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Material use in the European Union 1980-2000: Indicators and analysis

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Table of Contents

Preface

Eurostat is actively developing environmental accounts linked to national accounts. In many areas of environmental accounting we have already developed frameworks and statistical manuals and published numerical results (see overleaf for a list of Eurostat publications in the field of environmental accounting).

Eurostat is working on **economy-wide material flow accounts and balances** as part of the work to develop environmental accounts. Economy-wide material flow accounts provide aggregate descriptions of the material flows through economies. Important indicators of material use and material efficiency can be derived from these accounts. The Statistical Offices of several Member States have already started to compile economy-wide material flow accounts and balances.

In March 2001, Eurostat published a guidebook entitled '***Economy-wide Material Flow Accounts and derived Indicators – A Methodological Guide'*** (Office for Official Publication of the European Communities, Luxembourg). This Guide provides a framework and practical recommendations for establishing material flow accounts and balances and for deriving a set of physical indicators for a whole economy. It offers harmonised terminology, concepts and a set of accounts and tables for implementation.

This Guide also offers help to compilers on the types of accounts to be implemented first, on data sources and methods and on the interpretation of the derived indicators. Compilers are encouraged to base their work on the concepts and classifications presented in the Guide.

This Working Paper presents the results of work undertaken by the Department of Social Ecology of the Institute for interdisciplinary studies of Austrian Universities (IFF) for the European Commission's Directorate General for the Environment and Eurostat. The Working Paper provides estimates of a set of material-related indicators for the EU-15 and per Member State for the period 1980-2000. The Working paper also documents the data sources and methods used for establishing the data set from which the indicators were derived.

The data set presented in this Working Paper is based on an initial estimate for 1980-1997 produced by the Wuppertal Institute for the Directorate General for the Environment and for Eurostat. Eurostat published this initial estimate in 2001 ('Material use indicators for the European Union, 1980-1997', Working Paper No. 2/2001/B/2). The new 1980-2000 data set is a revision, update and expansion of this initial estimate.

The work on economy-wide material flow accounts is continuing at Eurostat. The focus is on refining and regularly producing material flow data sets and indicators of resource use for EU-15 as well as advancing the interpretation of the indicators and the analytical uses of the accounts.

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statistics of own resources

Eurostat Environmental Accounting publications

Official publications *(available at http://europa.eu.int/eurostat.html)*

- Environmental Taxes in the EU 1980-1999 – Statistics in Focus Theme 2 – 29/2002
- SERIEE Environmental Protection Expenditure Accounts – Compilation Guide (2002)
- Natural Resource Accounts for Oil and Gas – 1980-2000 (2002)
- NAMEAs for air emissions – Results of Pilot Studies (2001)
- Environmental Taxes – A Statistical Guide (2001)
- Economy-wide Material Flow Accounts and derived Indicators – A Methodological Guide (2001)
- Accounts for Subsoil Assets – Results of Pilot Studies in European Countries (2000)
- Valuation of European Forests - Results of IEEAF Test Applications (2000)
- Environmental Taxes in the EU – Statistics in Focus Theme 2 – 20/2000
- European Handbook for Integrated Environmental and Economic Accounting for Forests – IEEAF (2000)
- Pilot Studies on NAMEAs for air emissions with a comparison at European level (1999)
- The Environmental Goods & Services Industry – Manual for data collection and analysis (OECD/Eurostat 1999)
- The European Framework for Integrated Environmental and Economic Accounting for Forests: Results of pilot applications (1999)
- From research to implementation: policy–driven methods for evaluating macro-economic environmental performance – proceedings from a workshop, Luxembourg 28-29 September 1998 (DG Research Report 1999/1)
- The European System for the Collection of Economic Information on the Environment – SERIEE 1994 Version (1994). Also available in DE, FR and ES.

Eurostat Working Papers *(available at http://forum.europa.eu.int/Public/irc/dsis/pnb/library)*

- Including chemical products in environmental accounts (2/2001/B/7)
- Water satellite accounts for Spain 1997-1999 (2/2001/B/6)
- Methods for estimating air emissions from the production of goods imported into the UK (2/2001/B/5)
- Towards a Typology of 'Environmentally Adjusted' National Sustainability Indicators (2/2001/B/4)
- Valuation of oil and gas reserves in the Netherlands (2/2001/B/3)
- Material use indicators for the European Union, 1980-1997 (2/2001/B/2)
- Uses of Environmental Accounts in Sweden (2/2001/B/1)
- Environment taxes and subsidies in the Danish NAMEA (2/2000/B/12)
- Environment taxes and environmentally harmful subsidies in Sweden (2/2000/B/11)
- The environment industry in Sweden, 2000 (2/2000/B/10)
- Material flow analysis in the framework of environmental economic accounting in Germany (2/2000/B/9)
- A materiel flow account for Italy, 1988 (2/2000/B/8)
- Environment employment in France, methodology and results 1996-1998 (2/2000/B/7)
- Material flow accounts - material balance and indicators, Austria 1960-1997 (2/2000/B/6)
- The environment industry in Sweden, 1999 (2/2000/B/5)
- Environment industry and Employment in Portugal, 1997 (2/2000/B/4)
- Environment-related employment in Netherlands, 1997 (2/2000/B/3)
- Material flows accounts – DMI and DMC for Sweden, 1987-1997 (2/2000/B/2)
- Material flows accounts - TMR, DMI and material balances, Finland 1980-1997 (2/2000/B/1)
- A material flow account for sand and gravel in Sweden (2/1999/B/4)
- The Environment Industry in Sweden (2/1999/B/3)
- Industrial Metabolism (2/1999/B/2)
- The Policy Relevance of Material Flow Accounts (2/1999/B/1)
- The Economy, Energy and Air Emissions (2/1998/B/2)
- Physical Input-Output Tables for Germany, 1990 (2/1998/B/1)
- An Estimate of Eco-Industries in the European Union 1994 (2/1997/B/1)

Eurostat internal publications

- Natural resource accounts and environmental Input-Output tables for Greece 1988-1998 (9/2000)
- Statistics on Environmental taxes and other economic instruments for environmental protection in EU Member States (11/1999)
- Material Flow Accounting – Experience of Statistical Institutes in Europe (12/1997)

PART I – RESULTS AND ANALYSIS

1. Introduction

Since the notion of sustainability began to gain influence in the environmental discourse a decade ago, the features of this discourse have changed remarkably. The focus moved from the output side of the production system to a complete understanding of the physical dimension of the economy. In this view, the economy was conceptualised as an activity, as a process of extracting materials from nature, transforming them, keeping them as society's stock for a certain amount of time and, at the end of the production-consumption chain, disposing of them again in nature. It has been recognised that environmental problems can arise at every step in this process. Furthermore, it has been understood that not only problematic substances but also problematic amounts of matter set in motion by society's activities result in environmental problems.

These insights have induced new approaches to environmental accounting, in particular material flow accounting, which focuses on the „physical economy“ in a comprehensive and integrative manner. Economy-wide material flow accounts (MFAs) are consistent compilations of the overall material throughput of economies. MFAs cover their focal subject completely and allow for extensive and flexible secondary analysis as well as for the compilation of aggregate summary indicators.

For some years now, Eurostat and the Member States have been developing economy-wide material flow accounts (German Federal Statistical Office 1995, 2000, Schandl at al. 2000, Gerhold et al. 2000, Muukkonen 2000, Isacsson et al. 2000, DETR/ONS/WI 2001). Two international co-operations on material flow accounting under the leadership of the World Resources Institute (Adriaanse et al. 1997, Matthews et al. 2000) and the publication in 2001 of „Economy-wide material flow accounts and derived indicators - a methodological guide“ (Eurostat 2001b) were major steps towards methodological harmonisation.

The European Environmental Agency (EEA) published first estimates of aggregate material indicators (TMR and DMI) for the EU in its indicator report „Environmental signals 2000“ (EEA 1999). The Wuppertal Institute produced a first estimate of aggregate material use in the EU covering the period 1980-1997 for Eurostat and DG Environment (Eurostat 2001a). The report „Environmental signals 2002 - Benchmarking the millennium“ (EEA 2002) includes data on TMR for 1980-1997. An indicator for material consumption is included in the 2001 UN CSD List of Sustainable Development Indicators.

The objectives of this report are:

(1) to present the results of the revised and updated 1980-2000 version of the initial 1980-1997 economy-wide material flow account for the European Union compiled by the Wuppertal Institute (Eurostat 2001a).

(2) to take a first step towards identifying factors that explain the differences and changes in material use at an aggregate as well as detailed level, cross-country and cross-time.

(3) to describe the data sources and procedures applied, and to explain and justify the revisions made.

The indicators for material use that were compiled include:

- Domestic extraction (DE): all materials (biomass, fossil fuels, minerals) extracted for use in a country,
- Direct material input (DMI): DE plus imported materials,
- Domestic material consumption (DMC): DMI less exported materials
- Physical trade balance (PTB): materials imported less materials exported (synonymous with net imports or net trade).

The key goal of this revision and update was to improve data quality and comparability for the indicators considered most important and most developed in terms of data quality and meaningfulness for policy at present. These are DMC, DMI, and PTB (see Eurostat 2001b). TMR (Total material requirement), DPO (domestic processed output), and NAS (net additions to stock) were not compiled for the new estimate.

2. Accounting methods and revisions

The initial 1980–1997 data set (Eurostat 2001a) has been updated to the year 2000 and partly revised or newly compiled, including some revisions of the historical time series[1]. The applied methods are compatible with the Eurostat methodological guide for economy-wide MFA (Eurostat 2001b). In the following we briefly summarise the accounting methods applied. For a detailed report of the data problems identified, the procedures applied, the revisions made and a detailed comparison between the revised and the initial estimate, please see Part II – Sources and methods.

Domestic extraction (DE)

Domestic extraction of biomass from arable land and permanent crops, including by-products and „grazing," was newly compiled for all countries except for the following countries, where comparable data from national material flow accounts (nMFAs) were already available: Austria (Schandl et al 2000, Gerhold and Petrovic 2000), UK (DETR/ONS/WI 2001, revised and updated by ONS 2002), and Finland (Muukkonen, 2000, updated 2000 by Ilmo Mäenpää, Mika Pirneskoski). In comparison to the initial data set, the main changes refer to an updated and revised primary data set from FAO (FAOSTAT 2001), new protocols to correct statistical breaks in the fodder categories of the primary FAO data set, new protocols to calculate „grazing", new coefficients to calculate used by-products not covered by FAO statistics, and revisions of national MFAs from Sweden (Isacsson et al. 2000) and Germany (German Federal Statistical Office 1995, 2000). Biomass DE from forestry and fishery was updated using the same protocol as in Eurostat 2001a. The main data source was the FAOSTAT 2001 CD-ROM.

For calculating DE of fossil fuels we used data from nMFAs for all countries and years available and data from the previous data set (Eurostat 2001a) for all other countries and all years available. Data for those years not covered by nMFAs and by the previous data set (Eurostat 2001a) were estimated according to the same protocol as in Eurostat 2001a, using the IEA-OECD Energy Statistics of OECD Countries CD-ROM, except for Austria, where we used national data sources.

DE minerals were updated according to the same protocol as in Eurostat 2001a, with USGS (United States Geological Survey; www.usgs.gov) and UN-ICSY (UN 1999) as data source. A number of specific revisions of the historical time series were made to correct for double counting (Spain), lack of data (Greece), and flaws in the primary data sets (wrong dimension, implausible estimates by USGS, and revisions by USGS). The latter correction for flaws in primary data sets applies to Italy, Ireland, Denmark, and Portugal. Data from nMFAs were used for all countries and years available. For those years not covered by nMFAs we estimated DE of minerals according to the above mentioned protocol and data sources and adjusted the level to the nMFAs.

Foreign trade

The compilation of imports and exports is based on data from the Eurostat database COMEXT (Eurostat 1992, 2001c), which contains all intra- and extra-EU trade data for each EU Member State following the HS-CN classification.

COMEXT covers only EU Member States. National foreign trade data from nMFAs were used as far as possible to cover the years prior to accession. As national data are not subdivided into intra- and extra-EU trade, we used the ratio of intra/extra EU trade of the year of accession to the EU for all years prior to accession. For Portugal and Spain 1980-1985, Greece 1980, Sweden 1980-1986, and the former GDR 1980-1990 we estimated foreign trade data using the ratio between the trade volume of the Member State and that of the EU as a whole in the year of accession. (The foreign trade estimate for the former GDR was not actually included in the data set due to the high uncertainties surrounding this estimate. For detail see Part II – Sources and methods.)

[1] An extension of the time series backwards was postponed, mainly due to the workload and costs associated with the compilation of physical import and export data for the years prior to accession (see Part II – Sources and methods, section 7).

Checks of the compiled data set for statistical breaks resulted in a number of specific corrections using alternative data sources. The breaks have been investigated and corrected on a four-digit level. Corrections of COMEXT data apply to the Netherlands for 1997-2000 based on information from the national statistical agency and the IEA-OECD, to Denmark for 1980-1990 based on IEA-OECD data, and to Ireland for 1991 and 1996 based on monetary trade data.

Aggregation

In contrast to the previous data set in the revised version, a disaggregation of the material flows into four categories (namely biomass, industrial minerals and ores, construction minerals, fossil fuels) had to be kept at the highest level of aggregation (i.e. DE, imports, exports, DMI, DMC, PTB). A consistent allocation of material flow data to either construction minerals or to industrial minerals and ores could be applied for DE, using the distinction proposed in Eurostat 2001a. For foreign trade however, a consistent allocation to either construction minerals or industrial minerals/ores was not possible on a two-digit level (i.e. 99 categories). As construction minerals have very low monetary values per unit of weight, they are usually extracted locally to minimise transport costs. Assuming that construction minerals in foreign trade flows are small, we allocated all mineral trade flows to the category industrial minerals and ores. This means that DMC and DMI values for industrial minerals and construction minerals taken separately are somewhat less reliable than DMC and DMI for the whole minerals category.

Integration of national MFAs

Major efforts were made to achieve a consistent integration of national MFAs into the data set: With the help of the Member States available MFAs from national statistical offices were checked for compatibility with the Eurostat guide and comparability with our estimates based on international databases. We discussed biomass accounting with the UK ONS, the German Federal Statistical Office, and the Swedish statistical office. The ONS updated and revised the UK MFA accounts including the grazing estimates. In the case of Germany we established a protocol to consistently attribute FAO categories to the corresponding categories in the German national statistics (BMELF 1993, 2000) and compiled an account of DE of biomass from FAO and BMLF (1993, 2000) for the years 1990-1999 in accordance with the German statistical office. This account is compatible to the nMFA of the German Federal Statistical Office (1995, 2000) and the Eurostat (2001b) guide. In addition we estimated 1980-1989 and 2000, based on UN, USGS, IEA/OECD, FAOSTAT 2001, COMEXT, and Eurostat 2001a. As the Swedish national MFA was compiled using a different method for the biomass account, we calculated DE of biomass for Sweden for the whole period of time according to a protocol consistent with that of other EU countries, based on data from FAOSTAT 2001. We extended all other categories for the time periods not covered by the Swedish national MFA, using the same procedures as the Swedish statistical office. For Finland we estimated only the year 2000, using UN, USGS, IEA/OECD etc. as data sources. We updated the Austrian nMFA for the years 1998-2000 using the same protocols and data sources as Statistics Austria.

Impacts of the revisions

These revisions had a substantial impact on the levels of key indicators and a minor impact on the trends. The differences between the revised and initial data set are summarised in Table 1 for the year 1997 (the last year of the initial estimate – see Eurostat 2001a). The most substantial revisions refer to Ireland, Spain, and Sweden, three countries with large fractions of biomass extraction compared to overall resource use.

Table 1: Comparison of DMC for 1997 according to the initial and the revised estimate

	Initial estimate (WI)			Revised estimate (IFF)			Difference in DMC in %
	million tonnes	ECU/kg	tonnes per capita	million tonnes	ECU/kg	tonnes per capita	
EU 15	7 025	0.98	18.82	5 810	1.18	15.56	-17%
Austria	158	1.18	19.58	154	1.21	19.05	-3%
Belgium, Luxembourg	193	1.23	18.23	182	1.30	17.20	-6%
Denmark	145	1.00	27.49	130	1.12	24.66	-10%
Finland	182	0.60	35.46	173	0.63	33.63	-5%
France	1 062	1.15	18.27	881	1.39	15.16	-17%
Germany	1 696	1.13	20.68	1 518	1.27	18.52	-10%
Greece	191	0.50	18.21	144	0.66	13.70	-25%
Ireland	147	0.41	40.25	85	0.71	23.32	-42%
Italy	791	1.09	13.77	695	1.25	12.09	-12%
Netherlands	240	1.41	15.42	225	1.51	14.47	-6%
Portugal	124	0.72	12.48	141	0.63	14.19	14%
Spain	868	0.55	22.08	577	0.83	14.68	-34%
Sweden	242	0.78	27.36	165	1.15	18.64	-32%
United Kingdom	925	1.00	15.70	712	1.29	12.10	-23%

3. Main results of the 1980-2000 estimate

3.1. Structural Features of the European Union

The European Union currently comprises 15 Member States[2], 9 of which were already members of the Union in 1980. The past two decades have seen three phases of accession: 1981 (Greece), 1986 (Portugal, Spain), and 1995 (Austria, Finland, Sweden). With the German reunification in 1990 the former GDR also became a part of the European Union. Table 2 and Figure 1 summarise main structural features of the EU and its Member States and compares them to Japan and the US. All figures refer to the year 2000.

[2] For data reasons, Luxembourg and Belgium are treated as one entity. Our analysis therefore considers only 14 separate countries. In the following analysis EU-15 refers to the aggregate of all current 15 Member States, regardless of the actual composition of the EU in the year in question.

Table 2: Structural parameters of EU-15, EU Member States, Japan and US, 2000

	Population	Area	GDP*	TPES**	Population density	GDP per capita	GDP/capita 1980-2000
	[1000]	[km²]	[billion euro]	[ktoe]	[capita per km²]	[euro per capita]	[% increase]
EU 15	376 462	3 242 601	7 502	1 444	116.1	19 928	47%
Austria	8 103	83 858	204	28	96.6	25 202	48%
Belgium, Luxembourg	10 675	33 114	262	62	322.4	24 540	49%
Denmark	5 330	43 094	157	20	123.7	29 475	41%
Finland	5 171	338 145	127	33	15.3	24 591	56%
France	58 749	551 500	1 356	255	106.5	23 078	40%
Germany	82 163	356 978	2 056	337	230.2	25 021	44%
Greece	10 554	131 957	106	27	80.0	10 069	22%
Ireland	3 777	70 273	82	14	53.7	21 593	169%
Italy	57 680	301 318	921	169	191.4	15 961	43%
Netherlands	15 864	41 526	380	74	382.0	23 964	48%
Portugal	10 178	91 982	100	24	110.7	9 786	72%
Spain	39 733	505 992	539	118	78.5	13 555	63%
Sweden	8 861	449 964	212	51	19.7	23 976	38%
United Kingdom	59 623	242 900	1 001	230	245.5	16 787	55%
Japan	126 919	377 829	4 342		335.9	34 212	58%
US	275 423	9 363 520	6 894		29.4	25 029	55%

*GDP is at constant 1995 prices
**TPES: Total Primary Energy Supply according to IEA Energy Balances refers to 1999
Sources: Eurostat New Cronos (Population EU, GDP, Area), OECD 2002a (Population JP, US); OECD 2002b (TPES),

In terms of area France is the largest country in the EU (551 500 km²), followed by Spain (505 992 km²) and Sweden (449 964 km²), Belgium is the smallest (30 528 km²). In 2000 Germany was the largest country in terms of population (82.2 mio), followed by the UK (59.6 mio), and France (58.7 mio). Ireland with a population of 3.8 mio is the smallest country. The most densely populated country in the EU is the Netherlands (382 capita/km²). With 15.3 capita/km² Finland is on the other end of the scale with respect to population density.

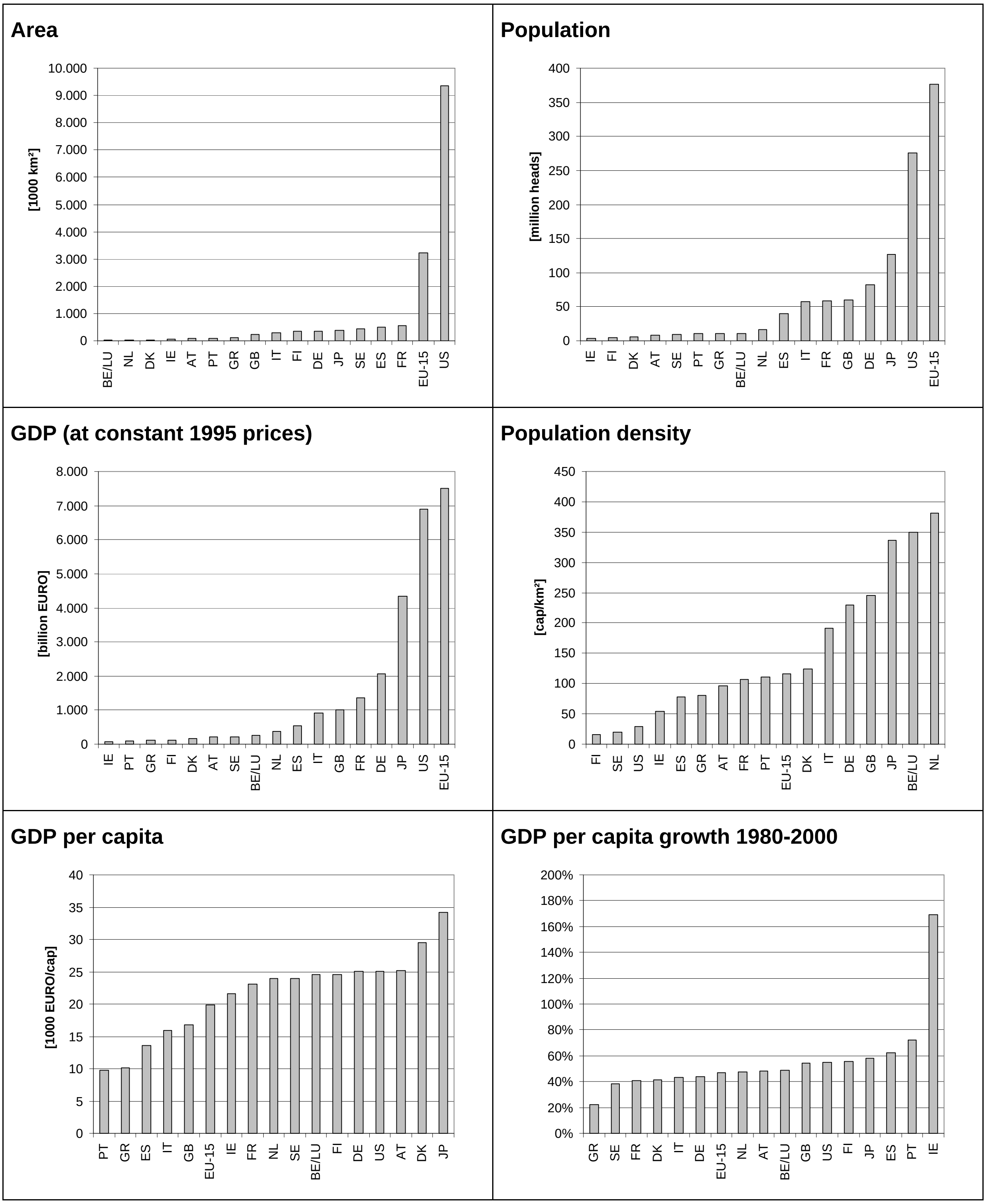
The volume of economic activity in absolute terms (measured as GDP) is largest in Germany (2 056 billion euro), followed by France (1 356 billion euro) and Italy (1 001 billion euro), and is smallest in Ireland (82 billion euro). Denmark was the Member State with the highest per capita GDP (29 475 euro per capita in 2000). Portugal is the country with the lowest per capita income (9 786 euro per capita in 2000).

The highest growth of per capita GDP from 1980 to 2000 could be observed in Ireland (169%). Greece had the lowest GDP/capita growth over the whole period (22%). In the same period total growth of population ranged from 2% in Italy to 13% in the Netherlands.

Japan and the US are, besides the EU, two of the largest and most influential economies at the global scale. A comparison of main structural parameters between the EU and Japan and the US reveals that in terms of total area the US is by far the largest of the three socio-economic systems. It is almost 3 times the size of the EU and 25 times the size of Japan, which covers about the territory of Germany. In terms of population, though, the EU is largest, its population being 1.3 times the size of the US and 3 times the size of Japan. Japan is therefore by far the most densely populated country (336 cap/km²), followed by the EU (116 cap/km²), while the US is rather sparsely populated (30 cap/km²). In terms of the volume of economic activity, the EU equals the US and is 1.7 times larger than Japan. Japan, with a per capita GDP of 34 212 euro, is significantly wealthier than both the US (24 496 euro per capita) and the EU (19 928 euro per capita). From 1980 to 2000 the United States had the fastest growing economy (real GDP growth of 88%), followed by Japan (72%) and the EU (56%).

The EU, the US, and Japan together cover an area of 13 mio km², have a population of 784 million inhabitants and produce a GDP of 18 738 billion euro.

Figure 1: Structural parameters of EU-15, EU Member States, Japan and the US, 2000



3.2. Main results: the European Union's resource use

Domestic Material Consumption (DMC) amounted to 5.9 billion tonnes and Domestic Material Input (DMI) to 6.3 billion tonnes in 2000 (see Table 3). In 2000 Germany had by far the largest share of total DMC_{EU-15} (25%), followed by France (15.3%), Italy (12.3%), the UK (11.7%) and Spain (11.3%). All other countries had a share of between 1.5% and 3%.

Table 3: Material flow parameters and indicators of the EU-15 countries, 2000.

	GDP	DE	Imports	DMI	Exports	DMC	PTB
	[billion euro]			[1000 t]			
EU 15	7 502	4 892 338	1 415 845	6 308 183	419 241	5 888 942	996 604
Austria	204	119 145	65 394	184 539	38 143	146 396	27 251
Belgium, Luxembourg	262	118 049	253 301	371 350	193 637	177 713	59 664
Denmark	157	119 234	44 959	164 194	43 238	120 955	1 721
Finland	127	164 995	53 856	218 851	34 984	183 867	18 871
France	1 356	761 731	338 973	1 100 704	199 873	900 831	139 100
Germany	2 056	1 231 254	506 130	1 737 384	273 524	1 463 860	232 606
Greece	106	137 936	52 985	190 921	23 309	167 612	29 676
Ireland	82	69 892	30 856	100 748	11 492	89 256	19 364
Italy	921	514 618	328 877	843 495	118 309	725 185	210 568
Netherlands	380	135 540	282 804	418 344	212 528	205 817	70 276
Portugal	100	109 725	50 639	160 365	15 452	144 913	35 188
Spain	539	538 580	221 005	759 585	94 870	664 716	126 136
Sweden	212	190 723	59 853	250 576	61 409	189 168	-1 556
United Kingdom	1 001	680 915	208 875	889 790	197 012	692 778	11 862

Source: New Cronos (GDP is in constant 1995 prices)

In terms of material consumption, the three most important countries of the EU-15 (Germany, France and Italy) together have a share of 52% of DMC_{EU-15} while they cover 37% of the territory of the EU, are inhabited by 53% of the population and produce 58% of the GDP of the EU.

Figures 2a and b compare the development of GDP and population with the development of DMC, DMI and material efficiency. The EU-15 showed a steady growth in population and GDP between 1980 and 2000: population grew by 6% from 355 to 376 million and GDP_{EU-15} grew by 55% from 4 808 to 7 502 billion euro (at constant 1995 prices). Negative growth in GDP occurred only from 1992 to 1993.

Figure 2a: Development of population and GDP, DMC, DMC per capita and material efficiency of DMC_{EU-15}, 1980 = 100%

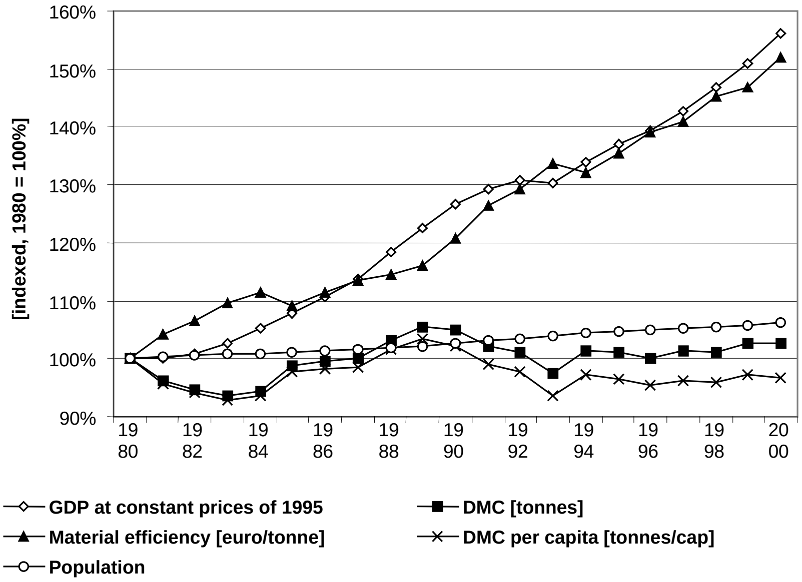
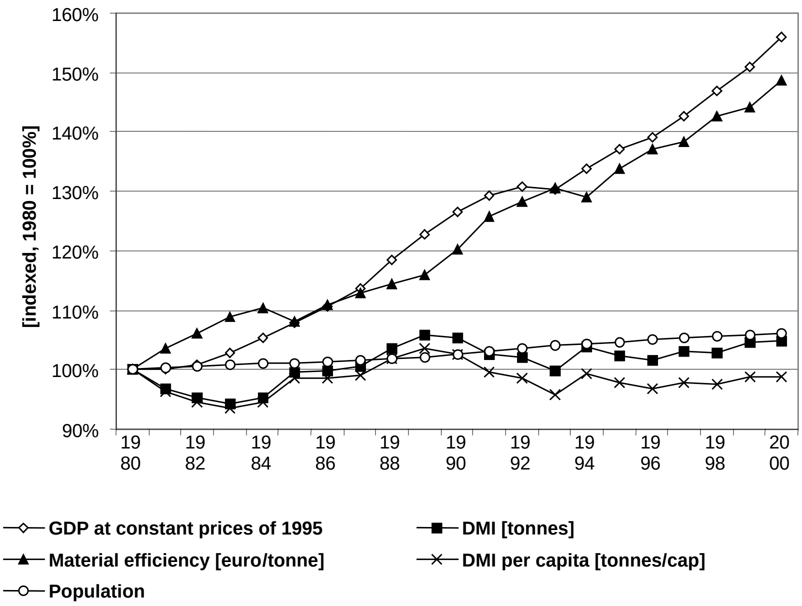


Figure 2b: Development of population and GDP, DMI, DMI per capita and material efficiency of DMI_{EU-15}, 1980 = 100%



DMC_{EU-15} (Figure 2a) and DMI_{EU-15} (Figure 2b) show a rather modest increase (of 2.7% and 5.0% respectively) between 1980 and 2000. Over the whole period the development of material use indicators does not show a homogenous trend. Using DMC trend as leading indicator[3], four phases can be distinguished: Phase 1: (1980-1983) characterised by constant decrease of DMC (total change –6.8%, average annual change rate: -2.1%), phase 2 (1983-1989): constant increase of DMC (total growth 11.2% average annual growth rate 2%), phase 3 (1989-1993): constant decrease of DMC (total change –8.2%, average annual change rate: -1.9%), phase 4 (1993-2000): decreases and increases alternate (total growth 5.1%, average annual change rate 0.7%). As a result DMC_{EU-15} in 2000 was similar to DMC_{EU-15} in 1980.

[3] Development trends and annual growth rates of DMI are very similar to those of DMC.

Table 4: Phases of development of DMC and GDP in the EU-15

	Phase 1 1980-1983	Phase 2 1983-1989	Phase 3 1989-1993	Phase 4 1993-2000
DMC				
total change in %	-6.8	11.2	-8.2	5.1
average annual change in %	-2.1	2.0	-1.9	0.75
range of annual change rate	-3.9 to -1.1	0.9 to 4.5	-0.6 to -3.6	-1.0 to 4.0
GDP				
total change in %	2.7	16.2	5.9	16.5
average annual change	0.9	2.8	1.9	2.2
range of annual change rate	0.12 to 1.8	2.4 to 4.2	-0.4 to 3.2	1.6 to 3.4

This pattern of DMC development seems to be closely linked to GDP development. Phase 1 covers a period of recovery from the late 1970ies recession and average annual GDP growth rate was beyond 1% in the period 1980-1983. From 1983 to 1989 annual GDP growth rate was constantly above 2.4%, average annual growth rate was at 2.8%. After 1989 annual GDP growth rates constantly declined from 3.4% in 1990 to –0.4% in 1993, the recession year. On average annual growth rate was below 2% in the period 1989-1993. The forth phase (1993-2000) was marked by a recovery from the 1993 recession and again a period of higher economic growth (average annual growth rate 1993-2000 above 2%).

Constant annual decrease in material consumption (i.e. exclusively negative annual growth rates over the whole period) only occurred in periods of average annual GDP growth rates below 2%, as in phase 1, a period of economic recovery and in phase 2, a period of economic downturn leading to the 1993 recession.

Increase in DMC only occurred in periods of higher economic growth. In phases 2 and 4 annual GDP growth rate never was below 1.6% and on average annual growth rate was above 2%. DMC constantly increased in phase 2 (annual growth rates between 0.9 and 4.5). Phase 4, which was marked by less pronounced economic growth rates as compared to phase 2, showed alternating negative and positive annual DMC growth rates and a total increase in DMC over the whole period of 5.1%.

Summarising, the data in Table 4 suggest a pattern of alternating periods of decreasing and increasing material consumption which mirror periods of slow economic growth or economic downturn and periods of higher economic growth respectively.

Overall, growth rates are much higher for GDP (average annual growth rate is 2.2% p.a.) than for DMC (average annual growth rate is 0.1% p.a.), resulting in a significant increase in material efficiency (ME)[4] at growth rates (average growth rate of ME_{DMC} of 2.1% p.a.) similar to the growth rates of GDP (cf. Figure 2). Over the whole period ME_{DMC} (Figure 2a) increased by 51.9% and ME_{DMI} (Figure 2b) by 48.6%. An absolute decrease in ME_{DMC} occurred only between 1984 and 1985 and between 1993 and 1994.

A comparison with the development of crude oil prices reveals that the phases of recession of DMC and DMI follow periods of surges in oil prices: Crude oil prices increased dramatically from 1979 to 1981 (Iranian revolution, Iran-Iraq War) and again from 1988 to 1990 (Gulf War).

Total domestic extraction of resources in the EU-15 ($DE_{EU\text{-}15}$) remained more or less constant between 1980 and 2000, varying slightly around the figure of 5 billion tonnes (Figure 3a). In 2000, construction minerals accounted for around 53% of total $DE_{EU\text{-}15}$, biomass for 29%, fossil fuels for 15%, and industrial minerals and ores for 3%. The respective share of these four main material categories in total DMC changed slightly

[4] Material efficiency is defined as GDP per unit of material use: ME_{DMC}=GDP/DMC or ME_{DMI}=GDP/DMI. The inverse value of material efficiency is referred to as material intensity (MI_{DMC} = DMC/GDP and MI_{DMI} = DMI/GDP).

between 1980 and 2000 (in 1980 the share of construction minerals of total DE was 51%, the respective numbers for biomass, industrial minerals/ores and fossil fuels were: 27%, 5%, and 17% respectively).

Over the whole period DE of fossils and industrial minerals decreased by 16 and 37% respectively. DE of biomass and DE of construction minerals increased in the same period by 8 and 4% respectively.

Table 5: Relative change of MFA parameters and indicators in EU-15 Member States, 1980-2000

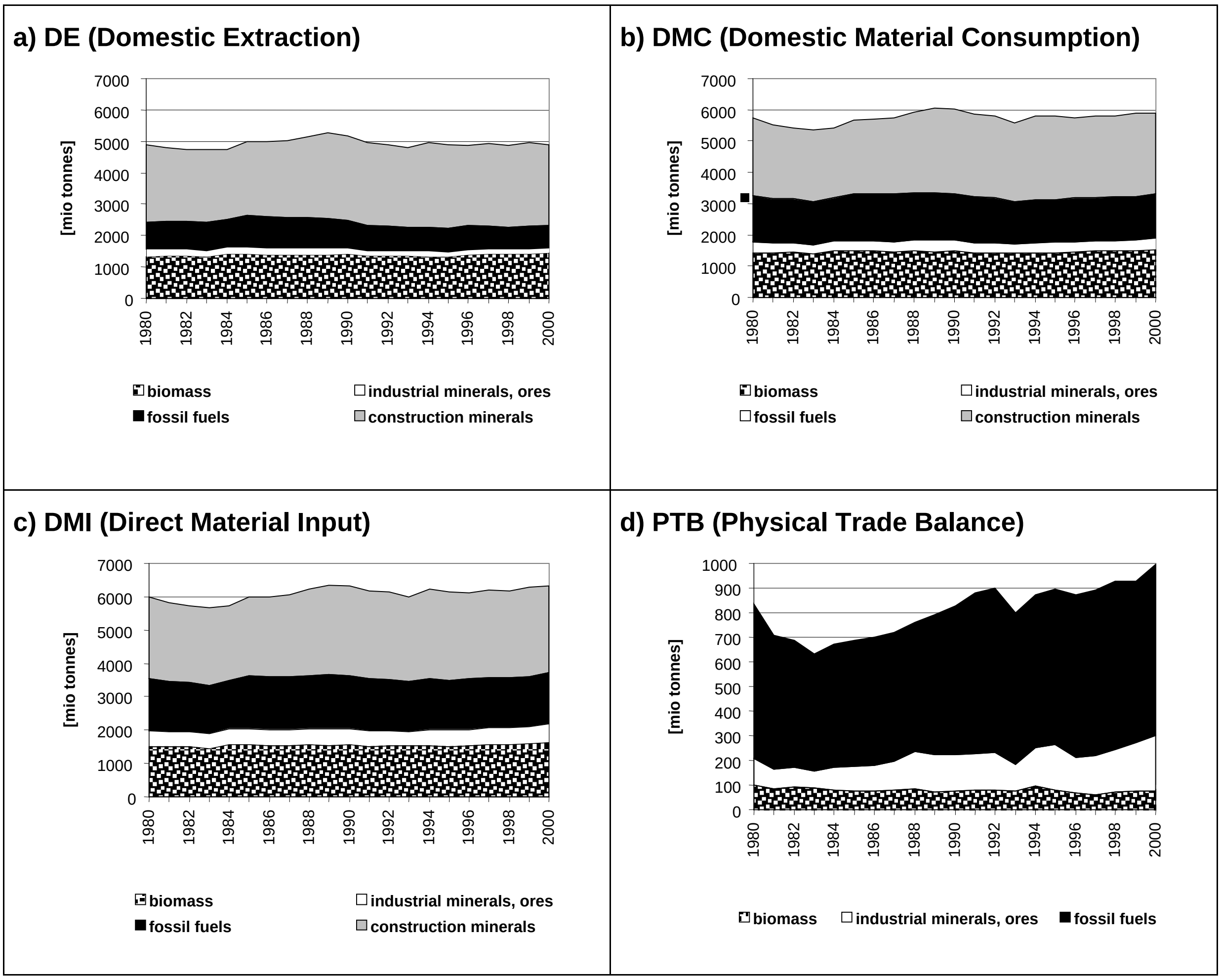
	DE	Imports	DMI	Exports	DMC	DMC per capita	DMI per capita	DMC/euro	DMI/euro
EU 15	0%	28%	5%	53%	3%	-3%	-1%	-34%	-33%
Austria	-2%	78%	17%	153%	2%	-5%	9%	-36%	-27%
Belgium, Luxembourg	13%	60%	41%	124%	1%	-4%	35%	-35%	-9%
Denmark	35%	12%	28%	237%	5%	1%	23%	-29%	-13%
Finland	7%	46%	14%	68%	8%	-1%	5%	-36%	-32%
France	-3%	19%	3%	51%	-4%	-12%	-6%	-38%	-33%
Germany	-14%	53%	-1%	75%	-9%	-13%	-6%	-40%	-35%
Greece	27%	223%	52%	80%	49%	35%	38%	11%	13%
Ireland	15%	92%	31%	124%	25%	12%	18%	-58%	-56%
Italy	-6%	45%	9%	119%	1%	-2%	6%	-31%	-26%
Netherlands	-20%	47%	16%	49%	-6%	-17%	3%	-43%	-30%
Portugal	23%	136%	45%	153%	39%	32%	38%	-23%	-20%
Spain	38%	117%	54%	112%	48%	39%	44%	-14%	-11%
Sweden	3%	33%	8%	85%	-4%	-10%	2%	-35%	-27%
United Kingdom	3%	50%	11%	96%	-1%	-7%	5%	-40%	-32%

Figure 3b shows that DMC_{EU-15} amounted to 5.9 billion tonnes in 2000. Construction minerals accounted for the largest share (44%), followed by biomass (26%), fossils (24%) and industrial minerals (6%). DMI exceeded DMC by 5-7% (trend increasing) and material composition of DMI was similar to DMC (Figures 3b and c).

While the level and structure of DE, DMC and DMI of the EU-15 has not changed dramatically from 1980 to 2000, physical foreign trade has increased significantly (see Figure 3d, 4a, and 4b). Although imports, and above all fossil fuel imports, decreased from 1980-1983 by 16%, they grew by 52% from 1983-2000 (Figure 4b). Currently imports amount to about 1.4 billion tonnes (Figure 4c), which corresponds to roughly 30% of the materials extracted domestically in the EU-15.

Exports grew by 53% from 1980 to 2000 (Figure 4b), but they amounted to 0.4 billion tonnes in 2000 and are thus considerably less than imports, which increased by 28%. Over the whole period imported materials exceeded exports by factors of four to five. Total growth of net imports over the period 1980 to 2000 was 19%. We see that the physical economy of the EU-15 is significantly dependent on net imports.

Figure 3: Development of material use indicators by material categories in the EU-15, 1980-2000: a) DE, b) DMC, c) DMI, d) PTB

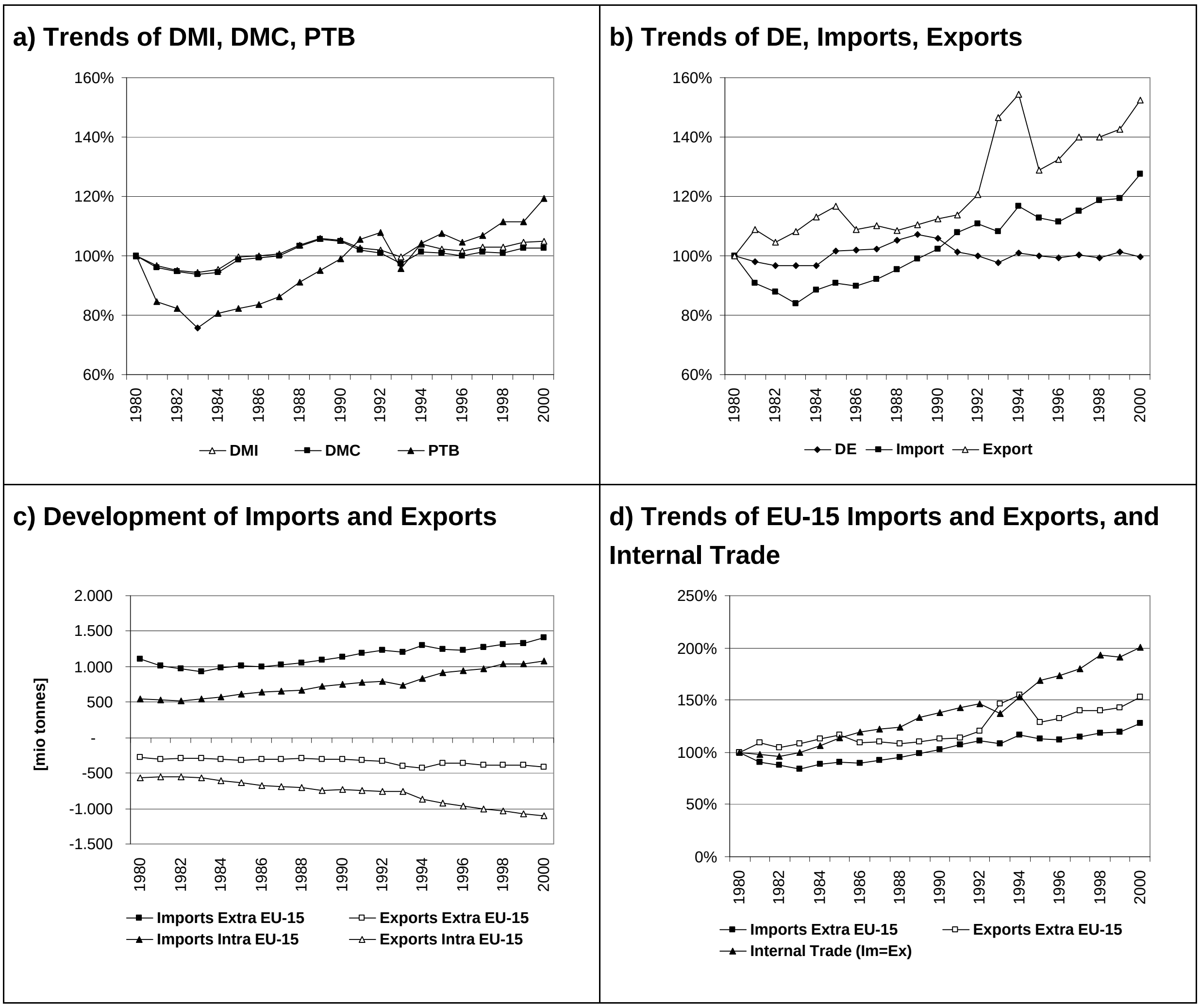


Physical Trade Balances (PTBs) measure the physical net trade. PTB is defined as imports minus exports. „Hence, a physical trade surplus (or net import of materials) occurs when imports exceed exports, and a physical trade deficit (or net export of materials) when exports exceed imports“ (Eurostat 2001b, p58).

The physical trade balance shows that the EU-15 is a net importer with respect to all three main material categories (see Figure 3d). In total, net imports amount to roughly 1 billion tonnes. Fossils account for the largest fraction of net imports (70% of total PTB), followed by industrial minerals (23%, trend increasing) and biomass (7%). Net imports decreased by 24% between 1980 and 1983 and have increased steadily since then by 58% (see Figure 4a), only interrupted by the 1993 recession.

Currently net imports account for 17% of total DMC_{EU-15}. Import dependency of DMC is largest for industrial minerals (61%) and fossil fuels (49%) while with respect to biomass it is only 5% (i.e., biomass „self sufficiency“ amounts to 95%). In general, the dependency of material consumption in the EU-15 on net imports is increasing; DE remains more or less constant (-0.2% from 1980-2000) while net imports increased by 19% during the whole period.

Figure 4: Trends in a) MFA-indicators (DMI, DMC, PTB) and b) parameters (DE, Import, Export), indexed (1980=100%). c) Development of trade within the EU-15 (intra-EU trade) and with non-EU-15 countries (extra-EU trade) and d) trends in trade (indexed, 1980=100%)



The Eurostat trade statistics allow us to differentiate between goods traded within EU-15 countries (intra-EU trade) and goods traded with non-EU countries (extra-EU trade). Figure 5d shows that intra-EU trade is growing significantly faster than trade with non-EU countries. Intra-EU trade has roughly doubled since 1980 and amounts to slightly over one billion tonnes,[5] while imports from non-EU countries have increased by 28% reaching the level of 1.4 billion tonnes in 2000 and exports by 53%, amounting to 0.4 billion tonnes in 2000 (see Figure 4c and 4d).

3.3. Comparing the EU-15 material use with that of Japan and the US

Only few consistent data sets are available for comparison with non-European countries. In the following section we compare the results for the EU-15 to material flow accounts for the US and Japan which were derived from two studies published by the World Resource Institute (Adriaanse et al., 1997; Matthews et al., 2000). Figure 5 compares the development (in absolute amounts) and the trends (indexed to 1980) of the indicators DMI/capita and material intensity of DMI (DMI/GDP) between the EU-15, Japan and the US.

[5] For trade within the EU-15 the amount of imports is equal to the amount of exports.

Figure 5: Comparison of material flow indicators in Japan, US and EU-15: a) DMI per capita, b) Trends in DMI per capita, c) Material intensity (DMI/GDP), d) Trends in material intensity

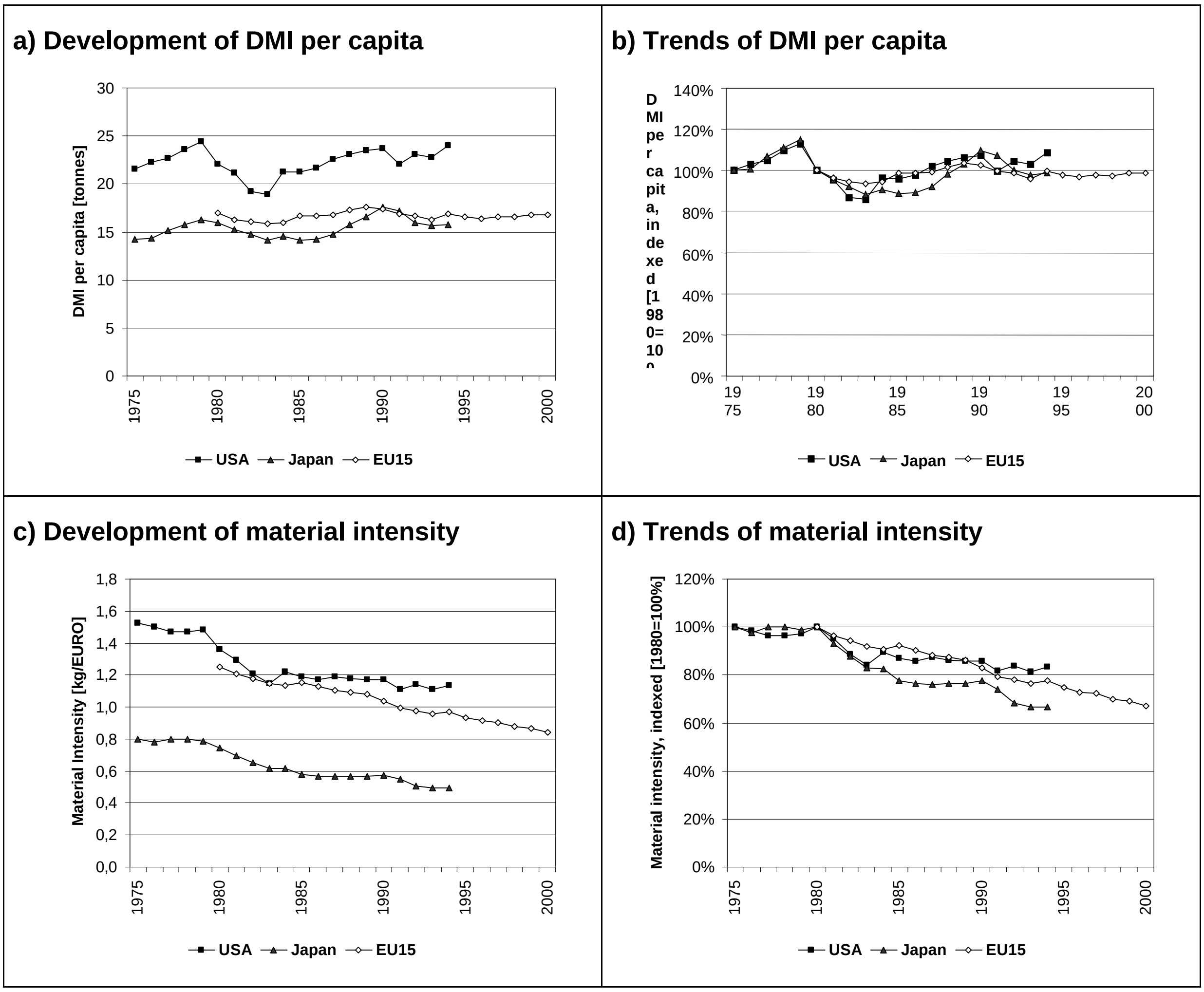
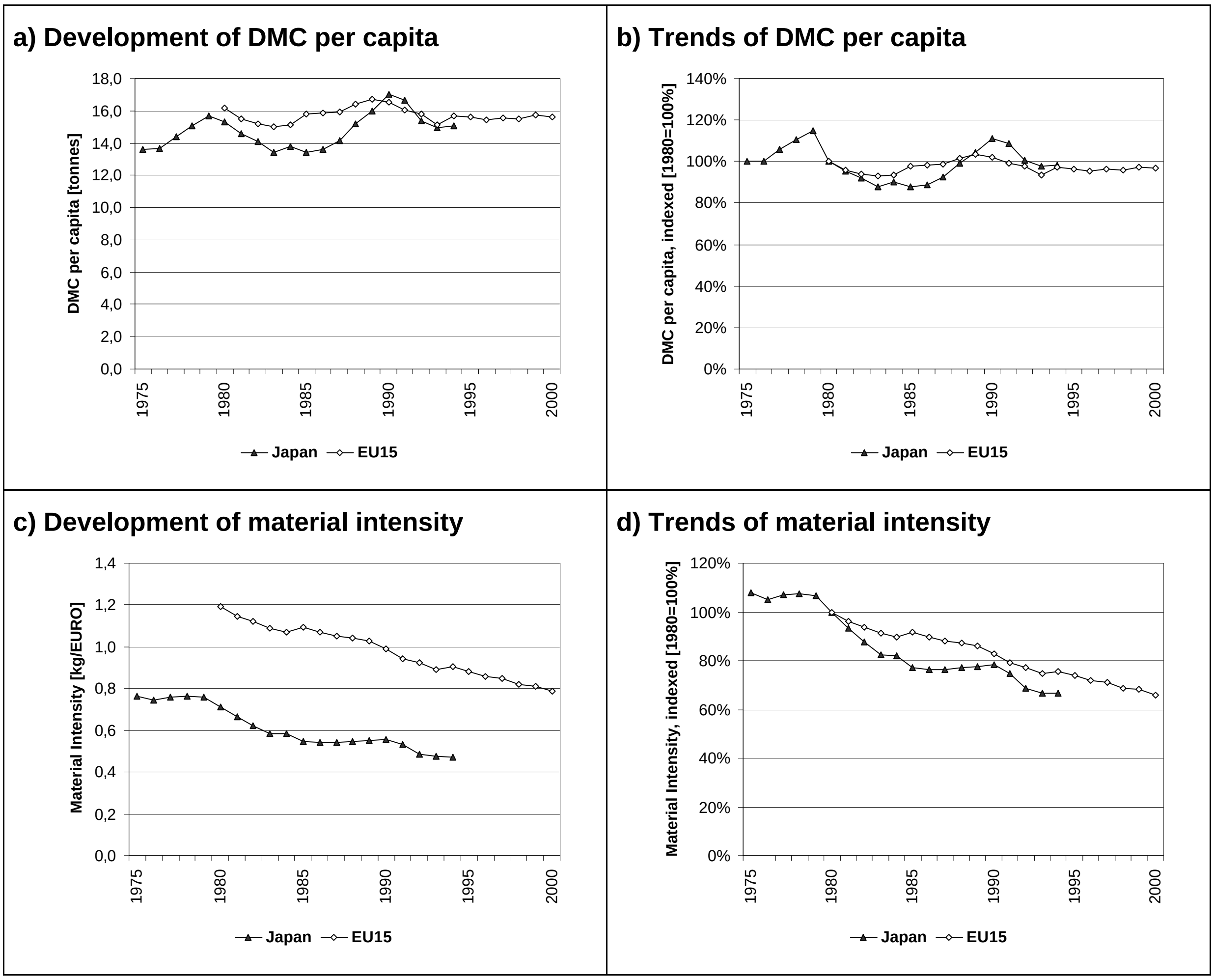


Figure 6 shows a similar comparison for the indicators DMC/capita and DMC/GDP between the EU-15 and Japan (DMC data for the US are not available).

Figure 6: Comparison of material flow indicators in Japan and EU-15: a) DMC per capita, b) Trends of DMC per capita, c) Material intensity (DMC/GDP) d) Trends of material intensity



Per capita values of DMI and DMC are of the same order of magnitude in the EU-15 and Japan while the US are characterised by significantly higher values. DMI_{US} per capita is 30-50% above the respective values for Japan and the EU-15. Interestingly, trends in the development of DMI (and DMC) show similar patterns in all three (or, two) countries. While the material use indicators for Japan and the US show a significant increase from 1975 to 1980, this upward trend came to an abrupt halt coinciding with the surge in oil prices in 1979. From 1980 to 1984 DMI and DMC decreased in all three countries at similar rates while in the mid-1980s this trend reversed and DMI and DMC increased until the beginning of the 1990s (again, this coincided with a significant increase in oil prices due to the Gulf War). Material intensity (MI, see Footnote 4) decreased significantly and at similar rates during the observed periods. MI_{DMC} decreased at annual rates of 2.1% in EU-15 and 2.5% in Japan while MI_{DMI} decreased by 2.0% in EU-15, 2.5% in Japan and 1.5% in the US.

4. Trends and patterns of resource use across Member States

The following section presents results in a comparative and more disaggregated way with the aim of gaining a first understanding of the factors that determine the level, the composition, and the trends in material use in the EU-15 countries. We begin with cross-country comparisons of the main aggregates which make up the MFA-derived indicators, i.e. domestic extraction, imports and exports. We then present and discuss levels and trends of DMC, DMI and PTB across the EU Member States. Finally, we will relate MFA-derived parameters and indicators to other biophysical parameters, in particular area and energy.

4.1. Domestic extraction

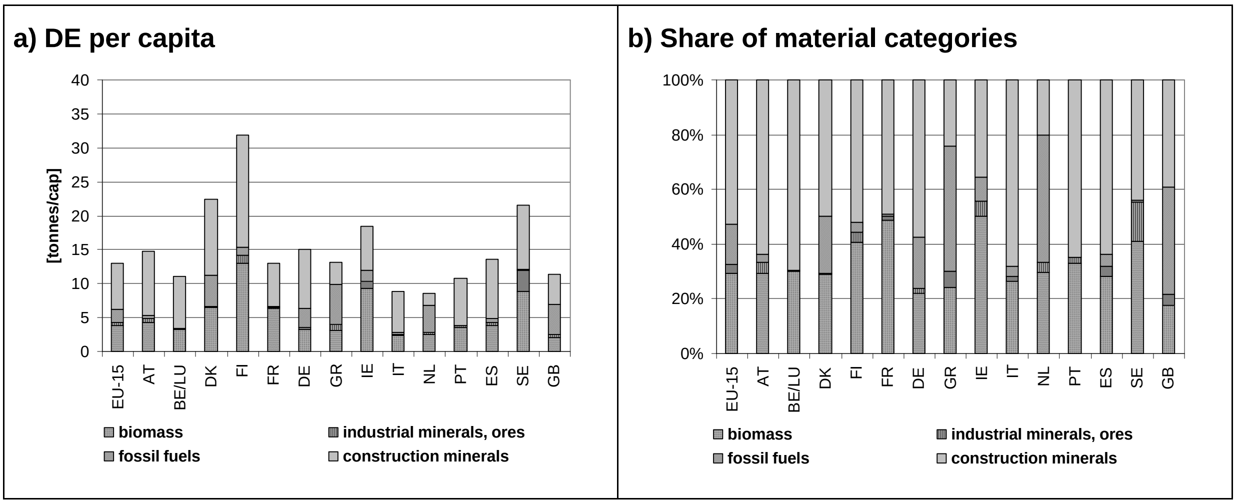
Figure 7 shows the domestic extraction per capita (7a) and the share of the main material categories (7b) of in the EU-15 countries in 2000. Per capita domestic extraction of the four main groups of materials (biomass, construction minerals, industrial minerals/ores, and fossil fuels) is summarised in Table 6. For the development of per capita DE in the Member States since 1980 see Figure 10.

Table 6: Domestic extraction per capita: main flows, 2000

	Domestic Extraction (DE) per capita	DE biomass per capita	DE construction minerals per capita	DE industrial minerals, ores per capita	DE fossil fuels per capita	DE per capita change 1980-2000
	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[%]
EU-15	13.0	3.8	6.9	0.4	1.9	-6.0%
Austria	14.7	4.3	9.4	0.6	0.5	-8.7%
Belgium, Luxembourg	11.1	3.3	7.7	0.05	0.0	8.4%
Denmark	22.4	6.4	11.1	0.2	4.6	29.7%
Finland	31.9	12.9	16.6	1.2	1.2	-1.5%
France	13.0	6.3	6.3	0.2	0.1	-11.3%
Germany	15.0	3.3	8.6	0.3	2.8	-18.2%
Greece	13.1	3.1	3.2	0.8	6.0	15.0%
Ireland	18.5	9.3	6.6	1.0	1.6	3.3%
Italy	8.9	2.4	6.1	0.2	0.3	-8.1%
Netherlands	8.5	2.5	1.7	0.3	4.0	-28.8%
Portugal	10.8	3.6	7.0	0.2	0.0	17.6%
Spain	13.6	3.8	8.6	0.5	0.6	29.1%
Sweden	21.5	8.8	9.5	3.1	0.2	-3.9%
United Kingdom	11.4	2.0	4.5	0.4	4.5	-2.8%

DE varies between 8.5 tonnes/capita in the Netherlands and 31.9 tonnes/capita in Finland. DE of biomass ranges from 2 to 13 tonnes/capita and contributes 18-30% to total DE in most countries except for Finland, France, Ireland, and Sweden, where the share of biomass is significantly higher (40-50%). While the high levels and shares of DE_{bio} in Finland and Sweden are due to wood harvest (8.0 and 5.3 tonnes/capita of wood), they are a result of grassland agriculture in Ireland (6.4 tonnes/capita hay etc.) and of cropland agriculture in Denmark and France (4.4 and 3.8 tonnes/capita of primary crops). The DE of industrial minerals and fossil fuels is small, ranging in most countries from 0.05 to 1.2 tonnes/capita and 0 to 3 tonnes/capita, respectively. Exceptions are Sweden, (iron mining, DE_{ind} of 3.1 tonnes/capita), Denmark (exploitation of North Sea oil and gas $DE_{fossils}$ of 4.6 tonnes/capita), Greece (lignite mining, $DE_{fossils}$ of 6.0 tonnes/capita), Netherlands (exploitation of North Sea oil and gas, $DE_{fossils}$ of 4.0 tonnes/capita) and the UK (exploitation of North Sea oil and gas, $DE_{fossils}$ of 4.5 tonnes/capita). Construction minerals contribute the largest part of total DE (more than 40% in most countries). Countries where construction minerals contribute less than 40% to DE are Greece (24%), Ireland (36%), the Netherlands (20%) and the UK (39%).

Figure 7: Domestic Extraction by material categories in tonnes/capita (7a) and share of material categories in total DE (7b), 2000



Only few countries show significant increases in total amounts of DE (see Table 5). Besides Denmark, where DE increased by 35% because of the growing exploitation of North Sea oil, the highest increases can be found in the low-income countries[6]. Greece increased DE by 27% mostly due to lignite mining, while rising DE in Ireland, Portugal and Spain (increases of 15%, 23%, and 38%, respectively) can be attributed mostly to growth in the DE of construction materials and biomass. Most of the other countries show a very modest increase (e.g., Sweden 3%, UK 3%) or even a reduction in DE. For example, Germany reduced its DE by 14% as a result of abandoning coal mines. Another example: the decreasing DE of construction materials resulted in a reduction of total DE by 20% in the Netherlands. Table 6 shows total change over the period 1980 to 2000 on a per capita level. Due to population growth decreases are more pronounced and increases less pronounced if measured on a per capita basis (compare Table 6 to Table 3).

These results indicate that domestic extraction is a variable, which with respect to its absolute level and structure is highly dependent upon the spatial distribution and regional availability of resources.[7] The regional availability of resources again depends with respect to biomass on factors like climate conditions and area (e.g., wood as is the case in Finland and Sweden), and with respect to fossils and minerals on geological preconditions (e.g., the UK's fossil fuels, Sweden's iron ores, or Greece's lignite and bauxite mines). In general, the interpretation and prediction of the level and structure of DE requires both an economic and a region-bound geomorphologic interpretation. The growth in DE in low-income countries and the rather modest increases or decreases of DE in many high-income countries indicate, however, that a) earlier stages of economic development are more closely linked to the extraction of domestic resources and that b) with rising income development occurs increasingly independently of DE.

[6] Within the EU we regard countries with a GDP per capita of less than 75% of the EU average as "low-income countries". This includes Greece, Spain and Portugal. Ireland also belongs to this group throughout the 1980s but changes its position in the 90s.

[7] Although, whether, to what extent and how these resources are exploited is, of course, influenced by economic and political decisions.

4.2. Imports, exports, and physical trade balances

Figure 8 shows that imports (8a) ranged from 3.5 to 10.4 tonnes/capita and that exports (8b) were below 5 tonnes/capita in most countries (see also Figure 10). Exports were, therefore, considerably lower than imports in all countries except Sweden, which exports large quantities of wood and minerals (iron ores). Belgium and the Netherlands were the only countries with both imports and exports significantly above average (23.7 tonnes/capita and 18.1 tonnes/capita, respectively, in Belgium and 17.8 tonnes/capita and 13.4 tonnes/capita in the Netherlands). The UK had the lowest level of imports (3.5 tonnes/capita) and Portugal had the lowest level of exports (1.5 tonnes/capita). In all EU countries imports and exports were significantly below DE values with the noteworthy exceptions of Belgium and the Netherlands, where imports were twice and exports 1.6 times the size of DE. This exceptional (compared to all other EU Member States) structure is due to the huge harbours Antwerp and Rotterdam which are the entry points of foreign trade not only for Belgium and the Netherlands but also for many other European Member States (the Rotterdam/Antwerp effect - see Eurostat 2001b). Table 7 shows that in most other countries the size of imports ranged from 31 to 64% and exports from 14 to 36% of DE in 2000. In 1980 the importance of DE was significantly higher compared to imports and exports: imports ranged from 15 to 45% and exports from 7 to 18% of DE. Figure 9 shows imports (9a) and exports (19b) by main material categories. The largest fraction of imports in most countries was fossil fuels, which accounted for 40 to 60% of total imports. The share of minerals ranged from 20-40% and that of biomass from 15-30%. All countries also exported significant quantities of all main material categories, but the shares of the various material categories differed for exports considerably more than they did for imports. The share of biomass in total exports ranged from 10% in the UK to 60% in Finland, while minerals ranged from 25-64% (Finland and Belgium) and fossil fuels from 8-61% (Austria and the UK).

Figure 8: Per capita imports (8a) and exports (8b), 2000

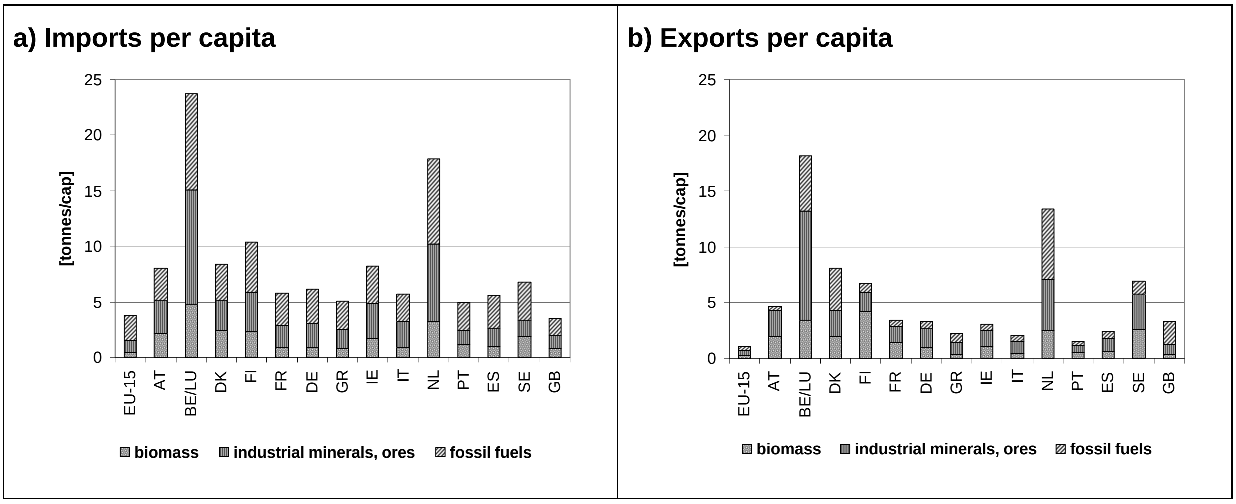


Figure 9: Share of material categories in total imports (9a) and exports (9b), 2000

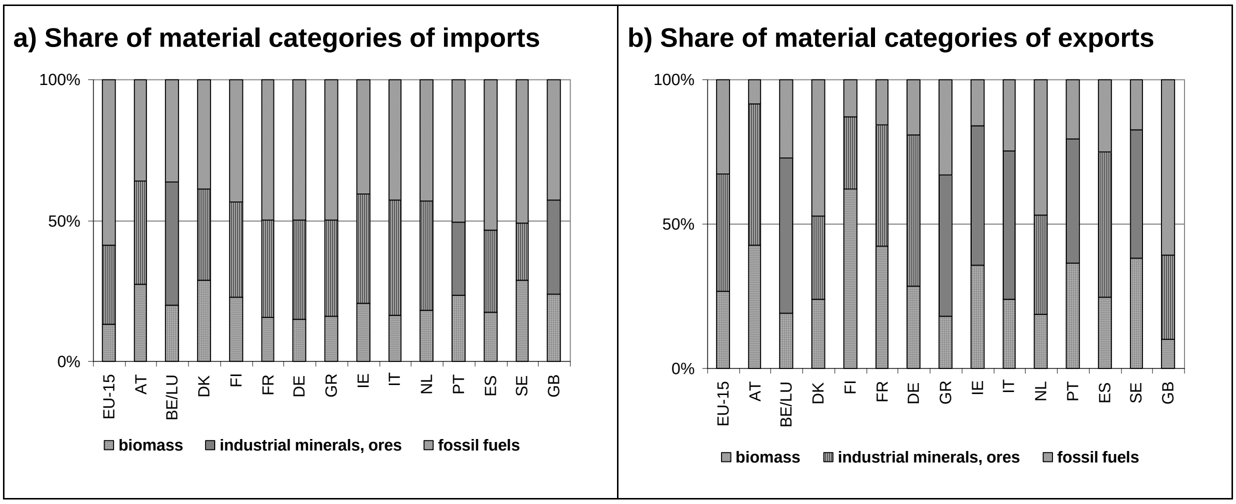
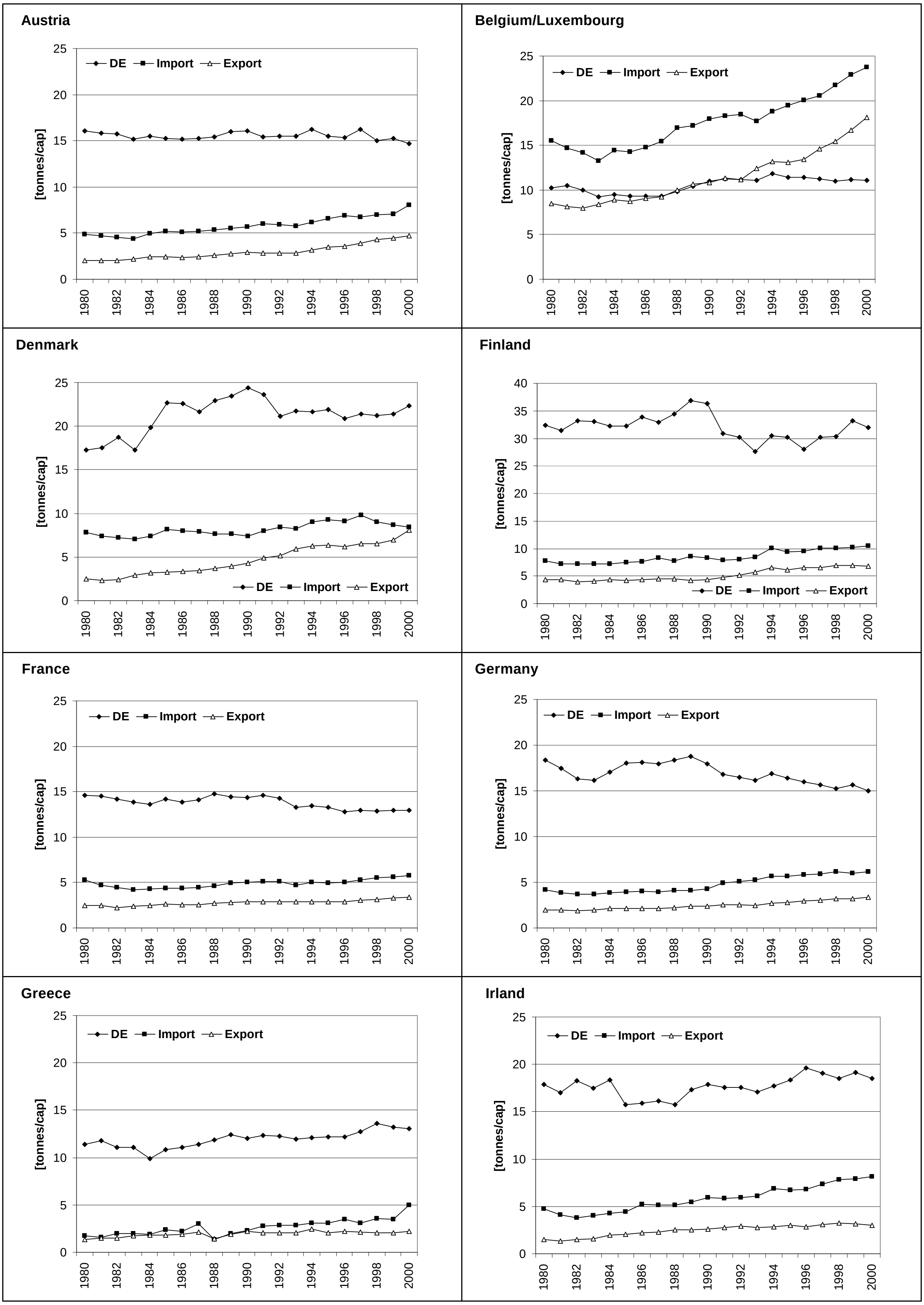


Table 7: Size of imports and exports in relation to domestic extraction (expressed as ratio to DE), EU-15 countries in 1980 and 2000

	1980		2000	
	Imports/DE	**Exports/DE**	**Imports/DE**	**Exports/DE**
EU-15	23%	6%	29%	9%
Austria	30%	12%	55%	32%
Belgium, Luxembourg	152%	83%	215%	164%
Denmark	45%	15%	38%	36%
Finland	24%	13%	33%	21%
France	36%	17%	45%	26%
Germany	23%	11%	41%	22%
Greece	15%	12%	38%	17%
Ireland	26%	8%	44%	16%
Italy	42%	10%	64%	23%
Netherlands	114%	84%	209%	157%
Portugal	45%	7%	46%	14%
Spain	26%	11%	41%	18%
Sweden	24%	18%	31%	32%
United Kingdom	21%	15%	31%	29%
Mean	43%	23%	66%	43%

In contrast to DE both imports and exports are highly dynamic variables (see Table 5 and Figure 10). They are increasing in all EU-15 countries by between 12% and 223% for imports and between 49% and 237% for exports. Imports more than doubled in countries with low per capita GDP in 1980 – Greece (223%), Portugal (136%), and Spain (117%) - but high-income countries also showed increases in imports of 50% and more (e.g. Austria 78% or Belgium 60%). Exports, however, increased fastest in high-income countries like Denmark (237%), Austria (153%), and Belgium (124%).

Figure 10: Development of MFA parameters per capita: Domestic Extraction (DE), Imports and Exports in EU-15 countries, 1980-2000



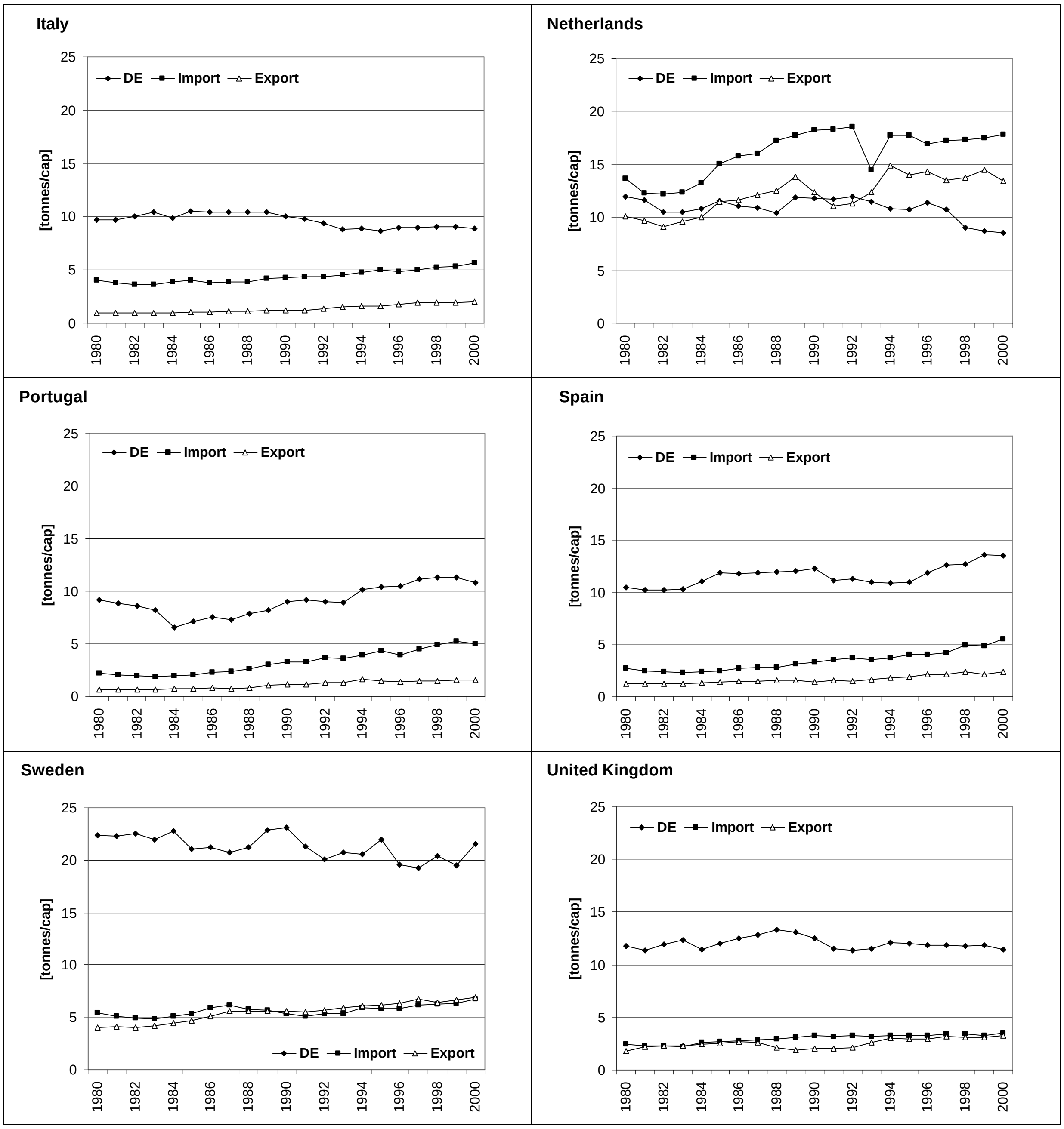

Italy
DE Import Export
[tonnes/cap]
Netherlands
DE Import Export
[tonnes/cap]
Portugal
DE Import Export
[tonnes/cap]
Spain
DE Import Export
[tonnes/cap]
Sweden
DE Import Export
[tonnes/cap]
United Kingdom
DE Import Export
[tonnes/cap]

Figure 11: Physical Trade Balance by material categories, 2000

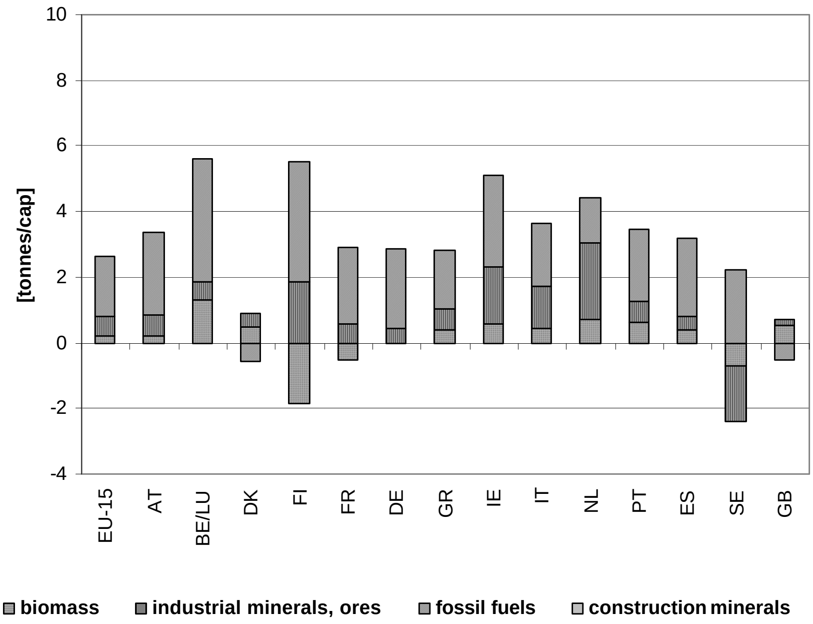


Figure 11 shows that all EU countries – except Sweden – have a positive physical trade balance, i.e. they are net importing countries in physical terms (see also Table 3 and Figure 12). Sweden is the only net exporting country (0.2 tonnes/capita) in the EU, which is due to its high exports of wood and minerals (iron ores) compared to its imports. Net imports per capita (Figure 11) are by far highest in Belgium (5.6 tonnes/capita), Ireland (5.1 tonnes/capita), and the Netherlands (4.4 tonnes/capita) and lowest in the UK (0.2 tonnes/capita) and Denmark (0.3 tonnes/capita).

Most countries are net importers with regard to all main material categories (Figure 10). Important exceptions are Finland (net exports of 1-2 tonnes/capita of biomass, especially wood), France (net exports of 0.5 tonnes/capita biomass), Greece (net exports of industrial minerals until 1998), Sweden (net exports of 1 tonne/capita of biomass and 1-2 tonnes/capita of industrial minerals), and the UK, which is the only net exporter (0.5 tonnes/capita) of fossil fuels in the EU.

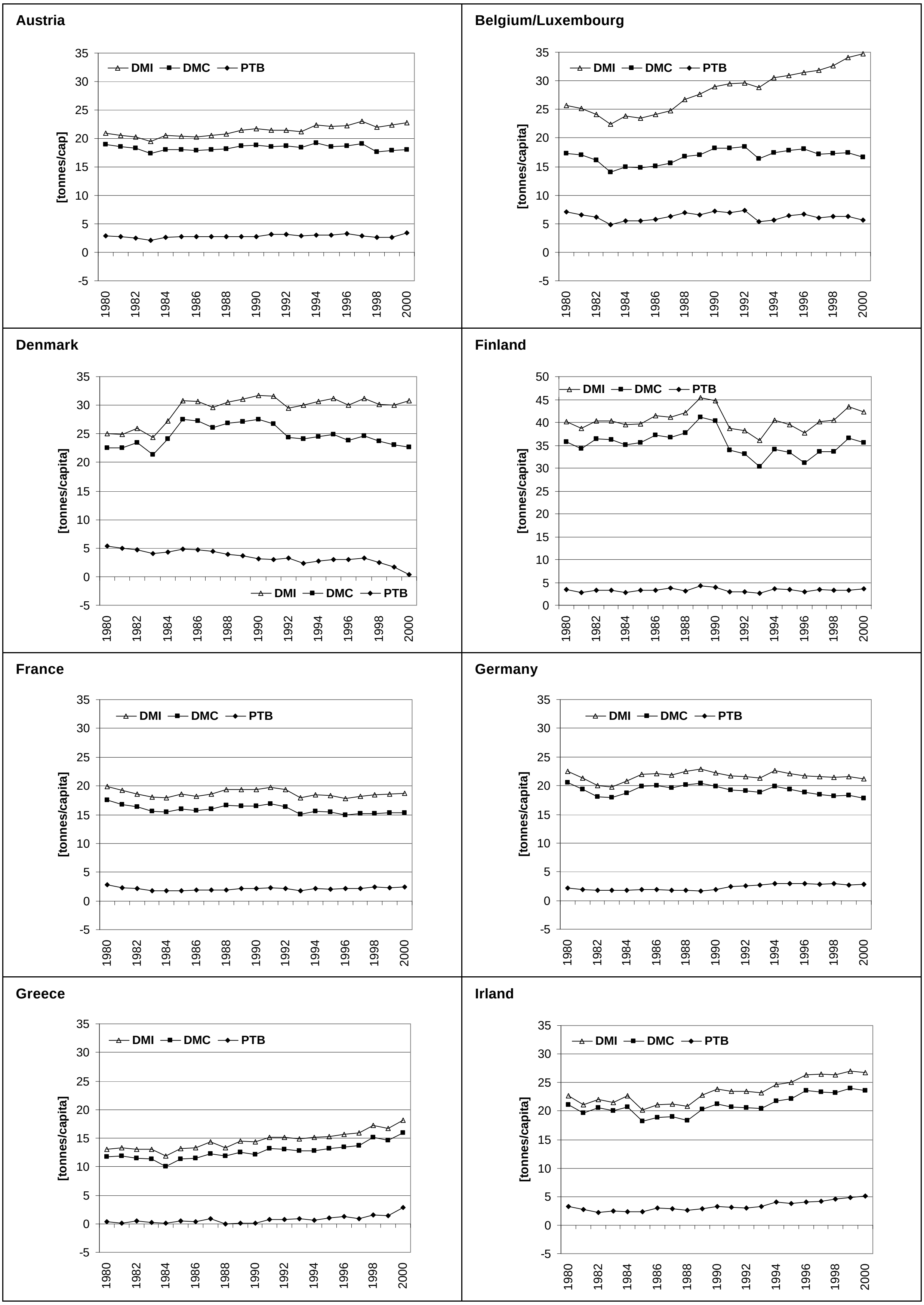
Fossil fuels account for the largest share of net imports (50-90% of net imports) in most EU-15 countries, followed by industrial minerals (10-50%) and biomass.

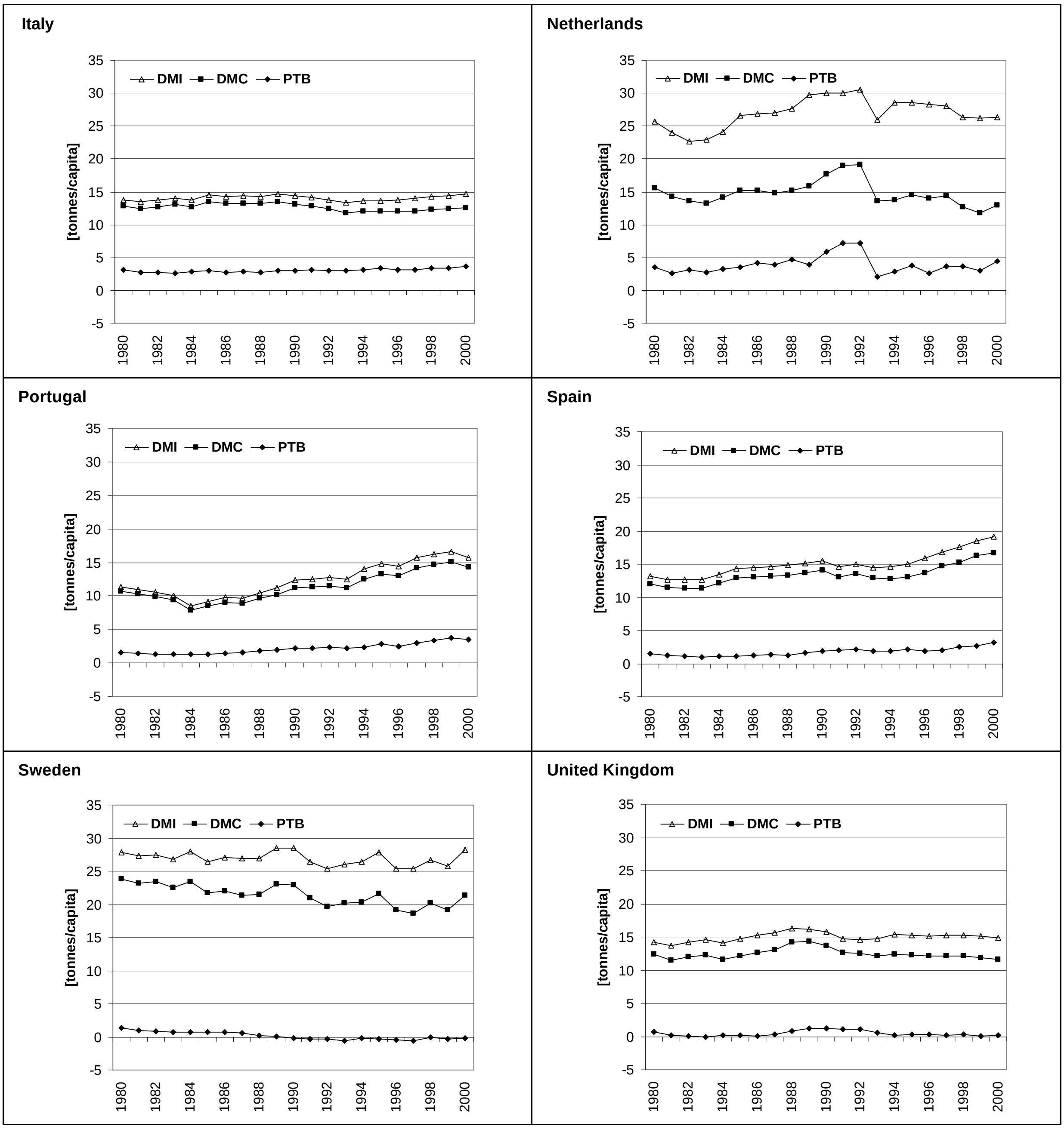
4.3. Domestic material consumption and direct material input

In many EU countries (e.g. Austria, Germany, France, UK) trends in DMC and DMI follow a pattern quite similar to the development on the EU-15 level (cf. Figures 2 and 13, and Table 4 with Figure 13b): DMC decreased in the early eighties by 10-20%, increased until the early 1990s and, after a short period of increase, has remained relatively stable since the mid-1990s. As a result values of DMC in 2000 were similar to DMC values of 1980 (within a range of +/-10%). Notable exceptions are the countries with the lowest income in 1980: Their DMC has grown more or less continuously since 1984. Since 1980 the DMC of Greece grew by 49%, of Ireland by 25%, of Portugal by 39%, and of Spain by 48% (see Figure 13a).

INDEX

Figure 12: Development of material use indicators (DMC, DMI and PTB) in EU-15 countries, 1980-2000





In general, DMI has grown at higher rates than DMC (Table 5) and shown an absolute increase in all countries except Germany since 1980. In many countries, but most clearly in the low-income countries the trend in DMI follows the development of DMC (e.g. Greece, Portugal, Spain, and Ireland). In most of the high-income countries DMI grew significantly faster than DMC reflecting increases in imports - e.g., in Belgium, where DMI grew by 41% while DMC hardly changed between 1980 and 2000.

Figure 13a: Development of DMC in countries with lowest GDP per capita in 1980

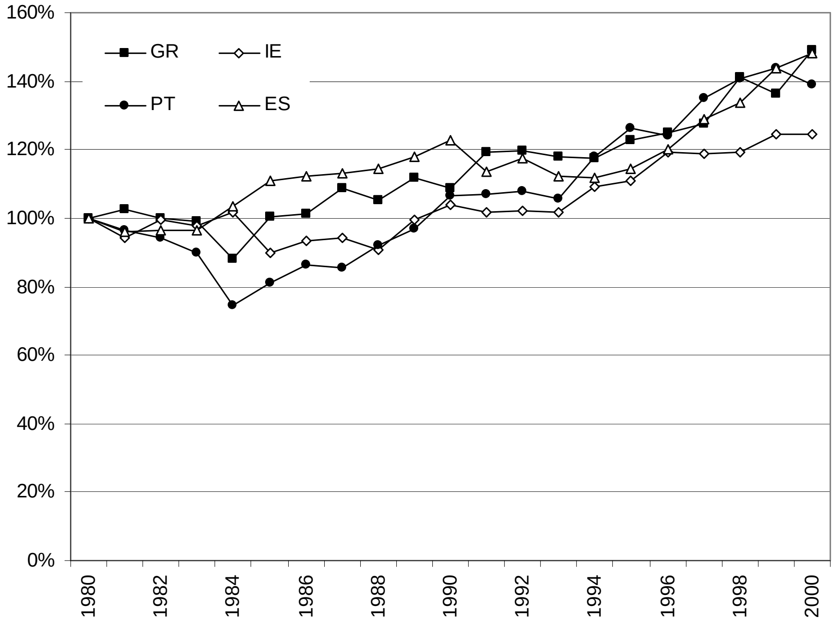
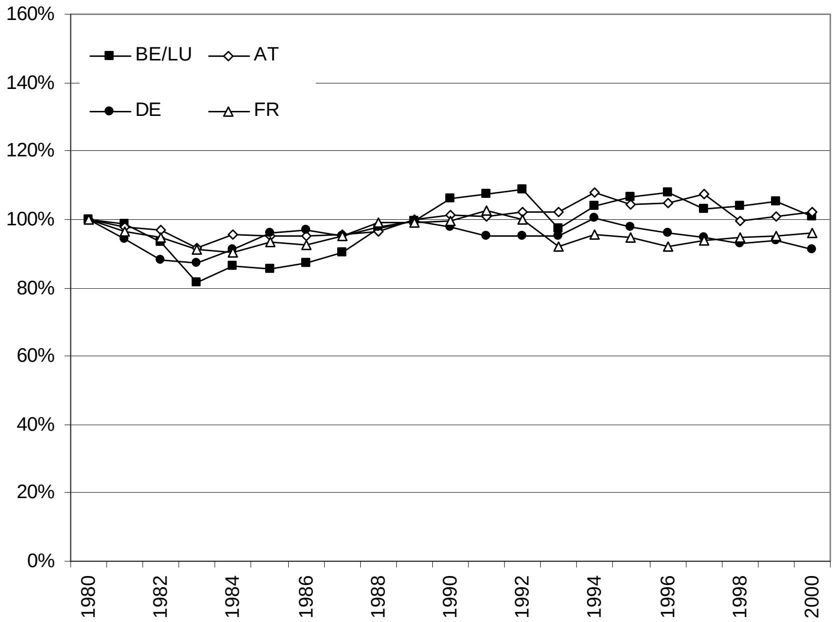


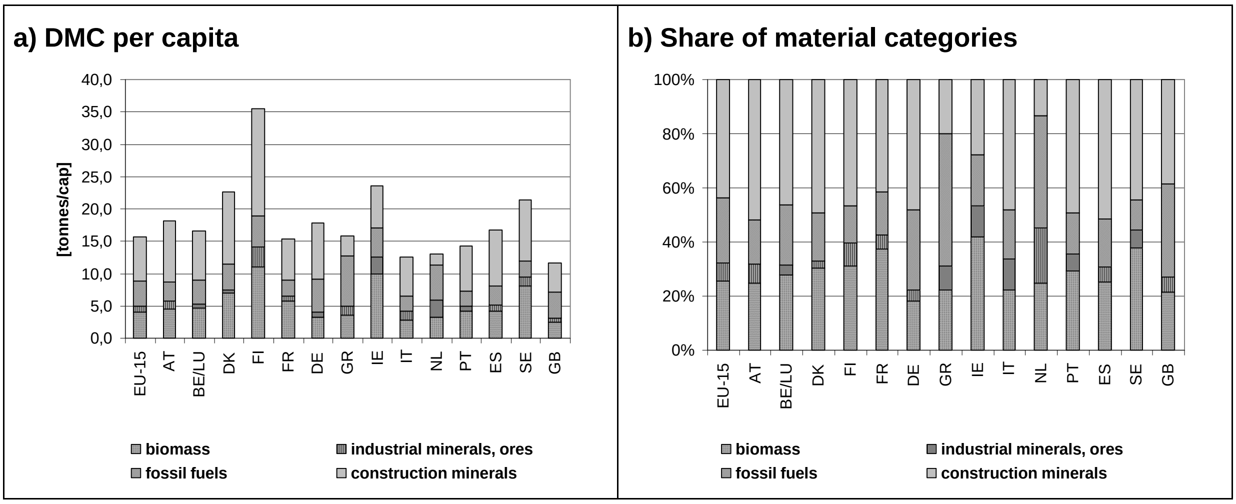
Figure 13b: Development of DMC in countries with high GDP per capita in 1980



Although the general trend in the development of the material use indicators DMC and DMI is quite similar in many of the EU-15 countries, these indicators vary significantly across the Member States with respect to both their per capita level and material composition as shown in Figures 14 and 15 for the year 2000.

Figure 14a and Table 8 show that an average of 15.6 tonnes of materials were consumed per capita in the EU-15 in 2000. The highest level of material consumption was found in Finland (35.6 tonnes/capita), Ireland (23.6 tonnes/capita) and Denmark (22.7 tonnes/capita), while the UK, Italy and the Netherlands showed the lowest values (11.6; 12.6 and 13.0 tonnes/capita) in 2000.

Figure 14: Domestic Material Consumption (DMC) by material categories in tonnes/capita (14a) and shares of material categories (14b), 2000



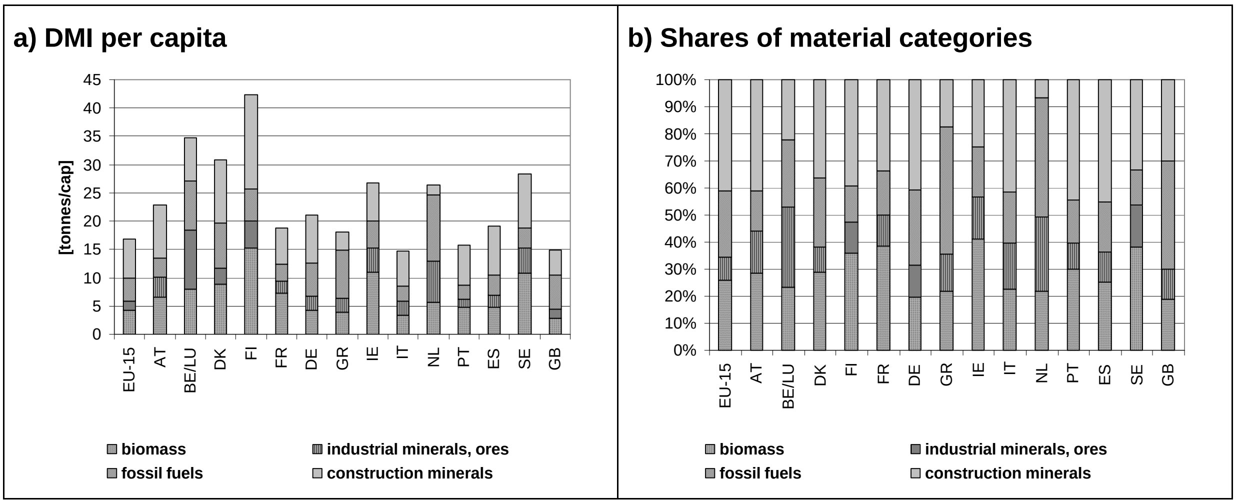
While the level of per capita DMC varies by a factor of 3.1, DMC of the main material categories is even more diverse across countries: DMC_{bio} ranges from 2.5 tonnes/capita in the UK to 11.1 tonnes/capita in Finland; DMC_{cons} ranges from 1.7 tonnes/capita in the Netherlands to 16.6 tonnes/capita in Finland; DMC_{ind} ranges from 0.6 tonnes/capita in Denmark to 3.1 tonnes/capita in Finland; and DMC_{fossil} ranges from 2.2 tonnes/capita in Portugal) to 7.8 tonnes/capita in Greece.

Table 8: Domestic Material Consumption (DMC) per capita and its main components, 2000

	Total DMC per capita	DMC biomass per capita	DMC construction minerals per capita	DMC industrial minerals and ores per capita	DMC fossil fuels per capita	DMC per capita change 1980-2000
	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[%]
EU-15	15.6	4.0	6.9	1.0	3.8	-3.3%
Austria	18.1	4.5	9.4	1.3	3.0	-4.8%
Belgium, Luxembourg	16.6	4.6	7.7	0.6	3.7	-3.7%
Denmark	22.7	6.9	11.1	0.5	4.1	0.5%
Finland	35.6	11.1	16.6	3.0	4.8	-0.6%
France	15.3	5.8	6.3	0.8	2.5	-12.3%
Germany	17.8	3.2	8.6	0.7	5.2	-13.3%
Greece	15.9	3.5	3.2	1.4	7.8	35.4%
Ireland	23.6	9.9	6.6	2.7	4.4	11.9%
Italy	12.6	2.8	6.1	1.4	2.3	-1.6%
Netherlands	13.0	3.2	1.7	2.7	5.4	-16.6%
Portugal	14.2	4.2	7.0	0.9	2.2	32.4%
Spain	16.7	4.2	8.6	1.0	3.0	39.0%
Sweden	21.3	8.1	9.5	1.4	2.4	-10.4%
United Kingdom	11.6	2.5	4.5	0.6	4.0	-6.6%

On average, biomass contributes 26% to DMC, construction minerals 44%, industrial minerals 6%, and fossil fuels 24% to the DMC of the EU-15. Figure 14b shows that the composition of DMC in the EU-15 countries is extremely variable: Biomass, for instance, contributes only 18% to the DMC of Germany but 42% to the DMC of Ireland and fossils contribute only 11% to the DMC of Sweden but 49% to that of Greece.

Figure 15: Direct Material Input (DMI) by material categories in tonnes/capita (15a) and shares of material categories (15b), 2000



The level of DMI is slightly above that of DMC and in most countries DMC is at the level of 80-90% of DMI (cf. Figure 14a and 15a). The only remarkable exceptions are the extremely „external trade-dependent economies“ of Belgium and the Netherlands, where DMI is about double the value of DMC.

Table 9: Import dependency (ID) of DMC and DMI 2000 and change since 1980

	*ID_{DMI}	**ID_{DMC}	ID_{DMI} 1980-2000	ID_{DMC} 1980-2000
EU-15	22%	17%	22%	16%
Austria	35%	19%	52%	23%
Belgium, Luxembourg	68%	34%	13%	-18%
Denmark	27%	1%	-12%	-94%
Finland	25%	10%	28%	9%
France	31%	15%	15%	-5%
Germany	29%	16%	56%	47%
Greece	28%	18%	112%	473%
Ireland	31%	22%	47%	43%
Italy	39%	29%	33%	21%
Netherlands	68%	34%	27%	50%
Portugal	32%	24%	62%	65%
Spain	29%	19%	41%	48%
Sweden	24%	-1%	23%	-114%
United Kingdom	23%	2%	35%	-69%

* ID_{DMI} = Imports/DMI
**ID_{DMC} = Net imports/DMC (net imports = Physical Trade Balance (PTB) = imports less exports)

Table 9 compares the relative importance of the foreign trade aggregates in the indicators DMI and DMC cross-country and cross time. In 2000 EU-15 imports amounted to 22% of DMI, PTB amounted to 17% of DMC. This means DE is the most important parameter determining the level of DMC and DMI. The rate of change, however, is much higher for the foreign trade flows than for DE. In the EU-15 imports increased by 28%, exports by 53% and DE did not change over the whole period of time (1980-2000).

The contribution of net imports to DMC (ID_{DMC}) ranges from 1% in Denmark to 34% in Belgium and the Netherlands and the contribution of gross imports to DMI (ID_{DMI}) ranges from 23% in the UK to 68% in Belgium and the Netherlands (see Table 5). In most Member States the contribution of net imports to DMC is increasing (total growth of ID_{DMC} over the period 1980 to 2000 varied between 473% in Greece and 9% in

Finland). In Belgium/Luxembourg, Denmark, France, Sweden and UK ID_{DMC} decreased over the same period. The most remarkable decrease was in Denmark, which reduced ID_{DMC} from 24% to 1% by substituting imports of fossil fuels by domestic extraction. In 2000 Denmark even became a net exporter of fossil fuels.

This indicates that the interconnectedness of the EU-15 with other economies is increasing both at the global level and within the EU-15 not only in monetary but also in physical terms.

4.4. Material use, area and population density

Figure 16 shows that DE and DMC per area (area intensity) in the Member States vary by a factor 10: DMC per area is highest in densely populated countries such as Belgium, Germany, and the Netherlands with values ranging from 41 to 58 tonnes/ha, reaching levels as low as 4 to 5 tonnes/ha in Sweden and Finland. Interestingly, the countries with the highest per capita material consumption and domestic extraction have the lowest material extraction and throughput per area (see Figure 17a and 17b). This suggests a relation between area, national abundance of resources and the amount of resource use.

To further analyse this hypothesis we correlated population density with DE/cap and DMC/cap. For countries with low population densities a strong inverse relation to per capita material consumption seems to exist. This applies to countries such as Finland, Sweden or Ireland (with 15.3, 19.7 and 53.7 cap/km² respectively, as compared to 116.2 cap/km² for EU-15 – see Table 2), which are characterised by high DE/capita and DMC/capita of biomass, which is an extremely area dependent material. In particular it is extraction of wood in Finland and Sweden, and extensive grasslands which provide fodder for a livestock twice the size the population in Ireland, which contribute to the high DE and DMC/cap consumption. Furthermore, low population densities may lead to a higher demand for infrastructure/capita and therefore higher DE and DMC of construction minerals.

Medium and highly densely populated countries however, do not show a strong relation between population density and per capita material consumption or domestic extraction.

Summarising, a plausible explanation for the observed pattern would be to assume that beyond a certain population density abundance of some materials, above all area dependent resources such as biomass, is so high compared to demand, that resource use is less or not restricted by scarcity.

Figure 16: Area intensity of EU-15 countries, 2000

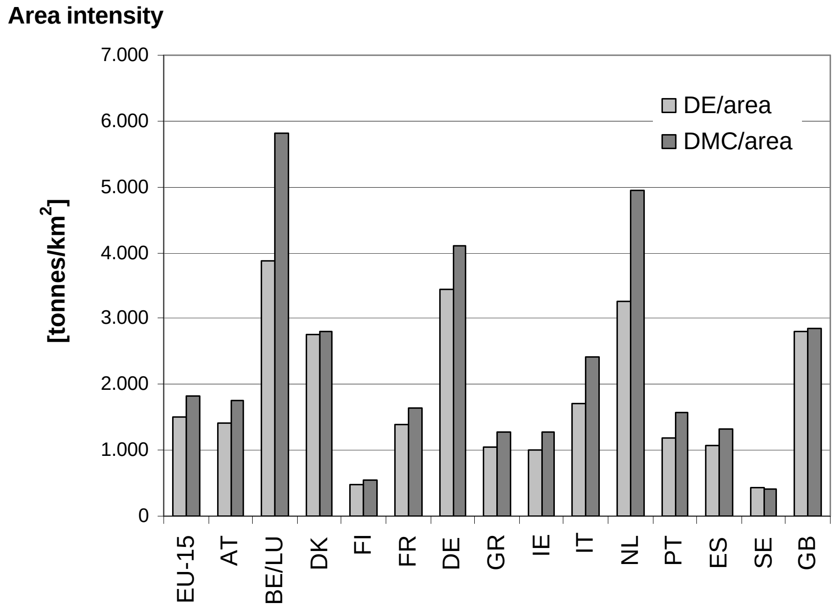
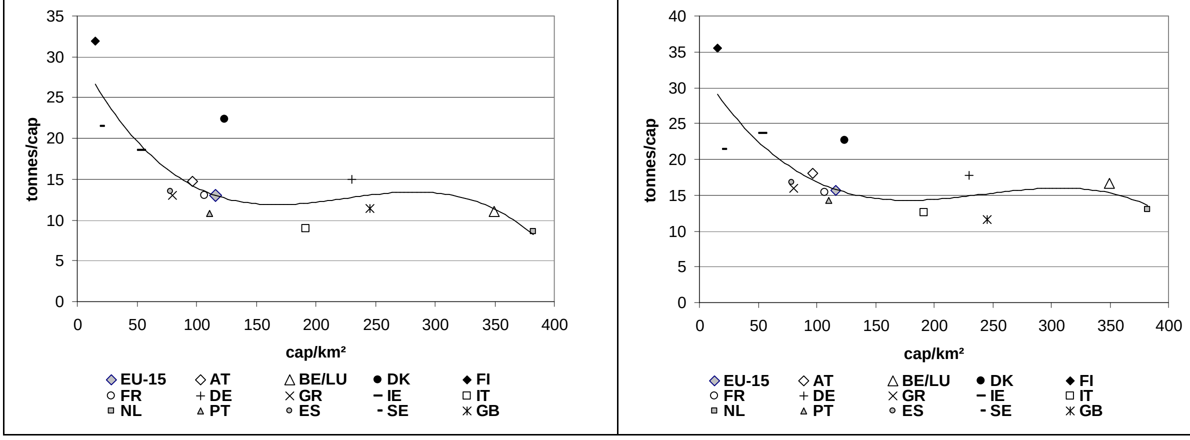


Figure 17: Correlation of population density (capita/km²) with DE per capita (a) and DMC per capita (b) in EU-15 countries, 2000

a) Correlation of population density with DE per capita

b) Correlation of population density with DMC per capita



4.5. Energy consumption and material use

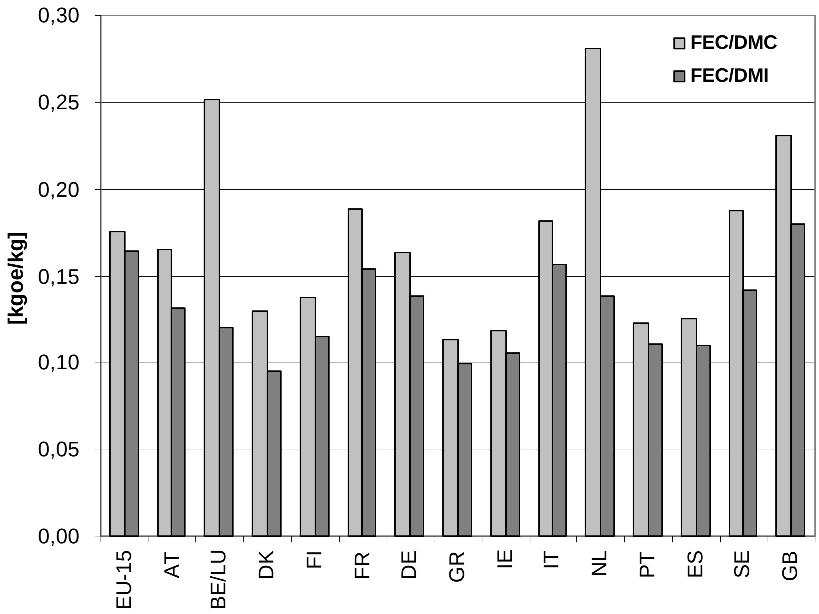
Energy consumption is one of the few (bio)physical parameters which is accounted for by national and international statistics in a consistent way and over long periods in time. The significance of energy availability and energy consumption for economic development has long been recognised and intensively discussed (Georgescu-Roegen 1980, Suri and Chapman 1998, Cleveland et al. 2000, Hall et al. 2000). This makes it all the more interesting to have a closer look at the relation between energy and material use in the EU-15 countries.

In analysing the energy intensity (and efficiency) of material use and the relation between energy use and material use, we used statistical data on energy consumption in the EU-15 countries compiled by the

International Energy Agency (e.g. IEA 1992) and available from the OECD database (OECD 2002b). We used the indicator Total Final Energy Consumption (FEC)[8] as reported in the IEA-Energy balances. Indicators for energy use and material use overlap to some extent but nevertheless measure significantly different things. The material use indicators DMI and DMC include fossil fuels and firewood – which are energy carriers also included in Total Primary Energy Supply (TPES) and in FEC. However, while MFA aggregate materials (incl. energy carriers) by weight, energy balances aggregate by energy content - usually net calorific values expressed as Joules or tonnes of oil equivalent (toe). The ratio oil equivalent to weight (toe/t) may differ by a factor of 3-4 among the most important energy carriers.

Furthermore, energy use indicators also include „immaterial" forms of energy[9] (e.g. electricity) which are not directly measured by MFA, while a large fraction of the materials accounted for in MFA are not considered by energy statistics (e.g., minerals, and a large fraction of the biomass compartment). To analyse the relation between energy and material use we calculated energy intensity[10] (figure 18) and related per capita energy consumption to per capita material use (Figure 19 a and b).

Figure 18: Energy intensity of EU-15 countries, 2000



With respect to DMI energy intensity (EI) varies between 0.10 and 0.18 kilograms of oil equivalent (kgoe) of final energy per kg of DMI. With respect to DMC the EI varies between 0.11 and 0.28 kgoe of final energy per kg of DMC.

Energy intensity for primary energy consumption is 30-50% above the respective values for final energy, depending mainly on the structure of the electricity supply and the energy conversion sector in the respective country. In general energy intensity varies considerably less (e.g., by a factor 1.8 for FEC/DMI) across countries than the per capita levels of material throughput (e.g., by a factor of 2.8 for DMI/capita) and other material use indicators.

[8] Final energy consumption (FEC) is the sum of consumption by the different end-use sectors (IEA 2002).

[9] FEC includes any form of electricity whereas TPES includes only primary electricity from e.g. hydropower, wind, nuclear power and imported electricity – (not electricity from burning fossil fuels).

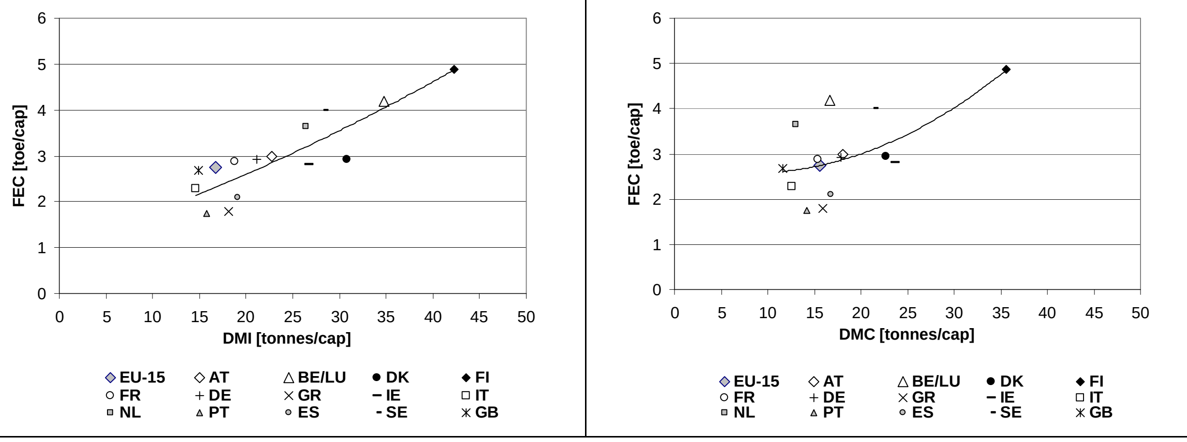
[10] Various forms of energy intensity can be analysed: Total primary energy supply (TPES) is made up of indigenous production + imports - exports - international marine bunkers ± stock changes. It includes only primary electricity from e.g. hydropower, wind, nuclear power and imported electricity – (not electricity from burning fossil fuels) per DMI, FEC per DMI, TPES per DMC, FEC per DMC. Our discussion focuses on the energy intensity of DMC and DMI with respect to final energy consumption (FEC). Considering both TPES and FEC would allow us to include the efficiency of the energy conversion sector in the analysis.

Among the countries with the lowest energy intensity is Denmark (less than 0.1 kgoe FEC/kg DMI), which has reduced energy intensity considerably since 1980 (e.g. FEC/DMI by 17%). Greece, Portugal, Ireland, and Spain also have very low levels of energy intensity (0.1-0.3 kgoe FEC per kg DMC and DMI). However, increases of EI were considerable in these countries (17-43% since 1980). High energy intensities of DMI can be found in the UK, Sweden, and France (0.16-0.18 kgoe FEC/kg DMI) and of DMC in Netherlands, Belgium, and the UK (0.23-0.31 kgoe FEC/kg DMC).

Figure 19: Correlation of Final Energy Consumption (FEC) per capita with DMI per capita (a) and DMC per capita (b), 2000

a) Correlation of FEC per capita with DMI per capita

b) Correlation of FEC per capita with DMC per capita



Figures 19a and b indicate that there is a positive correlation between final energy consumption (FEC) and DMI. In contrast correlation between FEC and DMC seems to be weaker, which is partly due to Belgium and Netherlands as DMI and DMC differ a lot for these two countries (see Figure 18). These two countries are characterised by high levels of energy consumption but rather low values of material consumption. At a very general level it appears that high levels of material input into a national economy are likely to be connected with high levels of energy consumption[11].

[11] An analysis of the correlation of TPES with DMC and DMI has shown similar results.

Table 10: Final energy consumption (FEC) per capita and per unit DMC and DMI, 1999

	FEC [toe per capita]	FEC per DMC [toe/tonne]	FEC per DMI [toe/tonne]
EU-15	2.75	0.18	0.16
Austria	2.99	0.17	0.13
Belgium, Luxembourg	4.19	0.25	0.12
Denmark	2.93	0.13	0.10
Finland	4.88	0.14	0.12
France	2.89	0.19	0.15
Germany	2.92	0.16	0.14
Greece	1.80	0.11	0.10
Ireland	2.80	0.12	0.11
Italy	2.28	0.18	0.16
Netherlands	3.65	0.28	0.14
Portugal	1.75	0.12	0.11
Spain	2.09	0.13	0.11
Sweden	4.00	0.19	0.14
United Kingdom	2.68	0.23	0.18

5. Resource use and economic development: Dematerialization analysis

In the whole body of empirical work on dematerialization only a limited number of studies so far have used MFA-derived indicators (for a review see Cleveland and Ruth 1999). Given the long and rich history of dematerialization studies, dating back to the publication in 1952 of the study by the US President's Materials Policy Commission (Paley Report 1952), one may be inclined to ask what exactly the added value of MFA indicators in such analyses can be?

Economy-wide MFAs are aggregate accounts of the total material use of an economy, compiled according to the conceptual standards of the system of national accounts and applying the law of conservation of mass. This has two consequences: First, MFAs cover their subject completely and consistently, second, they conceptually allow us to calculate a physical GDP equivalent.

Thus, in comparison to what analyses of single substances or material fractions can achieve, MFAs are considered to provide better information for an understanding of dematerialization in relation to long term macro-economic processes (such as substitution processes, structural change, and the international division of labour). For example, the environmental Kuznets curve (EKC) hypothesis, which states that environmental pressure increases in early stages of economic development but then falls as incomes rises, was originally tested using single substance emissions as indicator for environmental pressure (e.g. Malenbaum 1978). Later the EKC hypothesis was challenged by analyses using aggregate material indicators (e.g. Rogich 1993, Berkhout 1998, Matthews et al. 2000). Likewise, with increasing methodological standardisation and the growing number of available MFAs, it is gradually becoming possible to base cross-country studies on sufficient data samples so as to allow for more sophisticated statistical analysis.

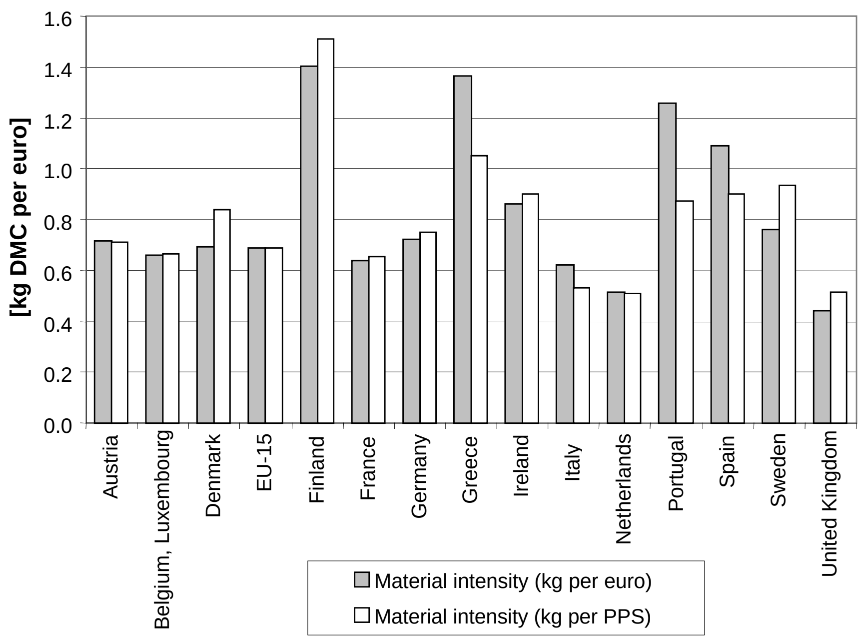
Various methodological approaches have been used for dematerialization studies, including: environmental Kuznets curves; material use and long wave theory; material decomposition analysis; statistical regression analysis; and input/output analysis (Cleveland and Ruth 1999). The use of MFA indicators in such frameworks requires considerable development in conceptual and methodological terms, as well as considerable data re-organisation. Although such developments are clearly beyond the scope of this report, we nevertheless attempt here to take the first step towards conceptual and methodological refinement.

We begin our analysis by comparing highly aggregated DMC to GDP values in various ways. This first step does not move beyond the customary „visual inspection mode" (Cleveland and Ruth 1999). After the first step we gradually refine the analysis asking more specific questions in terms of three approaches. These are the EKC, IPAT, and PTB approaches. The EKC approach asks if and how per capita income and per capita material use are related. Cross–country, IPAT asks how the three factors of population, affluence, and technology contribute to resource use; PTB analysis makes a first attempt to test the hypotheses that industrialised economies are dematerialising at the cost of developing countries. The latter two are carried out only at an aggregated EU level.

5.1. Material efficiency in the European Union

A customary way to compare material efficiency is to relate material use indicators to GDP. DMC (or DMI) per unit GDP is a measure for material intensity (MI_{DMC}; MI_{DMI}), while the inverse value (GDP per unit of DMC or DMI) is a measure of the material efficiency (ME_{DMC}; ME_{DMI}) of economic processes.

Figure 20: Comparison of material intensity of EU15 countries, 2000



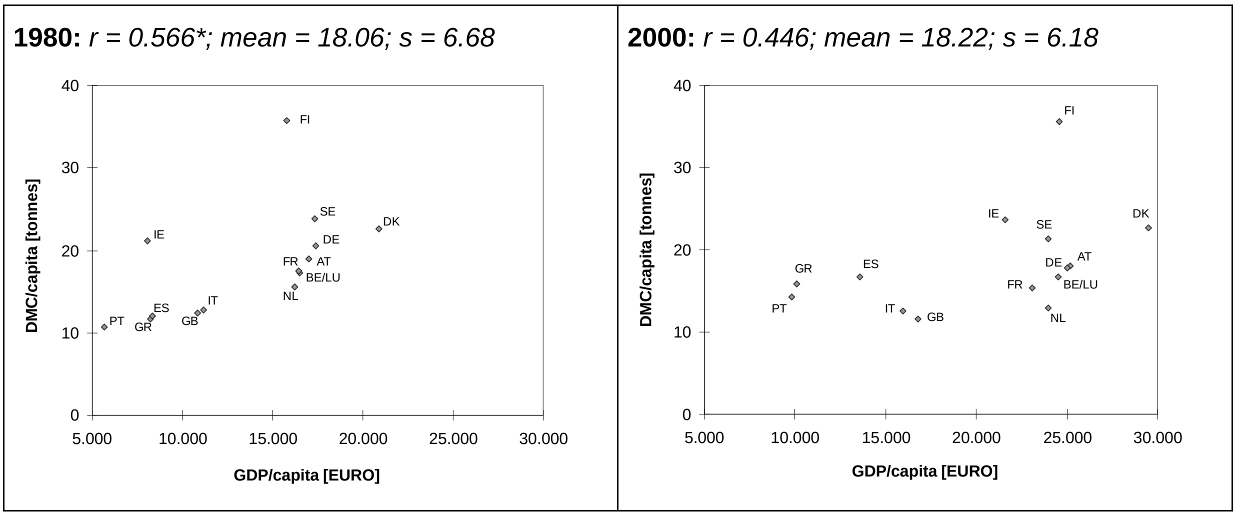
Source: Eurostat New Cronos (GDP in current prices and PPS)

MI expressed as DMC/GDP for the year 2000 for the EU and its Member States is presented in figure 20. MI is expressed as kilograms per unit of GDP in current (year 2000) prices as well as per unit of GDP expressed in Purchasing Power Standards (PPS). PPS eliminate price differences between countries and are better indicators of the volume of goods and services generated by economic activities. PPS are therefore better for comparing material intensity across countries. PPS are standardised on the EU-average so that GDP in euro is identical to GDP in PPS for the EU-15, whereas individual Member States may change position.

MI_{DMC} in kg per euro ranged from 0.44 kg/euro in the UK to 1.4 kg/euro in Finland (EU average 0.69 kg/euro). MI_{DMC} in kg per PPS ranged from 0.51 kg/PPS in the Netherlands to 1.51 kg/PPS in Finland (EU average remains at 0.69 kg/PPS). The largest differences of MI in kg/euro compared to MI in kg/PPS occurred for Sweden (MI increased by 23%) and Portugal (MI decreased by 31%).

In order to extend the cross-country comparison and also to assess the performance of individual member countries we relate per capita material consumption (DMC/capita) to per capita GDP. We start by comparing relative per capita material consumption at different GDP levels for each of the Member States for the years 1980 and 2000 (see Figure 21). For this analysis we use again GDP at constant (1995) prices.

Figure 21: DMC per capita for different levels of GDP per capita, 1980 and 2000



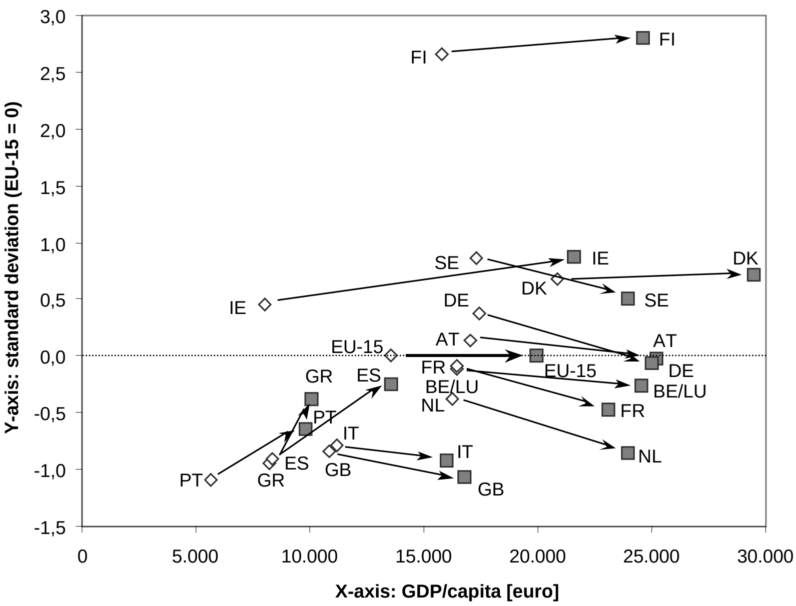
Notes: GDP is in constant 1995 prices. The correlation coefficient (r) measures the strength and direction of a linear relationship between two quantitative variables. The mean of a set of observations is their average. The standard deviation (s) measures the average distance of the observations from their mean.

Figure 21 shows that the average material consumption per capita increased slightly from around 18.1 tonnes/capita in 1980 to 18.2 tonnes/capita in 2000. The spread of observations decreased somewhat from an average distance from the mean of 6.7 tonnes/capita in 1980 to 6.2 tonnes/capita in 2000. This would show a slight trend towards convergence in material use of the different nations. The figures above also indicate that at the European level the correlation between per capita GDP and material consumption is rather weak, which points to the strong influence of other factors in explaining cross-country differences. Another reason for the weak correlation is due to the outlier Finland, which remains at almost the same DMC/capita over the 20 years period and irrespective of the GDP level per capita. A removal of this outlier leads to higher correlation coefficients of $r_{1980}=0.72^{**}$ and $r_{2000}=0.51$. In discussing the environmental Kuznets curve later, we will investigate whether a more pronounced relation is to be found between income and material consumption at the national level.

Moreover, the strength of the correlation between per capita GDP and material consumption has slightly decreased between 1980 and 2000. Comparing our figures with those in a similar study by Jaenicke *et al*. (1988) that analysed the environmental impacts of 31 nations indicates that the correlation between income and material inputs has considerably decreased since 1970.

To compare profiles of per capita material consumption and per capita GDP across the individual Member States, we integrated the two data points into one figure. In figure 22 below, the y-axis represents DMC/capita in standard deviations from the EU-15 mean and the x-axis represents GDP/capita in euro. For each Member State two data points are shown (1980 and 2000) and connected by an arrow. The length and angle of the arrows show the performance of each country; the mean for the EU-15 is shown as a horizontal line at y = 0.0. The performance of the EU-15 is shown as an arrow along this line. The figure therefore shows how each Member State performed relative to the EU average.

Figure 22: Material consumption per capita and economic performance (1980 = ◊, 2000 = ■)



Note: GDP is in constant 1995 prices.

Each data point is characterised by two values x and y. The y values show to what extent a country's DMC/capita was above or below the EU average represented by the line at y=*0.0)* in the years 1980 and 2000. A worse-than-average performance is above and a better-than-average performance is below the average. The angle of the arrows show improvement or deterioration for each Member State in 2000 compared to 1980. Upward angles indicate that material consumption per capita is increasing faster than the EU average, downward angles show that per capita material consumption decreased compared to the EU average. The distance between the two data points of each country parallel to the x-axis measures changes of GDP per capita, the distance parallel to the y-axis measures changes in DMC per capita as compared to the EU average.

All countries with a DMC/capita beyond EU-15 average in 1980 remained at a beyond average position in 2000. However, the low income countries Spain, Greece and Portugal worsened their relative position (upward angle) and high income countries such as the UK, Italy, Netherlands and France improved their relative position (downward angle). DMC per capita values above average for both years can be observed for Finland, Denmark, Sweden, Germany, Ireland, and Austria. The high-income countries Denmark and Finland further worsened their relative position, they increased their DMC per capita relative to the EU-15 average (indicated by upward angles). The third country starting at above average DMC per capita levels and worsening its position is Ireland, which at the same time experienced the highest increase in per capita income (see distance of the two data points along the x-axis).

In Figure 22 we used per capita values of GDP and DMC. In Table 11 we compare total change in absolute levels of DMC to total change of GDP over the whole period of time. From this we can see whether and to which degree the EU as a whole and its Member States have been dematerialising in the past two decade. We differentiate between „absolute dematerialization", i.e. declining material consumption and at the same time growing GDP, „relative dematerialization", i.e. material consumption and GDP are both growing but GDP is growing at a higher rate and „no dematerialization", i.e. material consumption increased faster than GDP.

Table 11: Dematerialization in the EU (Total growth rate 1980–2000)

	DMC	GDP (constant 1995 prices)
Absolute dematerialization		
Germany	-8.9%	51.0%
Netherlands	-6.1%	66.3%
Sweden	-4.4%	47.8%
France	-4.1%	53.6%
United Kingdom	-1.0%	63.8%
Relative dematerialization		
Belgium/Luxembourg	0.6%	55.6%
Italy	0.6%	46.2%
Austria	2.2%	59.0%
EU-15	2.7%	56.0%
Denmark	4.6%	46.9%
Finland	7.7%	68.8%
Ireland	24.6%	199.3%
Portugal	38.7%	80.6%
Spain	48.3%	73.4%
No dematerialization		
Greece	49.0%	34.7%

Note: the ranking above is by the change in DMC. This ranking does in no way reflect the position of the different countries in terms of the changes in material efficiency that occurred.

Overall, the EU economy grew by 56% whereas material use as measured by DMC grew by only 2.7% over a twenty-year period. The individual countries show quite diverse performances in their dematerialization. A group of countries including Germany, the Netherlands, Sweden, France, and the UK had absolute decreases in their DMC of between 1.0% and 8.9% while the economy grew by around 50%. Relative dematerialization can be observed in Belgium/Luxembourg, Austria, Italy, Finland, Ireland, Denmark, Portugal, Spain, and the EU as a whole. Minor increases in DMC, between 0.6% and 7.7%, can be observed for Belgium/Luxembourg, Austria, Italy, Denmark and Finland. Ireland was the fastest growing economy, almost tripling its GDP while its DMC grew by (only) 25% relative to 1980. Portugal and Spain had substantial growth rates for DMC, amounting to about half and two-thirds respectively of their GDP growth rates. The only EU Member State to increase its DMC by a larger rate than its GDP, was Greece.

5.2. Environmental Kuznets curves

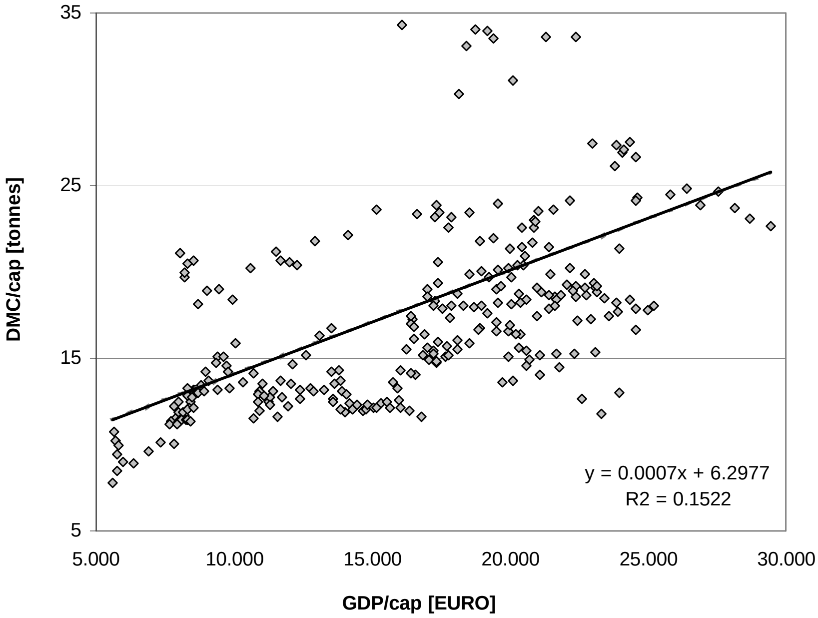
Environmental Kuznets curves (EKC) provide another framework for analysing the linkage between the economy in monetary terms and its associated physical flows. EKCs are constructed by explicitly relating per capita income (GDP or GNP per capita) to environmental indicators in the broadest sense (World Bank 1992, Selden and Song 1994, Shafik 1994, de Bruyn and Opschoor 1997).

EKCs thus allow for a conceptual separation of „economic growth“ in monetary terms from „physical growth“ in terms of tonnes and joules; they allow us to empirically assess how these two dimensions of the economy are related. The underlying idea, or hope, expressed in EKCs is that it could be possible to achieve environmentally sustainable economic growth by fostering monetary growth while at the same time reducing the physical flow associated to it.

The EKC hypothesis states that environmental pressures increase in early stages of development but then fall as income rises, producing an inverted U-shaped curve. This is based on two possible assumptions: (1) The environment is a *normal good* for the consumption of which people are willing to pay more as income rises; (2) Richer countries are increasingly able and willing to invest in energy- and material-saving technologies (Cleveland and Ruth, 1999). Thus in early stages of development when incomes are low, material requirements should be low, too.

We investigate this relationship by using DMC per capita to represent environmental pressure and GDP in euro at constant 1995 prices per capita to represent the income level. The estimated regression lines represent changes in *y*, here tonnes of DMC per capita, caused by changes in *x*, the income level. The R^2 represents a measure of how well the regression line fits a set of data. It measures the proportion or percentage of the total variation in *y* explained by the regression model. All coefficients presented below are statistically significant at a 1% level.

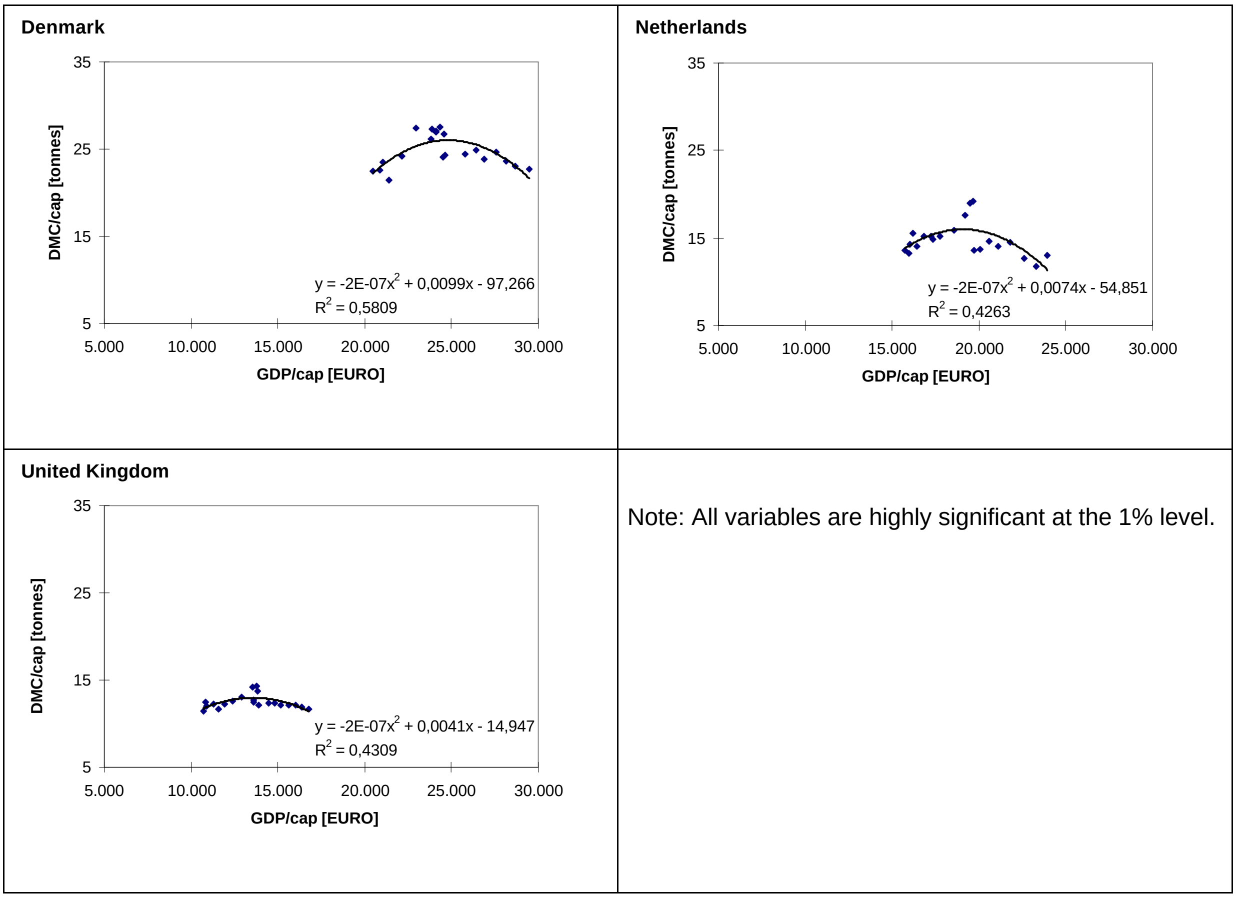
Figure 22: Environmental Kuznets Curve (EKC) for all Member States and all years



Note: x is highly significant.

Figure 23 shows DMC per capita in relation to GDP per capita for all Member States of the EU-15 and all years 1980-2000. EU-15 data are not included. The low R^2 indicates a low correlation between DMC per capita and GDP per capita across all countries. It could be that the different Member States, being in different phases of economic development also reveal different patterns of a relation between material consumption and income level. Mixing these different patterns would then hide the overall trends. Therefore we analyse in a next step the EKC hypotheses at the national level. In the following we present EKCs for those countries, where a highly significant correlation between DMC per capita and GDP per capita could be observed and R^2 was at least above 0.4.

Figure 24: Countries with inverted U-shape EKCs



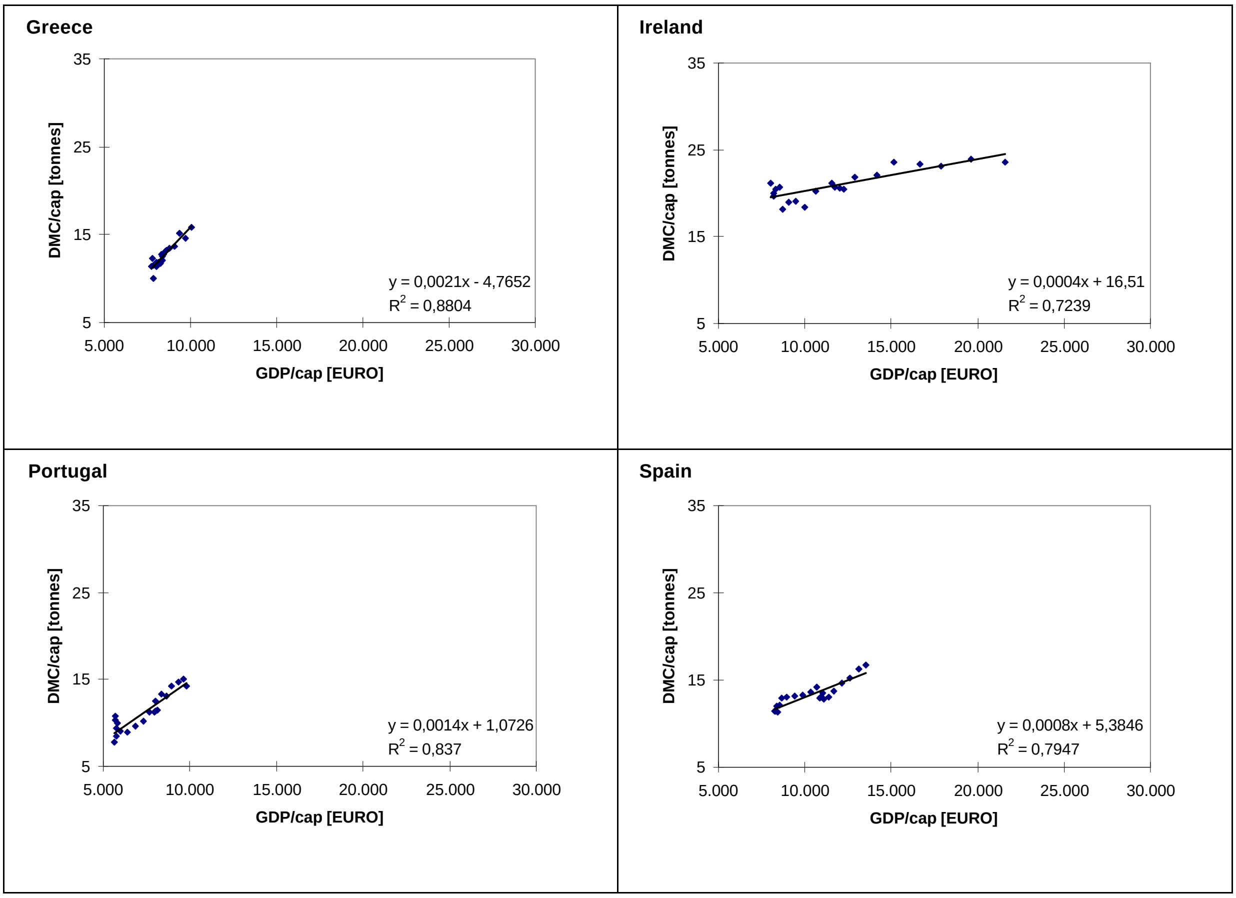
Note: All variables are highly significant at the 1% level.

Figure 24 shows EKCs for three EU Member States, which reveal inverted U-shape patterns. Denmark and The Netherlands are countries similarly situated in terms of economic performance as shown by the development of GDP per capita. The UK, also showing an inverted U-shape, has not reached a level of per capita income above 18 000 euro per capita. (It should however be noted that GDP is in euro at constant 1995 prices and therefore also at constant exchange rates whereas the British Pound shows substantial fluctuations against the euro and its forerunner, the ECU.) Nonetheless, the data suggest that the per capita income where a turning point may be expected has some variability.

Likewise, the material consumption as indicated by the DMC per capita has quite some variability. For example, the DMC per capita of the UK ranges from 11.5 to 14.3 tonnes, whereas the DMC per capita for Denmark ranges from 21.4 to 27.5 tonnes per capita. Similar developments are observable for France and Italy, which are not displayed here.

A different pattern of correlation between material consumption per capita can be seen in Figure 25 below. The following countries exhibit no inverted U-shape curve, but their per capita material consumption increases with increasing income.

Figure 25: EKC for countries with increasing material consumption (DMC) per capita



For the above countries (Figure 25) a linear regression function was chosen, because it showed similar results in terms of R^2 and significance compared to a function of second order. Accordingly, linear and square functions only slightly differed. From the interpretation however, a linear function is more plausible. On the contrary, Figure 24 shows countries for which only the square function showed high significance and high R^2 values. As GDP per capita generally increases over time, the development path is generally from left to right. We may therefore interpret Greece, Portugal, and Spain, with per capita income levels ranging from 9 786 to 13 555 euro as countries not having reached a level of income above which a reduction in material consumption may take place. Ireland again is an exception, with per capita income ranging from 10 000 to 22 000 euro but no pronounced reduction in per capita material consumption as yet. However, Ireland may be an exception also insofar as economic growth showed very high rates compared to other EU Member States only in the 1990s, whereas the changes that result in declining DMC may be structural in nature and therefore may need time.

There seems to be a relation between national trends in material use parameters and indicators for a country's relative „stage of economic development" (i.e., levels of per capita GDP). However, taken together with the above results no strong pattern can be observed, as regards the stage of economic development (measured as GDP per capita) at which a turning point to lower per capita material consumption can be expected.

5.3. The relationship between materials, welfare and technical change: *I=PAT*

A model commonly used to analyse socio-economic driving forces of environmental impact is the IPAT model developed some three decades ago by Holdren and Ehrlich (1971) and Commoner (1972). The model was designed by biologists and ecologists to operationalise and quantify the relationship between population, human welfare, and environmental impacts.

IPAT is an (conceptual) identity stating that environmental impact *(I)* is the product of population *(P)*, affluence *(A)*, and Technology *(T)*. Here, the IPAT equation is used to decompose factors responsible for changes in the consumption of materials, expressed as DMC, in the EU-15 from 1980 to 2000. DMC has been chosen to represent environmental pressure rather than environmental impact.

DMC = (Population) x (GDP/Population) x (DMC/GDP)

Used in this way, the equation takes on the characteristics of a mathematical identity. On the right hand side the two terms *Population* and *GDP* cancel out, leaving DMC. This identity can also be used to analyse a development over a certain period of time (see Table 12).

Table 12: DMC = P*A*T percentage change from 1980–2000 (numbers are rounded)

	DMC	POP	GDP/POP	DMC/GDP
1980-2000	1.03	1.06	1.47	0.66
1980-1990	1.05	1.03	1.23	0.83
1990-2000	0.98	1.03	1.19	0.79

Note: In the formulation used (see above equation) the various factors are not additive but multiplicative:
DMC = P x A x T or *1.03 = 1.06 x 1.47 x 0.66.*

The first row of Table 12 shows the development for the whole time period. We can observe an increase of the DMC of 3% per decade, which composed of a population growth of 6%, GDP per capita growth of 47%, and an efficiency gain as expressed by DMC per euro GDP of 34%. The counteracting effect of higher efficiency indicated by DMC per unit of GDP (DMC/GDP) of minus 34% is overwhelmed by the growth of affluence and population.

During the two decades we can observe the following trends: Direct material consumption increased by 5% in the first decade but decreased by 2% from 1990 to 2000. Population increased at a constant rate of 3% per decade. Affluence (GDP per capita) increased by 23% in the first decade and by 19% in the 1990s. The material efficiency indicator (DMC/GDP) decreased by 17% per decade in the 1980s and by 21% per decade in the 1990s.

5.4. The physical trade balance as an indicator for international environmental load displacement?

This section refers to the often-discussed hypothesis that environmental improvements in the developed countries are achieved by exporting environmental pressures to other countries. We use the physical trade balance (PTB) indicator to address this question. The PTB for the EU-15 assesses material flows crossing the borders that define the outer limits of the EU. In this section we present a PTB for the European Union in a time series from 1980 to 2000 and compare this PTB with the monetary trade balance. Finally, we disaggregate the physical trade data by material groups.

Figure 26: Physical trade balance for EU-15, 1980–2000

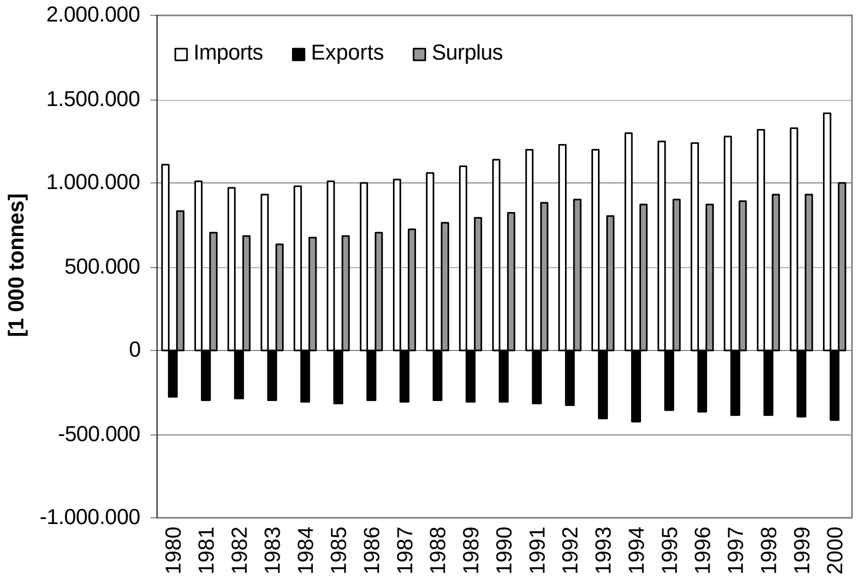
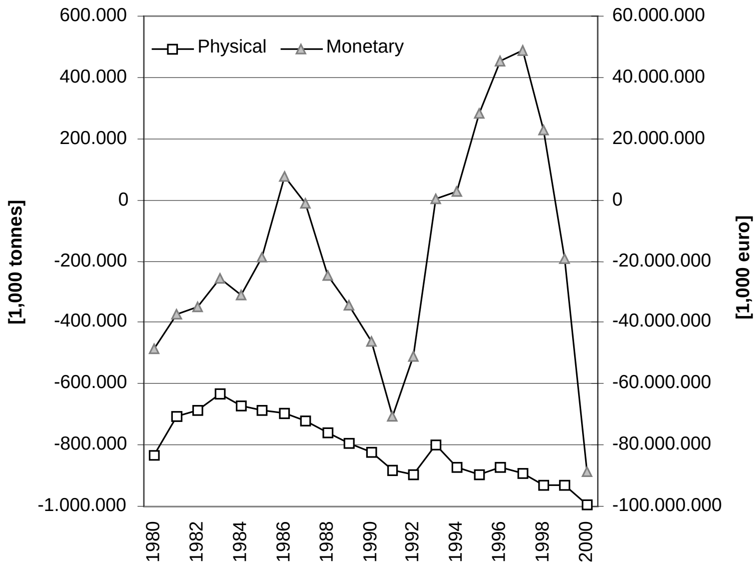


Figure 26 shows that imports into the EU-15 increased after a short recessionary period in the early 1980s from 1.1 billion tonnes to more than 1.4 billion tonnes, which is a 28% increase in imports. At the same time exports increased by 53%, from 275 million tonnes to 419 million tonnes. This caused the 1980 physical trade balance of 834 million tonnes to increase to 997 million tonnes by 2000. This is equivalent to an increase of 19% during these two decades. The physical trade balance as a percentage of DMC increased from 14.5% to 16.9%. In other words, in 2000 almost 17% of all materials consumed in the EU have been imported from outside of the EU-15.

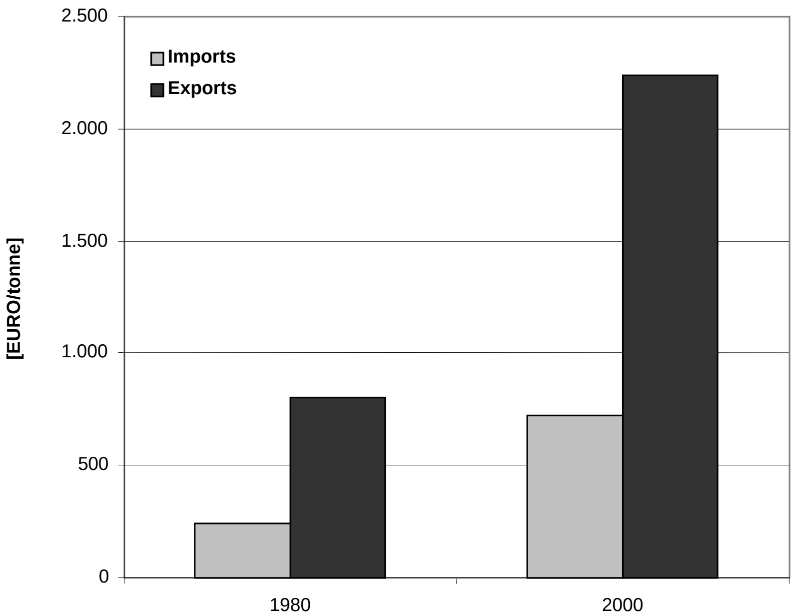
Figure 27: Physical versus monetary trade balance



Source: COMEXT (monetary data are in current prices)

Considerable fluctuations were evident in the monetary trade balance from 1980 to 2000, whereas the physical trade balance in the same time period tended to increase consistently. The higher fluctuations in the monetary trade balance are due to changing demand for EU-15 products on the world market (Figure 27). Exports with high added value are more sensitive to price changes or recessionary influences. The price elasticity of demand for goods with high added value is generally higher than for goods with lower added value (e.g., raw materials), the latter being such as are generally imported into the EU-15 (see Figure 28).

Figure 28: Value in ECU/euro per tonne of imports and exports of EU-15, in 1980 and 2000



Source: COMEXT (monetary data are in current prices)

Figure 28 shows the unit value disparity between imports and exports. The unit value of exports is by a factor of 3 greater than the unit value of imports. Comparing the years 1980 and 2000 we see that this ratio remained constant during this time period.

In order to further analyse the PTB it is necessary to decompose this indicator to a greater extent. What interested us in this next step was to see what share various material categories had in imports and exports and how these shares had changed over time (Figure 29).

Figure 29: PTB disaggregated for various materials (in 1 000 tonnes)

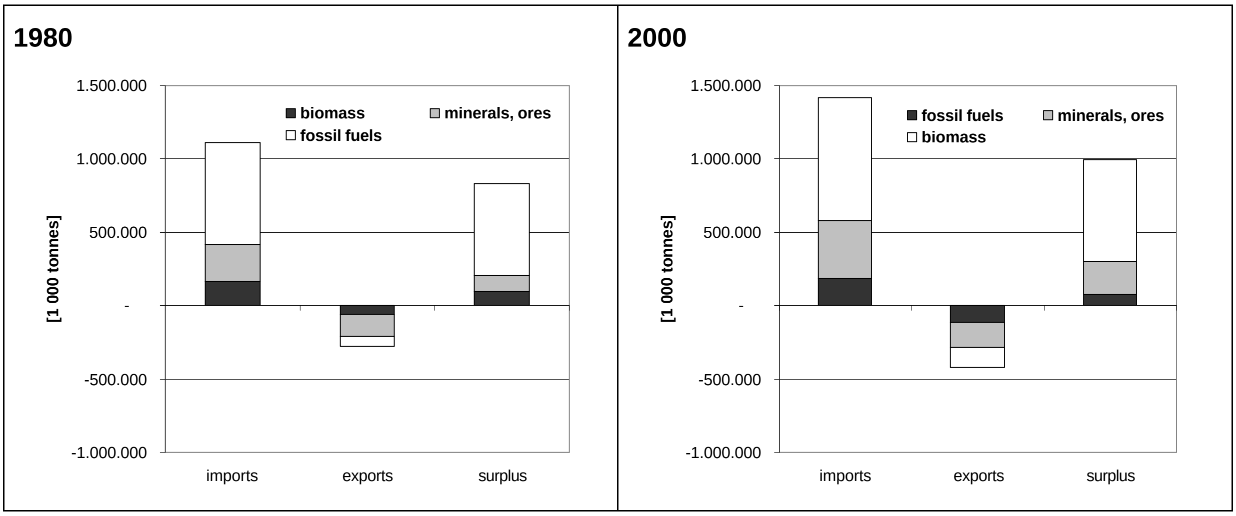


Table 13: Share of material categories of imports and exports, and PTB

	1980				2000		
	Imports	Exports	PTB		Imports	Exports	PTB
Biomass	14.7%	22.9%	12.0%	Biomass	13.2%	26.7%	7.5%
Minerals	22.7%	52.7%	12.8%	Minerals	28.0%	40.7%	22.7%
Fossil fuels	62.6%	24.3%	75.2%	Fossil fuels	58.8%	32.6%	69.8%
Total	100.0%	100.0%	100.0%	Total	100.0%	100.0%	100.0%

Table 13 shows that the share of biomass in EU-15 PTB decreased from 12.0% to 7.5% between 1980 and 2000, while that of minerals increased from 12.8% to 22.7%. The share of fossil fuels in the PTB decreased from 75.2% to 69.8% but remained larger than that of all other categories. It is notable that dependence on fossil fuels still manifests itself as a very high share of imports and of PTB: fossil fuels make up more than two-thirds of PTB.

The EU economy is increasingly linked to other parts of the world economy through imports of large amounts of resources and semi-manufactured goods. The EU in turn exports a great amount of final goods produced from these imported materials and product components and also from DE. Regarding the question of externalising or internalising environmental pressure through foreign trade, however, a PTB analysis is not sufficient, because physical import and export data from which PTB is derived, comprise goods at all stages of processing.

If we assume that goods in general loose weight in the course of their processing from raw materials to final goods and if we assume that environmental pressure is related to the amount of raw materials used to produce the final good and not to the weight of the final good, it is clear that PTB cannot account for the net impact of foreign trade in terms of environmental pressure. What would be needed to achieve this is to standardise all imports and exports to the same system boundary, e.g. by converting the imported and exported goods into their raw material equivalents.

6. Conclusions and future work

The results of the revised 1980-2000 estimate for the EU leads us to a number of conclusions and recommendations for future work in the following areas: methods and data quality, interpretation of indicators in terms of driving forces, interpretation of indicators in terms of environmental pressure.

Methods and data quality

A major step towards improving the quality and comparability of the material flow accounts cross-country and cross time has been made with this revision. However, further improvements are both necessary and possible. The question of data quality appears to be different for those Member States, where an estimate was compiled on the basis of international data sources and those Member States, where MFAs have already been established by the national statistical offices.

Concerning national MFAs, data quality in general is much higher. Not only do nMFAs rely on national statistical sources, but also on national expert knowledge, two decisive resources for improving MFAs. Still, major methodological differences appear in the accounts, in particular regarding fodder biomass, ores and construction minerals. Thus, an important task for the future is to improve comparability between nMFAs.

To discuss the standard of data quality and comparability achieved for the estimates based on international data sources we distinguish four categories of confidence: very high, high, medium, low and attribute them to the different partial accounts.

Very high: The accounts for domestic extraction of fossil fuels are definitely the best, which clearly is a result of the long standing tradition in energy statistics (itself being a result of the high policy interest in energy issues).

High: On the second rank concerning data quality are physical foreign trade accounts and domestic extraction of industrial minerals, ores, fish catch, forestry, and primary agricultural production. In these areas minor improvements will be needed, concerning mainly conversion factors (coefficients to calculate e.g. „run of mine" from metal content or timber harvest in tonnes from cubic meters), or the screening for partial inconsistencies in the aggregated physical foreign trade data.

The remaining categories of fodder biomass and construction minerals (sand and gravel, limestone, crushed stone) can be considered as weakest parts of a MFA. Both fodder biomass and construction minerals are huge material flows of minor economic value or not marketed at all. As a result primary data in these areas are not of particularly good quality, especially in international data sources.

Medium: For estimating the domestic extraction of fodder biomass, we developed and applied new procedures, including regionalised factors for estimating the potential of land to supply animal fodder, a dual approach to calculate „grazing" (we compared supply and demand estimates to cross evaluate limiting factors), and problem specific procedures to improve cross-time and cross-country comparability of fodder harvest data from FAO. These revisions significantly improved the estimate, but it still carries deficits of the primary data source with it, so we rank it as medium. Major improvements in this area can mainly be expected from new data sources, such as fodder balances.

Low: No stringent procedure to correct for data gaps in the primary sources could be applied to the category of construction minerals. We thus consider this category to be of less reliability compared to all other. International statistics are less comparable and reliable in this area, hence consistent methodologies to fill data gaps are extremely time consuming to develop. Improvements can be expected from a comparison between alternative data sources and cross checks using auxiliary data, such as construction activity or economic performance of the construction sector.

Taken together, the key to further improving data quality and compatibility is to support Member States in establishing and updating nMFAs and to start an effort to further harmonise these accounts.

Interpretation of indicators: patterns of resource use across Member States, driving forces

Our analysis revealed substantial differences in the per capita levels and material composition of DMC (and DMI) across EU-15 countries. The current levels and composition of material use indicators result from a combination of various socio-economic and bio-physical factors, among them: the state of economic development; the economic structure; the relation and relative size of the MFA-parameters DE, Imports and Exports; resource availability; land availability and use; population density; climatic conditions etc.

From the data presented here, a stringent and consistent pattern, that would explain cross-country differences, can not yet be deduced. There are tendencies, but they do not apply throughout the data sample. We can observe, for example, a tendency that sparsely populated countries have high per capita values of DMC and DE, which could lead to the idea that per capita values of resource use are correlated with available land per capita. However, as our data show, medium to low per capita values of DMC or DE are hardly related to population densities. Another tendency is that low income countries have low values of material use, but high growth rates, which correlate with economic growth. Again we see exceptions: Ireland started at a low GDP per capita and already high DMC per capita level in 1980, increased GDP per capita at enormous rates and DMC per capita only slightly. The reverse is true for Greece.

There are also significant differences in the composition of resource use cross country, which cannot easily be explained. They are not only due to resource availability, but also due to stages in the economic development and to political decisions: for example, Germany slowed down its lignite production, Greece did not, Sweden still continues to produce iron ores at considerable rates, whereas most other countries in the EU dramatically decreased or stopped iron ore production, and bauxite production only remained in Greece at considerable levels.

To further develop our understanding of cross-country differences in resource use and of the driving forces that explain trends, we have to apply more sophisticated approaches. A movement in that direction would imply the following issues:

- data should be analysed at a more disaggregated level, and we should extend the database regarding secondary data, including e.g. physical, economic, land use, regional, or social data.
- quantitative methods, using various statistical models, input/output analysis, econometric models etc. should be applied
- data quality should be evaluated in tandem, probably using uncertainty intervals.

Regarding the results presented in this report, and regarding the above suggestions, two steps towards further analysis of the driving forces for material use could be promising. First, the application of statistical methods that allow for quick selection and generation of plausible hypotheses about interrelations among variables out of a huge set of data. In particular, factor analysis and cluster analysis would be among the appropriate methods. This would imply to set up an additional data set with secondary data from various sources, including sectoral added value, energy data, production of strategic materials, labour force, capital, construction activities, land use patterns, traffic etc., which would be analysed together with the MFA data set. Second, the hypotheses emerging from such an analysis can then be tested and extended, using various quantitative approaches. Such an approach would allow an informed continuation and refinement of the analysis that we started in this project.

Interpretation of indicators: environmental pressure and sustainable development

The differences in composition and per capita levels of MFA indicators across Member States also raise questions about their interpretation in terms of environmental pressure. This issue was not explicitly addressed so far, but it is important for possible future applications of MFA indicators. We therefore would like to complete our conclusions by asking what insights in terms of environmental performance can be drawn from our results and how we could enhance our understanding in this issue.

The question at stake can be decomposed as follows:

- Does aggregation according to weight provide indicators that are at least directed in the sense that a lower level indicates an improvement?
- For cross-country comparisons absolute values have to be standardised. Is population the appropriate parameter to standardise MFA indicators according to environmental pressure?
- Are the proposed indicators derived from MFA conceptualised well enough to qualify them as environmental pressure indicators?

The first issue addresses an often repeated and so far not convincingly rejected critique against highly aggregated indicators. Without going into the details of this longstanding debate, we think that the exchange of qualitative arguments has reached saturation and that further insights can be expected mainly from quantitative analysis. Until recently, a sufficient number of case studies was not available, but this has changed in the last years. MFA data sets, as the one developed here, contain hundreds of data for the specific material components, which make up the aggregate indicators. Although methods have yet to be developed, MFA data sets allow to track substitution processes as well as to investigate specific impacts of material uses at a reasonable level of disaggregation. From such an analysis we might expect a more precise judgement concerning the directedness of MFA indicators. Our results, for example, suggest that the structure of the physical economy is quite stable at the national scale over time, but substantially divers cross-country. This might lead to the assumption that the MFA derived indicators available now are more meaningful in terms of time series analysis on the national level than for cross-country analysis.

Regarding the second issue our results suggest that population is probably not the appropriate parameter to standardise indicators derived from MFAs in terms of cross-country comparisons of environmental pressure. The use of total land area as reference parameter revealed quite different results, but was not totally convincing either.

Finally the third issue hints to the possibility to expand the current concepts of MFA indicators themselves. To enhance cross-country comparability probably new indicators from MFA have to be developed. A promising first step would be to calculate imports and exports at a raw material equivalent level, which would allow to derive new indicators for domestic material consumption and PTB which are more meaningful in cross-country comparisons and in terms of measuring externalising environmental effects of foreign trade. The possibility of alternative aggregation of the material components and alternative parameters to standardise MFA indicators should also be considered.

PART II – SOURCES AND METHODS

1. Introduction

This Part II describes all methods applied and data sources used in the compilation of the revised and updated 1980 to 2000 data set for the material use in the European Union. This Part II also discusses options for further improvement in terms of comparability and quality of the accounts, extension of the time series, and improvement of derived indicators. We organise this Part II along the following categories of main material flows: Domestic extraction (DE) of biomass (agriculture), DE of biomass (forestry), DE of biomass (fishery), DE of fossil fuels, DE of industrial minerals and ores, DE of construction minerals, and foreign trade. Table 1 gives an overview of the size and relative share (compared to domestic extraction) of these flows for the EU-15.

Table 1: Importance of main material flow categories for EU-15 in 2000

	magnitude of flow [billion tonnes]	percent of total DE
DE biomass agriculture	1.2	25%
DE biomass forestry	0.2	4%
DE biomass fishery	0.01	0.2%
DE fossil fuels	0.7	15%
DE industrial minerals/ores	0.15	3%
DE construction minerals	2.6	53%
DE total	*4.9*	*100%*
Imports (intra- and extra-EU trade)	2.5	51%
Exports (intra- and extra-EU trade)	1.5	31%
Imports (extra-EU trade only)	1.4	29%
Exports (extra-EU trade only)	0.4	9%

Note: For the EU as a whole only extra-EU trade is regarded as foreign trade. However, in order to indicate the importance of imports and exports at the national level, total trade (i.e. the sum of intra- and extra-EU foreign trade) is a better indicator.

Regarding DE, construction minerals with a share of more than 50% of the total DE are clearly the dominating fraction. The second largest flow in DE is agricultural biomass with 25%. In the same order of magnitude are the foreign trade flows with imports amounting to a size of half of the total DE and exports of roughly one third. Accordingly, our efforts to improve data quality concentrated on these four flows (DE of agricultural biomass, DE of construction minerals, imports and exports).

2. Domestic extraction of biomass (agriculture)

In the EU the share of agricultural biomass in the total DE of biomass was constantly at 85% over the whole period of time. Compared to total domestic extraction (all domestic materials) agricultural biomass was between 22 and 25% in the period from 1980 and 2000.

Domestic extraction of biomass (agriculture) was newly compiled for the whole period of time (1980-2000). Data for production and area were obtained from FAO (FAO 2001a, CD-ROM). The raw data set comprises all primary crops. To obtain a consistent, complete, and cross-country comparable data set we applied the following revisions of the primary FAO data and additional estimations.

2.1. Primary crops production from arable land and permanent crops

A) Correction of statistical breaks in FAO database „all primary crops", 1980-2000

FAOSTAT 2001 download of all primary crops production was screened for statistical breaks and inconsistencies with MFA methodology. Statistical breaks exclusively were found in fodder crop categories (i.e. item code group 600[12]).

The nature and significance of the statistical breaks differ among the EU Member States and across time as does the allocation of agricultural products to product items given by FAO. We therefore decided on a step by step approach. (1) We identified statistical breaks in area, production, and yield time series data for each EU Member State. (2) We then defined types of statistical breaks and developed type-specific procedures to revise the data. (3) Finally, we applied these procedures to each country's specific problems. The underlying hypothesis was that in agricultural statistics area data in general are more reliable than production data.

Identified statistical breaks in the primary FAO data set and applied revisions by country:

Austria
Area: total area drops from 2.4 mio ha to 1.6 mio ha from 1984 to 1985. Comparison with national statistics revealed that roughly 1 mio ha of permanent pastures wrongly had been reported as agricultural area in the years prior to 1985. No correction needed because we took data from the national MFA.

Belgium/Luxembourg
Production: category 651 is split into categories 636, 640, 641, and 645 after 1984, sum total remains constant, no estimates needed.

Denmark
Production: category 640 is divided into 640, 638, 639 after 1984, sum total remains constant, no estimates needed. No production data for 640 before 1982.
Area: consistent data for 640.
Revision: estimation of 640 production before 1982 using 1982 yield and annual area.

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[12] The applied corrections refer to the following material categories (FAO item codes):

636 Maize for Forage+Silage	644 Cabbage for Fodder
637 Sorghum for Forage+Silage	645 Mixed Grasses & Legumes
638 Rye Grass, Forage+Silage	646 Turnips for Fodder
639 Grasses nes, Forage+Silage	647 Beets for Fodder
640 Clover for Forage+Silage	648 Carrots for Fodder
641 Alfalfa for Forage+Silage	649 Swedes for Fodder
642 Green Oilseeds for Fodder	651 Forage Products nes
643 Leguminous nes, Forage+Silage	655 Vegetables+Roots, Fodder

Finland
Production and area statistics: new categories 645 and 649 introduced in 1985.
Revision: Estimation of production for years 1980-84 using 1985 production values.

France
Production: New categories 638, 641, 642, 645, 655 are introduced in 1985, leading to an increase in fodder production of 120 mio tonnes compared to 1984.
Area: Aggregated area data for categories 638, 639, 640, 641, 642, 643, 655 remain stable for the whole period of time. Category 639 splits into: 638, 639, 641, 642, 645, 655 in 1985.
Yield: yields of Categories 639, 640, 643 increase four to tenfold after 1984
Revision: Sum of production of categories 638, 639, 641, 642, 645, 655 for the years 1980-84 was estimated using area 639 1980-1984 and average yield of 638, 639, 641, 642, 645, 655 in 1985.

Germany
Production and area: 642 (green oilseeds) introduced in 1985. Identified as „Zwischenfrüchte" in national German Statistics (BMELF 1993 and BMELF 2000).
Revision: 642 replaced by national data (revised data in BMELF 2000) for the whole period of time.

Greece
Production and area statistics: new categories 636, 637, 639, 643 introduced in 1985.
Revision: Estimation of production for years 1980-84 using 1985 production values.

Ireland
Production and area statistics: new categories 645, 646 introduced in 1985.
Revision: estimation of production for years 1980-84 using 1985 production values.

Italy
Consistent time series in production, area and yield statistics. No estimates needed.

The Netherlands
Production and area statistics: new category 645 introduced in 1985. Production of maize for forage and silage (636) drops from 9.2 to 2.9 mio tonnes after 1997.
Revision: Estimation of production for years 1980-84 using 1985 production values. 636 production in 1998, 1999, 2000 changed to 9.2 mio tonnes (error in FAO database).

Portugal
Production and area statistics: new categories 636, 637, 645, 651, 655 introduced in 1985.
Revision: estimation of production for years 1980-84 using 1985 production values.

Spain
Allocation of material categories 640 „clover for fodder and silage“, 643 „leguminous nes“, and 645 „mixed grasses and legumes“ changed from 1984 to 1985, however, the sum of both production and area of all 3 categories show steady trends. All 3 material categories were allocated to „mixed grasses and legumes“.

Sweden
Production and area statistics: new category 645 introduced in 1985 (leading to a threefold production from arable land).
Revision: Estimation of production for years 1980-84 using 1985 production values.

United Kingdom
Revised data by the Office for National Statistics (ONS) were used.

B) Correction of grass harvest from arable land from fresh weight to 15% water content

Grass harvest in FAO statistics is reported as fresh weight (appr. 80% water content), whereas in primary statistics (we checked national statistical sources for Austria, Germany, and United Kingdom) grass harvest is reported in hay weight, i.e. appr. 15% water content. This leads to inconsistencies between nMFAs and estimates that use FAO data. As in some Member States grass harvest from arable land by far dominates total production from arable land the difference between fresh weight and hay weight may be enormous. For example in Sweden, total DE from arable land amounts to roughly 30 mio tonnes if grass harvest is given in fresh weight and to 15 mio tonnes if grass harvest is given in hay weight.

In addition to grass harvest, also direct grass uptake by ruminants („grazing") is included in the MFA accounts for DE. This flow normally is not reported in the primary statistics. An exception is Germany, where grazing is reported in the primary statistics, here the figures are given in hay weight. In most cases, however, grazing has to be estimated. Eurostat 2001b states that in material flow accounts grazing should be calculated in hay weight. Therefore a further bias is introduced if grass harvest is given in fresh weight and grazing in hay weight.

For reasons of consistency all grass categories, i.e. grass harvest and grass input by grazing from permanent pastures, should be included in the material flows accounts with 15% standardised water content.

We converted all primary crop categories from the FAO database, which clearly can be identified as grass harvest (i.e. 638, 639, 640, 641, 643, 645) to 15% water content using the following procedure.
yield (fresh weight: 80% water content) * 0.2 * 100 / 85 = yield (hay weight: 15% wc)
area * yield (15% wc) = total production (revised)

2.2. Straw, fodder beet leaves, and sugar beet leaves

All data for estimations for straw, fodder beet leaves, and sugar beet leaves were calculated from FAOSTAT 2001 production of primary crops using the following procedures:

Straw
Basis: production of all cereals except maize. We used the same coefficients as Eurostat 2001 (i.e., relation corn to straw = 1, relation straw used to total production of straw = 0.5, coefficients from Dissemond 1994)

Fodder beet leaves
New coefficients derived from BMELF 2000 (Germany):
relation beet to leave : 0.33
relation used leaves: 0.8

Sugar beet leaves
New coefficients derived from BMELF 2000 (Germany): relation beet to leave: 0.8
relation used leaves: 0.25.

2.3. Biomass uptake from permanent pastures („grazing")

According to Eurostat 2001 fodder from permanent pastures for livestock, including the fodder directly taken up by ruminants („grazing"), is counted as used extraction. This category of grazing is especially sensitive. First, it may add considerably to the total domestic extraction of biomass. Second, usually no primary data are available so it has to be estimated. Depending on the coefficients and applied methods the estimated data may vary substantially.

To narrow the range of uncertainty, we estimated both demand of animal fodder for ruminants and supply from permanent pastures for each Member State, compared both estimates and used the lower value for compiling DE of biomass.

The supply estimate

The area of permanent pastures (as given in FAO statistics) was multiplied with annual yield coefficients. Yield coefficients (converted to hay weight) were taken from FAO production and area statistics of primary crops. The basic idea was to choose the category representing most closely the productivity of permanent pastures, which is the grass production category with the lowest yield. The precise item code varies between Member States. We further reduced this respective yield by 15% to correct for an intrinsic overestimation in this procedure which stems from two sources. First, productivity of permanent pastures is considered to be lower than productivity on arable land. Second, the actual amount of fodder uptake is below total productivity.

Table 2. Source for productivity coefficients for estimating supply of animal fodder from permanent pastures.

Country	FAO item code
Austria	est. by Statistics Austria
Belgium-Luxembourg	639
Denmark	639
Finland	645
France	645
Germany	643, 645, 651 (depending on the year)
Greece	639
Ireland	645
Italy	639
Netherlands	645
Portugal	645
Spain	645
Sweden	645
United Kingdom	est. by ONS

The demand estimate

We calculated the fodder demand of ruminants (i.e. cattle, goats, horses, sheep) by multiplying annual livestock data (heads/year/Member State/species – FAO data) with average values for fodder demand in dry matter (Löhr 1990). Coefficients in dry matter were used to compensate for the fact that ruminants are not exclusively fed by grazing, but also to a varying degree by marketed fodder.

Table 3. Coefficients used to calculate fodder demand of ruminants

Species	average fodder demand	
Cattle	9	kg DM/head/day
Goats	1	kg DM/head/day
Horses	11	kg DM/head/day
Sheep	1	kg DM/head/day

For Member States with huge areas of permanent pastures compared to livestock numbers the demand estimation resulted in lower values (Belgium/Luxembourg, France, Greece, Ireland, Spain) as compared to the supply estimate.

In the previous data set (Eurostat 2001a) only the procedure to account for productivity of land supplying fodder was applied, using coefficients, which did not differentiate between Member States. As the coefficients were chosen from the upper level of the European productivity range grazing was significantly overestimated in the previous data set. Thus, our revision revealed lower values for grazing (as compared to the previous estimate) also for those Member States for which we used the supply estimate, because we used country specific productivity values.

3. Domestic extraction of biomass (forestry)

3.1. Applied procedures

The domestic extraction of forestry products in time series (1980-2000) was estimated using data from FAO forestry production (FAO, 2001a and www.fao.org). As items have been appraised: Sawlogs and veneer logs, pulpwood - round and split, other industrial roundwood, fuelwood; for these four items two categories have been distinguished: coniferous wood and non-coniferous wood. In contrast to the previous estimate, wood for charcoal was not considered, because this item is already comprised in the production statistic for fuelwood (FAO 1984, FAO 1999).

We used data from national Material Flow Accounts (nMFA) for all Member States (Germany, Austria, Sweden, Finland, United Kingdom) and years available. We estimated values for the missing years using the following procedures: Sweden 1980-86 and 1999-2000, Finland 2000: FAO based estimate was multiplied with the average ratio nMFA data/FAO estimate of all years where national data were available. Germany: 1980-92 data from the WI estimate (Eurostat 2001a) were used. 1999-2000: same procedure as above. Austria: procedures and data sources as in Gerhold and Petrovic 2000).

FAO data on forestry production are reported in cubic meters (CUM; m^3) roundwood underbark (i.e. excluding bark). The database comprises all wood obtained from removals (including, e.g., natural losses that are recovered). The conversion from cubic meters to tonnes has been performed for all countries by applying the same coefficients as used in Eurostat (Eurostat 2001a); derived from German statistics): 0.75 tonnes per m^3 for coniferous wood, 0.85 tonnes per m^3 for non-coniferous wood. These factors comprise the wood density coefficient (to obtain mass dry matter) as well as the water content coefficient (standardised to 15% wc).

Due to the high concordance of data sources and factors applied almost no divergence is found to exist. A slight deviation from the former MFA data set is due to the fact that the apparent double-counting (inclusion of the item „wood for charcoal“ in the previous calculation) was removed. This deviation is found to be less than 3% (of the category DE forestry) in single years for single countries (e.g. Spain between –2,2% and -2.9%, France: between 0% and -1.7%; Portugal: between 0,9% and 1,3%, others less than -1%.), whereas the trend of the two estimates is practically identical (0.96 r^2 0.99). Another negligible deviation for the later years is due to the preliminary nature of the FAO data (FAO updates its database irregularly and publishes estimated values – not reported data – for recent years).

3.2. Data reliability, remaining problems, further improvements

Coefficients

To convert forestry production data from cubic meters to tonnes, two coefficients have been applied for all member countries: 0.75 tonnes/m^3 for coniferous and 0.85 tonnes/m^3 for non-coniferous wood. These factors, derived from German statistics, have been applied in the previous MFA estimate. These coefficients account both for water content and wood density. Wood density coefficients convert the production data from volume to mass dry matter (assuming no water content), whereas water content coefficients account for the water content as percentage of total mass. As the latter shows a wide range (from appr. 30% to 60% at the time of harvest, to appr. 10-15% for air-dry wood, e.g. logs, panels), Eurostat (2001b) recommends to report wood DE with 15% water content. The use of coefficients which do not distinguish between the assumed values for density and water content respectively, prevent harmonisation efforts.

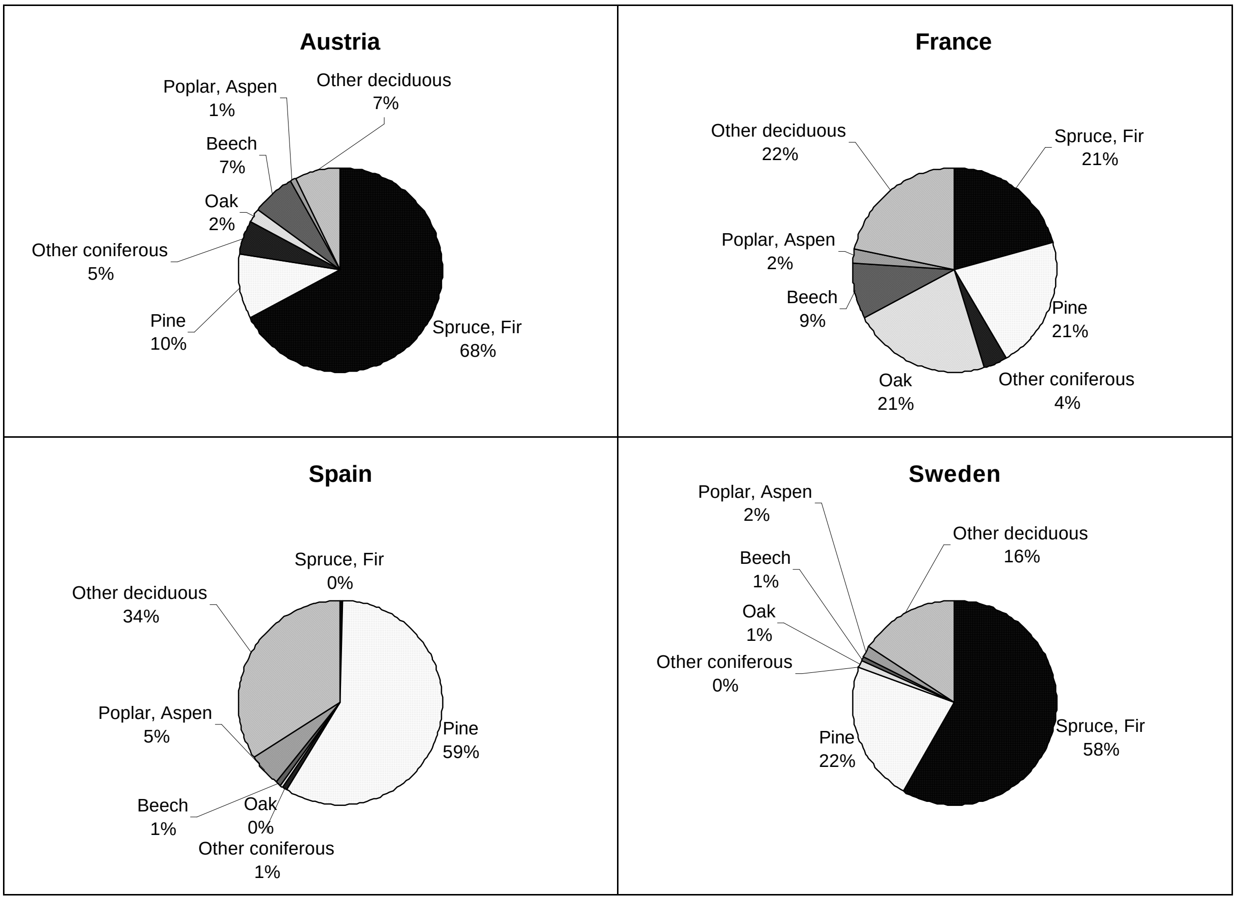
In order to improve the data set according to this issue (conversion from wood volume to wood mass), a more detailed approach would be necessary. Such an attempt was not undertaken in this study, however, as domestic extraction of wood biomass is significant on the EU-level only in Germany, Austria, Sweden, Finland and France. For these countries, except France, national material flow accounts have entered the final MFA data set. In general, these national accounts are of higher reliability and quality due to the inclusion of national databases and country-specific information (e.g. wood balances, specific national coefficients for the volume-to-mass conversion).

It will depend on the policy use of MFA indicators, whether the additional effort to improve the coefficients will pay. Apart from coefficients which explicitly distinguish between density and water content, improvements can be expected from taking into account regional differences. As Figure 1 illustrates for Austria, France, Spain and Sweden the share of different tree species used for wood production varies widely among the different countries.

Furthermore, as Figure 2 indicates, wood density is highly variable across Europe, as well as among and within the different tree species. The large density band width of the distinct tree species depends, apart from species-specific characteristics, on site-specific parameters affecting plant growth such as climate, length of vegetation period, and soil, among others. Using country specific data – which in general are based on site-specific information – would substantially narrow the error margins indicated in Figure 2. Hence, the combination of such country-specific (or even site-specific) with species-specific information, could improve the assessment of the domestic extraction of forestry products. Anyhow, such data is not readily available on the EU-level. Rather it has to rely on a broad range of statistical sources, such as wood balances and national forest inventories, among others (for a discussion on this topic see below).

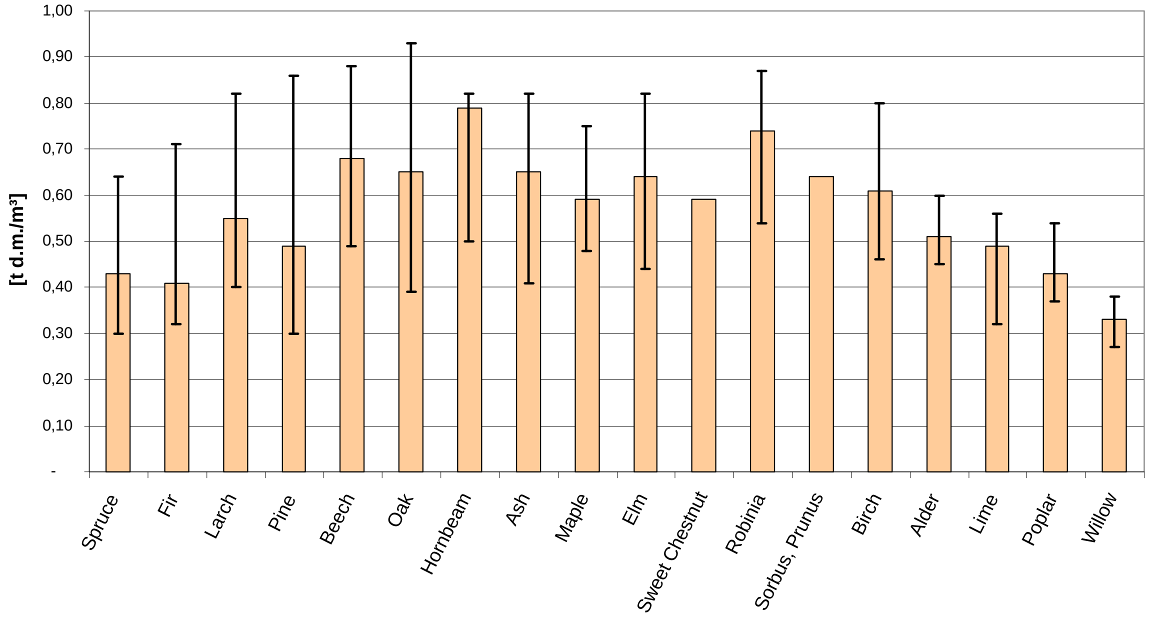
Although the expected improvements may not be substantial on an highly aggregated level, due to the minor importance forestry products play in the EU, such an improvement (and, furthermore, an assessment of the uncertainties associated with the data) may be desirable as it would provide a strong link of Material Flow Accounting to Carbon Accounting, an approach strongly favoured by the International Institute for Systems Analysis (IIASA) (see Jonas and Nilsson, 2001). Forest management plays a crucial role in the ongoing discussions on national Greenhouse Gas Accounts in the context of human induced carbon flows due to land use and land cover change (Borden et al. 2000, Schimel et al. 2001). This issue has gained much scientific and political attention in the last decade and its implementation in Climate Change policies is of increasing importance (Valentini et al. 2000). To achieve compatibility of MFA and Carbon Accounting definitely is one promising option to further improve policy use of MFA (Jonas and Nilsson 2001, Kubeczko 2001, Geisler and Jonas 2001).

Figure 1. Share of the main tree species according to wood harvest in Austria, France, Spain and Sweden



Source: own compilations from national forest inventories available on the internet: Austria: http://fbva.forvie.ac.at; France: http://www.ifn.fr/pages/index-gb.html; Spain: http://www.ine.es; Sweden: http://www-nfi.slu.se.

Figure 2. Wood density and range of coefficients of different tree species



Source: Wagenführ and Scheiber 1974, Kollmann 1982, Lohmann 1987, quoted in Weiss et al. 2000. D.m. = dry matter. The height of the columns represents the mean density of the different tree species, the error indicators reflect the extreme range of the coefficients as indicated by the literature sources. For sweet chestnut and *prunus sp.* no such coefficient range is available.

Quality of the FAO database

The FAO wood production statistics contain – according to their own specification – all wood obtained from removals, with or without bark (nevertheless reported underbark), from forests and trees outside forests, including wood recovered from natural, felling and logging losses during one calendar year. A comparison of the FAO data set with international compilations of forest inventories, such as the TBFRA 2000 (United Nations 2000) and the FRA 2000 (FAO 2001b) reveals that the FAO data underestimates domestically extracted wood. FAO relies on national statistics and reports parameters which are easily measurable on an annual basis, such as inputs of raw material to the forest industries, and hence does not include all forestry products extracted by society, whereas forest inventories or wood balances try to collect data and complete insufficient databases (e.g., statistically not included items such as the removal of bark, stumps, burls etc.) on basis of expert estimates. Furthermore, FAO reports forestry production in units underbark (i.e. without bark), regardless if the bark is removed or not. Anyhow, due to lack of information it is not an easy task to relate different items from forest inventories as reported by different national forest inventories (such as e.g. „total fellings overbark“, „fellings overbark – forest total“, „total removals overbark“, etc., see Table 3) to system boundaries used in MFA. As the TBFRA 2000 states, forest inventory data on fellings and removals have a number of inherent problems which are „almost impossible to resolve in the short term”. (United Nations 2000, p. 144). Although it is not yet fully clear which items from TBFRA best refers to domestic extraction in a MFA sense, the relation of the values given by FAO and the data from the forest inventories as compiled in the TBFRA at least reveal the magnitude to which the FAO data set underestimates the domestic extraction of wood in the different EU countries.

Table 4. Comparison of the FAO forestry data set and data sets from national forest inventories

	Reporting period of Forest Inventories	FAO [1 000 m³] mean*	TBFRA 2000 [1 000 m³] Total fellings overbark		Fellings overbark Forest total		Fellings overbark Forest available for wood supply		Fellings overbark Commercial use		Total removals overbark	
European Union (15)		246 242					302 505	(123%)	264 657	(107%)		
Austria	92-96	14 136	20 040	(142%)	19 821	(140%)	19 521	(138%)	16 921	(120%)	17 171	(121%)
Belgium-Luxembourg	86-95	4 320	4 400	(102%)	4 400	(102%)	4 400	(102%)	4 400	(102%)	4 400	(102%)
Denmark	96	2 282	2 444	(107%)	2 194	(96%)	2 194	(96%)			2 194	(96%)
Finland	91-96	43 525	54 300	(125%)	54 300	(125%)	54 300	(125%)	47 700	(110%)	49 500	(114%)
France	96	40 443	60 174	(149%)	60 174	(149%)	60 174	(149%)	47 403	(117%)	47 611	(118%)
Germany	96	37 014	48 584	(131%)	48 584	(131%)	48 584	(131%)			38 867	(105%)
Greece	92	2 321									2 408	(104%)
Ireland	96	2 291	2 330	(102%)	2 330	(102%)	2 330	(102%)	2 330	(102%)	2 330	(102%)
Italy	95	9 736	10 101	(104%)	8 746	(90%)	8 746	(90%)	8 746	(90%)	8 381	(86%)
Netherlands	91-95	1 120	2 150	(192%)	1 561	(139%)	1 438	(128%)	1 394	(125%)	1 219	(109%)
Portugal	95	9 451	11 500	(122%)	11 500	(122%)	11 200	(119%)	11 000	(116%)	11 400	(121%)
Spain	94	15 305	15 863	(104%)	12 639	(83%)	11 028	(72%)				
Sweden	92-96	56 744	67 766	(119%)	66 510	(117%)	66 115	(117%)	61 488	(108%)	61 593	(109%)
United Kingdom	95	7 555	9 500	(126%)	9 500	(126%)	9 500	(126%)	9 400	(124%)	8 200	(109%)

* arithmetic mean of FAO values (annual production statistic) according to the reporting period of the national forest inventories. Source: FAO 2001a, United Nations 2000
Percentage in brackets indicate the level of the different accounts from the forest inventories (as reported in TBFRA 2000) in comparison to the FAO production mean for the period.

The example of Austria, where consistent data sets with regard to material flow accounts exist, illustrates the shortcomings of the FAO timber database. The Austrian wood balance (Gerhold, 1994) contains data on fellings and removals, additional data on wood harvest from trees outside forests and estimates of bark, stumps etc. harvested in a MFA compatible framework. This gives a value for domestic extraction of woody biomass of 20.8 mio m³, indicating that the underestimation of the FAO data is even more significant than suggested by the forest inventory data in Table 4.

On the other hand the FAO data set is found to be the most comprehensive international data compilation for forestry products with regard to time series consistency and completeness (an issue not covered in general by forest inventories), and is also used in other reporting schemes, such as, for example, the UN-ECE database on forestry production and trade (UN-ECE 2002).

We conclude that the MFA estimate for forestry products (referring to domestic extraction) based on the FAO database reaches only intermediate data quality. As forestry does not play an overwhelming role for the generation of headline-indicators on the national and supranational level, such limitations can be regarded to be of minor importance, as long as only highly aggregated indicators are used. If MFA data are to be used also on a disaggregated level and/or in combination with other environmental accounting tools, such as carbon accounting, a more detailed approach based on additional national data and country-specific information is indispensable.

4. Domestic extraction of biomass (fishery)

4.1. Procedure

The data set on fishery published in the Eurostat Working Papers 2/2001/B/2 „Material use indicators for the European Union, 1980-1997” (Eurostat 2001b) was based on the FAO database. As the overall task formulated in the tender was to „improve and expand the existing data set” we based our data compilation on fishery also on the FAO database. However, for reasons of consistency and to get the latest revision we worked with original downloads instead of using the data of the previous publication.

Fishery data in the FAO database

The fishery data in the FAO database is available on the internet and is structured according the following criteria:

- period: data on fishery is available for the years 1960-99
- countries: any country of the world and several aggregates like political or economic communities are listed
- species: fishery is differentiated according to 50 groups of species (containing 1142 species items) of the FAO International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) FAO 2002
- fishing areas: in the FAO database 27 major fishing areas are identified: FAO 2002
    - eight major inland fishing areas covering continents
    - nineteen major marine fishing areas covering the waters of the Atlantic, Indian and Pacific Oceans and the „southern oceans“ (the Antarctic), with their respective adjacent seas
- unit: catches are expressed in tonnes

Relevant definitions

Some relevant issues need to be addressed to get an idea about the data quality and the quantities that are included respectively excluded. In the following we will therefore list some key definitions of the FAO concerning capture versus aquaculture and nominal catches versus landings.

Capture production

The total fish catch covers(FAO 2000b):

- nominal catches of fish, crustaceans, molluscs, other aquatic animals, residues and plants
- taken for all purposes: commercial, industrial, recreational, subsistence
- taken by all types and classes of fishing units: fisherman, vessels, gear etc.
- inland, fresh and brackish water areas
- inshore, offshore and high seas fishing areas
- killed, caught, trapped or collected
- mariculture, aquaculture and other kinds of fish farming are excluded
- the flag of vessel is used to assign its nationality, thus also those catches landed in foreign harbours are considered as capture of the country identified by the flag.

Nominal catches versus landings

- catches are reported as nominal catches which refers to the landings converted to a live weight equivalent
- landings refers to the net weight of the quantities landed as recorded at the time of the landing
- nominal catches = (landings + losses due to dressing, handling and processing – gains prior to landings) * conversion factors

Aquaculture production

Aquaculture covers per definition (FAO 2000a) the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production. Farming also implies individual or corporate ownership of the stock being cultivated.

Aquaculture production is reported by three culture environments (FAO, 2000a):

- freshwater: waters with a consistently negligible salinity
- brackish water: waters in which the salinity is appreciable but not to a constant high level. It is usually characterised by regular daily and seasonal fluctuations in salinity due to freshwater and full strength marine water influxes. Enclosed coastal and inland water bodies in which the salinity is greater than freshwater but less than marine water are also regarded as brackish.
- marine: coastal and offshore waters in which the salinity is maximal and not subject to significant daily and seasonal variation.

Whether the production from aquaculture should be regarded as domestic input or not is not yet sufficiently discussed. The societal influence on the natural living and reproduction conditions is manifold and appears on different levels. Similar to the methodological convention concerning game and livestock the question is where to draw the boundary between the natural and the societal system and resulting from this what to count as inputs and what as flows within the societal system. One approach could be to assume that the societal influence on the production from mariculture is rather minor because the animals are not fed but only limited in their living space. Whereas the animals kept in freshwater culture are fed and therefore only the food has to be counted as input and not the harvest of the fed animals so as to avoid double accounting.

But still, for an MFA-consistent decision further analysis on the production conditions in aquaculture is needed. For the time being we decided to account all production from aquaculture as domestic extraction.

Calculation of the data for 2000

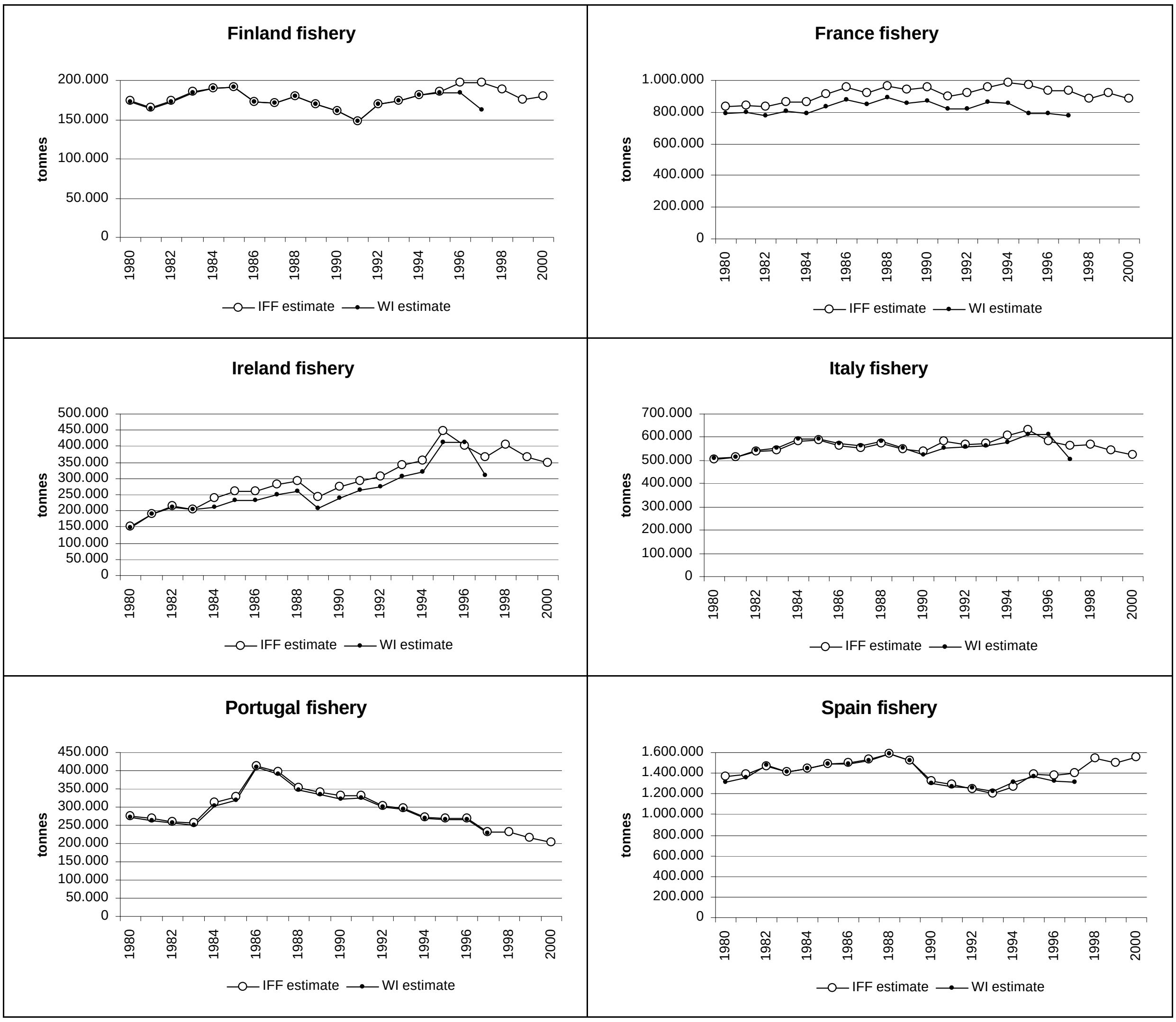
The FAO data covers the fishery production till the year 1999. The values for the missing year 2000 we obtained by applying a linear extrapolation of the data from 1995-99.

4.2. Final data set

The available data set shows the total fishery production (capture + aquaculture) for the EU-15 countries from 1980 to 2000. The data set mainly consists of data from the FAO database, the data for 2000 is an estimation based on a linear trend extrapolation. Where available we integrated national MFA data.

A comparison to the WI-data set shows high congruence for the most country data (Figure 4). In cases where nMFA were available these data were used. Slightly diverse values for the 1990s can be explained by data revisions by FAO.

Figure 4. Comparison WI data set and IFF data set



4.3. Open questions and further procedure

Concerning the fishery data no pressing problems remained. The FAO database provides high-quality data in all necessary partitions that cover the whole investigated period and still offers the possibility of enlarging the current time series both back and forth.

However, two possible starting points for a deeper debate can be addressed. The integration of aquaculture production is not yet adequately considered as already discussed above. Another problem arises by taking a look on the impacts of societal induced material flows. Thinking in physical values fishery plays a negligible role in MFA. But considering the impact on the natural environment fish catch does have an enormous impact on an ecosystem that is not yet fully investigated and thus effects can not yet be anticipated. Hence, the sector fishery should not be regarded as marginal.

5. Domestic extraction of fossil fuels

5.1. General Information

Data for fossil fuels are included in the UN-ICYS data set (CD-ROM), they can be taken from IEA/OECD sources (CD-ROM and printed documents), they are also part of USGS Minerals Yearbooks (downloads as pdf-files). A comparison of UN-ICYS and IEA/OECD data shows that – although definitions of material categories differ slightly – data are similar (with a very few negligible exceptions). IEA/OECD sources are the most comprehensive, and therefore we mainly took data from this source.

Domestic extraction of fossil fuels comprise the following material categories (Table 5):

Table 5. Fossil fuels as reported in IEA/OECD sources, aggregated according to Eurostat 2001b

Fossil fuels		
	Hard Coal	
		Coking Coal Other Bituminous Coal & Anthracite
	Lignite/Brown Coal/Sub-bituminous Coal	
		Lignite and Brown Coal Sub-bituminous Coal
	Crude Oil (incl. NGL)	
		Crude Oil Natural Gas Liquids (NGL)
	Natural Gas	
	Peat	

Definitions from IEA/OECD:

Coking coal: „Coking coal refers to coal with a quality that allows the production of a coke suitable to support a blast furnace charge. Its gross calorific value is greater than 23 865 kJ/kg ... on an ash-free but moist basis.“ (IEA 2000, I.9)

Other bituminous coal and anthracite: „Other bituminous coal is used for steam raising and space heating purposes and includes all anthracite coals and bituminous coals not included under coking coal. Its gross calorific value is greater than 23 865 kJ/kg (….) but usually lower than that of coking coal.“ (IEA 2000, I.9)

Sub-bituminous coal: „Non-agglomerating coals with a gross calorific value between 17 435 kJ/kg ... and 23 865 kJ/kg ... containing more than 31 per cent volatile matter on a dry mineral matter free basis.“ (IEA 2000, I.9)

Lignite and brown coal: „Lignite/brown coal is a non agglomerating coal with a gross calorific value of less than 17 435 kJ/kg (…) and greater than 31 per cent volatile matter on a dry mineral matter free basis.
Oil shale and tar sands produced and combusted directly are included in this category. Oil shale and tar sands used as inputs for other transformation processes are also included here. This includes the portion of oil shale and tar sands consumed in the transformation process. Shale oil and other products derived from liquefaction are included in *from other sources* under crude oil (*other hydrocarbons*).“ (IEA 2000, I.9)

Crude Oil: „Crude oil is a mineral oil consisting of a mixture of hydrocarbons of natural origin, being yellow to black in colour, of variable density and viscosity. It also includes lease condensate (separator liquids) which are recovered from gaseous hydrocarbons in lease separation facilities.
Other hydrocarbons, including synthetic crude oil, mineral oils extracted from bituminous minerals such as shales, bituminous sands, etc., and oils from coal liquefaction are included in the row *from other sources*. [...] Emulsive oils (e.g. orimulsion) are included here." (IEA 2000, I.10)

Natural Gas Liquids (NGL): „NGLs are the liquid or liquefied hydrocarbons produced in the manufacture, purification and stabilisation of natural gas. These are the portions of natural gas which are recovered as liquids in separators, field facilities, or gas processing plants. NGL include but are not limited to ethane, propane, butane, pentane, natural gasoline and condensate. They may also include small quantities of non-hydrocarbons." (IEA 2000, I.10)

Natural Gas: „Natural gas comprises gases, occurring in underground deposits, whether liquefied or gaseous, consisting mainly of methane. It includes both „non-associated" gas originating from fields producing only hydrocarbons in gaseous form, and „associated" gas produced in association with crude oil as well as methane recovered from coal mines (colliery gas).
Production is measured after purification and extraction of NGL and sulphur, and excludes re-injected gas, quantities vented or flared. It includes gas consumed by gas processing plants and gas transported by pipeline." (IEA 2000, I.12) Data are reported as gross calorific values.

Peat: „Combustible soft, porous or compressed, fossil sedimentary deposit for plant origin with high water content (up to 90 per cent in the raw state), easily cut, of light to dark brown colour. Peat used for non-energy purposes is not included." (IEA 2000, I.9)

5.2. Data sources and methods applied

For the 1998-2000 update we used the WI methodology (factors, calculations) and data sources (IEA/OECD and for a few exemptions data from USGS (peat)) as in the initial data set. In particular, the sources were:

- All fossil fuels 1997-1998: Energy Statistics of OECD Countries CD-ROM, download 01-2001 from the library of the University of Vienna (data for 1997 were only used for consistency checks)
- Coal 1999: IEA/OECD 2001: Energy Statistics of OECD countries, 1998-1999
- Coal 2000: IEA/OECD 2001: Oil, Gas, Coal & Electricity. Quarterly Statistics
- Oil 1999-2000: OECD/IEA 2001: Oil Information 2001
- Natural gas 1999-2000: IEA/OECD 2001: Natural Gas Information 2001
- Peat 1999-2000: USGS 2000: Minerals Yearbook

Integration of nMFA: We used data for DE of fossil fuels for all Member States and points in time series when these were available:

- Austria 1980-98
- Finland 1980-99
- Germany 1991-99
- Sweden 1987-98
- United Kingdom 1980-2000

The **Austrian** data set was updated for 1999 and 2000 using the same data sources and the same method as in Gerhold and Petrovic 2000.

For **Finland** we used the updated and revised nMFA (Juutinen, Mäenpää 1999). The value for 2000 was derived from IEA/OECD using the average ratio of nMFA to IEA/OECD (plus peat from USGS) to adjust the level with data for 1997 to 1999.

For **Germany** the 2000 update was carried out using data from IEA/OECD and WI methodology (including conversion factors for heat values, density of natural gas). For peat no data were available and therefore the value for 1997 was also used for 2000. Data for 1980-1990 were taken from Eurostat 2001b.

The nMFA for **Sweden** cover the years 1988-98. Missing data were taken from IEA/OECD and USGS (peat).

For **United Kingdom** a 2000 update was compiled by ONS.

5.3. Improvement of data quality and open questions

In general, data quality for fossil fuels can be considered very high. For international estimations, several databases are easily accessible (e.g. IEA/OECD), which are updated annually and supplemented by specialised and sometimes quarterly up-dated information for oil, gas, and coal.

Minor improvements could be made by providing regionalised factors for density and heat values of natural gas for all European countries.

Standards are still missing for the handling of gross production, losses, flared amount and re-injection of natural gas (i.e. what has to be accounted as used DE, which parts should be considered unused extraction).

6. Domestic extraction of minerals

6.1. General information

„Minerals“ are the largest group within the DE categories, both in terms of number of materials (e.g. 41 items in EMY, 57 items in UN-ICSY) and in terms of total volume. At the same time, data quality as well as data availability varies to a large extent.

According to Eurostat 2001b minerals are further disaggregated into

- metal ores,
- industrial minerals, and
- construction minerals.

Metal ores are materials extracted from nature containing a certain level of metal(s). Ores are the raw materials for the production of metals or metal concentrates.

Industrial minerals are defined as non-metallic mineral raw materials, used exclusively or primarily for industrial purposes.

Construction minerals are raw materials extracted from nature that are used for construction directly or that are used for the production of construction materials like bricks or tiles. In some cases (e.g. clays) a certain fraction is also used for non-construction industrial processing.

To build up a data set for domestic extraction of minerals with comparable data and that is extendable with reasonable efforts from internationally available statistics is not a straightforward task. The most important international data sources for minerals are:

- United Nations (UN): Industrial Commodity Statistics Yearbook (UN-ICSY), published annually, (United Nations 1999)
- United Nations (UN): Industrial Commodity Production Statistics Database 1950-1999 (CD-ROM, content is equivalent to UN-ICSY), (United Nations 2002)
- European Commission: European Minerals Yearbook 1996/1997 (EMY), (European Commission 1998)

- United States Geological Survey (USGS): Minerals Yearbook, published annually online since 1994 (pdf-files) for each country (http://minerals.usgs.gov/minerals/pubs/)
- British Geological Survey (BGS): World Minerals Statistics, published annually, (British Geological Survey 2000)

The major problems for the use of these data sources are:

- Each database covers different materials (with sometimes different names for the same materials)
- Each uses different categories to structure and aggregate materials
- Time covered by the data sources is also quite different: EMY covers 1986-95, UN covers 1950-99 (with increasing completeness), USGS covers 1990-2000, BGS is available for a long time back, but it does not include construction minerals and therefore it was not used for the current project.
- The only data set available on CD-ROM is UN-ICSY, all other sources are available online (USGS: pdf-files) or in libraries.
- Data are far from being complete or comparable.

6.2. Update and improvement of initial estimate

Different to the previous estimate (Eurostat 2001a), in this project the distinction between „industrial minerals, ores“ and „construction minerals“ was kept to the highest level of aggregation. The reason for this is that both material categories show remarkable differences especially concerning data quality. In some cases attribution to one of the material groups is not always clear (e.g. clays for construction and clays for industrial use, Eurostat, 2001b). For practical reasons, we used the material categories from the WI data set (and files) as far as possible.

Construction minerals in the extended and improved data set therefore comprise the following categories of the UN ICSY:

- class A, C, E (sand and gravel, natural stones, and other crude and broken natural stones),
- class B (limestone and dolomite), and
- class D (clays).

All other minerals and all ores are aggregated within the category **„industrial minerals, ores“**.

Data for the update of the WI data set come mainly from USGS, in some cases we also used data from United Nations (2002). The update of the time series was carried out using the same method as the WI estimate. Domestic extraction of class A, C, E materials was estimated using data from UN-ICSY for the years 1981-92, data from USGS for the years 1990-97, and data from EMY for 1986-95. EMY data were further used as the reference level for adjustment of time series from the two other sources. This procedure leads to high adjustment factors and to sometimes implausible leaps in the resulting time series.

Integration of nMFA: We used data for DE of minerals for all Member States and points in time series when these are available:

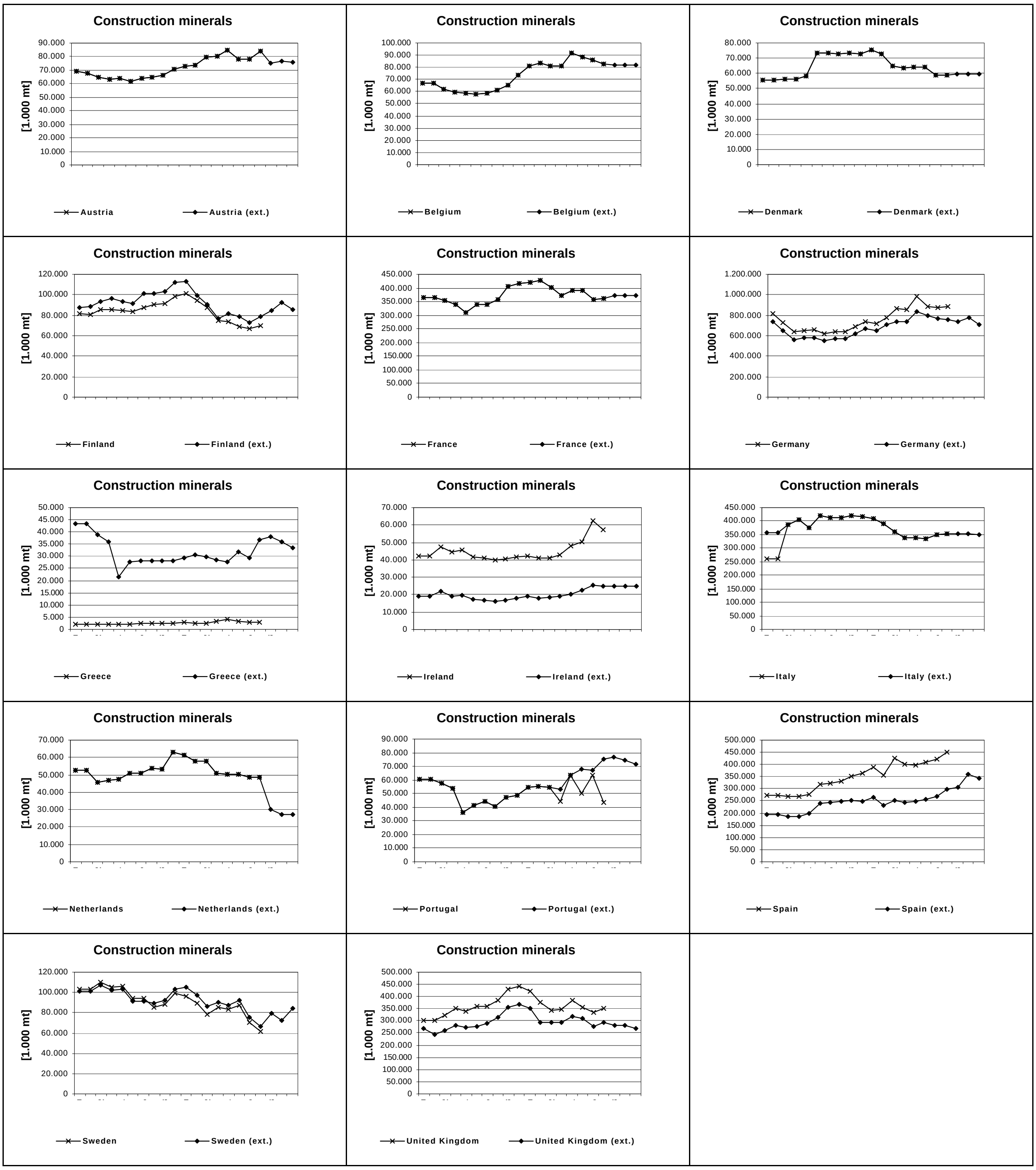
- Austria 1980-98
- Finland 1980-99
- Germany 1991-99
- Sweden 1987-98
- United Kingdom 1980-2000

Due to project constraints, we did not check the whole database systematically. Instead, we did a number of cross-checks to identify major inconsistencies, data gaps and leaps: Construction minerals vary significantly on a per capita basis, a fact that still is not very well understood. Stating that nMFA should be more reliable than international estimates we checked for implausible values in the latter group: Spain was identified as extremely high compared to Italy or Portugal, Ireland as extremely high compared to United Kingdom, and

Greece as extremely low compared to Portugal. In all three cases an in-depth analysis revealed major errors in the primary database (double counting, wrong units, missing data).

Our analysis of data led to several changes of the WI data set that are documented in the synopsis below (Table 6 and 7). Data for 1997-2000 were calculated using the same method and sources as in the WI data set. After analysing and discussing data differences and their reasons some revisions also of the historical time series were made. Third, reasons for data leaps were detected and – where indicated – data were changed. The resulting changes between the initial and the revised estimate can be seen in Figures 5 and 6 below and are described in Tables 6a and 6b.can be seen

Figure 5. Construction minerals: comparison of WI estimate and IFF estimate



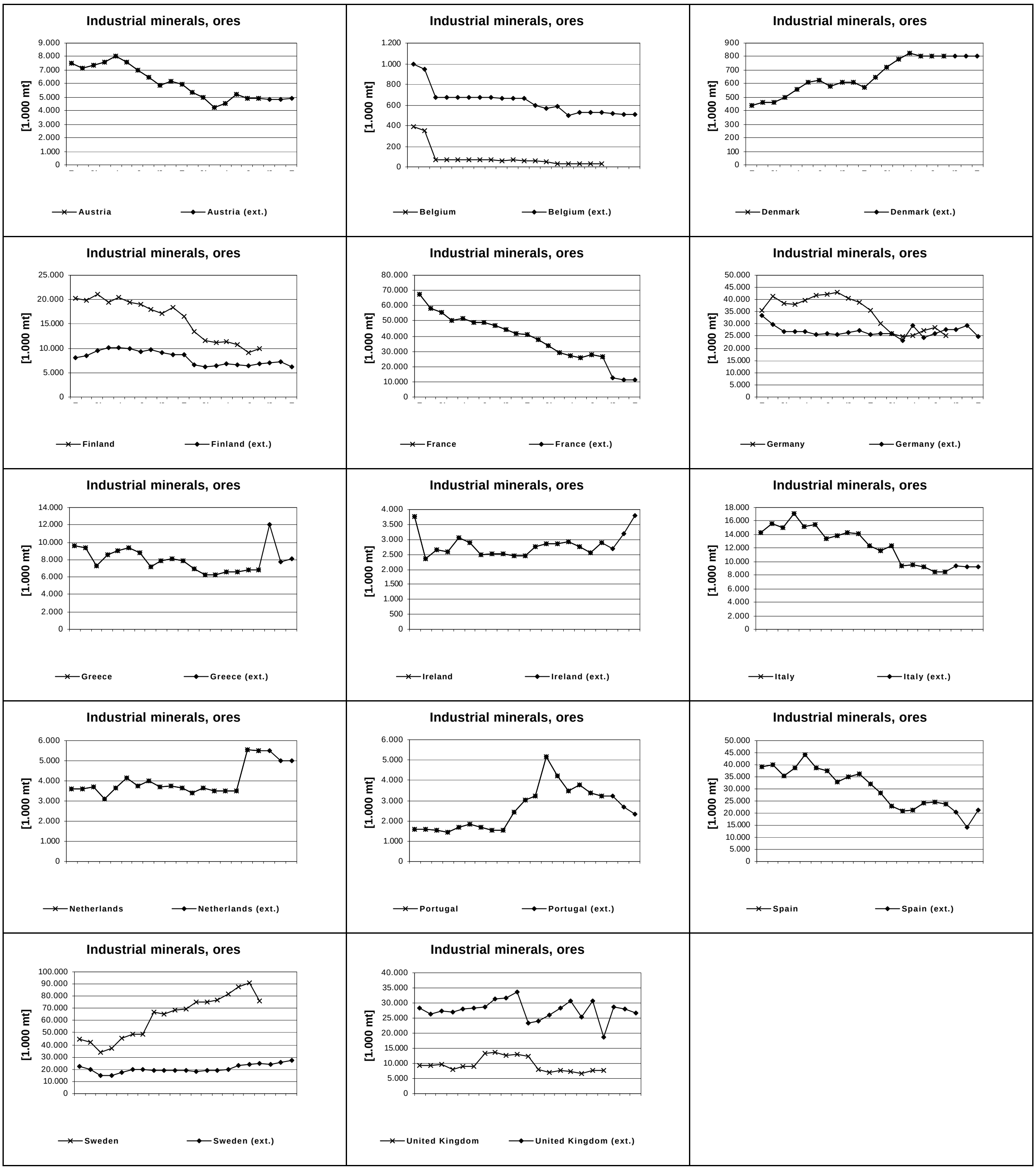
(ext.): improved and extended time series (IFF estimate)

Table 6a. Construction minerals: comparison of WI and IFF estimate

Country	Changes of time series (trend and level) compared to WI estimate	Concerned materials	Data revisions
Austria	equal		data by Statistics Austria (1980-1998); update 1999-2000 using the same data sources and methods
Belgium/ Luxembourg	equal		
Denmark	equal		
Finland	slightly different level and trend		revision of data by Statistics Finland (1980-99); data for 2000 were derived from updated WI-estimate, adjusted to the level of nMFA
France	equal		
Germany	level of revised data is lower than WI estimate, similar trend		revised data by Statistics Germany (1991-99); missing data were compiled using data from WI estimate and from primary sources (USGS), adjusted to the level of Statistics Germany
Greece	level of revised data is much higher than WI estimate, different trend	sand and gravel	no extraction of sand and gravel in WI data set, data for A,C,E from Portugal were taken instead (similar structural parameters)
Ireland	level of revised data is lower than WI estimate	other stones	data errors in USGS database: levels of production vary by a factor of 1 000: 1-2 mio tonnes (USGS 1994); 25-40 mio tonnes (USGS 1997); 35-40.000 tonnes (USGS 2000); assuming a plausible per capita extraction of construction minerals we took the level of USGS 1994 leading to a per capita extraction of construction minerals similar to United Kingdom or the Netherlands
		limestone	data for limestone show an implausible leap from USGS 1995 (level of 10 mio tonnes) to USGS 1996 (level of 1 mio tonnes); aggregation of UN-ICSY changed after 1994 (data for limestone is included in gravel and crushed stone from 1995 on); we took 1994 data from UN-ICSY for 1994 to 2000
Italy	difference in 1980 and 1981, for other years: equal trend and level	limestone flux and calcareous stone	data errors in UN-ICSY for 1980 and 1981, correction: we took data for 1982 instead
Netherlands	equal (1980-97)	sand and gravel 1998-2000	wrong unit in USGS data; we took data from UN-ICSY; 2000=1999
Portugal	equal until 1992, WI estimate shows major statistical breaks in the 1990s	granite	leaps in granite data (1993, 1995) were corrected using the average from the previous and the following year; adjusted by the relation of EMY data and USGS data
		limestone	for limestone we used reported figure instead of estimated figures (for 1993, 1995, and 1997-2000)
Spain	level of revised data is lower than WI estimate; similar trend	limestone	most probably data for limestone (however, in different aggregates) are included again in classes A, C, E in WI estimate: hence, limestone was subtracted from A, C, E (using data from UN-ICSY for 1996-2000)
Sweden	level of revised data is slightly different from WI estimate, same trend		revision of data by Statistics Sweden (1987-98); data for 1999-2000, and for 1980-86 were derived from updated WI-estimate, adjusted to the level of nMFA
United Kingdom	level of revised data is lower than WI estimate, trend is the same		revision of data by ONS (1980-2000)

INDEX

Figure 6. Industrial minerals and ores: comparison of WI estimate and IFF estimate



(ext.): improved and extended time series (IFF estimate)

Table 6b. Industrial minerals and ores: comparison of WI and IFF estimate

Country	Changes of time series (trend and level) compared to WI estimate	Concerned materials	Data revisions
Austria	equal		data by Statistics Austria (1980-1998); update 1999-2000 using the same data sources and methods
Belgium Luxembourg	level of revised data is higher than WI estimate, similar trend	natural phosphates	extraction of natural phosphates from Luxembourg are not included in WI estimate
Denmark	equal		
Finland	level of revised data is lower than WI estimate, different trend		revision of data by Statistics Finland (1980-99) (difference is due to the use of data for concentrates instead of ROM); data for 2000 were derived from updated WI-estimate, adjusted to the level of nMFA
France	equal		
Germany	different trend, (partly) different level		revised data by Statistics Germany (1991-99); missing data were compiled using data from WI estimate and from primary sources (USGS), adjusted to the level of Statistics Germany
Greece	equal for 1980-1997		
	peak in 1998	asbestos	WI estimate counted processed fibres instead of crude production; due to a lack of a complete time series for asbestos, WI estimate was not corrected for previous years
Ireland	equal		
Italy	equal		
Netherlands	equal		
Portugal	equal		
Spain	equal		
Sweden	level of revised data is lower than WI estimate, different trend		revision of data by Statistics Sweden (1987-98) (difference is due to the use of data for metal content instead of ROM); data for 1999-2000, and for 1980-86 were derived from UN-ICSY and USGS database, adjusted to the level of nMFA
United Kingdom	IFF estimate is higher than WI estimate, different trend		revision of data by ONS (1980-2000)

6.3 Further improvement of data quality

In international databases data quality of **construction minerals** can be considered as rather low. As construction minerals are not a very valuable material category in monetary terms, reported figures often are not complete and not consistently reported cross-time and cross-country.

This may even be true when using national statistics. In the case of Austria, for example, estimates for sand and gravel range from 23.7 mio tonnes (the value given in the primary data source: Industrie- und Gewerbestatistik) to 75.8 mio tonnes (estimation by Wagner/Nöstlinger).

Usually, data for construction minerals stem from a couple of different sources. Therefore it is important to check completeness and comparability of material categories and aggregates. From the primary data, it is not always clear, whether they are free of double counting, e.g. quartz sand may be reported in the category sand and gravel while it may also be included in quartz and quartzite. The same problem may occur with dimension stone and certain fractions of minerals, e.g. limestone.

Another source of uncertainty is the fraction of construction minerals extracted by small and medium enterprises from own pits. Usually, this fraction is not reported and can only be estimated. A promising way to improve data quality is to cross-check data for extraction of construction minerals with the use of these materials in industry and commerce. This would probably imply the use of national statistical sources.

In the case of **industrial minerals and ores**, data quality is much higher. Data quality could be further improved by providing more and better regional conversion factors from metal content to run of mine (ROM). This would especially effect data for metal ores with very low grades (e.g. silver, gold). However, as absolute values of domestic extraction of metal ores in general are quite low in the EU Member States (with a few exceptions) these improvements are of minor importance.

As can be seen from the MFAs compiled by the Member States, the recommendation given in Eurostat 2001b to use „run of mine" data was not applied consistently so far (e.g. Sweden, Finland).

Taken together, the two areas of accounting for domestic extraction of minerals which should further be harmonised across Member States are: the estimation of construction minerals and the „run of mine values" for ores.

7. Foreign trade

7.1. Data sources and methods applied

The data set on foreign trade published in the Eurostat Working Papers 2/2001/B/2 „Material use indicators for the European Union, 1980-1997" (Eurostat 2001a) was based on the Eurostat foreign trade database COMEXT. We used the same database but for reasons of consistency we worked with the original downloads instead of using the data of the previous publication.

7.1.1. The COMEXT database

The COMEXT database contains foreign trade data for all 15 EU Member States since 1976 or since their year of accession. The database is made available by Eurostat on two CD-ROMs. CD-ROM 1: Eurostat (1992): EEC external trade (Nimexe) 1976-87. Supplement 2. Cat.: CA-CK-92-S02-2A-Z. CD-ROM 2: Eurostat (2001d): Intra- and extra-EU trade. Supplement 2. Cat.: KS-CK-01-S02-3A-Z). The first CD-ROM contains foreign trade of EU Member States from 1976-87; the second CD-ROM comprises foreign trade data of the years 1988-2000.

Data are structured along the following categories:

- Reporting countries: the 15 EU Member States
- Partner countries: any country of the world but also aggregates like intra- and extra-EU trade
- Periods: the reported data is available for the periods 1976-2000 on an annual basis
- Products: the classification of products follows Nimexe on CD-ROM 1 and HS-CN[13] on the CD-ROM 2. Both classifications are numerical coding systems, which classify the goods based on raw materials and the stage of production of commodities (Eurostat 2002). The two classifications are very similar. Both differentiate 99 material categories on the 2-digit level with only slight changes in some categories. As we use the data on a very high aggregation level these differences can be neglected.
- Units: available units are monetary values (1000 ECU/euro), tonnes and supplementary units[14]
- Flows: imports and exports

[13] HS: „Harmonized Commodity Description and Coding System", simply the „Harmonized System", CN: „Combined Nomenclature" (Eurostat 2001d)

[14] Supplementary units are units other than net mass, for example litres, number of parts or square meters. In case of extraction on a high aggregation level, no numbers but zeros are given (Eurostat 2001d). In our data set we did not consider any other masses than those given in tonnes. The dimension of the resulting underestimation of the foreign trade cannot be quantified yet. Further analysis is needed and in a first step a rough estimation of the masses given in supplementary units could be done.

The downloads we extracted from the COMEXT -database were the following:

- Reporting countries: the 15 EU Member States
- Partner countries: intra- and extra-EU trade
- Periods: 1980 or the year of accession to 2000
- Units: tonnes
- Flows: imports and exports
- Products: We used the 2-digit level

Material categories and derived aggregates

The 99 material categories were aggregated to three groups of raw materials: biomass, minerals and ores, and fossil fuels. All semi-manufactured and finished products were allocated according to the main component. In the previous estimation some of the manufactured products had been allocated to a further category „products". Table 7 compares the aggregation procedures between the previous and the revised estimate.

Table 7. Comparison of aggregation of WI and IFF estimate

IFF data set		WI data set (Eurostat 2001a)	
naming	HS-CN categories	**naming**	**HS-CN categories**
Sum	Total of the material categories	Sum	Total of the material categories
Fossil fuels	27, 39, 40	Fuels	27, 39, 40
Minerals and ores	25, 26, 28-38, 68-99	Ores	26, 72-89
		Minerals	25, 68-71
---	---	Products	Sum minus the other material categories
Biomass	1-24, 41-67	Biomass	1976-1987: 1-24, 41-50, 53-55 1988-1997: 1-24, 41-50, 51-53

As in the WI estimate construction minerals are not listed separately. The initial plan was to apply the four material category scheme to all parameters (i.e. DE, Imports, and Exports). As it turned out though, a consistent distinction between construction minerals and industrial minerals could not be applied to foreign trade data at a 2 digit level. The alternative would have been to check data on the 4-digit level or even in more detail, which would have been too time consuming. As it can be assumed that construction minerals are mainly taken from the domestic environment and are only to a limited amount traded internationally, the error that will arise can be regarded as minor.

General trade and special trade

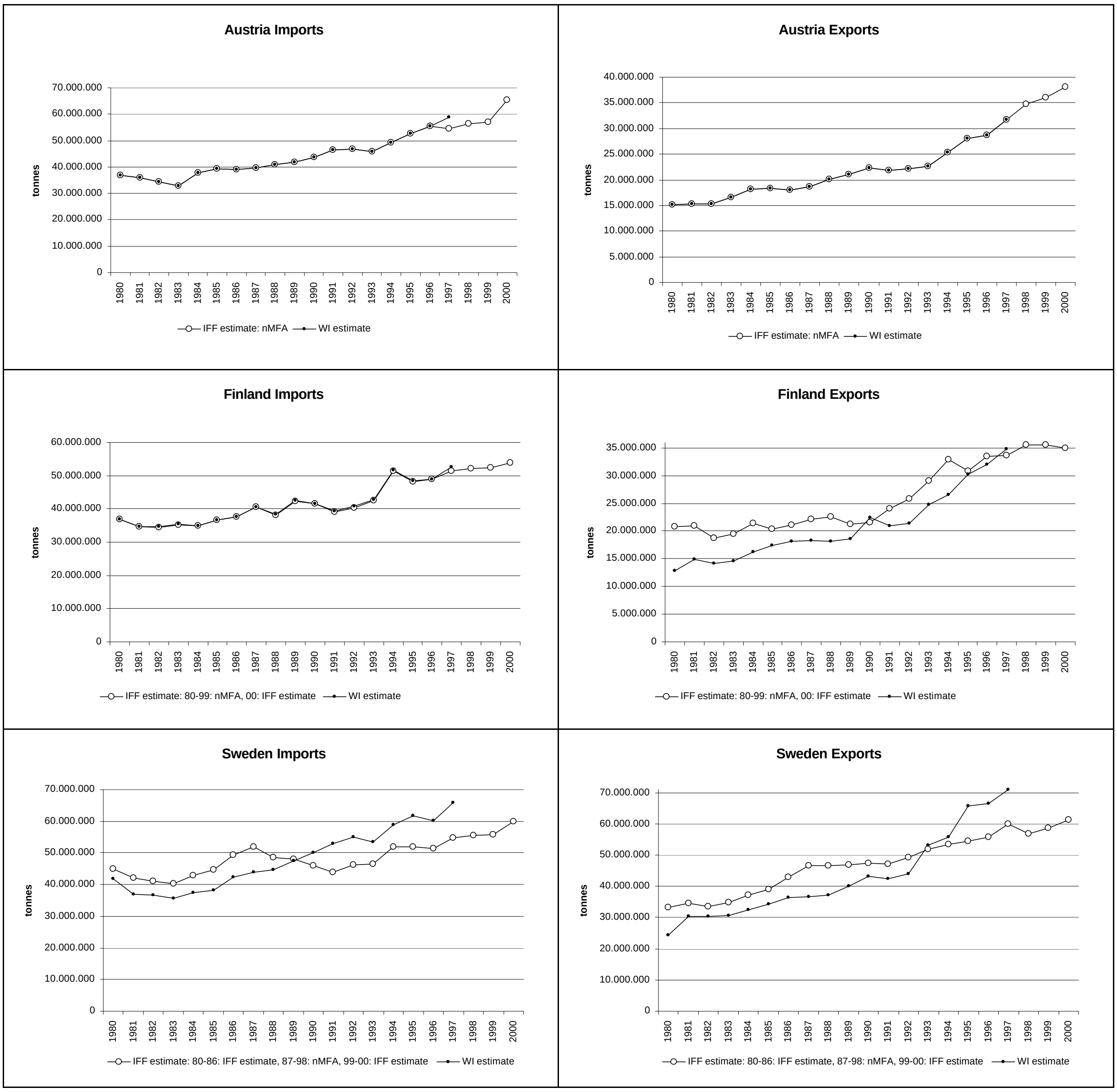
Two approaches are used for the measurement of international trade: the general trade system and the special trade system. Eurostat (Eurostat 2001d) defines the two concepts as follows:
„The general trade system is the wider concept and under it the recorded aggregates include all goods entering or leaving the economic territory of a country with the exception of simple transit trade. (…) The special trade system is a narrower concept. Goods from a foreign country which are received into customs warehouses are not recorded at that stage in the special trade aggregates but only on movement into free circulation within the country of receipt." And later: „The methodology of EU trade statistics means that extra-EU trade is compiled on a special trade basis. Intra-EU trade (…) is not precisely equivalent to either the general or special trade systems but in practice it closely matches the general trade system." This implies that intra EU trade tends to be overestimated as compared to extra EU trade.

7.1.2. Integration of national MFAs

One methodological task was to integrate national MFAs as consistently as possible. We integrated into our data set national data from the Austrian, Finnish and Swedish MFA and COMEXT data for United Kingdom and Germany. United Kingdom foreign trade data differ only slightly from COMEXT data (differences for imports are between 0.1% and 2.1%. for exports differences are between 0 and 0.2%). However, the distinction between intra and extra EU trade and the disaggregation into the three material categories (biomass, minerals, and fossils) could be done much more quickly with COMEXT data. A similar argument applies to Germany. In addition foreign trade data from national statistics for Germany were only available for the period 1991 to 1999. The differences between national data and COMEXT in the case of Germany are appr. 0.1% for imports and between 0.1 and 3% for exports.

Based on a comparison with the WI-data (see Figure 7) it can be assumed that in the previous estimate national data for Austria and for the Finnish imports were used but not for Sweden and the exports of Finland.

Figure 7. Comparison of IFF-estimate and WI-estimate



Updating to the year 2000

The last year available from national MFA data is the year 1997 for Austria, 1999 for Finland, and 1998 for Sweden. For updating the data set to the year 2000 we used data from national foreign trade statistics for Austria and COMEXT data for Finland and Sweden. We corrected the level using the ratio nMFA/COMEXT. The average ratio nMFA/COMEXT was 0.94 for Finland and 0.84 for Sweden. (The reasons why the imports and exports are lower in the nMFAs for some countries and years could not be determined. This is an issue that should be analysed further.)

Intra-/extra-EU trade

From nMFAs no distinction between intra- and extra-EU trade is available. To estimate the intra- and extra-EU share we used the ratio in the COMEXT -data for the years after accession. We calculated the proportion intra-EU/total trade and extra-EU/total trade and multiplied the total trade of the national MFA with the calculated share to obtain the figures for intra- and extra-EU trade.

For the years prior to the accession we used an average share of intra- and extra-EU trade of the years after accession and multiplied this average share with the total trade of the national MFA prior to the accession.

7.1.3. Extension of the data set back to 1980

6 countries joined the EU after the year 1980:

- 1981: Greece
- 1986: Portugal, Spain
- 1990: the former GDR with the German reunification
- 1995: Austria, Finland, Sweden

For these countries no COMEXT -data exists for the years prior to the accession. As national data for Austria and Finland are available for the years prior to accession (see section above) we only had to deal with Sweden, Greece, Portugal, Spain, and the former GDR.

In the previous estimation the following method for calculating the total, intra- and extra-EU trade for the years prior to accession was used (e.g. Greece):

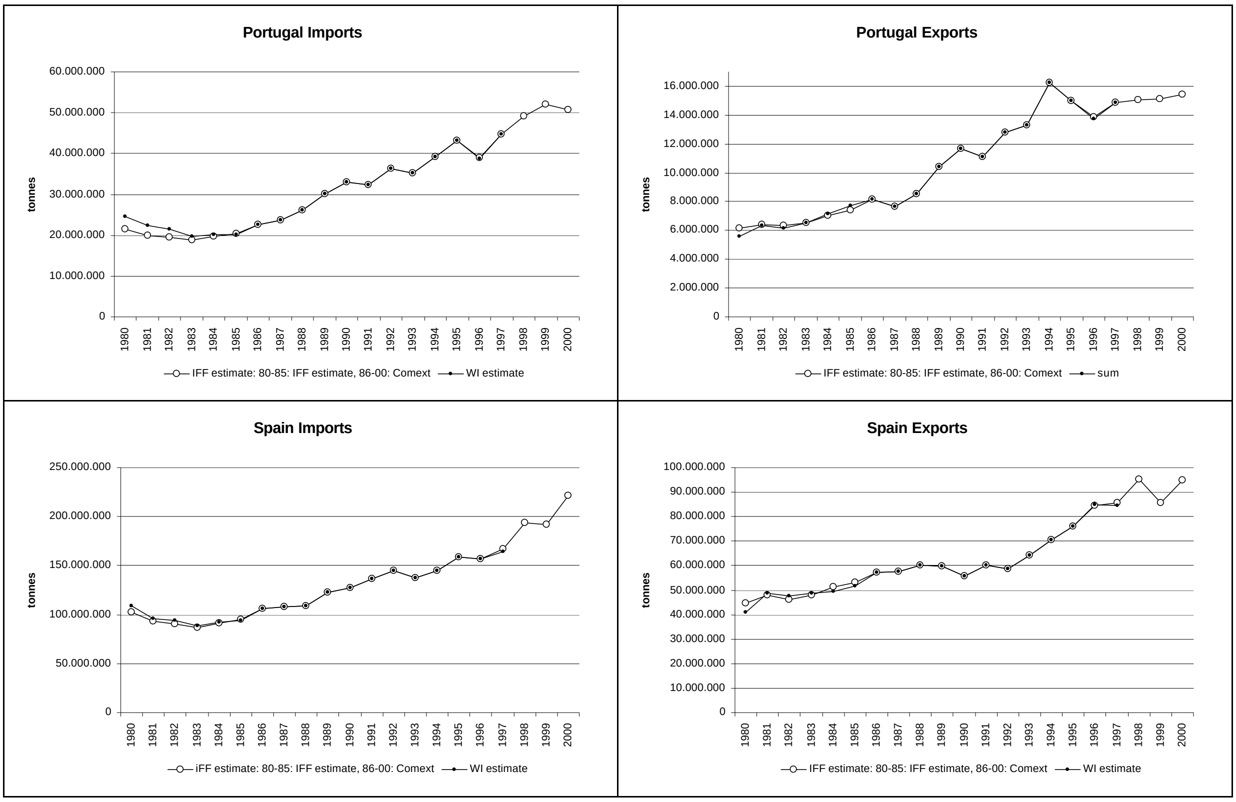
Extra-EU trade of GR (1980) =	extra-EU trade of EU (1980) * extra-EU trade of GR (1981) / extra-EU trade of EU (1981)
Intra+extra-EU trade of GR (1980) =	extra-EU trade of GR (1980) * intra+extra-EU trade of GR (1981) / extra-EU trade of GR (1981)

We used a similar method but always related the extra-EU trade to extra-EU trade and intra-EU trade to intra-EU trade, using the following procedure:

Extra-EU trade of GR (1980) =	extra-EU trade of EU (1980) * extra-EU trade of GR (1981) / extra-EU trade of EU (1981)
Intra-EU trade of GR (1980) =	intra-EU trade of EU (1980) * intra-EU trade of GR (1981) / intra-EU trade of EU (1981)

The underlying assumption is that the development of the extra- (and intra-) EU trade of the Member State is proportional to the development of extra- (or intra-) EU trade of the EU. Besides we avoid to use estimated values for calculating further estimates but rather base all estimation on primary data. This change in the procedure had no significant effect on the results, as it can be seen in the figures below.

Figure 8: Comparison IFF- and WI-data set: Imports and Exports



7.1.4. German reunification in 1990

The case of Germany with its reunification in the year 1990 provides a special problem. COMEXT database only reports the foreign trade of European Member States. In the case of Germany this means the data given by COMEXT for 1980-90 is the foreign trade of the Federal Republic of Germany, and from 1991 on the COMEXT foreign trade data represents the imports and exports for whole Germany (Federal Republic of Germany + former German Democratic Republic), leading to an increase of 53 mio tonnes of imports and 11 mio tonnes of exports in the year after reunification.

To estimate the missing data for the German Democratic Republic prior to the year 1991 we applied the same method as developed for the initial estimate. Hence we calculated the ratio (intra-EU trade of Germany / intra-EU trade of EU) for the years 1990 and 1991 and for the 3 material categories. The difference of the share for 1991 minus the share for 1990 should represent the proportion of the German Democratic Republic, share ‘x’.

share 'x' = (foreign trade of Fed.Rep.Germany 1991 / foreign trade of EU 1991) - (foreign trade of Fed.Rep.Germany 1990 / foreign trade of EU 1990)

To estimate the total German foreign trade prior to the year 1991 we calculated:

foreign trade of (Fed.Rep.Germany + Dem.Rep.Germany) = foreign trade of Fed.Rep.Germany + (foreign trade of EU * share ‘x’).

This method clearly is not satisfactory as the former GDR heavily depended on foreign trade with the former Soviet Union and other COMECON (Council for Mutual Economic Co-operation) countries, which established a trade system that substantially differed from the Western European trade system and which was to a certain degree isolated from the latter. This system broke down around 1990/. There is some evidence, e.g. from UN trade data for the former GDR, that suggest that the above estimation method might be seriously biased for both imports and exports. However, analysing foreign trade of the former GDR is difficult and time consuming due to the availability, structure and quality of the statistical data. A more thorough investigation of GDR foreign trade was beyond the scope of this report. Therefore, for the 1980-2000 data set, the foreign trade estimate for the former GDR was not incorporated. Developing new methods to estimate the level and structure of GDR foreign trade would be important to further improve data quality of the EU-15 time series.

7.1.5. Statistical breaks

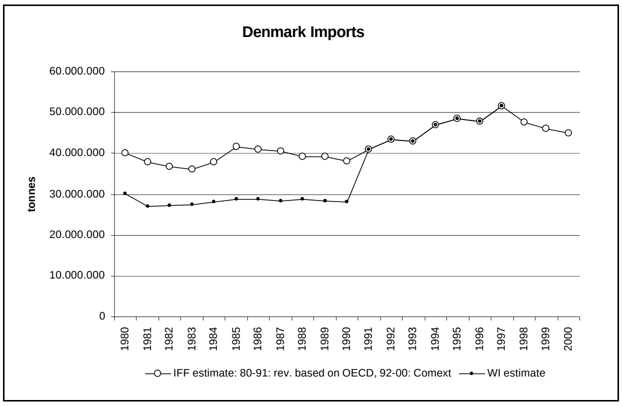
Rough cross checks of the compiled data set for statistical breaks resulted in a number of specific corrections using alternative data sources. The corrections apply to Denmark, Ireland, and the Netherlands.

Denmark

The following statistical break was identified:
1990 to 1991: material category „27" (part of „fossil fuels"): plus 13 mio tonnes, leading to an increase in total import of appr. 46%. The low level remained constant in the years prior to 1990 and the higher level remained constant in the years after 1991.

A screening of the data on a 4-digit level revealed that the break occurred in item 2701 (hard coal). We cross-checked the corresponding data from IEA/OECD energy statistic, which reports a constant level throughout the time period. Data from 1991 onwards matched quite well, but not for the years prior to 1991. Thus, we substituted COMEXT data (item 2701 1980-90) by the corresponding IEA/OECD data.

Figure 9. Comparison IFF- and WI-data set: Denmark: Imports



Ireland

The following statistical breaks were identified in the Irish imports:

Table 8. Statistical breaks identified in the Irish imports

Year	Total trade volume (after rev.)	Volume-increase or -decrease	Share	Material category	Specific material category
1991	21 mio tonnes	+ 6.5 mio tonnes	32%	Minerals, ores	38
1996	25 mio tonnes	+ 3 mio tonnes	12%	Fossil fuels	39
1996	25 mio tonnes	+ 7 mio tonnes	28%	Minerals, ores	73

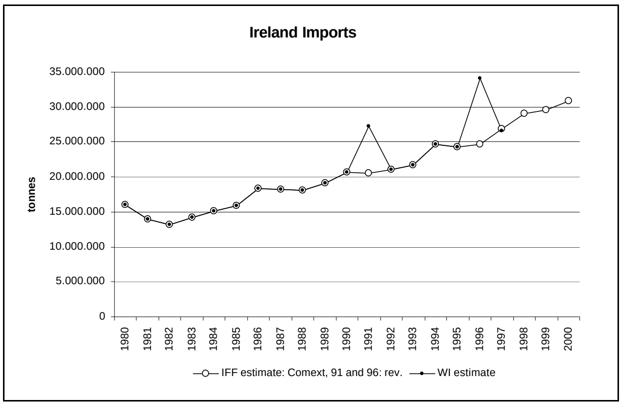
The download of the physical and monetary data on the 4-digit level showed that:

- the breaks only apply to the physical data and are not visible in the monetary figures
- the breaks only appear in the intra-EU trade
- the breaks only appear in specific categories on the 4-digit level: 3823, 3903, 7308
- the breaks only represent a peak and not a change in level

As the breaks only appear in the physical data we calculated the prices for the two years before and after the break and estimated a corrected price for the concerning year: corrected price 1991 = (price 1990 + price

1992) / 2. With this corrected prices we calculated a revised physical value on the 4-digit level. To obtain the revised value on the level of the 3 material categories we calculated the difference between the new physical value and the former value. This difference was then added (or subtracted) to the material category.

Figure 10. Comparison IFF- and WI-data set: Ireland: Imports



The Netherlands

The following statistical break was identified in the imports and exports of the Netherlands:

Table 9. Statistical breaks identified in the Netherlands' imports and exports

Year	Total trade volume (after rev.)	Volume-increase or -decrease	Share	Material category	Specific material category
1998 imports	270 mio tonnes	- 60 mio tonnes	22%	Fossil fuels	27
1998 exports	215 mio tonnes	- 0.3 mio tonnes	0.14%	Fossil fuels	27

The download of the physical and monetary data on the 4-digit level and lower showed the following results:

- the break applies to the physical and monetary data
- the break appears in the intra- and extra-EU trade
- the break only appears in a specific category on the 8-digit level: 27090090 „petroleum oils and oils obtained from bituminous minerals, crude (excl. natural gas condensates)"
- the breaks only represent a peak and not a change in level

After consultation with the statistical office in the Netherlands we replaced the false value of 1998 with the help of national figures in the specific category 27090090. To obtain the revised figure for the aggregate „fossil fuels" we calculated the difference of the national figures and the COMEXT value and added this difference to the aggregate „fossil fuels".

Additionally, the following statistical breaks were identified in the Netherlands imports:

Imports 1992/1993: total difference: minus 60 mio tonnes
Imports 1993/1994: total difference plus 80 mio tonnes

Breaks appeared in a number of categories. We identified the major ones as shown in Table 10.

Table 10. Statistical breaks

NL	product	1992	1993	1994
23	residues wastes	9.6	8.6	10.8
25	salt, minerals	43.6	34.4	37.7
26	ores	41.4	14.0	30.1
27	minerals fuels	103.9	93.8	134.5

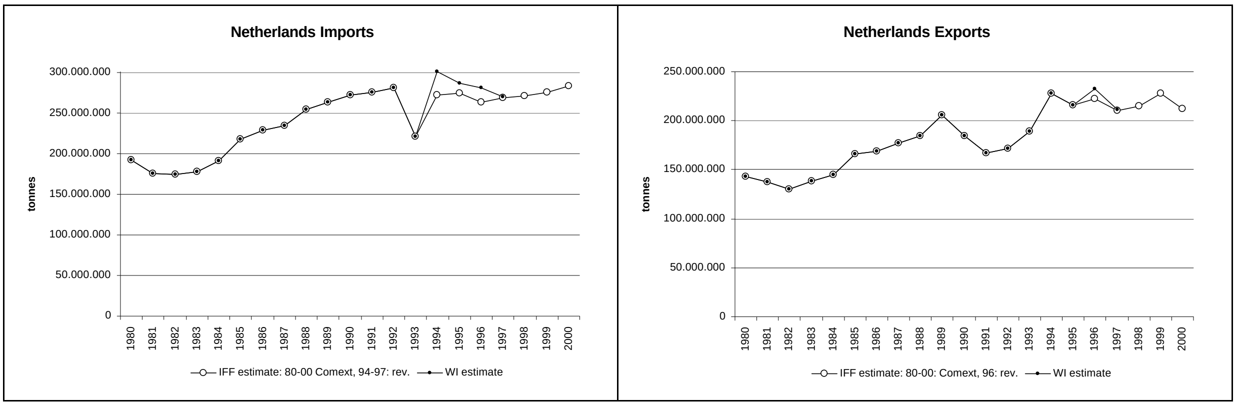
Source: COMEXT download 24.06.02, million tonnes

For categories 23, 25, and 26 we cross-checked the data using the trends of the prices. However, as prices did not fluctuate above a plausible level, we did not change the data.

Category 27 was cross-checked with data from IEA/OECD. We substituted COMEXT for IEA/OECD data of the 4-digit category 2709 (petroleum oils) for the years 1993 to 1996.

However, this substitution of item 2709, although increasing plausibility at the 4-digit level, did not contribute much to a more plausible total trend, in particular for the year 1993 (see Figure 11). We did some additional cross checks and estimates but up to now we are unable to either explain or correct the strange foreign trade trends of the Netherlands.

Figure 11. Comparison IFF- and WI-data set: the Netherlands: Imports and Exports



7.2. Final data set

The final data set contains imports and exports for the EU-15 countries from 1980-2000 disaggregated into three material categories: biomass, fossil fuels, and minerals and ores. Construction minerals are not separately listed. For reasons of consistency we took the calculated sum of the three material categories as the value for total trade

The COMEXT database also offers data for total trade of each Member State but these are higher than the calculated sum of the subcategories. The following table shows the differences for the imports of Germany.

Table 11. Germany, imports: comparison of total trade download from COMEXT and total trade as the sum of the three material categories (unit: tonnes)

	1980	1981	1982	1983	1984	1985	1986
Download	374 183 217	341 106 793	325 170 471	323 886 241	336 803 256	343 004 906	345 103 543
Sum	329 955 072	301 106 761	288 331 821	286 787 400	299 675 881	306 487 693	313 877 668
Difference	44 228 145	40 000 032	36 838 650	37 098 841	37 127 375	36 517 213	31 225 875
Difference in %	13.40%	13.28%	12.78%	12.94%	12.39%	11.91%	9.95%

	1987	1988	1989	1990	1991	1992	1993
Download	338 451 980	350 685 493	354 637 629	374 414 655	433 414 523	455 696 778	423 083 180
Sum	304 725 241	317 423 511	318 756 336	337 025 973	389 505 763	411 149 499	423 083 495
Difference	33 726 739	33 261 982	35 881 293	37 388 682	43 908 760	44 547 279	-315
Difference in %	11.07%	10.48%	11.26%	11.09%	11.27%	10.83%	0.00%

	1994	1995	1996	1997	1998	1999	2000
Download	463 147 774	463 590 944	474 990 849	482 415 332	504 722 067	488 954 099	506 129 557
Sum	463 148 101	463 591 411	474 991 161	482 415 724	504 722 468	488 954 602	506 130 035
Difference	-327	-467	-312	-392	-401	-503	-478
Difference in %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: COMEXT CD-ROM

Germany is the country with the highest divergence between downloaded and calculated sum. The figures in the table show that the difference varies between 40 mio tonnes (13.4% of the calculated total trade) in the early years down to only a few hundred tonnes from 1993 on. High differences can as well be observed for Denmark (imports: up to 13 mio tonnes or 45%), for Belgium and Luxembourg (exports: up to 4 mio tonnes or 4.5%), the Netherlands (exports: up to 4 mio tonnes or 3%), the United Kingdom (exports: up to 10 mio tonnes or 9.5%), and for some years also in Italy (imports: up to 25.5 mio tonnes or 10%). For the remaining Member States the difference is zero or of negligible dimension (a few hundred tonnes).

The comparison also shows that the divergence between downloaded and calculated sum changes from high positive values (downloaded value is bigger than the calculated sum) in the early years to rather low negative values (calculated sum bigger than the download) of only a few hundred tonnes in the late years. It does not show a stable trend, but changes occur rather rapidly:

- from the year 1987 to the year 1988 in France, Greece, Ireland, Portugal, Spain and for the imports in Belgium and Luxembourg
- from the year 1992 to 1993 in Denmark, Germany, Italy, the Netherlands, United Kingdom, and for the exports in Belgium and Luxembourg
- Values for Austria, Finland, and Sweden are only available from 1995 onwards. The differences in the years 1995 to 2000 are of minor significance.

Evidence suggests that the downloaded total are the correct figures, but a procedure to correct for the differences in the downloads could not be developed during this project. The issue clearly needs further attention and investigation.

For the EU-15 we calculated the intra-EU trade, the extra-EU trade, and the total trade according to the data of the individual Member States. The intra- and extra-EU trade values for the material categories represent the calculated sum of the 15 Member States.

On the EU-15 level the concept of foreign trade is different compared to that of the Member States. The foreign trade of the whole EU is the sum of the single extra-EU trade figures of the Member States. As a result the indicators ‘imports’, ‘exports’ and ‘DMI’ on the EU-15 level do not equal the sum of the indicators of the Member States. Table 12 gives an overview of the data sources used and revisions made.

Table 12. Overview on data sources and revisions

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Austria																					
Belgium/Lux.																					
Denmark	rev.	rev.	rev.	rev.	rev.	rev.	rev.	rev.	rev.	rev.	rev.										
Finland																					
France																					
Germany																					
Greece																					
Ireland												rev.					rev.				
Italy																					
Netherlands														rev.	rev.	rev.	rev.				
Portugal																					
Spain																					
Sweden																					
United Kingdom																					

	data from the COMEXT database
	data from national MFA
	accession
	calculation: foreign trade of Member State = foreign trade of EU x (foreign trade of MS in the year of accession) / (foreign trade of EU in the year of accession)
	calculation: trend: COMEXT data, level: nMFA
rev.	data revision of selected categories due to statistical breaks

Open questions and further procedure

The final data set still comprises some shortcomings that need further analysis, some of which were mentioned already in the text. Following the method developed concerning statistical breaks a consistent screening of the final data set is needed to identify further errors. Secondly, a way should be found to deal with the masses given in supplementary units. Here a rough crosscheck should be done to get a picture about the quantities that are given in supplementary units. In case that these masses are of relevant size a method has to be developed to integrated these quantities into the accounts.

Further analysis is also needed to explain the observed differences between the downloaded figures for total trade and the calculated sums for some countries in the 1980s. Finally, new procedures to estimate foreign trade of the former GDR should be developed.

7.3. Extending the time series back to 1975 or 1970

We want to discuss at this point the possibility of enlarging the data set backwards to the year 1975 or even 1970. The following table shows the data availability for the years 1970 to 2000.

Table 13. Data availability for the years 1970 to 2000

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium																															
Luxembourg																															
France																															
Germany																															
Italy																															
Netherlands																															
Denmark																															
Ireland																															
United Kingdom																															
Greece																															
Portugal																															
Spain																															
Austria	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA
Finland	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	
Sweden																		nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA	nMFA		
COMEXT																															
nMFA																															
accession																															

COMEXT data is available from the year 1976 or from the year of accession, national MFA data for Austria and Finland start with the year 1970. No data are available from COMEXT for 1976-1979 for Greece, Portugal, Spain, Sweden and the former GDR.

It is not clear whether the method we used to estimate foreign trade for the period 1980 to the year of accession for some countries produces plausible results if it is applied to estimate long time series backwards. An extension to the year 1970 is therefore more complicated. As the calculation cannot rely on COMEXT, alternative data sources are needed. One alternative could be data from the UN. The UN reports foreign trade data for the majority of countries from 1962 on, also in physical units if provided by the reporting country. Subsets of these data are made available on request. The problem here is that physical quantities only appear at the 3-digit level or even below. The amount of data that would have to be bought from the UN is enormous, and costs would be accordingly high. Thus, under the given circumstances, UN data provides no feasible alternative.

7.4. Enhancing policy meaning

In the discussion about international trade and the north-south conflict it is often mentioned that the international division of labour results in industrialised countries importing raw and semi-finished products at low prices from countries of the south and exporting finished products at high prices. This may result in an outsourcing of environmental pressures resulting from material intensive production processes such as material extraction and transformation processes to gain semi-finished products by industrialised countries. This process is supposed to contribute considerably to the increasing material efficiency of highly developed economies. The usefulness of MFA to further investigate these issues of globalisation and outsourcing of production processes could be enhanced by analysing foreign trade along a distinction between raw materials, semi-finished, and finished products. A much more challenging strategy would be to account for „raw material equivalents" (RME) of foreign flows, as this would standardise all resource uses, regardless of their origin (domestic or foreign) to the level of used extraction. In addition a new indicator for domestic material consumption (RMC- raw material consumption, see Eurostat 2001b) could be calculated from import and export values at a raw material equivalent. This indicator would reflect actual domestic material consumption more precisely than DMC does. Methodologically input/output analyses using multipliers derived from physical input output tables (PIOTs) would be a promising and feasible direction to estimate reliable coefficients for RME. However, methods still have to be developed and PIOTs are only available for a few Member States (DE, FI, DK, NL) and years.

8. Statistical territory

Regarding the 15 Member States of the European Union it can be seen that a number of territories with different status of independence are associated to some of the Member States. Thinking in MFA terms it is very important to define the socio-economic system that is observed in order to differentiate the biophysical flows that are regarded as inputs and outputs in the system.

The statistical territory of the European Union is defined in legislation and described by Eurostat (Eurostat 2001d) as corresponding to the customs territory with three exemptions:

- Germany includes Heligoland
- France: until 1996 the French overseas departments (Guadeloupe, Guyana, Martinique, Reunion) were regarded as non-member countries
- Spain: until 1996 the Canary Islands were regarded as non-member countries

A detailed overview of the 15 Member States and all associated territories will be given in the following list.

Austria

- No associated countries

Belgium

- No associated countries

Denmark

- Greenland: excluded from the EU statistical territory since 1985
- Other excluded territories: Faroe Islands

Finland

- Aland Islands: included in the EU statistical territory

France

- Monaco: included in the EU statistical territory
- French overseas departments: included in the EU statistical territory since 1997
  - French Guiana
  - Guadeloupe
  - Martinique
  - Réunion
- Other excluded territories: New Caledonia, Wallis, Futuna, French Polynesia, French Southern Territories, Mayotte, St. Pierre and Miquelon

Germany

- Island of Heligoland: included in the EU statistical territory
- Territory of Büsingen: excluded from the EU statistical territory (territory is attached to the statistical territory of Switzerland)

Greece

- No associated countries

Ireland

- No associated countries

Italy

- Livigno: included in the EU statistical territory
- Municipality of Campoine d´Italia: excluded from the EU statistical territory (Territory is attached to the statistical territory of Switzerland)

Luxembourg

- No associated countries

Netherlands

- excluded territories: Netherlands Antilles (autonomous state linked to the Netherlands since 1954, part of the Kingdom), Aruba (autonomous state but part of the Kingdom)

Portugal

- Azores: included in the EU statistical territory
- Madeira: included in the EU statistical territory

Spain

- Balearic Islands: included in the EU statistical territory
- Canary Islands: included in the EU statistical territory since 1997
- Ceuta, Melilla: excluded from the EU statistical territory

Sweden

- Islands of Gotland and Öland: included in the EU statistical territory

United Kingdom

- Channel Islands: included in the EU statistical territory
- Isle of Man: included in the EU statistical territory
- Other excluded territories: Antarctica, Bermuda, Falkland Islands, Gibraltar, South Georgia, South Sandwich Islands, British Indian Ocean Territories, Cayman Islands, Montserrat, Pitcairn, Santa Helena, Turks and Caicos Islands, British Virgin Islands

As it can be seen from the list several territories are associated to EU Member State countries and some of them become part of the European Community or leave the Community at some point in time. This makes it quite difficult to deal with as regards an MFA and we had to find a consistent way how to deal with these territories. Hence we discussed two questions:

Are the associated territories considered in the used databases?

Concerning the databases the associated territories are not always or not all of them separately listed. Furthermore it is not always obvious whether the database considers these territories as part of Member States or not.

Are the material flows attributed to these territories of a significant volume?

We discussed this question using the physical quantities for fish catch as we assumed that in this sector the material flows of the associated territories could have a significant effect. One of the largest territories concerning area is Greenland. For a rough check we thus compared the amount of total fish catch of Denmark and Greenland. The result of this comparison is shown in the following figure and table.

Figure 12. Total fish capture: comparison Denmark and Greenland

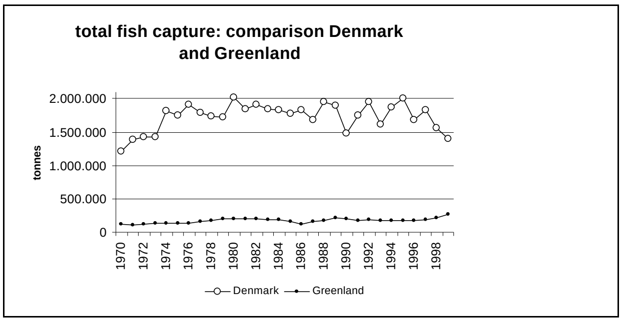


Table 14. Total fish capture: comparison Denmark and Greenland

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Denmark (tonnes)	1 217 228	1 388 991	1 429 007	1 430 532	1 823 180	1 751 851	1 905 048	1 792 979	1 734 709	1 724 138
Greenland (tonnes)	121 820	114 156	122 694	137 746	139 162	133 466	132 476	160 386	179 340	202 748
Share in %	10.0	8.2	8.6	9.6	7.6	7.6	7.0	8.9	10.3	11.8

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark (tonnes)	2 013 518	1 838 241	1 909 718	1 845 546	1 827 875	1 772 744	1 825 355	1 681 964	1 945 754	1 896 338
Greenland (tonnes)	201 024	208 463	205 269	194 417	188 308	162 285	125 043	162 673	176 199	215 017
Share in %	10.0	11.3	10.7	10.5	10.3	9.2	6.9	9.7	9.1	11.3

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Denmark (tonnes)	1 475 701	1 751 238	1 953 947	1 618 738	1 877 784	2 006 033	1 681 517	1 826 852	1 557 337	1 405 012
Greenland (tonnes)	199 097	178 822	182 612	170 059	180 191	176 062	174 137	187 806	214 312	266 446
Share in %	13.5	10.2	9.3	10.5	9.6	8.8	10.4	10.3	13.8	19.0

The quantities regarding fish capture show that the share of Greenland is rather negligible. From such analysis we concluded that the associated territories do not introduce any significant biases into the results for the Member States and the EU.

9. Recommendations for future improvement of sources and methods

In the following we summarise our recommendations for further methodological development for each partial account, considering data quality, feasibility of further improvements, importance of the flow in terms of size, and as a conclusion priority for improvements. Note: Indication of the size of the flows refers the share of the respective material flow on total DE of EU-15. These shares may be substantially different for single Member States.

- DE biomass agriculture: this is a large flow (22-25% of DE). With the revisions and methodological improvements (correction of statistical breaks in FAO data, standardisation of water content of grass harvest and grazing, dual approach to estimate grazing, new coefficients to estimate by products) gained in this project we consider data quality of this category as medium to high. In particular fodder biomass remains a category of only medium data quality. Minor further improvements can be achieved by cross checking and further regionalising coefficients, however, main improvements concerning level and trends can only be expected if fodder balances become available. Priority for improvement: medium.
- DE forestry: This is a relatively small flow at the EU level (4-5% of DE). However, in some countries (above all Finland and Sweden) wood is an important fraction of DE. Considering the size of the flow and the available national MFAs (which cover all major wood producing countries except France) we consider data quality as high. Further improvements can be expected from new coefficients (to convert volume to mass) which explicitly distinguish between density and water content, and which are regionalised regarding species composition and regional variations in species specific densities, and from additional data sources to account for the known underestimation in FAO statistics. The latter, however, may not be feasible in the short term, because of an incommensurability between MFA system boundaries and system definitions in the forestry statistics. Priority for improvement: low.
- DE biomass fishery: this is a tiny flow in terms of size (0.2% of DE) and data quality is high. Unless special indicators for fishery are to be derived from MFA, no need exists for further improvements.
- DE fossil fuels: this is a flow of medium size (15% of DE) and of high data quality, certainly the highest in the whole MFA data set. Minor improvements could be made by providing regionalised factors for density and heat values of natural gas for all European countries. Standards are still missing for the handling of gross production, losses, flared amount and re-injection of natural gas (i.e. what has to be accounted as used DE, which parts should be considered unused extraction). Priority of improvement: low.
- DE industrial minerals and ores: This is a rather small flow (3% of DE) of relatively high data quality. Data quality could be further improved by providing more and better regional conversion factors from metal content to run of mine (ROM). This would especially effect data for metal ores with very low grades (e.g. silver, gold). However, as absolute values of domestic extraction of metal ores in general are quite low in the EU Member States (with a few exceptions) these improvements are of minor importance. Priority of improvement: low.
- DE construction minerals: A huge flow, the largest in the whole data set, and unfortunately of low data quality. International statistics are less comparable and reliable in this area, as compared to all other data sources. Hence, consistent methodologies to fill data gaps are extremely time consuming to develop. Improvements can be expected from a comparison between alternative data sources and cross checks using auxiliary data, such as construction activity or economic performance of the construction sector. Priority of improvement: high, however: feasibility: medium to long term.
- Foreign trade: Imports and exports are large flows and experience the highest growth rates of all material flow categories in the data set. Data quality is medium to high, depending on the time period and country under consideration. This makes foreign trade the prime candidate for further improvements. Future work should focus on the following issues: flaws in the primary data set, differences between downloaded and calculated figures, method to deal with the masses given in supplementary units, new procedures to estimate foreign trade for the years prior to accession, extension of time series backward to 1970, development of a method to account for imports and exports at a raw material equivalent level. Priority of improvement: high, feasibility: short to medium term.

List of abbreviations

BMELF	Bundesministerium für Ernährung, Landwirtschaft und Forsten (Germany)
cap	capita
CN	Combined Nomenclature
CUM	cubic meter
d.m.	dry matter
DE	domestic extraction
DETR	Department of the Environment, Transport, and the Regions (United Kingdom)
DG	Directorate-General (of the European Commission)
DMC	domestic material consumption
DMC_{bio}	DMC of biomass
DMC_{cons}	DMC of construction minerals
DMC_{ind}	DMC of industrial minerals, ores
DMI	direct material input
EEA	European Environmental Agency
ECU	European Currency Unit (up to and including 1998; from 1999: euro)
EI	energy intensity
EI_{FEC}	EI based on FEC
EKC	Environmental Kuznets Curves
EMY	European Minerals Yearbook
EU	European Union
Eurostat	Statistical Office of the European Communities
ext.	extended
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO statistical database
FEC	final energy consumption
FRA	Global Forest Resources Assessment 2000 (Main Report FAO Forestry Paper 140)
GDR	German Democratic Republic (former)
GDP	gross domestic product
GNP	gross national product
HS	Harmonized Commodity Description and Coding System
ID	import dependency
ID_{DMC}	import dependency of DMC
ID_{DMI}	import dependency of DMI
IEA	International Energy Agency
IFF	Institute for Interdisciplinary Studies at Austrian Universities (Vienna, Austria)
IIASA	International Institute for System Analysis (Laxenburg, Austria)
IPAT	[Impact = Pollution*Affluence*Technology]
ISSCAAP	FAO International Standard Statistical Classification of Aquatic Animals and Plants
kgoe	kilograms oil equivalent
ME	material efficiency
ME_{DMC}	material efficiency of DMC
ME_{DMI}	material efficiency of DMI
MFA	material flow account
MI	material intensity
MI_{DMC}	material intensity of DMC
MI_{DMI}	material intensity of DMI
mio	million
MS	Member State(s)
NGL	natural gas liquids

nMFA	national MFA (MFA compiled by national statistical offices)
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics of the United Kingdom
p.a.	per annum
PIOT	physical input-output table
PPP	Purchasing Power Parities
PTB	physical trade balance
r	Pearson index, correlation coefficients
r^2	coefficient of determination
rev.	revised, revision
RMC	raw material consumption
RME	raw material equivalent
ROM	run of mine
s	standard deviation
t, mt	tonne(s) (metric ton(s))
TBFRA	Forest Resources of Europe, CIS, North America, Japan and New Zealand (Main Report UN Publication 99-II-E-36)
toe	tonnes oil equivalent
TPES	total primary energy supply
UN CSD	United Nations Commission on Sustainable Development
UN	United Nations
UN-ECE	United Nations Economic Commission for Europe
UN-ICSY	United Nations Industrial Commodity Statistical Yearbook
USGS	United States Geological Survey
wc	water content
WI	Wuppertal Institute for Climate, Environment, Energy (Wuppertal, Germany)

Country codes used for the figures (ISO 3166-1)

AT	Austria
BE	Belgium
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GB	United Kingdom
GR	Greece
IE	Ireland
IT	Italy
JP	Japan
LU	Luxembourg
NL	Netherlands
PT	Portugal
SE	Sweden
US	United States of America

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Annex: Detailed tables

Domestic Extraction (DE) in million tonnes

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	total	4901	4805	4747	4739	4746	4978	5004	5019	5162	5259	5191	4973	4901	4792	4945	4903	4872	4919	4869	4964	4892
	biomass	1331	1339	1354	1304	1412	1406	1392	1383	1389	1389	1403	1337	1342	1351	1327	1329	1377	1407	1403	1413	1440
	construction minerals	2475	2367	2296	2320	2242	2340	2387	2433	2595	2705	2703	2634	2611	2528	2700	2666	2564	2615	2598	2685	2584
	ind. minerals, ores	240	224	208	209	221	214	209	202	203	205	186	176	170	158	168	162	172	161	160	149	152
	fossil fuels	854	876	890	906	872	1018	1016	1001	976	960	899	825	778	755	750	746	759	736	709	717	717
Austria	total	122	120	120	115	117	115	115	116	117	122	123	120	122	123	130	125	124	131	121	123	119
	biomass	39	39	42	39	40	41	40	40	41	41	40	36	33	35	38	38	38	39	38	39	35
	construction minerals	69	68	65	63	64	62	64	65	66	70	73	74	80	80	85	78	78	84	75	76	76
	ind. minerals, ores	7	7	7	8	8	8	7	6	6	6	6	5	5	4	5	5	5	5	5	5	5
	fossil fuels	6	5	6	5	5	5	5	5	4	4	5	4	4	4	3	3	3	3	3	4	4
Belgium/	total	104	107	102	94	97	95	96	95	101	108	114	117	116	116	124	121	120	119	116	119	118
Luxembourg	biomass	30	34	33	28	31	30	31	29	31	32	31	31	33	34	32	32	34	36	34	36	35
	construction minerals	67	67	62	59	59	58	59	61	65	73	81	83	81	81	92	88	86	83	82	82	82
	ind. minerals, ores	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	fossil fuels	6	6	7	6	6	6	6	4	3	2	1	2	1	0	0	0	0	0	0	0	0
Denmark	total	88	90	96	89	102	116	116	111	118	120	125	122	109	112	113	114	110	113	112	114	119
	biomass	32	33	37	30	40	38	37	32	37	39	41	38	33	36	34	36	34	35	34	32	34
	construction minerals	55	55	56	56	58	73	73	72	73	73	75	73	65	64	64	64	59	59	59	59	59
	ind. minerals, ores	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	fossil fuels	0	1	2	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	18	21	25
Finland	total	155	151	160	160	157	158	166	162	170	183	181	155	152	139	154	154	144	155	156	172	165
	biomass	56	52	51	51	52	53	49	49	54	57	54	45	49	53	58	61	57	60	63	65	67
	construction minerals	88	89	94	96	93	92	102	102	103	112	113	100	90	77	82	79	73	79	85	92	86
	ind. minerals, ores	8	8	10	10	10	10	9	10	9	9	9	7	6	6	7	7	6	7	7	7	6
	fossil fuels	3	1	5	3	2	3	6	2	5	5	5	3	6	4	8	7	7	9	1	7	6
France	total	786	784	770	756	749	782	767	786	825	812	814	832	813	763	772	768	739	755	751	759	762
	biomass	324	330	334	340	361	367	353	356	354	335	333	349	363	344	339	339	341	357	357	366	370
	construction minerals	365	365	353	338	309	339	339	358	405	416	422	427	400	373	390	390	357	360	372	372	373
	ind. minerals, ores	67	58	55	50	52	49	49	47	45	42	41	38	34	29	27	26	28	26	12	11	11
	fossil fuels	29	30	28	28	27	27	25	26	21	20	18	17	16	16	15	14	13	11	10	9	8
Germany	total	1433	1371	1277	1263	1327	1401	1407	1394	1430	1471	1422	1341	1323	1307	1375	1335	1305	1285	1251	1282	1231
	biomass	257	272	266	240	276	288	280	278	270	276	305	244	231	253	236	246	254	258	261	255	269
	construction minerals	736	652	564	576	583	548	574	573	620	665	646	706	742	735	833	801	769	755	736	776	707
	ind. minerals, ores	34	30	27	27	27	26	26	26	26	27	26	26	26	23	30	24	26	28	28	29	25
	fossil fuels	407	417	420	421	441	538	528	517	514	502	446	366	323	296	277	265	256	244	227	221	231
Greece	total	109	114	108	109	98	108	110	114	119	125	122	126	126	124	126	127	127	134	143	139	138
	biomass	33	34	34	32	33	33	34	33	34	36	32	35	35	33	35	34	34	33	32	33	33
	construction minerals	43	43	39	36	22	28	28	28	28	28	29	30	30	29	28	32	29	37	38	36	33
	ind. minerals, ores	10	9	7	9	9	9	9	7	8	8	8	7	6	6	7	7	7	7	12	8	8
	fossil fuels	23	28	28	32	34	37	39	46	49	53	53	54	56	55	57	55	58	57	61	62	63
Ireland	total	61	58	63	61	65	56	56	57	56	61	63	62	62	61	64	66	71	70	68	72	70
	biomass	31	30	31	31	32	31	30	31	31	31	33	32	33	32	33	34	36	35	36	37	35
	construction minerals	19	19	22	19	19	17	17	16	17	18	19	18	18	19	20	22	25	25	25	25	25
	ind. minerals, ores	4	2	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3	4
	fossil fuels	6	7	7	9	10	5	7	8	6	10	8	9	8	7	8	7	7	7	5	7	6
Italy	total	547	548	567	589	557	596	593	590	591	592	571	555	534	504	508	495	514	516	520	522	515
	biomass	161	160	148	151	149	144	152	147	139	141	130	134	139	134	136	128	134	132	135	140	136
	construction minerals	357	357	387	406	377	420	411	413	419	418	408	389	362	339	340	335	348	353	353	352	350
	ind. minerals, ores	14	16	15	17	15	15	13	14	14	14	12	12	12	9	9	9	9	8	9	9	9
	fossil fuels	15	15	16	15	16	16	16	17	19	19	20	21	21	22	22	23	23	23	22	21	19
Netherlands	total	169	165	150	151	156	167	161	160	153	177	175	177	181	175	166	166	177	167	142	137	136
	biomass	34	37	38	34	36	37	43	39	40	43	43	40	44	44	39	39	41	41	37	40	40
	construction minerals	53	53	45	47	48	51	51	54	53	63	62	58	58	51	50	50	48	48	30	27	27
	ind. minerals, ores	4	4	4	3	4	4	4	4	4	4	4	3	4	4	4	4	6	6	6	5	5
	fossil fuels	79	73	63	67	68	75	63	63	56	67	67	75	75	76	73	73	82	73	70	66	63
Portugal	total	89	87	85	81	65	72	76	73	78	81	90	91	89	88	100	104	104	111	113	113	110
	biomass	27	25	26	26	27	28	30	31	30	30	32	32	29	31	33	32	34	33	33	36	36
	construction minerals	60	60	57	54	36	41	44	41	47	49	54	55	55	53	64	68	67	75	76	74	71
	ind. minerals, ores	2	2	2	1	2	2	2	2	2	2	3	3	5	4	3	4	3	3	3	3	2
	fossil fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	total	391	386	388	393	422	456	453	457	464	465	478	432	442	430	427	430	467	496	501	538	539
	biomass	129	116	126	125	138	134	130	141	145	142	143	139	133	135	129	119	144	146	149	139	151
	construction minerals	193	193	185	186	198	241	246	247	250	249	266	230	251	242	246	258	270	299	305	359	342
	ind. minerals, ores	39	40	35	39	44	39	37	33	35	36	32	28	23	21	21	24	25	24	20	14	21
	fossil fuels	30	37	41	43	42	42	40	36	33	38	37	35	35	32	30	29	28	27	27	25	24
Sweden	total	186	185	188	183	190	176	177	174	179	194	197	183	173	180	180	194	173	170	180	172	191
	biomass	63	64	65	66	69	65	66	65	67	70	72	66	67	71	71	78	74	78	76	73	78
	construction minerals	101	101	107	102	103	91	91	89	92	103	105	97	86	90	87	92	75	66	80	73	84
	ind. minerals, ores	22	20	15	15	18	20	20	19	19	19	19	18	19	19	20	23	24	25	24	25	27
	fossil fuels	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1
UK	total	661	639	674	695	645	681	710	729	762	747	716	662	658	669	705	704	697	697	694	702	681
	biomass	114	113	121	113	126	115	118	114	116	115	115	115	118	115	113	115	123	124	119	120	119
	construction minerals	269	244	259	280	274	278	290	316	356	367	350	295	293	295	320	309	277	292	282	280	268
	ind. minerals, ores	28	26	27	27	28	28	29	31	32	34	23	24	26	28	31	25	31	19	29	28	27
	fossil fuels	249	255	267	275	217	259	274	269	258	231	229	229	221	230	241	255	265	263	265	274	267

Sources: *Data from national MFAs (in italic)*, Eurostat 2001a, IFF estimates based on international data sources

Imports in million tonnes

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	total	1109	1006	974	930	983	1006	998	1023	1059	1096	1135	1195	1229	1201	1295	1252	1236	1276	1314	1322	1416
extra EU	biomass	163	154	158	157	156	157	151	161	164	162	171	173	180	176	196	171	158	159	168	184	186
trade	minerals, ores	252	233	220	215	247	260	247	258	290	290	283	288	297	277	332	338	309	329	337	351	397
	fossil fuels	694	619	595	559	580	590	600	604	605	644	681	734	753	749	767	743	769	788	809	786	833
EU-15	total	541	528	520	540	577	616	646	662	669	723	746	772	792	743	828	912	937	971	1043	1036	1083
Intra-EU	biomass	99	102	109	113	119	133	142	149	157	164	169	180	187	175	199	237	238	254	273	274	272
trade	minerals, ores	258	243	233	238	250	264	283	295	314	366	371	377	385	340	381	422	421	440	475	474	501
	fossil fuels	183	184	178	189	207	219	221	218	198	193	206	215	220	227	248	254	279	278	296	288	309
EU-15	total	1649	1534	1494	1470	1559	1622	1644	1684	1728	1820	1881	1967	2022	1944	2123	2164	2174	2247	2358	2358	2499
total intra-	biomass	262	255	268	270	275	290	293	310	321	326	340	353	367	351	396	407	395	412	440	458	459
and extra-EU	minerals, ores	510	475	453	453	497	524	530	553	604	657	654	665	681	617	713	760	730	768	812	825	898
trade	fossil fuels	878	804	773	747	787	809	821	822	802	837	887	949	973	976	1015	997	1048	1067	1105	1074	1142
Austria	total	37	36	34	33	38	39	39	40	41	42	44	46	47	46	49	53	55	55	56	57	65
	biomass	7	6	7	7	7	8	8	8	9	9	9	11	11	11	12	12	12	13	14	16	18
	minerals, ores	11	11	11	10	12	12	12	12	14	14	14	15	16	15	17	19	20	22	23	22	24
	fossil fuels	19	18	17	16	18	19	19	19	18	19	20	20	20	20	20	22	23	19	20	19	23
Belgium	total	159	150	145	135	147	145	151	158	173	178	185	190	192	185	197	205	211	218	231	244	253
Luxembourg	biomass	22	23	24	24	25	25	24	26	27	27	29	32	31	31	35	37	38	42	45	49	51
	minerals, ores	69	65	60	59	64	66	66	69	82	82	84	82	83	80	83	89	92	90	98	107	111
	fossil fuels	68	62	60	52	58	54	61	63	65	68	72	76	77	75	79	79	81	86	88	88	92
Denmark	total	40	38	37	36	38	42	41	40	39	39	38	41	43	43	47	49	48	52	48	46	45
	biomass	7	7	7	7	7	8	8	8	8	8	8	9	10	11	12	12	11	12	13	13	13
	minerals, ores	8	7	8	8	9	9	9	9	9	10	10	10	11	11	12	12	12	13	15	14	15
	fossil fuels	25	24	22	21	22	25	24	23	22	21	19	22	22	21	23	24	24	26	20	19	17
Finland	total	37	35	34	35	35	37	38	41	38	42	41	39	40	43	51	48	49	51	52	52	54
	biomass	5	5	7	7	8	7	6	7	7	8	7	6	8	8	10	12	10	10	11	13	12
	minerals, ores	9	8	9	9	9	10	10	11	11	14	14	12	13	13	15	14	15	17	18	17	18
	fossil fuels	22	21	19	19	18	20	22	22	19	21	21	21	20	21	26	21	24	25	23	22	23
France	total	286	256	242	229	235	240	244	249	259	278	283	293	291	269	289	287	293	305	322	327	339
	biomass	29	29	30	31	30	30	32	33	35	36	38	41	41	41	46	46	44	46	49	52	53
	minerals, ores	76	68	66	64	69	75	74	81	89	103	98	95	92	80	94	97	92	99	106	110	118
	fossil fuels	182	159	145	135	137	135	138	134	135	139	147	157	158	147	150	145	157	160	167	164	168
Germany	total	330	301	288	287	300	306	314	305	317	319	337	390	411	423	463	464	475	482	505	489	506
	biomass	54	52	52	53	53	56	57	58	59	60	63	69	71	65	70	70	69	70	74	77	75
	minerals, ores	130	119	109	110	122	122	121	117	127	134	137	152	165	143	167	171	159	165	174	165	179
	fossil fuels	147	130	127	124	125	128	136	129	131	124	137	168	175	215	226	223	247	247	257	247	253
Greece	total	*16*	15	19	19	19	23	22	30	14	20	23	29	29	30	32	32	37	33	37	36	53
	biomass	*2*	2	2	2	2	3	3	4	3	3	4	4	4	4	5	6	6	6	6	7	8
	minerals, ores	*4*	4	4	5	4	4	5	7	4	6	7	9	7	7	7	9	9	10	9	12	18
	fossil fuels	*11*	10	12	12	12	16	14	20	6	10	13	16	18	19	20	17	22	17	22	17	26
Ireland	total	16	14	13	14	15	16	18	18	18	19	21	21	21	22	25	24	25	27	29	30	31
	biomass	3	3	3	4	3	4	4	4	4	5	5	5	5	5	6	6	6	6	7	7	6
	minerals, ores	4	4	4	4	5	6	5	6	6	7	7	7	8	7	8	9	9	10	11	11	12
	fossil fuels	9	7	6	6	6	7	9	8	8	8	9	8	8	10	11	9	10	11	12	11	12
Italy	total	227	213	207	206	218	228	215	222	220	240	244	246	247	258	271	286	278	289	304	308	329
	biomass	33	30	31	31	34	36	35	37	38	41	40	44	43	41	44	47	46	49	51	52	54
	minerals, ores	56	46	46	44	54	55	54	57	61	68	69	69	69	88	93	104	98	104	112	119	134
	fossil fuels	139	137	130	130	131	137	126	127	121	131	134	133	136	129	134	135	133	135	141	137	141
Netherlands	total	193	175	174	177	191	218	229	234	254	263	272	275	281	221	272	274	263	269	271	276	283
	biomass	40	39	41	41	43	49	48	50	54	50	56	53	58	50	61	59	58	54	60	62	51
	minerals, ores	71	63	60	62	67	83	90	91	102	112	112	115	117	75	102	111	96	102	94	99	110
	fossil fuels	82	73	73	74	81	86	91	93	99	102	104	107	107	96	110	104	108	112	118	115	122
Portugal	total	*21*	*20*	*19*	*19*	*20*	*20*	23	24	26	30	33	32	36	35	39	43	39	45	49	52	51
	biomass	*5*	*5*	*5*	*5*	*5*	*5*	6	6	7	7	8	8	9	9	10	10	10	12	13	12	12
	minerals, ores	*4*	*3*	*3*	*3*	*3*	*4*	4	4	5	5	5	6	6	6	7	8	8	10	12	13	13
	fossil fuels	*13*	*11*	*11*	*10*	*11*	*11*	13	13	14	18	19	19	21	21	23	25	21	23	24	27	26
Spain	total	*102*	*93*	*90*	*87*	*92*	*95*	106	108	109	123	127	137	145	137	144	159	157	167	194	192	221
	biomass	*13*	*13*	*13*	*13*	*13*	*14*	15	16	17	19	20	23	24	24	27	32	29	31	36	36	39
	minerals, ores	*24*	*22*	*21*	*21*	*23*	*25*	26	27	29	33	35	37	37	34	38	43	45	47	57	56	64
	fossil fuels	*65*	*59*	*56*	*53*	*55*	*56*	65	65	64	71	71	77	83	79	79	83	83	89	100	100	118
Sweden	total	*45*	*42*	*41*	*40*	*43*	*45*	*49*	52	48	48	46	44	46	47	52	52	51	55	56	56	60
	biomass	*9*	*9*	*9*	*9*	*9*	*10*	*10*	11	11	11	8	8	10	9	12	13	11	14	14	15	17
	minerals, ores	*11*	*10*	*10*	*10*	*11*	*11*	*12*	13	10	10	10	9	8	9	10	9	9	10	11	11	12
	fossil fuels	*25*	*23*	*22*	*21*	*23*	*24*	*26*	27	27	27	28	27	29	29	30	29	31	31	31	29	31
UK	total	139	130	128	125	150	155	157	164	170	179	187	185	191	186	191	190	192	201	204	193	209
	biomass	32	31	34	34	34	34	37	39	42	42	42	40	43	42	46	45	45	47	48	48	50
	minerals, ores	32	38	35	36	40	42	42	48	54	59	52	48	50	50	61	65	64	68	73	67	70
	fossil fuels	75	62	59	56	76	78	78	77	74	79	93	97	98	94	83	80	83	86	83	77	89

Sources: Eurostat COMEXT database, national MFAs, IEA/OECD, *IFF estimates (italic) for pre-accession years*

Note: the totals are the calculated sums of the individual components. These calculated sums are somewhat lower than the totals that can be downloaded from COMEXT (for details see Part II – Sources and methods).

Direct Material Input (DMI) in million tonnes

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	total	6009	5811	5721	5669	5729	5985	6001	6042	6222	6355	6326	6167	6130	5994	6240	6154	6108	6195	6184	6286	6308
	biomass	1493	1493	1512	1461	1568	1563	1543	1544	1553	1550	1574	1510	1522	1526	1523	1499	1534	1566	1570	1597	1626
	construction minerals	2475	2367	2296	2320	2242	2340	2387	2433	2595	2705	2703	2634	2611	2528	2700	2666	2564	2615	2598	2685	2584
	ind. minerals, ores	492	456	428	424	467	473	455	460	493	496	469	464	467	435	499	500	482	490	497	501	549
	fossil fuels	1548	1495	1485	1465	1451	1608	1615	1605	1581	1604	1580	1559	1531	1505	1517	1489	1528	1524	1519	1503	1549
Austria	total	158	156	154	148	155	155	154	155	158	164	167	166	169	169	180	177	179	185	177	180	185
	biomass	46	45	49	45	47	49	48	48	50	50	50	47	44	46	49	50	50	52	52	55	53
	construction minerals	69	68	65	63	64	62	64	65	66	70	73	74	80	80	85	78	78	84	75	76	76
	ind. minerals, ores	19	18	18	18	20	20	19	19	20	21	20	20	21	19	22	24	25	27	28	27	29
	fossil fuels	25	24	22	21	23	24	24	24	22	23	24	25	24	24	24	25	27	22	23	23	27
Belgium/ Luxembourg	total	263	257	247	230	244	240	247	254	274	285	299	306	308	301	321	325	332	337	347	363	371
	biomass	52	56	57	52	56	55	55	55	58	59	60	63	65	66	67	69	72	78	78	85	86
	construction minerals	67	67	62	59	59	58	59	61	65	73	81	83	81	81	92	88	86	83	82	82	82
	ind. minerals, ores	70	66	61	60	65	67	67	70	82	83	85	83	84	80	84	89	93	90	98	107	111
	fossil fuels	74	68	67	58	64	61	66	67	68	70	73	78	79	75	79	79	81	86	88	88	92
Denmark	total	128	128	133	125	140	157	157	152	157	159	163	163	152	155	160	163	158	165	160	160	164
	biomass	39	40	44	37	48	46	45	40	46	47	49	47	43	47	46	48	45	47	47	45	47
	construction minerals	55	55	56	56	58	73	73	72	73	73	75	73	65	64	64	64	59	59	59	59	59
	ind. minerals, ores	8	8	8	8	9	10	10	10	10	11	11	10	11	11	13	13	13	14	16	15	15
	fossil fuels	26	24	24	23	25	29	29	29	28	29	28	33	33	34	37	38	40	44	38	41	42
Finland	total	191	185	194	195	192	194	204	203	208	225	223	194	192	182	206	202	193	206	208	224	219
	biomass	61	57	58	58	59	60	56	56	61	65	61	51	57	61	68	73	67	70	74	78	79
	construction minerals	88	89	94	96	93	92	102	102	103	112	113	100	90	77	82	79	73	79	85	92	86
	ind. minerals, ores	17	17	18	19	20	20	19	21	20	22	22	18	19	20	22	21	22	24	25	25	24
	fossil fuels	25	22	24	22	20	23	28	25	24	26	27	24	26	25	34	28	31	34	24	29	29
France	total	1072	1040	1012	986	984	1022	1011	1035	1084	1090	1097	1124	1104	1032	1061	1056	1033	1060	1073	1086	1101
	biomass	353	359	364	371	391	397	385	389	389	371	371	390	404	385	386	384	386	404	407	418	423
	construction minerals	365	365	353	338	309	339	339	358	405	416	422	427	400	373	390	390	357	360	372	372	373
	ind. minerals, ores	143	126	122	114	121	123	123	128	134	144	139	133	126	109	121	122	120	125	118	122	129
	fossil fuels	211	189	173	162	164	162	163	160	156	159	165	174	174	164	165	159	170	171	176	174	176
Germany	total	1763	1672	1565	1550	1627	1707	1721	1698	1747	1790	1759	1730	1734	1730	1839	1799	1780	1768	1756	1771	1737
	biomass	311	324	318	293	329	345	336	337	329	337	368	313	303	318	306	315	323	328	334	332	344
	construction minerals	736	652	564	576	583	548	574	573	620	665	646	706	742	735	833	801	769	755	736	776	707
	ind. minerals, ores	163	149	136	137	149	147	147	143	154	162	162	178	191	166	196	195	185	193	202	194	204
	fossil fuels	553	547	547	544	566	667	664	646	645	627	583	534	498	511	503	488	502	491	484	468	483
Greece	total	125	129	127	128	117	131	132	144	133	145	145	155	156	154	158	159	164	166	181	175	191
	biomass	34	36	36	35	35	36	37	36	37	40	36	40	39	38	39	40	39	39	38	40	42
	construction minerals	43	43	39	36	22	28	28	28	28	28	29	30	30	29	28	32	29	37	38	36	33
	ind. minerals, ores	13	13	12	13	13	14	14	14	12	14	15	16	13	13	14	16	16	17	21	20	26
	fossil fuels	34	37	41	44	46	54	53	65	56	63	66	69	74	74	77	71	80	74	84	79	90
Ireland	total	77	72	77	75	80	72	75	75	74	80	83	82	83	83	88	90	96	97	98	101	101
	biomass	34	34	35	34	36	34	35	35	35	36	37	37	38	37	39	40	41	41	42	43	41
	construction minerals	19	19	22	19	19	17	17	16	17	18	19	18	18	19	20	22	25	25	25	25	25
	ind. minerals, ores	8	6	6	7	8	8	8	8	9	9	10	10	10	10	10	12	12	13	14	15	16
	fossil fuels	15	13	13	15	16	12	15	16	14	17	17	17	16	17	19	16	17	18	17	18	19
Italy	total	775	761	774	795	775	824	808	812	811	832	814	801	781	762	779	780	792	805	824	830	843
	biomass	194	190	179	181	182	180	187	184	177	182	170	178	182	174	180	175	181	182	186	192	190
	construction minerals	357	357	387	406	377	420	411	413	419	418	408	389	362	339	340	335	348	353	353	352	350
	ind. minerals, ores	70	62	61	61	69	70	68	71	76	82	81	80	81	97	102	113	107	113	121	128	144
	fossil fuels	153	152	147	146	147	153	142	145	140	150	155	154	156	151	157	158	156	158	164	158	160
Netherlands	total	362	340	325	328	347	385	390	394	407	440	447	451	462	396	438	441	440	436	413	413	418
	biomass	74	76	79	75	79	87	91	89	94	93	99	93	102	94	100	98	99	95	96	101	91
	construction minerals	53	53	45	47	48	51	51	54	53	63	62	58	58	51	50	50	48	48	30	27	27
	ind. minerals, ores	74	67	64	65	71	87	94	95	106	115	115	118	120	78	105	114	101	108	100	104	115
	fossil fuels	161	145	136	142	149	161	155	157	155	169	171	182	182	173	183	178	191	185	187	181	185
Portugal	total	111	107	105	100	85	92	98	97	105	112	123	123	126	124	139	147	143	156	162	165	160
	biomass	32	30	32	31	33	34	36	37	37	37	40	40	38	39	43	42	44	44	46	48	48
	construction minerals	60	60	57	54	36	41	44	41	47	49	54	55	55	53	64	68	67	75	76	74	71
	ind. minerals, ores	5	5	5	5	5	5	6	6	6	8	8	9	11	10	10	12	11	14	15	16	16
	fossil fuels	13	12	11	11	11	12	13	13	14	18	20	19	22	21	23	25	21	23	24	27	26
Spain	total	493	479	478	480	514	551	560	565	573	588	605	569	586	567	571	589	624	663	694	730	760
	biomass	142	128	139	138	151	148	145	157	162	161	164	162	157	159	156	151	173	177	185	175	190
	construction minerals	193	193	185	186	198	241	246	247	250	249	266	230	251	242	246	258	270	299	305	359	342
	ind. minerals, ores	63	62	56	60	68	63	64	60	63	69	67	66	60	54	59	67	70	71	77	70	86
	fossil fuels	95	96	97	95	97	98	105	101	97	109	108	111	118	112	110	112	111	115	127	125	142
Sweden	total	231	228	229	223	233	221	226	226	227	242	243	227	220	227	231	246	225	225	236	228	251
	biomass	72	73	74	75	78	74	76	76	78	81	81	75	77	80	83	91	84	92	90	89	95
	construction minerals	101	101	107	102	103	91	91	89	92	103	105	97	86	90	87	92	75	66	80	73	84
	ind. minerals, ores	33	30	25	24	29	31	32	33	29	30	28	27	27	27	30	32	33	35	35	37	40
	fossil fuels	25	23	22	22	23	24	27	28	28	28	29	28	30	29	31	30	32	32	31	30	32
UK	total	800	769	801	820	794	836	868	893	932	926	904	848	848	854	896	894	889	898	898	895	890
	biomass	146	143	155	147	160	150	155	153	158	156	157	155	161	157	160	160	168	170	168	168	170
	construction minerals	269	244	259	280	274	278	290	316	356	367	350	295	293	295	320	309	277	292	282	280	268
	ind. minerals, ores	61	64	62	63	68	71	71	79	86	92	75	72	76	79	92	90	95	87	102	95	97
	fossil fuels	324	317	326	330	292	337	352	346	332	310	321	326	319	323	324	335	348	349	347	351	356

Sources: Data from national MFAs, Eurostat 2001a, IFF estimates based on international data sources

Exports in million tonnes

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	total	275	300	288	298	311	320	299	303	298	303	309	313	331	403	425	354	364	385	385	392	419
extra EU	biomass	63	71	66	70	75	81	75	82	80	89	94	92	99	100	101	92	89	97	97	106	112
trade	minerals, ores	145	150	141	146	156	159	141	141	140	139	135	141	144	167	176	151	167	170	163	158	171
	fossil fuels	67	79	81	82	80	81	83	80	78	75	81	80	88	135	148	111	108	117	125	128	137
EU-15	total	567	558	549	570	606	637	671	689	699	741	737	743	756	765	863	927	964	1000	1039	1073	1099
Intra-EU	biomass	119	123	130	131	142	149	160	169	173	182	186	195	201	205	226	243	250	264	281	287	285
trade	minerals, ores	257	245	237	243	254	266	288	303	336	367	359	346	352	344	388	420	435	445	462	486	492
	fossil fuels	191	190	182	197	211	222	224	217	190	192	193	202	203	217	249	264	279	291	296	300	322
EU-15	total	841	857	836	868	917	957	971	992	998	1045	1047	1056	1087	1168	1287	1281	1328	1384	1424	1465	1518
total intra-	biomass	181	194	196	201	217	230	235	251	253	271	280	287	299	305	327	334	339	361	378	394	397
and extra-EU	minerals, ores	402	395	378	389	409	425	429	444	477	506	494	487	497	512	564	571	602	615	625	644	662
trade	fossil fuels	258	269	263	278	291	302	307	296	268	267	273	282	291	352	397	375	387	408	421	427	459
Austria	total	15	15	15	17	18	18	18	19	20	21	22	22	22	23	25	28	29	32	35	36	38
	biomass	7	6	6	7	7	7	8	8	9	9	10	9	10	10	11	12	12	13	14	16	16
	minerals, ores	8	8	8	9	10	9	9	10	10	10	11	11	11	11	12	14	14	16	18	17	19
	fossil fuels	1	1	1	1	1	2	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3
Belgium	total	86	83	82	86	91	89	93	94	102	110	111	117	116	130	138	137	141	155	164	178	194
Luxembourg	biomass	13	14	15	15	17	17	17	17	17	19	20	22	23	25	27	30	29	31	34	35	37
	minerals, ores	55	51	49	52	55	56	56	57	64	68	69	71	70	72	77	80	80	87	90	97	105
	fossil fuels	19	18	17	18	19	17	20	20	21	23	22	24	24	32	34	28	31	37	40	45	52
Denmark	total	13	12	13	15	16	17	17	18	19	20	22	25	27	30	32	33	32	35	35	37	43
	biomass	6	6	6	7	7	8	8	7	8	8	10	10	9	9	10	11	10	10	10	10	10
	minerals, ores	5	5	5	5	5	5	5	5	6	6	6	7	8	11	12	12	13	11	11	11	12
	fossil fuels	2	2	1	3	4	4	4	5	5	6	6	8	10	10	11	11	10	13	14	16	20
Finland	total	21	21	19	20	21	20	21	22	23	21	22	24	26	29	33	31	33	34	35	36	35
	biomass	15	14	12	12	14	14	14	15	14	14	14	14	15	18	20	19	19	21	21	22	22
	minerals, ores	4	5	5	5	4	4	4	5	5	5	6	6	7	8	8	8	9	9	9	9	9
	fossil fuels	2	2	2	2	3	2	3	3	3	1	2	3	4	4	4	4	6	4	5	5	4
France	total	133	133	123	130	137	144	141	143	151	159	162	163	167	165	165	166	169	179	183	192	200
	biomass	41	45	42	48	52	59	57	62	64	69	70	70	72	72	67	69	69	72	75	84	85
	minerals, ores	71	67	64	65	69	67	66	65	69	73	73	73	74	70	75	76	76	79	79	81	84
	fossil fuels	20	21	18	17	17	18	18	16	19	17	19	20	21	24	23	22	24	28	29	28	31
Germany	total	156	155	148	151	163	163	163	167	175	188	189	200	204	202	223	225	238	249	260	265	274
	biomass	28	30	31	31	34	37	40	42	43	46	46	55	57	55	62	65	65	66	72	76	78
	minerals, ores	95	94	89	91	97	98	99	102	107	114	116	119	119	112	125	123	126	138	140	142	143
	fossil fuels	33	31	28	29	32	29	24	23	25	28	27	26	28	35	37	36	47	46	48	48	52
Greece	total	*13*	14	15	17	18	18	19	21	14	19	23	21	21	21	26	21	24	23	22	22	23
	biomass	*2*	2	3	3	4	3	4	4	2	4	8	4	5	4	5	4	4	4	4	5	4
	minerals, ores	*10*	11	10	12	12	12	12	13	9	11	10	11	13	12	13	12	13	12	12	10	11
	fossil fuels	*1*	1	2	1	2	3	2	5	3	4	4	5	3	5	8	5	6	6	6	7	8
Ireland	total	5	5	5	5	7	7	8	8	9	9	9	10	10	10	10	11	10	11	12	12	11
	biomass	3	2	2	2	3	3	3	3	4	4	4	4	5	4	4	4	4	4	4	4	4
	minerals, ores	2	2	2	2	3	3	4	4	4	4	4	5	4	4	5	5	4	5	6	5	6
	fossil fuels	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Italy	total	54	56	56	56	57	61	62	62	65	68	70	71	77	88	91	94	101	110	113	113	118
	biomass	11	13	13	12	13	15	13	13	16	16	15	16	17	19	20	20	25	28	26	30	28
	minerals, ores	29	29	26	29	31	31	30	31	32	35	35	34	36	42	46	50	52	54	56	56	61
	fossil fuels	14	15	17	15	13	15	19	17	17	18	20	21	24	27	25	24	24	28	31	28	29
Netherlands	total	143	137	130	138	145	166	169	177	184	205	184	167	172	189	228	216	222	211	215	228	213
	biomass	20	22	23	23	24	26	25	29	31	33	34	32	34	35	41	39	38	40	43	44	40
	minerals, ores	41	41	39	40	43	56	62	68	80	89	74	57	59	64	75	70	82	72	70	84	73
	fossil fuels	81	74	69	74	78	85	82	80	74	83	76	77	78	90	112	106	101	99	102	100	99
Portugal	total	*6*	*6*	*6*	*7*	*7*	*7*	8	8	9	10	12	11	13	13	16	15	14	15	15	15	15
	biomass	*3*	*3*	*3*	*3*	*4*	*4*	4	4	4	4	5	5	5	5	5	5	5	6	6	6	6
	minerals, ores	*2*	*2*	*2*	*2*	*2*	*2*	3	3	3	4	4	4	5	4	5	5	5	6	6	6	7
	fossil fuels	*1*	*1*	*1*	*1*	*1*	*1*	1	1	1	2	3	2	4	4	6	5	3	3	3	3	3
Spain	total	*45*	*48*	*46*	*48*	*51*	*53*	57	57	60	60	56	60	59	64	70	76	85	86	95	86	95
	biomass	*9*	*9*	*9*	*10*	*11*	*11*	12	14	15	14	13	14	14	16	18	20	21	24	26	22	23
	minerals, ores	*24*	*26*	*24*	*25*	*27*	*28*	29	31	30	31	29	30	30	33	37	41	46	43	47	43	48
	fossil fuels	*12*	*13*	*13*	*13*	*14*	*14*	16	13	15	14	14	16	14	16	15	16	17	19	23	21	24
Sweden	total	*33*	*35*	*34*	*35*	*37*	*39*	*43*	47	47	47	48	47	49	52	54	55	56	60	57	59	61
	biomass	*10*	*11*	*11*	*11*	*12*	*13*	*15*	17	17	16	17	17	17	18	20	20	21	22	23	23	23
	minerals, ores	*17*	*17*	*16*	*17*	*18*	*19*	*21*	22	24	23	23	22	22	24	25	26	26	28	25	25	27
	fossil fuels	*6*	*6*	*6*	*7*	*7*	*7*	*8*	8	7	8	8	8	10	10	9	9	9	10	9	10	11
UK	total	100	122	127	129	138	145	152	149	120	106	118	118	124	152	176	174	174	186	184	187	197
	biomass	9	10	14	10	13	12	16	15	9	15	15	15	16	16	18	17	18	20	20	19	20
	minerals, ores	31	31	27	26	29	30	29	30	34	33	34	36	39	46	49	51	54	56	56	56	58
	fossil fuels	61	81	86	93	96	103	108	103	77	59	69	67	69	91	109	106	103	110	107	112	119

Sources: Eurostat COMEXT database, national MFAs, IEA/OECD, *IFF estimates (italic) for pre-accession years*

Note: the totals are the calculated sums of the individual components. These calculated sums are somewhat lower than the totals that can be downloaded from COMEXT (for detail see Part II – Sources and methods).

Direct Material Consumption (DMC) in million tonnes

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	total	5735	5512	5434	5372	5418	5664	5702	5739	5923	6051	6017	5854	5799	5591	5815	5800	5744	5810	5799	5894	5889
	biomass	1430	1422	1447	1391	1493	1482	1468	1462	1473	1461	1480	1418	1423	1426	1422	1408	1445	1469	1474	1490	1514
	construction minerals	2475	2367	2296	2320	2242	2340	2387	2433	2595	2705	2703	2634	2611	2528	2700	2666	2564	2615	2598	2685	2584
	ind. minerals, ores	347	306	287	277	312	314	314	319	353	357	334	323	323	267	324	348	315	319	334	343	378
	fossil fuels	1482	1417	1404	1383	1371	1528	1533	1525	1503	1529	1499	1480	1442	1370	1369	1378	1420	1407	1393	1375	1413
Austria	total	143	140	139	131	137	136	136	137	138	143	145	144	146	146	154	149	150	154	143	144	146
	biomass	39	39	42	38	40	42	40	40	41	41	40	38	34	36	38	38	38	39	38	39	36
	construction minerals	69	68	65	63	64	62	64	65	66	70	73	74	80	80	85	78	78	84	75	76	76
	ind. minerals, ores	11	10	10	9	11	11	10	9	10	10	10	10	10	8	10	10	10	11	10	10	10
	fossil fuels	24	23	22	20	22	22	23	23	21	21	23	23	23	22	21	23	24	19	20	19	24
Belgium/	total	177	174	165	144	152	151	154	159	171	176	188	189	192	172	183	188	190	182	183	185	178
Luxembourg	biomass	39	42	42	37	39	38	38	38	41	40	40	40	42	41	40	39	43	47	45	50	49
	construction minerals	67	67	62	59	59	58	59	61	65	73	81	83	81	81	92	88	86	83	82	82	82
	ind. minerals, ores	15	15	12	8	10	11	11	13	18	15	15	11	14	8	7	9	12	4	8	10	7
	fossil fuels	55	51	49	40	45	44	46	47	47	47	51	54	55	42	45	51	50	48	48	44	40
Denmark	total	116	115	120	110	124	140	140	134	138	139	141	137	126	125	127	130	125	130	125	123	121
	biomass	33	34	38	30	40	38	37	32	37	39	39	37	34	37	37	37	36	37	37	35	37
	construction minerals	55	55	56	56	58	73	73	72	73	73	75	73	65	64	64	64	59	59	59	59	59
	ind. minerals, ores	3	3	3	3	4	5	5	5	4	5	5	3	4	1	1	2	0	3	4	4	3
	fossil fuels	24	23	23	20	21	25	24	24	23	23	22	24	24	23	26	27	31	31	25	25	22
Finland	total	171	164	175	176	171	174	183	181	186	204	201	170	166	153	173	171	159	173	173	188	184
	biomass	47	43	47	46	46	46	41	41	47	50	47	37	42	43	47	54	48	49	53	56	57
	construction minerals	88	89	94	96	93	92	102	102	103	112	113	100	90	77	82	79	73	79	85	92	86
	ind. minerals, ores	13	12	13	14	15	15	15	16	15	17	16	12	12	12	14	13	13	15	16	15	16
	fossil fuels	23	20	22	20	17	21	25	22	21	25	25	21	22	21	30	24	25	30	19	24	25
France	total	939	907	889	855	847	878	870	892	932	931	935	961	937	866	897	889	864	881	890	894	901
	biomass	311	314	323	323	339	338	328	327	325	301	301	320	331	313	319	315	317	332	331	335	338
	construction minerals	365	365	353	338	309	339	339	358	405	416	422	427	400	373	390	390	357	360	372	372	373
	ind. minerals, ores	72	59	58	49	52	56	57	64	65	72	66	60	52	40	46	46	44	46	39	41	45
	fossil fuels	191	168	156	145	147	144	145	144	137	142	146	154	153	140	141	138	146	143	147	146	145
Germany	total	1607	1517	1417	1398	1464	1544	1558	1531	1572	1602	1570	1530	1530	1529	1615	1574	1542	1518	1496	1505	1464
	biomass	283	294	287	262	296	308	297	294	286	291	322	258	245	263	244	250	259	263	263	256	266
	construction minerals	736	652	564	576	583	548	574	573	620	665	646	706	742	735	833	801	769	755	736	776	707
	ind. minerals, ores	68	55	47	46	52	49	47	41	47	48	47	59	73	55	72	72	59	55	61	52	60
	fossil fuels	520	516	519	515	534	638	640	623	620	598	556	508	470	476	466	451	455	445	436	421	431
Greece	total	112	115	112	111	99	113	114	122	118	126	122	134	135	133	132	138	141	144	159	153	168
	biomass	32	33	34	31	32	33	33	32	34	36	28	35	34	33	34	36	35	35	34	36	37
	construction minerals	43	43	39	36	22	28	28	28	28	28	29	30	30	29	28	32	29	37	38	36	33
	ind. minerals, ores	4	2	1	1	2	1	2	1	3	3	4	4	0	1	1	3	2	4	9	10	15
	fossil fuels	33	36	39	43	44	51	51	61	53	59	61	64	71	69	70	66	74	67	78	72	82
Ireland	total	72	68	71	70	73	64	67	67	65	71	74	73	73	73	78	79	85	85	86	89	89
	biomass	32	31	32	32	33	31	32	32	31	32	34	34	34	33	35	35	37	36	38	39	37
	construction minerals	19	19	22	19	19	17	17	16	17	18	19	18	18	19	20	22	25	25	25	25	25
	ind. minerals, ores	6	4	4	5	5	5	4	5	4	5	5	5	6	6	6	7	8	8	8	9	10
	fossil fuels	15	13	13	14	15	11	14	15	12	16	16	16	15	15	17	15	15	16	15	16	17
Italy	total	721	705	718	739	718	764	746	750	747	764	744	730	704	674	688	687	691	695	711	717	725
	biomass	184	177	166	170	170	166	174	171	161	167	155	162	165	156	160	155	156	153	159	162	162
	construction minerals	357	357	387	406	377	420	411	413	419	418	408	389	362	339	340	335	348	353	353	352	350
	ind. minerals, ores	41	33	35	32	38	39	38	40	43	47	47	47	45	55	57	63	55	59	65	72	83
	fossil fuels	139	137	130	131	134	138	123	127	123	133	134	133	133	124	131	134	132	130	133	130	130
Netherlands	total	219	203	194	190	203	219	221	217	223	235	263	285	290	207	210	225	218	225	198	185	206
	biomass	54	53	57	51	55	61	65	61	63	60	65	61	68	59	59	59	61	55	53	57	51
	construction minerals	53	53	45	47	48	51	51	54	53	63	62	58	58	51	50	50	48	48	30	27	27
	ind. minerals, ores	33	26	25	25	29	31	32	26	26	26	41	61	61	15	30	44	19	36	30	20	42
	fossil fuels	80	72	68	68	71	76	73	77	81	85	95	105	104	83	71	71	89	86	85	81	85
Portugal	total	104	101	98	94	78	85	90	89	96	101	111	112	113	110	123	132	129	141	147	150	145
	biomass	29	27	29	28	29	30	31	33	33	33	36	36	33	35	38	37	39	38	40	43	42
	construction minerals	60	60	57	54	36	41	44	41	47	49	54	55	55	53	64	68	67	75	76	74	71
	ind. minerals, ores	3	3	3	2	3	3	3	3	3	4	4	5	7	5	5	7	6	8	9	9	9
	fossil fuels	12	10	10	9	10	10	12	12	13	16	17	17	18	17	17	20	17	20	21	24	22
Spain	total	448	431	431	431	463	498	502	508	513	529	549	508	527	503	501	513	539	577	599	644	665
	biomass	133	119	130	128	141	137	133	143	147	151	151	148	143	143	138	132	151	153	159	154	166
	construction minerals	193	193	185	186	198	241	246	247	250	249	266	230	251	242	246	258	270	299	305	359	342
	ind. minerals, ores	39	36	32	35	41	36	34	29	33	38	38	35	30	22	22	26	23	28	31	27	38
	fossil fuels	83	83	84	82	83	84	89	88	82	94	94	95	103	96	94	97	94	97	104	104	118
Sweden	total	198	193	195	188	195	181	183	179	181	195	195	180	170	175	178	191	169	165	179	169	189
	biomass	62	62	63	63	66	61	61	60	62	65	64	57	59	62	64	71	64	70	67	66	72
	construction minerals	101	101	107	102	103	91	91	89	92	103	105	97	86	90	87	92	75	66	80	73	84
	ind. minerals, ores	16	13	8	7	11	12	12	10	6	7	6	5	5	3	5	7	7	7	10	11	12
	fossil fuels	19	17	16	15	16	17	19	20	21	20	21	20	20	20	22	21	23	22	22	20	21
UK	total	700	647	674	692	657	691	716	745	812	819	786	730	724	702	720	720	714	712	715	708	693
	biomass	138	133	140	136	147	138	140	137	149	142	142	140	145	141	142	142	150	150	148	150	150
	construction minerals	269	244	259	280	274	278	290	316	356	367	350	295	293	295	320	309	277	292	282	280	268
	ind. minerals, ores	30	33	35	37	39	41	42	49	52	60	42	36	37	33	42	39	41	31	45	40	38
	fossil fuels	263	236	241	238	196	234	245	243	255	251	252	259	250	232	216	230	245	239	240	239	237

Sources: Data from national MFAs, Eurostat 2001a, IFF estimates based on international data sources

Physical Trade Balance (PTB) in million tonnes

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	total	834	706	686	633	672	686	698	720	761	793	826	882	898	799	870	897	872	891	930	930	997
	biomass	100	83	93	87	81	76	76	79	84	73	77	80	81	75	95	79	68	61	71	78	74
	ind. minerals, ores	107	83	79	69	91	101	105	117	150	152	149	147	152	109	156	187	142	158	174	193	226
	fossil fuels	627	541	514	477	500	509	517	525	527	569	600	654	664	615	619	632	662	671	684	658	696
Austria	total	22	21	19	16	19	21	21	21	21	21	21	25	25	23	24	24	27	23	22	21	27
	biomass	0	0	0	0	0	1	0	1	0	0	-1	2	1	1	1	0	0	0	0	0	2
	ind. minerals, ores	3	3	3	2	3	3	3	2	4	4	4	4	5	4	5	5	6	6	5	5	5
	fossil fuels	18	18	16	15	17	17	18	18	17	17	18	19	19	18	18	19	21	16	16	16	20
Belgium/	total	72	67	63	49	56	56	58	64	71	68	74	73	76	56	59	67	70	63	67	66	60
Luxembourg	biomass	9	9	9	9	8	8	8	9	10	8	9	10	9	6	7	8	8	11	11	13	14
	ind. minerals, ores	14	14	11	7	9	10	11	12	18	14	15	11	14	7	6	9	12	3	7	9	6
	fossil fuels	49	44	43	34	38	37	40	43	44	45	50	52	54	42	45	51	50	48	48	44	40
Denmark	total	27	26	24	21	22	25	24	23	20	19	16	16	17	12	14	15	16	17	13	9	2
	biomass	1	1	0	1	0	0	0	1	0	0	-1	-1	1	2	2	2	2	2	3	2	3
	ind. minerals, ores	3	2	3	3	3	4	4	4	3	4	4	3	3	0	0	1	-1	2	4	3	2
	fossil fuels	24	22	21	18	18	21	19	18	17	15	13	14	12	11	12	13	15	13	7	4	-3
Finland	total	16	14	16	16	14	16	16	18	16	21	20	15	15	14	18	17	15	18	17	17	19
	biomass	-9	-9	-4	-5	-6	-7	-8	-8	-7	-7	-7	-8	-7	-10	-11	-7	-9	-11	-10	-8	-10
	ind. minerals, ores	5	3	3	4	5	5	5	6	6	8	8	5	6	6	7	7	6	8	9	8	10
	fossil fuels	20	19	17	17	15	18	19	20	17	19	19	18	16	17	22	17	18	21	18	17	19
France	total	153	123	119	99	98	96	103	106	108	119	121	130	124	104	124	121	124	126	138	135	139
	biomass	-13	-16	-11	-17	-22	-29	-25	-29	-29	-34	-32	-29	-32	-31	-20	-23	-25	-26	-26	-31	-32
	ind. minerals, ores	5	1	2	-1	0	8	8	17	20	30	25	22	19	11	19	21	17	20	27	30	34
	fossil fuels	161	138	128	117	120	117	120	118	116	122	128	137	137	124	126	123	132	132	138	137	137
Germany	total	174	146	141	136	137	143	151	138	142	130	148	189	207	222	240	239	237	233	245	224	233
	biomass	26	22	22	22	19	20	17	16	16	15	17	14	14	10	8	5	4	4	2	1	-3
	ind. minerals, ores	35	25	20	19	25	23	21	16	21	20	21	33	46	32	42	47	33	28	34	23	35
	fossil fuels	114	99	99	94	93	100	112	106	106	96	110	142	147	180	189	187	200	201	209	200	201
Greece	total	3	1	5	2	1	5	4	9	-1	1	1	8	8	9	6	11	13	10	16	14	30
	biomass	0	-1	0	-1	-1	-1	-1	0	1	-1	-4	0	-1	0	0	2	2	2	2	2	4
	ind. minerals, ores	-6	-7	-6	-7	-7	-8	-7	-6	-5	-5	-4	-3	-6	-5	-6	-3	-4	-3	-3	2	7
	fossil fuels	10	9	11	11	10	14	11	15	4	6	8	10	15	14	12	12	16	10	16	10	19
Ireland	total	11	9	8	9	8	8	11	10	9	10	12	11	11	12	15	13	14	15	17	18	19
	biomass	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2
	ind. minerals, ores	2	2	1	2	2	2	2	2	2	3	3	3	3	3	3	5	5	5	5	6	7
	fossil fuels	8	6	6	6	6	6	8	7	7	7	7	7	7	8	9	7	8	9	10	9	11
Italy	total	174	156	151	150	162	167	154	160	156	172	174	175	170	170	181	192	178	179	192	194	211
	biomass	22	17	18	19	21	22	22	24	22	26	25	28	26	22	24	26	22	21	25	22	25
	ind. minerals, ores	27	18	20	15	23	24	25	26	29	33	34	35	33	46	47	54	47	50	56	63	74
	fossil fuels	124	122	114	116	118	122	107	110	104	114	114	112	112	102	109	112	109	107	111	109	112
Netherlands	total	50	38	44	39	47	51	60	57	70	58	87	108	109	32	44	59	41	58	56	48	70
	biomass	20	17	19	18	19	24	22	22	23	17	22	21	23	15	20	20	20	14	17	18	11
	ind. minerals, ores	29	22	21	22	25	27	28	22	22	22	37	58	57	11	26	41	14	31	24	15	37
	fossil fuels	1	-1	5	0	3	1	9	13	25	19	28	30	29	7	-2	-2	7	13	16	15	22
Portugal	total	15	13	13	12	13	13	14	16	18	20	21	21	24	22	23	28	25	30	34	37	35
	biomass	3	2	2	2	2	2	2	2	3	3	4	3	4	4	5	5	5	6	7	7	6
	ind. minerals, ores	1	1	1	1	1	1	1	2	2	1	1	1	2	1	1	3	2	5	6	7	7
	fossil fuels	11	10	10	9	10	10	11	12	13	15	17	16	18	17	17	20	17	20	21	24	22
Spain	total	57	45	44	38	41	42	49	51	49	63	71	76	86	73	74	83	72	81	99	107	126
	biomass	4	3	4	4	3	3	3	2	2	5	8	9	10	8	9	13	8	7	11	14	15
	ind. minerals, ores	0	-4	-3	-4	-3	-3	-3	-4	-1	1	6	7	7	1	1	2	-1	4	11	13	17
	fossil fuels	53	46	43	39	41	42	49	52	49	57	57	60	69	64	64	68	66	70	77	79	94
Sweden	total	12	8	7	6	6	6	6	5	2	1	-2	-3	-3	-5	-2	-3	-4	-5	-1	-3	-2
	biomass	-1	-2	-2	-2	-3	-4	-4	-5	-5	-5	-8	-9	-8	-9	-8	-6	-10	-8	-9	-7	-6
	ind. minerals, ores	-6	-7	-7	-7	-7	-7	-8	-9	-13	-13	-13	-13	-14	-15	-15	-16	-17	-18	-14	-14	-15
	fossil fuels	19	17	16	15	16	16	19	20	20	19	20	19	19	19	21	20	22	21	22	19	20
UK	total	39	8	1	-3	12	10	6	15	50	72	70	67	67	33	15	16	18	15	20	6	12
	biomass	24	20	20	23	21	23	22	24	33	27	27	24	27	26	28	27	27	27	28	30	31
	ind. minerals, ores	1	7	7	10	11	12	13	18	20	26	19	12	11	5	12	14	10	12	17	12	12
	fossil fuels	14	-19	-26	-37	-20	-25	-29	-26	-3	19	24	30	29	3	-25	-25	-20	-24	-25	-35	-30

Sources: Data from national MFAs, Eurostat 2001a, IFF estimates based on international data sources

Main Indicators in million tonnes

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	DE	4901	4805	4747	4739	4746	4978	5004	5019	5162	5259	5191	4973	4901	4792	4945	4903	4872	4919	4869	4964	4892
	Imports	1109	1006	974	930	983	1006	998	1023	1059	1096	1135	1195	1229	1201	1295	1252	1236	1276	1314	1322	1416
	Exports	275	300	288	298	311	320	299	303	298	303	309	313	331	403	425	354	364	385	385	392	419
	DMI	6009	5811	5721	5669	5729	5985	6001	6042	6222	6355	6326	6167	6130	5994	6240	6154	6108	6195	6184	6286	6308
	DMC	5735	5512	5434	5372	5418	5664	5702	5739	5923	6051	6017	5854	5799	5591	5815	5800	5744	5810	5799	5894	5889
	PTB	834	706	686	633	672	686	698	720	761	793	826	882	898	799	870	897	872	891	930	930	997
Austria	DE	122	120	120	115	117	115	115	116	117	122	123	120	122	123	130	125	124	131	121	123	119
	Imports	37	36	34	33	38	39	39	40	41	42	44	46	47	46	49	53	55	55	56	57	65
	Exports	15	15	15	17	18	18	18	19	20	21	22	22	22	23	25	28	29	32	35	36	38
	DMI	158	156	154	148	155	155	154	155	158	164	167	166	169	169	180	177	179	185	177	180	185
	DMC	143	140	139	131	137	136	136	137	138	143	145	144	146	146	154	149	150	154	143	144	146
	PTB	22	21	19	16	19	21	21	21	21	21	21	25	25	23	24	24	27	23	22	21	27
Belgium/ Luxembourg	DE	104	107	102	94	97	95	96	95	101	108	114	117	116	116	124	121	120	119	116	119	118
	Imports	159	150	145	135	147	145	151	158	173	178	185	190	192	185	197	205	211	218	231	244	253
	Exports	86	83	82	86	91	89	93	94	102	110	111	117	116	130	138	137	141	155	164	178	194
	DMI	263	257	247	230	244	240	247	254	274	285	299	306	308	301	321	325	332	337	347	363	371
	DMC	177	174	165	144	152	151	154	159	171	176	188	189	192	172	183	188	190	182	183	185	178
	PTB	72	67	63	49	56	56	58	64	71	68	74	73	76	56	59	67	70	63	67	66	60
Denmark	DE	88	90	96	89	102	116	116	111	118	120	125	122	109	112	113	114	110	113	112	114	119
	Imports	40	38	37	36	38	42	41	40	39	39	38	41	43	43	47	49	48	52	48	46	45
	Exports	13	12	13	15	16	17	17	18	19	20	22	25	27	30	32	33	32	35	35	37	43
	DMI	128	128	133	125	140	157	157	152	157	159	163	163	152	155	160	163	158	165	160	160	164
	DMC	116	115	120	110	124	140	140	134	138	139	141	137	126	125	127	130	125	130	125	123	121
	PTB	27	26	24	21	22	25	24	23	20	19	16	16	17	12	14	15	16	17	13	9	2
Finland	DE	155	151	160	160	157	158	166	162	170	183	181	155	152	139	154	154	144	155	156	172	165
	Imports	37	35	34	35	35	37	38	41	38	42	41	39	40	43	51	48	49	51	52	52	54
	Exports	21	21	19	20	21	20	21	22	23	21	22	24	26	29	33	31	33	34	35	36	35
	DMI	191	185	194	195	192	194	204	203	208	225	223	194	192	182	206	202	193	206	208	224	219
	DMC	171	164	175	176	171	174	183	181	186	204	201	170	166	153	173	171	159	173	173	188	184
	PTB	16	14	16	16	14	16	16	18	16	21	20	15	15	14	18	17	15	18	17	17	19
France	DE	786	784	770	756	749	782	767	786	825	812	814	832	813	763	772	768	739	755	751	759	762
	Imports	286	256	242	229	235	240	244	249	259	278	283	293	291	269	289	287	293	305	322	327	339
	Exports	133	133	123	130	137	144	141	143	151	159	162	163	167	165	165	166	169	179	183	192	200
	DMI	1072	1040	1012	986	984	1022	1011	1035	1084	1090	1097	1124	1104	1032	1061	1056	1033	1060	1073	1086	1101
	DMC	939	907	889	855	847	878	870	892	932	931	935	961	937	866	897	889	864	881	890	894	901
	PTB	153	123	119	99	98	96	103	106	108	119	121	130	124	104	124	121	124	126	138	135	139
Germany	DE	1433	1371	1277	1263	1327	1401	1407	1394	1430	1471	1422	1341	1323	1307	1375	1335	1305	1285	1251	1282	1231
	Imports	330	301	288	287	300	306	314	305	317	319	337	390	411	423	463	464	475	482	505	489	506
	Exports	156	155	148	151	163	163	163	167	175	188	189	200	204	202	223	225	238	249	260	265	274
	DMI	1763	1672	1565	1550	1627	1707	1721	1698	1747	1790	1759	1730	1734	1730	1839	1799	1780	1768	1756	1771	1737
	DMC	1607	1517	1417	1398	1464	1544	1558	1531	1572	1602	1570	1530	1530	1529	1615	1574	1542	1518	1496	1505	1464
	PTB	174	146	141	136	137	143	151	138	142	130	148	189	207	222	240	239	237	233	245	224	233
Greece	DE	109	114	108	109	98	108	110	114	119	125	122	126	126	124	126	127	127	134	143	139	138
	Imports	16	15	19	19	19	23	22	30	14	20	23	29	29	30	32	32	37	33	37	36	53
	Exports	13	14	15	17	18	18	19	21	14	19	23	21	21	21	26	21	24	23	22	22	23
	DMI	125	129	127	128	117	131	132	144	133	145	145	155	156	154	158	159	164	166	181	175	191
	DMC	112	115	112	111	99	113	114	122	118	126	122	134	135	133	132	138	141	144	159	153	168
	PTB	3	1	5	2	1	5	4	9	-1	1	1	8	8	9	6	11	13	10	16	14	30
Ireland	DE	61	58	63	61	65	56	56	57	56	61	63	62	62	61	64	66	71	70	68	72	70
	Imports	16	14	13	14	15	16	18	18	18	19	21	21	21	22	25	24	25	27	29	30	31
	Exports	5	5	5	5	7	7	8	8	9	9	9	10	10	10	10	11	10	11	12	12	11
	DMI	77	72	77	75	80	72	75	75	74	80	83	82	83	83	88	90	96	97	98	101	101
	DMC	72	68	71	70	73	64	67	67	65	71	74	73	73	73	78	79	85	85	86	89	89
	PTB	11	9	8	9	8	8	11	10	9	10	12	11	11	12	15	13	14	15	17	18	19
Italy	DE	547	548	567	589	557	596	593	590	591	592	571	555	534	504	508	495	514	516	520	522	515
	Imports	227	213	207	206	218	228	215	222	220	240	244	246	247	258	271	286	278	289	304	308	329
	Exports	54	56	56	56	57	61	62	62	65	68	70	71	77	88	91	94	101	110	113	113	118
	DMI	775	761	774	795	775	824	808	812	811	832	814	801	781	762	779	780	792	805	824	830	843
	DMC	721	705	718	739	718	764	746	750	747	764	744	730	704	674	688	687	691	695	711	717	725
	PTB	174	156	151	150	162	167	154	160	156	172	174	175	170	170	181	192	178	179	192	194	211
Netherlands	DE	169	165	150	151	156	167	161	160	153	177	175	177	181	175	166	166	177	167	142	137	136
	Imports	193	175	174	177	191	218	229	234	254	263	272	275	281	221	272	274	263	269	271	276	283
	Exports	143	137	130	138	145	166	169	177	184	205	184	167	172	189	228	216	222	211	215	228	213
	DMI	362	340	325	328	347	385	390	394	407	440	447	451	462	396	438	441	440	436	413	413	418
	DMC	219	203	194	190	203	219	221	217	223	235	263	285	290	207	210	225	218	225	198	185	206
	PTB	50	38	44	39	47	51	60	57	70	58	87	108	109	32	44	59	41	58	56	48	70
Portugal	DE	89	87	85	81	65	72	76	73	78	81	90	91	89	88	100	104	104	111	113	113	110
	Imports	21	20	19	19	20	20	23	24	26	30	33	32	36	35	39	43	39	45	49	52	51
	Exports	6	6	6	7	7	7	8	8	9	10	12	11	13	13	16	15	14	15	15	15	15
	DMI	111	107	105	100	85	92	98	97	105	112	123	123	126	124	139	147	143	156	162	165	160
	DMC	104	101	98	94	78	85	90	89	96	101	111	112	113	110	123	132	129	141	147	150	145
	PTB	15	13	13	12	13	13	14	16	18	20	21	21	24	22	23	28	25	30	34	37	35
Spain	DE	391	386	388	393	422	456	453	457	464	465	478	432	442	430	427	430	467	496	501	538	539
	Imports	102	93	90	87	92	95	106	108	109	123	127	137	145	137	144	159	157	167	194	192	221
	Exports	45	48	46	48	51	53	57	57	60	60	56	60	59	64	70	76	85	86	95	86	95
	DMI	493	479	478	480	514	551	560	565	573	588	605	569	586	567	571	589	624	663	694	730	760
	DMC	448	431	431	431	463	498	502	508	513	529	549	508	527	503	501	513	539	577	599	644	665
	PTB	57	45	44	38	41	42	49	51	49	63	71	76	86	73	74	83	72	81	99	107	126
Sweden	DE	186	185	188	183	190	176	177	174	179	194	197	183	173	180	180	194	173	170	180	172	191
	Imports	45	42	41	40	43	45	49	52	48	48	46	44	46	47	52	52	51	55	56	56	60
	Exports	33	35	34	35	37	39	43	47	47	47	48	47	49	52	54	55	56	60	57	59	61
	DMI	231	228	229	223	233	221	226	226	227	242	243	227	220	227	231	246	225	225	236	228	251
	DMC	198	193	195	188	195	181	183	179	181	195	195	180	170	175	178	191	169	165	179	169	189
	PTB	12	8	7	6	6	6	6	5	2	1	-2	-3	-3	-5	-2	-3	-4	-5	-1	-3	-2
UK	DE	661	639	674	695	645	681	710	729	762	747	716	662	658	669	705	704	697	697	694	702	681
	Imports	139	130	128	125	150	155	157	164	170	179	187	185	191	186	191	190	192	201	204	193	209
	Exports	100	122	127	129	138	145	152	149	120	106	118	118	124	152	176	174	174	186	184	187	197
	DMI	800	769	801	820	794	836	868	893	932	926	904	848	848	854	896	894	889	898	898	895	890
	DMC	700	647	674	692	657	691	716	745	812	819	786	730	724	702	720	720	714	712	715	708	693
	PTB	39	8	1	-3	12	10	6	15	50	72	70	67	67	33	15	16	18	15	20	6	12

Main Indicators in tonnes per capita

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	DE	13.82	13.50	13.30	13.25	13.26	13.89	13.93	13.94	14.31	14.52	14.27	13.61	13.35	12.99	13.36	13.20	13.08	13.18	13.01	13.23	13.00
	Imports	3.13	2.82	2.73	2.60	2.75	2.81	2.78	2.84	2.94	3.03	3.12	3.27	3.35	3.26	3.50	3.37	3.32	3.42	3.51	3.52	3.76
	Exports	0.77	0.84	0.81	0.83	0.87	0.89	0.83	0.84	0.83	0.84	0.85	0.86	0.90	1.09	1.15	0.95	0.98	1.03	1.03	1.05	1.11
	DMI	16.95	16.32	16.03	15.86	16.00	16.70	16.71	16.78	17.24	17.55	17.39	16.88	16.70	16.25	16.85	16.57	16.40	16.59	16.53	16.76	16.76
	DMC	16.17	15.48	15.22	15.02	15.14	15.80	15.88	15.94	16.42	16.71	16.54	16.02	15.80	15.16	15.71	15.62	15.43	15.56	15.50	15.71	15.64
	PTB	2.35	1.98	1.92	1.77	1.88	1.91	1.94	2.00	2.11	2.19	2.27	2.41	2.45	2.17	2.35	2.42	2.34	2.39	2.48	2.48	2.65
Austria	DE	16.10	15.84	15.77	15.16	15.51	15.24	15.19	15.24	15.45	16.00	16.05	15.42	15.50	15.48	16.26	15.52	15.35	16.22	15.00	15.27	14.70
	Imports	4.88	4.75	4.52	4.35	4.98	5.18	5.13	5.23	5.39	5.48	5.68	5.97	5.94	5.74	6.14	6.54	6.87	6.77	6.97	7.05	8.07
	Exports	2.00	2.03	2.02	2.18	2.40	2.41	2.38	2.46	2.64	2.75	2.89	2.81	2.82	2.84	3.15	3.50	3.57	3.93	4.30	4.46	4.71
	DMI	20.98	20.59	20.29	19.50	20.49	20.42	20.32	20.47	20.84	21.49	21.73	21.39	21.44	21.21	22.40	22.06	22.22	22.98	21.97	22.32	22.78
	DMC	18.98	18.56	18.27	17.32	18.09	18.01	17.94	18.00	18.20	18.74	18.84	18.58	18.62	18.37	19.25	18.57	18.66	19.05	17.67	17.86	18.07
	PTB	2.88	2.72	2.50	2.17	2.57	2.77	2.75	2.76	2.75	2.73	2.79	3.17	3.11	2.90	2.99	3.05	3.31	2.83	2.67	2.59	3.36
Belgium/ Luxembourg	DE	10.20	10.50	10.00	9.23	9.46	9.27	9.34	9.33	9.81	10.44	11.03	11.25	11.13	11.07	11.85	11.44	11.40	11.24	10.96	11.19	11.06
	Imports	15.53	14.67	14.16	13.24	14.40	14.22	14.80	15.47	16.92	17.24	17.93	18.29	18.47	17.72	18.76	19.44	20.01	20.58	21.72	22.92	23.73
	Exports	8.45	8.15	8.01	8.41	8.93	8.73	9.10	9.23	10.00	10.63	10.79	11.30	11.17	12.38	13.15	13.05	13.39	14.62	15.43	16.70	18.14
	DMI	25.73	25.17	24.16	22.47	23.85	23.49	24.14	24.79	26.73	27.68	28.96	29.55	29.59	28.79	30.61	30.89	31.41	31.82	32.69	34.11	34.79
	DMC	17.28	17.02	16.15	14.06	14.92	14.76	15.05	15.56	16.73	17.04	18.17	18.25	18.42	16.40	17.45	17.84	18.02	17.20	17.25	17.42	16.65
	PTB	7.08	6.52	6.15	4.82	5.46	5.49	5.70	6.23	6.92	6.61	7.14	6.99	7.30	5.33	5.61	6.39	6.62	5.95	6.29	6.22	5.59
Denmark	DE	17.25	17.49	18.76	17.30	19.88	22.64	22.63	21.67	22.94	23.45	24.37	23.63	21.11	21.70	21.66	21.89	20.88	21.42	21.19	21.38	22.37
	Imports	7.82	7.39	7.19	7.04	7.42	8.13	8.01	7.89	7.62	7.64	7.40	7.96	8.41	8.29	9.04	9.30	9.12	9.80	9.01	8.65	8.44
	Exports	2.50	2.36	2.44	2.93	3.14	3.30	3.34	3.42	3.66	3.98	4.28	4.90	5.19	5.89	6.25	6.35	6.15	6.56	6.54	6.97	8.11
	DMI	25.07	24.88	25.96	24.35	27.31	30.77	30.65	29.56	30.56	31.09	31.77	31.59	29.52	29.99	30.69	31.20	30.00	31.22	30.20	30.03	30.81
	DMC	22.57	22.52	23.51	21.42	24.17	27.47	27.31	26.15	26.90	27.11	27.50	26.69	24.32	24.11	24.45	24.85	23.84	24.66	23.66	23.05	22.69
	PTB	5.32	5.03	4.75	4.11	4.29	4.83	4.68	4.47	3.96	3.66	3.12	3.06	3.21	2.40	2.79	2.96	2.97	3.24	2.47	1.67	0.32
Finland	DE	32.40	31.44	33.15	33.01	32.29	32.25	33.89	32.96	34.45	36.92	36.39	30.91	30.18	27.58	30.42	30.15	28.08	30.17	30.37	33.24	31.91
	Imports	7.73	7.22	7.17	7.28	7.18	7.46	7.64	8.23	7.74	8.54	8.34	7.84	8.03	8.43	10.11	9.43	9.55	10.01	10.11	10.16	10.41
	Exports	4.36	4.39	3.89	4.03	4.39	4.15	4.30	4.50	4.56	4.28	4.33	4.81	5.13	5.74	6.48	6.06	6.55	6.55	6.90	6.90	6.77
	DMI	40.13	38.66	40.32	40.28	39.47	39.71	41.53	41.19	42.19	45.46	44.73	38.75	38.21	36.01	40.53	39.59	37.63	40.18	40.47	43.40	42.32
	DMC	35.77	34.27	36.43	36.25	35.08	35.56	37.23	36.69	37.63	41.18	40.40	33.94	33.08	30.27	34.05	33.52	31.08	33.63	33.58	36.50	35.56
	PTB	3.37	2.83	3.28	3.25	2.79	3.31	3.34	3.74	3.18	4.26	4.01	3.02	2.90	2.69	3.63	3.37	3.00	3.46	3.21	3.26	3.65
France	DE	14.62	14.50	14.17	13.84	13.64	14.18	13.83	14.12	14.74	14.43	14.38	14.63	14.24	13.30	13.41	13.30	12.76	12.99	12.89	12.97	12.97
	Imports	5.32	4.74	4.46	4.20	4.29	4.35	4.40	4.47	4.63	4.94	5.01	5.15	5.10	4.69	5.02	4.97	5.06	5.25	5.52	5.60	5.77
	Exports	2.47	2.46	2.27	2.39	2.50	2.62	2.54	2.57	2.71	2.83	2.87	2.86	2.92	2.88	2.86	2.88	2.92	3.08	3.15	3.28	3.40
	DMI	19.94	19.24	18.63	18.04	17.93	18.53	18.24	18.59	19.36	19.37	19.39	19.78	19.33	17.99	18.44	18.28	17.83	18.23	18.40	18.56	18.74
	DMC	17.48	16.79	16.36	15.65	15.43	15.92	15.70	16.02	16.66	16.54	16.52	16.91	16.41	15.10	15.57	15.40	14.91	15.16	15.26	15.28	15.33
	PTB	2.85	2.28	2.19	1.81	1.79	1.73	1.87	1.90	1.92	2.11	2.14	2.28	2.18	1.81	2.16	2.09	2.15	2.17	2.37	2.31	2.37
Germany	DE	18.33	17.49	16.28	16.14	17.01	18.03	18.12	17.92	18.36	18.77	17.98	16.81	16.48	16.14	16.91	16.38	15.96	15.67	15.25	15.63	14.99
	Imports	4.22	3.84	3.68	3.67	3.84	3.94	4.04	3.92	4.07	4.07	4.26	4.88	5.12	5.22	5.69	5.69	5.81	5.88	6.15	5.96	6.16
	Exports	2.00	1.98	1.88	1.93	2.09	2.10	2.10	2.15	2.25	2.40	2.39	2.51	2.54	2.49	2.74	2.76	2.91	3.04	3.17	3.24	3.33
	DMI	22.55	21.33	19.96	19.80	20.86	21.97	22.16	21.83	22.43	22.84	22.24	21.69	21.61	21.37	22.60	22.06	21.76	21.56	21.40	21.59	21.15
	DMC	20.56	19.35	18.08	17.87	18.77	19.87	20.06	19.69	20.18	20.43	19.85	19.18	19.06	18.88	19.86	19.31	18.85	18.52	18.23	18.35	17.82
	PTB	2.22	1.86	1.79	1.73	1.75	1.84	1.94	1.77	1.83	1.66	1.87	2.37	2.58	2.74	2.95	2.93	2.89	2.84	2.98	2.72	2.83
Greece	DE	11.37	11.80	11.06	11.10	9.91	10.85	11.06	11.37	11.89	12.45	12.01	12.38	12.29	11.95	12.11	12.18	12.16	12.75	13.64	13.23	13.07
	Imports	1.71	1.55	1.97	1.96	1.93	2.33	2.23	3.03	1.36	1.96	2.32	2.80	2.84	2.89	3.06	3.05	3.52	3.11	3.56	3.45	5.02
	Exports	1.35	1.47	1.50	1.71	1.80	1.81	1.87	2.15	1.42	1.91	2.23	2.04	2.03	2.02	2.46	2.02	2.25	2.17	2.08	2.09	2.21
	DMI	13.08	13.35	13.03	13.06	11.84	13.18	13.30	14.40	13.25	14.41	14.34	15.18	15.12	14.83	15.17	15.23	15.68	15.86	17.20	16.68	18.09
	DMC	11.73	11.88	11.53	11.35	10.04	11.37	11.43	12.25	11.83	12.50	12.10	13.14	13.09	12.81	12.72	13.21	13.43	13.70	15.12	14.58	15.88
	PTB	0.36	0.08	0.46	0.25	0.13	0.52	0.37	0.88	-0.06	0.05	0.09	0.76	0.80	0.86	0.60	1.03	1.27	0.94	1.48	1.35	2.81
Ireland	DE	17.91	17.00	18.25	17.49	18.33	15.77	15.92	16.15	15.73	17.34	17.88	17.55	17.58	17.11	17.73	18.36	19.58	19.08	18.53	19.15	18.51
	Imports	4.73	4.08	3.79	4.06	4.28	4.47	5.20	5.13	5.13	5.44	5.91	5.85	5.93	6.08	6.90	6.74	6.82	7.36	7.87	7.91	8.17
	Exports	1.51	1.38	1.52	1.56	1.95	2.09	2.19	2.26	2.50	2.53	2.59	2.74	2.92	2.78	2.84	3.00	2.83	3.12	3.25	3.13	3.04
	DMI	22.63	21.08	22.03	21.56	22.61	20.24	21.12	21.29	20.86	22.78	23.79	23.40	23.51	23.19	24.63	25.09	26.40	26.44	26.40	27.06	26.68
	DMC	21.12	19.71	20.51	20.00	20.66	18.15	18.93	19.02	18.36	20.25	21.20	20.66	20.60	20.41	21.79	22.09	23.57	23.32	23.15	23.93	23.63
	PTB	3.21	2.70	2.27	2.50	2.33	2.38	3.01	2.87	2.64	2.91	3.32	3.11	3.02	3.30	4.06	3.74	3.99	4.24	4.62	4.78	5.13
Italy	DE	9.70	9.71	10.03	10.42	9.85	10.54	10.47	10.43	10.44	10.45	10.06	9.79	9.41	8.85	8.88	8.64	8.96	8.98	9.03	9.07	8.92
	Imports	4.03	3.77	3.67	3.63	3.86	4.03	3.81	3.92	3.89	4.24	4.30	4.33	4.35	4.52	4.75	4.99	4.86	5.03	5.29	5.34	5.70
	Exports	0.96	1.00	0.99	0.98	1.00	1.07	1.09	1.09	1.14	1.20	1.23	1.25	1.36	1.54	1.59	1.63	1.76	1.92	1.95	1.97	2.05
	DMI	13.74	13.48	13.70	14.05	13.71	14.57	14.27	14.35	14.33	14.69	14.36	14.12	13.77	13.37	13.63	13.63	13.81	14.02	14.31	14.41	14.62
	DMC	12.78	12.48	12.71	13.07	12.70	13.50	13.18	13.26	13.19	13.49	13.13	12.87	12.41	11.83	12.04	11.99	12.06	12.09	12.36	12.44	12.57
	PTB	3.08	2.77	2.68	2.65	2.86	2.96	2.71	2.83	2.75	3.04	3.06	3.09	3.00	2.98	3.16	3.35	3.10	3.11	3.33	3.37	3.65
Netherlands	DE	12.00	11.64	10.52	10.53	10.84	11.58	11.09	10.95	10.41	11.93	11.77	11.76	11.95	11.49	10.84	10.79	11.41	10.75	9.06	8.72	8.54
	Imports	13.67	12.32	12.20	12.37	13.29	15.07	15.76	16.03	17.28	17.78	18.25	18.31	18.58	14.52	17.74	17.78	16.96	17.25	17.34	17.49	17.83
	Exports	10.12	9.66	9.11	9.62	10.05	11.51	11.63	12.12	12.52	13.87	12.38	11.11	11.35	12.39	14.86	13.98	14.32	13.53	13.75	14.46	13.40
	DMI	25.67	23.96	22.72	22.89	24.13	26.65	26.85	26.97	27.69	29.71	30.02	30.08	30.53	26.00	28.58	28.56	28.37	28.00	26.39	26.21	26.37
	DMC	15.55	14.30	13.61	13.27	14.09	15.14	15.22	14.86	15.17	15.84	17.64	18.97	19.19	13.61	13.72	14.58	14.04	14.47	12.65	11.76	12.97
	PTB	3.55	2.66	3.09	2.75	3.25	3.56	4.13	3.91	4.76	3.92	5.87	7.20	7.23	2.13	2.88	3.80	2.63	3.72	3.59	3.03	4.43
Portugal	DE	9.17	8.88	8.64	8.18	6.52	7.15	7.57	7.31	7.86	8.19	9.05	9.17	9.04	8.96	10.13	10.44	10.52	11.18	11.33	11.35	10.78
	Imports	2.21	2.02	1.96	1.90	1.99	2.04	2.26	2.36	2.62	3.02	3.32	3.28	3.69	3.58	3.97	4.37	3.92	4.51	4.93	5.21	4.98
	Exports	0.63	0.65	0.64	0.66	0.71	0.74	0.82	0.76	0.86	1.05	1.17	1.13	1.30	1.35	1.64	1.51	1.40	1.50	1.51	1.52	1.52
	DMI	11.38	10.90	10.60	10.08	8.51	9.19	9.82	9.67	10.48	11.20	12.37	12.45	12.73	12.53	14.10	14.81	14.44	15.69	16.25	16.56	15.76
	DMC	10.75	10.25	9.96	9.42	7.80	8.45	9.01	8.91	9.62	10.16	11.20	11.32	11.43	11.18	12.46	13.30	13.04	14.19	14.74	15.05	14.24
	PTB	1.58	1.37	1.32	1.24	1.28	1.30	1.44	1.59	1.76	1.97	2.14	2.15	2.39	2.23	2.33	2.85	2.52	3.01	3.41	3.70	3.46
Spain	DE	10.50	10.25	10.24	10.33	11.05	11.89	11.78	11.85	12.00	12.01	12.32	11.11	11.33	11.01	10.91	10.97	11.89	12.61	12.71	13.61	13.55
	Imports	2.74	2.48	2.38	2.27	2.40	2.48	2.76	2.80	2.82	3.17	3.27	3.51	3.71	3.51	3.69	4.04	4.00	4.25	4.92	4.86	5.56
	Exports	1.20	1.28	1.22	1.26	1.34	1.39	1.48	1.49	1.56	1.54	1.43	1.55	1.51	1.65	1.80	1.94	2.16	2.18	2.41	2.16	2.39
	DMI	13.24	12.73	12.62	12.61	13.45	14.37	14.54	14.65	14.82	15.18	15.58	14.63	15.04	14.52	14.60	15.02	15.89	16.86	17.63	18.47	19.12
	DMC	12.04	11.45	11.40	11.34	12.11	12.98	13.06	13.16	13.26	13.64	14.15	13.08	13.54	12.88	12.80	13.08	13.73	14.68	15.21	16.31	16.73
	PTB	1.54	1.20	1.16	1.01	1.06	1.09	1.27	1.31	1.27	1.63	1.84	1.97	2.21	1.87	1.89	2.11	1.84	2.07	2.50	2.69	3.17
Sweden	DE	22.40	22.30	22.57	21.92	22.79	21.08	21.18	20.74	21.25	22.89	23.07	21.29	20.06	20.74	20.53	21.97	19.60	19.22	20.35	19.45	21.52
	Imports	5.42	5.06	4.93	4.85	5.14	5.35	5.90	6.20	5.76	5.68	5.38	5.12	5.35	5.35	5.94	5.88	5.81	6.20	6.29	6.31	6.75
	Exports	4.00	4.15	4.04	4.19	4.46	4.68	5.13	5.57	5.55	5.56	5.57	5.48	5.70	5.96	6.12	6.19	6.30	6.78	6.41	6.62	6.93
	DMI	27.83	27.36	27.50	26.77	27.93	26.43	27.08	26.94	27.01	28.57	28.45	26.41	25.41	26.10	26.47	27.85	25.41	25.42	26.64	25.76	28.28
	DMC	23.83	23.21	23.45	22.58	23.46	21.75	21.95	21.37	21.46	23.01	22.88	20.93	19.71	20.14	20.35	21.66	19.11	18.64	20.23	19.14	21.35
	PTB	1.43	0.91	0.88	0.66	0.67	0.67	0.77	0.63	0.20	0.12	-0.19	-0.36	-0.35	-0.61	-0.18	-0.31	-0.49	-0.58	-0.12	-0.31	-0.18
UK	DE	11.75	11.34	11.96	12.33	11.43	12.03	12.51	12.81	13.34	13.05	12.46	11.48	11.36	11.51	12.10	12.03	11.87	11.84	11.75	11.82	11.42
	Imports	2.47	2.31	2.27	2.23	2.65	2.74	2.77	2.88	2.98	3.12	3.26	3.22	3.29	3.20	3.27	3.24	3.27	3.40	3.45	3.25	3.50
	Exports	1.79	2.17	2.26	2.28	2.44	2.56	2.67	2.61	2.10	1.86	2.05	2.05	2.14	2.62	3.02	2.97	2.97	3.15	3.11	3.14	3.30
	DMI	14.22	13.65	14.23	14.56	14.08	14.76	15.29	15.69	16.32	16.17	15.73	14.70	14.65	14.71	15.36	15.27	15.14	15.24	15.21	15.07	14.92
	DMC	12.44	11.48	11.97	12.28	11.64	12.21	12.61	13.08	14.22	14.31	13.68	12.65	12.51	12.09	12.35	12.30	12.17	12.10	12.09	11.93	11.62
	PTB	0.69	0.14	0.01	-0.06	0.21	0.18	0.10	0.27	0.88	1.26	1.22	1.17	1.15	0.58	0.25	0.27	0.30	0.25	0.34	0.10	0.20

Main Indicators in tonnes per 1000 ECU/euro of GDP (in constant 1995 prices)

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15	DE	1.02	1.00	0.98	0.96	0.94	0.96	0.94	0.92	0.91	0.89	0.85	0.80	0.78	0.77	0.77	0.74	0.73	0.72	0.69	0.68	0.65
	Imports	0.23	0.21	0.20	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.19	0.20	0.19	0.18	0.19	0.19	0.18	0.19
	Exports	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.07	0.05	0.05	0.06	0.05	0.05	0.06
	DMI	1.25	1.21	1.18	1.15	1.13	1.15	1.13	1.11	1.09	1.08	1.04	0.99	0.97	0.96	0.97	0.93	0.91	0.90	0.88	0.87	0.84
	DMC	1.19	1.14	1.12	1.09	1.07	1.09	1.07	1.05	1.04	1.03	0.99	0.94	0.92	0.89	0.90	0.88	0.86	0.85	0.82	0.81	0.78
	PTB	0.17	0.15	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.13	0.14	0.14	0.13	0.13	0.13	0.13	0.13
Austria	DE	0.95	0.93	0.91	0.85	0.87	0.83	0.81	0.80	0.79	0.79	0.76	0.71	0.71	0.71	0.74	0.69	0.67	0.70	0.63	0.62	0.58
	Imports	0.29	0.28	0.26	0.24	0.28	0.28	0.27	0.28	0.28	0.27	0.27	0.28	0.27	0.26	0.28	0.29	0.30	0.29	0.29	0.29	0.32
	Exports	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.13	0.13	0.13	0.14	0.16	0.16	0.17	0.18	0.18	0.19
	DMI	1.23	1.21	1.17	1.09	1.15	1.12	1.09	1.08	1.06	1.06	1.03	0.99	0.98	0.98	1.01	0.99	0.98	0.99	0.92	0.91	0.90
	DMC	1.12	1.09	1.06	0.97	1.01	0.98	0.96	0.95	0.93	0.92	0.89	0.86	0.85	0.85	0.87	0.83	0.82	0.82	0.74	0.73	0.72
	PTB	0.17	0.16	0.14	0.12	0.14	0.15	0.15	0.15	0.14	0.13	0.13	0.15	0.14	0.13	0.14	0.14	0.15	0.12	0.11	0.11	0.13
Belgium/ Luxembourg	DE	0.62	0.64	0.61	0.56	0.55	0.53	0.53	0.52	0.52	0.54	0.55	0.55	0.54	0.54	0.57	0.53	0.53	0.50	0.48	0.47	0.45
	Imports	0.94	0.89	0.86	0.80	0.84	0.82	0.84	0.86	0.89	0.88	0.89	0.90	0.90	0.87	0.90	0.91	0.92	0.92	0.95	0.97	0.97
	Exports	0.51	0.50	0.48	0.51	0.52	0.50	0.52	0.51	0.53	0.55	0.54	0.56	0.54	0.61	0.63	0.61	0.62	0.65	0.67	0.71	0.74
	DMI	1.56	1.53	1.46	1.35	1.40	1.35	1.37	1.37	1.41	1.42	1.44	1.45	1.44	1.41	1.46	1.44	1.45	1.42	1.43	1.45	1.42
	DMC	1.05	1.04	0.98	0.85	0.88	0.85	0.85	0.86	0.88	0.87	0.91	0.90	0.89	0.81	0.83	0.83	0.83	0.77	0.75	0.74	0.68
	PTB	0.43	0.40	0.37	0.29	0.32	0.32	0.32	0.34	0.37	0.34	0.36	0.34	0.35	0.26	0.27	0.30	0.31	0.27	0.27	0.26	0.23
Denmark	DE	0.83	0.86	0.89	0.81	0.90	0.99	0.95	0.91	0.95	0.97	1.00	0.96	0.86	0.88	0.84	0.83	0.78	0.78	0.75	0.75	0.76
	Imports	0.37	0.36	0.34	0.33	0.33	0.35	0.34	0.33	0.32	0.32	0.30	0.32	0.34	0.34	0.35	0.35	0.34	0.36	0.32	0.30	0.29
	Exports	0.12	0.12	0.12	0.14	0.14	0.14	0.14	0.14	0.15	0.16	0.18	0.20	0.21	0.24	0.24	0.24	0.23	0.24	0.23	0.24	0.28
	DMI	1.20	1.22	1.23	1.14	1.23	1.34	1.28	1.24	1.27	1.29	1.31	1.29	1.20	1.22	1.19	1.18	1.12	1.13	1.07	1.05	1.05
	DMC	1.08	1.10	1.12	1.00	1.09	1.20	1.14	1.10	1.12	1.12	1.13	1.09	0.99	0.98	0.95	0.94	0.89	0.89	0.84	0.80	0.77
	PTB	0.25	0.25	0.23	0.19	0.19	0.21	0.20	0.19	0.16	0.15	0.13	0.12	0.13	0.10	0.11	0.11	0.11	0.12	0.09	0.06	0.01
Finland	DE	2.05	1.96	2.01	1.96	1.86	1.82	1.87	1.75	1.75	1.79	1.77	1.61	1.64	1.52	1.62	1.55	1.40	1.42	1.36	1.43	1.30
	Imports	0.49	0.45	0.43	0.43	0.41	0.42	0.42	0.44	0.39	0.41	0.41	0.41	0.44	0.47	0.54	0.49	0.47	0.47	0.45	0.44	0.42
	Exports	0.28	0.27	0.24	0.24	0.25	0.23	0.24	0.24	0.23	0.21	0.21	0.25	0.28	0.32	0.35	0.31	0.33	0.31	0.31	0.30	0.28
	DMI	2.54	2.41	2.44	2.39	2.28	2.24	2.29	2.18	2.14	2.20	2.18	2.02	2.07	1.99	2.16	2.04	1.87	1.89	1.81	1.87	1.72
	DMC	2.27	2.13	2.21	2.15	2.03	2.00	2.05	1.95	1.91	1.99	1.96	1.77	1.79	1.67	1.82	1.73	1.55	1.58	1.50	1.57	1.45
	PTB	0.21	0.18	0.20	0.19	0.16	0.19	0.18	0.20	0.16	0.21	0.20	0.16	0.16	0.15	0.19	0.17	0.15	0.16	0.14	0.14	0.15
France	DE	0.89	0.88	0.84	0.81	0.79	0.82	0.78	0.78	0.78	0.74	0.72	0.73	0.70	0.67	0.66	0.65	0.62	0.62	0.59	0.58	0.56
	Imports	0.32	0.29	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.25	0.23	0.25	0.24	0.24	0.25	0.25	0.25	0.25
	Exports	0.15	0.15	0.13	0.14	0.14	0.15	0.14	0.14	0.14	0.15	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.14	0.15	0.15
	DMI	1.21	1.16	1.10	1.06	1.04	1.06	1.03	1.03	1.03	0.99	0.97	0.99	0.96	0.90	0.91	0.89	0.86	0.87	0.85	0.83	0.81
	DMC	1.06	1.01	0.97	0.92	0.90	0.91	0.89	0.89	0.88	0.85	0.83	0.84	0.81	0.76	0.77	0.75	0.72	0.72	0.70	0.68	0.66
	PTB	0.17	0.14	0.13	0.11	0.10	0.10	0.11	0.10	0.10	0.11	0.11	0.11	0.11	0.09	0.11	0.10	0.10	0.10	0.11	0.10	0.10
Germany	DE	1.05	1.01	0.95	0.92	0.94	0.97	0.95	0.93	0.92	0.91	0.84	0.75	0.72	0.72	0.74	0.71	0.69	0.67	0.64	0.64	0.60
	Imports	0.24	0.22	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.22	0.23	0.23	0.25	0.25	0.25	0.25	0.26	0.24	0.25
	Exports	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.13	0.13
	DMI	1.30	1.23	1.16	1.13	1.15	1.19	1.17	1.13	1.13	1.11	1.03	0.97	0.95	0.96	0.99	0.96	0.94	0.92	0.90	0.89	0.85
	DMC	1.18	1.11	1.05	1.02	1.04	1.07	1.06	1.02	1.01	1.00	0.92	0.86	0.84	0.85	0.87	0.84	0.81	0.79	0.76	0.75	0.71
	PTB	0.13	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.09	0.11	0.11	0.12	0.13	0.13	0.12	0.12	0.12	0.11	0.11
Greece	DE	1.38	1.47	1.41	1.44	1.26	1.35	1.38	1.46	1.46	1.48	1.44	1.45	1.44	1.43	1.43	1.42	1.38	1.40	1.45	1.36	1.30
	Imports	0.21	0.19	0.25	0.25	0.25	0.29	0.28	0.39	0.17	0.23	0.28	0.33	0.33	0.35	0.36	0.35	0.40	0.34	0.38	0.36	0.50
	Exports	0.16	0.18	0.19	0.22	0.23	0.23	0.23	0.27	0.18	0.23	0.27	0.24	0.24	0.24	0.29	0.23	0.26	0.24	0.22	0.22	0.22
	DMI	1.59	1.67	1.66	1.69	1.51	1.65	1.66	1.84	1.63	1.72	1.72	1.78	1.77	1.78	1.79	1.77	1.78	1.74	1.83	1.72	1.80
	DMC	1.43	1.48	1.46	1.47	1.28	1.42	1.42	1.57	1.46	1.49	1.45	1.54	1.54	1.54	1.50	1.53	1.53	1.51	1.61	1.50	1.58
	PTB	0.04	0.01	0.06	0.03	0.02	0.06	0.05	0.11	-0.01	0.01	0.01	0.09	0.09	0.10	0.07	0.12	0.14	0.10	0.16	0.14	0.28
Ireland	DE	2.23	2.07	2.20	2.13	2.15	1.81	1.76	1.71	1.58	1.63	1.55	1.50	1.46	1.40	1.37	1.30	1.29	1.15	1.04	0.98	0.86
	Imports	0.59	0.50	0.46	0.49	0.50	0.51	0.57	0.54	0.51	0.51	0.51	0.50	0.49	0.50	0.53	0.48	0.45	0.44	0.44	0.40	0.38
	Exports	0.19	0.17	0.18	0.19	0.23	0.24	0.24	0.24	0.25	0.24	0.22	0.23	0.24	0.23	0.22	0.21	0.19	0.19	0.18	0.16	0.14
	DMI	2.82	2.57	2.66	2.63	2.66	2.32	2.33	2.25	2.09	2.15	2.06	2.00	1.96	1.89	1.91	1.77	1.74	1.59	1.48	1.38	1.24
	DMC	2.63	2.40	2.47	2.44	2.43	2.08	2.09	2.01	1.84	1.91	1.84	1.76	1.71	1.67	1.69	1.56	1.56	1.40	1.30	1.22	1.09
	PTB	0.40	0.33	0.27	0.30	0.27	0.27	0.33	0.30	0.26	0.27	0.29	0.27	0.25	0.27	0.31	0.26	0.26	0.25	0.26	0.24	0.24
Italy	DE	0.87	0.86	0.89	0.91	0.84	0.87	0.84	0.82	0.79	0.77	0.72	0.70	0.66	0.63	0.62	0.59	0.61	0.60	0.59	0.58	0.56
	Imports	0.36	0.34	0.32	0.32	0.33	0.33	0.31	0.31	0.29	0.31	0.31	0.31	0.31	0.32	0.33	0.34	0.33	0.33	0.35	0.34	0.36
	Exports	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.11	0.11	0.11	0.12	0.13	0.13	0.13	0.13
	DMI	1.23	1.20	1.21	1.23	1.17	1.20	1.15	1.12	1.08	1.08	1.03	1.00	0.97	0.96	0.96	0.93	0.93	0.93	0.94	0.93	0.92
	DMC	1.14	1.11	1.12	1.14	1.08	1.12	1.06	1.04	0.99	0.99	0.94	0.91	0.88	0.84	0.84	0.82	0.81	0.80	0.81	0.80	0.79
	PTB	0.28	0.25	0.24	0.23	0.24	0.24	0.22	0.22	0.21	0.22	0.22	0.22	0.21	0.21	0.22	0.23	0.21	0.21	0.22	0.22	0.23
Netherlands	DE	0.74	0.73	0.67	0.66	0.66	0.69	0.64	0.63	0.59	0.64	0.61	0.60	0.61	0.58	0.54	0.52	0.54	0.49	0.40	0.37	0.36
	Imports	0.84	0.77	0.78	0.78	0.81	0.89	0.92	0.92	0.97	0.96	0.95	0.94	0.94	0.74	0.88	0.86	0.80	0.79	0.77	0.75	0.74
	Exports	0.62	0.60	0.58	0.60	0.61	0.68	0.68	0.70	0.70	0.75	0.65	0.57	0.58	0.63	0.74	0.68	0.68	0.62	0.61	0.62	0.56
	DMI	1.58	1.50	1.44	1.44	1.47	1.58	1.56	1.55	1.56	1.60	1.56	1.54	1.55	1.32	1.42	1.39	1.34	1.28	1.17	1.12	1.10
	DMC	0.96	0.89	0.86	0.83	0.86	0.90	0.88	0.86	0.85	0.85	0.92	0.97	0.97	0.69	0.68	0.71	0.67	0.66	0.56	0.50	0.54
	PTB	0.22	0.17	0.20	0.17	0.20	0.21	0.24	0.23	0.27	0.21	0.31	0.37	0.37	0.11	0.14	0.18	0.12	0.17	0.16	0.13	0.18
Portugal	DE	1.62	1.56	1.49	1.42	1.16	1.24	1.26	1.15	1.14	1.12	1.18	1.14	1.11	1.13	1.26	1.25	1.22	1.25	1.21	1.18	1.10
	Imports	0.39	0.35	0.34	0.33	0.35	0.35	0.38	0.37	0.38	0.41	0.43	0.41	0.45	0.45	0.50	0.52	0.45	0.50	0.53	0.54	0.51
	Exports	0.11	0.11	0.11	0.11	0.13	0.13	0.14	0.12	0.12	0.14	0.15	0.14	0.16	0.17	0.20	0.18	0.16	0.17	0.16	0.16	0.16
	DMI	2.01	1.91	1.83	1.75	1.51	1.60	1.64	1.52	1.52	1.53	1.62	1.55	1.57	1.58	1.76	1.78	1.67	1.75	1.74	1.72	1.61
	DMC	1.89	1.80	1.72	1.64	1.39	1.47	1.50	1.40	1.40	1.38	1.46	1.41	1.41	1.41	1.55	1.59	1.51	1.59	1.58	1.56	1.45
	PTB	0.28	0.24	0.23	0.22	0.23	0.23	0.24	0.25	0.26	0.27	0.28	0.27	0.29	0.28	0.29	0.34	0.29	0.34	0.37	0.38	0.35
Spain	DE	1.26	1.24	1.23	1.23	1.30	1.37	1.32	1.26	1.22	1.16	1.15	1.02	1.03	1.01	0.98	0.96	1.02	1.04	1.01	1.04	1.00
	Imports	0.33	0.30	0.29	0.27	0.28	0.29	0.31	0.30	0.29	0.31	0.31	0.32	0.34	0.32	0.33	0.35	0.34	0.35	0.39	0.37	0.41
	Exports	0.14	0.15	0.15	0.15	0.16	0.16	0.17	0.16	0.16	0.15	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.18	0.19	0.17	0.18
	DMI	1.59	1.54	1.52	1.50	1.58	1.66	1.63	1.56	1.50	1.47	1.46	1.34	1.37	1.34	1.31	1.32	1.36	1.39	1.40	1.41	1.41
	DMC	1.44	1.39	1.37	1.35	1.42	1.50	1.46	1.40	1.35	1.32	1.32	1.20	1.23	1.18	1.15	1.15	1.18	1.21	1.21	1.25	1.23
	PTB	0.18	0.15	0.14	0.12	0.12	0.13	0.14	0.14	0.13	0.16	0.17	0.18	0.20	0.17	0.17	0.18	0.16	0.17	0.20	0.21	0.23
Sweden	DE	1.29	1.29	1.29	1.23	1.23	1.12	1.09	1.04	1.04	1.10	1.10	1.04	1.00	1.06	1.01	1.06	0.93	0.90	0.92	0.84	0.90
	Imports	0.31	0.29	0.28	0.27	0.28	0.28	0.30	0.31	0.28	0.27	0.26	0.25	0.27	0.27	0.29	0.28	0.28	0.29	0.28	0.27	0.28
	Exports	0.23	0.24	0.23	0.24	0.24	0.25	0.26	0.28	0.27	0.27	0.27	0.27	0.28	0.30	0.30	0.30	0.30	0.32	0.29	0.29	0.29
	DMI	1.61	1.59	1.58	1.51	1.51	1.40	1.40	1.35	1.32	1.37	1.36	1.29	1.27	1.33	1.31	1.34	1.21	1.19	1.20	1.11	1.18
	DMC	1.38	1.34	1.34	1.27	1.27	1.15	1.13	1.07	1.05	1.10	1.09	1.02	0.98	1.03	1.01	1.04	0.91	0.87	0.91	0.83	0.89
	PTB	0.08	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.01	0.01	-0.01	-0.02	-0.02	-0.03	-0.01	-0.02	-0.02	-0.03	-0.01	-0.01	-0.01
UK	DE	1.08	1.06	1.10	1.09	0.99	1.01	1.01	0.99	0.99	0.95	0.90	0.84	0.84	0.83	0.84	0.81	0.78	0.76	0.73	0.72	0.68
	Imports	0.23	0.22	0.21	0.20	0.23	0.23	0.22	0.22	0.22	0.23	0.24	0.24	0.24	0.23	0.23	0.22	0.22	0.22	0.22	0.20	0.21
	Exports	0.16	0.20	0.21	0.20	0.21	0.21	0.22	0.20	0.16	0.13	0.15	0.15	0.16	0.19	0.21	0.20	0.20	0.20	0.19	0.19	0.20
	DMI	1.31	1.28	1.30	1.29	1.22	1.24	1.24	1.22	1.21	1.17	1.14	1.08	1.08	1.06	1.06	1.03	1.00	0.97	0.95	0.92	0.89
	DMC	1.15	1.07	1.10	1.09	1.01	1.02	1.02	1.01	1.05	1.04	0.99	0.93	0.92	0.87	0.85	0.83	0.80	0.77	0.75	0.73	0.69
	PTB	0.06	0.01	0.00	0.00	0.02	0.01	0.01	0.02	0.06	0.09	0.09	0.09	0.08	0.04	0.02	0.02	0.02	0.02	0.02	0.01	0.01