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Calculation and analysis of a hybrid energy input-output table for Germany within the Environmental-Economic Accounting (EEA)

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by
Helmut Mayer[1]

1. Introduction

The energetic input-output (I/O) analysis is an important method in the German Environmental Economic Accounting (EEA) in the analysis of energy, especially on the sources for energy demand and the effects of final use and production on energy consumption. Both the direct and the indirect consumption of energy are analysed. Direct energy is analysed by calculating adequate indices for energy consumption, e.g. consumption of primary energy of branches and households or intensities on energy consumption for branches. By means of the decomposition analysis the determining factors for energy demand – the level of demand, the composition of demand and the intensity of energy use – are analysed. This analysis is done regularly both for the energy consumption of households and for the energy use of the branches in the production process.

The energy used in the production of products (goods and services) – the indirect energy consumption of final use – is thoroughly analysed by using the energetic I/O-analysis. Therefore indirect energy consumption related to the final demand of products – produced domestically or abroad - and caused by the final use categories is calculated regularly on the basis of the monetary input-output tables (MIOT) provided by the input-output accounts of the Federal Statistical Office (FSO) and with the help of energy-flow tables of the EEA. The energy-flow tables are showing the consumption of energy for more than 70 branches and for households in a detailed breakdown to thirty energy carriers.

The following analysis and calculations are made in the EEA with the energetic I/O analysis:

- Analysis of the effects of increasing international integration (globalization) with respect to energy consumption and air emissions within the economy and abroad.
- Comparison of total cumulated energy consumption (direct and indirect consumption of energy) with domestic energy consumption (of primary energy).
- Calculation of import shares on total cumulated (primary) energy.
- Calculation of energy consumption according to final use categories (final consumption, gross capital formation, exports).
- Calculation of energy intensity for final demand categories in a breakdown to commodities.
- Determination of indirect energy related to the production of imports and exports.
- Calculation of indirect energy needed for the production of imported goods for final use and for intermediate consumption.

Those calculations have been made with an I/O-model using the Leontief inverse matrix on the basis of the monetary IOT (MIOT). This model is relatively demanding with regard to some conditions: it implies homogeneity of the rows (commodities) and columns (homogeneous production units) of the IOT. This requirement is difficult to fulfil. Improvements can be made by disaggregation of the IOT and/or by substituting monetary flows through (homogeneous) physical flows for certain inputs – like energy.

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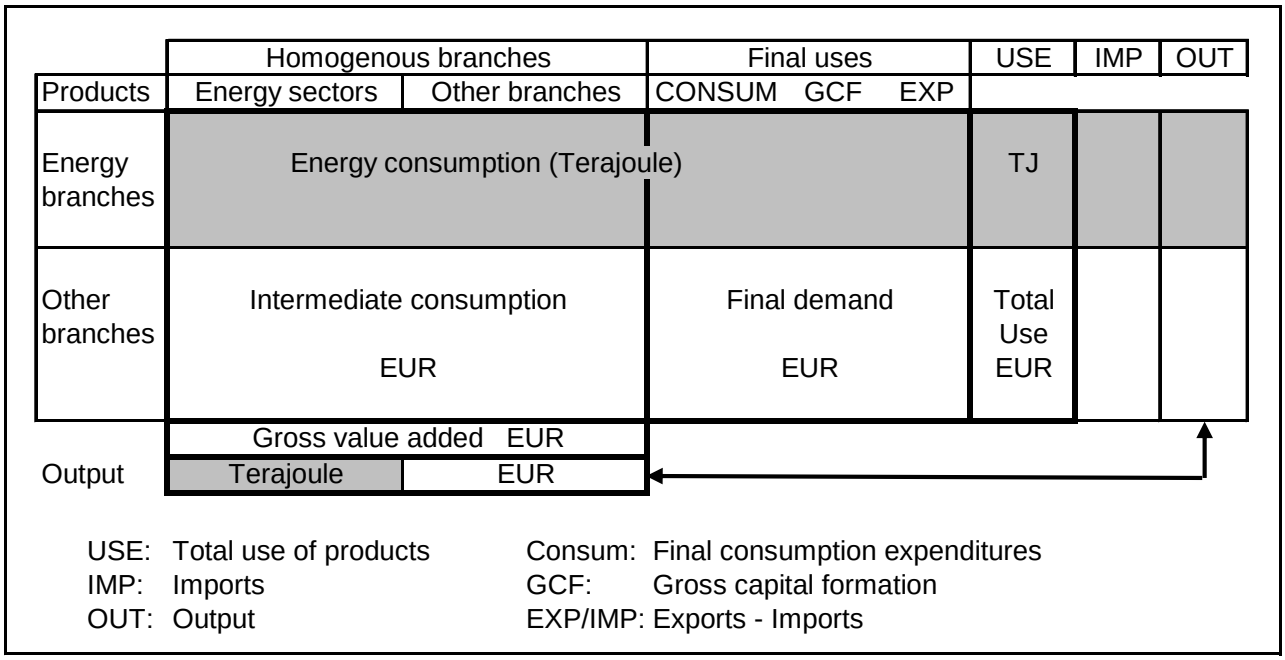
This paper shows how the energetic I/O-analysis has been improved in Germany on one hand by disaggregation of important energy producers and users (homogeneous branches) and on the other hand by integrating the physical energy flows into the IOT and constructing a hybrid (energy) IOT (HIOT).

The HIOT integrates the figures on the physical energy flows into the IOT (cf. figure 1). For the calculation of the Leontief-inverse both are used the physical and the monetary entries. The input coefficients therefore are of different type: for the energy rows either TJ/TJ or "mixed" TJ/EUR, for the other inputs they are of a mixed type EUR/TJ or "simple" EUR/EUR.

Figure 1: Hybrid energy Input-Output table



The Leontief inverse of the mixed model give more reliable results with regard to the energy content of final demand because they better reflect the "true" energy requirements of the supplying industries. On the basis of monetary models (MIOT) energy requirements of a certain demand are systematically underestimated if the supplying industries purchases energy at a price lower than the average. This is e.g. true for most of the basic industries which purchase electricity at a much lower price than service industries e.g. or households.

Comparisons of the results of the monetary model with the results from the mixed model showed significant differences, especially for the demand of products with a high content of "basic industries" – like chemicals, ferrous and non-ferrous metals.

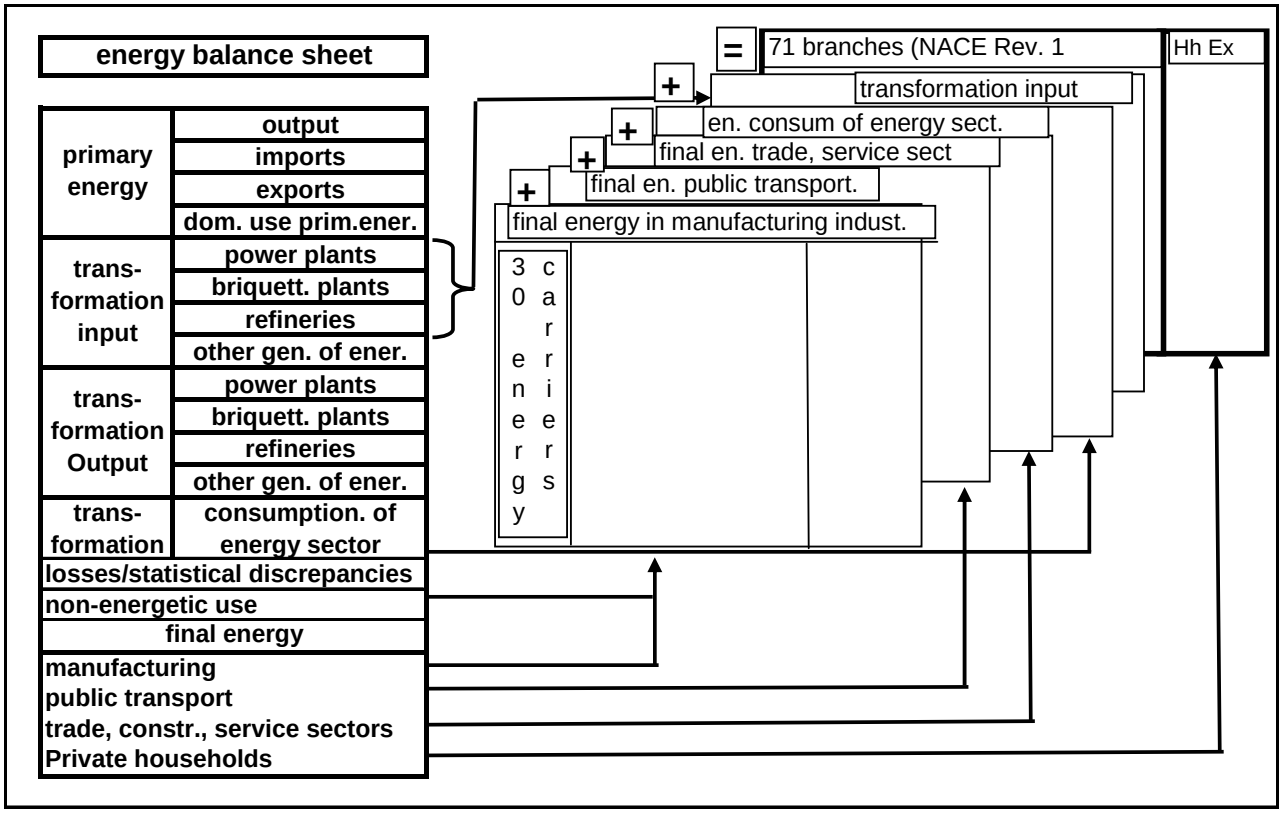
In the following first the methods of calculating the energy flow tables are presented (chapter 2). Later in this chapter it is presented how the IOT is further disaggregated in the area of energy producers and important energy users like the chemical industry. In chapter 3 some results from the energetic I/O analysis done for 1995, 2000 and 2004 are presented.

2. Construction of the energy input-output tables

In the EEA energy flow tables are calculated regularly. Energy consumption is calculated for 71 branches (homogeneous production units) for private households and for exports (including bunkering) and comprises a breakdown of about 30 energy carriers according to the classification of energy carriers in the national energy balances. The breakdown of branches is the same as in the (monetary) IOT. For the construction of the energy IOT further disaggregation is applied for the energy branches and for selected energy-intensive branches (see table 2 in annex).

The calculation of the energy flow tables is closely linked to the figures in the energy balances: the data in the sub-balances for the various sectors (energy producing and transforming sectors, non-energetic use, manufacturing, traffic, households and agriculture, construction, trade and service industries) are the key figures for the calculation of the detailed energy consumption of branches:

Figure 2: Energy balance and energy flow tables



In the monetary IOT for Germany five energy branches are specified. This breakdown corresponds to the requirements of EUROSTAT for the annual transmission of SUT (supply and use tables) and IOT (every five years) from the member states to EUROSTAT. This breakdown of energy branches is not sufficient to get accurate results in the energetic I/O analysis. To get more homogeneous energy branches a further breakdown to 9 energy branches was carried out (cf. table 1).

Table 1: Disaggregation of energy branches in the IOT:

CPA	Energy branches in the M-IOT	No.	CPA	Branches in the energy-IOT
10	Mining of coal and lignite; extraction of peat	1 2	10.1 10.2	Hard coal and hard coal products Lignite (brown coal) and lignite products, peat
11	Extraction of crude petroleum and natural gas; service activities	3	11	Extraction of crude petroleum and natural gas; service act.
23	Manufacture of coke, refined petroleum products and nuclear fuel	4 5 6	23.1 23.2 23.3	Coke Refined petroleum products Nuclear fuel
40.1/3	Production and distribution of electricity and heat	7	40.1	Electricity
40.2	Gas	8 9	40.2 40.3	Gas Long-distance heat

The new breakdown has a much better correspondence to the national energy balance which specifies 13 energy producing sectors. Among them five different types of electricity power plants are listed. Within this analysis it was not feasible to apply such a detailed breakdown of the electricity sector. However this could be a future task and would possibly allow further improvements. Using roughly the breakdown of the energy balance sheets, this enabled to utilise directly the figures for the transformation inputs and the consumption of the energy sectors. The non-energy inputs had to be estimated on the basis of commodity-flow tables from the input-output accounts and the structural business statistics.

Besides an adequate disaggregation of energy sectors, also a sufficient detail of energy intensive branches is necessary to get reliable results on indirect energy used for the production of goods. The MIOT already comprehends a disaggregation of important energy users:

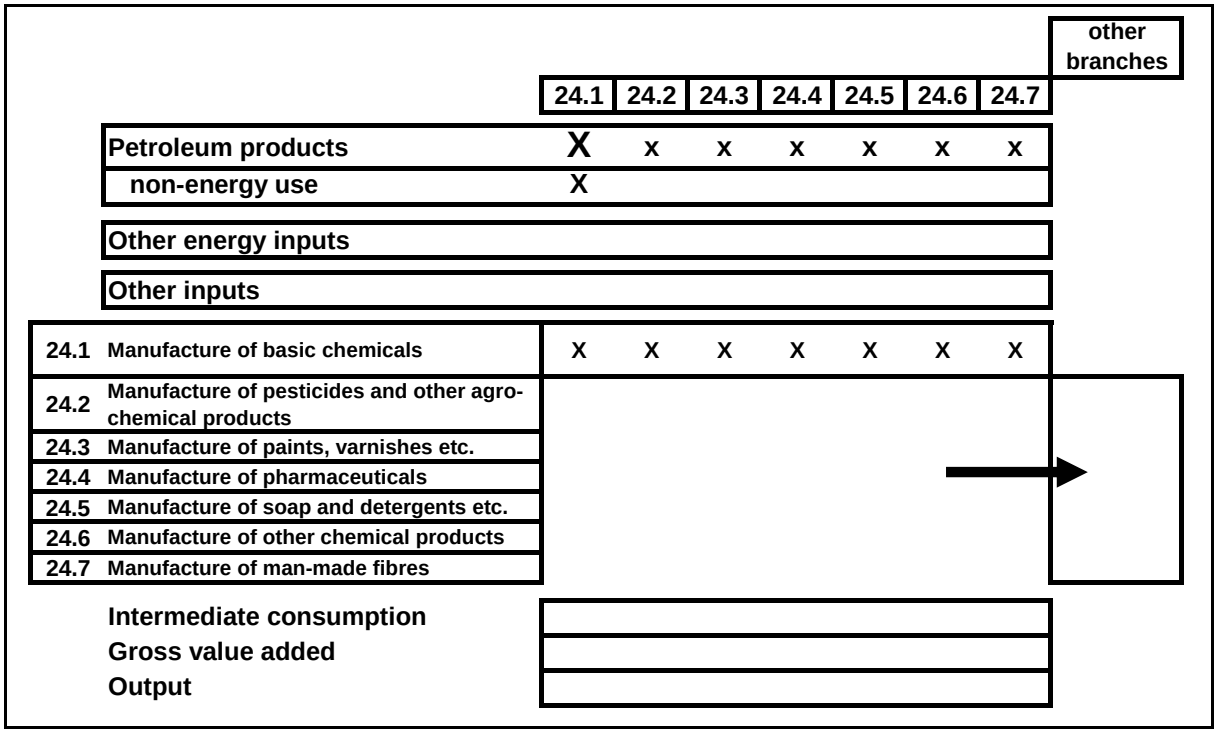
Table 2: Energy-intensive homogeneous production units

CPA	Classification of branches used in the MIOT for Germany
21.1	Pulp, paper and paper products
25.1	Rubber products
25.2	Plastic products
27.1-3	Basic iron, steel and tubes and semi-finished products made from basic iron, steel and tubes
27.4	Basic precious and non-ferrous metals and semi-finished products made from basic precious and non-ferrous metals
27.5	Casting of metals
60.1	Transport via railways
60.2-3	Other land transport, transport via pipelines

Within the frame of the calculation of the energy IOT one further significant breakdown was made – the disaggregation of the chemical industry. The work of another disaggregation – of the non-ferrous industry – is in progress.

For the chemical industry the basic chemicals industry (CPA 24.1) was separated from the chemical industry (without pharmaceuticals, which are already shown as an own branch). The chemical industry is the most important energy consumer in production and especially for the production of basic chemicals a high specific amount of energy is needed. In 2004 total chemical industry had a consumption of primary energy of 1 350 PJ. That is 13.1 % of total energy consumption of all branches. The basic chemicals industry alone had an energy consumption of 1 269 PJ of which 69 % (872 PJ) are used as raw materials for the production of basic chemicals (non-energy use). The basic chemicals show an energy content far above average. Therefore for the calculation of indirect energy a separate presentation of the basic chemical industry and a depiction of the links between the basic chemicals and the branches which further process basic chemicals is essential and improves the quality of the calculations.

Figure 3: Disaggregation of the chemical industry (NACE 24):



The disaggregation of the chemical industry in the energy IOT is planned in two steps: in a first step the sub-branch "manufacture of basic chemicals" (CPA 24.1) is shown as an own column and row in the IOT. This step has been already finalised and has led to substantial improvements of the results. In a second step the other groups of division 24 will be separated and integrated into the IOT also. This step needs further research especially with regard to the determination of the relationships between the basic chemical industry and the other sub-sectors of the chemical industry, but also with regard to their specific cost structures[2].

For the calculations of the inputs and outputs of the basic chemicals various sources were used:

- Use of basic chemicals for intermediate consumption and for final use (row of the IOT): figures were taken from the detailed commodity-flow table showing in great detail the use of basic chemicals both for output from domestic production and for imports.

- Energy inputs: the inputs were calculated in physical units as well as in monetary units. The figures for the physical energy inputs (in Terajoule) were taken from the energy balance sheets as well as from the energy statistics. In the energy balance sheets energy consumption within the basic chemical industry is shown separately as non-energy use and as final use of energy carriers. The physical energy inputs had to be valuated in order to get a total for intermediate consumption. This total was used as a check by comparing it with the figure for gross value added which has been calculated independently on the basis of the structural business statistics.

- Other (monetary) inputs: a wide range of inputs like raw materials could be selected from the figures for the whole chemical industry on the basis of the detailed entries in the commodity flow table. After determining and balancing raw materials and energy inputs with subtotals from the structural business statistics the remaining inputs – mostly services – were determined according the average input structure for the chemical industry in the MIOT.

Another important energy user in the manufacturing industries is the non-ferrous metals industry (CPA 27.4). This industry and especially the production of aluminium and aluminium products (CPA 27.42) require a great deal of energy. Therefore this industry will be also shown separately. For the calculation of energy used for the production of aluminium results from the life-cycle analysis (LCA) will be used.

Energy requirements of imported goods were compiled on the basis of the HIOT for Germany. It is assumed, that these goods would have been produced domestically, that means with the domestic technology. As a consequence not the actual energy content of the imports is compiled but the energy saved domestically by producing the goods abroad.

For imported goods for intermediate consumption the energy requirement matrix was compiled by subtraction. Two matrices were calculated. First, energy requirements for intermediate consumption of domestic origin were calculated by combining final demand from domestic output with the Leontief-Inverse for inputs from domestic production. Secondly, the same final use vector was combined with the Leontief-Inverse for total use. The first matrix was subtracted from the second one, showing then the energy requirements for imported products for intermediate consumption in a classification to branches (rows) and final use product categories (columns). This matrix provides additional information on the significance of imported goods for intermediate consumption and enables to integrate specific information on actual energy coefficients in production abroad.

3. Results

Calculations for indirect energy were made on the basis of the hybrid energy IOT for the years 1995/2000/2002/2003 and 2004. HIOT were calculated separately for total use of products (from domestic output and imports), for imported products and for products from domestic production. The calculations were done in a breakdown of 73 branches and for seven final use categories.[3] For the final use categories matrices for the energy requirements were compiled in a classification to products of final use and branches which contribute to the production of these products. These matrices allow both an analysis of energy requirements according to final demand product categories and according to the producing branches engaged in the production of these goods.

[2] A research project with the Fraunhofer Institute Karlsruhe was initiated with the goal of determining the energy requirements of the chemicals sub-sectors and processes and to get figures for the linkages between the sub-sectors. Results are expected for the end of 2007.

[3] Cf. Classification of branches in Annex, table 2.

In the following results for aggregated final use categories are presented.[4] Table 3 shows the results of the calculation for direct, indirect and cumulated energy consumption for 1995, 2000 and 2004.

Total energy consumption (total supply) increased from 23.6 EJ to 24.8 EJ (+5.4 %). There was a slight drop in domestic production from 12.6 EJ in 1995 to 12.4 EJ in 2004, whereas direct imports of energy carriers rose by 13 % from 11.0 EJ to 12.4 EJ and contributed to half of total supply of direct energy. About 63 % (2004) of energy is consumed by the homogeneous branches, the rest by private households (24 %) and exports (11 %).

When looking at energy used for the production of goods and services – indirect energy – this leads to extremely interesting results: both the importance of imports and the significance of exports increases. Energy needed for the production of imported products got up by 15 % from 5.4 EJ to 6.2 EJ. Energy needed for the production of exported products jumped up by 39 % from 5.3 EJ to 7.4 EJ. Therefore the production of exports absorbs now more energy (2004: 45.0 % of total primary energy) than the production of products for private consumption (2004: 34.8 %). Whereas energy for exports showed that boost, energy for private consumption products in absolute terms even dropped from 6.1 EJ to 5.7 EJ. Probably an increased energy efficiency in production and structural changes in the composition of consumption expenditures compensated for the volume increase in expenditures.

Table 3: Supply and use of energy 1995/2000/2004 (Petajoule)

		1995	2000	2004	1995	2000	2004	1995	2000	2004
		Direct			Indirect			Cumulated		
1	Domestic production	12,560	12,099	12,392				12,560	12,099	12,392
2 +	Imports 1)	11,007	12,119	12,463	5,383	6,572	6,188	16,390	18,692	18,650
3 =	Supply	23,567	24,218	24,855	5,383	6,572	6,188	28,950	30,791	31,042
4 -	Transformation output/do. primary energy	8,232	8,294	8,542				8,232	8,294	8,542
5 =	Supply of primary energy	15,335	15,924	16,313	5,383	6,572	6,188	20,718	22,497	22,501
6 -	Homogeneous branches	10,245	10,373	10,373	-10,245	-10,373	-10,373	0	0	0
7 =	Final uses	5,090	5,551	5,940	15,628	16,946	16,561	20,718	22,497	22,501
8 -	Export and ship bunkers 1)	1,165	1,715	1,795	5,348	6,865	7,449	6,512	8,581	9,244
9 =	Final domestic uses	3,926	3,836	4,145	10,280	10,080	9,113	0	0	0
10	Of which:									
11	Consumption of private households	3,911	3,839	3,905	6,130	5,994	5,760	10,041	9,833	9,665
12	Consumption of non profit institutions				89	87	90	89	87	90
13	Government final consumption				1,255	1,206	1,120	1,255	1,206	1,120
14	Gross fixed capital formation				2,654	2,574	2,072	2,654	2,574	2,072
15	Changes in stocks	15	-4	239	152	219	71	167	216	311
					1995=100					
1	Domestic production	100	96.3	98.7						
2 +	Imports	100	110.1	113.2	100	122.1	115.0	100	114.0	113.8
3 =	Supply	100	102.8	105.5						
4 -	Transformation output/do. primary energy	100	100.8	103.8				100	100.8	103.8
5 =	Supply of primary energy	100	103.8	106.4				100	108.6	108.6
6 -	Homogeneous branches	100	101.3	101.3	100	101.3	101.3			
7 =	Final uses	100	109.0	116.7	100	108.4	106.0	100	108.6	108.6
8 -	Export and ship bunkers	100	147.3	154.1	100	128.4	139.3	100	131.8	141.9
9 =	Final domestic uses	100	97.7	105.6	100	98.1	88.6			
10	Of which:									
11	Consumption of private households	100	98.2	99.9	100	97.8	94.0	100	97.9	96.3
12	Consumption of non profit institutions				100	97.5	100.3	100	97.5	100.3
13	Government final consumption				100	96.1	89.2	100	96.1	89.2
14	Gross fixed capital formation				100	97.0	78.1	100	97.0	78.1
15	Changes in stocks				100	144.4	47.0	100	129.7	186.6

1) Without re-exports.

Table 4 provides more information on the imports and exports and the energy needed for their production. Imports (without re-exports) - in value terms – (row 1) increased more than domestic production (row 7) – by more than 63 % compared to an increase of 23 % for domestic output. Both the demand for imported goods for final

[4] An aggregated hybrid energy IOT for 2002 is annexed (table 2 of annex). More detailed results will be presented later this year in the context of a press conference on the topic „environmental-economic consequences of globalisation" planned for November.

use and for intermediate consumption contributed to that jump in total imports. But the exports increased even more: the exports incl. re-exports increased by more than 90 % from 1995 to 2004, without re-exports the rise is 86%.

The calculations for indirect energy show that while in 1995 the energy requirements for the production of (net) imports exceeded the (net) exports by 35 PJ (row 20) the situation has totally changed since 2000. From there on the production of exports needs more energy than for imports. In 2004 the exports exceeded the imports by more than 1260 PJ. Almost half of the primary energy – exactly 46 % - consumed by domestic branches (row 18) is needed for the production of export products. In 1995 this percentage amounted to 36 %.

Table 4: Imports and exports of goods 1995/2000/2004 and consumption of energy for their production 1)

No.		1995	2000	2004	04/95	00/95	04/00
			bn Euro			change in %	
1	Imports	340	538	555	63.1	58.1	3.1
2	Final demanded goods	122	180	171	40.2	47.7	-5.1
3	Imported intermediate consumption	219	358	384	75.8	63.9	7.3
4	Exports	429	670	823	91.9	56.2	22.8
5	Re-Exports	54	93	126	132.7	72.2	35.1
6	Net-Exports (domestic production) (4 - 5)	375	577	697	86.0	53.9	20.8
7	Total domestic production	3,229	3,786	3,982	23.3	17.3	5.2
8	of which: final demanded of goods	1,928	2,261	2,429	26.0	17.3	7.4
	Foreign trade balance						
9	**Net-Exports - Imports (6 - 1)**	**34**	**39**	**142**			
			share in %			change %-points	
10	Net-Exports (inld. Prod.)	19.4	25.5	28.7	9.2	6.1	3.2
11	Production of final demanded goods	100	100	100			
			petajoule			change in %	
	Energy for the production of...						
12	Imports	5,383	6,572	6,188	15.0	22.1	-5.9
13	Final demanded goods	1,332	1,634	1,469	10.3	22.7	-10.1
14	Imported intermediate consumption	4,051	4,939	4,719	16.5	21.9	-4.5
15	Net-Exports	5,348	6,865	7,449	39.3	28.4	8.5
16	Domestic production	3,681	4,328	4,765	29.4	17.6	10.1
17	Imported intermediate consumption	1,666	2,537	2,683	61.0	52.2	5.8
18	Total domestic production	10,245	10,373	10,373	1.3	1.3	0.0
19	Total Indirect Energy (12 + 18)	15,628	16,946	16,561	6.0	8.4	-2.3
20	**Net-Exports - Imports (16- 12)**	**-35**	**293**	**1,261**			
			share in %			change %-points	
21	Net-Exports (domestic production)	35.9	41.7	45.9	10.0	5.8	4.2
22	Total domestic production	100	100	100			

1) Without re-exports.

The figures reflect an enhanced relationship of the domestic economy with the economy abroad both for the households and the domestic producers. The rise in imported goods for intermediate consumption indicates not only an overall expansion of exchanges with the foreign economies but a change in the international division of work. Especially the boost in the period 1995 to 2000 reflects the period of 'outsourcing'. For Germany this period was characterised by an enormous capital investment in the Middle and East European countries and a substitution of own production activities through purchases from suppliers in the East.

4. Outlook

A main objective of the I/O analysis on energy in the EEA is to get reliable results about the pressure of the economic activities on the environment. This implies that the real consequences of the demand for imported goods should be analysed. For this analysis most often life-cycle analysis (LCA) and not I/O analysis is used, because I/O analysis fails to consider the often very special production processes in foreign economies. Nevertheless I/O analysis seems to be appropriate for such an analysis - especially for the analysis in the field of energy - also. Data for production processes abroad could be integrated in the calculations for imports, e.g. special energy coefficients for the production of specific goods. E.g. the production of electricity is the main source for the demand of primary energy. Concerning the imports for Germany about 29 % of total energy is required by the "electricity branch" in the frame of production of imported goods. Data on the physical inputs and the input-output coefficients of power plants abroad are available and could be integrated in an hybrid energy IOT.

In the German EEA work is done to integrate data from the LCA for selected energy-intensive production processes abroad in the I/O analysis of energy and CO2-emissions. This work is part of an analysis on the consequences of globalisation on the environment. In that analysis especially the effects of a substitution of resource-intensive domestic processes by imports and the effects of the increased export activity on the use of environmental resources will be analysed in more detail. It is expected that the results will contribute to the question on the effects of globalisation on the environment.

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ANNEX:

Table 1 A: Hybrid Energy Input-Output-Table 2002 for Germany

Petajoule (PJ)[1] and billions of Euro[2]

No.	CPA	Branches (CPA) / Homogeneous branches (products)	Intermediate consumption								
			10.1	10.2/3	11	23.1	23.2/3	40.1	40.2	40.3	Energy sectors
			1	2	3	4	5	6	7	8	9=1-8
1	10.1	Hard coal	3	0	0	238	17	1,200	0	108	1,566
2	10.2/3	Lignite, peat	0	113	0	6	0	1,537	0	30	1,687
3	11	Crude petroleum and natural gas	0	0	18	29	4,578	406	0	198	5,229
4	23.1	Coke oven products	0	0	0	0	0	0	0	0	0
5	23.2/3	Refined petroleum products, nuclear fuel	1	1	0	19	847	1,886	1	17	2,771
6	40.1	Electricity	12	18	2	1	23	155	4	0	214
7	40.2	Manufactured gas	1	0	0	27	5	88	0	4	125
8	40.3	Steam and hot water supply services	1	2	0	0	0	0	0	0	3
9		**Total energy (input) PJ**	**18**	**134**	**20**	**321**	**5,470**	**5,271**	**4**	**358**	**11,596**
10		**Total energy (input) bn Euro**									**41,679**
11	01/02/05	Products of agriculture, forestry, fisheries	2	13	10	0	0	0	0	0	25
12	24.1	Basic chemicals	28	0	0	0	110	17	21	0	175
13	27.1-3	Basic iron and steel, tubes, other first processed iron and steel	53	16	40	0	3	47	176	24	359
14	27.4	Basic precious metals and other non-ferrous metals	25	0	1	0	0	3	0	2	31
15	C, D n.e.c.	Metal ores and other mining and quarrying products; manufactured products n.e.c.	833	549	201	13	437	3,647	426	176	6,283
16	41/45	Water; distribution services of water; construction work	88	85	6	2	90	570	217	62	1,120
17	50-55	Wholesale and retail trade services;repair services, hotels and restaurant services	189	121	51	3	111	1,283	293	211	2,262
18	60-64	Transport and communication services	20	21	197	15	635	1,124	199	22	2,233
19	65-95	Other services	465	363	501	45	1,878	8,826	1,779	475	14,332
20		Intermediate consumption (basic prices) (bn Euro)									68,499
21		Gross value added (incl. net product taxes)									31,818
22		Output (PJ)	818	1,759	794	207	5,145	2,102	242	316	11,383
23		Output at basic prices by product (bn Euro)									100,317
24		Imports (cif) (bn Euro)									51,203
25		Total supply (bn Euro)									151,520

NO.	CPA	Branches (CPA) / Homogeneous branches (products)	Intermediate consumption								
			01/02/05	24.1	27.1-3	27.4	C, D n.e.c	41/45	50-55	60-64	65-95
			10	11	12	13	14	15	16	17	18
1	10.1	Hard coal	2	42	72	0	49	0	3	0	4
2	10.2/3	Lignite, peat	1	7	0	0	47	0	1	0	2
3	11	Crude petroleum and natural gas	14	274	97	29	514	15	116	25	280
4	23.1	Coke oven products	0	6	355	4	19	0	0	0	0
5	23.2/3	Refined petroleum products, nuclear fuel	93	779	46	7	322	233	251	716	499
6	40.1	Electricity	21	150	79	60	559	26	146	79	186
7	40.2	Manufactured gas	0	4	91	0	7	0	0	0	0
8	40.3	Steam and hot water supply services	1	10	1	0	38	1	16	2	71
9		**Total energy (input) PJ**	**131**	**1,273**	**742**	**100**	**1,557**	**277**	**533**	**822**	**1,042**
10		**Total energy (input) bn Euro**	**1,413**	**7,812**	**3,962**	**822**	**18,173**	**1,858**	**5,726**	**7,027**	**8,207**
11	01/02/05	Products of agriculture, forestry, fisheries	7,209	35	0	0	33,715	0	768	53	2,166
12	24.1	Basic chemicals	1,441	38,572	332	638	35,099	492	43	0	144
13	27.1-3	Basic iron and steel, tubes, other first processed iron and steel	23	31	29,117	2	17,860	792	142	169	131
14	27.4	Basic precious metals and other non-ferrous metals	5	293	492	10,098	11,922	457	22	0	30
15	C, D n.e.c.	Metal ores and other mining and quarrying products; manufactured products n.e.c.	8,484	5,458	4,042	2,465	417,498	56,056	27,899	10,902	45,470
16	41/45	Water; distribution services of water; construction work	593	273	502	153	4,703	8,564	2,230	1,828	27,426
17	50-55	Wholesale and retail trade services;repair services, hotels and restaurant services	2,793	2,663	2,413	756	54,778	10,477	17,728	8,958	17,718
18	60-64	Transport and communication services	315	1,682	1,880	365	32,891	1,879	40,010	71,770	19,238
19	65-95	Other services	7,241	8,865	2,598	1,827	138,756	31,477	72,943	30,641	344,482
20		Intermediate consumption (basic prices) (bn Euro)	29,517	65,683	45,338	17,126	765,396	112,052	167,511	131,348	465,012
21		Gross value added (incl. net product taxes)	22,820	20,948	8,232	4,339	368,734	98,647	261,508	111,496	1,054,617
22		Output (PJ)									
23		Output at basic prices by product (bn Euro)	52,337	86,631	53,570	21,465	1,134,130	210,699	429,019	242,844	1,519,629
24		Imports (cif) (bn Euro)	17,355	23,372	12,372	15,325	411,883	2,907	8,881	26,678	46,984
25		Total supply (bn Euro)	69,692	110,003	65,942	36,790	1,546,013	213,606	437,900	269,522	1,566,613

Table 1 A continued: Hybrid Energy Input-Output-Table 2002 for Germany

NO.	CPA	Branches (CPA) / Homogeneous branches (products)	Total	Final consumption expenditures by...			Fixed capital formation		Changes in inventories	Exports	Final use	Total use
				House-holds	NPISH	Govern-ment	Mashinery equipment	Con-struction				
			19	20	21	22	23	24	25	26	27	28
1	10.1	Hard coal	**1,741**	24	0	0	0	0	-38	16	2	**1,743**
2	10.2/3	Lignite, peat	**1,748**	16	0	0	0	0	0	12	28	**1,776**
3	11	Crude petroleum and natural gas	**6,609**	1,003	0	0	0	0	138	299	1,440	**8,049**
4	23.1	Coke oven products	**390**	5	0	0	0	0	-13	2	-5	**384**
5	23.2/3	Refined petroleum products, nuclear fuel	**5,722**	2,072	0	0	0	0	-138	1,057	2,991	**8,713**
6	40.1	Electricity	**1,526**	491	0	0	0	0	93	164	749	**2,275**
7	40.2	Manufactured gas	**234**	0	0	0	0	0	15	0	15	**249**
8	40.3	Steam and hot water supply services	**151**	135	0	0	0	0	39	0	174	**324**
9		**Total energy (input) PJ**	**18,120**	**3,746**	**0**	**0**	**0**	**0**	**97**	**1,551**	**5,394**	**23,514**
10		**Total energy (input) bn Euro**	**96,689**	**43,346**	**0**	**285**	**60**	**0**	**-1,350**	**12,500**	**54,841**	**151,530**
11	01/02/05	Products of agriculture, forestry, fisheries	**43,982**	17,316	0	0	-130	3,481	-204	5,258	25,721	**69,703**
12	24.1	Basic chemicals	**76,948**	98	0	0	0	0	322	32,648	33,068	**110,015**
13	27.1-3	Basic iron and steel, tubes, other first processed iron and steel	**48,639**	0	0	0	93	812	769	15,645	17,316	**65,955**
14	27.4	Basic precious metals and other non-ferrous metals	**23,364**	0	0	0	0	0	-144	13,587	13,440	**36,804**
15	C, D n.e.c.	Metal ores and other mining and quarrying products; manufactured products n.e.c.	**584,572**	271,329	0	13,844	131,808	14,801	-15,992	545,663	961,455	**1,546,028**
16	41/45	Water; distribution services of water; construction work	**47,408**	8,464	0	0	0	157,646	0	104	166,214	**213,622**
17	50-55	Wholesale and retail trade services; repair services, hotels and restaurant services	**120,563**	246,503	0	11,797	17,679	0	0	41,375	317,354	**437,917**
18	60-64	Transport and communication services	**172,281**	64,903	0	2,713	0	0	0	29,643	97,259	**269,540**
19	65-95	Other services	**653,181**	417,844	35,680	378,751	22,956	15,774	-6,171	48,617	913,451	**1,566,632**
20		Intermediate consumption (basic prices) (bn Euro)	**1,867,627**	1,069,803	35,680	407,390	172,466	192,514	-22,770	745,040	2,600,119	**4,467,746**
21		Gross value added (incl. net product taxes)	**1,983,180**									
22		Output (PJ)	**11,383**									
23		Output at basic prices by product (bn Euro)	**3,850,641**									
24		Imports (cif) (bn Euro)	**616,960**									
25		Total supply (bn Euro)	**4,467,601**									

[1] Rows 1 to 9, 22.

[2] Rows 10 to 21, 23 to 25.

Table 2 A: Classification of branches in the energy input-output table for Germany

No.	CPA[1)]	Homogeneous branches	No.	CPA[1)]	Homogeneous branches
1	01	Products of agriculture, hunting and related services	38	33	Medical, precision and optical instruments, watches and clocks
2	02	Products of forestry, logging and related services	39	34	Motor vehicles, trailers and semi-trailers
3	05	Fish and other fishing products, services incidental to fishing	40	35	Other transport equipment
4	10.1	Hard coal and hard coal products	41	36	Furniture; other manufactured goods n.e.c.
5	10.2/3	Lignite (brown coal) and lignite products, peat	42	37	Secondary raw material
6	11	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	43	40.1	Electricity, services of production and distribution of electricity
7	12/13/14	Metal ores (including uranium and thorium ores), Mining and quarrying products	44	40.2	Gas, services of manufacture of gas, distribution of gaseous fuels through mains
8	15.1-8	Food products	45	40.3	Steam and hot water supply, services of production and distribution of steam and hot water
9	15.9	Beverages	46	41	Water and services of collection, purification and distribution of water
10	16	Tobacco products	47	45.1/2	Site preparation, building of complete constructions or parts thereof, civil engineering
11	17	Textiles	48	45.3-5	Building installation and other building work
12	18	Wearing apparel; furs	49	50	Trade, maintenance and repair services of motor vehicles; retail trade services of automotive fuel
13	19	Leather and leather products	50	51	Wholesale trade and commission trade
14	20	Wood and products of wood and cork (except fumiture), articles of straw and plaiting materials	51	52	Retail trade services, except of motor vehicles, repair services of personal and household goods
15	21.1/9	Pulp, paper and paper products	52	55	Hotel and restaurant services
16	21.2	Paper and paperboard	53	60.1	Transport via railways
17	22.1	Publishing	54	60.2/3	Other land transport, transport via pipelines
18	22.2+3	Printed matter, recorded media	55	61	Water transport services
19	23.1	Coke	56	62	Air transport services
20	23.2	Refined petroleum products	57	63	Supporting and auxiliary transport services
21	23.3	Nuclear fuel	58	64	Post and telecommunications
22	24.1	Basic chemicals	59	65	Services of the monetary institutions
23	24.4	Pharmaceuticals	60	66/67	Insurance and pension funding services, except compulsory social security services; services auxiliary to financial intermediation
24	24 nec.	Chemicals (not incl. pharmaceuticals)	61	70	Real estate services
25	25.1	Rubber products	62	71	Renting of machinery and equipment without operator and of personal and household goods
26	25.2/9	Plastic products	63	72	Computer and related activities
27	26.1	Glass and glassware	64	73	Research and development services
28	26.2-9	Non-refractory ceramic goods, treated stone and earths	65	74	Other business services
29	27.1-3	Basic iron, steel and tubes and semi-finished products made from basic iron, steel and tubes	66	75.1/2	Public administration and defence services
30	27.42	Aluminium products	67	75.3	Compulsory social security services
31	27.4 nec.	Basic precious and non-ferrous metals and semi-finished products made from basic precious and non-ferrous metals	68	80	Education services
32	27.5	Casting of metals	69	85	Health and social work services
33	28	Fabricated metal products	70	90	Sewage and refuse disposal services, sanitation and similar services
34	29	Machinery	71	91	Membership organisation services n.e.c.
35	30	Office machinery and computers	72	92	Recreational, cultural and sporting services
36	31	Electrical machinery and apparatus n.e.c.	73	93/95	Other services, private households with employed persons
37	32	Communication equipment and apparatus, radio, television, other electronic components			

1) Classification of products by activity (CPA) in the European Economic Community (1993 edition)