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Developing integrated explorative and normative scenarios: The case of future land use in a climate-neutral Sweden

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ABSTRACT

Transition from the current oil-based world economy to an economy based on renewable resources can become a strong driving force for land use change. This paper describes the development of integrated explorative and normative scenarios for the analysis of future land use in a climate-neutral Sweden. The aim is to show how backcasting scenarios fulfilling far-reaching greenhouse gas reduction targets can be related to assumptions on possible external developments, in order to contribute to the discussion on future sustainable land use. A target-fulfilling scenario element was combined with an external scenario element, i.e. developments that cannot be influenced by the targeted actors. The scenarios were developed and analysed in collaboration with local actors. Four scenarios were used to describe how land in Sweden could be used when Sweden has achieved zero emissions of greenhouse gases in 2060. The explorative dimension stretched from a situation where there is no international climate agreement to one where there is an international agreement on reducing greenhouse gases. The backcasting dimension illustrated different strategies to achieve the target and stretches from a very influential municipal level to one where the national/EU level is most influential.

1. Introduction

Climate change is considered one of the most severe challenges humankind has to face. The latest report of the Intergovernmental Panel on Climate Change (IPCC, 2013) establishes that warming of the climate system is unequivocal and will have profound environmental impacts. The well-being of humans, societies and economies will also be severely affected in the years to come (IPCC, 2007). Society needs to respond and adapt to climate change, and also continue and enforce the process of mitigation (reduction of greenhouse gas (GHG) emissions). For Sweden, the GHG reduction target for 2020 is 40% below 1990 levels and for 2050 a "vision" of 100% reductions has been set (no net emissions of GHG in the atmosphere) (Swedish Government, 2009). Even if short-term targets may be reached in Sweden (National Institute of Economic Research, 2012), long-term targets will be very difficult to achieve. Transformative change is needed in order to address such challenges, requiring new norms, new policies and new forms of governance (van Vuuren et al., 2012). In this process, futures studies can be a powerful means to illustrate the transformations needed to achieve set targets (Börjeson, Höjer, Dreborg, Ekvall, & Finnveden, 2006). Images of the future can provide examples of what society may be like when targets are fulfilled,

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and widen the perceptions of what is considered possible (Dreborg, 1996; van der Heijden, 1996). They can also shed light on gaps between current policies and policies and actions that would be required to achieve the targets, as well as illuminating conflicts between different societal goals and visions (Höjer & Mattsson, 2000).

The Intergovernmental Panel on Climate Change (IPCC) has drawn the conclusion that fossil fuels are an important source of anthropogenic GHG emissions (IPCC, 2013). Thus, a profound change in the energy supply system on the global and national level is needed in order to mitigate climate change. However, transition from the current oil-based world economy to an economy based on renewable resources will influence land use and become a strong driving force for land use change, since biofuel production competes for land with other land uses. Growing demands for both energy and food will increase the pressure on productive land areas globally (cf. Nonhebel, 2005; Tilman, Cassman, Matson, Naylor, & Polasky, 2002). This will have implications for land use in Sweden too.

This paper reports on the scenario development work in the Swedish research project SCALER (Strategies for mitigating Climate chAnge–scenarios for Land usE in Rural areas). The aim of the project was to explore strategies for land use in zero GHG emission (i.e. no use of fuels that contribute to climate change) contexts, by the use of scenarios. The scenarios and the scenario process, which included continuous iterations with stakeholders, are presented here. Four scenarios of future land use were developed, iterated and discussed in two Swedish municipalities and with national experts. The ultimate aim was to contribute to the discussion on sustainable land use and potential trade-offs between different land uses and other policy targets, and to give municipalities a tool to evaluate transformative change in relation to climate mitigation and land use in a longer time frame than they usually work with.

2. Futures studies and scenarios as a tool for exploring zero GHG emission land use futures

According to Kahn and Wiener (1967. p. 6), scenarios are "hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision-points", that answer questions of how a hypothetical situation may come about and what alternatives exist to prevent, divert and facilitate such a process. Aligica (2005, p. 816) describes scenarios as "an attempt to draw instruction from a process of hypothetical reasoning that proceeds by drawing out the consequences of an hypothesis which, although it may be anchored in well established facts, refers to future (that is possible) developments".

Kok, Verburg, and Veldkamp (2007) argue that scenario development is a relatively under-explored method in land use planning. There are, however, several examples of quantitative and explorative scenarios dealing with land use. Many take the European perspective and several use the IPCC scenarios (Nakićenović et al., 2000) as a basis for building scenarios (e.g. Eickhout, van Meijl, Tabeau, & van Rheenen, 2007; Rounsevell et al., 2006). Rounsevell et al. (2006) use alternative scenarios for future agriculture in Europe in an exploration of how agricultural land use might respond to future environmental change drivers, one of these being climate change. These authors expect a large decline in agricultural area, based on assumptions about far-reaching technological advances and hence a surplus of land. Eickhout et al. (2007) combine economic analyses of agricultural and trade policies (the Common Agricultural Policy and World Trade Organisation agreements) with environmental analyses of land use. Wirsenius, Azar, and Berndes (2010) model explorative scenarios in order to estimate land requirements for food production in 2030. They conclude that an expansion of arable land on a global level will be necessary unless changes are made in terms of e.g. food wastage or dietary changes.

There are, however, fewer examples of land use scenarios based in the futures studies field, within which the present study is based. While there is no generally accepted definition of what the futures studies field is, Amara (1981 p. 26) states that the goals of the field are to form perceptions of the future (the possible), to study likely alternatives (the probable) and to make choices to bring about a particular future (the preferable). Many futures studies methods exist and can be used for different purposes and for answering different research questions (Bell, 2003; Börjeson et al., 2006). In any case, futures studies methods provide possibilities to formulate and illustrate different future developments, a process that can address uncertainties and enhance preparedness for the unforeseeable and unexpected (Svenfelt, 2010).

If possible futures are being sought, then methods for developing explorative scenarios, or scenario planning (van der Heijden, 1996), may be a suitable tool. Such scenarios can describe future events or developments that are considered possible and can be useful in a process of developing robust strategies (that can prevail in several kinds of external developments) (Börjeson et al., 2006). If preferable futures, or futures fulfilling a specific target, are sought, then methods for developing normative scenarios can be used (Börjeson et al., 2006). Backcasting (e.g. Robinson, 1982, 1990) is one kind of normative scenario approach that is suitable when the problem being examined is complex, multilateral (affecting many sectors and levels of society), major changes are needed, dominant trends are part of the problem, externalities are involved and, finally, "when the time horizon is long enough to allow considerable scope for deliberate choice" (Dreborg, 1996). We argue that these criteria definitely apply to the case of future land use related to climate change mitigation and adaptation.

Backcasting has been used particularly to explore goal-fulfilling or desirable futures for the climate change mitigation part, i.e. for decreased energy use and decreased emissions of GHG (e.g. Green & Vergragt, 2002; Höjer, Gullberg, & Pettersson, 2011; Svenfelt, Engström, & Svane, 2011). Backcasting scenarios for future land-use are less common, but a few studies take on a backcasting approach. Houet et al. (2010) do not develop target-fulfilling scenarios, but use a backcasting approach to model more efficient long-term water management in future landscapes together with decision makers and local stakeholders (farmers, water managers). The backcasting component in the scenario presented in Houet et al. (2010) is that it explores "what an intensively farm landscape that results in highly degraded water would look like in 2030" and "how