Future distribution and environmental impact of iron and steel industry in China

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ASIA-PACIFIC INTEGRATED MODEL

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Introduction

China's iron and steel industry (ISI):

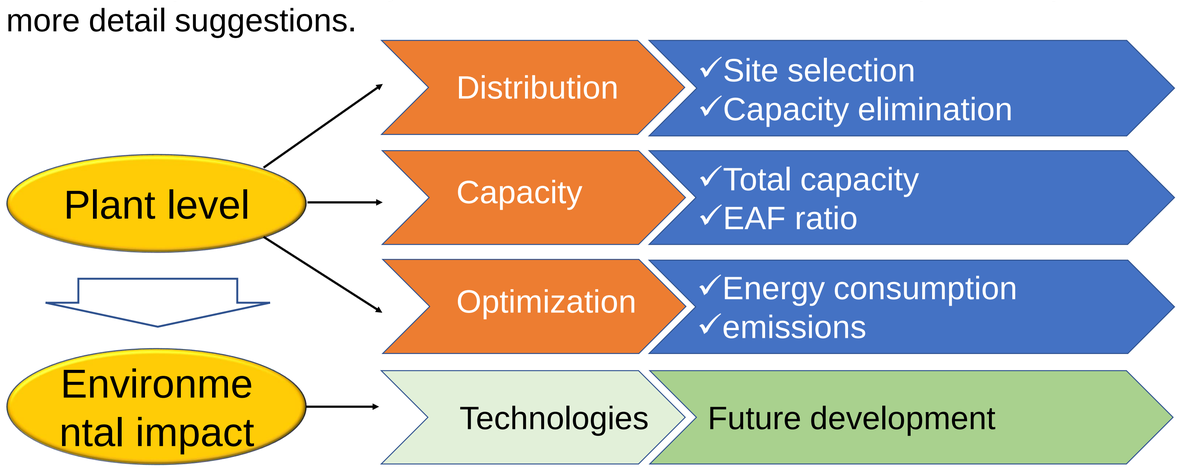
- Consumed 688.4 Mtce in 2013, which is 16.5% of the national total;
- Emitted 16.2% of total national CO_2 emissions in 2013 (1687.2 Mtons);
- Air pollutants emission and heavy metal emission from iron and steel industry (ISI) are also serious problems.

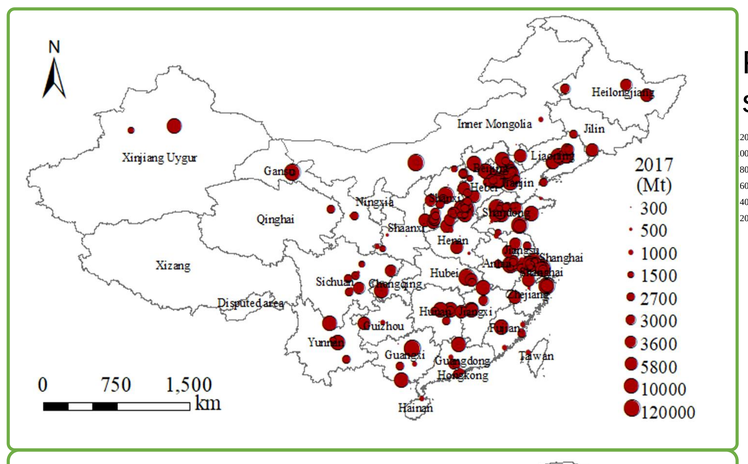
Table 1 Restriction of air pollutants emission from iron and steel industry in China

		PM (mg/m^3)	SO_2 (mg/m^3)	NO_x (mg/m^3)	Oxygen content
2012		80	600	500	
	General	50	200	300	
2015	Sensitive region	40	180	300	
2017	2+26 region	20	50	100	
	Sintering & pelletizing	10	35	50	16%
2018	Other process	10	50	150	

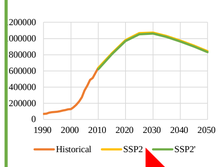
Research objectives

The current researches analyzed China's ISI from industrial level. This research focuses on plant level analysis to estimate the environmental impact and provide more detail suggestions.





Future crude steel demand



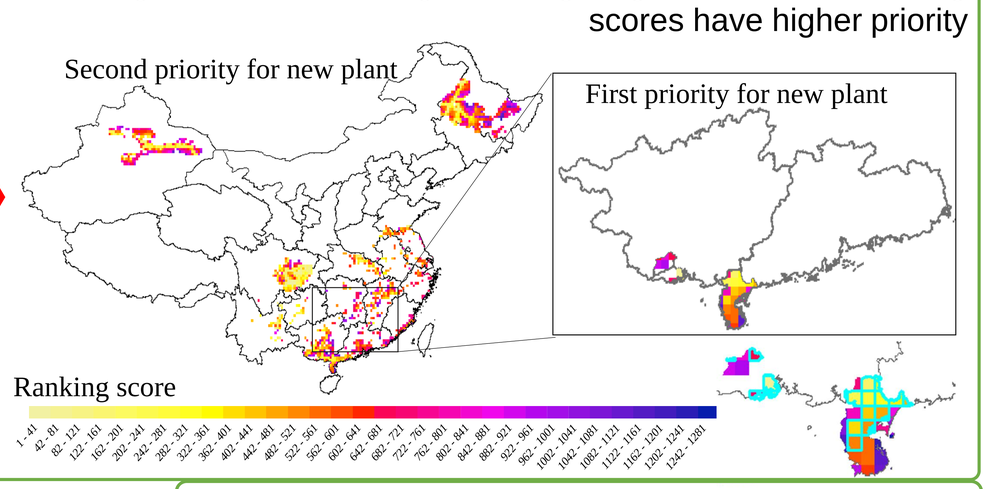
Future distribution model

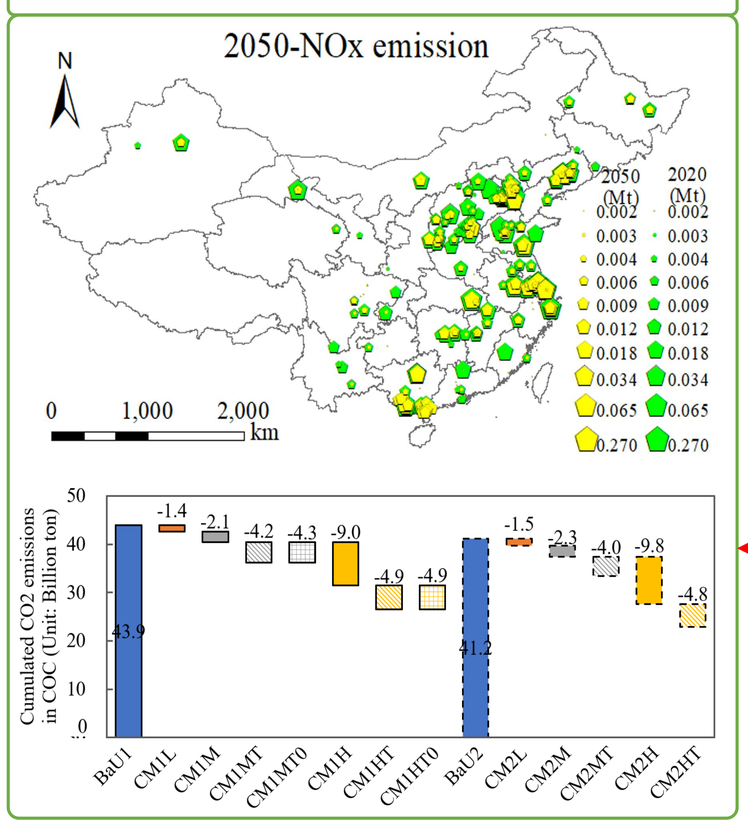
➢ Site selection for new plant construction

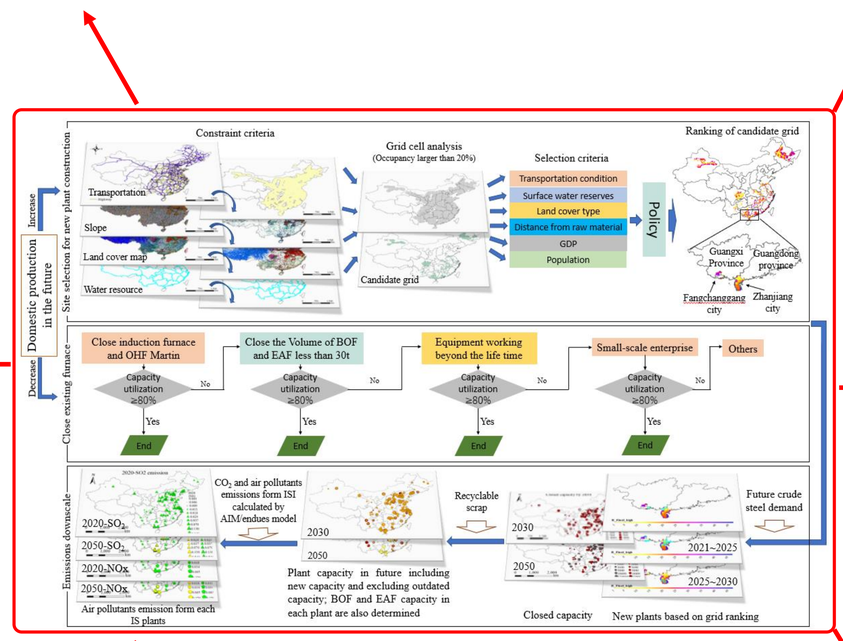
Constraint criteria: Transportation; Slope; Land cover type; Water resource — To select candidate site

Evaluation criteria: Distance to railway/highway; Surface water reserves; Land cover type; Distance to raw materials; GDP; POP — To rank the candidate site

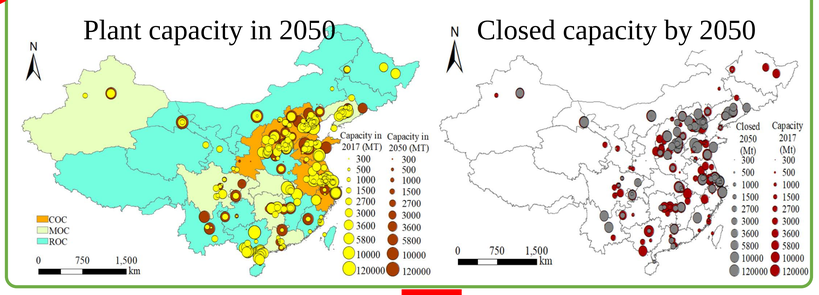
Candidate grids and the ranking of each grid; grids with lower ranking scores have higher priority



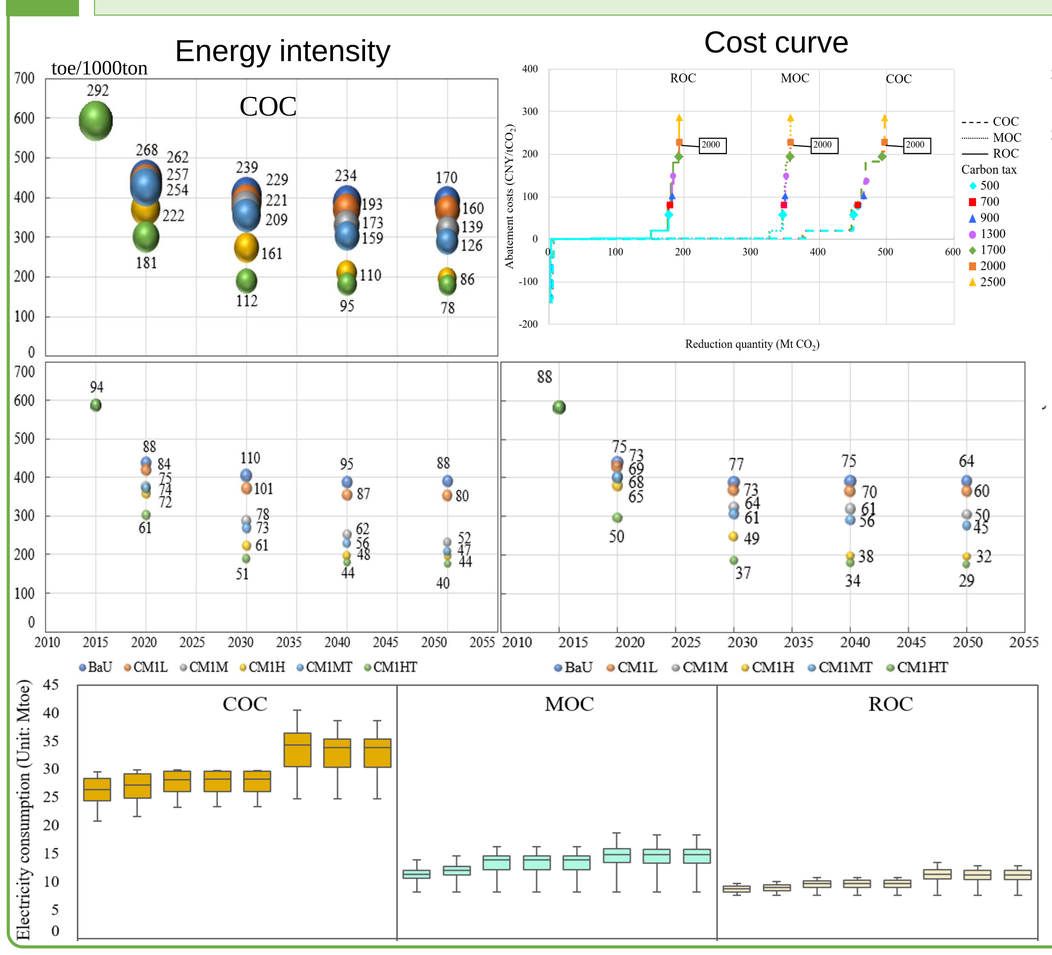




Period	Different stages		Scrap-and-build actions
~2020	Crude steel demand increase	Ferrous scrap increase, and EAF increase	• Close 101 Mt outdated crude steel capacity • Build 5 new plants • BtE 24 Mt
2021~2025			• Build 15 new plants
2026~2030			• Build 2 new plants • BtE 29 Mt
2031~2045	Crude steel demand decrease		• Close 164 Mt outdated rude steel capacity • BtE 60 Mt
2046~2050		EAF decrease	• Close 68 Mt outdated rude steel capacity

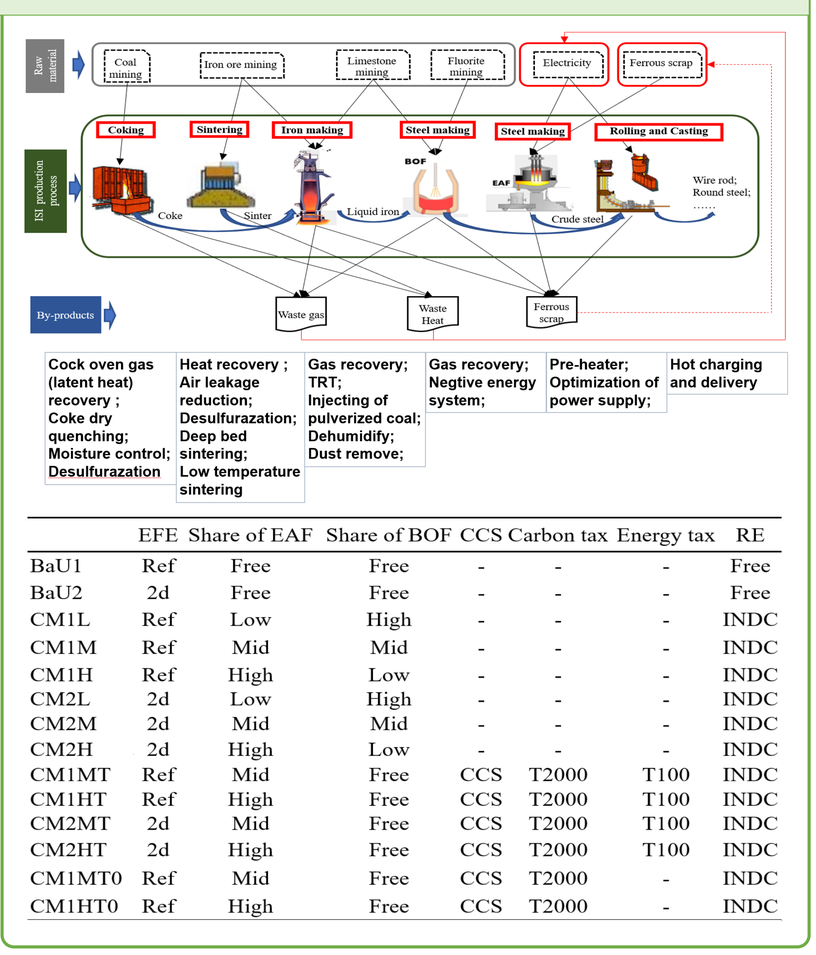


AIM/Enduse model



MCL conservation in COC

Note: positive value in Y axis means coke consumption, bubble size in upper part is coke consumption intensity (toe/1000 ton crude steel); negative value in Y axis means coke conservation, and bubble size in lower part is coke conservation intensity (toe/1000 ton crude steel).



Cock oven gas (latent heat) recovery ; Coke dry quenching; Moisture control; Desulfurazation	Heat recovery ; Air leakage reduction; Desulfurazation; Deep bed sintering; Low temperature sintering	Gas recovery; TRT; Injecting of pulverized coal; Dehumidify; Dust remove;	Gas recovery; Negtive energy system;	Pre-heater; Optimization of power supply;	Hot charging and delivery		

	EFE	Share of EAF	Share of BOF	CCS	Carbon tax	Energy tax	RE
BaU1	Ref	Free	Free	-	-	-	Free
BaU2	2d	Free	Free	-	-	-	Free
CM1L	Ref	Low	High	-	-	-	INDC
CM1M	Ref	Mid	Mid	-	-	-	INDC
CM1H	Ref	High	Low	-	-	-	INDC
CM2L	2d	Low	High	-	-	-	INDC
CM2M	2d	Mid	Mid	-	-	-	INDC
CM2H	2d	High	Low	-	-	-	INDC
CM1MT	Ref	Mid	Free	CCS	T2000	T100	INDC
CM1HT	Ref	High	Free	CCS	T2000	T100	INDC
CM2MT	2d	Mid	Free	CCS	T2000	T100	INDC
CM2HT	2d	High	Free	CCS	T2000	T100	INDC
CM1MT0	Ref	Mid	Free	CCS	T2000	-	INDC
CM1HT0	Ref	High	Free	CCS	T2000	-	INDC

Conclusion: 1. This framework is able to handle different criteria for selecting ISI plants location. The capacity utilization rate is within a reasonable level between 87% - 90%.

2. Results show that increasing EAF ratio is more effective to conserve energy and reduce emission than tax and EFE