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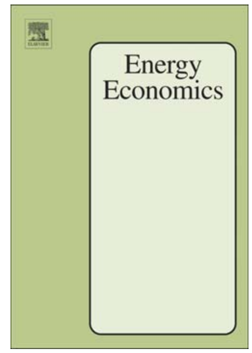

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Renewable energy in the equilibrium mix of electricity supply sources

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Abstract

A method to derive the long-run supply curve for a given renewable energy source and technology is proposed. The method accounts for the spatial complexity arising from the distribution of the energy source and the energy transport infrastructure of the territory. The use of the resultant supply curve within the partial equilibrium competitive model for the design and evaluation of renewable energy support schemes and for the determination of optimal supply mixes is illustrated. A case study with the application of the method for wind energy in Rapa Nui (or Easter) Island is presented.

Keywords: support schemes, renewable energy, supply curve, partial equilibrium, ISOPROFIT model

1. Introduction

Anthropogenic climate change has been called the greatest market failure the world has ever seen (Stern, 2007). It has been characterised as the greatest threat to future generations (Obama, 2015) and is viewed by the public as a top global concern second only to terrorism (Pew Research Center, 2015). Renewable energy support schemes are one of the main interventions undertaken by countries to address the problem. This is because the world's energy sector is the largest contributor to greenhouse gas emissions (IPCC, 2014), it is expected to continue growing with economic development (Bruns et al., 2013), and the belief exists that there is ample space in it for efficient emission abatement (IPCC, 2011). But the unexpected termination or drastic curtailment of national schemes in countries like Spain, the UK and Germany in the last years endorse the view that an improved method to set up such schemes is needed. Misleading regulation signals brought about by inadequate support schemes result in sub-optimal levels of renewable energy infrastructure investment, of fiscal expenditure, of technical development efforts, of carbon reduction targets and of energy prices, bringing economies farther away from the economically efficient energy matrix.

Increasing international pressure for energy subsidy reform (Coady et al, 2015), growing hunger for energy of developing economies (Wolfram et al., 2012; King et al., 2015), the advent of the electric car and the pressing commitments made at the 2015 UNFCCC Paris conference foretell demanding times for policy makers working on renewable energy schemes. The IPCC (2014) estimates that fulfilling by 2100 the main goal of the Paris Agreement[1], would require anthropogenic greenhouse gas emissions to be by 2050 in the range of 60 to 30% those of 2010. There is little doubt that these challenges require major transitions in the worldwide energy system (van Vuuren et al., 2015), a key outcome to our subsistence on Earth.

Energy supply can be classified as coming from non-renewable and from renewable sources. The supply mix of the non-renewable part can be optimised using a set of criteria based on least cost or profit maximisation. However, the optimal supply mix of the renewable part is more complex to determine, as it depends on each territory's potential for that kind of generation. It is here where energy policy may fail to provide proper regulation, hence one of the reasons for the constant need for revision of support schemes. In fact, the territorial potential for incorporating renewable energy becomes the central problem when studying policy interventions to favour the

[1] The main goal of the Paris Agreement consists in "holding the increase in global average temperature to well below 2°C above pre-industrial levels" (UNFCCC, 2015).