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Marginal abatement cost curves for UK agriculture, forestry, land-use and land-use change sector out to 2022

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Greenhouse gas emissions from agriculture, land use and land use change (ALULUCF) are a significant percentage of UK industrial emissions. The UK Government is committed to ambitious targets for reducing emissions and all significant industrial sources are coming under increasing scrutiny. The task of allocating shares of future reductions falls to the newly appointed Committee on Climate Change (CCC), which needs to consider efficient mitigation potential across a range of sectors. Government recognises the need to achieve emissions reductions in an economically efficient manner. In theory this means that some attempt should be made to equalise marginal abatement costs across different sectors. In other words, the cheapest units of greenhouse gas should be abated first. This suggests a requirement for information on abatement schedules or marginal abatement cost curves (MACC's), which show the relative cost of greenhouse gas mitigation by alternative mitigation methods and technologies. This paper describes the derivation of MACC's to depict abatement potential for ALULUCF for the UK. While there is a literature attempting to construct MACC's (e.g. Nera 2007, US-EPA (2005, 2006), Weiske & Michael (2007) and Smith et al. (2007a,b,c), we are unaware of a similar comprehensive attempt to that presented here. MACC analysis offers a representation of cost and abatement potential that is built up from a bottom-up analysis of data on mitigation options within respective sectors. These mitigations are projected to be adopted over and above a baseline of what would normally happen, thereby giving rise to extra abatement potential. This information provides a basis for deriving a sector greenhouse gas budget that is based on a cost-effectiveness of analysis. The methodology for deriving abatement potentials and the derivation of associated cost curves was supplied by the Office of Climate Change/CCC to be consistent with MACC analysis in other sectors of the economy. The methodology allows for abatement potentials to be represented using a range of alternative cost metrics. This paper focussed predominantly on CO2 abatement in forestry and non CO2 gases specifically, methane and nitrous oxide, which make up the main emissions from the land based sector. A range of sub sector specific abatement measures were identified from a variety of published and unpublished sources. Information on relevance and applicability to UK conditions was then derived from expert opinion, which was also used to estimate abatement potentials under UK conditions and the extent to which measures would be additional to a business as usual baseline. Expert input was also sought for some of the relevant information on implementation costs. Cost information was augmented by modelling decision-making at the farm scale. The resulting abatement potentials are clearly influenced by levels of expected adoption of these measures. Accordingly, the analysis considers a range of technical potentials that might set the limits on abatement. A full technical potential determined the absolute upper limit that might result form the highest technically feasible level of adoption or measure implementation in the subsectors. Since this limit is not informed by the reality of non adoption or likely policy or social constraints, we also estimate high, central and low feasible potential abatements, which are the levels thought most likely to emerge in the time scales and policy contexts under consideration. There are several ways to present the resulting MACC information for the CCC budget periods 2012, 2017 and 2022. In addition to the differing levels of abatement related to adoption, MACC variants can be created using private or social costs or a hybrid of both. The key distinctions here are the different discounting assumptions and whether or not the analysis reflects private or social costs. Abatement potentials have also been estimated for the separate UK devolved administrations, i.e. England, Scotland, Wales and Northern Ireland. This information was compiled in spreadsheets that allow transparency and flexibility in altering assumptions in several key data inputs. Estimated total abatement in ALULUCF is clearly influenced by the forestry potential, which is significantly enhanced by the extent to which wood products are assumed to displace carbon intensive construction materials and energy sources. We also estimate significant abatement potential in crop and soil measures and in livestock management. Other land uses and land use changes offer negligible or limited abatement or are relatively costly compared to any reasonable cost threshold such as the current UK Shadow Price of Carbon. The

combined total central feasible abatement potential estimates for 2012, 2017 and 2022 (private discount rate) are 7.95 MtCO2e 13.48 MtCO2e and 21.48 MtCO2e respectively. This potential for 2022 is demonstrated in table E1, which defines the MACC curve shown in figure E1. For demonstration purposes, using the 2022 MACC this total potential is divided between crop and soil measures 6.49 MtCO2e, livestock measures 3.40 MtCO2e, and forestry measures 11.59 MtCO2e. Table XXXX also suggests that all three sub sectors offer measures capable of delivering abatement at zero or low cost (expressed in 2006 prices) below thresholds set by the Shadow Price of Carbon (currently about £36/t CO2e projected for 2025). Indeed around 5.41 MtCO2e could possibly be abated at negative or zero cost. As demonstrated by Table E1 and associated MACC, costs then rise progressively. After measure AC (crop-soils drainage) there is a steep rise in the abatement cost per tonne. For agriculture alone, the central feasible potential of 7.88MtCO2e (at <£100/t) represents 17.6% of the 2005 UK agricultural GHG emissions (the NAEI reported these as 44.733 MtCO2e, excluding LUC). Although there are no similar benchmark studies, the results presented here partly corroborate conclusions on abatement potential identified in IGER (2001) and CLA/AIC/NFU (2007) in relation to N2O. A number of caveats need to be stressed on the results as they are currently presented. The first is that the results do not include a quantitative assessment of ancillary benefits and costs, i.e. other positive and negative external impacts likely to arise when implementing some greenhouse gas abatement measures. Reduced water pollution related to more efficient use of nitrogen fertiliser is a classic example. Some ancillary impacts will be significant, and they ideally need to be quantified and added to the cost estimates. A similar caveat applies to the need to extend the consideration of costs to the life cycle impact of some measures. Annex 2 provides a qualitative assessment of these impacts and we suggest that the analysis does need to be extended to consider selected life cycles assessments (LCA), which could change the MACC ordering. This paper raises a number of complicating factors that increase the uncertainty inherent in the definition of MACC's, and that distinguish the ALULUCF exercise from that undertaken in other sectors characterised by fewer firms and a common, relatively well understood technology. In contrast agriculture and land use are more atomistic, heterogeneous and regionally diverse. These factors can alter the abatement cost-effectiveness outlined here. As with other sectors, the effectiveness of measures is influenced by interactions between measures and their environment We have tried to reduce this uncertainty by explicit consideration of interactions, but we stress that further work is required to derive more targeted abatement potentials e.g. across a variety of farm types and on a regional basis.

References

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