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Research on the evaluation method of the business model for the recycling of hazardous waste in power grid

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Abstract. Hazardous wastes in power grids include waste transformer oil and waste lead-acid batteries, etc. Due to the problems of extremely large number of points, wide distribution, and small number of units, coupled with differences in hazardous waste recycling technologies, policies, and markets in various regions, so Possible business models need to be listed and evaluated. This paper establishes an evaluation index system for the business model of hazardous waste recycling, and uses the TOPSIS method to evaluate five feasible business models. The evaluation results will help relevant departments of power grid companies at all levels to formulate recycling strategies according to the characteristics of hazardous waste recycling, so as to facilitate the recycling and reuse of hazardous wastes.

Keywords: Hazardous wastes recycling; Evaluation method; Business model; TOPSIS.

1. Introduction

As a key link in asset life cycle management, the rationality of grid hazardous waste disposal determines the overall cost and benefit of grid assets[1]. Today, with the continuous emergence of new technologies, the use of adaptive information technology to improve the existing management model has the advantages of realistic meaning[2]. In the process of power grid hazardous waste recycling, because power grid hazardous waste is characterized by a large amount, a wide range of aspects, the management and control is relatively difficult, and the disposal process and procedures are complicated, so the market competitiveness is poor, and the business model has been greatly improved. Require. In addition, due to scattered temporary storage sites for grid hazardous waste and inappropriate auction prices, recyclers are often reluctant to recycle and lose bids, resulting in a low rate of hazardous waste disposal by grid companies and overdue temporary storage.

Therefore, it is necessary to consider the characteristics of various types of hazardous waste recycling business models, and apply and promote them according to local conditions, so as to solve the problems existing in the recycling of hazardous wastes in various regions.

2. Business model options

2.1 Bidding mode

The bidding announcement for hazardous waste disposal will be published on the State Grid Co., Ltd. e-commerce platform by means of open bidding, and qualified recyclers who are interested in bidding will be invited to participate in the bidding.

2.2 Framework Agreement Mode

The provincial power grid material company comprehensively considers the business performance and recycling capacity of hazardous waste recyclers, selects enterprises with hazardous waste recycling qualifications, and after comprehensive evaluation by the bidding committee, uses entrustment or competitive negotiation to determine recyclers and related material disposal Unit

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price, sign an annual framework agreement with the recycler, within the term of the agreement, each unit regularly reports the disposal demand according to the application rules, and when the storage volume reaches the agreed limit, the material company will notify the recycler to centrally recycle at the agreed price.

2.3 Extended producer responsibility system

When bidding to purchase some hazardous wastes or related equipment, include recycling requirements in the initial technical specification, specify recycling conditions and cycles, clarify the recycling responsibilities of equipment suppliers, and require equipment suppliers to periodically or quantitatively recycle hazardous wastes and dispose of them in accordance with the law .

2.4 Self-utilization and disposal

The entire production line for recycling and reuse is built independently, and all the work is done by internal units.

2.5 Payment for disposal

Pay to a hazardous waste recycler with disposal qualifications and dispose of it for a fee. Considering the total amount of hazardous waste generated by power companies every year, some provincial companies are under great financial pressure by adopting payment disposal methods.

3. Index system of evaluation

According to actual analysis, literature research, preliminary screening and expert evaluation, the evaluation index system of the business model of hazardous waste recycling and reuse is finally determined. Among them, multiple second-level indicators are set under each first-level indicator, so as to establish the evaluation indicators of the business model of hazardous waste recycling and reuse from multiple dimensions, in order to make a more accurate and objective overall business model of hazardous waste recycling and reuse. evaluate.

3.1 Profitability

Profitability refers to the ability of a power grid enterprise to make a profit within specific time period. Profitability is the most direct and basic indicator for evaluating a company's profitability, and it is also the premise for analyzing and evaluating the quality of a company's profitability. Good profitability is the internal driving force and source of the company's continuous operation, and it is the basic guarantee for obtaining high-quality profitability. In this paper, the profitability of the hazardous waste recycling business and the return on net assets are selected to measure the profitability of the business model.

①Recycling business profit margin

Main business profit rate = main business profit / main business income × 100%

② Return on net assets

Return on net assets = net profit / (net assets at the beginning of the year + net assets at the end of the year) / 2 × 100%

③Sales net profit margin

Net sales profit ratio = company net profit / net sales × 100%

④Market share

Market share = company sales / total market sales × 100%

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3.2 Operational capability

The quality of a power grid enterprise operation directly determines the use of the company's existing capital and the prospect of future capital expansion. This paper selects the total asset turnover rate, asset return rate and channel channel to measure the company's operating ability.

①Total asset turnover rate

Turnover rate of total assets = net operating income / total average assets × 100%

② Return on assets

Return on total assets-net profit before interest and tax / average total assets × 100%

③Channel access

Channel access is the channel for waste treatment companies to recycle and process solid waste to achieve their own revenue goals.

3.3 Growth ability

The growth ability of the power grid enterprise is the ability of the company to achieve business expansion and sustainable development through continuous expansion of scale, continuous innovation and reform on the basis of survival. Companies must achieve sustainable growth if they are to be competitive in the hazardous waste recycling market.

①Main business income growth rate

Main business income growth rate = (this period's main business income-last period's main business income) / last period's main business income × 100%

②Net profit growth rate

Net profit growth rate = net profit growth of the current year/ net profit of last year× 100%

③The growth rate of net assets

Net assets growth rate = (end net assets-beginning net assets) / beginning net assets × 100%

④Technological innovation ability

The technological innovation capability of the business model, that is, the ability to continuously provide valuable new theories, new methods and new inventions to all aspects of society during the application of the business model. Considering the public welfare of the business model of hazardous waste recycling, this value is not only reflected in commercial value, but also includes social value and ecological value.

3.4 Risk protection

At present, one of the management bottlenecks encountered by most hazardous waste service providers in the further development is how to obtain residual value from cutting corners and non-standard operations to fully exploit equipment, staff efficiency and improve service quality to improve economic performance.

① Pollutant discharge rate

Pollutant discharge amount = various pollutant discharge amount / ten thousand yuan income × 100%

②Comprehensive energy consumption rate

Comprehensive energy consumption rate = comprehensive energy consumption/10,000 yuan income × 100%

In summary, the business model evaluation system for the recovery and reuse of sulfur hexafluoride is obtained as shown in the following table

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Table.1 Evaluation system for business model of hazardous waste recovery and reuse

Primary indicators	Secondary indicators
Profitability	Recycling business profit margin
	Return on net assets
	Sales net profit margin
	Market share
Operational capability	Total asset turnover rate
	Return on assets
	Channel access
Growth ability	Main business income growth rate
	Net profit growth rate
	The growth rate of net assets
	Technological innovation ability
Risk protection	Pollutant discharge rate
	Comprehensive energy consumption rate

4. Index system of evaluation

There are many comprehensive evaluation methods in the evaluation of business model. In this paper, TOPSIS is introduced. According to the process of TOPSIS method, m targets and n attributes are needed in its calculation. After the j-th attribute of the i-th target to Xij were estimated and scored by expert group, which consists of a number of experts in related fields, and the initial judgment matrix V can be achieved[3,4].

$$V=\begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \ddots & & & x_{2n} \\ x_{i1} & & x_{ij} & & x_{in} \\ \vdots & & & & \\ x_{m1} & & & & x_{mn} \end{bmatrix} \tag{1}$$

Considering the fact that each indicator may have different dimensions, the decision matrix should be normalized in order to take the value of different indicators into comparison:

$$V'=\begin{bmatrix} x'_{11} & \cdots & x'_{1j} & \cdots & x'_{1n} \\ \vdots & \ddots & & & x'_{2n} \\ x'_{i1} & & x'_{ij} & & x'_{in} \\ \vdots & & & & \\ x'_{m1} & & & & x'_{mn} \end{bmatrix} \tag{2}$$

Where

$$x'_{ij}=\frac{x_{ij}}{\sum_{k=1}^{n} x_{ij}^2} \tag{3}$$

According to the value scored by the expert group, the information weight matrix B can be obtained. With a series of matrix transformation, the weighted judgment matrix Z can be thus formed. Then he positive and negative ideal solutions which refers to the best and worst value of each element in the evaluation target, are obtained.

$$Z=VB=\begin{bmatrix} f_{11} & \cdots & f_{1j} & \cdots & f_{1n} \\ \vdots & \ddots & & & f_{2n} \\ f_{i1} & & f_{ij} & & f_{in} \\ \vdots & & & & \\ f_{m1} & & & & f_{mn} \end{bmatrix} \tag{4}$$

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The positive ideal solution can be written as the equation below:

$$f^* = \max f_{ij}, j = 1,2,3..n \quad (5)$$

The difference between each value and the positive/negative ideal value is demonstrated by their Euclidean distance.

$$S_i^* = \sum_{j=j}^{m} \left(f_{ij} - f_j^* \right)^2, j = 1,2,3...n \quad (6)$$

After the Euclidean distances between all elements and the ideal solution are calculated, the evaluation results of the TOPSIS method can also be obtained.

5. Results of evaluation

After calculation, the sub-scores of the five types of hazardous waste recycling business models after normalized calculation are as follows:

Table.2 Five types of business model evaluation scores

	Secondary indicators	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5
Profitability	Recycling business profit margin	0.46	0.32	0.21	0.16	0.86
	Return on net assets	0.63	0.42	0.38	0.95	0.13
	Sales net profit margin	0.26	0.33	0.19	0.83	0.76
	Market share	0.45	0.26	0.05	0.23	0.82
Operational capability	Total asset turnover rate	0.53	0.65	0.85	0.22	0.09
	Net profit growth rate	0.38	0.19	0.77	0.81	0.32
	Channel access	0.41	0.26	0.63	0.26	0.08
Growth ability	Main business income growth rate	0.73	0.86	0.81	0.93	0.13
	Net profit growth rate	0.42	0.55	0.63	0.51	0.39
	The growth rate of net assets	0.36	0.27	0.54	0.81	0.73
	Technological innovation ability	0.31	0.38	0.57	0.76	0.68
Risk protection	Pollutant discharge rate	0.17	0.25	0.96	0.81	0.08
	Comprehensive energy consumption rate	0.53	0.67	0.92	0.43	0.68

After standardized calculation and Euclidean distance calculation, the scores are as follows

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Table.3 Five types of business model evaluation scores

	Secondary indicators	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5
Profitability	Recycling business profit margin	0.1837	0.0522	0.0051	0.0000	1.0000
	Return on net assets	0.3718	0.1251	0.0930	1.0000	0.0000
	Sales net profit margin	0.0120	0.0479	0.0000	1.0000	0.7932
	Market share	0.2699	0.0744	0.0000	0.0546	1.0000
Operational capability	Total asset turnover rate	0.3352	0.5429	1.0000	0.0293	0.0000
	Net profit growth rate	0.0939	0.0000	0.8751	1.0000	0.0440
	Channel access	0.3600	0.1071	1.0000	0.1071	0.0000
Growth ability	Main business income growth rate	0.5625	0.8327	0.7225	1.0000	0.0000
	Net profit growth rate	0.0156	0.4444	1.0000	0.2500	0.0000
	The growth rate of net assets	0.0278	0.0000	0.2500	1.0000	0.7257
	Technological innovation ability	0.0000	0.0242	0.3338	1.0000	0.6760
Risk protection	Pollutant discharge rate	0.0105	0.0373	1.0000	0.6881	0.0000
	Comprehensive energy consumption rate	0.0416	0.2399	1.0000	0.0000	0.2603

After calculation and integration, the scores are as follows:

Table.3 Overall business model evaluation and sub-item scores

	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5
Profitability	0.915	0.547	0.313	1.433	1.671
Operational capability	1.163	1.218	1.897	1.462	0.210
Growth ability	0.232	0.711	1.607	1.714	1.184
Risk protection	0.342	0.707	1.414	0.000	0.656
Overall score	2.482	2.460	2.898	2.844	2.518

6. Conclusion

It is not difficult to see from the calculation results that it is the most ideal way to promote the extended producer responsibility system at the current stage, and its main advantages are reflected in risk protection and operational capabilities. With the promotion of the extended producer responsibility system, the risk of hazardous waste recycling and reuse is fully borne by the producers, and considering that manufacturers often have more advanced and efficient recycling technology, it is necessary to support this method from the policy level.

From the perspective of profitability, the profitability of paid disposal and utilization is the strongest. Obviously, this method does not require any up-front investment, and only needs to be properly screened for service providers. However, its negative impact is that in the process of paying for disposal, some service providers may give up some hazardous waste disposal compliance in order to save costs, which may cause environmental risks. From the perspective of growth ability, self-utilization and disposal has the strongest growth ability, because the production lines are built by themselves, and their products and scales have high autonomy, so it is hoped to incubate a better business model. However, the consequence of consolidating the production line is that the risk of its recycling is completely retained within the enterprise, so it needs to face more stringent environmental impact assessment and production process assessment.

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