China Council for International Cooperation on Environment and Development (CCICED)

Green Transition and Sustainable Social Governance

CCICED Special Policy Study Report

CCICED 2021 Annual General Meeting

September 7-10, 2021

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Executive Summary

In 2018, Phase VI of the China Council for International Cooperation on Environment and Development (CCICED) established a Special Policy Study (SPS) on Green Transition and Sustainable Social Governance under the Task Force (TF) on Innovation, Sustainable Production and Consumption. During its research work in 2019 and 2020, the SPS mainly focuses on the following 4 components: 1) the status and trends of consumption and its impacts on resources and the environment in China; 2) the mechanisms for green consumption and production to promote a green transition; 3) assessment of the status of green consumption and social-economic green transition in China including the setup of the assessment index system and summary of green consumption and production policy and practice; 4) industry-based case study of green consumption and production covering green buildings, green automobile production and consumption, greening of the power market, green circulation of materials, digital and low-carbon lifestyle platform, etc.; 5) relevant international experiences and insights for China.

Based on the above-mentioned research results, the SPS has put forward three policy recommendations to the Chinese government in 2020 as follows: 1) illustration of why a great emphasis should be placed on the comprehensive transition to green production and consumption, drawing results from empirical and quantitative analyses as well as employing relevant theories; 2) determining objectives, key sectors and a policy framework to launch green production and consumption during the 14th "Five-Year" Plan period; 3) introducing specific policy recommendations for green buildings and green automobile production and consumption; reforming the power market to be greener, promoting material circularity, and launching a digital and low-carbon lifestyle platform, etc.

It is gratifying to see that the policy recommendations of the SPS, alongside with other CCICED research results have caught the attention of relevant departments of the Chinese government. Consequently, grand and in-depth targets and measures for a social-economic green transition and green production and consumption have been specified in the 14th "Five-Year" Plan for National Economic and Social Development and the Long-Range Objectives through the Year 2035.

The SPS stemmed mainly from the great contributions made by the Chinese and international TF Co-Chairs and CCICED leaders. Especially important was the guidance and support of Mr. Han Wenxiu, the Chinese Co-Chair of the TF, CCICED member and Executive Deputy Director of the General Office of the Central Financial and Economic Affairs Commission, who twice listened to the special report on the progress of the research and offered clear instructions and specific suggestions on the research. Naturally, the results of the SPS are the crystallization of the concerted efforts of the Co-Chairs, advisers, key members, support team and coordinators of the SPS, as well as the guidance and support from the Chinese and International Chief Advisors, the CCICED Secretariat, the Swedish Ministry of the Environment and the Embassy of Sweden in China.

Based on the previous two years' research results, the SPS focused its attention on the following three aspects in 2021: 1) research on the new policies needed to launch green production and consumption during the 14th "Five-Year" Plan period in light of the new

situation of eco-civilization construction in China and green and low-carbon trends worldwide; 2) based on the green production and consumption objectives and tasks identified in the 14th "Five-Year" Plan, research on further and more targeted policy measures including policies on taxation reform for green and low-carbon development of the automobile industry, green design for the iron and steel industry, eco-design for waste disposal facilities, green consumption of food and green labeling, which is the highlight of the research; 3) further study of the assessment index system for green consumption in China with follow-up empirical analysis and initiation of a simulation analysis of green consumption trends and policy intervention scenarios employing a CGE model.

The 2021 SPS policy report's summary of the research results stands as a separate chapter in the report, a usual practice for the convenience of reading although international experiences enriched the entire study process.

Key Conclusions and Policy Recommendations

The 2021 SPS research results and policy recommendations are based on the latest domestic and international situation and this year's research results. Policy recommendations from 2020 remain valuable to the decision-making process.

I. China's "14th Five-Year Plan" has entered an "in-depth" green transition period with the promotion of green production and consumption patterns moving into a substantive stage of practice, and important changes will occur. There are at least five main features:

First, as China steps onto the stage as a new and modernized great power having accomplished the goal of building an all-around well-off society, new themes are on the agenda dealing with high-quality development and the associated principles of innovation, coordination, greenness, openness and sharing. Green development is the core feature and gauging standard for high-quality development. Such strategic thought and principles will steer the direction, objectives and tasks of China during the 14th "Five-Year" Plan period and beyond.

Second, compared with its predecessors, the 14th "Five-Year" Plan for National Economic and Social Development and the Long-Range Objectives through to the Year 2035 have for the first time put green development into an individual chapter, identifying targeted requirements for green production and consumption while specifying further and higher requirements on resource and energy conservation, efficiency improvements, ecological conservation and environmental quality betterment. Specifically, they stipulate that the transition towards green production and green lifestyle shall take substantial effect in 2025; and green production and lifestyle will take shape extensively in 2035.

Third, China has incorporated the commitment of peaking carbon emissions and achieving carbon neutrality into its 14th "Five-Year" Plan as well as the overall plan for achieving an ecological civilization, and also using the task of reducing pollution and carbon emissions and its synergy effects to promote a comprehensive social and economic green transition.

Fourth, as China enters into a comprehensive well-off society marked by a per capita GDP over US $10,000, public awareness of green lifestyles has strengthened rapidly while the Covid-19 pandemic has fueled public awareness on green development at the same time. It is predicted that the middle-income population will surge to 560 million during the 14th "Five-Year" Plan period with a corresponding increasing in the rate of consumption by up to 60%. This huge potential will gradually build-up the solid social foundation necessary for realizing green consumption.

Fifth, the Covid-19 pandemic has magnified the significance of a green and low-carbon transition and there is a new tide of interest in low-carbon transitions in the international community. These developments can greatly contribute to the advancement and replication of an in-depth green transition in China.

II. Several specific policy issues still need to be addressed in order to launch the green production and consumption campaign in China in a bid to accomplish the

relevant targets set out in the 14th "Five-Year" Plan.

Although the 14th "Five-Year" Plan of China has spelt out the targets for the transition to a green production and lifestyle, the relevant tasks and measures are quite preliminary within the existing framework. Therefore, more detailed and specific actions are needed for actual implementation, including well-designed supportive laws and regulations, policy mechanism and infrastructure construction.

1. **Incorporating steps to achieve a comprehensive green production and consumption system into national legislation**

The existing laws most closely related to green production and consumption include the Law of the People's Republic of China on Promoting Clean Production (enacted in 2002 and amended in 2012) and the Law of the People's Republic of China on Promoting Circular Economy (enacted in 2008 and amended in 2018). The building of a legal system centered on green production and consumption can be carried out along two different paths: the first is to integrate the above-mentioned two laws into one unified green production and consumption law, while the second is to amend the existing two laws, making a clear and rational identification of the legal boundary of the two by deleting the word "Promoting" and in this way making them more legally-binding so that they can serve as the basic laws for promoting green production and consumption and serve the demands for green development.

2. **Formulating the national action plan on green consumption**

The management of green production falls under the competency of government authorities for resource and energy, industry, infrastructure construction, economy and eco-environment, while implementation falls under the domain of enterprises. Green production as identified in the 14th "Five-Year" Plan can be integrated in the portfolio and policy measures of relevant governmental departments. In contrast, green consumption involves a larger number of administrative departments covering all organizations, units and individuals from various sectors, adding complexity and challenges for a unified coordination and implementation. Bearing in mind the experience of Germany and Sweden, we think it is necessary to formulate a special national action plan on green consumption under the 14th "Five-Year" Plan in an effort to draw a middle and long-term implementation plan for more comprehensive, in-depth and specific initiation of the green consumption and lifestyle campaign.

3. **Stressing source-based measures and a systemic methodology, fully initiating eco-design tools for industrial products and vigorously constructing green supply chain.**

Studies have shown that 80% of resource and energy consumption and its environmental impacts are determined at the design stage of products. Eco-design of industrial products refers to the notion that systemic consideration should be given to the environmental impacts of a product through its entire lifecycle from the selection of raw materials to the production, sale, usage, recycle and disposal at the design and development stage in a bid to maximize the reduction of resource consumption, cutting or making it free from the use of toxic and hazardous raw materials and in this way cut

pollution and emissions. The EU already passed eco-design legislation as early as 2009, while China has made some meaningful exploration thereof in recent years. The Chinese government should draw up technical specifications on eco-design and initiate an eco-design methodology while at the same time launch a lifecycle management approach that expands from a product and enterprise focus to include the entire industrial chain. The Chinese government should incorporate the concept of a green supply chain in the new development framework of the "dual circulation strategy" (in which the domestic economic cycle plays a leading role while the international economic cycle remains an extension and supplement) so as to build a green dual circulation development pattern.

4. **Heightening efforts to certify green and low-carbon labeled products, relevant services and specialized enterprises so as to force the greening of production and services, expand green products and service provision and guide green consumption.**

As green products and services are the key elements of green consumption, the expansion of green products and services provision is a natural basis for promoting green consumption. The SPS simulation showed that the provision of a consistent and appropriate subsidies for green products at the consumption stage is a viable and effective policy option for fostering a market for green products.

Certification of green and low-carbon products and services connects the consumer and the producer, which can leverage both green consumption and production which has proven to be an effective market-based mechanism, and a top-runner system. Since the EU and China have both accumulated rich experiences in this area, the Chinese government should further emphasize and give full play to the effect of this system in enhancing green production and consumption. First, top-level design should be stepped up to forge a unified certification system for green and low-carbon products and services, and this system should be integrated with related constraints and mandatory measures and incentives for achieving synergy effects; second, the certification should be expanded to the green and low-carbon performance of enterprises to exert the effect of the top-runner system; third, the Government Procurement Law should be revised to include governmental departments and institutional organizations at various levels and SOEs under the scope of green procurement requirements, and it should be explored if the scope of green products and services procurement can be widened into a compulsory green procurement system. Relevant incentive policies should be drafted to encourage other civil societies and enterprises to exercise green procurement. In addition, initial attempts could be taken to introduce a 'carbon neutral' requirement system for large-scale events organized by governmental departments and institutional organizations at various levels and SOEs; similar actions should also be called for other subjects.

5. **Launching infrastructure construction and capacity building for green production and consumption**

The two-year study of the SPS on the building of a green consumption assessment index system and evaluation methodology for China turned out to be quite unsatisfactory; a dominant underlying reason for this was the lack or relevant data for key indices. To rectify this, China must make simultaneous efforts to build relevant infrastructure and

strengthen capacity following the full launch of the green production and consumption campaign during the 14th "Five-Year" Plan period. This includes:

1) Setting up a green consumption statistical system, including monitoring, data collection, accounting and an evaluation report on green consumption;

2) Constructing a green consumption assessment index system and middle and long-term objective index system based upon it. The relevant assessment and objective indices could be set up on a regional and category specific basis accommodating the varied gap in natural conditions and development levels between urban and rural areas and different localities;

3) Building a unified green consumption information platform, publishing information on green products and services, raising the transparency for the production and consumption of green products and encouraging various stakeholders to take credit in the certification and assessment results of green products and services;

4) Beefing up capacity building and training on green consumption for the government, social organizations enterprises and the general public; setting up partnerships and networks among various stakeholders to boost active participation;

5) Making full use of digital technology to support green and low-carbon lifestyles. For example, a digital green and low-carbon lifestyle platform of nationwide influence and uniform and applicable standards can be constructed to support the green and low-carbon actions of individual consumers and organizations.

6. Encouraging the normalization of the green and low-carbon work patterns and lifestyles that emerged during the Covid-19 pandemic, guarding against an impulsive growth of energy-intensive and heavily-polluting industries during economic recovery and supporting carbon neutrality.

Under the context of the Covid-19 pandemic, the popularization of such new working patterns and lifestyles as online-working, videoconferencing and Internet shopping have triggered the rapid growth of "no-contact" industries. These emerging industrial forms should be fully evaluated against their economic and environmental impacts so as to sift out and encourage the normalization of green and low-carbon work pattern and lifestyle. At the same time, resource and environmental management should be strengthened to gear up efforts to offer and spread training sessions on peaking carbon emissions and achieving carbon neutrality and related policies in a bid to prevent localities and enterprises from realizing economic recovery by resorting to new energy-intensive and heavily-polluting projects which would boost carbon emissions. Meanwhile, attention should also be given to new issues such as the sharp increase of packaging from online shopping by beefing up green logistic construction.

III. Conducting green taxation reform in the automobile industry

As the leading industry in China, automobile production also stands out as a key contributor to energy consumption, pollution discharges and GHGs emissions. In 2018, the consumption volume of gasoline and diesel from the transportation sector accounted for 46% and 68% of the national total, respectively; carbon emissions from automobiles

accounted for 7.5% the national total. While the automobile sector accounted for 43.6% of the national total of NOx emissions, it contributed only to 20% of the NOx reductions achieved nationally. Therefore, great priority should be given to promoting green consumption and production in this industry.

In 2020, the SPS put forward policy recommendations related to the green development of the automobile industry in terms of production, procurement, usage and recycling, which are regarded as the four overarching breakthrough points needed to achieve a systemic green reform and development of this industry. With this in mind and based on previous study results, the following suggestions are made on green taxation reform of the automobile industry following due consideration to the need for conservation of raw material and fuel, pollution reduction and carbon neutrality:

The first is to implement the fiscal policies stimulating the development and usage of non-HFC substitutes and substituting technologies. The spreading of refrigerant compressors for the air conditioning of green automobiles can be achieved through reward and punishment taxation policies for the industry, namely incorporating automobile air conditioning refrigerant compressors into the emission checkup index and offering preferential reductions in the consumption and vehicle purchase taxes for vehicle models meeting refrigerant compressor emission and other relevant energy-conservation and environmental protection standards. In addition, the existing practice of promoting green automobiles of/less than 1.6L should be further carried out by incorporating emission requirements for refrigerant compressors to drive the application of green technologies and products including environment-friendly refrigerant compressors.

The second is to implement a preferential taxation policy promoting the extended producer responsibility system. A simplified tax levying method is to be adopted in order to tackle the problem of limited deductible input tax for enterprises as a result of the difficulty in obtaining input VAT invoices during the process of recovery of scrapped vehicles. While for other problems such as the huge investments needed for advanced technology and facilities for the recovery and dismantling of scrapped vehicles vs. the long capital payback period, corporate income taxes should be deducted for enterprises making large investments in environmental protection and passing related checkups. In order to boost the environmental performance of enterprises specialized in recovery and dismantling of scrapped vehicles, raise the price for recovered vehicles, reduce the number of such vehicles entering the black market and increase the overall vehicle recovery and recycling rate, R&D investments can be factored in by adding a deduction policy with 50% of the investment amount to be deductible from taxable income.

The third is to develop a reward and punishment tax policy for automobile products. Under the pretext of ensuring the overall tax balance of the automobile industry, optimization and adjustment is to be made to the existing automobile tax system to augment the regulation effect of existing taxes on energy conservation and environmental protection. The design of the policy shall combine both short-term and long-term objectives to outline different phases for implementation in line with the competitiveness and development stage of the industry. Specifically, during the 2021~2025 period, the current policy of vehicle purchase tax exemption for alternative fuel vehicles will be further exercised with a gradual phase-out; starting from 2026, new vehicle purchase taxes gauged on an energy-efficiency index coupled with a

reward and punishment based consumption tax will be ushered in. Presently, China has already built up a rather comprehensive fuel consumption standard system for passenger vehicles, thus making it quite viable to integrate related indices into the automobile taxation system. The implementation of such a reward and punishment system should be carried out in a step-by-step manner with the addition of the index of fuel consumption volume/100 km for passenger vehicles to the existing tax system as a first step, to be gradually followed by a vehicle emission index, and a power consumption index for electric vehicles when the time is ripe.

As the simulation analysis pointed out, the execution of the above green taxation reform in the automobile industry shall yield substantive effects in various aspects ranging from a cut of input of raw materials in automobile production, an increase in production volume of alternative fuel vehicles to the reduction of fossil fuels, the substitution of refrigerant compressors and emission reductions of CO_2 and other regular pollutants.

IV. Introducing green design policies for the iron and steel industry

In 2019, the volume of crude steel produced by China equaled 53.3% and pig iron 64.2% of world totals. The iron and steel sector not only dominates the discharge of regular pollutants in China, but also overshadows other industries in terms of carbon emissions, accounting for 15% of the national total. Therefore, the promotion of green product design in the industry and an increase in the environmental-friendliness of its products, starting from the very beginning stage of design is of great significance for its green development and future green trade.

In recent years, the Chinese government has attached great importance to the issue of green development of this sector by resorting to measures including heightening resource and energy efficiency, industrial layout adjustment and restructuring, improvement of pollution prevention and control and improvement of key production technologies as well as the implementation of a clear-cut plan for a green manufacturing system for this industry. Currently, 30-odd industrial standards on green design for iron and steel products are under research and drafting. However, viewed holistically, the concept of green design has yet to mainstream the green development of the iron and steel industry, which is still characterized by outdated standards, lack of incentive measures and relevant capacity, directly hampering the in-depth advancement of the green development of the industry.

In this connection, the following recommendations are put forward:

1. Enhancing the top-level design of green policy and building a promotion mechanism involving the different departments and upper and lower reaches of the industry

The top-level design of green policy aims to draw up a roadmap and construction map for both overall and long-term implementation. The building of coordination mechanisms would require relevant governmental departments to unify their efforts and the observation of uniform standards and specifications through the industry to set up a green industrial chain.

2. Introducing an entire lifecycle evaluation method for the iron and steel

industry

Enterprises in this sector shall be guided to make extensive application of the entire lifecycle concept, methodology, data and plans for their industrial production and service provision. To this end, a green iron and steel product evaluation system shall be construct and consolidated, a database for resource and environmental impact of products along the entire lifecycle shall be developed, and the resource and energy intensity and related environmental indices shall be quantified to specify the green level of a product; green improvement plans for products shall be developed for the various stages in the lifecycle; and a technical service system shall be set up for enterprises to translate green design into real production.

3. Developing green design standards, an evaluation system and certification and recognition systems for the iron and steel industry featuring synergy effects in reducing pollution and carbon emissions

As green design standards act as the basic technical baseline for conducting green design in the industry, the construction of a relevant evaluation system and certification and recognition system addressing the performance of enterprises can act as a barometer for management and the market. These systems should be drafted covering the entire lifecycle of the industry with unified consideration to resource and energy efficiency, pollution prevention and control and reduction of carbon emissions to realize synergistic effects.

4. Tie evaluation results and the certification and recognition of green design to the setup of relevant incentive mechanisms

Evaluation results and the certification and recognition of green design in the iron and steel industry should be pegged to relevant policies and administrative measures, such as environmental credit appraisal, environmental taxes, the tax revenue derived from the integrated utilization of resources, pollution responsibility insurance, the frequency and times of environmental surveillance, governmental green procurement, corporate tax income and fiscal subsidies, in order to forge a comprehensive incentive policy and mechanism for the practice of green design by the industry.

5. Supporting the iron and steel industry to carry out personnel training and capacity building on green design

By relying on various industrial associations, universities and research institutions, national and local governments can support enterprises in this sector in training of personnel specialized in green design and strengthening professional skills with capital, intelligent resources and technologies.

V. Employing the concept and methodology of eco-design to upgrade waste incineration facilities into green facilities that provide products for enhancing living environment

Power generation from waste incineration has already mainstreamed domestic refuse

treatment methods in China with an ever-surging construction of related facilities. In 2020, China boasted 519 domestic refuse incineration power generation facilities. An additional 476 such facilities shall be constructed in the next decade according to plans released for 18 provinces and municipalities.

China has encountered two major obstacles in the construction and operation process of waste incineration facilities: first, with the unsound environmental performance of some facilities in operation, local residents of adjacent communities have been negatively impacted, thus causing public discontent and complaints; second, with the rapid betterment of people's living standards, the public has become quite sensitive to environmental quality and risks and may have a bias against waste disposal facilities seeing them as "dirty", and thus generating strong emotional resistance to existing waste disposal facilities or the construction of such facilities, a typical Not In My Backyard (NIMBY) situation.

Regarding the first issue, the Chinese government has made substantial improvement through heightened surveillance in recent years. As indicated by the national public platform on monitoring data from waste incineration power plants, the emission concentration of flue gas from almost all domestic refuse incineration power generation facilities meet national standards with most facilities even making better performance in flue gas emissions than prevalent national standards. Current Chinese waste incineration power generation technologies and equipment has put China in the leading position worldwide from the perspective of technical capability.

In terms of NIMBYism, the Chinese government has taken integrated measures from various technological, management, social and informational aspects, greatly curbing NIMBY cases. However, since NIMBY is a rather complex problem comprised of multiple factors, including psychological factors and the interests of stakeholders associated with the environmental performance and risks of the facility as well as the overall social-economic development stage. Viewed from the perspective of the social-economic and environmental protection development situation of China, environmental NIMBY incidences will reoccur well into the future. Only long-term, stable and effective solutions can elevate the functioning of waste incineration power plants, and change their image with the public.

The SPS has come up with the following suggestions to further green development: the concept and methodology of eco-design should be employed to upgrade waste incineration facilities into green facilities that can enhance the surrounding living environment.

The specific method for achieving this includes the construction of a string of technical standards under the four categories of environmental safety, ecological harmony, community friendliness and economic efficacy. The waste disposal facilities constructed and operated in light of these standards shall be enabled with multiple functions: first, the problem of pollution from waste will be solved without any further environmental risks; second, the facilities will be in coordination and harmony with the local ecological landscape, the urban design layout and features as well as local customs and culture; third, the operation of the facility shall benefit local communities, thus creating a benign interaction. In addition, economic efficacy will be a key issue to consider. Presently, successful cases can be found in Chinese cities like Huizhou, Changzhou and Hangzhou.

The specific practical steps are as follows: first, existing regulations on the construction and operation of waste incineration power generation facilities should be integrated into a unified set of green standards and technical specifications; second, experience is to be accumulated from exercising the top-runner system with these green standards followed by large-scale duplication.

VI. Exercising a sustainable (green) food consumption policy

The sustainable consumption of food has been gaining more and more attention from international society, since food spoilage and waste implies an ineffective consumption of resources, considering also food production and the corresponding emission of GHGs. Waste food with its varied disposal methods also generates a huge amount of GHGs emission. Should we treat all the wasted food generated worldwide as a nation, it would be the third largest emitter of GHGs globally.

The situation in China is also far from gratifying. On the one hand, there is a huge overall loss and level of waste throughout the food supply chain. As the sample survey of the State Bureau of Grain Reserve showed, the annual loss of grain from production to final consumption stood at 135 billion tons in 2016, equal to roughly 10% of the total grain yield in that year. In China, the average spoilage rate of fruits is 20%-30% during transportation, and there is a similar spoilage rate for vegetables: 30%-40%. On the other hand, more food spoilage and waste occurs at the consumption stage. As the 2018 survey report of the Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Sciences indicated, the annual amount of food wasted from the dining table alone was 17-18 million tons from 2013-2015, enough to feed 30-50 million people for a whole year. In 2018, the amount of kitchen waste was over 100 million tons with the daily average nearing 300,000 tons. Researchers estimate that China's annual CO_2 emissions from food calculated over the entire lifecycle stands at 1.605 billion tons. The similar figure would still be as high as 300 million tons even if we assume only a one-fifth food spoilage and waste rate (in comparison the FAO estimates the world average is roughly a one-third spoilage and waste rate).

The SPS is glad to see that the Anti-food Waste Law of China was officially enacted and put into effect on April 29, 2021 as our research proposes policy recommendations on green food consumption. As a green and low-carbon consumption model underpins this law, numerous stipulations have been made for various consumption stages and subjects. The SPS regards the law as being more than a law simply opposing food waste; it is the first of its kind to enhance a green and low-carbon lifestyle in China and should be fully implemented. In specific, four major tasks are needed: first, as green consumption of food involves every household, there should be large-scale and continuous popularization of the law and public and stakeholder awareness raising about the content of the law; second, feasible and detailed rules and regulations must be drafted targeting specific stipulations in the law for its effective implementation; third, relevant government departments, industrial associations and social organizations should take the lead in working with catering enterprises and consumers should exercise self-discipline; fourth, scientific research and data collection and statistical work on sustainable consumption of food should be upgraded with a regular reporting system.

VII. Accelerating and Deepening the Green Consumption Transition: International Experiences

International experiences with promoting sustainable consumption, including the United Nations' 10-Year Framework of Programmes on Sustainable Consumption and Production initiated in 2012, show that past efforts to address sustainability problems have often failed to examine consumption and production processes in their full complexity or across their entire value chain. Innovative business models that follow a system perspective to achieve lower environmental and social impacts are needed to mitigate the increasing demand for products and services. Consumers must also be incentivized to consume at more sustainable levels, with less waste and more focus on product quality and the social and environmental impacts of their purchasing behavior. This requires sustainability considerations at all levels from the setting of green transition visions and pathways through to implementation and the introduction of a broad array of new regulatory and market-based policies and measures as well as educational campaigns.

In the current context of post-corona pandemic recovery and the transition to low carbon development, the following recommendations may be of particular interest for China as it designs its own green transition policies and social governance system.

1. **Follow a holistic approach to support sustainable development, link sustainability to post-corona recovery**

In developing approaches to support sustainable consumption, follow a holistic approach. This means a focus on the complete value chain from material and energy inputs, through to product design and production processes to product use and post-consumption management. Green transition and social sustainability are complex challenges that call for a system perspective. Furthermore, link sustainability to post-corona recovery. Corona recovery plans provide an opportunity to make some of the major infrastructural investments and policy transitions that will be needed for the green recovery. If these recovery funds are directed towards the green transition and the creation of green jobs and green infrastructure, green innovation will flourish.

2. **Demonstrate and foster sustainable lifestyles and education, integrate new digital technologies along products' entire value chains**

Launch campaigns to promote sustainable lifestyles, drawing on the Swedish and Japanese co-led program (2012-22) on sustainable lifestyles and education, which aim at fostering the uptake of sustainable lifestyles as the common norm to address global challenges such as biodiversity conservation, resource efficiency, climate change mitigation, poverty reduction and social well-being. Education for sustainable living for future generations and scenarios for 1.5 degree living in 2050 will be important to realize a green transition and increased well-being. Provide consumers with information about the sustainability of products through websites, educational campaigns, and certification systems and launch educational campaigns to promote sustainable lifestyles as is occurring in international society, including in Japan.

Integrate new digital technologies into production processes along the entire value chain of products to enhance efficiencies. Use internet platforms and social media to disseminate information about the importance of the green transition and steps that can be taken by individuals and businesses to make a difference. A green transition requires an overall digital structural transformation that considers the goals and targets set in Agenda 2030.

3. Make use of green taxation and economic incentives to encourage lifestyle balancing in the post-pandemic future

Make use of green taxation and economic incentives. Tax products with high environmental externalities and provide incentives to promote the purchase of more environmentally sustainable products. Tackle fields which to date have received too little attention in sustainability discussions, such as the food supply system and textiles. These are fields with large ecological footprints. Encourage lifestyle changes that promote greater life-work balance and encourage sustainable enjoyment of nature in the post-pandemic era.

1. Policy Issues with China's Promotion of Green Production and Consumption at the New Development Stage

China has currently entered a stage of high-quality development. At the 5th Plenary Session of the 19th Central Committee of the Communist Party of China (CPC), China's economic and social development goals for the 14th Five-Year Plan (FYP) period has been set up and a blueprint for 2035 drawn up. Promoting a comprehensive transition to green development of economy and society has become an inherent requirement and an inevitable option for China to achieve the ambitious goal of building a modern socialist country in an all-round way. To this end, it is extremely necessary to accurately identify the major issues with China's green production and consumption at the new development stage, and to improve key policies on promoting green production and consumption.

1.1 China's deployment for the green transition at the new development stage

1.1.1 The relations between the new stage, new concept and new pattern, high-quality development, and green development

Since the 18th National Congress of the CPC, the development of socialism with Chinese characteristics has entered a new era, and the Chinese nation has achieved a great leap from standing up to getting rich and getting stronger. The 19th National Congress of the CPC marked a new and higher historical starting point with a two-stage strategic arrangement for the realization of the second centenary goal. At the 5th Plenary Session, the 19th Central Committee of the CPC, it is clearly stated that China should grasp opportunities at the new development stage, thoroughly implement new development concepts, accelerate the construction of a new development pattern, and achieve high-quality development, which is determined by the theoretical, historical and realistic logic of China's economic and social development. The new development stage marks China's progress from building a moderately prosperous society in an all-round way to building a modern socialist country in an all-round way. It is important in China's socialist development and clarifies the historical position of China's development. The new development concepts, which include innovation, coordination, greenness, openness and sharing, are a comprehensive theoretical system that answers a series of theoretical and practical questions on the purpose, motivation, method and path of development, clarifies China's political stance, value orientation, development pattern, development path and other major political issues regarding development, and clarifies the guiding principles of China's modernization drive. Therefore, it is a major strategic task of China to forge a new development pattern featuring dual circulation, in which domestic and overseas markets reinforce each other with the domestic market as the mainstay. To form a new development pattern and implement high-level opening-up, China must have a strong domestic economic cycle system and a solid economic foundation. The key to it lies in the smooth operation of economic cycle with the most essential feature of achieving a high-level self-reliance, which is a clear path of economic modernization for China.

The economic and social development during the 14th FYP period shall be under the theme of promoting high-quality development, which is a scientific judgment based on China's development stage, development environment, and changes in development

conditions. It derives from the following facts of China: China is at the primary stage of socialism and will remain so for a long period of time; China is the largest developing country in the world; and development is the top priority of CPC in governance and nation revitalization. At present, the principal contradiction facing the Chinese society has evolved into the one between unbalanced and inadequate development and the people's ever-growing needs for a better life. The contradictions and problems in development are concentrated in the quality of development, which requires that China put development quality in a more prominent position, and improve the quality and efficiency of development. Therefore, development in the new era and at the new stage must be guided by new concepts and must have high quality.

It is through high-quality development that the people's ever-growing desire for a better life can be met, the new development philosophy be manifested, innovation be the primary driving force, coordination be an endogenous feature, go-green be a prevailing mode, openning-up be the only path; and sharing be the fundamental goal. Therefore, high-quality development is not only high-quality economic development, but also a universal requirement for all aspects and the whole process of economic and social development to implement new development concepts and build a new development pattern at the new development stage.

In short, after building a moderately prosperous society in an all-round way, China should aim for high-quality development in its modernization drive, with go-green as the guiding principle, characteristic and standard. To achieve high-quality development at the new development stage, it is necessary to implement new development concepts and build a new development pattern. These concepts and their logical relationships determine the goals and tasks of China's economic and social development during the 14th FYP period.

1.1.2 China's carbon emissions peak goal and carbon neutrality vision

On September 22, 2020, President Xi Jinping announced at the General Debate of the 75th Session of the United Nations General Assembly that China would scale up its Intended Nationally Determined Contributions by adopting more vigorous policies and measures, and aim to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060. On December 12, 2020, President Xi Jinping announced further commitments for 2030 at Climate Ambition Summit: China would lower its carbon dioxide emissions per unit of GDP by over 65 percent from the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 25 percent, increase the forest stock volume by 6 billion cubic meters from the 2005 level, and bring its total installed capacity of wind and solar power to over 1.2 GW.

Achieving carbon emissions peak and carbon neutrality are a solemn promise made by China to the world, which also means a broad and profound economic and social change. China has committed to moving from carbon peak to carbon neutrality in a much shorter time span than many developed countries might take, and that requires extraordinarily hard efforts from China. The targets of carbon peak and carbon neutrality have been added to China's overall plan for ecological conservation. China is developing an action plan for large-scale in-depth nationwide implementations toward carbon peak. Support is being given to pioneers from localities, sectors and companies. China will strictly control coal-fired power generation projects, and strictly limit the increase in coal

consumption over the 14th FYP period. Moreover, China has decided to accept the *Kigali Amendment to the Montreal Protocol* and tighten regulations over non-carbon dioxide emissions. China has opened its national carbon market for trading.

1.1.3 China's goals and tasks for green and low-carbon development in the 14th FYP period

During the 14th FYP period, the construction of ecological civilization in China has entered a critical period of taking carbon reduction as the key strategy, promoting the synergy of pollution reduction and carbon reduction, facilitating the overall green transition in economy and society, and realizing the qualitive change of ecological environment. It is necessary to maintain strategic resolve and develop economic and social plans from the perspective of the harmonious coexistence of humans and nature in a bid to build a modern pattern of such coexistence by forming a spatial layout, an industrial structure, a mode of production, and a lifestyle that conserves resources and protects the environment, coordinating pollution control, ecological protection and response to climate change, and improving ecological environment constantly.

By 2025, China's green development goal is to achieve new progress in ecological civilization. In specific, land and space development and protection pattern will be optimized; **the green transition of production and lifestyle will achieve remarkable results**; the allocation of energy resources will be more reasonable, the utilization efficiency of energy resources will be greatly improved, the total discharge of major pollutants will continue to decrease, the ecological environment will continue to improve, the ecological security shelter will be firmer, and the urban and rural human settlement environment will be significantly improved. By 2035, **green production and lifestyle will be widely promoted**, carbon emissions will fall steadily after reaching the peak, the ecological environment will be fundamentally improved, and the goal of building a beautiful China will be basically achieved.

Generally speaking, compared with the 13th FYP period, China's economic and social development in the 14th FYP period has entered an in-depth green transition phase, and green production and consumption have entered a substantive stage of implementation. This is also a critical mark of the depth of green transition. In accordance with the current 14th FYP, to promote green production and consumption in an all-round and in-depth manner, it is necessary to put in place more specific supporting action plans and more practical policy measures, have departmental coordination and division of labor, and formulate action plans for key consumption sectors and key production industries as soon as possible, making blueprints for green production and consumption.

1.2 Challenges and opportunities in promoting green production and consumption during the COVID-19 epidemic

1.2.1 Opportunities

It could be said that the COVID-19 pandemic has caused the most serious global economic crisis since World War II or even since the Great Depression, and has also sounded a wake-up call on how humans should deal with their relations with nature. Humans have realized that the best way to deal with such economic and social shocks

in the future is to adjust their economic and social systems for ecological and social sustainability. The outbreak of the epidemic has forced humans to re-examine their lives, desires and development methods. Humans have thus begun to adjust their way of production, living and consumption. As a result, the proportion of material consumption is declining, and that of mental consumption is rising. After the outbreak of the epidemic, the stay-at-home economy and consumption have come into being. Some new forms of consumption have developed rapidly, online consumption has become popular, online video consumption has grown rapidly, and short-video platforms have developed rapidly. The epidemic has had a major impact on the offline traditional retail industry, and accelerated the development of e-commerce and new retail, providing consumers with more choices. The epidemic has struck traditional economy and triggered an enormous demand for "contactless" industries, forming a potential emergence of "contactless" economy. At the same time, it has also reduced environmental pollution and energy consumption, infusing "contactless" economy with green connotation and sustainable development significance.

Since the epidemic, the international community has also begun to accelerate and deepen green transition. For example, the European Union, Germany, Sweden, Japan and other countries and regions are formulating visions and paths of green transition. They adopt green recovery plans to fight with the epidemic. And in fields like low-carbon transition, green travel, circular economy, ecological design and sustainable food, they require to implement the sustainability concept at all levels. Moreover, a large number of new regulatory and market-oriented policies, measures and educational activities have been introduced to promote green recovery.

1.2.2 Challenges

It should also be keenly aware that in response to the economic slowdown caused by the epidemic, countries have introduced or planned to introduce stimulus measures to boost the economy. Although these measures have brought hope and opportunities for green development, great uncertainties still exist. Driven by the pressure of and desire for economic development, once the environmental requirements are loosened, dependence on the path of seeking economic growth at the expense of the environment will increase. This will be a huge challenge to environmental governance, and may even cause the regression of ecological environment quality.

According to data from the National Bureau of Statistics (NBS), China's total energy consumption reached 4.98 billion tons of standard coal equivalent in 2020, a year-on-year increase by 2.2 per cent, of which coal consumption grew by 0.6%. According to *Global Economic Prospects* report published in June 2021 by World Bank, China's growth rate in 2021 is expected to increase to 8.5%, 0.6% higher than that expected by World Bank in *Global Economic Prospects* report published in January. China's recovery has expanded from public investment to consumption, and due to active exports, the formerly suppressed demand has been released after the epidemic has been effectively controlled, with the growth impulse of non-green industries increasing. The development of new business formats during the epidemic, such as express delivery and take-out food, also brings environmental concerns. By September 2020, China has produced 60 billion pieces of packaging waste, which is close to 63.52 billion pieces in 2019. If the rapid growth of packaging waste cannot be effectively controlled, a large amount of resources will be consumed, and a large amount of waste will also be generated.

2. Economic Contribution Analysis and Comprehensive Evaluation of China's Green Consumption

2.1 Empirical analysis of the economic contribution of green consumption

At present, China has undergone profound and unprecedented changes in the structure, pattern, groups and market pattern of consumption. Green consumption has become an important part and characteristic of China's consumption revolution. It can bring about the green reconstruction of the entire industrial chain through the transmission mechanism of the upper, middle and lower reaches of the industrial chain, which will play an important and active role in promoting China's economic reform in quality, efficiency and power, thereby stimulating green and high-quality growth.

2.1.1 Analysis of the status quo of residents' income and outlook for the 14th FYP period

In 2020, China's GDP reached RMB 101.6 trillion. Based on a population of 1.4 billion, the per capita GDP reached RMB 72,600, which was about USD 10,500. In terms of regions, the per capita GDP of Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang and other provinces reached USD 15,000, while that of 20 other provinces and cities did not exceed USD 10,000. Forecasts indicate that, during the 14th FYP period, China's regional development pattern will not have significant change, and the level of local development is expected to improve further. The number of provinces with a per capita GDP of over USD 10,000 will increase to 19, and there will be 12 provinces and cities with a per capita GDP of less than USD 10,000. But that of most provinces and cities will be close to USD 10,000.

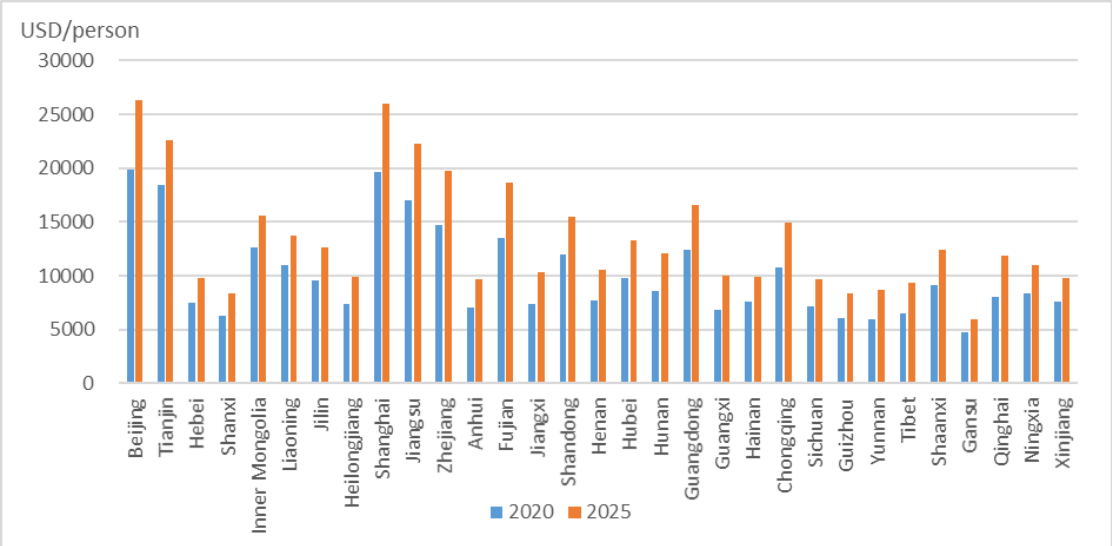

Figure 2-1 Prospects for the trend of per capita GDP by province during the 14th FYP period

It is estimated that the population with an upper-middle income is about 450 million based on the statistical analysis of urban and rural per capita disposable income data (in 2018 and 2019) of 2,851 districts and counties across the country and the corresponding urban and rural population, by selecting districts and counties with a per capita disposable income above the upper-middle-income national standard released by World

Bank (USD 4,000, approximately RMB 28,000), and matching them with corresponding population. Considering that the per capita income is expected to grow up simultaneously with economic development in the 14th FYP period, it is estimated that the size of middle-income population is going to increase by more than 100 million people to 560 million. During the 14th FYP period, China's consumption rate will rise from 54.3% in 2020 to about 60% in 2025, and the investment rate will drop to about 40%. Therefore, on the whole, the continuous increase in people's income will greatly promote the consumption potential of green products. Green consumption in the 14th FYP period is expected to enter a stage of rapid development.

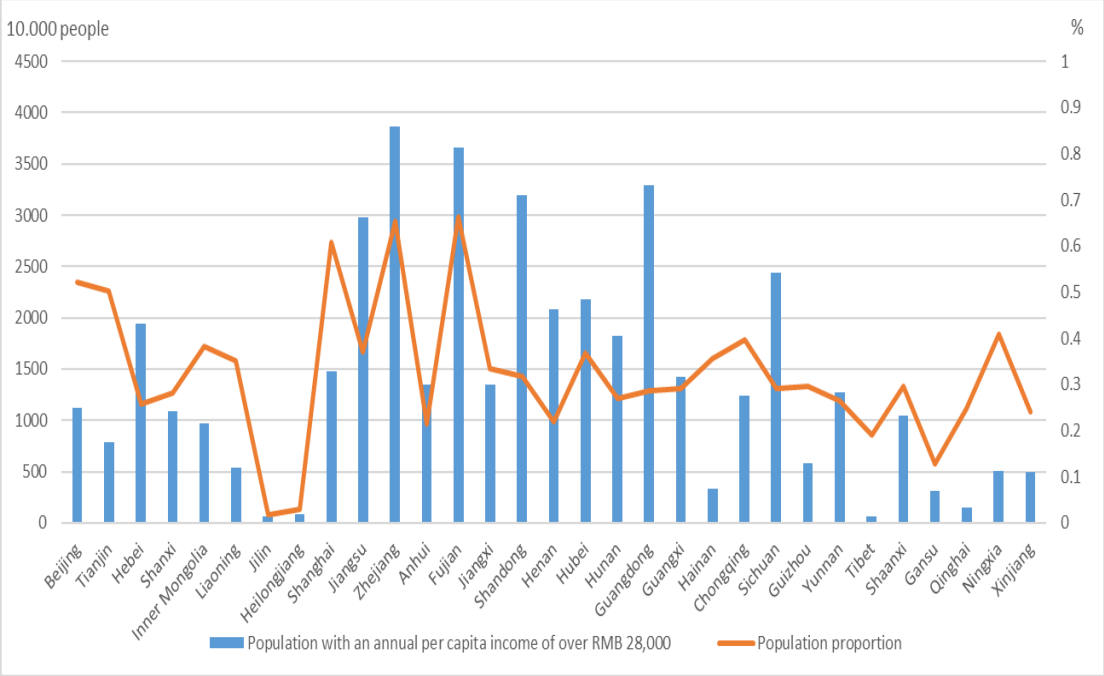

Figure 2-2 Population with an upper-middle income by province

2.1.2 Analysis of the consumption of green products in China

According to a research conducted by the Environmental Development Center of the Ministry of Ecology and Environment (MEE), about 8,800 domestic enterprises have obtained the Environmental Labeling Certification[1] by 2020, and eco-labeling products are mainly distributed in 20 industries, with an output value of over RMB 5 trillion. China's green industry is beginning to take shape.

1 Regarding the scope of environmental protection certification: China Environmental United Certification Center (CEC) is a leading comprehensive certification and service organization in the fields of environmental protection, energy conservation and low-carbon in China, which is approved by the Ministry of Ecology and Environment (MEE) and the Certification and Accreditation Administration. Based on the availability of data, this project defines environmental protection certification mainly based on the Environmental Labeling Product Certification, Green Product Certification, Green Packaging Certification, Organic Product Certification, and China Low-Carbon Product Certification carried out by CEC and carries out related quantitative calculations.

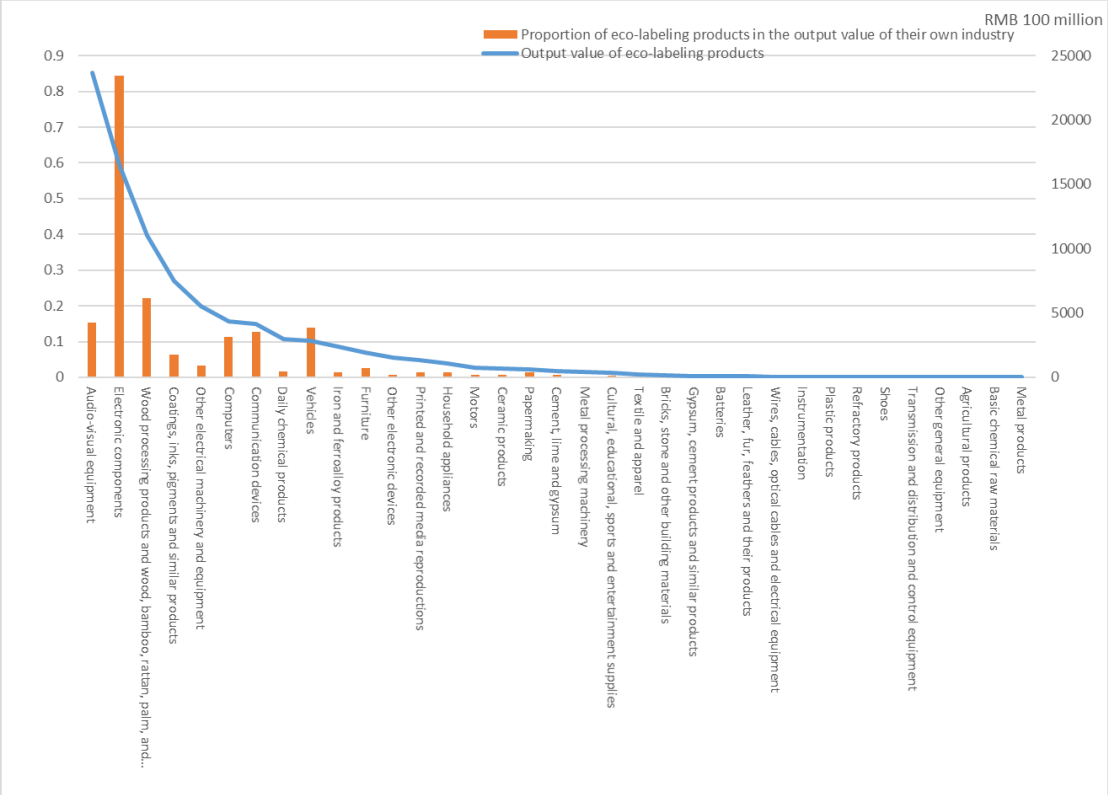

Figure 2-3 Proportion of eco-labeling products in industrial output value

Based on the estimation of 2017 input-output table, the proportion of eco-labeling products used in the final demand is still not high, and they are mainly driven by exports. In general, the proportions of eco-labeling products in final consumption, investment and export in the total output of corresponding sectors are 1.6%, 1.9% and 5%, respectively. Among the final demand, eco-labeling products with the highest proportion in the total final use are audio-visual equipment, and both domestic consumption and exports accounted for 27%. As for products like electronic components, other electrical machinery and automobiles, computers, communication equipment and furniture, their proportions in consumption are far lower than those in exports. This indicates that the production of domestic green products is still mainly driven by exports, rather than domestic consumption and investment.

Table 2-1 Proportions of eco-labeling products in the final use

	Proportion in the final use	Proportion in consumption	Proportion in investment	Proportion in exports
Audio-visual equipment	61.4%	26.7%	7.7%	27.0%
Electronic components	13.7%	0.0%	0.8%	12.9%
Wood processing and wood, bamboo, rattan, palm, and straw products	3.0%	0.8%	0.2%	2.0%
Coatings, inks, pigments and similar products	1.9%	0.0%	0.2%	1.8%
Other electrical machinery and equipment	14.9%	0.2%	0.7%	14.1%
Computers	10.8%	0.8%	1.7%	8.3%

Communication devices	12.6%	2.0%	2.3%	8.3%
Daily chemical products	6.6%	5.3%	0.0%	1.3%
Vehicles	10.1%	2.8%	7.0%	0.3%
Iron and ferroalloy products	0.4%	0.0%	0.0%	0.4%
Furniture	5.6%	1.2%	1.8%	2.7%
Other electronic equipment	0.9%	0.2%	0.7%	0.0%
Printed and recorded media reproductions	0.2%	0.0%	0.0%	0.1%
Household appliances	3.0%	1.2%	0.6%	1.1%
Motors	1.2%	0.0%	0.8%	0.4%
Ceramic products	0.5%	0.1%	0.0%	0.4%
Papermaking	0.1%	0.0%	0.0%	0.1%
Cement, lime and gypsum	0.0%	0.0%	0.0%	0.0%
Metal processing machinery	1.0%	0.0%	1.0%	0.1%
Cultural, educational, sports and entertainment supplies	0.8%	0.2%	0.0%	0.5%
Textile and apparel	0.5%	0.2%	0.0%	0.3%
Bricks, stone and other building materials	0.02%	0.00%	0.00%	0.02%
Gypsum, cement products and similar products	0.00%	0.00%	0.00%	0.00%
Batteries	0.13%	0.02%	0.02%	0.09%
Leather, fur, feathers and their products	0.36%	0.21%	0.00%	0.15%
Wires, cables, optical cables and electrical equipment	0.09%	0.00%	0.03%	0.07%
Instrumentation	0.28%	0.02%	0.08%	0.18%
Plastic products	0.09%	0.01%	0.00%	0.08%
Refractory products	0.03%	0.00%	0.00%	0.03%
Shoes	0.56%	0.34%	0.00%	0.22%
Transmission and distribution and control equipment	0.25%	0.00%	0.11%	0.14%

The CGE model has been applied to simulate the development potential of green consumption products (eco-labeling products). Based on the 2017 input-output table, this research has spined off eco-labeling products and constructed a CGE model that can analyze the economic impact of green consumption. First, the CGE model is used to carry out baseline scenario analysis. Specifically, in accordance with the BAU scenario design idea, the future market size of green consumption goods can be predicted by assuming that no additional subsidy policy is implemented. Preliminary calculations show that the scale of green consumption goods was RMB 2.2 trillion in 2020, and will expand to RMB 3.1 trillion by 2025, an increase of 40% over 2020; by 2035, it will reach RMB 5.6 trillion, which is 2.6 times that of 2020 and is slightly higher than the development rate of doubled per capita GDP.

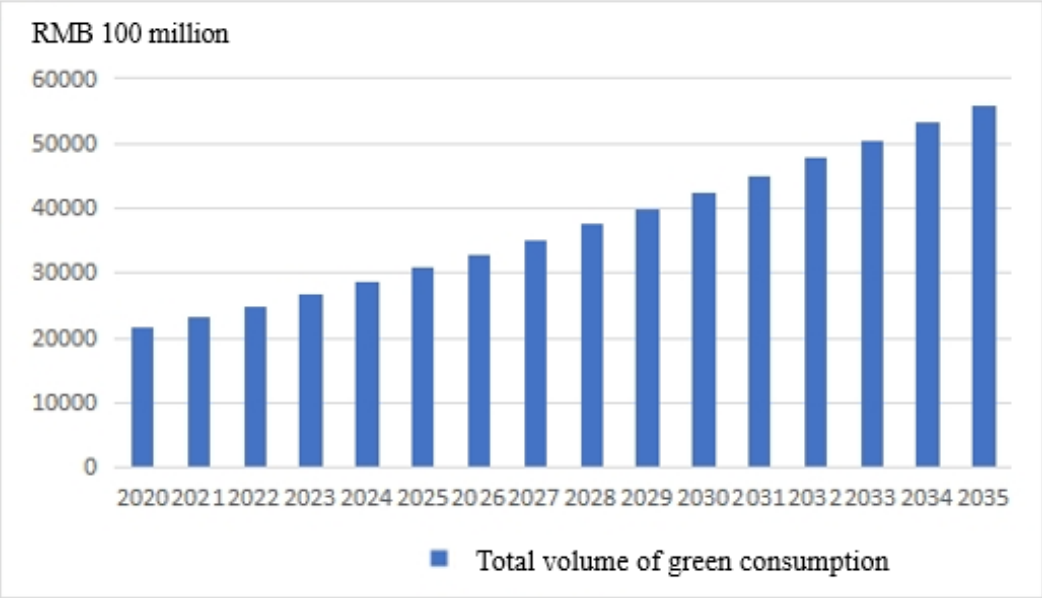

Figure 2-4 Prospects of the growth trend of green consumption in the baseline scenario

2.1.3 Multi-scenario analysis of the potential and impact of green consumption during the 14th FYP period

A policy scenario research is conducted based on the baseline scenario, assuming that the development of green consumption will be boosted by tax cuts for green goods during the 14th FYP period, and focusing on the analysis of the economic stimulus effect of green consumption.

2.1.3.1 Forecast and analysis of green consumption scale

Policy scenario: In order to promote green power consumption, price subsidies for green products used for consumption are the main feasible means. Therefore, this research initially assumes that the pri Total volume of green consumption s will be kept stable basically through consumption subsidies to support green consumption. Specifically, it is assumed that beginning from 2021, China will implement policies and measures to stimulate the development of green consumption: in the 14th FYP period, small-scale subsidies or tax cuts will be frequently provided for green products for consumption every year, so that the prices of green goods will decrease by 2 percentage per year relative to the baseline scenario, which means the prices of green products will remain stable relative to the base year to support green products consumption. The calculation results show that subsidies can effectively expand green consumption; and the scale of green consumption in 2025 and 2035 will reach RMB 3.25 trillion and RMB 5.9 trillion, respectively, an increase of RMB 170 billion and RMB 340 billion compared with the baseline scenario.

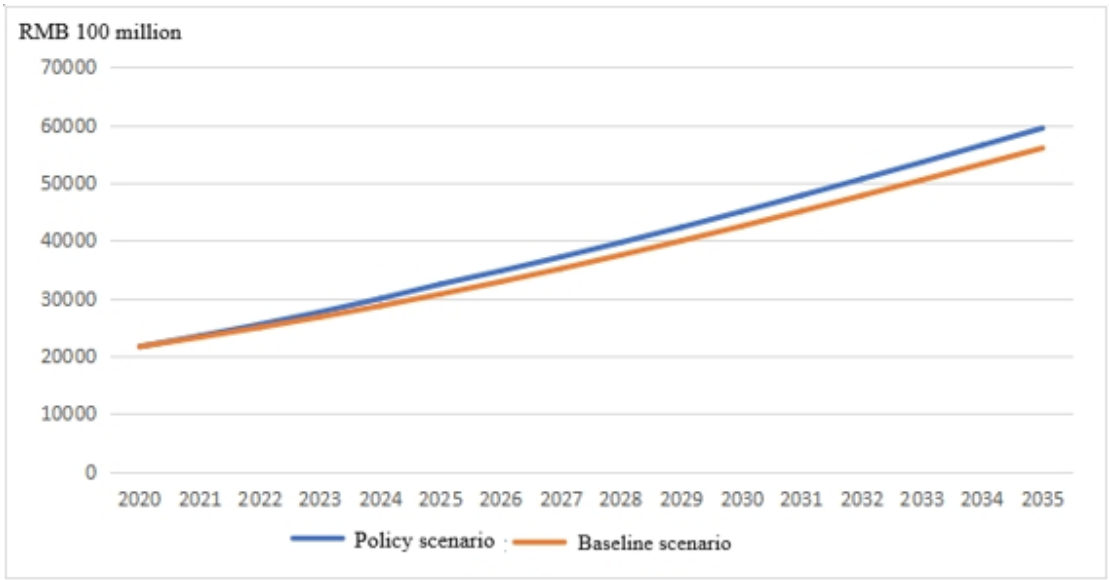

Figure 2-5 The stimulus effect of consumption tax cuts for green products on green consumption

2.1.3.2 The contribution of green consumption to the macro economy

The growth of green consumption has not only expanded the scale of consumption, but also stimulated GDP growth. During the 14th FYP period, the effect of tax cuts will be manifested further, and the scale of household consumption will continue to expand on the baseline scenario, with an increase of 0.2 percentage in 2025. Meanwhile, expanded consumption will substitute export to some effect. In 2025, exports will drop by 0.24 percentage relative to the baseline scenario. Consumption-driven GDP will continue to expand relative to the baseline scenario, with an increase of 0.08 percentage in 2025. After the 14th FYP period, the scale of economic growth will continue to expand due to the technology policies spillover.

Table 2-2 The proportion of macroeconomic variables in the scenario of green consumption tax reduction relative to the baseline scenario (%)

	2021	2022	2023	2024	2025	2030	2035
GDP	0.03	0.05	0.06	0.07	0.08	0.1	0.12
Consumption	0.05	0.10	0.14	0.17	0.20	0.22	0.24
Investment	0.01	0.02	0.02	0.03	0.04	0.06	0.08
Export	0.00	-0.03	-0.08	-0.15	-0.24	-0.20	-0.19
Import	0.03	0.07	0.11	0.16	0.21	0.22	0.20

2.1.3.3. The impact of green consumption on energy conservation and emission reduction

The output of green products in 2025 will increase by RMB 130 billion relative to the baseline scenario, which is slightly less than the increase in consumption, reflecting a certain degree of export-substitution benefits. In 2035, the output of green products will increase by RMB 280 billion relative to the baseline scenario.

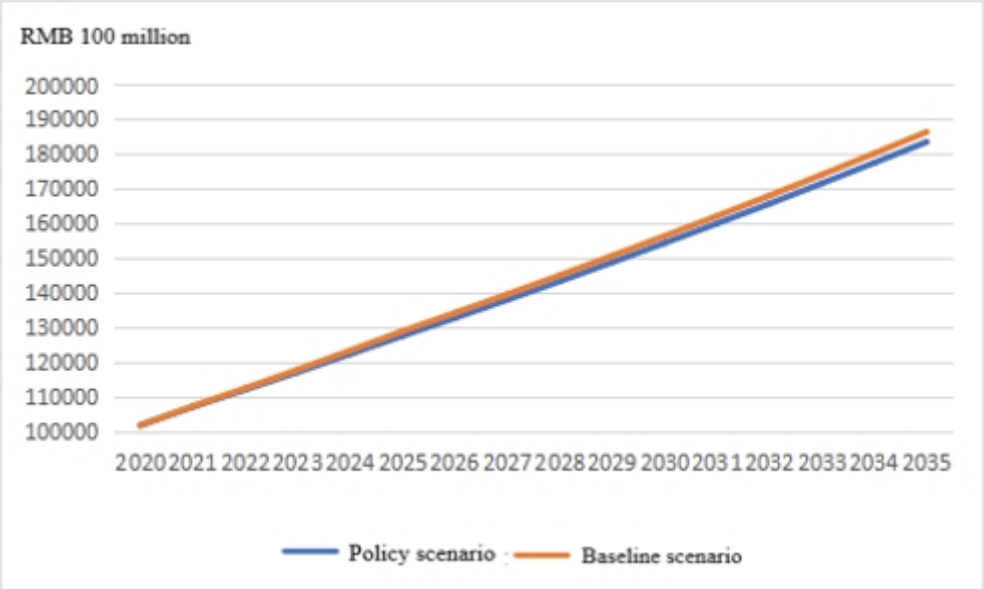

Figure 2-6 The growth trend of green product output under the policy scenario

From the perspective of energy conservation, the promotion of green consumption through subsidies will affect the carbon emission in two ways. On the one hand, the expanded total scale of consumption will increase the scale of output, which will stimulate the increase of carbon emissions; on the other hand, it will promote the go-green shift of consumption structure and reduce the carbon emissions intensity of consumption goods. The combination of both determines the effect of green consumption incentive policies on China's carbon emission reduction. On the whole, the main contradiction lies in the impact of expanded consumption scale in the short term. After the policy of stimulating green consumption is introduced, energy consumption and carbon dioxide emissions will grow slightly in the short term; but in the long term, the effect of optimizing the consumption structure will be stronger, which will generate lasting effect of energy conservation and carbon reduction.

Table 2-3 The impact of tax cut policies for green products on energy demand (%)

	2021	2022	2023	2024	2025	2030	2035
Coal	0.02	0.03	0.03	0.03	0.00	-0.04	-0.05
Oil	0.01	0.02	0.02	0.01	-0.01	-0.02	-0.04
Natural gas	0.01	0.01	0.01	0.00	-0.01	-0.07	-0.12
Electricity	0.02	0.03	0.03	0.03	0.03	-0.02	-0.05

2.1.4 Summary

Currently, about 450 million people in China have reached the upper-middle income level. As the per capita income during the 14th FYP period is expected to increase along with economic development, it is estimated that the size of middle-income population is going to increase by more than 100 million to 560 million. The continuous increase in people's income has greatly enhanced the consumption potential of green products.

At present, the development of China's green product industry is mainly driven by

exports. In the future, as the income increases, the potential of domestic green consumption will increase substantially and lay a foundation for the transition of domestic green product industry from being driven by export to being driven by both export and domestic consumption.

In order to increase the consumption of green products, subsidies in the consumption are effective. Thus, appropriate subsidy policies may be introduced during the 14th FYP period to increase the consumption of green products. In terms of specific measures, it is recommended to frequently provide continuous small-scale subsidies to steadily cultivate the green product market.

2.2 Construction and comprehensive evaluation of China's green consumption index

To measure the level and extent of green consumption in different regions, identify shortcomings and deficiencies in green consumption development, and promote the overall green transition of social development, it is necessary to construct a green consumption composite index, form a systematic quantitative evaluation system, and scientifically evaluate the level of green consumption in different regions.

2.2.1 Construction of green consumption composite index in China

2.2.1.1 Construction principles

This study defines residents as the behavioral agent of green consumption, focuses on the use and disposal of products and service consumption, as well as the impact on the economy, society, resources and the environment. The basic principles of construction include:

Scientificity. The design of each indicator should have clear practical significance, and can ensure that evaluation methods are scientific, and evaluation results are authentic and objective.

Independence. The selected indicators should be independent at the same level, have no causal relations, and do not overlap with each other.

Policy-relevance. The selected indicators must not deviate from the green consumption policy, and they can trace, guide and reflect the effect of the policy.

Data availability. The acquisition of data needs to be realistic and feasible for operability, and ultimately facilitate the scientific evaluation of green consumption level in China.

2.2.1.2 Framework of core indicators

According to the above construction principles, the study constructed the following indicator system (see Table 2-1). The indicators selected are comprehensive and reflect the impact of consumption behavior on the environment and energy resource consumption, including four reverse indicators, i.e., domestic carbon dioxide emissions, domestic electricity consumption, domestic water consumption, and domestic waste

collection, and three positive indicators, i.e., per capita park and green land area, passenger capacity of urban public transport per 10,000 population, and per capita urban investment in environmental infrastructure. The former indicators are used to reflect the resource and environmental impact of consumption, and the latter are used to reflect the efforts made to promote green consumption.

As green consumption is based on a certain standard of living, in order to eliminate the incomparability of green consumption caused by differences in the income levels of different regions, the reverse indicators are readjusted accordingly, and they are determined as per capita domestic carbon dioxide emissions per RMB 10,000 of consumption expenditure, per capita daily electricity consumption per RMB 10,000 of consumption expenditure, per capita daily domestic water consumption per RMB 10,000 of consumption expenditure and per capita domestic waste collection amount per RMB 10,000 of consumption expenditure in cities and towns.

Table 2-4 Green consumption indicator system

No.	Indicators	Type of Indicator
1	Per capita domestic carbon dioxide emissions per RMB 10,000 of consumption expenditure (kg)	Reverse
2	Per capita daily electricity consumption per RMB 10,000 of consumption expenditure (kilowatt-hour)	Reverse
3	Per capita daily domestic water consumption per RMB 10,000 of consumption expenditure (litre)	Reverse
4	Per capita domestic waste collection volume per RMB 10,000 of consumption expenditure (kg)	Reverse
5	Per capita park and green land area (m^2)	Positive
6	Passenger capacity of urban public transport per 10,000 population (10,000 passengers/10,000 persons)	Positive
7	Per capita urban investment in environmental infrastructure (RMB)	Positive

Source: Official website of National Bureau of Statistics and statistical yearbooks of various provinces (cities, districts).

Note: Per capita urban investment in environmental infrastructure construction includes investment in gas, drainage, landscaping, city appearance and sanitation, etc., but does not include that in central heating. Due to the lack of data on the amount of waste generated, the amount of waste collection is used instead.

2.2.1.3 Core construction methods

The value of each statistical indicator is standardized, and the extremum method is used to calculate the individual indexes. Each statistical indicator is scored by the centesimal system. The calculation formula is:

$$\text{Positive indicator: } Y_i = \frac{[X_i - \min(X_i)]}{[\max(X_i) - \min(X_i)]} \times 40 + 60$$

$$\text{Reverse indicator: } Y_i = \frac{[\max(X_i) - X_i]}{[\max(X_i) - \min(X_i)]} \times 40 + 60$$

Specifically, *Yi* is the individual index of the i^{th} indicator, *Xi* is the statistical value of the indicator, min (*Xi*) is the minimum value of the statistical indicator, and max (*Xi*) is the maximum value of the statistical indicator.

The objective weighting method, i.e., the entropy weight method, is used to determine the indicator weight. In accordance with the first-level indicators and their assigned weights, the synthetical index method is used to calculate the green consumption composite index of each province, which is:

$$Z = \sum_{j=1}^{n} W_j F_j$$

Specifically, Z is the green consumption composite index, *Fj* is the index value of the j^{th} first-level indicator, *Wj* is the weight of each first-level indicator, and n is the number of first-level indicators. **The index reflects the overall green consumption level in the region. The larger the index, the higher the level of green consumption.**

2.2.2 Empirical evaluation of China's green consumption index

China's provinces (cities, districts) differ greatly in the degree of economic development, urbanization rate, income level and consumption habits, and even the urban and rural areas of the same province (city, district) differ in consumption environment and lifestyle. Therefore, in order to avoid consumption differences between urban and rural areas, this study selected three municipalities directly under the central government, i.e., Beijing, Tianjin, and Shanghai for regional comparison, to initially measure the differences of different regions in the green consumption level.

Table 2-5 Statistics on consumption-related indicators of Beijing, Shanghai, Tianjin and the whole country in 2020

	Beijing	Shanghai	Tianjin	Country
Built-up area	1268	1563	605	---
Permanent population (ten thousand people)	2189.3	2487	1386.60	---
Per capita GDP (RMB ten thousand)	16.49	15.56	9.1	7.24
Per capita disposable income of residents	69434	72232	43854	32189
Per capita disposable income of urban residents	75602	76437	47659	43834
Per capita consumption expenditure of residents	38903	42536	28461	21210
Per capita consumption expenditure of urban residents	41726	44839	30895	27007
Climatic conditions	It lies in the warm temperate zone and has a semi-humid and semi-arid monsoon climate, with high temperature and much rainfall in summer; cold and dry in winter; with short	It has a subtropical monsoon climate with distinct seasons, abundant sunshine and rainfall. It has a mild and humid climate, with short spring and autumn and long winter and summer.	It lies in the warm temperate zone and has a semi-humid monsoon climate, with distinct seasons, windy and dry in spring, with little rainfall; hot in summer, with concentrated	

	spring and autumn.		rainfall; cool in autumn, with moderate temperature; cold and dry in winter, with little snow.	
Geographical conditions	It is located in the northern part of China's North China Plain. It is surrounded by mountains on the west, north and northeast and has a plain sloping gently towards Bohai Sea on the southeast.	It is located in East China, on the western coast of the Pacific Ocean and the eastern coast of the Asian continent. It is the center of the northern and southern coasts of China, and the confluence of the Yangtze River and the Huangpu River. It is part of the alluvial plain of the Yangtze River Delta.	It is located in the northern part of the North China Plain, with Bohai Sea in the east and Yan Mountains in the north. It is dominated by plains and depressions, with hills in the north, and falls gradually from north to south.	

The urbanization rates of the three cities have all exceeded 80%, and their economic development levels are relatively high and similar, which can avoid to a certain extent the impact of inconsistency caused by urban and rural differences in green consumption evaluation and those in the income level. Specifically, in terms of city size, Shanghai ranks first, with a relatively large amount of total consumption, as well as a high per capita disposable income and per capita consumption expenditure. In terms of consumption stage, Shanghai is leading. Beijing has the highest per capita GDP and leads in the level and extent of development, while Tianjin is relatively weak in the development level and residents' income and expenditure (Table 2-2).

2.2.2.1 Green consumption composite index

Observed from changes in the green consumption composite index, the indexes of the country, Beijing, Tianjin and Shanghai all showed a rising trend in fluctuation. The growth rate began to slow down after 2014, reached a peak between 2015 and 2017 and fluctuated below this level (Figure 2-1). An analysis of relevant indicators reveals that

after 2014, indicators that are "unfavorable" to green consumption, like the per capita domestic electricity consumption, have grown rapidly, while the growth rate of positive indicators such as per capita green land area and per capita investment in environmental protection infrastructure has slowed down. The two types of indicators run in parallel, and jointly bring about a slowdown or even a decline in the growth trend of green consumption composite index.

A comparison of different cities indicates that Beijing's green consumption composite index has always been at a leading level; the index of Tianjin is basically comparable with the national average; the index of Shanghai is slightly higher than the national average and that of Tianjin, and is lower than that of Beijing. In terms of specific indicators, Beijing's per capita park and green land area and per capita investment in environmental infrastructure have contributed significantly to the level of green consumption. Tianjin's domestic carbon dioxide emissions and public transport have lagged the city's green consumption level. The three cities have showed no significant differences in other indicators (Table 2-3).

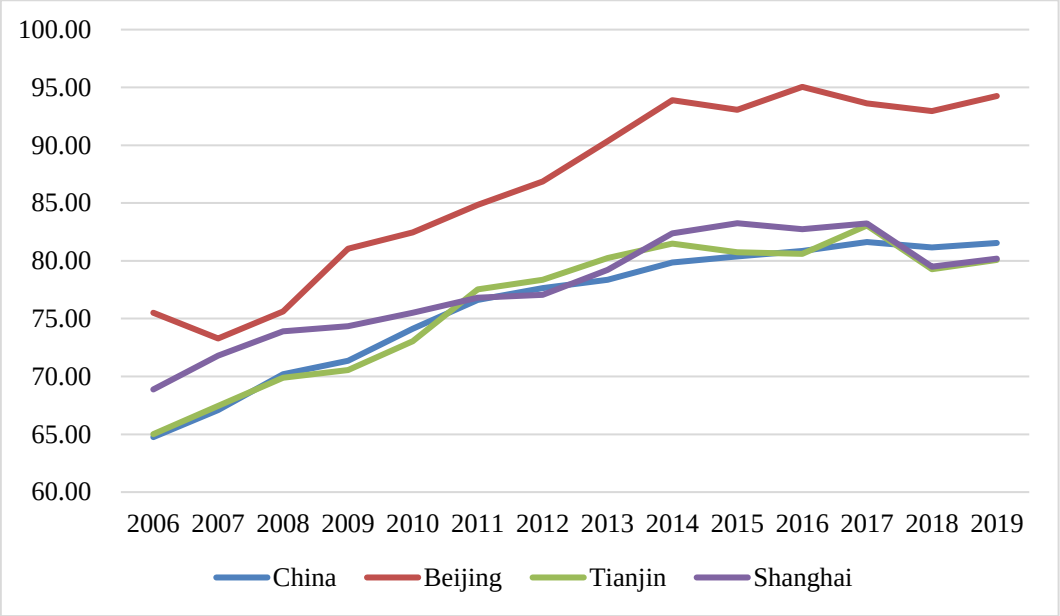

Figure 2-7 Changes in the green consumption composite index (2006-2019)

Table 2-6 Green consumption composite index (2006-2019)

Year	Country	Beijing (BJ)	Tianjin (TJ)	Shanghai (SH)	Rank
2006	64.76	75.51	65.01	68.88	BJ＞SH＞TJ＞Country
2007	67.09	73.29	67.46	71.81	BJ＞SH＞TJ＞Country
2008	70.19	75.63	69.88	73.92	BJ＞SH＞Country＞TJ
2009	71.36	81.05	70.55	74.34	BJ＞SH＞Country＞TJ
2010	74.12	82.45	73.04	75.50	BJ＞SH＞Country＞TJ
2011	76.62	84.84	77.52	76.82	BJ＞TJ＞SH＞Country
2012	77.64	86.87	78.35	77.06	BJ＞TJ＞Country＞SH
2013	78.37	90.35	80.23	79.22	BJ＞TJ＞SH＞Country
2014	79.85	93.91	81.50	82.38	BJ＞SH＞TJ＞Country
2015	80.39	93.06	80.75	83.26	BJ＞SH＞TJ＞Country
2016	80.86	95.05	80.60	82.75	BJ＞SH＞Country＞TJ

Year	Country	Beijing (BJ)	Tianjin (TJ)	Shanghai (SH)	Rank
2017	81.63	93.61	83.06	83.23	BJ＞SH＞TJ＞Country
2018	81.16	92.96	79.29	79.50	BJ＞Country＞SH＞TJ
2019	81.54	94.27	80.08	80.20	BJ＞Country＞TJ＞SH
Average	76.11	86.63	76.24	77.78	BJ＞SH＞TJ＞Country

2.2.2.2 Analysis of green consumption indicators

(1) Per capita domestic carbon dioxide emissions per RMB 10,000 of consumption expenditure. On the whole, this indicator shows the impact of consumption on resources and the environment. In the ranking, Tianjin takes the lead, followed by Beijing, the country and Shanghai, and their differences are obvious. To a certain extent, carbon dioxide emissions in the domestic field are attributed partly to the intensity of energy use in life, and the difference in domestic energy use is mainly manifested in changes in the consumption structure, which indirectly reflects differences in the consumption stage. Tianjin has relatively high consumption intensity in household appliances, construction, transport and other sectors, while Beijing and Shanghai have relatively high consumption intensity in leisure, entertainment, culture and education, which causes their differences in this indicator (Figure 2-2).

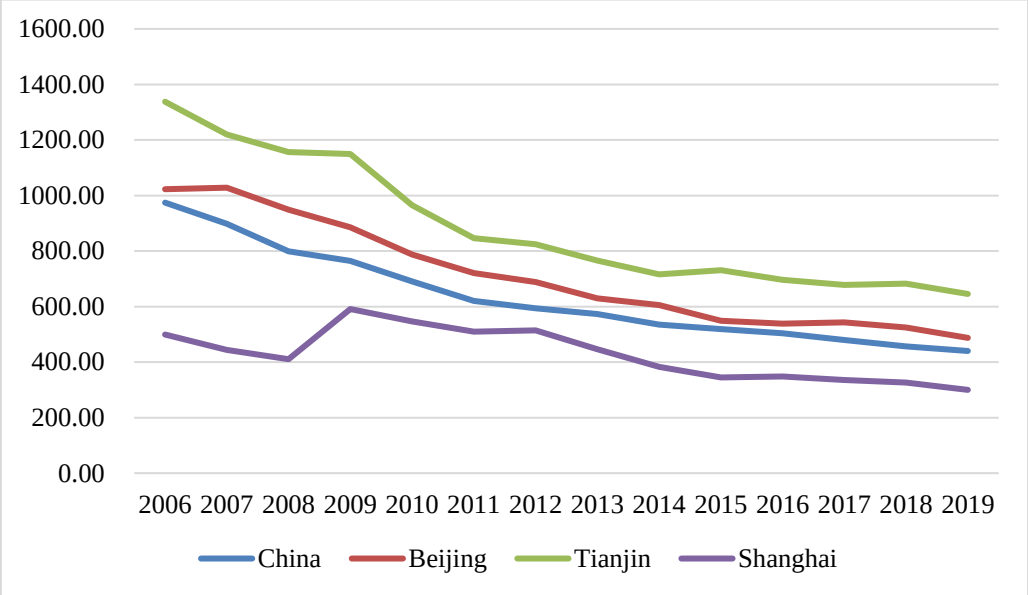

Figure 2-8 Changes in per capita domestic carbon dioxide emissions per RMB 10,000 of consumption expenditure (2006-2019)

(2) Per capita daily electricity consumption per RMB 10,000 of consumption expenditure. There is no significant difference among the three municipalities in terms of domestic electricity intensity, and this indicator has little impact on the ranking of the green consumption composite index. In terms of time series, in recent years, both per capita consumption expenditure and per capita daily electricity consumption have shown a trend of relatively high growth, with the per capita daily electricity consumption per unit of consumption expenditure slowing down in decline and even picking up (Figure 2-3).

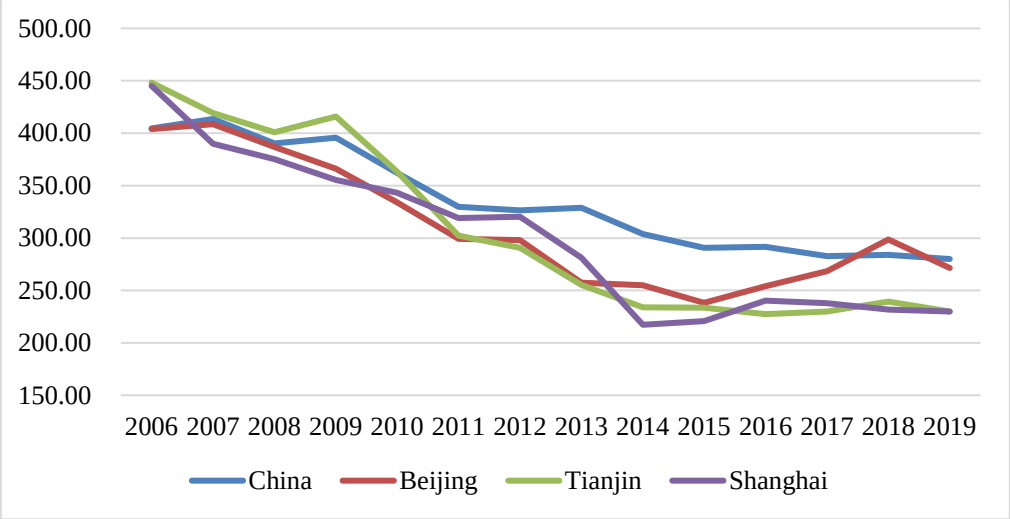

Figure 2-9 Changes in per capita daily electricity consumption per RMB 10,000 of consumption expenditure (2006-2019)

(3) Per capita daily domestic water consumption per RMB 10,000 of consumption expenditure. On the whole, the levels of Tianjin, Beijing and Shanghai are significantly lower than the national average. In comparison, this indicator has significantly lowered the national average green consumption composite index, partly because the urbanization level of the three cities is significantly higher than that of the whole country, while the per capita daily domestic water consumption of urban areas is more intensive than that of rural areas. (Figure 2-4).

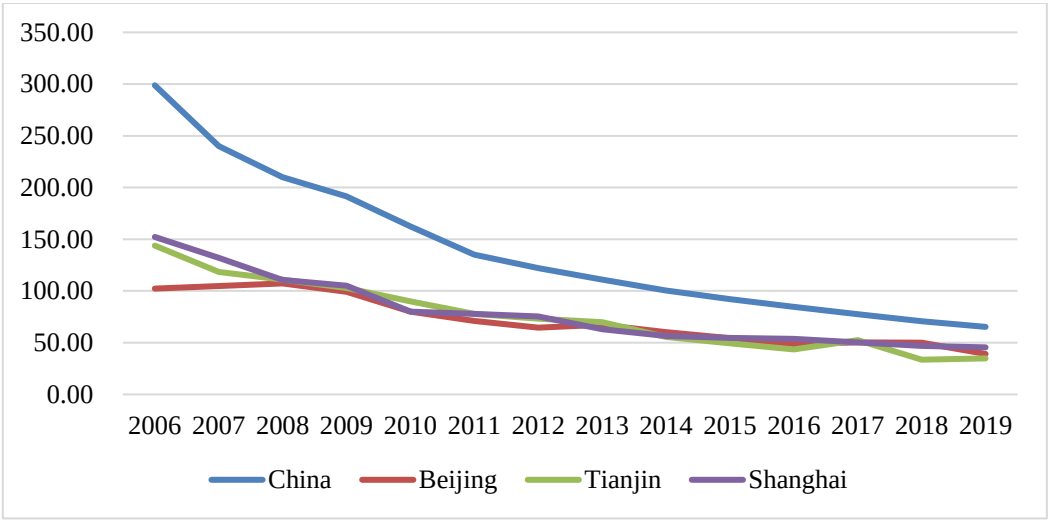

Figure 2-10 Changes in per capita daily domestic water consumption per RMB 10,000 of consumption expenditure (2006-2019)

(4) Per capita daily domestic waste collection volume per RMB 10,000 of consumption expenditure. Compared with the national average, the volume of Beijing is significantly higher, that of Tianjin is significantly lower, and that of Shanghai is basically the same with it. When the consumption level is similar to the consumption structure, this indicator usually shows differences in consumption behavior. Beijing produced more per capita domestic waste, which also indicates that its consumption

behavior was more extensive and not green (Figure 2-5).

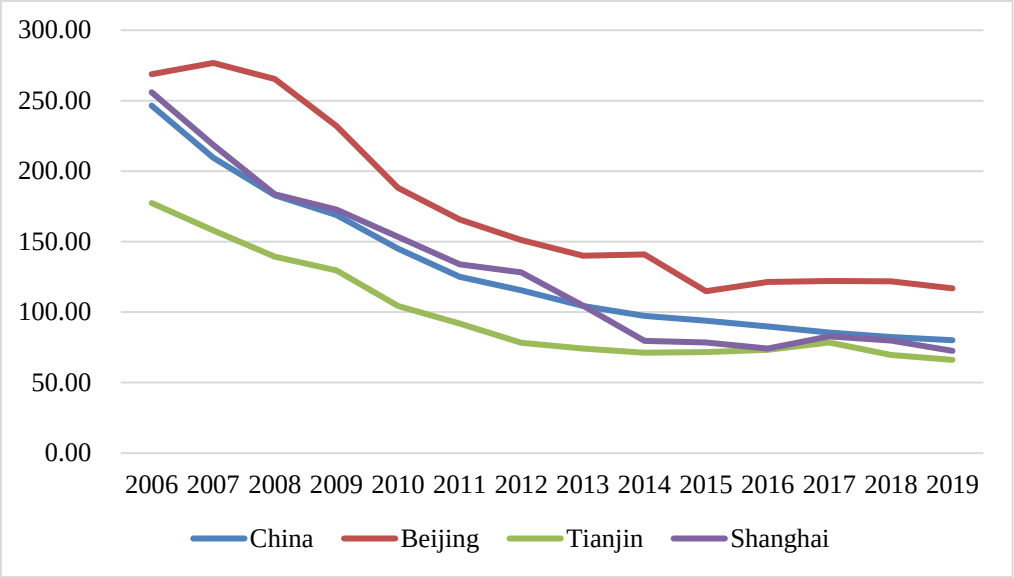

Figure 2-11 Changes in the per capita daily domestic waste collection volume per RMB 10,000 of consumption expenditure (2006-2019)

(5) Per capita park and green land area. In general, this indicator shows an upward trend. Studies show that Beijing gyrated up and is slightly higher than the national average, while Tianjin and Shanghai are significantly lower than the national average, reflecting to some extent the insufficient supply of per capita public green land in the two cities (Figure 2-6).

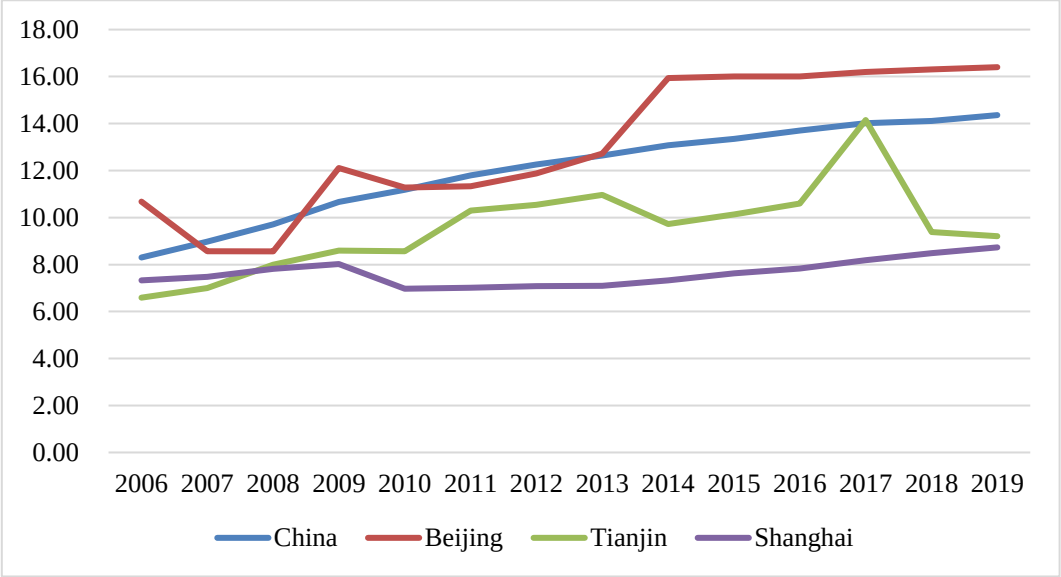

Figure 2-12 Changes in per capita park and green land area (2006-2019)

(6) Passenger capacity of urban public transport per 10,000 population. This indicator varies greatly among cities, and contributes a lot to the difference in the green consumption composite index. Statistics show that Beijing is much higher than other regions and the national average, followed by Shanghai, and Tianjin is slightly higher than the national average. This indicates the higher degree of green public transport in

Beijing and Shanghai (Figure 2-7).

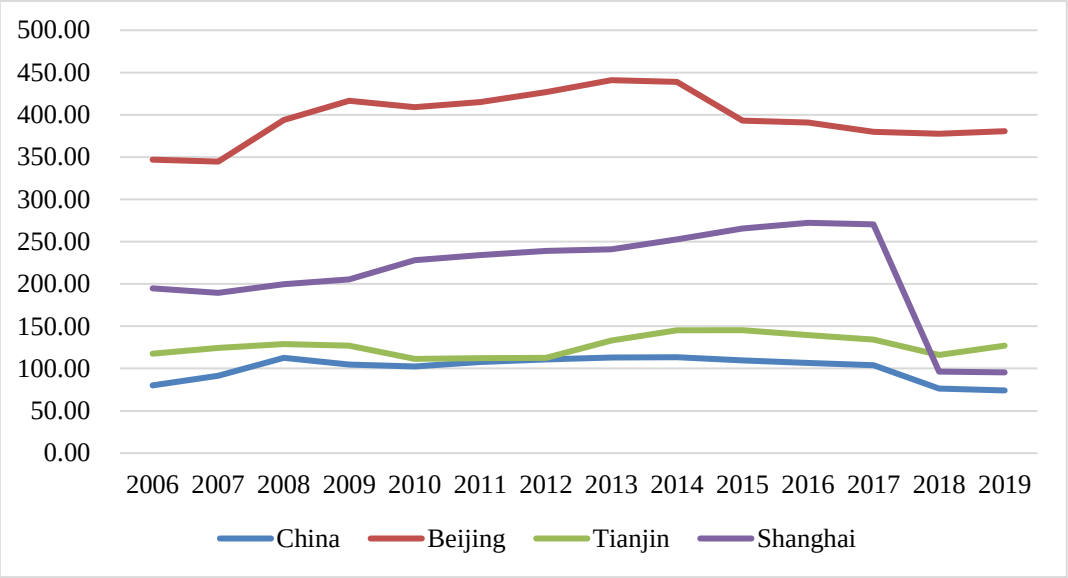

Figure 2-13 Changes in passenger capacity of rural public transport per 10,000 population (2006-2019)

(7) Per capita urban investment in environmental infrastructure construction. This indicator reflects the supply capacity of urban green infrastructure: the higher the supply capacity of green infrastructure, the more conducive to the formation of green consumption patterns, and the more conducive to mitigating the impact of consumption activities on resources and the environment. After 2010, the steep increase in investment in environmental infrastructure construction in Beijing has significantly enhanced Beijing's green consumption composite index (Figure 2-8).

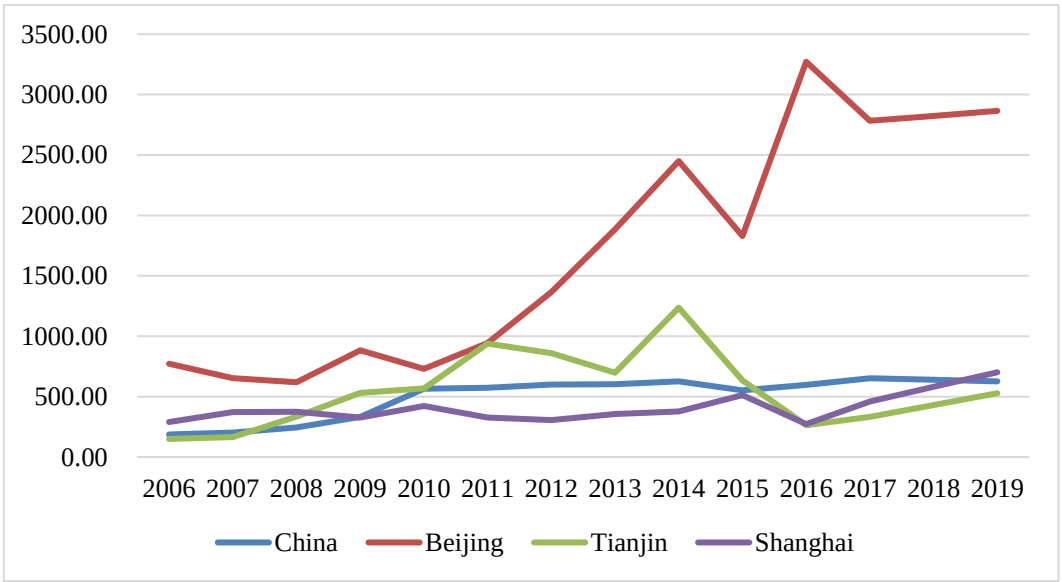

Figure 2-14 Changes in per capita urban investment in environmental infrastructure construction (2006-2019)

2.2.3 Summary

Based on the construction and analysis of the green consumption index, the main conclusions are as follows: First, the index is on the rise in general. However, with the accelerating upward trend of per capita domestic electricity consumption, per capita domestic energy consumption and other indicators since 2014, the upward trend of the comprehensive green consumption level has slowed down. Second, in comparison, Beijing showed obvious advantages in the supply of per capita park and green land, the go-green degree of urban public transport, and the supply of public environmental infrastructure, which contributed to Beijing's overall higher level of green consumption; Tianjin performed poorly in the per capita domestic carbon dioxide emissions per RMB 10,000 of consumption expenditure, but well in the per capita daily domestic water consumption per RMB 10,000 of consumption expenditure; Shanghai performed well in the per capita domestic carbon dioxide emissions per RMB 10,000 of consumption expenditure, but poorly in per capita park and green land area and per capita urban investment in environmental infrastructure.

For the construction and evaluation of the green consumption composite index, relevant scholars have carried out some researches, and improved the evaluation instruments and methods. However, most of these researches are restricted by the availability and relevance of data, which is related to the overall weak level in the collection, monitoring and analysis of green consumption-related statistical data. During the 14th FYP period and even a long period in the future, the green transition of China's consumption field is still facing huge challenges. The establishment of statistical and monitoring systems for relevant data is the top priority of future green consumption evaluation. The enlightenment to policy of this study is that in order to promote the green transition of social consumption at various local levels in the country, efforts need to be made in three aspects. Firstly, long-term strategic targets need to be formulated to promote green consumption and target-based indicators need to be prioritized in accordance with the current green consumption policy and practice progress and the requirements of future economy for achieving green transition and high-quality development. Secondly, it is necessary to formulate a local green development indicator system and a monitoring and evaluation system to provide a scientific basis for the decision-making of government departments, and establish a sound green consumption policy system with incentives and constraints, to accelerate the green transition of consumption. Thirdly, it is necessary to form a differentiated path to green consumption and clarify targeted key areas and tasks in accordance with the socio-economic development level and the current consumption stage of regions, to promote the transition of consumption patterns towards green and low-carbon conservation.

3. Case Studies on Green Production and Consumption Industries and Fields in China

3.1 The green tax system of China's automobile industry based on carbon neutrality

Automobiles are a pillar industry of China's national economy, and China's automobile production and sales have ranked first in the world for 12 consecutive years. Although the industry and supply chain have been shocked by COVID-19 in 2020, the growth rate of production and sales has begun to pick up gradually since March, and the annual accumulative production and sales have exceeded 25 million, due to the improved epidemic prevention and control situation, and continuous support of consumption promotion policies and measures. Moreover, the automobile industry is an important sector of energy consumption and greenhouse gas emissions: transport is a sector that consumes relatively high fossil fuels, with the consumption of gasoline and diesel accounting for 46% and 68% of the country's total consumption respectively (data of 2018 from NBS); the carbon emissions of automobiles account for about 7.5% of the country's total (most of which come from fossil energy such as gasoline and diesel consumed in the operation and use of automobiles). Therefore, effective control of total carbon emissions in the automobile industry is particularly important for China to reach carbon emissions peak and to achieve carbon neutrality as soon as possible.

The project of last year firstly clarified the strategic position of automobiles in green consumption and production, referred to the performance evaluation methods of new energy vehicles at home and abroad, and found the ecological benefits of new energy vehicles in CO_2 emissions and energy consumption. Secondly, from top-level design, consumption and production, it analyzed the status of domestic and foreign policies and the main problems with China's policies. Finally, based on the previous research, it proposed a policy system for promoting green consumption and production in the automobile industry from the following aspects, i.e., top-level design, production, purchase, use, scrappage and recycling. The policy system includes the establishment of a green tax system for car products, the improvement of incentive policies for energy-saving and new energy vehicles, the promotion of research on the alternative technologies of HFC refrigerants in air-conditioning, the improvement of policies and regulations for the remanufacturing of auto parts, and the promotion of industry norms and sustainable development of the recycling and utilization of power batteries.

Based on the previous year's research, this year's research project organically combines the goal of carbon neutrality with the reform of vehicle tax system, focuses on the green tax system, and studies and proposes policies and measures to promote the green and low-carbon development of the automobile industry through the green tax system.

3.1.1 Problems in China's policy on promoting green and low-carbon development in the automobile industry

China has basically established a policy system to promote the green and low-carbon development of the automobile industry. In terms of production, China has successively promulgated the *Law on the Prevention and Control of Environmental Pollution by Solid Waste*, *Law on Promoting Clean Production*, *Circular Economy Promotion Law* and other laws to put forward requirements on reducing pollution at the source,

improving resource utilization efficiency, and producer responsibility, and successively introduced a series of relevant policies and standards. In terms of consumption, China has basically established several policy systems to promote green consumption, covering tax policies, fiscal subsidies and transport policies. Among them, fiscal subsidies include vehicle purchase subsidies, urban bus operation subsidies, charging infrastructure rewards and subsidies, and relevant supporting fiscal subsidies provided by local governments. Overall, China is accelerating the development of new energy automobile industry through the joint force of central and local finance. Tax policies mainly use the tax leverage to guide automobile consumption and adjust product structure, including the formulation of differentiated tax rates and the implementation of preferential tax policies for new energy vehicles. Transport policies are mainly local policies. They aim to enhance the convenience of energy-saving and new energy vehicles and reduce the cost of use. For purchase, they include preferential licenses and preferential insurance fees. For transport, they include preferential road and bridge tolls, high-speed tolls, and parking fee reduction and exemption discounts, road rights convenience privileges, parking convenience privileges, etc.

However, the current policies need improvement because they have failed to play a guiding role in green and low-carbon development. First, they lack systemic coordination and long-term planning. The green consumption and production policies of the automobile industry have not been planned in a unified manner, and a policy system covering laws, regulations, standards and technical specifications is still not in place. Moreover, these policies involve multi-department coordination for which various supporting policies are not systemic and coordinated. In addition, production and consumption policies have not been organically combined. Second, incentives are not in place to encourage the use of environment-friendly refrigerants. At present, automobile manufacturers in China have failed to recognize the social significance of the use of environment-friendly air-conditioning refrigerants and emission reduction, and a financial mechanism for phasing out HFCs has not been established. Third, the extended producer responsibility system has not yet been implemented. Operational difficulties in dismantling have also prevented producers from performing their responsibilities. **Fourth**, a green consumption policy that combines rewards and punishments has not yet been established. China's early-stage green consumption guidance policy measures focus on incentive mechanisms, including fiscal subsidies or tax reductions, which requires direct or indirect input, and a long-term benign mechanism for guiding green consumption has not yet been formed.

3.1.2 Tax reform design for the green and low-carbon development of the automobile industry

To solve the above-mentioned four problems in the green and low-carbon development of the automobile industry of China, especially the latter three problems, the green tax system must be reformed, which has a traction effect and multiple benefits. Based on policy effects and implementation characteristics, policy design should focus on tax policies, with fiscal subsidy policies as an effective supplement for joint promotion. Specifically:

First, putting in place fiscal and taxation policies that encourage the development and application of non-HFC alternatives and alternative technologies. The promotion of environment-friendly air-conditioning refrigerants can be guided by the

implementation of preferential tax policies for energy-saving and new energy vehicles. At present, the *Limits and Measurement Methods for Emissions from Light-Duty Vehicles (CHINA 7)* are being formulated, and greenhouse gases are an important object to control. In the future, preferential policies for passenger vehicle purchase tax and consumption tax can be implemented based on emissions and fuel consumption indicators. For vehicles that meet the target values of fuel consumption and emission requirements (including refrigerant emission requirements) in advance, tax incentives will be offered based on the number of years for meeting the targets in advance. Moreover, efforts should be made to directly "encourage the use of energy-saving and environment-friendly technologies and products such as environment-friendly refrigerants", while drawing on the mode of the *Notice on Implementing Popularization Work of Energy Saving and Environment-Friendly Vehicles with 1.6 Liters or Less*.

Second, promoting preferential tax policies for the establishment of an extended producer responsibility system. In view of difficulties in obtaining VAT input invoices and the limited amount of input tax that can be deducted in the scrappage and recycling of automobiles, a simplified collection method can be implemented. In response to the problems of high investment in advanced technology and equipment for recycling and dismantling scrapped vehicles, and long investment return periods, corporate income tax can be reduced for enterprises with high investment in environmental protection and meeting relevant review requirements. In order to encourage enterprises that recycle and dismantle scrapped vehicles to improve environmental protection, increase the recycling price, reduce the flow of scrapped vehicles into the illegal market, and increase the overall recycling rate of vehicles, policies for weighted tax deduction of R&D expenses can be referred for implementation, and the actual amount of corporate income tax may be deducted by half in the calculation of the amount of taxable income.

Third, implementing reward and penalty tax policy for car products. While ensuring the overall balance of automobile taxation, efforts should be made to optimize and adjust the existing vehicle tax system to strengthen the regulation of existing taxes on energy conservation and environmental protection. In the design of policy, short-term and long-term goals should be combined, and policy implementation stages should be set based on industrial competitiveness and development level. From 2021 to 2025, continued efforts should be made to implement the current vehicle purchase tax exemption policy for new energy vehicles and phase out the policy; from 2026, preferential policies for vehicle purchase tax and consumption tax based on energy efficiency indicators will be introduced. In terms of energy efficiency indicators, China has formulated, released and implemented a series of standards on the test methods, limits and labels of automobile fuel consumption, including *GB 19578 Fuel Consumption Limits for Passenger Cars* and *GB 27999 Fuel Consumption Evaluation Methods and Targets for Passenger Cars*. Moreover, China has established a relatively complete fuel consumption standard system for passenger vehicles, had a certain foundation in incorporating the fuel consumption indicators of passenger vehicles into the vehicle tax system and implemented the reward and penalty tax system. The fuel consumption indicators of passenger cars per 100 kilometers can be increased first based on the original tax system, and when the time comes, the emission indicator and the electricity consumption indicator of electric vehicles can be gradually added.

3.1.3 Achievement evaluation of the green tax system in the automobile industry

3.1.3.1 Putting in place fiscal and taxation policies that encourage the development and application of non-HFC alternatives and alternative technologies

To encourage the automobile industry to utilize environment-friendly air-conditioning refrigerants through the vehicle tax system. It fully reflects the contribution of the automobile industry to environmental protection as an exemplary and pillar industry in China, and also creates opportunities and conditions for the upgrading and transformation of China's fluorine chemical industry. It is calculated that, if R152a (difluoroethane) or R1234yf (2,3,3,3-tetrafluoropropene) is used as an alternative refrigerant of R134a (1,1,1,2-tetrafluoroethane), and if the application increases linearly each year among new vehicles since 2021 and will cover all new vehicles by 2030, carbon emissions peak can be reached in 2029. Under this alternative scenario, R152a as an alternative refrigerant can achieve a carbon equivalent emission reduction of 3 million tons in 2025, and R1234yf as an alternative refrigerant can achieve a carbon equivalent emission reduction of 2.3 million tons in 2025. By 2030, R152a and R1234yf can reduce emissions by 20.7 million tons and 18.3 million tons respectively.

3.1.3.2 Promoting preferential tax policies for the establishment of an extended producer responsibility system

In terms of encouraging industrial development, to implement preferential tax policies that promote the establishment of an extended producer responsibility system can, on the one hand, increase the overall recycling price and expand the total recycling amount of scrapped automobiles; and on the other hand, reduce the industry's dependence on fiscal subsidies and form a sustainable development mechanism. Specifically, the adjustment of the value-added tax calculation method helps save the tax cost of enterprises, and corporate income tax incentives help improve the profitability of enterprises, raise the overall recycling price, and thus expand the total recycling amount of scrapped vehicles.

According to the statistics of China National Resources Recycling Association, in 2009, the total value-added tax of the scrapped automobile recycling and dismantling industry in China was about RMB 2 billion, and the preferential value-added policy could save about RMB 1.5 billion in value-added tax costs for the industry; the industry's operating profit was RMB 3.16 billion, and the preferential corporate income tax policy could increase profits by about RMB 300 million. If an enterprise spends 50% of saved tax costs and increased profits in increasing the recycling price, the average recycling price per vehicle can increase by about RMB 400; by referring to the automobile demand price elasticity coefficient (each 1% reduction in the purchase cost can drive sales growth by approximately 2.6 %), the average recycling price per vehicle can increase by RMB 300, accounting for about 0.4% of vehicle purchase costs. This way, it is expected to drive the sales of old-for-new vehicles (and the total amount of scrapped vehicles) up by 1.0% of the year's sales, or 250,000. For the recycled scrapped vehicles, some parts can be remanufactured. Remanufacturing is the highest form of resource reuse, which can save a lot of materials and reduce the generation of gas and solid waste. Take the engine as an example. Each remanufactured engine can save 59 kg of steel, 8 kg of aluminum, and 170 KWH of electricity; reduce carbon dioxide emissions by 56

kg, carbon monoxide by 6 kg, nitrogen oxides by 1 kg, sulfides by 4 kg, and solid waste by 290 kg. If the engines of 5% of scrapped vehicles are remanufactured, with policy support, 12,500 more engines can be remanufactured, which can save 7.375 million tons of steel, 1 million tons of aluminum materials, save 2.125 million KWH of electricity, and reduce 7 million tons of carbon dioxide emissions, 1.375 million tons of Carbon monoxide, nitrogen oxides, sulfides emissions, and 36.25 million tons of solid waste.

The implementation of weighted tax deduction policy will play a leading role in stimulating investment in the extension of producer responsibility. Based on industrial research and estimation, the current investment of scrapped automobile recycling and dismantling enterprises in safety and environmental protection is about 10% of their annual sales. Based on the industrial sales data in 2019, it is about RMB 3 billion. If the weighted tax deduction policy is implemented, the taxable income will be reduced by RMB 1.5 billion, and the income tax will be reduced by RMB 380 million. In addition, as the policy for implementing the extended producer responsibility system strengthens, enterprises will increase investment in this area. Thus, the weighted tax deduction policy helps reduce the industry's dependence on fiscal subsidies and form a sustainable development mechanism.

3.1.3.3 Implementing reward and penalty tax policy for car products

The implementation of reward and penalty tax policy for car products, and pegging the tax rate to the level of energy consumption (carbon emissions), are conducive to encouraging the consumption of green and low-carbon auto products in the long term.

In order to forecast the overall passenger car market space and the sales proportions of various vehicles in the future, the research team constructed a passenger car market penetration model. The model is divided into two parts: the inventory module and the market penetration rate module, which are used to forecast the overall passenger car market space, annual sales trends, and the market share of models. The two parts are combined to forecast the sales of various vehicles. In order to analyze the market shares of various vehicles based on different policy scenarios, the study assumes that while purchasing passenger cars, consumers mainly consider the purchase price of each model, fuel cost during usage, and convenience of charging and refueling, which are classified into three costs, i.e., purchase cost, fuel cost and convenience cost. Then, each cost is subdivided, and different tax growth plans and comprehensive tax rates are set based on the basic policy scenario with only compliance costs and the comprehensive policy scenario with the implementation of the green tax system plan. The study uses the nested multivariate logit model and through judging the model's indicators and their influencing factors, predicts consumers' choice probability for each vehicle to obtain the market share of each vehicle in the passenger car market and forecast the implementation effect of the green tax system.

Models are used for prediction and analysis. Under the green tax system, the sales of new energy vehicles are expected to exceed 3.3 million in 2025, and the market share will increase to 14.1%; the advantages of the new energy vehicle market will be further revealed in 2030, the sales volume is expected to exceed 9 million, and the market ratio will increase to 35.0%; the market size of new energy vehicles is expected to be close to 13 million in 2035, and the market proportion will increase to 47.0%.

Based on the fuel consumption targets of various vehicles proposed in the *Development Plan for the New Energy Vehicle Industry (2021-2035)* and the *Energy-Conservation and New Energy Vehicle Technology Roadmap 2.0*, as well as the analysis of the actual operation law of China's new energy vehicles in *Top-Level Design and Strategic Synergy for Automotive Revolution* by China EV 100, under the green tax policy, considering the decline of fuel consumption brought by new energy vehicles and the enhanced fuel efficiency of traditional vehicles and HEVs, it is expected that vehicles sold in 2025 alone will save 3.03 million tons of oil, 5.79 million tons of oil in 2030, and 6.64 million tons of oil in 2035. While under basic policies, it is estimated that vehicles sold in 2025 will save 2.85 million tons of oil, 5.6 million tons in 2030, and 6.2 million tons in 2035, which are equivalent to 8.98 million tons, 17.64 million tons and 19.53 million tons of reduced carbon dioxide emissions.

The pollutant emission factors of passenger vehicles are calculated with reference to pollutant emissions released in *China Mobile Source Environmental Management Annual Report (2019)* by the MEE. It is estimated that under the green tax system, 3.3 million new energy passenger vehicles will be sold in 2025, which can reduce the emissions of various pollutants by about 30,000 tons; 9.22 million new energy passenger vehicles are expected to be sold in 2030, which can reduce the emissions of various pollutants by about 85,000 tons; 13 million new energy passenger vehicles are expected to be sold in 2035, which can reduce the emissions of various pollutants by approximately 117,000 tons.

3.2 Green design policy for China's iron and steel industry

In 2013, the Ministry of Industry and Information Technology (MIIT), the National Development and Reform Commission (NDRC), and the former Ministry of Environmental Protection (MEP) jointly issued the *Guiding Opinions on Conducting the Ecological Design of Industrial Products* (Ministry of Industry and Information Technology Lianjie [2013] No. 58), to clarify the ecological design of China's industrial products. The document points out that ecological design is an activity that is based on the whole lifecycle concept and systemically considers at the design and development stage the resource and environmental impacts of a product during its whole lifecycle, including the selection of raw materials, production, sales, use, recycling and processing, to minimize resource consumption in the whole life cycle, minimize the use of or use no raw materials containing toxic and hazardous substances, reduce the generation and discharge of pollutants, and thus realize environmental protection. In practice, in order to integrate with the green manufacturing system, "eco design" is usually referred to as "green design". In this report, the concepts of "eco design", "green design" and "industrial ecological design" are not strictly distinguished. But their core connotation is consistent with the concept of "eco-design" defined above, which is based on "products" or "facilities", and extends to production, consumption, recycling and disposal. For example, in this section, to ensure consistency, it is referred to as "green design in the iron and steel industry"; in the next section, it is referred to as "ecological design" for waste incineration facilities.

3.2.1 Significance of the green and low-carbon development of the iron and steel industry

In accordance with statistics, China's crude steel output in 2019 was 996 million tons,

accounting for 53.3% of the world's steel output; the output of pig iron was 809 million tons, accounting for 64.2% of the world's pig iron output. At present, the carbon emission contribution of China's iron and steel industry accounts for more than 60% of the total carbon emissions of the global iron and steel industry, and about 15% of the country's total carbon emissions, ranking first among all domestic industries. During the 14th FYP period, China's overall crude steel output will remain at a high level, and the pressure of pollution and carbon reduction will still be huge. In addition, with the gradual removal of tariff barriers, non-tariff measures like green trade barriers are likely to become the main sanctions on China's steel exports. Only by promoting the green design of products in the iron and steel industry and improving the green level of products from the source is it possible to deal with green trade barriers and give play to the role of the industry in reducing pollution and carbon emissions and realizing green trade.

3.2.2 The development status quo and overall evaluation of green design in the iron and steel industry

In order to deal with overcapacity, serious pollution, high carbon emissions in the iron and steel industry, relevant departments of the Chinese government and local governments have issued more than 30 targeted plans and industrial policies, providing important support for the green development of the industry. However, current policies overemphasize the efficient use of energy, adjustment of industrial structure and green transition of key technologies, while lacking overall consideration for green lifecycle design. Policies adopted by local governments mainly restrict the development of iron and steel enterprises, such as relocation plans and policies. The strong government intervention in the industry may facilitate management and product quality control, but is not conducive to the differentiation of products and the formation of unique corporate advantages.

Documents such as the Notice of the General Office of the Ministry of Industry and Information Technology on Building Green Manufacturing Systems and the Guidelines for the Construction of Green Manufacturing Standard System, which were released and implemented in 2016, require to accelerate the formulation and revision of standards in key areas including green design products. In accordance with statistics, more than 30 industrial standards for green design products in the iron and steel industry have been determined and are being formulated. After the above-mentioned standards are released, a standard system for the evaluation of green design products in the iron and steel industry will be gradually established.

Case: Green Design of Baogang
Baogang (Group) Co., Ltd. (hereinafter referred to as Baogang) is a 10 million-ton steel industrial base in China and the world's largest rare earth industrial base. In terms of green design, it has independently researched into and developed an online system for the lifecycle evaluation of steel products that integrates data collection, calculation, analysis, and result display. Through this system, Baogang has carried out a whole lifecycle evaluation of rare earth, rare earth steel and other products, and applied the evaluation results to product development and process improvement. For example, through evaluation, it is found that the yield rate of steel products is the most critical factor affecting the environmental load, and thus the on-site production focuses on ensuring the yield rate to minimize

energy consumption and environmental emissions. On this basis, Baogang took the lead in drafting three green design product evaluation standards, for rare earth steel, iron concentrate (mined in open-pits), and sintered NdFeB permanent magnet material. Nine of its products have been included in the green design product list of the MIIT. Through green design practice, Baogang has reduced electricity consumption per ton of steel by about 4%, fresh water consumption per ton of steel by about 19%, smoke and dust emissions by about 14%, and sulfur dioxide emissions by about 74%. The sales of green products have created a direct economic benefit of over RMB 96 million, which effectively enhanced the company's green influence and product visibility, and achieved good environmental and economic benefits.

3.2.3 Policy issues in the green design of China's iron and steel industry

(1) Related policies are not designed in a holistic approach, and inter-departmental coordination needs to be further improved. China has not yet established an overall top-level institutional system for green design. For example, the product certification and evaluation systems for environment-friendly, energy-saving, water-saving, recycling, low-carbon, renewable, organic, green, and eco-designed products in China overlap to a certain extent. Take sanitary wares as an example. There is an 80% overlap between *Technical Specification for Green-Design Product Assessment: Sanitary Wares (T/CAGP 0010-2016, T/CAB 0010-2016)* issued by the MIIT and *Green Product Assessment: Sanitary Wares (GB/T35603-2017)* issued by State Administration for Market Regulation (SAMR), which easily leads to unclear understanding on the concept of green products.

(2) The establishment of standards on green design products in the iron and steel industry needs to be further promoted. The MIIT proposed to issue 100 green design product evaluation standards in key industries by 2020. Of the 129 standards that have been promulgated, only 9 are in the iron and steel industry. Judging from the existing standard system of the industry, except for a few technical evaluation specifications on products, all standards are on the control of terminal emissions. In terms of source substitution, process control, resource and energy consumption, etc., technical guidance and standards are still not in place. The green design product categories issued by the MIIT include nearly 100 categories of products such as household detergents, stainless steel for kitchen utensils, and rare earth steel, covering a total of 2,176 products. However, as of now, only over 10 steel products from 5 iron and steel enterprises have been on the list of green design products. These enterprises only account for less than 1% of iron and steel companies with smelting capacity in the entire industry and these products only account for less than 1% of the total number of green design products.

(3) Guiding methods for the collaborative promotion of green design and low-carbon development have not yet been determined. Many internationally renowned iron and steel enterprises, such as Arcelor Mittal, Baowu of China, Pohang Iron and Steel Company of South Korea, JFE of Japan and HBIS Group, have released timetables and roadmaps for carbon emissions reduction. However, China has not had guiding documents, such as a policy system for the low-carbon development of the industry, carbon emissions peak and carbon neutrality programs and paths, carbon emissions control requirements and standards.

(4) The incentive mechanism for green design in the iron and steel industry needs to be improved. Enterprises that carry out lifecycle evaluation are mostly strong enterprises in the industry. The main driving force comes from the procurement and access requirements of downstream enterprises. However, the government provides insufficient guidance on the green transition of the industry, and has not yet issued clear, practical and effective incentive measures. This is not conducive to mobilizing the enterprises in terms of product design, innovation and technological breakthroughs in key green products. Thus, enterprises are insufficiently motivated to carry out relevant work.

(5) The promotion and application of the life cycle assessment (LCA) concept needs to be improved. The concept of LCA has not been sufficiently promoted in China, and has not formed social influence. Domestic iron and steel enterprises and downstream users are still unclear about or insufficiently aware of the concept of the whole life cycle, and they are not enthusiastic about participating in the LCA. Only a few enterprises with strong technical strength participate, but they often work alone. A joint force needs to be formed and communication among them needs to be enhanced.

(6) The talent training mechanism and capacity building work need to be further improved. In the context of China's high-quality development, green development, and dual-carbon goals, the green and low-carbon development of the industry featuring low energy consumption, low emissions, and low pollution has become imperative. However, the industry is facing a series of problems such as a bloated staff structure, surplus of low-end talents, lack of high-end talents, low labor productivity, low rate of capacity utilization, and an imperfect talent development system, resulting in weak innovation capabilities, insufficient scientific research output and slow green progress.

3.2.4 Recommendations on implementing green design policies in the iron and steel industry

(1) Strengthen the top-level design of green design policies and promote inter-departmental collaboration. MIIT, NDRC, MEE, and various industrial associations are involved in green design. They should strengthen the top-level design, establish a horizontal cooperation mechanism, and clarify their respective responsibilities and form a joint force to promote the application of green design concepts; leverage the advantage of multi-departmental collaboration, coordinate and strengthen the correlation and applicability of upstream and downstream industry standards, and simultaneously formulate new material R&D with production standards and utilization specifications to reflect the consistency of production and utilization targets.

(2) Promote green design standards and evaluation in the iron and steel industry with full-process environmental diagnosis and carbon emission reduction as the core. Standards are the basis for green design. Relevant associations and iron and steel enterprises should actively participate in the formulation of a series of green design technical specifications and standards. In addition, the iron and steel industry, with the highest carbon emissions in China, is directly related to the achievement of China's goals of carbon emission peak in 2030 and carbon neutrality in 2060. During the 14th FYP period, priority should be given to carbon emissions reduction and efforts should be made to establish a methodology that effectively integrates the life cycle and low-carbon concepts, and while building a green design system for the industry, based on

the national goals of carbon emissions peak and carbon neutrality, coordinate tasks, formulate scientific action plans and promote carbon emission peak in the industry as soon as possible.

(3) Introduce incentive measures to promote the credibility of green design and evaluation results in the iron and steel industry. Measures such as green procurement, tax reduction, strengthened price advantage for green products should be taken to encourage enterprises to explore green design paths and accelerate the promotion of green design products, technologies and services; support the establishment of a green design evaluation standard system and the release of a green design product list; and make full use of the opportunities of consumption contents and channel upgrading brought by the "new infrastructure" for vigorous industrial green design and the double upgrading of green industry and consumption. In addition, the environmental and economic policy incentive mechanism should be made full use to explore new management modes that link the results of green design evaluation with corporate environmental credit evaluation, environmental taxes, tax policies for comprehensive utilization of resources, and environmental pollution liability insurance.

(4) Actively guide the promotion and application of LCA in the iron and steel industry. Efforts should be made to promote the establishment of a sound iron and steel green product evaluation system, accelerate the improvement of the whole-life-cycle resource and environmental impact database, quantify the resource and energy consumption and environmental indicators of iron and steel products, and clarify the green degree; encourage the R&D of green improvement plans for all links of a product's life cycle to provide a decision-making basis for iron and steel enterprises to save energy, reduce consumption and reduce pollution; and actively guide LCA promotion and application to strengthen environmental communication among upstream and downstream users and promote the construction and development of an environment-friendly and green supply chain.

(5) Establish a sound green design talent training mechanism for the iron and steel industry. Efforts should be made to enhance the awareness of enterprises in actively carrying out green design; strengthen the green design personnel team and capacity building in technical support; increase financial support for green design-related technology R&D, publicity and training; encourage enterprises to introduce senior talents from abroad, and emphasize the development of human resources.

3.3 Eco-design policies and standards for incineration facilities in China

3.3.1 The significance of ecological design for promoting the healthy and orderly development of incineration facilities

3.3.1.1 Characteristics of the construction and development of incineration facilities in China

Incineration has become a major way of waste treatment in China. In the next decade, the construction of solid waste incineration facilities in China will enter a peak period, with heavy tasks and serious risks. In accordance with the *13th Five-Year Plan on the Construction of Safe Disposal Facilities for Municipal Solid Waste*, by the end of 2020, the municipal solid waste incineration capacity should account for more than 50% of

the total harmless treatment capacity, and that of the eastern region should reach 60% and above. Occupying small land, having obvious reduction effect, being able to generate power, and reused for residual heat resources, incineration is vital for cities to lift their waste sieges, and has gradually replaced traditional landfills as a major harmless treatment. China's first solid waste incineration facility (Zhuhai Municipal Solid Waste Treatment Center) was put into operation as early as on July 18, 2000. Since then, the number of new solid waste incineration facilities has increased year by year, reaching a peak in 2017, when 76 new facilities were constructed and then showed a downward trend. As of the end of 2020, China had a total of 519 solid waste incineration facilities, of which 66 were constructed by Shandong Province, which had the most. Provinces with more than 50 such facilities include Zhejiang (52), Guangdong (51) and Jiangsu (51). These facilities are mostly located in the eastern coastal area. In addition, incomplete statistics show that 18 provinces and cities have issued a *Medium and Long-Term Special Plan for Solid Waste Incineration*. From 2021 to 2030, China plans to build 476 (including new projects and rebuilding and expansion projects) solid waste incineration facilities, of which 54, 49 and 35 will be built by Shandong, Guangxi and Jiangxi, respectively, which rank the top three in the number of new facilities. The number of such facilities in inland provinces has gradually increased.

3.3.1.2 Challenges in constructing incineration facilities in China and countermeasures

The "stigmatized" impression and the NIMBY dilemma of waste incineration facilities need to be eliminated urgently. In accordance with the public opinion monitoring data of the MEE, from 2017 to 2020, more than 330 incidents of environmental and social risks (social risks caused by environmental issues) happened in NIMBY facilities nationwide, most of which were waste incineration projects. The stigmatized impression of waste incineration facilities has become an important factor of inducing the NIMBY problem, which has seriously hindered the construction and sustainable development of public infrastructure. The main reasons for the "stigmatization" and NIMBY conflicts of waste incineration facilities are as follows: First, some old projects have problems in incineration technology and environmental protection measures, and their standards are not high. As a result, pollutants cannot be discharged continuously and stably, and odor pollution is serious. For being dissatisfied with the ecological and environmental performance of existing facilities, many people object to the construction of more such facilities. Second, some projects ignore the integration of industrial buildings and ecological landscapes in their design. As the stigmatized impression of these projects is not changed, the disconnection and contrast between industrial buildings and ecological landscapes can easily aggravate the anxiety and rejection of the surrounding public. Third, some facilities fail to take neighborhood into account, and are deficient in the popularization of science and the design of facilities that benefit the people. Without sufficient positive publicity and public participation, it is hard to enhance public awareness of waste incineration facilities. The "stigmatization" of these facilities often leads to the opposition of surrounding residents to new projects, and such projects fall into the predicament of "causing chaos once the construction begins, and being stopped once such chaos happens". This has not only affected the construction of important public infrastructure, but also caused adverse social impact and affected social stability.

The existing waste incineration facilities perform well in environmental protection,

but fail to meet the requirements of landscape coordination and humanistic harmony. In order to promote the environmental governance and green development of waste incineration industry, China has proposed a number of standards and normative documents for waste incineration plants. These regulatory documents mostly focus on terminal management and control, having the most comprehensive requirements on environmental governance, being dominated by requirements on pollution discharge, and being close to international standards, such as the collection and treatment methods of waste gas, and the discharge compliance rate of leachate. Through analysis of the environmental performance data of all 519 facilities in operation on the national incineration plants monitoring data disclosure platform (https://ljgk.envsc.cn/manage/index.html), it is found that the flue gas emission concentration of almost all domestic waste incineration facilities can meet national standards, and the flue gas emission concentration of most facilities is better than existing national standards. In accordance with the *GB 18485-2014* standard on incineration, from December 2019 to December 2020, out of a total of 1,961,626 detection records of 5 flue gas pollutants, 29 over-pollution incidents occurred, and the compliance rate reached 99.99%. In accordance with the *RISN-TG022-2016 Guideline on the Incineration of Domestic Waste*, more than 90% of the emissions of sulfur dioxide, particulate matter, and carbon monoxide reached the first-level base value (the advanced international level for clean production), more than 90% of nitrogen oxides and hydrogen chloride reached the second-level base value (the advanced domestic level for clean production), and the overall environmental performance was good. However, there is still no high-level control standards and guidance for the existing facilities. In addition, the current regulatory documents are still inadequate in terms of landscape coordination and harmonious design that are of public concern. Thus, it is necessary to further strengthen regulatory constraints, and conduct case summaries and experience promotion.

Apply the concepts and methods of ecological design to upgrade waste incineration facilities into green facilities to provide the public with a good living environment and environment-friendly products. To get rid of the NIMBY dilemma, efforts must be made to change the public impression of stigmatization, and restore the function of waste treatment facilities, i.e., disposing of waste and returning a good and qualified living environment to the people. Waste incineration facilities have dual properties: on the one hand, as industrial treatment facilities, they can dispose of waste through incineration; on the other hand, as green facilities, they can reduce the amount of waste and reduce land occupation, water pollution, soil pollution and odor pollution caused by waste, thus providing environment-friendly products and services. The application of ecological product design concepts in the design, construction and operation of waste incineration plants is of great significance to the industry's green development. They are not only an innovation in ideas, but also an innovation in the methods and tools, which will inevitably bring about a policy and institutional reform to prevent NIMBY.

3.3.2 Research on ecological design standards of incineration facilities

3.3.2.1 Establishment of standards for the ecological design of incineration facilities

Based on the existing evaluation indicators and requirements as well as the level of existing incineration facilities, this study aims to propose comprehensive evaluation indicators and requirements by establishing an ecological design evaluation model for

incineration facilities that meets the needs of industrial development with comprehensive and systematic principles. The final ecological design evaluation indicator system includes 28 indicators in four aspects, i.e., environmental safety, ecological harmony, community-friendly, and economic and effective (see Table 3-1), and has basically formed an *Eco-Design Evaluation Standard for Incineration Projects*, including the standard settings and release suggestions. Specifically, Environmental Safety requires that environmental emissions meet or exceed the requirements of relevant national or local laws, regulations and standards; Ecological Harmony requires that buildings, waste incineration facilities and pollutant treatment equipment and facilities should be integrated into the natural ecological landscape and urban cultural landscape to reduce the abruptness and discomfort of the natural environment or the area where the people live; Community-Friendly requires that the access requirements should be met, and publicity, education and public facilities be put in place; Economic and Effective requires the input of energy and resources and investment and operating costs should be reasonable.

Table 3-1 Evaluation standards for the ecological design of incineration facilities

No.	First-level indicators	Second-level indicators	Third-level indicators
1	Environmental safety	Facilities	Special equipment
2			Pollutant treatment equipment and facilities
3		Flue gas emission	Flue gas emission
4			VOC emission (optional)
5		Sewage treatment	Leachate discharge
6			Whole-plant sewage discharge
7		Slag treatment	Slag reduction rate
8		Fly-ash treatment	Fly-ash disposal
9		Environmental noise	Factory boundary noise
10		Greenhouse gases	Greenhouse gas emissions (optional)
11	Ecological harmony	Location	Planning and location
12-15		Buildings	Intensive construction land
16			Harmonious architectural landscape
17		Greening	Go-green rate
18	Community-friendly	Information disclosure	Environmental information disclosure
19		Affiliated facilities	Publicity and education facilities (optional)
20			Public facilities (optional)
21	Economic and effective	Recycling	Comprehensive utilization rate of slag
22			Waste heat utilization rate
23		Resource conservation	Electricity consumption per ton of waste entering the plant
24			Steam consumption rate of steam turbines
25			Water consumption per unit of power generation
26-27		Investment fees	Reasonable investment costs
28		Operation fees	Annual operating hours

3.3.2.2 Cases of ecological design evaluation of incineration facilities

The research team investigated and researched into two cases, i.e., Dynagreen

Environmental Protection Group's Lanzilong Comprehensive Treatment Project in Huiyang District, Huizhou City and Everbright Environment Group's Changzhou Municipal Domestic Waste Incineration Project, and conducted ecological design evaluation from four aspects, i.e., environmental safety, ecological harmony, community-friendly, and economic and effective, to create an eco-design prototype of incineration facilities. The former project is characterized by industrial recycling, which, through scientific planning and design, organically connects the processes applied in various projects in the circular economy industrial park to form a mutually reinforcing process chain, so that the park forms an organic whole where resources can be recycled, thus truly realizing energy conservation and emission reduction, and facilitating the green, low-carbon and sustainable development of the city. The project of Everbright Environment Group is characterized by community interaction, and has rich experience in the design of landscape, information disclosure, and public facilities and measures. The analysis results show that both domestic waste incineration projects have performed well in pollution emissions, opening to the public, and public facilities, and played a leading role in the industry, but their economic costs are slightly high, to which more attention shall be paid in the design of waste incineration projects.

3.3.3 Policy recommendations

(1) Give full play to the late-comer advantages of China's incineration industry, introduce ecological design concepts, protect the ecological environment and turn NIMBY into "open-arms". At present, the emission standards and design and construction capabilities of China's newly-built waste incineration facilities have reached advanced levels at home and abroad in terms of environmental safety technology, ecology, and community-friendliness. It is recommended to vigorously promote advanced concepts in the ecological design of incineration facilities, introduce ecological design methods and modes to the waste incineration industry, and generally improve the environmental performance of waste incineration facilities in China to the international advanced level, to accelerate the industry's green development, and help prevent NIMBY.

(2) Actively integrate existing green-related standards and promote ecological design in the incineration industry. Currently, green standards and normative documents on incineration facilities have different sources and the preventative mechanism from the source is not perfect. To form a joint force of promoting the application of eco-design concepts, it is recommended that the industrial authorities take the lead and unite with the MEE and other departments and industrial associations to strengthen top-level design, establish horizontal cooperation mechanisms, unify evaluation standards and technical specifications, and set up a policy framework for the ecological design of waste incineration facilities, including building an evaluation indicator system, formulating eco-design guidelines, and developing eco-design evaluation.

(3) Promote a pioneer system of incineration facilities. It is recommended to establish role models and pioneers in the ecological design of waste incineration plants, and combine them with corporate supervision. Capital investment and tax preferential policy support will be given to waste incineration plants that have obtained the eco-design environmental protection label, so that the ecological design of waste incineration plants can be promoted in the market. In addition, a list of enterprises for

eco-design of incineration facilities will be established to encourage and urge enterprises to carry out industrial eco-design and green transition.

3.4 Green consumption policy for China's food

The sustainable consumption of food has attracted more and more attention from the international community. The loss and waste of food not only mean the ineffective consumption of resources and other inputs and the emission of a large amount of greenhouse gases in the process of production, but also means that a large amount of greenhouse gases is generated by wasted food in various treatment methods, such as carbon dioxide, methane and carbon monoxide. If the total amount of greenhouse emission derived from the global wasted food is compared with that from a country, it will rank the third largest emitter of greenhouse gases. To reduce carbon emissions and protect biodiversity, this report analyzes the food waste problem in China and recommends relevant countermeasures.

The green consumption of food in this report refers to food consumption behavior characterized by resource conservation and environmental protection, which is mainly manifested as advocating thrift, reducing loss and waste, choosing efficient and environment-friendly food and services, and reducing resource consumption and pollution emission in the process of consumption.

3.4.1 The status quo of resources and environmental issues concerning food consumption in China

3.4.1.1 The amount of overall loss and waste in the food supply chain is large

As a large agricultural country, China feeds 22% of the world's population with only 7% of the world's arable land. Its main food, from agricultural production to consumption, is being lost and wasted at varying degrees at each stage. In China, more than 60% of grain is stored by more than 200 million farmers. The lack of professional technical guidance in post-harvest processing, processing and transportation, poor tools and equipment, rough processing, and limited market information acquisition capabilities have led to a large amount of food loss and waste in various supply links. According to the results of a sample survey conducted by the National Food and Strategic Reserves Administration (formerly the National Food Administration) in 2016, the annual food loss from field to table was about 135 billion jin, accounting for 10.9% of the year's total food output. Specifically, merely in the link of storage by farmers, the annual food loss amounted to 40 billion jin, accounting for about 8% of the stored volume, which was equivalent to 61.6 million mu of grain production. Due to the low degree of specialization, insufficient fruit and vegetable processing conversion rate, and the lagging in the development of cold chain logistics, the average loss rate of fruits in the logistics link is 20% to 30%, and that of vegetables is close to 30% to 40%. Each year, more than 100 million tons of fruits, vegetables and agricultural products are lost due to rot, causing up to RMB 100 billion of economic losses (Bi Jinfeng et al., 2013).

3.4.1.2 Consumers are a key contributor to food waste

It is estimated that about 35% of food loss and waste occurs in consumption[2]. In China's entire food supply chain, the consumption end has the largest proportion of food loss[3]. Especially in recent years, due to the improvement of living standards, people eat out more frequently, and the trend of waste and extravagance becomes obvious. An investigation report shows that from 2013 to 2015, China's annual food waste was as high as 17 to 18 million tons, which was equivalent to the annual food needs of 30 to 50 million people[4]. In 2016, China's kitchen waste was about 97 million tons, of which more than 60 million tons came from several major cities, and accounting for about 37% to 62% in municipal domestic waste. In 2018, the country generated more than 100 million tons of kitchen waste, reaching 108 million tons, an average of nearly 300,000 tons per day.

3.4.1.3 Food loss and waste have caused huge economic losses

Food waste in consumption causes economic losses to consumers themselves. For example, the economic value of food wasted by Finnish households in 2010 was equivalent to 70 euros per person per year. Food waste also causes losses to society. In accordance with the food waste record of a retail store in Italy, the amount of wasted food in this store was 70.6 tons in 2015, which was mainly bread, fresh vegetables and fruits, with a total value of nearly 170,000 euros. Knowing the economic cost of wasted food may urge consumers to improve their consumption behavior, and the money saved by reduced food waste is seen as a key driving factor for preventing consumers' food waste behavior.

Globally, FAO proposed in 2015 that the economic value of food lost and wasted globally in 2012 amounted to USD 936 billion, which was equivalent to one year's gross national product in the Netherlands. Thus, reducing food loss and waste is significant for the economy. The average benefit-to-cost ratio of reducing food waste in the catering industry can reach 7 to 1. Studies in Australia have shown that in the food loss and waste reduction campaigns initiated by non-governmental organizations, every USD invested could save USD 5.71 of food from being wasted.

3.4.1.4 Food waste has caused certain environmental costs

The data research of China Health and Nutrition Survey (CHNS) shows that food waste from Chinese households has a negative impact on the climate, water and land resources. In 2011, food waste from Chinese households amounted to 16kg per person per year, equivalent to 40kg of carbon dioxide emissions and $18m^3$ of additional water loss. By analyzing the greenhouse gas emission characteristics of food and estimating the whole-life-cycle carbon emissions of food in 1996, 2000, 2005 and 2010, Wang Xiao (2013) of Tsinghua University concluded that the whole-life-cycle carbon emissions of food in

2 LIPINSKI B, HANSON C, LOMAX J, et al. Installment 2 of "creating a sustainable food future": Reducing food loss and waste. http: //www. worldresourcesreport. org. World Resources Institute, Washington, DC, 2013.

3 LIU J, LUNDQVIST J, WEINBERG J, et al. Food losses and waste in China and their implication for water and land. Environmental Science & Technology, 2013, 47: 10137-10144.

4 Cheng Shengkui, Liu Gang, Liu Xiaojie, et al. Report on Urban Food Waste in China [R]. Beijing: Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, 2018.

China were 1.605 billion tons of carbon dioxide equivalent per year. Even if only one-fifth of food is lost or wasted in China (rather than one-third, the global average level proposed by FAO), carbon emission will reach over 300 million tons, which is huge and cannot be ignored. In addition, the amount of kitchen waste is large in China. Domestic scholars conducted a study on 7-year household food waste in 9 provinces and cities in China in 2015 and found that 1kg of kitchen waste could produce 0.34kg of methane under fully fermented conditions, and under the standard state (0□, 1.013×106Pa), the theoretical amount of methane generated would be 0.44m^2/kg. If the wasted food of the 9 provinces in 7 years is buried and fermented, 19 million tons of carbon dioxide will be emitted. In contrast, if the wasted food can be fully used as resources, 8.45 million tons of standard coal can be saved.

3.4.2 Policy recommendations on promoting green food consumption

3.4.2.1 For government departments

First, strengthen legislation, supervision and inspection on food waste and stop food waste in the form of legal documents by formulating local laws and regulations against food waste and putting in place rules to punish food waste in restaurants. Second, carry out diversified and multi-channel publicity and education. Efforts should be made to intensify multi-channel publicity against food waste, expose food waste phenomena, promote role models, and encourage voluntary objection against food waste in the whole society. Third, curb position-related consumption and prohibit food waste. Continued efforts need to be made to restrict position-related consumption, guide social consumption behavior by position-related dining behavior, and transform social atmosphere and dietary concepts from top to bottom. Fourth, strengthen guidance and further optimize the catering structure. Efforts need to be made to implement the *Guiding Opinions of the Ministry of Commerce on Accelerating the Development of Popular Catering* issued in 2014 to promote the rational and healthy development of the catering structure. Fifth, improve laws, regulations and application systems on the collection and recycling of kitchen waste. Legislation should be strengthened to prevent the illegal processing of kitchen waste. The existing waste recycling mechanism should be improved to encourage the disposal and recycling of kitchen waste as resources. Sixth, strengthen scientific research and platform support in the field of food consumption and waste. A basic information database on food waste should be built in typical cities and major food supply chains. A decision-making support system should be established to reduce food waste. And the advantages and experience of research institutes and universities in related fields should be actively leveraged to carry out food waste-related investigations and research.

3.4.2.2 For industrial associations and NGOs

First, formulate industrial standards. Functions of industrial organizations should be strengthened to expand the field of industrial supervision and promote the standard, regulated and scientific development of food production, transportation, processing and consumption. Second, give play the role of intermediary organizations. Industrial exchanges should be organized to strengthen the communication and coordination of enterprises with the market, enterprises and consumers, consumers and the government, and promote the healthy development of the catering industry. Third, strengthen public opinion supervision and public propaganda. Scientific, moderate and green food

consumption patterns should be actively called for and advocated to avoid food waste at the dining table, promote civilized dining and establish a new style of catering.

3.4.2.3 For catering enterprises

First, rationally position catering enterprises and improve the way of serving meals. Standardized dishes should be provided so that consumers can season their food based on needs, optional set menus can be determined, and small dishes can be offered. One ingredient for multiple dishes and one dish with multiple flavors should be advocated to make the best use of ingredients. Second, be active and responsible and encourage civilized dining among consumers. Ordering service should be improved to remind consumers of their order. Oriented dining service should be stressed to promote scientific, healthy, green and civilized consumption by recommending reasonably configured menus and offering package services. Third, strengthen the sense of responsibility and help dispose of kitchen waste. Government regulations should be abided by to dispose of or utilize kitchen waste, and prevent illegal collection and processing of kitchen waste and its circulation into the food industry.

3.4.2.4 For consumers

First, establish a correct concept of food consumption and follow a scientific, moderate and green consumption pattern. (1) Scientific consumption: forming healthy dietary habits and pursuing balanced taste and nutrition; (2) moderate consumption: ordering meals based on one's own economic capacity and actual needs; (3) green consumption: consumption behavior that minimizes the negative effects on the environment and maximizes the long-term environmental benefits. Second, actively participate in publicity and education activities. Actively participate in campaigns like "green consumption, healthy consumption and low-carbon consumption" to enhance the awareness of sustainable consumption and the development of healthy consumption habits; encourage consumers to monitor and report food waste behevior and hidden dangers in catering; promote thrift and voluntary objection against food waste in society. Third, actively promote the meal-sharing system. The meal-sharing system can not only prevent and reduce the chance of cross-infection of various diseases, but also reduce food waste, so that the national catering industry can save a considerable amount of food and agricultural and sideline products each year.

3.5 Green label certification policy

3.5.1 The roles of green label certification in promoting green production and consumption

Establishing a unified green product standard, certification, and labeling system can promote green, low-carbon and circular development, cultivate a green market, strengthen supply-side structural reform, improve the quality and efficiency of green product supply, guide industrial transformation and upgrading, enhance the competitiveness of manufacturing, lead green consumption and guarantee and improve people's livelihood. In the phase of achieving high-quality development and promoting green development in China, green label certification can promote green production and consumption:

First, urge enterprises to make green innovation, transformation and upgrading from the consumption end. Green label certification, for example, the environmental labeling system, adheres to the concept of whole-life-cycle process management and connects with producers with products as a carrier. Through the certification of products, it puts forward green standards and requirements in the whole life cycle, including product design, raw material use, production processes, product use and waste recycling, which provides the market with green products. Green label certification is also linked with consumers. By releasing information on green label products to consumers, the system encourages consumers' green choices, and urges the green transition of production to provide impetus for supply-side reform. Take the green label certification of China Environmental Labeling as an example. The environmental performance of certified enterprises from 2017 to 2019 is shown in the following table:

Table 3-2. Environmental performance of China Environmental Labeling products (2017-2019)

Category	Pollution factor	Emission reduction in 2017	Emission reduction in 2018	Emission reduction in 2019
Air Pollution	VOCs	472,400 tons	524,900 tons	805,500 tons
	NO_x	13,400 tons	16,400 tons	29,000 tons
	SO_2	3,500 tons	4,300 tons	7,600 tons
	CO_2	3.0252 million tons	3.6805 million tons	6.5375 million tons
Water pollution	Total phosphorus	3,780 tons	4,574 tons	5,297 tons
Solid and hazardous waste	Plastic waste	6,411 tons	7,566 tons	5,026.6 tons
	Heavy metal Hg	8.89 tons	11.00 tons	10.988 tons
Energy conservation	Electricity conservation	10.219 billion KWH	17.260 billion KWH	19.403 billion KWH
Resources conservation	Water conservation	68.422 million tons	131.408 million tons	253.353 million tons
	Plastic conservation	9,930 tons	11,360 tons	9,520 tons
	Industrial waste	2.7487 million tons	1.9061 million tons	3.1418 million tons
	Pulp consumption reduction	1.4174 million tons	1.3229 million tons	1.4904 million tons
	Toner cartridge/Inkjet cartridge	21.6174 million	25.0001 million	2.2177 million

Second, promote the communication of environmental information among the government, enterprises in various industries, and consumers. Green label certification, especially the green label certification system, focuses on the country's ecological civilization construction and the overall goals of carbon emissions peak and carbon neutrality. As a market and economic tool, it advocates green consumption, promotes the sustainable development of social economy, improves environment quality, protects consumers' rights and interests, achieves institutional innovation that uses market mechanisms to intervene in micro-environment governance, and provides technical support for green consumption policies. More and more consumers begin to feel the environmental superiority of green products and choose to purchase green label products. Through the public consumption choices, green label products can become a

link between the public and green development, thereby further promoting green consumption. Green label certification will give full play to the guiding role of standards and credibility of certification labels, and become a powerful tool to encourage enterprises to create a green, circular and low-carbon development pattern.

3.5.2 Problems in the development of green label certification

In recent years, the Chinese government has attached great importance to the development of certification labels and system. Various certification labels have effectively promoted the progress of green manufacturing, and played an active role in building an efficient, clean, low-carbon and recycling green manufacturing system. However, with the in-depth development of relevant practices, problems in the green label certification have gradually become prominent.

(1) The top-level design is not in place and government supervision functions are inconsistent. Green product certification labels are various and managed by multiple entities, which perform overlapping supervision functions and have inconsistent powers and responsibilities. This is not conducive to the adjustment of existing policies, laws and regulations. The certification and evaluation process of enterprises has the problems of repeated evaluation and testing, which has increased the burden on enterprises.

(2) Continuous and effective incentives are not in place. At the current stage, a continuous financial investment mechanism for certification and labeling has not been set up, and financial investment is inconsistent and unstable. In addition, there is no clear taxation, support and preferential incentive mechanisms in the market and product evaluation, leading to inactive market adjustment.

(3) The system of laws, regulations and standards is to be improved. The existing policies and norms guiding the certification of green label products mainly include the *Opinions on Establishing a Unified Green Standard, Certification, and Labeling System* and the *General Rules for the Evaluation of Green Label Products*. As the latter has only been applied for a relatively short period of time, the level of certification is not high and management experience is insufficient. In general, laws, regulations and standards on certification labels are far from being complete, and cannot meet the needs of relevant technologies and products for scientific evaluation.

(4) The validity of certification is controversial, and the certification and evaluation system needs to be improved. China currently has a variety of green label product certification systems, and has not yet formed a unified label, standard and certification system. For a unified product range, a unified standard and conformity assessment procedure has not been formed. Enterprises are inconfident in the credibility of certification labels, consumers find it difficult to identify labels and the labels are not fully recognized in the market.

3.5.3 Policy suggestions

In the field of green label certification, it is necessary to gradually establish a system of green label product standards and a system of certification and labeling that is scientific, open, integrated, authoritative and consistent with advanced indicators, and improve laws, regulations and supporting policies to achieve the systemic goals for the same product, the same standard, the same list, the same certification and the same label, so

as to form a joint force to significantly enhance the market recognition and international influence of green label products, increase their market share and quality benefits, reverse the current supply-demand imbalance of domestic green label products, and significantly strengthen the sense of acquisition of domestic consumers.

(1) Give play to the leading role of green label certification and promote green production and lifestyle. In the field of consumption, give full play to the leading role of green label certification/evaluation standard system to achieve the systematic and effective connection between production and consumption. In the industrial field, to promote industrial green upgrading and carbon emissions peak, focuses should be attached on the R&D of green production and the improvement of green label standard systems for green transition-related industries, such as iron and steel, chemicals, non-ferrous metals, building materials, textiles, paper, leather, etc., with the certification of green label products as a means to lead the industry towards green and low-carbon development.

(2) Strengthen top-level design and create a unified certification system for green label products. In the field of green label certification, strengthen the collaborative management of the SAMR, the MEE, the MIIT, the NDRC and various industrial associations, and leverage the respective advantages of existing green labels, to form a joint force to strengthen top-level design and build a rational management system. A horizontal cooperation mechanism should be established to determine label management tasks from the time and space dimensions, harmonize evaluation standards and technical specifications, and form a scientific, rational, efficient and powerful management mechanism. An inter-ministerial conference system for label certification should be established to coordinate and unify different green label certifications.

(3) Improve the incentive mechanism for green label certification. Certification labels could be used to promote industrial ecological design among enterprises. In addition, environmental and economic policy incentives could be applied to incorporate industrial ecological design into the purposes and measures of corporate environmental management, which encourages enterprises to form a full-chain ecological and environmental management system. Government departments should continue to play a leading role in certification, and highlight the prominent position of label certification in promoting the green development of enterprises by purchasing green label products that have passed label certification.

(4) Improve the validity and international recognition of green label certification results. Operational and post-operational supervision should be strengthened to enhance the validity of labels and certification results, hold certification bodies accountable, form an information chain that is traceable and accountable, form a complete green label certification and evaluation system, and improve the validity of green label certification. In terms of establishing a green trade system, intergovernmental cooperation should be promoted to deepen the mutual recognition mechanism for green label certification internationally, and give play to the role of green label certification as trade passes.

4. International Experience: Accelerating and Deepening the Green Transition

4.1 Urgency of action

The ten-year anniversary of the launch of the United Nations' 10-Year Framework of Programmes on Sustainable Consumption and Production in 2022 provides a wonderful opportunity to highlight a critical message: "the major cause of environmental degradation is our current unsustainable patterns of consumption and production."[5] The One Planet network, a multi-stakeholder partnership formed to implement the program's commitments, addresses six main areas: sustainable public procurement, tourism, consumer information, buildings and construction, food systems, and lifestyles and education. Many of these link to the 17 Sustainable Development Goals, including most notably SDG 12 (responsible consumption and production).

Past efforts to address sustainability problems have often failed to examine consumption and production processes in their full complexity or across their entire value chain. Unless there is a market for recycled materials, the incentive to recycle will be limited. Unless products are made using clean energy, recycled materials and sustainably derived resources, pollution problems will continue unabated. Full life-cycle approaches are needed that consider the sustainability of material and energy inputs, production processes, product design, and product use as well as the reusability of product parts and their recyclability. Innovative business models with less environmental and social impact from a system perspective are needed to mitigate the increasing demand for products and services.

Consumers must also be incentivized to consume at more sustainable levels, with less waste and more focus on product quality and the social and environmental impacts of their purchasing behavior. This also means that products must be developed that provide consumers with suitable choices and information so that they can opt for sustainable products. Results from the Swedish MISTRA Sustainable Consumption Research Programme show that it is possible to attain as much as 40% reduction of greenhouse gas emissions from consumption through switching to more sustainable products and services that are already available, e.g. switching from a meat-based diet to a vegetarian diet or from buying new furniture to buying second hand (Carlsson Kanyama et al. 2019). While a transition to sustainable consumption will demand some investments in new infrastructure and more sustainable products, these results show that considerable effects can be achieved here and now also through behavioral changes.

For the past many decades, the main goal of most societies has been to foster economic growth through industrial production and consumption; too little attention has been paid to the negative environmental and societal consequences of this growth. While some progress has been made in areas, such as recycling of paper, glass, and metals; automobile emission standards; and food safety standards, the reality is that high and rising consumption volumes are leading to ever more packaging-, product-, textile-, and food waste. And even in areas where there has been progress, many challenges remain. Many products and materials are not recycled; transportation continues to be one of the

[5] https://europa.eu/capacity4dev/articles/one-planet-network-global-partnership-sustainable-future

largest sources of greenhouse gas emissions; and food security faces new risks from climate change, plastic pollution, and excessive pesticide use.

The green transition will require the adoption of sustainability concepts into all realms of business, finance, government, and society. Also crucial will be sensitivity towards gender dimensions of sustainability as women and men are differently involved in and impacted by production and consumption patterns and do not always share the same preferences or have the same opportunities to be heard.

The governments of Germany, Sweden, and Japan as well as the European Union have signaled their growing concern with the sad state of the global environment by elevating the attention being paid to the green transition. They are doing this by setting green transition visions and pathways, requiring sustainability at all levels in their own operations, and introducing a broad array of new regulatory and market-based policies and measures and educational campaigns. A growing body of research and practice provides insights into how fundamental system change can be achieved (The European Environment: State and Outlook, 2020).

4.2 Responding to the COVID-19 pandemic with green recovery plans

The importance of the green transition has been amplified by the COVID-19 pandemic. Within a few short months the pandemic spread around the world bringing economies to their knees. It has led to tragic loss of life, illness, and huge economic setbacks and losses. There are good reasons to believe that environmental degradation and the loss of natural habitats are contributing to the spread of zoonoses as humans are more frequently encountering wild animals. Climate change will certainly have even much larger economic and societal impacts. The costs of storms, floods, hurricanes, droughts, and other climate-related impacts are already enormous and will get worse as the climate continues to warm. The loss of biodiversity and wide-spread environmental degradation will have severe impacts for not only this but also future generations. A silver lining to the otherwise horrific global coronavirus pandemic is the growing recognition of the need to accelerate the sustainability transition by investing in a green recovery.

4.3 Supranational level: The European Union Green Deal and the Green Recovery Plan

The EU has been a frontrunner in setting ambitious plans for a green recovery. The European Union is actively moving to direct member states' economies to limit resource use and waste, develop new industries, promote green jobs, redesign urban structures, and change societal behavior through the promotion of a green transition. The European Green Deal sets a new growth strategy intended "to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use". The European Union decided to raise its 2030 greenhouse gas emissions reduction target to 55 percent (compared to 1990 levels) and to achieve climate neutrality by 2050.

Part of the EU Corona recovery package that was spearheaded by Germany and France calls for a tax on non-recycled plastics and the introduction of carbon border taxes

starting in 2023 on products being produced in countries with lower carbon emission standards than the EU. Thirty percent of the total €1.8 trillion package combining the multiannual financial framework (MFF) and Next Generation EU is to target climate-related projects (European Council 2020).

The Recovery and Resilience Facility (RFF) is the central pillar of the recovery plan. It provides financial support to EU countries to mitigate the social and economic impact of the COVID crisis. The Next Generation EU envelope amounts to €807.1 billion including €724 billion for the RFF plan. National plans must include reforms and public investment projects that align with EU priorities, reflect country-specific challenges, support the green transition and foster digital transformation. Reforms and investments must be carried out by 2026.

4.4 National government strategies on Corona Recovery and Green Transitions

The following sections provide background details on case study countries - Germany, Sweden and Japan - highlighting the unique characteristics of each country's approach and presenting options which may be of interest for China as it designs its own green transition policies and social governance system.

4.4.1 Germany

In June 2020 Germany launched an economic stimulus package to strengthen demand and secure employment while helping the economy to emerge from the crisis in a more climate-friendly manner. In December 2020 the Federal Cabinet adopted the German Recovery and Resilience Plan (*Deutsche Aufbau- und Resilienzplan*), a follow-up to the stimulus package.

The issuance of a National Recovery and Resilience Plan is a pre-requisite to receiving funding from the EU COVID recovery plan, Next Generation EU. The German Recovery and Resilience Plan's six priority areas are: 1.) climate change (with an eye toward Germany's 2050 carbon neutral target), 2.) the digital transformation of the economy and infrastructure, 3.) digitalization in education, 4.) strengthening social participation (e.g. with a digital portal introducing retirement schemes, day-care facilities for children etc.), 5.) strengthening the health care system for pandemic-resistance, and 6.) modernization of administration and reduction of barriers to investment.

The German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) has developed a Corona Response Package under its International Climate Initiative (IKI). The €68 million package supports IKI's partner countries efforts to address pandemic challenges. The aim is to maintain and strengthen existing social structures, promote and accelerate economic transformations with a focus on climate change mitigation and conservation of biodiversity to contribute to the prevention of future pandemics. The fast-track procedure has been simplified for speed and effectiveness. Priorities include: introducing emergency measures to protect nature reserves and biodiversity hotspots from a rise in poaching and deforestation linked to the loss of tourism funds; helping indigenous populations who are at acute risk; financing economic advisors in twelve partner countries so they can provide support to planning and finance ministries in designing climate-friendly economic stimulus

programmes; funding ongoing IKI projects that have a special employment effect and long-term impacts on energy efficiency, renewable energies, urban development and sustainable investments; and, supporting the design and implementation of the new global framework for biological diversity and the Biodiversity Finance Initiative (BIOFIN) which aims to address knowledge gaps on the actual costs that are needed to effectively implement biodiversity strategies in partner countries.

4.4.2 Sweden

The government bill (2021-23) on green recovery focuses on transforming Swedish industry to lower GHG emissions, furthering the transition toward a sustainable transportation system, reducing loss in biodiversity and supporting the shift to resource effective, low-carbon, circular and non-toxic material and energy flows. The investments are expected to increase environmental quality, create new jobs and strengthen competitiveness.

One example is the introduction of governmental credit guarantees. In 2021 green credits of up to 10 billion SEK were issued to promote long term capital-investments to enable a green transformation of industry and open up future green employment opportunities. The credits are expected to increase to 15 billion SEK in 2022 and 25 billion in 2023.

The spread of the COVID-19 virus and the resulting economic crisis have had a severe impact on Swedish society. The Swedish government foresees new opportunities to intensify a transition to a circular economy through a green recovery and has recently (2020-21) introduced a national strategy and action plan for a circular economy, including sustainable consumption. Further digitalisation of both demand and supply is a key strategy. A national strategy on digitalization and sustainability was presented to the government in May 2021 (Vinnova, May 17, 2021).

4.4.3 Japan

Although many events related to climate change, including COP26, were postponed due to the coronavirus pandemic, a ministerial meeting on the "online platform" was held in September 2020 with the aim of sharing measures against COVID-19 as well as concrete actions and knowledge on climate change and environmental measures in different countries, and building global momentum to ensure that climate change measures would not be set back by the coronavirus disaster. The Chair's Summary confirmed the importance of "redesign" through the "three transitions".

In October 2020, Prime Minister Yoshihide SUGA declared that the government would make maximum efforts for the realization of a green society, focusing on the virtuous cycle of economy and the environment as a pillar of Japan’s growth strategy, and set the goal of achieving a carbon-neutral, decarbonized society by 2050. In December 2020, the Growth Strategy Conference, chaired by Chief Cabinet Secretary Katsunobu KATO, decided on the Green Growth Strategy Though Achieving Carbon Neutrality in 2050 as an industrial policy to create a "virtuous cycle of economy and the environment”. The strategy calls for setting high targets and initiating policies in expected growth industries (Offshore wind power; Fuel ammonia; Hydrogen; Nuclear power; Mobile and battery; Semi-conductor and ICT; Maritime； Logistics, People flow

and infrastructure; Food, agriculture, forestry and fisheries; Aviation, Carbon Recycling; Housing and building; Next generation perovskite solar cell; Resource circulation; Lifestyle-related industry).

In the "With-Corona, Post-Corona Era", it has proven to be important to unleash the vitality of local communities. The Japanese government has promoted the " Circular and Ecological Economy" proposed in the Fifth Basic Environment Plan which was approved by the Cabinet in 2018. The " Circular and Ecological Economy " is a concept that aims to maximize regional vitality by forming a self-reliant and decentralized society while maximizing the use of local resources such as beautiful natural scenery, and by complementing and supporting each other's resources according to local characteristics. Japan's Ministry of the Environment is supporting organizations that are working on the creation of a Circular and Ecological Economy.

Learning from the "With-Corona Era", Japan is expected to see a shift toward new lifestyles and work styles, including the growing popularity of outdoor leisure activities with low risk of infection, increased interest in moving to provincial areas, and the prevalence of telework. In particular, the work style called "workation," in which people conduct remote work in nature and enjoy leisure time and nature activities in between work, is attracting attention. Even prior to the COVID-19 pandemic, local governments and other authorities were promoting workation as a measure to increase population in rural and smaller urban areas. In 2019, Workation Alliance Japan was established (as of July 2021, 195 organizations (23 prefectures and 172 municipalities) were members), and local governments have been working to attract people. The Ministry of the Environment of Japan supports this initiative. By May 2021, MoE has supported 269 Workation activities. Some companies have joined in on the initiative as data shows that productivity is improved when the mind and body are refreshed and a better work-life balance is achieved.

4.5 Promoting Low Carbon Transitions

In this section, examples of some of the innovative and impactful measures being taken to reduce greenhouse gas emissions and to shift industry and society in less carbon-intensive directions are explored.

4.5.1 Germany: A Federal Climate Change Act and a Coal-Phase Out Plan

The 2019 Federal Climate Change Act mandated a minimum 55 percent reduction in GHG emissions by 2030 (relative to 1990 levels); introduced annual emission budgets for the energy, industry, transport, buildings, agriculture, and waste sectors; and set climate neutrality as a goal for 2050. Government operations and investments were to be climate neutral by 2030. In May 2021, however, the German Federal Court for Constitutional Matters issued an order requiring the Federal Government to increase its GHG reduction target for the coming years in order to more evenly spread the reduction burden across generations. The court reasoned that the 55% reduction target the government had set for 2030 (compared to 1990) would mean a disproportionately large share of the remaining reduction needed to reach climate neutrality (a further 45% cut in GHGs) would have to be achieved in just 20 years (between 2030 and 2050). The court determined this was unfair to younger and future generations. In response, in June 2021 the federal government amended the Climate Change Act raising the CO_2

reduction target for 2030 to 65%, setting an 88% reduction target for 2040, moving up the date for when climate neutrality is to be reached to 2045, and aiming for negative emissions thereafter.

A wide variety of policies and programs have been introduced to convince industry, society, and energy producers to become more sustainable. Building efficiency standards have been tightened, excessive consumption and waste is being targeted, recycling and reuse is being expanded, digitalization is being promoted to enhance the efficiency of processes and the use of resources, and new transport modes are being explored. Climate policy and energy transition measures focus on innovative energy systems such as hydrogen technologies and climate-friendly infrastructure and construction. Climate-friendly construction aims at increasing the use of wood as a building material and establishing innovation clusters in the field of wood construction. Public financial investments for building renovations and the shift to renewable energies for heat generation are key measures intended to reduce greenhouse gas emissions in the building sector to 70 million tonnes of CO_2 equivalents by 2030 and to achieve both the national and the European energy and climate targets by 2030.

The Climate Change Act establishes GHG reduction expectations for various sectors (e.g. energy, buildings, agriculture, transport, and waste); these were further tightened in June 2021 when the act was amended. To support the achievement of the climate goals a national emission trading scheme for fossil fuel burning processes in the housing and transport sectors was introduced at the beginning of 2021. The price of a certificate for one ton of GHGs was fixed at €25/t CO_2 in 2021 to rise to €30/t CO_2 in 2022, 35 Euro/t CO_2 in 2023, and €55/t CO_2 in 2025. This measure will also have a direct effect on household energy consumption.

The National Sustainability Strategy also aims to lower household per capita GHG emissions. In May 2021, the `Green Cabinet ´of the Federal Government added a target to cut in half per capita consumption-based GHG emissions by 2030 (compared to a base year of 2016) in a further advancement of the National Programme on Sustainable Consumption. The plan is to start a societal dialogue on a `budget approach ´in order to raise consumers' awareness of their `personal consumption footprint´ and stimulate their thinking about how their own GHG emissions can be reduced. The goal here is to achieve a shift in consumer mindsets. The strategy also includes targets for 2030 like halving food waste, doubling use of bicycles, and increasing the market share of certified sustainable products in e-commerce to 34%.

4.5.2 Sweden

Fossil Free Sweden, an initiative started by the Swedish Government in 2015, aims to mobilize society-wide involvement in climate action, and give companies, municipalities, and organizations opportunity to showcase their efforts under a common umbrella. The goal is to foster industrial competitiveness while creating more jobs and export opportunities by going fossil free.[6]

In 2017, the Swedish parliament introduced a climate policy framework containing new

6 https://www.regeringen.se/4add1a/contentassets/790b8b0d7c164279a39c9718ae54c025/faktablad_fossilfritt_sverige_webb.pdf

climate goals, a Climate Act and plans for a climate policy council. By 2045, Sweden aims to have net zero territorial greenhouse gas emissions and to achieve thereafter negative emissions[7].

At the request of the government, the Swedish EPA has developed five indicators to follow GHG emission performance in key consumption areas: personal transportation, air travel, food, building construction and accommodation, and textiles.[8] This tracking of consumption-based emissions can be used as a complement to territorial emissions tracking and to promote action by inhabitants and companies. An overall indicator for consumption based GHG emissions is being used in the national follow-up process for Agenda 2030 target 12.1.

In November 2020, the Swedish Government called on the environmental parliament preparation board to develop a strategy to reduce the climate impacts of Swedish consumption with the possible introduction of national consumption objectives, policy instruments and measures.[9] The investigation will be presented January 2022 and will contribute to the generational goal of delivering to the next generation a society that has solved the major environmental problems without exporting such problems to other parts of the world (henceforth, Generational Goal), the Environmental Quality Objective "Limited Climate Change" and Agenda 2030.

Sweden has already more or less decarbonised its electricity and heating sectors, so the focus now is on decarbonising transport, decarbonising heavy industry, and achieving negative emissions.[10] The industrial sector accounts for about a third of Sweden's total territorial GHG emissions (32% in 2019). As part of initiative Fossil Free Sweden industries have produced roadmaps to show how they can enhance their competitiveness by going fossil free or climate neutral.[11] The roadmaps identify opportunities and obstacles, industrial commitments and political proposals.[12] The Swedish Steel Producer' Association addressed fossil free steel production as well as a fossil free value chain from energy to mining to iron and steel production.

A system transformation will require comprehensive policies and governance approaches. The roadmap calls for: financing for long-term research and knowledge development; secured access to electricity and bio-based energy at internationally competitive costs; supporting further development of qualified life-cycle based models of climate impacts; and, supporting the creation of market demand for fossil-free steel and new business/pricing models for cost-sharing along value-chains[13]. Innovative cost-sharing and new business models will be needed to engage both down-stream industrial sectors as well as consumers. If fossil-free steel can be produced, this would aid producers of automobiles as well as consumers in transitioning toward climate-friendly transport. By developing climate-smart technology that can contribute to more circular and fossil-free solutions, competitive advantages, employment and export

[7] https://www.government.se/articles/2017/06/the-climate-policy-framework/

[8] Regeringsuppdrag Mätmetoder och indikatorer för att följa upp konsumtionens klimatpåverkan - Naturv årdsverket (naturvardsverket.se)

[9] Parlamentarisk utredning ska ta fram strategi för minskad klimatpåverkan från konsumtion - Regeringe n.se

[10] Swedish Environmnetal Protection Agency 2019; Klimatpolitiska rådet 2019

[11] https://fossilfrittsverige.se/en/roadmaps/

[12] https://fossilfrittsverige.se/wp-content/uploads/2020/12/Sammanfattning_Webb_ENG_2020.pdf

[13] https://www.jernkontoret.se/en/vision-2050/climate-roadmap-for-a-fossile-free-steel-industry/

opportunities can be created.

4.5.3 Japan

In Japan, the specifics of upgraded decarbonization measures will be revealed once the revision of the Plan for Global Warming Countermeasures is realized, but two points will be key in the new framework. The first is the maximum introduction of renewable energy as a national project and the bold use of innovative new technologies. The Green Growth Strategy of December 2020 focuses on 14 priority industry sectors for green growth, including hydrogen. This will lead to unprecedented national government investments in the green transition. The second is the creation of a framework that incentivizes individual local communities to reduce their GHG emission as much as possible, while at the same time ensuring their efforts to do so have a positive impact on their own economies. Many local governments in Japan have announced their commitment to net zero carbon emissions by 2050, and their aim to be “Zero Carbon Cities”, but many still lack comprehensive plans and specific measures to achieve carbon neutrality.

On May 26, 2021 the Diet amended the Act on Promotion of Global Warming Countermeasures without any objection. A basic principle is newly set in the revised law: all stakeholders in Japan will have to make efforts to achieve a decarbonized society by 2050, in line with the Paris Agreement. The second pillar is to promote renewable energy also as a way of contributing to regional revitalization. The act establishes a system whereby municipalities can certify projects that contribute to the decarbonization of the region, as well as to the resolution of regional issues, by utilizing local renewable energy sources. At the same time, it introduces special measures to such projects, such as a one-stop system for related administrative procedures to facilitate smooth consensus building in the region and promote the introduction of renewable energy that contribute to the region.

In order to achieve decarbonization, in addition to national industrial policy, local governments that are engaged in activities directly related to communities need to put decarbonization policies in place. The Council for National and Local Decarbonization was established in December 2020. It is chaired by the Chief Cabinet Secretary and aims for a decarbonized society at the community level by 2050 through collaboration and cooperation between the national and local governments. The Council has studied the viewpoints of consumers, ministries, agencies, and local governments and formulated a regional decarbonization roadmap in June 2021. This includes the regional implementation of latest available technologies over a five-year intensive period to 2025 and the creation of more than 100 decarbonization leading areas by 2030, to promote bold climate actions throughout the nation.

Greenhouse gas emissions from the household and business sectors are also major sources of emissions. Japan's Ministry of the Environment is promoting a national campaign called "COOL CHOICE," which encourages people to make smart choices that are beneficial to the fight against global warming, such as purchasing products, using services, and choosing lifestyles that contribute to the creation of a decarbonized society. Specific campaigns include the "Cool Biz" and "Warm Biz" campaigns, which promote appropriate air conditioning settings and clothing in summer and winter, the "Eco-Drive" and "Smart Move" campaigns, which encourage the appropriate use of

automobiles and transportation, and the "Lighting Future Plan" campaign, which advocates energy conservation and the spread of high-efficiency lighting.

In Fukushima Prefecture, which was severely damaged by the Great East Japan Earthquake and the nuclear disaster in 2011, efforts are being made to realize the "Fukushima Innovation Coast Initiative" (specified in the government's 2014 Framework Policy), a national project that aims to build a new industrial base in order to recover the lost industries in Hamadori and other areas. In 2016, the government's "Conference for the Realization of the Fukushima Plan for a New Energy Society" chaired by the Director General of the Agency for Natural Resources and Energy formulated the "Fukushima Plan for a New Energy Society" (revised in February 2021) to accelerate the efforts in the energy field of the Plan. The government, prefectural government, and related companies are working together to expand the introduction of renewable energy and hydrogen with the aim of generating more than 100% of Fukushima Prefecture's primary energy demand from renewable energy sources by around 2040.

4.6 Electric Mobility

The transport sector is an important economic engine in the countries examined in this international contribution. The sector is under growing pressure to tackle its greenhouse gas emissions. Various approaches are being followed in the cases examined in this report.

4.6.1 Germany

The German automobile industry is Europe’s largest passenger car producer and a very important contributor to Germany’s economy. Despite the government’s setting of voluntary targets in the past (e.g. to reach one million electric vehicles in use by 2030), German car producers have been slow in introducing electric mobility and targets have not been met. With growing concern about the sector’s slow progress towards meeting GHG emission reduction targets, the industry’s large environmental and climate impacts, as well as growing international competition, the Federal Government is beginning to intervene more strongly to support electric mobility. In 2011, the government introduced the National Development Plan for Electric Mobility and in 2016 issued a market incentive package with temporary purchase incentives (an environmental bonus for hybrid and non-hybrid electric cars) and introduced plans for enhancement of charging infrastructure and the purchase of electric vehicles by public officials.

In order to accelerate the shift toward direct zero-emission vehicles, new targets have been set. There are to be 7 to 10 million electric vehicles on the market and 1 million charging stations by 2030. Germany’s Recovery and Resilience plan is to enhance the environmental subsidy for electric vehicles. The Federal Government has doubled the share of the state-funded buyer’s premium for electric vehicles until the end of 2021, a so called “innovation bonus” that supplements the environmental bonus already in place since the market incentive program was launched in 2016 and extended until the end of 2025. Plug-in hybrid electric vehicles and hybrid and fully electric second-hand vehicles also benefit from this premium; combustion engines are excluded. The Federal Government is sending a clear message to private consumers by dedicating around €3

billion to electric car purchase subsidies. The subsidy rates for electric vehicles with a net list price of less than €40,000 are up to €9,000 for a purely electric drive (battery electric or fuel cell) vehicle and up to €6,750 for a hybrid electric vehicle that can be charged externally (plug-in hybrids). The subsidy rates for electric vehicles over €40,000 net list price are up to €7,500 for a purely electric drive (battery electric or fuel cell vehicle) and up to €5,625 for a hybrid electric vehicle that can be charged externally (plug-in hybrids). For comparison it was previously €4,000 for a purely electric drive and €3,000 for plug-in hybrids. In addition, anyone who buys a new electric car is exempted from vehicle tax for 10 years from the date of initial registration. This tax exemption runs until the end of 2030. Parallel to the extension of the environmental bonus, the installation of an acoustic warning signal specifically for low-noise electric vehicles will be introduced. The subsidy for this is a flat rate of €100.

An additional incentive to promote e-mobility is the tax-free charging of e-cars at employers' premises. This savings on electricity costs that would otherwise be incurred, is exceptionally not taxed as a non-cash benefit unlike other taxable employer benefits, such as a company car or meal vouchers.

The Federal Government is supporting a nationwide, demand-oriented network of charging infrastructure to meet users' needs. The Federal Ministry of Transport and Digital Infrastructure intends to supplement its funding policy by commissioning the construction and operation of a nationwide fast-charging network at 1,000 locations, although the Federal Government does not intend to become an operator of charging facilities itself. In addition, the Federal Ministry of Transport and Digital Infrastructure is developing further funding programmes with the aim of extending the nationwide development of charging infrastructure to the private and commercial sector with €6 billion.

In order to promote low-emission motor oil passenger cars and take CO_2 emissions more strongly into account, the German Parliament revised the Motor Vehicle Tax Act (KraftStG) in October 2020. Similar to the case in Sweden, owners with high CO_2 emissions will be taxed more and those with low emission vehicles will receive tax breaks. The tax will depend on engine capacity and CO_2 emission levels. Cars emitting up to 95 g CO_2/km will incur no taxes. In addition, owners of cars purchased between June 2020 and December 2024 will have an annual tax bonus (International Council of Clean Transportation). There is a progressive increase of the CO_2 component and the annual tax liability for vehicle ownership based on the revised Motor Vehicle Tax Act (§ 9 Absatz 1 Nummer 2 KraftStG and § 10b KraftStG). Environmentalists warn that the tax is still too low to have much impact and point to France where taxes are higher.

Another instrument to promote use and competitiveness of clean vehicles is public procurement. Based on the revised EU Clean Vehicles Directive the Federal Government in January 2021 adopted the Law on Promotion of Clean and Energy Efficient Vehicles, requiring public authorities procure a significant share of clean vehicles. It also includes a quota for electric buses of 22.5% between 2021 and 2025) and 32.5% between 2026 and 2030.

4.6.2 Sweden

The transport sector is responsible for one-third of Swedish CO_2 emissions; this level

has remained stable over time. The Swedish vehicle fleet has long been dominated by large and relatively old high-fuel consuming cars. The Swedish Government set an ambitious target to reduce transport emissions by 70 per cent by 2030, compared with 2010 levels in its climate bill. [14] A Bonus-and-Malus System, which provides a subsidy for environmentally friendly vehicles and a tax on vehicles with combustion engines based on their emissions was introduced on July 1, 2018. The system has several policy objectives: 1.) to shift the relative price of high-emission and low- and zero-emission vehicles so as to encourage the purchase of climate-friendly vehicles; 2.) to speed up the renewal of the vehicle fleet to meet the EU target of an average CO_2 emissions of 95g/km for new cars by 2021; and, to make support schemes for zero- and low-emission vehicles less expensive by having the "bonus" financed by a "malus" tax. In Sweden fossil fuels are subject to a VAT and fuel taxes (carbon and energy taxes). In addition, car owners pay an annual vehicle tax. The idea is that the system should pay for itself and not rely on public funding. Those who choose to buy a car with higher CO_2 emissions subsidize the purchase of those who choose a car with lower CO_2 emissions. The Bonus-Malus-system is part of a policy package with combined tools affecting vehicle purchase, usage and technology development.

To further strengthen emission reduction outcomes as well as to ensure the financing of the system, in 2020 the Government proposed a further increase in vehicle taxes on new light petrol and diesel vehicles. Stronger incentives for the purchase of zero-emission vehicles have been announced.[15] Electric vehicle registrations in Sweden hit a historic high of 18% in 2019, reaching a 32% share of newly sold cars that are chargeable in 2020.[16] Nevertheless, the current policy packages, including the Bonus-Malus system will not be sufficient for Sweden to reach EU's average CO_2 emissions target by 2021. In terms of future policy design, the entire life cycle of the vehicle and the emissions tied to the production of electricity need to be taken account in the Bonus-Malus-system to ensure sustainability outcomes. To assure fairness, a bonus needs to be put in place to make it possible for those with lower incomes to afford more sustainable choices, such as electric vehicles.

4.6.3 Japan

In 2000, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) first launched an environmental labeling system to certify automobile models that meet a certain level of emission and fuel efficiency standards. In 2009, an eco-car tax reduction program was launched for next-generation vehicles (electric vehicles, fuel cell vehicles, natural gas vehicles, plug-in hybrid vehicles, and clean diesel vehicles) and vehicles that meet certain emission and fuel efficiency standards. By imposing heavier or lighter taxes on both the acquisition and ownership of vehicles, the system encourages the acquisition and ownership of vehicles with higher environmental performance, as well as the reduction of the use of vehicles with high environmental impact that have passed a certain age. The auto-related tax revenues that funded the FY2020 budget totaled 2,618 billion yen. The tax is equivalent to 2% of Japan's tax revenues (the initial

[14] https://fossilfrittsverige.se/wp-content/uploads/2020/12/Sammanfattning_Webb_ENG_2020.pdf3ae8e123bc4e42aa8d59296ebe0478/the-swedish-climate-policy-framework.pdf" the-swedish-climate-policy-framework.pdf

[15] For more details, see: https://www.regeringen.se/rattsliga-dokument/departementsserien-och-promemoror/2020/10/forstarkt-och-forenklad-miljostyrning-i-bonusmalus-systemet/

[16] https://www.bilsweden.se/statistik/Nyregistreringar_per_manad_1/nyregistreringar-2020/definitiva-nyregistreringar-under-2020

FY2020 budget, total of national and local taxes).

4.7 Circular Economy and Eco-Design

4.7.1 The European Union

Regulations on circular economy and resource efficiency including reparability, durability, availability of spare parts, and mandatory repair instructions were initially covered by the EU Ecodesign Directive 2009/125/EG and in separate directives for single product groups. [17] The Ecodesign Directive has been very effective in providing energy savings and reductions in GHG emissions.[18] It has also provided other resource savings, such as water, and reduced pollutants.

Nevertheless, in 2020 the EU-commission launched consultation on a Sustainable Product Initiative to explore how further product legislation and actions could facilitate the transition towards a circular economy and contribute to reaching sustainable development goals on consumption, production, climate, air, water and biodiversity. [19] The public has been invited to contribute ideas to the redesign of the Ecodesign Directive 2009/125/EG.[20]

The new Circular Economy Action Plan for a Cleaner and More Competitive Europe was launched in 2020 with the aim of making sustainable products the norm, empowering consumers to make sustainable consumption choices, and ensuring less waste through a sustainable product framework and by shifting towards greater circularity in production processes. Key product value chains covered are electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, and food, water and nutrients.[21] In 2021, the European Commission presented a proposal for a Battery Ordinance which addresses the whole life cycle of batteries (from small household batteries to large vehicle and industrial batteries) and from the sourcing of materials and battery design to the treatment of used batteries.[22]

Regulations targeting the textile sector are also now under consideration as part of the Circular Economy Action Plan. The textile sector causes massive global environmental and social impacts. The popular and growing embrace of fast fashion is being accompanied by a growing concern about the impacts the sector is having in terms of water and land use, toxic emissions, plastic waste, and textile waste as well as human health and working conditions in many developing countries. The EU aims at issuing a

[17] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related productsText with EEA relevance (europa.eu)

[18] Ecodesign Impact Accounting. OVERVIEW REPORT 2018, VhK for the European Commission.

[19] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12567-Sustainable-products-initiative_en

[20] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12567-Sustainable-products-initiative

[21] A new Circular Economy Action Plan: For a cleaner and more competitive Europe, https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-1aa75ed71a1.0017.02/DOC_1&format=PDF

[22] See European Parliament Briefing. New EU regulatory framework for batteries, setting sustainability requirements, https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/689337/EPRS_BRI(2021)689337_EN.pdf. See also, European Commission, COM(2020) 798 final, 2020/0353 (COD), Brussels 10.12.2020, https://eur-lex.europa.eu/resource.html?uri=cellar:4b5d88a6-3ad8-11eb-b27b-01aa75ed71a1.0001.02/DOC_1&format=PDF.

textile strategy before the end of 2021. It will follow a holistic approach and cover the whole life cycle of textiles from growing of natural fibers to separate collection of used textiles and their reuse or recycling. The aim will be to reduce negative impacts in the textile supply chain and support circularity, durability and recyclability of textiles. The use of instruments like targets for recycled content in new textiles or sustainable public procurement are likely to be included in the strategy.[23] From 2025 EU waste management legislation will require the separate collection of textiles.

4.7.2 Germany

Germany has promoted circular economy concepts for decades. The packaging ordinance of 1991 was among the first regulations worldwide to introduce Extended Producer Responsibility in a sector. The first circular economy law (Kreislaufwirtschaftsgesetz), which focused on waste management, was adopted by the Federal Government in 1996. In the meantime, a much broader understanding of the circular economy concept is being followed.

The newly revised circular economy law (2020) addresses many areas of product policy and the throw away culture that has developed. It includes an obligation for public procurement to favor sustainable products and in particular those which contribute to the circular economy. The law includes a new instrument called *Obhutspflicht*, an obligation to take care of goods. Producers, retailers and selling platforms (like Amazon) which had been treating goods returned by customers as trash (unused and often still in original packing) will now be obliged to either donate these goods or sell them. They are further obliged to report on how they dealt with returned goods.

Another piece of legislation to promote more sustainable products and ensure an enhanced circular economy is the newly revised Packaging Law (*Verpackungsgesetz*), which was adopted by the Federal Cabinet in January 2021. The revision of the law stipulates that all one-way plastic bottles and metal drink cans will have a mandatory deposit of €0.25. The aim is to give a competitive advantage to multi-use drink bottles (glass or plastic) as these are environmentally preferable. In addition PET-bottles for drinks must contain 25% recycled material starting in 2025.

The revised packaging law also contains a regulation that restaurants, take away-shops, and cafes which sell food must offer multi-use containers starting in 2023; the multi-use container option shall also not be more expensive than the single-use one. The aim is to reduce the fast rising amount of packing waste tied to “to-go” consumerism.

The German Ministry for Development Cooperation (BMZ) has set up a textile alliance as a reaction to the Ragna Plaza disaster where 2000 people died in a collapsed textile factory. The members of the alliance cover about 45% of the German textile market; they have committed to social and some environmental improvements in their textile value chain. To make these efforts visible BMZ has set up a new labelling scheme, the Green Button, which is used by companies in the alliance. Still the share of sustainable textiles in the German clothing market remains below 5%.

The Federal Government has set a target for federal public procurement of sustainable

[23] European Commission. EU Strategy for Sustainable Textiles, Roadmap. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12822-EU-Strategie-fur-nachhaltige-Textilien_de.

textiles: 50% of all textiles procured shall meet recommended sustainability standards like the Global Organic Textile Standard (GOTS), Green Button or Blue Angel.

In addition to the EU regulations for reparability, durability, and availability of spare parts included in the criteria set by the Blue Angel, Germany has introduced its own even more ambitious targets. These are also to be used in public procurement decisions.

4.7.3 Sweden

The EU Ecodesign Directive and its product regulations are directly applicable in Sweden and secured by the Swedish Energy Agency through information campaigns and market surveillance. The Swedish Energy Agency's internal lab (Testlab) is unique in the EU. Sweden uses both negotiations and market control to bring ecodesign and energy labelling under one roof. [24] The internal lab has helped to build expertise and is one reason the Swedish Energy Agency is often asked to contribute advice to the European Commission.

The Swedish Energy Agency informs producers, retailers and other stakeholders through the web, seminars and newsletters about EU Ecodesign policies. The Swedish Energy Agency sees good possibilities to set further resource efficiency product requirements through ecodesign, though it needs to be complemented by economic incentives, information and possibly new business models. These requirements contributing to prolonged product lifetime and increased recycling also imply increased cooperation between agencies on other issues, such as electric safety and chemical issues.

The way energy efficient product policies such as ecodesign and energy labelling are negotiated, formulated and implemented in Europe serve as an inspiration to other countries. The Swedish Energy Agency participates in a SIDA-funded UNIDO project called EELA (Efficient Lighting and Appliances), aimed to assist 21 countries in southern and eastern Africa in building product legislation for ecodesign and energy labeling. The Swedish Energy Agency helps with dialogue with the business community, building up labs and test activities as well as advanced training for various stakeholders including policy officers, lab technicians, market authorities, manufacturers, importers and public and private procurers. By supporting policy capacity building, technology transfer and business development, the overall goal is to achieve market transformation towards more energy efficient products and services outside of Europe as well.

4.7.4 Japan

In Japan, there is growing interest in closing the loop from design to disposal to achieve a sustainable consumption and production system. Historically, increases in waste generation and illegal dumping led to the enactment of the Basic Act on Establishing a Sound Material-Cycle Society under the Basic Environment Law in 2000. The law prioritized the 3Rs (Reduce, Reuse and Recycle), introduced extended producer responsibility, and led to the revision of earlier laws and the establishment of new laws addressing waste and recycling in areas ranging from packaging to home appliances,

[24] Energy labelling regulation 2017/1369/EU, REGULATION (EU) 2017/ 1369 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 4 July 2017 - setting a framework for energy labelling and repealing Directive 2010/ 30/ EU (europa.eu)

food, and automobiles, as well as green purchasing requirements.

In response to these laws, industrial organizations and individual companies have promoted various initiatives. As examples, the Japan Automobile Manufacturers Association (JAMA) established the "Guidelines for Prior Evaluation at the Product Design Stage to Promote 3Rs of End-of-Life Vehicles," and Toyota is actively adopting designs for new vehicles that are easy to disassemble and sort. UNIQLO, a casual fashion retailer, reuses clothes collected from recycling boxes set up at UNIQLO stores nationwide and delivers them to people in need around the world, including those living at refugee camps and disaster-stricken areas in the form of emergency disaster relief, together with the United Nations High Commissioner for Refugees (UNHCR), NGOs and NPOs. Clothes that cannot be reused are processed and recycled as fuel or soundproofing material, and recently the company has been promoting "clothes-to-clothes recycling".

In addition to the initiatives by companies and organizations, the government also implements measures to realize a transition to circular economy. The Ministry of the Environment together with other ministries and agencies formulated the Resource Circulation Strategy for Plastics in 2019 to address issues including the marine plastic crisis. In June 2021, the Diet unanimously passed "Act on Plastic Resource Circulation" to realize plastic materials' circulation by 2050, covering all processes from product design to waste disposal.

4.8 Sustainable Food Systems

4.8.1 The European Union

The European Farm to Fork Strategy, a key element of the Green Deal, promotes sustainable food systems. This involves sustainable agriculture; a food environment that makes the healthy and sustainable choice the easy choice; and, a sustainable food-labelling framework that allows consumers to choose healthy diets as well as socially and environmentally-friendly food products. It involves ensuring food security, stimulating sustainable food processing, wholesale, retail, hospitality and food services practices, and fighting against food waste. The strategy is also considered important for achieving climate neutrality and reducing other environmental externalities.[25]

4.8.2 Germany

The German Federal Ministry of Food and Agriculture (BMEL)'s Scientific Advisory Board on Agriculture Policy, Food and Consumer Health Protection (WBAE) recommends four target dimensions to create fair food environments and more sustainability in food consumption: health, social aspects, the natural environment and animal welfare.

The food environment begins with exposure to food and food stimuli (e.g. in advertisements and on social media). Exposure calibrates our perceptual field; currently,

[25] European Commission, Farm to Fork Strategy: For a fair, healthy and environmentally-friendly food system, https://ec.europa.eu/food/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf. See also, Hanna Schebesta & Jeroen J. L. Candel, "Game-changing potential of the EU's Farm to Fork Strategy," Nature Food 1, 586-588 (2020), https://www.nature.com/articles/s43016-020-00166-9.

this field is often calibrated towards products with an unfavourable nutrient profile (e.g. fast food, soft drinks) and a high climate footprint. Access to food depends on various factors, including price, availability of information, and social eating and behavioural norms. Actual food choices are shaped by socio-economic aspects, preferences, attitudes, knowledge, social norms and habits. Marketing and, to an increasing extent, social media. They are influential environmental factors that associate food with certain values and characteristics, which then influence consumer preferences. These factors play a role in determining consumption, i.e. what food is eaten, and how much and how quickly it is eaten.

The German government has started to recognize the need for an integrated policy for promoting sustainability in food consumption that significantly improves the food environment. Currently too much responsibility is placed on the individual to act. The State Secretaries' Committee for Sustainable Development is now taking up the issue. The Committee (also called `The Green Cabinet´) is in charge of the National Sustainable Development Strategy's measures and is monitoring indicators to ensure alignment with the 17 Sustainable Development Goals. In July 2020 the State Secretaries' committee published sustainable development requirements for the food system.

A simplified and extended nutritional labelling system on the front of packaging is a key element of a holistic policy for promoting healthy eating. In 2019 a representative consumer survey was made on different nutritional labelling systems. German consumers prefer the Nutri-Score, a food-labelling framework that is already available in some European countries. The Nutri-Score uses a 5-level colour scale from A to E developed by independent scientists. The scale indicates the nutritional quality of food. Energy content as well as nutritionally favorable and unfavorable nutrients are offset against each other. For example, the fibre and protein content as well as the vegetable, fruit and nut content are classified as favorable. Energy inputs and the content of saturated fatty acids, salt and sugar are rated as unfavorable. The Nutri-Score makes it possible to compare products within a product group. It only concerns food products that have a nutritional values table. Fresh products such as fruits and vegetables are excluded. It is a voluntary labelling scheme so far but an EU-wide mandatory introduction is envisaged.

A variety of different labelling schemes exist to address the environmental impacts of food. The Bio-Label based on EU legislation is the most commonly used. Other labels based on higher standards also play a role in the market. The Eaternity Score from the Eponymous Consulting company assesses climate and water footprints quantitively for caterers and canteen managers, and assesses animal welfare and rainforest protection qualitatively. The Ministry for Environment uses this in their cafeterias to orient customers.

The Federal Ministry for Nutrition and Agriculture (BMEL) has also launched a campaign "Too good for the bin" to handle the issue of food waste. It is estimated that there are about 75 kilos of food waste per person per year much of which is preventable. Consumers can find useful tips for everyday life (how to make better food purchasing, storage, and consumption choices) and cooking recipes on the web and via a smartphone App.

During the German presidency of the European Commission in the second half of 2020,

the European Council unanimously supported a German proposal for the development of an animal welfare label and has tasked the EU Commission with elaborating a regulation for all livestock species over their entire life span.[26]

4.8.3 Sweden

The Swedish government launched a long-term food strategy in 2017, with a vision that its food chain be globally competitive, innovative, sustainable and attractive to operate within by 2030.[27] The main purpose of the strategy is to increase production, support a competitive food chain, increase employment, enhance innovation capacity and profitability and achieve relevant environmental objectives. Three strategic action areas have been identified: rules and regulations, consumers and markets (giving consumers a high degree of confidence in food and the ability to make informed and sustainable choices), and knowledge and innovation to contribute to increased productivity in the food supply chain and the sustainable production and consumption of food. The government believes that the solution is to increase environmentally efficient production, particularly production that has a low impact on the environment in global terms.

Collaboration among relevant stakeholders at the local, regional and national levels is a key factor in the implementation of the strategy. The Government has launched a series of action plans in 2017, 2019, and 2021.

Action Plan I (2017 to 2019) introduced targeting goals to have 30 percent of Swedish agricultural land certified as pursuing organic agriculture and 60 percent of public food consumption (e.g. public schools and hospitals) offering certified organic products. [28]

The Swedish Board of Agriculture in consultation with other authorities, representatives of companies and organizations along the food chain as well as consumer and environmental organizations is drawing up an action plan and milestone targets to achieve this 2030-target. Public procurement of food and meals (such as school meals) can be used to promote even better animal protection and environmental concerns. Another area of action is reducing food waste throughout the food chain by increased cooperation between actors along the food chain and authorities. Information targeting consumers is also important.

Action Plan II (through 2025) gave assignments to the Swedish Agency for Economic and Regional Growth to advance more effective "Rules and regulations" and to the Swedish Innovation Agency and Swedish Research Council for Sustainable Development (FORMAS) to promote innovation and research, respectively. The central part of Action Plan III (starting January 2021) is a so-called "simplification package"; concerned authorities are asked to simplify rules and regulations while making them more effective.[29]

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[26] https://www.eu2020.de/eu2020-en/news/pressemitteilungen/animal-welfare-kloeckner-eu/2427904

[27] https://www.government.se/articles/2017/04/a-long-term-food-strategy-for-sweden/

[28] https://www.regeringen.se/informationsmaterial/2017/02/handlingsplan---en-livsmedelsstrategi-for-sverige--fler-jobb-och-hallbar-tillvaxt-i-hela-landet/

[29] https://www.regeringen.se/regeringens-politik/en-livsmedelsstrategi-for-jobb-och-hallbar-tillvaxt-i-hela-landet/handlingsplan-for-livsmedelsstrategin/

Some main findings from the 2020 evaluation are that Swedish companies need to increase the added value of their products and strive for increased product value rather than increased production volumes, and that knowledge and innovation are central to the long-term development of the food chain. As production becomes more high-tech and knowledge-intensive, the competitive advantage of firms and nations are more than ever dependent on a leading position in knowledge and research. If education and research in the food chain is not strengthened, Swedish food firms will fall behind in global development.

In the Swedish environmental objectives system, there are two milestone targets on reducing food waste, and both should be reached by 2025.[30] Target one is to reduce food waste in food production, before food reaches the store and the consumer. Progress is to be monitored by the Board of Agriculture. Target two is to reduce food waste by at least 20% by weight per capita from 2020 to 2025 and is to be monitored by the Swedish EPA.

Röös et al. (2020)'s research on food policy instruments highlighted the importance of: 1) setting national goals for sustainable food consumption; 2) going beyond information provision to introducing regulations, making demands of producers and retailers, and adjusting prices; 3) recognizing that policies receive more public support if they are combined into *packages* with for instance higher taxes on red meat, coupled with lower taxes on vegetables and fruit; and, 4) using public sector meals – in schools, hospitals, kindergartens, etc. – as role models for sustainable eating.

4.8.4 Japan

In Japan efforts are underway to link food production to the Sustainable Development Goals (SDGs). This includes, for example, making nutritional food available to children in school (free food for poor children) (SDG 1, no poverty), international cooperation for nutritional improvement through the promotion of sustainable agriculture, forestry and fishery (SDG 2, zero hunger), the creation of welfare farms employing handicapped people (SDG 3, good health and well-being), food education (SDG 4, quality education), gender equality in farming, forestry, and fisheries (SDG 5, gender equality), promoting sustainable use of irrigation water in developing countries (SDG 6 clean water and sanitation), renewable energy use in farming, mountain, and fishing villages (SDG 7, affordable and clean energy), creating innovation through smart agriculture, forestry, and fisheries (SDG 9), reduction of food loss and food recycling (SDG 12 responsible, consumption, and production), among other goals.

Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF) is promoting efforts to spread the "Japanese-style diet" with its excellent nutritional balance. The ministry holds national conferences for the promotion of dietary education, gives awards for dietary education activities, and supports the provision of opportunities to experience agriculture, forestry, and fisheries and communal dining. Regarding the reduction and utilization of food waste and food loss, it is estimated that Japan generated 25.31 million tons of food waste of which 6 million tons was discarded despite being edible in FY2017. The Food Recycling Law was promulgated in 2000 in order to reduce the final disposal volume of food waste by controlling its generation and reducing its volume, as well as to reuse it in the form of feed and fertilizer as resources recycled from food or

[30] https://www.sverigesmiljomal.se/etappmalen/

for heat recovery. Measures were also taken to promote recycling by food-related businesses, such as setting standards and targets for recycling, requiring periodic reporting, registering businesses, and certifying business plans. Under this law, the Ministry of the Environment of Japan is implementing efforts to match food-related businesses, recycling businesses, agriculture, forestry, and fishery businesses, etc., in order to expand the food recycling loop.

To reduce food waste, the Food Loss Reduction Promotion Act was promulgated in 2019. The goal is to reduce by half the volume of household and business food loss by FY2030 compared to the FY2000 level. As an example of efforts to encourage businesses and consumers to take action, the Ministry of the Environment is conducting the "No-Foodloss! Youth Action Project", in which students from all over Japan who want to engage in activities/projects for food loss reduction are invited to discuss and present ideas for activities in their own neighborhoods. In addition, the Ministry of the Environment, the Consumer Affairs Agency, and the Ministry of Agriculture, Forestry and Fisheries are holding the "New Doggy Bag Idea Contest" to solicit ideas from the general public on how to popularize and establish a new style of taking home leftover food from restaurants.

4.9 Gender

Gender equality is a prerequisite for sustainable societal development and crucial for the ability to innovate. The entire population's experiences, skills and knowledge are needed to take full advantage of a society's innovation potential.

In Germany gender equality plays an important role in the society and in politics for decades now. It is still an evolving issue and the process toward gender equality is still going on. Gender equality is still not reached in every part of social and work life in Germany.

In Germany, gender equality is enshrined in the Basic Law (equality article, Article 3 GG) and was recognised by a Cabinet resolution on 23 June 1999 as a universal guiding principle of the Federal Government's actions. It has also been enshrined in the Common Rules of Procedure of the Federal Ministries since 2000. At that time, it was decided to promote this task by means of Gender Mainstreaming. Gender Mainstreaming was integrated into the Federal Equality Act (BGleiG) as the legal basis for gender equality. The more consistent application of these principles and their concrete consideration in or alignment with policies and measures, remains a challenge for policy in the present day; this is equally true for climate policy, which is increasingly subject to justice requirements.

Political measures to ensure and promote gender equality are mostly found in areas like equal payment, no discrimination in work life, equal opportunities for job promotion etc. There was new legislation adopted in January 2021 which requires that companies with shares at the stock exchange have to give at least one seat in their executive board to a woman when the board has 4 or more members. For the supervisory board of these companies a law adopted in 2016 requires a share of women of 30%. For state owned companies the required share is 50%.

Environmental policies are often not addressing the issue even though there are actual differences in average attitudes on sustainability issues, different consumption habits,

different eating habits etc. But usually the instruments in the area of SCP are not differentiating particular groups in the society (nor young and old, men and women, rich and not rich etc.). And it seems to be very difficult to differentiate (and by that not discriminate). Therefore gender aspects do not play a significant role in SCP policies so far but that might change.

The overall objective guiding the Swedish gender equality policy clarifies that women and men must have the same power to shape society and their own lives. With this as its starting point, the Government is working towards six sub-goals; 1. Equal distribution of power and influence, 2. Economic gender equality, 3. Gender equality in education, 4. An equal distribution of unpaid housework and provision of care work, 5. Gender equality in health, care and social services; 6. Stopping violence against women. [31]

It is widely accepted that tax income must be used to benefit both women and men equally. The Swedish Innovation Agency's policy is that an equality perspective should be integrated into agency activities and that gender equality should be promoted in the distribution of funds for research and innovation. All activities in government should be permeated by a gender equality perspective and business should be developed so that it contributes to the gender equality policy goal that women and men should have the same power to shape society and their own lives.[32] It is important to integrate gender equality into the development of policy measures for a green transition, including in the realm of sustainable consumption and production. Recent research shows that with the same expenditure Swedish men give rise to 16 percent higher GHG emissions than Swedish women. Men's higher consumption of vehicles and fuels are possible reasons for this.

In 1999, the Japanese government enacted the Basic Act for Gender Equal Society. The Fifth Basic Plan for Gender Equality (approved by the Cabinet on December 25, 2020) states that in order to realize a sustainable society, the Government shall, in response to environmental issues such as climate change, expand women's participation in the policymaking process, taking into account international trends, and actively work to reflect the perspective of gender equality in specific initiatives. The Central Environment Council, which was established under the Basic Environment Law as an advisory body to the Minister of the Environment, has 14 women out of 30 expert members (as of February 2021).

The plan also calls for promoting gender mainstreaming in the implementation of Official Development Assistance (ODA) programs and projects, and encouraging gender equality and the empowerment of women and girls, thereby facilitating women's participation in all stages of development cooperation and ensuring that they receive equitable benefits from development activities. In April 2020, the Japanese government issued gender guidelines for joint crediting mechanism (JCM) Subsidy Projects in accordance with Article 6.2 of the Paris Agreement. The gender guidelines outline the actions required to achieve gender equality in the project cycle (planning, implementation, and operation stages) of JCM subsidy projects, and urge recipients of

[31] https://www.government.se/49c604/contentassets/efcc5a15ef154522a872d8e46ad69148/gender-equality-policy-in-sweden-210608-ny.pdf

[32] https://www.vinnova.se/m/jamstalld-innovation/

JCM subsidy projects, especially the representative entities and joint businesses in charge of project implementation, to take actions for gender equality.

4.10 Conclusions and recommendations

The Corona pandemic has arguably led to the worst global economic crisis since the Second World War or even the Great Depression. The causes of the pandemic are many, but among them environmental degradation has certainly played a role. The pandemic moreover is a warning that future crises will certainly occur. The best way to mitigate against such future economic and social shocks is to revamp our economic and social systems in such a way that they are deeply sustainable – ecologically and socially. With growing recognition of the precarious state of the global environment and the perverse incentives that have supported polluting industries and processes, major steps are beginning to break with the past and to set European and the Japanese economies on new more sustainable paths.

With much of the low hanging fruit already picked, governments are paying more attention to how major polluting industries can be incentivized or mandated to reduce their energy and resource footprints. Here we have considered a handful of examples of how through the post-Corona recovery plans as well as new plans and regulations big and powerful sectors are being addressed, including the energy, transportation, steel, and agricultural/food sectors. The Corona recovery plans should be as an opportunity to build more resilient and ecologically sound societies.

To meet the Paris Agreement goals, more fundamental changes may be needed, such as shifting spending from private consumption to public investments and reduction of work time.[33]

Public acceptance is also key. The most important factor for public acceptance of a policy is that it be perceived as *fair* and effective (Matti et al, forthcoming). For environmental policy-making this means that fairness – both how it should be interpreted and how it can be achieved - needs to be given a more central role in the design of policy packages. Policies directed to companies (e.g. biofuel use and climate labelling) have more public support than policies directed towards consumers (e.g. air passenger and meat taxes) (Larsson et al., 2020).

This chapter has only been able to touch upon a few efforts, but the major lesson to take out of it is that achieving climate neutrality and a circular economy will mean that deeper structural changes and societal approaches to consumption and living will be needed. This means systems must be developed to make it possible to examine the ecological and social footprints of products at each stage of their life cycle. Consumers need options and incentives to consume more wisely and to throw away less. This can only be achieved if both industrial actors and consumers are considered at the same time and work together to find approaches to product design, recycling, and reuse that are convenient for consumers. Strengthening the interface of public engagement is

[33] (Nässén & Larsson, 2015) argue that there is a correlation between income and environmental impact, suggesting that reduced income through for instance work-time reduction is an effective strategy to reduce environmental impact. Studies of work time reduction schemes have not only shown reduced environmental impact but also shown positive effects on well-being (e.g. Buhl & Acosta, 2016, Larsson et al, 2020). Overall policies for sustainable consumption need to be oriented towards *sufficiency* and *well-being* (Callmer & Bradley, forthcoming).

critical to promoting societal movements and transitions for sustainable consumption and living.

Recommendations:

In developing approaches to support sustainable consumption, follow a holistic approach. Changes are needed on the part of suppliers so that they offer consumers more sustainable product choices. This means a focus on the complete value chain from material and energy inputs, through to product design and production processes to product use and post-consumption management. Use of sustainable and recycled materials, easily recyclable products, and the right to product repair can go a long way in reducing ecological footprints on the supply side. On the private consumer demand side, enhanced information transparency, easy to understand labels which help consumers to make smart choices, and policy approaches based on behavioral insights can lead to more sustainable consumption practices. Green transition and social sustainability are complex challenges that call for a system perspective. [34]

Link sustainability to post-Corona recovery. Corona recovery plans provide an opportunity to make some of the major infrastructural investments and policy transitions that will be needed for the green recovery. The recovery packages are some of the largest investments seen in decades. If the funds are channelled into polluting industries and processes, then a major opportunity for change will be lost and existing global environmental problems will be exacerbated. If on the other hand, these funds are directed towards the green transition and the creation of green jobs and green infrastructure, green innovation will flourish.

Integrate new digital technologies into production processes along the entire value chain of products to enhance efficiencies. Use internet platforms and social media to disseminate information about the importance of the green transition and steps that can be taken by individuals and business to make a difference. A green transition requires an overall digital structural transformation that considers the goals and targets set in Agenda 2030. Digitalization provides new possibilities to develop solutions to complex challenges if utilized in a sustainable way. Areas of relevance are for example digital policy for the transition to a circular economy and enhancing citizen participation opportunities.

Provide consumers with information about the sustainability of products through websites, educational campaigns, and certification systems and launch educational campaigns to promote sustainable lifestyles as is occurring in Japan. Sweden and Japan are co-leading a program (2012-22) on sustainable lifestyles and education aiming at fostering the uptake of sustainable lifestyles as the common norm to address global challenges such as biodiversity conservation, resource efficiency, climate change mitigation, poverty reduction and social well-being.[35] Education for sustainable living for future generations and scenarios for 1,5 degree living in 2050 will be important to realise a green transition and increased well-being.

Make use of green taxation and economic incentives. Tax products with high

[34] Catalysing Science-Based Policy Action on Sustainable Consumption and Production: The Value-Chain Approach and its Application to Food, Construction and Textiles | One Planet Network

[35] Sustainable Lifestyles and Education | One Planet Network

environmental externalities (like conventional automobiles, steel, and coal-based energy on their carbon emissions) **and provide incentives to promote the purchase of more environmentally sustainable products**, including those making use of recycled materials and renewable energy.

Tackle fields which to date have received too little attention in sustainability discussions, such as the food supply system and textiles. These are fields with large ecological footprints. Requiring suppliers to report on their initiatives to enhance sustainability and providing consumers with more information about the sustainability of the clothes and food they purchase are possible first steps. Eventually, in the textile field recycled content requirements could also be considered. Here there is much potential to make contributions.

Building on lessons learned during the Corona pandemic, **encourage lifestyle changes that promote greater life-work balance and encourage sustainable enjoyment of nature**.

Promote gender equality in all aspects of product development and use to enhance the multiplicity of perspectives from which problem and solutions are developed.