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A multi-method approach for analysing the potential employment impacts of material efficiency

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ABSTRACT

Material efficiency, reducing the amount of new material inputs per given level of service or output, can improve both the resource efficiency of an economy and reduce demand for energy and GHG emissions intensive materials. It requires a change in the way materials, components and final products are used along the supply chain with associated impacts on employment. Domestic policy support for material efficiency can be hindered by concerns that reducing demand for new materials will impact on employment. A multi-method approach for evaluating the employment impacts of material efficiency strategies across different products and regions is presented. It is applied to two case studies that could reduce demand for new steel in the UK: car clubs and re-using steel sections. Industry interviews supplemented by a literature review reveal how sector labour intensity, product prices and sales volumes might change along the mobility and construction supply chains in the short-term as a consequence of introducing these strategies. A static multi-regional input-output model is used to estimate the immediate direct and indirect supply chain employment impacts of increasing the material efficiency of steel use in the UK. The principal finding of this paper, based on industry expectations of feasible rates of deployment, is that the initial, immediate consequences of these actions would not adversely affect employment prospects in the UK. This is partly because car clubs can stimulate demand for new vehicles and deconstructing rather than demolishing buildings is labour intensive, substituting domestic labour for imported steel. These initial findings should motivate further research on the opportunities for material efficiency.

1. Introduction

In 2011, the European Commission (2011) developed a Resource Efficiency Roadmap to enable Member States to shift their economies onto more sustainable growth trajectories while improving competitiveness and creating more employment. To achieve this change, innovation is needed across industries and supply chains to maximise the opportunities from stocks of resources, minimise waste and understand the interactions between different sustainability objectives.

Climate change is one such objective. Current greenhouse gas emissions targets are unlikely to keep temperature increases below 2 °C (Anderson and Bows, 2011). Material efficiency, reducing the amount of new material inputs per given level of service or output, would improve both the resource efficiency of an economy and reduce demand for energy and greenhouse gas (GHG) emissions intensive materials such as steel. DECC (2015) reported that in 2013 steel production accounted for around 20% of domestic industrial GHG emissions in the UK. Eurofer (2014), the European steel manufacturer's association, concludes the introduction of cost effective mitigation technologies would lead to just a 15% improvement in the CO_2 emissions intensity of steel production by 2050 relative to 2010 levels. Therefore in the case of steel, demand-side GHG abatement measures, including material efficiency are both complementary and critical for contributing to the UK's 2050 economy-wide emissions target of reducing domestic greenhouse gas emissions by at least 80% below 1990 levels by 2050 (HMSO, 2008).

Allwood et al. (2012) propose six categories of material efficiency: (1) light-weighting, (2) scrap diversion, (3) yield improvements, (4) reuse without re-melting, (5) life extension and (6) more intense use. All options are preferable to material recycling

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in the European Parliament and Council (2008) waste hierarchy. In spite of these potential environmental benefits, material efficiency has received little attention to date (IPCC, 2014).

As discussed in Söderholm and Tilton (2012) there are a multitude of market failures that act against the adoption of material efficiency. In addition, labour taxes distort the incentive to adopt certain material efficient practices (Skelton and Allwood, 2013). This should motivate further investigation into policy interventions to support material efficiency initiatives. However, policymakers can be discouraged from actively addressing these market failures due to concerns that reducing demand for new materials will adversely affect employment. Employment is highlighted in the HM Treasury's Green Book on appraisal and evaluation as both a motivation for, and an important evaluation indicator of, government intervention in the UK. This paper presents a novel multi-method approach for investigating the immediate direct and indirect supply chain employment impacts of increasing the material efficiency of steel use in the UK. It includes surveys, literature reviews and multi-regional input–output (MRIO) modelling. This approach is replicable for other categories of material efficiency and can be applied to any geographic region covered by an MRIO model.

2. Motivation for material efficiency and modelling approaches for measuring employment impacts

Two case studies were selected in the UK automotive and construction sectors as these are the largest users of steel globally, accounting for over two thirds of demand in 2007 (Cullen et al., 2012). For the construction sector, the material efficiency category of 'reuse without re-melting' was chosen, using the example of reusing steel sections. In the automotive sector, the category of 'more intense use' was investigated using the example of car clubs. Two literature reviews were conducted. First to understand the feasibility and possible motivation for introducing these two strategies in the UK and second to ascertain different modelling approaches and estimates of the employment impacts associated with their introduction.

2.1. Feasibility and motivation for increasing re-used steel sections in UK construction

There are several options for re-using steel in the construction sector without recycling. Individual elements (e.g. a steel sections), components (e.g. trusses) and whole steel structures could theoretically be reused in new construction projects. Reuse can occur either in-situ or in a new location, and is more likely if a building has been designed for deconstruction and reuse early in the project development process (Densley-Tingley and Davison, 2011). The focus of this research is on the reuse of steel sections. Statistics from the ISSB reveal that between 2003 and 2008 around half of the tonnage of steel purchased by the UK construction industry were steel sections. Currently only 7% of steel salvaged from demolition sites in the UK is reused (Sansom and Avery, 2014). The remaining 93% is recycled by upstream steel manufacturers. Although less emissions intensive than making virgin steel, recycling scrap still generates an average of 0.33 t CO_2/t steel (Milford et al., 2013). Ley et al. (2002) conducted a MFA of steel use in the UK construction sector and estimated that in 2011 approximately 250 kt of scrap steel sections could have been salvaged from demolition sites. If all sections were re-used rather than recycled, this would have avoided approximately 83 kt of CO_2 emissions per annum. Reusing steel sections is technically feasible across a number of geographies and building types, as demonstrated by case studies for industrial (Pongiglione and Calderini, 2014) residential, (Chance, 2009) and commercial buildings (Gorgolewski, 2008). Using evidence from case studies in Canada, Gorgolewski (2008) concludes that reuse could also be facilitated by ensuring a sufficient local stock of reuseable steel sections to reduce project delays; attaining early buy-in from designers; and improving the traceability of reuseable steel to overcome any potential concerns around quality for downstream users.

2.2. Feasibility and motivation for increasing the number of car club members

UK citizens are making fewer and shorter trips by car (DFT, 2014a) but the total number of cars registered to UK drivers is rising (SMMT, 2015). On average a car contains around 900 kg of steel, generating approximately 1.8 t of CO_2 by steel manufacturers upstream (World Steel, 2014). Cars are increasingly under-utilised but there is still a clear demand from drivers to have access to one. Car sharing offers an opportunity to increase drivers' access to cars and increase the intensity of car use. Drivers can either share car journeys or vehicles. The latter of which can occur through peer-to-peer sharing, where individuals retain ownership of their cars and loan them temporarily to others or via car clubs, where vehicles are owned by the car club operator. Around 0.01% of UK drivers currently belong to a car club (Steer Davis Gleave, 2015; DFT, 2014b). The focus of this research is on increasing the number of car sharers via car clubs in the UK. Membership to a car club can lead to a driver delaying or deterring a private car purchase, thus reducing the demand for cars and for emissions intensive inputs including steel. However, Millard-ball et al. (2005) highlight the challenge of accurately measuring private vehicle displacement rates, particularly if interviewees are asked to speculate on avoided future purchases. Recognising this challenge and the associated uncertainty, Carplus, a not-for-profit environmental transport NGO, surveyed UK car club members (Steer Davis Gleave, 2015) and estimated that, in 2014/2015, between 3.5 and 8.6 private new and second-hand vehicles were removed from the road for every car club vehicle. Sharing vehicles has many additional potential environmental and social benefits including reduced congestion and competition for parking spaces, improved local air quality and increased mobility access. These potential benefits have prompted local and central government to support the expansion of car club membership across the UK (DFT, 2014c).

If introduced at a large scale, these two material efficiency strategies would change the supply chain for delivering personal mobility and construction projects in the UK

2.3. Modelling approaches to estimate the employment impacts of material efficiency

Four categories of methodological approaches for assessing the employment impacts of emissions mitigation are proposed in Mirasgedis et al. (2014). These are: (i) indices and multipliers from specific case studies, (ii) input–output (IO) analysis (iii) top down modelling approaches such as econometric or computable general equilibrium models and (iv) hybrid approaches. A static MRIO model was used in this study as provides a transparent method that can offer an estimate of the likely scale and sectoral location of the immediate, direct and indirect employment impacts arising from changes in the structure of an economy due to the introduction of material efficiency initiatives. Static MRIO models provide a snapshot of an economy at a particular point in time. When the production structure within these models is modified, as is the case in this study, the results reveal net changes in output and employment relative to the historical structure of the economy. These changes include direct employment impacts from a change in direct sector purchases (e.g. less new steel bought by the construction