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TABLE I. Expressions of different decomposition methods

METHODS	OUTPUT VARIABLE / ΔE_{pdn}	STRUCTURE VARIABLE / ΔE_{str}	INTENSITY VARIABLE / ΔE_{int}
LASPEYRES	$\sum_i Y_T S_{i,0} I_{i,0} - E_0$	$\sum_i Y_0 S_{i,T} I_{i,0} - E_0$	$\sum_i Y_0 S_{i,0} I_{i,T} - E_0$
SAD1	$0.5\sum_i \left(E_{i,T} + E_{i,0}\right)\ln\left(Y_T / Y_0\right)$	$0.5\sum_i \left(E_{i,T}+E_{i,0}\right)\ln\left(S_{i,T}/S_{i,0}\right)$	$0.5\sum_i \left(E_{i,T} + E_{i,0}\right)\ln\left(I_{i,T} / I_{i,0}\right)$
SAD2	$0.5\left(I_0 + I_T\right)\left(Y_T - Y_0\right)$	$0.5\sum_i \left(I_{i,0}Y_0+I_{i,T}Y_T\right)\left(S_{i,T} - S_{i,0}\right)$	$0.5\sum_i \left(S_{i,0}Y_0 + S_{i,T}Y_T\right)\left(I_{i,T} - I_{i,}\right.$
LMDI	$\sum_i L\left(E_{i,T}, E_{i,0}\right)\ln\left(Y_T / Y_0\right)$	$\sum_i L\left(E_{i,T}, E_{i,0}\right)\ln\left(S_{i,T} / S_{i,0}\right)$	$\sum_i L\left(E_{i,T}, E_{i,0}\right)\ln\left(I_{i,T} / I_{i,0}\right)$
MIRCI	$\sum_{ij} M_{ij}\left(*\right)\left(1/\overline{y}\right)\left(y_t - y_0\right)$	$\sum_{ij} M_{ij}\left(*\right)\left(1/\overline{S_j}\right)\left(S_{i,T} - S_{i,0}\right)$	$\sum_{ij} M_{ij}\left(*\right)\left(1/\overline{I_j}\right)\left(I_{i,T} - I_{i,0}\right)$

III. RESULTS

After the indicators at all levels are sorted, the original data from 1991 to 2014re converted into mutation fuzzy membership function values [16]. For the positive index, the bigger the better, the maximum value in the sample is used as the benchmark, and the mutation fuzzy membership function value is taken as 1.0; for the reverse index, the smaller the better, the minimum value in the sample is used as the benchmark, and the mutation fuzzy membership function value is taken as 1.0. The degree function value is acted as 1.0, and the mutation fuzzy membership function value of each evaluation index from 1991 to 2014 shown in TABLE II.

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TABLE II Factor decomposition of the carbon emission increment caused by China's industrial combustion of energy from 1992 to 2014 (%)

	TOTAL ENERGY CONSUMPTION	ENERGY STRUCTURE	TECHNOLOGY	MIDDLE PUT-IN	OUTPUT VALUE STRUCTURE	TOTAL PRODUCTION
1992-1997	34.09	-3.30	5.28	-65.93	-30.77	60.63
1997-2002	7.43	0.24	-13.74	-86.26	7.54	84.79
2002-2007	35.96	1.07	13.10	-100.00	2.84	47.03
2007-2014	45.78	2.03	14.02	-90.63	0.48	28.32

Similarly, the evaluation results of CO_2 emission reduction in other years can be computed in turn, as shown in the following table. [17]

From the three influencing factors of primary structure of energy consumption, energy technology management level and industrial structure, primary energy consumption structure plays a leading role in CO_2 emission reduction. This requires further strengthening the development and utilization of new energy, increasing the proportion of clean energy in the energy consumption structure, and reducing the use of conventional carbon energy [18]. From 1991 to 2007, Chinese energy processing and conversion efficiency and production management showed an obvious upward trend, indicating that technological progress has played an obvious direct and indirect role in the use of carbon energy. From the aspect of industrial structure, combining the two tables, the CO_2 emission reduction in the industrial structure in 2007-2014 showed a downward trend, and in 2002-2007, the CO_2 emission reduction increased slightly. The proportion of the tertiary industry has gone up [19], and the proportion of the tertiary industry has decreased. In 2007-2014, the proportion of the tertiary industry has increased, and the proportion of the industry has decreased, reflecting that the industrial structure adjustment will also play a certain role in promoting CO_2 emission reduction.

IV CONCLUSION

First, fluctuations in the economic growth cycle and the increase in industrial production are the major reasons for the prompt increase in emissions of carbon. From 1992 to 2005, the increment of carbon emissions caused by industrial combustion of energy in China increased rapidly, especially from 2002 to 2005. In 1992, Chinese industrial combustion energy emitted a total of 494 million t/c. It increased by 639 million t/c between 1992-2005, reaching 1.132 billion t/c in 2005. In terms of time period, the increase was

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the largest between 2002 and 2005, and the increase in only 3 years accounted for 2/3 of the total increase in 13 years.

Second, the insignificant increase in energy efficiency is a key factor in the increase in carbon emissions. If the total energy consumption also increases with the increase of the total production, it indicates that the energy consumption per unit of output value does not decrease significantly. Although the comparable energy consumption per unit of GDP in China dropped from 4.05t standard coal/10,000 yuan GDP in 1992 to 2.44t standard coal/10,000 yuan GDP in 2014, the increase in total energy consumption is still the direct cause of the increase in carbon emissions. This reflects Chinese basic national conditions of using coal as the main energy source, and also reflects the low efficiency of China's energy utilization.

Third, the overall lack of improvement in the overall energy structure is the fundamental reason for the rapid growth of carbon emissions. Because the carbon emission coefficients of various energy sources vary greatly, especially the carbon emission coefficients of cleaner energy such as hydropower, nuclear power, wind energy, and biomass energy are almost zero. Therefore, a radical change in the energy structure can fundamentally change the total carbon emissions of a country or region.

However, the change in the amount of intermediate inputs has an obvious inhibitory effect on carbon emission reduction. It may be manifested in the change of intermediate input structure and total input, which cannot be distinguished here due to the limitation of the formula itself and data.

In a word, the growth of total economic output, low energy utilization efficiency and coal-based energy consumption structure are the major reasons for the rapid increase in carbon emissions in China. However, changes in technology (proportion of intermediate inputs), industry output value structure, energy structure and other factors have little effect on carbon emission reduction. Therefore, accelerating technological progress, adjusting industrial structure and energy structure, and developing clean energy power generation to improve energy utilization efficiency and transform energy consumption structure can effectively reduce industrial carbon emissions. This is consistent with the conclusion of the aforementioned evaluation of the impact factors of energy consumption and carbon emissions.

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