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Title: Layers of uncertainty: the wicked problem of life-cycle assessment in bioenergy policy appraisal

Abstract: UK policy decision-makers have been developing increasingly complex models to inform potential pathways to sustainable bioenergy futures. These bioenergy systems models draw on the life-cycle assessment (LCA) of a range of products and processes to assess their 'cradle to grave' environmental impact. However, decision-makers are often relatively unaware of how such assessments are carried out and of the uncertainties inherent in the methodologies, processes and parameters used; with important implications for decision-makers who are trying to interpret the results of these assessments. In approaching the assessment of potential environmental impacts as a wicked problem in policy appraisal, this paper will explore why understanding uncertainty – and especially different types of uncertainty, drawing on Wynne (1992) and Stirling (1998) – is important for discussions around LCA and modelling sustainable bioenergy futures.

A number of prominent theoretical or conceptual frameworks of different types of uncertainty under different knowledge conditions (risk, uncertainty, ignorance, indeterminacy) operate at the level of policy decision-making. But uncertainties at the preceding level of policy appraisal, such as those inherent in LCA methodologies, processes and parameters, are generally not captured by these frameworks nor are they recognised and understood by policy-makers. A workshop that brought together LCA practitioners and bioenergy policy analysts and modellers to explore the key issues around understanding and managing uncertainties in assessments used in policy appraisal found that the articulation of (often tacit) assumptions about system boundaries and data validity, for example, would seem to be a necessary prerequisite to enable informed policy judgements about the reliability and comparability of appraisal outcomes. Instances of policy appraisal such as LCA thus represent a wicked problem in that they embody interrelated layers of uncertainty. A key role for the social sciences consists of drawing attention not only to different types of uncertainty but to different layers of uncertainty in specific assessments and methods of policy appraisal which may otherwise impede decision-making (Stirling 1998), or lead to decisions without contingency plans (Brown 2004).