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Towards Consistent and Effective Carbon Pricing in Germany?

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Joseph Curtin**

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TOWARDS CONSISTENT AND EFFECTIVE CARBON PRICING IN GERMANY?

by Ivana Capozza and Joseph Curtin

Keywords: Germany; carbon prices; environmentally related taxes; environmentally harmful subsidies; feed-in tariffs; emission trading systems.

JEL classification: H23, Q48, Q52, Q54, Q58.

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ABSTRACT

Germany committed itself to challenging greenhouse gas (GHG) emission reduction targets to 2020 and beyond. It has implemented a composite mix of policy measures to achieve its climate change mitigation goals, including a range of market-based instruments. These measures have helped reduce domestic GHG emissions, as well as achieve other policy objectives. However, they have generated multiple (explicit and implicit) carbon prices, which can reduce the overall cost-effectiveness of climate change mitigation policy. This paper examines the carbon prices that have emerged from the implementation of three key market-based instruments in Germany: energy taxes, vehicle taxes and the EU Emissions Trading System. It also reviews the use of feed-in tariffs to promote electricity generation from renewable sources, with a focus on the implied GHG abatement costs and the interactions with other environmental policy instruments. This Working Paper relates to the 2012 *OECD Environmental Performance Review of Germany*:

<http://www.oecd.org/environment/environmentalcountrreviews/oecdenvironmentalperformancereviewsgermany2012.htm>.

JEL classification: H23, Q48, Q52, Q54, Q58.

Keywords: Germany; carbon prices; environmentally related taxes; environmentally harmful subsidies; feed-in tariffs; emission trading systems.

RÉSUMÉ

L'Allemagne s'est engagée à respecter des objectifs ambitieux de réduction des émissions de gaz à effet de serre (GES) en 2020 et ultérieurement. Elle met en œuvre tout un éventail de mesures pour atteindre ses objectifs d'atténuation du changement climatique, et notamment divers instruments économiques. Ces mesures ont contribué à réduire les émissions nationales de GES, et à atteindre d'autres objectifs. Cependant, il en découle plusieurs prix du carbone (explicites et implicites), qui risquent de nuire à l'efficacité globale par rapport aux coûts de son action. Le présent rapport examine les prix du carbone qui se dégagent de l'application de trois instruments économiques clés en Allemagne : les taxes sur l'énergie, les taxes sur les véhicules et le système d'échange de quotas d'émission de l'UE. Il aborde aussi le recours aux tarifs d'achat pour encourager la production d'électricité moyennant des sources renouvelables, en mettant l'accent sur les coûts implicites de réduction des émissions de GES et les interactions avec d'autres instruments de la politique d'environnement.

Ce document de travail se rapporte à l'*Examen environnemental de l'OCDE de l'Allemagne, 2012* :

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Mots clés : Allemagne ; prix du carbone; taxes liées à l'environnement ; subventions dommageables pour l'environnement ; tarifs d'achat ; systèmes d'échange de droits d'émission.

FOREWORD

This paper has been authored by Ivana Capozza of the OECD Environment Directorate and Joseph Curtin of the Institute of International and European Affairs, Ireland. The paper is based on Chapters 2 and 5 of the *OECD Environmental Performance Review: Germany* published in May 2012. It reflects information and data available up to January 2012. The authors would like to thank Nils-Axel Braathen, Brendan Gillespie, Ivan Hašič, Caroline Klein, Reo Kawamura, Krzysztof Michalak, and Frédérique Zegel for valuable comments on and inputs to earlier drafts. Special thanks go to Carla Bertuzzi for statistical assistance, and to Rebecca Brite and Shayne MacLachlan for editorial support. This paper also benefitted from discussions with officials of the German government and with delegates to the OECD Working Party on Environmental Performance. The views expressed in this paper do not necessarily reflect those of the OECD and its member countries.

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TOWARDS CONSISTENT AND EFFECTIVE CARBON PRICING IN GERMANY?

Introduction

Germany set ambitious greenhouse gas (GHG) emission reduction targets and has deployed innovative policy measures and technologies to mitigate domestic GHG emissions. Emissions declined during the 2000s, and in 2010 they were 24% below the 1990 level (compared to the Kyoto Protocol target of -21% by 2008-12).¹ Germany is also committed to reduce GHGs by 40% from the 1990 level by 2020, which goes beyond what would be required under current EU arrangements. Achieving this target will be challenging. It will require accelerating the pace of reductions in the 2010s and scaling up investment in abatement technologies, in the order of EUR 20 billion per year, or 0.8% of 2009 GDP. A cost-effective policy mix will, therefore, be needed to reduce the risks of negative impacts on the economy and the society. A consistent price on GHG emissions will need to be at the core of such a policy mix (De Serres *et al.*, 2011).

Germany has increasingly used economic instruments as part of its climate mitigation policy, thereby improving pricing of GHG emissions. It is among the few OECD countries that have implemented an ecological tax reform. Estimates indicate that this reform helped reduce energy consumption and GHG emissions, while having positive employment and economic effects. Germany participates in the EU Emissions Trading System (ETS) and vehicles are now partially taxed on the basis of their CO₂ emission performance. At the same time, Germany pioneered the use of feed-in tariffs to support electricity generated from renewable sources. This mix of instruments imposes both explicit and implicit prices on CO₂ emissions. This paper analyses the extent to which these prices converge towards the uniform and consistent carbon price across the economy that would be needed to minimise the cost of GHG emission reduction.

The first two sections of this paper discuss to what extent taxes on energy products and vehicles adequately reflect the value of GHG emissions (and of other environmental externalities). Section 3 discusses Germany's participation in the EU ETS and the potential interactions between this cap-and-trade system and other environmental policy instruments. Section 4 reviews the use of feed-in tariffs to promote electricity generation from renewable sources, with a focus on the implied GHG abatement costs. Finally, a concluding section ties the findings together.

1. Energy taxes and carbon prices

1.1. The ecological tax reform

The ecological tax reform (*Ökologische Steuerreform*) was introduced in 1999 with the objectives of mitigating CO₂ emissions, providing incentives for job creation and boosting innovation. It introduced a tax on electricity consumption and gradually increased the excise duties on fossil fuels between 1999 and 2003 (Table 1). The tax rates have remained virtually unchanged since then. A key feature of the eco-tax reform was the use of about 90% of energy tax revenue to lower payroll contributions by employers and employees. A small share of tax revenue was recycled to support renewable energy.² A second feature was the provision of generous eco-tax exemptions for energy-intensive manufacturing sectors exposed to international competition. This meant that it was mainly small manufacturing businesses and the residential, commercial, public services and road transport sectors that bore the cost of the eco-tax.

Table 1. Eco-tax reform schedule

Tax base	Original tax	Stages of reform				
		1999	2000	2001	2002	2003
Electricity (EUR cents/kWh)	--	1.02	1.28	1.54	1.80	2.05
Transport fuels (EUR cents/litre)						
Diesel	31.7	34.77	37.84	40.91	43.98	47.04
Petrol	50.11	53.18	56.25	59.32	62.39	65.45
Liquefied natural gas	6.00	7.00	7.00	8.00	8.00	8.00
Liquefied petroleum gas	6.00	7.00	7.00	8.00	8.00	8.00
Heating fuels						
Light heating oil (EUR cents/litre)	4.09	6.14	6.14	6.14	6.14	6.14
Heavy heating oil (EUR cents/kg)	1.53	1.53	1.79	1.79	1.79	2.50
Natural gas (EUR cents/kWh)	0.18	0.34	0.34	0.34	0.34	0.55

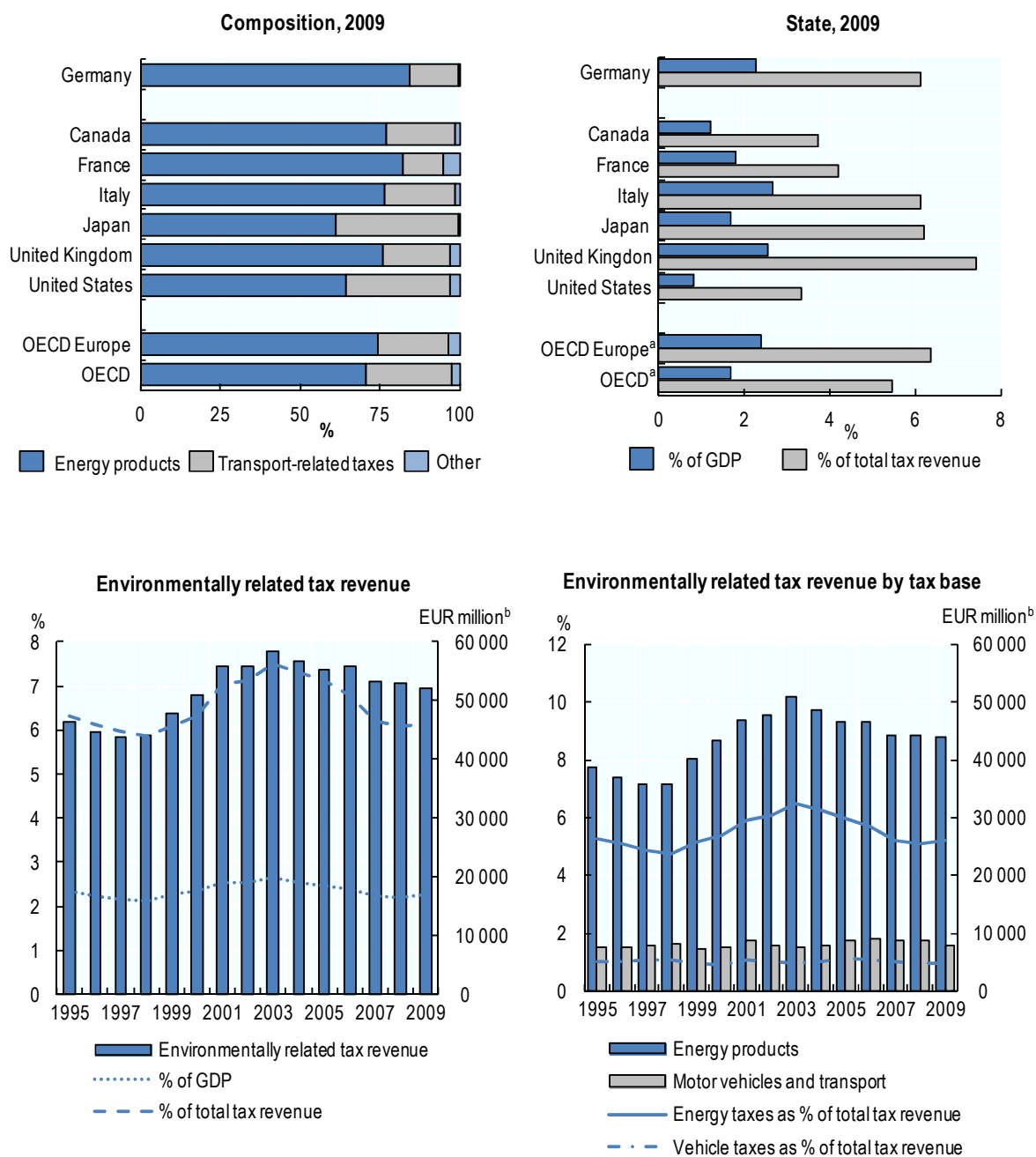
Source: BMU (2004).

As a result of the reform, revenue from energy taxation rose by 27% in real terms between 1999 and 2003, and from 5.1% to 6.5% as a share of total tax receipts. Revenue from environmentally related taxes, which is mostly made by energy taxes, followed a similar trend (Box 1 and Figure 1). The deflated implicit tax rate (ITR) on energy,³ which measures taxation per unit of fuel used, also increased sharply, in line with the increases in tax rates and in revenue (Figure 2). While the taxation burden on energy increased, that on labour income, measured by the ITR on labour,⁴ decreased (although to a much lesser extent), which partly offset the impact on businesses and households. Overall, despite the increase in energy tax revenue until 2003, the tax-to-GDP ratio declined (Figure 2).

Box 1. Environmentally related taxes

As in all other OECD countries, in Germany environmentally related taxes largely coincide with taxes on energy products and vehicles. In 2009 most environmentally related tax revenue (84.5%) came from energy taxation, including transport fuels and electricity; 15% was generated by the motor vehicle tax and about 0.5% by other taxes, such as hunting and fishing taxes. Energy taxes accounted for a larger share of environmentally related tax revenue than on average in the OECD (Figure 1). Revenue (in real terms) rose sharply between 1999 and 2003 as a consequence of the progressive increase in energy taxation. However, real revenue has since decreased by about 11%: the slight increase in revenue from vehicle taxes has only partly compensated for the strong decline in revenue from energy taxes. Environmentally related taxes have declined as a share of GDP and total tax revenue. In 2009, environmentally related tax revenue accounted for 2.3% of GDP and 6% of total tax revenue, slightly below the respective OECD Europe averages (Figure 1).

There is scope to further extending the use of environmentally related taxes in Germany. Such taxes should be introduced in clearly defined stages so that the economy can adapt to changes in relative prices. Distributional impacts (e.g. on low-income households) should be addressed by means of targeted social support. The country's experience with the eco-tax reform, while to a certain extent incomplete, shows that environmentally related taxes can make the tax system more growth-friendly if revenue is used to reduce more distortionary taxes such as those on labour and capital.⁵ In addition, increased revenue from such taxes could contribute to the government's fiscal consolidation efforts.

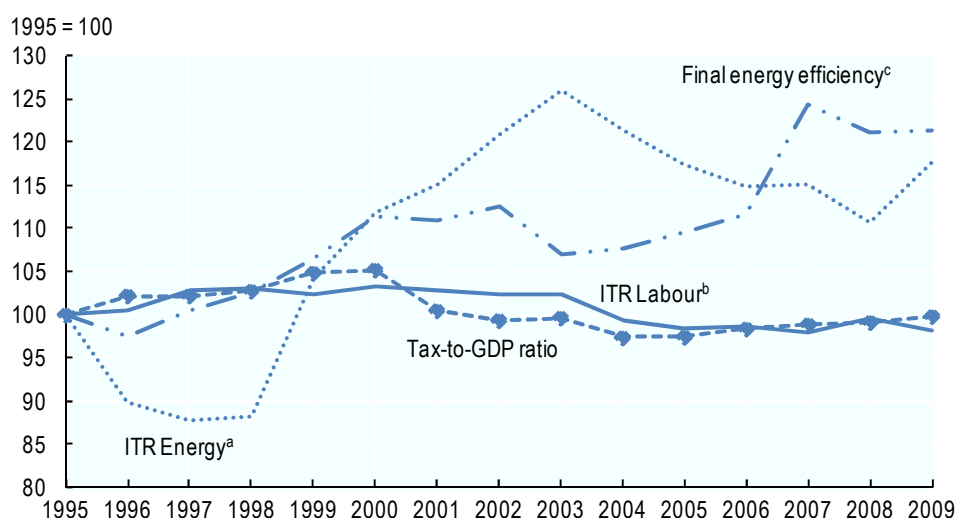
Figure 1. Environmentally related taxes

a) Weighted average.

b) At constant 2005 prices.

Source: OECD/EEA Database on instruments used for environmental policy; OECD (2010), *OECD Economic Outlook No. 88*.

Figure 2. Implicit tax rates on energy and labour

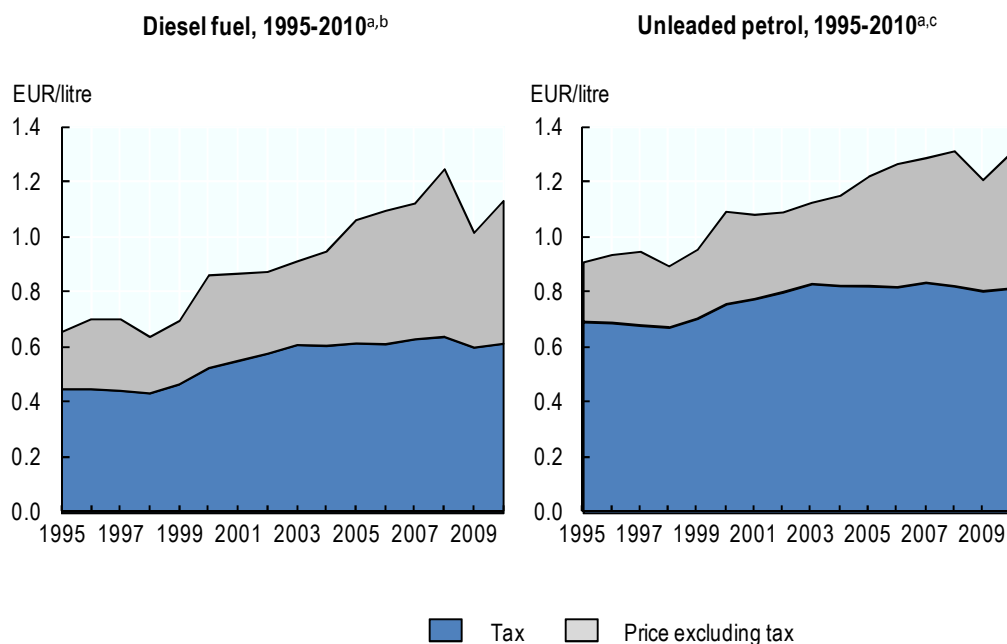


- a) The implicit tax rate (ITR) on energy is the ratio between the revenue from energy taxes (2000 prices) and final energy consumption.
- b) The ITR on labour is the ratio between the revenue from taxes on labour income and social contributions and overall compensation of employees.
- c) Final energy efficiency is the ratio between GDP (2000 prices) and total final energy consumption; it is the inverse of final energy intensity.

Source: EC (2011), *Taxation trends in the European Union*; OECD-IEA (2011), *Energy Balances of OECD Countries*; OECD (2010), *OECD Economic Outlook No. 88*.

In the context of rising world oil prices, the eco-tax reform has achieved most of its objectives. An analysis by the German Institute for Economic Research (DIW) indicated that energy use considerably decreased as a result of the reform, especially in the transport sector.⁶ Final energy efficiency (or GDP generated per unit of energy used) improved in the first years of the eco-tax reform implementation, although less than in previous years (Figure 2). The analysis estimated that reductions in emissions arising from the introduction of the tax would reach 2-3%, or 20-25 Mt CO₂, by 2010 (Ludewig *et al.*, 2010). Estimates also indicated that the decrease in social contributions by employers and employees had positive employment and economic effects, of the order of 250 000 jobs and +0.5% of GDP by 2003, compared to a reference scenario without the eco-tax reform. Overall, the net cost of the reform to the economy was estimated at EUR 0.3 billion in 2002 and EUR 12 billion in 2003, well below the additional energy tax revenue (EUR 18.7 billion in 2003). The reform also promoted development and market penetration of energy-saving technological innovations (Görres, 2006; Knigge and Görlach, 2005).

While the eco-tax rates were initially set at levels too low to induce substantial energy savings, their scheduled increases in the first years of the reform allowed the economy to adjust gradually to the change in relative prices (Kohlhaas, 2000). However, tax rates have remained virtually unchanged since 2003, undermining the eco-tax's incentive function. Combined with the increase in world market oil prices, this has resulted in a declining share of taxation in fuel prices. For example, after having increased in the early 2000s, the share of taxes in prices decreased from 74% in 2003 to 62% in 2010 for petrol and from 67% to 54% for diesel (Figure 3).⁷

Figure 3. Road fuel prices and taxes

a) At constant 2005 prices.

b) Automotive diesel for non-commercial use.

c) Unleaded premium (RON 95)

Source: OECD-IEA (2011), *Energy Prices and Taxes*.

Final energy efficiency returned to the 1999 level in 2003, when tax rate adjustments ended, and rose at a higher rate between 2003 and 2007. The decrease in consumption of the taxed energy products, especially transport fuels, was mainly due to soaring world market oil prices rather than to the energy-saving incentive provided by the eco-tax. The consumption share of diesel, which is taxed at a lower rate than petrol (see below), also grew. All this resulted in a decline of revenue from energy taxation; by 2009, the share of energy taxes in total tax receipts had returned to 1999 levels (Box 1 and Figure 1). Overall, the taxation burden on energy for both stationary and transport uses has declined since 2003, as indicated by the decline of the deflated ITR on energy (Figure 2). Continued adjustments would have sent clear price signals and helped maintain the energy tax as a stable revenue source. However, as in many countries, oil price increases made such adjustments politically difficult. Some form of tax indexing, therefore, merits consideration.

1.2. Implicit carbon prices

The energy and ecological tax rates do not adequately reflect the value of GHG emissions and of other environmental externalities. The taxes are not set against the CO₂ content of fuels, but rather differentiated according to fuel type. They vary by energy source and user group, reflecting concerns about competitiveness and distributive impact rather than cost-effectiveness (Kohlhaas, 2000). When expressed per tonne of carbon, the levels of the taxes vary widely (Table 2). While the multiple policy objectives of the ecological tax reform may partly explain the variation in carbon prices across fuels, the level of variance is difficult to justify from an environmental perspective in several cases.

Table 2. Eco-tax rates expressed as EUR per tonne of CO₂

	Total eco-tax	CO ₂ emission factor (kg of CO ₂ /unit)	Implicit CO ₂ tax (EUR/tonne CO ₂)
Transport fuels (EUR cents/litre)			
Diesel	15.34	2.64	58.1
Petrol	15.34	2.30	66.7
Liquefied natural gas	2.00	1.23	16.3
Liquefied petroleum gas	2.00	1.49	13.4
Heating fuels			
Light heating oil (EUR cents/litre)	2.05	2.53	8.1
Heavy heating oil (EUR cents/kg)	0.97	3.19	3.0
Natural gas (EUR cents/kWh)	0.37	0.21	18.0

Sources: Ludewig *et al.*, (2010); Emission factors from UK Department for Environment, Food and Rural Affairs.

When expressed per tonne of CO₂, the eco-tax rates (*i.e.* the additional tax applied to the original excise duties) on fuel oils for heating have usually been lower than the average emission allowance price under the EU ETS, which had hovered around EUR 15-20 per tonne of CO₂ for most of the second trading period (since 2008), before plummeting to below EUR 10 in late 2011 and to around EUR 6 in 2012. Hence, they have not reflected the value of CO₂ emissions, let alone that of other environmental externalities such as air pollution generated by fossil fuel combustion. Rates for natural gas, used either for transport or for heating, are in line with the EU ETS price (Table 2).

On the other hand, as everywhere in the OECD, fuels for transport are taxed at a much higher level than fuels for stationary combustion. Additional negative externalities related to the transport sector, such as noise, accident and congestion, could justify the higher rates, although excise duties are not well designed to address such externalities. In particular, diesel is taxed less than petrol (Table 2), but it has a higher carbon content, and its combustion generates higher levels of nitrogen oxides and fine particles than combustion of petrol. The higher vehicle tax applied to diesel passenger cars (Section 2) is an inadequate substitute for the reduced fuel tax, as shown by the increasing share of diesel cars in the fleet.⁸

Revenue losses resulting from the favourable tax treatment of diesel are considerable: the Federal Environment Agency (UBA) quantified such losses at EUR 6.6 billion in 2008, or about 13% of the total environmentally harmful subsidies as calculated by the agency (UBA, 2011) (Box 2). All this argues in favour of bringing the diesel tax rate at least to the same level as that of petrol, although concerns about fuel tourism could make this difficult in practice. Germany should review the taxation of diesel and petrol with a view to internalising their environmental external costs. If diesel-petrol tax parity is achieved, the vehicle tax for diesel cars could be set at the same level as that for petrol cars, as suggested by the UBA (Section 2). Overall, eco-tax rates should be based at least in part on the CO₂ content of the fuel taxed, with the CO₂ component made explicit so as to provide a clear price signal.

Box 2. Fossil fuel subsidies

Germany spends large amounts on support measures that have a potentially negative impact on the environment. The UBA, which regularly reviews federal subsidies, estimates that in 2008, EUR 48 billion (1.9% of GDP) in subsidies had negative primary or secondary effects on the environment.⁹ This is comparable to the revenue from energy taxes. Many long-time subsidies are no longer justified on economic or social grounds (UBA, 2011). In general, they contravene the polluter-pays and user-pays principles, distort competition, lock in inefficient technology and lead to inefficient allocation of resources. As direct transfers or various forms of tax breaks, subsidies weigh on current public finances, and can entail additional future expenditure to remediate the potential environmental and health damages. Germany's public finances, and the cost-effectiveness of its environmental policy, would greatly benefit from the reform of support measures that are environmentally harmful and economically inefficient. A systematic screening of existing and proposed subsidies against their potential environmental impact could facilitate such reform.

Coal production is supported through direct subsidies covering the difference between production costs and the world market price of coal exports. Germany has made progress in cutting these subsidies with a view to gradually phasing them out by 2018. Subsidies to hard-coal mining fell from EUR 4.9 billion in 1999 to EUR 2.1 billion in 2009 (OECD, 2012b). Nevertheless, support to production and consumption of fossil fuels, including coal, accounts for a large part of environmentally harmful subsidies and runs contrary to Germany's ambitious climate change policy. For 2008, estimates vary between EUR 7.5 billion and EUR 24 billion, depending on the methodology used and the kind of subsidies included (OECD, 2012b; UBA, 2011).¹⁰ Much of this support goes to energy-intensive sectors and coal, often in the form of tax exemptions, such as the exemptions from the eco-tax. As in many other countries, aviation fuel is also exempt, though the government introduced an air travel tax in 2011.

The price signal provided by the energy tax is also distorted by a number of exemptions and partial derogations. In particular, coal is virtually tax-free, and tax rates are reduced for heating fuels. Other exemptions have been granted to export-driven manufacturing and agriculture, which are potentially exposed to international competition. Under the so-called peak equalisation regime, many energy-intensive manufacturing sectors and those exposed to international competition are refunded most of the eco-tax payment that exceeds the relief on social contributions. Exemptions were further extended in 2006 so that specific energy-intensive processes in the steel and chemical sectors are totally exempt from energy taxation (OECD, 2012b). In addition, the manufacturing, agriculture and forestry sectors pay reduced rates on electricity and heating fuels. In many cases, these exemptions are granted to businesses that are not exposed to strong international competition (UBA, 2011).

Such tax benefits reduce energy prices, thereby encouraging energy use and reducing incentives to adopt energy-efficient technology, with negative implications for GHG emissions. Also, they distort competition among energy sources and can favour the use of dirtier fuels. As a result, existing low-cost abatement options have not been sufficiently exploited (OECD, 2012a). Exempted sectors have tended to postpone the necessary adjustments and investments despite their substantial potential for energy savings. For instance, the energy intensity of industrial production (ratio of industrial energy consumption to industrial production), which decreased moderately during the first years of the eco-tax reform, has declined much more significantly since 2003 with the increase in pre-tax market energy prices. Also, energy use in the agriculture and forestry sectors has increased: in 2009 it was 6% above the 2000 level, while agricultural production increased by 4% in the same period.

Exemptions and tax relief have been intended to mitigate the impact of the eco-tax on energy- and capital-intensive sectors (such as chemicals and iron and steel), which could have been hit harder by energy taxation than other sectors and benefited less from cuts in social contributions (Kohlhaas, 2000). While concerns about international competitiveness are legitimate, the risk of reduced competitiveness in some exempted enterprises is likely to have been overstated (OECD, 2012a). Technologies are available that allow for significant reductions in fuel consumption and carbon emissions in the most energy-intensive industries (e.g. cement and steel). A gradual reduction of exemptions from the energy tax seems, therefore,

feasible and would not necessarily endanger the economic activities of these sectors, especially if combined with targeted technology investment programmes. As the 2012 *OECD Economic Survey of Germany* suggests, competitiveness concerns need to be addressed by means of payments or refunds that are not proportional to the level of energy consumption, so that incentives for energy savings and emission reductions are maintained.

Some tax exemptions have recently been made less generous. For example, the German fiscal consolidation package for 2011-14 includes the reduction of some eco-tax and energy tax exemptions.¹¹ From 2013, following an agreement with the European Commission, energy-intensive companies that are granted the eco-tax rebate under the peak equalisation regime will be required to operate an energy management system (or other measures) and to demonstrate energy savings (Bundesregierung, 2010). However, many of these exemptions remain unjustifiable on economic grounds and should be phased out rather than made conditional on the introduction of energy management systems. These benefits should be reviewed in the framework of a broader review of energy subsidies (Box 2). Reforms must be considered also in terms of the implications of the EU ETS for these sectors. Tax breaks should only be used to avoid double taxation/pricing. For example, companies participating in the EU ETS face a carbon price and should not be subject to the part of the eco-tax or energy tax that is clearly referable to CO₂ emissions (see Section 3).

2. Vehicle taxes and carbon prices

Germany relies less on vehicle taxation than most other OECD countries. Vehicle taxes accounted for about 0.35% of GDP and 1% of total tax revenue in 2009, and have hovered around these levels since 2000 (Box 1 and Figure 1). Germany is one of the few European countries that do not apply a tax on vehicle purchase or registration. An annual motor vehicle tax has, however, long been in place.

In July 2009, the annual motor vehicle tax was restructured to include a CO₂ component in addition to cylinder capacity, with the aim of reducing per-vehicle CO₂ emissions. The CO₂ tax is proportional to emissions (above a certain threshold). The CO₂ tax rate is linear at EUR 2 per g CO₂/km, but cars with CO₂ emissions below 120 g/km (falling to 110 g/km in 2012-13 and then to 95 g/km) and electric vehicles are exempt.¹² In line with recommended practice, the CO₂ component of the tax is not differentiated according to fuel type, but the cylinder capacity component is nearly five times higher for diesel vehicles than for petrol vehicles because the former have a greater impact on local air pollution.¹³

Evidence in several countries indicates that the CO₂-based differentiation of vehicle taxation can provide car owners with an incentive to choose low CO₂ emission vehicles, thereby affecting fleet composition. In addition, recurrent taxes, such as the German annual vehicle tax, can, in principle, provide stronger incentives to change cars, since they must be paid annually rather than only at the moment of purchase (OECD, 2009a). While evidence to this effect is limited,¹⁴ Vance and Mehlin (2009) found that German car owners take into account the lifetime costs of car ownership and use in their car purchasing decisions, implying that annual vehicle taxes, and even more so fuel costs (and taxes), significantly affect the composition of the car fleet. However, taxes on vehicle ownership are theoretically less efficient than fuel taxes and road charges in reducing GHG and air pollutant emissions since they are more removed from actual vehicle use.

According to OECD analysis, the incentive to abate CO₂ emissions that is implicit in Germany's vehicle taxation reaches a maximum of about EUR 100 per tonne of CO₂ over the lifetime of vehicles (OECD, 2009b).¹⁵ This is much higher than the incentives provided in other sectors of the economy (e.g. those covered by the EU ETS), but in line with a reasonable carbon price.¹⁶ However, this implicit incentive also appears to be relatively weak. For instance, the motor vehicle tax decreased on average through the reform (Ludewig *et al.*, 2010). The absolute amount of the vehicle tax remains small compared to the total cost of vehicle ownership and use, ranging from 1% to 5%. Furthermore, the CO₂-related

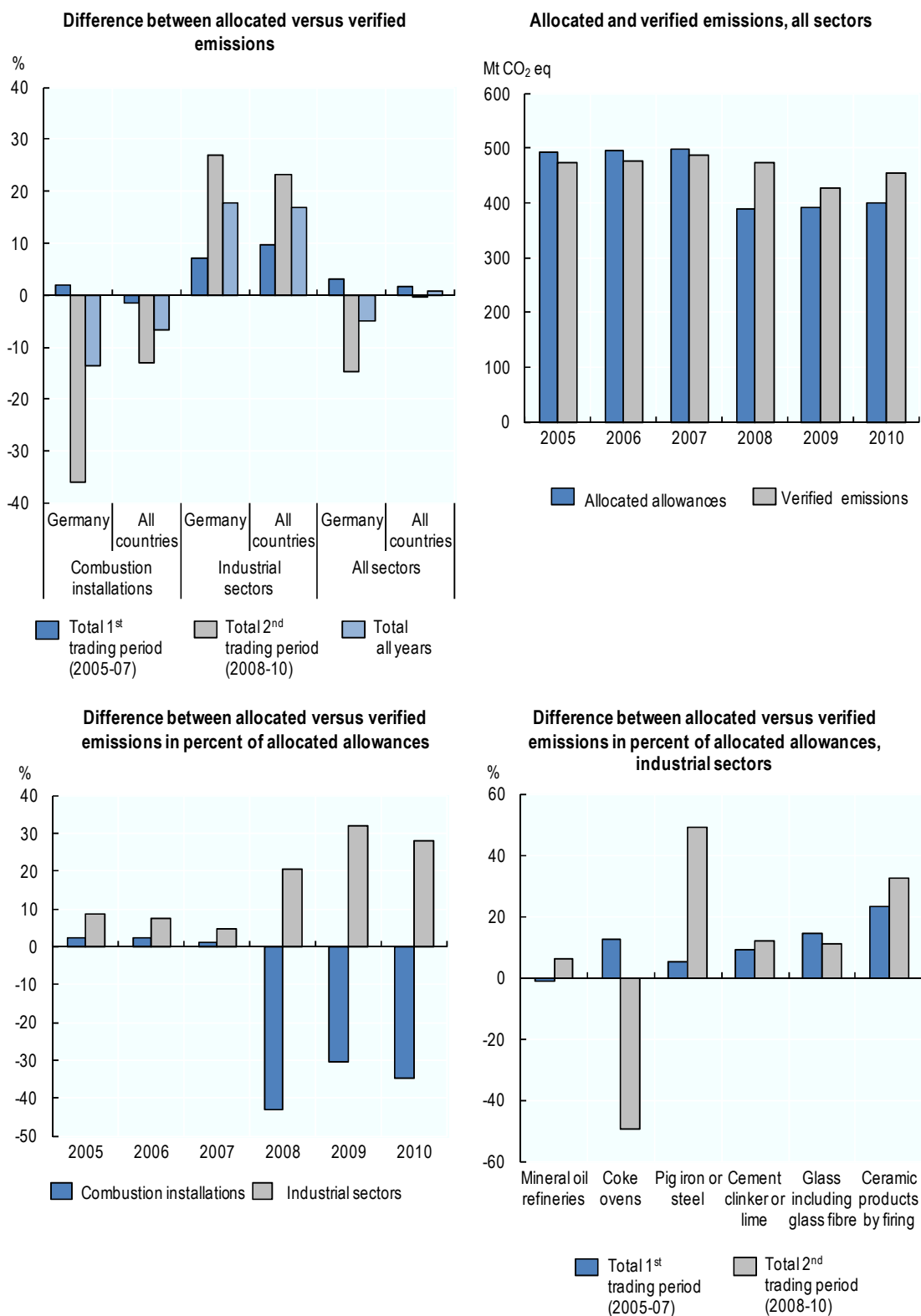
component accounts for a relatively low share of the tax and, while the tax differential across vehicle categories is higher under the new system, it remains among the lowest applied in European countries (Kalinowska *et al.*, 2009). Vehicles registered before the tax reform remain subject to the old annual tax until 2013, which may also undermine the incentive to change cars.¹⁷

It is too early to assess the impact of the new tax, especially because car sales in 2009-11 were heavily influenced by the economic crisis and the car scrapping incentive launched in 2009 as part of the stimulus package. Overall, the German car scrapping programme was a more expensive way of reducing CO₂ emissions than similar programmes implemented in France and the United States (ITF, 2011). It led to a shift towards smaller and less powerful cars, although this trend was quickly reversed as soon as the subsidy was removed. While these effects are typical of such incentive programmes, the shift back to bigger and more powerful cars in 2010 was swifter than in other countries with similar programmes (ACEA, n.d.). This fact suggests that the new CO₂-based vehicle tax rates are too low to provide an incentive towards smaller, more fuel-efficient vehicles.¹⁸ This could be addressed by adjusting the rates of the annual tax and complementing it with a moderate registration or purchase tax also based on CO₂ emission performance.

In addition, the tax treatment of personal road transport tends to encourage car use over public transport, as does the lack of tolls for passenger cars on German highways. Company cars used for private purposes are taxed at a flat, low rate (1% per month of the vehicle's list price at the time of first registration). OECD (2012c) estimated that forgone revenue due to this favourable tax treatment reaches more than EUR 12 billion per year, which is second only to the amount foregone in the United States. Moreover, company-paid operational costs, including fuels, are not considered taxable income. Hence, the cost to company car users of driving the car is virtually zero. This encourages employers to pay their employees partly in the form of a car. As a result, in 2008 30% of new car registrations in Germany were company cars, which tend to be bigger, more powerful and more polluting than private cars (UBA, 2011). This tax treatment should be made less advantageous: income tax on company car ownership should reflect the true value of the car, and possibly be differentiated on the basis of vehicles' CO₂ emission levels. Distance-based income tax deductions for commuters also promote use of cars and encourage workers to live further away from their place of work (travel to and from work using private transport is tax deductible at a rate of EUR 0.30 per kilometre). Germany is one of the few European countries to have such a system in place. It is estimated that abolition of this allowance could cut CO₂ emissions by more than 2 Mt CO₂ per year by 2015 and 2.6 Mt CO₂ per year by 2030 (UBA, 2011). This concession should be revised by making the allowance not conditional on distance driven and/or linking it to environmental criteria (*e.g.* car fuel efficiency).

3. The EU Emissions Trading System

The EU ETS covers about 60% of total CO₂ emissions and over 2 000 industrial installations and large power plants.¹⁹ Germany, like most member states, over-allocated allowances to installations covered by the ETS in its first (2005-07) trading period (partly due to insufficiently comprehensive data), which contributed to a collapse in the allowance price in Phase I (EEA, 2008). As Figure 4 shows, in this period the over-allocation of permits was more serious in Germany than the average for all participating countries. In the second trading period (2008-12), the German government agreed on an overall annual cap of 453 Mt CO₂ eq with the European Commission.²⁰ Germany has been one of the few countries with an allocation below verified emissions in the second phase. In 2008-10, allocation of allowances was far below verified emissions in Germany than on average in the market, and this corrected for the over-allocation of the first phase, albeit with a striking difference among sectors. Industrial sectors continued to receive considerable over-allocation of permits while combustion installations in the power generation sector, which is less exposed to international competition, had their allocations reduced far below verified emissions in 2008-10 (Figure 4).

Figure 4. Allocated allowances and emissions under the EU ETS

Source: EEA (2011), EU ETS data viewer.

Allowances were largely allocated free of charge to German industries, including electricity generators. Since the allowance price is passed through to electricity consumers via price increases, electricity producers across Europe reaped substantial windfall profits in the first and second trading periods. Ellerman *et al.* (2010) concluded that the rents totalled about EUR 29 billion, using a modest carbon price estimate of EUR 12 per tonne of CO₂.²¹ Another estimate put total windfall profits for German electricity generators alone at EUR 39 billion and argued that German companies in the chemical, refining, cement, and iron and steel sectors had also generated substantial windfall profits by selling significant surplus emission allowances (Figure 4) (Öko-institut, 2010).

As was the case in several EU countries, over-allocations, collapsed permit prices and windfall profits have meant that the externalities associated with GHG emissions have not been fully internalised by German companies operating under the EU ETS in the first and second trading periods. Nor has the allowance price been stable, certain or high enough to provide a signal to industry to invest in low-carbon technologies.²²

Modifications to the EU ETS, particularly the progressive introduction of auctioning and tightening of the overall cap, should enhance its effectiveness in the next trading period. The wide range of price forecasts for allowances underlines the continuing market and regulatory uncertainty, however: the allowance price may continue to be too low or too volatile to provide sufficient incentives to invest in low-carbon technologies (HM Treasury, 2010). Furthermore, as most energy-intensive installations will receive freely allocated allowances even after 2013 to prevent their relocation outside the EU, windfall profits will likely continue to accrue to those sectors (De Bruyn *et al.*, 2010; Martin *et al.*, 2010). The extent to which the EU ETS will fully internalise the GHG externalities in the period to 2020 is therefore open to question.

As other countries participating in the EU ETS, Germany faces the need of combining energy taxation and the ETS to provide a clear price signal across the economy and avoid both gaps and double regulation (OECD, 2011a). Currently, the electricity sector and other energy-intensive industries are covered by the EU ETS, whereas households, small and medium-sized enterprises and the transport sector are covered by the eco-tax. In a number of areas, double regulation is a concern²³ and in others, neither instrument prices the environmental externality; the latter areas include small combustion plants, export-oriented agriculture and manufacturing (Wartmann *et al.*, 2008).²⁴ However, direct overlaps between the eco-tax and the EU ETS are relatively limited. Perhaps more significantly, consumers may be subject to cumulative indirect effects via increased electricity prices (Ludewig *et al.*, 2010). While large industries get a reduced rate on the energy tax, private households and many small and medium-sized service companies are affected by both instruments, as well as by higher electricity prices due to the feed-in tariffs apportionment (see Section 4).

However, the current eco-tax has broader objectives than pricing CO₂ emissions, including redistributing the tax burden from labour (social contributions) to energy (Ludewig *et al.*, 2010). This may justify a certain degree of overlap. In addition, given the volatility of the emission allowance price, some overlap of the two instruments might be justified to the extent that the tax is used to supplement the anticipated price of allowances under the EU ETS and establish a minimum, predictable carbon price. For example, when offshore oil and gas companies in Norway were included in the EU ETS in 2008, the Norwegian government reduced the CO₂ tax on them, but did not eliminate it as would have been required to avoid double carbon pricing. This was done to keep the CO₂ price constant for the sector, based on an anticipated EU ETS allowance of 160 Norwegian kroner (OECD, 2011b). A similar system is proposed in the UK, where the climate change levy or fuel duty would be extended to fossil fuels used in electricity generation, which is covered by the EU ETS. The so-called carbon price support rates will reflect the differential between the future market price of carbon and the floor price determined by the government (HM Treasury, 2010). Such combination of taxation and cap-and-trade systems can provide investors with

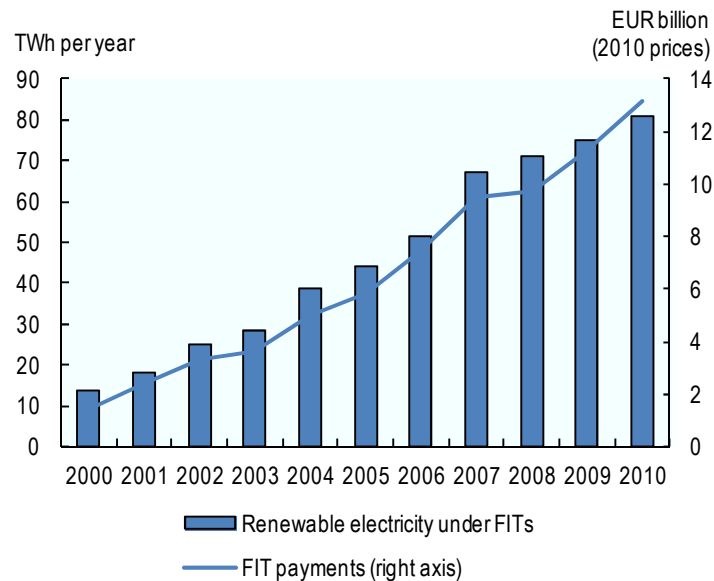
greater certainty and stimulate investments in low-carbon technologies. However, to the extent that the overall emission cap remains unchanged, this would not lead to a reduction in EU-wide emissions, because emissions would be displaced to countries where the floor price is not in place (OECD, 2011a). To maintain the cost-effectiveness of the EU ETS, the floor price of carbon should be applied at EU level or, more simply, all EU partners should agree to tighten the cap. Germany should contribute to discussion at EU level about possible measures to maintain an effective carbon price signal in the EU ETS in line with overall medium- and long-term EU emission reduction targets.

4. Support to renewable energy sources: implied GHG abatement costs and carbon prices

Increasing the share of renewables is a priority of the German government. According to the 2010 Energy Concept, renewable energy will account for at least 35% of gross electricity consumption in 2020, to reach 80% in 2050. The Renewable Energy Sources Act (EEG) of February 2000, subsequently amended several times, introduced feed-in tariffs (FITs) for electricity generated from renewable sources. The FITs vary with the generation capacity of the installations and the type of source. They decline annually to take account of cost decreases for installations and parts, and to encourage technological advancements. Germany's feed-in structure for renewables promotion has been adopted by about two-thirds of EU member countries as well as several non-EU countries.

The use of FITs has been effective in promoting electricity generation from renewables. The share of renewables in electricity generation increased from 7% of in 2000 to 17% in 2010. In 2009, savings of 52 Mt CO₂ eq were attributed to the FITs. Investment in renewables has continued to increase dramatically, even during the recession: in 2009 investment in renewable energy installations increased by more than 30% over the previous year, while investment in most other sectors declined (BMU, 2010). Overall, the German FITs appear to be better designed and to have been more effective than those used in many other countries. There has also been a positive influence on innovation which has benefited the German economy (OECD, 2012d).

Nevertheless, the overall costs and economic efficiency of Germany's renewables policy has been the subject of considerable national and international debate. Contrary to similar FIT systems in other countries, the costs of the system are passed on to end-use consumers in the form of a surcharge on the electricity price, referred to as the EEG apportionment.²⁵ With the increase in electricity generation from renewables, also the amount of FITs paid grew considerably between 2000 and 2010, from about EUR 1 billion to nearly EUR 14 billion, in 2010 prices (Figure 5). The overall costs of the system have increased sharply in recent years, far above government expectations, mainly due to the strong development of photovoltaics (PV). Between 2000 and 2010, the total EEG cost amounted to EUR 46 billion (in 2010 prices).²⁶ The EEG apportionment paid by residential electricity customers increased from EUR cent 0.2/kWh in 2000 to EUR cent 2.3/kWh in 2010. This represents about 10% of the total price per kWh paid by residential customers (BMU, 2011).²⁷ While the increase in electricity prices could encourage the displacement of electricity by more carbon-intensive fuels, it could also encourage energy savings.

Figure 5. Renewable electricity generation and feed-in tariff payments

Source: Adapted using data from BMU (2011), *Development of Renewable Energy Sources in Germany in 2010*.

As in most countries with FITs systems, the German tariffs are higher than electricity prices, varying from about 2 to 3 times the electricity price for biomass, biogas, wind and hydropower to 5 times for PV. Some estimates indicate that the FIT for PV was eight to ten times higher than the electricity price in 2009 (Fronzel *et al.*, 2010). The cross-subsidies implied by the FIT (excluding hydropower) were estimated to account for some 0.2-0.33% of GDP in 2009, the highest share in OECD Europe countries after Spain (Égert, 2011). The largest share went to wind and solar PV. The subsidies provided to PV contributed to generating 9% of the electricity which fell under the EEG, but accounted for 40% of differential costs (Bundesregierung, 2010). In response to increasingly rapid deployment of solar PV and the high costs entailed, the federal government revised the FIT regulations to introduce a dynamic degression of tariff rates for solar installations: instead of fixed degression rates to determine tariffs to be offered in future years, the degression rates are now linked to market developments (OECD, 2012d).²⁸

If GHG emission abatement represents the exclusive policy objective of renewables promotion, the abatement costs implied by feed-in tariffs should ideally be aligned with the carbon price projected by the government to achieve GHG emission goals. These costs should be set equal for all sources of renewable energy to ensure that those with the lowest actual abatement costs are chosen and to avoid favouring particular technologies (Égert, 2011).²⁹ Overall, the cost of abating one tonne of GHG emissions implied by Germany's FITs is estimated to be quite high, well above the carbon price prevailing in the EU ETS (and a realistic carbon price), with a large variation across energy sources: it ranges from about EUR 65 per tonne of CO₂ for hydropower, biomass and biogas to EUR 655 for solar.³⁰ This is mainly because, leaving aside considerations of energy security and industrial policy, FITs reflect the actual costs of investment in renewables. Still, GHG abatement costs implied by FITs are lower in Germany than in some countries because renewables displace energy produced from a more carbon-intensive fuel mix than in countries such as France or the Slovak Republic, where nuclear power plays a bigger role (Égert, 2011). While the level of subsidy, in particular for PV, has been criticised as being too high, it has brought renewables technologies closer to grid parity by driving technological innovation and widespread diffusion faster than would have otherwise occurred (OECD, 2012d).

As in other EU countries, the interactions between Germany's renewables support policy and the EU ETS should be taken into account as well. The EU-wide emission allowance market ensures that operators in the electricity market face a carbon price which provides an incentive to invest, among other things, in renewables. In this context, the promotion of renewable energy sources in one country, especially a big player such as Germany, can lead to lower allowance prices and the displacement of emissions, impairing the overall cost-effectiveness of the system.³¹ For example, Traber and Kemfert (2009) estimated that the growth in renewables-based electricity generation stimulated by the German FITs would reduce the allowance prices by 15% (from EUR 23 to EUR 20 per tonne of CO₂). This would result in increased GHG emissions from electricity generation across the EU by 3.9% (Australian Government Productivity Commission, 2011). While expected development of renewables in EU countries has been taken into account in setting the EU cap for the third ETS phase (from 2013) to limit unintended price-lowering effects, uncertainty remains.

In general, using multiple policy instruments to target the same environmental externality (GHG emissions, in this case) might shift abatement to more costly technologies without adding any climate mitigation benefits (OECD, 2011a). However, the price of CO₂ emissions in the EU ETS has been generally too low to stimulate such investment, as some technologies cannot compete with conventional energy sources even when the allowance price is taken into account. Technology-specific instruments such as FITs are being used to promote renewables beyond the incentives provided by the EU ETS, to the extent that such measures aim at encouraging innovation and long-term cost reductions rather than only short-term emission abatement. In addition, measures are needed to overcome other obstacles to the development of renewables, such as network effects, learning and demonstration effects, and limited access to finance.

Conclusions

Germany has implemented a composite mix of policy measures to achieve its ambitious climate change mitigation goals. This policy mix includes a range of market-based instruments, which have helped improve pricing of GHG emissions. However, potential synergies among measures have not been fully exploited and multiple instruments have addressed the same environmental externality. This has led to carbon prices that vary greatly across the economy, potentially undermining the cost-effectiveness of the policy mix. For instance, the eco-tax rates do not consistently reflect the carbon content of fuels, and several forms of subsidies remain that distort price signals and can encourage fossil fuel use.

While a least-cost strategy should involve a combination of complementary instruments, a uniform carbon price across different sources of GHG emissions is a necessary condition for minimising the costs of emission reduction. A combination of energy taxation and the EU ETS is, therefore, needed so as to fully internalise the value of GHG emissions and to provide a consistent price signal. To minimise the cost to society, energy taxes and the EU ETS should be combined in a manner that avoids both gaps and double regulation. Hence, Germany should consider implementing a form of carbon tax in sectors not covered by the EU ETS, as well as removing energy tax exemptions that are not needed to avoid double taxation or pricing. For instance, the eco-tax rates could be based at least in part on the CO₂ content of the fuel taxed, with the CO₂ component made explicit so as to provide a clear price signal. In addition, Germany should review existing distortions to the price signal provided by fuel and vehicle taxes. These include the preferential tax treatment of company cars and the commuting allowance.

Uncertainty remains about whether the EU ETS will lead to a CO₂ allowance price that is sufficiently stable and high to provide incentives for investing in low-carbon technologies. Germany should coordinate with the other EU partners to implement measures to maintain an effective carbon price in the sectors covered by the ETS. For example, a flexible form of taxation could be applied at EU level to the ETS sectors to supplement the anticipated (low) price of allowances and help control price volatility.

However, in addition to carbon pricing, other instruments are required to address persisting obstacles to low-carbon investment, production and consumption choices. These include learning and demonstration effects, high technology costs, and myopic consumer behaviour, which limit responsiveness of companies and consumers to (politically and socially acceptable) price signals. This paper has analysed two such instruments: the annual motor vehicle tax and the feed-in tariffs for electricity generated from renewable sources. The experience of Germany and of other countries shows that these instruments are effective in stimulating the uptake of “cleaner” vehicles and energy technologies. However, they can imply very high GHG abatement costs (as in the case of feed-in tariffs), and their interaction with other policy instruments such as the EU ETS should be carefully managed. Nonetheless, these measures usually aim at broader goals than short-term GHG emission abatement, which can justify a certain degree of abatement cost variance and overlap with other policy instruments.

NOTES

1. The EU burden sharing agreement was reached in 1998, after the EU15 collectively committed, in the 1997 Kyoto Protocol, to reduce emissions by 8% from 1990 levels by 2008-12.
2. Electricity produced from renewables was also subject to the electricity tax.
3. The ITR on energy is the ratio between the revenue from energy taxes and final energy consumption (EC, 2011).
4. The ITR on labour is the ratio between the revenue from taxes on labour income and social contributions and overall compensation of employees (EC, 2011).
5. Germany's tax system remains skewed towards labour, notably because of the still high social security contributions (OECD, 2012a).
6. Between 1999 and 2003, final energy use fell by 8.6% in transport and by 3.5% in the residential sector, possibly due to the incentive provided by the eco-tax reform. On the other hand, energy use in industries, many of which were shielded from the energy tax rise, continued to increase.
7. Nevertheless, the share of taxes in transport fuel prices remains among the highest in the OECD.
8. The share of diesel vehicles in the total automobile fleet rose significantly, from 14.5% to 24.4%, between 2001 and 2008 (UBA, 2011b).
9. The UBA (2011b) defines primary effects as environmentally harmful effects resulting directly from the subsidised activity or product, and secondary effects as those that the subsidy triggers indirectly via cause-and-effects chains.

10. For example, the UBA (2011b) considers the allocation of CO₂ emission allowances in the EU ETS and the lower taxation of diesel as fossil fuel subsidies, whereas the OECD (2012b) does not.
11. From 2011, the tax reduction for industry and agriculture is reduced from 40% to 25%, and the peak equalisation is reduced from 95% to 90% of the tax payment exceeding the relief of social contributions.
12. By comparison, EU Directive 2009/33/EC requires average CO₂ emissions for new cars registered in the EU to be no more than 130 g/km by 2012. Electric vehicles receive a tax exemption over five years from first registration; afterwards they are assessed on the basis of total weight, with tax relief of 50%.
13. The base tax is EUR 2 per 100 cc for petrol vehicles and EUR 9.50 per 100 cc for diesel vehicles.
14. There is some evidence that car purchases are more affected by retail prices than by lifetime costs, implying that vehicle registration taxes are more effective in reducing the average CO₂ emissions of new cars than annual circulation taxes (Vance and Mehlin, 2009).
15. The OECD (2009b) calculated the values per tonne of CO₂ emitted over the lifetime of vehicles that are implicit in the CO₂ component of vehicle taxes (assuming that each vehicle is driven 200 000 km in its lifetime). According to this analysis, in Germany the implicit CO₂ tax rate is zero for vehicles emitting up to 120 g CO₂/km and EUR 30 to 103 per tonne of CO₂ for vehicles with emission levels between 150 and 380 g CO₂/km.
16. By comparison, the carbon tax rate in place in Sweden is about EUR 100 per tonne of CO₂.
17. The old vehicle tax was based on vehicles' cylinder capacity and emissions according to Euro standards.
18. Cars in Germany tend to be bigger and more powerful than in many other European countries. This phenomenon is linked to the traditionally relatively low level of taxation and tax differentiation across car types, as well as to the large number of company cars, which tend to be larger and to have above-average fuel consumption (Kalinowska *et al.*, 2009; UBA, 2011b).
19. The Emissions Trading Directive (2003/87/EC) required EU member states to assign an amount of allowances to companies operating under the ETS.
20. The federal government's initial proposed cap was 482 Mt CO₂, which was reduced by 6% in negotiations with the European Commission. German companies had access to a further 20% (90.62 Mt CO₂ eq) per year in emission reduction credits from allowances under the Kyoto Protocol's Joint Implementation and Clean Development Mechanism provisions.
21. Despite the over-allocation of permits in the first trading period, the price of permits remained at around EUR 12, allowing companies that had received allowances to make a profit by selling them.

22. Reduced industrial production and energy use during the economic crisis also contributed to the increased volatility of CO₂ allowance prices.
23. For example, a limited number of small energy generators over 20 MW in the commercial sector (*e.g.* heat generation at hospitals) are covered by both instruments. Also covered by both instruments are industry installations not excluded from the energy tax, such as pulp, paper and cardboard, and crackers in the chemical industry. It should be noted that these companies (particularly labour-intensive ones) may experience net relief through reduced social contributions.
24. Other gap areas include thermal waste, exhaust air treatment and ship transport, which may be covered under other regulations.
25. Over 500 electricity-intensive manufacturing companies and rail operators are largely exempt from the EEG apportionment, which leads to increased prices for all other electricity customers.
26. This cost is referred to as “differential cost”, *i.e.* the difference between the fixed average tariffs paid to the electricity generated from renewable sources and the procurement prices for the conventionally generated electricity.
27. The impact on electricity prices would have been higher without the so-called merit order effect – the impact that priority feed-in of renewably generated electricity has on wholesale electricity prices. Because demand for conventionally generated electricity decreases as a result, under a merit-order system the most expensive of the power stations that would otherwise be used are no longer needed to meet demand. This exerts downward pressure on wholesale electricity prices on the spot market, with the reductions being passed on to some electricity consumers, mainly electricity-intensive companies, via lower electricity prices (BMU, 2010).
28. As a consequence, the FITs offered to installations commissioned in future years might increase or decrease by a predefined percentage depending on the total volume of new capacity installed in the previous year. Traber *et al.* (2011) predict a significant moderating effect of dynamic degression on FIT cost apportionment.
29. However, it should be noted that the large number of externalities to be taken into account, including local air pollution, pollution of land, air and damage to the countryside, does not necessarily mean that a strict equalisation of feed-in tariffs would be optimal (Égert, 2011).
30. By comparison, the cost of abating one tonne of GHG emissions implied by support to CHP is estimated to be in the range of EUR 30/t CO₂ (Australian Government Productivity Commission, 2011). The 2002 Combined Heat and Power Act provides CHP generators with payments for each kWh of electricity they feed into the grid, depending on the age of the plant, its size and its efficiency.
31. If the increase in electricity generation from renewables in one country replaces fossil fuel-generated power, demand for emission allowances from power plant operators decreases. If the EU-wide cap is not reduced, this results in lower prices and the displacement of GHG emissions to other sectors or countries.

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