Auctioning Wind Power Sites when Environmental Quality Matters

Ciaccia Gervasio
Italian Authority for Electricity and Gas (AEEG) and "Sapienza" University of Rome
gciaccia@autorita.energia.it

Doni Nicola
University of Firenze
Nicola.doni@unifi.it

Fontini Fulvio
University of Padova
fulvio.fontini@unipd.it

Overview

Auctions are frequently used when there is a need to assign exploitation rights of public resources (cf. Afualo *et al.* 1998). Even if their adoption is (at least in some cases) mainly due to the possibility to raise money for the public spending they have also interesting theoretical properties, allowing for an efficient allocation of scarce resources. In this work we frame within the auction theory an index that allows to order different project for the construction of onshore wind energy plants whenever environmental quality is at stake. Indeed, there are two main problems correlated to the decisions about onshore wind power sites. On one hand, even if wind is a public good wind plants need to be set on the ground and land is a scarce resource. This implies that there exists a rivalry between different projects of wind plants that needs to be resolved according to a (hopefully efficient) pre-defined criteria. On the other hand, onshore wind power sites are often claimed to generate negative externalities on the surrounding environment. This implies that the public regulator is called to define the maximum quantity of plants that can be installed in a specific zone and assess both the social acceptability of various exploitation projects (in the sense that their social benefits are higher than their social costs) and their ranking in case the "demand" for the installation of new plants is higher than the predefined "supply" of land. From an economic point of view, the problem resembles a multidimensional auction (cf. Che, 1993; Asker *et al.*, forthcoming): a wind farm project can be interpreted as a vector of attributes, each one affecting public welfare. For every project, we propose to consider four components of such a vector: $I = (E, N, S, R)$, where E is the technical properties of the project; N is its social impact; S is the environmental impact; R is the share of earnings that the proponent offers to the collectivity in compensation for the negative externalities of the wind plant; these components can be reduced to a single measure by a pre-defined scoring function that enables the decision maker to index each project.

Methodology

The index has a twofold aim: it should order different proposals and evaluate the acceptability of each project. For this reason we adopt an absolute scoring function, in which the score achieved by every proposal depends only by its contents[1]. The proposed index allows also to cope with two other issues, that are related with the problem of uncertainty and environmental evaluation. For the former, consider that every technical evaluation of a project depends on two different aspects: the characteristics of the planned investments and the suitability of the chosen site, which are not independent. The information regarding wind power of a site is uncertain and the best estimation is privately known by the proponent. Therefore the index has to reduce the risk borne by the proponent but at the same time it must also provide incentives to the proponent to correctly report his survey on the properties of the site. We propose in the index a mechanism that induces a truth revelation of the private information, fostering the proponent to pay a royalty which is a function of

[1] In Dini *et al.*, 2006, can be found other motivations regarding the superiority of this kind of methodology with respect to alternative formulas that make the score of each proposal interdependent.

both the estimated and the real quantity of energy produced. In this way he has no incentive to inflate the anemometric estimate and at the same time allows the proponent not to bear the whole risk associated to the uncertain evaluation. As far as environmental evaluation is concerned, the index must deals with the assessment of the environmental impact associated to a given wind farm. Indeed, the negative externalities associated to onshore wind energy exploitation are related to the noise and visual pollution, the possible interference with the existing flora and fauna, the reduced value of close sites and other similar aspects. In the light of the complexity of this interrelation, our index allows to assign a score to each of these environmental aspects on the basis of a pre-defined scoring rule and assess the overall environmental quality of the whole project.

Results

We propose a general index that is based on a linear combination of four different parameters that measure the suitability of the wind power site, the social impact of the plant, the economic compensation for the collectivity and the consequences of the project from an environmental point of view: $I = \theta E + \sigma N + \nu S + \rho R$. We attribute a score to the royalty R offered by the proponent by means of a linear function which allows to define the monetary value of a single point in the index (cf. Dini et al., 2006). This enables us to calibrate the index in order to consider the impact of the other components of the vector according to a coherent scale. In other words, our method allows public decision maker to understand the economic meaning of every point assigned to a specific proposal. The social impact S is synthesized by the number of new employees that the proponent of the projects aims at hiring, which is evaluated by means of a linear function; the suitability of the site E is based on the amount of the “equivalent working hours” (the ratio between the energy produced by the considered wind farm and the nominal power of the same wind farm) and its score is calculated by means of a concave function in order to reduce the potential misreporting of the evaluation of the proponent. Finally, as far as the environmental parameter N is concerned, we propose a score based on a set of pre-defined parameters, discretionally evaluated by a technical committee (on the basis of pre-defined scoring rule) which assess the externalities of the plant on the landscape, on the population, on the flora and fauna, as well as the design, the architectural characteristics and the potential attractiveness of the project.

Conclusions

The index allows the decision maker to order different proposals of wind power sites’ exploitation and to assess their environmental and social acceptability. For this purpose it is necessary to predefine a threshold-score that discriminates the acceptability of the projects, which depends on the specific environmental value of the zone in which plants are to be installed. This methodology requires also a predefinition of the maximum and the minimum acceptable values for each of the aspects that compose the evaluation vector. We present a calibration of the index, on the basis of the analysis of some representative cases, according to given characteristics of wind power sites and proposed projects.

References

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