Energy Policy 88 (2016) 355–360

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Short communication

The evolution of green jobs in Scotland: A hybrid approach

Kevin Connolly [a,*], Grant J Allan [b], Stuart G McIntyre [b]

[a] Doctoral Training Centre in Wind Energy Systems, Department of Electronic and Electrical Engineering, University of Strathclyde, Royal College Building, 204 George Street, Glasgow, G1 1XW, United Kingdom
[b] Fraser of Allander Institute, Department of Economics, University of Strathclyde, 130 Rottenrow, Glasgow G4 0GE, United Kingdom

HIGHLIGHTS

- A "hybrid" approach estimates green jobs from bottom-up detail and top-down data.
- Illustrative results show the evolution of such jobs in Scotland from 2004 to 2012.
- Method provides policymakers a timely measure of the jobs success of energy policy.

ARTICLE INFO

Article history:
Received 23 April 2015
Received in revised form
26 October 2015
Accepted 29 October 2015

Keywords:
Green jobs
Renewable energy
Low carbon economy

ABSTRACT

In support of its ambitious target to reduce CO_2 emissions the Scottish Government is aiming to have the equivalent of 100% of Scottish electricity consumption generated from renewable sources by 2020. This is, at least in part, motivated by an expectation of subsequent employment growth in low carbon and renewable energy technologies; however there is no official data source to track employment in these areas. This has led to a variety of definitions, methodologies and alternative estimates being produced. Building on a recent study (Bishop and Brand, 2013) we develop a "hybrid" approach which combines the detail of "bottom-up" surveys with "top-down" trend data to produce estimates on employment in Low Carbon Environmental Goods and Services (LCEGS). We demonstrate this methodology to produce estimates for such employment in Scotland between 2004 and 2012. Our approach shows how survey and official sources can combine to produce a more timely measure of employment in LCEGS activities, assisting policymakers in tracking, consistently, developments. Applying our approach, we find that over this period employment in LCEGS in Scotland grew, but that this was more volatile than aggregate employment, and in particular that employment in this sector was particularly badly hit during the great recession.

1. Introduction

Since the Kyoto agreement was signed there has been a significant global debate around reducing carbon emissions, and many regions and nations have adopted a target to reduce national greenhouse gas (GHG) emissions. In Scotland the target is to reduce GHG emissions by 42%, relative to 1990 levels, by 2020. Given that the energy sector is a major source of emissions, the Scottish and UK governments have introduced policies to develop renewable energy or low carbon technologies to help meet these emissions targets. A prime example of this is the Scottish Governments target to generate the equivalent of 100% of gross (Scottish) electricity consumption from renewable technologies by 2020. This target builds upon Scotland's existing high level of renewable generation capacity, and natural advantage in renewable resources, principally wind (on- and offshore), wave and tidal.

If this 100% target is to be met it is expected that the size of the Scottish Low Carbon Economy (LCE) will increase significantly with an associated increase in employment or so-called "green". The Scottish Government have made clear that their renewable electricity target is also required to assist in the "re-industrialisation" of Scotland (Scottish Government, 2011), and the Scottish Government have estimated that this sector could create an additional 60,000 jobs by 2020 (Scottish Government, 2010). Given these targets, it is important for policy makers to have robust measures of the employment in the LCE.

However, estimates of the number of such jobs vary greatly depending on the source. Principally, this is because estimates use different definitions of the LCE, producing a variety of estimates of

* Corresponding author.
E-mail address: k.connolly@strath.ac.uk (K. Connolly).

http://dx.doi.org/10.1016/j.enpol.2015.10.044

the scale of employment (e.g. see Allan et al., 2014a). Classifying jobs in operating renewable electricity devices in Scotland as "green jobs" would likely be uncontroversial, the inclusion of other activities (such as jobs in the supply chain for energy technologies) may be more controversial and may be omitted in some measures of "green jobs".

A widely used definition – indeed one used by the Scottish Government (2010) – captures activities in "Low Carbon Environmental Goods and Services" (LCEGS). This covers a range of renewable, low carbon and environmental activities. The Scottish Government methodology produces an aggregate figure for employment in the LCEGS, however it is only for a specific period, usually a year, is costly to produce and is not typically produced on a regular basis.

In this paper we propose a methodology which can produce a time series of employment in LCEGS. Our method combines the detail from "bottom-up" surveys with "top-down" time series data from official surveys. We use industrial data on Scottish employment by sector alongside information from a regional UK survey of employment in LCEGS to track the evolution of LCEGS employment annually between 2004 and 2012 – a time of significant development of low carbon and renewable energy technologies in Scotland.[1]

The approach which we use was first proposed by Bishop and Brand (2013), who examined LCEGS employment in Plymouth, UK, focusing on a single year. We extend the approach firstly to the national (Scottish) level and secondly, to show the evolution of the total number of jobs in LCEGS activities ("green jobs") between 2004 and 2012. In doing so, we demonstrates how "bottom-up" and "top-down" data can be combined to produce a measure which can be updated frequently, can be used to measure progress towards targets for jobs in LCEGS and can be used to evaluate the employment "success" of energy policy.

The paper proceeds as follows. The next section discusses different definitions of 'green jobs' and the ways in which they are measured. Section 3 gives details on the methodology used in this paper. Section 4 provides our results and discussion, and the final section provides our conclusions and policy implications.

2. Measuring "green" employment

Although measures to increase employment in "green" activities are a policy area for many countries and regions across the world, there are a wide range of definitions used to measure progress towards these goals. This occurs for a variety of reasons, which might be classified as either conceptual or empirical, and which are summarised in Sections 2.1 and 2.2, respectively, below.[2] In Section 2.3 we review previous estimates of LCEGS employment in Scotland.

2.1. Conceptual issues

There are two principle conceptual challenges. First, there is little agreement on which activities might be considered as "green". Furchtgott-Roth, (2012, pS50) for instance, writes that "no one knows what green jobs are". Noting the US Bureau of Labour Services definition as "jobs in business that produce goods or provide services that benefit the environment or conserve natural resources" leads to the apparent contradiction that, for example, in the case of two farmers producing the same crop, one would be classed as having a green job if that crop was used in biofuels, while the other would not be counted if her output was used in food production. As the worker may not necessarily know where her output will be used it makes it difficult to simply ask workers if they have what might be considered a "green job".

A second conceptual issue is with employment in the "supply chain". Workers employed in the operation of renewable energy facilities would, without controversy, be included in a measure of green jobs. However, this employment may require inputs from (and employment in) other sectors, e.g. installers of offshore wind turbines will require vessels, which will in turn require the production of metals, engines, and fuel and so on. It would not be natural to consider employment in these kinds of intermediate sectors as "green" jobs, but nevertheless they are part of the supply chain for these green activities.

Aside from these conceptual issues, and the empirical considerations which are the subject of the next section, there is another important issue to consider which is the language and implied definitions of "green jobs". For instance, some authors refer to the "low carbon economy" while others prefer the "low carbon environmental goods and services (LCEGS) sector" nomenclature (other names seen in the literature include the "clean economy", "green economy" or "green goods or services").

The LCEGS measure has become widely used in recent years in the UK (Innovas, 2009; kMatrix, 2010, 2011, 2012). This measure provides a "bottom-up" definition of employment across a range of activities and services, including through the supply chain, while also providing comparable estimates for other countries around the world. Perhaps part of the rationale for the LCEGS measure is to understand more about the parts of the economy which are undertaking work in the low carbon area, without placing restrictions on the precise industrial activities that are included. In other words, the use of the LCEGS definition perhaps represents a move away from a focus on decarbonising the domestic economy to maximising the economic benefit from publicly supported investment in the low carbon economy. Given the adoption of this broader LCEGS definition by the Scottish Government (and others), as we shall see in Section 2.3, it is the measure which we use here.

2.2. Empirical considerations

There are two broad approaches which have been used in the literature to date to measure the number of "green jobs" in an economy. We can classify these as those based on Standard Industrial Classifications and those based on surveys. We refer to these in the rest of the paper as "top-down" and "bottom-up" approaches respectively. This classification between top-down and bottom-up is merely used to illustrate the different ways in which estimates of "green" employment have been produced.[3]

First, the "top-down" measures use the classification of employment to industries which is compiled from official statistics covering the whole economy. By identifying specific industrial activities as "green" and tracking employment in these categories, such measures provide a regularly updated metric of employment

[1] Renewable electricity capacity in Scotland almost tripled between 2004 and 2012 while the amount of electricity from renewables increased from the equivalent of 14.1% of consumption in Scotland to 38.8% (Scottish Government, 2014).

[2] Allan et al. (2014a) contains a longer discussion of the issues raised in this section.

[3] Note that we omit from this *ex ante* studies of the potential employment impacts of changes in the energy sector, some of which use Input–Output models (e.g. Moreno and Lopez, 2008; Tourkolias and Mirasgedis, 2011; Markaki et al., 2013; Fanning et al., 2014; Cai et al., 2011), Computable General Equilibrium (CGE) approaches (e.g. Allan et al., 2014b) or other modelling techniques (e.g. Lehr et al., 2012). We note that reconciling *ex ante* predictions with *ex post* evaluations is an important area for future research, and that there has been considerable debate in the literature about whether "green" policies and increases in "green" employment create net additional jobs (see, e.g. Furchtgott-Roth, 2012 and Blyth et al., 2014).