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The sustainability of forestry biomass supply for EU bioenergy: A post-normal approach to environmental risk and uncertainty

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ABSTRACT

Most bioenergy supply scenarios suggest that a substantial fraction of future European energy supply could be biomass-based. Yet stakeholder opinion on the risks posed by a high level of bioenergy supply varies and the related science base is relatively undeveloped. Thinking on post-normal science advocates that issues with contested sustainability and risk implications are best resolved or negotiated via inclusive stakeholder fora, in which a variety of values and ways of thinking are respected. As the potential impacts of a large scale supply of forestry biomass for bioenergy have generally received less attention than the potential impacts of first generation biofuels, we use woody biomass risks to illustrate a novel risk perception typology that is consistent with thinking on post normal science. The typology is intended to both strengthen the case for inclusive decision-making in general and to clarify the nature of the risks posed by global solid biomass supply for European bioenergy.

1. Introduction

As a renewable resource, bioenergy technologies are increasingly used to provide low carbon energy in the UK, Europe and worldwide (UNECE/FAO, 2009). This article discusses the environmental risks principally posed by feedstock options for a large scale, globally-sourced supply of solid (woody or lignocellulosic) biomass for EU production of bioenergy, as an illustration of a particular, post-normal approach to characterising risk and uncertainty in policy contexts. The primary aims are to illustrate the implications of applying a post-normal science approach to an environmental policy area in which risk and uncertainty are significant and to argue for a more precautious and inclusive form of policy development in the arena of bioenergy. Solid biomass for bioenergy is used as an example because this has received less attention than has the cultivation of biomass for transport fuels.

Variation in bioenergy scenarios and assumptions (global, national and sub-national) is substantial. Here it is necessary to be selective in briefly indicating and illustrating the possible scales of bioenergy supply at European, national and global levels. Considering the European level first, bioenergy policy is

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driven by the Directive on the promotion of energy from renewable sources (Renewable Energy Directive, RED), which set new targets to be achieved by 2020: to reduce greenhouse gas (GHG) emissions by 20%; to establish a 20% share for renewable energy; and to improve energy efficiency by 20% (20–20–20) (EC, 2009). The European Environment Agency (EEA) suggests that environmentally-constrained, European-sourced bioenergy could reduce 2030EU GHG emissions by some 11–13% relative to baselines without bioenergy/biofuels (EEA, 2008). An earlier EEA study with relatively strong environmental assumptions (e.g., at least 30% of the agricultural land dedicated to 'environmentally-oriented farming' in 2030 in most Member States; current protected forest areas maintained; use of primarily woody and grass-species energy crops) estimates the bioenergy potential in 2030, from European supply, as c.15% of projected EU-25 primary energy requirements in 2030 (EEA, 2006). However it is important to note that the EEA study assumes on-going liberalisation of global agricultural markets, which is modelled as releasing substantial EU land areas from food production: nearly 15 mha of additional arable land is assumed to be available by 2030 (EU-22; EEA, 2006). Most scenarios of bioenergy for European nations do not assume the use of only EU-sourced biomass. Nonetheless, the assumption of biomass imports need not imply a larger percentage contribution to energy supply. For example, Thornley et al. (2009) estimate that by 2020, environmentally constrained bioenergy supply, both imported and domestically produced, could provide at best some 5% of the UK's 2020 final energy demand.

At the global scale, primary energy supply potential has been estimated to be in the range 125–760 EJ per year (IPCCC, 2007). Taking into account multiple previous bioenergy scenarios, Doornbosch and Steenblik (2006) estimate a plausible and environmentally constrained 2050 value to be some 245 EJ/year (110 EJ/year from bioenergy crops, from wood residues 90.6 EJ/year, from crop residues 34.8 EJ/year, from animal and organic waste 10.8 EJ/year). This estimate assumes no use of high quality arable or so-called marginal/degraded land (Doornbosch and Steenblik, 2006). To put this in perspective in energetic terms, global primary energy supply in 2007 was 504 EJ (IEA, 2009, converted from Mtoe), so this scenario envisages 2050 bioenergy as capable of supplying nearly 50% of current primary energy supply. For a different and more partial perspective, for the Southern hemisphere to meet 20% of 2020 OECD transport fuel demand would require producing 18 times as much biofuel as Brazil's 2007 production (Mathews, 2007).

The prospect of a large-scale, international bioenergy/biofuel trade raises a wide variety of concerns and issues, including: the use of arable land for food (e.g., Ariza-Montobbio and Lele, 2010; Ariza-Montobbio et al., 2010); control of access to resources (including land, water and genomes); loss of biodiversity (e.g., Wakker, 2004); net GHG emissions from direct and indirect land use change (e.g., Upham et al., 2009; Ravindranath et al., 2010); and inadequate governance systems (Thornley et al., 2009; Upham et al., 2009, 2011; Tomei and Upham, 2009). With the above concerns in mind, we have earlier called for more politically inclusive processes for developing biofuel and bioenergy policy (Upham and Tomei, 2010). This is justified on several grounds: the high level of dissent for what is generally supposed to be an environmentally sustainable policy; the many uncertainties and cross-policy domain complexities involved; and the involvement of non-state organisations in managing and validating the sustainability of biofuels and bioenergy–i.e., the critical role of civil society in legitimating certification processes (Upham and Tomei, 2010).

The following sections first provide an overview of EU bioenergy policy relating to solid biomass. Several of the main woody biomass options for EU bioenergy are then described, selecting from, and adding to, those identified in European Environment Agency (EEA) scenarios, focussing on production scales and impacts. Following this, a particular approach to conceptualising risk and uncertainty is articulated and related to existing thinking on both risk perception and post-normal science. The implications of this approach for thinking about bioenergy risks are then considered, followed by discussion of the implications for the processes by which European bioenergy and biofuel policy is developed.

2. European policy on managing the risks of solid biomass for bioenergy

The European RED does incorporate measures intended to address the sustainability risks of expanding global biofuels and solid biomass markets (EC, 2009). However, in the case of solid biomass, legislators either appear willing to admit being defeated by the complexity of the regulatory environment, or use the rhetoric of being so, with an EC press release stating that: 'the wide variety of biomass feedstocks make(s) it difficult to put forward a harmonised scheme at this stage' (EC, 2010). The Commission has further taken the view that the sustainability risks relating to domestic biomass production originating from wastes and agricultural and forestry residues, where no land use change occurs, are currently low (EC, 2010). Observers note that although the Commission's environment department and several member states favoured binding sustainability criteria, it was the view of the Commission's energy and transport department that prevailed (EurActiv, 2010). The Commission's reasoning includes the further argument that, unlike in the case of some agricultural crops and energy crops (such as short-rotation coppice), biomass wastes and processing residues are not produced specifically for use in the energy sector, but result from other economic activity that would take place anyway (EC, 2010, Section 2.1). In this respect, the use of waste biomass for energy is potentially of net environmental benefit and is regarded by the Commission as something to be encouraged rather than subjected to the additional costs of regulatory control. The Commission further reasoned that, particularly where forest or agricultural residues are used, the GHG savings of European feedstocks are high, generally above 80% savings compared to the fossil alternative, such that the risk of not achieving high GHG savings is correspondingly lower than for liquid biofuels. The difference is attributed to the typical processing (e.g., pelletisation) generally being less energy-intensive than the processes required to make transport biofuels (EC, 2010).

In the discussion of GHG savings over the life cycle, the Commission foot-notes that the typically high GHG savings