Risk-based analysis and policy implications for renewable energy investments in Greece

Dimitrios Angelopoulos⁎, Haris Doukas, John Psarras, Giorgos Stamtsis

School of Electrical and Computer Engineering, Decision Support Systems Laboratory (EPU-NTUA), National Technical University of Athens, 9, Iroon Polytechniou str., 15773 Athens, Greece

ARTICLE INFO

Keywords:
Policy risk
Onshore wind
Solar PV
Weighted average cost of capital
Energy policy
Greece

ABSTRACT

Significant renewable energy (RE) investments have to be implemented in order to achieve the ambitious RE targets set in the EU for 2020 and beyond. Moreover, a great amount of capital has to be leveraged, as these projects are followed by high investment and financing costs. Main aim of this paper is the provision of a comprehensive assessment of the existing risk elements of RE investments in relation to the respective policies and the evaluation of their impact on the weighted average cost of capital (WACC) in Greece. A consultation procedure with key national energy stakeholders took also place, including policy makers, project developers, investors, equity providers, bankers and energy analysts in the Greek RE market, in order to provide a validation of the respective results. It has been concluded that the policy design risk represents the risk element with the greatest impact on the cost of capital and, thus, the level of RE investments’ deployment. Based on the cost of capital valuation process followed, the WACC was estimated to reach approximately 12% for onshore wind and little lower values for solar PV projects in Greece.

1. Introduction

In the context of the Energy Union established (EC, 2015), the European Union (EU) is committed to become the leader in renewable energy (RE) development at a global level. The extended implementation of RE investments constitutes a necessity in order the EU Member States to achieve the national binding targets set by Directive 2009/28/EC for 2020 (EC, 2009).

On the ground of the EU Directive 2009/28/EC, Law 3851/2010 determines ambitious national targets for renewable energy sources (RES) in Greece by 2020 (Governmental Gazette 85/4-6-2010). In addition, the European Commission has also set ambitious EU climate and energy goals for 2030, including an increase of the share of renewable energy in final energy consumption by at least 27% at EU level (EC, 2016; European Council, 2014).

In order these sustainable energy objectives to be fulfilled, extensive investments have to be implemented in the RE sector during the upcoming years (IRENA, 2016a). These capital intensive investments are followed by high upfront costs and, in most cases, low operation and maintenance costs (IRENA, 2016b; Liu et al., 2016; Lee and Zhong, 2015; Abdmonleeh et al., 2015; Dai et al., 2016). Due to the economic nature of these projects, the financing costs are critical and constitute a considerable part of the overall cost of renewables (IEA, 2015).

Main influential parameters of the levelized cost of electricity (LCOE) produced by RE projects are, among others, the initial investment expenditures (upfront payments) and the discount rate, which reflects the cost of capital of the investment, i.e. the rate at which net cash flow future values are being discounted against current values (Ouyang and Lin, 2014; IRENA, 2012).

The weighted average cost of capital (WACC) has been identified as a key financial indicator that efficiently represents the cost of capital in a considerable amount of literature (Donovan and Corbishley, 2016; Byrnes et al., 2016; IRENA, 2015; de Jager et al., 2011; Gross et al., 2010). In particular, the WACC has emerged as an effective and efficient tool in capturing the real cost of capital of investments and an understandable and easily applicable indicator in projects’ profitability assessments that provides the minimum acceptable rate of return at which an investor is willing to invest capital in a particular project (Mir-Artigues and del Rio, 2014). The economic profitability of an investment may be accessed through the comparison of the internal rate of return (IRR) of this project with the respective WACC (EIB, 2013).

Specifically, this financial indicator is defined as the weighted sum of both the cost of equity and debt capital, based on their particular shares on the total funding capital, and represents the opportunity cost.
of these capital components, i.e. equity and debt, that are invested in a particular project (UNDP, 2014).

Moreover, the importance of the cost of capital on the total cost of RE investments is expected to be enhanced in the future due to the declining installation (mainly equipment) costs of both wind and solar power projects (IRENA, 2016c). This is mainly based on the fact that the financial costs are expected to become an even greater part of the total levelized cost of electricity produced by renewables as all the other cost components are facing a constant decline over time. This impact is also augmented by the fact that the cost of capital is highly affected by existing investment risks (IRENA, 2016a; Arnold and Yildiz, 2015; Gross et al., 2010; Mitchell et al., 2006).

In this respect, the sustainable energy transition depends on the opportunity of RE markets to attract high amounts of capital (IRENA, 2016a; Masini and Menichetti, 2012). This may be applied via a stable and efficient policy and regulatory framework and a well-functioning RE market (IEA-RETD, 2016), as the established policy targets and the respective policy actions exert a critical role in the deployment of RE investments (Masini and Menichetti, 2012). Specifically, the smooth integration of renewables in an efficiently designed and well-functioning energy (electricity) market is deemed necessary in the mid-term. In this context, the cost of capital is identified as a key driver for enhancing competitiveness of RE investments and, thus, facilitate the extended implementation of these projects (IRENA, 2016b; DIA-CORE, 2016).

The feed-in tariff (FIT) scheme has been the most commonly applied mechanism for supporting RE projects in most European countries (Jenner et al., 2013; Lüthi and Wüstenhagen, 2012). The high levels of effectiveness and cost efficiency, as well as the low risk premiums and secure returns to RE investors are the main advantages of the FIT system (Abdmouleh et al., 2015; Ecofys, 2014; NREL, 2010). Even though the FIT has proved to best mitigate risks for investors, the inadequate formulation of the tariffs, not in line with the real and gradual declining RE investment costs, may lead to distortions in the energy market (Ecofys, 2014). In addition, the maintenance of guaranteed remuneration level for RE projects may result in adverse effects on competitiveness and, thus, to less investments, due to the absence of credibility at the long-term level, and, therefore, future policy actions for further mitigation of RE applications’ cost (Kwon, 2015; Criscuolo and Menon, 2015).

The fixed and regulated tariffs and the clear tariff degression introduced in Germany have been the main determinants for the increased investors’ confidence and the extensive development of RE projects in the country (Liu, 2015). In addition, the long contract period (of 20 years) along with the guaranteed grid priority have been additional critical parameters that facilitated the extended financing of RE projects at low interest rates and the creation of a stable investment environment (Pegels and Liitkenhorst, 2014; Mabee et al., 2012).

Changes of the legislative framework, including, among others, alterations of the FITs and retroactive actions, may lead to an uncertain economic environment, negative effects on RE projects’ profitability and a less favorable investment environment for investors (Frantál and Prousek, 2016). Several retroactive changes of policies have been already taken in several countries of the EU, including Belgium, Bulgaria, Czech Republic, Greece, Italy and Spain, leading to negative impacts on the RE investment environment of these countries (de la Hoz et al., 2016; SolarPower Europe, 2015; Di Dio et al., 2015). Retroactive policy actions have taken place in Belgium, in 2013, as the implemented reforms of the Flemish RE support mechanism led into changes of the tradable green certificates (TGC) including a limitation of the TGC eligibility to 10 years for units already commissioned (El Kasmioui et al., 2015). In December 2013, a 20% tax has been imposed by the Bulgarian government on the income of wind and solar PV energy producers (Keep on Track, 2015). Retroactive legislation has been also introduced in Czech Republic, in 2010, with a tax of 26% for PV projects of installed capacity greater than 30 kW (Janda and Tyuleubekov, 2016). In Italy, the Legislative Decree No. 91, issued by the Italian Government, has also resulted into retroactive impacts on incentives for PV projects (Di Dio et al., 2015). For the case of Spain, the Royal Decree-Law 9/2013 has introduced retroactive reduction of the FIT levels for all RE producers (Gallego-Castillo and Victoria, 2015).

Regarding the policy costs induced by renewables, their control is vulnerable under a FIT policy scheme as the prediction of the market uptake’s rate is deemed difficult with no intermediate caps or capacity-based regression (Helapco, 2010). In several EU countries, such as Italy and Spain, the enormous growth of the solar PV market, as a result of the excess FITs provided, has led into considerable policy costs and enlarged electricity deficits (Ecofys, 2014). On the contrary, regular tariff formulation, on the ground of adjustment formulae related to market growth, is identified as an effective way of efficiently managing policy costs and, in parallel, avoiding negative effects to the RE investment environment (Ragwitz and Rathmann, 2011). Therefore, a fixed premium scheme is considered more favorable to less uncertain policy costs (Ecofys, 2014).

According to the European Commission’s Guidelines on State aid for environmental protection and energy 2014–2020, the FIT scheme will remain active solely for small-scale RE projects and the transition to feed-in premium (FIP) or tendering and auctioning mechanisms will be mandatory, leading to competitive bidding processes for RE remuneration (EC, 2014a). The maturity of RE technologies along with the need for increased cost-effectiveness and reduction of current distortions have been the most decisive factors for the gradual introduction of competitive bidding processes in the support of RE projects by the EU (EC, 2014b; EC, 2013). This transition is also promoted in the context of the Energy Union, which aims to effectively deal with market failures, guarantee effectiveness in terms of costs and avoid phenomena of excess compensation (EC, 2015). In this context, market-oriented policy measures and mechanisms are critical to be implemented in order to facilitate the augmentation of RE competitiveness (Eurelectric, 2014), aiming at both the reduction of the generation cost of RE applications and the attraction of external financiers’ active participation for providing their capital in sufficiently profitable investment options (Lee and Zhong, 2015).

Main aim of this paper is to assess the risks elements related to RE investments and quantify the cost of capital for onshore wind and solar PV projects in Greece. This study of analyzing risks and quantifying the cost of capital for RE investments in Greece is driven by the following questions:

- Which risks are influencing investments in the RE sector?
- How policies have affected these risks?
- Which is the expected return for a RE investor in Greece?

Within this framework, the WACC has been selected as the most appropriate financial indicator that reflects the risk environment in the country. The quantification of the WACC has been implemented via the application of the related financial models suggested by the scientific literature and the extracted results have been validated through numerous interviews with policy makers, project developers, investors, equity providers, bankers and energy analysts in the national RE market. In addition, a series of workshops has been implemented in order to reach a broader audience and receive feedback on the research results. Therefore, the involvement of key national energy experts in the assessment of the most critical risk elements of RE projects in Greece and the quantification of the respective cost of capital increases the validity of the study’s extracted outcomes.

The development of the most mature and widely applied RE technologies, namely onshore wind and solar PV, and the respective policies adopted in Greece are presented in Section 2. Section 3 introduces the theoretical model applied and describes the consultation procedure followed for the validation of this methodological approach
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات