

## EXECUTIVE SUMMARY

The fossil fuel extraction, transport and distribution sector comprises the exploration, transport and distribution of oil, natural gas and coal. Within the EU, the fossil fuel extraction, transport and distribution sector is an important source of methane, accounting for 20% of total methane emissions in 1990. This equals to about 2.3% of total greenhouse emissions in the EU in 1990. Between 1990 and 1995 (the latest year for which emissions data was available at the time of writing), emission from the fossil fuel extraction, transport and distribution sector fell by about 20%, due principally to decrease in production of hard coal.

In the oil and gas sector, methane emissions occur throughout system: during exploration, in production, at transport and distribution. From wellhead to end user, the gas moves through hundreds of valves, processing mechanisms, compressors, pipes, pressure-regulating stations and other equipment. Whenever the gas moves through valves and joints under high pressure, methane can escape to the atmosphere. In many cases, gas is vented to the atmosphere as part of normal operations. In coal mining, methane emissions occur along the entire supply chain from the mine up to the end-user. The vast majority of the emissions, however, come from gassy underground mines. In summary there are two main sources of emissions of methane in the fossil fuel extraction, transport and distribution sector:

- Methane emissions from fugitive sources, including distribution pipelines of natural gas;
- Methane emissions from mining of hard coal.

### **Description of the sector**

The total EU *oil* production amounted in 1990 to about 114 million tonnes. In 1998 the total production has increased to 159 million tonnes. The production of oil is estimated to grow until the year 2000 by 40%, compared to 1990. The *natural gas* production amounted in 1990 to about 5.6 EJ, gradually increasing to 7.5 EJ in 1998. Since 1971 world production of hard *coal* has grown at 2 to 2.5% per year until 1992 when production flattened out [IEA Statistics, UN]. Production in the European Union has declined sharply due to cheaper overseas coal. In 1998 the EU coal production amounted to about 5 EJ.

Table 1 gives an overview of the production of oil, natural gas and coal of the EU-15 Member States in 1990 and 1998.

Table 1. Production of oil, natural gas and coal in the EU [EC, 2000; BP-Amoco, 1999; Esso, 1999; Coal information 1995, 1996; EC, 1998]

	Oil production		Natural gas production		Coal production	
	1990	1998 <sup>1</sup>	1990	1998 <sup>1</sup>	1990	1998
	PJ <sup>2</sup>	PJ	PJ	PJ	PJ	PJ
Austria	50	38	46	<i>51</i>	-	14
Belgium	-	-	0.41	<i>0.01</i>	-	11
Denmark	251	544	117	285	-	-
Finland	-	-	-	-	-	86
France	126	80	101	89	327	147
Germany	151	121	599	636	5078	2568
Greece	35	20	6	2	297	348
Ireland	-	-	79	<i>80</i>	-	49
Italy	196	248	653	703	-	3
Netherlands	167	113	2282	2395	-	-
Spain	33	15	53	7	683	503
Sweden	0.12	-	-	-	-	-
United Kingdom	3836	5553	1717	3404	2363	1052
<b>EU</b>	<b>4845</b>	<b>6732</b>	<b>5654</b>	<b>7652</b>	<b>8749</b>	<b>4669</b>

<sup>1</sup>Numbers in *italic* refer to production rates in 1997.

### Frozen technology reference case

The emission reduction potential for 2010 is calculated using an emission reference level based on frozen technology development. The frozen technology reference level is based on change in physical activity assuming no improvement in reducing greenhouse gas emissions from the activity. The activity levels (production and distribution of coal, oil and natural gas) of 1990 and for 2010 are taken from the Primes model [Primes, 1999]. Any application of emission reduction measures after 1990 is therefore not taken into account in the frozen technology reference level, but considered in the potential of the emission reduction options.

### Summary of emission reduction options

Emission reduction options in the oil and gas sector minimise emissions from associated gas, process vents and flares, engines, turbines, compressors and pumps, system upsets, and transmission and distribution activities. In coal production emission reduction options are directly related to minimising methane emissions associated with mining activities. Table 2 gives an overview of the investment costs, the yearly costs (sum of operation and maintenance costs and savings), average specific mitigation costs and potential for options applicable in the fossil fuel extraction, transport and distribution sector. The specific costs are calculated using a real interest rate of 4% and using the lifetime of the option, i.e. equipment. The technical emission reduction potential of the identified options is estimated at 34 Mt of CO<sub>2</sub> equivalent. or about 55% of the total projected emissions in 2010.

**Table 2. EU15-average costs and total potential (Mt CO<sub>2</sub>) for emission reduction of methane options in the oil and gas and coal mining sectors (summary table).**

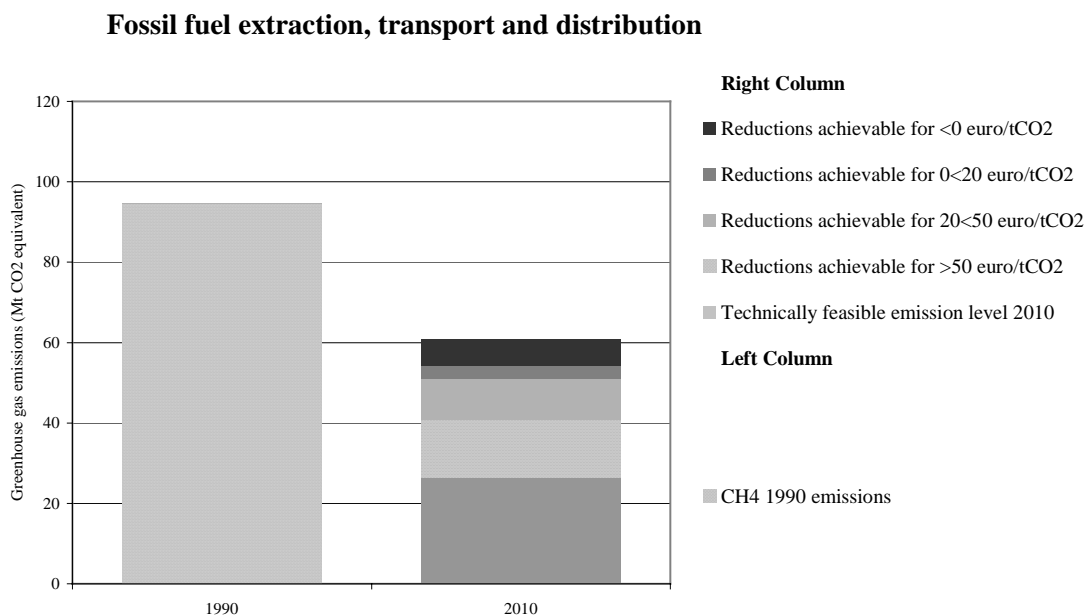
Pollutant: CH4 Measure Name	Subsector	Emission reduction	Investment	Yearly costs	Lifetime	Specific abatement costs
		Mt CO <sub>2</sub> eq.	euro/tCO <sub>2</sub> eq.	euro/tCO <sub>2</sub> eq.	year	euro/tCO <sub>2</sub> eq.
Various improvements of compressors	Compressors	0.4	0 .. 0.3	-4.0	1	-4
Inspection and maintenance - power equipment	Energy requirements	0.1	0	-3.5	1	-4
Increased gas utilisation	Process vents/flares	0.1	30	-4.1	15	-1
Coal mining degasification (low and medium recovery rate)	Coal mining	6	30 .. 40	-5 .. -4	15	-1
<b>Subtotal : Cost ranges for &lt; 0 euro /t CO<sub>2</sub></b>		<b>6.5</b>				
Coal mining degasification (medium recovery rate)	Coal mining	2	47	-4	15	0.1
Coal mining abatement from ventilation air	Coal mining	0.6	18	-0.2	15	1
Reducing flaring/venting emissions related to associated gas	Associated gas	0.2	30 .. 60	-3 .. 1	15	1 .. 3
Utilisation of process vents and other options	Various oil and gas	0.2	60 .. 145	-4 .. 7	15 .. 20	2 .. 18
<b>Subtotal : Cost ranges for 0 &lt; 20 euro /t CO<sub>2</sub></b>		<b>3</b>				
Offshore flaring instead of venting of process vents	Process vents/flares	0.1	179	5	15	21.4
Replacement grey cast iron network low	Fugitive emissions	10	952	-8.6	50	36
<b>Subtotal : Cost ranges for 20 &lt; 50 euro /t CO<sub>2</sub></b>		<b>10</b>				
Various options: compressors, associated gas, system updates	Various oil and gas	0.4	0 .. 900	10 .. 90	various	75 .. 90
Increasing the pipeline examination frequency	Fugitive emissions	4	0	77	1	77
Replacement grey cast iron network high	Fugitive emissions	10	1905	-9	50	80
<b>Subtotal : Cost range for &lt; 50 euro /t CO<sub>2</sub></b>		<b>14</b>				
<b>Total emission reduction potential</b>		<b>34</b>				

Note: Table 4.1 presents the complete list of options

**Table 3. Summary of methane emissions (Mt CO<sub>2</sub> equivalent)**

	1990	2010 reference	2010 with measures
<i>Coal production</i>	62	27	8
<i>Oil and gas sector</i>	33	34	19
<b>Total</b>	<b>95</b>	<b>61</b>	<b>27</b>

**Figure 1. Fossil fuel extraction, transport and distribution sector: 1990 base year direct emissions (left), 2010 frozen technology reference level and reduction potentials per cost bracket (right)**



### **Summary of emission levels and reduction potentials**

Table 3 summarises the frozen technology reference level in the fossil fuel extraction, transport and distribution sector and shows the position if all the measures in the table above were adopted. Figure 1 shows the share in emission reduction categorised in four costs brackets.