DOI: 10.23977/pree.2024.050209
ISSN 2616-2253 Vol. 5 Num. 2

Financing Efficiency Evaluation of Environmental Protection Business Economy Green Industry Oriented to Sustainable Development

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Keywords: Green Industry Financing, Sustainable Development, Co-evolutionary Genetic Algorithm, Genetic Algorithm, Elite Optimization Objective Function

Abstract: With the intensification of global environmental pollution, the economies of various countries are also affected. In this case, green industry came into being. Green industries can not only produce social benefits, but also protect the ecological environment. Green industry is the future economic development trend of various countries. However, the green industry would also encounter various operational problems, such as the source of corporate funds, the utilization efficiency of corporate funds and so on. In view of the above problems, this paper conducted data analysis and research on green industry financing from the perspective of sustainable development. The research results showed that: under the grid-connected operation mode, the comprehensive cost of co-evolutionary genetic algorithm (CGA) on typical days in summer and winter was 332.4 and 73.73 lower than that of genetic algorithm (GA), respectively; in the isolated network operation mode, the comprehensive cost of CGA on a typical day in summer was 28.11 lower than that of GA; CGA helped to reduce comprehensive costs and improve efficiency, which helped to improve the financing efficiency of green industries.

1. Introduction

With the gradual expansion of green industry, many scholars conduct research on green industry. Scholar Wu T studied the asymmetric duopoly model of competitive supply chains with financing risks, and the financing risks of green supply chain capacity investment can be provided to traditional supply chains as complete or incomplete information [1]. Schinas O devised a pay-as-you-go financing model that promoted the development of green technologies [2]. Ross H H introduced the sequential preference combination technique based on the interaction of different technical measures such as ship age, size, propulsion, speed and consumption, and the policy benchmark of the energy efficiency design index [3]. Henderson C studied the shipping industry as a major contributor to harmful air pollution, accounting for an estimated 2.5% of global greenhouse gas emissions. In the global market, however, ocean shipping is seen as a reliable and cost-effective way to transport goods [4]. Yuan Q had established a comprehensive index system including economic growth, social stability and environmental friendliness based on the actual needs of China's green industry development and the United Nations Sustainable Development Goals [5]. These studies have analyzed the financing of environmental protection business economy and green industry from various aspects, and have continuously improved the financing efficiency of environmental protection business economy and green industry. However, these studies only stay at the theoretical level, and do not conduct in-depth and high-dimensional analysis, so it is difficult to discover its essence. Therefore, it is necessary to study and analyze the financing of environmental protection business, economy and green industry from other dimensions.

In response to the above problems, this paper studied green industry financing from the perspective of sustainable development, which has long been widely used in other fields. The improved universal health coverage measures by scholar Fullman N provided the basis for monitoring the expansion of health services needed to achieve the Sustainable Development Goals [6]. Broman G I proposed a unified strategic sustainable development framework [7]. Stafford-Smith M believed that it is necessary to pay more attention to the linkages between the three fields of cross-sectoral, cross-social actors, and low-income groups, and drew on the concept of global sustainable development for practice [8]. Feris L attempted to analyze good governance decisions in an environmental context by understanding and explaining the relationship between good environmental governance and sustainable development in South Africa [9]. Franca C L proposed a business model design method for strategic sustainable development. This approach linked an organization's sustainable vision, strategy and business model [10]. These studies have shown the application of the concept of sustainable development in many fields, but most of them are applied to national development, and there is a lack of research and analysis on green industry financing. Therefore, this paper evaluated and analyzed the financing efficiency of environmental protection business economy and green industry from the perspective of sustainable development, and provided a theoretical direction for its subsequent development and laid the foundation for future practical applications.

The research on green industry financing in this paper was mainly based on the perspective of sustainable development. It explored the composition and development of green industry financing from a novel perspective, and explored more branches. In this paper, the dynamic economic dispatch analysis of the microgrid was carried out for the typical daily load data in summer and winter under two modes of grid-connected operation and isolated grid operation. The result is that the CGA algorithm was better than the GA algorithm. The innovations of this paper are: (1) the mathematical model of microgrid environmental protection and economic dispatch was used for analysis. (2) the CGA algorithm was used to study green industry financing.

2. Sustainable Development and Green Industry Financing

2.1 Sustainable Development

Sustainable development mainly emphasizes that people must take into account the social environment when pursuing economic development, so that enterprises and society can coexist harmoniously and maintain the sustainable development of enterprises [11]. Even though it was originally proposed for the environment, its subsequent development has become one of the main national development strategic goals to ensure the harmonious coexistence of multiple perspectives. Specifically, the content of sustainable development theory includes the aspects shown in Figure 1.

(1) Sustainable economic development

Enterprise is the main carrier of market economy. Sustainable development is the benign interaction between the economy and society, promoting the sound development of both. At the same time, special emphasis is placed on the quality of economic development. That is to say, while pursuing economic development, it is necessary to abandon the traditional high-energy-consuming development model and instead advocate a low-energy-consuming and clean environment-friendly development model. In this way, both development and environmental protection are taken into account to ensure the quality and quantity of development [12].

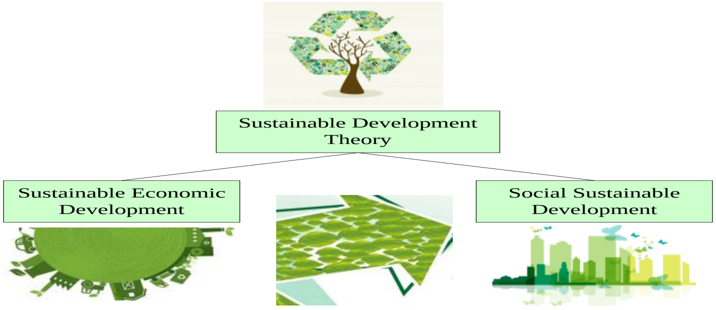


Figure 1: Sustainability theory

(2) Sustainable social development

The goal of enterprise sustainable development is to coordinate the relationship between the enterprise's own development and the society. The benign and sustainable development of an enterprise is closely related to the social environment. Therefore, the sustainable development of an enterprise should emphasize that it actively fulfills its social responsibilities to stakeholders such as the government, creditors, internal employees and consumers in the process of development. This is not only the responsibility that the enterprise should pay, but also the basis for the sustainable development of the enterprise [13].

2.2 Microgrid Economic Scheduling

(1) Basic structure of microgrid

Whether the microgrid operates in the grid-connected mode or the island mode, the relationship among distributed power sources, energy storage devices, power generation and loads in the microgrid system is complex and there is a certain matching relationship. In order to realize the safe, economical, environmental protection and reliable operation of microgrids, it is necessary to carry out dynamic economic dispatching based on safety and environmental protection for each microgrid. The premise of dispatching is to understand the characteristics of micro-power and the basic structure of micro-grid [14]. The basic structure of micro-grid is shown in Figure 2.

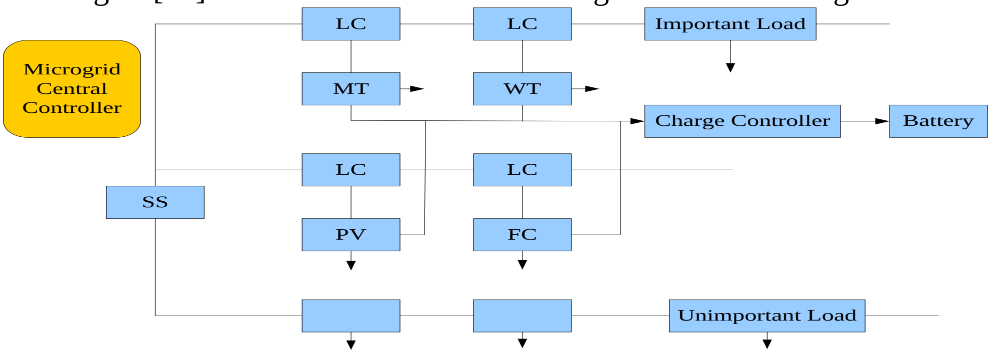


Figure 2: Basic structure of microgrid

(2) Mathematical model of microgrid environmental protection economic dispatch

According to different decision-making methods, microgrids are usually divided into centralized and decentralized control. Distributed control utilizes the "plug and play" function of distributed power, but the specific implementation is complicated; centralized control uses the idea of layered control of conventional power systems, which is easier to implement. The mathematical model of microgrid environmental protection and economic dispatch refers to the integration of the mathematical models of various micropower sources to form an overall optimization mathematical model of the microgrid, which is composed of objective functions and constraints [15].

Elite optimization objective function: the optimization objective function of the application is to minimize the integrated cost of the microgrid consisting of power generation costs, pollution emission control costs, load shedding costs, cooling and heating benefits of the cogeneration system, and power generation subsidies from renewable energy. The elite optimization objective functions are established as:

$$\min F(x) = [F_1(x), F_2(x), F_3(x)]^H \tag{1}$$

$$F_1[x] = \sum_{t=1}^{T} (B_F + B_{DEP} + B_{OM} + B_{Grid}) \tag{2}$$

$$F_2(x) = \sum_{t=1}^{T} B_E \tag{3}$$

$$F_3(x) = \sum_{t=1}^{T} (B_{buh} - B_{BBTP} - B_{AL}) \tag{4}$$

Among them, $F_1(x)$ is the cost of power generation, which includes fuel cost B_F, investment depreciation cost B_{DEP}, operation and maintenance cost B_{OM} and interaction cost B_{Grid} between the microgrid and the external grid, so as to maximize the profit of the microgrid itself.

$F_2(x)$ is the impact cost of pollutant emissions on the environment, and the utilization rate of energy is indirectly reflected in a certain social benefit; $F_3(x)$ is the cost of load shedding and partial income.

Among them, B_F is the fuel cost of each micro-source at time t, and B_{DEP} is the investment depreciation cost of each micro-source at time t. B_{OM} is the operation and maintenance cost of each micro-source at time t, and B_{Grid} is the profit obtained from purchasing power from the large power grid and selling it to the large power grid at time t. B_E is the environmental impact cost of each pollutant discharge at time t, and B_{buh} is the load shedding cost of users in the microgrid at time t. B_{BBTP} is the heating and cooling income of the cogeneration system at time t, and B_{AL} is the power generation subsidy of renewable energy at time t.

Power generation cost

Fuel consumption: wind and photovoltaic power generation utilizes non-polluting, renewable natural resources wind and solar power to generate electricity, which are inexhaustible and inexhaustible, without the cost of fuel. Only the power generation units such as micro gas turbines, fuel cells and boilers need to consume fossil fuel energy to generate electricity, but the fuel cost needs to be calculated:

$$B_{fuel,j} = \sum_{j=1}^{T} K_{fuel,j} \cdot P_j^h \tag{5}$$

In Formula (5), $K_{fuel,j}$ is the fuel coefficient of the j-th micro-power supply, and P_j^h is the power generation of the j-th micro-power supply at time h.

Depreciation expense for unit B_{DEP}:

$$B_{DEP} = \sum_{j=1}^{n}\left(\frac{B_j}{8760}\cdot\frac{\alpha(1+\alpha)^{year}}{(1+\alpha)^{year}-1}\cdot P_{jT}\right) \tag{6}$$

Operation and maintenance cost B_{OM}: the operation and maintenance cost of the micro power supply is a linear function related to the output electric energy or thermal energy of the unit [16], then there are:

$$B_{OM} = \sum_{j=1}^{n} P_j^h \cdot K_{\mathrm{om},j} \tag{7}$$

Electricity purchase cost or electricity sale profit B_{Grid}:

$$B_{Grid} = B_{buy}^h \cdot \max\left(P_{Grid}^h, 0\right) + B_{sell}^h \cdot \max\left(P_{Grid}^t, 0\right) \tag{8}$$

Pollutant emission cost

According to the power generated by each micro power supply, the category of pollutant emissions can be obtained. Then, according to the value standard of various pollutants and the magnitude of the fine, the impact cost on the environment is calculated, and the calculation is:

$$B_E = K_{emission,j} \times R_{emission} \times P_{gen,j} \tag{9}$$

In Formula (9), $K_{emission,j}$ is the emission coefficient of the j-th distributed power generation device, and $R_{emission}$ is the price of greenhouse gas emissions.

The treatment cost of the main pollutants emitted by each distributed power source are comprehensively considered, and Formula (9) can also be expressed as:

$$F_2(x) = \sum_{j=1}^{T} B_K \gamma_{jk}\left(P_{jh}\right) + B_K \gamma_{grid}\left(P_{grid}\right) \tag{10}$$

Among them, the environmental value standards of pollutants in the power industry and the order of magnitude of fines for major polluting gases are shown in Table 1 and Table 2, respectively. Table 3 shows the pollution emission data of various distributed power sources. In the current energy environment, the introduction of relevant standards and the imposition of appropriate fines are more conducive to promoting economic and environmental justice and fairness.

Table 1: Environmental value standards for pollutants in the power industry

Serial Number	Type	Standard
1	SO_2	0.76
2	NO_X	1.10
3	CO_2	0.002854
4	CO z	0.126

Table 2: Order of magnitude of fines for major polluting gases

Serial Number	Type	Magnitude
1	SO_2	14.523
2	NO_X	62.524
3	CO_2	3.35
4	CO	0.022

Load shedding charges and partial benefits

The formula for calculating load shedding costs is:

$$B_{cut} = B_{IN} \cdot P_{cut}^{h} \tag{11}$$

The calculation formula of the cooling and heating income of the cogeneration unit is:

$$B_{BBHP} = Q_{to} \cdot K_{pt} + Q_{bo} \cdot K_{pb} \tag{12}$$

The formula for calculating the power generation subsidy for renewable energy is:

$$B_{AL} = B_{al} \cdot \left(P_{PV}^{h} + P_{WT}^{h}\right) \tag{13}$$

Table 3: Pollution emission data of various distributed power sources

Exhaust Emissions	Micro Gas Turbine	Internal Combustion Engine (Gas)	Internal Combustion Engine (Diesel Fuel)	Fuel Battery
NO_X	0.6122	4.8526	4.3252	0.024
CO_2	185.0235	170.5246	233.5245	636.5241
CO	0.1752	1.2321	2.5234	0.05247
SO_2	0.000952	0.02352	0.4257	0

Group optimization objective function

According to the electricity purchase and sale prices of the microgrid during peak, flat and valley periods, a virtual charging and discharging price is given to the battery, that is, the virtual discharging cost and charging profit. The group optimization objective function of discharge penalty and charging reward is established, which is applied to the process of finding the optimal individual from the group [17]:

$$\min F'(x) = \min F(x) + B_{CS} P_{CS}^{h} \tag{14}$$

It corresponds to the electricity purchase/sale electricity price of the microgrid during peak, flat and valley periods that the virtual charge/discharge electricity price of the battery is shown in Table 4.

Table 4: Purchase/sale electricity price and virtual charge/discharge electricity price

Internet Price				Battery Virtual Price			
Project	Peak	Flat	Valley	Project	Peak	Flat	Valley
Purchase Electricity	1.54	0.6	0.45	Virtual Discharge	0.55	1.4	1.23
Electricity Sales	1.25	0.52	0.35	Virtual Charging	0.35	0.70	1.11

(3) Microgrid economic scheduling based on CGA

GA requires that every possible solution to a problem be encoded as an individual. The pros and cons of each individual are evaluated and their fitness values are obtained. Finally, the optimal individual is selected from the population [18], and the process of GA is shown in Figure 3.

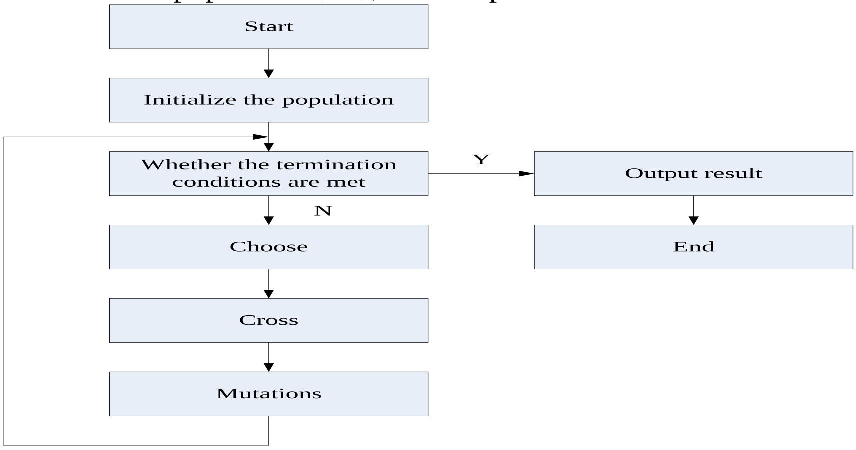


Figure 3: General flow of GA

There are various feedback mechanisms in nature, which are reflected between species and individuals within species, such as food chains, parasitism and symbiotic relationships. These together maintain the stability of nature. Mutual stimulation and common constraints among different species promote the evolution of species and promote ecological balance. This biological evolution phenomenon based on the relationship of the food chain and based on the symbiotic relationship is called co-evolution [19].

The idea of CGA can be used to deal with complex system evolution, one of which is shown in Figure 4.

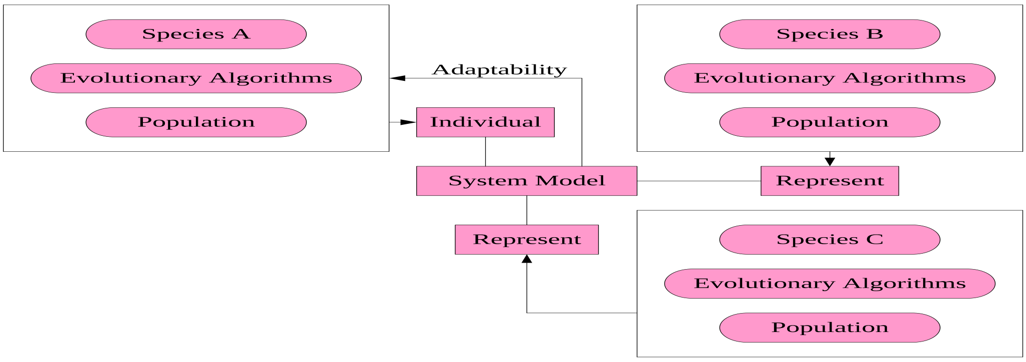


Figure 4: CGA framework

The comparison of CGA with conventional traditional algorithms is shown in Figure 5 and Figure 6.

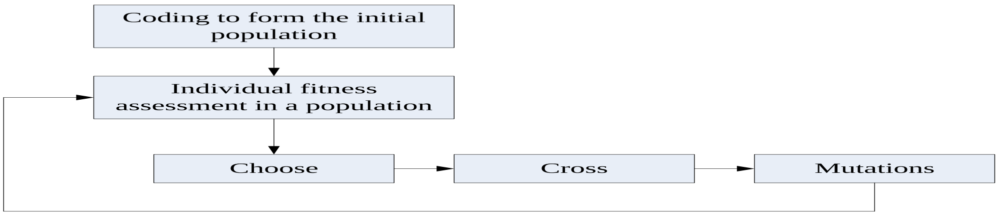


Figure 5: Conventional genetic algorithm

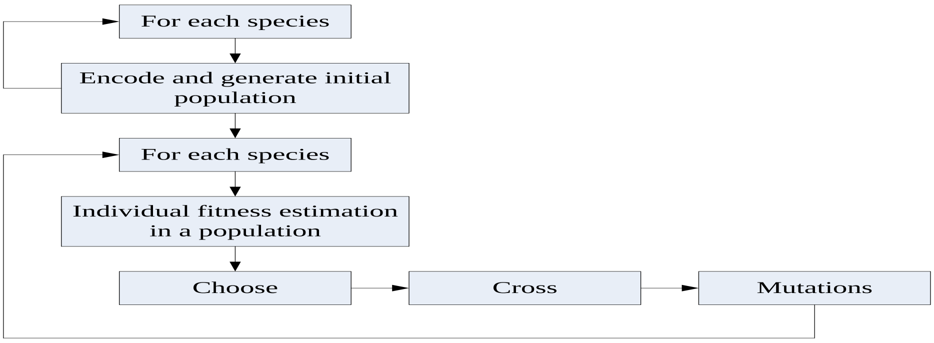


Figure 6: CGA

Environmental dynamic economic dispatch of microgrid based on CGA, the fitness evaluation function of individuals in the decision-making population, the fitness evaluation function of the penalty function population, the method of incorporating constraints into the objective function in the scheduling process, and the elite retention mechanism corresponding to the phased optimization objective function are all important. The flow chart of CGA in microgrid economic dispatch is shown in Figure 7.

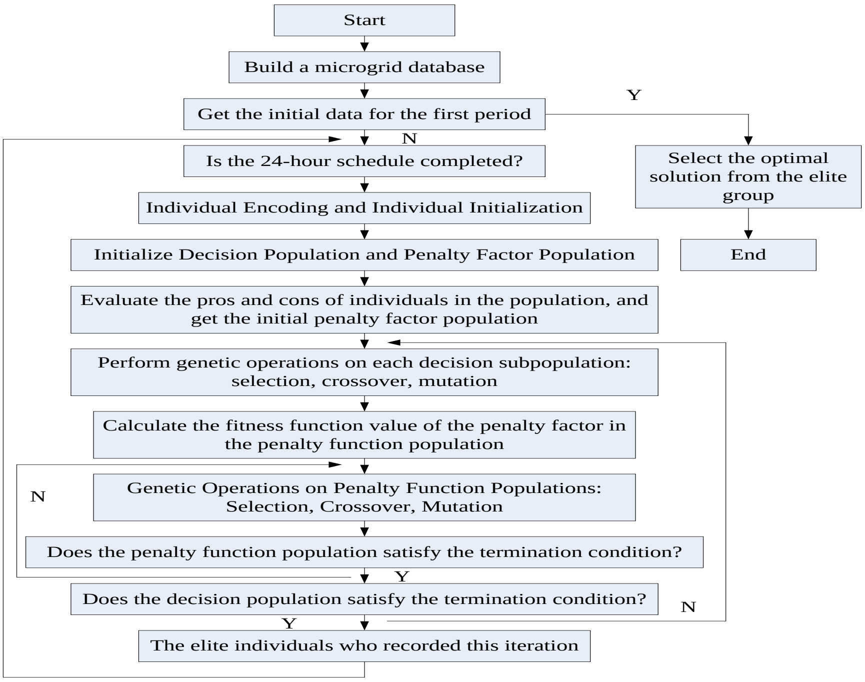


Figure 7: CGA flow chart

Formula (15) is used to evaluate the fitness function of individuals in the decision-making subpopulation, which considers both the function of the number of violations and the degree of violations.

$$adapt(x)=1/\left(f_j(x)+sum\cdot v_1+num\cdot v_2\right) \tag{15}$$

In Formula (15), $f_j(x)$ is the objective function, and in the group optimization, $f_j(x)=\min F'(x)$. $\min F'(x)$ is the group optimization objective function. In the elite optimization, $f_j(x)=\min F(x), \min F(x)$ are the group optimization and elite optimization objective functions respectively. v_1 and v_2 are the penalty factors corresponding to individual y_i in the penalty function population Y. num represents the number of violations of constraints by the individual, and sum represents the sum of the number of violations of constraints. The calculation formula is:

$$sum = \sum_{j=1}^{N} H_j(x) \qquad \forall H_j(x) \succ 0 \tag{16}$$

In Formula (16), N represents the total number of all constraints, and $H_j(x)$ is the degree of individual violation of constraints. Generally, the method of converting all equality constraints into inequality constraints and then calculating the amount of violation constraints is adopted.

Each individual y_i in the penalty function population Y represents a set of penalty factors v_1 and v_2. When the decision population X_j evolves for k generations, the penalty factor y_i can be evaluated. The fitness function of individual y_i in the penalty group Y is calculated in two cases:

If there is at least one feasible solution in X_j, then y_i is a valid individual, and the evaluation is as Formula (17):

$$P(y_i) = \frac{1}{num_{fit} + \sum_{j=1}^{num_{fit}} adapt_{fit}(x)} \tag{17}$$

In Formula (17), num_{fit} represents the number of feasible solutions in X_j, and $adapt_{fit}(x)$ represents the fitness function value of feasible solutions in X_j.

If there is no feasible solution in X_j, then y_i is an invalid individual. The evaluation function is:

$$P(y_i) = adapt_{\max}(x) + \frac{\sum sum}{\sum num} + \sum num \tag{18}$$

Among them, $adapt_{\max}(x)$ is the maximum fit value among all valid individuals in Y; $\sum sum$ is the sum of the number of individuals violating the constraint in X_j; $\sum num$ is the total number of individuals violating the constraint in X_j. The smaller the value of $\sum sum$ and $\sum num$, the smaller the value of $P(y_i)$, so that X_j is searched in the direction where the number of violations of constraints is small and the amount of violations is small.

When calculating $\sum sum$ by factoring the constraints into the objective function, normalize the violation for each constraint:

$$\sum sum = \sum_{j=1}^{N} \frac{H_j(x_i)}{H_{\max}(x_i)} \tag{19}$$

2.3 Green Industry Financing

(1) Definition of green industry

The most important thing in the definition of green industry is to determine some basic conditions of the industry, rather than simply delineate the scope. These basic conditions include but are not limited to: the final product is energy-saving, environmentally friendly, low-polluting, conducive to environmental protection and sustainable development; the production process and production technology are advanced, clean, energy-saving and efficient, and the production process is circular and low-emission; infrastructure construction and engineering construction follow the laws of nature and maintain the original ecological appearance; the production, living environment and people's quality of life are improved through high and new technology; the industries that provide policy consultation, technical design and other services for these industries are all green industries.

(2) Definition of environmental protection industry financing

The concept of green investment and financing was first proposed by Western environmental protection organizations. Western scholars generally refer to "green investment and financing" as "socially responsible investment and financing". Investment and financing of environmental protection industry includes two aspects, industrial investment and industrial financing, which are interrelated and inseparable. It refers to a social activity in which all relevant investment entities in the society invest funds in green environmental protection industries through various investment channels to improve the ecological environment, prevent environmental pollution, as well as protect the environment.

(3) Financing characteristics of environmental protection industry

The financing characteristics of the environmental protection industry are shown in Figure 8.

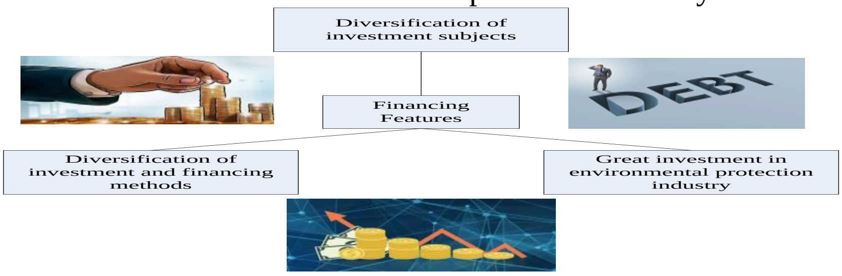


Figure 8: Financing Characteristics

First, investment subjects are diversified. For the development of the environmental protection industry, western developed countries generally take a variety of methods to solve the problem of "financing difficulties" in industrial development. They focus their attention on the market to the maximum extent, and allow the market to regulate itself without relying too much on government intervention. Western developed countries have different development models from China's environmental protection industry. In the process of development, they have gradually formed a diversified market structure that focuses on the market's own investment, while combining with the government and environmental protection organizations.

Second, investment and financing methods are diversified. For the financing of environmental protection enterprises, the most traditional way is to rely on the governments of various countries. However, in recent years, in some infrastructure construction projects, the private sector and commercial companies have also actively participated. At the same time, various financing means of cooperation between the government and the private sector have also emerged in the market. For example, due to the large amount of funds invested in some infrastructure projects, the government cannot bear the huge pressure of funds, and local taxpayers are unwilling to bear the cost of pollution control, which forces the government to create new financing methods.

Third, the investment in the environmental protection industry is huge. According to statistics, from 1995 to 2004, the cost of investment in environmental protection in western developed countries increased by an average of 14.5% annually. In the field of corporate investment in environmental protection products, the average annual investment had steadily increased, with an increase of 18.5%; while between the 1980s and 1990s, the growth rates of the two were only 10.3% and 11.8%. Among them, Germany was far ahead. In the past 10 years, the average annual growth of investment in the field of environmental protection can reach 25% [20].

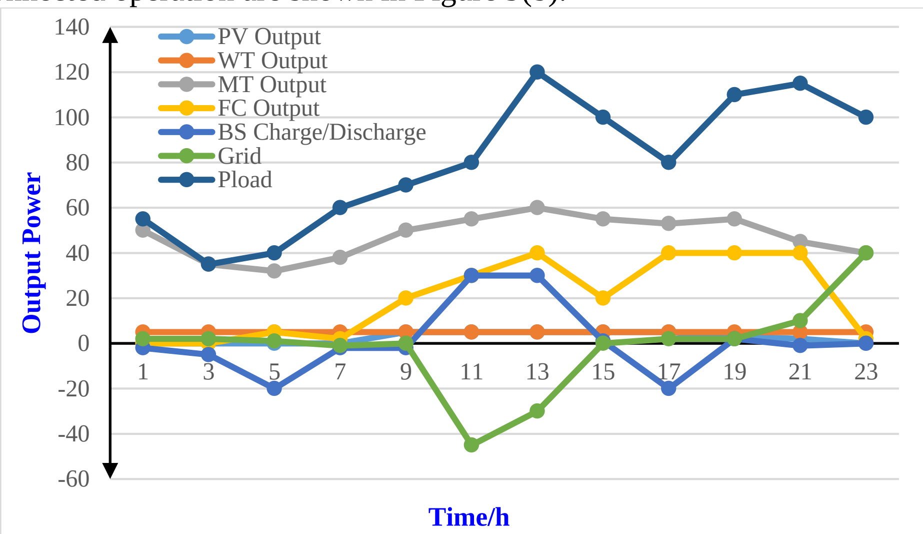
3. Experiments and Results of Green Industry Financing Efficiency

3.1 Sample data

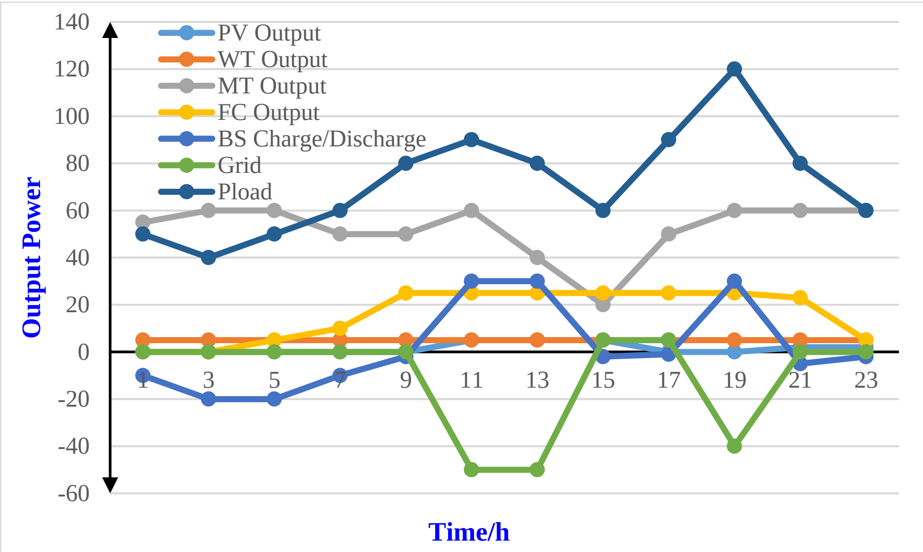
The economic dispatch of the microgrid is carried out by applying the equal weight method, and the same weight coefficients are assigned to the optimization indexes in the objective function of the microgrid. The power generation cost, pollutant emission cost, load shedding cost, heating and cooling revenue, and the comprehensive cost of renewable energy subsidies are taken as the objective function, and the co-evolutionary genetic algorithm is used for optimization to obtain the global minimum value. The dynamic economic dispatch analysis of the microgrid is carried out for the typical daily load data in summer and winter under grid-connected operation and isolated grid operation respectively.

3.2 Experimental results

Grid-connected operation mode: the algorithm proposed in this paper is used to optimize the scheduling of typical summer days in the grid-connected operation mode, and the output scheduling results during grid-connected operation are shown in Figure 9(a). Optimal scheduling is carried out on typical winter days in the grid-connected operation mode, and the output scheduling results during grid-connected operation are shown in Figure 9(b).



a. The output scheduling results of the microgrid system in summer



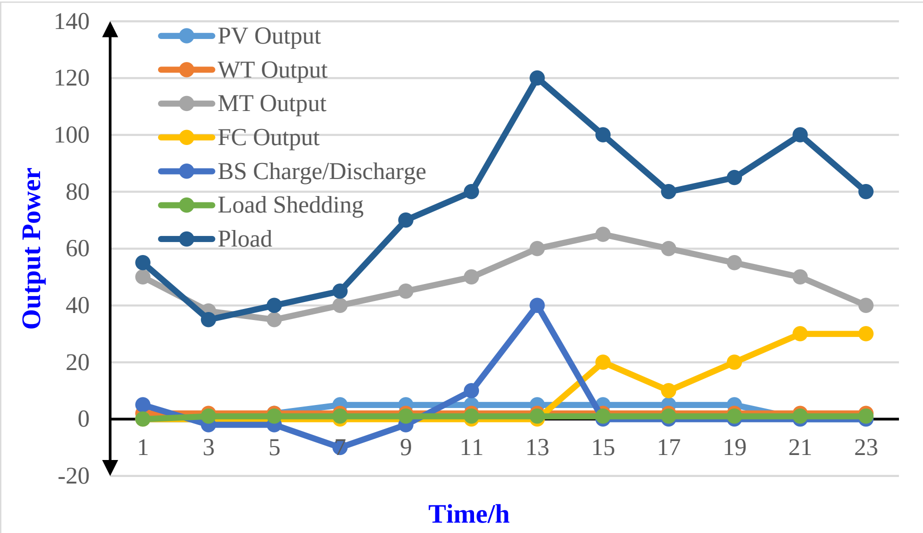
b. Output scheduling results of the microgrid system in winter

Figure 9: Comparison of output scheduling results of microgrid systems in summer and winter under grid-connected operation mode

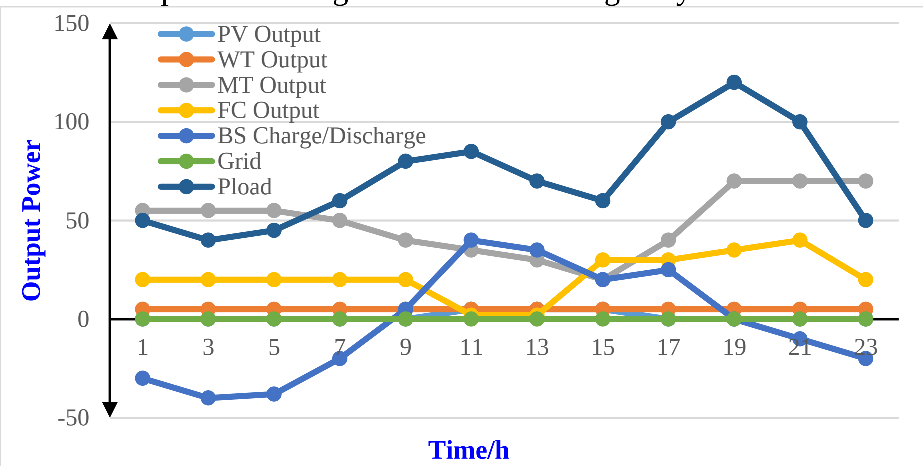
It can be concluded from Figure 9(a) that MT power generation first meets the cooling demand. When the battery is in the charging state and there is a power shortage in the valley and normal periods, the microgrid purchases electricity from the external network to meet the load demand. At 1:00, 3:00, 7:00-9:00, MT increases a little output on the basis of satisfying the cooling load, so as to ensure the economical basis to charge the battery, and FC also increases the output from 7:00. At 10:00-14:00, when the battery is fully discharged and the energy stored in the battery is fully released at 19:00-20:00, the FC output is increased to achieve power balance. At 12:00-14:00 and 18:00-22:00 FC output reaches the upper limit. At 1:00, 12:00, and 15:00, the MT increases output on the basis of meeting the cooling load to achieve power balance.

It can be concluded from Figure 9(b) that MT power generation first meets the heat load demand. During peak hours, the battery is discharged and the microgrid sells electricity to the external grid, and the output of the battery reaches the maximum during 10:00-14:00 and 18:00-19:00. During the 3 periods, the battery started to discharge at maximum power at 10:00. When the energy stored in the battery is almost completely discharged from 19:00 to 20:00, the MT increases the output on the basis of meeting the heat load demand. During the period from 9:00 to 20:00, MT increases output on the basis of meeting the thermal load to achieve power balance. During the period of 5:00-9:00, the output of FC increases, and the output of FC reaches the maximum during the period of 9:00-20:00.

Isolated network operation mode: the algorithm proposed in this paper is used to optimize the scheduling of typical summer days in the isolated network operation mode, and the output scheduling results in the isolated network are shown in Figure 10(a). The optimal scheduling is carried out on typical winter days in the isolated network operation mode, and the output scheduling results in the isolated network are shown in Figure 10(b).



a. The output scheduling results of the microgrid system in summer



b. The output scheduling results of the microgrid system in winter

Figure 10: Comparison of output scheduling results of microgrid systems in summer and winter under isolated grid operation mode

It can be concluded from Figure 10(a) that MT power generation first meets the cooling load demand. From 2:00 to 7:00, the PV and WT power generation is fully utilized, and the MT power generation can meet the cooling load demand. The output of PV, WT and MT is greater than the load demand, charging the battery. During 8:00-13:00, the battery is discharged to meet the load demand. From 14:00 to 24:00, the stored energy in the battery is almost exhausted, and the FC output is increased. When the load value is large, the MT output needs to be increased to maintain the power balance. At 20:00 and 22:00, the output of each micro-source reached the upper limit. The battery is fully discharged, but the load still cannot be balanced. Therefore, the load shedding operation is performed, and the non-critical loads of 1.23kW and 2.23kW are respectively removed.

It can be concluded from Figure 10(b) that MT power generation first meets the heat load demand. From 1:00-8:00 and 20:00-24:00, the PV and WT power generation is fully utilized, and the MT power generation can meet the heat load demand. The output of PV, WT and MT is greater than the load demand, the battery is charged. During normal times, the battery is discharged at 9:00 and 15:00-17:00, and charged at other times.

In the experiment, GA and CGA methods are used for environmental protection and economic dispatch of microgrid. The comparison of optimization results obtained by using GA and CGA algorithms in summer and winter respectively in grid-connected operation and isolated grid operation mode is shown in Table 5.

Table 5: Comparison of optimization results using GA and CGA algorithms

		GA		CGA	
		Summer	Winter	Summer	Winter
Grid-connected	Overall Costs	2858.75	1275.25	2526.35	1201.52
Isolated Network	Overall Costs	4313.25	5438.52	4285.14	5466.25

From the perspective of comprehensive cost, in the economic dispatch of microgrid on typical days in summer and typical days in winter under grid-connected operation and isolated grid operation, the comprehensive cost of using CGA is much lower while compared with using GA for environmental protection and economic dispatch of microgrid. From the optimal scheduling results of GA, it can be seen that GA makes the economic scheduling of microgrid easy to fall into the local optimal solution, while CGA can avoid this problem. It searches for the optimal solution globally and has better optimization results. Under grid-connected operation, the comprehensive cost of CGA on typical days in summer and winter is lower than GA332.4 and 73.73 respectively; under isolated grid operation, the comprehensive cost of CGA on typical days in summer is lower than GA28.11. The overall cost of using CGA is larger than that of GA on a typical winter day in the isolated network operation mode. However, this is not because CGA is worse than GA, but when using GA for environmental protection and economic dispatch of microgrids, some constraints are sacrificed to improve economy. The results has verified the superiority of CGA.

4. Conclusion

This paper studied the evaluation and analysis of financing efficiency of environmental protection business economy and green industry for sustainable development, which can provide a better foundation and method for the improvement and development of environmental protection business economy and green industry financing. In today's society, a series of negative impacts such as environmental pollution, resource depletion, and ecological damage caused by industrialization have attracted more and more attention, and the development of green industries has become a general consensus. However, people's understanding of green industry financing is not sufficient and comprehensive, and there are great limitations. This paper analyzed green industry financing from the perspective of sustainable development. Through scientific and higher-dimensional analysis methods, it studied how green industry enterprises choose financing methods and make good use of relevant funds to promote the improvement of business performance.

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