The research on decarbonization pathway of synthetic ammonia industry by province in China

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INTRODUCTION:

- The gasification process emits almost all CO2 in the traditional synthetic ammonia industry. It's significant to analysis and project the application potential capacity of zero carbon ammonia production technology in China under the carbon neutral target.
- This research integrates the AIM/Enduse model to analyzing and providing China's synthetic ammonia industry zero CO_2 emission pathway by province.

METHODS:

We adopt AIM/Enduse to establish China provincial synthetic ammonia production technology economic model. The chosen six traditional production technologies which using fossil materials and three zero production technologies which were powered by renewable electricity were showed in the table below (Table 1). And the two scenarios are designed based on the zero CO_2 emissions goal (Table 2). This model also contained the cost and CO_2 emission factor of each technology.

Table 1 The ammonia production technologies

Material	Technology	Code
Coal	Fixed-bed intermittent gasification technology	NH3JX
	Fixed-bed continuous gasification technology	NH3LX
	Coal water slurry gasification technology	NH3SMJ
	Pulverized coal gasification technology	NH3GFM
Natural Gas	Natural Gas	NH3TRQ
Coke oven gas	Coke oven gas PSA	NH3JLMQ
Electricity&H2O	Alkaline electrolysis	AE
	Proton exchange membrane electrolysis	PEM
	Solid Oxide Electrolysis	SOEC

Table 2 The assumption scenarios design

Scenario	Note
REF	Business as usual
PV	Consider zero-carbon technologies

RESULTS:

(1) Ammonia production in provinces in different scenario

Fig.1 Ammonia production in provinces in 2018 and 2050

- The ammonia industry will be attracted by lower cost of solar electricity, such as in 2050 Qinghai, Gansu, Inner Mongolia will be the major production areas.

(2) CO2 emissions of ammonia production in provinces in different scenario

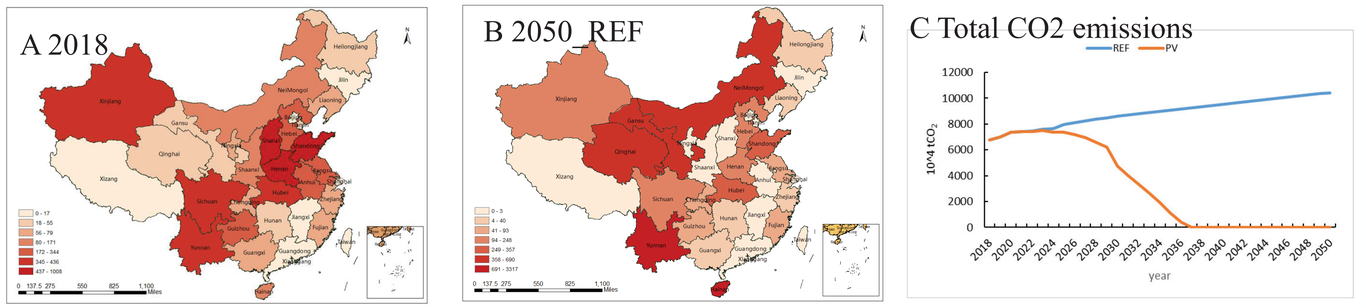

Fig.2 CO2 emissions of Ammonia production in provinces in 2018 and 2050

- With consideration of net-zero technology powered by solar electricity, CO2 emissions will rapidly reduce to zero in 2037, while without any market subsidies.

DISCUSSION AND CONCLUSION:

- This research only analysis the ammonia generation cost in different technologies. Photovoltaic electrolysis of water to produce hydrogen will have a strong market competitiveness in near future. And the profitability of new ammonia projects with traditional production processes around 2023 will be severely crippled, especially in Inner Mongolia.
- In future, ammonia consumption module will be added in.