October 2023
Volume 45 Issue 5

Journal of
Latin American Studies

Oct 2023
Vol 45 No 5

Special topic on dual carbon and critical mineral resources

Analysis of carbon peak scenarios in industrial activities in Latin American countries

Wang Song

Abstract: Based on the multi-regional input-output model of environmental expansion, this article analyzes the changing trend of carbon emissions in Latin American countries from 1990 to 2021, sorts out the Intended Contribution policies of Latin American countries, and analyzes the production carbon emissions and consumption carbon emissions in Latin American countries from 2022 to 2035. A scenario analysis was conducted on the emission change trajectory. The study found that from 1990 to 2021, the total production carbon emissions and consumption carbon emissions in Latin America showed an overall growth trend, and were affected by the commodity cycle. Regional production carbon emissions and consumption carbon emissions were highly concentrated. Focusing on a few countries such as Brazil, Mexico, Argentina, Colombia and Chile, the production carbon emissions and consumption carbon emissions of most Latin American countries are far from reaching their peaks. Scenario analysis results show that increasing the implementation of carbon emission reduction policies can effectively reduce the peak of carbon emissions. ÿ And accelerate through the carbon emission peak. By choosing the appropriate implementation intensity of carbon emission reduction policies, major carbon emitters such as Argentina, Brazil, Colombia, and Mexico can pass the carbon emission peak during the forecast period. From the perspective of absolute emission reduction targets, Argentina The targets of Peru and Peru are relatively loose. The targets of Colombia and Ecuador are relatively difficult. They need to sacrifice economic growth to a certain extent to increase emission reduction measures. The policy targets of Brazil, Chile and Costa Rica are difficult to achieve. Finally, this article discusses climate change negotiations and national

autonomy. Propose policy suggestions on contribution policy formulation, cleaner production technology, China-Latin America green

cooperation, etc. Keywords: Scenario analysis of spatial and temporal characteristics of carbon emissions Nationally Determined Contributions

Input-output analysis About the author: Wang Song, Ph.D. in Economics,

Latin American Studies, Chinese Academy of Social Sciences Assistant Researcher of the Institute. China National Library Classification Number:

Since the second half of the 20th century, climate change has become a threat to global economic, social and environmental sustainability. A major challenge to development, greenhouse gas emissions from human activities, mainly carbon dioxide, are considered to be the main causes of climate change. The main driving factors of globalization. In 2015, the international community reached the Paris Agreement, committing to significantly reduce climate change. greenhouse gas emissions, ensuring that the global temperature rise does not exceed 2°C, and strives to control it within 15°C. In 2018, the Intergovernmental Panel on Climate Change (IPCC) issued a special report on global temperature rise of 15°C. report», pointing out that in order to avoid the serious impacts of climate change, it is necessary to limit temperature rise to 15°C. Greenhouse gases Emissions need to be reduced by 45% by 2030 to achieve net zero emissions by 2050. The carbon neutrality goal is thus has become the focus of climate change negotiations. As of September 2022, 136 countries around the world have pledged to Achieve net zero emissionsÿÿ

Carbon peaking is a prerequisite for carbon neutrality. The time and peak level of carbon peaking directly affect carbon neutrality. The time and difficulty of achieving carbon neutrality. The earlier the peak time, the smaller the pressure to achieve carbon neutrality. The higher the peak value, the more practical it is. The faster and more difficult the technological progress and development model transformation required by carbon neutrality will be. ÿResearch Research shows that most developed countries in Europe and the United States have reached carbon peaks, while developing countries represented by China and India have reached carbon peaks. Emissions are still in a stage of rapid growth. ÿ Therefore, developing countries will largely determine the future of the global economy. The trajectory of carbon emissions. Accurately predict the scale of carbon emissions in developing countries and understand possible peak timelines. and approaches, which are of great significance to address global climate change.

As important members of developing countries, Latin American countries have accounted for the largest share of global carbon emissions since 1990. At around 7%, major Latin American countries (such as Bolivia, Brazil, Chile, Colombia and Costa Rica, etc.) are still in the growth stage. There are also some Latin American countries (such as Argentina, the Bahamas, (Barbados, Belize, Cuba, etc.) have entered a downward trajectory or plateau since 2010 Period ÿ Energy structure, industrial structure, technological level, economic growth, population size, etc. are responsible for the The main driving factors for the differences in carbon emission trends among industrial activities.ÿ In 2018, 43% of Latin American countries

---

ÿ "The Climate Action Monitor 2022: Helping Countr ies ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ"ÿ ÿÿÿÿÿÿ 7ÿ 2022 https: / / www oecd org / climate - action / ipac / t he - climate - action - monitor - 2022 - 43730392 / [2023 - 06 - 02]

ÿ «Economic Interpretation of Carbon Peak and Carbon Neutrality», Xinhuanet, June 22, 2021, http://www.xinhuanet.com/ ÿÿÿÿÿ/ 2021 - 0ÿ / 22 / ÿÿÿÿÿÿÿÿÿÿÿÿÿÿ [2023 - 0ÿ - 22]

ÿ Germán Bersalli et al , "Most Industrialized Countries Have Peaked C arbon dioxide emissions during Economic Crises Through Strengthened Structure ural Change"ÿ in Communications Earth & Enviro nmentÿ Vol 4ÿ No 1ÿ 2023ÿ pp 1 -11ÿ Jingjing Jiang et al "Research o n the Peak of CO2 Emissions in the Developing W orld: Current Progress and Future Prospect"ÿ in App Lied Energyÿ Vol 235ÿ 2019ÿ pp 186-203

ÿ European Communityÿ "Global Greenhouse Gas Emissions ÿÿÿÿÿ v7 0". https: / / edgar ÿÿÿÿecÿ europa eu / dataset_ghg70 [2023-06-22]

ÿ William F Lamb et al , "A Review of Trends and Drivers of Greenhouse Gas Emissions by Sector from 1990 to 2018" in Environmental Research Letters ÿ Vol 16ÿ No 7ÿ 2021ÿ pp 1 - 31

Carbon emissions come from energy consumption related to industrial activities. Studying the changing trends of carbon emissions from industrial activities in Latin American countries and the carbon peak schedule will help understand China-Latin America cooperation in climate change negotiations, clean energy development, low-carbon technology cooperation and other fields. Cooperation potential is of great research significance in promoting the early

realization of the global carbon peak and carbon neutrality goals. The academic community has conducted extensive research on the carbon emission change path, mainly using macro analysis methods based on the energy-economy-emissions model and energy-based There are two types of methods for technical optimization model analysis. ÿ The former usually uses methods such as environmental impact assessment (IPAT), scalable stochastic environmental impact assessment (STIRPAT), logarithmic mean weight decomposition (LMDI), and long-term energy alternative planning system (LEAP). Combined with econometric analysis, a macro analysis of carbon emission trends is conducted. The latter mainly predicts changes in carbon emissions by constructing objective functions such as cost minimization, benefit maximization or emission minimization, as well as relevant socio-economic and environmental constraints, including based on gross national product. , input-output table and social accounting matrix "top-down" model and

"bottom-up" model based on engineering and technology. At present, empirical research on the carbon peak problem mainly focuses on China, covering countries, provinces, and cities. It involves multiple levels, including electricity, steel, petrochemicals, cement, construction, transportation and other major carbon emission sectors. For example, at the city level, some scholars studied six megacities including Beijing, Shanghai, Guangzhou, Shenzhen, Tianjin and Chongqing. For the object, the threshold-STIRPAT model was used to analyze the driving factors of carbon emissions in 6 megacities, and the peak carbon emissions of each city were predicted under 27 scenarios. ÿ At the provincial level, some scholars applied the STIRPAT model and ridge regression method . This paper analyzes the influencing factors, changing trends and emission reduction potential of carbon emissions in Guangdong Province, China. The results show that fixed asset investment is the main driving factor of carbon emissions in Guangdong Province, followed by population and economic development, while urbanization has no significant impact on carbon emissions. It is not significant. Technological progress and energy consumption structure have a restraining effect on carbon emissions. Under the 20 scenarios assumed in the article, Guangdong Province's total carbon emissions will continue to grow by 2030. ÿ Some scholars analyzed China's 31 Carbon emission trends in each province were divided into five categories based on heterogeneity such as economic development, industrial structure, energy consumption and emission characteristics. The progress and situation of peaking actions in each province were analyzed, and differentiated peaking actions were proposed. Path ÿÿ At the national level, some scholars combine the extended STIRPAT model and

ÿ Cai Bofeng et al.: «Research Methods for Carbon Peaking Paths in Key Industries/Fields», published in «Environmental Science Research», Issue 2, 2022, pp. 320-328. Wang

—— ÿ Yong, Xu Ziyi, Zhang Yaxin: «Carbon Emissions Peak in China's Megacities Influencing factors and combination scenario prediction——based on threshold Research on STIRPAT model» Published in "Journal of Environmental Science", Issue 12, 2019, Pages 4284 - 4292

ÿ Shaojian Wang et al ÿ "Socioeconomic Driving Forces and Scanario S Imulation of CO2 Emulations for a Fast - developing Region in China"ÿ in Journal of Cleaner Productionÿ Vol 216ÿ 2019ÿ pp 217-229

ÿ Zhang Shihui et al.: "China's Provincial Carbon Emission Trends and Differentiated Peaking Paths", published in "China's Population Resources and Environment", 2021 Issue 9, 2016, pages 45-54.

The system dynamics model analyzed China's carbon peak path under different scenarios. The study found that by choosing appropriate environmental policies, China can achieve carbon peak in 2023 or 2025. The peak range is 81 5 ~ 10 4 9 billion tons of CO_2 ÿÿ Based on the national energy technology model, some studies have proposed a carbon neutralization timetable and roadmap for China's carbon peak that takes into account both economy and security. The results show that in order to achieve the "double carbon" goal at low cost and safety, in different socio-economic conditions Under the development scenario, China needs to achieve a carbon peak between 2026 and 2029, with the peak not exceeding 12.7 billion tons of CO_2. ÿ From an industry perspective, some scholars have used the generalized Disch index decomposition method to examine the driving factors of carbon emissions in China's manufacturing industry, and Based on Monte Carlo simulation, a dynamic scenario analysis of the carbon emission trend in the manufacturing industry was conducted, and it was found that under the baseline scenario, the carbon emissions in the manufacturing industry will continue to grow before 2030. ÿ Some scholars conducted a scenario analysis on the peak path of CO_2 emissions in China's steel industry and found that The total CO_2 emissions of China's steel industry are expected to reach a peak between 2020 and 2024. The peak of the total industry CO_2 emissions is 18 1 to 18 5 billion tons. ÿ

The input-output model takes into account the industrial correlation and mutual constraints between departments, and can track carbon emission responsibilities from the production side and the demand side. Based on the environmentally extended input-output model, the existing literature mainly analyzes the production carbon emissions and consumption carbon emissions of various countries. The changing trend is combined with econometric analysis methods for scenario simulation. Some studies have shown that developed countries in Europe and the United States are net importers of carbon emissions, while developing countries and resource exporting countries are mainly net exporters of carbon emissions. ÿ Some scholars use multi-regional structural decomposition analysis Assessed the driving factors and future trends of carbon emissions in countries co-constructing the “Belt and Road” and found that technological progress has only partially offset the increase in carbon emissions caused by the deterioration of the cross-border production structure and the surge in final demand. Under the baseline scenario,

ÿ Dunnan Liu and Bowen Xiaoÿ “Can China Achieve It's Carbon Emission Peaking? A Scenario Analys ÿÿ Based on STIRPAT and System Dynamics Model”ÿ in Ecological Indicatorsÿ Vol 93ÿ 2018ÿ pp 647-6 57

ÿ Wei Yiming et al.: "Research on China's carbon peak carbon neutrality timetable and roadmap", published in "Journal of Beijing Institute of Technology" (Social Science Edition), Issue 4, 2022, pp. 13-26. Shao Shuai, Zhang

ÿ Xi, Zhao Xingrong: «Empirical decomposition and peak path of carbon emissions from China's manufacturing industry—Generalized Di's index decomposition and dynamics Dynamic Scenario Analysis» Published in "China Industrial Economy", Issue 3, 2017, Pages 44-63.

Wang Xuying et al.: "Research on the peak path of carbon dioxide emissions in China's steel industry", published in "Environmental Science Research", Issue 2,

2022, Pages 339 - 346, Boya Zhang et al ÿ “Reassuring the Embodied Carbon Emissions i n China' s Foreign Trade: A New Perspective from the Ex Port Routes Based on the Global Value Chain”ÿ i n Environmental Science and Pollution Resear chÿ Vol 30ÿ No 11ÿ 2023ÿ pp 31348 - 31369ÿ Yuhuan Zhao et al ÿ “Driving Factors of Carbon Emissions Emb ÿÿÿÿÿÿÿÿÿÿÿÿÿÿ Trade: A Structural Decomposition Analysis”ÿ in Journal of Cleaner Productionÿ Vol 131ÿ 2016ÿ pp 678 - 689ÿ Kehan He and Edgar G Hertwichÿ “The Flow of Embodied CarbonThrough the Economies of Chinaÿ the European Unionÿ and the United S ÿÿÿÿÿÿÿÿÿResourcesÿ ÿÿÿÿÿÿÿÿÿÿÿ Recycling a in Global Value Chains Based on an Inter-Co Untry Input - Output Model with Multinational "Enterprises" in Applied Energyÿ Vol 307ÿ 2022ÿ pp 1-14

ÿ "Reevalation of the Carbon Embodi ed

From 2015 to 2030, the export carbon emissions of countries along the "Belt and Road" will increase by more than 20%. ÿ Based on the multi-regional input-output model (MRIO), some scholars used scenario analysis and Monte Carlo simulation methods to simulate the production-based production of various provinces in China. and consumption accounting. The study found that the peak time of consumption carbon emissions in each province is 4 to 5 years later than production carbon emissions on average.ÿ

This paper uses the environmentally extended multi-regional input-output model (EE-MRIO), starting from the production side and demand side perspectives, and predicts the changing trends of production carbon emissions and consumption carbon emissions in Latin American countries from 2022 to 2035 through scenario analysis, and analyzes the carbon emissions in Latin American countries. By analyzing the differences in peaking paths, we provide policy suggestions on how Latin American countries can achieve efficient peaking and China-Latin America cooperation in carbon emission reduction. By comparing the production responsibility and consumption responsibility of industrial activity carbon peaking paths in Latin American countries, we can provide quantitative guidance for relevant countries' emission reduction efforts. Support. The subsequent parts of this article are organized as follows: The first part introduces the multi-regional input-output model of environmental expansion, the input-output table prediction method based on the generalized two-proportion equilibrium method (GRAS), and the data source and processing. The second part is the result analysis. ÿThe third part gives the research conclusions and policy suggestions.

1. Model methods and data sources

This article uses the environmentally extended multi-regional input-output model to measure production carbon emissions and consumption carbon emissions. On this basis, an input-output table prediction method is constructed based on the GRAS method, which is used for scenario analysis of production

carbon emissions and consumption carbon emissions. (1)

Environmentally extended multi-regional input-output model The input-output model is an economic model that describes the interdependence between different industries in the economic system based on the input-output table. It is widely used to analyze the operation of the economic system and evaluate policies. Decision-making impact, and measuring the environmental impact of economic activities. In the input-output table, from the horizontal direction, each row represents the distribution and use of departmental products in the economic system, that is, for intermediate demand and final demand. Satisfy the balance condition of "total output = intermediate demand + final demand". From a vertical perspective, each column represents the input composition of departmental products, that is, from intermediate input and initial input. Satisfy the balance condition of "total input = intermediate input + initial

input". According to the preparation scope of the input-output table, the input-output model can be roughly divided into two categories: single-region input-output model and multi-region input-output model. The latter takes into account the inter-regional industrial correlation. able

ÿ 2030"ÿ in Ecological ÿ "Patterns and Determinants of Carbon Emissio nFlows along the Belt and Road from Yafei Yang et al 2005 to Economicsÿ Vol 192 ÿ 2022ÿ pp 1 - 14 Xuepeng Guo and Jun Pangÿ "Analysis o fProvincial CO2

ÿ Emission Peaking in China: Ins ights from Product and Consultation" in Applied Ener gyÿ Vol 331ÿ 2023ÿ pp 1 - 15

Capable of capturing the spillover and feedback effects of inter-regional economic activities, it has received increasing attention with the increase in data availability. Assuming that there are M economies and each economy has N industrial sectors, the basics of the multi-regional input-output model are The equation relationship is:

$$x = (I - A) - 1Yi = LYi \quad (1)$$

Among them, the MN × 1-dimensional column vector x represents the total output, the element xri i represents the total output of the economy r, sector i, the MN s is the economic unit required for the unit output of sector j. r is the direct product input ij of sector i. The MN × MN dimension matrix L represents the Leontief inverse matrix. The element l rs represents the economic unit required for the unit output ij of sector j in the economy s . r is the direct and indirect product input of department i. The MN × M-dimensional matrix Y represents the final demand. The element y rs represents the final product demand of economy s for department i of economy r. All elements of MN × 1-dimensional column vector i are 1. Formula (1) reflects the driving relationship between final demand and total output, and is also called a demand-driven model.

The environmentally expanded input-output model further introduces environmental factors such as energy use, pollution emissions, greenhouse gas emissions, and natural resource consumption. It is mainly used to evaluate the impact of economic activities on the environment and how policy decisions affect the relationship between the economy and the environment. Definition MN × The 1-dimensional column vector e represents the carbon emission intensity, and the element eri i is the greenhouse gas carbon dioxide equivalent (CO2-e) per unit output of department i of the economy. The relationship between final demand and carbon emissions from industrial activities can be expressed as:

$$u = eÿ LYi \quad (2)$$

Among them, MN × 1 dimensional column vector u represents production carbon emissions, and element uri is the carbon of sector i of economy r. Emissions ÿ e ÿ represents the diagonal matrix of column vector

e. According to formula (2), the consumption carbon emissions ce r of economy r is:

$$ce^r = eÿL y^r \quad (3)$$

Among them, 1 × MN dimensional row vector eÿ is the transpose vector of the carbon emission intensity vector, MN × 1 dimensional column vector

The quantity y r represents the final product demand of economy

r. (2) Input-output table forecasting method based on GRAS method The

GRAS method is a method for extrapolation and adjustment of the intermediate input matrix of the input-output table. It mainly uses the intermediate input in the target year. The total and intermediate use the total as the control number. Based on the base year intermediate input matrix, iterate and finally obtain the target year intermediate input matrix that conforms to the row sum control number and column sum control number. If there is a row sum control of the target year final product matrix numbers, columns and control numbers. You can also use The GRAS method predicts the final product matrix of the target year. Let D 0 and D 1 matrices to represent before and after adjustment. D D be defined:

$$ÿÿÿ ÿ \begin{cases} ÿ / ÿ^1_{ij} ÿ ij ÿ^0 \\ 1ÿ D^0_{ij} = 0 \end{cases} \quad (ÿ)$$

Then the GRAS method essentially solves the following problems:

ÿÿÿÿ ÿÿ ÿÿÿÿ ÿÿ 0 ij | 1nÿij _ æ ö ÿÿij ç ÷ e ø e (ÿ)

For any i satisfies:

ÿÿÿ 0 ijÿij = ui (ÿ)

And for any j satisfies:

ÿÿÿ _ 0 ijÿij = ÿj (7)

where, e represents the base of the natural logarithm, ui and ÿj represent row constraints and column constraints respectively. With The volume solution process refers to the research of Temusoev et al. ÿ

Based on the GRAS method, this paper uses the following steps to predict the global multi-regional input-output table. (1) Based on the final product vectors over the years, the linear regression method and the trend extrapolation method are used to predict the MN × 1-dimensional final product vector in the target year, and the domestic The GDP growth forecast value is used to further adjust the final product vector in the target year. (2) Assuming that the final demand growth rate of each country is equal to the GDP growth rate, use the GDP growth forecast value to calculate the 1 × M-dimensional final demand in the target year. Vector ÿ (3) Taking the predicted values of the final product vector and final demand vector in year t + 1 as constraints, apply the GRAS method to the MN × M dimensional final demand matrix in year t to obtain the final demand matrix in year t + 1. (4) Utilize Obtain the initial prediction vector of MN × 1-dimensional total output in t + 1 year using the Leontief inverse matrix in t year and the final product vector in t + 1 year. (5) Use the added value coefficient vector in t year and the total output in t + 1 year The initial forecast vector obtains the initial forecast of the 1 × MN dimension added value in t + 1 year. According to the equation relationship that the added value of a country is equal to the final product of a country, the added value forecast vector of t + 1 year is adjusted to obtain. (6) The added value forecast The adjustment items of the vector are included in the initial forecast vector of total output, and the total output forecast vector in year t + 1 is obtained. (7) Calculate t + 1 by using the total output forecast vector in year t + 1, the added value forecast vector and the final product vector. The number of rows and controls and the number of columns and controls of the annual intermediate input matrix. Apply the GRAS method to the intermediate input matrix of year t to obtain the MN × MN dimensional intermediate input matrix of year t + 1.

(3) Data source and processing This

article uses the global multi-regional input-output table and greenhouse gas emission data provided by the Eora database. The Eora database provides global multi-regional input-output tables covering 189 economies (and 1 region) and 26 sectors from 1990 to 2021. It also provides a series of greenhouse gas emission accounts derived from the PRIMAP database. Baseline scenario GDP The growth forecast data is taken from the baseline forecast value of the CEPII EconMap version 3.1 database. It should be noted that the Eora global multi-regional input-output table only contains 28

ÿ ÿÿÿÿÿÿÿÿÿÿÿÿ ÿÿÿÿÿ ÿÿÿÿÿÿÿÿÿÿ e C Bowmeesterÿ “A Note on the GRAS Method”ÿ in Economic Systems Researchÿ Vol 25ÿ No 3ÿ 2013 ÿÿÿÿÿÿÿÿÿ

Latin American countries, excluding 5 countries including Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines.

ÿ The greenhouse gas emission data of the PRIMAP database include carbon dioxide, methane (CH_4) and 2 oxide Three major greenhouse gases including nitrogen (N_2O) ÿÿ

2. Result analysis

The following analyzes the development trends of production carbon emissions and consumption carbon emissions in Latin American countries from 1990 to 2021, summarizes the Intended Contribution policies of Latin American countries, and conducts a scenario analysis of the change trajectory of production carbon emissions and consumption carbon emissions in Latin American countries from 2022 to 2035.

(1) Change trends in carbon emissions in Latin American

countries From 1990 to 2021, the total production carbon emissions and total consumption carbon emissions in Latin America showed an overall growth trend. As shown in Figure 1, the total production carbon emissions and total consumption carbon emissions in the region increased from 1990 to 2021. The 189.5 billion tons of CO_2- e and 190.1 billion tons of CO_2- e in 1990 increased to 343.2 billion tons of CO_2 -e and 339.1 billion tons of CO_2-e in 2021 , among which ÿ The growth rate was relatively fast during 2004-2014 Corresponding to the rapid economic growth of Latin America under the commodity super cycle. Since 2014, with the slowdown of Latin American economic growth, regional production carbon emissions and consumption carbon emissions have shown a stagnant trend from 2014 to 2017. Despite this, the production side and From a demand-side perspective, carbon emissions in Latin America have not reached their peak, and have shown an increasing trend again after 2018. As shown in Table 1, in 2021, Brazil, Mexico, Argentina, Colombia and Chile are the top five production carbon emitters in Latin America, and also It is the top five consumer carbon emitters in Latin America. Brazil's production carbon emissions and consumption carbon emissions account for nearly 30% of the total regional emissions. Mexico's production carbon emissions and consumption carbon emissions account for nearly 30% of the total regional emissions. Cost-effective carbon emissions account for nearly 20%. In most Latin American countries, consumption carbon emissions are greater than production carbon emissions. Among them, consumption carbon emissions in Antigua and Barbuda, the Bahamas, Barbados, Costa Rica, El Salvador, and Panama are higher than production carbon emissions. Emissions are more than 20% higher. The consumption carbon emissions and production carbon emissions of countries such as Argentina, Belize, Brazil, Chile, Ecuador, Honduras, Mexico, Peru, Uruguay and Venezuela are relatively close, with the gap within 5%. Trinidad and Trinidad Tobago is a notable exception. The country's production carbon emissions are 75% greater than consumption carbon emissions. ÿ

ÿ Among the 189 economies in Eora's global multi-regional input-output table, the Soviet Union and the Netherlands Antilles were disintegrated in 1991 and 2010 respectively. In principle, the corresponding values in the tables for subsequent years should be 0, but in the compilation of the tabulation Very small values

ÿ are assigned during the balancing process. For detailed information about the PRIMAP database, see https://www.pik-potsdam.de/par is - reality - check / primap - hist / [2023-05-23]

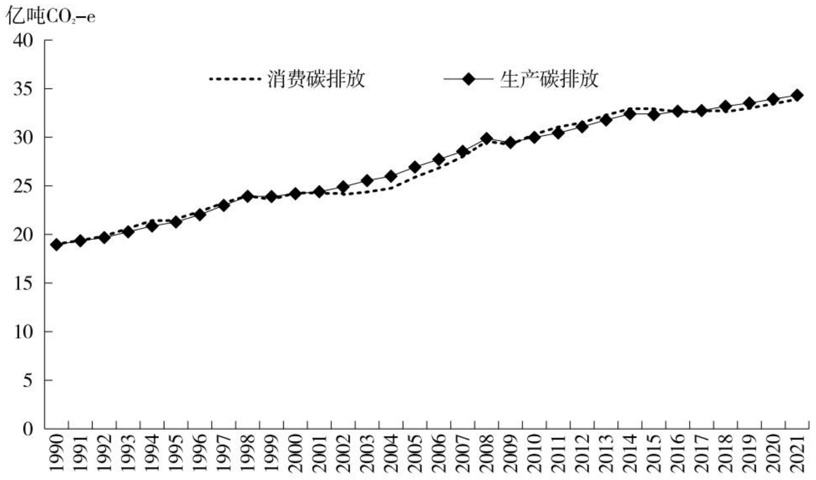


Figure 1 Consumption carbon emissions and production carbon emissions in Latin America (1990-2021)

Data source: Calculated based on Eora database data. https: / / worldmrio com/ eora26 / [2023-05-23]

Table 1 Production carbon emissions in Latin American countries (1990-2021) (Unit: billion tons CO2-e)

nation	1990	1995	2000	2005	2010	2015	2021
Antigua and Barbuda 0 00		0 00	0 00	0 01	0 01	0 01	0 01
Argentina	2 30	2 47	2 83	3 10	3 03	3 29	3 19
Bahamas	0 02	0 02	0 02	0 02	0 02	0 03	0 03
Barbados	0 01	0 01	0 01	0 02	0 02	0 01	0 02
Belize	0 01	0 01	0 01	0 01	0 01	0 01	0 01
Bolivia	0 15	0 25	0 43	0 50	0 63	0 75	1 02
Brazil	5 68	6 60	7 59	8 64	9 52	10 70	11 57
Chile	0 51	0 60	0 75	0 79	0 90	1 07	1 49
Colombia	0 95	1 08	1 12	1 23	1 39	1 53	1 71
costa rica	0 06	0 11	0 11	0 13	0 14	0 16	0 17
cuba	0 50	0 39	0 39	0 37	0 49	0 47	0 48
dominican	0 13	0 24	0 26	0 25	0 26	0 28	0 32
Ecuador	0 42	0 48	0 40	0 52	0 61	0 65	0 66
El Salvador	0 07	0 09	0 10	0 11	0 11	0 12	0 13
Guatemala	0 15	0 18	0 21	0 24	0 26	0 32	0 39
Guyana	0 03	0 03	0 03	0 03	0 03	0 04	0 11
Haiti	0 06	0 07	0 08	0 11	0 11	0 14	0 17

Honduras	0 09	0 10	0 11	0 15	0 16	0 18	0 22
jamaica	0 09	0 11	0 13	0 13	0 09	0 10	0 09
Mexico	4 41	4 72	5 48	5 76	6 69	6 73	7 62
Nicaragua	0 09	0 09	0 12	0 13	0 14	0 17	0 16
Panama	0 06	0 07	0 09	0 11	0 13	0 15	0 17
Paraguay	0 24	0 29	0 24	0 33	0 43	0 51	0 56
Peru	0 52	0 60	0 66	0 79	0 97	1 06	1 28
Surinam	0 03	0 03	0 03	0 02	0 03	0 03	0 04
Trinidad and Tobago	0 26	0 25	0 38	0 66	0 81	0 86	0 93
Uruguay	0 26	0 29	0 28	0 32	0 31	0 34	0 33
Venezuela	1 84	2 10	2 31	2 47	2 68	2 61	1 47

Data source: Calculated based on Eora database data. https: / / worldmrio com/ eora26 / [2023-05-23]

Table 2 Consumption carbon emissions in Latin American countries (1990-2021) (Unit: billion tons CO_2-e)

nation	1990	1995	2000	2005	2010	2015	2021
Antigua and Barbuda	0 01	0 01	0 01	0 01	0 01	0 01	0 01
Argentina	2 25	2 59	2 93	2 85	2 93	3 35	3 30
Bahamas	0 04	0 04	0 04	0 04	0 04	0 05	0 04
Barbados	0 02	0 02	0 02	0 03	0 03	0 03	0 02
Belize	0 01	0 01	0 01	0 01	0 01	0 01	0 01
Bolivia	0 16	0 22	0 37	0 38	0 44	0 54	0 96
Brazil	5 61	6 88	7 69	8 38	10 11	11 05	11 31
Chile	0 48	0 64	0 74	0 80	0 94	1 15	1 56
Colombia	0 98	1 21	1 18	1 28	1 56	1 76	1 91
costa rica	0 09	0 13	0 13	0 15	0 17	0 20	0 22
cuba	0 59	0 43	0 43	0 42	0 55	0 53	0 52
dominican	0 15	0 24	0 26	0 25	0 29	0 32	0 38
Ecuador	0 37	0 43	0 33	0 48	0 56	0 63	0 67
El Salvador	0 08	0 11	0 13	0 14	0 15	0 17	0 17
Guatemala	0 16	0 20	0 21	0 26	0 28	0 34	0 46
Guyana	0 27	0 37	0 39	0 41	0 73	0 66	0 12
Haiti	0 06	0 07	0 07	0 10	0 11	0 13	0 18
Honduras	0 09	0 10	0 11	0 14	0 16	0 19	0 21

jamaica	0 11	0 13	0 14	0 15	0 12	0 12	0 10
Mexico	4 51	4 39	5 47	5 60	6 32	6 51	7 22
Nicaragua	0 10	0 09	0 12	0 13	0 14	0 17	0 14
Panama	0 09	0 11	0 13	0 14	0 17	0 19	0 23
Paraguay	0 22	0 29	0 23	0 29	0 40	0 49	0 51
Peru	0 53	0 64	0 67	0 80	1 02	1 17	1 30
Surinam	0 04	0 03	0 02	0 03	0 03	0 04	0 04
Trinidad and Tobago	0 20	0 15	0 16	0 30	0 30	0 38	0 53
Uruguay	0 25	0 29	0 29	0 33	0 34	0 38	0 34
Venezuela	1 53	1 75	1 98	200	2 36	2 32	1 47

Data source: Calculated based on Eora database data. https: / / worldmrio com/ eora26 / [2023-05-23]

At the national level, as shown in Table 1, except for a few countries such as Antigua and Barbuda and Guyana, Production carbon emissions and consumption carbon emissions generally show similar trends with Latin American countries. According to carbon emissions According to the emission change trend, Latin American countries can be divided into the following four categories: (1) Carbon emissions maintain an overall growth trend Countries including Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Panama, Para Guyana, Peru, Suriname, Trinidad and Tobago, etc. (2) The growth of carbon emissions tends to stagnate and fluctuate. Countries including Argentina, Bahamas, Barbados, Belize, Cuba, Nicaragua and Uruguay Guyana, etc. (3) Countries whose carbon emissions have passed their peak and entered a downward trend, such as Jamaica. (4) Carbon production Countries with different emission and consumption carbon emission trends include Antigua and Barbuda and Guyana, whose production Carbon emissions maintain a growing trend, while consumption carbon emissions are in a volatile situation. It should be noted that in recent years, the Commission has The Venezuelan economy has been severely sanctioned and blocked by the United States. Oil production has dropped sharply, and oil exports have been blocked. The economy has shrunk significantly, and the corresponding production and consumption carbon emissions have dropped sharply, but this does not mean that Venezuela's carbon emissions Emissions have passed their peak. To sum up, the production carbon emissions and consumption carbon emissions of most Latin American countries are far from reaching their peaks. Even for countries whose carbon emissions are stagnating or fluctuating, they still need to observe their long-term trends.

(2) Analysis of the Intended Contributions Policy of Latin American Countries

As of the end of 2022, 33 Latin American countries have ratified the Paris Agreement and submitted updated national agreements. Nationally determined contribution (NDC) targets. Among them, 30 countries have nationally determined contribution targets covering the entire economy. From a sectoral perspective, as shown in Figure 2, the INDC targets of all Latin American countries involve the energy sector. The communication sector and the land use, land-use change and forestry sector (referred to as the "land and forestry sector") LULUCF) has also received major attention. From the perspective of greenhouse gas types, as shown in Figure 3, 33 Latin American countries Both have included carbon dioxide in their nationally determined contribution emission reduction targets, including methane (CH_4) and nitrous oxide (N_2O).

As a "super greenhouse gas", it has also become a key regulatory target.

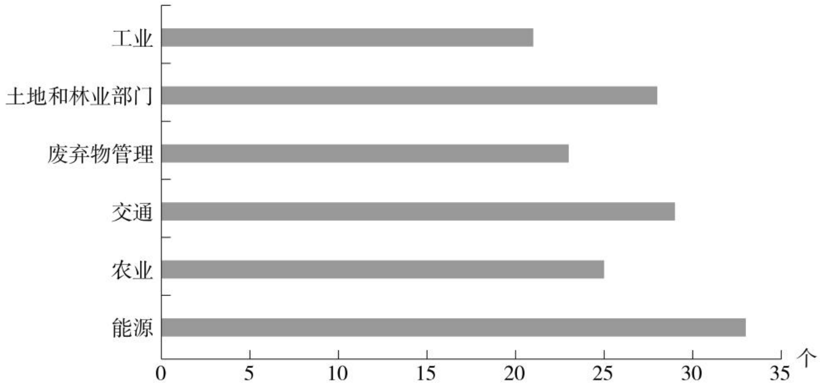


Figure 2 Number of Latin American countries whose nationally determined contribution targets involve relevant sectors

Data source: IGES ÿÿÿ database ÿ ÿÿÿÿ: / / ÿÿÿÿÿÿ or ÿÿ / ÿÿ / ÿÿÿ / ÿÿÿÿ - indc - ndc - database / en [2023 - 07 - 20]

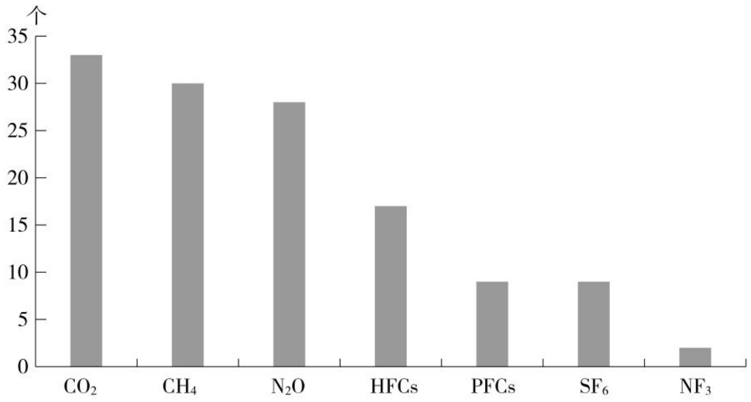


Figure 3 Number of Latin American countries whose nationally determined contribution targets involve related greenhouse gases

Data source: IGES ÿÿÿ database ÿ ÿÿÿÿ: / / ÿÿÿÿÿÿ or ÿÿ / ÿÿ / ÿÿÿ / ÿÿÿÿ - indc - ndc - database / en [2023-07-20]

Table 3 summarizes the policy goals of the INDCs of Latin American countries. From the perspective of target type, 14 Latin American countries including the Bahamas, Barbados, El Salvador, and Mexico have set relative emission reduction targets, that is, greenhouse gas emissions in the target year are compared with "business as usual" (BAU) emissions fall by a certain percentage under the (BAU) scenario. Eleven Latin American countries, including Argentina, Brazil, Chile, and Colombia, have set absolute emission reduction targets, that is, greenhouse gas emissions in the target year will be reduced by a certain amount compared to the base year emissions, or Do not exceed a certain scale. Six Latin American countries, including Antigua and Barbuda and Bolivia, have launched climate change mitigation policies.

policies and actions, but no specific emission reduction targets have been set. Chile has set a target for peaking greenhouse gas emissions in 2025, while Uruguay has set targets for greenhouse gas emissions such as carbon dioxide, methane (CH_4), and nitrous oxide (N_2O) . From the perspective of target year setting, the vast majority of Latin American countries (29) use 2030 as a single target year. Barbados, Dominica and other countries also list 2025 and 2030 as target years. Brazil, The determined contribution policies of countries such as Costa Rica and Panama further set 2050 as the target year for carbon neutrality. In addition, Costa Rica and Chile have proposed multi-year goals. For example, Chile proposed that its carbon emissions budget during the period 2020-2030 should not exceed 11 Billion tons of CO_2-eÿ From the perspective of policy goals, countries such as Barbados, Brazil, Colombia, Dominica, El Salvador, Grenada, and St. Kitts and Nevis have set relatively bold emission reduction targets. For example, if there is international support, Next, Barbados proposed a target of reducing emissions by 70% in 2030 compared with 2008 levels.

Table 3 Policy goals of Latin American countries' determined contributions

nation	policy type	Baseline year	target year	policy objectives
Antigua and Barbuda	Policy and Action	N/A	2030	Renewable energy generation to reach 86% by 2030
Argentina	Absolute emission reduction	N/A	2030	Net emissions in 2030 will not exceed 34.9 billion tons of CO_2-eÿ
Bahamas	Relative emission reduction	BAU	2030	30% decrease relative to BAU scenario
Barbados	Relative emissions reduction	2008	2025 2030	Without international support, emissions would be reduced by 20% and 35% respectively relative to normal emissions in 2025 and 2030. With international support, emissions would be reduced by 35% and 70% respectively.
Belize	Relative emission reduction	N/A	2030	By 2030, a total of 5.6 million tons of CO_2-e emissions will be avoided, and by 2030, CO_2-e emissions will be reduced by 1 million tons per year.
Bolivia	Policy and Action	N/A	2030	By 2030, 79% of energy consumption will come from renewable energy generation
Brazil	Absolute emission reduction	2005	2025 2030	Greenhouse gas emissions in 2025 and 2030 will be reduced by 37% and 50% respectively compared with 2005.
Chile	Absolute emission reduction	N/A	2030	The greenhouse gas emission budget from 2020 to 2030 shall not exceed 1.1 billion tons of CO_2-e, reaching the peak of greenhouse gas emissions by 2025, and reaching a greenhouse gas emission level of 95 million tons of CO_2-e by 2030.
Colombia	Absolute emissions reduction	BAU	2030	Emissions in 2030 will not exceed 16.9 billion tons of CO_2-e, a 51% reduction compared to the BAU scenario
costa rica	Absolute emission reduction	N/A	2030	The maximum net emission value in 2030 is 9.11 million tons of CO_2-eÿ The maximum net emission budget from 2021 to 2030 is 10.7 billion tons of CO_2- e ÿ Achieve net zero emissions in 2050
cuba	Policies and Actions	N/A	2030	Reducing greenhouse gas emissions from Cuba's pig industry

Dominica	Absolute emission reduction	2014	2025 2030	Greenhouse gas emissions in 2025 and 2030 will be higher than those in 2014 respectively. Reduction of 39% and 45%
dominican	Relative emission reduction	BAU	2030	Compared with the BAU scenario, greenhouse gas emissions will decrease in 2030 27% ÿ And the 20% decline is conditional on external financial support
Ecuador	Absolute emission reduction	2010	2025	Compared with 2010, greenhouse gas emissions in 2025 will be 9% reduction. With external support, it can be reduced by 20 9%
El Salvador	Relative emission reduction	BAU	2025 2030	Suppose a 100 MW power plant using CCS technology is successfully operated. In this case, compared with the BAU scenario, greenhouse gas emissions in 2025 and 2030 are Gas emissions dropped by 39% and 61% respectively.
Greneda	Absolute emission reduction	2010	2030	Greenhouse gas emissions in 2030 will be reduced by 40% compared to 2010
Guatemala	Relative emission reduction	BAU	2030	Compared with the BAU scenario, greenhouse gas emissions in 2030 are unconditionally Decrease 11.2% ÿ With external support, emissions reductions can Increase to 22.6%
Guyana	Policies and Actions	N/A		Increase the proportion of renewable energy to 100% in 2025
Haiti	Relative emission reduction	BAU	2030	Compared with the BAU scenario, 6% of the 32% reduction in emissions in ÿ That 2030 is unconditional
Honduras	Relative emission reduction	BAU	2030	By 2030, emissions from all sectors except the land and forestry sectors will be The increase in volume is reduced by 16% compared to the BAU scenario.
jamaica	Relative emission reduction	BAU	2030	Compared with the BAU scenario, greenhouse gas emissions in 2030 are unconditionally 25.4% reduction. With external support, emissions reductions can increased to 28 5%
Mexico	Relative emission reduction	BAU	2030	Compared with the BAU scenario, greenhouse gas emissions in 2030 are unconditionally Decrease 22% ÿ With external support, emissions reductions can increase Increase to 36%
Nicaragua	Policies and Actions	N/A	2030	Increase the proportion of renewable energy power generation to 60% in 2030
Panama	Relative emission reduction	BAU	2030 2050	Compared with the BAU scenario, greenhouse gas emissions from the energy sector in 2030 Emissions will drop by 11,5% and by 24% in 2050
Paraguay	Relative emission reduction	BAU	2030	Compared with the BAU scenario, greenhouse gas emissions in 2030 are unconditionally 10% reduction ÿ With external support, greenhouse gases Emissions reduced by an additional 10%
Peru	Absolute emission reduction	N/A	2030	In 2030, net greenhouse gas emissions will not exceed 20.9 billion tons of CO2-eÿ With external support, greenhouse gas emissions can fall to 17.9 billion tons of CO2-e
Saint Kitts and Nevis	will absolutely reduce emissions	from 2010	to 2030.	CO2 emissions in 2030 will be reduced by 61% compared to 2010.
saint lucia	Absolute emission reduction	2010	2030	Greenhouse gas emissions from the energy sector in 2030 will be reduced compared to 2010 7% less
saint vincent and grenadines	Relative emission reduction	BAU	2025	Greenhouse gas emissions in 2025 are reduced by 22% compared to the BAU scenario

Surinam	Policies and Actions	2008	2025 2030	The proportion of renewable energy will reach 25% and 35% respectively in 2025 and 2030
Trinidad and Tobago	Relative Emission Reduction	BAU	2030	Greenhouse gas emissions in 2030 will be reduced by 15% compared to the BAU scenario.
Uruguay	Reducing carbon intensity	1990	2025	Compared with 1990, the emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) per unit of GDP in 2025 will be unconditionally reduced by 24% respectively 57% and 48%
Venezuela	Relative emission reduction	BAU	2030	Greenhouse gas emissions in 2030 are reduced by 20% compared to the BAU scenario

Note: N/A means no baseline year.

Data source: compiled from IGES NDC database. https: / / www.igesor.jp / en / p ub / iges - indc - ndc - database / en [2023 - 07 - 20]

(3) The carbon emission change path of Latin American countries under different scenarios

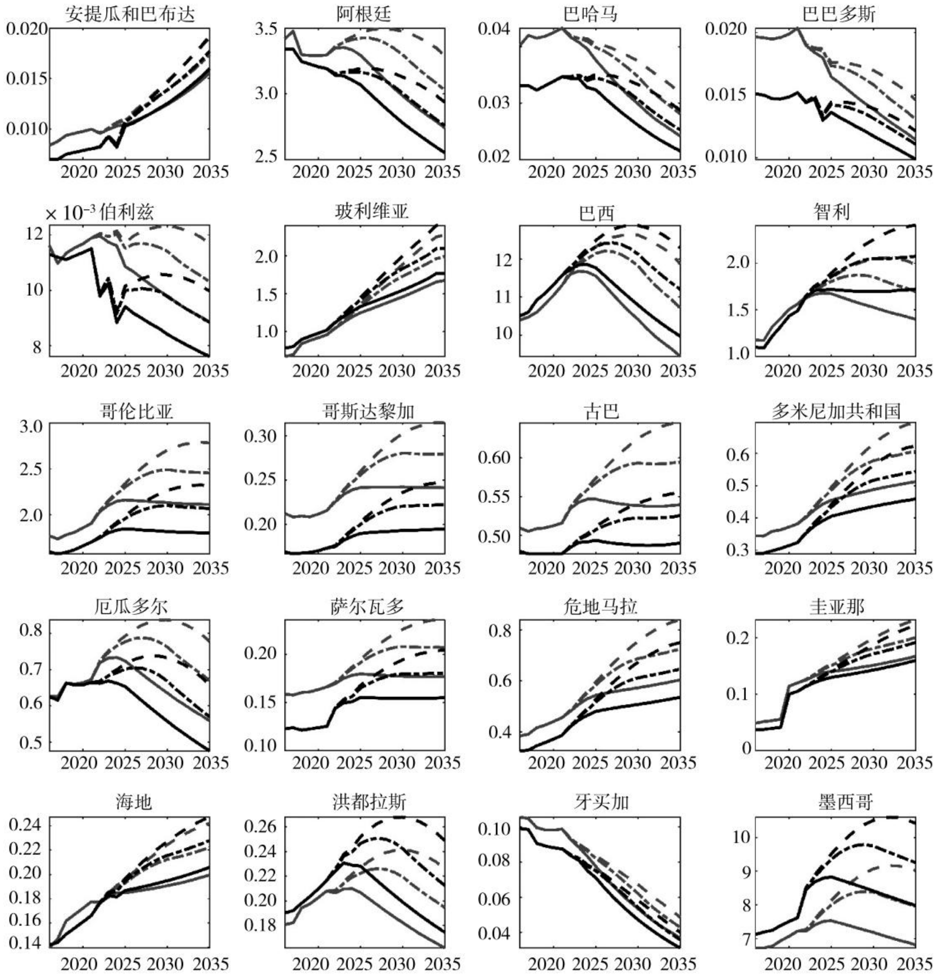
is based on the carbon emission intensity data from 1990 to 2021. The average annual change rate of carbon emission intensity in each country's sub-sectors can be calculated. ÿ Linear regression from the carbon emission intensity change rate in 2021 to the average annual change rate The time required can be used to measure the implementation intensity of carbon emission reduction policies. The shorter the time required, the greater the intensity of implementation of emission reductions. ÿ Let S0 represent the baseline scenario, assuming that the change rate of carbon emission intensity gradually increases from 2022 to 2035. Return to the average annual change rate of carbon emission intensity. Let S1 represent the scenario in which the adjustment period of the emission intensity change rate is 10 years. That is, it is assumed that the change rate of carbon emission intensity in each country's sub-sectors from 2022 to 2031 is adjusted at a uniform rate to that of the period from 1990 to 2021. The average annual change rate, the change rate of carbon emission intensity from 2032 to 2035 is equal to the average annual change rate. By analogy, S2 represents a scenario with an adjustment period of 5 years. Considering that the adjustment period helps buffer the short-term economic impact of carbon emission reduction policies, Therefore, it is assumed that the economic growth rate under the three scenarios is consistent with the baseline scenario. Comparing the change trajectories of carbon emissions in Latin American countries under different scenarios will help to understand the impact of the implementation of carbon emission reduction policies on greenhouse gas emissions.

Under the baseline scenario S0, as shown in Figure 4, (1) The production carbon emissions of countries such as Argentina, Bahamas, Barbados, Belize, Brazil, Ecuador, Honduras, Jamaica, Mexico and Suriname passed the peak and entered a downward channel. (2) Production carbon emissions in countries such as Antigua and Barbuda, Bolivia, Dominica, El Salvador, Guatemala, Guyana, Haiti, Nicaragua, Panama, Paraguay and Peru still maintain a rapid growth trend. (3) Countries such as Colombia, Costa Rica and Peru The production carbon emissions have entered the platform range. The change trajectories of consumption carbon emissions and production carbon emissions in various countries are generally similar, but there are also situations where the trends are different. For example, Chile's consumption carbon emissions passed the peak, while

ÿ The average annual change rate of carbon emission intensity is generally negative. For a few cases where the average annual change rate of carbon emission intensity is positive, the average annual change rate of carbon emission intensity in each sector of each country (negative value) is used instead.

ÿ For absolute values, For most countries and sectors, the absolute value of the change rate of carbon emission intensity in 2021 is less than the average annual change from 1990 to 2021 The absolute value of the rate

Production carbon emissions are in the growth range. In addition, the difference between consumption carbon emissions and production carbon emissions in countries such as Colombia, Costa Rica, Cuba, Ecuador, Panama, Trinidad and Tobago, and Paraguay continues to expand, reflecting the consumption-side carbon reduction. The importance of emission policies. Table 4 shows the realization of absolute emission reduction targets of some Latin American countries under different scenarios. It should be noted that because the BAU scenario setting conditions in the determined contribution policies of Latin American countries are different, it is difficult to compare different policy scenarios. Under the baseline scenario S0, countries such as Argentina and Peru can achieve absolute emission reduction targets relatively easily without taking additional emission reduction measures. In other words, these countries have large policy margins. It can further improve its emission reduction targets and make greater contributions to mitigating climate change. In contrast, the emission scale of countries such as Brazil, Chile, Colombia, Costa Rica and Ecuador will exceed the target value, and these countries need to implement more emission reduction measures. To achieve the goal of independent contribution.



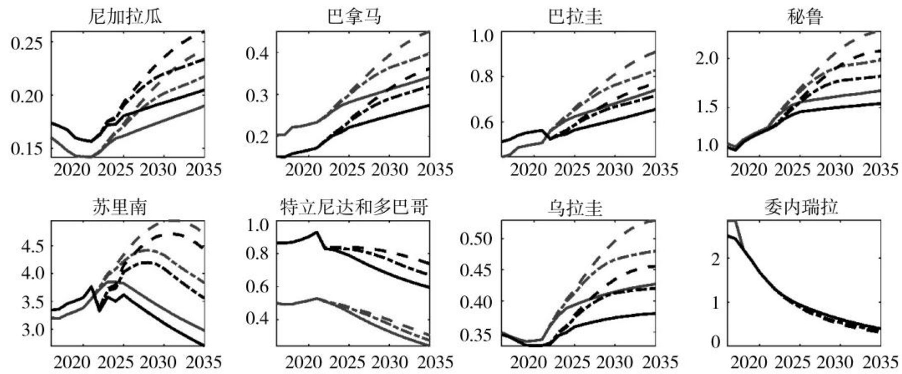


Figure 4 Change path of production carbon emissions and consumption carbon emissions in Latin American countries (2016-2035)

Note: Gray represents consumption carbon emissions, black represents production carbon emissions, linear " ——— —", " ——" respectively correspond to S0, ", " S1, S2 scenarios. The value unit is billion tons of CO 2-eÿ Among them, the value from 2022 to 2035 is the scenario prediction result.

Data source: S0 ~ S2 scenario prediction results are calculated by the author. The values from 2016 to 2021 are taken from the Eora database. https: / / worldmrio com/e ora26 / [2023-05-23]

Under the S1 and S2 scenarios, as shown in Figure 4, increasing the implementation of carbon emission reduction policies can effectively reduce the emission peak and speed up the passage of the emission peak. For most Latin American countries, production carbon emissions and consumption carbon emissions follow similar changes. Trajectory. It should be noted that under the same scenario setting, Chile's production carbon emissions show a growth trend during the forecast period, while consumption carbon emissions have passed the peak. (1) Antigua and Barbuda, Bolivia, Guyana, The production carbon emissions and consumption carbon emissions of countries such as Haiti, Nicaragua, Panama, Paraguay and Peru continue to grow during the forecast period and are not yet close to the peak. The carbon emissions of countries such as Costa Rica, Cuba, El Salvador and Uruguay have entered a plateau period. (2) The Bahamas Carbon emissions in , Barbados and Jamaica continue to decline, and they have a good foundation to achieve long-term carbon neutrality goals, with large room for policy maneuver. (3) Countries such as Argentina, Belize, Brazil, Colombia, Ecuador, Honduras, Mexico and Suriname have adopted To choose the appropriate implementation intensity of carbon emission reduction policies during the forecast period, we can use the emission peak. Based on the S1 and S2 scenarios,

further set up S3 and S4 scenarios with higher intensity of carbon emission reduction policy implementation. Among them, the S3 scenario assumes 2022 -The change rate of carbon emission intensity of various sectors in various countries in 2035 is equal to the average annual change rate of carbon emission intensity from 1990 to 2021. Due to the lack of an adjustment buffer period, short-term GDP is affected. It is assumed that the economic growth rate drops by 0.2 percentage points compared with the baseline scenario. S4 The scenario assumes that the change rate of carbon emission intensity in various sectors of each country from 2022 to 2035 is equal to 1.2 times the average annual change rate from 1990 to 2021, and the economic growth rate is 0.4 percentage points lower than the baseline scenario. As shown in Table 4, it can be found that Argentina The emission reduction targets of Colombia and Peru are relatively loose and can be achieved under the S1 and S2 scenarios with weak implementation of carbon emission reduction policies. The emission reduction targets of Colombia and Ecuador are relatively difficult and require a certain de

Sacrificing economic growth to increase emission reduction measures. Without further increasing emission reduction efforts and enduring a decline in economic growth, it will be difficult for Brazil, Chile and Costa Rica to achieve their established emission reduction policy goals.

Table 4 Achievement of absolute emission reduction targets in Latin American countries under different scenarios

national	policy goals	S0	S1	S2	S3	S4
exceed	Net emissions in 2030 will not Argentina's 34.9 billion tons of CO2-	3 1.3 billion tons of CO2-e	2 7.8 billion tons of CO2-e	30 billion tons of CO2-e	25.6 billion tons of CO2-e	2 3.8 billion tons of CO2-e
Brazil	e. Greenhouse gas emissions in 2025 and 2030 will be reduced by 37% and 50% respectively compared with 2005.	+ 45% (2025) + 49% (2030)	+ 36% (2025) + 25% (2030)	+ 43% (2025) + 40% (2030)	+23% (2025) + 12% (2030)	+20% (2025) + 6% (2030)
Chile	From 2020 to 2030, the greenhouse gas emission budget is 20.6 billion tons 1.82 billion tons 1.99 billion tons 1.62 billion tons 15.6 billion tons. The gas emission budget does not exceed CO2-e CO2-e CO2-e CO2-e CO2-e Over 1.1 billion tons of CO2 - eÿ (2020 - 2030), (2020 - 2030), (2020 - 2030), (2020 - 2030), (2020 - 2030), Reaching warm temperatures by 2025, 2025, 2025, 2 025 is not 2025 is not 2025 Annual indoor gas emissions peak, reach peak, 22.5 billion peak, 16.9 billion peak, 20.5 billion peak, 14.3 billion peak, 13.3 billion by 2030, reach ton CO2-e ton CO2 - e ton CO2 -e tons of CO2-e tons of CO2-e 95 million tons of CO2-e (2030) (2030) (2030) (2030) (2030) Greenhouse gas emission levels					
Colombia	Emissions in 2030 shall not exceed 16.9 billion tons 2 2.7 billion tons 18.2 billion tons 2 1 billion tons 16 billion tons 14.9 billion tons CO2-eÿ and BAU situation CO2-e (2030) CO2-e (2 030) CO2 -e (2030) CO2-e (2030) CO2-e (2030) Emission reduction of 51% compared to the scenario					
net emission net emission	The maximum net emission value in 2030 is 23.61 million tons, which is 9.11 million tons CO2-eÿ CO2-e (2030). Costa's value from 2021 to 2030 is 20.6 billion tons. The maximum budget of Costa Rica is 107 CO2-e (2021 - Billions of tons of CO2-e 2030)		19.32 million tons of CO2-e (2030), 18.7 billion tons of CO2-e (2021-2030)	22.06 million tons 17.07 million tons 15.78 million tons CO2-e (2030), CO2-e (2030), CO2-e (2030), 20 billion tons 17 billion tons 1 63 Billions of tons of CO2-e CO2 -e CO2- e (2021-2030) (2021-2030) (2021-2030)		
Ecuador	Compared with 2010, greenhouse gas emissions will unconditionally decrease by 9% in 2025 With external support, it can be reduced by 209%	+170% (2025)	+ 6 8% (2025)	+ 14 7% (2025)	- 8 3% (2025)	- 130% (2025)
Peru	In 2030 , net greenhouse gas emissions shall not exceed 20.9 billion tons of CO2- e (2030) CO2-e (2030) CO2-e (2030) CO2-e (2030) Body emissions can be reduced to 17.9 billion tons of CO2-e					

Note: Only Latin American countries that have set absolute emission reduction targets are included. The gray shading indicates that the emission reduction targets are achieved under the corresponding scenarios. Source: S0 - S4 Scenario prediction results are calculated by the author. Policy targets are compiled from the IGES NDC database. https : / / www iges or jp / en / pub / iges - indc - ndc - databas e / en [2023-07-20]

Three conclusions and policy suggestions

Based on the multi-regional input-output model of environmental expansion, this article analyzes the development trend of carbon emissions in Latin American countries from 1990 to 2021, sorts out the Intended Contribution policies of Latin American countries, and analyzes the changes in production carbon emissions and consumption carbon emissions in Latin American countries from 2022 to 2035. A scenario analysis was conducted on the trajectory and the following

research conclusions were drawn. First, during the period from 1990 to 2021, carbon emissions in Latin America were concentrated in major economies such as Brazil, Mexico, Argentina, Colombia and Chile. The consumption carbon emissions of most Latin American countries were is greater than production carbon emissions. From the perspective of carbon emission trends, the production carbon emissions and consumption carbon emissions of most Latin American countries are still on a growth trend and are far from reaching their peaks. Even in countries where carbon emissions are stagnant or fluctuating, it is still necessary to observe their carbon emissions. Long-term trends in carbon emissionsÿ

Second, from the perspective of carbon peak and carbon neutrality policies, most Latin American countries' nationally determined contribution targets cover the entire economy, focusing on the energy sector, transportation sector, land and forestry sectors. The greenhouse gases covered are carbon dioxide, methane and monoxide. Nitrogen is the main target. Emission reduction targets are mainly of two types: relative emission reduction and absolute emission reduction. Target setting for a single year is often chosen. Barbados, Brazil, Colombia, Dominica, El Salvador, Grenada, St. Kitts and Nevis, etc. China's emission reduction targets are more ambitious than those of other Latin American countries.

Third, in the process of achieving the "double carbon" goal under the baseline scenario, Latin American countries can be divided into three categories. The first category is those with continued growth in carbon emissions, including Antigua and Barbuda, Bolivia, Guyana, Haiti, and Nicaragua. The production carbon emissions and consumption carbon emissions of countries such as , Panama, Paraguay and Peru continue to grow during the forecast period, and are not yet close to the peak. The second category is the carbon emission stagnation and shock type. The carbon emissions of Costa Rica, Cuba, El Salvador, Uruguay and other countries enter the forecast period. During the plateau period, the above two types of countries need to consider increasing carbon emission reduction policies. The third type is the type where carbon emissions continue to decline. The carbon emissions of the Bahamas, Barbados and Jamaica continue to decline, and they have a good foundation to achieve long-term carbon

neutrality goals. There is a large room for policy maneuver. Fourth, on the basis of the baseline scenario, by assuming that the implementation of carbon emission reduction policies will gradually increase and the economic growth rate decline will be introduced, four scenarios S1-S4 are designed. The scenario analysis results show that Argentina, Burma Countries such as Leeds, Brazil, Colombia, Ecuador, Honduras, Mexico, and Suriname can pass the emission peak during the forecast period by choosing appropriate carbon emission reduction policy implementation efforts. Argentina and Peru have relatively loose absolute emission reduction targets, and Colombia and Ecuador have It is relatively difficult to achieve absolute emission reduction targets. The absolute emission reduction targets of Brazil, Chile and Costa Rica are difficult to achieve. Some Latin American co

Faced with the difficult choice of increasing the implementation of carbon emission reduction policies and enduring the short-term economic growth slowdown.

Based on the above research conclusions, this article puts forward the following policy recommendations.

First, for Latin American countries with relatively loose emission reduction targets, such as Argentina and Peru, they have room to further tap their emission reduction potential. China should encourage them to further improve their emission reduction targets in climate change negotiations. Emission reduction targets. For Latin American countries with relatively difficult emission reduction targets, such as Colombia, Ecuador, Brazil, Chile and Costa Rica, China should pay close attention to the achievement of its emission reduction targets and the direction of domestic climate policies. Under the United Nations Framework Convention on Climate Change, China should communication and cooperation among these countries in setting emission reduction targets, implementing emission reduction policies, funding needs and technical assistance.

Second, China should start a dialogue with Latin American countries on improving the nationally determined contribution policy, promote the China-Latin America nationally determined contribution policy to improve sub-sector emission reduction targets, strengthen the pertinence of emission reduction policy formulation, and encourage the expansion of greenhouse gas coverage, especially the reduction of methane "Super greenhouse gases" such as nitrous oxide and nitrous oxide are included in the nationally determined contribution targets. In November 2021, the United States and the European Union jointly launched the "Global Methane Commitment", proposing to reduce anthropogenic methane emissions by at least 30% by 2030 based on 2020 levels. % At present, 150 countries have been mobilized to commit to reducing methane emissions, including more than 20 Latin American countries such as Argentina, Brazil, Mexico, and Colombia. China should carry out consultations and dialogues with relevant Latin American countries, not only to prevent the United States and Europe from using this to strengthen their control of developing countries. To put pressure on and pass on the responsibility for greenhouse gas emission reductions, we must also reach a consensus on accelerating the reduction of methane and other "super greenhouse gases" emissions under the United Nations climate change framework. Focusing on the absolute limits of the carbon budget, we must explore solutions that are consistent with the economic and social development goals of Latin American countries. Based on the coordinated optimal emission reduction path, we will formulate multi-year carbon emission reduction targets on this basis to ensure that the “double carbon” target is consistent with the carbon budget limit. Based on their respective objective conditions, we will strive to increase the emission reduction targets.

Third, according to scenario analysis, countries such as Colombia, Ecuador, Brazil, Chile and Costa Rica need to accelerate the reduction of carbon emission intensity to achieve their nationally determined contribution goals. On the one hand, they need to accelerate the transformation of their energy structure and increase the proportion of renewable energy. On the other hand, they need to accelerate the transformation of their energy structure and increase the proportion of renewable energy. ÿ It is necessary to accelerate the research and development and application of clean production technology. China should give full play to its technological and production capacity advantages in the new energy industry, and based on the renewable energy resource endowments and development plans of Latin American countries, promote photovoltaic, wind power, tidal energy, biomass energy and other renewable energy sources in Latin America. The development and utilization of renewable energy promotes the transformation of the energy structure of Latin American countries, reduces the carbon emission intensity of industrial activities, strengthens cooperation with Latin American countries in the research and development and application of cleaner production technologies, optimizes the design of emission reductions in industrial activities, strengthens China-Latin America transnational research cooperation, and scientifically deploys industries Upgrading work. Considering that accelerating the implementation of carbon emission reduction policies may lead to a decline in short-term economic growth, China should join hands with Latin American countries to urge developed countries to implement their annual climate finance commitments of US$100 billion as soon as possible and propose a roadmap for doubling adaptation funds to support Developing countries, including Latin American countries, respond to the challenge of climate change (Editor-in-Chief Gao Han Shi Peiran)