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# Sustainability that backfires: the case of biogas in Emilia Romagna

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ABSTRACT

The development of a low carbon society does not always deliver sustainable outcomes at local level, as in the case of bioenergy. This paper analyses the impacts of biogas development in Emilia Romagna (Italy) from a social, economic and environmental perspective (triple bottom line). Since 2009, the number of biogas plants has exponentially increased here, following the introduction of the feed-in tariff. Social opposition has been rising since. Therefore, the goal of the study is to investigate the causal processes of biogas development in order to understand what endangered its triple bottom line sustainability. The study does so by employing qualitative system dynamics (i.e. causal loop diagram). Results show that sustainability is threatened by weak local synergies, plants management and equipment deficiencies and agriculture related issues. The analysis suggests that policy interventions should focus on biomass supply and outputs diversification, governance, and social participation.



## 1. Introduction

In the last decade, the development of a low carbon and sustainable society has received enormous political and academic attention as it represents a desirable solution to climate change, energy security and economic growth (e.g. European Directive 2009/28/CE; European Commission, 2010a; European Commission, 2010b; Smith et al., 2005; Geels and Schot, 2007; Leach et al., 2010; Markard et al., 2012). Accordingly, the transition toward a low carbon society is supposed to lead toward a better future (e.g. renewable energy, electric cars) though in reality it may generate several negative outcomes e.g. social opposition, poor redistribution, higher energy bills, land pollution, bad smells, or competition with food production. The transition to bioenergy is a good example of this. Among other renewables, bioenergy has the greatest potential to be integrated in the rural economy, since it uses its endogenous resources such as land and agricultural products, human resources and local expertise (Bluemling et al., 2013; Del Rio and Burguillo, 2009; OECD, 2012; Raven and Gregersen, 2007; Raven and Verbong, 2004). However, evidence shows that what seems to be good at national level may become negative at local levels (Batel and Devine-Wright, 2014; Zoellner et al., 2008. In several cases the alleged benefits of bioenergy adoption (e.g. new job and business opportunities; capacity building and community empowerment, affordable energy and energy security) are not perceived, and the negative effects trigger local tensions and conflicts (OECD, 2012; Batel et al., 2013; Buchholz et al., 2009, 2007; Carrosio, 2013; Cavicchi et al., 2014; Domac et al., 2005; Geels and Raven, 2006; Mangoyama and Smith, 2011;

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Thornley et al., 2009; Upreti, 2004; Upreti and Van der Horst, 2004; Walter and Gutscher, 2010; Wüstenhagen et al., 2007). Yet, if such opposition emerges, as it has in many areas, it inevitably delays bioenergy adoption and increases the costs for bioenergy businesses, hindering the achievement of bioenergy goals. Bioenergy policies have rarely reckoned with the risks of linking such diverse systems – i.e. socio-economic and eco systems – without a serious account of potentially interrelated effects.

Therefore, the novelty of this study is twofold: on one hand, it questions the alleged benefits of bioenergy development and to investigate the causes for unsustainability. On the other hand, it considers social, environmental, economic activities and outcomes as mutually influenced via feedback relations. It thus draws on the case of biogas development (i.e. diffusion of biogas plants, biomass supply, electricity production) in Emilia Romagna (Italy) as an example of policy failure to support the adoption of a sustainable biogas system as per the triple bottom line (TBL) perspective of sustainability. The TBL considers environmental, social, economic activities and their outcomes as endogenously interrelated (e.g. Elkington, 1998; Bryden et al., 2008, 2011). The study uses qualitative system dynamics (i.e. causal loop diagram, CLD) to investigate these endogenous feedback relations. The CLD will map the causal processes of biogas development by using the information gathered through semi-structured interviews and public reports (i.e. regional database and statistical reports).

The paper is structured as follow: firstly, it presents the problem situation, research questions and objectives. Secondly, it introduces the theory, methodology and methods applied in the study. It then moves on into the results section, which includes the key facts, regulations and analysis of causal processes. The concluding discussion and policy recommendations highlight the key findings and potential policy implications.

### *1.1. Problem articulation: research questions, objective and structure*

The current paper is based on a previous study of bioenergy policy in Emilia Romagna – and Norway – (Cavicchi et al., 2014; Cavicchi, 2013) that investigated the impact of policies and institutions on bioenergy and rural development in Emilia Romagna. Emilia Romagna hosts part of the largest plain in Italy (Padana Plain or Poí Valley) and quite a well-functioning regional agriculture. However since the introduction of the feed-in tariff at the beginning of 2009, the diffusion of biogas production has been causing several unforeseen problems (Cavicchi et al., 2014; Cavicchi, 2013; Carrosio, 2013). After initial high profit expectations, most of biogas operators are encountering economic difficulties. Additionally, people throughout the region have organized themselves in committees against biogas and perceive this new rural activity as extremely harmful for their health, the rural economy and the environment. The SWOT analysis in that study (Cavicchi et al., 2014) showed that obstacles to sustainable bioenergy development in the region were social opposition, the weak role of local governments, and weak links between government–businesses–research sector and negligible local benefits (Cavicchi et al., 2014; p. 362–363). The study looked at *bottom-up local participation* (p. 363)—although in the form of social opposition—as a potential trigger for policy and institutional change. Therefore, this paper asks: *what feedback relations influence the unfolding of biogas development in the case study? And which of them seem to foster or hamper its sustainable development (where sustainable means economic, social and environmental sustainability)?* By drawing on the triple bottom line concept, *"sustainability"* of biogas is understood as processes of its development that secure economic long-term feasibility to biogas producers while providing rural areas with social and environmental benefits, e.g. local GHG emissions reduction, new sources of income, local cooperation, etc. (see for instance OECD 2012; Bluemling et al., 2013; Del Rio and Burguillo, 2009; Mangoyama and Smith, 2011). In this sense, the paper particularly relies on the information gathered through semi-structured interviews with regional and local informants, public documents (e.g. regional policies – energy plans; resolutions, etc.) and relevant publications on Emilia Romagna and other cases (see for instance the OECD report 2012, Carrosio, 2013; Fabbri et al., 2013).

## 2. Theory and methodology

### *2.1. Theory*

This study is predominantly an inductive 'ground-up' rather than a deductive 'theory-down' process, seeking to develop a contextual explanation of the causal processes of biogas development and sustainable outcomes in Emilia Romagna. It does not start off by hypothesizing a relationship between dependent and independent variables. Rather it aims at exploring the causes that link biogas development to unsustainable outcomes (dependent variable) in the case study. As such, the study's theoretical ground rests on the systems thinking tradition (Checkland, 1981; Senge 1990; Richardson, 1991; Forrester 1968; Sterman, 2000). Systems thinking is a broad and general approach to deal with a problem, whatever the subject area is. Two of the most influential scholars (Checkland, 1981; Senge, 1990) stress that "*systems thinking*" is a *"meta-discipline whose subject matter can be applied within virtually any other discipline"* (Checkland, 1981; p.5). Scholars within this tradition share a particular way of regarding the world, i.e. they assume that the world is made of 'wholes', which include social, biophysical, chemical etc. elements connected together.

There are different approaches within the systems thinking tradition. Literature commonly distinguishes between *hard-systems* and *soft systems* approaches. The former rest upon cybernetics and servomechanisms and employ mathematical modeling and simulations to seek the most efficient system's behavior solutions; the latter use a more interpretative–constructivist approach to enable an in-depth understanding of the organization's behavior (i.e. the system's behavior) to improve the way actors tackle critical organizational issues. However, there are significant overlaps