Problem Chosen	2020 MCM/ICM Summary Sheet	Team Control Number
E		2007586

Invest a green put option to reduce global plastic waste

Plastic waste is increasing, how to reduce plastic waste has become a global problem.

Task I： First of all, we found that plastic waste in the packaging industry accounts for 36% of the industry, plastic waste in East Asia and the Pacific accounts for 23% of the world, and plastic waste that can be recycled accounts for only 9%. Referring to the status quo, we use the recycling layer in the "waste hierarchy" as the base layer. Next, we rely on the logical Sty's finite growth model to use matlab to find the maximum saturation for the production of disposable plastic products at 580 million metric tons per year. Finally, we set up "plastic waste green put option model ", and get "$1 Call = 31.23\% * A - 0.4882 * B$".

Task II： In combination, we choose the consumption of plastic packaging (Million MT/year), utilization, ecological productivity (GDP/waste total), and resource tax rate as reference indicators. Firstly, the index evaluation to promote the reduction of plastic waste was established by AHP and entropy weight method respectively. Then, according to the weight of each index, we propose four decision directions. Finally, the grey prediction model is used to predict the trend of plastic waste change in four decision directions, and the chart is used to realize visualization. It was found that the two decision-making directions could be reduced by 30.9% to 36.2% after 30 years to reach the level of environmental security.

Task III： On the basis of the above conclusions, we have set the minimum achievable level of global waste as a reduction of 30 per cent on the basis of raw plastic waste, or 6.5 billion tons of global plastic waste by 2050. The realization of this goal requires a lot of financial, human and material resources. For the trillions of dollars in plastics industry: the proportion of degradable plastics industry is expected to rise from 3% to around 68% in 2050. For people's living standards: the global elimination of one-time non-recyclable plastic industry year by year, people reduce or even no longer use non-recyclable plastic packaging finished products, more regions advocate green products. For the environment: Not only did it ease The high-speed rising trend of carbon oxide emissions has also effectively reduced the amount of plastic waste. And, we take China as an example to express the concrete influence in three-dimensional coordinate system

Task IV： We analyze the global plastic waste crisis from the global ecological productivity and per capita plastic waste production, and visualize the indicators. give appropriate ICM recommendations through discussion.

Memo： First, we describe a global goal based on the above, and refine it, for the solution of plastic waste. Next, we give the concrete measure, and draw the time plan diagram.Finally, we set target values for plastic waste on all continents over the next 30 years.

Keyword：Green Put Options Model for Plastic Waste AHP - Entropy Weight Method Logic Sty's Limited Growth Model GM(1,1)

Catalogue

1. Introduce

1.1 The background and significance of the research

The world's first fully synthetic plastic was invented in the early 20th century by American Belgian Leo Hendrick Bakerland. Plastic has the characteristics of good processing characteristics, strong chemical stability, high electrical insulation, low thermal conductivity and light density, so it developed rapidly in the 20th century. [1]

But waste plastics are difficult to degrade naturally, and many plastic products are disposable. The rise of disposable plastic products has aggravated the production of plastic waste, so the environmental pollution caused by it is becoming more and more serious. Studies have shown that plastic products are used for far less time than they take to alleviate plastic waste. According to the Ocean Conference, marine litter consists mainly of plastic waste and accounts for 100% of floating waste. [2]

The serious environmental consequences of plastic waste are not only manifested in the sea, but its impact on human health is not yet clear. Therefore, the problem of reducing plastic waste is now the focus. For the purpose of solving plastic waste, we can slow down the speed of plastic production from the source, and we can also improve the management of plastic waste.

1.2 Our work

1. To develop and establish a green put option model for plastic waste based on logically finite growth model to predict the production of plastic industry in the next 30 years, and to estimate the maximum level of single-use or disposable plastic product waste.
2. Based on AHP and entropy weight method, the factors that can reduce plastic waste are weighted, and the future decision direction is discussed.
3. Design a memorandum and map the time plan for global waste to be reduced to about 6.5 billion tons after 30 years.

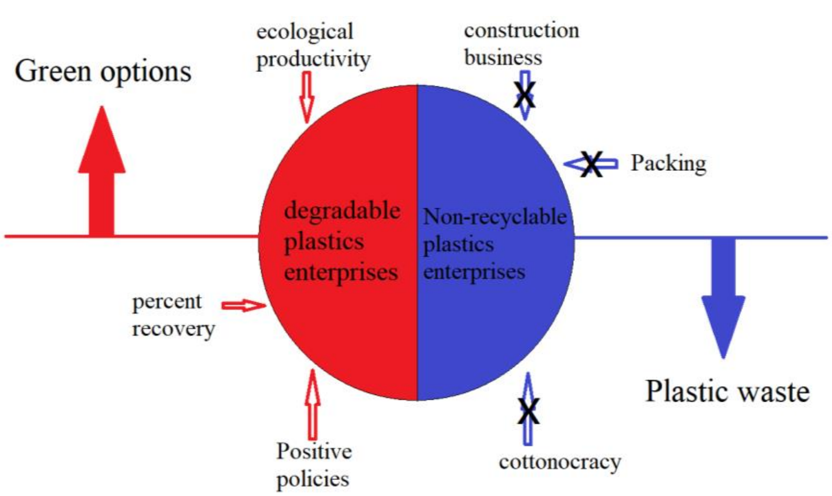


Figure 1 Specific schematic diagram

2. Problem Assumptions and Symbols

2.1 symbol description

Symbol	Explain
A	the world's plastic industry output
B	World Plastics Production Year-end Recoverable
C	the amount of plastic waste
$F_{\text{Return on investment}}$	Production growth rate of recyclable plastics industry
$R_{\text{The geometric growth}}$	Geometric growth rate of world plastics production
$W_{\text{Can be recovery}}$	Recoverable rate

2.2 Problem assumptions

To facilitate our research, we make the following assumptions：

1. Suppose that future A, B, and C future output changes are either higher or lower than stocks and bonds.；
2. Suppose the plastic waste is reduced by 30% on an existing basis to an environmentally safe level；
3. Assuming that developed regions are active in aid recovery, areas under ecological productivity clean up plastic waste；
4. Suppose that plastic products account for 5% of global household expenditure per capita .

3. Solution to Task One

3.1 Model background

This question asks us to develop a model to estimate the maximum level of plastic product waste, and clearly states that we may need to consider the source of the waste, the extent of the current waste problem, and the availability of resources to handle the waste. Therefore, we analyze and consider the above three factors.

3.1.1 Waste sources

Plastic is light in density and has excellent chemical stability and electrical insulation.Therefore, its growth rate far exceeded the growth rate of other materials in the twentieth century.It is widely used in packaging, agriculture, construction, automobiles, daily consumption, etc. Field. To study the source of plastic waste, we analyze it from the perspective of industry and region.

Industry perspective: We divide the source industry into eight categories, namely Packing, Health care and agricultrue, Building and cinstruction, Consumer and instiutional products, Electricia, Transportation, Textiles, and Industrial, with the proportions of 36%, 12%, and 16%, respectively. , 10%, 4%, 7%, 14%, 1%. In order to facilitate data display and analysis, we visualize the data to draw Figure 2. [3]

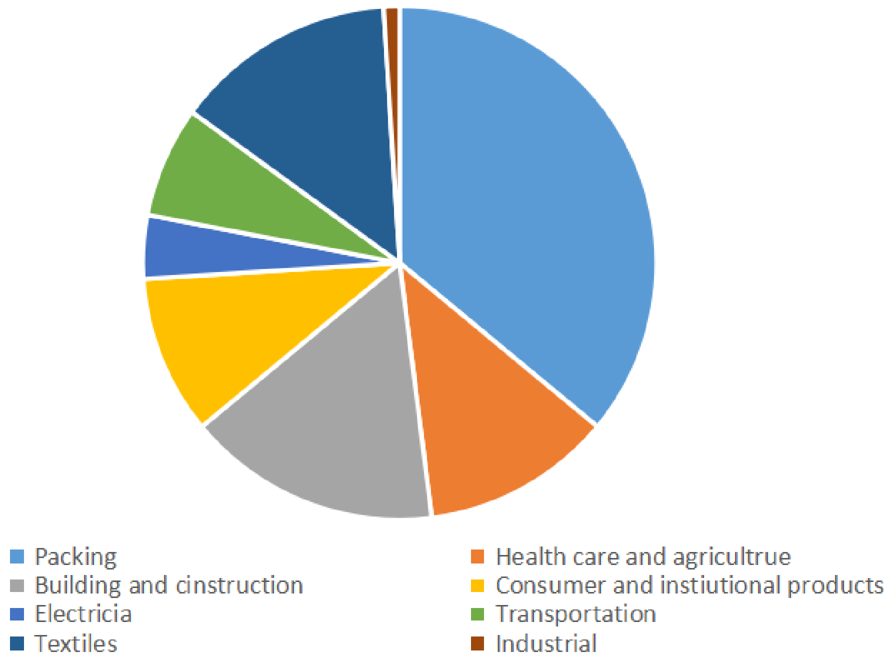


Figure 2 Proportion of plastic waste from different industries

Regional perspective: Research shows that plastics are mostly single-use, so the amount of plastic waste produced can be estimated by observing the amount of plastic waste produced. According to statistics from the National Bureau of Statistics, most of the discarded plastic waste is produced in the same year, so Here we statistically summarize the plastic production in different regions of the world, and we get Figure 3. [4]

Figure 3 Proportion of plastic waste from different regions

3.1.2 Extent of current waste problem

Plastic products are not easy to decompose and difficult to handle.The data show that only about 9% of plastic is recycled, and about 4-12 million tons of plastic products enter the ocean every year. [3,5] In order to highlight the severity of the current plastic waste problem, we use water The ball chart shows it (Figure 4), which visually shows the proportion of recycled plastic and plastic waste in the total plastic.

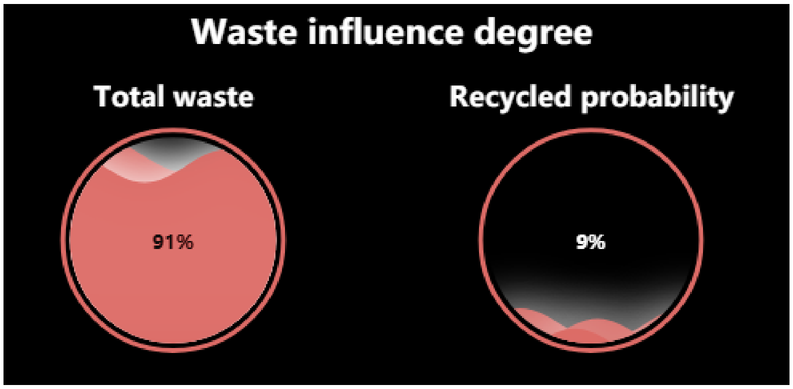


Figure 4 Proportion of recycled plastic waste

WWF's recently released " Solving Plastics through Accountability " report shows that unless major changes are made in the management of plastic waste, by 2030, another 104 million tons of plastic may enter the ecosystem. The plastic system is expected to double the amount of plastic pollution on the planet, the most severe of which is the ocean. The report states that inadequate recycling of plastics has already caused devastating effects on wildlife and ecosystems. More than 270 species are affected by plastic It has been entangled, and more than 240 species have been found to eat plastic by mistake. However, it is still not clear what impact humans and animals will continue to eat plastic from food and drinking water every year [6].

3.1.3 Availability of waste treatment resources

A good waste management system is usually a system that rationally prioritizes actions by "waste level" (see Figure 5). [7] The waste level is an assessment of resource and energy consumption in the course of an action from the most favorable to the most unfavourable. Waste Proper application of layers helps to build a good sustainable waste management system and prioritization of treatment, thereby reducing waste and achieving the highest return at the lowest cost.

At present, the management of plastic waste disposal and recycling around the world is still in its infancy, so we use the recycling layer in the waste hierarchy as a reference layer to guide the statistics of the recoverable proportion of the plastic industry in the world.

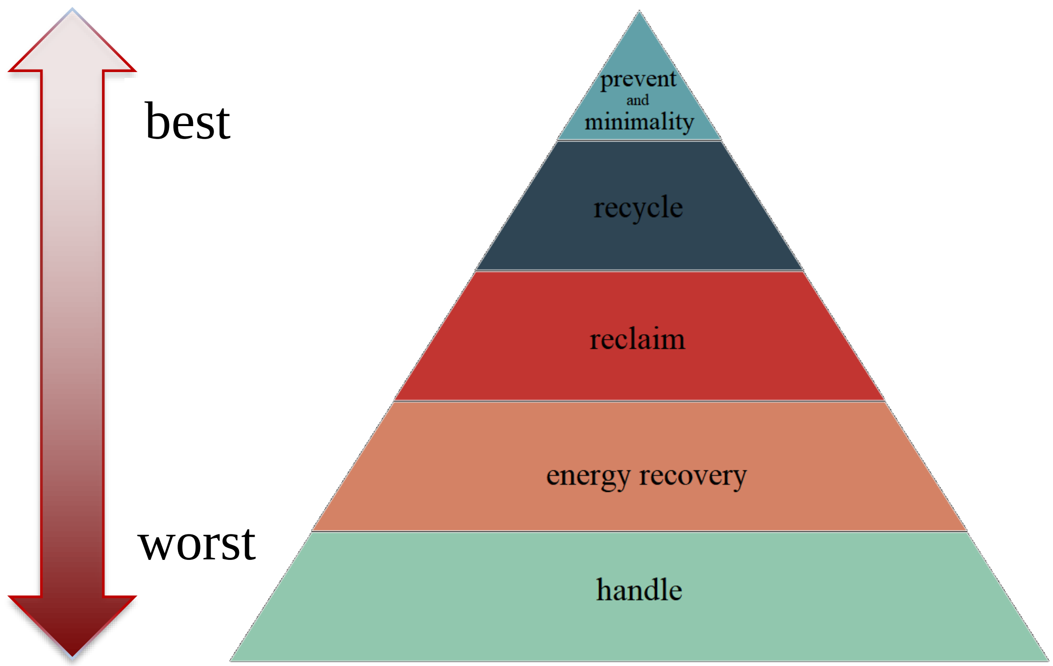


Figure 5 Waste level

3.2 Model establishment and solution

The principle of whether there is arbitrage pricing between stocks, bonds and options. No arbitrage refers to the state of price equilibrium without arbitrage opportunities. The key to no arbitrage pricing is to copy assets, that is, use one set of assets to copy another set of assets, making two Group assets have the same cash flow at the beginning and end of the period. Generally speaking, the assets that are copied are those with more complex pricing.

We improved and applied this relationship principle to create a "put green option" to reduce the amount of plastic waste.

3.2.1 Finding the maximum saturation of the output of disposable plastic products with the help of the logical finite-growth model

Logistic model is almost the only mathematical model to describe s-type growth. Its s-type curve changes at a slower growth rate at the beginning, increases in the middle section, and then decreases and stabilizes. It can be used to characterize the population. Quantitative dynamics, describing the growth process of objective things, can also be used as a theoretical basis for complex models.

By analyzing and researching the ten-year trend chart of the world's plastic industry output and the main sources of plastic waste, we find that the output is limited by resources, the environment and other factors.Therefore, we use a logical growth limited model to predict the future world plastic output. [9]

At the end of the 19th century, the Danish biomathematician Pierre-Francois Verhulst improved the logistic model to:

$$\frac{d_p}{d_t} = r(M-p)p, r>0 \tag{1}$$

Where M is the maximum population. [8]
Equation (2) is called the logistic finite growth model, and its solution is:

$$p(t) = \frac{M p_0}{[p_0 + (M-p_0)e^{-rM(T-T_0)}]} \tag{2}$$

We use Matlab to predict the output of the world plastics industry (A) from 2008 to 2050 through the Logistic Limited Growth Model, and obtain Figure 6.

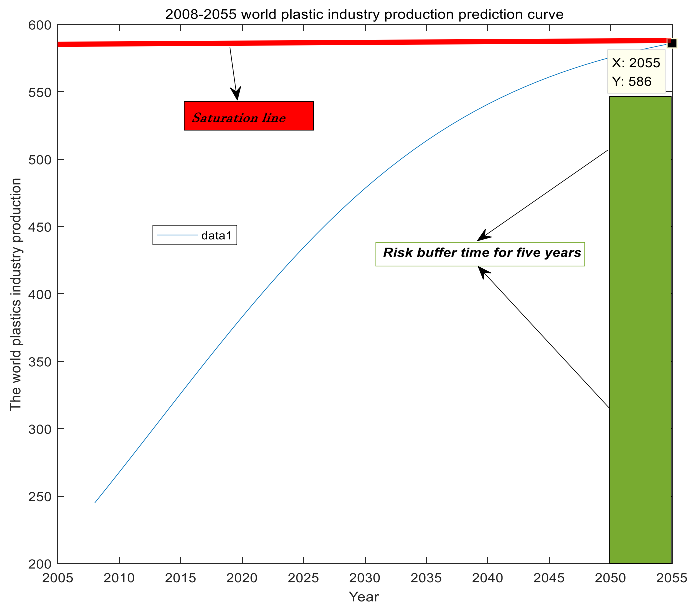


Figure 6 2008-2050 Forecast of World Plastic Industry Output

Observing Figure 5 shows that the growth rate of the output of the world's plastics industry is gradually decreasing, and will tend to zero after 20 years. From this, we can predict that the industry will reach saturation at 58 billion tons.

3.2.2 Establishment and Solution of Green Put Option Model for Plastic Waste

We take the geometric growth rate of the world's plastic industry output from 2020-2050 as the default growth rate, and the derivative of its geometric growth rate can be found in formula (3).

$$\sqrt[(30)]{\frac{A_{2050}}{A_{2020}}} - 1 = R_{\text{The geometric growth}} \tag{3}$$

The output of the world's plastic industry at the end of 2019 was 356 Million metric tons, with a geometric growth rate of 1.42%

The principle of relationship without arbitrage pricing: the future cash flow of an option = the future cash flow of X shares of stock + the future cash flow of Y bonds, that is, $1\,\text{Call} = \text{X Shares} + \text{Y Bonds}$;

We compare the world's plastic industry output (A) at the end of each year as the future price of stocks, and the recoverable amount (B) of the world's plastic industry output at the end of each year as the bond maturity price, and the amount of plastic waste (C) as a green put option The analogous growth rate of the world's plastic industry output ($R_{\text{The geometric growth}}$) is the growth rate of stock prices.The future change of a green put option for plastic waste = x changes in the output of the world's plastic industry + y changes in the recoverable amount of the world's plastic industry output, that is, $1\text{C} = \text{X} * \text{A} + \text{Y} * \text{B} - \lambda$ 。

Assume that the future output changes of A, B, and in the future are similar to that of stocks and bonds, which will either rise or fall.

1.Demonstration of changes in world plastic industry output:

$$356*(1+R_{\text{The geometric growth}})^{n} = A_1$$

(1) Free development model:

$$\text{goal}=356*(1+g\%)^{n} = A_0$$

(2) Target management mode:

2.The recoverable amount in the output of the world plastics industry can be obtained from formula (4):

$$356*(1+F_{\text{Return on investment}})^{n} * W_{\text{Can be recovery}} = B$$
$$F_{\text{Return on investment}} = r_{\text{temunerati on}} \tag{4}$$

Among them, A_1 represents the value of the plastics industry under the free development model; A_0 is the goal to reduce the value through management in the future; g represents the reduction rate of the plastics industry's output that managers call for efforts from all regions of the world; $F_{\text{Return on investment}}$ represents the output of recyclable plastics industry The growth rate can also be analogized to the return on investment in the industry. λ Indicates other related factors.

Suppose we, as the management, define the opening amount of the green put option for plastic waste in 2020 (C) as the maximum level of single-use or disposable plastic product waste, and continue to reduce (C) through global actions to make more Of people are involved.

According to the above formula, the world's plastic industry output (A), the world's plastic industry output (B), and the amount of plastic waste (C) can be expressed as a binomial, as shown in Figure 7.

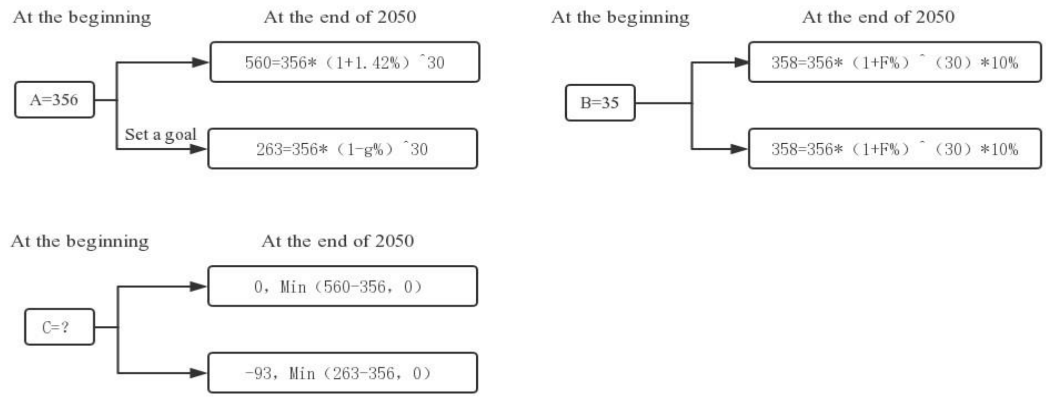


Figure 7 Pricing of binomial green options

According to the principle of no arbitrage pricing “$1C = X*A + Y*B$”, Simultaneous equations can be obtained:

$$\begin{cases} 560X - 358Y - \lambda = 0 \\ 263X - 358Y - \lambda = -93 \end{cases}$$

$$\begin{cases} X = 31.23\% \\ Y = 0.4882 \end{cases}$$

$$C_{\text{The initial}} = 31.23\% * 356 - 0.4882 * 35 = 94.1$$

Using matlab, the solution to this linear equation is: "$1\,\text{Call} = 31.23\% * A - 0.4882 * B$". From this: If the production of plastic production declines, the world can promote sustainable development by buying 0.3123 parts of the plastic industry products and investing 0.4882 parts of the renewable plastics industry with a return of 8%; To achieve a reduction in the amount of plastic waste, the maximum level of green options purchased is 94.1 Million metric tons.

4. Solution to Task Two

4.1 Evaluation of indicators for promoting reduction of plastic waste based on ahp and entropy weight method

We comprehensively consider the factors affecting the level of plastic waste, and select the four factors of consumption (Million MT / year), utilization rate, ecological productivity (GDP / total waste) [10], and resource tax rate of plastic packaging for discussion. Reference indicators. We statistically calculated the index values of these four indicators [11,12] and compiled Table 1.

Table 1 Value of each indicator

	B12	B13	B14	B15
area	Packing consumption	utilization rate	Ecological productivity	Resource tax rate
North America	4.61	15.50%	1.75	30%
South America	3.62	15%	0.76	28%
North Africa	1.98	25%	0.35	22%

South Africa	2.96	20%	0.21	30%
East Asia and Pacific	7.58	45%	1.55	25%
Europe	6.59	28%	1.28	28%
Australia	2.31	14%	0.30	23%
Middle-south Asia	3.29	35%	1.06	26%

4.1.1 Analytic Hierarchy Process

On the basis of Table 1, we establish an index evaluation system by analytic hierarchy process. The overall goal here is to reduce the amount of plastic waste, and the four index values are lowered for each level of sub-targets.

First, we make a pairwise comparison of the above four indicators to construct a judgment matrix. Then, we use the pairwise comparison method to determine the relative importance of the factors, quantify it according to the index scale table (Table 2), and base it on An order matrix was constructed for the comparison method (Table 3).

Table 2 Index scale table

Scaling	Scale definition
1	a is as important as b
1.3-1.5	a is slightly more important than b
1.6-1.8	a is more important than b
2	a is obviously more important than b
4	a is more important than b
6	a is more important than b

Table 3 Pairwise comparison

	Packing consumption	utilization rate	Ecological productivity	Resource tax rate
factor	B12	B13	B14	B15
B12	1	4	6	2
B13	0.25	1	1.8	0.67
B14	0.17	0.56	1	0.33
B15	0.50	1.5	3	1

Then, we perform a consistency check on it to obtain a consistency index $CI = 0.0047$ Test coefficient $CR = 0.0053$ Therefore, the judgment matrix passes the consistency check.

Finally, we calculate the weight of the target's relativity and get Table 4.

Table 4 Index weight

Judgment matrix	Weight	λ_{Max}	CR
$A = \begin{pmatrix} 1 & 4 & 6 & 2 \\ 1/4 & 1 & 9/5 & 2/3 \\ 17/10 & 14/25 & 1 & 1/3 \\ 1/2 & 3/2 & 3 & 1 \end{pmatrix}$	55% 14% 8% 24%	4.0141	0.0053<0.1

4.1.2 Entropy weight method

Through the entropy weight method, we can calculate the weight of each indicator, so as to provide a basis for comprehensive evaluation of multiple indicators. We import the values of each indicator in Table 1 into Python and run to get the weight of each indicator (Table 5).

Table 5 Weight of each indicator

index	Weights
Packing consumption	26.3%
utilization rate	31.9%
Ecological productivity	25.0%
Resource tax rate	16.9%

4.1.3 Summary

Therefore, we can discuss the four factors that affect the level of plastic waste and make a decision on how to reduce the amount of plastic waste in the future in accordance with the weight order obtained by the two methods above. The decision direction is as follows:
1) Reduce the world's Packing consumption and increase the ecological productivity of each region;
2) Properly increase the Resource Tax (except for the degradable renewable plastics industry that encourages development) and strive to increase the utilization rate in each region;
3) Reduce the world's Packing consumption and strive to increase the utilization rate;
4) The above methods are fully implemented (considering that it may be difficult to decline rapidly in five years in reality).

4.2 Grey prediction model predicts development trends and realizes visualization

The Grey Forecast Model (GM) is used to predict and visualize the trend of plastic waste changes in the above four decision directions (Figure 8).

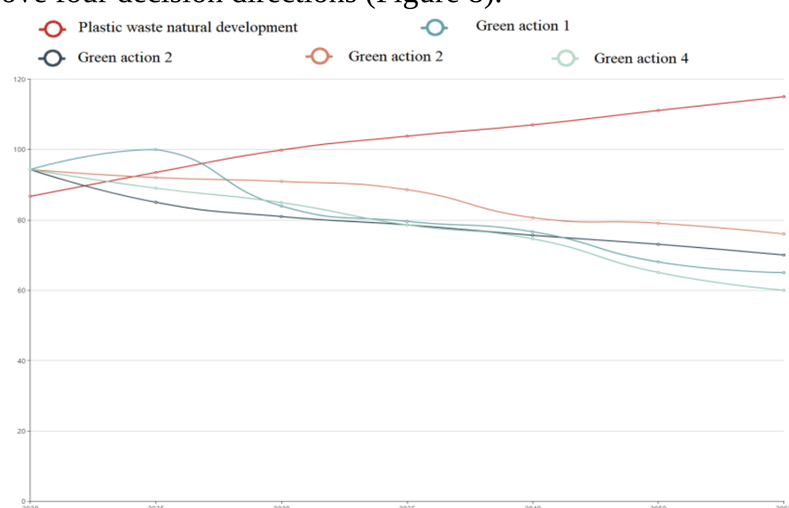


Figure 2 Changes in the amount of plastic waste under four decisions

From Figure 8, it can be seen that under the premise of assumptions, the four decisions are conducive to a significant reduction in the amount of plastic waste; if no measures are taken to allow its development, the amount of plastic waste will reach about 11,000 Million metric tons in 2050. According to the gray prediction, The fourth decision may cause the amount of plastic waste to rise at a low rate and then continue to decline in the short term, which is more in line with realistic development. The detailed results are shown in Table 6.

Table 6 Impact of four decisions

name	Packing	Resource Tax	utilizatio n rate	Ecological productivity	Total 2050 plastic waste	The degree of change
Green action 2	down	-	-	up	70	25.6%
Green action 3	-	up	up	-	76	19.2%
Green action 4	down	-	up	-	60	36.2%
Green action 1	down	up	up	up	65	30.9%

From Table 6, it can be seen that Greenaction1 and Greenaction4 can be reduced by 30.9%-36.2% after 30 years to meet the assumption of environmental safety level.

5. Solution to Task Three

Through the above "plastic waste green put option" model and discussion, we will reduce the original level by 30% to set the minimum possible level of global garbage for single-purpose or disposable plastic products. Plastic waste is reduced to 6.5 billion tons in 2050. The impact on the trillions of dollars in plastics industry at this point is shown in figure 8, based on grey forecasts. Overall evaluation: the degradable plastic industry will develop rapidly, from the original 3% of the entire plastic industry to about 68%, meaning that the world will accelerate the elimination of the one-time non-recyclable plastic industry.

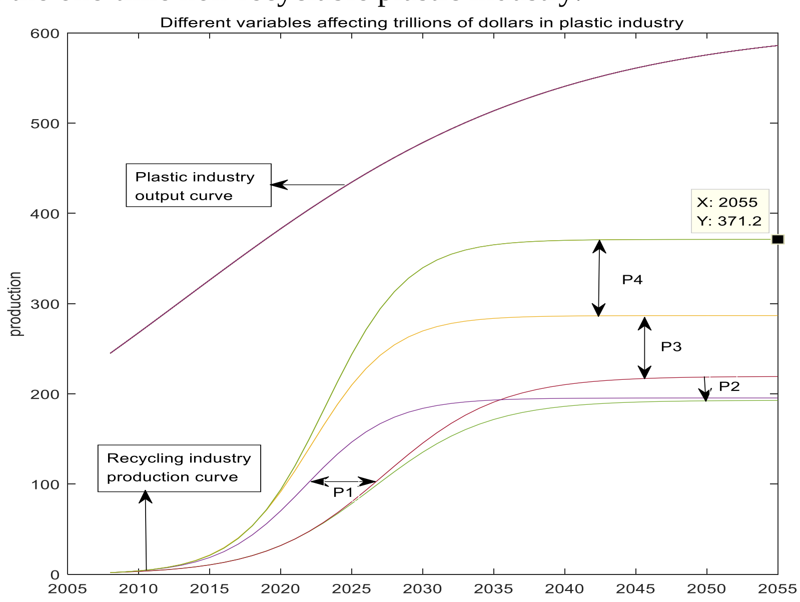


Figure 3 Grey prediction results

P1 indicates that reducing the resource tax and corporate income tax of the degradable plastic industry will accelerate the development of the industry for about 6 years;

P2 indicates that on the basis of p1, encouraging the development of high-tech degradable plastics industry and increasing the recyclability of plastics will increase the share of the degradable plastics industry in the entire plastics industry by about 8%;

P3 indicates that on the basis of p2, people in various regions increased their investment capital to purchase 'green puts', which can not only accelerate the development of the industry for about 10 years, but also increase its share of the entire plastics industry by about 30%;

P4 indicates that on the basis of p3, people in various regions actively increase their capital to buy 'green puts' and resist the non-recyclable one-time plastic industry, which can not only accelerate the development of the industry for about 10 years, but also make it account for the entire plastics industry Increase by about 30%.

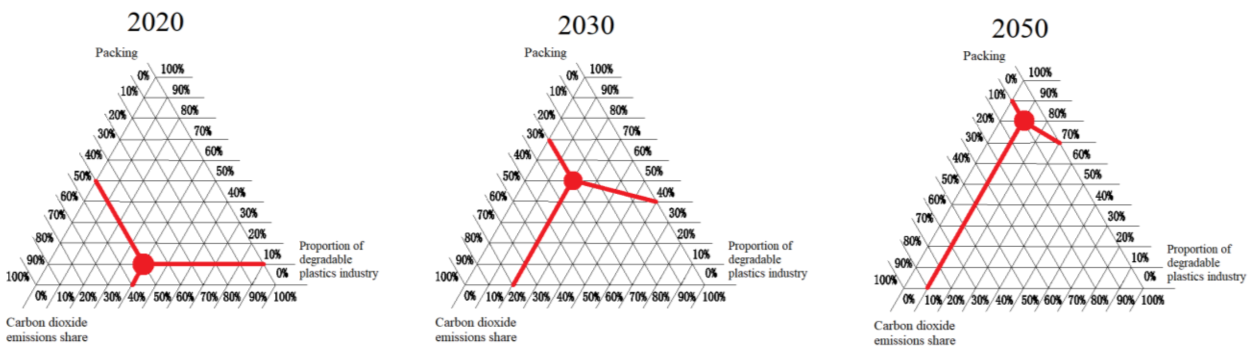
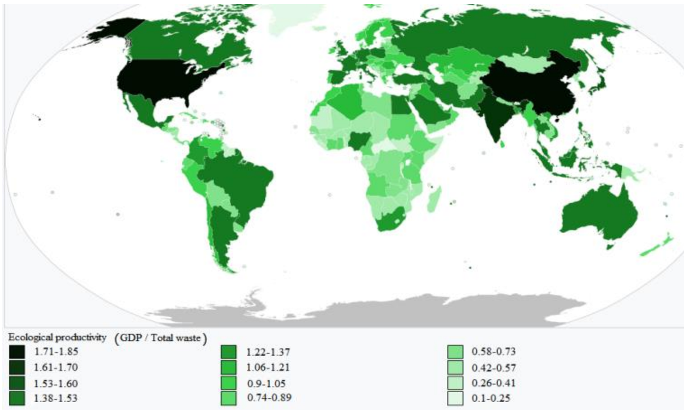


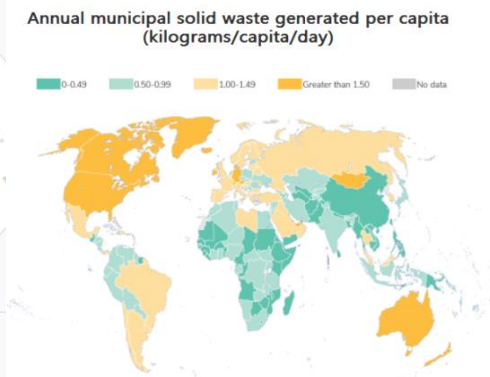
Figure 4 Triangular coordinate statistics

For the above conclusion, we take China as an example, and we can see the trend of the red dot keeping moving to the upper left by plotting the triangular coordinate statistics (Fig.9). This shows that the Chinese people are constantly reducing or even not using disposable non-recyclable plastic products, and the declining proportion of carbon emissions in China has made a great contribution to alleviating global warming, and China's degradable plastic industry is also developing rapidly.

6. Solution to Task Four

Although the growth of plastic waste is a global problem, its causes and effects are not exactly the same across regions. We start from the point of view of ecological productivity around the world, study and discuss the differences between regions, and then put forward corresponding suggestions.





10-1 10-2

Figure 5 Visualization of various indicators [13]

Table 7 Ecological productivity index values in each region

area	Ecological productivity
North America	1.75
South America	0.76
North Africa	0.35
South Africa	0.21
East Asia and Pacific	1.55
Europe	1.28
Australia	0.30
Middle-south Asia	1.06

From the perspective of the distribution of ecological productivity in the world (Figure 10-1) and the specific indicator values in various regions (Table 7), the indicators of developed countries are> 1.53, which meets high-level treatment of plastic waste; the indicators of most countries such as Central Asia and Africa are <0.9, It shows that there is not enough financial expenditure to guarantee the treatment of plastic waste. Excessive plastic waste accounts for 90% of marine debris, which "suffocates" the ocean. In 2016 alone, 242 million tons of plastic waste was generated worldwide, which is equivalent to about 24 trillion 500 mm 10-gram plastic bottles [13].

In addition to global trends, What a Waste 2.0 [13] also depicts the state of plastic waste management in each region. For example, waste generated in East Asia and the Pacific accounts for 23%, although they make up only 16% of the world's population; A total of 34% of waste is generated in high-income countries.

The per capita waste plastic waste output across the globe is shown in Figure 10-2. We expect that plastic waste will increase with economic development and population growth, so the waste output of lower-middle-income countries may see the largest increase. The regions are sub-Saharan Africa and South Asia, and the total waste generation in these regions is expected to triple to triple each year in 2050, accounting for 35% of the world's waste;

7.2 Recommendations

Due to the huge differences in ecological productivity between most regions in Africa and Central Asia compared with developed countries, we encourage developed countries to invest in several more green put options.Financers can establish special recycling plastics or high-tech degradable plastics in most regions in Africa and Central Asia. Industrial parks, thereby promoting local employment and changing the local environment while improving residents' living standards.

Combined with the conclusion of Question 1, we take the United States as an example to make recommendations to developed countries. Assume that plastic product consumption accounts for 5% of the average American household expenditure. According to formula (5), it can be obtained that if each U.S. citizen invests $ 587.75 a year to govern plastic Waste, then the best results can be achieved.

$$\begin{gathered}\text{Per capita household expenditure} * \text{Consumption of plastic products} * \\ \text{Buy Green Put Options Score} = \text{Annual per capita investment}\end{gathered} \tag{5}$$

7. Sensitivity Analysis of Logical Sty's Limited Growth Model

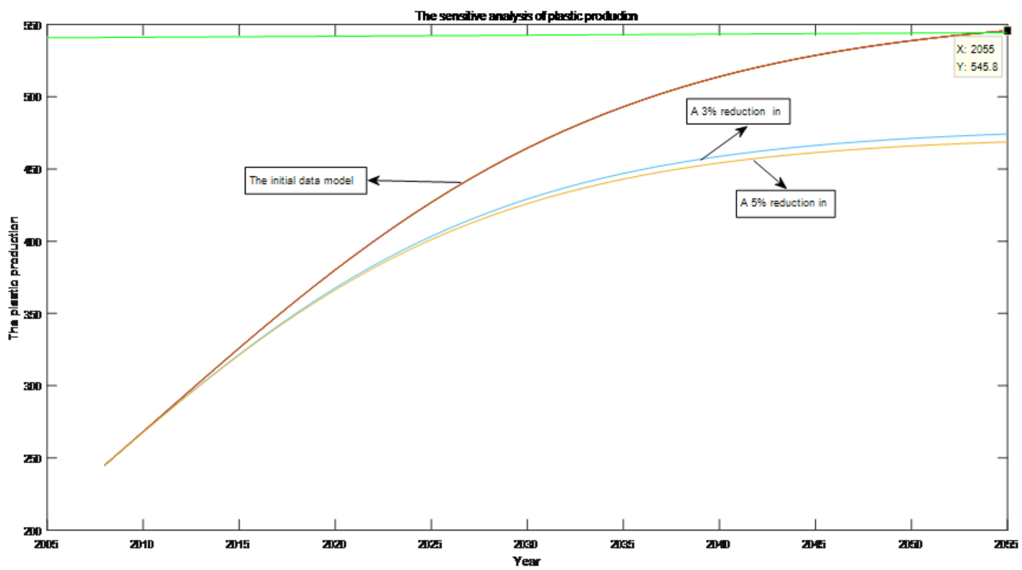


Figure 6 Production Sensitivity Analysis of Plastic Industry

Table 8 Sensitivity analysis results

Logistic growth model limited sensitivity analysis		
Name	Down 3%	Down 5%
The initial value 2020	91.47	89.40
Predictive value 2050	450	438
Sensitive coefficient	5.95	4.11

We analyze the sensitivity of the logical Sty finite growth model by Matlab, and get the table 8 and graph 8. It can be seen that the initial plastic industry output value (within 1%-3%) is more sensitive to the prediction of output in the next 30 years, and less sensitive when the reduction is 3%-5%.

8. Memo

TO : ICM
FROM : Our team
Date : February 17th，2020
Subject： Report on global goals and measures to reduce plastic waste

Using an Echartsjs drawing based on a grey prediction model, we draw a trend map of plastic waste and carbon dioxide emissions (Figure 11),it is found that the development trend of the two is similar. Reducing plastic waste is therefore a global goal and significant.

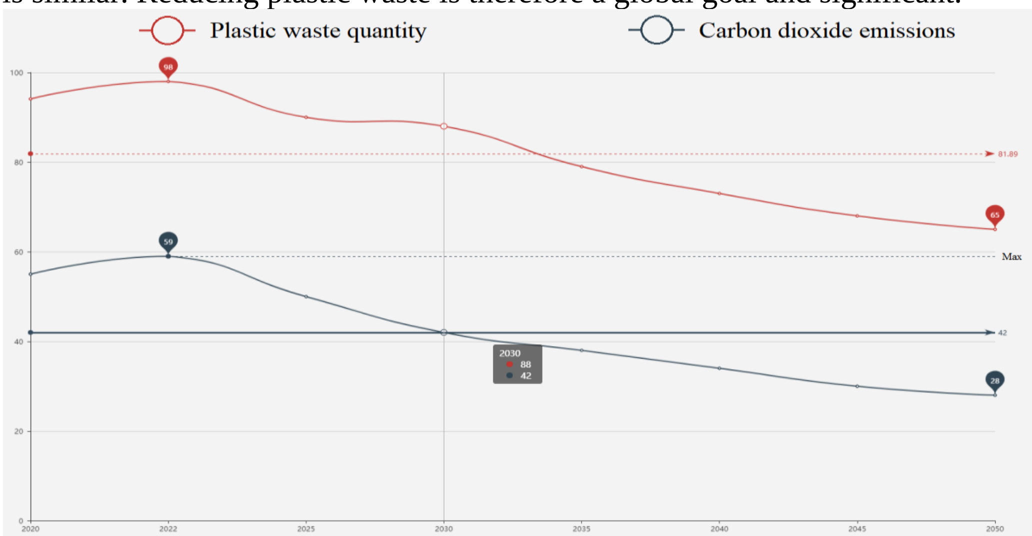


Figure 7 Tendency chart

According to our conclusion, we reduce the global total plastic waste to 6.5 billion tons as a achievable global goal. To split the target, we set out the following detailed objectives:
Goal 1: A ceiling of 10 billion tons to allow a slow increase in plastic waste within two years;
Goal 2: Increase the proportion of plastic waste that can be recycled;
Target 3: A marked downward trend in the volume of plastic waste within 2022-2050;
Goal 4: By 2050, global plastic waste will be reduced to about 6.5 billion tons and carbon emissions to about 28 billion tons [14].

In order to achieve this goal, we give the following measures, based on the actual situation and the conclusions already reached:
Measure 1: Starting in 2020 to curb the rapid growth of plastic waste;
Measure 2: Strengthen the research and development of substitute products and plastic degradation process;
Measure 3: prohibit or restrict the production of non-degradable plastic products and disposable plastic products;
Measure 4: Promote green products, strengthen the publicity of plastic pollution, and raise the awareness of the whole people；
Measure 5:In the early stage of the increasing resource (in addition to encourage the development of biodegradable plastics industry), the late mature biodegradable plastics industry development in the callback rate.

To sum up, we set targets for plastic waste on the next 30 years on all continents (Table 9),and give the time plan for the next 30 years (figure 13).

Table 9 The next 30 years the global continents target value of plastic wastes (one hundred million tons)

Region	2020	2022	2025	2030	2035	2040	2045	2050
North America	13.174	13.72	12.6	12.32	11.06	10.22	9.52	9.1
South America	10.351	10.78	9.9	9.68	8.69	8.03	7.48	7.15
North Africa	5.646	5.88	5.4	5.28	4.74	4.38	4.08	3.9
South Africa	8.469	8.82	8.1	7.92	7.11	6.57	6.12	5.85
East Asia and Pacific	21.643	22.54	20.7	20.24	18.17	16.79	15.64	14.95
Europe	18.82	18.82	18.82	18.82	18.82	18.82	18.82	18.82
Australia	6.587	6.86	6.3	6.16	5.53	5.11	4.76	4.55
Middle-south Asia	9.41	9.8	9	8.8	7.9	7.3	6.8	6.5
The world average	11.7625	12.25	11.25	11	9.875	9.125	8.5	8.125

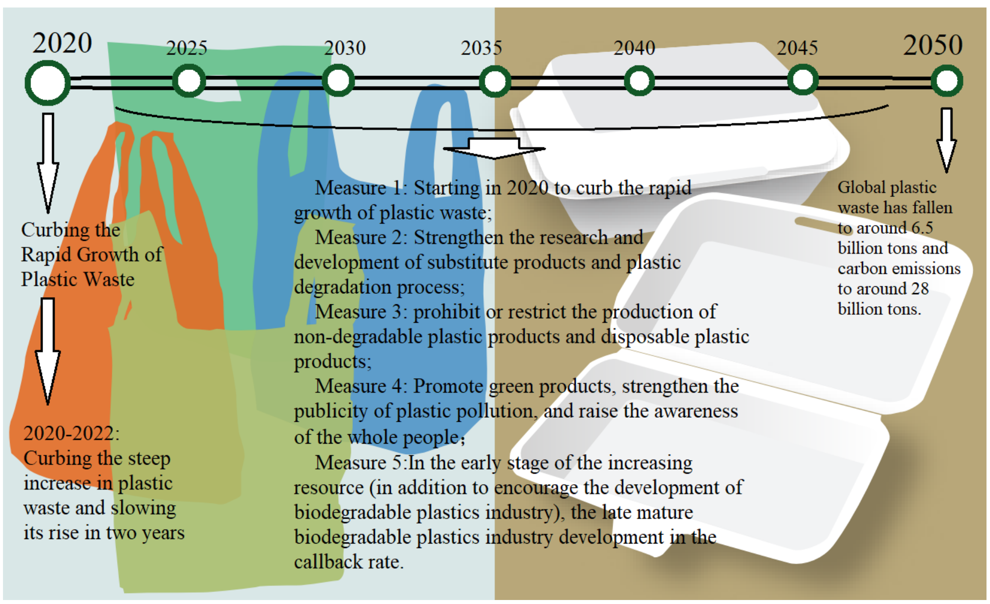


Figure 8 Time Plan

9. Model Evaluation

9.1 merit

1. The principle of the "green put option model" for plastic waste is derived from the financial management in accounting, and the improvement on the basis of the original model meets the innovation requirements.
2. On the basis of AHP and entropy weight method, it is logical to use grey forecasting model to predict the total amount of plastic waste in the next 30 years.

3. The model is innovative and easy to understand, and the prediction of the minimum value of environmental safety level is more realistic.

9.2 shortcoming

1. The model's assumption of 2020 as the maximum level of plastic waste is somewhat difficult to implement quickly in reality, although the two-year buffer period has been considered in the later period, but there are still many practical factors that are not considered;
2. Different economic strength in different regions, the strength of the purchase of green options may lead to delays in the target.

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