frontiers in Environmental Science

POLICY BRIEF
published: 12 November 2021
doi: 10.3389/fenvs.2021.739943

Policy Implications on Carbon Labeling Scheme Toward Carbon Neutrality in China

Rui Zhao, Dingye Wu and Junke Zhang*

Faculty of Geosciences and Environment Engineering, Southwest Jiaotong University, Chengdu, China

Carbon labeling scheme as a quantitative measure on carbon emissions of product or service, can be applied to leading low carbon consumption and production, which is also a powerful tool to achieve carbon neutral. The policy brief reviews the progress of carbon labelling scheme to provide insight into its future perspectives on carbon neutrality in China. The results show that: ① China has not officially fostered as a carbon labeling system, but there is a pilot attempt to electric appliance; ② Publics' perception towards carbon labeling scheme is in a lower level; ③ There is a room for improvement on the existing carbon labeling scheme, to improve its transparency and comparison.

Keywords: carbon labeling scheme, carbon neutrality, challenge, policy implication, China

OPEN ACCESS

Edited by:
Xander Wang,
University of Prince Edward Island, Canada

Reviewed by:
Xiong Zhou,
University of Regina, Canada
Ying Zhu,
Xi'an University of Architecture and Technology, China

****Correspondence:***
Rui Zhao
ruizhaoswjtu@hotmail.com

Specialty section:
This article was submitted to Interdisciplinary Climate Studies, a section of the journal Frontiers in Environmental Science

Received: *12 July 2021*
Accepted: *07 October 2021*
Published: *12 November 2021*

Citation:
Zhao R, Wu D and Zhang J (2021) Policy Implications on Carbon Labeling Scheme Toward Carbon Neutrality in China. Front. Environ. Sci. 9:739943. doi: 10.3389/fenvs.2021.739943

INTRODUCTION

Greenhouse gas emissions pose a potential threat to the environment to cause global warming (Yin and Shi, 2019). The energy structure on China's social and economic presents a high-carbon characteristic, which faces tremendous pressure on its carbon emissions reduction (Li et al., 2017). China unwaveringly attaches great importance to addressing clime change, making it a significant national strategy to promote green development as an important component of the ecological civilization. In September 2020, President Xi Jinping proposed at the 75th United Nations General Assembly that China strives for peaking its carbon emissions by 2030 and achieving carbon neutrality by 2060 (The Central People's Government of the People's Republic of China, 2020). In March 2021, The State Council's government work report again pointed out that it is necessary to formulate a carbon peaking action plan, optimize the industrial structure and energy structure, develop renewable energy, and promote green transition on production and life (The Central Government of the People's Republic of China, 2021). Such vision regarding carbon peaking and carbon neutral fully demonstrates China's determination and confidence in controlling carbon dioxide emissions, not only to inject new vitality into high-quality economic development, but also to call for a holistic low-carbon transition.

China's low-carbon transition in essence is to accelerate improvement on energy and industrial structure, to increase energy efficiency and savings, ultimately to promote low-carbon consumption and production (Du, 2016). Carbon labeling scheme is an insightful policy tool that contains the concept of carbon footprint, which has become a significant indicator of sustainability, indicating as the total amount of carbon dioxide, or its equivalent to greenhouse gas emissions generated by a product or service during the life cycle (Rondoni and Grasso, 2021). On this basis, carbon labeling is presented in a tag summary to provide the carbon footprint information for consumers, either in numerical value or in emissions reduction commitment of embodied product, to enhance consumers' awareness related to sustainable consumption (Zhao et al., 2012; Tan et al., 2014; Wu et al., 2015). It can be regarded as a visual green permit, to play a crucial role in optimizing supply

chain management, increasing international competitiveness of products or services, and battling against green trade barrier (Cheng et al., 2018).

Carbon labeling scheme also shows strong significance for enhancing urban green competitiveness toward carbon neutrality. First, the carbon label has a green gene, which is conducive to allowing its low-carbon characteristics to interact with the city's cultural heritage of inclusiveness, openness, and innovation, becoming the city's most distinctive feature. Second, it can be used to create low-carbon consumption scenarios with participating, obtainable, and perceptible attributes, to stimulate the formation of new consumer demand. Third, carbon labeling scheme can help enterprises to identify their high-carbon emissions process, explore the potential of energy-savings and emission-reductions, thus to develop green industries in cities (Zhao et al., 2016). Besides, it may introduce green life for urban residents, by advocating the citizens to participate in the creation of a high-quality living environment, to perceive urban green value.

In such context, carbon labeling scheme shows significant insight into promotion of low-carbon consumption and production. However, China currently has not taken such a policy regarding carbon labeling scheme into administrative practice (Xu and Lin, 2021). This study aims to analyze the development of carbon labeling scheme and identify its challenges based on a mini review, by which the associated challenges are identified to provide policy implications and recommendations on green development toward carbon neutrality in China.

DEVELOPMENT OF CARBON LABELING SCHEME

UK took the lead in launching the "Carbon Reduction Labelling Scheme" in 2007, and became a pioneer in the implementation of low-carbon product certification, where its original intention is to reduce the impact of carbon emissions on the production and service sectors (Zhao et al., 2017a). Subsequently, developed countries (such as the United States, France, Switzerland, Japan and Canada) have adopted such policy tool to reveal the life cycle environmental impact of products or services, e.g. the European Union's CO_2 Star and French Group Casino Indice Carbon etc. (Liu et al., 2016). At present, carbon labeling scheme has been applied in 43 countries or regions around the world, which is divided into two types, namely numerical presentation and emission reduction commitment (Zhao et al., 2020). It is normally adapting the form of government driving, enterprise voluntarily participating, and the third-party certification (Liu et al., 2016).

The successive implementation of the carbon label scheme in developed countries may lead to it becoming a global product/service label, which will become a new type of barrier in import and export trade (Plassmann, 2018). To address such challenge, China National Institute of Standardization firstly introduced the PAS 2050 carbon footprint assessment in 2008, and conducted trials in the cement and Polyvinyl Chloride (PVC) manufacturing industries (Liu et al., 2016). In 2013, the National Development and Reform Commission issued the "Temporary Measures of the Administration of Low-carbon Product Certification" to standardize and manage the certification activities of low carbon products, and establish a unified low-carbon product certification system (Yu and Tian, 2013). In 2018, China Electronic Energy Saving Technology Association, China Quality Certification Center and National Low-carbon Certification Technology Committee determined the carbon labeling pilot in the electrical and electronic industry (Hou et al., 2019). In 2019, China issued the first carbon labeling assessment certificate and carbon footprint certificate (Low Carbon Think Tank, 2020).

In contrast to the development of international and China's carbon labeling systems, it can be found that the two have similar starting times, but the latter's progress is relatively slow. Developed countries, such as the United Kingdom, Japan, France, etc., have established the certification system from carbon footprint accounting to carbon footprint labeling as early as 2009. Although a number of incentive policies have been introduced in China, there is still a lack of direct administrations on the carbon labeling practice from the National Development and Reform Commission, and the Ministry of Ecology and Environment (Xu and Lin, 2021). In addition, the carbon labeling scheme has not yet been introduced into domestic terminal consumer products, possibly because producers and consumers are more perceived to benefits, rather than their awareness of environmental protection (Zhao and Geng, 2021). In such context, it is necessary to study the potential impact by such an initiative.

CHALLENGES RELATED TO CARBON LABELING SCHEME

Carbon labeling may accelerate the formation of trade barriers and trigger green transitions on the supply chain. At the initial stage of the implementation of carbon labeling scheme, developed countries may be oriented to a so-called low-carbon choice, to decrease their willingness to buy the export commodities from developing countries (Edwards-Jones, 2009). Especially, the promotion of carbon labels will bring unilateral imposition of carbon tariffs by developed countries, which will increase the burden on small and medium-sized enterprises in developing and underdeveloped countries (Brenton et al., 2009). For those enterprises featuring heavy pollution and high energy consumption, they will face the survival dilemma (Shi, 2013). Carbon labeling scheme may force green transformation on the supply chain to increase marginal cost by the certification, trigger product premiums that may lead to a decline in consumers' willingness to pay (Plassmann, 2018). Relevant studies have shown that the implementation of carbon labels requires producers and consumers to be sufficiently rational and willing to pay a certain premium, indicating that the interests among various stakeholders are yet to be consistent (Carrero et al., 2021).

Consumers have a lower perception towards carbon labeling. On the one hand, there is no direct relationship between carbon

labeling and consumers' perceived benefit (Hornibrook et al., 2015; Zhao et al., 2018a). On the other hand, it is difficult for consumers to assess their direct and indirect carbon footprints, which greatly reduces their enthusiasm to participate in carbon labeling practices (Gheewala and Mungkung, 2013). In addition, there are a number of labels presented on the product package, such as food miles, organic food, fair trade, carbon footprint and so on (Caputo et al., 2013; De-Magistris et al., 2017). Various labels not only add complexity of packaging design, but also bring information shock, even resulting in more confusion when consumers purchase products.

The methodology of carbon labeling certification is different in dimension and boundary, which needs to be optimized. Life Cycle Assessment (LCA) is a cornerstone to support the presentation of carbon labeling (Huysveld et al., 2015). Although methods have gradually developed, the boundary of life cycle accounting for a specific product or service is still difficult to define. For instance, the carbon footprints of crops are varied by place of production, and such inconsistency may give rise to the same product that has different numerical values labeled on the package (Cohen and Vandenbergh, 2012). The carbon footprint of the same products consumed in different channels can be deemed as different due to consumers' preferences for retail channels and modes of transportation, which may decrease credibility of carbon labeling scheme (Wang and Lin, 2021). Besides, a functional unit is generally followed by the LCA, which limits comparability among various types of products (Wu et al., 2015).

Though the above mini-review on the existing studies of carbon labeling scheme, there are three issues to be taken into account for further policy implications and recommendations: ① how to stimulate low-carbon transition on consumption and production by application of carbon labeling scheme to break the green barrier; ② how to enhance public awareness regarding low carbon consumption through the application of carbon labeling scheme; ③ how to improve carbon label design and enhance its transparency.

DISCUSSION

The study underlines the novelty that a carbon labeling scheme may be a valuable policy tool to lead low carbon transition on both supply side and demand side, thus to assist carbon neutrality in China. Specifically, the study contributes in several ways to understanding the development of the carbon labeling scheme, discriminating international and China's carbon labeling practice, and identifying the challenges on the existing carbon labeling scheme, which provides a basis for establishment of a national carbon labeling scheme to promote low-carbon consumption and production.

From the supply side, carbon labeling scheme provides an opportunity for enterprises to conduct a lifecycle impact assessment on their products or services, which may encourage producers to develop environmentally sounded products and pay more attention to corporate social responsibility (Zhao et al., 2018b). However, it is worthy noted that carbon labeling is a voluntary act, by which it may impose heavy marginal cost on small and medium-sized enterprises (SMEs) to intensify the trade barriers. For instance, export trade in Southeast Asia mainly relies on those small and medium-sized enterprises, and their associated production is based on the energy structure with relatively high carbon emissions (Shi, 2013). In such context, there is a call for policy incentives to drive enterprises to have the opportunities to integrate into such initiatives. Existing studies believe that the policy tools including direct government subsidies, tax preference, and green procurement etc., are essential to incentivize carbon emissions reduction (Zhao et al., 2017b). However, there is a call for trade-off between the intensity of the incentives and the consequent effect, i.e., a continuous high-intensity incentive may not only increase pressure on governmental finance, but also demotivate enterprises to voluntarily engage in carbon labeling practice (Zhao and Geng, 2021).

With regard to the demand side, understanding consumers' preferences for the carbon labeled products or services is of great significance to formulating environmental policies to battle against climate change. Their purchase intention and willingness to pay are affected by individual difference and external stimulus, in which the former is related to the demographic characteristics such as age, income, gender, education level etc. (Grunert et al., 2014; Shuai et al., 2014). Specifically, the consumers with higher education and higher incomes are more likely to have pro-environmental behaviors, and are more willing to buy carbon-labeled products (Zhao and Zhong, 2015). The external stimulus focuses on product attributes, including brand, price, packaging, carbon label, etc. (Lampert et al., 2017; Zhao et al., 2020). Only when the product price and product quality are sufficiently satisfied, consumers will consider the labeling information (Hartikainen et al., 2014). Such findings indicate that the consumption channels for carbon-labeled products have not been successfully established. It is critical to motivate green education towards low-carbon consumption by using social media to facilitate the environmental knowledge of purchasing carbon labeled products.

POLICY RECOMMENDATIONS

In order to actively respond to the above challenges, to give full play to the positive role of carbon labeling scheme, and to build a carbon labeling system in line with China's national conditions, the brief proposes the following policy recommendations:

As a carrier for the transformation of green value, carbon labeling scheme may be applied to stimulate low-carbon transition on consumption and production, to incentivize green development. First, with support for targeted poverty alleviation and rural vitalization as the experimental plot for carbon labeling practices, through the construction of an integration APP sharing platform, low-carbon consumption scenarios are built to enjoy preferential purchases of distinctive agricultural products with certain discounts, ultimately to form a multi-directional guidance mechanism that combines policy and commercial incentives with

emissions reduction certification. Second, it is imperative to speed up establishing a certification system and a credit system for carbon labeled products or services, produce a third-party supervision mechanism to enhance the transparency and trust of the carbon labeling scheme. Subsidies, preferential tax and approval support should be given to enterprises who are voluntarily participated in the certification system. Besides, carbon labels may be used to facilitate the transformation of urban ecological value, to quantify the relationship between carbon sources and carbon sinks, thus to explore its utility on green premium. For instance, neutralize the emissions carbon labeled by conferences, travels and competitions through the construction of carbon sink forests, to coordinate social development and environmental protection.

As a carrier of carbon emissions quantification, carbon labeling scheme may enhance public awareness of climate change, and encourage people to adapt into voluntary emissions reduction practices. First, based on the combination of Visual Reality (VR), Neuroscience and Artificial Intelligence, application scenarios (waste classification, travel, shopping choices) are constructed to investigate public perceptions towards low-carbon consumption in terms of brain waves and pulse monitoring, to further promote green lifestyle (Zhao, 2019). Second, based on regional heterogeneity including individual characteristics (such as age, education, income), appropriate utility products (such as food, toys, home appliances and other terminal consumption products) may be selected as the experimental plot to drive carbon labeling practice. Besides, taking public institutions as a pilot for carbon labeling practice, a key indicator system for their labeling certification is proposed to be established by taking a number of attributes into account, such as area of energy consumption, status of energy utilization, personnel composition etc. On such basis, the baseline for carbon labeling certification regarding public institutions towards construction of a "zero-carbon" organization can be established.

The integration of various labelling policies and incorporation with domestic elements are essential to improve the transparency of carbon labelling. First, it is important to collaborate with universities and certification authority through multi-dimensional data analysis, to identify public behaviours related to low-carbon consumption and provide insight into carbon footprint accounting. Second, the design ideas of carbon labelling logo can be widely collected in the whole society to form a significant demonstration effect, as well as it is important to integrate national carbon labelling design with international standardized certification, thus breaking through the bottleneck of insufficient communication by the existing labelling system. Besides, it is proposed to establish carbon-neutral scenarios in industrial parks, tourist attractions and exhibitions. For example, distribute the low-carbon tourism information in transportation hubs such as airports and railway stations, and contact famous scenic spots by sightseeing buses, to create a low-carbon tourism atmosphere and arouse tourists' interest.

AUTHOR CONTRIBUTIONS

RZ is the coordinator of the manuscript, the lead author of Sections Introduction, Discussion and Policy Recommendations as well as the contributor to all the other sections; DW is the contributor to the section Development of carbon labelling scheme and Challenges related to carbon labelling scheme; JZ is the contributor to the Section Discussion.

FUNDING

This study is sponsored by the National Key Plan for Research and Development of China (2019YFC1905600), National Natural Science Foundation of China (41301639; 41571520), Sichuan Young Talent Scientific Funding (2019JDJQ0020), Sichuan Province Circular Economy Research Centre Fund (XHJJ-2002; XHJJ-2005), Chengdu Soft Science Fund (2020-RK00-00246-2F), and Fundamental Research Funds for the Central Universities (No. 2682021ZTPY088).

REFERENCES

Brenton, P., Edwards-Jones, G., and Jensen, M. F. (2009). Carbon Labelling and Low-Income Country Exports: A Review of the Development Issues. *Dev. Pol. Rev.* 27, 243–267. doi:10.1111/j.1467-7679.2009.00445.x

Caputo, V., Nayga, R. M., and Scarpa, R. (2013). Food Miles or Carbon Emissions? Exploring Labelling Preference for Food Transport Footprint with a Stated Choice Study. *Aust. J. Agric. Resour. Econ.* 57, 465–482. doi:10.1111/1467-8489.12014

Carrero, I., Valor, C., Díaz, E., and Labajo, V. (2021). Designed to Be Noticed: A Reconceptualization of Carbon Food Labels as Warning Labels. *Sustainability* 13 (3), 1581. doi:10.3390/su13031581

Cheng, Y., Sun, H., Jia, F., and Koh, L. (2018). Pricing and Low-Carbon Investment Decisions in an Emission Dependent Supply Chain under a Carbon Labelling Scheme. *Sustainability* 10, 1238. doi:10.3390/su10041238

Cohen, M. A., and Vandenbergh, M. P. (2012). The Potential Role of Carbon Labeling in a Green Economy. *Energ. Econ.* 34, S53–S63. doi:10.1016/j.eneco.2012.08.032

De-Magistris, T., Gracia, A., and Barreiro-Hurle, J. (2017). Do consumers Care about European Food Labels? an Empirical Evaluation Using Best-Worst Method. *Brit Food J* 119, 2698–2711. doi:10.1108/BFJ-11-2016-0562

Du, X.-W. (2016). China's Low-Carbon Transition for Addressing Climate Change. *Adv. Clim. Change Res.* 7, 105–108. doi:10.1016/j.accre.2016.06.004

Edwards-Jones, G., Plassmann, K., York, E. H., Hounsome, B., Jones, D. L., and Milà i Canals, L. (2009). Vulnerability of Exporting Nations to the Development of a Carbon Label in the United Kingdom. *Environ. Sci. Pol.* 12, 479–490. doi:10.1016/j.envsci.2008.10.005

Gheewala, S. H., and Mungkung, R. (2013). Product Carbon Footprinting and Labeling in Thailand: Experiences from an Exporting Nation. *Carbon Management* 4 (5), 547–554. doi:10.4155/cmt.13.52

Grunert, K. G., Hieke, S., and Wills, J. (2014). Sustainability Labels on Food Products: Consumer Motivation, Understanding and Use. *Food Policy* 44, 177–189. doi:10.1016/j.foodpol.2013.12.001

Hartikainen, H., Roininen, T., Katajajuuri, J.-M., and Pulkkinen, H. (2014). Finnish Consumer Perceptions of Carbon Footprints and Carbon Labelling of Food Products. *J. Clean. Prod.* 73, 285–293. doi:10.1016/j.jclepro.2013.09.018

Hornibrook, S., May, C., and Fearne, A. (2015). Sustainable Development and the Consumer: Exploring the Role of Carbon Labelling in Retail Supply Chains. *Bus. Strat. Env.* 24, 266–276. doi:10.1002/bse.1823

Hou, L., Tang, L., Qian, Y., Chen, H., and Wang, L. (2019). Study of County-Level Low-Carbon Standards in China Based on Carbon Emissions per Capita. *Int. J. Sust. Dev. World Ecol.* 26 (08), 698–707. doi:10.1080/13504509.2019.1672589

Huysveld, S., Van linden, V., De Meester, S., Peiren, N., Muylle, H., Lauwers, L., et al. (2015). Resource Use Assessment of an Agricultural System from a Life Cycle Perspective - a Dairy Farm as Case Study. *Agric. Syst.* 135, 77–89. doi:10.1016/j.agsy.2014.12.008

Lampert, P., Menrad, K., and Emberger-Klein, A. (2017). Carbon Information on Vegetables: How Does it Affect the Buying Process? *Int. J. Consum Stud.* 41, 618–626. doi:10.1111/ijcs.12375

Li, Q., Long, R., and Chen, H. (2017). Empirical Study of the Willingness of Consumers to purchase Low-Carbon Products by Considering Carbon Labels: A Case Study. *J. Clean. Prod.* 161, 1237–1250. doi:10.1016/j.jclepro.2017.04.154

Liu, T., Wang, Q., and Su, B. (2016). A Review of Carbon Labeling: Standards, Implementation, and Impact. *Renew. Sustainable Energ. Rev.* 53, 68–79. doi:10.1016/j.rser.2015.08.050

Low Carbon Think Tank (2020). The Certification and Evaluation of Carbon Labels in China. (in Chinese) Available at: https://www.sohu.com/a/433114753_100284179 (Accessed June 20, 2021)

Plassmann, K. (2018). Comparing Voluntary Sustainability Initiatives and Product Carbon Footprinting in the Food Sector, with a Particular Focus on Environmental Impacts and Developing Countries. *Dev. Pol. Rev.* 36, 503–523. doi:10.1111/dpr.12293

Rondoni, A., and Grasso, S. (2021). Consumers Behaviour towards Carbon Footprint Labels on Food: A Review of the Literature and Discussion of Industry Implications. *J. Clean. Prod.* 301, 127031. doi:10.1016/j.jclepro.2021.127031

Shi, X. (2013). Spillover Effects of Carbon Footprint Labelling on Less Developed Countries: The Example of the East Asia Summit Region. *Dev. Pol. Rev.* 31, 239–254. doi:10.1111/dpr.12005

Shuai, C.-M., Ding, L.-P., Zhang, Y.-K., Guo, Q., and Shuai, J. (2014). How Consumers Are Willing to Pay for Low-Carbon Products? - Results from a Carbon-Labeling Scenario Experiment in China. *J. Clean. Prod.* 83, 366–373. doi:10.1016/j.jclepro.2014.07.008

The Central People's Government of the People's Republic of China (2020). Xi Jinping Proposed an Important Speech at General Debate of the 75th United Nations General Assembly. (in Chinese) Available at: http://www.gov.cn/xinwen/2020-09/22/content_5546168.htm (Accessed June 20, 2021)

The Central People's Government of the People's Republic of China (2021). The State Council's Government Work Report Highlighted Policy Measures to Strengthen Pollution Prevention and Control and Improve Environmental Quality. (in Chinese) Available at: http://www.gov.cn/premier/2021-03/05/content_5590461.htm. (Accessed June 20, 2021)

Tan, M. Q. B., Tan, R. B. H., and Khoo, H. H. (2014). Prospects of Carbon Labelling - a Life Cycle point of View. *J. Clean. Prod.* 72, 76–88. doi:10.1016/j.jclepro.2012.09.035

Wang, J., and Lin, P.-C. (2021). Should the Same Products Consumed in Different Retail Channels Have an Identical Carbon Footprint? an Environmental Assessment of Consumer Preference of Retail Channels and Mode of Transport. *Sustainability* 13 (2), 615. doi:10.3390/su13020615

Wu, P., Feng, Y., Pienaar, J., and Xia, B. (2015). A Review of Benchmarking in Carbon Labelling Schemes for Building Materials. *J. Clean. Prod.* 109, 108–117. doi:10.1016/j.jclepro.2015.07.067

Xu, M., and Lin, B. (2021). Leveraging Carbon Label to Achieve Low-Carbon Economy: Evidence from a Survey in Chinese First-Tier Cities. *J. Environ. Manage.* 286, 112201. doi:10.1016/j.jenvman.2021.112201

Yin, J., and Shi, S. (2019). Analysis of the Mediating Role of Social Network Embeddedness on Low-Carbon Household Behaviour: Evidence from China. *J. Clean. Prod.* 234, 858–866. doi:10.1016/j.jclepro.2019.06.274

Yu, J., and Tian, X. F. (2013). Low Carbon Product Certification Management (Interim) Method" Key Points Interpretation. *China Qual. Certification* 7, 25–26. (in Chinese). doi:10.16691/j.cnki.10-1214/t.2013.07.004

Zhao, R., and Geng, Y. (2021). *Carbon Labeling Practice: From the Perspective of Stakeholder' S Interaction*. Singapore: Springer Nature.

Zhao, R., and Zhong, S. (2015). Carbon Labelling Influences on Consumers' Behaviour: A System Dynamics Approach. *Ecol. Indicators* 51, 98–106. doi:10.1016/j.ecolind.2014.08.030

Zhao, R., Deutz, P., Neighbour, G., and McGuire, M. (2012). Carbon Emissions Intensity Ratio: An Indicator for an Improved Carbon Labelling Scheme. *Environ. Res. Lett.* 7, 014014. doi:10.1088/1748-9326/7/1/014014

Zhao, R., Zhou, X., Han, J., and Liu, C. (2016). For the Sustainable Performance of the Carbon Reduction Labeling Policies under an Evolutionary Game Simulation. *Technol. Forecast. Soc. Change* 112, 262–274. doi:10.1016/j.techfore.2016.03.008

Zhao, R., Min, N., Geng, Y., and He, Y. (2017a). Allocation of Carbon Emissions Among Industries/sectors: An Emissions Intensity Reduction Constrained Approach. *J. Clean. Prod.* 142, 3083–3094. doi:10.1016/j.jclepro.2016.10.159

Zhao, R., Zhou, X., Jin, Q., Wang, Y., and Liu, C. (2017b). Enterprises' Compliance with Government Carbon Reduction Labelling Policy Using a System Dynamics Approach. *J. Clean. Prod.* 163, 303–319. doi:10.1016/j.jclepro.2016.04.096

Zhao, R., Geng, Y., Liu, Y., Tao, X., and Xue, B. (2018a). Consumers' Perception, purchase Intention, and Willingness to Pay for Carbon-Labeled Products: A Case Study of Chengdu in China. *J. Clean. Prod.* 171, 1664–1671. doi:10.1016/j.jclepro.2017.10.143

Zhao, R., Han, J., Zhong, S., and Huang, Y. (2018b). Interaction between Enterprises and Consumers in a Market of Carbon-Labeled Products: A Game Theoretical Analysis. *Environ. Sci. Pollut. Res.* 25, 1394–1404. doi:10.1007/s11356-017-0595-9

Zhao, R., Wu, D., and Patti, S. (2020). A Bibliometric Analysis of Carbon Labeling Schemes in the Period 2007-2019. *Energies* 13 (16), 4233. doi:10.3390/en13164233

Zhao, R., Yang, M., Liu, J., Yang, L., Bao, Z., and Ren, X. (2020). University Students' Purchase Intention and Willingness to Pay for Carbon-Labeled Food Products: A Purchase Decision-Making Experiment. *Int. J. Environ. Res. Public Health* 17, 7026. doi:10.3390/ijerph17197026

Zhao, R. (2019). Neuroscience as an Insightful Decision Support Tool for Sustainable Development. *Iran J. Public Health* 48 (10), 1933–1934. doi:10.18502/ijph.v48i10.3507

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.