

The impact of a stimulus to energy efficiency on the economy and the environment: A regional computable general equilibrium analysis

Nick D. Hanley ^a, Peter G. McGregor ^b, J. Kim Swales ^{b,*}, Karen Turner ^c

^a *Department of Economics, University of Stirling, Stirling FK9 4LA, UK*

^b *Fraser of Allander Institute, CPPR and Department of Economics, University of Strathclyde,
Sir William Duncan Building, 130 Rottenrow, Glasgow G4 0GE, UK*

^c *Fraser of Allander Institute and Department of Economics, University of Strathclyde,
Sir William Duncan Building, 130 Rottenrow, Glasgow G4 0GE, UK*

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Abstract

Sustainable development is a key objective of UK national and regional policies. Improvements in resource productivity have been suggested as both a measure of progress towards sustainable development and as a means of achieving sustainability. Making ‘more with less’ intuitively seems to be good for the environment, and this is the presumption of current UK policy. However, in a system-wide context, improvements in energy efficiency lower the cost of energy in efficiency units and may even stimulate the consumption and production of energy measured in physical units, and increase pollution. Simulations of a computable general equilibrium model of Scotland suggest that an across the board stimulus to energy efficiency there would actually stimulate energy production and consumption and lead to a deterioration in environmental indicators. The implication is that policies directed at stimulating energy efficiency are not, in themselves, sufficient to secure environmental improvements: this may require the use of complementary energy policies designed to moderate incentives to increased energy consumption.

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1. Introduction and background

Sustainable development is a key objective of UK government policies (Department of Environment [1]), is one of the outcome objectives of the Scottish Executive’s Framework

* Corresponding author. Tel.: +44 141 548 3966; fax: +44 141 548 4445.

E-mail address: j.k.swales@strath.ac.uk (J.K. Swales).

for Economic Development (Scottish Executive [2]), and is receiving increasing emphasis in a regional development context more generally. The Scottish Parliament re-affirmed its commitment to sustainable development in 2002 with the publication of a document (Scottish Executive [2]) setting out Scotland's approach to promoting sustainable development through the adoption of targets for 24 sustainability indicators (see also Scottish Executive [3]). Clearly the success of national sustainability programmes will depend upon policy delivered at the regional level. The region therefore appears to be the natural level on which to focus policy evaluation, a perspective that proves significant in our analysis.

Resource productivity has been suggested as both a measure of progress towards sustainable development, and as a means of achieving sustainability (Cabinet Office [4]). The popular interpretation of resource productivity is 'doing more with less': that is, of reducing the material or energy requirements of economic activity. As we note below, there are many possible interpretations of resource productivity. However, the (untested) presumption appears to be that improving resource productivity will lower the burden on the environment. In this paper, we begin to explore the conditions under which this presumption would be expected to hold, and present some empirical evidence from an energy–economy–environment computable general equilibrium (CGE) model of the Scottish economy.

In Section 2, we define resource productivity, summarise previous analyses and sketch our own analysis of the likely system-wide ramifications of a stimulus to energy efficiency. We outline our computable general equilibrium model of the Scottish economy in Section 3. In Section 4 we present the results of simulating an across the board stimulus to energy efficiency. We conclude in Section 5.

2. Resource productivity

2.1. Background

As De Bruyn and Opschoor [5] have noted, the intensity with which economies utilise material and energy resources changes over time. Trends of both 'dematerialisation' and 'rematerialisation' have been noted by them, as by other authors (e.g. Young and Sachs, [6]). Perhaps based on these empirical observations, an argument has emerged in favour of deliberately improving resource productivity as a part of sustainable development policy (Weizsacker [7]) and as a way of reducing the environmental impacts of economic activity (Chadwick [8]). This academic literature has had an impact on the policy community, with increasing resource productivity being promoted by several governments and international agencies (Nordic Council of Ministers [9]; Cabinet Office [4]; EEA [10]). Resource productivity measures have also emerged as official indicators of sustainability (DETR [11]). Rather large improvements in resource productivity have been suggested as being both possible and desirable, in the case of both 'factor four' and 'factor ten' arguments (Weizsacker et al. [7]). For example, the UK has set targets of a 20% improvement in energy efficiency by 2010, with a further 20% improvement by 2020.

How is resource productivity defined however? Pearce [12] suggests as the ratio of output to the resource input (Y/R), where R may be materials or energy input. Y may be interpreted as GDP, thus Y/R becomes materials or energy efficiency (output per unit of materials/energy

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