

Carbon Peak and Carbon Neutrality: A Consumption Dimension

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Abstract: China's manufacturing sector is on the move towards carbon peak and carbon neutrality, but carbon-neutral consumption has yet to take off. As the external constraints to consumption behaviors, carbon peak and carbon neutrality (CPCN) commitments will transform energy-dependent modern lifestyle and excessive material consumption and encourage circular and sustainable consumption. According to international experience, low-carbon consumption can be achieved primarily by reducing per capita household and office carbon emissions and encouraging e-mobility, low-carbon mobility, recycling and circular economy. In promoting green and low-carbon consumption, China should focus on eight areas, including food, clothing, transportation, housing, consumer goods and energy. Among them, a priority is to prevent food waste and establish a new food culture. Food waste stems from various reasons, such as communal dining, the profit-driven business practices of catering companies, the influence of traditional dining culture, and dining on public funds. We suggest conducting special research and pilot programs on green and low-carbon dining consumption, involving the masses, and exploring ways for the implementation of the Anti-Food Waste Law.

Keywords: Carbon peak and carbon neutrality (CPCN) initiatives, green and low-carbon, consumption mode, food waste

JEL Classification Code: P36, Q59

DOI: 10.19602/j.chinaeconomist.2022.03.05

1. A Tossed Stone Raises a Thousand Waves

In September 2020, President Xi Jinping announced at the 75th session of the United Nations General Assembly that China would commit itself to reaching carbon peak before 2030 and carbon neutrality before 2060. The carbon peak and carbon neutrality (CPCN) goals have stirred extensive discussions among the Chinese public and especially economists. The topic of CPCN has been widely discussed in numerous articles published by the media and through opinions shared at public forums. Experts and entrepreneurs have all joined the fray.

In 2021, the Chinese government issued *Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy, Action Plan for Carbon Dioxide Peaking before 2030* and *Opinions on Fighting the War on Pollution*. These policy documents have laid out a top-down design and initiated the implementation stage for CPCN goals.

CPCN goals have aroused broad public discussions far beyond ecological and environmental spheres. As noted by the CPC Central Committee, the reason is that "carbon peak and carbon neutrality are an extensive and profound economic and social transformation." Such a transformation - if divided in the two segments of production and consumption - is incomplete since CPCN initiatives in the production sphere are not matched by progress in the consumption sphere. Green and low-carbon

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consumption is a key aspect of CPCN initiatives. It is of great practical significance to reveal how CPCN initiatives will influence and challenge people's ways of consumption and advocate green and low-carbon ways of consumption.

2. Overview of China's CPCN Action Plan

China's CPCN initiatives aim to form a green and low-carbon economic system for circular development by 2025 with significant energy efficiency improvements in key sectors; reduce energy consumption per unit of GDP by 13.5% and CO₂ emissions per unit of GDP by 18% from 2020; increase the share of non-fossil fuel consumption to around 20%, forest coverage to 24.1% and forest biomass to 18 billion cubic meters. By 2030, China aims to achieve great progress in greening its economic and social development across the board and reach internationally advanced levels in terms of energy efficiency in key energy-consuming sectors; significantly slash total energy consumption per unit of GDP; reduce CO₂ emissions per unit of GDP by over 65% from 2005; increase the share of non-fossil fuel consumption to around 25%, expand total installed wind and solar capacity above 1.2 terawatts; reach a forest coverage rate of 25% and forest biomass of 19 billion cubic meters, and peak and steadily decrease CO₂ emissions. By 2060, the goal is to fully establish an economic system of green and low-carbon circular development with a clean, safe and efficient energy sector, lead the world in energy efficiency, raise the share of non-fossil fuel consumption to over 80%, and achieve carbon neutrality.

Achievement of the above goals entails eight priorities: (i) The all-round green transition of economic and social development; (ii) industrial restructuring; (iii) a clean, low-carbon, secure and efficient energy system; (iv) low-carbon mobility; (v) green and low-carbon urban and rural development with better quality; (vi) green and low-carbon technology development and application; (vii) carbon sink capacity; (viii) green and low-carbon opening up.

Among those priorities, energy, mobility, urban and rural development and carbon sink are all closely related to consumer behaviors. The green transition of economic and social development calls for green and low-carbon lifestyles. Aside from greening the economy, CPCN initiatives will also transform people's ways of life. There is an urgent need for the public to embrace green and low-carbon lifestyles.

3. Challenges of CPCN Initiatives to Consumer Behaviors

People's ways of life will influence the ecological environment directly by emitting pollution and wastes and indirectly by encouraging environmentally harmful ways of production. By reducing environmental pressures on both production and consumption sides, green lifestyles have received great importance from policymakers as a key aspect of China's ecological civilization. Recent announcement of the CPCN goals puts forth higher requirements on adopting green and low-carbon lifestyles.

First, CPCN initiatives are targeted at transforming energy-dependent modern lifestyles. Amid China's rapid economic development and rising living standards, consumer behaviors have also become increasingly energy-dependent. Energy consumption has become essential in every aspect of people's life from elevator to home appliances, gas-fueled cooking, winter heating and gasoline-fueled mobility. The intensity of daily energy consumption is increasing as well. With fossil fuels still dominating the energy mix, energy-intensive consumer behaviors have left a larger carbon footprint. Despite per capita energy consumption below world average, China's total consumer carbon emissions are very high given its population of 1.4 billion. CPCN initiatives are an energy revolution that will transform the current energy mix, consumption pattern and efficiency. Over recent years, the Chinese government has introduced a flurry of policies on equipment depreciation and issuance of subsidies to replace energy inefficient home appliances and promote electric and other new-energy vehicles, exerting significant effect on reducing energy consumption, pollution and carbon emissions. Further implementation of CPCN initiatives will continue to transform the current energy-dependent consumer behaviors and

consumption modes, setting the stage for low-carbon consumption as a future trend.

Second, CPCN initiatives will mitigate excessive material consumption. With rising standards of consumption, the chain of material production in modern life becomes extended and involves more processes from raw materials to the final product. Consumer demand for product refinement has led to a splurge on auxiliary materials such as luxurious product decoration and packaging. Recent years have seen a surge in China's courier and food delivery services. China's express delivery sector handled 31.28 billion parcels in 2016 and 83.36 billion parcels in 2020, up 166% in four years, or 60 parcels per person; this volume increased to 49.4 billion parcels in the first half of 2021 with annual total expected to exceed 100 billion parcels, or 72 parcels per person. The number of online food delivery users in China has increased from 209 million in 2016 to 419 million in 2020, up 100% in four years; among them, those who ordered meals via mobile devices jumped from 194 million in 2016 to 418 million in 2020, up 115% in four years. By 2020, China's food delivery sector handled over 17.1 billion orders (Wei, 2021). Each day, China's express delivery sector processes over 300 million parcels, which consume large volumes of woven bags, plastic bags, paper envelopes, cardboards, wooden boxes, tapes and cushions. In 2020, China's express delivery industry generated over 10 million tons of packaging waste (Zhang, 2021; CCICED Task Force, 2021; CICC, 2021). Production of those packaging materials also consumed large volumes of energy and emitted greenhouse gases. Curbing the excessive use of packaging materials, therefore, should be a key element of CPCN initiatives.

Third, CPCN initiatives will facilitate circular and renewable sustainable consumption. As living standards rise, material consumption will increase, and recycling waste becomes the only option to reduce carbon emissions. Recycling on the basis of reduction is a key element of CPCN initiatives. China is drafting the *Technical Standard for Parcel Waste and Pollution Control*, which requires courier waste disposal to follow the priority of reuse, recycling, degradation, incineration and landfill. In fact, stringent environmental requirements have already pushed up the cost of waste landfill and incineration. According to the China Association of Environmental Protection Industry (CAEPI), China's large enterprises made 81.842 million tons of plastic products in 2019 and that would mean 63 million tons of waste plastics; if 31% of which - or some 19.53 million tons - were incinerated, this would generate some 59.18 million tons of CO₂ emissions. Waste reuse and recycling will, therefore, reduce both the cost of disposal and carbon emissions as well.

In a nutshell, CPCN goals and initiatives put additional constraints over consumer behaviors. For China as a populous country with a large consumer demand, such additional constraints are in conflict with growing consumer demand. A key aspect of CPCN initiatives is to balance carbon emissions mitigation with consumption. The general principle is to encourage consumption and oppose waste.

4. Progress of China's Green and Low-Carbon Consumption

In China's decades-long material scarcity, frugality and reuse have emerged as dominant consumer behaviors. Those concepts of consumption have profoundly influenced consumer habits and swayed policymaking. Since the dawn of this century, the Chinese government has enacted over 100 policy documents to encourage green and low-carbon consumption in such areas as energy and water conservation, environmental and energy efficiency labels, organic products, green food, green buildings, green products, green mobility, and green government procurement. A broad range of policies, including fiscal subsidies, tax exemption, price preference, investment support, financial convenience and voluntary activities, have been offered to expedite the green and low-carbon consumption transition.

4.1 Policies for Green and Low-Carbon Consumption

(i) Energy efficiency label: The State requires energy consumption measurement and labeling for energy-consuming products such as refrigerators and air conditioners, whose level of energy

consumption should be labeled to encourage consumer choice of energy-efficient products.

(ii) Environmental label: Since 1993, the State has implemented the environmental labelling program to certify and promote environmentally-friendly products.

(iii) Tiered water rate: Corporate and individual users are charged water tariffs at rates according to their monthly water consumption. Higher water rates are applied beyond a certain threshold of consumption and for water scarce regions to encourage water conservation.

(iv) Home appliance allowance: The State offers allowances or price discounts for households to replace energy-inefficient old home appliances with energy-efficient ones.

(v) New energy vehicle allowance: The State offers allowances for the purchase of electric vehicles and other new energy vehicles to reduce the cost of new energy vehicles for end consumers and encourage the substitution of gasoline vehicles with new energy ones.

(vi) Bike-sharing: Many cities provide bike-sharing venues and other supportive measures to extend bike-sharing services to every corner of the city to ease traffic pressures and vehicle emissions.

(vii) Green government procurement: The State gives priority to products with energy and environmental labels for government procurement to incentivize the manufacturing of green products.

(viii) Organic products: The State certifies high-quality agricultural products free from pesticides and fertilizers and issues them organic product labels to encourage green consumption and manufacturing.

4.2 Effects of Green and Low-Carbon Consumption

As reported in the *Green Transition and Sustainable Social Governance* published by the China Council for International Cooperation on Environment and Development (CCICED), China has achieved the following results of green and low-carbon consumption:

By conservative estimate, in 2017, China's sales volume of energy-efficient air conditioners, refrigerators, washing machines, flat panel TVs and water heaters was close to 150 million units, or 500 billion yuan, and output of organic products was close to 140 billion yuan. In the same year, China had 1,500 green hotels, 4,500 green buildings, and over 31,000 products labelled as green food. Over 777,000 new energy vehicles were sold, and more than 25 million shared bikes were put into use. According to the *China Green Consumer Report 2016* released by the Ali Research Institute, there were 200 million green basket commodities in 50 categories available over Alibaba's online sales platform in 2015 (green basket commodities are energy-efficient, eco-friendly and wholesome), and green basket consumption accounting for 11.5% of Alibaba's gross sales volume. By the end of 2018, the environmental label certification covered over 100 types of products worth more than 4 trillion yuan in China.

5. International Experience of Low-Carbon Consumption Transition

Many countries have committed to carbon peak and carbon neutrality (CPCN) as an international trend and taken actions to expedite low-carbon consumption. Based on the CCICED's *Green Transition and Sustainable Social Governance* completed in 2021, this paper has identified the following international experiences:

The United Nations *10-Year Framework of Programmes on Sustainable Consumption and Production Patterns* adopted in 2010 involves 10 priority areas including sustainable public procurement, tourism, consumer information, building and construction, food system, lifestyles, and education. These areas have covered almost all specific aspects of people's life. According to a study by the Swedish Foundation for Strategic Environmental Research, a consumption shift to more sustainable products and services would reduce greenhouse gas emissions by 40% (CCICED Task Force, 2021).

Specifically, the following international experiences for low-carbon consumption are worth referencing:

(i) Reducing per capita household and office carbon emissions. In 2021, Germany pledged to halve its per capita greenhouse gas emissions at the consumption level by 2030 from 2016 by raising consumer awareness of their “personal consumption footprint,” halving food waste, doubling bicycle use, and increasing the market share of certified sustainable products in e-commerce to 34%, among other measures.

In 2017, Sweden adopted a five-pronged plan to track greenhouse gases in consumer sectors like personal mobility, air travel, food, buildings and textiles as supplemental measures for regional emissions trading.

In 2021, the Japanese parliament adopted an amendment to the *Act on Promotion of Global Warming Countermeasures*, which calls for establishing a decarbonized society by 2050 (carbon neutrality). Environmental authorities launched the “Cool Choice” campaign nationwide to encourage less use of air conditioning by wearing cool or warm clothes and promoting smart mobility and energy-efficient lighting.

(ii) Encouraging e-mobility and low-consumption transportation. In the developed world, road vehicles and air transport are chief sources of carbon emissions, which make the case for a transition towards low-carbon mobility. In 2011, Germany enacted the *National Development Plan for Electric Mobility*. In 2016, Germany introduced environmental subsidies and other incentives of up to 9,000 euros each for electric-only vehicles and 6,750 euros each for plug-in hybrids priced below 40,000 euros, or up to 75,000 euros each for electric-only vehicles and 5,625 euros each for plug-in hybrids priced above 40,000 euros. Moreover, new electric vehicles are exempted from motor vehicle tax for 10 years.

In 2020, Germany amended the *Motor Vehicle Tax Act* to curb carbon emissions from gasoline-fueled vehicles by raising tax on vehicles with high CO₂ emissions and rewarding climate-friendly vehicles with an annual tax bonus. While vehicles with emissions of no less than 95gCO₂/km will be exempted from the motor vehicle tax, those with higher CO₂ emissions will be taxed more heavily. In 2021, Germany adopted the *Clean Vehicle Directive (CVD)*, which requires 22.5% of buses purchased between 2021 and 2025 to be zero emissions, and this quota will reach 32.5% from 2026 to 2030.

Transportation accounts for one third of Sweden’s carbon emissions, and the Swedish vehicle fleet is dominated by old, heavy and energy-intensive vehicles with high CO₂ emissions. In 2018, Sweden imposed VAT and fuel tax (carbon and energy tax) on fossil-fuel vehicles and subjected car owners to an annual vehicle tax. In 2019, electric vehicles accounted for 18% of total vehicle registrations in Sweden, a record high.

Since 2000, Japan has introduced an environmental label system to certify vehicles that meet certain emission and fuel efficiency standards. Since 2009, “next-generation vehicles” including electric vehicles, fuel cell vehicles, natural gas vehicles, plug-in hybrids and clean diesel vehicles have been entitled to tax exemption. In the fiscal year of 2020, Japan collected 2.6 trillion yen from vehicle-related taxes, accounting for 2% of its total tax revenue.

(iii) Encouraging recycling and circular economy. Recycling physical products is one of the key pathways for reducing carbon emissions. The European Union’s Ecodesign Directive (Directive 2009/125/EC) aims to cut energy consumption in the EU by 9% by 2020 and 16% by 2030. In 2020, the EU released *A New Circular Economy Action Plan For a Cleaner and More Competitive Europe*, which encompasses major commodity value chains from ICTs, batteries and vehicles, packaging, plastics, textiles, buildings, food, water and nutrients. Since 2025, the EU’s waste management regulations will require textiles to be recycled.

As early as in 1991, Germany enacted the *Packaging Ordinance*, which adopted the famous extended producer responsibility (EPR) system that holds producers accountable for the environmental impacts of their products throughout product lifecycle, thus encouraging dismantlable and recyclable product designs. In 2020, Germany adopted an amendment to the *Circular Economy Act*, which calls for transforming the “throw-away” culture. It requires manufacturers, retailers and sales platforms to donate

or reuse commodities or their packages. The *Packaging Act* amended in 2021 has imposed a statutory deposit of 0.25 euros each on all throwaway plastic bottles and tin cans. Since 2023, restaurants, takeaway shops and coffee bars must all provide multi-purpose containers to increase the ratio of reusable items.

Japan embraced a “circular society” concept to broaden the scope of circular economy and promote resource recycling throughout the society. The *Basic Act on Establishing a Circular Society* enacted in 2000 calls for the reduction, reuse and recycling of wastes in sectors like packaging, home appliances, food, and automobiles. The Japan Automobile Manufacturers Association (JAMA) has enacted guidance for the early assessment of product design stage for the reduction, reuse and recycling of end-of-life vehicles (ELVs) for the design of dismantlable new vehicles. Some apparel makers and distributors have launched a “garment to garment recycling” campaign to recycle old clothes for those in need around the world. Unrecyclable clothes would be recycled as fuels or sound insulation materials. The *Act on Resource Circulation for Plastics* adopted in 2021 stipulates that all plastic materials should be recyclable by 2050.

The above international experiences are just part of global experiences for the transition towards low-carbon consumption. For the purpose of protecting the environment and tackling climate change, mankind has worked very hard to reflect upon and change their ways of life and work. Unlike in the production sector with large-scale corporate actions, specific and individual efforts in the consumption sector will combine to make a great difference.

6. China’s Path towards Green and Low-Carbon Consumption

In moving towards carbon peak and carbon neutrality (CPCN), green transition in the production sector and the promotion of green and low-carbon consumption are the “two wings of a bird.” Progress should be made on both fronts to move things forward.

In China, a populous developing country with strong economic fundamentals and limited natural resources, there is a duality in people’s lifestyles: As rooted in its traditional culture of man and nature as one and in harmony, the Chinese people are used to leading a frugal and simple life and recycling old items, which chime with green and low-carbon concepts and have to do with China’s material scarcity in history. On the other hand, China has experienced rapid industrialization and urbanization over the past decades and drastically improved people’s living standards. Under the influence of Western culture, excessive and wasteful consumption has gained ground to the detriment of sustainable development. Both consumer behaviors exist in reality and pose opportunities and challenges to green development and CPCN initiatives.

The question is how to promote green and low-carbon consumption and foster green lifestyles in the context of CPCN goals? In 2022, the National Development and Reform Commission (NDRC) and six other ministerial agencies laid out clear arrangements in the *Implementation Scheme for the Promotion of Green Consumption* to promote green consumption, enhance public conservation awareness, oppose luxurious, wasteful and excessive consumption, increase the supply and consumption of green and low-carbon products, improve systems and policies to encourage green consumption, facilitate the green transition of consumption structure, and form simple, moderate, green, low-carbon, civilized and healthy lifestyles and consumption modes.

By 2025, the goal is to establish the concept of green consumption, effectively curb luxurious and wasteful consumption, substantially increase the market share of green and low-carbon products, widely adopt green consumption modes, and initially form a consumption system of green and low-carbon circular development. By 2030, we should make green consumption modes widely accepted among the public, mainstream green and low-carbon products, establish green and low-carbon development modes in key consumption sectors, and improve green consumption policies and systems.

Priority should be given to the following eight areas in promoting green and low-carbon consumption and fostering green lifestyles:

(i) Promoting green food consumption. We should guide consumers to adopt civilized and healthy food consumption concepts, and encourage moderation in procuring, storing and making food and ordering and consuming meals. We should step up food waste supervision for food producers and operators, carry out the “Clear Your Plates” campaign, and recycle kitchen waste. Food conservation and civilized dining should be written into the code of conduct for citizens and villagers and industry standards.

(ii) Encouraging green clothing. Government agencies, enterprises, public institutions and schools should purchase more uniforms with green and low-carbon labels. Rational consumption should be advocated for consumers to purchase clothes reasonably and rationally. Public-interest donation of old clothes should be standardized to encourage companies and households to donate old clothes as appropriate to those in need. Organizations, residential compounds and apparel stores should be encouraged to set up old clothes recycling points.

(iii) Promoting green dwellings. Priority should be given to the energy efficiency renovation of rural dwellings and the development of green rural dwellings. Renovation of clean heating facilities should be carried out according to local conditions. Efforts should be made to promote green and low-carbon building materials, recycle building materials, and develop green home decoration. The government should encourage the use of energy-efficient lighting equipment, eco-friendly cooking utensils and water-efficient toilets. We should raise public awareness about the reasonable control of indoor temperature, brightness and electrical equipment, and expedite the deployment of biomass, solar energy and other renewables in rural life.

(iv) Developing green mobility. The government should nudge consumers to purchase light-weight, small and low-emission passenger vehicles, and increase the share of bus and rail transport in urban mobility. Greater efforts should be made to develop non-motorized urban mobility systems such as pedestrian and bicycle lanes. We should also encourage the standardized development of bike sharing.

(v) Encouraging green consumption. We should enhance the quality and branding of green and low-carbon products, encourage consumers to replace or purchase energy-efficient home appliances and environmentally-friendly furniture. Great efforts should be made to promote smart home appliances, reduce unnecessary energy consumption, and participate in the peak-load regulation of power grid by optimizing switch time and staggering power consumption. E-commerce platforms, department stores, supermarkets and other distribution enterprises should establish special areas for green and low-carbon products in their daily operations and during promotions.

(vi) Encouraging green consumption in culture and tourism sectors. The government should improve transportation links between tourist hubs such as airports, railway stations and tourist ports, build biking routes and hiking trails, and encourage low-carbon travel such as walking, cycling and public transportation among tourists. Tourism authorities should issue code of conduct or guidance for green tourist consumption, enhance public awareness, and standardize green tourism consumption for scenic areas, travel agencies and tourists.

(vii) Further unleash the potentials of green power consumption. In various localities, power grid enterprises should regularly publish green power time-of-use schedules to encourage green power consumption. Within the power grid capacity, demand-side management should give priority to users with a high share of green power consumption. Smart photovoltaic innovations and building-integrated photovoltaics (BIPV) should be developed vigorously to increase the share of household green power consumption.

(viii) Advancing the green consumption transition of public institutions. Government agencies, public institutions and other organizations should take the lead in procuring new energy vehicles, and EV charging facilities should be installed or reserved. Public events should be held in a civilized and frugal manner.

7. Food Waste: An Unresolved Problem

Notably, food consumption is given top priority among the above initiatives to promote green and low-carbon consumption and foster green lifestyles. General Secretary Xi Jinping made a special instruction on the avoidance of food waste, and the *Anti-Food Waste Law* also went into effect. This points to the urgency of establishing green and low-carbon ways of food consumption.

Nearly a year has elapsed since the *Anti-Food Waste Law of the People's Republic of China* took effect as of April 29, 2021. Yet during this period, mind-boggling food waste continued.

Staggering food waste occurs everywhere across the country. According to *Report on Food Waste in China's Urban Restaurants* published by the World Wide Fund for Nature (WWF) and the Institute of Geography Sciences & Natural Resources Research of the Chinese Academy of Sciences (CAS), per capita food waste in China is 93 grams/person/meal, which means 11.7% of food is wasted; according to a preliminary estimate, 17 million to 18 million tons of food became wasted on the dining table in China's urban catering industry; food waste reached 107 grams and 102 grams per person per meal for family gatherings and business banquets, respectively, and 95 grams for family gatherings (CICC, 2021).

Food production involves a very long production chain and massive energy and material consumption in planting, processing and disposal. In this sense, food is a high-carbon product. Wasteful food consumption contradicts with carbon peak and carbon neutrality (CPCN) goals and is intolerable under China's traditional culture of frugality. It takes time to change people's habits. Foreseeably, food waste will persist for a long time after China's enactment of the *Anti-Food Waste Law* considering the entrenched culture of food waste.

Food waste, though largely inadvertent, can be attributed to the following reasons: First, traditional communal dining makes it hard to prepare exactly the right amount of food for a table of diners and easily leads to excesses. Second, catering enterprises tend to recommend and provide consumers with excessive food to earn more profits. Third, hosts tend to order more dishes than necessary to show hospitality. Fourth, consumption on public funds is more likely to cause excessive spending. Aside from dissuading and restricting excessive consumption, it is also important to foster a new food culture and explore new dining practices to address food waste, which cannot be accomplished overnight.

Food culture is a mass culture. In exploring green and low-carbon dining practices based on the fine Chinese tradition of food culture, we should seek advice from the people. Our country should be known for delicious food and not for food waste. We suggest that authorities in charge of CPCN initiatives for green and low-carbon lifestyles carry out pilot programs in a few regions for the broad implementation of the *Anti-Food Waste Law*. ■

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