ARTICLE IN PRESS

Energy Policy ■ (■■■) ■■■-■■■



Contents lists available at ScienceDirect

Energy Policy

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



Effects of changes in Italian bioenergy promotion schemes for agricultural biogas projects: Insights from a regional optimization model

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HIGHLIGHTS

- We review the evolution of agricultural biogas support schemes in Italy over last 20 years.
- · A biogas supply chain optimization model which accounts for feed-in-tariffs is introduced.
- The model is applied to a regional case study under the two most recent support schemes.
- Incentives in force until 2013 caused homogenization towards maize based 999 kW_{el} plants.
- Wider, manure based supply chains feeding smaller plants are expected with future incentives.

ARTICLE INFO

Article history: Received 11 April 2014 Received in revised form 16 September 2014 Accepted 16 September 2014

Keywords: Agricultural biogas Supply chain optimization Bioenergy support schemes

ABSTRACT

Italy has witnessed an extraordinary growth in biogas generation from livestock effluents and agricultural activities in the last few years as well as a severe isomorphic process, leading to a market dominance of 999 kW power plants owned by "entrepreneurial farms". Under the pressure of the economic crisis in the country, the Italian government has restructured renewable energy support schemes, introducing a new program in 2013. In this paper, the effects of the previous and current support schemes on the optimal plant size, feedstock mix and profitability were investigated by introducing a spatially explicit biogas supply chain optimization model, which accounts for different incentive structures. By applying the model to a regional case study, homogenization observed to date is recognized as a result of former incentive structures. Considerable reductions in local economic potentials for agricultural biogas power plants without external heat use, are estimated. New plants are likely to be manure-based and due to the lower energy density of such feedstock, wider supply chains are expected although optimal plant size will be smaller. The new support scheme will therefore most likely eliminate past distortions but also slow down investments in agricultural biogas plants.

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1. Introduction

In the last few years, electricity generation from agricultural and landfill biogas in Europe has increased from approximately 17 TW h in 2006 (Eurobserv'er, 2008) to almost 36 TW h in 2011 (Eurobserv'er, 2012). In Italy, installed capacity and yearly electricity production increased by a factor of approximately 9 between 2007 and 2011 (Table 1).

Production values recently achieved in Italy are just a fraction of potentials: Tricase and Lombardi (2009) estimated that animal breeding sewage digestion alone could generate up to 3.6 TW h year⁻¹, which is approximately twice as much as *total* production levels in 2011.

http://dx.doi.org/10.1016/j.enpol.2014.09.014 0301-4215/© 2014 Elsevier Ltd. All rights reserved. In the near future, it would thus be technically feasible to expand agricultural biogas generation beyond current production levels. Whether expanding agricultural biogas generation would also be economically feasible depends largely on promotion schemes. In fact, several studies from different countries (e.g., Yiridoe et al., 2009; Gebrezgabher et al., 2010) confirm that, even considering co-benefits from cogenerated heat or digestate exploitation, power generation from agricultural biogas plants is profitable only when some form of incentive is available. Indeed, in the recent expansion of agricultural biogas in Italy, incentives were decisive.

1.1. The evolution of biogas support programs in Italy

The first incentives for electricity generation from agricultural biogas were introduced in Italy before the liberalization of energy markets with the resolution known as CIP6 (Provvedimento

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