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The networking dynamics of the Italian biofuel industry in time of crisis: Finding an effective instrument mix for fostering a sustainable energy transition

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ABSTRACT

This paper aims to design the effective instrument mixes for fostering a sustainable energy transition in times of crises. We focus on a sufficiently developed green niche – namely the Italian biofuel sector – implementing a two-step investigation: 1) a social network analysis, to study the effects of the crisis on the basic niche development mechanisms, with the aim of eliciting its development needs; 2) a fuzzy inference simulation based on a causal-effect map drawn from experts' knowledge to identify the most effective instrument mix for the development of the niche studied. The major needs emerged in the case investigated are for an increase of actors' expectations towards the further development of the sector, and a need for a tailored networking activity, devoted to attracting specific knowledgeable actors. The results indicate that, among others, effective policy instruments are, in this case, the cooperation that has the best outcome in terms of networking, and the public procurement, which remarkably increases the level of expectation. The analysis presented constitutes a model to evaluate single policy drivers and their combinations to find adequate policy actions to promote the green energy transition in times of crisis.

1. Introduction

The dominant debate about the recent economic crisis has, so far, focused on issues such as stagnating growth, increasing unemployment, reducing consumption and investment, failing banks and nations, etc., almost completely overlooking the ecological and social issues. However, economic crises can affect the transition towards a decarbonized energy system by means of two opposing forces.

On the one hand, economic crises may consolidate the lock-in trajectories towards a fossil-based regime due to several aspects (van den Bergh, 2013). Firstly, the consumption of green goods and services may be significantly affected by the general decrease in aggregate demand during economic crises. Secondly, economic crises can constrain companies' green investments as a consequence of the associated financial crunch. Thirdly, austerity policies in response to economic crises may reduce public support of renewable energy, such as subsidies and feed-in tariffs. Finally, the possible reduction in fossil-fuel price during economic crises can bring lower biofuel prices due to their high degree of substitution, therefore hampering the profitability of investment in bio-refineries. For instance, the slump in renewable energy investments in the recent economic crisis has intensified, particularly at the beginning of 2009, with about a 40% drop in spending with respect to the end of 2008 (International Energy Agency, 2009).

On the other hand, economic crises can foster sustainable energy transitions by creating favorable conditions for greener production and consumption systems (Geels, 2013; Antal and Van Den Bergh, 2013). According to van der Ploeg and Withagen (2013), a combination of well-designed policy tools (e.g. tax relief, R&D subsidies, etc.) may drive growth from polluting to cleaner economic activities, making green growth a possible solution to escape the global economic crisis. Indeed, in times of economic crises, green industries can provide a relevant number of direct and indirect job opportunities, as occurred recently at the EU level where the number of jobs provided by green industries amounted to approximately 14.6 million in 2012 (EU Sustainlabour, 2013).

In this framework, the sociotechnical transition (STT) approach can provide a multidisciplinary framework that draws on different disciplines; this then offers an integrative system-wide view for investigating the relationship between some landscape shocks (e.g. economic crises, etc.) and new environmental challenges. Several studies

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employ the Multi-Level Perspective (MLP) as a framework to analyse sustainable energy transition since it allows a focus on different dynamics occurring at various levels (Mattes et al., 2015; Falcone, 2014). In particular, it is possible to identify three linked levels, namely a macro-level (the landscape), a meso-level (the regime), and a micro-level (the innovation niches) (Rip and Kemp, 1998; Geels, 2002). The landscape level embodies exogenous determinants including material and social infrastructure, politics, natural setting, etc. The regime represents a stable set of institutional rules, technical knowledge, and social interaction patterns shaping the fundamental configuration of technologies. Finally, the innovation niche can be conceived as a protected space where promising technologies are developed and experimented.

It can be seen from this that sustainable energy transition results from the interaction of the MLP levels, namely when a sufficiently developed niche-innovation challenges the dominant regime which, in turn undergoes an adequate amount of pressure from the landscape (Hansen and Nygaard, 2014). However, governing the above co-evolutionary dynamics involves a number of challenges for policymakers who are called to identify the effective policy mix to foster the transition process (Hildingsson and Johansson, 2016). Such government challenges increase noticeably in time of crisis when decision makers face the problem of setting appropriate policy instruments to deal, simultaneously, with the economic downturn on the one hand and the decarbonization of the economy on the other (Solomon and Krishna, 2011). From this view, our knowledge about how to govern a sustainable energy transition in time of crisis still looks very limited (Costa-Campi et al., 2015).

For the purpose of our analysis, we posit the discussion concerning the economic crisis with reference to the Italian context. In particular, the country is among the major EU Member States with a relatively high consumption and production rate of biofuels (Assocostieri, 2015) as well as a frontrunner in the EU's bioeconomy context (Intesa San Paolo, 2015). However, the Italy's economy is still lagging behind its European peers (FocusEconomics, 2017). Specifically, while much of the world has recovered from the economic and financial crisis of 2008–09 (e.g. Asia, Latin America, USA), though with slower growth e.g. in the U.S., China and Western Europe, Italy's severe economic problems have lingered much longer. In this framework, Italy represents a highly relevant case for investigating which policy mix is most effective for a sustainable energy transition to occur in time of economic crisis. In other words, we seek the effective mix of instruments to give momentum to a sustainable energy niche to become a solid alternative to the dominant regime. In particular, our analysis is based on a two-step investigation addressed at a sufficiently developed green niche, namely the Italian biofuel sector. The first step is devoted to the analysis of the Italian biofuel niche, with the purpose of eliciting the development needs of the sector. More specifically, by means of the social network technique, we study the effect of the recent economic crisis on the fundamental niche development mechanisms. To this end, we initially carry out a stakeholder analysis aimed at identifying all the relevant actors for the Italian biofuel niche. Actors have then been surveyed to explore the networking evolution of the niche and to identify the effects brought by the economic crisis. The second step is addressed at the identification of the effective instrument mixes that can foster the niche development. Specifically, through a number of interviews with experts, we derive a causal-effect map of policy instruments by employing a fuzzy cognitive map method to understand effective instrument mixes that can contribute to drive the transition towards a decarbonized energy system in light of the recent economic crisis.

The rest of this work is organized in the following way: Section 2 depicts the state-of-the-art; Section 3 reports the case-study and methodology; Section 4 deals with the results achieved; Section 5 contains some discussion of results; finally, some concluding remarks are provided in Section 6.

2. Literature review

2.1. Sustainability transitions and policy mixes

When an innovation is specifically developed to address environmental problems, a 'double externality problem' arises, with this type of innovation combining both private and social benefits (Hemmelskamp, 1997). Adding these two externalities justifies, therefore, the need for policy combinations to drive companies' innovative effort (Ziegler and Rennings, 2004). As a matter of fact, the importance of policy mixes for driving the decarbonization of the energy system has been increasingly acknowledged in the sustainability transition literature (Markard et al., 2012). In this context, the debate to what extend policy mixes can foster the transition towards a more sustainable system has recently gathered growing interest among policymakers and academics concerned with the emerging topic of socio-technical transition theory. Several contributions relies upon the notion of 'policy mix' proposed by Borrás and Edquist (2013, p. 1514) who refer to *"a set of different and complementary policy instruments to address the problems identified"* in a national or regional innovation system. However, wider interpretations have been provided recently. Essentially, policy mixes are "complex arrangements of multiple goals and means which, in many cases, have developed incrementally over many years" (Kern and Howlett, 2009, p. 395). These include the integrate consideration of traditional technology push and demand pull instruments as well as the systemic concerns relevant for the transition towards sustainability (Rogge and Reichardt, 2016).

Originally, much attention was placed upon the mere interaction of diverse policy instruments for an effective outcome (Gunningham and Grabosky, 1998; Gunningham and Sinclair, 1999; del Río González, 2007), and on the process of policy shaping and design of such instruments to develop a prescriptive framework for policymakers (Howlett and Rayner, 2007).

Lately, a broader conceptualization of the policy mix notion appeared so as to propose a more comprehensive background for examining the cause-effect relations between policies and technological innovation. The rationale of referring upon a broader policy mix conceptualization is justified by the presence of multiple traits looking beyond a mere policy instrument in combinations, in terms of long-time policy aims, and the other policy mix properties such as consistency, comprehensiveness, credibility and stability (Costantini et al., 2017; Uyarra et al., 2016; Reichardt and Rogge, 2016; Sovacool, 2009). In this vein, Reichardt and Rogge (2016) have contributed to the debate on policy mixes for sustainable transitions by providing: (i) an extended interpretation of the policy mix in order to better capture the intricacy and dynamics of real world, going beyond the mere combination of instruments and strategies for long lasting aims; (ii) a comprehensive analytical framework able to facilitate empirical study focusing also on neglected aspects, in order to allow a more accurate policy proposal. Likewise, Quitzow (2015) suggests an integrating framework for comparative policy evaluation, concentrating on some explicit challenges concerning the spread of sustainable innovations. To this end, the author further develops the conceptualization of the "policy strategy" also including the normative dimension of policy making (e.g. value judgements, political opportunities and societal pressures) as well as the objectives, measures, and processes at the basis of a specific mix of policy. Finally, Kivimaa and Kern (2016) emphasizes that 'ideally' policy mixes for sustainable transitions embrace elements of 'creative destruction', concerning both policies aimed at the 'creation' of new and for 'destabilising' the old. Essentially, they propose a new analytical framework by expanding the notion of 'motors of innovation' to 'motors of creative destruction' that consider both policy mix dimensions ('creation' and 'destruction'). Therefore, transitions involve not only the creation or diffusion of innovative and environmentally friendly technologies, but also a broader shifting of the current unsustainable system.