INVESTIGATING THE EFFECTIVENESS OF UK ENERGY POLICY IN PROMOTING RENUEWABLE INVESTMENTS AND REDUCING CARBON EMISSIONS[1]

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Abstract

The UK developed an energy policy which focused on providing for energy security and cutting carbon emissions. A number of obstacles confronted this policy and slowed down investments in renewable energies.

This research aims to investigate the effects of UK energy policy on deriving investments in renewable technologies and reducing carbon emissions, and hence on energy security. The study will try to answer the following question: How successful the UK energy policy has been in promoting investments in renewable energy options and in reducing carbon emissions.

To answer the above question and achieve the above stipulated research objectives data was collected by means of content analysis from governmental publications and statistics. Our findings suggests that in order for the UK to achieve its policy objectives it needs to stabilise its energy policy and to reduce uncertainties surrounding investments in renewable energies.

Key Words: Carbon Emissions, Policy, Renewables, Tax, UK

Introduction

The European Union (EU) requires its member states to reduce carbon emissions by set targets by 2020 and 2050. This reduction in emission is sought by increasing dependant on green energy that is generated by investments in renewable energy sectors. This directive is known as 2020 and is aiming at providing sustainable energy by increasing the generation of clean and affordable energy. In this regard, the UK is aiming to achieve significant improvement on the energy sustainability measures by increasing the share of renewables of its energy mix to 15%, and to cut the carbon emissions by 34% by 2020 and further to 80% by 2050 (DTI, 2006: 8; DECC, 2011a, online; DEFRA, 2013).

In order to implement the EU set target, the UK has developed an energy policy that is hoped to be successful in providing efficient, clean and affordable energy, i.e. sustainable energy, to the UK citizens and businesses. In this regard, the UK needs to attract an inflow of billions of pounds to be invested in low-carbon and renewable energy projects over the next decade or so. However, according to Bawden (2012), research shows that investments in renewable energy projects has more than halved in the past three years.

In tackling climate change issue, the UK government introduced a number of measures: Carbon Floor Price (CFP); Vehicle Excise Duty (VED); Industrial Energy Tax (IET); Landfill Tax and Climate Change Levy (CCL). It is aimed that these duties will result in reducing carbon emissions and encourage investments in renewable energies.

There seems to be lack of studies on the UK energy policy and its effectiveness on promoting investments in renewable technologies and in cutting carbon emissions. Therefore, this study tries to fill in this gap by highlighting aspects of the UK energy policy and its roles in providing for secure energy supply to the UK; the effects of this policy on reducing emissions will also be analysed. To what extent do UK energy policy affect investing in renewable technologies and reduction of emissions; and how penetration of renewable energy may endorse UK energy security, are in fact empirical question.

The economic theory suggests that encouraging behavioural changes of individuals and businesses alike in order to reduce their environmental damage would conserve significant social and environmental costs. This change in behaviour can be influenced by using taxes as penalty tools for those who pollute. Carbon taxes have been used as tools to guide investments in energy projects and which gained popularity in Europe. In fact, emission taxes are thought of being economically viable tools as by penalising they incentivise polluters to reduce their pollutions.

Carbon Taxes

Adapting to climate change requires energy policy makers to promote policy options that incentivise energy producers and consumers to improve energy efficiency and reduce carbon emissions. This led governments to introduce taxes on carbon emissions to penalise polluters and drive them to reduce their carbon dioxide emissions (Pearce, 2006; Markandya et al, 2009). Zhang and Baranzini (2004: 508) define carbon taxes as "an excise tax imposed according to the carbon content of fossil fuel and is thus restricted to carbon-based fuels only".

The debate on the effectiveness and impacts of carbon tax goes back to earlier 1990s when the European Community's Joint Council of Energy and Environment set a target for EU member states to stabilise emissions of carbon dioxide. Finland was the first country to launch carbon tax in 1990, followed by the Netherland, Norway, Denmark and Sweden. The first carbon/energy tax was proposed by the European Commission in September 1991; the intention was that revenue from this tax would be used to reduce other taxes rather than to increase public spending (Smith, 1995; Hasselknippe and Christiansen, 2003).

The purpose of a carbon tax is to reduce carbon emissions; the base of such tax is the amount of CO2 emissions. This tax would penalise the use of a high-carbon fuels leading to less use of these fuels or depending on substitute types of energy with less, or zero, CO2 emissions; implementing these taxes on emitting industries act as a continuous incentive for using cleaner technologies (Zhang and Baranzini, 2004; Pearce, 2006).

Using a carbon taxes as policy tool to reduce carbon emission has a number of objectives, whilst reserving the environment it encourage the production of clean energy (Govinda et al., 2011). Achieving these objectives by a given country means providing energy security, recovering some of the country's energy self-sufficiency and sustaining sufficient supply of clean energy. However, carbon taxes drive a number of concerns to governments and businesses alike. These are related to the industry's costs, diverse effects of products costs' increases on low income groups and on the international competiveness (Hasselknippe and Christiansen, 2003; de Miguel and Manzano, 2011; Lin and Li, 2011). Also, the effect of such a tax is questionable on the efforts of governments on providing sustainable energy:

secure, clean, affordable and efficient energy (Booker, 2012). Carbon Taxes may discourage generation energy from sources that described as carbon intensive, hence reduce energy being produced and shaken the energy security.

It is argued that for a government to minimise the effects of green taxes on individuals energy revenues raised from these taxes could be used to offset effects of other taxes, such as VAT. If this action is taken by a government to offset VAT on energy efficient products it would in fact have a double dividend, on one hand it will still act as a tool to reduce carbon emissions and on the other hand it would encourage energy efficiency behaviours (Zhang and Baranzini, 2004). Also, revenue from carbon taxes can be used as subsidies for renewable energy generation, and this would drive renewable energy costs down and increase their competing opportunities.

Previous Studies on Carbon Taxes and Renewable Energies

It is well documented in the literature of green taxes that most of the studies have mainly been based on simulation in different scenarios, and only a handful of empirical studies have been conducted on the effects of green, and particularly carbon, taxes (see Lin and Li, 2011). This section presents some of these studies to illustrate how issues of carbon taxes and renewable energy have been tackled in the literature.

Ekins (1994) investigates the likely successfulness of imposing carbon taxes on companies to reduce their CO2 emissions. Ekins argues that for environmental taxes to be successful in meeting their proposed objectives their rates should be increased gradually so liable companies can adopt new technologies that allow them to save on costs. Revenues from these taxes ought to be recycled, in forms of reducing other taxes such as income taxes and national insurance contributions. Ekins (1994) concludes that carbon taxes can entail economic benefits, than a cost, to a given country should they be well designed and directed.

Hasselknippe and Christiansen (2003) tried to map the use of energy related taxation at the EU level and to explain the key driving forces and barriers governing the use and evolution of revenues arising from these taxes. Varma (2003) examined the cost effectiveness of the UK's climate change levy in reducing GHG emissions and evaluated the levy's impact on competitiveness of UK firms. Varma concluded that there is a need for a comprehensive policy involving the use of standards, emission trading as well as energy taxes to achieve energy efficiency and emission reduction. Further, Varma asserted that competitiveness advantage of UK firms depends on a number of factors and recycling revenues generated from CCL ease off most of the adverse effects of the levy on companies' competitive advantage. On a similar line of enquiry, Zhang and Baranzini (2004) researched the impact of carbon/energy taxes on competitiveness and distributional income. They concluded that carbon/energy taxes seem not to have significant impact on competitive losses; but these taxes although seem to be regressive their overall impact on distribution income is relatively weak.

Markandya et al (2009) studied the effects of tax incentives for energy-efficient durables in the EU. They concluded that tax incentives were an effective tools on the case of promoting customers to buy efficient boilers in Denmark and Italy, but been less effective on incentivising customers to buy other energy efficiency products. Lin and Li (2011) investigated the real mitigation effects of five European countries. They used the difference-in-difference method in their analysis, and they concluded that carbon tax can reduce energy use, improve energy efficiency and promote development of renewable energy. They also added that carbon taxes have different impacts in different countries and this is down to differences in carbon tax rates, scopes of tax exemptions and usage of carbon tax revenues.

Govinda et al (2011) examined the conditions that allow a carbon tax to stimulate dependence on biofuels in the energy mix. They found that when carbon tax revenues are recycled in lump sums to household impact on penetration of biofuel is minimal; but if part of the carbon tax is used to subsidise biofuel the impact would be significant. Des Santos Ribeiro and Raiher (2013) were more specific of their enquiry, they argue that energy supply in the state of Paranà / Brazil could significantly be increased by adopting public policies that aim to strengthen the agriculture production chain. Des Santos Ribeiro and Raiher see that this would contribute into the power generation from waste and agriculture products and expand the production of decentralized energy.

McDowall et al (2012) examined the implication of adopting precautionary approach to bioenergy development in the UK. They used the UK MARKAL energy system model in their investigation to develop precautionary and optimistic resource scenarios. McDowall et al (2012) found that bioenergy is an important option for heat and power in a least-cost low carbon energy system, but adopting a strictly precautionary approach adds to the cost of decarbonisation. They also reported that with less land available for bioenergy production in the UK the cost of decarbonisation will rise.

It is evident now that previous studies have focused on green taxes from different perspectives: recycling tax revenues, effects on reducing emissions, effects on competitiveness advantages of industrial sectors, incentivising investments in biofuels and energy from waste projects, and on deriving energy efficient behaviours. These studies were in most cases built on econometric models and prediction scenarios. This study is well situated in the literature in that it focuses on the effects of green taxes on investments in energy from biomass in the UK with a focus on East Midland region in England. This study whilst using the previous studies as a literature base, it differs from other research as it tackles the issue of green taxes and investments in bioenergy projects from a policy assessment paradigm.

The Objectives of the Study and Methodological Approach

This research aims to assess the success of UK energy policy in driving the energy market towards achieving the UK and the EU aims in reducing the carbon emissions from the UK industry while securing clean and sufficient energy supply to the UK households and businesses. Therefore, this study raises the following question, almost for the first time, what is the effects of UK energy policy on investments in renewables and on reducing carbon emissions? To answer this question and achieve the above stipulated research objectives data will be collected by means of content analysis from governmental publications and statistics.

Analysis and Discussion

In order to answer the above research question and meet the stated objective, this section provides a systematic analysis and discussion to a number of key issues that are linked together and related to the topic under discussion. It starts with discussing issues related to UK green taxation where a number of UK green taxes are illustrated and their impacts discussed. Then, UK energy capacity is tackled in some details. Investments in UK renewable energies and implications of the UK energy policy will be discussed before a conclusion is drawn based on findings.

UK Green Taxation

In terms of climate change and green taxation, the UK is bounded by both the Kyoto Protocol and the EU carbon reduction targets (Pearce, 2006). The Kyoto Protocol bounded developed countries by a reduction of Greenhouse Gas Emissions (GHG) of 5.2% below the 1990 levels during the period 2008-12. The EU states have agreed a higher reduction of GHG of 8%, and the UK set even a higher reduction target of 12.5% (Varma, 2003; Pearce, 2006; IEA, 2013); this means that annual emissions from the UK ought to be no more than 682.4 million tonnes carbon dioxide equivalent (MtCO2e).

The EU target was set at 20 per cent reduction of greenhouse gas emissions, relative to 1990, as a base year, by 2020. The EU target was agreed based on a combination of EU ETS emissions caps and a further reduction from other sectors that are not covered by EU ETS (DEEC, 2013).

Relative to the above targets, the UK has been successful in meeting its emission reduction commitments, see Table 1. During the period 2008-12 emissions never exceeded 682 MtCO2e, but has been on a decreasing trend up to 2012.

Table 1: Kyoto Protocol: (all figures are emissions in MtCO2e)

Assigned Amount		Actual emissions including EU ETS						Overall emissions below Assigned Amount 2008-2012
Total Emissions (2008-12)	Equivalent average emissions p.a.	2008	2009	2010	2011	2012 (p)	Cumulative emissions (2008-12)	
3412	682	610	590	601	577	585	2962	450

Source: DECC (2013: online)

As mentioned above, the UK has used a number of emission taxes as policy tools to achieve its energy objectives, the following is brief description of three main UK green taxes.

The Climate Change Levy (CCL): The UK announced in its 1999 Budget that the CCL will be introduced in 2001, the levy came into effect from 1st April in that year. The levy, a downstream tax, is designed to be applied on industrial and commercial use of energy, this includes electricity, natural gas, liquidised oil products (LPG) and oil (Varma, 2003; Lin and Li, 2011; HMRC, 2014: online). The CCL was initially introduced by the UK Government as tool to meet its Kyoto and EU targets of reducing carbon dioxide emissions. It was intended that the levy would promote energy efficiency, encourage investments in cleaner technologies and open up employment opportunities. It was planned that the CCL will raise one billion sterling pound in the first year, revenues from this levy is planned to be used to reduce employer national security contribution by 0.3%, support energy efficiency schemes and to subsidize investments in clean technologies (Varma, 2003; Aidt, 2010). This leads us to hypothesise that UK green taxes have a positive impact on generating renewable energy and on reducing GHG emissions.

Upon the introduction of the CCL, commentators such as Church (2001) suggest that the CCL would have significant adverse effects on small and medium sized companies that are energy intensive in nature with low labour cost. Church (2001) claims that these companies would lose their international competitive advantages and this in its turn would lead to higher imports, closure of industry and rise in unemployment. However, Varma (2003) argues that competitiveness advantage of companies depends on a number of factors, and if revenues from CCL recycled the effect of CCL would not be significant on companies' competitiveness advantages.

Emission Trading Scheme: The European Union Emission Trading Scheme (EU ETS) was introduced in 2005. The objective of this scheme is to allow the EU states to reduce their GHG emissions by 8%, on 1990 levels, by 2020. The EU ETS is seen as an effective measure to reduce emissions from power and industrial sectors at a lowest possible cost, hence lowering the cost of tackling climate change (DECC, 2013b). The UK government introduced ETS in combination with CCL, this is to incentivise firms to reduce emissions and rewards those who do so successfully. The scheme is simply based on the idea that if a business meets its target GHG emissions it can claim emission permits. These permits can be sold to other businesses that may want to buy them and who initially did not meet their GHG emissions. If the business may not wish to sell its permits, it can bank them for future use or to use these permits between its own portfolios of activities (Varma, 2003; DECC, 2013b).

Carbon Price Floor (CPF): The Budget of 2011 introduced the CPF as a new regulatory policy tool with an effective date as of 1st April 2013. This tool stipulates that polluters must pay for the right to pollute; the CPF aims to support investment in low-carbon generation. It is intended that supplies of fossil fuels used in most forms of electricity generation will become liable either to CPF rates of CCL. The CPF rates are determined by the average carbon content of each fossil fuel and these reflect the differential between the future market price of carbon and the floor price as set out at Budget 2011 (HMRC, 2013: online). The carbon price per tonne of CO2 (tCO2) is currently equivalent to £16, rising to £30 per tCO2 by 2020, and to £70 per tCO2 by 2030 (HMRC, 2011; Abdo, 2013).

The aim of the CPF was announced by the UK government as to support investments in low-carbon alternatives and nuclear power. However, upon introducing the CPF there were clear concerns that political interference in the mechanism of this economic tool would distort its functioning. Also, there were concerns that fluctuations in the Emission Trading System (ETS) and carbon price may deter investments in energy technology (Ares, 2012). This in fact led us to set a mull hypothesis that UK green taxes have a negative impact on generating renewable energies.

The introduction of CPF in 2011 has led commentators to state that the unilateral UK green policies would risk the competitiveness of UK energy-intensive industries, this is because the UK industrial electricity prices have been already higher than those in EU and G7 average prices (Professional Engineering, 2011). As a solution to this disorder in the prices of electricity, calls for compensation packages were made to safeguard the competitiveness of the UK energy-intensive industries. Expectations of the impact of the CPF on energy prices have in fact happened, as six energy companies working in the UK announced increases of their price in October 2013.

The UK Energy Capacity

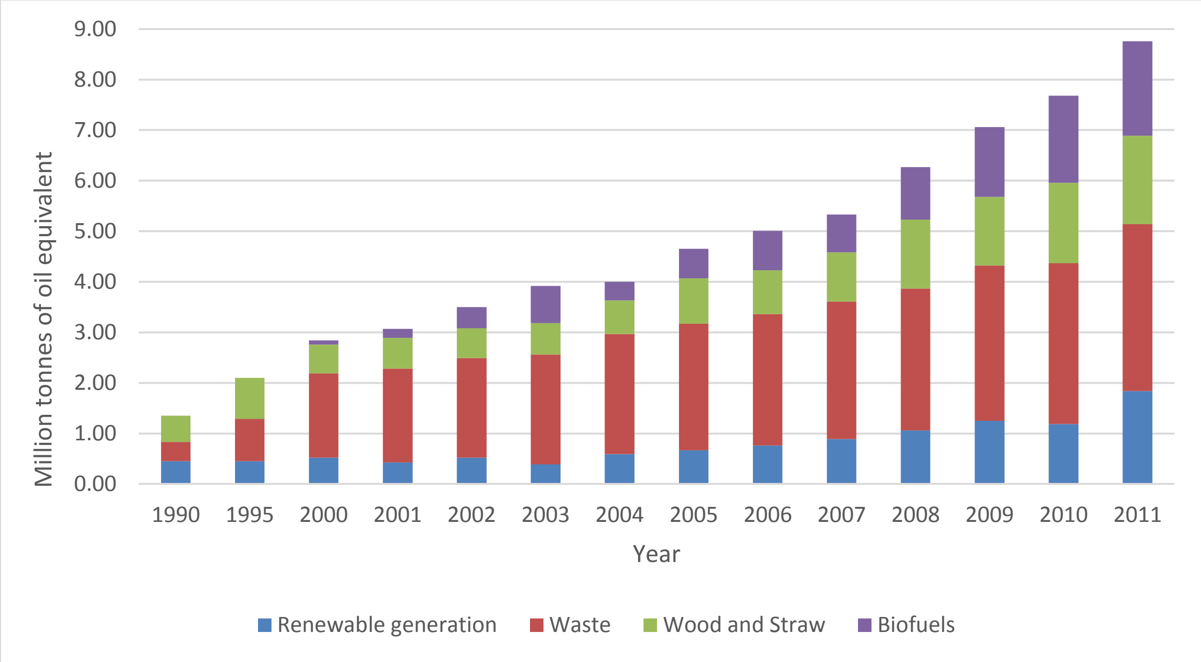
In 2011 total discovered oil reserves declined by 46.7% compared to the peaked discovered reserves in 1994, and gas reserves were 64.3% down from the peak point in 1997 (ONS, 2013). In the same year, fossil fuel accounted for 88.3% of total direct energy used in the UK, representing a 7.4% decline compared to 1990 levels. Although the share of renewable energy has increased from 1.5% in 2003 to 3.7% in 2010 the UK renewable contribution to primary energy supply is ranked fourth lowest among IEA countries (number 25 out of 28 countries). In terms of electricity generation, 7.2% of total UK electricity was generated from renewable sources in 2010, of this total 3.5% came from biofuel (IEA, 2013). This means that the UK needs to increase the share of its renewables in the total energy mix by more than four folds to meet the EU set target of 20% by 2020.

In order to reach the goal of 20% renewable electricity, 20GW of renewable capacity would need to be connected to the national grid system. This implies that the UK is in need for technical, commercial and regulatory framework, flexible enough, to facilitate the transmission of renewable electricity generated by different options into the national grid (DTI, 2007).

Energy consumptions from renewable energies have been on an increasing trend since 1990. For example, energy from waste sources increased from 0.4 Mtoe in 1990 to 3.3 Mtoe in 2011. In 2012, bioenergy accounted for 3% of total primary energy consumption in the UK with the majority (65%) being used in power generation, see

Figure 1 (DECC, 2012; ONS, 2013; DECC, 2013a).

Figure 1: Energy Consumption of Renewable and Waste Sources, 1990-2011

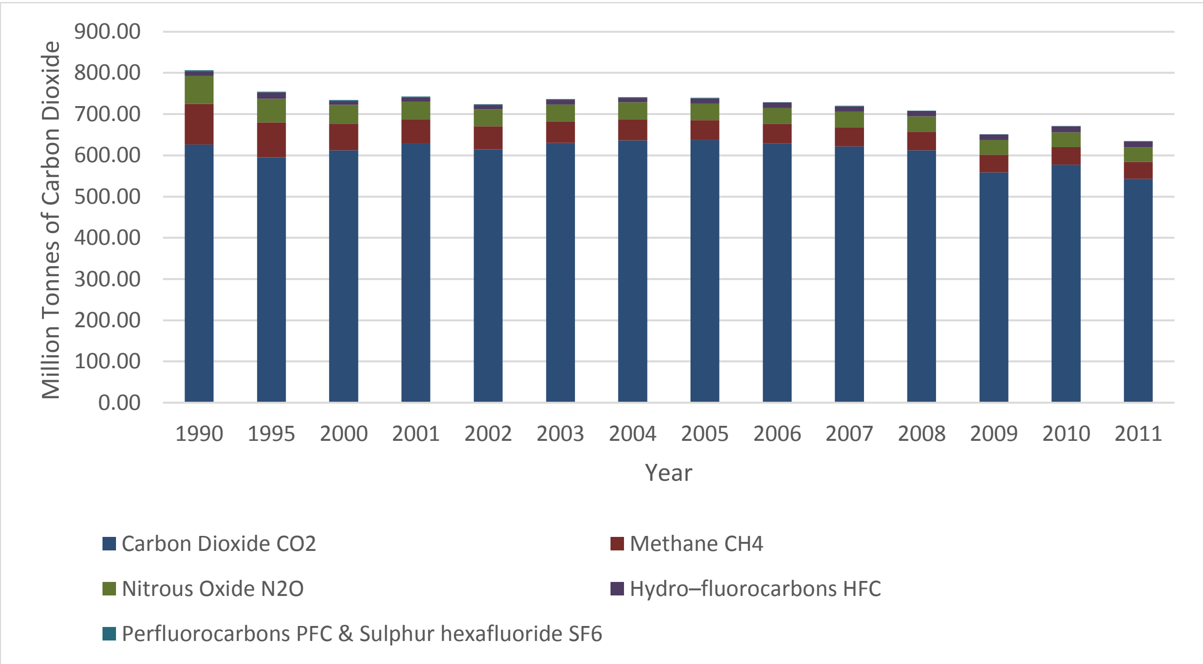


Source: Based on data from ONS, 2013

In terms of GHG emissions, the UK has reduced its emissions by 21.3% in 2011 compared to 1990, this accounts for 634.8 $MtCO_2$ equivalent (ONS, 2013). The significant drop in emissions level in 2011 is linked to a decline in energy consumption between 2010 and 2011 (see

Figure 2). It is worth mentioning that whilst emissions from the manufacturing sector witnessed a decline in CO_2 emissions between 1990 and 2011, emissions from transport and communication sector scored a 39.7% increase during the same period; this is mainly down to increases in emissions from aviation (ONS, 2013). These observations motivate us to suggest that in order to reduce CO_2 emission to a further lower levels policy makers should focus more on using effective instruments that target transportation sector, and particularly aviation.

Figure 2: Greenhouse Gas Emissions: by type of gas, 1990-2011

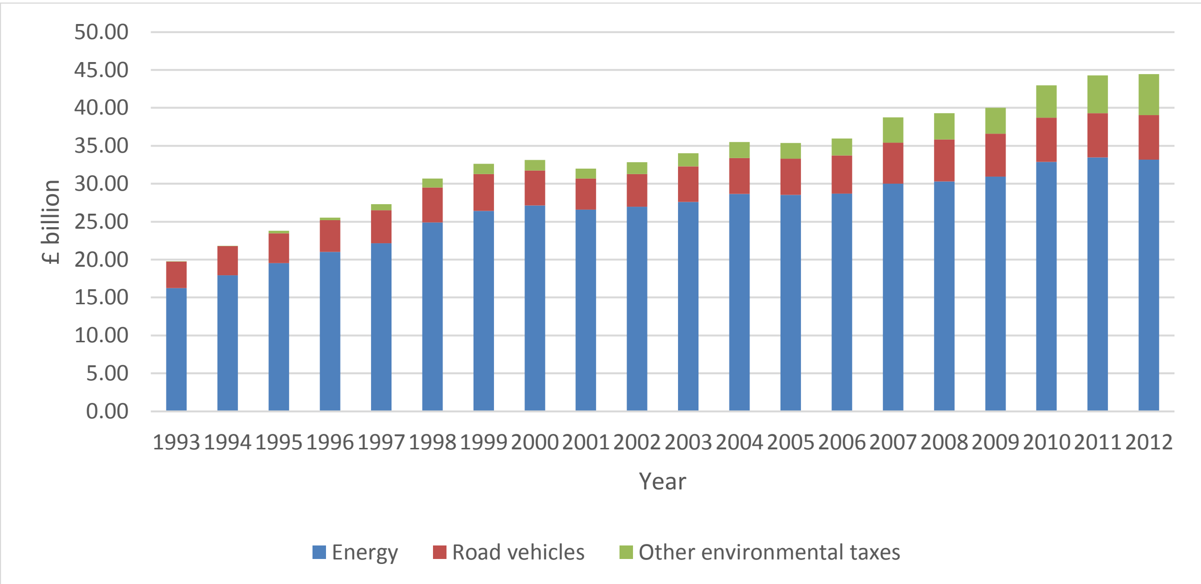


Source: Based on data from ONS, 2013

Environmental taxes accounted for 2.9% of the UK Gross Domestic Production (GDP) in 2012, in money terms these are £44.5 billion (ONS, 2013).

Figure 3 depicts the increasing trends of UK environmental taxes between 1993 and 2012.

Figure 3: Environmental Tax Revenues, 1993-2012



Source: Based on data from ONS, 2013

The figure shows that environmental taxes have increased significantly over the last 20 years. In theory, these significant tax revenues should make a material effects on the UK energy objectives in terms of reducing GHG emissions and incentivising investments in clean energy technologies, only if they have been well utilised.

In order to see whether environmental taxes do have an effects on emission reductions, we calculated the correlation coefficient between total UK environmental taxes and total emissions over the period 2000-2011. The result of this correlation is -0.88, this high negatively correlated result shows that the increase in environmental tax revenues is met by reduction in greenhouse gas emissions. This leads us to state that UK environmental taxes have been used as a successful tool to reduce greenhouse gas emissions.

Investments in UK Renewable Energies

In order to encourage investments in nuclear and renewable options the UK energy policy introduced a number of measures, as mentioned above. The key aim of these measures is to ensure energy security is in place and this not to be at the expense of climate change. To ensure energy security, the UK has always called up at diverse energy sources. This diversity means using every possible option to generate energy domestically while ensuring climate change policies are well maintained, and when importing energy not to depend on a single one country.

In order to stimulate investments in renewables, the UK announced in its renewable strategy that there will be increased funding available to encourage investments in large-scale renewable energy projects. This support is directed on new renewable energy technologies and infrastructure. Furthermore, the UK government encourages dialogue between government officials and the finance and investment policy on renewable energy and investments strategy (HM Government, 2009). In order to stimulate investments in the UK, the government doubled the capital allowance to 40% for new investments for one year. The question that is still needs answering is whether these procedures are sufficient to encourage adequate investments in the renewable energies that will allow the UK to meet its energy objectives.

With all the above mentioned supports to investments in renewable energies, the UK ranks 7 among the top 10 countries in renewable energy production. See Figure 4.

Figure 4: Top 10 Countries in Clean Energy Investment

	2012 (In billions of dollars)	2012 Rank	2011 (In billions of dollars)	2011 Rank
China	65.1	1	54.1	2
United States	35.6	2	56.8	1
Germany	22.8	3	31.3	3
Rest of EU-27	16.3	4	17.7	5
Japan	16.3	5	9.3	8
Italy	14.7	6	30.1	4
United Kingdom	8.3	7	10.0	7
India	6.9	8	12.5	6
South Africa	5.5	9	0.03	20
Brazil	5.3	10	7.8	10

Source: Bloomberg IN the PEW Charitable Trust (2012: 18)

In order for the UK to stimulate more investments in clean energy the cost of generating energy from renewables should be lowered, and investments in different options must be deployed, with focus on areas that may have greater potentials, such as bioenergy. Table 2 depicts electricity generated by means of renewable sources between 2008 and 2012.

Table 2: Electricity Generated from Renewable Sources (GWh), 2008-2018

	2008	2009	2010	2011	2012
Wind:					
Onshore	5788	7553	7140	10384	12121
Offshore	1305	1754	3044	5126	7463
Shoreline wave / Tidal	0	1	2	1	4
Solar photovoltaic	17	20	40	244	1188

Hydro:					
Small Scale	555	577	483	701	653
Large Scale	4600	4664	3092	4989	4631
Bioenergy:					
Landfill gas	4729	4929	5037	5092	5154
Sewage sludge digestion	549	604	697	764	720
Biodegradable energy from waste	1239	1509	1597	1739	2279
co-firing with fossil fuels	1575	1625	2332	2964	1783
Animal biomass	620	637	627	615	643
Anaerobic digestion	16	43	151	278	523
Plant biomass	807	1327	1594	1749	4098
Total bioenergy	9535	10674	12035	13201	15200
Total Generation	21800	25243	25836	34646	41260
Source: DUKES (2013: 186)					

It is clear from the above table that electricity generated by renewables has almost doubled between 2008 and 2012. It also can be seen that bioenergy contribution to electricity generation has steadily increased over the period 2008-12. What can be taken from the above table is that the UK is making progress in generating electricity from renewables; however significant progress could be achieved by focusing more on bioenergy as the UK has significant potentials from this source.

UK Energy Policy Implications

The UK has drawn a renewable energy strategy in 2009 along implementing a number of energy efficiency measures as a responses to both energy insecurity and adverse climate change. Also, the country has used a number of energy and green taxes, as mentioned above, to promote investments in renewable energy project and to penalise carbon emissions. Investment incentives seem to have been steered more towards wind, hydro and solar power compared to biomass sources, this is reflected in the less energy produced by these sources.

The peaked North Sea oil and gas production meant that the UK became a net oil and gas importer; this, coupled with the spike increase of oil and gas prices, present a clear sign of energy insecurity for the country. Climate change regulations whilst de-incentivising the use of energy sources that emit GHG significantly, such as coal, encourage the use of clean and renewable energy sources.

The absence of a coherent stable energy policy and the uncertainty about the existing policy may have shaken the trust and confidence of the existing and potential financers and investors who needed more assurance that their investments would yield a satisfactory return to them. The uncertainty of the UK energy policy, the instability of the UK petroleum fiscal regime, and the lack of clarity about the level of government's subsidy, coupled with the sudden and unexpected attempt of the government to reduce solar subsidy in 2012, have resulted in a significant low-carbon energy projects being put on hold. By the same token, fluctuations in the price of carbon in the form of EU Emission Trading Scheme (EU ETS) has increased the investors' uncertainty and lowered their expectations from low-carbon technology projects (Ares, 2012, DEEC, 2013b).

Based on the above account, it can be noticed that while the government policy pushes towards reducing carbon emission by penalising emitters, the energy policy seems not to be providing a 'healthy enough' environment for investments in low-carbon and renewable energy projects in the UK. There seems to be contradiction between the governments aims of providing sustainable energy and the policy in place.

Concluding Remarks

Using green taxes to cut carbon emissions and stimulate investments in clean energy projects seems to be making progress in the UK towards these objectives, however a slow progress. To accelerate this progress the UK needs to undertake a number of measures and provide further incentives for investments in renewable energy technologies, the most important seems to be a coherent energy policy that assures certainty and stability.

UK green tax revenues have been on an increasing trend, and these needs to be well utilised in a subsidy system that lead to reduced renewable energy costs. This must provide true incentives for potential renewable energy investments that may enhance the chance of achieving the 2020 and 2050 renewable targets.

It is relatively significant for regulatory and policy makers to provide a suitable investment environment for bioenergy projects in the UK. This would, besides offering a waste management tools, offer renewable energy that would aid the UK renewable objectives and reduce dependence on fossil fuel, hence providing sustainable sources of heat and power which benefit energy security objectives.

In order to provide suitable investment environment for renewable sources the UK is required to stimulate private investments in energy infrastructure and maintain stable long-term regulatory framework and energy policy. So doing must reduce investment risks and encourage energy investors to undertake long-term investment projects in renewable sources in the UK. In other words, the UK needs to develop an energy industrial strategy that, besides being stable, draw a roadmap for each source of renewables that can be an option to aid the government objectives of energy security and decarbonising the future electricity. A related point is that the UK needs to maintain a suitable and flexible connection of the national grid to renewable projects. In order to have this connection in place suitable technical and regulatory framework will need to be in place to facilitate a wider renewable energy mix in the electricity system of the UK.

The UK is a leading state in energy efficiency, and it is recommended that the country to keep investing in energy efficiency measures. This must reduce energy cost for final users and provide for energy security while decarbonising the future economy (Abdo, 2013).

In order to establish a closer link between investments in renewable energy projects and green taxation in the UK a further primary data needs to be collected and analysed and real case studies need to be investigated. Data needed from different renewable projects so comparison can be made between the different options in terms of energy generation potentials and emission reduction roles. This will be our focus in the next study.

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