Study of the development countermeasures for Hebei province photovoltaic power generation enterprise Based on the cost-benefit analysis[1]

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Abstract. Uses cost-benefit analysis theory, combined with analytic hierarchy process, set up the cost benefit analysis index system for hebei province, Quantitative study the present situation and problems of photovoltaic power generation enterprises in hebei, then put forward the development countermeasures, which can make Hebei find suitable mode for their own photovoltaic development according to their characteristics.

Introduction

The contradiction between economic-social development and sustainable energy bearing capacity in Hebei province is outstanding. As clean energy, photovoltaic power generation industry has important strategic significance and economic support effect for Hebei. However, the photovoltaic power generation in Hebei is facing many problems, such as the high investment cost、 technology does not pass、 PV grid-connected. So, it is necessary from the cost-benefit analysis to make a more comprehensive and objective benefit evaluation. Use monetary value to reflect the indirect cost benefits can give full play to its important role in adjusting energy structure、 optimization of the economic development mode and environmental protection in Hebei province.

Set up the cost-benefit analysis index system for photovoltaic power generation enterprises in Hebei province

Now, the PV power generation in Hebei have begin to take shape, But in face of increasingly fierce foreign trade protectionism and deficiency of effective demand in the domestic market, it must find the suitable development road. Dividing the index system into cost、 benefit two aspects, cost divided into initial investment cost, annual operation cost two son index, benefits divided into financial benefit, strategic benefit and external influence three son index. Further subdivision indexes are screened according to the principle of importance and simplification, index selection results are shown below.

Evaluation the development of photovoltaic power generation enterprises in Hebei province using AHP

Set the hierarchical structure model

According to the theories of AHP, the cost-benefit analysis index system for PV power generation enterprises in Hebei is divided into three layers, which is shown in Table1:[1]

Table 1: The multilevel hierarchic structure model

Target		Criterion layer(B)	Scheme layer(C)

layer(A)			
Hebei		Initial investment cost (B1) (0.0673) (RC=0.0079)	Analysis/design of costC11(0.0363)
			Implementation cost C12(0.0110)
photovoltaic			Management expensesC13(0.0200)
	cost	Annual operation cost (B2) (0.1069) (RC=0.0462)	Operation cost C21(0.0564)
power			Maintenance cost C22(0.0355)
			Operation management cost C23(0.0149)
generation		Financial benefit (B3) (0.1332) (RC=0.0462)	Reducing the operation cost C31(0.0186)
			Improve work efficiency C32(0.0703)
enterprise			Sales profit increase C33(0.0443)
		Strategic benefit (B4) (0.2889) (RC=0.0966)	Enterprise credit to improve C41(0.0215)
cost			Management level to improve C42(0. 0267)
	benefit		Technology capability to improveC43(0. 1148)
benefit			Core competitive capability to improveC44(0. 0476)
			Foreign cooperation capability to improveC45(0. 0783)
(A)		External influence (B5) (0.4037) (RC=0.0079)	Reduce energy consumption C51(0. 2178)
			Technology demonstration C52(0. 1199)
(RC=0.0919)			Environmental protectionC53(0.0660)

Structure the judgment matrix

Through expert investigation method, judge between various factors relative importance, Saaty scale meaning table is shown in table 2, the judgment matrix is shown in figure 1 below:

Table 2 Saaty scale meaning table

1	Factor y_i and y_j compared, they have the same importance
3	Factor y_i and y_j compared, the former slightly important than the latter
5	Factor y_i and y_j compared, the former obvious important than the latter
7	Factor y_i and y_j compared, the former strong important than the latter
9	Factor y_i and y_j compared, the former extremely important than the latter
2 4 6 8	The middle value of the adjacent judgment above
reciprocal	If the rate of importance between factor y_i and y_j is a_{ij}, then, the rate of importance between factor y_j and y_i is $a_{ji} = 1 / a_{ij}$

$$A1=\begin{bmatrix} 1 & 1/3 & 1/3 & 1/3 & 1/3 \\ 3 & 1 & 1/2 & 1/3 & 1/4 \\ 3 & 2 & 1 & 1/4 & 1/4 \\ 3 & 3 & 4 & 1 & 1/2 \\ 3 & 4 & 4 & 2 & 1 \end{bmatrix} \quad B1=\begin{bmatrix} 1 & 3 & 2 \\ 1/3 & 1 & 1/2 \\ 1/2 & 2 & 1 \end{bmatrix} \quad B2=\begin{bmatrix} 1 & 2 & 3 \\ 1/2 & 1 & 3 \\ 1/3 & 1/3 & 1 \end{bmatrix}$$

$$B3=\begin{bmatrix} 1 & 1/3 & 1/3 \\ 3 & 1 & 2 \\ 3 & 1/2 & 1 \end{bmatrix} \quad B4=\begin{bmatrix} 1 & 1/2 & 1/3 & 1/3 & 1/3 \\ 2 & 1 & 1/3 & 1/3 & 1/4 \\ 3 & 3 & 1 & 3 & 3 \\ 3 & 3 & 1/3 & 1 & 1/3 \\ 3 & 4 & 1/3 & 3 & 1 \end{bmatrix} \quad B5=\begin{bmatrix} 1 & 2 & 3 \\ 1/2 & 1 & 2 \\ 1/3 & 1/2 & 1 \end{bmatrix}$$

Fig.1 The judgment matrix

Calculate weight and examine consistency

According to AHP, using the related procedures software calculated the corresponding weights of each factor and the random consistency rate (RC), examined the consistency, the results is as shown in table 1, then can draw the conclusion that the RC value of indexes in each layer are less than 0.10, indicating that it has good uniformity. The index weight is listed in table 1 above.

Expert scoring and collecting

Contacting six industry experts in Hebei PV power generation rate and score the development situation. The basic grade principle is Hebei compared with other provinces, PV power generation compared with the traditional way of power generating, the marking results is shown in table 3.

Table3 the performance score of power Supply Company

Index	Reference score	expert1	expert 2	expert 3	expert 4	expert 5	expert 6
Analysis/design of cost	10	8	7	9	8	8	7
Implementation cost	10	7	8	8	8	9	8
Management expenses	10	7	7	8	7	8	7
Operation cost	10	7	7	8	8	8	9
Maintenance cost	10	8	8	8	9	9	9
Operation management cost	10	8	8	7	7	8	8
Reducing the operation cost	10	8	8	9	9	8	9
Improve work efficiency	10	8	7	7	8	7	8
Sales profit increase	10	7	6	6	6	6	5
Enterprise credit to improve	10	9	9	8	8	9	9
Management level to improve	10	8	7	7	6	8	7
Technology capability to improve	10	8	8	8	7	9	7
Core competitive capability to improve	10	8	8	7	8	9	7
Foreign cooperation capability	10	9	8	8	8	8	8
Reduce energy consumption	10	9	9	9	9	8	9
Technology demonstration	10	8	9	9	9	8	9
Environmental protection	10	9	9	9	10	9	9

Calculation the cost-benefit comprehensive scores

The score formula of positive indexes is: Basic score = (score / Reference score)*100, the score formula of negative indexes is: Basic score = (Reference score / score)*100, the formula of final score is: Final score = Basic score *Index weight, the calculation results is shown in table 4.

Table4 the calculation of final scores

Index	Basic score	Index weight	Final scores
Analysis/design of cost	1.2864	0.0363	0.0467
Implementation cost	1.2566	0.0110	0.0456
Management expenses	1.3690	0.0200	0.0497
Operation cost	1.2864	0. 0564	0.0467
Maintenance cost	1.1806	0.0355	0.0419
Operation management cost	1.3095	0.0149	0.0195
Reducing the operation cost	0.8500	0.0186	0.0158
Improve work efficiency	0.7500	0.0703	0.0527
Sales profit increase	0.6000	0.0443	0.0266
Enterprise credit to improve	0.8667	0.0215	0.0186
Management level to improve	0.7167	0. 0267	0.0191
Technology capability to improve	0.7833	0. 1148	0.0899
Core competitive capability to improve	0.7833	0. 0476	0.0373
Foreign cooperation capability	0.8167	0. 0783	0.0639
Reduce energy consumption	0.8833	0. 2178	0.1924
Technology demonstration	0.8667	0. 1199	0.1039
Environmental protection	0.9167	0.0660	0.0605

Comprehensive scores	——	——	0.9027

Analysis the cost-benefit comprehensive scores

From the above calculation result, the cost-benefit scores of Hebei PV power generation is 0.9027, which is in a good development stage. From the internal points, cost including initial investment cost and annual operation cost, its overall cost amount is larger, which maybe lead by the technology and technical conditions. As for the weight, Technical ability, technology demonstration function and reduce the energy consumption is paid great attention, especially reduce of energy consumption, it is 0.2178. The score of operation management cost and operation cost is low, which shows that the cost of photovoltaic power generation enterprise is relatively large and it need further measures to reduce the cost. The score of enterprise credit and management level is also low, which shows that though photovoltaic power generation is emerging high technology enterprise, but the future development of its stability and the technique is not mature, which need to be improved further.

Study of the development countermeasures for Hebei province photovoltaic power generation enterprise

Actively develop domestic market, while continue to strive for the foreign market. The government announced the PV online electricity price benchmarking in 2011. This announcement will help the domestic PV market to truly open, Hebei should provide more policy support, encourage enterprises to "go out". Hebei should also introduce related policies and measures as soon as possible, which can be used as the powerful backing for export enterprises and help enterprises to cope with the unfair treatment in overseas market, explore foreign market share actively.

Policy support should take more ways, focus on the key point, technology research and development. As to whether it is ok to spend much capital to introduce the key technology and equipment, for it is good to the rapid development of Hebei PV power generation, it should continue increases the investment to technology importation and financial subsidies, combine the introduction of technology with independent development, do a good job in the introduction of core technology、digestion and absorption work, with policy as the guide, cultivate the ability of independent innovation gradually.

The construction of PV power generation project should follow national policy development direction, develop with a steady pace. Compared with other provinces such as Qinhai、Gansu, whose Photovoltaic power generation industry is relatively better, the photovoltaic power station quantity in Hebei is not many, but Hebei should be rational to the photovoltaic power generation project, should not be anxious to development just in order to stimulate the economy, should strictly control the quality, adjust measures to local conditions, complete the demonstration work in the earlier period, make sure that each photovoltaic power station can ensure its power quality and future economic benefits.

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