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The Impact of Renewable Energy Development on Industrial Materials and Carbon Emissions in China

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I. INTRODUCTION

As the world‘s largest emitter, China’s carbon emissions account for more than a quarter of the world‘s emissions, facing the pressure of responsibility for climate change. Renewable energy is one of the important ways to China’s low-carbon development. Renewable energy such as solar energy and wind energy does not cause carbon emissions by itself. However, a large amount of industrial materials is needed in the process of infrastructure construction, equipment maintenance, transportation, and installation, resulting in indirect carbon emissions.

Three questions will be answered:

- How much industrial materials consumption will be needed in the mid- and long-term renewable energy development?
- How much carbon emissions will be produced in China by 2050?
- How much impact does China's mid- and long-term renewable energy development have on the carbon emission path of the industrial sector?

II. METHODOLOGY

A. Life Cycle Assessment (LCA)

The objective is to calculate the industrial materials and potential carbon emissions of renewable energy power generation.

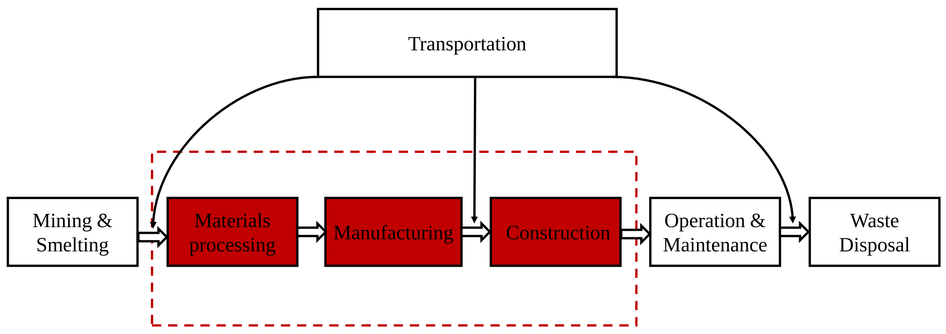


Fig.1 Scope definition of wind power and PV power

B. Scenario Analysis

Scenarios	Hypothesis
BAU	Bussiness-as-usual baseline scenario
LCE	Renewable energy develope vigorously; the NDC target of China is achieved and the requirement of 2℃ of the Paris Agreement is met.
LCI	LCE scenario + technological innovation

C. Data

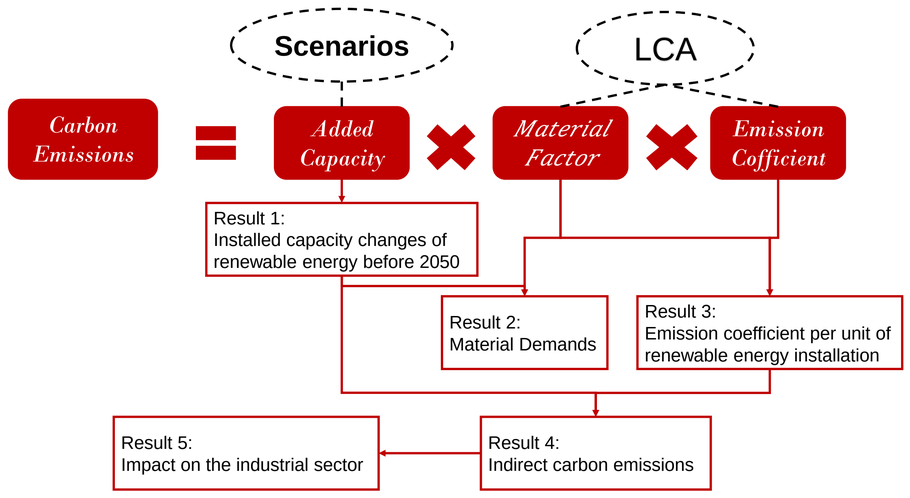
The data about renewable energy and industrial sectors is from **PECE-LIU2017** model that is based on the LEAP framework. This model covers all industrial sectors of China and 38 technologies related to power generation and power transmission.

The data about industrial materials comes from typical literature.

For wind power, material factors choose one of the literatures whose values are closest to average and median;

For PV power, material factors select the most complete and the most representative one. Emission coefficients of different materials come from official reports (Material Economics 2018) and representative literatures.

III. RESEARCH IDEA



IV. RESULTS

A. Trend of Renewable Energy Power Generation

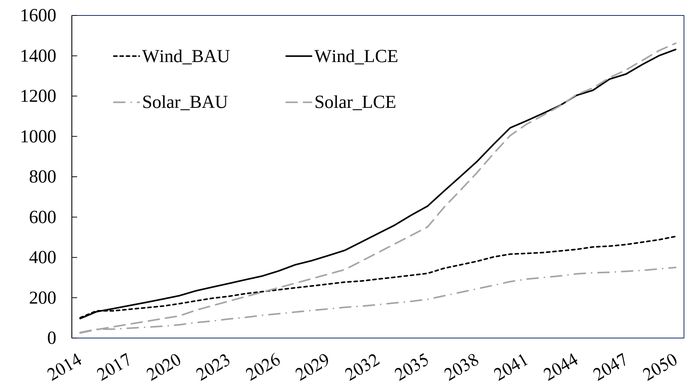


Fig.2 Gross Installed Capacity (GW)

B. Materials Demands

	Materials (10000 tons)	BAU 2020	BAU 2030	BAU 2040	BAU 2050	LCE 2020	LCE 2030	LCE 2040	LCE 2050
Wind Power	Concrete	3298	9318	17858	26958	4672	14829	41149	64914
	Steel	847	2392	4584	6920	1199	3807	10563	16663
	Iron	205	579	1110	1675	290	922	2557	4034
	Crude Iron	66	186	357	539	93	297	823	1298
	Plastic	62	174	334	504	87	277	769	1214
	Glass	41	116	223	336	58	185	513	809
	Copper	9	27	51	77	13	42	118	185
Solar PV	Galvanized Iron	1190	3633	7097	10789	2227	8049	24189	39809
	Glass	1006	3070	5998	9118	1882	6802	20442	33642
	Copper	982	2998	5858	8905	1838	6643	19965	32857
	Aluminum	503	1535	2999	4559	941	3401	10221	16821
	Steel	17	51	100	152	31	113	341	561

C. Comprehensive Emission Coefficient for Wind Power and PV

Wind Power: 480.64 tCO2/MW (approximately **13 gCO2/kWh**)

Solar PV: 3368.57 tCO2/MW (approcimately **86 gCO2/kWh**).

D. Total Emissions from Renewable Energy Development

BAU Scenario: 1905.90 Mt

LCE Scenario: 6557.66 Mt

LCI Scenario: 5163.07 Mt

E. Impact on the Carbon Emission Path of the Industrial Sector

The development of renewable energy in China has a certain impact on the total emissions and the peak path of the industrial sector. Considering renewable energy development**, the peak of industrial sector will be postponed for one year, and the peak level will be increased by 110 million tons in BAU scenario**.

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