Renewable Energy 50 (2013) 481–487

Contents lists available at SciVerse ScienceDirect

Renewable Energy

journal homepage: www.elsevier.com/locate/renene

The investment risk analysis of wind power project in China

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ARTICLE INFO

Article history:
Received 18 December 2011
Accepted 9 July 2012
Available online 9 August 2012

Keywords:
China
Policy and regulation
Wind power project
Investment risk
Monte Carlo simulation

ABSTRACT

In the context of a focus exploiting for alternative and renewable energies to reach the emission reduction goal in China, wind power industry serves as a significant development object and also shows vast development space. However, for its investors, project risks and the long-term positive trend are coexistent, due to the joint influence of several factors as the result of Chinese wind power industry circumstance and relative policies and regulations, such as investment in construction period, cost in operation period, electricity connected to grid, feed-in tariff, CDM project income, and government subsidy. To assess the investment risk of wind power project, this paper constructed a process which initially simulated NPV with Monte Carlo method and then analyzed the investment payback period as well as IRR based on it. Next, combining with a specific case in north China, firstly the credibility and accuracy of proposed simulation process were verified, then the NPV was simulated and the investment payback periods as well as IRR were evaluated under different grid-connected ratios in two conditions, namely the project with and without CDM income. The simulation results indicated the proposed case having high investment risk, so afterward general suggestions on mitigating the investment risks of wind power project in China were presented.

1. Introduction

In order to prevent global warming from deteriorating and threatening human living, the international societies have acted and will act growingly stringent environmental regulations on the limit of carbon dioxide emissions. As the major resource of greenhouse gases, the consumption of fossil fuels must be declined, yet the rapid development of global economy requires totally growing energy. Thereby, the gap between these two above-mentioned facts is motivating the emergence of cleaner and lower carbon dioxide renewable energy. In the future, alternative and renewable energies will not suddenly substitute for traditional energy products, but will in a gradual way, and the 21st century will undoubtedly be the era of renewable energy [1].

In China, early in September 2009, Chairman Hu explicitly proclaimed on the UN Climate Change Summit, that China will strive for increasing the proportion of non-fossil energy to 15% in the primary energy consumption by 2020. In the same year, Premier Wen made a solemn promise on the Copenhagen Climate Change Conference, that by 2020 the carbon dioxide emissions per unit GDP in China will decrease by 40–45% compared to that of 2005. Apparently, China will explore the development and utilization of renewable energies as a way of reaching the emission reduction goal and fulfilling the Copenhagen commitment [2].

Among several renewable energies, including solar energy, wind energy, biomass energy and so on, wind energy serves as a fast growing alternative energy source which is also cleaner and more productive. In this way, it is playing a growingly influential role in tackling the problem of energy scarcity and adjusting energy structure. Further, "The China wind power development roadmap 2050" [3], published by the Energy Research Institute of the National Development and Reform Commission, indicates that by the year 2020, 2030 and 2050 the installed capacity of wind power will reach 0.2, 0.4 and 1 billion kW respectively, thus can meet 5%, 8% and 17% of total electricity demand in each one of the three years, then by that time wind power will be one of the five largest power supplies in China.

Nowadays, the European wind power industry is very much mature and gradually saturated, while wind energy in China shows considerable vitality and profound potentials in spite of the relatively late start, and significant progress has been made. For instance, the new installed wind power capacity had achieved

Abbreviations: CDM, Clean Development Mechanism; NPV, net present value; GDP, Gross Domestic Product; IRR, internal rate of return; NDRC, National Development and Reform Commission; CERs, Certified Emissions Reductions; WWF, World Wildlife Fund; VAT, Value-added Tax; EU, European Union; VAT, Value-added Tax.

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0960-1481/$ – see front matter
http://dx.doi.org/10.1016/j.renene.2012.07.007

Symbols:

T_D	dynamic investment payback period;
CI_i	annual cash inflow;
CO_i	annual cash outflow;
S_i	CDM project income;
OI_i	opportunity income;
RV_i	residual value of fixed assets;
RL_i	recovery of liquid capital;
G_i	theoretical generated electricity;
P	feed-in tariff;
I_i	investment;
L_i	liquid capital;
OC_i	operating cost;
ST_i	sales tax and surcharges;
T_i	income tax;
OI_i	opportunity income;
MC_i	equipments maintenance cost;
AT_i	tax rebate of VAT;
EAT_i	unreduced VAT of the newly purchased equipments;
TC_i	annual total cost;
v	wind velocity;
P_c	carbon equivalent transaction price;
P_r	rated output power;
$P(v)$	actual output power;
EF_i	baseline emission factors;
EF_{OM}	marginal emission factor;
EF_{BM}	capacity emission factor.

a 100% increase for four consecutive years since 2006. As a result, the overall installed capacity exceeded 2500 MW by the end of 2009, which transformed China into the second largest wind power capacity country in the world. One year later, it hit a record high in that China surpassed that of America to become the world's largest. When it comes to the proportion of the global data that China accounts for, as shown in Fig. 1, the new wind power installed capacity in China has already reached over 50% in 2010, up from approximately 1% in 2001. Moreover, the overall installed wind power capacity in China has risen up to 22% (44,751 MW/196630 MW) or more by the end of 2010.

Chinese government's planning measures on new energy have provided opportunities for promoting and developing wind energy in China. However, due to a surge of rash investment, there was once in 2009 the phenomenon of imbalance that the supply of renewable energy exceeded insufficient demand, therefore overriding investors' initiative. Owing to the joint influence of several factors, the long-term positive trend and the short-term volatility risks are coexistent in wind energy industry. As a result, investors should not only seize the precious opportunities but also achieve comprehensive risk analysis against the short-term volatility during investment process.

Researches on wind energy nowadays mainly concentrate on forecasting and estimating wind power, such as wind energy resources of Jiangsu province (China) [4], Fujian province (China) [5], Madrid (Spain) [6], Grenada [7], Kirklareli (Turkey) [8] and so on [9]. However, only a few investigations have been conducted with respect to the investment risk of wind power project. For example, Su carried out analysis of investment risk and its countermeasures of wind power projects in China [10], the majority of which are qualitative; German qualitatively analyzed various models for evaluating investment under risky conditions taking the highly fortuitous nature of wind velocity into account [11]; Then Brian briefly discussed some investment and cost risks of offshore wind power in the U.S. [12]. Regrettably, quantitative research specifically on investment risks of Chinese wind power projects is even rarer.

Consequently, based on current relative regulations and policies on wind energy in China, this paper considers the net present value (NPV), dynamic investment payback period (T_D), and internal rate of return (IRR) as indexes to evaluate the investment risk of wind power project. Section 2 analyzes the risk factors of wind power project in China. In Section 3, the process of utilizing Monte Carlo simulation method to calculate the NPV is established, afterward the T_D and IRR of project are also analyzed based on the relationship between NPV and them. Next, a case study is illustrated in Section 4. Finally, in accordance with the simulation results, general suggestions on mitigating the investment risks are proposed.

2. Risk factors of wind power project investment

Investment in construction period. The construction investment of wind power project embrace equipment purchasing, construction installation cost, reserve fund, construction period interest and so on. Moreover, the purchase and installation cost of equipment can account for over 70% of the overall construction investment. In China, the rapid grow of wind power project, combined with policy supports from government for wind power equipment manufacturing sector, have given effective impetus to the progress of these entities. Nevertheless, resulting from information asymmetry, different equipment prices from various manufactures bring about uncertainty and risks to investment.

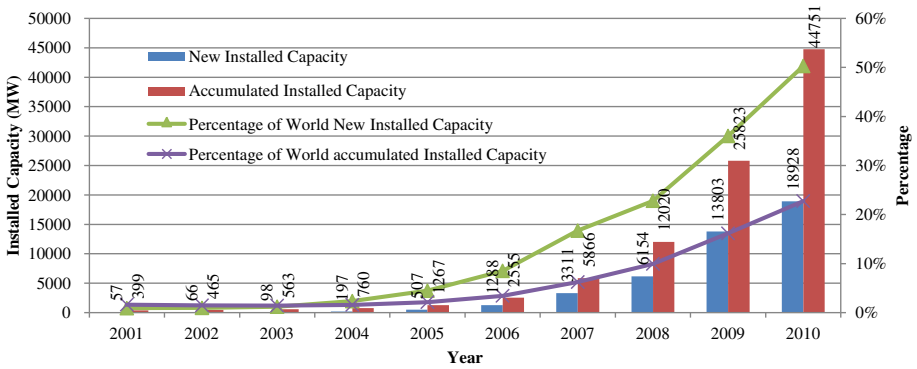

Fig. 1. The installed wind energy capacity in China and its proportion to that of the world sources: Chinese wind energy Association (2010); world wind energy report 2010 by WWE (2011).