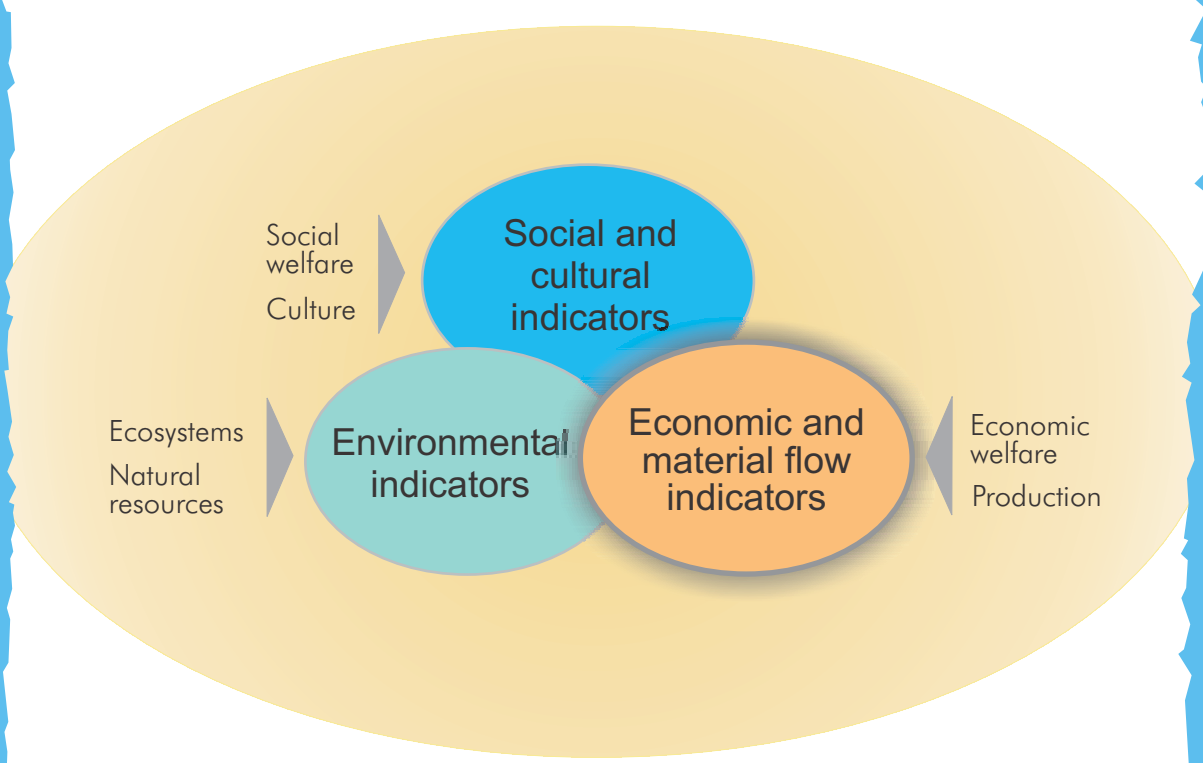
ENVIRONMENTAL PROTECTION

Ilmo Mäenpää and Esa Mänty

Economic and material flow indicators for the Kymenlaakso region

Documentation report 2 of the ECOREG project



FINNISH ENVIRONMENT INSTITUTE

The Finnish Environment 698en

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HELSINKI 2004

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This publication is also available in the Internet
www.environment.fi/publications

ISBN 952-11-1696-X
ISBN 952-11-1697-8 (PDF)
ISSN 1238-7312

Cover picture: Katariina Kytönen
Page layout: Ritva Koskinen

Printing: Dark Ltd., Vantaa 2004

Foreword

The Finnish Environment Institute, the Southeast Finland Regional Environment Centre, the Regional Council of Kymenlaakso and the Thule Institute of the University of Oulu are conducting (September 1, 2002 – December 31, 2004) a Life-Environment project called "The Eco-efficiency of Regions – Case Kymenlaakso (ECOREG)" (LIFE02 ENV/FIN/000331).

In the second task of the ECOREG project, regional monetary and physical input-output tables were constructed for the Kymenlaakso region for the year 2000, and economic and material flow indicators were designed on the basis of their results. The work is documented in this report. The economic and material indicators can be used as such for monitoring economic and structural changes in Kymenlaakso, but ultimately they will be utilized as part of the eco-efficiency monitoring mechanism to be constructed for the Kymenlaakso region later in the ECOREG project.

The tentative input-output tables and indicators were discussed in several meetings of the ECOREG steering group and at two regional workshops arranged in Kymenlaakso.

Ilmo Mäenpää and Esa Mänty from the University of Oulu are the authors of the report.

Matti Melanen
Project Manager, ECOREG project

Contents

Introduction

The report analyses the special characteristics of the economy of Kymenlaakso, as compared with Finland as a whole and the European Union, and in terms of its development during the time-period 1995-2001 (Chapter 2). The structural characteristics of the economy are analysed using an input-output table for Kymenlaakso created in the present project (Chapter 3).

The estimation and analysis of the material flows in Kymenlaakso were conducted using an input-output table of material flows developed for the region of Kymenlaakso (Chapter 4).

Finally, the central descriptors of the economy and its material flows were compiled as a set of indicators (Chapter 5).

2 General features of the regional economy in Kymenlaakso

2.1 Data sources and basic concepts

In the following, we present an overview of the Kymenlaakso economy and its special characteristics as compared with the entire Finnish economy, and that of the European Union (EU-15).

Central information sources used include the Regional Accounts by Statistics Finland (Statistics Finland 2003a, 2004), for the entire Finnish economy the National Accounts (Statistics Finland 2003b), and for Europe the regional statistics on GDP and population by Eurostat, the Statistical Office of the European Communities (Eurostat 2004).

In the European Community, the National Accounts and the Regional Accounts form an integrated system with its own concepts and measurement methods, which are presented in the handbook on the European System of Accounts (Eurostat 1996).

In the Regional Accounts, a central measure of production is the value added. The value added of a production unit is obtained by taking the value of the products – i.e., the goods and services – that it has produced and subtracting from this figure the value of the products used for their production. Thus, value added can be considered to measure the amount of new economic value that the production unit has produced. The value of the products produced is called the output of the production unit.

In the published statistics of the Regional Accounts, the production units include the region as a whole and the industries, or economic branches, in the region. When calculating the value added of the entire region, the share of costs due to financial intermediation services is subtracted from the sum of values added by the industries, or economic branches, as this cost item cannot be allocated to the industries in the European System of Accounts. The share of financial intermediation services is, however, only less than 3 % of the value added.

The value added of a region can also be called the gross domestic product of the region at basic prices.

The most well-known concept in the System of National Accounts is the gross domestic product at market prices (GDP). It is obtained by adding to the value added – or gross domestic product at basic prices – the taxes on products that are included in the market prices of products used in the economy (e.g., value-added tax, fuel taxes), and subtracting the subsidies on products. In the European Community, GDP at market prices is not calculated in the national-level Regional Accounts, because evaluating the amount of products consumed in the region is not within the scope of the Regional Accounts. Instead of this, Eurostat adds to the regional value-addeds a share of product taxes using a standardised calculation procedure, so that the GDPs of the regions at market prices add up to the GDP at market prices of the national economy of each country. These market-priced GDPs produced by Eurostat form a central basis for regional subsidies in the EU. GDP at market prices is about 15 % higher than value added in Finland.

A central measure of economic growth is GDP at constant prices, or value added at constant prices. In constant-priced time-series, changes in prices have been eliminated by calculating monetary values such as output or value added according to the price level of a specific base year. Currently, the base year both in the National and in the Regional Accounts is the year 2000.

In order to produce statistics at constant prices, national statistical offices have calculation systems based on detailed product-level price indexes, in which the price indexes for different economic sectors are derived from the product-level price indexes according to the product composition in these sectors prevailing in the base year (see Lehtinen and Ranki 1998, Kinnunen and Lehtinen 1998). Time-series at constant prices are obtained by dividing the time-series at current prices of the sectors by the price indexes.

The basic principle in compiling price indexes is that they monitor price changes in products of the same quality, and thus changes in the quality of products are eliminated from the changes in prices. When a current-priced time-series is divided by this kind of a price index series, the change in quality remains in the time-series at constant prices.

Series at constant prices are often also called the development of real GDP. Depending on how it is calculated, real GDP includes a quantitative change (e.g., measured in kilos), and also a qualitative change. For example, in the price index of mobile phones, the price difference of camera phones compared with ordinary phones is eliminated. When the time-series of mobile phone production at current prices is divided by the price index for mobile phones, the growth in the share of camera phones is reflected in a considerably larger growth in the economic volume of mobile phone production (i.e., mobile phone production at constant prices) compared with the growth in mobile phone production as measured in physical units.

In indicators of eco-efficiency, value added or GDP is often the numerator, and environmental burdens are often the denominators. The environmental burden is often related to the size of the physical material flows of the economy. In addition to actions that are specifically directed at reducing environmental burdens, we can also identify some general factors in the development of the economy that tend to decouple economic growth, i.e., the growth in real GDP, from the physical growth of the economy:

- Changes in the production structure toward a structure dominated by services or high value-added production mean that value added grows without a corresponding growth in physical material flows.
- Increasing the level of processing of products, i.e., improving and expanding their quality characteristics, usually implies that the economic value of the products increases without a corresponding increase in their physical quantity. Increasing the level of processing of products also usually means that the share of value added in economic output grows, thus providing more value added with the same amount of economic output.
- Savings achieved in intermediate inputs – e.g., energy or raw materials – mean that a decreasing share of the value of the output goes into costs for intermediary products, thus providing a higher value added with the same output. Savings in intermediate inputs often also have a concurrent influence on environmental burdens, such as reductions in air emissions or wastes.

2.2 Kymenlaakso in Finland and Europe

To provide a very general overview of the economy of Kymenlaakso, Table 1 presents the total area, population and GDP of Kymenlaakso, the whole of Finland and the European Union (EU-15) in the year 2000. The area of Kymenlaakso is less than 2% of Finland, but in terms of population and national product, it accounts for 3.5% of Finland as a whole. Within the whole EU, Kymenlaakso amounts to 0.17 % of the area, and in terms of population and national product, its share is 0.005%.

Table 1. General measures of the economies of Kymenlaakso, Finland and the EU in 2000 (Statistics Finland 2000, table 597, Eurostat 2004).

	Kymenlaakso	Finland	EU-15
Total area, km^2	5 588	338 150	3 242 690
Population, 1000 persons	188	5 176	379 179
GDP, million euro	4 819	130 145	8 568 387

Population density and GDP per capita are commonly used indices to compare economies of different sizes. According to Table 2, the population density of Kymenlaakso was more than twice as high as the average in Finland, but less than one-third of the average population density in the EU. The GDP per capita in 2000 was slightly higher than the Finnish average, and about 13 % higher than the average of the EU member states.

Among the Finnish regions, the GDP in Kymenlaakso is the fifth highest, following Uusimaa, Åland, South-West Finland and Southern Karelia.

Table 2 also presents a less familiar metric, the GDP per area, i.e., the spatial density of economic activity. The spatial density of economic activity is a useful metric providing a background for analyses of the spatial intensity of the environmental burdens of economic activities. The GDP density of Kymenlaakso is double the average in Finland, but only about one-third of the EU average.

Table 2. Measures of the economies of Kymenlaakso, Finland and the EU-15 in 2000

	Kymenlaakso	Finland	EU-15
Population density, persons/km^2	34	15	117
GDP per capita, euro/resident	25 621	25 144	22 597
GDP per area, 1000 euro/km^2	862	385	2 642

Table 3 presents a comparison of the production structure of the regions in terms of contributions to value added. Primary production includes agriculture, forestry and fishing, secondary production consists of mining and quarrying, factory industries, the electricity, gas and water supply, and construction. Kymenlaakso is exceptional in its large share of secondary production, which still mainly consists of the pulp and paper industry. The share of services is larger in the whole EU than in Finland as a whole.

Table 3. The production structure of Kymenlaakso, Finland and the EU-15 as measured by contribution to value added in 2000, % (Statistics Finland 2004, Eurostat 2001)

	Kymenlaakso	Finland	EU-15
Primary production	3.3	3.7	2.2
Secondary production	43.3	34.2	28.2
Services	53.4	62.1	69.6

2.3 The development of the economy in Kymenlaakso

Figure 1 presents the development of value added, employment and population in Kymenlaakso in 1995-2001. During this six-year period, value added has increased by 14 %, employment only slightly, 0.6 %, and the population has decreased by about 3 per cent, by an average of 600 persons per year. The unemployment rate in Kymenlaakso, however, was still 12 % in the year 2000.

In the development of Kymenlaakso, it is interesting to note that the employment rate has not followed the development of the volume of value added. In 1998, when the economy grew relatively rapidly, the employment rate, in contrast, decreased. Similarly, in 2001, when the value added of the economy decreased, the employment level, conversely, increased.

The divergent development of production and employment is explained by the large share of the forest industry, especially the pulp and paper industry, in the economy of Kymenlaakso. As the pulp and paper industry is a capital-intensive industry, it has a large impact on value added, but has little influence on employment. Thus, the economic cycles of the pulp and paper industry influence the value added in Kymenlaakso, but not the level of employment.

Figure 2 presents the shares of the different sectors in the composition of the value added in Kymenlaakso, with the forest industry as a separate category. The figure shows how the decline of the economy in 2001 was solely the result of decreased production in the forest industry.

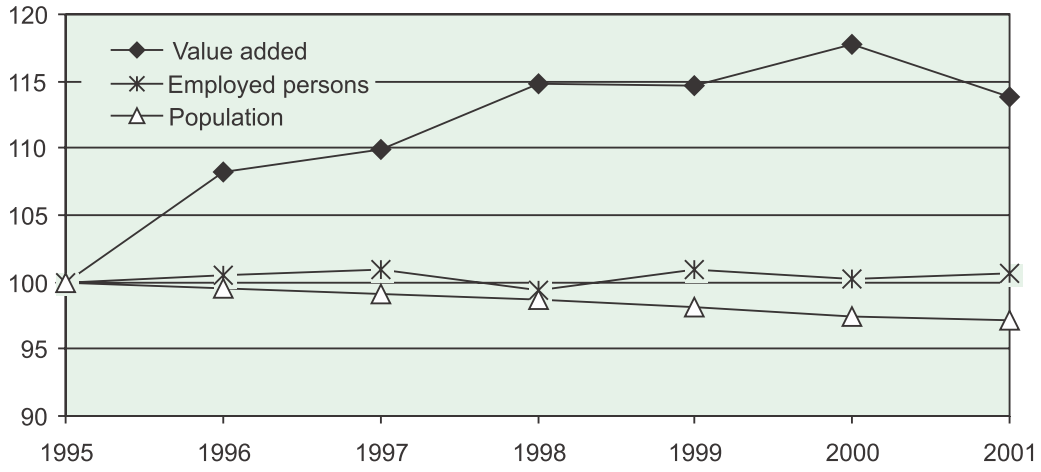


Figure 1. The development of the volume of value added, employment and population in Kymenlaakso, 1995-2001. Index 1995 = 100.

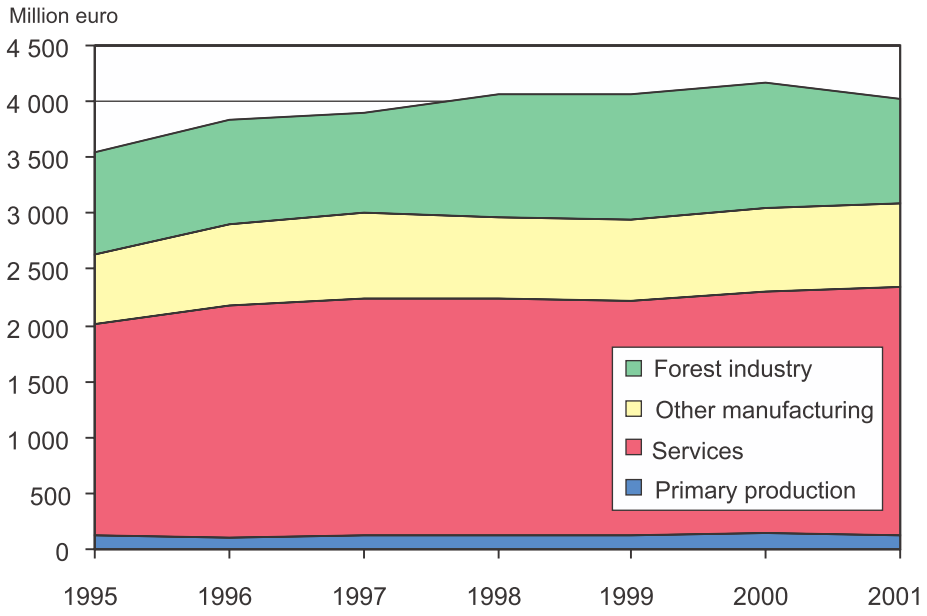


Figure 2. The composition of value added in Kymenlaakso in 1995 – 2001, at 2000 prices.

Figure 3 presents the average annual growth rates of production by sector in 1995-2001 compared with the respective growth rates for Finland as a whole. The growth rate of production in Kymenlaakso has been about half of the average for Finland. Especially in secondary production, Kymenlaakso has not had the benefit of the growth of the electronics industry, which has been the engine of the Finnish economy. Furthermore, at the end of the period analysed, production in the forest industry declined in 2001.

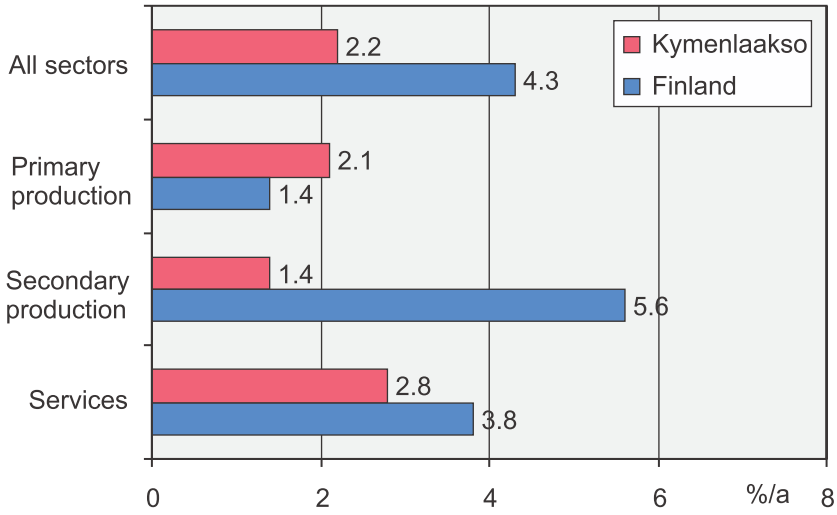


Figure 3. Annual average growth of production, %, in Kymenlaakso and Finland as a whole, 1995 – 2001.

2.4 Industry structure

The industry structure of Kymenlaakso is presented in detail in Table 4. The contents of the industries are provided in more detail in Annex 1.

The special features of the economy in Kymenlaakso include the large shares of the forest and transport industries of the total production.

The forest industry makes up more than one-fourth of the value added of the regional economy, and more than 60 % of the secondary production. Kymenlaakso accounts for 13 % of the value added of the forest industry in Finland, whereas it only accounts for 4 % of the total value added of the country.

The large proportion of the transport industry is due to two important ports in Kymenlaakso, Hamina and Kotka. These two ports account for 7 % of the imported goods and 21 % of the exported goods passing through all the Finnish ports. The ports hold an especially important position in the transit transports to Russia. Hamina and Kotka together accounted for 75 % of transit transports through Finland in 2000, and almost one-fourth of all the goods passing through the ports of Hamina and Kotka were transit transports (Finnish Maritime Administration 2002).

Table 4. Contributions of the industries to value added in Kymenlaakso in 1995 and 2000 and in Finland as a whole in 2000, %.

		Kymenlaakso		Finland
	Industry	1995	2000	2000
1	Agriculture, hunting & fishing	1.6	1.5	1.6
2	Forestry and logging	1.8	1.9	2.2
3	Mining and quarrying	0.2	0.2	0.2
4	Manufacture of food products	1.7	1.9	1.6
5	Forest industry	25.5	26.8	7.4
6	Chemical industry	2.5	2.0	2.6
7	Metal industry	1.4	1.4	2.8
8	Other manufacturing	5.7	5.1	12.3
9	Electricity, gas & water supply	1.4	1.6	1.8
10	Construction	5.0	5.9	5.9
11	Transport and communication	12.1	14.8	10.7
12	Other services	34.0	31.6	46.1
13	Public administration	7.1	5.3	4.9
	Total	100.0	100.0	100.0

Table 5 compares the distribution of the value added of the industries with the distribution of their contribution to employment. The contribution of agriculture, hunting and fishing to employment is more than 5 %, but their contribution to value added amounts to only one-and-a-half per cent. The contribution to employment of the forest industry is less than 12 %, even though its share of value added amounts to more than one-fourth. The contribution to employment of transport, warehousing and communications, about 10 %, is less than their share of the value added. The contribution to employment of the other services is 43 per cent, and that of public administration, about 10 per cent. The contribution to employment of the other services is one-fourth and that of public administration about one-half higher than their contribution to value added.

Table 5. Contributions to value added and employment of the industries in Kymenlaakso in 2000, %.

	Industry	Value added	Employment
1	Agriculture, hunting & fishing	1.5	5.2
2	Forestry and logging	1.9	0.8
3	Mining and quarrying	0.2	0.2
4	Manufacture of food products	1.9	1.8
5	Forest industry	26.8	11.7
6	Chemical industry	2.0	1.3
7	Metal industry	1.4	1.8
8	Other manufacturing	5.1	5.2
9	Electricity, gas & water supply	1.6	0.8
10	Construction	5.9	7.0
11	Transport & communication	14.8	10.3
12	Other services	31.6	43.0
13	Public administration	5.3	10.7
	Total	100.0	100.0

The productivity of labour, i.e., the value added per labour input, is higher in Kymenlaakso than the average in Finland (Figure 4). The difference is due to the high labour productivity in secondary production, and within secondary production especially, the large share of the pulp and paper industry.

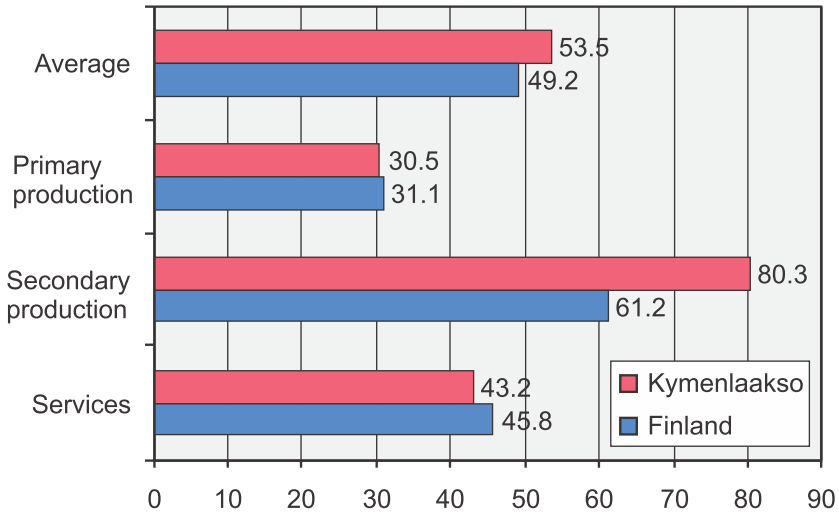


Figure 4. The productivity of labour in Kymenlaakso and in Finland as a whole in 2000, value added of 1000 euro/ person employed.

2.5 Income generation

Value added includes the compensations for labour and capital inputs. Thus, while value added is a measure of production, it also forms the basis for regional income generation. The current Regional Accounts do not include the complete flows of incomes and income use, but only the income generation of households. Central concepts pertaining to income include the primary income and the disposable income of households. The primary income of households includes the earned incomes of households living in the area (wages and proprietors' incomes), and their incomes on property. The disposable income is obtained by subtracting from the primary income the income taxes and other income transfers paid, and by adding to it the income transfers gained, such as pensions and different kinds of social benefits.

The Regional Accounts (Statistics Finland 2003a) also present the income generation of households.

Income development is best considered in terms of income purchasing power, i.e., the development of real income. We can obtain the purchasing power of household income by dividing nominal income with the consumer price index (see Kinnunen and Lehtinen 1998). When the consumer price index series is normalized so that the base year is given the value 1, we can speak of the real income in the prices of that year.

Figure 5 presents the income development in Kymenlaakso in the period studied. The different income categories have developed in a fairly similar manner: the primary income of households has been about 2/3 of the value added, and their disposable income has been about 85 % of the primary income. Similarly to employment, however, the income generation of households has been independent of the economic cycles.

Figure 6 compares the income generation in Kymenlaakso with that of Finland as a whole in the year 2000. The per capita value added in Kymenlaakso is slightly higher than the national average, but the household income is slightly lower. The redistribution of income from primary income to disposable income levels out these differences to some extent.

On the level of the national economy, the households' disposable income has been almost equal to their consumption expenditures in the past few years. In other words, the average net savings of households have been almost nil, and thus the income after taxes is almost entirely used for consumption. Hence, the households' disposable income can be considered the best available measure on the regional level for the physical standard of living of the population

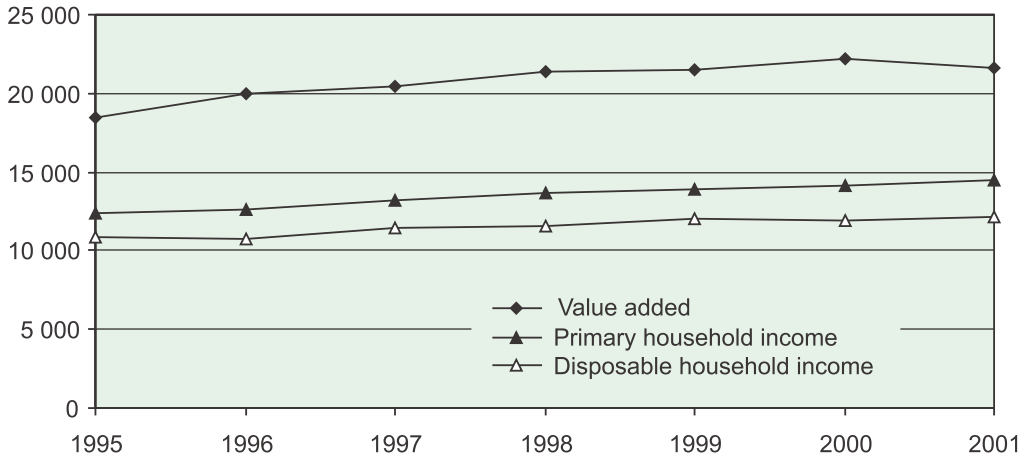


Figure 5. Development of real income in Kymenlaakso, 1995 – 2001, euro / resident at 2000 prices.

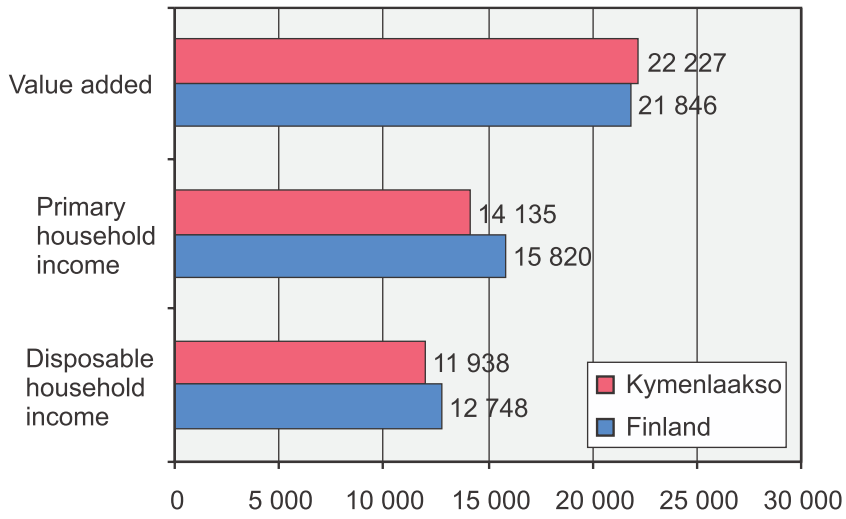


Figure 6. Income generation items in Kymenlaakso and in Finland in 2000, euro / resident.

The households' disposable income is less than their primary income. In other words, households pay out in the form of taxes and other income transfers more than they gain in income transfers. Households get back part of the remainder in the form of free services provided by the government, or services partly paid by the government. In the System of National Accounts, the value of services to households financed by the government – either ones it produces itself or ones purchased from the private sector – is referred to as the expenditure on public services for individual consumption. Furthermore, the expenditures of non-profit institutions (NPIs), the so-called third sector, can be considered as being entirely directed to households. The sum of household expenditures, expenditures by non-profit organizations and goverment expenditures on services for individual consumption can be referred to as the actual final consumption of households.

Figure 7 presents the relations between available household income, consumption expenditure and household actual final consumption on the national level in Finland in the year 2000. The individual consumption expenditures of non-profit institutions (NPIs) and government institutions were almost one-third, i.e., 32 %, of the household consumption expenditures. The Regional Accounts, however, do not provide information for calculating actual final consumption expenditures. Thus, on the regional level, we are forced to make do with the incomplete measure of disposable household income as a measure of the standard of living.

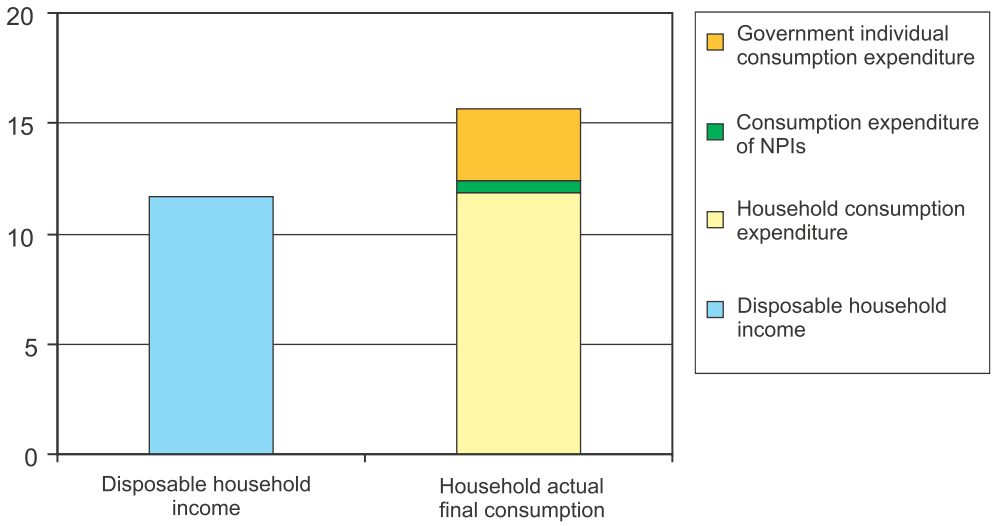


Figure 7. Per capita disposable household income and actual final consumption of households in Finland as a whole in 2000, 1000 euro/capita (Statistics Finland 2003b).

Structural analysis of the economy of Kymenlaakso

3

3.1 Background

The structure of the economy is described in detail in the input-output tables, which present the flows of products between economic activities, as well as the imports of products for economic activities and their exports outside the economy. Input-output tables are today a central part of the System of National Accounts, and standards for their compilation have been developed in, e.g., the European System of National Accounts (Eurostat 1996). In the Finnish System of National Accounts, the supply and use tables used as the basis for the input-output tables are currently produced annually, and these tables have been compiled since 1995 (Statistics Finland 2003c).

In the European System of National Accounts, the input-output tables are not required items in the Regional Accounts, but in Finland, Statistics Finland drew up the regional input-output tables for 1995 (Statistics Finland 2000), and the compilation of regional input-output tables for the year 2000 is currently under way. Elsewhere in Europe, the statistical offices have not produced regional input-output tables, although such tables have been compiled in regional economy studies, usually for individual regions.

In the present study, input-output tables were drawn up for Kymenlaakso for the year 2000. The basis for this work was the adjustment of the national supply and use tables into the information of the Regional Accounts for Kymenlaakso at the highest level of detail possible. After this, the estimation was elaborated using, among others, the data for Kymenlaakso in the Industry Statistics. The compilation procedures are presented in more detail in Annex 2.

The input-output tables enable us to consider the production structure of the economy from many angles, especially using the so-called multiplier effects analysis, which has features that are similar to life cycle assessment.

3.2 The input-output tables for Kymenlaakso

The input-output tables for Kymenlaakso were constructed using a breakdown into 25 categories of economic activities (Annex 1). In Table 6, the economic activities are combined into 13 industries in order to enable the presentation of the table on one page.

The rows and columns in Table 6 first present the production industries in Kymenlaakso. In the columns for the industries, only the ordinal numbers of the industries are given in order to save space. The respective names of the industries can be seen on the rows. After the industries, there is a correction column for financial intermediation services (Fis). The end columns present the final use activities, which are private and public consumption, investments, and exports to elsewhere in the country and abroad. The rows below the industries present first the imports of products from elsewhere in Finland and from abroad, and then some rows with adjustment entries related to foreign exchange, and a row for product taxes and subsidies. As the sum of product inputs and adjustment entries, we obtain the sum

of product inputs used by industries and final use categories. In the columns for industries, these are also followed by items of value added, i.e., mainly compensations to employees and capital compensations. In the industry columns, the sum total is the value of the output of the industry.

The sums of the row and the column for each industry are equal, designating the value of the output of the industry. On the row for each industry in the table, we can see the use of the products of this industry as intermediate products, for final use within the region – in private or public consumption or for investments – or for exports elsewhere in Finland or abroad.

The columns for the industries indicate the inputs that each industry has used in terms of products from the region or imports. The intermediate use and the value added together add up to the value of the output of the industry.

In the main table, Table 6, the imported products are summed up as one figure. In Table 7, the imports are also divided into product groups by industry.

In the tables, we can see the dominant share of the forest industry in the product flows in Kymenlaakso. The forest industry makes up almost 40 % of the value of the output of Kymenlaakso, 45 % of the value of its imports, and more than 70 % of the value of its exports.

The tables for Kymenlaakso can also be summarized to produce the overview of the product flows in the region presented in Figure 8. More than half of the value of the products is generated within the region, about one-fourth is imported from elsewhere in Finland, and 16 % from abroad. About half of the value of the products remains within the region in terms of final use, i.e., consumption and investments, whereas 13 % is exported to the rest of Finland and 36 % abroad.

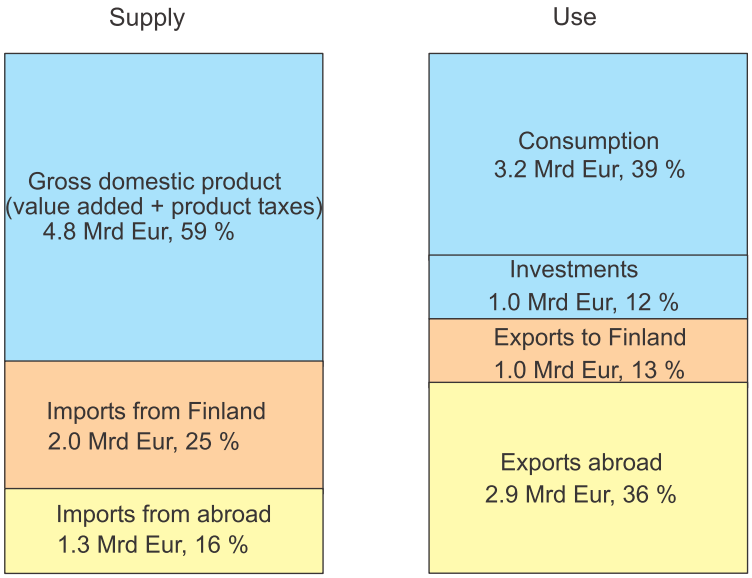


Figure 8. Supply and use balance of product flows in the economy of Kymenlaakso in 2000.

Table 6. Input-output table, Kymenlaakso in 2000, million euro

	INDUSTRIES															FINAL USE						Total
INDUSTRIES	1	2	3	4	5	6	7	8	9	10	11	12	13	Vrp	**Total**	Private consumption	Public consumption	Invest-ments	Exports Domestic	Exports Abroad	**Total**	
1 Agriculture, hunting & fishing	23	0	0	71	0	0	0	0	0	1	0	2	0	0	**99**	16	0	1	29	0	**46**	**144**
2 Forestry and logging	0	3	0	0	80	0	0	0	0	0	0	0	0	0	**83**	1	0	1	19	0	**20**	**103**
3 Mining and quarrying	0	0	0	0	3	1	0	1	1	2	0	0	0	0	**7**	0	0	1	5	3	**9**	**16**
4 Manufacture of food products	8	0	0	60	31	6	3	1	1	2	3	24	3	0	**142**	84	1	0	100	15	**199**	**342**
5 Forest industry	2	1	0	11	801	18	8	4	5	24	8	33	9	0	**923**	28	14	6	418	2 388	**2 855**	**3 778**
6 Chemical industry	2	0	0	3	65	16	3	1	0	8	1	7	1	0	**107**	8	2	1	117	171	**298**	**405**
7 Metal industry	0	0	0	2	16	3	19	2	1	38	1	5	2	0	**91**	7	2	22	191	182	**403**	**494**
8 Other manufacturing	0	0	0	1	6	2	2	8	0	32	0	4	1	0	**57**	6	1	2	21	55	**85**	**142**
9 Electricity, gas & water supply	2	0	0	2	66	8	1	1	2	3	3	30	4	0	**122**	14	0	1	9	0	**23**	**145**
10 Construction	3	0	0	0	2	0	0	0	0	33	12	68	2	0	**121**	2	4	491	11	2	**510**	**631**
11 Transport and communication	1	1	2	18	285	25	12	7	8	14	51	67	15	0	**507**	121	145	2	114	39	**422**	**928**
12 Other services	10	3	1	19	147	25	24	6	7	47	59	177	68	63	**656**	1 034	411	76	6	0	**1 526**	**2 183**
13 Public administration	0	0	0	2	17	3	3	1	1	2	6	15	5	0	**57**	24	351	6	2	0	**382**	**440**
Use of products from the region	53	9	4	190	1 518	107	73	32	27	206	145	433	111	63	**2 971**	1 344	930	610	1 041	2 855	**6 779**	**9 750**
Imports from Finland	23	11	3	55	726	65	112	19	23	117	80	161	45	54	**1 494**	310	2	173	0	0	**485**	**1 979**
Imports from abroad	8	2	2	42	396	139	108	21	25	50	59	102	33	0	**984**	173	9	143	0	9	**334**	**1 318**
Cif/fob-adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	-51	**-51**	**-51**
Finns' purchases abroad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	47	0	0	0	0	**47**	**47**
Foreigners' purchases in Finland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	-53	0	0	0	87	**34**	**34**
Product taxes and product subsidies	-2	0	0	-24	20	11	1	1	4	11	30	54	29	0	**136**	408	3	57	0	-12	**456**	**592**
Intermediate use/ Final use	81	22	8	263	2 660	322	295	72	80	384	313	751	217	117	**5 584**	2 230	944	983	1 041	2 887	**8 085**	**13 669**
Compensations to employees	17	10	4	38	424	42	137	40	24	166	212	838	199	0	**2 153**							
Other production taxes, net	-37	0	0	-1	-1	-1	-1	0	0	0	0	-2	0	0	**-43**							
Depreciation of fixed capital	23	15	1	19	297	22	15	8	40	11	131	260	37	0	**880**							
Operating surplus, net	60	56	3	22	399	20	48	22	1	69	271	336	-14	-117	**1 176**							
Value added at basic prices	63	81	8	79	1 118	83	199	70	65	247	615	1 432	222	-117	**4 166**							
Output at basic prices	144	103	16	342	3 778	405	494	142	145	631	928	2 183	440	0	**9 750**							

Table 7. Use table for imports, Kymenlaakso in 2000, million euro

	INDUSTRIES															FINAL USE						Total
INDUSTRIES		1	2	3	4	5	6	7	8	9	10	11	12	13	Fis	**Total**	Private consumption	Public consumption	Invest-ments	Exports Domestic	Exports Abroad	**Total**	
1	Agriculture, hunting & fishing	10	0	0	34	0	0	0	0	0	0	0	1	0	0	**46**	13	0	0	0	0	**14**	**60**
2	Forestry and logging	0	9	0	0	304	0	0	0	0	0	0	0	0	0	**313**	3	0	2	0	0	**6**	**319**
3	Mining and quarrying	0	0	1	0	72	31	1	4	20	7	0	0	0	0	**137**	0	0	0	0	0	**0**	**137**
4	Manufacture of food products	2	0	0	26	20	2	1	0	0	0	1	10	1	0	**63**	31	0	0	0	0	**31**	**94**
5	Forest industry	0	0	0	1	145	2	1	3	2	25	3	23	4	0	**208**	27	0	0	0	1	**28**	**236**
6	Chemical industry	5	1	1	8	218	124	8	8	6	17	27	33	2	0	**458**	34	10	0	0	0	**44**	**502**
7	Metal industry	1	0	2	7	116	12	180	8	8	47	16	38	19	0	**453**	72	1	246	0	8	**327**	**780**
8	Other manufacturing	0	0	0	1	10	3	3	10	0	19	2	15	2	0	**66**	53	0	6	0	0	**60**	**126**
9	Electricity, gas & water supply	1	0	0	1	37	4	1	0	1	1	1	11	2	0	**61**	6	0	0	0	0	**6**	**67**
10	Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	**0**	**0**
11	Transport and communication	0	0	0	2	28	4	3	1	2	2	53	26	8	0	**129**	39	0	0	0	0	**39**	**168**
12	Other services	11	2	1	17	172	22	22	5	8	49	36	106	39	54	**543**	204	1	61	0	0	**266**	**808**
13	Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	**0**	**0**
	Total	31	13	5	97	1 123	204	220	39	48	167	138	263	77	54	**2 478**	483	12	316	0	9	**820**	**3 297**

3.3 Multiplier effect analysis

The input-output table describes the central linkages in the operation of the regional economy in the form of product flows. Input-output analysis usually refers to calculations enabling the assessment of the multiplier effects resulting from these linkages.

Calculations of the multiplier effects are based on what is known as the Leontief inverse matrix. When constructing this matrix, one first takes out of the input-output table the section pertaining to intermediate flows among the industries. This is divided, by column, with the outputs of the industries, thus obtaining the output coefficient matrix **A** of industry x industry. The output coefficient matrix is used to produce the Leontief inverse matrix $\mathbf{B = (1-A)^{-1}}$. Whereas the column of matrix **A** presents the amount of products by each industry that each industry uses for each of its own output units, the column in matrix **B** presents the total amount of both direct and indirect inputs that are needed of the outputs of the different industries to produce an output unit of the industry in question. In life cycle assessment, this corresponds to the calculation of the upstream impacts of an industry.

Next, we construct a basic input matrix **P** of the industries, in which the columns represent the industries and the rows represent the variables, calculated per output units of the industries giving rise to the effects that we want to study. In this chapter, the variables considered are value added, employment and imports. In Chapter 4, the variable is the material requirement. We could also use as variables, e.g., consumption of primary energy, emissions to air or other environmental impacts related to the physical volume of production. We construct the basic input matrix and the internal product for the Leontief inverse matrix, **PB**. The columns of the matrix indicate how much each industry has contributed, directly and indirectly, to each variable per output unit. Because the matrix product **PA** indicates the direct contribution of each industry, the indirect contribution of the industries is obtained as the remainder **PB – PA**.

We denote the final use section of the input-output table as matrix **Y**. Then, the matrix product **PBY** indicates how much each final use activity, i.e., private and public consumption, investments and exports, have contributed to each variable – or inversely, what amount of each variable has been caused by each final use activity.

Figure 9 presents the direct and indirect effects on value added of each industry in Kymenlaakso per unit of output. The direct effect on value added is highest in forestry and logging, due to the high share of the price of standing timber in the total value of the output. In contrast, the indirect effect of the forestry on output is low. In the service industries, the high share of labour costs also makes the direct contribution to value added high. The food industry has the highest indirect effect on value added due to the demand effect on agriculture. In the manufacture of wood products, the indirect effect on value added is slightly larger than the direct effect; in the pulp and paper industry, the indirect contribution is slightly smaller. The indirect effect is also fairly small in the metals industry. The relatively small regional multiplier effects of both the forest industry and especially the metals industry are due to the large share of imports in the production factors of these industries.

Figure 10 presents a similar analysis for the employment effects. Agriculture has the highest effect on employment per output unit. This is explained by the fact that due to high subsidy levels, the value of agricultural output, i.e., the price of agricultural products, remains fairly low compared with the labour costs. Due to the high employment coefficient of agriculture, the food industry also has a relatively large indirect effect on employment. In general, the regional multiplier effects on employment are fairly limited, and most of the employment effects leak out of the region though the transmission of imports.

Table 8 presents the distribution of value added, employment and imports on final use categories in Kymenlaakso. About half of the value added is generated directly or indirectly by production for exports, less than one-fourth is due to private consumption, and 17 % is due to public consumption. In terms of employment, the contribution of exports is 37 %, whereas private and public consumption contribute almost equally, by 28 and 26 per cent, respectively. More than half of the imports go into exports, and about one-fourth are transformed into private consumption.

Table 8. Distribution of value added, employment and imports by final use category in Kymenlaakso in 2000, %.

	Private consumption	Public consumption	Investments	Exports	Total
Value added	24	17	9	50	100
Employment	28	26	10	37	100
Imports	24	6	16	54	100

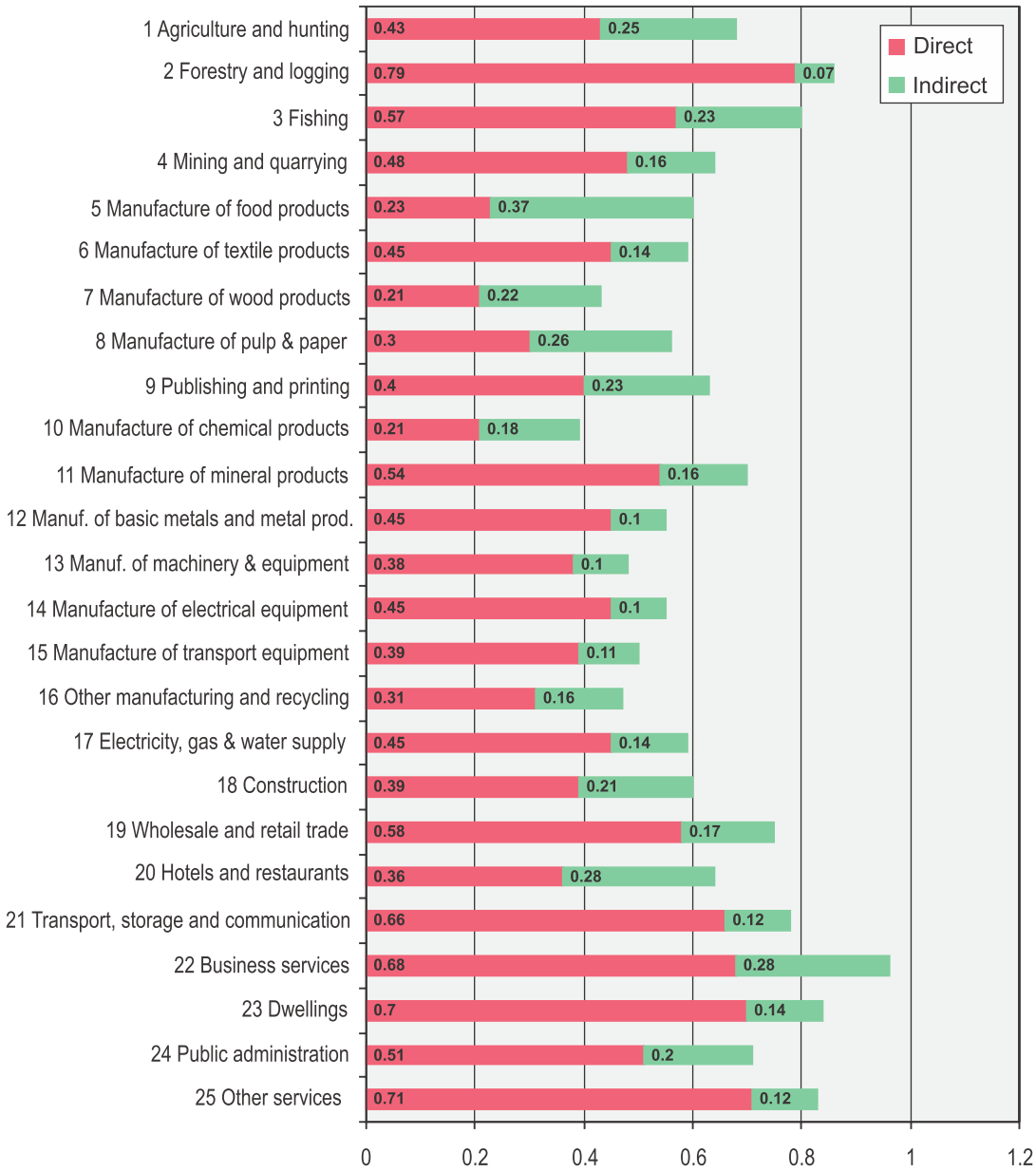


Figure 9. Direct and indirect effects of industries on value added, per one euro of output in Kymenlaakso in 2000.

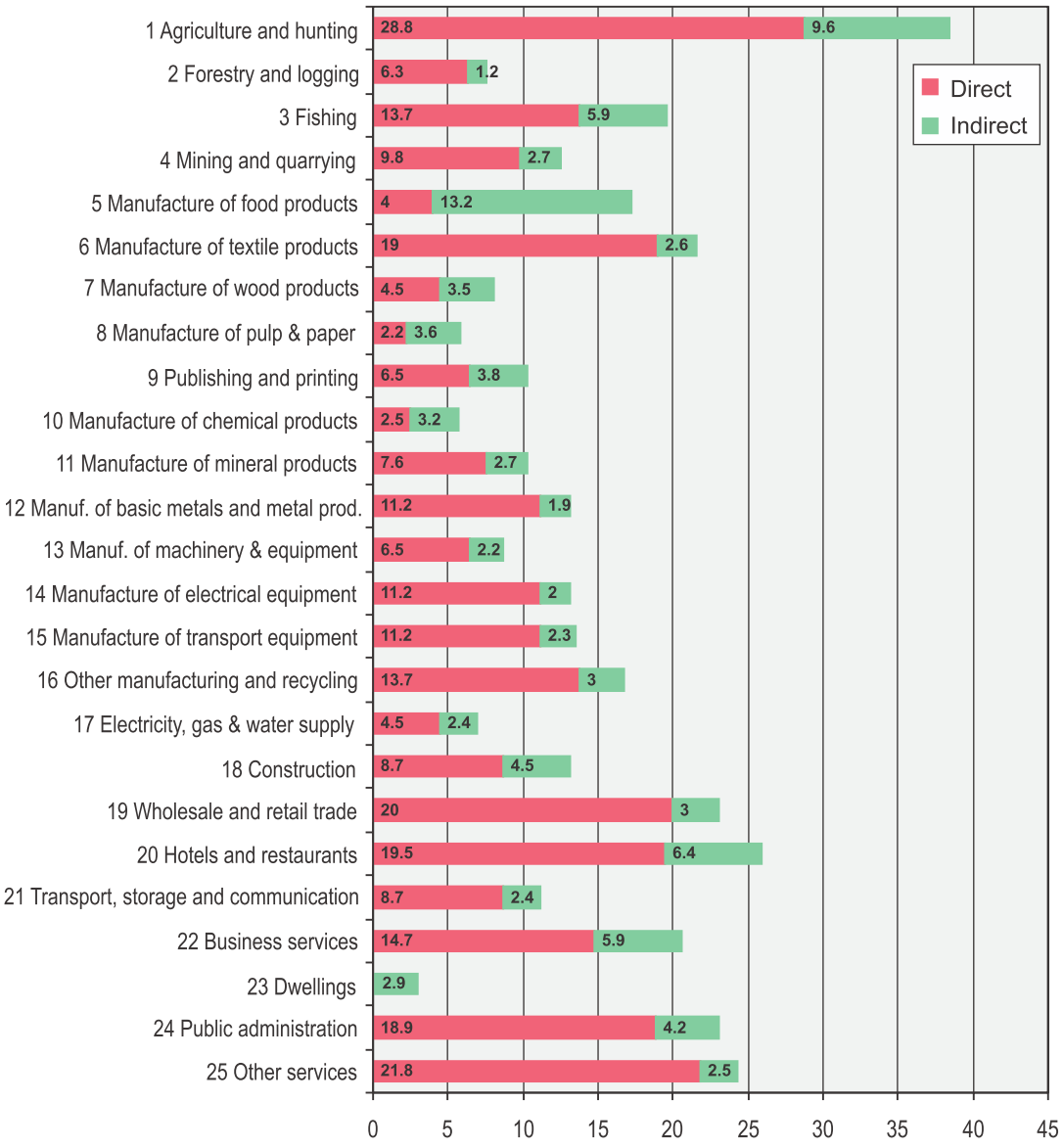


Figure 10. Direct and indirect effects of industries on employment, persons employed per output of one million euro in Kymenlaakso in 2000.

4 Material flows and total use of natural resources of the economy of Kymenlaakso

4.1 Background

The measurement and analysis of the natural resource use of the economy gained international recognition following the report by the World Resources Institute, *Resource flows: the material basis of industrial economies* (Adriaanse et al. 1997). The concepts and methods had been developed at the Wuppertal Institute in Germany in the early 1990s. The report presented estimations and evaluations of the development of natural resource use in four countries: the Netherlands, Japan, Germany and the United States. Since then, the method has been adopted in many countries. The Statistical Office of the European Communities, Eurostat, published a guidebook (European Commission 2001), in which the concepts and methods for compiling statistics on natural resource use were refined and standardized. Eurostat has also produced time-series of natural resource use in the entire EU area (Eurostat 2001, Eurostat 2002).

The measurement of material flows is also part of the integrated framework for environmental and economic accounting approved by the UN, and also by e.g., the EU, the OECD and the IMF (United Nations et al. 2003).

In Finland, time-series on the total material requirements have been presented in reports by Mäenpää et al. (2000) and Mäenpää and Juutinen (2002). Since then, the time-series have been maintained, updated and made compatible with the new EU standards at the Thule Institute.

The total material requirements per person have also been included in Finland's indicators for sustainable development (Rosenström and Palosaari 2000, 70).

Total Material Requirement (TMR) measures the total amount of the natural resources utilised by the economy in the commensurable unit of tons. The total material requirement includes the following main categories:

- *Domestic direct material inputs* taken from the domestic nature into further processing in the economy
- *Domestic hidden flows*, i.e., transports or transformations of natural materials caused by the intake of direct inputs or construction
- *Imported direct material inputs*, i.e., the amount of materials that enter the economy through imports from abroad
- *Hidden flows of imports*, i.e., the direct inputs and hidden flows of materials used abroad to produce imported products, which are not included in the mass of the imported products themselves.

The domestic direct material inputs and the imported material inputs, together, constitute the flow of materials actually passing through the economy. The direct inputs together with the domestic hidden flows constitute the amount of materials that forms the basis for the environmental burdens occurring domestically. The hidden flows of imports indicate the additional global ecological rucksack connected to the material flow of the economy.

On the regional level, it is laborious to construct time-series for total material requirement, because imports into the region are not monitored, as in national statistics, and they need to be investigated separately. Because of this, the present study has settled for studying the material flows of Kymenlaakso in one year, the year 2000.

4.2 The physical input-output table of product flows

In the present study a physical input-output table of product flows, using tons as a measure, was constructed for Kymenlaakso in accordance with the input-output table measured in euro. The compilation methods of the physical input-output table are presented in more detail in Annex 2.

The physical input-output table for Kymenlaakso is presented in Table 9 and a more detailed use table for imports, in Table 10.

In the physical input-output table, the sums of rows and the sums of columns for the industries are not equal, because the product flows do not encompass all the material flows included in production: on the output side, missing flows include wastes and emissions to air and water, and on the input side, e.g., oxygen and water, which are combined with the material flows, for example, in fuel combustion and in many chemical processes. Furthermore, the product flow tables do not include the natural raw materials obtained directly by the industries.

The physical input-output tables are used in the present study to estimate the amount of natural resources – from the region itself and included in imports – that are used by the industries in Kymenlaakso. At the same time, the tables provide an overview of the relative sizes of the product flow masses in the regional economy.

Taulukko 9. Physical input-output table for material flows in Kymenlaakso in 2000, 1000 tons

	INDUSTRIES														FINAL USE					Total
INDUSTRIES		1	2	3	4	5	6	7	8	9	10	11	12	13	Total	Private consumption	Invest-ments	Exports Domestic	Exports Abroad	Total	
1	Agriculture, hunting & fishing	321	0	0	140	0	0	0	0	0	0	0	3	0	**463**	12	0	88	0	**99**	**563**
2	Forestry and logging	12	0	0	0	1 163	0	0	0	4	0	0	2	0	**1 181**	138	0	286	0	**423**	**1 604**
3	Mining and quarrying	1	0	12	0	72	0	0	14	5	2 445	3	5	2	**2 558**	1	0	42	23	**66**	**2 624**
4	Manufacture of food products	1	0	0	22	68	2	0	3	0	0	0	7	0	**102**	46	0	252	47	**345**	**447**
5	Forest industry	0	0	0	0	2 336	1	0	3	1	61	0	1	1	**2 403**	9	0	379	3 129	**3 517**	**5 920**
6	Chemical industry	0	0	0	3	267	79	2	30	0	0	0	0	0	**382**	3	0	241	429	**673**	**1 055**
7	Metal industry	0	0	0	0	0	0	0	3	0	13	0	0	0	**17**	0	5	9	10	**24**	**41**
8	Other manufacturing	0	0	0	0	0	0	3	190	0	232	0	1	0	**426**	2	0	61	130	**194**	**620**
9	Electricity, gas & water supply	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	**0**	**0**
10	Construction	0	0	0	0	0	0	0	0	0	0	51	0	0	**51**	0	4 313	0	0	**4 313**	**4 364**
11	Transport and communication	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	**0**	**0**
12	Other services	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	22	0	0	0	**22**	**22**
13	Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	**0**	**0**
Use of products from the region		334	0	12	165	3 906	82	5	242	10	2 752	54	20	3	**7 584**	232	4 318	1 357	3 768	**9 676**	**17 260**
	Imports from Finland	16	1	4	109	6 559	176	26	187	5	1 255	29	64	18	**8 448**	113	5	0	0	**118**	**8 567**
	Imports from abroad	43	2	5	151	2 033	342	19	150	253	373	48	56	7	**3 482**	82	62	0	0	**144**	**3 626**
Total of products		394	3	21	424	12 498	600	50	578	268	4 380	131	140	28	**19 515**	428	4 385	1 357	3 768	**9 938**	**29 453**

Table 10. Physical use table of imports into Kymenlaakso 2000, 1000 tons, imports from Finland and abroad combined

		INDUSTRIES														FINAL USE					Total
INDUSTRIES		1	2	3	4	5	6	7	8	9	10	11	12	13	**Total**	Private consumption	Invest-ments	Exports Domestic	Exports Abroad	**Total**	
1	Agriculture, hunting & fishing	1	0	0	75	0	0	0	0	0	0	0	2	0	**78**	19	0	0	0	**19**	**97**
2	Forestry and logging	0	0	0	0	5 417	0	0	0	0	0	0	0	0	**5 417**	0	0	0	0	**0**	**5 417**
3	Mining and quarrying	26	0	7	9	992	164	8	240	253	1 345	1	6	0	**3 050**	1	0	0	0	**1**	**3 050**
4	Manufacture of food products	0	0	0	172	35	25	0	1	0	0	0	12	0	**246**	53	0	0	0	**53**	**298**
5	Forest industry	0	0	0	0	2 059	0	0	28	4	20	0	3	1	**2 115**	1	0	0	0	**1**	**2 117**
6	Chemical industry	33	3	2	4	80	214	3	3	1	34	73	95	24	**568**	110	0	0	0	**110**	**678**
7	Metal industry	0	0	0	0	0	0	32	2	0	89	3	1	0	**128**	7	16	0	0	**23**	**151**
8	Other manufacturing	0	0	0	0	9	115	1	64	0	138	0	1	0	**328**	6	0	0	0	**6**	**334**
9	Electricity, gas & water supply	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	**0**	**0**
10	Construction	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**	0	51	0	0	**51**	**51**
11	Transport and communication	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	**0**	**0**
12	Other services	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	**0**	**0**
13	Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	**0**	**0**
	Total	60	3	8	260	8 592	518	44	337	258	1 628	78	120	25	**11 930**	195	67	0	0	**263**	**12 193**

4.3 Total material requirement

Table 11 presents an estimate of the total material requirement of Kymenlaakso and its breakdown by industrial sector.

Table 11. Total material requirement of Kymenlaakso in 2000, 1000 tons

		From nature in the region		Imports	
		Direct inputs	Hidden flows	Direct inputs	Hidden flows
1	Agriculture, hunting and fishing	480	0	60	199
2	Forestry and logging	1 604	722	3	1
3	Mining and quarrying	2 624	453	8	11
4	Manufacture of food products	0	0	260	384
5	Forest industry	0	0	8 592	6 077
6	Chemical industry	0	0	518	1 633
7	Metal industry	0	0	44	184
8	Other manufacturing	0	0	337	457
9	Electricity, gas and water supply	0	0	258	344
10	Construction	697	1 598	1 628	2 994
11	Transport and communication	0	0	78	67
12	Other services	0	0	120	233
13	Public administration	0	0	25	37
	Households	0	0	195	948
	Investments	0	0	67	149
	Exports	0	0	0	0
	Yhteensä	5 406	2 773	12 193	13 719

The direct inputs into the economy of Kymenlaakso from its own natural environment consist of the following items. The direct inputs of agriculture, hunting and fishing consist of the total crop of cultivated plants, which also includes grasses for fodder and pastures, as well as of the fish catch in the region, which also includes an estimate of the recreational fishing catch. The amount of natural produce gathered such as berries and mushrooms is not, however, included in the estimate. The direct inputs of forestry include timber logged from the forests, and also firewood and wood chips. Mining and quarrying includes the building stones, gravel, peat and soil resources extracted. The direct inputs of construction include the soil resources extracted on the construction site and used in the structures constructed. The hidden flows include the logging waste left by forestry operations, topsoils removed and mine tailings due to mining and quarrying, and surplus soils removed from the construction site in construction operations.

The direct inputs of imports consist of the imported products. The hidden flows of imports are estimations of the amounts of materials required for the production of the imported products, which are not included in the products themselves. The hidden flows of imports were calculated in connection with the construction of the physical input-output tables, using a detailed breakdown into four hundred imported products. The hidden flows of individual products were calculated using coefficients for the hidden flows obtained from the Wuppertal Institute, which were partly modified to fit the special characteristics of the Finnish imports in the project *Total material requirement in Finland* (Mäenpää et al. 2000). Even though there are considerable uncertainties related to the coefficients, they have the advantage of being consistent with the coefficients used on the level of Finland as a whole, and on the international level.

When interpreting Table 11, it is important to note that it does not describe the total material requirement of individual industries, but how the total material requirement is channeled into the economy through the different sectors. When calculating the total material requirement of an individual industry, we also need to include the natural resource content of the intermediate products from within the region used by the industry. This issue will be considered later in the report.

Figure 11 presents a comparison of the total material requirement of Kymenlaakso with that of the whole of Finland. The per capita total material requirement in Finland as a whole is close on a hundred tons, 97 tons, whereas in Kymenlaakso it is 181 tons. There are significant differences in the structure of material use. In Kymenlaakso, the share of imports of direct inputs is 70 %, whereas in the whole of Finland, the share of imports is less than one-fourth. On the other hand, the hidden flows of imports in Kymenlaakso are only slightly greater than the direct import flows, whereas in Finland as a whole, the hidden flows of imports are three times as large as the direct flows.

The high material intensity in Kymenlaakso is due to the export-oriented forest industry, which processes imported wood into paper for exports. On the other hand, the hidden flows of the imported timber are smaller per product ton than those of the more highly processed intermediary products.

The input-output model can be used to calculate the breakdown of material requirement by final use categories using the method presented in section 3.3. Figure 12 presents the results of this calculation in terms of per capita use and compared with the respective breakdown for Finland as a whole. The figure indicates that the high material intensity of Kymenlaakso is almost solely due to exports. Exports make up more than two-thirds of the material use in Kymenlaakso, whereas their share in the whole of Finland is slightly more than half. Private and public consumption use fewer natural resources in Kymenlaakso than elsewhere in Finland. In contrast, slightly more natural resources are used for investments in Kymenlaakso than on an average in Finland.

Figure 13 presents the total material intensities by industry per unit of output calculated using the input-output model. In mining and quarrying, in which gravel is the major product, the material intensity obtained is exceptionally high. The

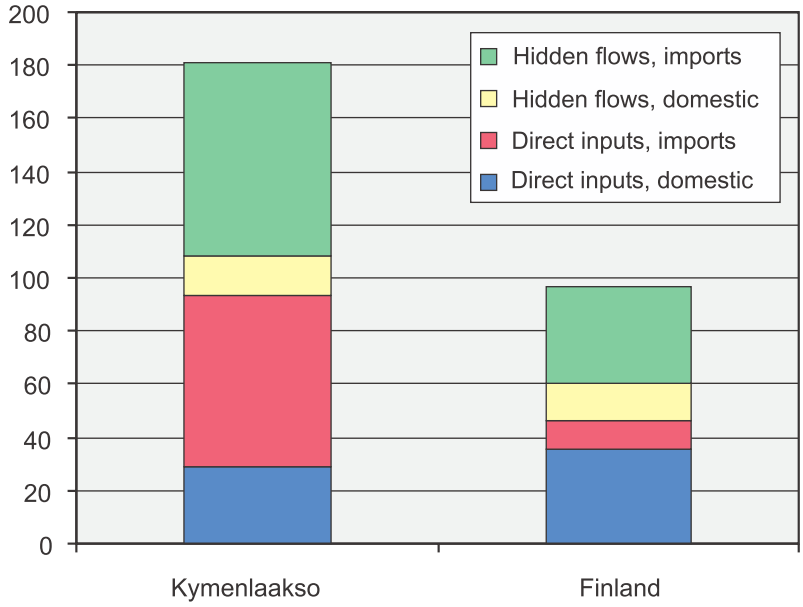


Figure 11. Total material requirement per capita in Kymenlaakso and in Finland in 2000, tons per capita.

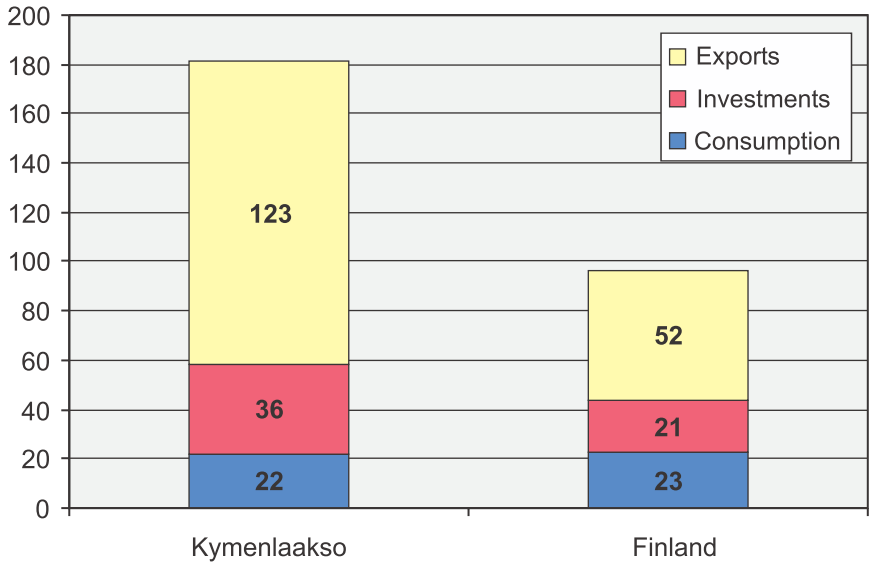


Figure 12. Total material requirement per capita, by main final use category in Kymenlaakso and in Finland in 2000, tons per capita.

intensities are also high in forestry and construction. It is interesting to note that in the service industries, mainly due to fuel used for heating the facilities, the products in many industries have a higher material intensity than in the industries in the fields of electronics and engineering.

On the level of the European Union as a whole, the total material requirement has not been estimated for the year 2000. Instead, time-series for direct material inputs up to the year 2000 have been estimated by EU country (Eurostat 2002). Figure 14 presents a comparison of the material intensities of Kymenlaakso and Finland with that of the EU-15 using two indicators: in relation to gross domestic product, on the one hand, and in relation to area, on the other.

In relation to gross domestic product, the material intensity of Finland is twice as high as the European average, and in comparison among countries, it is the highest in the European Union. The material intensity of Kymenlaakso is four times as high as the EU average. Because per capita GDP does not vary very much within the EU-15, the differences in material intensity per GDP also provide a good illustration of the differences in material intensities on a per capita basis.

However, when considering the potential environmental burdens of the material flows, it is also useful to compare the size of the material flow with the area of the region, which is presented in part (b) of Figure 14. When making comparisons on the basis of area, the material intensity of Finland is only one-third of the intensity of the entire EU, and it is the second lowest among the individual EU countries. The intensity for Kymenlaakso, however, is still 40 % higher than the EU average in relation to area.

The comparison in relation to area also explains the unique character of Finland and Kymenlaakso among the European countries. Due to the low population density in Finland, the economy is surrounded by relatively abundant natural resources. Thus, compared with the other countries in Europe, the Finnish economy is more specialized in extracting natural resources and exporting products based on them to the rest of Europe. This characteristic still remains strong today, even though the electronics industry, which is unrelated to this phenomenon, has been the engine of economic growth for a number of years already. Kymenlaakso, in turn, is characteristically an export gateway from the raw material sources to the markets, and thus a central location for industries processing raw materials. This gateway characteristic has also increased the material intensity of Kymenlaakso, even in relation to area, to a high level.

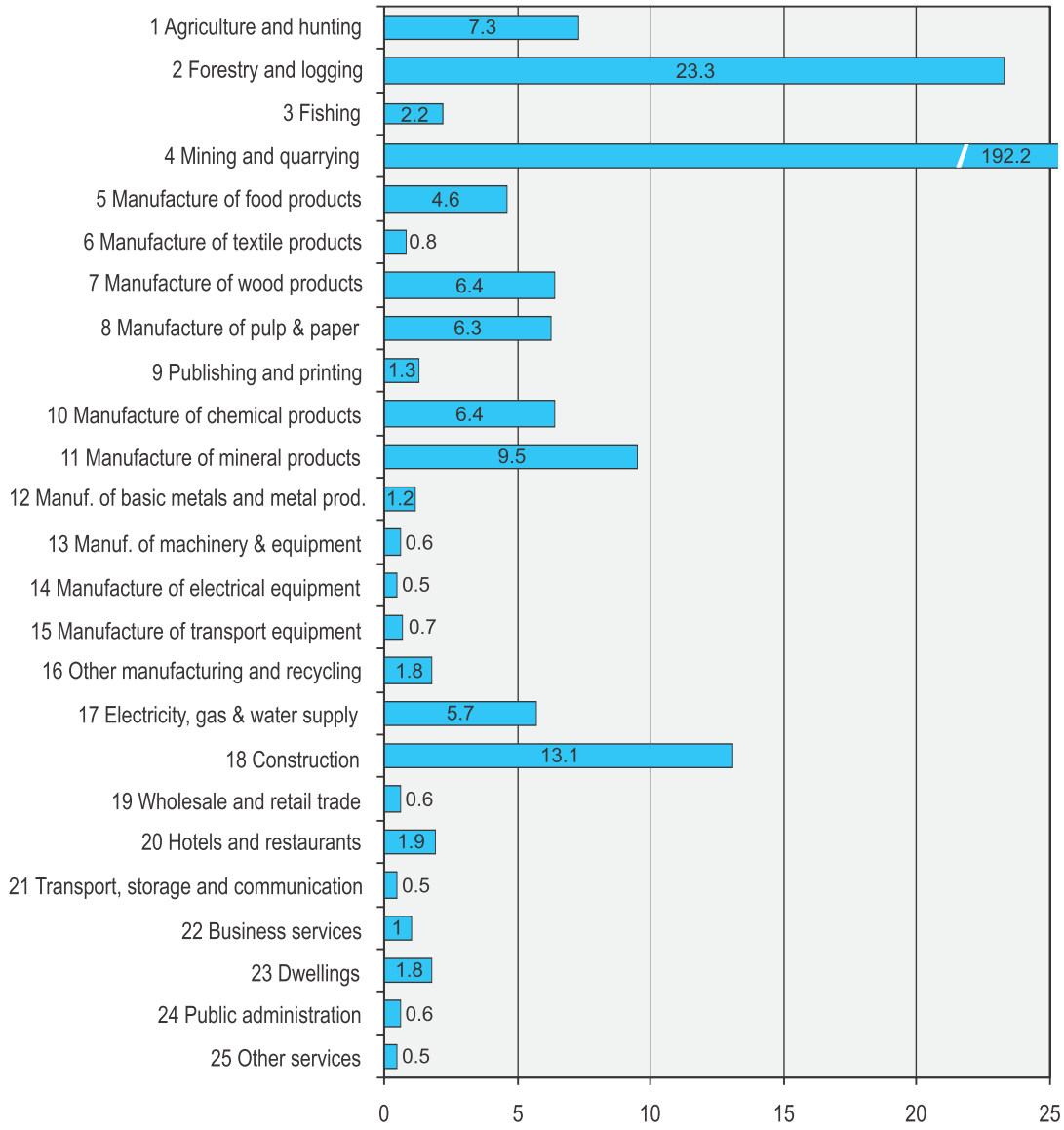


Figure 13. Total material requirement of industries in Kymenlaakso, kilograms per output of one euro in 2000. (NB: The bar for mining and quarrying is interrupted).

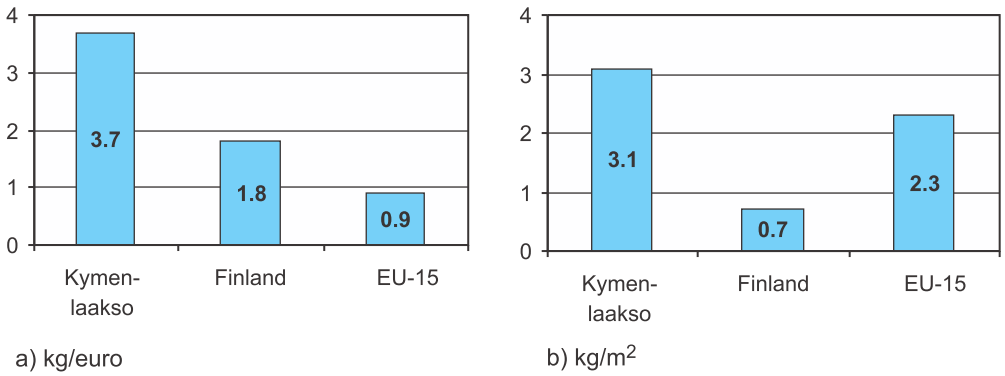


Figure 14. Direct material input of Kymenlaakso, Finland and the European Union a) per gross domestic product and b) per area, in 2000.

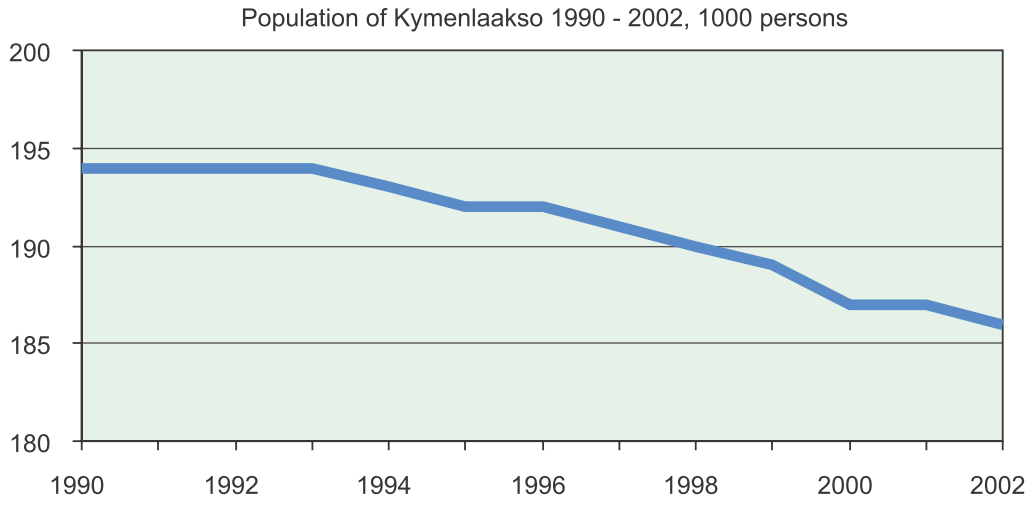
5 Indicators for the economy and material flows

On the basis of the analysis conducted in the previous chapters, the indicators for the economy and material flows were selected for Kymenlaakso. There are four themes: one for general background factors, two for the economy and one for material flows. Some of the indicators describe the development of the region over time, while others are especially suitable for making comparisons between regions.

Theme	Link to eco-efficiency	Indicators
Background factors	Provide a sense of proportion for comparisons among regions.	Total area of the region Average population Population density
Economic growth	Both value added and gross domestic product can be used as the numerator denoting the economic values in eco-efficiency indicators for the entire economy. Indices calculated per capita and per area facilitate comparisons among regions.	Value added at constant prices Gross domestic product at market prices Gross domestic product per resident Gross domestic product per area
Economic welfare of the population	Can be used as the numerator in eco-efficiency indicators when the measurement of economic benefits focuses on the economic welfare of the population rather than on economic activity as such.	Real disposable household income per person
Material flows	Material flows entering the economy form the overall basis of the environmental burdens of the economy at the origin of the material flows, in the intake of natural resources, and at their end, as emissions and wastes.	Total material requirement (TMR) Direct material inputs (DMI) Total material consumption (TMC)

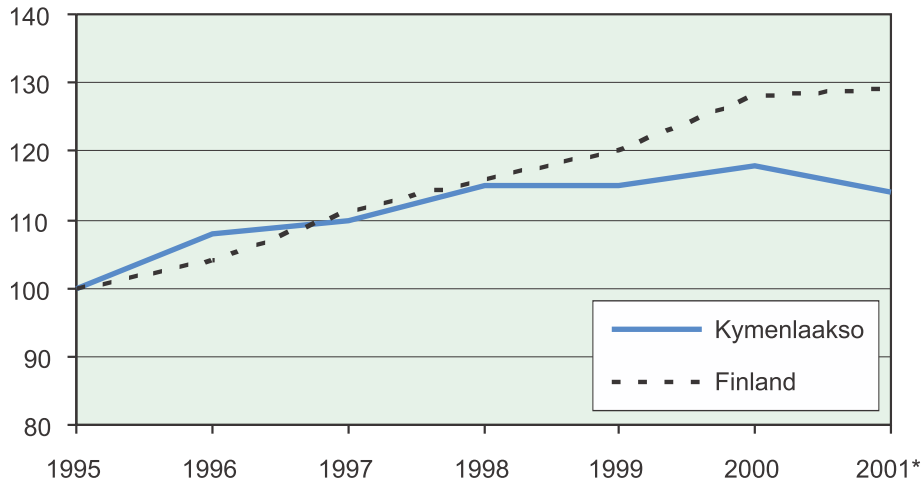
Theme:	Background factors
Indicators:	Total area of the region (km^2) Average population Population density (persons/km^2)
Grounds for selection:	The area of the region is an important background factor when comparing the damage to the environment of the quantity of environmental burdens in different regions. Thus, for example, when comparing the levels of emission or natural resource use among different regions or regional levels (regions, nations, the EU), indicators calculated per area – alongside those per population and GDP - provide an important additional perspective. The size of the population is also a basic measure when comparing regions. Per capita indicators indicate the responsibility of an individual person for burdening factors. Population density is a common explanatory factor for the severity of environmental burdens.
Background documents:	Finnish statistical yearbook 2003. Statistics Finland.
Link to eco-efficiency:	Provide a sense of proportion for comparisons between regions.
Decision applications:	General background factors when making comparisons among regions.
Interpretation of the table and the figure:	Kymenlaakso is a relatively densely populated area in Finland, yet its population density is only one-third of the EU average (in 2000). The population in Kymenlaakso is continually on a slight decline; in the period 1995 – 2002, the population has decreased by an annual average of 800 persons.
Sources:	Statistics Finland
Updating frequency:	Annually

	Average population 1000 persons	Total area km^2	Population density persons/km^2
Kymenlaakso	188	5 588	34
Finland	5 176	338 150	15
EU-15	378 914	3 242 690	117

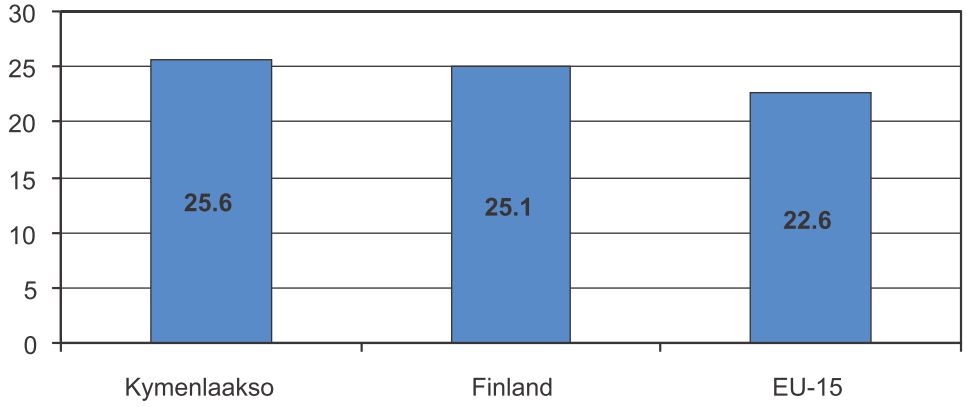


Theme:	Economic growth
Indicators:	Value added at constant prices Gross domestic product per resident (comparisons of regions) Gross domestic product per area (comparisons of regions)
Grounds for selection:	Value added (VA) measures the new value created by economic activity. Value added can be measured both on the industry level and on the level of the entire regional economy. Gross domestic product at market prices (GDP) is the most commonly used measure of the economic activity of the entire economy. It is obtained by adding the product taxes to the value added, and subtracting the product subsidies. Value added or GDP at constant prices, in which the impact of price changes has been eliminated, can be used to describe the volume changes in economic activities over time, i.e., economic growth. Per capita gross domestic product is a commonly used measure when making comparisons among regions. The growth of the gross domestic product influences many factors of welfare, but it is not a direct measure of welfare.
Background documents:	Statistics Finland 2003. Regional Accounts 1995 - 2001*. Production and employment - Household regional consumption. SVT National Accounts 2003:12. Helsinki. Statistics Finland 2003. National Accounts 1995 - 2001*, Revised tables. SVT National Accounts 2003:2. Helsinki. Eurostat 1996. European System of National Accounts, ESA 1995. Statistical Office of the European Communities, Luxembourg.
Link to eco-efficiency:	Are frequently used as the numerator in eco-efficiency indicators to denote the economic value produced.
Decision applications:	Commonly-used criterion when considering the impact of a course of action on the competitiveness of the region.
Interpretation of the figures:	The economy of Kymenlaakso has continued to grow with the exception of the latest year. The growth has been slower than in Finland as a whole, however. The domestic product per resident in 2000 was slightly higher than the Finnish average, and considerably higher than the EU average. The domestic product per area in Kymenlaakso was more than twice the Finnish average, but only one-third of the EU average. If we were to assume that the average eco-efficiency of the economy, i.e., environmental burden/GDP, was equal on all regional levels, we might conclude that the environmental burdens in Kymenlaakso are twice as severe as the average for Finland as a whole, but only one-third of the EU average.
Sources:	Statistics Finland: Regional Accounts, National Accounts
Updating frequency:	Annually

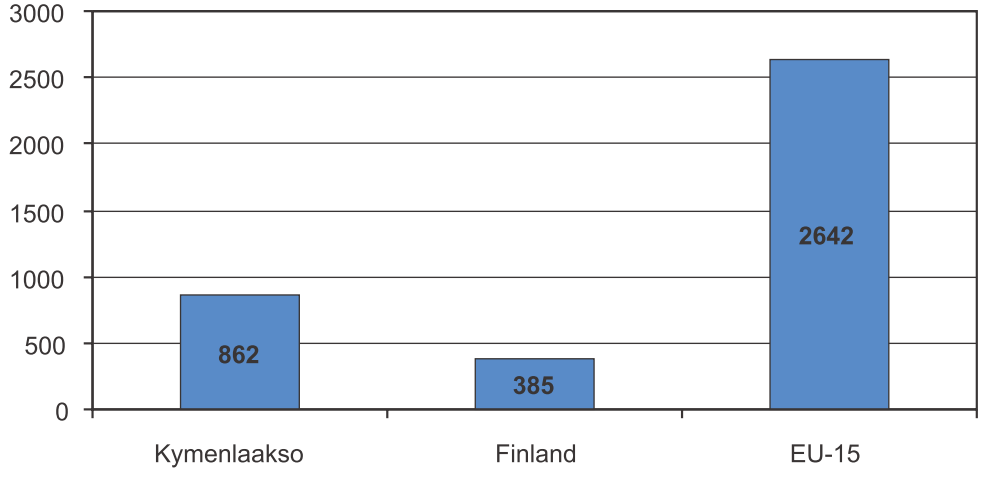
Volume growth of value added in Kymenlaakso and in Finland, 1995 = 100



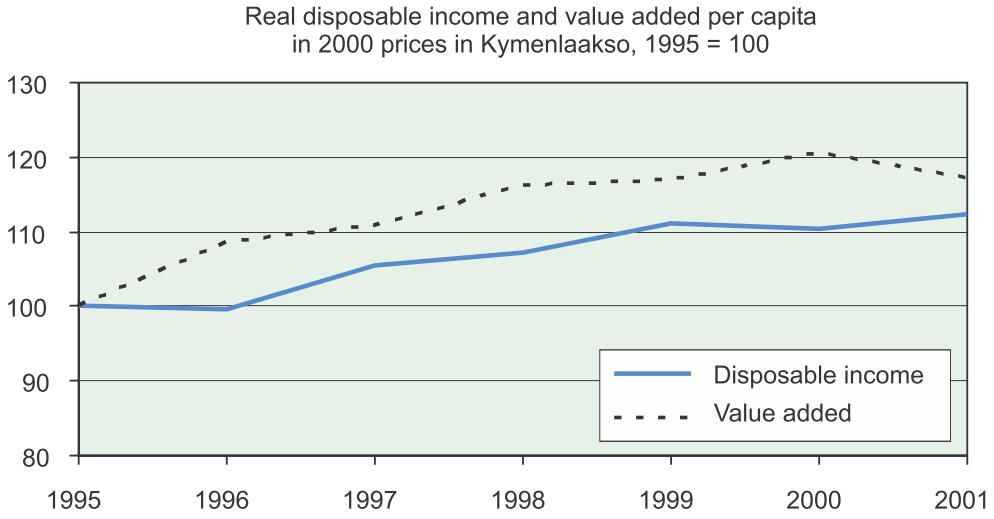
Gross domestic product per capita in Kymenlaakso, Finland and the EU in 2000, 1000 euro



Gross domestic product per total area in Kymenlaakso, Finland and the EU in 2000, 1000 euro/km^2

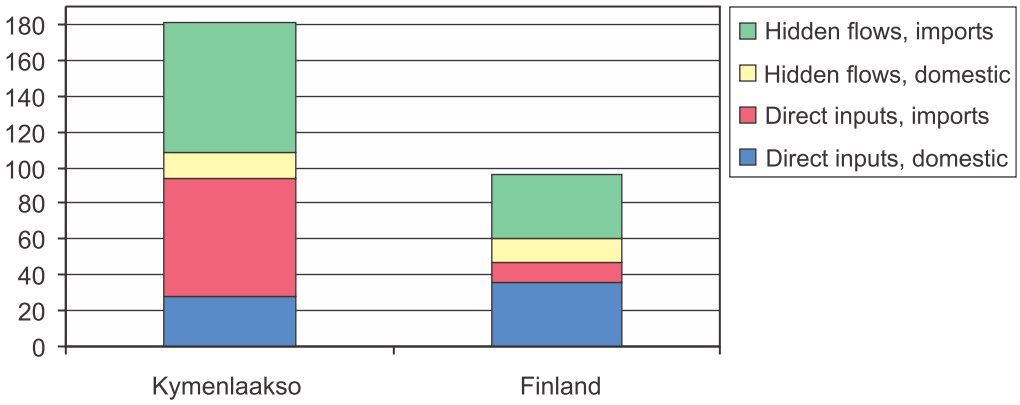


Theme:	Economic welfare of the population
Indicators:	Real disposable household income per person
Grounds for selection:	In the Regional Accounts, disposable household income is the best available measure to the economic welfare (or standard of living) of the population in the region. In time-series analyses, real disposable income is obtained by dividing disposable income by the consumer price index.
Background documents:	Statistics Finland 2003. Regional Accounts 1995 - 2001*. Production and employment - Household regional consumption. SVT National Accounts 2003:12. Helsinki. Statistics Finland 2003. National Accounts 1995-2001*, Revised tables. SVT National Accounts 2003:2. Helsinki. Eurostat 1996. European System of National Accounts, ESA 1995. Statistical Office of the European Communities, Luxembourg.
Link to eco-efficiency:	Can be used as the numerator in eco-efficiency indicators in cases when the emphasis in measuring economic benefits is on the welfare of the population rather than on the level of economic activity as such.
Decision applications:	Developing welfare policy in the region.
Interpretation of the figure:	The real household income in Kymenlaakso has grown fairly smoothly, but slightly more slowly than the value added of the economy. The development of real income has been independent of the fluctuations in production levels.
Sources:	Statistics Finland: Regional Accounts
Updating frequency	Annually

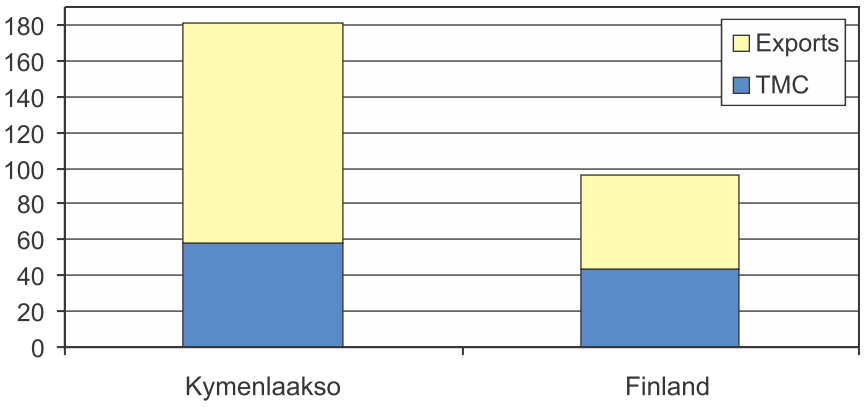


Theme:	**Material flows**
Indicators:	Total material requirement (TMR) per person Direct material input (DMI) per person Total material consumption (TMC) per person DMI/GDP, DMI/area
Grounds for selection:	The material flow through the economy forms the general basis that gives rise to the different kinds of environmental burdens of the economy. The direct material input (DMI) entering the economy from within the region and from outside it forms the basis for the direct environmental burden of the economy. When the natural materials used indirectly for the production of the direct inputs produced within and outside the area are added to the direct inputs, we obtain the total material requirement (TMR) of the region. The total material requirement (TMR) forms the basis for the environmental burdens within and outside the region caused by the regional economy. When subtracting the total material requirement of exported products from the total material requirement, we obtain the material requirement for consumption and capital formation within the region, i.e., the total material consumption (TMC) of the region.
Background documents:	European Commission 2001. Economy-wide material flow accounts and derived indicators. A methodological guide. Office for Official Publications of the European Communities, Luxembourg. Eurostat 2001. Material use indicators for European Union, 1980 - 1997. Eurostat working paper No 2/2001/B2. Eurostat 2002. Material use in the European Union 1980 - 2000: Indicators and analysis. Eurostat working papers and studies. Mäenpää, I., Juutinen, A., Puustinen, K., Rintala, J., Risku-Norja, H., Veijalainen, S. & Viitanen, M. 2000. Total material requirement in Finland. Ministry of the Environment, Finnish Environment 428, Helsinki. (In Finnish) Mäenpää, I. & Juutinen, A. 2002. Resource use in a small open economy: the case of Finland. Journal of Industrial Ecology 5(3): 33 - 48.
Link to eco-efficiency:	General factors of eco-efficiency.
Decision applications:	Environmental and industrial policy programmes.
Interpretation of the figures:	The per capita total material requirement in Kymenlaakso is almost twice as large as that of Finland as a whole. The share of imported inputs is especially large. However, about two-thirds of the total material requirement are used for exports, and thus the total material consumption for final use within the region itself is only slightly higher than the Finnish average.
Sources:	Calculations by the Thule Institute
Updating frequency:	Every five years

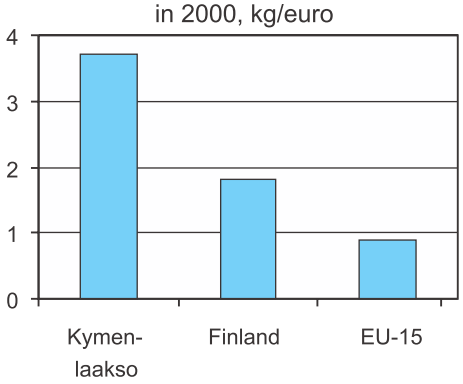
Total material requirement per capita in 2000, tons/capita



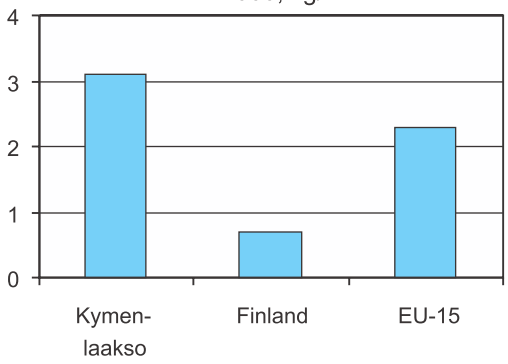
Total material requirement and total material consumption (TMC) per capita by final product use in 2000, tons/capita



Direct material inputs/GDP in 2000, kg/euro



Direct material inputs/area in 2000, kg/m^2



Acknowledgements

The support given by the LIFE financial instrument of the European Community (LIFE-Environment) and the Finnish Ministry of the Environment to the ECOREG project is gratefully acknowledged. The guidance offered by the ECOREG steering group in the course of the project has been crucial. We would also like to sincerely thank the other actors from Kymenlaakso, who have provided us with important feedback on our interim findings at two workshops arranged in Kymenlaakso. Finally, we would like to thank the external examiners of our report manuscript, Executive Director Tapio Välinoro and Environmental Planner Lasse Liljeqvist from the Regional Council of Kymenlaakso, for their constructive comments.

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Annex 1. Breakdown of economic activities and their relations to the European industrial classification NACE (Rev 1.1)

No	Industry	NACE codes
1	Agriculture and hunting	01
2	Forestry and logging	02
3	Fishing	05
4	Mining and quarrying	10 – 14
5	Manufacture of food products	15 – 16
6	Manufacture of textile products	17 – 19
7	Manufacture of wood products	20
8	Manufacture of pulp & paper	21
9	Publishing and printing	22
10	Manufacture of chemical products	23 – 25
11	Manufacture of mineral products	26
12	Manufacture of basic metals & metal prod.	27 – 28
13	Manufacture of machinery & equipment	29
14	Manufacture of electrical equipment	30 – 33
15	Manufacture of transport equipment	34 – 35
16	Other manufacturing & recycling	36 – 37
17	Electricity, gas & water supply	40 – 41
18	Construction	45
19	Wholesale and retail trade	50 – 52
20	Hotels and restaurants	55
21	Transport, storage and communication	60 – 64
22	Business services	65 - 70 not 7021
23	Dwellings	7021
24	Public administration	75
25	Other services	80 – 95

	Aggregated industrial breakdown	
1	Agriculture, hunting & fishing	1, 3
2	Forestry and logging	2
3	Mining and quarrying	4
4	Manufacture of food products	5
5	Forest industry	7, 8, 9
6	Chemical industry	10
7	Metal industry	12-15
8	Other manufacturing	6, 11, 16
9	Electricity, gas & water supply	17
10	Construction	18
11	Transport and communication	21
12	Other services	19, 20, 22, 23, 25
13	Public administration	24

Annex 2. Procedures for compiling the input-output tables for Kymenlaakso

1 Monetary input-output tables

The basis for the compilation of the monetary tables for Kymenlaakso were the nation-wide supply and use tables on the level of 59 industries and products from the System of National Accounts by Statistics Finland (2003), and the industry-level production accounts with a detailed breakdown by industry obtained from Statistics Finland from the system of the Regional Accounts (Statistics Finland 2004, 2000). First, the nation-wide supply and use tables were adjusted to the boundaries of the Regional Accounts for Kymenlaakso. The exports from Kymenlaakso by industry were obtained from the regional-level structural statistics for industry and construction on the Internet site of Statistics Finland, the STATFIN information service. The boundary for household consumption was obtained by using the disposable household income from the Regional Accounts. The level of gross capital formation was obtained from the Regional Accounts and the structural industry statistics.

The estimate thus obtained was refined using information from different sources, especially concerning important industries in Kymenlaakso. For industry, the commodity and fuel statistics for Kymenlaakso were obtained from the Industry Statistics by Statistics Finland.

Finally, the supply and use tables were balanced with the import of products. The use of imported products was separated from the use of products from within the region using the import share method. The final input-output tables were constructed by combining the supply and use tables. In this connection, the industries were combined into 25 industries.

2 The physical input-output tables

The physical input-output tables for product flows in tons were constructed by first compiling the supply and use tables using the physical amount data in the commodity and fuel statistics for Kymenlaakso from the Industry Statistics using a very detailed breakdown into almost 500 products. All data on amounts were converted into tons.

The supply data for agricultural and forestry products were obtained from the data collected in sub-project 1 (environment) of the ECOREG project, and the data on mining and quarrying from the statistics on extractable land resources (Rintala 2002). The physical input structures of construction, services, household consumption expenditure and capital formation were obtained from the nation-wide physical use table for 1999 of the FINPIOT99 project by the Thule Institute, and adjusted for Kymenlaakso using the monetary use tables. However, the data on fuel use for the non-industrial economic branches were obtained, for traffic and agricultural fuel use, from the data estimated in the ECOREG sub-project 1, and for the other service industries, from the data on fuel use by dwellings and service industries from the Energy Statistics by Statistics Finland, using the nation-wide and regional building stock data obtained from the STATFIN service.

Finally, imports and exports for the supply and use tables were derived by balancing supply and use on a detailed level of 500 products. If the supply of a product is greater than its use, then the surplus is exported, and conversely, if the

demand is greater than the supply, then the deficit is imported. For some products, cross trade was also assumed in order to gain compatible proportions with the monetary table.

Finally, the physical supply and use tables were aggregated to a level corresponding to that of the monetary tables, and exports and imports were divided among the rest of Finland and outside Finland with the use of the monetary tables.

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ECOREG, sub-project 1 (environment)

FINPIOT99 –project, Thule Institute

Documentation page

Publisher	Finnish Environment Institute (SYKE)	Date: May 2004
Author(s)	Ilmo Mäenpää and Esa Mänty	
Title of publication	Economic and material flow indicators for the Kymenlaakso region. Documentation report 2 of the ECOREG project	
Parts of publication/ other project publications	This publication is also available in the Internet www.environment.fi/publications	
Abstract	The report deals with the specific characteristics of the economy of the Kymenlaakso region, compared with the average Finland and the European Union (EU-15). The development of the economy during 1995 – 2001 is also addressed. The structural features of Kymenlaakso's economy are analysed by an input-output table constructed for the year 2000. The material flows of Kymenlaakso in 2000 have been estimated and analysed by a physical input-output table. On the basis of the analyses made, the central variables have been selected as the economic and material flow indicators for the Kymenlaakso region.	
Keywords	Regional Accounts, input-output, material flow accounting, total material requirement	
Publication series and number	The Finnish Environment 698en	
Theme of publication	Environmental protection	
Project name and number, if any	ECOREG project (LIFE02 ENV/FIN/000331)	
Financier/ commissioner	EU LIFE-Environment Programme, Finnish Ministry of the Environment	
Project organization	Finnish Environment Institute, Southeast Finland Regional Environment Centre, Regional Council of Kymenlaakso, Thule Institute of the University of Oulu	
	ISSN: 1238-7312	ISBN: 952-11-1696-X 952-11-1697-8 (PDF)
	No. of pages: 46	Language: English
	Restrictions: Public	Price
For sale at/ distributor	Edita Publishig Ltd., P.O. Box 800, FIN-00043 Edita Finland, Phone +358 20 450 00 Mail orders: Phone +358 20 450 05, telefax +358 20 450 2380 Internet: www.edita.fi/netmarket	
Financier of publication	Finnish Environment Institute, P.O. Box 140, FIN-00251 Helsinki, Finland	
Printing place and year	Dark Ltd., Vantaa 2004	

Kuvailulehti

Julkaisija	Julkaisuaika Suomen ympäristökeskus (SYKE) Toukokuu 2004
Tekijä(t)	Ilmo Mäenpää ja Esa Mänty
Julkaisun nimi	Kymenlaakson taloudelliset ja ainevirtaindikaattorit. ECOREG-hankkeen dokumentointiraportti 2
Julkaisun osat/ muut saman projektin tuottamat julkaisut	Julkaisu on saatavana myös internetistä www.environment.fi/publications
Tiivistelmä	Raportissa tarkastellaan Kymenlaakson talouden ominaispiirteitä verrattuna koko Suomeen ja Euroopan unioniin sekä Kymenlaakson talouden kehitystä ajanjaksolla 1995 – 2001. Talouden rakenneominaisuuksia analysoidaan hankkeessa laaditun Kymenlaakson panos-tuotostaulun avulla. Kymenlaakson ainevirtojen estimointi ja analyysi on tehty Kymenlaaksolle laaditulla fyysisten tuotevirtojen panos-tuotostaulukolla. Talouden ja sen ainevirtojen tarkastelun keskeiset kuvaajat on koottu indikaattorisarjaksi.
Asiasanat	Aluetilinpito, panos-tuotos, ainevirtatilinpito, luonnonvarojen kokonaiskäyttö
Julkaisusarjan nimi ja numero	Suomen ympäristö 698en
Julkaisun teema	Ympäristönsuojelu
Projektihankkeen nimi ja projektinumero	ECOREG-hanke (LIFE02 ENV/FIN/000331)
Rahoittaja/ toimeksiantaja	EY:n Life-Environment-ohjelma, ympäristöministeriö
Projektiryhmään kuuluvat organisaatiot	Suomen ympäristökeskus, Kaakkois-Suomen ympäristökeskus, Kymenlaakson Liitto, Oulun yliopiston Thule-instituutti
	ISSN 1238-7312 ISBN 952-11-1696-X 952-11-1697-8 (PDF)
	Sivuja 46 Kieli Englanti
	Luottamuksellisuus Julkinen Hinta
Julkaisun myynti/ jakaja	Edita Publishing Oy, PL 800, 00043 Edita, vaihde 020 450 00 Asiakaspalvelu: puh. 020 450 05, telefax 020 450 2380 Sähköposti: asiakaspalvelu@edita.fi, www.edita.fi/netmarket
Julkaisun kustantaja	Suomen ympäristökeskus, PL 140, 00251 Helsinki
Painopaikka ja -aika	Dark Oy, Vantaa 2004

Presentationsblad

Utgivare	Datum Finlands miljöcentral (SYKE) Maj 2004
Författare	Ilmo Mäenpää och Esa Mänty
Publikationens titel	Ekonomiska indikatorer och indikatorer för materialflöden för Kymmenedalen. ECOREG-projektets andra dokumentationsrapport
Publikationens delar/ andra publikationer inom samma projekt	Publikationen finns tillgänglig också på internet www.environment.fi/publications
Sammandrag	I rapporten jämförs särdragen för Kymmenedalens ekonomi med hela Finlands ekonomi och den Europeiska Unionen, dessutom presenteras den ekonomiska utvecklingen i Kymmenedalen under perioden 1995 - 2001. Ekonomins struktur analyseras med hjälp av den input-output-tabell för Kymmenedalen som utarbetats inom ramen för projektet. Estimeringen och analysen av materielflödena inom Kymmenedalen har gjorts med hjälp av fysiska input-output-tabeller över produktflöden. De centrala variabler som beskriver ekonomin och materialflödena har samlats till indikatorserier.
Nyckelord	Regionalräkenskaper, input-output analys, materialflödesräkenskaper, total materialkonsumtion
Publikationsserie och nummer	Miljön i Finland 698en
Publikationens tema	Miljövård
Projektets namn och nummer	ECOREG-projektet (LIFE02 ENV/FIN/000331)
Finansiär/ uppdragsgivare	EG:s Life-Environment-program, miljöministeriet
Organisationer i projektgruppen	Finlands miljöcentral, Sydöstra Finlands miljöcentral, Kymmenedalens landskapsstyrelse, Thule-institutet vid Uleåborgs universitet
	ISSN 1238-7312 ISBN 952-11-1696-X 952-11-1697-8 (PDF)
	Sidantal 46 Språk Engelska
	Offentlighet Offentlig Pris
Beställningar/ districution	Edita Publishing Ab, PB 800, FIN-00043 Edita, Finland, växel +358 20 450 00 Postförsäljningen: Telefon +358 20 450 05, telefax +358 20 450 2380 Internet: www.edita.fi/netmarket
Förläggare	Finlands miljöcentral, PB 140, FIN-00251 Helsingfors, Finland
Tryckeri/ tryckningsort och -år	Dark Ltd., Vantaa 2004

ENVIRONMENTAL PROTECTION

Economic and material flow indicators for the Kymenlaakso region
Documentation report 2 of the ECOREG project

The Finnish Environment Institute, the Southeast Finland Regional Environment Centre, the Regional Council of Kymenlaakso and the Thule Institute of the University of Oulu are conducting (September 1, 2002 – December 31, 2004) a Life-Environment project called "The Eco-efficiency of Regions – Case Kymenlaakso (ECOREG)" (LIFE02 ENV/FIN/000331).

In the second task of the project, regional monetary and physical input-output tables were constructed for the Kymenlaakso region for the year 2000, and economic and material flow indicators were designed on the basis of their results. The work is documented in this report.

Produced with the contribution of the LIFE financial instrument of the European Community.

The publication is available in the internet:
www.environment.fi/publications

ISBN 952-11-1696-X
ISBN 952-11-1697-8 (PDF)
ISSN 1238-7312

Edita Publishing Ltd
P.O.Box 800, FIN-00043 EDITA, Finland,
Phone + 358 20 450 00.
Mail orders:
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EDITA-BOOKSHOP IN HELSINKI
Annankatu 44, phone 020 450 2566

ISBN 952-11-1696-X
9 789521 116971