

Supplementary Materials:

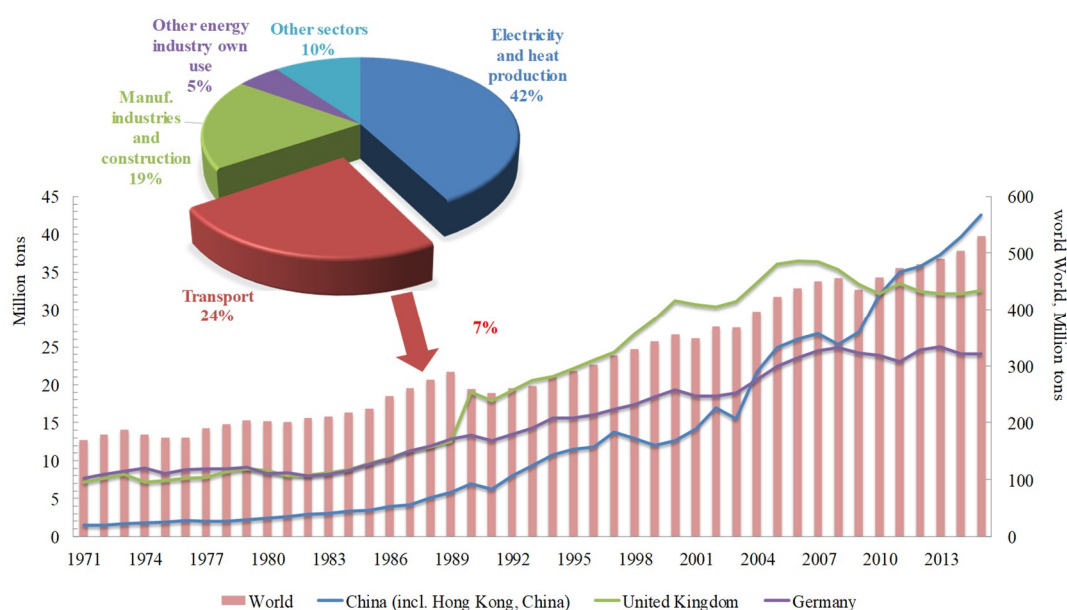


Figure S1. Carbon emissions of transportation and aviation industry [9].

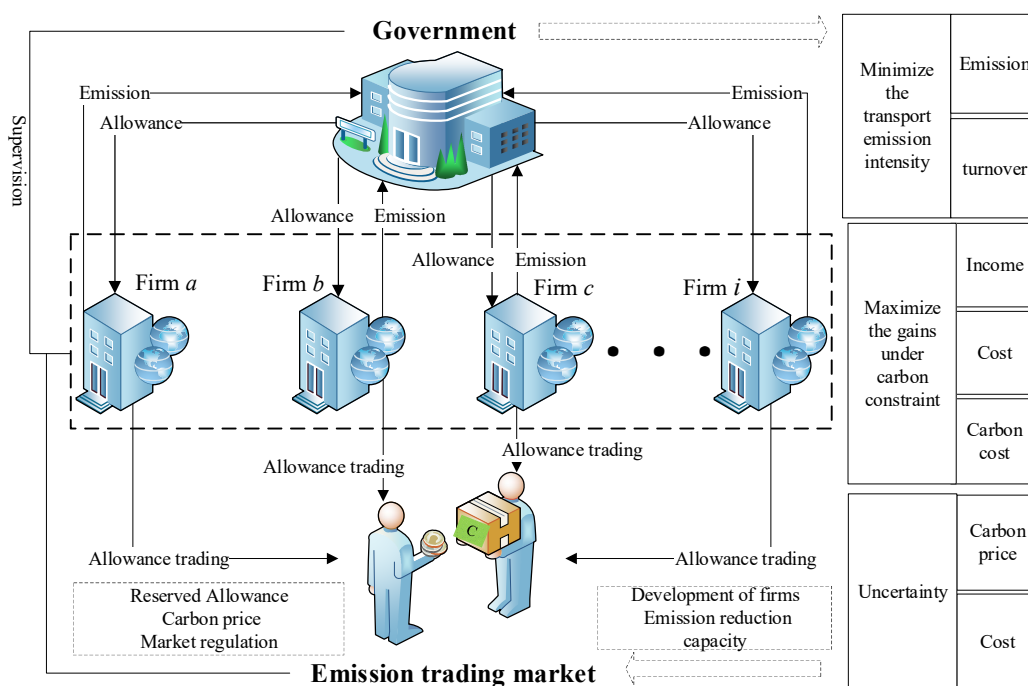


Figure S2. The conceptual model of MCAA in the aviation industry.

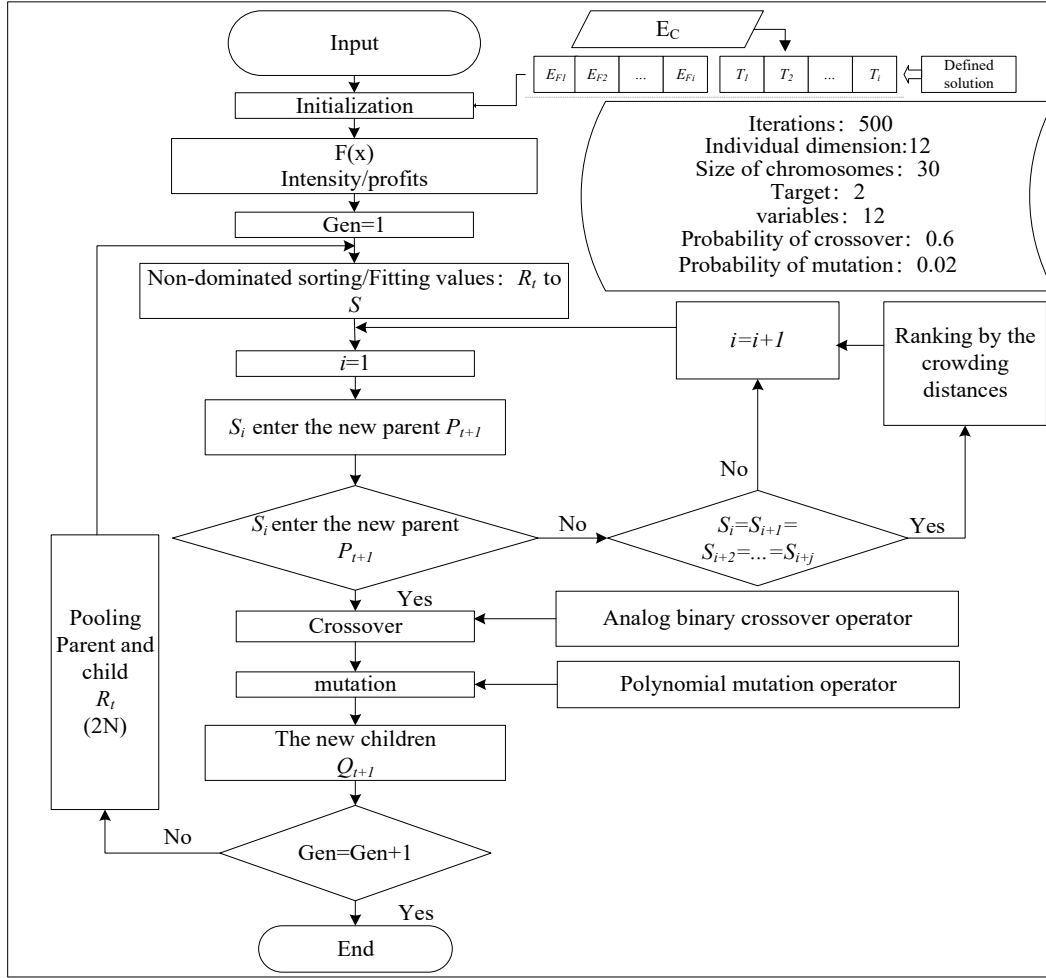


Figure S3. The solution process of multi-objective genetic algorithm. Note: The solution process is to initialize the group, calculate our target value, sort, and compare the crowded distances of the same level, and then select the non-inferior solution to enter the crossover, mutation, and iteration, and finally work out the optimal solutions.

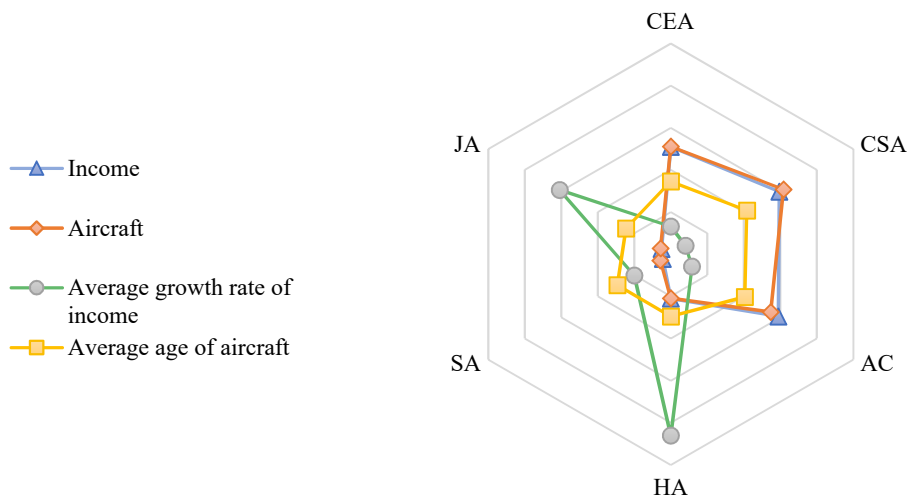


Figure S4. Categories of 6 airlines.

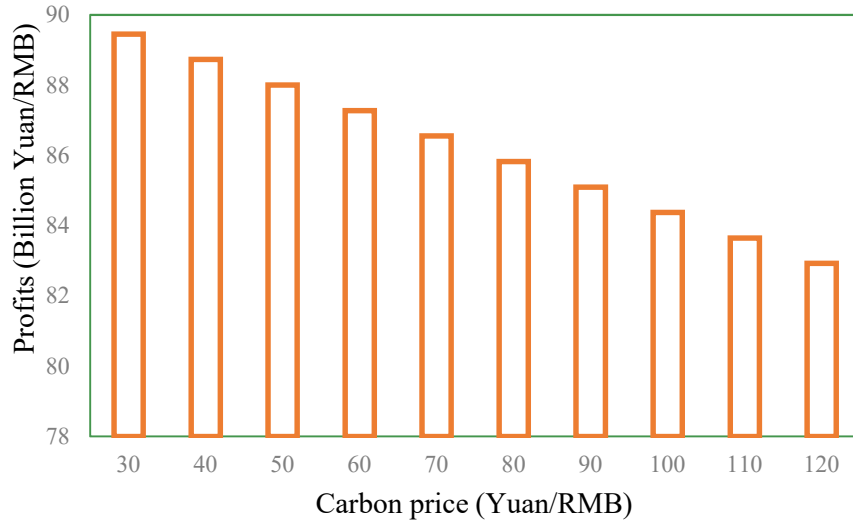


Figure S5. Relationship between the carbon price and firms' profits.

Table S1. Description of parameters and variables.

Function	Description
E_i	Actual emissions of firm i
T_i	Tons and kilometers of output
p_i	Price of per transportation of firm i
C_i	Cost of firm i
p_c	The carbon price, which is 30 RMB according to China's ETS
E_{ti}	Emissions trading volume
Parameters	Description
E_i	Actual emissions of firm i
p_i	Price per instance of transportation of firm i ; equal to the average of their historical price
C_i	Cost of firm i
p_c	The carbon price, which is 30 RMB according to China's ETS
E_{ti}	Emissions trading volume
E_C	The total quotas
$Q_{fuel}^{CO_2}$	The quantity of fuel emitting CO ₂
$F_{fuel}^{CO_2}$	Emission factor, which indicates the CO ₂ emissions of fuel's combustion
E_i^{\min}	Minimum emissions of Firm i , which is 80% of the minimum actual emissions in the past three years
E_{ti}^+	Amount of allowance that Firm i purchases
E_{ti}^-	Amount of allowance that Firm i sells
d_i^{\min}	The minimum value in the total turnover of Firm i in the past three years
d_i^{\max}	120% of the maximum value in the total turnover of Firm i in the past three years
Decision Variables	Description
T_i	Tons and kilometers of output
E_{Fi}	Free allowance volume of Firm i

