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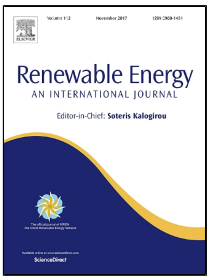

Wind energy plants repowering potential in Italy: technical-economic assessment

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Wind energy plants repowering potential in Italy: technical-economic assessment

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Abstract:
In many countries, pioneers in wind plants installation during the last decades of XX century, there is a progressive shortage of land based sites suitable for new wind farms and, at the same time, many installed wind turbines are reaching the end-of-life. Three options can be considered for a wind plant at the end-of-life: the decommissioning, the revamping and the repowering. The main advantages of the repowering option are the better exploitation of wind resource, the reduction of the wind turbine number and the prevention of further "virgin" land consumption. However, there are some issues that may affect the success of repowering initiatives: the significantly high investment costs and long and the complex authorization process. In this frame, in order to support both operators and decision-makers, RSE undertook a research activity concerning the evaluation of the wind repowering potential in Italy. The main objectives of this work were to understand the amount, the features and the geographical distribution of wind capacity that will reach the end-of-life in 2020 and also to develop repowering scenarios and to evaluate their technical-economic sustainability. A three steps methodology was designed and applied for the evaluation of the national repowering potential.

Keywords: wind energy, wind farm, repowering, WAsP code, internal return rate, payback time.

1. Introduction

The benefits of producing electricity from Renewable Energy (RE) sources, and, in particular, the reduction of greenhouse gas (GHG) emissions, are well known and promoted since 1997 with the adoption of Kyoto Protocol [1][2]. Since that date, RE production has significantly grown thanks to the support policies put in place by several countries in the world. In particular, the European Union played a remarkable role in fostering RE production in its Member States [2][3]. The share of renewables to at least 27% of EU energy consumption by 2030 has already been set as target by the 2014 EC Communication "A policy framework for climate and energy in the period from 2020 to 2030" [4]. Specific Member States targets are expected to be defined within 2018. In August 2015 President Obama and the U.S. Environmental Protection Agency (EPA) established the Clean Power Plan, announcing a path toward a 32 percent reduction in carbon pollution by 2030. This target will be achieve through a significant increase of the electric energy production by RE [5].
Among the RE technologies, on-land wind energy has nowadays reached a significant maturity level and a wide penetration. According to the Global Wind Energy Council (GWEC), at the end of 2015, the global amount of the installed wind capacity was 432 GW. China, with around 145 GW of installed wind capacity, has continued to establish itself as the most active country in this field and its contribution was decisive to allow Asia to overcome Europe and North America. After China, the United States were in the second place with around 74 GW, followed by Germany with 45 GW, India with 25 GW, Spain with 23 GW [6].At the same date, Italy positioned itself at the ninth place, with about 9 GW of installed wind capacity. This is a quite significant result taking into account that Italy has a slightly lower wind resource compared to Northern European countries, quite small territorial extension, high terrain complexity, high population density, significant number of high value crops and archeological sites, strong touristic vocation and almost total lack of national manufacturers involved in the construction/assembling of large size wind turbines [7].
Italy, together with Germany, Denmark, Spain, The Netherlands, UK and U.S, can be fully included among the "pioneer" countries involved in the development of wind energy plants. In fact at the end of 2000, when wind energy had its great development with more ambitious goals, Italy was among the five countries with the biggest installed wind capacity.[8]. In many of these countries, there is a progressive shortage of land-based sites suitable for new wind farm installations and, at the same time, many installed wind turbines are reaching the end-of-life[1]. In some cases (e.g. Germany, United Kingdom and Denmark), for further exploitation of wind energy they are looking to offshore installations [9], however, sooner or later, all the above mentioned countries will have to face the problem of a large amount of land-based wind turbines at the end-of-life, as recently highlighted by the European Commission [10].
Three options can be considered for the wind plants at the end-of-life: the decommissioning, the revamping and the repowering. In the first case, the whole power plant is dismantled. In the second case, some significant components of the wind turbines are replaced and the power plant goes on producing electricity. In the third case, the word "repowering" is intended as an intervention finalized to the complete replacement of the old wind turbines with new

[1] In general, the lifetime of an on-land wind farm is 20 years. In this paper the authors assume the end-of-life to be at least 15 years, corresponding to the maximum duration of the old incentive mechanisms, being conservative in assessing the national repowering potential at 2020.