Abstract of paper to be presented at the 4th General Conference of the International Microsimulation Association, 11-13 December, Canberra

Title: Producing and validating small area estimates of inequalities in household electricity demand for England.

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Whilst small area of indicators of income, health and consumption levels are commonly produced using small area estimation methods, the estimation of 'utility' resource demand is less frequent. Although some attention has previously been given to the estimation of domestic water demand (Williamson, 2001) and there is renewed interest in this area (Polebitski and Palmer, 2010, Parker and Wilby, 2013) there appear to have been few if any attempts to estimate small area household energy demand with the exception of work on carbon emission profiles (Druckman and Jackson, 2008). Given the potentially increasing need for local transmission infrastructure engineering in the context of localised production and the recent focus on understanding national and local energy consumption profiles this represents a significant gap in current knowledge.

This paper lays out a framework for the estimation of future small area energy demand using a range of spatial and aspatial microsimulation approaches and presents preliminary results from an attempt to create small area electricity demand estimates for England using a survey re-weighting approach. Following Ballas and others (Ballas and Clarke, 2001, Simpson and Tranmer, 2005, Anderson, 2013), the process used the iterative proportional fitting algorithm to re-weight a national level consumption expenditure survey from 2010 to fit small area statistical tables derived from the UK 2001 Census. The constraints on which to re-weight were selected using a regression-based prioritisation approach and the resulting synthetic 'consumption census' microdata was then used to estimate total and mean household electricity consumption in each small area. The results were validated internally using standard 'absolute error' approaches and externally using small area totals for 2010 derived directly from measured electricity consumption and made available by the Department for Energy and Climate Change. Whilst there is a reasonable correlation between the small area means and totals for the estimated and observed data, further analysis suggests that there is substantial underestimation in some areas. Multi-variate analysis suggests that as might be expected some 60% of the 'error' for the 2010 estimates is due to the use of outdated small area household counts from Census 2001 in the estimation process. The paper then discusses the results of updating the process to include newly available Census 2011 household counts. The results demonstrate the extent to which the assumption of compositional stability over time affects the reliability of the results for particular places and thus highlights those areas where updated small area tables are more or less necessary for the purposes of estimating consumption. Finally the paper develops and presents a novel small area 'electricity gini' which highlights local inequality in estimated electricity consumption. This gini is calculated for each small area using the weighted synthetic 'consumption census' microdata. The value of the results in general and the small area gini in particular is then discussed with particular reference to the potential for applying microsimulation methods to the synthetic 'consumption census' microdata to assess the small area consequences of potential demand management interventions or future changes to consumer demand.

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