts and contributions of the chemical industry to a green society. At the same time, AICM also believes that the performance of AICM member will bring new insights and basis for the administration to formulate policies and support the management to accelerate the improvement of management rules. To support the Chinese government and the chemical industry in addressing and mitigating climate change and achieving carbon peaking and carbon neutrality, AICM will serve as a communication platform linking companies, authorities, and communities through providing timely interpretation of official documents and analysis of policy trends. Meanwhile, AICM serves to showcase truthfully the low carbon related achievements of chemical companies, and share experience in carbon neutrality management with the outside world, which improves the outside perceptions of the chemical industry development. We will actively facilitate dialogues among authorities, sustainability organizations, and stakeholders at all levels along the chemical industry value chain. We will also participate in building a multilateral and collaborative carbon-neutral mechanism to jointly promote the green transformation of China's chemical industry.

Achieving carbon neutrality involves systemic efforts and actions taken by the whole society. The issues discussed in this report that are of concern to foreign chemical companies in China in their pursuit of low carbon development require joint efforts of both the government and the companies for future improvement. It is our sincere hope that the suggestions in this report will be reasonably adopted to help address the issues within the chemical industry while providing valuable lessons for other industries.

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Project Leaders

Jeff Zhu

Member of Executive Committee
Senior Vice President
President of Performance Additives
President of Asia Pacific Region
Cabot Corporation

Paul Lindblad

President of Greater China
Wacker Chemicals (China) Co., Ltd.

Project Sponsors

Richard Yu

Head of Governmental Relations and
Public Affairs
Henkel (China) Investment Company
Limited

Xuelin Liu

Director of Legal, Public Affairs and
Communications of Greater China
Wacker Chemicals (China) Co., Ltd.

Beryl Ma

Executive Director
AICM

Xiaopeng Niu

Director of Government Affairs
Senior manager
Dow Chemical (China) Investment
Co.,Ltd.

Honglin Zhang

VP, Government & Public Affairs
VP, Corporate Communications
Air Liquide China

John Gao

Senior Manager, Government and
Industrial Affairs
AICM

Project Participants

Fernando Vallina

Chairman
ExxonMobil (China) Investment Co., Ltd.

Andy Walti

Vice President, Head of Region China &
APAC
Clariant

Dr.Bradley Morrison

Senior Vice President, Operations &
Site Management
BASF

Lei Li

Vice President and President of North
Asia
SABIC

Nicolas Poirot

President & CEO
Air Liquide China

Project Participating Members

Air Liquide China
Arlanxeo High Performance Elastomers (Changzhou)
Altana China
Albemarle China Corp
Celanese (China) Holding Co., Ltd.
Covestro China
Eastman Chemical (China) Co., Ltd.
Evonik Greater China
Ingevity China
Mitsui Chemicals (China) Co., Ltd.
Nouryon Chemicals
PPG
Shanghai HOYER Sinobulk Transport Co., Ltd.
Trinseo
Polyplastics Group

AkzoNobel China
Arkema Greater China
BASF (China) Company Limited
Asia-Pacific, Cabot Corporation
Clariant China
Dow Greater China
ExxonMobil (China)
Henkel (China) Investment Company Limited
LANXESS China
Merck Holding (China)
North Asia, SABIC
Borouge Sales and Marketing (Shanghai)
Asia Pacific, Solenis
Wacker Chemicals (China) Co., Ltd

Room 902, Building A, Phoenix Plaza, No.5 Shuguangxili,
Chaoyang District, Beijing
100028

www.aicm.cn



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