ISBN 92-64-01693-7
Sustainable Development in OECD Countries
Getting the Policies Right

Chapter 3

Reducing Emissions of Greenhouse Gases

Climate change may impose very large costs in the second half of the century and later unless greenhouse gas emissions are kept under control. Given the magnitude of the emission reductions that are required in the long run, it is of paramount importance to ensure that the most cost-efficient measures are used. For this reason, the twenty country reviews dealing with the issue have focused on the capacity of climate change policies to deliver the highest possible amount of emission reductions for the cost incurred. The chapter reports the findings and recommendations from country reviews based on analysis for each policy instrument: voluntary agreements, regulations, schemes to promote the use of renewable energy sources, carbon taxes and tradeable permits. It also includes data comparing actual emissions against adopted objectives and provides insights about the extent to which emission trends have been decoupled from economic growth.

1. Introduction

This chapter provides a synthesis of the 21 reports on climate change policy that have been undertaken for OECD country economic surveys that have or will appear in the period October 2002 to the autumn of 2004.[1] The focus of these country sections has been the cost-efficiency of the greenhouse gas (GHG) abatement policies implemented by OECD member countries. They have also discussed the social consequences of climate change policies and how the perceived social implications have influenced the design of policies. Against the background of the policy analysis, the economic surveys have provided general and specific policy recommendations on the use of instruments. The sections have not addressed whether the objectives are appropriate given the expected costs and benefits of the policies. This issue will be important for the design of future greenhouse gas policies, but the benefits of abatement at global level are still uncertain though knowledge about the damage of climate change is improving (see Box 3.1). The examples given below are mostly drawn from the countries reviewed on this topic and therefore generally do not cover all OECD countries.

2. Objectives and performance

The international community has twice chosen quantity-based objectives to address the challenge of climate change. First, all OECD countries bar Mexico, Korea and Turkey set an indicative target of keeping their domestic emissions below 1990 levels by 2000 under the UN Framework Convention on Climate Change (UNFCCC) signed in Rio in 1992. Secondly, the same group of countries and a number of non-OECD countries (together known as Annex B countries)[2] accepted national emission limits for the 2008/2012 period during the Kyoto conference in 1997, with a view to lowering emissions to 95 per cent of their 1990 level by 2008 to 2012. Subsequently the international community agreed limits on the extent to which increased uptake of carbon in agriculture and forestry (sinks) could count against the emissions of Annex B countries and on the extent to which emission credits from developing countries could be set against national emission limits. The overall result of these changes is that if maximum use is made of sinks and imports from developing countries (both of which are difficult to monitor), then the minimum domestic emission reduction required for all Annex B countries was set at 2 per cent, against the reduction of 5 per cent in net emissions that was initially foreseen in the Kyoto Protocol.

Box 3.1. **Estimating the marginal benefit of reducing greenhouse gas emissions**

Man-made emissions of greenhouse gases (GHG) have been found to modify the earth's climate and will have contrasting consequences across countries according to the Intergovernmental Panel on Climate Change (IPCC, 2001a). Despite considerable progress in climate modeling in the past decade, impact forecasts are still marked by a high degree of uncertainty, especially with respect to the likelihood and nature of catastrophic occurrences. There is, however, a general consensus that climate change will affect ecosystems and human activities in many ways because mean temperatures will increase, the climate may become more variable, the sea level will rise and extreme climatic events may become more frequent (IPCC, 2001a). On the basis of numerous assumptions, these changes can be translated into economic gains and losses. Over the longer term, these estimates suggest that some countries stand to gain from climate change, notably because of higher farm productivity (Russia, Canada), a few others may be little affected (United States), while the majority of countries may incur losses, especially if they fail to improve their public health capabilities. At high levels of global warming (a temperature increase of 4 °C or more), which is projected by a few models for the second part of the 22nd century, impacts might become overwhelmingly negative on the assumption of little technological change (Smith and Hitz, 2003).

While there is considerable uncertainty surrounding the estimated benefits of a reduction in emissions, the country reviews showed that governments have used a central value for policy integration and project evaluation purposes. For example, the UK government has provisionally retained a damage estimate of GBP 20 per tonne of carbon dioxide, the French government uses a point estimate of EUR 27 and the European Commission has suggested a price range of EUR 21 to 54.[1]

These values are based on research conducted in the early 1990s reported in IPCC (1995) and, since then, evaluation techniques have improved substantially. The rapid evolution of the state of knowledge meant that no update on consensual damage cost estimates could be included in the third assessment report issued by the IPCC (2001b). The main factors that influence the marginal benefits are better known. Thus, estimates will differ according to the choice of the discount rate, integration of catastrophes in the modelling scenarios, estimation of future income and rising damage estimates, the consideration of ancillary benefits, such as reduced air pollution and noise that arise from lowering greenhouse gas emissions,[2] and the choice of social welfare function that is used to aggregate income losses for different groups in the world economy. The median of 88 estimates surveyed by Tol (2003) is a marginal damage of emitting GHG of USD 1½ per tonne of carbon dioxide. It is, however, subject to a large degree of uncertainty and results are strongly dependent on the discount factors used in the analyses (OECD, 2004).[3]

1. All monetary quantities in source documents have been updated to 2003 prices and, where appropriate, converted into a currency other than that used in the source at average 2003 exchange rates.
2. Estimates of ancillary benefits range from USD 0.8 to USD 92 per tonne of carbon dioxide (OECD, 2001). Including ancillary benefits in estimates of the gains of reducing GHG emissions may not be warranted if other policies are in place to deal with such externalities.
3. For policy evaluation purposes, a positive discount rate is necessary.

Of the Annex B countries, the United States and Australia have re-examined their stance and both decided not to ratify the Kyoto Protocol. At present, the Protocol will only enter into force if it is ratified by Russia. Australia, however, retains a national emission target equal to that in the Kyoto Protocol and the United States has set a national goal to reduce the ratio of GHG emissions to GDP (emission intensity) by 18 per cent between 2002 and 2012. Such a reduction in intensity would permit an increase in emissions of 16 per cent in that ten year period, bringing the increase since1990 to 31 per cent against a reduction of 7 per cent in the Kyoto Protocol.

The majority of OECD countries (14 out of 25 committed) did not attain the indicative objective of keeping domestic emissions below 1990 levels by 2000 (Table 3.1). Emission intensity diminished in virtually all OECD countries (Table 3.2) but, in many of them, not strongly enough to offset the effect of output growth. Thus, the level of GHG emissions in 2000 was more than 10 per cent higher than in 1990 in both the United States and Japan, and while significant cuts were achieved in the European Union as a whole over the same period, some EU member countries recorded particularly high emission increases. The sharp reduction in emissions in transition countries was primarily due to the economic contraction in the early 1990s combined with major cuts in emission intensity in the manufacturing sector following major industrial re-structuring. Falling emissions in Germany were also driven by industrial restructuring in the new *Länder*. Emission abatement in France and Switzerland was facilitated by increases in climate-neutral electricity production from uranium and water, respectively, while privatisation and regulatory reform of the power industry in the United Kingdom induced a switch to cheaper gas-based electricity with a by-product being a fall in emissions (Table 3.3).

Similarly, emissions are set to exceed Kyoto targets, on existing policies, in sixteen out of the 25 OECD countries that have ratified the Protocol and accepted emission ceilings (Table 3.1).[3] However, if the Kyoto Protocol enters into force, countries may satisfy emission requirements by importing permits, a large supply of which can be found in Former Soviet Union countries. The difference between quotas and emissions in these countries is indeed forecast to be larger than the shortfall of permits that would arise in the 25 OECD countries party to the Kyoto protocol in a business-as-usual scenario (Böhringer, 2002). On the other hand, if countries retain their Kyoto targets in the absence of permit trade with the FSU countries, large further cuts in emissions would be required in the coming ten years and could prove very costly, especially if policies are not designed to be cost efficient. Looking beyond the current Kyoto commitment period (*i.e.* after 2012), emission abatement will have to be much more ambitious to stabilise carbon-dioxide concentrations in the atmosphere at levels that do not involve excessive temperature increases, implying that exploiting low-cost options will become more urgent with time.

Table 3.1. **Countries' performance towards adopted objectives**

	Rio Convention		Kyoto Protocol						Projection on implemented policies
			Agreed reduction in net emissions		Maximum from sinks and Clean Development Mechanism		Agreed minimum reduction from emissions		
	Rio indicative target	Actual	Kyoto	EU limits	Marrakech	EU limits	Overall	EU limits	
	1990-2000		2008-2012, per cent change from 1990						1990-2010
Austria	0	3.1	–8.0	–13.0	1.5	4.0	–6.5	–9.0	12
Belgium	0	6.7	–8.0	–7.5	1.5	1.1	–6.5	–6.4	15
Denmark	0	–1.2	–8.0	–21.0	1.5	1.8	–6.5	–19.2	17
Finland	0	–4.1	–8.0	0.0	1.5	1.8	–6.5	1.8	17
France	0	–1.7	–8.0	0.0	1.5	1.6	–6.5	1.6	10
Germany	0	–18.9	–8.0	–21.0	1.5	1.4	–6.5	–19.6	–20
Greece	0	24.0	–8.0	25.0	1.5	1.3	–6.5	26.3	36
Ireland	0	24.8	–8.0	13.0	1.5	1.3	–6.5	14.3	40
Italy	0	5.1	–8.0	–6.5	1.5	1.1	–6.5	–5.4	4
Luxembourg	0	–55.6	–8.0	–28.0	1.5	1.3	–6.5	–26.7	–22
Netherlands	0	3.6	–8.0	–6.0	1.5	1.0	–6.5	–5.0	6
Portugal	0	30.4	–8.0	27.0	1.5	2.2	–6.5	29.2	41
Spain	0	34.8	–8.0	15.0	1.5	1.9	–6.5	16.9	48
Sweden	0	–1.7	–8.0	4.0	1.5	4.0	–6.5	8.0	1
United Kingdom	0	–12.6	–8.0	–12.5	1.5	1.6	–6.5	–10.9	–14
European Union			–8.0		1.5		–6.5		0
Canada	0	19.6	–6.0		11.0		5.0		26
Czech Republic	0	–23.6	–8.0		1.6		–6.4		–32
Hungary	0	–17.0	–6.0		2.0		–4.0		–9

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Table 3.1. **Countries' performance towards adopted objectives** *(cont.)*

	Rio Convention		Kyoto Protocol						Projection on implemented policies
			Agreed reduction n net emissions		Maximum from sinks and Clean Development Mechanism		Agreed minimum reduction from emissions		
	Rio indicative target	Actual	Kyoto	EU limits	Marrakech	EU limits	Overall	EU limits	
	1990-2000		2008-2012, per cent change from 1990						1990-2010
Iceland	0	6.9	10.0		10.2		20.2		. .
Japan	0	11.2	–6.0		4.8		–1.2		7
New Zealand	0	5.2	0.0		40.6		40.6		–15
Norway	0	11.2	1.0		4.0		5.0		22
Poland	0	–16.0	–6.0		1.5		–4.5		–15
Slovakia	0	–33.3	–8.0		3.6		–4.4		–25
Switzerland	0	–0.9	–8.0		4.5		–3.5		–4
Annex B without Australia and the United States			–4.8		3.6		–1.2		–11.6

Table 3.1. **Countries' performance towards adopted objectives** *(cont.)*

	Rio Convention		National targets	
	Rio target	Actual	National target	Projection on implemented policies
	Total GHG emissions, percentage changes			
	1990-2000		1990-2010	1990-2000
Australia	0	–18.2	+8	+16
			National targets	
			National target	Projection on implemented policies as of Jan. 2002
			Ratio of emissions to GDP, percentage change	
			1990-2012	1990-2010
United States	0	+14.2	–33	–28

Note: Korea, Mexico and Turkey have no targets.
Australia: implemented policies as of 2002.
United States: implemented policies as of January 2002.

Source: OECD for emission data, European Environmental Agency for projections on existing policies for EU countries, national reports for projections for Canada, Hungary, Japan, New Zealand, Norway, Poland, Slovak Republic, Switzerland and the United States.

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Table 3.2. **Main indicators: climate change**

	Total GHG emission intensity	CO_2 emission intensity, electricity	CO_2 emission intensity, transport	GHG emission intensity, other sources	Total GHG emission intensity	CO_2 emission intensity, electricity	CO_2 emission intensity, transport	GHG emission intensity, other sources
	2000, g CO_2 per 1995 US$ using PPPs				Percentage change 1990-2000			
Australia	1 061	360	159	542	–1.82	–0.46	–1.52	–2.70
Austria	403	66	96	241	–2.05	–3.20	–0.02	–2.42
Belgium	600	105	97	398	–1.47	–1.27	–0.19	–1.81
Canada	888	156	183	549	–0.94	0.24	–0.85	–1.28
Czech Republic	1 082	468	100	514	–2.77	2.54	6.33	–6.58
Denmark	501	171	88	242	–2.38	–2.73	–0.84	–2.64
Finland	597	178	99	321	–2.56	–0.17	–1.83	–3.84
France	402	30	102	271	–2.00	–2.60	–0.02	–2.57
Germany	519	168	91	260	–3.92	–3.57	–1.05	–4.95
Greece	819	275	122	422	–0.16	0.07	–0.02	–0.34
Hungary	747	192	79	476	–2.60	–1.30	–0.24	–3.40
Iceland	398	0	84	314	–1.82	. .	–2.47	. .
Ireland	643	152	98	392	–4.63	–2.97	0.23	–6.03
Italy	432	108	89	235	–1.06	–0.43	0.01	–1.70
Japan	441	132	81	229	–0.34	0.13	0.89	–0.99
Luxembourg	314	6	249	59	–12.47	–27.09	0.62	–23.13
Netherlands	553	138	80	335	–2.49	–0.95	–1.09	–3.34
New Zealand	1 078	82	179	817	–2.21	2.87	0.80	–3.12
Norway	454	3	97	354	–2.91	–1.57	–2.86	–2.93
Poland	1 109	458	74	576	–5.19	–6.48	–1.39	–4.46
Portugal	516	129	111	276	–0.06	0.85	3.47	–1.51
Slovakia	846	249	70	526	–5.21	0.98	1.98	–7.60
Spain	536	130	127	278	0.35	1.21	0.97	–0.28
Sweden	340	35	110	195	–1.91	–1.52	–0.77	–2.56
Switzerland	267	2	78	187	–0.94	–3.82	–0.40	–1.11
United Kingdom	512	137	106	268	–3.58	–4.30	–1.41	–3.94
United States	779	273	192	315	–1.86	–0.73	–1.30	–3.04
Total of above OECD countries	639	201	137	307	–1.81	–0.79	–0.58	–2.76
	CO_2 emissions				CO_2 emissions			
Non-Annex 1 countries								
Korea	679	232	134	. .	0.33	4.49	1.08	. .
Mexico	456	150	124	. .	–1.22	2.86	–1.88	. .
Turkey	488	178	84	. .	0.47	4.52	–1.26	. .

Source: Greenhouse gas emissions: national submissions to the UNFCCC and national publications. Carbon dioxide emissions for electricity and transport: IEA (2001). GDP: OECD, SNA database.

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Table 3.3. **Greenhouse gas emissions and sectoral indicators**

	Total GHG emissions		CO_2 emissions per Kwh electricity	Manufacturing CO_2 emissions per unit of output	Residential CO_2 emissions per unit of private consumption	Road transport CO_2 emissions per vehicle-kilometre	Electricity use per unit of GDP	Industrial output per unit of GDP
	Level million tonnes CO_2 equivalent	Annual average percentage change						
	2000	1990-2000	1990-2000	1990-2000[1]	1990-2000[2]	1990-1999	1990-2000	1990-2000[1]
Australia	502	1.7	0.1	–0.7	–1.1	–0.8	–0.6	–1.6
Austria	80	0.3	–2.2	–1.7	–2.4	–1.8	0.1	0.3
Belgium	152	0.7	–1.6	–0.2	–1.1	–0.8	–0.2	–0.5
Canada	726	1.8	1.0	–2.6	–2.0	–0.4	–0.5	1.0
Czech Republic	147	–2.7	–0.2	–7.7	–15.4	4.1	2.8	0.2
Denmark	69	–0.1	–3.4	–1.7	–4.0	–0.2	0.7	–0.6
Finland	74	–0.4	–0.9	–7.2	–7.0	–1.4	0.7	3.2
France	550	–0.2	–2.8	–2.4	–1.7	–0.5	0.6	0.3
Germany	991	–2.1	–1.3	–1.1	–4.0	0.7	–2.1	–1.8
Greece	130	2.2	–2.0	–0.4	2.6	–4.4	2.1	–1.7
Hungary	84	–1.8	–1.3	–12.7	5.4	–3.3	0.2	5.3
Iceland	3	0.7	4.9	. .	–7.7	0.3	2.6	. .
Ireland	67	2.2	–1.3	. .	–6.2	4.8	–1.8	. .
Italy	547	0.5	–1.2	–2.0	–1.4	–1.1	0.8	–0.2
Japan	1 386	1.1	–0.5	–0.8	0.1	0.3	1.0	–0.2
Luxembourg	6	–7.8	–24.5	–13.0	–2.3	3.8	–3.4	–2.2
Netherlands	218	0.4	–2.8	–1.8	–2.9	–0.1	1.8	–0.6
New Zealand	77	0.5	3.7	. .	–3.2	–2.1	–0.8	. .
Norway	55	0.6	0.5	0.8	–8.8	0.5	–1.9	–2.7

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Table 3.3. **Greenhouse gas emissions and sectoral indicators** *(cont.)*

	Total GHG emissions		CO_2 emissions per Kwh electricity	Manufacturing CO_2 emissions per unit of output	Residential CO_2 emissions per unit of private consumption	Road transport CO_2 emissions per vehicle-kilometre	Electricity use per unit of GDP	Industrial output per unit of GDP
	Level million tonnes CO_2 equivalent	Annual average percentage change						
	2000	1990-2000	1990-2000	1990-2000[1]	1990-2000[2]	1990-1999	1990-2000	1990-2000[1]
Poland	386	–1.7	0.5	–5.8	–6.7	–6.4	6.9	4.4
Portugal	85	2.7	–0.9	0.7	–1.0	–0.4	1.8	–0.6
Slovakia	49	–4.0	1.0	–4.7	–7.4	2.3	0.2	2.4
Spain	386	3.0	–0.2	–0.6	0.4	–0.3	1.2	–0.1
Sweden	69	–0.2	–2.3	–4.7	–4.1	–1.4	–0.5	2.5
Switzerland	53	–0.1	1.8	. .	–1.7	–0.3	1.1	. .
United Kingdom	649	–1.3	–4.1	–2.1	–1.9	–0.5	–0.7	–1.6
United States	7 001	1.3	–0.4	–4.0	–1.9	–0.2	–0.4	0.4
Total of above OECD countries	14 543	0.6	–0.7	–2.2	–1.8	–0.3	–0.2	0.0
OECD excluding US	7 542	–0.1	–1.0	–1.5	–1.7	–0.4	0.0	–0.3
EU countries	4 073	–0.3	–2.1	–1.8	–2.4	–0.4	–0.2	–0.7
	Total CO_2 emissions							
Other OECD countries								
Korea	444	6.5	–0.7	–2.3	–7.9	–4.3	5.2	2.0
Mexico	369	2.2	1.0	–6.9	–2.7	1.5	1.7	0.9
Turkey	206	4.1	0.2	1.2	–2.6	–5.0	4.3	0.4

1. 1991-2000 for Germany and Hungary; 1992-2000 for Poland; 1993-2000 for Slovakia; 1990-1999 for Portugal; no data for Iceland, Ireland, New Zealand and Switzerland.
2. 1991-1998 for Czech Republic; 1993-2000 for Slovakia.

Source: GHG National submissions to UNFCCC, national sources and UNFCCC; carbon dioxide data, IEA; industrial production, private consumption, OECD.

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3. Policies

The assessment of current greenhouse gas policies in the country reviews concluded that the current policy stance is imposing excessive costs on the economic pillar of sustainable development for a given cut in emissions, or, in other words, a much greater emission reduction could be obtained for the same cost to society. This resulted in policy recommendations for almost all the reviewed countries that would involve a fundamental change in policies in this area, generally calling for the substitution of current voluntary agreements and command-and-control approaches with environmental taxes or permit trading where such instruments can be readily applied. The recommendations are summarised in Table 3.4 and are further discussed below.

3.1. An overview

At present, climate-change polices are in a state of flux. Climate strategies have been prepared for most OECD countries, setting out the objectives that countries hope to achieve but with little quantification of costs or details of the precise instruments that are going to be used to achieve these goals. As the date for meeting these goals draws nearer, countries are laying out more of the detail of the required policies but uncertainty about whether the Kyoto Protocol will be ratified is growing, despite the arguably marked watering down of required emission cuts agreed at the Marrakech conference in 2001.

Almost all OECD countries have responded to their objectives with piecemeal climate policies, often relying on varied sectoral measures. This is the case in eighteen out of the twenty examined countries. The exceptions are Denmark, which decided to apply a single cap to all its abatement efforts, and New Zealand, which announced a climate-change policy based on taxing GHG emissions at a rate set in line with international permit prices. In other countries, the authorities have concentrated on different policies to abate emissions (Table 3.5).

3.2. Traditional policies

3.2.1. Voluntary agreements and energy audits

Voluntary agreements to reduce emissions have been the major plank of climate change policies in many of the countries surveyed, but they have generally been found to be ineffective or costly. Companies have lobbied intensively to promote the use of voluntary targets or accepted negotiated agreements, especially when they felt the alternative was a carbon tax or increased regulation. Negotiated agreements that allow industrial firms to avoid paying the full burden of a carbon tax (see below) have been concluded in France, Germany, the Netherlands, New Zealand and the United Kingdom.

Table 3.4. **Policy recommendations in Country Surveys**

	Austria	Czech Republic	Denmark	Finland	France	Greece	Hungary	Iceland	Ireland	Italy	Luxembourg	Netherlands	New Zealand	Norway	Poland	Slovak Republic	Spain	Switzerland	United Kingdom	United States
Plan to import international emission permits					X					X	X			X			X	X		
Price emissions from power plants (with taxes or permits)	X			X					X		X	X			X	X	X	X	X	X
and suppress carbon taxes on electricity use	X			X					X		X	X							X	
and re-consider restrictions on the use of nuclear reactors																	X			
and stop subsidising, or exempting from tax, coal and peat		X		X				X	X	X							X		X	
Improve the cost-effectiveness of the renewables part of the climate change strategy		X	X	X	X	X	X				X	X	X				X	X	X	
by scaling down support to wind power and					X	X	X				X	X							X	
by scaling down support to biomass		X	X									X							X	
by aligning incentives across sub-national levels of government																				X
Reduce support to combined heat and power (CHP) plants			X								X	X								
Put a single price on industry emissions with taxes or permits	X			X					X		X	X		X		X	X	X		X
and wind down exemptions granted to industry				X								X	X	X						
and end voluntary agreements with industry					X				X			X								
Use fuel pricing instead of regulations and standards to improve energy efficiency in the residential and service sectors.	X	X		X			X				X					X				
Begin building an infrastructure for emissions trading	X										X			X	X	X		X		X
and use the price of permits to prompt the same level of efforts in non-covered sectors,	X		X		X	X					X	X		X	X	X	X	X	X	X
by adjusting fuel tax rates accordingly	X		X			X					X	X		X			X	X	X	

Table 3.4. **Policy recommendations in Country Surveys** *(cont.)*

	Austria	Czech Republic	Denmark	Finland	France	Greece	Hungary	Iceland	Ireland	Italy	Luxembourg	Netherlands	New Zealand	Norway	Poland	Slovak Republic	Spain	Switzerland	United Kingdom	United States
and, more broadly, by replacing voluntary and regulatory measures with economic instruments that make emitters pay a price close to that of permits in the emissions trading scheme.					X	X					X									
Tax permits, unless they can be auctioned in the first place, and use revenues to reduce distortive taxes			X				X				X				X			X		
Scale down abatement efforts in the road transport sector	X				X					X	X							X		
Tax emissions from air and sea transport					X			X												
Create efficient incentives for carbon sequestration								X					X							
Use specific instruments to address objectives of social and regional policies instead of skewing GHG abatement efforts				X												X				

Table 3.5. **National climate change policies: a summary**

	Austria	Canada	Czech Republic	Denmark	Finland	France	Greece	Hungary	Iceland	Ireland	Italy	Luxembourg	Netherlands	New Zealand	Norway	Slovak Republic	Spain	Switzerland	United Kingdom	United States
Cap-and-trade emissions from large sources	P		P	X	P	P	P	P		P	P	P	P		P	P	P	P	X	
Tax energy use with a view to reducing CO_2 emissions				X	X					P			X	P	X				X	
Obtain voluntary commitments from industry		X				X	X			X			X	X				X	X	X
Improve energy efficiency	X	X	X			X		X			X	X				X				X
By subsidising the insulation of buildings	X	X						X				X								
By tightening efficiency and insulation standards						X		X			X									
By negotiating efficiency standards with carmakers	X	X		X	X	X	X			X	X	X	X				X		X	
By pricing energy in line with costs			X					X								X				
With energy audits				X	X															
Authorise utilities to build new nuclear reactors					X															X
Favour combined heat and power plants						X							X				X		X	X
Favour renewable sources of energy	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X
With guaranteed feed-in tariffs or price premiums	X		X	X		X	X			X		X	X			X		X		
With tax breaks					X								X							X
With investment subsidies					X		X	X						X		X				
With tradeable renewable certificates											X								X	
Contain CO_2 emissions from road transport	X					X			X		X				X					
Through road pricing																		X		
By taxing the purchase of new cars				X											X					
By subsidising rail and inland navigation	X					X					X				X					
By orientating urban planning towards higher density	X					X														
Increase forest cover								X	X					P			X			
Purchase foreign emission permits		P																		
Purchase of foreign, project-based emission credits	P			P							P		X				P			

Note: X indicates that the policy instrument is already implemented.
P denotes a plan to introduce such a measure.

European, Japanese and Korean car manufacturers have also signed voluntary agreements with the European Commission to pre-empt regulation (ACEA, JAMA and KAMA accords). Unilateral abatement pledges by firms constitute the central part of the climate policy change in the United States. In practice, voluntary agreements for environmental protection have often produced little demonstrable result, notably because the emission baseline presented by companies prior to the agreement is difficult to assess (O'Brien and Vourc'h, 2001 and OECD, 2003a). In addition, the costs of abatement efforts in voluntary agreements remain private information. This implies that abatement targets embedded in agreements may in effect correspond to trend (for example, in France and Germany) or, in other cases, be unduly costly, like the ACEA agreement which is estimated to implicitly price carbon dioxide at EUR 140 and EUR 250 per tonne for diesel and petrol cars respectively (OECD, 2003b). The lack of price mechanisms also means that marginal abatement costs can differ amongst participating firms and thus that efforts to reduce emissions are likely to be distributed inefficiently. The US voluntary registry may be somewhat more cost efficient because it certifies emission reductions in firms' unilateral pledges and enables them to trade in such verified reductions.

Policies designed to exploit perceived "no-cost" emission reduction options through voluntary energy efficiency audits have also played a role in government plans. Such policies take as given that there are energy-saving projects that would be profitable at normal rates of return but which entrepreneurs ignore due to various "barriers". The evidence from Denmark and the United States is that it is difficult to find such projects in the private sector. In Denmark, of over 7 000 energy audits undertaken in the private sector by a government agency, only 12 provided savings sufficient to cover the cost of the audit and the required equipment, even when the benefits included a credit for all reduced externalities (Larsen, 1999). Lack of information can be a barrier to uptake of energy saving projects but information is a commodity that specialised companies can be expected to exploit. Indeed, many service companies are specialised in managing energy use in enterprises. According to Lefevre (1996), the biggest gains from energy audits are to be found in the public sector.

In view of the disappointing experience with voluntary approaches, the surveys recommended that such instruments should not be employed in climate change policies. For Canada, France, Greece, Luxembourg, the Netherlands, Norway and Switzerland, it was specifically recommended to end voluntary agreements with industry as part of a strategy of putting a single price on industry emissions with taxes and permits or preparing the infrastructure for emission trading. The review of the United States also concluded that the current voluntary approach was a poor substitute for a cap-and-trade system.

3.2.2. Expanding renewable energy

Nearly all of the countries surveyed have introduced policies to foster renewable sources of energy, but such strategies have involved abatement costs that are usually far out of line with abatement costs in other programmes to reduce GHG emissions (Table 3.5). This policy has been pushed vigorously in the member countries of the European Union, where an indicative target has been set that 22 per cent of electricity production in 2010 should be based on renewables compared with 14 per cent at present. Several European countries have also expanded combined heat and power (CHP) plants with the aim of reducing GHG emissions. Both renewable and CHP sources remain costlier than fossil fuel- and nuclear-powered plants. Avoiding GHG emissions through generating electricity from wind, a policy option pursued in many countries, entails conceding a price premium of 180 per cent to renewable producers in member countries of the European Union and, as legislation ensures that electricity consumers bear the cost of this regulation, the wholesale electricity price may have been raised by 13 per cent in the area as a whole. The associated abatement cost for carbon dioxide saved is estimated at EUR 125 per tonne of carbon dioxide, with an overall cost to the EU economy of EUR 9.5 billion (0.1 per cent of GDP) (Table 3.6). Nevertheless, some support schemes have been more cost-effective than others. For instance, in Ireland competitive bidding for subsidies enabled the deployment of windmills at one of the lowest costs in the OECD area. However, competitive bidding and tradeable certificates only deliver low cost if the targets are kept within the expansion capabilities of the industry, allowing for the difficulties of establishing plants. When excessively ambitious targets are set, even competitive markets lead to high costs as in Italy and the United Kingdom. Equally, fixed buy-back prices for wind energy tend to be associated with very high costs, as is the case in Austria, Denmark, the Walloon region of Belgium, France, Germany and Portugal. However, in the case of Denmark, the costs were eventually judged to be excessive and the level of price support has been scaled back substantially. In general, from the standpoint of climate change policy, specific targets to expand the use of renewable sources appear to be less cost efficient than pricing emissions and letting market forces determine the appropriate energy mix.

Objectives unrelated to the aim of mitigating climate change are often invoked to justify support to renewables. They include reducing local air pollution, ensuring the security of energy supplies, raising employment levels and fostering innovation. However, although air quality benefits from using renewables vary depending on the energy source that is being displaced, they represent at most a fraction of the "excess" GHG abatement cost of this technology.[4] Moreover, as regards employment and innovation objectives, it is doubtful that special high support to one particular industry could constitute the most efficient means of attaining them.

Table 3.6. **Abatement costs of measures promoting renewable sources of energy**

	Biomass	Photovoltaic	Dams	Geothermic	Wind	Wind
	Euros per tonne of CO_2					Extra cost, per cent
Austria	341	1 454		114	134	212
Belgium						
Wallonia	63		125		125	168
Flanders	79	79	79		79	107
Czech Republic	64	153				
Denmark	149				91	174
Finland	20				52	89
France	86	328	155		154	264
Corsica		656				
Germany	195	1 217	118	163	167	264
Greece					60	62
Hungary					147	
Ireland	62		74		32	36
Italy	200	200	200	200	200	183
Luxembourg	63	1 265	63		63	100
Netherlands	87	87	87		87	103
Portugal	58	938	83		112	113
Spain	84	910	75		65	69
Sweden	25	25	25		73	121
United Kingdom	117	117	117	117	117	165
United States	39				39	48

Note: The extra cost column gives the difference between the price at which wind-based electricity is bought and the average wholesale price of electricity, in percentage terms. Abatement cost are calculated with the assumption that the displaced energy source is natural gas burnt in combined cycle turbines, because such plants represent the most profitable choice for additional investment in base or semi-base power generation.

Source: OECD estimates from data in country surveys and European Renewable Energy Federation (2003).

Given the high abatement cost of carbon-dioxide emissions through the build-up of renewable energy, the surveys recommended improved cost efficiency of such energy sources in 14 out of the 21 country reviews. The scaling down of support to wind power was recommended for France, Greece, Hungary, Italy, Luxembourg, the Netherlands and the United Kingdom. Similarly, reduced support for biomass energy was recommended for the Czech Republic, Denmark, the Netherlands and the United Kingdom. In the United States, it was judged important to align incentives across sub-national levels of government. In Finland, Spain and Switzerland, the recommendations in this area were more general, basically calling for lower incentives to expand renewable energy sources. Also, Denmark, Luxembourg and the Netherlands were encouraged to reduce support to CHP plants.

3.2.3. *Abatement policies in the transport sector*

Policies to reduce carbon-dioxide emissions from the road transport sector generally appear to have little effect and to entail relatively high costs. Even though the implicit tax on carbon is already much higher for diesel and petrol than for other fuels (Table 3.5), virtually all countries are implementing additional measures to curb emissions from vehicles. Measures to that end include taxing car purchases (Denmark, Greece, Norway, Portugal), financing investments in railways or waterways (Austria, France, Italy, Norway, Switzerland), subsidising biofuels (France, United States) and fuel cells (Iceland, United States). Although the costs are difficult to assess precisely for such measures, they are known to be quite high. For instance, the marginal cost of Austria's goal to reduce transport emissions from trend by one fifth has been estimated to exceed EUR 235 per tonne of carbon dioxide. In France, the climate strategy aims to reduce emissions from lorries by 10 per cent by rebalancing investment in rail and road, but the marginal cost of such a switch rises very quickly (MIES, 2000). Moreover, the surveys indicated that large price increases for private transport would be required to achieve modest absolute reductions in emissions in most countries, given that already high taxation meant that low-cost abatement methods had already been exploited. Again in France, the promotion of biofuels in road transport costs EUR 225 per tonne of carbon dioxide avoided. The use of high taxes on the purchase of new cars to discourage the use of private transport is difficult to assess since the sign of their effect on emissions is unclear. Indeed, such taxes may raise the average age of road vehicles because they penalise investment in new cars and delay reductions in air pollution (see Annex 4). Since fuel efficiency in the European member countries has improved since 1990 and is poised to increase even more before 2010, high purchase taxes might even result in higher emissions.

Specific recommendations for GHG abatement in transportation were confined to eight of the reviewed countries. Given the ambitious and costly abatement efforts in road transportation in Austria, France, Italy, Luxembourg and Switzerland, the scaling down of attempts to reduce emissions from vehicles was recommended for these countries. On the other hand, the surveys called for the stepping up of abatement efforts in road transportation in Greece, Iceland and the United States. For France and Iceland, it was recommended that policies should cut GHG emissions from air and sea transport, using taxes rather than regulatory measures and seeking the necessary degree of international co-operation.

3.2.4. *Measures to increase energy efficiency*

Measures to improve energy efficiency have brought contrasting results in terms of abatement costs, depending on whether they relied on reducing

below-cost pricing or on directly prompting specific investments. In transition countries, the surveys suggested that aligning energy prices to costs has reduced emissions while improving the allocation of resources in the economy (Czech Republic, Hungary, Slovakia). Inversely, regulatory measures and subsidies targeting specific means to save energy, such as investment in insulation, have proved a costly way of reducing CO_2 emissions in several OECD countries (Austria, Denmark, Italy, Spain, Switzerland), even reaching EUR 7 600 per tonne of carbon dioxide in Luxembourg. This lack of cost efficiency stems from the fact that energy efficiency was already high in these countries and that specific regulations, as well as subsidies directed at particular investments, are not needed for economic agents to identify least cost options to save energy.[5] To stimulate energy saving in a cost-efficient way, the economic surveys recommended the use of fuel pricing instead of regulations in Austria, the Czech Republic, Finland, Hungary, Luxembourg and the Slovak Republic.

3.3. Taxes and subsidies

3.3.1. The taxation of carbon emissions

Many OECD countries have altered their tax systems to place a cost on emissions but have fallen short of establishing efficient, consistent price signals. In countries which have introduced explicit carbon taxes, rates vary markedly across fuels (Table 3.7). In addition, large emission-intensive sectors, particularly in industry, have obtained reduced rates or tax breaks in all of these countries. Differences in actual rates distort the allocation of efforts to abate emissions and place unnecessary costs on the economies. Indeed, emissions of carbon dioxide constitute one of the few cases where external effects are proportional to the quantity of fossil fuels used and that can therefore be addressed with uniform fuel taxes.[6] Other external effects, such as emitting local atmospheric pollutants, contributing to congestion or deteriorating road infrastructure, can vary considerably in extent for the same amount of fuel burnt. The negative consequences from using fossil fuels other than emitting CO_2 are better dealt with by specific instruments (see Annex 4 on air pollution).

One of the most flagrant examples of tax differentiation is the gap between the excise on diesel and petrol fuel, as has been highlighted in the country surveys. Such differentials result in consumers gradually switching to diesel cars as the quality difference between models gradually shrinks. This switch involves considerable resource costs for the economy. Diesel engines cost, on average, in Europe almost EUR 1 100 more than their petrol counterpart and, over a typical lifetime, only generate pre-tax fuel savings of about one-third of that amount. The remaining differential can be seen as the

Table 3.7. **Rates of CO_2 taxation in OECD countries which introduced carbon taxes**

	Treatment of industry	Treatment of power generators	Electricity use		Coal	Natural gas	Fuel oil	Diesel	Petrol
	Industrial firms		Euros per MWh		Euros per tonne of CO_2			Euros per tonne of CO_2	
			Households	Industry				Cars	
Austria	Tax payments capped at 0.35 per cent of firm's net production value	Untaxed	15	0	0	19	25	110	181
Denmark	Lower rates in exchange for abatement agreements	Untaxed	97	11	Between 0.4 and 131			141	241
Finland	85 per cent refund if energy taxes exceed 3.7 per cent of value added	Untaxed	7.4	4.5	14.5	8.7	23	121	260
Germany	Carbon tax payments capped	Taxed[1]	21	12	0	17	20	179	289
Ireland	Likely to receive exemption	Undecided	0	0	Tentatively € 15 to 20			124	177
Netherlands	No tax on quantities above 10 GWh or 1 Mm^3 per year for electricity and gas respectively	Untaxed	64	0	–	80	66	136	281
New Zealand	Only emissions above negotiated targets are liable to the tax	Taxed	0	0	To be set in line with Kyoto permit prices			–	93
Norway	Special rates for:	Untaxed	12	0	20		36	156	251
	Metals processing				0				
	Domestic aviation and shipping						14		
	Fishing						0		
	Pulp and paper, fish processing						10		
	Off-shore activities					40	35		
Sweden	Reduced rates	Untaxed	11	0	78		104	132	227
	Industry				17		19		
United Kingdom[2]	Only 20 per cent of the climate levy if abatement targets are agreed to	Untaxed	0	4.8	5.5[3]	11	15	253	312

Note: All excise taxes on fuels are attributed to CO_2 unless they are adjusted to charge another pollutant in a direct fashion (*e.g.* sulphur in heating fuel for Norway).

1. At reduced rates.
2. The climate change levy applies only to businesses.
3. 0 for coal tailings.

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implied marginal abatement cost for a switch from petrol to diesel engines amounts to about EUR 120 per tCO_2 (Bates, 2001). At European prices for coal and gas, the same reduction in CO_2 could be obtained for one-quarter the cost by replacing coal power stations with gas-fired plants. Moreover, a change to diesel cars worsens air pollution because of the induced emission of particulates. Holding the level of air pollution constant, through the compulsory installation of a particulate filter, would raise the abatement cost even further, to EUR 370 per tCO_2.

3.3.2. The difficulties in applying uniform carbon tax rates

The main reason behind reduced rates and exemptions is the desire to preserve employment in certain activities, especially in energy-intensive industries that compete with foreign firms not subject to any carbon constraint. Since exempting some sectors implies more costly abatement efforts in the rest of the economy, it reduces welfare compared with uniform taxation. As noted in some of the country reviews, the exempted sectors are often those likely to have the lowest abatement costs, implying particularly high economy-wide costs of non-uniform carbon taxes. Moreover, the efficiency costs entailed by varying tax rates will grow over time as innovation efforts to reduce costs will concentrate in highly-taxed emitting activities which do not necessarily offer the most promising return for society. On the other hand, the taxation of emissions of sectors facing intense foreign competition will result in deteriorating competitiveness for those sectors, but this is an efficient way to cut domestic emissions. Global GHG emissions will be less affected due to the so-called "leakage", but with most trading partners now in the process of taking measures to contain releases of such gases, the replacement of domestic with foreign emissions is smaller at present than earlier. On the basis of such arguments, several country surveys hence recommended the unwinding of tax exemptions for heavy industry (Finland, Netherlands, Norway).

Regional and social policy objectives have also led to tax exemptions and subsidies for emitting activities. Fuel used to propel fishing boats is untaxed in Norway with the aim of preserving employment in coastal communities. Coal and natural gas used for home heating is not subject to taxation in the United Kingdom to avoid creating problems of "fuel poverty". The Czech Republic, Greece, Hungary and the Slovak Republic regulate energy prices for households below costs, or exempt them from certain energy taxes, because of the burden that prices based on full cost recovery would put on the poor.

Similar social or regional concerns led to the subsidisation of activities that entail high GHG emissions. Even though they have, or plan to have, carbon taxes, Finland and Ireland keep subsidising the use of peat – a fuel even more carbon intensive than coal – in power generation to maintain jobs

in remote areas. Pursued for social purposes, these subsidies impose high costs on the environmental and economic pillars of sustainable development. In some countries, progress has been made in re-orienting and reducing subsidies to fossil fuel industries. In Germany, for example, the coal subsidy has become a producer subsidy designed to keep local production competitive, rather than to boost consumption. It is in any case in the process of being reduced. In the United States, federal subsidies granted to fossil fuel industries fell by a quarter between 1992 and 1999 and amounted to only 0.8 per cent of the value of the output of these industries in 1999 (EIA, 2000). Most of these subsidies were in the form of wealth transfers rather than subsidies that affected relative prices (Sutherland, 2001).

Social and regional objectives could be better served by direct budgetary support that did not impinge on the environment. Although direct transfers may imply higher labour taxes and associated efficiency losses, these are likely to be much lower than the welfare costs of exemptions in most cases (Bovenberg and Goulder, 2000). Moreover, direct transfers bring the additional benefit of making the costs transparent. Against this background, the surveys of the Czech Republic, Greece, Hungary, the Slovak Republic and the United Kingdom suggested to establish full-cost pricing for households' energy consumption and to use direct income support to mitigate any undesirable social consequences. As for regional policy objectives, the review of Finland recommended that energy subsidies or tax breaks aimed at maintaining employment in isolated areas should be unwound and replaced by direct payments or different regional policy measures. Even if such transfers would still lock resources in less productive activities and impose a cost of society, the cost would be lower and more transparent.

3.4. *New developments: the trading of emission permits*

3.4.1. *The trading of carbon emission permits*

Although the international community has chosen to regulate GHG emissions by quantitative targets, at present only Denmark and the United Kingdom have cap-and-trade schemes up and running. Operating since 2001, Denmark's trading scheme applies to emissions from the electricity sector and includes a feature designed to avoid excessive price hikes. Firms can emit more than the amount of permits they hold simply by paying the authorities a fixed price of DKK 40 per tonne of CO_2 (EUR 5.45) on the excess. Prices averaged EUR 4 per tonne of carbon dioxide in 2001 and EUR 2.7 in 2002. In the United Kingdom, trade occurs amongst firms bound by emission targets of two different types: targets set in negotiation with the government in exchange for an 80 per cent reduction in the climate levy, and targets committed in exchange for government subsidies on the basis of an auction.

The only auction cleared with the government paying a subsidy of GBP 16 (EUR 23) per tonne of CO_2 saved. Companies can then meet these targets either by reducing their own emissions or by buying certified reduction from other companies. Permit prices averaged GBP 2.7 (EUR 3.8) per tonne of carbon dioxide in 2002, implying a net gain for companies that have commitments to reduce such emissions. A shortcoming in the UK trading scheme is that it does not include electricity generation despite the sector being emission intensive.

Carbon trading is poised to gain in scope and to reduce abatement costs in many OECD countries when a recently approved EU cap-and-trade scheme starts to operate in January 2005 (Box 3.2). By putting a single price on CO_2 emissions in the covered activities, the EU trading scheme will bring considerable cost savings compared to current climate change policies which result in varied marginal abatement costs. The bulk of cost reductions comes from including power generators in the scheme because marginal abatement costs vary considerably across EU countries in the electricity sector and CO_2 emissions from power plants remained largely un-priced in most national climate change strategies. The extent of the savings are difficult to assess, primarily because it is not clear what would have been the cost of alternative polices. As an example, assuming that EU countries would otherwise have applied their burden sharing targets uniformly to all sectors within their economies, Capros and Mantzos (2000) estimate that the emissions trading scheme will divide the total cost associated with attaining the Kyoto target for EU countries by three.

Restrictions on international trade are likely to limit the gains that could be made and will have no effect on the amount of GHG emissions. In particular, the emissions trading directive does not allow firms to tap into the supply of Kyoto permits that might be available in FSU countries which could help lower prices to an estimated EUR 5 per tonne of CO_2 (Blanchard *et al.*, 2002 and IEA, 2002). The EU scheme also includes a provision that may limit the import of project-based credits from outside the EU (see Box 3.2). Such restrictions will not reduce global emissions as permits can be sold to other buyers (such as Canada and Japan) or banked for subsequent periods.

The EU trading scheme covers 40 per cent of total emissions but could be widened to transport and residential uses. The scheme may be extended to cover more gases in 2008. It could also be expanded to cover emissions from small, diffuse sources such as vehicles and small boilers as found in commercial premises and homes. Monitoring the emissions of these emitters would be impractical. However, given that there is a fixed relationship between the fuel used and emissions, there are other more practical ways in which these sectors could be covered. Refineries (and imported refined fuels) could be brought into the system and given the duty to match sales to final users with allowances.

Box 3.2. **The EU trading scheme**

The directive establishing a scheme for greenhouse gas emission trading was issued in July 2003. The trading scheme starts in January 2005 and regulates emission of carbon dioxide (CO_2) from energy activities, production and processing of ferrous metals, the mineral industry and the pulp and paper industry for installations of a certain capacity. The trading scheme is obligatory, but member countries can apply for national adjustment and exclude some emission sources under certain circumstances for the period 2005-2007. Member countries can apply for including more activities in the trading scheme during the second period 2008-2012.

Each member state is to develop a national plan stating the total quantity of allowances that it intends to allocate for that period and how it proposes to distribute them. The directive obliges member states to allocate at least 95 per cent of first-period allowances for free. For the following five-year period beginning 1 January 2008, member states shall allocate at least 90 per cent of the allowances for free. These provisions in effect force EU countries to give away the scarcity rent created by the carbon constraint to past polluters.

The EU trading scheme may be connected to external cap-and-trade regimes. Countries outside the European Union which have ratified the Kyoto Protocol can link their own trading schemes to the EU one after a procedure leading to common recognition of the systems.

The EU trading scheme will be partially open to project-based overseas credits. The European Commission put forward a proposal of a specific directive in July 2003 to link the trading scheme with the project-based mechanisms foreseen by the Kyoto Protocol, joint implementation (JI) and clean development mechanism (CDM). Although the emission trading directive recognises the use of external non-EU credits as important to achieve the goals of both reducing GHG emissions globally and reducing compliance costs in the European Union, the proposed "linking" directive includes several restrictions on the use of such credits. First, the proposed directive does not allow companies to meet their targets by buying assigned amount units (AAUs), the main category of emission allowances created by the Kyoto protocol, from non-EU governments despite the large supply in FSU countries. This means that AAUs from Russia and the Ukraine cannot be imported into the European system, so keeping prices higher than they would otherwise be. Secondly, under the proposed "linking" directive, the European Commission would have the power to limit the quantity of JI and CDM credits imported in the EU trading scheme to 8 per cent of the total volume of allowances. Thirdly, the proposed "linking" directive rejects certain technological options for avoiding emissions or reducing GHG concentrations, such as nuclear power and afforestation, any associated credits being declared not eligible for conversion into EU allowances.

Carbon trading should also gain ground outside the European Union as Canada, Norway and Switzerland intend to run cap-and-trade schemes. The Norwegian plan would first establish a limited trading scheme in the period 2005-2007 and then supersede the existing carbon tax as from 2008 and also include non-CO_2 greenhouse gases. Norway's authorities mean to sell most of the permits, primarily by means of auctions, in the second stage of the scheme (2008-2012). A permit market is to cover Canada's heavy industry and power generation with a price cap of CAN$ 15 per tonne to keep abatement costs in check. In the United States, the infrastructure to support emission trading is being built up, but any decisions about further moves towards such a system will await a review in 2012.

More than half of all the reviewed countries received a recommendation in the country surveys to begin building or strengthening an infrastructure for emission trading (Austria, Canada, Denmark, France, Greece, Luxembourg, Netherlands, Norway, Slovak Republic, Spain, Switzerland, United Kingdom and the United States). Carbon trading in the European Union will allow France, Italy, Luxembourg, Spain and Switzerland to act on the recommendations given in the country reviews to import international emission permits.[7] As recommended in several surveys of current and acceding EU countries (Czech Republic, Denmark, France, Greece, Hungary, Italy, Luxembourg, United Kingdom), a widened EU trading scheme provides an opportunity to re-think some of the policies used to curb GHG emissions in the area, notably regarding renewable sources and fossil fuel taxation. As permits put a uniform price on CO_2 emissions, market forces will bring about a socially efficient mix of fuels in power generation, provided that other externalities (mainly releases of local atmospheric pollutants) are integrated in production costs through environmental taxes or specific trading schemes. Hence minimum target levels of the kind embedded in the EU renewables directive are either irrelevant for being below optimum or wasteful because they force investment in renewable plants that are not justified by the avoided emissions of GHG and local air pollutants. Similarly, there would be no need for carbon taxes on fossil fuels used in sectors covered by the directive. The EU trading scheme will put a uniform price on emissions where carbon taxes resulted in emission costs varying across sectors and fuels, provided that these taxes are abolished (Table 3.7).

3.4.2. The allocation of carbon emission permits

The EU emissions trading directive obliges the authorities to allocate most permits free of charge (see Box 3.2), and provides past polluters with large wind-fall gains. Producers would in most cases be able to shift the extra production cost associated with the permits into the price of the products and hence onto consumers. The only net loss for the producers would occur if the

demand for their product were to significantly fall in response to the higher price. It is estimated that compensation for this loss could justify the grandfathering of around 10 to 20 per cent of past emissions. The "excess" grandfathering in the EU system would accordingly amount to 70 to 80 per cent, which is a transfer of wealth from the government to the emitting industries. The auctioning of permits would have left the scarcity rent with the government, and would have allowed it to be used to reduce other distortionary taxes. Goulder (2002) found that the choice to grandfather can almost double the welfare cost of capping CO_2 emissions.[8] To allow national governments to retain some of the scarcity rent in the face of a requirement to grandfather the bulk of all the permits, the country reviews of the Czech Republic, Denmark, Hungary, Luxembourg and Switzerland recommended that the permits should be taxed.

The main reason behind the choice to grandfather allowances is the mistaken view that such a policy would preserve the competitiveness of emission-intensive industries. Certain industries such as steel, paper and pulp, aluminium and cement are part of markets where prices are set internationally in competition with companies that face no carbon constraint. But companies with allowances that were allocated on a free basis face exactly the same opportunity cost when emitting – equal to the market price of CO_2 – as if they had been obliged to buy the allowances. Therefore, competitiveness and employment in exposed industries will reach a level identical to what would occur with auctioning. In other words, grandfathering does compensate the owners of exposed firms but does not preserve jobs or activity. However, permits allocated free of charge may protect activity if they are conditional on keeping existing plants in business as is required by the UK national allocation plan for permits issued to implement the EU emissions trading directive. However, restrictions of this nature distort resource allocation by locking resources in less productive activities.

Notes

1. Climate change was one of three policy topics selected for the following countries: Austria, Czech Republic, Denmark, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Norway, Poland, Slovak Republic, Spain, Switzerland, Turkey, United Kingdom and United States.
2. This broadly corresponds to the Annex I countries in the Rio Convention.
3. Korea and Mexico took no quantitative target under the Kyoto Protocol, which both countries ratified. The United States and Australia signed but decided not to ratify the Kyoto Procol. Turkey did not sign nor ratify the Rio Convention. Hence, Turkey was not presented the Kyoto Protocol for signature nor ratification. But Turkey is now in the process of becoming a Party to the Rio Convention which is planned to be ratified by May 2004.

4. The review of Poland estimated the induced air quality benefits of avoiding the emission of one tonne of carbon dioxide from a typical coal power plant at EUR 17. However, in the same country, if the coal plant used state-of-the-art pollution scrubbers, the estimated air quality benefits would drop to EUR 1.8. Taking a longer view, were the plant to generate power using cost-efficient technology (such as combined-cycle gas turbines), avoiding one tonne of CO_2 would imply only EUR 0.7 in air quality benefits.
5. Another difficulty with using subsidies and regulations to improve energy efficiency is the so-called "rebound effect" by which lower unit costs of energy-based services translate into higher use, unless they are backed by higher fuel and electricity prices.
6. Sulphur oxides emissions from road vehicles are also directly proportional to the sulphur content of fuel, but the quantitative importance of this externality is very small (since low-sulphur motor fuels have become the norm) and is region-specific. Moreover, sulphur oxides emissions from other sources (such as ships and oil-fired power plants) are not proportional to the sulphur content of the fuel because technical options are available to scrub sulphur during the combustion process or at the end of pipe.
7. Even though not a member of the European Union, Switzerland has expressed interest in participating in the EU trading scheme.
8. Goulder's work was carried for the United States. The welfare loss of grandfathering is likely to be greater in Europe where the deadweight cost of taxation is higher.

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