Study on Economic Evaluation of Power Generation Capacity Increase Project Based on Improved Income Accounting Method

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Abstract. With the rapid development of our economy and the need to build a "beautiful China" and protect the environment, as a thermal power enterprise, the technical transformation of improving power generation efficiency and reducing energy consumption has begun to attract much attention. Firstly, this paper expounds the necessity of improving efficiency and capacity of generating units, secondly, it analyses the principle of economic evaluation of current flow capacity enhancement transformation and the main influencing factors. Then, the paper puts forward the method of calculating the cash inflow of technical and economic evaluation by using the energy-saving benefits of increasing generation and reducing consumption brought by the capacity-increasing part. Finally, the economic benefit post-evaluation of Y thermal power plant's technical renovation project is carried out, and it is concluded that the improved income accounting method can reflect the actual income of the project more truthfully.

Introduction

At present, although China's economic development has entered a new normal, the optimization of industrial structure has accelerated significantly, the growth rate of energy consumption has slowed down, the development of resource-based, high-energy-consuming and high-emission industries has gradually declined, and the intensity of energy and resources consumption has been greatly reduced. However, with the acceleration of industrialization and urbanization and the continuous upgrading of consumption structure, the rigid growth of energy demand in China, the problem of resources and environment is still one of the bottlenecks restricting China's economic and social development. Energy conservation and emission reduction are still in a grim situation and arduous tasks, and the protection of ecological environment has a long way to go. The report of the Nineteenth National Congress of the Communist Party of China clearly points out that we should promote green development, promote the comprehensive conservation and recycling of resources, implement national water-saving actions, reduce energy consumption and material consumption, and realize the circular link between production system and life system. In 2016, China's total coal consumption was 1.888 billion tons of oil equivalent, accounting for 50.58% of global coal consumption[1]. Therefore, as the main enterprise of energy consumption and pollutant emission, thermal power enterprises will face more severe challenges. More importantly, they should actively carry out technological innovation, technological transformation, improve energy efficiency, and make greater contributions to energy saving and emission reduction, environmental protection and pollutant emission reduction in China.

In recent years, with the continuous development of thermal power enterprises in improving energy efficiency, energy saving and environmental protection technology reform, the related research on post-evaluation of technical transformation projects has also been developed to a certain extent. However, as the technical transformation project of thermal power enterprises is only one of the links to improve energy efficiency in power production, most of them have small investment scale, short project cycle, and can not form an independent production system. The project does not directly produce economic benefits. It is difficult to define the inflow and outflow of cash in the process of economic evaluation[2]. At present, many post-project evaluation studies are only the

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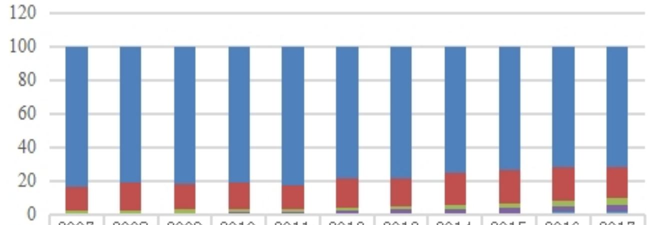
comparative analysis of the relevant indicators before and after the transformation, but only through the comparative analysis of index data such as heating coal consumption, power generation coal consumption and auxiliary power rate to evaluate the economic effect of the technical transformation. However, we can not accurately and comprehensively evaluate the corresponding economic benefits brought by technological reform, thus causing some meaningless investment.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Thermal power	83.3	81.2	81.8	80.8	82.4	78.7	78.6	75.2	73.7	72.2	71.8
Hydropower	14.4	16.4	15.5	16.2	14.1	17.2	16.6	19.2	19.4	19.4	18.32
Nuclear power	1.9	2	1.9	1.9	1.8	2	2.1	2.3	2.9	3.5	3.9
Wind power	0.2	0.4	0.8	1.2	1.6	2.1	2.6	2.8	3.2	3.9	4.6
Solar energy and others	0.1	0	0	0	0	0.1	0.2	0.6	0.7	1	1.4

Figure 1. China's Power Generation Structure 2007-2017

Therefore, this paper is based on the principles of systematicness and operability of post-evaluation of technological reform projects.Firstly, the main influencing factors of thermal power technology renovation project in the process of economic benefit evaluation are analyzed; secondly, the internal rate of return on investment and investment payback period are put forward; Then through the actual data of Y power plant capacity enhancement project, an example is analyzed. Finally, the economic benefit evaluation of Y power plant capacity enhancement project is carried out by analyzing the calculation results. The research in this paper will provide some reference for the economic benefit post-evaluation of the technical transformation projects of thermal power enterprises in the future. Therefore, it has important application value.

Methodology

Principle of Post-evaluation of Operational Effect. Systematic principle is that any problem should be considered in the process of operation effect evaluation, and the project after technological transformation should be evaluated with systematic concept[3]. It requires that the internal relations among various elements be fully considered, the rigid idea of analyzing problems in isolation and stationary should be overcome, and the evaluation of project operation effect should be carried out in the process of comprehensive and systematic dynamic analysis and demonstration.

Operability principle, the selection of evaluation indicators should be based on objective facts, the calculation formula should be as simple as possible, the parameters in the work can be easily obtained and the relevant indicators should be relatively high, the existing information resources should be used as far as possible, the statistical and queriable indicators should be selected, and the data should be easy to obtain, reliable and acceptable.

The principle of objectivity is to respect the objective law, not subjectively arbitrary, to be scientific, to proceed from reality, to insist on in-depth investigation and research, to seek truth from facts, to grasp information comprehensively and systematically, to eliminate the interference of subjective consciousness, and to strive to reflect the objective reality by the relevant results of post-evaluation calculation[4].

Analysis on the Influencing Factors of Post-evaluation of Operational Effectiveness. Annual increment of power generation. For thermal power enterprises, the revenue mainly comes from the sales of electricity, but for the technical renovation project of flow enhancement and capacity, in the process of technical and economic evaluation, the inflow of cash flow should be considered to be brought by the project itself. Therefore, this paper takes the annual increment of generating capacity as one of the cash flow inflows in the system, and its calculation formula is as follows:

$$\text{Annual Increment of Generation} = \sum \left(\text{Increased Capacity Load} * \text{Operation Time under this Load} \right) \quad (1)$$

Standard coal saving. On the other hand, due to the technical transformation of the project, the energy consumption and utilization efficiency of coal-fired boilers have been improved, and the standard coal consumption of power supply has been greatly reduced compared with that before the technical transformation, thus saving a lot of fuel costs. The calculation formula is as follows:

$$\text{Standard Coal Saving} = \sum \left(\text{Unit Power Supply Standard Coal Saving} * \text{Sales of Electricity} \right) \quad (2)$$

Selection of Economic Evaluation Index. Internal rate of return. Internal rate of return is the discount rate at which the present value of the net cash flow of each year of a project investment plan is accumulated equal to zero in the calculation period. If the computer is not applicable, the IRR should be calculated with several discount rates until the discount rate whose NPV is equal to or close to zero is found. Internal rate of return (IRR) is the rate of return that an investment desires to achieve[5]. It is the discount rate that can make the net present value of an investment project equal to zero. The bigger the index, the better. In general, when the IRR is greater than or equal to the benchmark income, the project is feasible. The calculation formulas are as follows:

$$NPV = \sum_{i=1}^{n} (CI_t - CO_t)(1 + IRR)^{-t} = 0 \quad (3)$$

where the "CI_t" variable represents cash inflows in year t;

where the "CO_t" variable represents cash flow in year t.

The payback period is the time required for net cash flow to offset project investment, that is, the year in which the cumulative present value equals zero. It is a method of calculating the payback period of a project after converting the net cash flow of each year into the present value according to the benchmark rate of return. It is an evaluation index from the perspective of time[6]. The payback period of investment shall be calculated on an annual basis from the beginning of the project construction, and shall be expressed in terms of formulas as follows:

Investment payback period = cumulative net cash flow begins to appear positive years - 1 + absolute discounted net cash flow of the previous year / discounted net cash flow of the current year

Results and Analysis

This project takes the capacity-increasing technical renovation project of No.1 steam turbine (600MW) of Y power plant as an example to analyze. Turbine No.1 of this plant is a 158 series of turbines manufactured by Shanghai Steam Turbine Co., Ltd. with sub-critical, single shaft, three cylinders (high and medium pressure cylinder), four exhaust steam, one intermediate reheat and condensing steam turbines.Upgrading and renovation ended in May 2017 and put into operation in June 2017. According to the actual survey data, the capacity-increasing capacity of the steam turbine is 22 million Kwh per year due to the capacity-increasing part after the technical renovation.The annual load curve from June 2017 to May 2018 is shown in Fig. 2 Meanwhile, the average coal consumption of power supply after technical transformation is 313.22g/kWh, which is 13.22g/kWh lower than 326.54g/kWh before technical transformation.

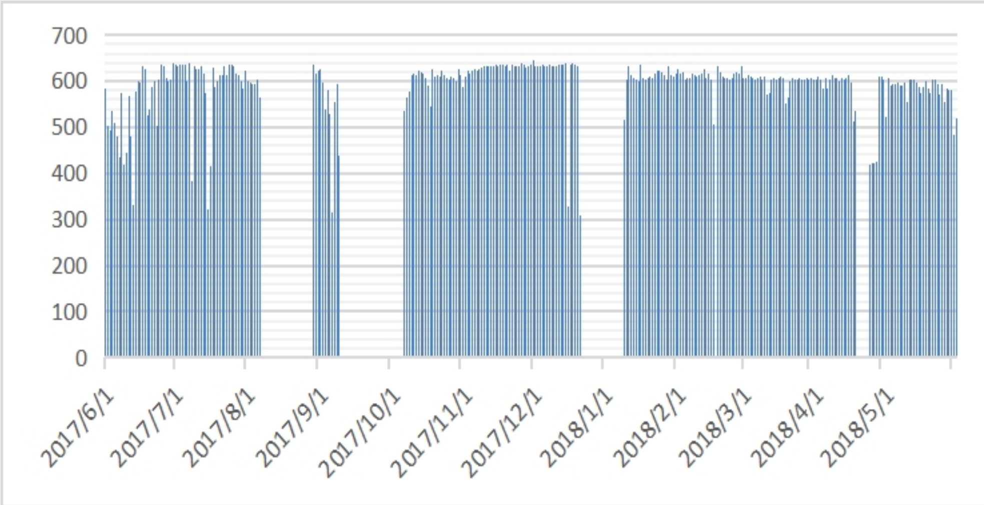


Figure 2. Load Curve of No.1 Steam Turbine from June 2017 to May 2018

According to the accounting method of this paper, the internal rate of return on investment is 30.25% and the payback period is 4.33 years, which is 5.37% lower than the internal rate of return calculated directly by difference before and after technological transformation, and the payback period of investment is increased by 1.82 years in 2.51 years.

Conclusion

Through the above analysis, it can be seen that the internal rate of return and payback period of investment calculated by the traditional method are affected by many external environments, and the incremental effect is difficult to define, which can not truly reflect the actual benefits of the flow capacity-increasing project. The economic effect of the project is exaggerated due to the increase of utilization hours.Therefore, this paper takes the annual increment of power generation and the cost of coal-fired fuel saved by the capacity-increasing part as the income in the economic benefit evaluation, which more reasonably reflects the actual income of the project.

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