Research on the Evaluation Index System of Scientific and Technological Achievements in the Field of New Energy

Tailai Liao

School of Management, Wuhan University of Technology, Wuhan, China, 430070

1269774167@qq.com

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Abstract. Through the study of different industry evaluation index system of scientific and technological achievements, combined with the current situation of the development of new energy industry and new energy industry and new energy characteristics of scientific and technological achievements, the new energy sector to build evaluation index system and grading standards of scientific and technological achievements, on this basis, using the fuzzy comprehensive evaluation method and Delphi method to various indicators of empowerment, and set up the corresponding score calculation method.

Introduction

New energy industry as an important part of economic development, to improve the energy structure, optimize the human survival environment, reduce resource waste and environmental pollution have a vital role, is different from the traditional energy industry, new energy industry with low pollution, low emission, sustainable regeneration, and many other advantages[1], and accorded with the basic idea of low carbon economy development in our country. "Much starker choices-and graver consequences-in" energy planning in our country is put forward, and optimize the energy structure, clean, low carbon development is the basic requirement of promoting energy revolution, is also the urgent needs of the development of China's economic and social transformation, will also be elevated to a strategic height, new energy industry development in recent years, the number of scientific and technological achievements of new energy industry shows a tendency of rapid growth, for new energy industry scientific and technological achievements evaluation is particularly important[2-4]. And at present, new energy science and technology achievements transformation development are faced with many problems, for new energy science and technology achievements evaluation research in China is less, the lack of a set of relatively complete evaluation index system, evaluation system is not sound, not the science is restricting the effective transformation of scientific and technological achievements of new energy industry of the important reasons for[5], in this article, through the research on different industry evaluation index system of scientific and technological achievements, on the basis of the combination of new energy industry and new energy industry characteristics of scientific and technological achievements, to build a set of relatively perfect evaluation index system of scientific and technological achievements of new energy industry.

Characteristics of New Energy Industry and New Energy Science and Technology Achievements

Characteristics of New Energy Industry Strategic.

The new energy industry itself is strategic and plays a strong driving role in other industries[6]. At present, China's energy supply is still dependent on coal and oil based fossil energy, and fossil energy belongs to non-renewable resources. Along with the accelerated process of industrialization, the rapid growth of the energy consumption is certainly lead to the rapid decline, the stock of fossil fuels, especially oil, 1993 into oil importers in our country, the external dependency of oil has more than 60% in 2015, the shortage of energy supply become the economic development of our country is unable to avoid problems, even will affect China's political and military security. Under such

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circumstances, only by developing new energy and expanding the total amount of energy can energy supply be guaranteed. Therefore, China takes the development of new energy industry as an important task of energy strategy. Energy industry is the basic industry and the basis and prerequisite for the development of other industries. The new energy industry can not only reduce the energy cost of other industries, but also directly drive the development of related industries.

Environmental Friendliness.

As a green industry, new energy industry is characterized by environmental protection, safety and cleanliness. Coal, oil and other fossil energy will not only emit sulfur dioxide and other harmful gases in the use process, resulting in serious pollution of the atmosphere, its release of large amounts of carbon dioxide, but also cause the global warming effect intensified. By the European Commission (European themselves) and the Netherlands Environmental Assessment Agency (the Netherlands Environmental Assessment Agency) of EDGAR emissions of carbon dioxide released in 2013, the main countries, estimates that in 2013 China's carbon emissions account for 29% of global emissions, carbon emissions are one of the world's first year, and November 4, 2016, the Paris agreement took effect marks a global climate change control mode, China's commitment to peak carbon emissions in 2030, means that China's energy industry will face the adjustment in the future, and compared with the fossil energy such as coal, petroleum industry, new energy industry in solar energy, wind energy, biomass energy, ocean energy and other renewable energy as the foundation, has the advantages of environmental protection, safe, clean, value is very high [7,8] to the environment.

Policy Dependence.

New energy industry is a new industry. Because energy industry plays an important role in national social and economic security, it needs special support from the government [9]. Since 2006, relevant policies in the new energy sector have gradually increased, reaching 31 in 2012. From the perspective of the field of policy introduction, the policy focuses on wind power and photovoltaic, biomass Marine energy and other forms of power generation are few. The reason is that the development cost of wind power and photovoltaic power generation is relatively low, the technology is relatively mature, and the application scope is relatively wide. In terms of stages, the policies introduced before 2008 are basically wind power generation, and photovoltaic power generation policies have been introduced closely since 2009. In the following years, relevant policies were introduced in a corresponding intensive manner. In 2015, the plan for the revitalization and development of the new energy industry pointed out the strategic plan for the development of the new energy industry, as well as the reform of traditional energy. The ministry of finance and the ministry of industry and information technology of the People's Republic of China have also issued policies on the development of the new energy industry, creating a good external environment for the development of the new energy industry.

Characteristics of New Energy Science and Technology Achievements Professional Complexity.

New energy science and technology achievements is closely related to the process of energy utilization, including heat and mass transfer, combustion, carbonization, condensation and evaporation, electricity and other physical and chemical process, professional and strong, with growing energy and environmental problems, all countries to strengthen research and development of new energy technology, new technology appear constantly, technology is also increasingly complex

High investment and high risk.

New energy science and technology achievements are characterized by large capital investment and high return risk. The new energy industry involves biological, Marine, new materials, electronics and other high and new technologies, and its technology research and development needs huge capital investment to support, accompanied by high research and development risks. In photovoltaic industry, for example, after years of photovoltaic industry in China's high investment, industrial efficiency of solar cells and components, the solar cell efficiency of absolute average 0.3% a year, followed by photovoltaic power station unit construction costs a trend of decline year by year, but

the fund of photovoltaic industry demand is still high. In 2017, China plans to add 18 gigawatts of installed photovoltaic power capacity, or 126 billion yuan per kilowatt if 7,000 yuan is invested. In addition to the high investment, the photovoltaic industry also needs to face a series of risks such as difficulties in accessing the Internet, power limit and subsidy gap [10-11].

High profitability.

New energy science and technology achievements have high level of economic and social benefits. Not only can enterprises achieve good economic benefits, but also good social benefits, which can improve social labor productivity, save various resources, transform traditional industries and increase the vitality of the whole economy.

Uncertainty of effect.

New energy science and technology achievements by the energy distribution, the load rate, fuel production and raw material quality, the equipment operation parameters, the influence on local climate conditions, and as a result, the benefit of the new energy science and technology achievements has certain uncertainty, technology application is also facing the market environment, finance, policy, management, and many other factors influence [12].

Research on Evaluation Index System of Scientific and Technological Achievements of New Energy Industry

According to the design principle of the index system and the characteristics of new energy science and technology achievements, the value evaluation index system of new energy science and technology achievements is set up. The index system mainly examines the technical value, benefit value, system risk and other aspects of scientific and technological achievements [13-14], and sets three first-level indicators, namely, technical value, benefit value and system risk. A number of secondary indicators are set under each secondary indicator, a total of 13 secondary indicators; A number of third-level indicators are set under each second-level indicator, a total of 43 third-level indicators (Table. 1).

Evaluation Method and Model Construction of Scientific and Technological Achievements of New Energy Industry

Determine the set of Evaluation Factors.

According to the new energy industry scientific and technological achievements value evaluation index system, and then determine the evaluation factor set. The new energy industry scientific and technological achievements value evaluation index system has three first-level indicators, namely, the evaluation factor set of first-level indicators is X={x1,x2,x3}.

If there are n secondary indicators under the ith primary indicator, the evaluation factor set of the JTH secondary indicator is Yi j= {yi1, yi2..., Yin}, where I =1,2,3.

If there are k third-level indicators under the p-level 2 indicator, the evaluation factor set of the q-level 3 indicator is Zpq={zp1,zp2... , ZPK}, where p=1,2... , n.

Determine the Star Set.

Star set is the evaluation grade that experts make on the value of scientific and technological achievements U. Generally, it is appropriate to have 3 to 5 elements of star set. If there are too few elements, the degree of differentiation is not high enough. After comprehensive consideration, set 5 evaluation levels,V ={V1,V2,V3,V4,V5}, V1 represents one star,V2 represents two stars,V3 represents three stars,V4 represents four stars,V5 represents five stars, the number of stars, it means the value of the scientific and technological achievements is higher. Corresponding comment set score: W={1,3,5,7,9}, as shown in Table 2.

Table 1 Value evaluation index system of new energy science and technology achievements

Level indicators	**The secondary indicators**	**Level 3 indicators**
Technology value	Innovative	1. The innovation points
		2. Technical innovation difficulty
		3. Technological innovation complexity
	Advanced nature	1. Level of innovation
		2. Energy technology applicability
		3. Industry development trend
		4. Professional level of energy technology
	Stability	1. Reliability
		2. Technical reproducibility
		3. Technology of life
	Maturity	1. Degree of industrialization
		2. Technical radiation level
	Intellectual property rights	1. Patent authorization
		2. Standard conditions
		3. Number of papers published
		4. Book case
		5. Number of patent applications from multiple countries
Efficiency value	Economic benefits	1. Application converted sales revenue
		2. Market share after application
		3. The degree to which production costs are reduced
		4. Degree of energy structure optimization
		5. Energy efficiency
	Social benefits	1. Promote the development of related industries
		2. To create more employment opportunities
	Ecological benefits	1. Energy saving effect
		2. Emission reduction benefits
Systematic risk	Technical risk	1. The possibility of creating a potential risk
		2. Potential technological development risks
		3. Degree of technical support
		4. Technological substitutability
	Market risk	1. How easy it is to enter the market
		2. Competitiveness
		3. Industry supply and demand
	Policy risk	1. Industrial policy compatibility
		2. Regional policy coherence
		3. Policy support
	Natural risk	1. Degree of influence of climate factors
		2. Degree of influence of geographical factors
	The legal risks	1. Legal risks can be avoided
		2. Potential rights dispute
		3. Patent infringement is determinable
		4. The period of validity

Table 2 Stars and corresponding scores

Grade V	The star	Score W	Assign a partition between
V_1	★	1	[0,2]
V_2	★★	3	(2,4]
V_3	★★★	5	(4,6]
V_4	★★★★	7	(6,8]
V_5	★★★★★	9	(8,10]

Determine the Single factor Evaluation Matrix.

Fuzzy comprehensive evaluation method is used to evaluate the value of scientific and technological achievements in the new energy field [15-16]. Firstly, the fuzzy evaluation is carried out from a factor, and the evaluation element of the evaluation object and the evaluation set V is determined, which is called the single-way evaluation, and then the three-level index fuzzy evaluation matrix is obtained.

The three-level index fuzzy evaluation matrix R is obtained according to the scoring of the technology by experts in the field of new energy, that is, the single factor evaluation matrix R= (rij), where the rows in the single factor evaluation matrix R represent the scoring of each index. Rij represents the expert approval rate of each indicator under each evaluation.

Its matrix model is:

$$R = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ r_{21} & r_{22} & & r_{2j} \\ & \vdots & \ddots & \vdots \\ r_{i1} & r_{i2} & \cdots & r_{ij} \end{pmatrix}$$

Perform Fuzzy Transformation.

The comprehensive evaluation model of fuzzy transformation was established by experts to evaluate the value of new energy science and technology achievements as follows: B=A * R, where B is the description of the grading degree of each evaluated object; A is the three-level index weight; R is the three-level index fuzzy evaluation matrix; bj represents the degree to which the rated object has rated vj.

The calculation model is as follows:

$$B=A\times R=\ (a_1,a_2,\ldots,a_i)\begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ r_{21} & r_{22} & & r_{2j} \\ & \vdots & \ddots & \vdots \\ r_{i1} & r_{i2} & \cdots & r_{ij} \end{pmatrix}=\ (b_1,b_2,\ldots,b_j)$$

Obtain the second-level index evaluation score.

The corresponding score vector W= {1,3,5,7,9} can be obtained by multiplying the score vector W and the transpose vector of evaluation vector B to obtain the evaluation score value of the second-order index, which is denoted as V.

The calculation formula of V is as follows: ： V=W×BT

Get the Final Evaluation Score and Corresponding Star Level.

By step 6 V score can draw all the secondary indicators, suppose new energy evaluation index of value of scientific and technological achievements have three first-level indicators, score for T1, T2, T3, its weight respectively, S1, S2, S3, the index of a class I have n secondary indexes, the index weight of Gij respectively under the primary index, score of Vij respectively (I = 1, 2, 3; J = 1, 2,..., n).

The score calculation formula of the first-level index is as follows:

$$T_i = \sum_{j=1}^{n} V_{ij} \cdot G_{ij}$$

Then the final evaluation score of the value of new energy science and technology achievements is:

$$T = \sum_{i=1}^{4} T_i \cdot S_i$$

Finally, it is concluded that the value score T of new energy scientific and technological achievements will be between 0 and 10, and the scientific and technological achievements can be rated according to the assigned partitions in table 2, so as to obtain the objective value embodiment of the achievements.

Conclusions and Suggestions

Establishing and improving the evaluation index system of scientific and technological achievements plays an important role in the smooth implementation of scientific and technological achievements evaluation. We should strengthen the dominant position of the evaluation organizations and implementing units, and, in light of the actual situation of evaluation of new energy science and technology achievements, distinguish the rights and obligations of the evaluation organizations, the evaluated units and other participating units, so as to bring into play synergistic effects. The assessed units shall provide authentic and reliable technical data to the evaluation experts as required. The organization and evaluation unit shall be responsible in strict accordance with the procedures and put an end to the occurrence of illegal behaviors.

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