Nomenclature			
	Set		Numbers in set
$t \in T$	Time		30
$i \in I$	Technology		4
	Parameters	Unit	Non-zero value range
$disc_t$	Discount rate	--	0.06
cr_i^t	Raw material cost	CNY/t	400-16685
ci_i^t	Investment cost	CNY/t	2578-15495
fom_i^t	Fixed o&m cost	CNY/t	76.3-774.75
vom_i^t	Variable o&m cost	CNY/t	2701-8491
τ_i	Technology lifetime	Year	20-20
η_i	Raw material conversion efficiency	--	0.07-0.90
α_{ij}	Production conversion efficiency	--	0.25-1.00
λ_j	Summation conversion efficiency	--	1.00-1.05
$emif_i$	Emission factor	tC02/t	0.05-4.75
f_i^t	Technology utilization rate	--	0.5-1
d^t	Demand	t	2.66×10^8-4.16×10^8
c_i^0	Initial installed capacity	t	1.0×10^6-2.38×10^8
	Variables		
r_i^t	Raw material consumption amount		t
c_i^t	Installed capacity		t
RTR_i^t	Retried capacity		t
totaCost	Total cost		CNY
investmentCost	Total investment cost		CNY
materialCost	Total raw material cost		CNY
OMCost	Total operation and maintenance cost		CNY
CO2	Total CO2 emission		T
	Decision variables		
NCAP	Newly installed capacity		t
ACT	Activity of a technology		t

One criteria of our model analysis are the accumulative total cost of the liquid fuel supply system for China's transportation sector from 2020 to 2060. The mathematical expression of total cost is defined by Eq (1)

$$tatalCost = materialCost + investmentCost + OMCost \tag{1}$$

Total cost in our model consists of three parts, which includes:

1) Total raw material cost is defined by Eq (2)

$$marterialCost = \sum_{i \in I} \sum_{t \in T} disc_t \cdot cr_i^t \cdot r_i^t \tag{2}$$

2) Total investment cost, which refers to the cost of building production capacities (i.e., plants) of different technologies and is defined by Eq (3)

$$investmentCost = \sum_{i \in I} \sum_{t \in T} disc_t \cdot ci_i^t \cdot NCAP_i^t \tag{3}$$

3) Total operation and maintenance cost, which donates the cost to maintain the well

function of the plant. All costs are occurring in the future, so they are all discounted into the present value of the base year. The mathematical expression is defined by Eq (4)

$$OMCost = \sum_{i\in I}\sum_{t\in T}\sum_{c\in C} disc_t \cdot \left(fom_i^t c_i^t + vom_i^t \cdot ACT_i^t\right) \tag{4}$$

Where *t* is time period (year), $disc_t$ denote the discount rate at time *t*, *i* is technology, cr_i^t is the price of raw material used for technology *i* at time *t*, while r_i^t is the raw material consumption amount of technology *i* at time *t*. ci_i^t is the capital investment for technology *i* at time *t*, while $ncap_i^t$ is newly installed production capacity of technology *i* at time *t*. Similarly, fom_i^t and vom_i^t denote fixed and variable operation and maintenance cost of technology *i* at time *t*. c_i^t is the cumulative installed capacity of technology *i* at time *t*. act_i^t denotes the activity of technology *i* at time *t*.

Other environmental outcomes or criteria including CO_2 emissions. Detailed mathematical expressions in Eq. (5).

Outcome 2:

$$CO2 = \sum_{t\in T}\sum_{i\in I}\sum_{c\in C} emif_i \cdot ACT_i^t \tag{5}$$

Where$emif_i$ is the emission factor of technology *i* for at time *t*.

These objects also satisfying with a series of relations and constraints.

Let $r_{i,c}^t$ represent the quantity of the raw material used for producing product *c* at time *t*, is defined by Eq. (6)

$$r_i^t = \frac{ACT_i^t}{\eta_i}, i \in I, t \in T \tag{6}$$

Where $\eta_{i,c}$ is the conversion efficiency of technology *i* for producing product *c*.

c_i^t is the installed capacity of technology *i* at time *t* which is defined by Eq. (7)

$$c_i^t = c_i^{t-1} + NCAP_i^t - RTR_i^t \tag{7}$$

Where RTR_i^t is the retired capacity of technology *i* at time t and is defined by Eq. (8)

$$RTR_i^t = \frac{\tau_i - t}{\tau_i} c_i^0 \tag{8}$$

Where τ_i is the life time of technology *i.*

Let x_j^t denote the production amount of product type *j* at time *t*, the x_j^t can be defined by Eq. (9)

$$x_j^t = \sum_i \alpha_{ji} \cdot ACT_i^t,\ \ j \in J, t \in T \tag{9}$$

Where α_{ji} is the conversion efficiency of technology *i* for producing product *j.*

Additionally, the demand of the summation for liquid fuel must be satisfied and can be denoted in Eq. (9)

$$d^t \le \sum_j \lambda_j x_j^t, t \in T \tag{10}$$

Where d^t stands for the demand of total liquid fuel at time *t*, while λ_j is the conversion coefficient of products *i* when make a summation.

Besides output of the products of the fuel should not exceed the production capacity and is defined by Eq. (10)

$$\sum_{c\in C} ACT_i^t \le f_i^t c_i^t, i \in I, c \in C, t \in T \tag{11}$$

Where f_i^t is the production capacity utilization rate.