

CO₂ emissions induced by EU's final use of products are estimated to be 9 tonnes per capita

Eurostat estimates the emissions of carbon dioxide (CO₂) induced by the EU's final use of products to be 9 tonnes per capita per year. The modelling-estimations are based on environmentally extended input-output tables which have been compiled for the very first time for the aggregated EU. The integrated data form a powerful basis for researchers and policy advisors – some illustrative examples related to environmental and macro-economic policies are presented in this Statistics in Focus.

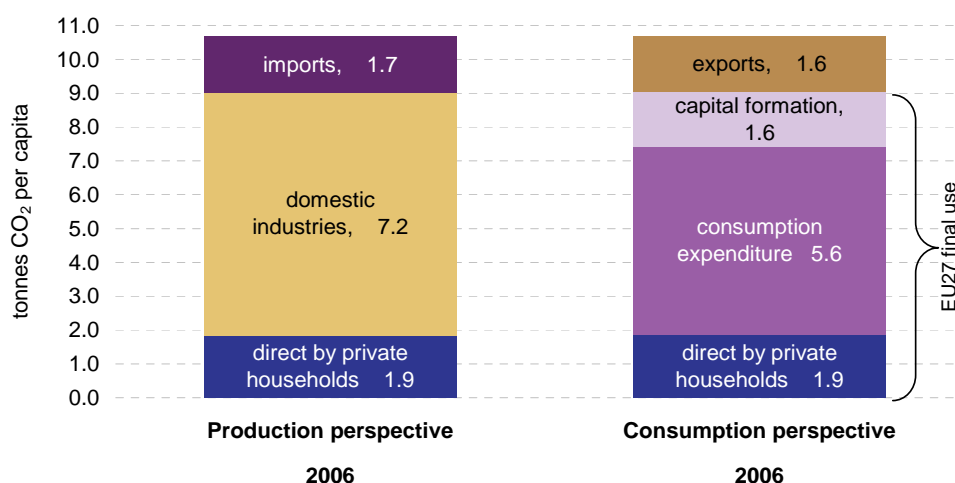
Carbon dioxide emissions associated with EU consumption

As an example, the environmentally extended supply, use and input-output tables (EE-SUIOT) have been used to estimate the CO₂-emissions induced by the final use of products within the EU (data on emissions of 7 other gases are also

available). Beside the CO₂-emissions emitted by EU industries in order to create products for final use, this estimate also takes into account CO₂-emissions "embodied" in imports to the EU. The latter arise along the worldwide production chains of imported products. CO₂-emissions "embodied" in products exported out of the EU go on the account of consumers abroad.

The total of 9 tonnes CO₂ per capita (t/cap) associated with EU final use in 2006 is composed of three main elements (see Figure 1, right hand bar, see also Table 1): the biggest part of 5.6 tonnes per capita is due to the consumption expenditures or goods and services purchased by households and governments. A further 1.9 t/cap are due to direct CO₂-emissions by EU's private households from burning fossil fuels for private cars and heating. Another 1.6 t/cap are due to investments (capital formation) in the EU economy (see also Table 1).

Figure 1: Domestic and global CO₂-emissions - production and consumption perspective, EU27 2006 (tonnes per capita)



Source: Eurostat (online data codes : [env_ac_ainacehh](#), [env_ac_io](#))

Carbon dioxide emissions from a production perspective

CO₂-emissions are also analysed from a production perspective, i.e. according to where the emissions are actually generated. This is presented by the left-hand bar in Figure 1.

Firstly, one has to take into account again the direct CO₂-emissions by private households amounting to 1.9 t/cap. Here, the production-perspective considers households also as producing units. They "produce" their private services namely heating their dwellings and driving their own cars.

Secondly, the production activities by all branches constitute the biggest source of CO₂ from a production perspective. The EU production system emits about 7.2 tonnes CO₂ per capita.

Finally, the production perspective has to take into account the CO₂-emissions "embodied" in goods and services imported for intermediate and final use. These are estimated with the help of environmental input-output modelling to be at least 1.7 t/cap. The latter estimate is based on the "domestic-technology-assumption" i.e. that the imported products are produced with EU production technologies. Moreover one can state that through the import of goods and services from the rest of the world the EU has avoided 1.7 t/cap of CO₂ emissions in their own production system. Some evidence can be derived from e.g. international energy statistics that the rest of the world economy may have a more carbon-intensive production system compared to the EU. Hence, the 1.6 t/cap may be considered as a minimum estimate.

Table 1: CO₂-emissions induced by final use, by product groups and categories of final use, EU27 2006 (kg per capita)

	final consumption expenditure	gross capital formation	exports	total final use	
product groups	kg CO ₂ per capita				%
Electrical energy, gas, steam and hot water	1 101	2	42	1 146	10.7
Construction work	37	829	2	867	8.1
Food products and beverages	453	5	52	510	4.8
Chemicals, chemical products and man-made fibres	195	- 3	203	395	3.7
Motor vehicles, trailers and semi-trailers	170	106	115	391	3.7
Machinery and equipment	37	177	129	343	3.2
Health and social work services	319	0	0	319	3.0
Public administration and defence services; compulsory social security services	314	1	1	316	3.0
Hotel and restaurant services	284	0	2	287	2.7
Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods	263	13	10	286	2.7
Wholesale trade and commission trade services, except of motor vehicles and motorcycles	189	43	41	273	2.6
Coke, refined petroleum products and nuclear fuel	188	- 6	85	267	2.5
Land transport and transport via pipeline services	226	13	24	263	2.5
remaining 46 product groups	1 788	1 036	1 369	2 287	21.4
Total products	5 563	1 632	1 637	8 832	82.7
direct emissions by private households	1 853			1 853	17.3
Total (products and direct by households)	7 416	1 632	1 637	10 685	100.0

Source: Eurostat (online data code : [env_ac_io](#))

11% of EU jobs depend on exports

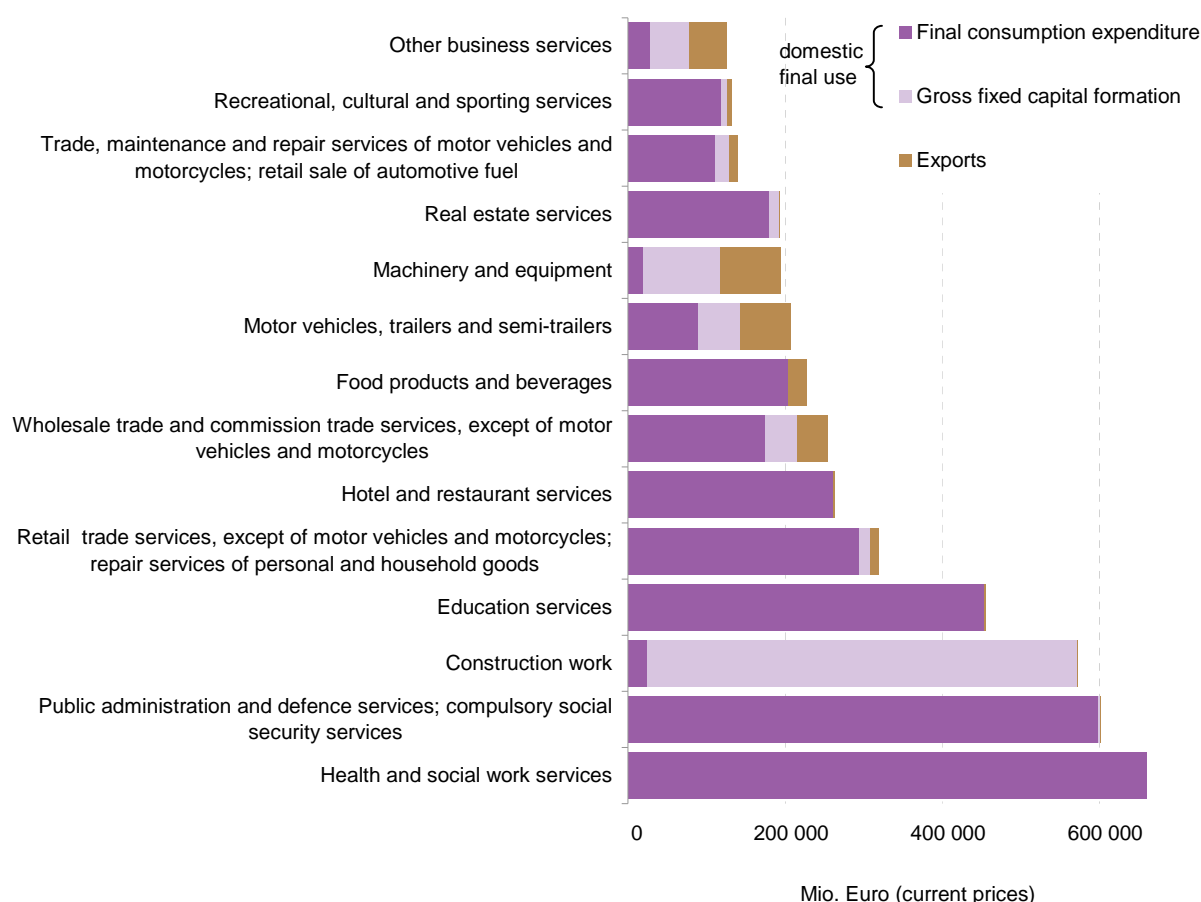
A typical macro-economic question answered by input-output modelling is: how many jobs depend on exports?

Labour is an important production factor input into branches. It is also a significant element of GDP, i.e. value added. The SUIOT data set shows that compensation of employees (i.e. salaries) form more than half (57%) of the total value added (see Table 3). Hence, it is interesting to analyse for which products the demand (or final use) creates most jobs and income. Figure 2 shows the top 14

products the final use of which creates most jobs and income.

Public services (including health and social) "embodies" more than one fifth of total jobs (expressed as compensation of employees). Another important creator of jobs is investment in construction (about 10% of total salaries). Using the new SUIOT data and a Leontief model, one can estimate that the exports of products outside the EU count for about 11% of job-related income.

Figure 2: EU employment (compensation of employees) induced by final use (million euro)



Source: Leontief-type calculations based on Eurostat data

The potential of Supply, Use, and Input-Output Tables in more detail

For the first time Eurostat has compiled consolidated supply and use tables (SUTs) and derived symmetric input-output tables (IOTs) for the aggregated EU27 and the euro area. These tables show – at a glance – the production and use of products distinguishing 59 industry branches and product groups.

Compiling SUTs is a time and resource demanding routine. National Statistical Institutes require more than three years to compile SUTs. The current data set includes the period 2000 to 2006 and will be soon expanded. The data set forms a powerful basis for analysis and models in macro-economics and Eurostat disseminates these data in particular for use by economic analysts, researchers, and policy advisors.

Table 2 and 3 illustrate the data contained in the SUT and IOT, for this purpose aggregated to six product groups and sectors.

The supply table shows the supply of goods and services, both domestic and imported, by product and type of supplier in basic prices (i.e. price when goods leave the factory excluding value added and other taxes on the product). The use table shows the use of goods and services by product and type of use, i.e. as intermediate consumption by industries and final use, the latter broken down into consumption by households and governments, gross capital formation and exports. The use table also contains the income components of the value added by industry, i.e. compensation of employees, other taxes less subsidies on production, consumption of capital, and net operating surplus. Usually, use tables are provided in purchaser prices (including all taxes and the transport and trade margins needed to bring goods to the shop), but the aggregated use table in Table 2 for the EU27 was already converted into basic prices. The SUT reflects some basic identities, such as that the total supply (domestic and imports) of each product category equals total use (intermediate use plus

final use including exports minus taxes less subsidies). The SUT also allows the calculation of the GDP of the EU27 in various ways (e.g. the sum of value added and the total final use minus imports corrected for taxes less subsidies), equalling 11.7 trillion euro in 2006.

The SUT can be transformed into a square input-output table. An industry by industry IOT shows the relations between industries – how much one

industry buys from the other industries and how much it sells to other industries and for final uses. Eurostat decided to derive product by product IOTs showing which products form input into the production of another product, and conversely, for what purposes this product is used. The product by product IOT is shown in Table 3. For more information see the "Methodological Notes" on page 7.

Shares of imports and exports in total use

We live in a globalised world. Different countries specialise in certain production processes. The SUT and IOT produced allow for a direct comparison of a number of parameters relevant for this field (also over time). Figure 3 shows the top-10 products (out of the 59 covered) in terms of import shares, i.e. the fraction of use of products covered by imports.

Not surprisingly the graph reflects that the EU is relatively poor in natural resources: product groups such as metal ores and fossil fuels dominate. But

the graph also shows computers and electronics, clothing, and leather products reflecting that production of such products has moved largely to other parts of the world. For these products the EU relies heavily on production abroad.

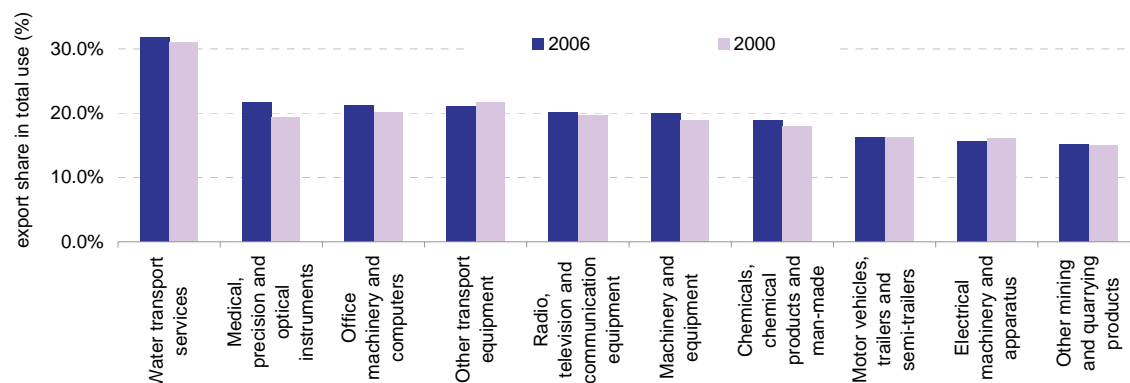
Conversely, the EU also produces products which are mainly exported (Figure 4). The EU has particularly high exports of shipping, machinery, precision instruments, vehicles, and chemicals.

Figure 3: Share of imports in the total use of selected products, EU27 2006 (in %)



Source: Eurostat (online data code: [naio_15_agg_60](#))

Figure 4: Share of exports in total use of selected products, EU27 2006 (in %)



Source: Eurostat (online data code: [naio_16_agg_60](#))

Table 2: Supply and Use tables at basic prices and CO2-emissions by industries, EU27 2006 (million euro)

SUPPLY Table	INDUSTRIES (NACE)							Imports cif	Total supply at basic prices
	Agriculture, hunting and fishing	Industry incl. Energy	Construction	Trade, transport and communication services	Financial services and business activities	Other services	Total		
PRODUCTS	1	2	3	4	5	6	7	8	9
Products of agriculture, hunting and fishing	377 305	1 774	159	1 779	143	715	381 876	36 054	417 930
Industrial products (incl. energy)	15 438	6 726 534	11 369	77 673	11 527	9 403	6 851 944	1 267 521	8 119 465
Construction work	1 643	20 001	1 663 229	15 206	15 479	4 718	1 720 275	2 124	1 722 399
Trade, transport and communication services	4 102	173 946	8 326	4 370 089	24 051	16 312	4 596 826	83 730	4 680 556
Financial services and business services	2 026	146 746	22 860	96 742	4 773 837	70 132	5 112 343	125 505	5 237 848
Other services	2 423	19 766	1 267	17 354	7 447	3 529 366	3 577 624	18 597	3 596 221
Total	402 937	7 088 768	1 707 211	4 578 843	4 832 484	3 630 645	22 240 888	1 533 531	23 774 419
cif/ Job adjustments on imports	0	0	0	0	0	0	0	- 11 784	- 11 784
Direct purchases abroad by residents	0	0	0	0	0	0	0	226 244	226 244
Output at basic prices (total supply)	402 937	7 088 768	1 707 211	4 578 843	4 832 484	3 630 645	22 240 888	1 747 991	23 988 879

USE Table	INDUSTRIES (NACE)							Final consumption expenditure	Gross capital formation	Exports	Final uses at basic prices	Total use at basic prices
	Agriculture, hunting and fishing	Industry incl. Energy	Construction	Trade, transport and communication services	Financial services and business activities	Other services	Total					
PRODUCTS	1	2	3	4	5	6	7	8	9	10	11	12
Products of agriculture, hunting and fishing	48 817	177 412	2 538	19 086	1 557	5 836	255 226	101 765	11 811	13 075	126 650	381 876
Industrial products (incl. energy)	81 625	2 531 727	358 951	471 836	154 045	254 299	3 852 483	1 469 520	562 335	967 607	2 999 462	6 851 944
Construction work	2 788	41 356	346 162	44 015	106 999	46 379	569 699	48 082	1 080 334	2 160	1 130 576	1 720 275
Trade, transport and communication services	37 057	743 085	113 975	844 155	214 387	178 898	2 131 556	2 082 144	150 386	232 739	2 465 270	4 596 826
Financial services and business services	25 694	666 191	174 721	731 009	1 220 204	361 801	3 179 619	1 462 441	282 700	187 583	1 932 724	5 112 343
Other services	5 029	80 649	9 502	67 746	93 859	266 444	523 230	3 014 418	23 353	16 622	3 054 393	3 577 624
Total Domestic	201 010	4 240 420	1 005 848	2 177 826	1 793 051	1 113 657	10 531 812	8 178 370	2 110 920	1 419 785	11 709 075	22 240 887
Products of agriculture, hunting and fishing	2 775	17 199	166	1 420	55	572	22 187	11 601	1 241	1 025	13 867	36 054
Industrial products (incl. energy)	7 473	606 217	30 404	53 736	18 849	43 043	759 722	242 800	160 634	104 366	507 799	1 267 521
Construction work	5	156	893	48	119	92	1 312	41	765	6	812	2 124
Trade, transport and communication services	324	12 575	1 138	39 152	6 295	3 252	62 737	15 244	369	5 382	20 994	83 730
Financial services and business services	559	29 134	4 144	18 728	43 123	10 665	106 353	7 324	5 965	5 863	19 152	125 505
Other services	24	2 111	110	2 088	902	5 415	10 649	6 362	1 041	544	7 948	18 597
Total imports from third countries	11 159	667 392	36 855	115 173	69 342	63 039	962 959	283 372	170 014	117 185	570 572	1 533 531
Taxes less subsidies on products	4 845	68 153	16 932	77 642	77 087	95 673	340 333	742 770	180 117	6 318	929 205	1 269 538
Total intermediate consumption/final use at purchasers' prices	217 014	4 975 965	1 059 635	2 370 641	1 939 480	1 272 369	11 835 104	9 204 513	2 461 051	1 543 288	13 208 852	25 043 956
Compensation of employees	65 475	1 209 848	384 820	1 291 515	1 157 929	1 780 453	5 890 041					
Other net taxes on production	- 22 178	125 913	30 497	135 209	117 801	144 399	531 642					
Consumption of fixed capital	20 912	204 975	21 960	162 910	428 233	150 015	989 005					
Operating surplus, net	121 715	572 067	210 298	618 568	1 189 040	283 409	2 995 097					
Operating surplus, gross	142 627	777 042	232 258	781 478	1 617 273	433 424	3 984 101					
Value added at basic prices	185 924	2 112 803	647 576	2 208 202	2 893 004	2 358 276	10 405 783					
Output at basic prices	402 937	7 088 768	1 707 211	4 578 843	4 832 484	3 630 645	22 240 888					
CO₂-emissions by industries (1000 tonnes)	107 257	2 564 189	48 310	608 667	55 011	143 619	3 527 054	913 601				

Source: Eurostat (online data codes : [naio_15_agg_6](#), [naio_16_agg_6i](#) and [env_ac_aينةac](#))

Table 3: Symmetric Input-Output table at basic prices - domestic and imports, EU27 2006 (million euro)

	Homogenous branches										Total	Final consumption expenditure	Gross capital formation	Exports	Final uses at basic prices	Total use at basic prices
	Agriculture, hunting and fishing	Industry incl. energy	Construction	Trade, communication services	Financial services and business activities	Other services										
PRODUCTS	1	2	3	4	5	6	7	8	9	10	11	12				
Products of agriculture, hunting and fishing	45 984	173 007	2 824	23 558	3 630	6 223	255 226	101 765	11 811	13 075	126 650	381 876				
Industrial products (incl. energy)	77 135	2 420 959	358 832	519 579	219 335	256 642	3 852 483	1 469 520	562 335	967 607	2 999 462	6 851 944				
Construction work	2 679	42 210	338 556	45 149	115 441	45 664	589 699	48 082	1 080 334	2 160	1 130 576	1 720 275				
Trade, transport and communication services	35 294	721 866	116 605	827 984	250 806	179 001	2 131 556	2 082 144	150 386	232 739	2 465 270	4 596 826				
Financial services and business services	24 685	650 201	177 631	721 684	1 248 467	356 951	3 179 619	1 462 441	282 700	187 583	1 932 724	5 112 343				
Other services	4 798	78 308	10 497	68 916	102 976	257 734	523 230	3 014 418	23 353	16 622	3 054 393	3 577 624				
Total Domestic	190 575	4 086 552	1 004 945	2 206 870	1 940 655	1 102 216	10 531 812	8 178 370	2 110 920	1 419 785	11 709 075	22 240 887				
Products of agriculture, hunting and fishing	2 619	16 658	186	1 888	238	599	22 187	11 601	1 241	1 025	13 867	36 054				
Industrial products (incl. energy)	7 079	576 283	31 600	67 847	33 206	43 707	759 722	242 800	160 634	104 366	507 799	1 267 521				
Construction work	4	154	872	54	136	91	1 312	41	765	6	812	2 124				
Trade, transport and communication services	315	12 326	1 288	38 242	7 307	3 259	62 737	15 244	369	5 382	20 994	83 730				
Financial services and business services	542	27 807	4 282	19 029	44 156	10 538	106 353	7 324	5 965	5 863	19 152	125 505				
Other services	24	2 033	134	2 104	1 277	5 078	10 649	6 362	1 041	544	7 948	18 597				
Total imports from third countries	10 582	635 260	38 362	129 163	86 320	63 271	962 959	283 372	170 014	117 185	570 572	1 533 531				
Taxes less subsidies on products	4 598	66 135	17 346	76 874	81 898	93 482	340 333	742 770	180 117	6 318	929 205	1 269 538				
Total intermediate consumption/final use at purchasers' prices	205 755	4 787 947	1 060 653	2 412 907	2 108 873	1 258 968	11 835 104	9 204 513	2 461 051	1 543 288	13 208 852	25 043 956				
Compensation of employees	62 593	1 183 080	386 808	1 277 489	1 231 574	1 748 497	5 890 041									
Other net taxes on production	- 20 638	121 883	30 927	133 121	124 299	142 051	531 642									
Consumption of fixed capital	19 726	197 842	25 797	163 027	435 521	147 093	989 005									
Operating surplus, net	114 440	561 192	216 091	610 283	1 212 077	281 014	2 995 097									
Operating surplus, gross	134 166	759 034	241 887	773 309	1 647 597	428 108	3 984 101									
Value added at basic prices	176 121	2 063 997	659 622	2 183 919	3 003 470	2 318 655	10 405 783									
Output at basic prices	381 876	6 851 944	1 720 275	4 596 826	5 112 343	3 577 624	22 240 886									

Source: Eurostat (online data code: [naio_17_agg_6](#))

METHODOLOGICAL NOTES

This Statistics in Focus employs various data sets which are briefly described in the following. More detailed methodological explanations are documented in a [technical report](#) which can be downloaded from the Eurostat website.

[Consolidated supply, use, and input-output tables \(product-by-product\) at basic prices](#) [[naio](#)]

Under the European System of National and Regional Accounts (ESA95), EU Member States transmit to Eurostat Supply and Use Tables (SUT, annually) and Input-Output Tables (IOT, 5 yearly). The compilation of SUTs is very time and resource consuming; they are submitted only 36 months after the end of the reference period. A Supply table shows the supply of goods and services by product and type of supplier at basic prices, while the Use table shows the use of goods and services by product and type of use at purchaser prices. These tables transmitted by Member States formed the point of departure for a sequence of manipulations leading to a consolidated data set for the aggregated EU27 and the euro area.

For each Member State, SUTs at basic prices were estimated with the available SUTs (in basic/purchaser prices) and (in part confidential) auxiliary valuation data. Due to confidentiality reasons the SUTs are published only for the aggregated EU27 and euro area.

The SUTs for the individual Member States were aggregated to EU27 and euro area SUTs. The main sub-steps included:

For each Member State, the Use table was subdivided into an Import Use and Domestic Use part, and subsequently in an Intra-EU import Use table and an Extra-EU import Use table.

Each of the domestic use, intra-EU import use, and extra EU import use tables were aggregated across countries to an EU27 total.

A confrontation and rebalancing took place of the intra-EU import use total with the intra EU export supply totals - which in theory should be identical apart from valuation differences, but in practice are not so, due to the fact that the data are collected and reported independently by different countries and hence may be subject to statistical differences.

The relatively small intra EU export/import differences were moved to the rest of world. The intra-EU import use and intra-EU export supply data were now identical and cancelled each other out. The aggregated EU27 SUT now could be created by aggregating the individual country Domestic SUTs and extra-EU import Use and export Supply tables.

The aggregated SUTs were transformed into symmetric product-by-product Input-Output Tables (IOTs). A product by product IOT shows which products form input into the production of another product, and conversely, for what purposes this product is used. A

product by product IOT, shown in Table 3, was calculated as follows from the SUTs. A transformation matrix is calculated according to market shares. This market share matrix shows the relative amount of product output by each industry. The transformation matrix is then multiplied by the use matrix to give the symmetric Input-Output table (product-by-product). In the transformation matrix used here, the so-called *industry technology assumption* was applied (see Model B, Eurostat Manual of Supply, Use and Input-Output Tables, p.349).

The resulting data set comprises in total six tables, each for the aggregated EU27 and the euro area. The time period covered so far ranges from 2000 to 2006 and will be extended soon. The tables come in two resolutions: 60*60 and 6*6 product groups.

[Air Emissions Accounts by activity \(NACE industries and households\)](#) [[env_ac_ainacehh](#)]

Eurostat's Environmental Accounts programme publishes regularly Air Emissions Accounts recording emissions of greenhouse gases and air pollutants in the same format as used for SUT and IOT (i.e. in a breakdown by industries and households).

Data for eight pollutants (CO₂, N₂O, CH₄, SO_x, NO_x, NH₃, CO, NMVOC) were added to the above mentioned consolidated SUTs and IOTs for the aggregated EU27 and euro area.

[Domestic and global emissions of greenhouse gases and air pollutants induced by final use of products – results from environmental input-output analysis](#) [[env_ac_io](#)]

The combination of all this data in the form of Environmentally Extended Input-Output Tables (EE IOT) provides – as shown in this document – a powerful analytical instrument to inform policy.

With the EU27 EE IOT some basic modelling and analysis steps were performed, leading to the results in this Statistics in Focus in particular creating the Leontief inverse that allowed the assessment of the environmental impacts of final consumption, etc.

Some of the environmental-economic modelling results are published. As an illustration it shows the CO₂ emissions induced by the final use of products in the EU27 and the euro area, broken down by product groups, categories of final use, and origin of the emissions (domestic or worldwide).

Further information

Eurostat Website: <http://ec.europa.eu/eurostat>

Data on 'Environmental accounts'

http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/data/database

Data on 'ESA 95 supply Use and Input-Output tables'

http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database

Further information about on 'Environmental accounts'

http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/introduction

Further information about on 'ESA 95 supply Use and Input-Output Tables'

http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/introduction

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