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Less pain, more gain: the potential of carbon pricing to reduce Europe's fiscal deficits

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Overview

An overriding challenge for many European governments and policy-makers is to reduce major fiscal deficits with the least collateral damage to their economy. This paper aims to clarify the role carbon-related fiscal measures can play in contributing to fiscal re-balancing in Europe. It builds on a broader report carried out by Vivid Economics for the European Climate Foundation and Green Budget Europe (Vivid Economics, 2012), which includes a detailed assessment and modelling of the issue. This paper provides an overview of the analysis in the report, and extracts key messages for policy-makers.

A review of current carbon-energy taxes across a sample of nine EU member states reveals a great discrepancy in the tax rates used within and across countries. Without a common set of signals, various economic problems can emerge, from inappropriate investments in fuels and technologies, to carbon and economic leakage[1] between countries and, ultimately, overall loss of welfare.

Raising or adjusting national taxes on energy and carbon can help to correct these discrepancies, while generating useful revenues that can contribute to fiscal re-balancing. The analysis compares such carbon-related taxes with conventional direct and indirect taxes raising similar amounts of revenue. It reveals that carbon fiscal measures can indeed raise significant revenues while having less detrimental macro-economic impact than other tax options.

Similar results are found for a tightening of the cap in the European Union Emissions Trading System (EU ETS). Such a tightening could raise considerable revenue at lower macroeconomic cost than equivalent increases in direct or indirect taxes, both at the level of the EU as a whole and for a significant majority of Member States. The analysis suggests that the smaller the proportion of allowances that are allocated for free, the more attractive EU ETS reform becomes as a mean of raising revenue.

Raising energy and carbon taxes and tightening the EU ETS, however, are not without adverse impacts. In particular, they can have a negative impact on income distribution, and lead to loss of competitiveness and to carbon leakage.

[1] i.e. the distribution of economic activity according to differences in taxation rates rather than underlying comparative advantage.

Nevertheless, although the modelling confirms that energy taxes are often regressive, it also shows that other forms of taxes can lead to significant decline in economic activity, which in turn can cause even greater losses to lower income and disadvantaged households. Further, the regressive impact of energy taxes can be alleviated. The appropriate approach is likely to vary by country – depending on factors such as data availability and variability in energy consumption across (low-income) households. Once such variables are factored in, the negative impacts on low-income groups may be offset using a relatively small proportion of the tax revenue (that would otherwise be) raised.

As for carbon leakage, the analysis suggests that, over the medium to long term, border carbon adjustments have the potential to deliver better protection against leakage than free allocations of ETS permits. Border adjustments could in fact contribute to fiscal consolidation more than a shift to full auctioning on its own, and are a more attractive way of raising revenue than an increase in direct taxes. However, considerable challenges relating to their feasibility, compatibility and political acceptability remain. If introduced, therefore, carbon tax adjustments will require careful and smart design.

Overall, carbon fiscal measures have the potential to play an important role in fiscal policy. In the past such measures have generally been considered only as instruments of environmental policy; their fiscal role has been largely overlooked. In the light of Europe's current fiscal crisis, it is time to reconsider that view.

1 Introduction: the fiscal crisis and the role of carbon taxation

The over-riding challenge for many European governments today is to reduce major fiscal deficits with the least collateral damage to the economy. Fiscal consolidation remains a key policy driver in many European Union countries. Notably, in March 2012, 25 EU Member States signed the Treaty on Stability, Coordination and Governance[2], containing a 'fiscal compact' to limit their structural deficit to 0.5 per cent of their gross domestic product (1 per cent for low-debt countries), and to ensure that general government debt does not exceed, or is sufficiently declining towards, 60 per cent of GDP.

In the current economic circumstances, a common view has been that dealing with climate change takes second place to fiscal consolidation, or that, simply, it cannot be 'afforded'. Carbon taxation, however, is and can be a significant source of fiscal revenue, and can therefore contribute to fiscal re-balancing in Europe. Further, it causes less economic harm per unit of revenue than direct (e.g. income) or other indirect taxes (such as VAT), while also producing environmental benefits. Indeed, the OECD (2012) noted: *'Introducing or increasing taxes on polluting behaviour provides potentially a win-win option. […] Since many countries are committed to reducing greenhouse gases, the time is propitious for addressing fiscal consolidation and environmental protection jointly.'*

This policy paper builds on a broader report prepared by Vivid Economics for the European Climate Foundation and Green Budget Europe (Vivid Economics, 2012). The report provides a detailed analysis of the topic, drawing on a rich literature review (including work by the UK Green Fiscal Commission[3]) as well as on new modelling results. This paper provides an overview of the analysis in the report, and extracts key messages for policy-makers.

While this is not intended to be a comprehensive analysis of Member States' practices, nor to provide specific advice to the countries chosen for modelling, it aims to offer examples and lessons from a sample of country-specific practices that can be of use for current and future national policies across the EU. This paper aims to inform political discussions about fiscal reform at national level, as well as reform of energy taxation and emissions targets at European level.

The paper is structured as follows. Section 2 presents an overview of existing carbon and energy taxation in the EU. Section 3 illustrates the economic impacts of a set of theoretical tax reforms in three Member States (Spain, Poland and Hungary), and compares their performance with direct, labour and value added taxes which would raise similar revenues. Section 4 applies the same approach to the tightening of the EU Emissions Trading System (ETS). Section 5 considers ways to mitigate the distributional effects of energy tax reforms and to reduce carbon leakage through border carbon adjustments. Section 6 presents key conclusions and recommendations. Additional insights about the methodology used for the analysis are provided in Annex 1.

[2] http://european-council.europa.eu/eurozone-governance/treaty-on-stability
[3] http://www.greenfiscalcommission.org.uk/

2 Carbon and energy taxation in Europe today

If the EU, along with its international partners, is to achieve its goal of avoiding dangerous climate change, then it will have to convince firms and households to reduce their emissions of greenhouse gases. Markets operate through prices and, although there are market failures which limit the responsiveness of energy-users to changes, without price signals it will be difficult if not impossible to change behaviour sufficiently. Carbon prices, in the form of taxes and emissions trading, are an essential part of the policy prescription.

This section introduces the concept of energy and carbon taxes, provides some historical evidence on their effects, offers an overview on current practices at national level - building on an analysis of nine EU Member States – and discusses taxation at EU level, particularly the proposed changes to the EU Energy Tax Directive.

2.1 Implementing environmental taxes: lessons from experience

Environmental taxes and charges are particular forms of market-based or economic instruments. A widely-used definition of an environmental tax describes it as '*a tax whose tax base is a physical unit (or a proxy of it) that has a proven specific negative impact on the environment'* (United Nations et al, 2005). Since the 1980s, many such taxes have been introduced in all European countries (European Environment Agency, 2005).

Environmental taxes, including energy and carbon taxes, have in some cases been incorporated into broader policy packages defined as 'environmental tax reform'[4]. These consist of '*a gradual shift of the tax base away from taxing 'good resources' such as investment and labour, toward taxing 'bad resources' such as pollution and inefficient use of energy'* (European Environment Agency, 2005). The revenue raised through environmental tax reform can be used to reduce other forms of taxation, such as on labour, or for other purposes (see Box 1). Arguments for and against such instruments are discussed in Box 2.

To date, a number of EU Member States have adopted forms of environmental tax reform, including Denmark, Estonia, Finland, Germany, the Netherlands, Slovenia, Sweden and the UK. Others have adopted a variety of environmental taxes, but not within wider reform packages.

Analysis of the experience of energy and environmental taxes in Europe provides useful insights on their effects, especially on energy consumption, carbon emissions, employment and GDP. The impact on income distribution, which is a particularly critical issue in relation to energy taxes, is discussed in section 5.

[4] The term 'ecological tax reform' and 'green tax reform' are also frequently used. 'environmental fiscal reform (EFR)' instead refers to a broader concept that includes reform of environmentally-harmful subsidies.

Box 1. Revenue recycling, hypothecation and earmarking

Energy and environmental taxes raise revenue which can be used for different purposes. Revenue 'recycling' occurs where such revenues are accompanied by reductions in other forms of taxation with the intention of leaving the overall tax take unchanged. In accordance with the principles of environmental tax reform (shifting the share of taxation from 'goods' to 'bads'), a common practice has been to reduce employers' social security contributions or income taxes in compensation.

In other cases, revenues have been used to finance various kinds of public expenditure, usually on the environment (examples might include subsidies for energy efficiency or spending on environmental remediation).

When discussing the use of revenues, it is helpful to distinguish between the concepts of hypothecation and earmarking. Hypothecation relates to a situation where there is a formal commitment to link the tax revenues raised to an associated spending (e.g. on energy efficiency measures, emission abatement technologies, renewable energy, etc.), such that if tax receipts rise (or fall) public spending on the associated activity rises (or falls) by the same amount. Economists have tended to criticise this, pointing out that there need be no direct relationship between the revenues generated by the tax rate, the levels of which are meant to be appropriate to deal with a given environmental damage, and the needs of a particular spending programme, which may be greater or smaller than the revenue raised. In practice, a less rigid 'earmarking' of revenue is more common, where, despite political links being made between specific taxes and specific spending items, less than 100 per cent of revenue is used for the associated expenditure, and/or other sources are used to fund the spending programme.

Studies analysing environmental tax reform with recycling have tended to find positive impacts on employment and on GDP. Several studies across Europe[5] report positive effects on GDP in the range of 0.1 to 1 per cent (Ščasný and Piša, 2009; Kiuila and Markandya, 2005; Labandeira and Rodríguez, 2007). In Germany, environmental tax reform was found to have positive employment effects of 0.15 to 0.75 per cent (Truger, 2008). Another analysis across six EU Member States predicted positive changes in employment and negative changes in labour productivity (Barker et al., 2011, p. 224-6). Likewise, at a global level, the International Labour Organization (ILO, 2009) reports that, if there was a coordinated effort to introduce a global price on carbon dioxide and the resulting revenues were used to cut labour taxes, then global employment would rise by 0.5 per cent, or 14.3 million jobs, by 2014. These positive findings are not, however, universal, with studies in the United States in particular being more sceptical about positive impacts on GDP and employment (Goulder, 1995).

In terms of energy consumption, recent European modelling of carbon-energy taxes shows a reduction in fuel demand and an increase in both energy and carbon productivity. For example,

[5] Interestingly, these studies use a range of different modelling techniques. For instance, Ščasný and Piša, (2009) use the econometric E3ME model also used in the Vivid Economics (2012) analysis, while the ILO (2009) findings are based on a different vector autoregressive (VAR) time series econometric model. By contrast, Kiuila and Markandya (2005) utilise a computable general equilibrium (CGE) model. Labandeira and Rodríguez (2007) create an integrated micro-macro model, with the macroeconomic module, based on a CGE model, used to assess the macroeconomic effects of policies and the microeconomic module used to analyse their distributional effects. The finding that different forms of model lead to similar conclusions is corroborated by OECD (2004) which states: *'Using general equilibrium models to assess environmental policies implemented through economic instruments (taxation, tradable permits etc.) leads to similar results, in qualitative terms, as obtained with econometric models, with comparable orders of magnitude obtained.'*

by 2012, fuel demand was estimated to have been 4 per cent lower than it would have been without carbon-energy taxes across Sweden, Denmark, UK, Netherlands, Finland and Germany (Barker et al., 2009). Similarly, it was estimated that UK and German environmental tax reforms lowered energy consumption by 2 to 4 per cent.

There is also evidence that energy and carbon tax rates in selected EU countries have led to emissions savings of around 5 per cent (Barker et al., 2009). Evidence from country-specific experiences varies depending on the measures adopted. For instance, in Germany environmental tax reform appeared to have saved 6.4 million tonnes of carbon dioxide by 2003, which is around 0.7 per cent of its 1999 emission levels (Prognos and IER, 2004). A much larger effect was reported for Sweden, where it was estimated that its environmental tax reform led to a decrease in greenhouse gas emissions of almost 9 per cent between 1990 and 2007 (Hammar and Åkerfeldt, 2011). In the UK, by contrast, widespread exemptions to the Climate Change Levy, an energy tax, appear to have reduced its environmental efficacy. Firms that were fully exposed to the levy reduced the growth in their emissions by between 5 and 26 per cent more than those that were partially exempted through participation in Climate Change Agreements (OECD, 2010, p. 232-4).

Box 2. Considerations for and against energy and carbon taxation: the 'double dividend ', the 'Porter hypothesis' and the 'green paradox'

Three considerations are frequently voiced in favour of or against energy-carbon taxation: the 'double dividend' thesis, the 'Porter hypothesis' and the 'green paradox'.

The **double dividend thesis** is a claim that the taxation of environmental bads and use of revenue to reduce more distortionary income and labour taxes will, over and above the environmental benefits (the first dividend), generate macroeconomic benefits (the second dividend), particularly in the form of employment gains. This claim has been controversial, as it has been pointed out that higher energy taxes reduce real wages or profits and hence erode the base of pre-existing capital or labour taxes (the so-called tax interaction effect). However, as this paper shows, a significant number of modelling studies of environmental taxes provide some evidence for the existence of such twin benefits. As discussed in more detail in Vivid Economics (2012), European Commission and International Institute for Labour Studies (2011) and OECD (2004), there are a number of factors which can make a double dividend more likely. These relate to the existing features of an economy and its tax system e.g. if the environmental tax can be passed on to factors that are inelastically supplied or if there are large numbers of non-working households.

The **Porter hypothesis** argues that environmental regulations, including taxation, may have net macroeconomic benefits if they spur innovation in regulated sectors. In relation to environmental taxes, there is, in practice, only weak evidence for such effects.

The **green paradox** cautions that energy-carbon taxation might accelerate fossil fuel extraction if resource-owners believe that taxation will rise in the future, so they might therefore paradoxically increase emissions. However, no empirical evidence has yet been advanced for the green paradox, such that Werf and Maria (2011) describe it as a *'most striking void in this literature'*. Research by Potsdam Institute for Climate Impact Research on the green paradox will be completed in 2014.

In summary, while the double dividend thesis provides some grounds to support environmental taxation for macroeconomic as well as environmental reasons, neither the Porter hypothesis nor the green paradox currently appear to substantially affect the case for or against it.

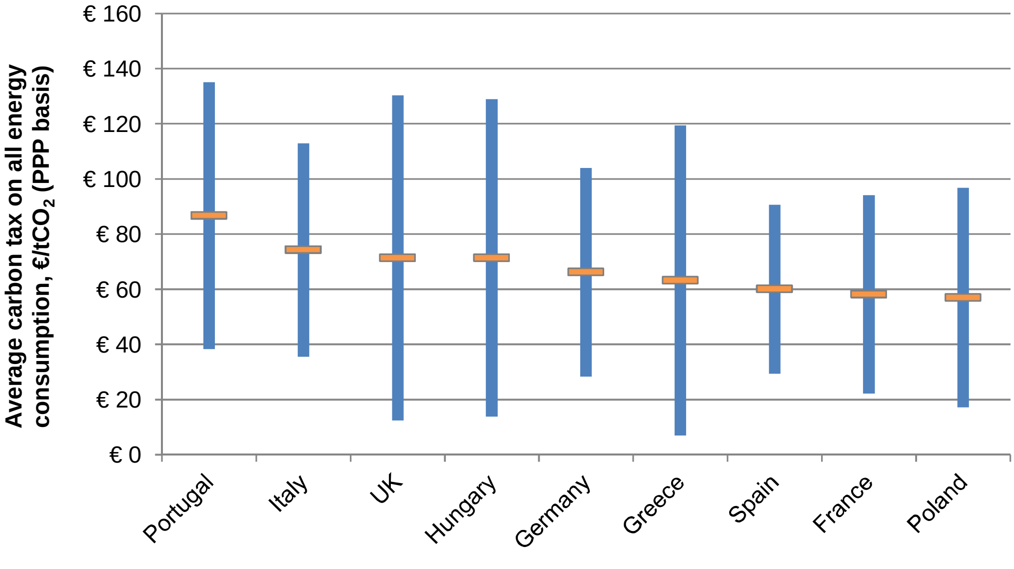
2.2 Current practices in selected EU Member States

There is a diversity of approaches to energy and carbon taxes across Europe. In order to have a better understanding of the different tax structures in use, a detailed review of national energy tax profiles was carried out by Vivid Economics (2012) for a sample of nine countries: France, Germany, Greece, Italy, Hungary, Poland, Portugal, Spain and the UK.

In different countries, energy and carbon tax rates are often expressed in different units, for example in terms of € per kWh, tonnes, litres etc. For practical reasons, in this study they have all been converted into a per-tonne-of-carbon-dioxide basis (€/tCO_2). This not only makes tax rates comparable across countries, sectors and fuels, but also makes their environmental component explicit - i.e. the price charged on actual carbon emissions[6].

The analysis revealed that carbon and energy tax rates are not uniform in any of the countries examined. Instead, they vary by fuel type (e.g. gasoline, diesel etc.), by user (residents, large and small business and several modes of transport) and even type of use. There are also considerable targeted exceptions and tax rebates, frequently used to direct subsidies to favoured groups of users, like households or high-energy-demanding sectors. Altogether, there is a diverse picture of variation across Europe – see Figure 1.

Figure 1. There is significant variation within and between European countries in rates of energy taxation



Note: Yellow bars indicate the weighted average for each country; blue boxes indicate the size of a standard deviation for each country, not minimum and maximum tax rates. PPP is purchasing power parity and takes account of the relative purchasing power of a €/domestic currency converted to € at market exchange rates.
Source: Vivid Economics (2012)

The average tax rate[7] among the countries analysed ranges from €35/tCO_2 in Poland to double that figure, €78/tCO_2 in Italy[8]. The average tax rate in Portugal, the UK and Germany is also relatively high, at around €70/tCO_2 or above – see Table 1.

[6] Although there are other externalities associated with fuel/energy consumption that provide a rationale for their taxation, most notably congestion as a result of transport fuel combustion.
[7] Here defined as the best estimates of total tax receipts from those taxes placed on energy consumption divided by total carbon dioxide emissions from energy consumption.

Furthermore, there is also a wider variation in how much each country taxes different sectors. Germany and Italy have relatively high tax rates across all sectors. The UK and Greece apply high rates of tax on transport (€248/tCO_2 and €213/tCO_2 respectively) while these are relatively low in Poland and Spain (€126/tCO_2 and €115/tCO_2 respectively). The highest tax rates on business can be found in the UK and Germany (€26/tCO_2 and €32/tCO_2 respectively), while they are low in Greece (€5/tCO_2). Tax rates on the residential sector are highest in Italy, at €70/tCO_2. The UK is by far the most generous to residential users, directing a substantial subsidy towards them (in the form of a reduced rate of Value Added Tax[9]) to achieve what is effectively a negative tax rate of €-31/tCO_2.

Table 1 Carbon-energy taxes at market exchange rates, 2011, €/tCO_2

Country	Mean	Residential	Transport	Industry, public and commerce
Italy	78	70	179	24
Portugal	72	10	151	15
UK	71	-31	248	26
Germany	70	34	199	32
France	66	12	149	15
Greece	58	5	213	5
Spain	56	20	115	17
Hungary	44	-4	144	13
Poland	35	9	126	18

Source: Vivid Economics (2012)

It is also apparent that road transport fuels are treated quite differently from other uses of energy. They are almost exempt from the EU ETS[10], but they are subject to a much higher rate of excise duty, reflecting the greater externalities associated with the transport sector (e.g. congestion). Tax rates are between 6 and 47 times higher than the tax rates on residential and business use.

Furthermore, there is surprising variation in rates by fuel type, even within the same sector. Most countries allow this variation to persist, even though it may distort economic behaviour. Most notably, electricity is taxed more heavily than natural gas. On average it is €17/tCO_2 more expensive when used by households, and costs €10/tCO_2 more when used by the business sector. Another example is the heavier taxation of gasoline than diesel, with gasoline more heavily taxed by €92/tCO_2 on average. This differential is particularly stark when the rates per litre are translated into emissions terms, because diesel has a higher carbon content.

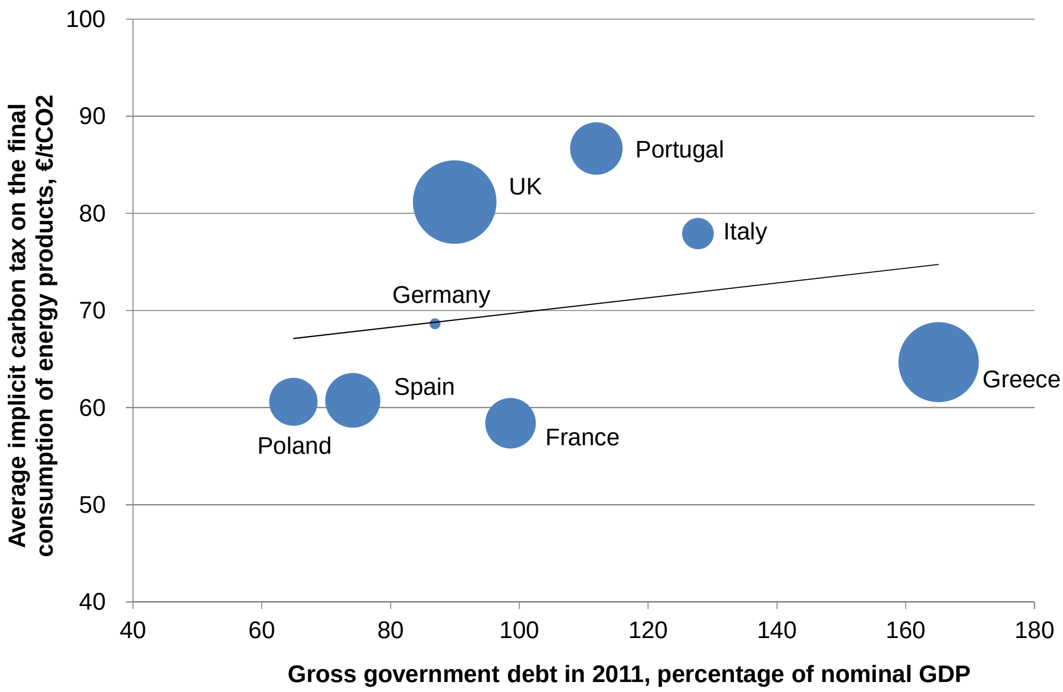
As for the use of carbon and energy taxes in fiscal consolidation, there is little evidence of this so far, with the Netherlands being the major exception. In April 2012, the Dutch government increased several environmental taxes to raise revenue for deficit reduction. Elsewhere, the data for this small sample of nine countries show that countries with higher deficits and higher gross debt have tended to have higher carbon-energy tax rates, but the relationship is weak, as

[8] Using market exchange rates.
[9] This was converted into an average subsidy per tonne of carbon dioxide using data about average household electricity/gas prices from Eurostat.
[10] The emissions from refineries when producing transport fuels are covered by the EU ETS.

Figure 2 indicates. Portugal, Italy and Greece carry more debt and have higher tax rates than Poland, Spain and France. However, Germany, which is fiscally almost in balance, has the same tax rates as Greece. Collectively, those countries in greatest need of fiscal injection do not seem to have chosen to set higher carbon-energy tax rates.

There are certainly other factors at play, and perhaps fiscal health has not been a strong influence on energy tax rate-making. If that conclusion tells us anything, it is that there is reason to look thoroughly at the opportunities for carbon-energy tax reform.

Figure 2. There is no clear relationship between average implicit carbon tax rates and measures of fiscal health



Note: The size of the bubble reflects the government deficit as a percentage of GDP, 2011.
Source: Vivid Economics (2012)

2.3 The EU Energy Tax Directive and its proposed revision

The great diversity across Member States' energy and carbon tax regimes reflects the limited appetite for harmonisation at EU level. Fiscal issues have always been considered a national matter, and unanimity is required when the European Council wishes to adopt fiscal measures to pursue environmental policy objectives. Earlier attempts to introduce an EU carbon tax in the 1990s, for instance, faced firm opposition from some Member States. The Directive on the taxation of energy products and electricity (or Energy Tax Directive, 2003/96/EC)[11] was devised to circumvent such opposition. The Directive was much less ambitious than previous carbon tax proposals and aimed merely to broaden, harmonise and gradually increase the minimum rates of duty applicable to a range of energy products (Institute for European Environmental Policy, 2012). It specifies minimum tax levels for motor fuels, heating fuels (oil products, natural gas and coal) and electricity. It also provides for a large number of exemptions, postponements and

[11] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0096:en:HTML

special arrangements for specific fuels, activities and Member States, many of which expired by the end of 2006 (Bassi et al., 2009). To date, these rates are relatively low compared with those applied by several Member States.

In 2011, the European Commission presented a proposal to overhaul the outdated rules on energy taxation (European Commission, 2011a) in order to remove current imbalances across energy products. The proposed Directive requires the establishment of higher minimum tax rates for energy products, with the minima being the sum of two elements: their carbon dioxide emissions and their energy content.

The energy content element is already reflected in the current Directive, but the proposal envisages revised minimum rates (€9.6/GJ for all motor fuels as from 2018, and €0.15/GJ for heating fuels from 2013). The proposed new carbon dioxide element is €20/tCO_2 and applies from 2013, except for nine member states, which may postpone the inclusion of the element until January 2021. Combustion emissions from installations within the EU ETS are exempt from the carbon dioxide element and residential energy consumption can be entirely exempted from both minima.

The proposal also requires that the relativities established between the different minimum rates are reflected in the actual rates. That is, since the proposed minimum transport diesel rate is 8.3 per cent higher than the minimum petrol rate (€390/1,000 litres compared with €360/1,000 litres), actual diesel rates should also be 8.3 per cent higher than petrol rates, even if they are above the €360 or €390/1,000 litres minima. The resulting minima are shown in Table 2.

Table 2. The proposed EU Energy Tax Directive would increase the minima for all energy uses and products

Energy use	Product	Current minima	Proposed future minima	Year when minima must be reached
Transport	Petrol	€359/1,000l	€360/1,000l	2018
	Diesel (Gas oil)	€330/1,000l	€390/1,000l	2018
	Kerosene	€330/1,000l	€392/1,000l	2018
	LPG	€125/1,000l	€500/1,000l	2018
	Natural gas	€2.6/GJ	€10.7/GJ	2018
Heating	Diesel (gas oil)	€21/1,000l	€57.37/1,000l	2013
	Heavy fuel oil	€15/1,000l	€67.84/1,000l	2013
	Kerosene	€0/1,000l	€56.27/1,000l	2013
	LPG	€0/1,000l	€64.86/1,000kg	2013
	Natural gas	€0.15/GJ	€1.27/GJ	2013
	Coal and coke	€0.15/GJ	€2.04/GJ	2013
All	Electricity	0.5/MWh	0.54/MWh	2013

Source: European Commission (2011b)

Although still awaiting approval, the new tax rates proposed in the revised Directive have been used as a reference for the modelling carried out in this study. Possible improvements to the proposed Directive are outlined in Box 3.

Box 3. Possible improvements to the proposed revision of the EU Energy Tax Directive

The European Commission's proposal to revise the Energy Tax Directive envisages taxing heating and transport fuels based on both their energy and their carbon content (European Commission 2011a). While the rationale for carbon taxation is clear, there are reasons why it may not be optimal to tax fuels based on their energy content.

First, it is not immediately obvious what externalities would be corrected. Secondly, some lower-carbon fuels have high energy contents. Taxing them according to their energy content discourages their use and instead encourages the use of more carbon-intensive fuels. Moreover, tax rates based on energy content would require substantial increases in diesel tax rates in some Member States. These increases (more than 50 per cent in France and Germany) may not be politically feasible and could present a serious obstacle to the Directive reform as a whole.

An alternative would be to leave out the energy content tax basis. For heating fuels, just the carbon content element would remain, although this constitutes the bulk, more than 90 per cent, of the minima within the Energy Tax Directive.

Furthermore, a mark-up could supplement the carbon content element of transport fuels to account for transport-specific externalities and road financing. The mark-up would reflect that there are significant non-climate externalities associated with transportation, but that these are unlikely to vary significantly, or at all, by fuel type. In contrast to energy content taxation, such a mark-up would leave room for additional flexibility in policy negotiations, and would allow taking into account future technology developments.

3 National carbon and energy taxes versus alternative means of raising revenue

The European Union has targeted 2020 as the year for achieving a significant milestone in emissions reduction and energy efficiency and has outlined challenging ambitions beyond that date.[12] Europe's chances of succeeding will be higher if it can keep costs down, encouraging least cost actions through competitive markets. This implies the same or similar carbon-energy taxation across users, uses and fuels (after taking into account non-carbon externalities).

This paper therefore explores the opportunities for Member States to use energy taxes as a means to reduce government deficits, and compares these with direct or other indirect taxes which raise the same revenue.

Case studies were developed each for Poland, Hungary and Spain to illustrate the potential of energy tax reform. These three countries span a variety of size, location, and economic structure, while all requiring various degrees of fiscal tightening. In particular, Spain was chosen given its status as one of the largest European economies currently facing severe fiscal challenges, while the much smaller Hungarian economy provides a useful counterpoint. Poland was added as a particularly interesting case as, unlike Spain and Hungary, it does not rely on energy imports but rather on high levels of domestic energy production. These three countries may therefore yield useful lessons for a number of member states, even though circumstances and policy needs differ from country to country.

For each country, a package of illustrative energy tax reforms has been designed. The key focus of these packages has been to move towards a rationalisation of their current approach on energy and carbon taxation. As section 2.2 shows, there is currently a very significant variation within and between countries regarding the extent to which carbon dioxide emissions are (implicitly) taxed. This can create significant and costly distortions in the way in which emissions are mitigated: low tax rates on some emissions make it possible that some low-cost abatement opportunities are being lost, while higher taxes on other sources may induce some inappropriately high cost abatement. The aim of the theoretical tax packages presented here is to move in the direction of establishing a single carbon price across the economy[13]. Modelling is then used to examine the macroeconomic impact of such reforms and compare them with other approaches that raise similar amounts of revenue. In moving towards this more rational approach, account has been taken of the proposed changes in the Energy Tax Directive (see section 2.3). Further details of the model used for the analysis are presented in Annex 1.

3.1 Spain

The illustrative energy tax package envisaged for Spain includes an increase in the tax on transport fuels (particularly diesel), the introduction or increase in taxes on residential energy

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[12] As in the EU Climate and Energy Package: http://ec.europa.eu/clima/policies/package/index_en.htm

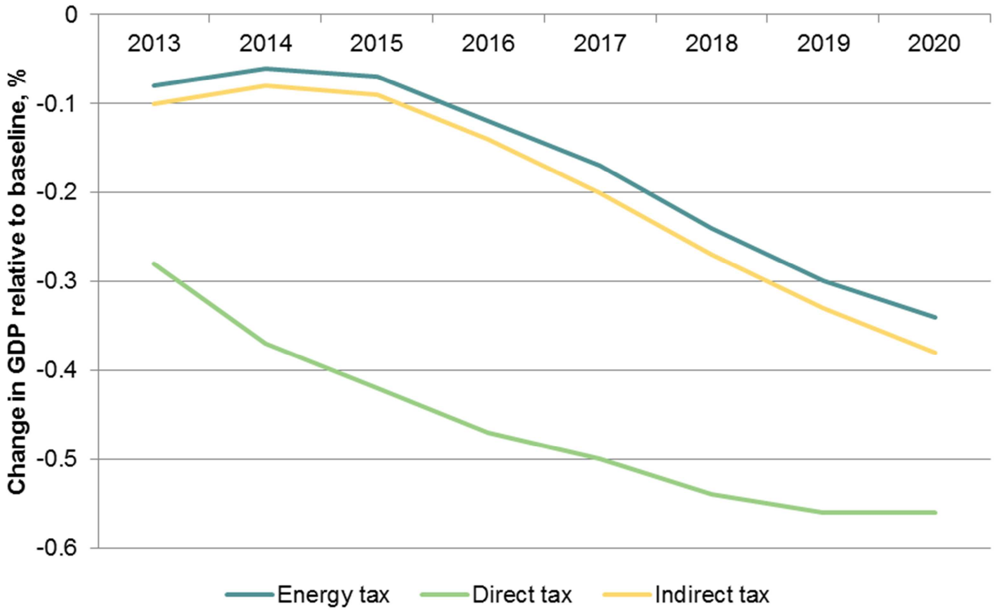
[13] An important exception here relates to the taxation of transport fuels which, as well as being responsible for carbon dioxide emissions, also causes a range of other externalities i.e. congestion, noise and accidents. Here the principle has been to move towards a common tax rate on all transport fuels when expressed on a per tonne of carbon dioxide basis, especially for diesel and petrol, with the (implicit) assumption that the levels of non-carbon-dioxide externalities are broadly similar across different fuel types. This then helps to establish appropriate relative price signals between different transport fuels.

consumption to bring them in line with rates for non-residential use, and increases in taxes on non-residential energy use in line with the minima proposed in EU Energy Tax Directive.

The revenues that could be raised appear substantial. They could deliver more than €10 billion per annum by 2020, equivalent to more than 1 per cent of projected Spanish GDP.

Crucially, if the same amount of money was raised through either direct or other indirect taxes, there would be a more likely detrimental macroeconomic impact. While, by 2020, the energy tax package is expected to reduce GDP by a little more than 0.3 per cent relative to the baseline, other indirect taxes might reduce GDP by a further 0.04 per cent and direct taxes by a further 0.2 per cent – see Figure 3. This is partly because energy taxes beneficially divert spending away from energy imports to domestically produced goods and services, boosting the economy (hence explaining why energy taxes have a less detrimental impact on GDP than other forms of indirect tax)[14] and partly because the modelling suggests that changes in prices lead to smaller falls in real wages than changes in direct taxes (explaining the superior performance of energy taxes and other indirect taxes compared with direct taxes).

Figure 3. Spain: the energy tax package has a smaller impact on GDP than a package of direct and other indirect taxes that raise the same amount of revenue

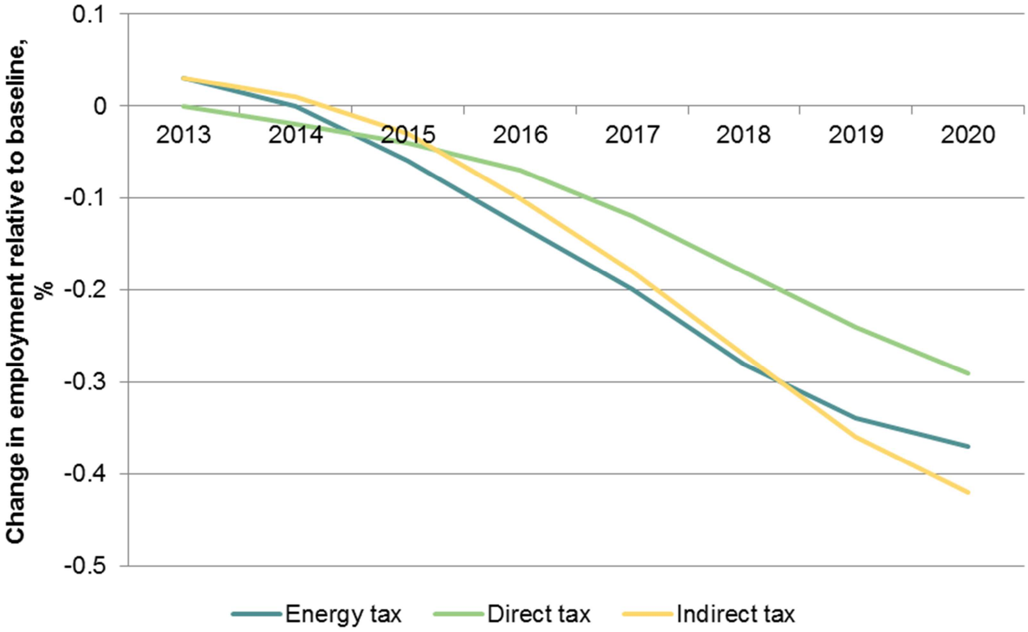


Source: Cambridge Econometrics E3ME model

Energy taxes and direct and other indirect taxes are expected to have broadly similar impacts on employment to 2015, at which point the direct tax package leads to smaller falls in employment, while energy and indirect taxes continue to have broadly similar impacts – see Figure 4. This is because the larger falls in real wages under the direct tax scenario make labour relatively more competitive than in the indirect/energy tax scenario, leading to smaller falls in employment.

[14] Exchange rates are determined exogenously in the model.

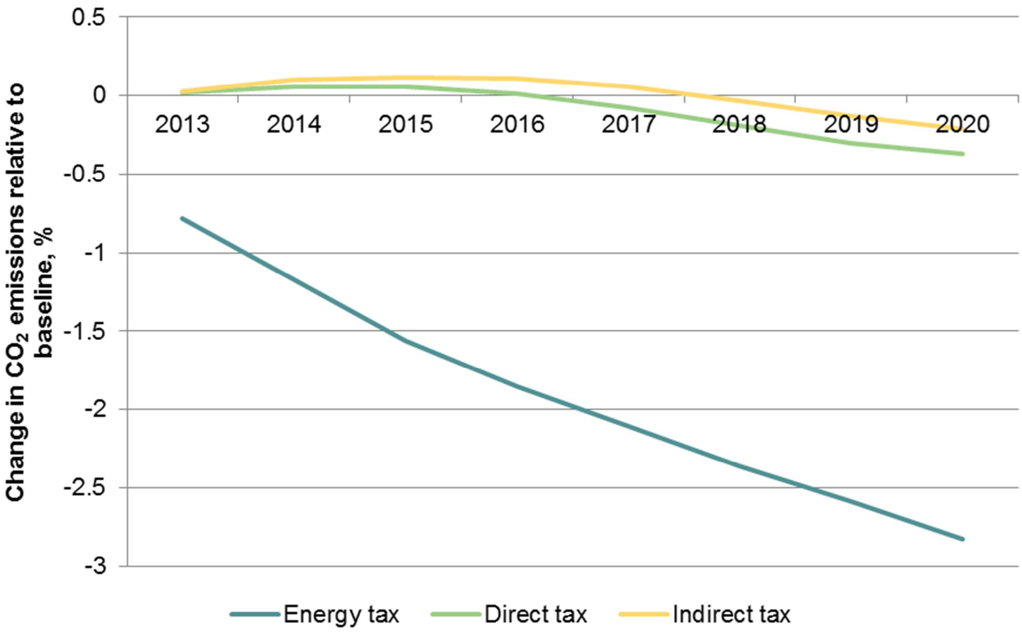
Figure 4. Spain: in 2020, the decline in employment from the other indirect tax rise is expected to be the greatest



Source: Cambridge Econometrics E3ME model

At the same time, the energy tax reform could lead to a significant improvement in emissions performance that would not be delivered by direct or other indirect taxes. It is estimated that, in this package, energy taxes could deliver national reductions in carbon dioxide emissions of more than 2.5 per cent per annum by 2020, while the other forms of taxation would have a negligible impact on emissions, as shown in Figure 5.

Figure 5. Spain: the energy tax package results in a greater emissions reduction than the direct and other indirect taxes packages



Source: Cambridge Econometrics E3ME model

Taking into account the proposed Energy Tax Directive, as well as the desirability of setting appropriate (relative) price signals, the most obvious opportunities for increasing taxes in Spain relate to the taxing of transport fuels, especially the closer alignment of petrol and diesel rates and the gradual removal of subsidies for commercial diesel use. These would also deliver the greatest emission savings. However, although the greatest amount of additional tax revenues would come from transport fuels, taxes on non-residential energy use appear both to have the least detrimental impact on GDP and employment and to deliver the greatest emissions savings.

There has also been recent attention to the need to achieve fiscal consolidation while also preserving or enhancing levels of economic activity. This could be achieved by recycling some or all of the revenues that the tax package would raise. For instance, in a situation in which 50 per cent of the revenues raised from the energy tax package were recycled through lower employer social security contributions, the decline in GDP would be around 40 per cent lower in 2020 and there would only be a negligible impact on employment (only -0.05 per cent lower than in the baseline). The sectors that would see the largest percentage improvements in gross output by 2020 as a result of this policy include sectors that are relatively labour-intensive, such as computing and banking, as well as light manufacturing, such as electronics. As such sectors do not consume significant amounts of energy, this increase in economic activity from recycling 50 per cent of revenues would not detract significantly from the reduction in emissions that might be achieved.

3.2 Poland

The illustrative package of Polish energy tax reforms consists of similar elements to the Spanish package, although the precise reforms reflect specific national circumstances. It involves steady increases in the excise duty rate on diesel, liquefied petroleum gas (LPG) and natural gas, the introduction of taxes on residential coal and gas consumption and increases in taxes on business energy consumption to reach the revised Environmental Tax Directive minima.

The package is estimated to deliver tax revenues of more than €5 billion per annum by 2020, equivalent to 1.3-1.4 per cent of projected Polish GDP in that year.

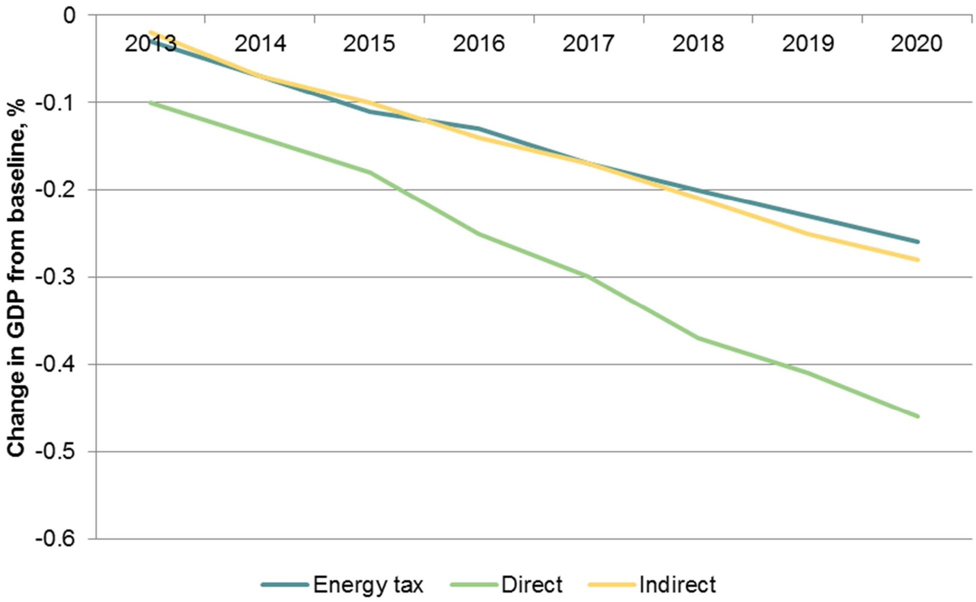
Direct or other indirect taxes could be used to raise the same amount of revenue as the energy tax package, but, the modelling suggests, they would have an equal or more detrimental impact on economic activity.

Both the energy tax package and indirect tax package result in higher prices. This leads to broadly equivalent increases in nominal wages, allowing real consumption to remain close to its previous levels. As a result, the two packages reduce GDP by the same amount, i.e. 0.25-0.30 per cent below the baseline by 2020. This is different to the case of Spain, where energy taxes have a smaller impact on GDP. This is because, unlike the Spanish energy package, the Polish energy package causes a smaller fall in imports than the indirect tax, as Poland is less dependent on energy imports than Spain[15].

[15] Indeed, in Poland (in contrast to Spain) the fall in imports from the energy tax is slightly smaller than the fall in imports from the indirect tax. However, this is offset by the fact that the energy tax does not lead to such a large decline in investment as the indirect tax (as there is some offsetting increase in capital investment as producers switch from energy to capital i.e. invest in energy efficiency) and because not all of the increase in

The real wage response to direct tax increases is assumed to be less pronounced than to energy and direct taxes, leading to a greater decline in consumption. The effect is a reduction of GDP of close to 0.5 per cent – see Figure 6.

Figure 6. Poland: Other indirect and energy taxes have very similar impacts on GDP; direct taxes cause more significant declines in GDP

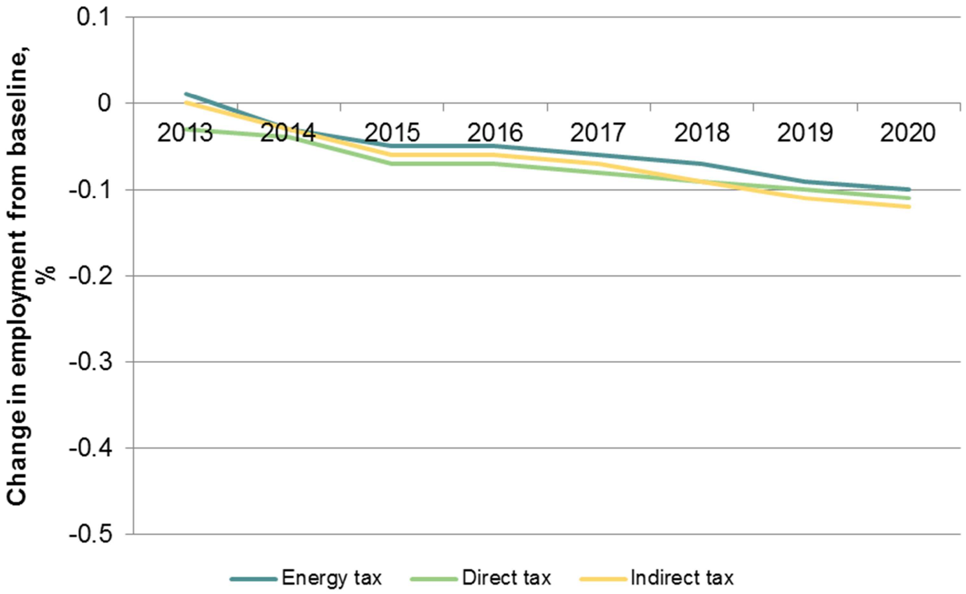


Source: Cambridge Econometrics E3ME model

All three taxes are expected to have similar impacts on employment (see Figure 7). The direct tax has a similar impact on employment to the other packages, despite its worse GDP impact, because the smaller adjustment in nominal wages makes labour relatively cheaper than under the other options.

energy taxes is passed through as higher prices, and so does not depress real wages by as much as indirect taxes do.

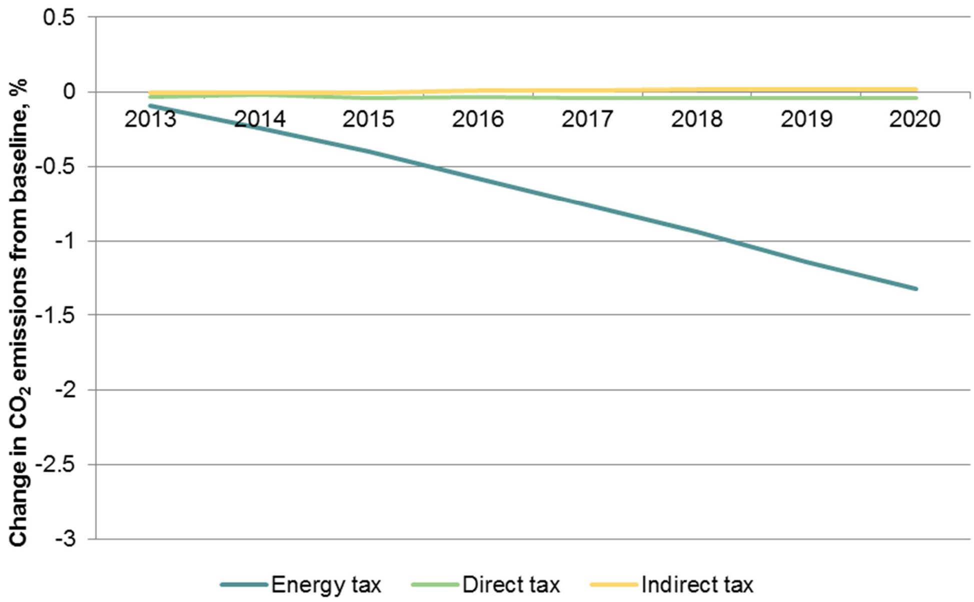
Figure 7. Poland: all of the tax packages are expected to lead to similar declines in employment



Source: Cambridge Econometrics E3ME model

The modelling shows that energy taxes would reduce Polish fuel consumption and emissions by 1.3 per cent, while the direct and other indirect taxes have a negligible impact – as shown in Figure 8.

Figure 8. Poland: the energy taxes reduce emissions by more than 1 per cent while the direct and other indirect taxes have no material impact



Source: Cambridge Econometrics E3ME model

There is an important trade-off between different types of energy tax increases in Poland. Higher taxes on transport fuels and non-residential energy consumption would be less economically detrimental than taxes on residential energy consumption, but they are also a less cost-effective way of reducing emissions.

As with Spain, besides using the energy tax revenues for fiscal consolidation, it would be possible to recycle some of them to ameliorate the negative economic impacts that were noted previously. In a situation in which 50 per cent of the energy tax revenues were recycled through reduced employer social security contributions, the modelling suggests that by 2020 there would be a barely negligible impact on GDP (-0.03 per cent relative to the baseline) and that employment would in fact increase by 0.1 per cent. Labour-intensive sectors such as hotels and catering, communications, banking and computer services would be the main beneficiaries of this recycling policy. As none of these sectors are significant consumers of energy, there would only be a very small impact on the emissions reduction impact of the package (emissions are estimated to be -1.32 per cent lower than the baseline without recycling; -1.30 per cent with 50 per cent of revenues recycled). The benefits of greater economic activity from partial recycling can be expected to be spread quite uniformly across different income groups.

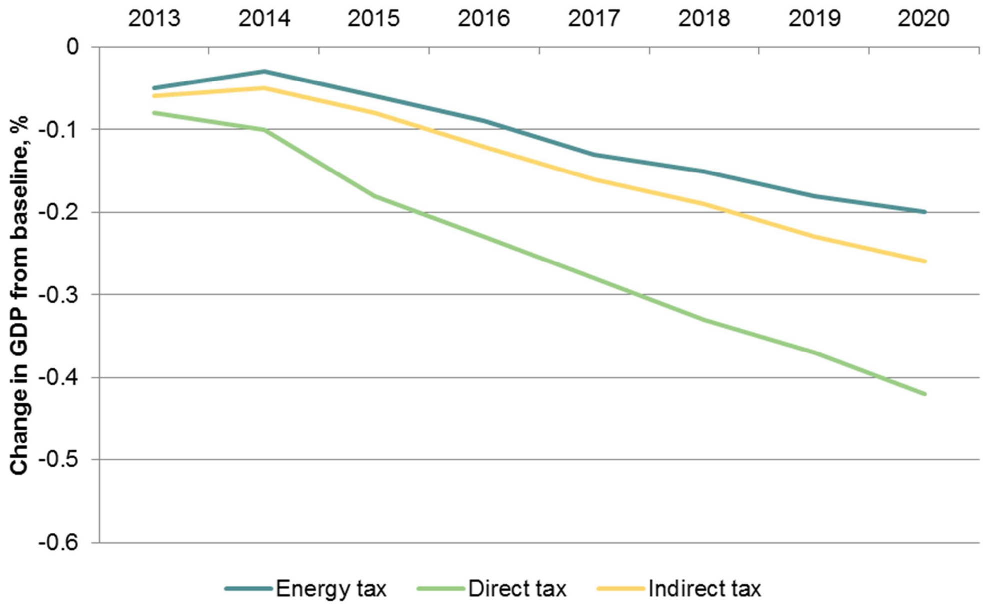
3.3 Hungary

The illustrative energy tax package envisaged for Hungary is similar to those designed for Spain and Poland. It foresees a steady increase in diesel, natural gas and LPG transport fuel taxation, the introduction of tax rates on the residential consumption of gas and coal, and a steady increase in non-residential energy tax rates when they are below the proposed Energy Tax Directive minima.

The modelling analysis indicates that such an energy package might raise tax revenues of about €1 billion, equivalent to more than 1.2 per cent of GDP by 2020.

As in the case of Spain and Poland, such a package is likely to have a similar or more benign impact on the economy than alternative packages of other indirect and direct tax increases that raise the same amount of revenue. While the latter are expected to reduce GDP below the baseline by 0.42 per cent and 0.26 per cent respectively, the energy tax package is expected to cause a decline in GDP of 0.2 per cent (see Figure 9). In Hungary, energy taxes outperform direct taxes due to their differential impacts on real wages whereas, in the case of Spain, energy taxes are preferred to indirect taxes as they tend to disproportionately depress imports - i.e. economic activity outside of the country (and, indeed, Europe).

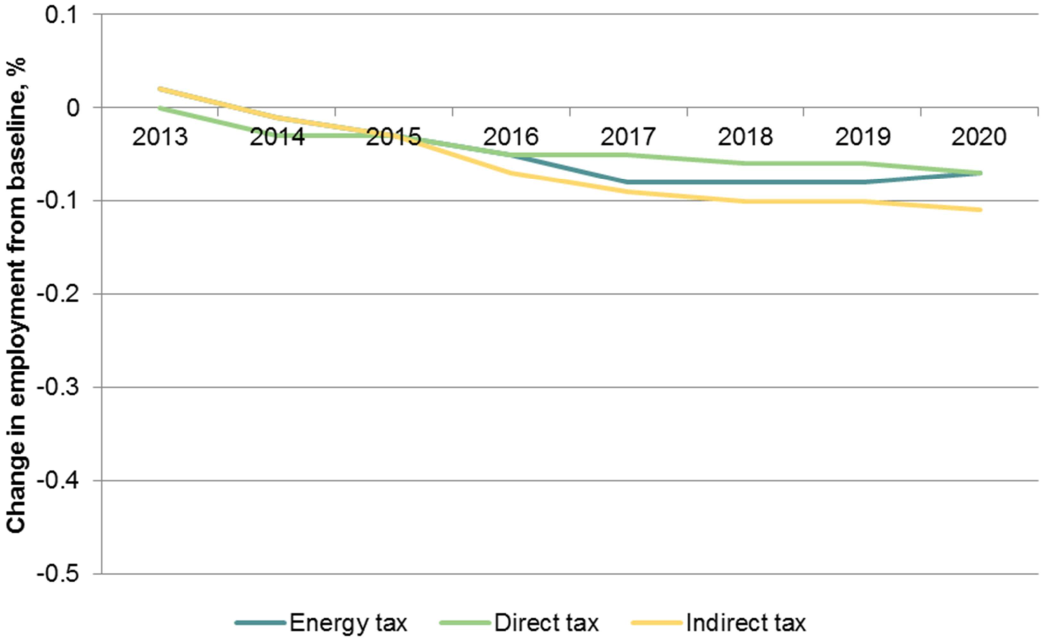
Figure 9. Hungary: the model suggests that the energy tax package would have a less detrimental impact on GDP than either direct or other indirect taxes



Source: Cambridge Econometrics E3ME model

The impact of the different taxes on employment levels is shown in Figure 10. While all three tax packages might lead to modest falls in employment, typically of no more than 0.1 per cent, the direct and energy taxes have similar impacts by 2020, while the other indirect tax is expected to be slightly worse. The small magnitude of the impact on employment under all three tax scenarios is a consequence of the large proportion of employment in the public sector in Hungary, which is assumed to be less sensitive to changes in GDP.

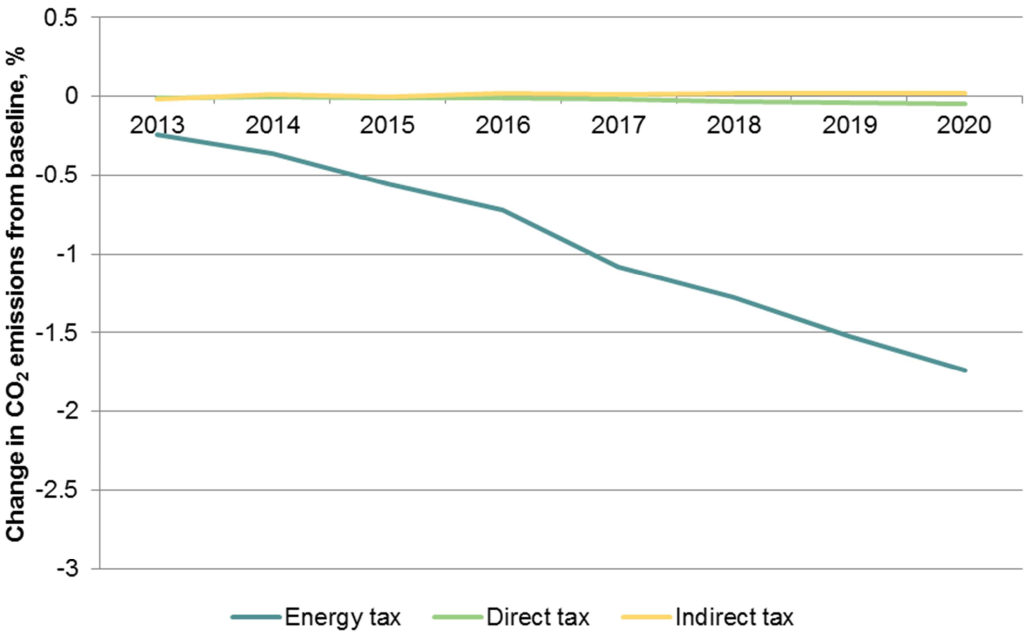
Figure 10. Hungary: the other indirect tax package is expected to lead to the largest fall in employment



Source: Cambridge Econometrics E3ME model

The energy tax package is expected to deliver emissions savings of more than 1.7 per cent relative to the baseline, while direct and other indirect packages would have no impact.

Figure 11. Hungary: the energy tax delivers emissions reductions of around 1.8 per cent while there is no discernible impact on emissions by either the direct or other indirect taxes



Source: Cambridge Econometrics E3ME model

The energy tax package in Hungary appears to be even more attractive than in either Spain or Poland. The significant reduction in imports that accompanies the packages means that the GDP reduction per Euro of revenue raised is smaller than in either of the other two countries. At the same time, the package also delivers more or similar emissions savings per Euro of revenue than in either of the other countries.

As with Spain and Poland, there are important differences between the elements of energy tax reform in Hungary. The greatest revenue potential comes from the higher taxation on transport diesel which, by 2020, could alone raise tax revenues equivalent to more than 0.9 per cent of expected 2020 GDP. However, this is less effective at reducing emissions than either residential or non-residential energy taxes. Meanwhile, the largest mitigation potential appears to be from residential energy taxes, but with a more adverse economic effect than other forms of energy taxation. Taxes on non-residential energy consumption may be less economically damaging than residential energy taxes and have an intermediate emissions saving potential, but the scope for raising substantial revenues from these taxes is limited.

Finally, if some of the revenues are recycled, then a similar picture emerges as those for Spain and Poland. Recycling 50 per cent of the energy tax revenues through reduced employer social security contributions would be sufficient for both the GDP and employment impact in 2020 to be practically negligible (-0.04 per cent relative to baseline for GDP in 2020; 0.02 per cent relative to baseline for employment in 2020). These gains would be spread evenly across all income groups, but concentrated in the retailing and distribution sector, hotels and catering services, the construction sector and the basic metals sector. This distribution of economic activity means that the introduction of a 50 per cent recycling of revenues would have virtually no impact on the emissions performance of the tax reform package.

4 Raising the EU ETS carbon price versus alternative means of raising revenue

Unlike energy and carbon taxes, the EU ETS is applied uniformly across Europe, with a single universal rate and coverage (see a brief overview in Box 4).

As the EU is contemplating moving from an annual emissions target of 20 per cent below 1990 levels by 2020 to a target of 25 or 30 per cent, a tightening of the EU ETS cap is seen as the principal tool to achieve this higher ambition. This would raise the price of allowances under the scheme and hence the revenues that could be raised through their sale.

This analysis examines the impact of tightening the EU ETS cap from a new perspective, by comparing the macroeconomic impacts of raising revenue in this way with direct taxes. Further details about the model and assumptions used are provided in Annex 1.

Box 4. The EU Emission Trading System (ETS)

Launched in 2005, the EU ETS works on the 'cap and trade' principle. This means there is a 'cap', or limit, on the total amount of selected greenhouse gases that can be emitted by the factories, power plants and other installations in the system. Within this cap, companies receive emissions allowances which they can sell to or buy from one another as needed. The limit on the total number of allowances available ensures that they have a value.

At the end of each year each company must surrender enough allowances to cover all of its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so.

The number of allowances is reduced over time so that total emissions fall. In the first and second phase of the EU ETS (from 2005 to 2012) permits were mostly allocated to companies for free (grandfathering). In the third phase (from 2013 to 2020) a progressive move towards auctioning of allowances will be introduced. As a result, at least 50 per cent of allowances will be auctioned from 2013.

Source: European Commission (2010a)

4.1 Comparing the tightening of EU ETS with direct and other indirect taxes

The modelling by Vivid Economics (2012) shows the effects of a tightening of the EU ETS cap to help achieve a 30 per cent reduction target, which is equivalent to reducing EU ETS emissions by 34 per cent compared with 2005 levels. The analysis is based on the European Commission's assumption that the decrease in allowances needed to tighten the cap comes entirely through a reduction in the number of auctioned allowances (European Commission, 2012), while the amount of freely allocated allowances stays the same. Although this will lead to a gradual reduction of the allowances auctioned, it is expected to push up their prices, so that the overall revenues raised through auctioning will increase.

Revenues will be highest in the near term and slowly decline over time, reflecting the tightening of the cap over the period. On average, additional revenues are expected to be around €30 billion per annum, equivalent to around 0.18 per cent of EU GDP during that period.[16] This would imply an average carbon price of approximately €44/tCO_2 over the Phase III period (2008 prices).

It is estimated that, should the same amount of revenue be raised through direct tax increases, this would have a much more immediate negative impact on GDP than EU ETS reform. Although the performance of the two taxes would converge over the period, by 2020 the cumulative loss in GDP would be almost 50 per cent greater from direct tax increases than from EU ETS reform (see Figure 12).

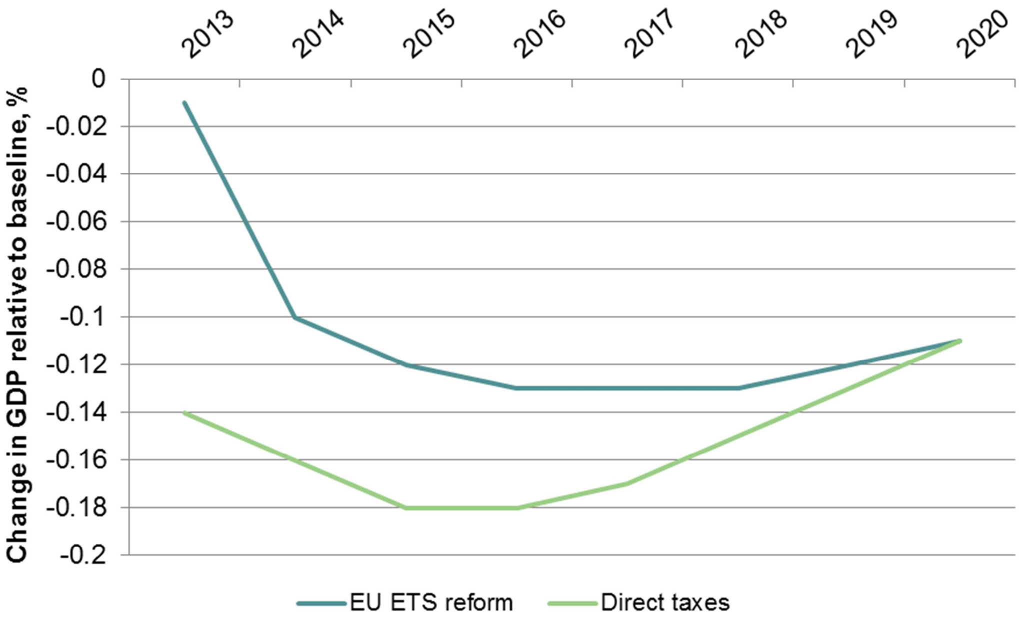
This is because increases in direct (labour) taxes have an immediate depressing impact on take-home real wages, which in turn leads to an immediate decline in consumption and hence GDP. However, over time, the burden of direct tax rises is expected to be increasingly shared between employer and employee through wage bargaining, leading to a (relative) appreciation in real wages. This has a positive impact on consumption, and therefore ameliorates the initially negative impact on GDP.

By contrast, the impact of the higher costs brought about by a tighter EU ETS cap will take longer to feed through into the wider economy, and even then the pass through to final consumers will be incomplete. The modelling also anticipates that there will be a modest increase in investment under the EU ETS reform option of around €2 billion per annum in the period 2013-2016 as firms respond to higher energy prices through energy-capital substitution.

These impacts are found both at the level of the EU as a whole and also for a significant number of Member States (21 out of 27). Notably, the EU ETS reform could be particularly attractive for east European countries, as they will receive a proportion of the auction revenues raised in other countries. On the other hand, in the countries that are net providers in this redistribution mechanism, ETS reform can lead to higher GDP losses than direct taxes. This is the case, for instance, for Cyprus, the UK, and Sweden.

[16] These reforms are assumed to be introduced in a situation in which the EU has implemented the Climate and Energy Package, including the renewable energy target. This is consistent with the way in which the European Commission has analysed the impact of tightening the EU ETS cap.

Figure 12. The model suggests that the using direct taxes to raise the same revenue as provided by EU ETS reform would result in greater losses in GDP

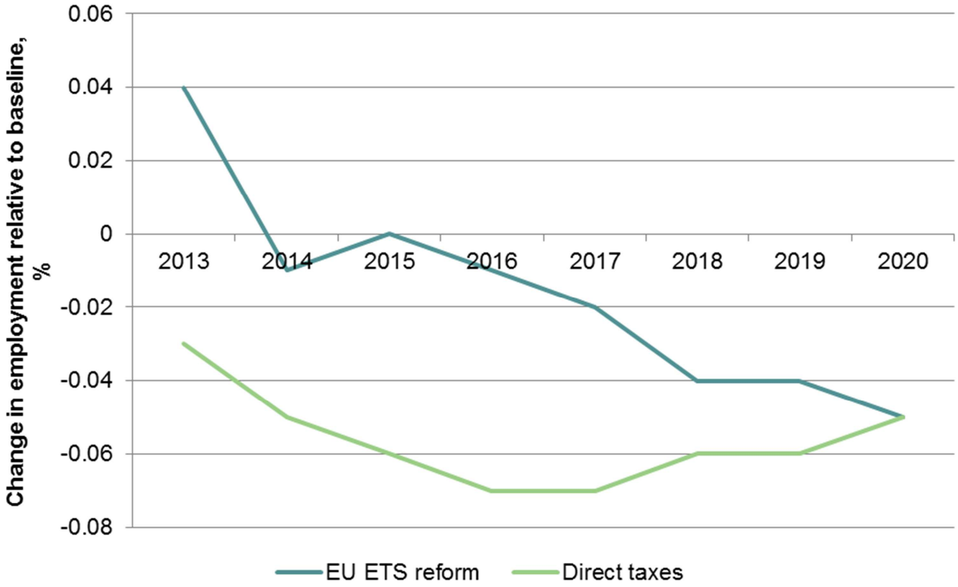


Source: Cambridge Econometrics E3ME model

Notably, the modelling also suggests that employment impacts from the EU ETS reform will be more favourable. On average, employment declines would be around three times as large under the direct tax reform as they are under the EU ETS reform option (126,000 compared with 40,000 – see Figure 13).

The same explanations for the differences in GDP impacts also apply to the employment impacts. A further contributory factor is that the impact of EU ETS effect will be concentrated in sectors which are not particularly labour-intensive. The direct tax increase is expected to lead to larger declines in output in a number of service sectors accounting for significant shares of employment, including retail, banking, insurance, professional services and public administration.

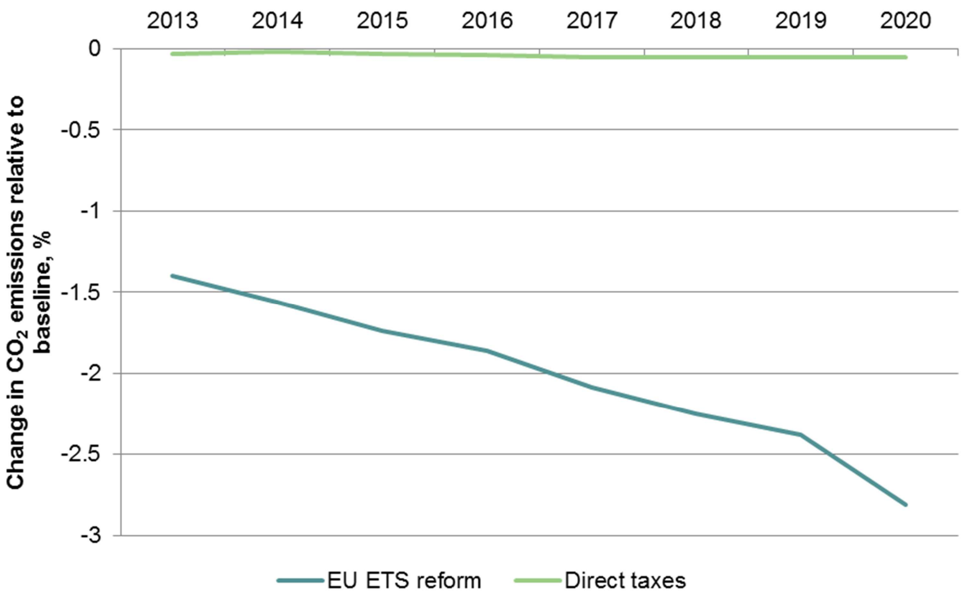
Figure 13. Increases in direct taxes are expected to lead to larger declines in employment than EU ETS reform



Source: Cambridge Econometrics E3ME model

Reform of the EU ETS also results in greater EU emissions reductions. The model estimates an immediate reduction in emissions, relative to the baseline, of almost 1.5 per cent with this steadily increasing to between 2.5 and 3.0 per cent by 2020.

Figure 14. Reform of the EU ETS leads to substantial carbon dioxide emissions reductions while direct taxes have no real impact on emissions



Source: Cambridge Econometrics E3ME model

An alternative approach would be to assume that the tightening of the EU ETS cap is brought about through a reduction in both auctioned and freely allocated allowances, keeping the proportions between the two types of allowances constant.

This second approach is estimated to boost the revenue raised by about €20 billion over the period to 2020 without any impact on GDP or employment. By contrast, raising this higher amount of revenue from direct taxes would be more economically damaging to a significant extent.

In summary, the greater the proportion of allowances that are auctioned, the more appealing the EU ETS becomes as a means of raising revenue.

5 Issues related to carbon and energy fiscal measures and possible ways forward

Although both carbon and energy taxes and the EU ETS perform better than conventional taxes in terms of macroeconomic impact, these instruments face key challenges. In particular, carbon and energy taxes are widely considered to have a potentially detrimental effect on income distribution, as they often appear to be regressive. The EU ETS is also criticised for hampering the competitiveness of some energy-intensive sectors and for leading to carbon leakage. These issues, however, can be addressed with adequate policy measures, which are discussed below.

5.1 The effect of energy and carbon taxes on distribution

A valid concern regarding energy taxes is that they are often regressive. That is, the negative impact of the tax reforms, expressed as a proportion of income, are larger for low-income or disadvantaged groups than for higher income groups. The modelling confirms that this concern is real. Nevertheless, impacts vary as much, or more, with other household characteristics as they do with household income. They also differ across tax types, with transport-related taxation being the least regressive (and can even be progressive), and the taxation of domestic fuel use being the most regressive.

Whether or not a tax reform is regressive or non-regressive, however, may not be the most relevant metric in the current circumstances. Given that one of the main aims of reforming energy taxes is the raising of revenue, the relevant comparator may not be how well other groups fare under the same reform, but rather how the same group would fare under other tax reforms that would raise a similar amount of revenue.

The modelling carried out for Vivid Economics (2012) suggests that energy tax reform packages can be less harmful, as they impose smaller losses on almost all vulnerable groups in the three countries studied than an increase in other indirect or direct taxes. This partly follows from the finding that the energy taxes have a smaller overall economic impact than other forms of taxation, with some of this benefit being shared by low-income and disadvantaged households. However, the results may be partly driven by the assumptions underpinning the model[17].

Nevertheless, it remains the case that certain groups, such as the elderly, suffer disproportionately from energy taxation, so specific compensation policies are needed to address distributional concerns. The three main flanking measures applicable to energy taxation are:

- Compensation which reduces the price of energy. Examples of this are common, and include tax exemptions and VAT reductions. By leaving the choice of quantity in the hands of households, this type of compensation reduces impacts by counteracting the higher prices resulting from the tax increase.

[17] In particular, the model links benefit payments to changes in GDP.

- Compensation which reduces the quantity of energy consumed, such as vouchers for the installation of energy efficient equipment or expansion of public transport. This leaves energy prices unchanged.

- Compensation in the form of universal refunds, reductions in unrelated taxes (such as income tax or social security contributions), or refunds based on location. By leaving both prices and quantities unaffected, this type of compensation counteracts the general welfare loss from higher energy taxes.

Tightly-targeted fixed rebates tied to both income and (historical) energy use is the first-best option. In countries where sufficient data is available, or where policy-makers have sufficient confidence in a self-selection mechanism, they offer the best combination of incentive structure, fiscal cost-efficiency, and social protection. In countries where this level of targeting is impossible, and where the dispersion of energy costs is small, a single-level fixed support scheme for all eligible households may be the best choice, preserving the incentive effect. Where the dispersion is large, tax exemptions for eligible households may be more appropriate.

5.2 Competitiveness, carbon leakage and border carbon adjustments

Carbon prices can undermine the competitiveness of certain sectors of the economy, leading to shifts in the geographic patterns of production to places where carbon prices are lower. Furthermore, if the emissions intensity of production is higher after the shift in production, global emissions could rise. That is, higher carbon prices can give rise to carbon leakage.

To date, the EU has addressed these concerns through the provision of free emissions allowances. In Phase III of the EU ETS, installations in industries that are determined to be at 'significant risk' of carbon leakage will receive 100 per cent of a benchmark amount of allowances for free until 2020 (European Commission 2010b). However, this is an expensive way of providing assistance. If free allowance allocation were gradually phased out in the period to 2020 at the same time that the EU ETS was tightened, revenues amounting to an extra 0.29 per cent of GDP (more than €54 billion) could be raised by 2020. And with deeper emissions cuts and hence higher carbon prices beyond 2020, the fiscal cost of free allowances could grow higher.

An alternative approach, in the long run (i.e. after 2020)[18], is to introduce border carbon adjustments (BCAs). These are adjustments to the prices of traded goods based on some measure of the greenhouse gas emissions embodied in the goods. They can be applied to imports (as a tariff) and/or to exports (as a rebate).

Although politically controversial, BCAs are an important option for addressing leakage and declining competitiveness caused by carbon pricing. They allow the substantial revenues currently tied up in free allowances to be recovered by governments. Furthermore, BCAs might have further positive effects on global emissions by inducing more mitigation in other jurisdictions. They could also enable the EU to take on a more stringent mitigation target, which could in turn induce other countries to raise their own.

[18] The mechanism for providing assistance to emissions-intensive trade-exposed (EITE) sectors has been set up until 2020, which makes the earliest plausible timing for introducing BCAs after 2020.

The modelling used here investigated the economic and environmental effects of import and export border carbon adjustments applied to steel, aluminium and cement, i.e. those sectors where the practical challenges associated with introducing the adjustments are smallest. Border carbon adjustment scenarios were compared to a 'full auctioning' scenario; a 'free allowance' scenario, in line with the distribution of allowances under Phase III; and an 'equivalent direct taxes' scenario raising the same amount of revenue than a border carbon adjustment (further details on how the model was applied can be found in Annex 1).

The modelling results for Vivid Economics (2012) showed that BCAs have the potential to deliver better protection against leakage than 'lump sum' free allocations. They could contribute to fiscal consolidation more than a shift to full auctioning on its own, and are a more attractive way of raising revenue than an increase in direct taxes. However, considerable challenges relating to the feasibility, compatibility and political acceptability of BCAs remain.

In order to address these challenges, careful design of BCAs is needed. For instance, a border adjustment based on emissions permits rather than taxes appears preferable for both economic efficiency and World Trade Organisation (WTO) compatibility reasons. It should ideally be applied to both imports and exports, start from a small set of sectors – for example steel, cement and aluminium - and expand its sectoral scope gradually if initial outcomes are favourable. It could first be introduced for goods for which direct emissions can be relatively easily determined, such as less elaborately transformed goods for which there are a limited number of technologies for production. The adjustment base (i.e. the direct emission intensity used to determine the carbon content of imports) could be chosen on the basis of information available and sectoral characteristics. For a full discussion about design options, see Vivid Economics (2012).

6 Conclusions and recommendations

Many European countries are running high annual fiscal deficits and have high debt liabilities, and are looking at the options for raising tax revenues. While energy-carbon taxes have generally been considered an instrument of environmental policy rather than fiscal policy, it is time to reconsider that view.

Recognising that raising tax revenue is costly, the tax portfolio ought to be weighted towards tax bases associated with the lowest costs of taxation. The modelling results presented in this paper from Vivid Economics (2012) show that energy and carbon taxes perform well against labour taxes and other indirect taxes such as VAT, in terms of their impacts on GDP and employment. However, given the range of approaches and techniques that are available to assess the impact of tax policies, there would be merit in this issue being addressed using a broader suite of models.

That said, the evidence collected in this study is sufficiently strong, being derived from empirical statistical analysis of the European economy, to make the claim that energy-carbon taxes currently play too small a role in the tax portfolio of many European countries. This evidence is not widely known, which perhaps is why energy-carbon taxes do not fulfil their potential role in fiscal strategy, possibly with the exception of some on transport fuels.

Furthermore, governments have allowed the energy-carbon tax schedule to become overly complex, decreasing the cost-effectiveness of this class of taxes. Governments have also reduced tax efficiency by varying tax rates by activity or input, which means, unsurprisingly, there is substantial variation within and between nations. These features increase costs by distorting the allocation of resources within the economy and, in so doing, reducing the welfare of citizens. The European economy is less able to bear costs now than during growth periods; thus, at a time when the cost of restoring fiscal balance is high, it is especially important for governments to act efficiently in taxation. It is plain to see that improvements could be made, preferably through reforms directed towards a unified energy-carbon tax rate.

Unlike the taxation of labour or consumption via VAT, there is an appropriate minimum level of energy taxation. This minimum reflects the costs energy consumption imposes on society. Those costs are primarily proportional to the carbon content of energy (more precisely, its contribution to global warming). This is a matter of efficiency and fairness in the long run, and of avoiding the regret of living with the burden of dangerous climate change. At a minimum, efficient energy taxation should ensure that all energy consumers pay the carbon costs of their energy consumption, but because of numerous exemptions, subsidies and the issue of excessive allowances within the ETS, this is currently not the case. To avoid intra-regional distortion of resources, the minimum carbon price ought to be set at the very least at EU level, both within the tax system and through the control levers of the ETS. This would bring both tax rates and allowance prices broadly in line with each other and raise them to an appropriate level. These reforms could raise significant fiscal revenues at the same time as delivering an environmental dividend.

It is crucially important for the future low-carbon competitiveness of the EU to get the taxation of the major fuel types - petrol and diesel - right. Currently, EU countries collect less revenue from diesel than they could, with negative implications for the fiscal balance. Furthermore, the tax preference given to diesel has led to an imbalance in the demand for oil products, imposing costs on European refining. The solution is to agree a collective increase in diesel tax rates. Of course, rates which have for so long remained differentiated cannot be raised overnight, because the public would not accept it. Yet, a gradual programme of alignment would be worthwhile for all countries collectively and for each individually.

In the long term, broader and higher energy taxation and a higher EU ETS carbon price may make it necessary to reinforce the protection against distorted international competition. This is because, while consumers and earners largely cannot move their consumption or earnings outside Europe to avoid tax, the production of energy-intensive goods could be encouraged to partly shift away from the EU by taxation. The current system imposes an onerous fiscal burden through the granting of free allowances. In its place a new system of border carbon adjustments might offer protection and impose appropriate climate policy incentives on trade partners, while delivering a net fiscal contribution instead of a cost. It is too early to dismiss border carbon adjustments as unworkable: it is time to explore smarter designs that address the criticisms levelled at them.

Annex 1. Method

This annex provides a brief overview of the macroeconomic methods used in this study, which relies on the E3ME model developed by Cambridge Econometrics (a more detailed description is available on the E3ME website (www.e3me.com). It also gives an overview of the method used to calculate energy-carbon tax rates, which are presented in Table 1 of this policy paper.

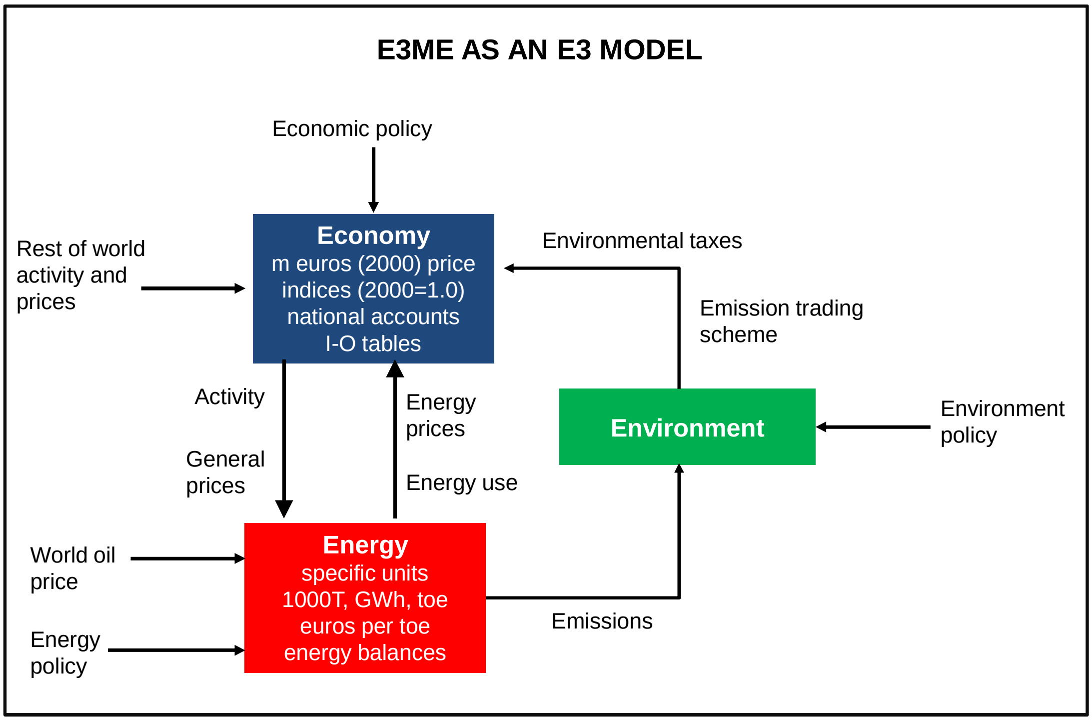
E3ME - macroeconomic modelling of energy tax reforms and EU ETS tightening

E3ME is a computer-based model of Europe's economic system, energy system, and the environment. The model is widely used in Europe for policy assessment, for forecasting and for research purposes. The overall structure of the E3ME model is shown in Figure A.1.

In this study, the model was used to:

- analyse illustrative tax packages in Spain, Poland and Hungary (section 3 of this paper);
- analyse the tightening of the EU ETS at European and national level[19] (section 4); and
- assess the impact of taxation on household income in Spain, Poland and Hungary (section 5.1).

Figure A.15 The E3ME model consists of three main modules, and their various interactions



Source: Cambridge Econometrics

[19] In the EU ETS assessment, the impacts of the various policies modelled are assessed relative to a 'reference scenario' which reflects full implementation of the Climate and Energy Package, including the 20 per cent renewable energy target, although not the proposed Energy Efficiency Directive. This is in contrast to the analysis of illustrative tax packages in Spain, Poland and Hungary, which were assessed relative to the existing mix of policies in each country. Assumptions about the allocation of free allowances, the banking of allowances, and the implementation of a 30 per cent target are outlined in a later section. For details about the assumptions for the redistribution of revenues between Member States, see Appendix D of the Vivid Economics (2012) report.

The E3ME model captures the interactions between the economy and the energy system within European countries and across the EU as a whole. The relationships within the model are determined through econometric analysis of historical trends and allow for disequilibria in goods and the labour market. This is in contrast to the family of Computable General Equilibrium models, in which it is assumed markets are in equilibrium and parameters are typically calibrated rather than estimated econometrically - i.e. parameters are taken from other studies and adjusted to describe an equilibrium at a benchmark point (OECD, 2004).

The structure of the E3ME model is based on the system of national accounts, as defined by ESA95 (European Commission, 1996), with further linkages to energy demand and environmental emissions. The economic model runs on three 'loops': the export loop, the output-investment loop, and the income loop, as shown in Figure A.1 above. The labour market is also covered in detail, including estimates for labour demand, supply, wages and working hours.

The model comprises 33 sets of econometrically estimated equations, covering the individual components of GDP (consumption, investment, and international trade), prices, energy demand, and materials demand. Each equation set is disaggregated by country and by sector.

Overall, 33 countries (EU27 Member States, Norway, Switzerland and four candidate countries), 42 economic sectors, 43 categories of household expenditure, 19 different users of 12 different fuel types, 14 types of air-borne emissions (including the six greenhouse gases monitored under the Kyoto Protocol) and 13 types of household (including the unemployed, inactive and retired, and an urban/rural split) are covered.

The historical database in the E3ME model covers the period between 1970 and 2008. The main sources of data are Eurostat, the European Commission's DG ECFIN's AMECO database and the International Energy Agency, and other sources where appropriate.

Typical outputs from the model include GDP and sectoral output, household expenditure, investment, international trade, inflation, employment and unemployment, energy demand and carbon dioxide emissions. Each of these outputs is available at national and EU level, and most are also defined by economic sector. The model projects forward annually to 2050, and can be used to estimate trends.

Despite its robustness, it should be noted that the model also has some weaknesses compared with Computable General Equilibrium models. First, the econometric approach relies heavily on the input of high-quality data. This is more problematic outside Europe than within, but nevertheless may limit the results for certain countries. There are also problems in dealing with structural change, for example if behavioural relationships change over time or in response to policy changes. Finally, the model does not have explicit bilateral trade relationships. The model therefore works with total exports and imports for each sector in each country, with only two destinations: EU and non-EU.

Further details for the modelling of a tightening of the EU ETS (section 4 of the paper) are given here, showing assumptions about the allocation of free allowances, the banking of allowances, and the implications of a 30 per cent target for the EU ETS cap.

Allocation of free emissions allowances in the reference scenario

In the reference scenario a number of assumptions regarding the proportion of allowances that are allocated for free were made[20] - these are shown in Table A.1.

Table A.1. It is assumed that just over one-third of allowances are allocated for free in the reference scenario

Year	2013	2014	2015	2016	2017	2018	2019	2020
Percentage of freely allocated allowances	37%	37%	36%	35%	35%	35%	34%	34%

Source: Vivid Economics (2012)

These estimates are based on 65 per cent of emissions being in the power sector, just under 27 per cent being in sectors at risk of carbon leakage and just over eight per cent being in other sectors not at risk of carbon leakages (European Commission, 2010c). Aviation is treated separately (see below). All allowances in the power sector are assumed to be auctioned. Although it was known at the time of the modelling that up to eight Member States may receive a temporary derogation from this requirement, this was not taken into account.

Sectors at risk of carbon leakage receive 100 per cent of benchmarked allowances for free. Sectors not at risk of carbon leakage receive 80 per cent of their benchmark emissions for free in 2013, declining in a linear fashion to 30 per cent by 2020. It is assumed that, on average, there is a 5 per cent difference between the actual emissions in an installation/sector and the benchmark that has been set.

It is also assumed that just under 215 million allowances are included in the EU ETS in relation to the aviation sector (EEA Joint Committee 2011, pp. 2-5), and that 85 per cent of these allowances are allocated for free.

Banked allowances from phase II

All scenarios assume that there are 600 Mt of allowances banked from Phase II into Phase III of the EU ETS. This is based on visual inspection of the graphs (figures 5 and 7) as reported by the European Commission (2010d).

Impact of moving to a 30 per cent reduction target on the EU ETS cap

The impact of moving to a target of a reduction by 30 per cent compared with 1990 levels is assumed to mean that the EU ETS cap tightens to be 34 per cent lower than 2005 emissions (excluding aviation). Following the European Commission (2012), this is consistent with the 30 per cent reduction target being met through a 25 per cent reduction in domestic emissions and with the remaining 5 per cent achieved through the purchase of international offsets.

[20] For the 'tightened cap' scenario we assumed, following the European Commission, that the decrease in allowances needed comes entirely through a reduction in the number of auctioned allowances (European Commission, 2012). We also explored an alternative scenario, in which the decrease in certificates is shared between the auctioned pool and the freely allocated pool such that the proportion between the two pools remains constant.

Methodology for calculation of energy-carbon tax rates

In order to calculate energy-carbon tax rates for the economies in the study sample, the total tax burden from energy and carbon taxes was calculated for each economic activity for which energy use and emissions data were available.

Data for energy use and emissions were gathered from the International Energy Agency (IEA)'s 'Extended World Energy Balances' (IEA, 2011a) and the IEA's 'CO_2 Emission from Fuel Combustion' (IEA, 2011b). Data for energy taxes were compiled from the European Commission's 'Excise Duty Tables, Part II Energy Products and Electricity' (European Commission, 2011c), while data for tax expenditures were gathered from the OECD's 'Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels' (OECD, 2011). This was supplemented with further information from national tax codes. Furthermore, the EU ETS incentive effects was treated as equivalent to a marginal tax on emissions and therefore included in the modelling. It was assumed that the EU ETS tax rate was equivalent to the spot prices of European Union Allowances (EUAs), based on data from Bluenext.eu.

For both emissions and energy use and for tax rates the most up to date data available were used. For taxes, this should closely resemble the status quo, though there may have been changes in tax rates between July 2011 and the publication of this report that have gone unnoticed. For EUA prices a simple average of daily prices between 24 January 2011 (when calculations for energy tax rates were performed) and 25 January 2011 was taken, equivalent to €11.74/EUA. For emissions and energy use, the latest year available at the time of writing was 2008.

In order to combine tax rates and emissions from energy use, tax rates and tax expenditures were converted from their original units (per weight, or per volume, or percentage of price) into a common unit (euro per tonne of carbon dioxide). Taxes on volume or weight (excise taxes) and tax expenditures based on product price (reduced VAT rates) were first converted into taxes/tax expenditures per unit of energy, using standard conversion factors and prices from various sources. In a second step, these were converted into taxes per unit of emissions, using emissions factors calculated by comparing IEA energy use and IEA emissions data.

Taxes on electricity and heat were converted into taxes per unit of emissions by using country-specific grid emissions factors. These were sourced from the Climate Analysis Indicators Tool (CAIT) database (World Resources Institute, 2012). Once taxes are expressed in euros per tonne of carbon dioxide, they are matched to IEA emissions data (which indicate emissions throughout the economy, split into more than 20 sectors and accounting for more than 40 fuels). The taxes that apply to each combination of fuel and sector (representing the use of a particular fuel in a particular sector, e.g. natural gas used in households, or electricity used in iron and steel, or diesel used in road transport, etc.) were determined. The total tax burden on any fuel/sector is then given by the sum of the tax rates of all the taxes that apply to the particular fuel/sector combination.

Caveats and assumptions

With regards to interpreting the European Commission's 'Excise Duty Tables', the following assumptions were made:

- 'Business use' in all countries except Germany corresponds to the following IEA sectors: Iron and Steel; Chemical and Petrochemical; Non-Ferrous Metals; Non-Metallic Minerals; Transport Equipment; Machinery; Food and Tobacco; Paper, Pulp and Print; Wood and Wood Products; Textile and Leather; Non-Specified (Industry); Commercial and Public Services (partially, see next caveat).
- 'Business use' category in Germany is interpreted according to details given in EnergieStG[21] (in particular §2, §51, §54 and §56) and Stromsteuergesetz[22] (in particular §9).
- Energy used in the Commercial and Public Services category was allocated to business use and non-business use based on Eurostat input-output tables. The allocations are given in appendix B of Vivid Economics (2012).
- The 'Excise Duty Table' category of 'Industrial and Commercial Usage' is assumed to correspond to the IEA's categories of Construction, and Mining and Quarrying.

The EU ETS has been treated as follows:

- All emissions from the following four IEA sectors are assumed to be covered by the EU ETS: Iron & Steel; Chemical and Petrochemical; Non-Metallic Minerals; Paper, Pulp and Print.
- 70 per cent of all emissions in the IEA sector Food and Drink are assumed to be covered by the EU ETS. This is based on a comparison of IEA emissions data for the entire sector, and data from the UK's National Allocation Plan, providing emissions covered by the EU ETS.
- 12 per cent of all emissions in the IEA sector Commercial and Public Services are assumed to be covered by the EU ETS. This number was calculated with the same methodology as the EU ETS share for the Food and Drink sector.
- We have assumed that electricity producers pass on 100 per cent of EU ETS costs, hence that all usages of electricity are assumed to be subject to an implicit carbon tax equivalent to the EU ETS rate.
- We have also assumed that refinery operators pass on 100 per cent of EU ETS costs. Emissions from refineries covered by the EU ETS are taken from the European Environment Agency's EU ETS data viewer. Total petroleum product output is taken from Eurostat data.

Fuels used in agriculture, unless they are subject to special rates, are assumed to be used and taxed as follows: diesel, LPG, and motor gasoline as propellants; all other fuels as business heating use.

All fuels used in the IEA's category of Commercial and Public Services are assumed to be used for heating, and not transport.

Further country-specific assumptions and caveats are given in appendix B of the Vivid Economics (2012) report.

[21] Energiesteuergesetz, 15 July 2006 (BGBl. I P. 1534; 2008 I P. 660; 1007), last amended by article 1, Energiesteuergesetz, 1 March 2011 (BGBl. I p. 282)

[22] Stromsteuergesetz, 24 März 1999 (BGBl. I p. 378), last amended by article 2, Stromsteuergesetz, 1 March 2011 (BGBl. I p. 282)

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