Environmental Assessment of Shopping, Cooking and Eating scenarios
Hungary
Bacground Report
SusHouse Project

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SusHouse

Strategies towards the Sustainable Household

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Contents

1 Introduction

The environmental assessment of the "Strategies towards the sustainable household" project has carried out by a simplified qualitative LCA . This part of the research presents the environmental impact of the scenarios for the future household in 2050 and compares with the current situation of nutrition (Shopping, Cooking and Eating; further SCE) in the nineties.

2 Set up of the assessment

2.1 Function definition and functional unit

Definition of the **SusHouse Shopping, Cooking and Eating function means** from point of view of the household the following:

- obtaining food (from take-away and in restaurants and, through *shopping*, from supermarkets and special food shops and markets; this will also include food obtained from household gardens and semi-subsistence farms);
- *storing* bought food in cupboards and refrigerators;
- preparing and *cooking* the food using a range of kitchen equipment;
- *eating* the food itself (at home or eating out) and
- *clearing away* all the packaging and food scraps, and washing up

The **functional unit** has been defined as the eaten nutrition material (foods) quantity {kg} for one average Hungarian household per year.

The number of persons in average Hungarian household: 2.5, number of household 4011 x 10^3 (Each calculation will be done by this statistical average.)

2.2 System to be included

The focus of the scenarios of the SusHouse project concerning the SCE function. The core of SCE function is defined all activities of the household *directly* associated with the purchase, storage, cooking, eating and clearing up of food and drink, *"from supermarket door to home waste disposal".* Beside assessment of the core of this function it is necessary to assess the environmental impacts of the broader system of the food chain. Carried out the LCA analysis from the cradle to crave. The system includes the food production (agriculture and food processing, home growing food, import foods, usage of chemicals pesticides, fertilisers) and production of consumables and durable. Furthermore the investigated system includes the phase of the after consumption stage as well, e.g. waste collection, treatment etc.

The function Shopping Cooking Eating can be divided into the following phases and elements:

Table 1 Overview of function phases and elements

	Phase elements in the SCE function	Sub-phases and sub-elements
Production	This phase is the cradle of SCE assessment	- Food production in the agriculture; - Home growing of foods; - Food production and processing; - Production and use of consumables and durable (e.g. chemicals, pesticides, etc.);
Consumption Acquisition/Use	This phase includes the different elements until the foods reach the households.	- Shopping of foods; - Shopping consumables & durable; - Travel and transportation;
	Includes the specific activities related to the consumption of foods.	- Preparation; - Storing; - Cooking; - Eating; - Cleaning up;
After consumption (Disposal)	This phase includes disposal activities as sorting of waste; Selective collecting, bringing glass to reuse, to make compost;	- Reuse; - Recycling; - Bio composting; - Landfill; - Incineration; - Travel for disposal;

2. 3 Process tree

Process tree of the Shopping, Cooking and Eating function looks as follow (based on system figure in function format, GREEN, K., 1998).

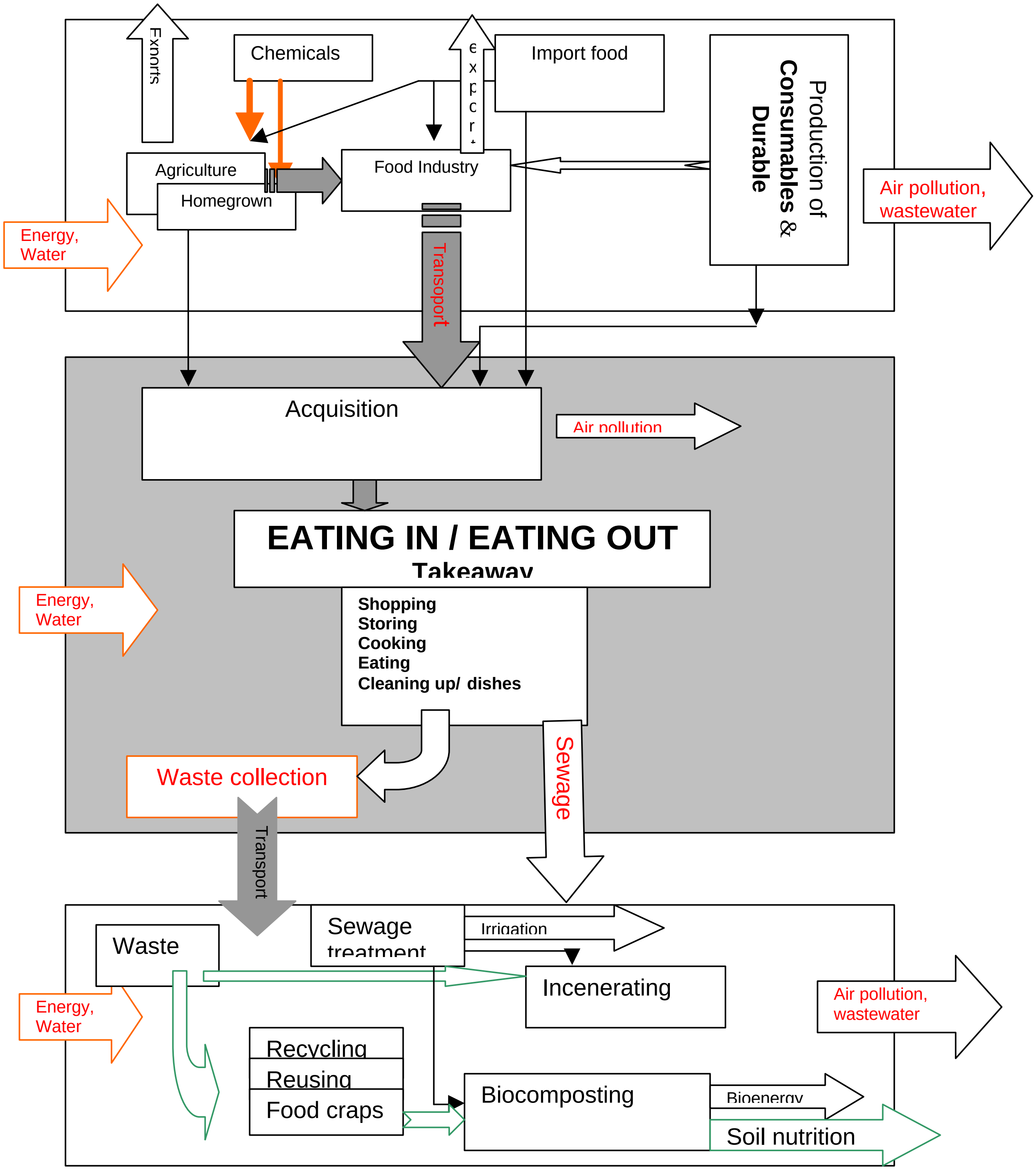


Figure 1 Process tree of Shopping, Cooking and Eating

2.4 Indicators and units

Table 2 Indicators used in the environmental assessment

Indicator	Unit	Explanation
Materials	kg	Home growing, fresh, processed,
Energy	MJ	*Energy* [MJ] is divided by sources of energy (coal, petrol, etc.) and 'renewable' and 'non-renewable'. Since most data sources mention the primary energy, this indicator is used. Energy is a part of every function phases from plant-production to after consumption.
Water	m^3	Water is an important resource because this is used to produce foods (irrigation and raw materials) and in the SCE (kitchen activities), and also food-industrial raw material (bread, canned food)
Pesticides	mg	Used during the agriculture production phase (home growing, industrial agricultural production). It means fungicide, insecticide and herbicide together.
Fertiliser	kg	Used during the agriculture production phase (home growing, industrial agricultural production) as N, P, K.
Consumables	kg	Consumables used in the usage phase, e.g. detergents
Durable	Pieces	Durable goods consist of kitchen equipment, such as storing, cooking, cooling, machines and other durable used in the consumption phase. Equipment for production, waste recycling etc. is however not included.
Household sewage	m^3	Waste water of households. Waste water of industry hadn't investigated.
Solid Waste	kg	Household waste consists of food scrap-compostable organic material, packaging materials-metal, glass, plastic, paper, textile, waste of durable. Other waste, e.g. production waste, is not included.
Emissions	kg	The indicator 'emissions', refers to all other emissions (to air, water and soil) occurring in households or during production processes.
Freight transport	tkm	Transport by truck, aeroplane, train etc. of one ton over a distance of one kilometre.
Personnel travel	km	The travel by persons per bike, car, public transport for shopping, going to restaurants and other activities.

Comments:

- energy, resources used to produce durable, consumables, to transport of goods and personal transport are not assessed;
- waste, emissions etc. of durable and consumables, transport and travel are not assessed as well to prevent double counts;
- at the end-of-life cycle, the energy and resources etc. are not assessed. Only the quantity of household waste is used as indicator.

To assess this would have been very difficult and the results very uncertain, especially for 2050.

3. Assessment current situation (reference situation)

The environmental indicators of the current situation in the nineties are assessed for that reason to be able to compare the current situation (DOS 0 scenario) with the future scenarios.

Table 3 Hungarian data of present situation

Basic data and assumptions:	
Population (thousand)*	10 065
Population over 15 (%)	82.5
Number of households (thousands)	4 011
One-person household (%)	26.1
Two-persons households (%)	68.2
Two-family-household (%)	2.9
Average number of persons per household	2.5
State of Shopping Cooking Eating (1997)	
Average spent per household on food per year (ECU)	1.028.18
Proportion on food shopping (%)	33.1
Food and nutritive material consumption per household (MJ/year)	11 245
Food and nutritive material consumption per household (kg per year)	1 473.75
Average food and nutritive material consumption per household detailed,	kg per year**
Protein	
Meat, meat products, fish	156.25
Milk and dairy products	340
Eggs	37.5
Fat	
Fats and oils kg per year	90
Carbohydrate	
Cereals	220.5
Sugar	94
Potatoes	165.5
Vegetables	220
Fruits	150
Proportion of eating out (%)	3.0
Proportion of take-away (%)	1.0

***** 06 30 1999

** Products are converted into basic material weight

Source: CSO Hungarian Statistical Yearbook, 1998

The structure of food consumption is very different in the Hungarian household. The real food consumption differs from average consumption. The food consumption is depending on a lot of things, mainly family's income and size of family. The supply figures (per head) are show in the commodity balances therefore represent only the average supply available for the population as a whole and, do not necessarily indicate what is actually consumed by individuals. Even if they are taken as approximation to consumption (per head), it is important to bear in mind that there could be considerable variation in consumption between individuals. In many cases commodities are not consumed in the primary form in which they are presented, e.g. cereals enter the household mainly in processed form like flour, meal, and husked or milled rice. The average data cover the differences, but the differences of family expenditure show the other rates in the consumed foods.

The difference in food related expenses at the Hungarian households reflect different nutrition possibilities. Food consumption of the lowest income households is satisfactory in quantity. At the same time the quality is not in compliance with the requirements of healthy consumption patterns. Concerning food physiology low income consume inadequate food: larger portion cereals, lard in spite of the higher number of young children. Their consumption in dairy products, vegetable and fruit is only 66 %, 42 % and 25 % of the food consumption of households with the highest income respectively.

3.1 Consumption of foods and overview life-cycle

The data of consumption food is well known from Statistical Yearbook. The consumed food origin mainly from domestic sources, but the rate of import food is increasing. It is about 20 % currently expressed in prices. The role of home growing (not purchased) food is very important in the big part of households. The portion of home growing food is relative high in the food consumption: 21.25 %. The total quantity (Q) of consumed food is average 1474 kg per household per year. It can divide by the following methods:

1. Industrial processed food 44.44 % (Q_{fi}), agricultural 30.87 % (Q_a), home growing (Q_{hg}) and direct import (Q_i) food to the household 3,44%. The quantity is converted for basic material weight.

$$\mathbf{Q = Q_{fi} + Q_a + Q_{hg} + Q_i}$$

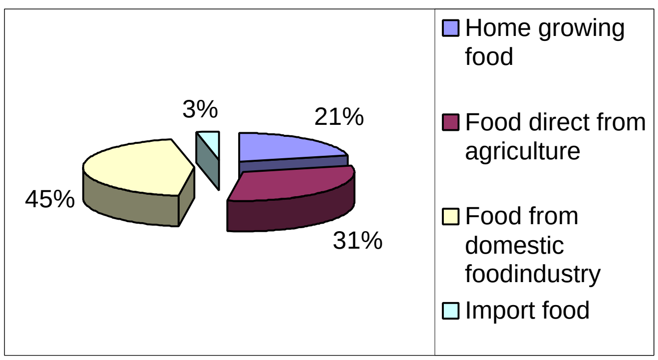


Figure 2 Proportion of the consumed food by origin in m/m %

2. The consumed food is divided into food from agriculture 455 kg per year (mainly fresh vegetable and fruit, processed often ready-to-eat food), 655 kg from the domestic sector and 50,5 kg import food directly to the household, furthermore 313,2 kg home growing food.

$$\mathbf{Q\ (100\ \%) = Q_{fresh}\ (30\ \%) + Q_{processed,\ half\ made}\ (60\%) + Q_{ready\text{-}to\text{-}eat}\ (10\%)}$$

3. The consumed food might be made at home (eating-in) 1414 kg, eating out 44,9 kg and take away (14,7 kg):

$$\mathbf{Q\ (100\ \%) = Q_{eating\ in}\ (96\%) + Q_{eating\ out}\ (4\%)}$$

4. Origin of raw material:

$$\mathbf{Q\ (100\ \%) = Q_{meat} + Q_{milk} + Q_c + Q_v + \ldots + Q_{fruit}}$$

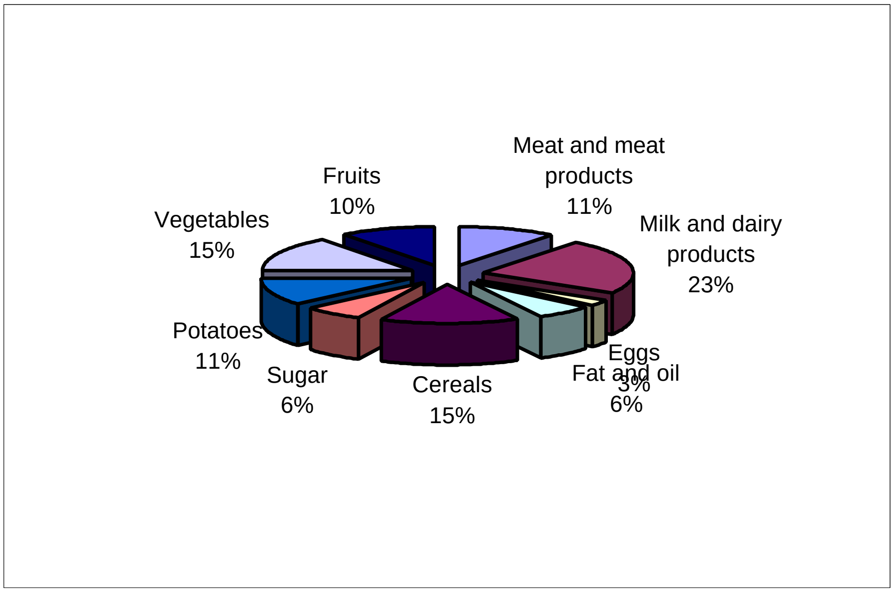


Figure 3 Structure of consumed food

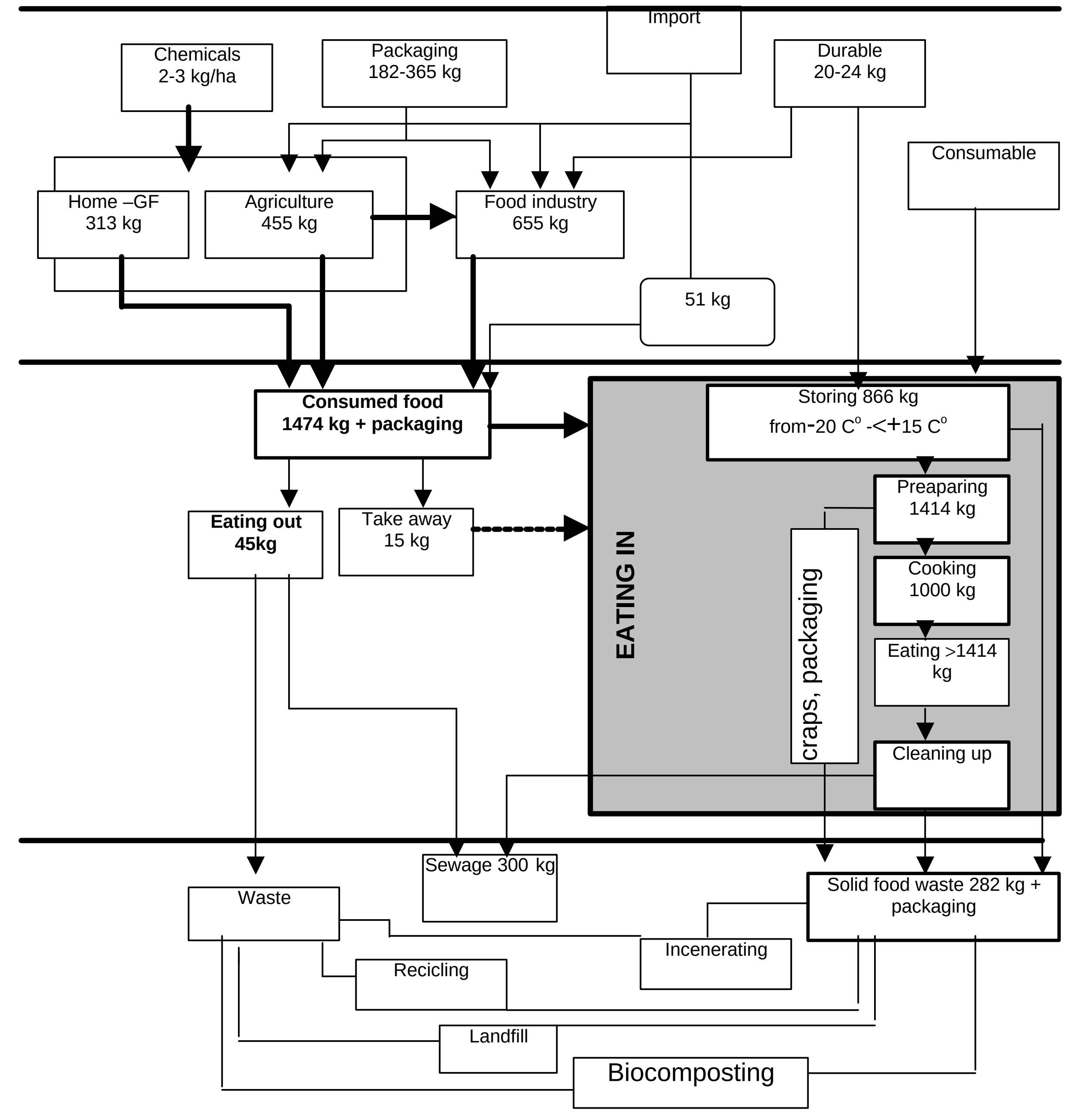
In the present it is impossible to calculate how many food the different household types have eaten. Beside analysis of the statistical data we investigated the consumption by questionnaires as well. More than 500 persons have been asked from different part of the country. The quantity of the consumed food changed between 1368 kg and 2323 kg .

Table 4 Differences in household types for the food consumption (%)

	Average of household (2,5 persons)	One member	Two members	Family (2+3)
Consumed food Per household (%)	100	39-45	71-75	125-160

Source: CSO, 1998

The change of the rate of the different food inducts changes in the environmental impacts too.



Note: We could not account the food balance because of the biological transformation.
(Data are round off)

Figure 4 Life cycle of the Shopping, Cooking and Eating in Hungary, at the end of nineties (1996)

3.2. Production of food and its indicators

The consumed food includes raw agricultural products, home growing, processed by industry and import food. The biggest part of the consumed food comes from the food industry. The material balance (round off data):

- Raw agricultural products 455 kg

- Home growing food 313
- Processed food by industry 655 kg
- Import food 51 kg (directly to the household)

In this phase the following relevant indicators are used for the environmental assessment:

- Energy
- Water
- Pesticides, fertilisers
- Transport

3.2.1. Energy

Methods of the calculation for energy requirement

We can calculate the quantity of the energy requirement with different methods. The following calculation method was used in the assessment (other ones in the Appendix 1)

$$\mathbf{E} = \frac{S\,[\mathbf{E_{Ts}\ x\ (1\text{- export})}]}{\mathbf{Number\ of\ households\ (N_h)}}$$

E: Energy demand of food production and processing per one household (MJ, average value) from different sector: $E = E_a + E_{hg} + E_{fi} + E_i$

E_{Ts}: Total energy demand of food producing and processing in different sectors per year (1996). It might: energy demand of agriculture, home growing food, processed food by industry and import food (E_{Ta}, E_{Thg}, E_{Tfi}, E_{Ti})

N_h: Number of households (4011×10^3)

It is a very simple method. In every country use these statistical data, it might to calculate easily. The allocation of resources also is known, generally in every country. The method gives good result in Hungary. However, in UK and The Netherlands the percentage of imported food is very high. For this reason this method is not applicable.

3.2.1.1 Energy data of the agricultural food production

The export rate of the total primer agricultural production is 5,4 percent the import rate is 0,97 percent. The import rate will not be calculated in case of households. **E_a**: Energy demand of food from agricultural production per one household is summarise in the following table.

Table 5 Resources of energy in the agriculture 1996

	Total	Coal	Fire wood	Petrol	Gas&Oil	Fire oil	Gas	Electric
Total energy using in the agriculture [TJ]	29465	2254	1125	646	13037	340	8636	3427
Per cent(%)	100	7.6	3.8	2.2	44.4	1.1	29.3	11.6
E_a per one household [MJ]	6949	528.1	264	152.8	3085	76.4	2036	806

Source: CSO Agriculture Statistical Yearbook, 1996

The energy usage connects to engine capacity (44 %) and to the drying (29 %). The stock of the main durable[1], such as tractors, combine and trucks responsible for the high-energy consumption in the agriculture and responsible for the air pollution of the agriculture.

3.2.1.3 Home growing food quantity and energy

The quantity of home growing food is 313.2 kg 21.2 % of total consumed food. The energy content of it might be lower than energy of the products of industrial agriculture because it requires more manual work than other technology. If the households use 11 533 TJ energy for other aims (in it also gardening) of their energy consumption (CSO Consumption of energy in the household, 1998). It takes **2875 MJ** energy per household (1 kg home growing food requires 9.1 MJ energy, it less than the agricultural food production requirement (15.3 MJ).

Table 6 Structure of the energy requirement of home growing food

	Total	Coal	Fire wood	Petrol	Gas&Oil	Fire oil	Gas	Electric
Total [TJ]	11533						517	11016
E_{hg} (MJ/house-hold)	2875	-	-	-	-	-	129	2746

Source: Housing statistic, 1998

3.2.1.4 Food industrial energy consumption

One of the most important indicators is the energy usage of food-industry. We have not correct data about allocation of energy using in food industries. The data differ by sources. There are different kinds of energy, such as gas, oil, electric energy, and petrol. It is known that the total energy consumption of the Hungarian Food industry is 26692 TJ. 61,2 % of the total amount of Hungarian food industrial produced foods are consumed in Hungary.

[1] Total productive land area 8 035.6 thousand ha, agricultural area 6194.6 thousand ha. Number of tractors 1.48 per square km agricultural area, number of combine harvester 0.15 per square km agricultural area, number of trucks 0.47 per ha agricultural land area

Table 7 Resources of energy in food industry 1996

	Total	Coal	Coke	Petrol	Gas&Oil	Fire oil	Gas	Electric
Terra Joule	26692	35	415	274	1812	532	3310	20320
Per cent	100	0.13	1.55	1.02	6.78	1.99	12.4	76.13
E_{fi} (MJ/house-hold)	4070	5,3	63	41.5	276	81	504.7	3098.5

E_{fi}: average food-industrial energy requirement per household
Sources: CSO Environmental Statistical Data 1996, 1998

Because of the food-industrial raw material an important part have been agricultural product (51.88 %), other part is some food industrial product (21.54 %) primary processed, the total energy requirement of these products is higher than energy usage of food-industrial process. On this way the following data have been calculated for food produced by food industry per household:

Uncertainties that these data contain all produced foods and beverages, spirits and animal feed too. Therefore it might higher more than 20 percent than the real value but the export food contents a lot of animal fodder too, and in this value 4070 not includes the export.

Table 8 Energy requirement of the food production and processing phases (MJ)

	Total	Coal + Coke	Fire wood	Petrol	Gas&Oil	Fire oil	Gas	Electric
E_a 455 kg	6949	528.1	264	152.8	3085	76.4	2036	806
E_{hg} 313,2 kg	2875						129	2746
E_{fi}	4070	68.3	-	41.5	276	81	504.7	3098.5
Total	13894	596	264	194	3361	157	2670	6651

Energy needed for the three food types:

Agriculture	15.27 MJ/kg
Home growing	9.18 MJ/kg
Food industry	6.21 MJ/kg

3.2.2 Water

Water is used mainly for food production (agriculture, food industry, home growing) and beside these in the technological phase it is raw material and amount of it is very high. In the agriculture (irrigating water) and in the food industry we calculate with that same data.

Water -use during the production of food differs from 3-11 L per kg food products. The higher requirement has the meat-, poultry and canning industry. Water usage depends on the characteristic of product (type, packaging, etc.) This is in average 7x1473.75 =10316 L =**10.3** m^3, water per household per year.

The home growing water usage might be more 29.4 m^3, - because irrigation -we calculated it might be 25 –30 % of total water (98 m^3), which has been used by the average household.

3.2.3 Fertiliser and pesticides

For the maintenance of proper nutrient value of the soil demand - depending on the type of the soil and the agricultural system - at least 100-150 kg / ha fertiliser (N, P, K) is required.

The total fertilisers' consumption was 49 kg per hectare of arable land, garden orchard and vineyard (in active ingredients, 1995). There were in the eighties about 222 kg/ha. Nowadays is increasing, 157 kg/ha (1999), but it is lower than in the western country. The figure shows the differences.

Fertiliser usage in the SusHouse countries (active ingredients per hectare) in 1995[2]

Germany	234 kg;
Italy	175 kg;
The Netherlands	543 kg;
UK	379 kg;
Hungary	49 kg;

We can calculate the quantity of fertiliser as 0.07 kg per household to use the following method:

$$\text{Fertiliser (kg) per household} = \frac{\text{Quantity of } \Sigma \text{ used fertiliser}}{\text{Number of households}}$$

Pesticide might indicator in this system as used chemicals to the plant cultivation, annual usage of the pesticide kg active ingredients per square kilometres arable land. The annual pesticide usage is 2-3 kg per hectare in Hungary. The OECD data represents the differences in this indicator (Barry Field, 1994)

$$\text{Pesticides (mg) per household} = \frac{\text{Quantity of } \Sigma \text{ used pesticides}}{\text{Number of households}}$$

Pesticides intake per one household = (arable land ha or square km) x (pesticide kg per ha or square km): number of households. The result is **650 mg pesticides**. Aldicarb, paraquit and ethilparathion strictly restricted.

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[2] CSO Statistical yearbook of agriculture, 1997

For long time (since 1990) the pesticide usage has been at low level in Hungary. It is not enough for efficient plant protection. The reason of the low-level usage is that the prices of pesticides were very expensive, and after the political change they were not subsidised at all. We know that the production without/or low level pesticide result a higher fungi infection in the crops, which is very dangerous (the human toxicity) because there is a lot of unknown mico-toxin could produce by fungi. In world wild a lot of food contain the following micro-pollutants: aflatoxin, B_1, B_2, G_1, G_2, DON, Fusarium F_2, Fusarium T_2, ochratoxin A and patulin - produced by fungi or caused by pesticide. We can measure these micro-pollutants by Gas Chromatograph (GC) and High-Pressure Liquid Chromatograph (HPLC) analytical method in ppb quantity. The result shows a little increasing of the pollution and the toxin was over MTL in some sample. The pesticide usage and the mico-toxins in the crops are in relevant connection. These mico-toxins invisible but very dangerous, the monitoring and measuring of those are very expensive. The pesticides might use as an environmental indicator as measured residuum mg per kg food [ppm] or μg per kg [ppb]. Every pesticide have a maximum residuum level MRL, above this it might be dangerous for the health of people. (Certain pesticides are to be banned in farm products intended to use for baby foods.)

Effects of the pesticides →

- **prevent fungi infection** **+**
- **better crops, bigger yields** **+**
- **affect to ecosystem** **-**
- **bio-accumulate in food chain** **-**
- **residuum in food** **-**

On the basis of the 1998 laboratory measuring results of food samples for harmful chemical residues it can be stated that in Hungary the contamination of foods – produced in authorised places – with harmful chemical ***residues is significantly below the threshold values determined by the related legal measures***. In some cases the residues can not be detected even with sensible analytical methods. The different foods analysed for additives are in compliance with the related measures. (Ministry of Agricultural and Rural Development: Analysis of residual substances1998)

3.2.4 Transport

Energy requirement of transport in Hungary probably higher per tkm refer to other countries West Europe, because the average age of trucks is 9.78, the ratio of stock transported by trucks operated by petrol is 37.7 per cent, operated by gas oil is 62 per cent. Most of the trucks have 1-10 tons carrying capacity (293 627 pieces equal 97.0 per cent).

The transported mass of foods were 5412 thousands tons in 1996. It is based on data from enterprises with more than 50 employees. It was total 1243 millions freight ton-kilometres; of which transported food per household ($1243 \times 10^6/4011 \times 10^3$) 310 tkm.

Table 9 Main data of food transport

Types	Amount (1000 tons)	Average distance (km)	
		Inland transport	Import transport
Rail	2108	116.1	175
Public road	5250.5	112.5	

Water road	4.21	37.0	1142.7
Airway			2714.3

Source: CSO Hungarian Statistical Yearbook, 1998

Table 10 Relation between energy, transport distances and carrying capacity

Energy requirement	Distance (km)	Carrying capacity (t)	Energy demand [MJ] to 1 tkm
1 MJ	0.13	truck 1	7.69
1 MJ	0.22	truck 2	4.54..2,72
1 MJ	0.82	truck 10	0.121..1.21
1 MJ	1.29	truck 20	0.038…0.52
1 MJ	11.5	water way	
1 MJ	2.46	rail	

Source: Lox, 1992

The result of calculation (**310 tkm** per household) is less, than the total transported food quantity, because the statistical data don't content the transport data of small companies. Most of the transported food on public road was transported mainly by 1 or less 10 tons track. Energy requirement for the transport is 7.69 MJ for 1km 1 ton food. The transport energy requirement takes more 2000 MJ.

The freight ton-km of imported food might higher than this inland transport. Most of the imported food comes from Germany, The Netherlands, Austria, Italy and Poland.

3.2.5 Other indicators

Emission

Airpollution is connecting to:

- methane emission and NH_3 is mainly from livestock,
- nitrogenoxids (NO_x), CO, C emissions are mainly impacts of the transport.
- CO_2, SO_2, CO, NO_x emission connecting to heating
- cooling gas NH_3, CFCs only from havaria pollution

Waste

This waste in one of part is used as second raw material of meat or bone mill, animal protein, animal feed, raw material of lysine production, organic manure, other less part is used to bio-gas production, in third part landfill deposit. The waste of home growing food is recycling to the production except the packaging of chemicals. One part of the waste has been burned other part - for example organic waste - composted.

Packaging used by industry also waste at end of life cycle. The structure of the packaging was the following (in price) in 1990 in Hungary (Biro, 1994):

Paper, card	40…42 %
Glass	14…16 %,
Metal	20…22 %,
Plastic	20…22 %,
Wood, textile	3.….4 %

These indicators are not assessed.

Sewage waste

Both the agriculture and food industry demands about 1-11 litre water (mainly drinking water) per kg food. About 70 % of used water in the food industry will be sewage water. Agriculture produces sewage mainly in the animal breading. But the food processing demands more water for the technologies. It contents very high Biological Oxygen Demand (BOD_5), CCl_4 extracts because of not efficient cleaning process. These indicators assessed.

3.2.6 Summarising of indicators for production

Table 11 Characteristics indicators of production phases per households per year

	Materials [kg]	Transport [tkm]	Energy [MJ]	Electricity [MJ]	Re-newable [MJ]	Water [m^3]	Fertiliser [kg]	Pesticide [mg]
Food industry	655	310	4070	3099		10.3	-	-
Agriculture	455		6949	806	264	10.3	0.043	385
HGF	313	n.a.	< 2875	2746	n.a.	29.4	0.027	215
Total	1423	310	13894	6651	264	50	0,070	650

Note: The table does not include the direct imported foods to households.

3. 3. Acquisition of durable and consumables

To buy foods, consumables and durable, each household travels approximately 316 km per year. Many housewife buy every day 2-3 kg food in the near shop, supermarket and local food market. They are walking or travel 1-2 stop by tram or bus.

The average household has to change and buy new equipment only after 12 -15 years. The total number of these equipment is 3,62 pieces per household (refrigerator, deep-freezer, cooker, dish washer, microwave). Environmental impacts of these does not assessed.

The environmental impacts of acquisition phase mainly air pollution from the car: NO_x, CO and CH_n.

3.4 Use

This phase includes the specific activities related to the consumption of food: preparation, cooking, storing, eating and cleaning of dishes (cleaning up).

3.4.1. Preparation

Average household consumes 1474kg foods per year, of which 1414 kg as eating in. The most of this quantity requires preparation. We assume that in the preparation phase not the all amount participates.

Table 12 Environmental indicators for an average household

	Unit (kg)	Energy (MJ)	Water (m3)	Waste (kg)	Sewage (m3)
Preparation	<1414	450	1.4	213	1.4

3.4.2. Storing

The consumed food stored for longer-shorter time in the household. The mill, sugar, salt, bread, grocers, paprika, potatoes don't demand cooling storage and haven't environmental effects.

Table 13 Environmental indicators for the storage

	Unit (kg)	Energy (MJ)	Water (m3)	Waste (kg)	Sewage (m3)
Storing	1187	422-950	-	-	-

3.4.3. Cooking

Cooking is a traditional kitchen activity that takes up 1-2 hours per days, it depends on the household size, meal types and eating habits etc. The time of the cooking is very different in the different households. Households, which have hot breakfast every day (0,5 hour) 8 %, hot lunch (1-1.5 hour) 73 % and hot dinner (0.5-1 hour) 18 %. 65 % of the households cooks every day. We calculated the following data. The quantity of cooked food less than the total consumed food. (fruits and vegetable have been eaten as fresh; bread, one part of salami, bacon etc. also don’t require cooking)

Table 14 Environmental indicators for the cooking

	Unit (kg)	Energy (MJ)	Water (m3)	Waste (kg)	Sewage (m3)
Cooking	1000	11238	1	-	-

Table 15 Rate of different kind of energy consumption for the cooking

Fuel	Cooking energy (MJ)	%
Electricity	674	6.0
Crude gas	5158	45.9
PB-gas	1967	17.5
Black coal	2	0.02
Firewood	2630	23.4
Other	807	7.18
Total	11238	100.0

Source: CSO-Consumption of energy in the household, 1998

3.4.4 Cleaning of dishing (cleaning up)

Table 16 Environmental indicators for cleaning

	Unit (kg)	Energy (MJ)	Water (m^3)	Waste (kg)	Detergent (kg)	Sewage (m3)
Cleaning	1414	40-400	3.6-7.3	50	30	3.6-7.3

Daily 3 times eating generates a lot of dirty plates, pots. It requires in average 0,5 hour per day. The kitchen have to be cleaned up (at least ones a week), while the rubbish have to be collected. It requires at least 30kg detergents per household/year.

3.5 After consumption (disposal)

In this phase is assumed the total amount waste derived from the use phase. It consists of the total kitchen solid waste. We assume the different type waste were counted in the use phase, and added the all packaging matters to it. (exclude the sewage)

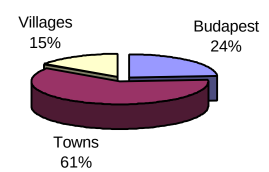


Figure 5 Transported minicipal waste 1990 in cum

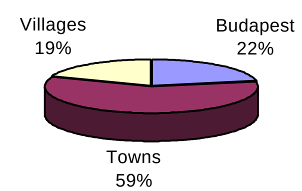
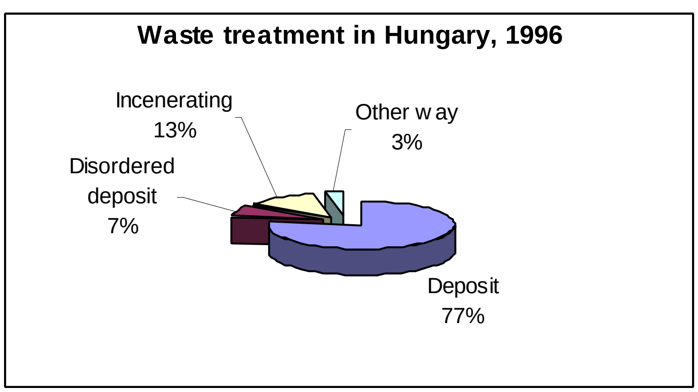


Figure 6 Transported minicipal waste 1996 in cum

Sources: CSO Environmental statistic data 1996



Sources: Environmental statistic data 1996

Figure 7 Municipal waste treatment in Hungary 1996

Ways of the waste treatment:

- Reuse and recycling (mainly glass and plastic)
- Biocomposting (organic food scrap)
- Landfill
- Incineration (waste of Budapest)

Table 17 Municipal waste deposit in Hungary (household per year 1995)

	Unit (kg)	Organic, compostable (kg)	Glass (kg)	Plastic (kg)	Paper	Other (metal textile, hazardous)
Total	2000-3000	710	195	287	480	828
Reuse and recycling	175	-	125	50	0	0
Biocomposting	20	20	-	-	-	-
Landfill	1855	620	50	160	375	650
Incineration	420	70	20	77	105	178

Source: Counted data by PRs on base of CSO Environmental Statistical data 1996

These data (table 17) contents the total waste quantity per average household, which is more than the waste of SCE function[3]. We calculated 1 m^3 waste = 600 kg, as a result but this data is not very precise.

[3] There are other wastes from other household functions.

3.6 Overview of data for current situation

Table 18 Summarising data of the indicators

	Quantity (kg)	Energy (MJ)	Water (m3)	Pesticides (mg)	Fertiliser (kg)	Transport (tkm)	Durable (pieces)
Production	***1423***	***13894***	***50***	***650***	***0.07***	***310***	***Not inc.***
Food industry	655	4070	10.3	0	0	310	Not inc.
Agriculture	455	6949	10.3	385	0,04		Not inc.
Home growing food	313	2875	29.4	215	0,03	n.a.	Not inc.
Import food	***51***	***n.a.***	***0***	>***650***	>***0,07***	***Not inc.***	***Not inc***
Acquisition	***1474****	***-***	***-***	***-***	***-***	***1***	***-***
Use	***1414***	***12138-13060***	***6-9.7***				***3.6***
Preparation	<1414	450	1.4	-	-	-	0.6,
Storing	1187	422-950	-	-	-	-	1.7
Cooking	1000	11238	1	-	-	-	1.29
Cleaning	1414	40-400	3.6-7.3	-	-	-	0.01
Waste disposal	***250-300***	***not inc.***	***-***	***-***	***-***	***-***	***-***
Recycling	18-20	-	-	-	-	-	-
Bio-composting	2.5-3	-	-	-	-	-	-
Landfill	220-260	-	-	-	-	-	-
Incineration	9.5-17	-	-	-	-	-	-
Total		**26032-26954**	**56.9-59.7**	**650**	**0,07**	**310**	

*****1474 - 1414=60kg as eating out is not assessed

Table 18 Summarising data of the indicators (continue)

	Quantity (kg)	Consumable (kg)	Household sewage (m^3)	Emission	Personal travel (km)	Waste (kg)
Production	***1423***		**-**		**-**	
Food industry	655	14(detergents, disinfectant)	-	water , BOD_5, air pollution , CO_2, CO, C,	-	-
Agriculture.	455	feed additives, medicines + disinfectant	-	300 kg (CH_4), CO, NOx, SO_2, NH_3	-	-
Home GF	313	see above	-	CO_2, , NH_3, C (dust)	-	-
Import food	***51***	***additives, medicines***	**-**	***air pollution (transport)***	**-**	**-**
Acquisition	***1474***	**-**	**-**	***negligible***	***316***	**-**
Use			***5-7.3***		**-**	**-**
Preparation	<1414	-	1.4	-	-	Food craps 200-250 packaging
Storing	1187	-	-	-	-	-
Cooking	1000	-	-	CO_2, CO, SO_2, C, steam, odour	-	-
Cleaning	1414	30 (detergent)	3.6-7.3	-	-	-50
Waste disposal	***250-300***	**-**	**-**	***air pollution***	**-**	***250-300***
Recycling	18-20	Chemicals, detergents	no data	-	-	18-20
Bio-composting	2,5-3	-	-	-	-	2,5-3
Landfill	220-260	-	-	-	-	220-260
Incineration	9.5-17	-	-	air pollution, NOx, dust, biphenils, dioxine, heavy metals (Pb, Zn, etc.)	-	9.5-17

3.6.1 Main conclusions of environmental impact

Table 19 Evaluation of the effects of the present existing SCE

	Annual average data[4] per household	Observations /*Environmental problems*/
The amount of consumed food [kg]	1475	The consumption of almost all types of food decreased in the past 10 years. The most significant decrease can be seen in the case of meat consumption, and owing to this the emission of environmentally polluting substances reduced. Nevertheless the indicators of the utility of environmental sources became worse.
		The extreme values vary depending on the income of the household. Between 549 and 929 kg/capita/year
		The nourishing energy consumed is 4500 MJ/year/household. In the case of those with lower income the nourishing energy is provided by a higher ratio of fats.
The energy requirements of food products [MJ]	26493	The process, within the system, requiring the highest energy is cooking done in the household (60 % of the households cook everyday). Storage (freezing) needs less energy than cooking and the washing up follows it. The preparation of meals requires minimal energy (time-consuming live labour instead). More than 80 % of the energy is not regenerated. Wood can be considered a regenerating source of energy. */ozone layer, greenhouse effect/*
Water requirement [m^3]	58	The water requirement is the highest in private vegetable growing, and what is more, the water used for irrigation is mostly of drinking water quality. */reducing water supplies/*
Pesticides [mg]	650	The usage of pesticides is considerably under the EU average, less than the desired amount. In small enterprises (gardens) the consumption of pesticides is above the national average. The dose used in Hungary is 2-3 kg/ha, while in England it is 1,4 times more and in the Netherlands it is six-fold. The dangerous Aldicarb, paraquit and ethyl-parathion are strictly restricted. */human toxicity, biodiversity/*
Fertilisers [kg]	0,07	The use of fertilisers declined in the past ten years. This amount is not enough to give back the nourishing value of the soil, it does not come up to 10 % of the Dutch consumption. (In The Netherlands 11 times more, in England 7,5 times more is used. /*acid rains*/
Transportation [tkm]	310	The environmental impact of transportation is felt in energy consumption, air pollution and noise. 1-10 ton vehicles transport the majority of food-products. Their energy (fuel) requirement is high. As for the energy (fuel) consumption, the proportion of more desirable ways of transportation, such as railway and waterway, is insignificant. Since the vehicles are rather old (9-10 years), their outdated engines cause greater air-pollution. /*global heating, escaping of ozone/*
Distance [km^2]	300-500	Most households do the major part of their shopping by car, and their number is still growing, especially with the appearance and spread of the large hypermarkets, increasing distances between household and shop. According to our survey, the families with a car (36%) do their shopping in a large shopping centre at least every second month. /*toxic substances/*

[4] The data change more times during the assessment (newer data, revising of assessment, critical remarks etc.)

Waste [kg]	208	25-30% of the mixed waste from households is organic waste. 30 % paper-based packing material, 20 % compound material and 20 % metal is deposited. The waste of durable consumer goods gets into a waste-yard. The ratio of selective waste collection and recycling is under 5%. */erosion of the soil/*
Sewage [m3]	30	30 % of the household-sewage comes from areas without drainage, and goes to an outdated clarifying system or directly into the soil. Another part of the sewage pours into live waters (rivers, lakes and oceans) without any cleaning or clarification. The kitchen sewage is characteristic of its high fat-proportion and, consequently, high detergent-concentration and settling floating-tarlatan. This is why the BOI_5 value is high as well. */eutrofication/*
Emissions [kg]	No data	Mostly have a link with the energy (fuel)-use. (CO_2, NO_x, CH_n), and transportation (dust). Besides, emission can be found in food production and procession (pollen, volatile substances, NH_3, CH_4) and during kitchen work (dust, volatile substances), and the present wax of waste management also causes emission (SO2, NO_x, heavy metals, PCD, dust, volatile substances. */greenhouse effect, acid rains/*
Durable kitchen equipment [item]	3,6	During the last ten years the significant part of refrigerators and cookers in the households were changed, and new types of equipment appeared (deep-freezer, microwave oven, pressure cookers, fryers etc.) The average life-span of all these is more than 10 years. 18-20-year-old equipment is common in the households. Their impact on the environment depends on their poor efficiency. Their average life-span is 10-15 years. */ozone layer, greenhouse effect/*

Key uncertainties

- The quantity of consumed food is uncertain since it is highly depending on household income and consumption pattern.
- Exact ration of processed and semi-processed food.
- The exact quantity of waste as it has already been mentioned. The ratio of different waste utilisation (composting, recycling etc.)
- The standard deviation in statistical data and data from questioners is high.
- Energy related data of production varies depending on data sources and allocation.
- Industrial sewage water component and the effectiveness of cleaning is unknown.

3.7 Expected trends

- The situation in the nineties is described above. For the exact comparison of the future scenarios (2050) with the present situation the following statements should be considered:
- There are different assumptions considering population in 2050. According to a part of it there will be a dramatic increase meanwhile others say that it will decrease.
- Eating patterns also have considerable effect on SCE. The ration between eating in and eating out will probably differ from present situation. The relatively high ration of households with everyday cooking (65%) will probably decrease considerably. This will lead a dramatic environmental benefit since cooking is responsible for the major part of energy consumption.
- The consumption of ready to eat deep-frozen food will increase.

- The nutrition consumption per capita will slightly increase approaching to the EU average.
- Energy efficiency in food industry will increase rapidly since new energy saving technologies and alternative energy sources are being applied.
- The role of logistical services will increase dramatically.
- Water usage will decrease, and the cleaning efficacy will increase.
- Production waste will be mainly recycled (reproduction, energy production). The quantity of packaging materials will decrease, recycling and reuse will increase.
- *The* recent level of *pesticide and fertiliser* application is not enough. We can say on base of the experts opinion: twice of presently applied quantity is necessary, but it should be applied with a special new doses and antidotum, that allows only necessary and enough quantity usage.

Allternatives for the future:

- if we reduce the pesticide to 0 level does it means a sustainable way (accelerate the spread of cancer illness?);
- if we reduce the pesticides to 0 level we might and should use natural pesticides in the multicultural production and cutting edge technology for bio or green production;
- if we increase the quantity of pesticide and use the earlier technology it would be unsustainable way;
- if we use more pesticides combined with antidotum in the High-Tech Rural Garden or in Local and Green there are no residuum, no pollution. The applied dose is in relation with the soil and environment quality. Neutralisation happens in the planting. It might be sustainable way;

The last possible alternative needs new technology and products. The "new pesticides" differ from today used. These are mainly products of biotechnology. The "antidotum" helps in the decomposition of residuum in the field without environmental risk.

The maintenance of proper nutrient value of the soil demand depends on the type of the soil and the agricultural system. At least 100-150 kg / ha fertiliser (N, P, K) is required.

4 Assessment of environmental impacts of the scenarios

4.1 Local and Green Diet

4.1.1 Essential characteristics

Food is supplied from local, organic sources. People purchase food mainly in local street corner shops and local farmers' market to prepare and eat at home.

People preferably consume dishes consist ingredients with the lowest possible environmental burden.

Changes in Local and Green Diet compared with present situation

- Shift to markets where local production is dominant.
- High labour capacity requirement
- Shift to transport systems, which provide information for the distribution of products at the local level.
- Shift to local shops buying large amounts of products for separation and packaging. Storage place of shops are varied in order to satisfy it
- New types of shop equipment
- Climate chambers as prerequisites of house-building
- New logistic services
- Production conforms to demands
- Decreasing role of supermarkets
- Packaging and storage are not significant. There are lots of decomposable and recycled packaging.
- Wrapping can almost be eliminated. The quality, the inner characteristics of the products will be important more for the consumers than the wrapping.
- Although the prices of the products might be higher because of the environment-friendly production. This can be partly compensated by the reduction of the wrapping and transport costs.
- Healthy, delicious, full of nutritive meals.
- Internalisation of the environmental profit, which is cannot be expressed in money today into the production.
- Reducing transportation has less pollution-output and less input on the energy-consumption side.
- Developing local technology for waste utilisation to reduce the level of local pollution-load.

4.1.2 Consumption of food

People consume healthy, tasty food, rich in nutritive materials, avoiding unnecessary food, which is not vital and often even harmful for the human organism. Using seasonal products. Restaurants and take away complying to new values and expectations with local taste-banks to help popularise the traditional dishes of the region. The home consumption food will increase only 4.5-5 % in the future. The fresh and green vegetable and fruits will increase also.

Table 19 Expected consumption per household in the future

	Present situation DOS 0 [kg]	Local and Green Diet 2050 [kg]
Meat and meat products	156.25	*180**
Milk and dairy products	340	*374*
Eggs	37.5	*37.5*
Fats and oil	90	*45*
Cereals	220.5	*220.5*
Sugar	94	*85*
Potatoes	165.5	*170*
Vegetables	220	*250*
Fruits	150	*180*
Total	1473.7	*1542*
Nutrition E MJ/ year	11 245	*11 245*

* mainly fish and white meat

Comments:

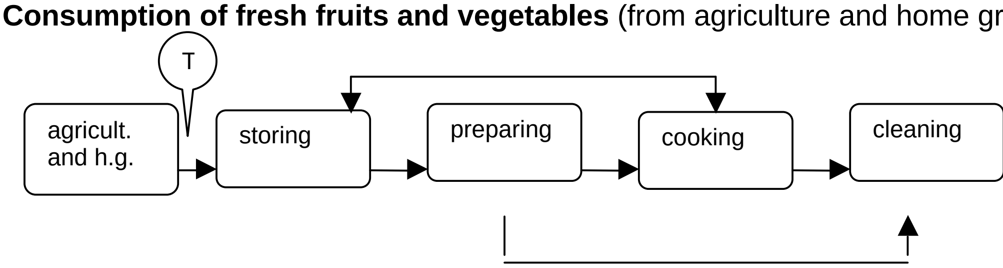
- there will be only a structural change in consumption
- fresh unprocessed or locally processed food will be more dominant
- bio-product consumption will increase
- the new consumption patterns will also reflect in restaurant meals
- proportion of white meat and fishes will increase among the total ones.

This function is unique in several respects:

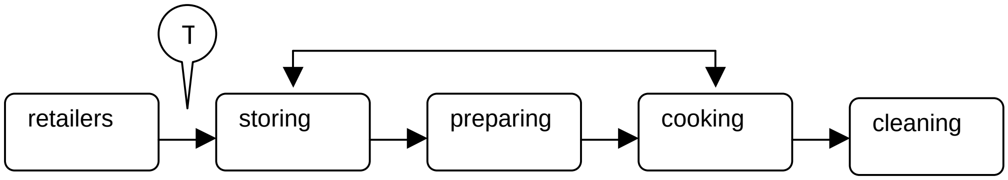
- reducing the amount of food consumed can not reduce environmental burden of SCE. In our opinion the amount or quantity of food consumed today is more or less the same than the quantity will be consumed in 2050.
- within the consumed food quantitative change can be considerable. The determination of environmental benefits as a consequence of using more effective technologies, techniques, alternative energy sources etc. is extremely difficult if it is possible at all !
- realising this anomaly we tried to use a different approach. We created new flow charts for modelling and better understanding of different ways of different types of eating.

4.1.2.1 Models of consumption in this scenario

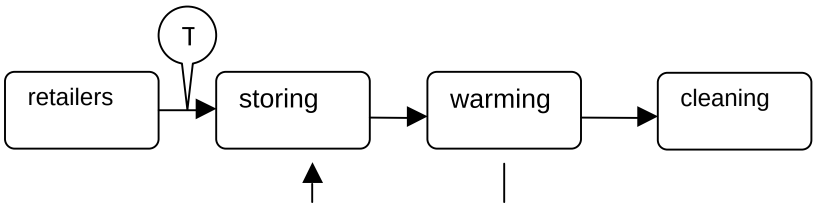
Consumption of fresh fruits and vegetables (from agriculture and home growing)



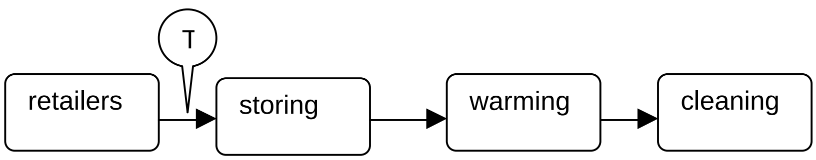
Consumption of food prepared from raw materials in the kitchen at home



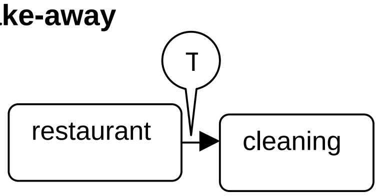
Consumption of semi ready foods



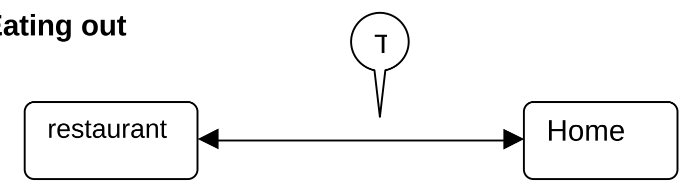
Consumption of ready to eat food



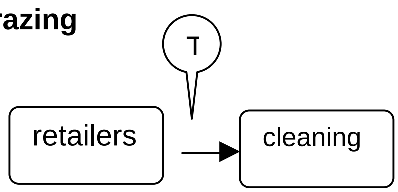
Take-away



Eating out



Grazing



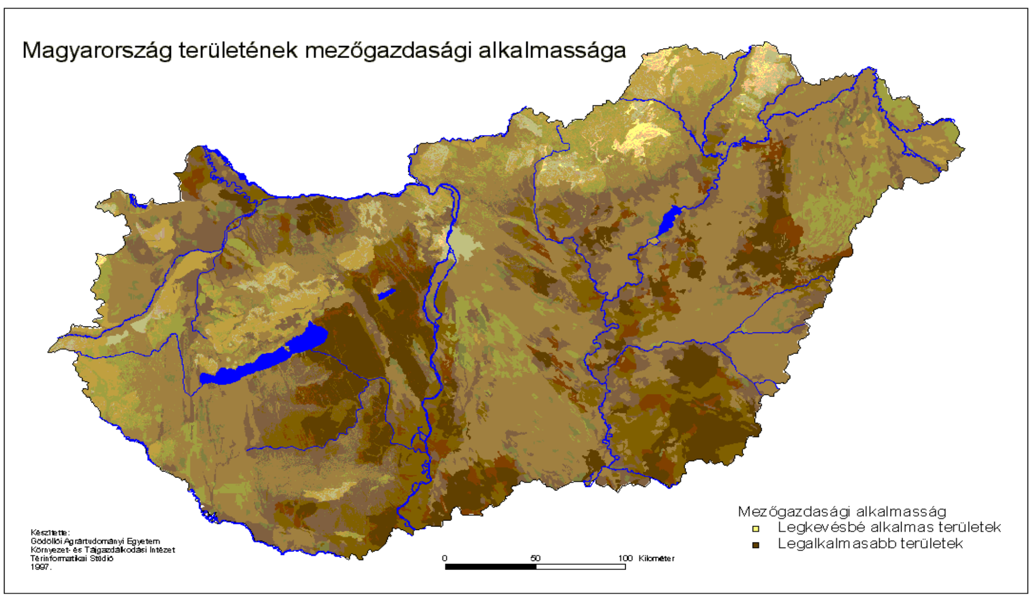
Note: The “T” indicates only the personal transport in the charts

These seven variants give the total consumption of the households today and could give in 2050 as well. The ratios of different ways can be different. Calculating the environmental effects of these ways the total environmental burden can be calculated for the *use phase*. This can be a good base for the assumption of future environmental benefits of the households. The environmental effects of these variants are different. If the ratios of these variants change, the environmental impact changes also. Within this DOS the changes in agriculture and/or food industry can result the major environmental benefit.

4.1.3 Production phase in 2050

Almost 40 % of the consumed food are locally produced (within 100km circle) fresh fruit and vegetable. Food processing is also concentrated close to the production therefore the transportation of raw materials and processed food is minimal. The ratio of highly processed products will increase by 5-10 % and the use of alternative and renewable energy sources will be dominant. The amount of packaging materials will decrease due to the introduction of new type packaging. Water consumption will considerably decrease due to the effective use and reuse (after purification). The application of food additives will decrease as well.

Local agricultural production and food processing systems conforming to the ecological circumstances of the region plant cultivation, animal husbandry, forestry and organic farming. Production is better controlled because of the consumer claims.



Source: GRID database (dark colour: best agricultural field)

Figure 8 Soil map for the agricultural production in Hungary

4.1.3.1. Main characteristics of production

Agriculture

- less machines is required for the production of same amount of food ;
- growing economies of scale in the agricultural production ;
- better machines require less energy - more effective energy usage (factor 3) ;
- organic production does not require pesticides and much fertiliser;
- developing biological control and protection;
- increasing in quantity but less environmental impact;
- local recycling and reusing;
- utilising alternative energy sources.

Food processing

- more local enterprises but more effective machines - multifunctional equipment;
- new generation of packaging in strongly reduced mass;
- more smaller local plants ;
- high level of waste treatment, elimination, recycling and "pet food";

Environmental impacts of the production of the scenario

Table 20 Characteristics of production phase in 2050 *(present situation equal 100 %)*

	Materials [kg]	Transport [tkm]	Energy [MJ]	Re-newable [MJ]	Water [m^3]	Fertiliser [kg]	Pesticide [mg]
Production of food	**105 %**	**50%**	**50%**	**2060%**	**85%**	**50%**	**50%**

Comments:

- Nutrition patterns will change towards healthier products; the size of the households will not decrease further; more fruits and vegetable will be consumed; in the SCE function environmental benefits can not be gained by decreasing of the quantity of consumed food but the content of the diet will modified;
- Due to the local production and processing facilities as one of the consequences of the scenario the transport will decrease considerably (at least by 65 %); the transport distance - relating to at least 60 % of the consumed food - will not exceed 50 km; transport requires less energy. More renewable energy sources will use for transportation;
- Energy necessary for production and processing will change considerably since more processing facilities will be established in one region; the non-renewable energy sources will be more or less replaced by renewable energy sources.
- Due to the characteristics of “green” technologies (water saving processing, recycling etc.) the water consumption will decrease by 50%;
- Fertilisation will stabilise at a level which is higher then today assuring constant regeneration of soil fertility;
- Pesticide use in Hungary is on a very low level therefore if it will be on the same level then it can be considered as environmental benefit; more labour intensive and organic production requires less or no pesticides;

- Durables: more or less but more efficient than today - number of these depend on the economies of scale;
- Due to the decrease in transport tkms and the elimination of fossil fuels the emissions related to the food production per household will decrease;
- Waste not included

4.1.3 Use phase

4.1.3.1 Acquisition of food

The household purchases food mainly from the local market and near shops. The more preferable products the local and seasonal foods which have less environmental impacts. The shops have efficient cleaning systems and after the shopping everybody can clean the vegetable in the shops. The local and green diet do not like the imported food, do not buy multi-ingredient products. At the purchasing very important factor the origin of food (organic, certificate bio, certificate without GM.). Today the growth of the organic agricultural production is 22.9 % in UK and 4.6 % in The Netherlands (Middle, A. 1999). The number of bio enterprises In Hungary was 401 in 1998. The number of these enterprises increased 5.8 % and the field increased 7.59 % between 1991 and 1998. (Kissné Bársony E. 2000). Because the households consume more fresh vegetable and fruits the acquisition is more frequent.

4.1.3.2 Acquisition of durable and consumables

The kitchen equipped with energy efficient equipment. The fourth generation of the kitchen cookers, refrigerators and other equipment are working with alternative energy and energy saving methods. Their life cycle is longer than today. Have to buy new one only every 10-12 year.

4.1.3.3 Storing of food

Food has been stored shorter time at home. Purchase of fresh food will be more often. Applied traditional methods for storage demand decreasing energy compare with the nowadays situation. There might be 25 % decreasing in the energy. The cereals, oil and sugar (350,5 kg) do not require cooling during the storage. Because of the consumed food eating out will increase at least double less food will be stored.

Table 21 Environmental indicators for storage below 15 C^o

	Unit [kg]	Energy [MJ]	Water [m3]	Waste [kg]	Sewage [m^3]
Storing	1071	317-713	-	-	-

3.1.3.4. Preparation

Average household consumes **1542** kg food per year of which **1422** kg is eating in. We assume that in the preparation phase not all the amount participates. The preparation phase will change, because it is connected with the acquisition phase. The food craps will be reduced. The water demand decreases 50 %, the energy demand 80 %, waste and sewage 50 % of the present.

Table 22 Environmental indicators for average household

	Unit [kg]	Energy [MJ]	Water [m^3]	Waste [kg]	Sewage [m^3]
Preparation	<1422	360	0.7	106.5	0.7

4.1.3.5. Cooking

It is very important household activity in this Local and Green Diet scenario. Aspects of healthy lifestyle are focused on consumption of environmentally friendly local foods. The cooked food will increase only 4 % because the increasing of total quantity of consumed food. But the take away and eating out will increase higher. There could dominate the healthy and safety food without additives. Very important to use the recipes of the grandparents, the old tastes. The cooking habits usually do not change. The electricity and/or gas will be complete with solar energy. The cooking requires only 50% of today energy using (efficiency of energy using increases, 50 % of the fruit and vegetable (215 kg) do not require cooking). New cooking methods require less water for the cooking sandwich pots.

Table 23 Environmental indicators of cooking

	Unit [kg]	Energy [MJ]	Water [m^3]	Waste [kg]	Sewage [m^3]
Cooking	860	4832	0.5	-	-

Table 24 Rate of different kind of energy consumption of cooking

Fuel	Cooking energy %
Electricity using alternative energy	50
Bio gas	8.1
Bio-briquettes	0.03
Firewood	32
Other alternative	9.87
Total	100.0

4.1.3.6. Cleaning of dishes, cleaning up

After cooking and eating it must wash the dishes in this scenario. The pots covered with teflon and other new healthy and safety materials. The cleaning could easier and requires less water (hot water) and detergents.

Table 25 Environmental indicators for cleaning

	Unit [kg]	Energy [MJ]	Water [m^3]	Waste [kg]	Detergent [kg]	Sewage [m^3]
cleaning	1422	32-320	1.8-3.65	25	15	1.8-3.65

4.1.4. After consumption phase

The total amount of the kitchen waste has been collected by selective method. It contents less food scraps from preparation. Less waste from cleaning phase and less packaging.

Ways of the waste treatment:

- reuse and recycling 40 %
- biocomposting and/or biogas 35 %,
- landfill 5 %,
- incineration 20 %.

Table 26 Summarising table of municipal waste deposit in Hungary 2050

	Unit [kg]	Organic, compostable [kg]	Glass [kg]	Plastic [kg]	Paper [kg]	Other (metal textil, hazardous) [kg]
Total	1422	71	50	25-30	24	10
Ways		composting & bio gas	reuse	compost or incenerating	incenerating	recycling or landfill

4.1.5 Overview of Local and Green Diet scenario

Table 27 Summarising data of the indicators for Local and Green Diet scenario

	Quantity [kg]	Energy [MJ]	Water [m3]	Pesticides [mg]	Fertiliser [kg]	Transport [tkm]	Durable [pieces]
Production	*1542*	*7294*	*45*	*325*	*0.035*	*155*	*Not inc.*
Import food	-	-	-	-	-	-	-
Acquisition	1542	-	-	-	-	1	-
Use	*1422*	*5883*	*3.0-4.85*				*3.6*
Preparation	<1422	360	0.7	-	-	-	0.6
Storing	1071	317-713	--	-	-	-	1.7
Cooking	860	4832	0.5	-	-	-	1.29
Cleaning	n.a.	32-320	1.8-3.65	-	-	-	0.01
Waste disposal	180-185	**-**	**-**	**-**	**-**	**-**	**-**
Recycling	60	-	-	-	-	-	-
Bio-composting	96-101	-	-	-	-	-	-
Landfill	5	-	-	-	-	-	-
Incineration	9-19	-	-	-	-	-	-
Total		**13177**	**49.5**	**325**	**0.035**	**155**	

Table 27 Summary data of the indicators (continue)

	Quantity [kg]	Consumable [kg]	Household sewage [m^3]	Emission	Personal travel [km]	Waste [kg]
Production	*1542*		-		-	
Food industry		14(detergents, disinfectant)	-	water, steam , BOD_5, air pollution , CO_2, CO, C,	-	-
Agriculture.		disinfectant	-	300 kg (CH_4), CO, NOx, SO_2, NH_3	-	-
Home GF		see above	-	CO_2, , NH_3, C (dust)	-	-
Import food	**-**	**-**	**-**	**-**	**-**	**-**
Acquisition	*1542*	-	-	*negligible*	*180*	-
Use			*3-4.85*		-	-
Preparation	<1414	-	0.7	-	-	-
Storing	1187	-	-	-	-	-
Cooking	1000	-	0,5	CO_2, CO, SO_2, C, steam, odour	-	-
Cleaning	n.a.	30 (detergents)	1.8-3.6	-	-	-
Waste disposal	*180-185*	-	-	*air pollution*	-	*180-185*
Recycling	60	chemicals, detergents	no data	-	-	n.a.
Bio-composting	96-101	-	-	-	-	-
Landfill	5	-	-	-	-	n.a.
Incineration	9-19	-	-	air pollution, NOx, dust, biphenils, dioxine, heavy metals (Pb, Zn, etc.)	-	n.a.

Table 28 Comparison of Local and Green Diet (LGD) scenario and the current situation (DOS 0)

Indicator	Unit	Current situation DOS 0	Local and Green Diet	Change current=100 %	Decrease [absolute]	Increase [absolute]
Materials	kg	1474	1542	104.6	-	68.75
Energy	MJ	26493	13177	50	13316	
Water	m^3	56.9-59.7	49.5	85	28.9-29.8	
Pesticides	mg	650	325	50	0	
Fertiliser	kg	0.07	0.084	50	0	
Consumables	kg	44	44.	100	0	
Durable	pieces	3.6	3.6	100	0	
Household sewage	m^3	5-7.3	3-4.85	60-66	2-2.45	
Solid Waste	kg	250-300	180-185	66	70-115	
Emissions	-					
Freight transport	tkm	310	108	36	210	
Personnel travel	km	316	180	57	136	

In the LGD scenario the energy demand decreases, because of changes in the structure of the agricultural production and food processing. The plant production requires more efficient machines, the organic production requires more labour work. The transport energy also decreases because of the shorter transport distances. The storage will be less. The non-renewable energy can decrease 25-50 %, but necessary new alternative energy. The total energy decreases about %.

4.1.6 SW analysis of Local and Green Diet

Strong points	**Weak points**
- proportion of seasonal and bio-products will increase, they will be grown in same area; no changes of the quantity; - fossil energy consumption decreases*;* - total energy consumption decreases about 50% ; - more efficient water management; - minimal pesticides; - less transportation; -local waste management	- more labour-requiring, - controlling is necessary to bioproduction

Environmental benefits of this scenario:

- 50 % less harmful soil erosion,
- 50 % less acid rains,
- 50 % less impact for global heating, escaping ozone, emission from transport,
- 50 % less toxic substances if there is an efficient monitoring and preventive biological protection in the legislated bio-farming

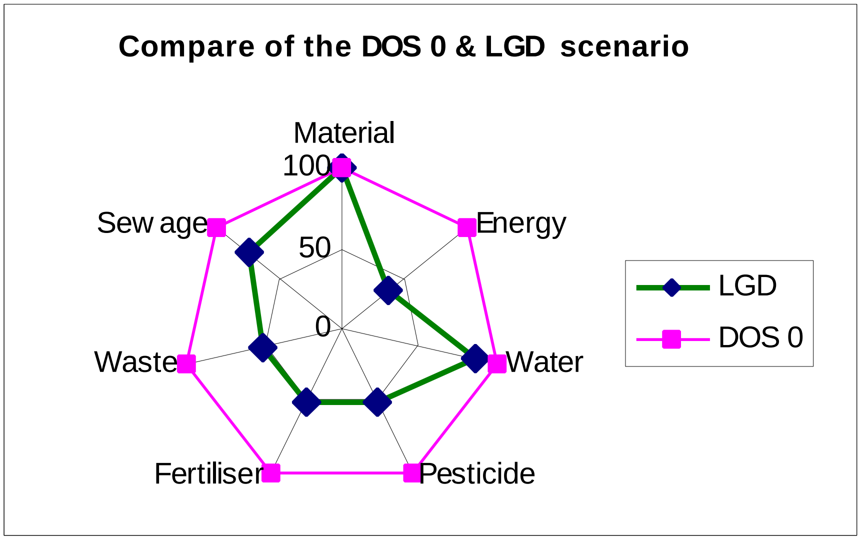


Figure 9 Comparison of current situation (DOS 0) and LGD scenario

4.2 High-Tech Rural Garden

4.2.1 Essential characteristics

Most of households (rural *and* urban) have hobby gardens suitable for food production. The household's daily routine involves working in the kitchen garden from spring to autumn. Daily working in the kitchen garden is made possible by increased spare time, flexible working time and working from home. Food production in the garden is connected based on user-friendly and environmentally friendly high-tech equipment mainly providing for family needs; though rural households will sell their surpluses in farmers' markets

Changes in High-Tech Rural Garden compared with present situation

- Only food supplements and foods that can not be produced in the region are bought in supermarkets.
- The households for self-consumption produce most of the food but the surplus is collected and sold by local enterprises.
- Food can be ordered by Internet.
- The type of the storing depends on the product feature. For the winter period they use traditional conservation or freezing method. In the gardens, stores (pantry, cellar) also belong to small buildings, which is used for storing the products in fresh state.
- At cooking 40-50% of the raw material comes from the hobby gardens of the households. They use energy saving cooking methods which preserve vitamins and valuable nutrients and meet the requirements of healthy nutrition.
- Local small restaurants available where home made type meals are served.
- After finishing cooking and consumption the wastes are collected separately. They take the organic wastes back to the garden for composting.
- During production the use of chemicals is low, the creation of wastes is excluded, since the wastes arisen get back into the production.
- Development and spreading of such product groups which make easy the high-tech production in small gardens
- The production is environmentally friendly, effective, controllable, continuous and less labour intensive. So the time spent in the hobby garden can be considered as spare-time.
- The householders get continuous, updated information on the product that is needed to produce (Internet).
- New services support the production in the small rural garden.
- The retailer sector collaborate with the association of high tech rural gardens on regional level and exactly known the actual amount and variety of home produced foods and demand of consumer (e.g. for one week) and only the necessary foods and supplements are supplied.

4.2.2 Consumption of food

The total food consumption does not change in this scenario, but their structure is changing: the consumption of fresh fruits and vegetable increases. The home growing production process is controlled by DIY monitoring and by service sector also. The consumed food from rural gardens are safety and healthy. One part of these products made by biodynamic technique. The import food decreases or stabilises on today level.

Table 29 Consumed food quantities in the HRG scenario

	Present situation Quantity of foods per household *, [kg]	Estimated food consumption In 2050 [kg]
Meat and meat products	156.25	*135**
Milk and dairy products	340	350
Eggs	37.5	30
Fats and oil	90	40
Cereals	220.5	225
Sugar	94	70
Potatoes	165.5	170
Vegetables	220	270
Fruits	150	180
Total	1473.7	*1470*
Nutrition E MJ/ year	11 245	*11 100*

*Note: *meat is mainly fish and white meat*

About 300kg fresh food and vegetable grows in the rural gardens. It produces by high-tech: computerised technology, Internet forecasting for the biological prevention etc.

Food consumption is sharing between the household and eating out (in the garden parties or *"eco-rural-garden-house-centre"* on which will be showing of new techniques, methods of rural gardening and cooking).

4.2.3 Production phase in 2050

4.2.3.1 Main characteristics of production

Agriculture

- the role of rural gardens is important but the traditional agriculture rests dominant in the mass production; the gardening going maximum on 2 % of total arable land.;
- this work is not the main activity of the people;
- there are a lot of smart, high-tech machines and equipment, which help the joint activities of neighbour families;
- very well *organised service sector*, *controlling system* and *rented high-tech equipment* help the production;
- more machines and services require more energy but the energy efficiency increases. Increasing use of bio-energy; the total energy demand increases rather than decreases.

Food processing

- old fashion food processed by traditional methods or using new, efficient equipment and processing technologies in small, local factories; there can be more multifunctional equipment and machines which work with more effectiveness;

- no changes in energy demand;
- water demand decreases;
- high level of waste management, elimination, recycling.

Table 30 Characteristics of production phase in 2050 **(present situation equal 100 %)**

	Materials [kg]	Transport [tkm]	Energy [MJ]	Re-newable [MJ]	Water [m3]	Fertiliser [kg]	BiologicalPesticide [mg]
Production of food	**100 %**	**75 %**	**116%**	**3000%**	**50%**	**150%**	**100[5]%**

Comments:

- Quantity of home growing food doesn't change, but changes the technology and the characteristics of products (e.g. new long production time and more resist seeds); lots of vegetable might consume directly from the garden without storage or conservation; it demands more protection biological dotum together with antidotum; it has not environmental burden;
- *Transport:* decreasing due to the reduction of long distance transportation; reduced energy demand.
- *Durable*: increasing because of the increase of machines and equipment
- *Waste*: local waste treatment system in the rural garden or common waste treatment by neighbour gardens; waste treatment system available in different size.

4.2.4 Use phase

4.2.4.1 Acquisition of food

- household consumes more home growing fresh vegetable and fruit;
- new types of co-operation for the sale and purchasing between the rural gardener households;
- some specific certificate product of rural gardens can be collect and sell to the shops and supermarkets also; There
- using new types of limited weight packaging materials (GM potato starch); deposit on bottles, cracks and other packaging materials at the place of acquisition;
- important factor the origin, safety and quality of food;

4.2.4.2 Acquisition of durable and consumables

- The gardens and the kitchens have energy efficiency equipment. The gardeners have and rent eco-intelligent machines and equipment. The production is connected to very developed service sectors. The fourth generation of kitchen cookers and refrigerators and use alternative energy and/or energy saving methods. Their life cycle is longer than the today's equipment. Households buy new one only every 10-12 years.

[5] The biological pesticides might 500 %.

4.2.4.3 Storing of food

The storing time of food at home is shorter then now. The purchases are more often of fresh food. The households apply traditional methods for storage. It demands less energy compare with the nowadays situation (25 % decrease of energy consumption). The more frequent eating out - more than double increase – the storage food decreases.

Table 31. Environmental indicators for storage

	Unit [kg]	Energy [MJ]	Water [m³]	Waste [kg]	Sewage [m³]
Storing	750	317-713	-	-	-

4.2.4.4. Preparation

Average household consumes much more fresh and unprocessed food (vegetable and fruits) from the gardens. The preparation phase changes. The households prepare lot of traditional home processed meals sometimes uses new preparation technologies and machines together with the neighbours. The food craps can be used at the moment in the local bioenergy system or for biocomposting.

Table 32 Environmental indicators for average household

	Unit [kg]	Energy [MJ]	Water [m³]	Waste [kg]	Sewage [m³)]
Preparation	<1320	360	077	10655	0.7

More efficient equipment decreases the energy demand in this phase.

4.2.4.5 Cooking

This activity shows similarities to the other two DOSs. This is a very important household activity in this scenario also with both traditional and high-tech kitchen technologies. The cooking habit usually doesn't change. The households use more alternative energy and home "made" energy e.g. solar, wind and bioenergy. The efficiency in the energy use is increasing. Cooking 1kg food requires only 80-85 % of present energy. New cooking methods (cooking sandwich pots) require less water. Common cooking and eating could be more frequency.

Table 33 Environmental indicators for cooking

	Unit [kg]	Energy [MJ]	Water [m³]	Waste [kg]	Sewage [m³]
Cooking	1000	9552	0.5	-	-

Table 34. The rate of different kind of energy consumption for the cooking

Fuels	Cooking energy %
Electricity using alternative energy	50
Bio gas	9
Bio-briquettes	0,03
Firewood	31
Other alternative	9.87
Total	100.0

4.2.4.6 Cleaning of dishes, cleaning up

Similar to the Local and Green Diet scenario.

Table 35 Environmental indicators for cleaning

	Unit [kg]	Energy [MJ]	Water [m^3]	Waste [kg]	Detergent [kg]	Sewage [m^3]
Cleaning	n.a.	32-320	1.8-3.65	25	15	1.8-3.65

4.2.4 After consumption phase

The total amount of kitchen waste can collect selective. The waste contents a lot of food scraps from preparation, which can be treat in the local compost or/and biogas system. Less waste comes from the cleaning phase and from the packaging materials.

Way of the waste treatment:

- reuse and recycling 40 %
- biocomposting and/or biogas 35 %,
- landfill 5 %,
- incineration 20 %.

4.2.5 Overview of High-Tech Rural Garden scenario

Table 36 Summarising data of indicators for High-Tech Rural Garden scenario

	Quantity [kg]	Energy [MJ]	Water [m^3]	Pesticides [mg]	Fertiliser [kg]	Transport [tkm]	Durable [pieces]
Production	1470	16117	25	650	0.105	233	increase
Acquisition	1470						
Use	1320	11245					increase
Waste disposal	125-150	-	-	-	-	-	-
Total %		**116**	**50**	**100**	**150**	**75**	

Table 37 Summarising data of indicators (continue)

	Quantity [kg]	Consumable [kg]	Household sewage [m^3]	Emission	Personal travel [km]	Waste [kg]
Production	***1470***		-		-	
Food industry		14(detergents, disinfectant)	-	water, steam , BOI_5, air pollution , CO_2, CO, C,	-decrease	-
Agriculture.		Disinfectant	-	300 kg (CH_4), CO, NOx, SO_2, NH_3	-	-
Home GF		see above	-	CO_2, , NH_3, C (dust)	-	-
Import food	-	-	-	-	-	-
Acquisition	***1470***	-	-	***negligible***	***180***	-
Use		30 (detergent)	*1,8-3,65*	CO_2, CO, SO_2, C, steam, odour	-	-
Waste disposal	*180-185*	- Chemicals, detergents	-	*Air pollution* NOx, dust, biphenils, dioxine, heavy metals (Pb, Zn, etc.)	-	*180-185*

Table 38 Comparison of High-Tech Rural Garden (HTRG) scenario and the current situation (DOS 0)

Indicator	Unit	Current situation	HTRG	Change, current=100 %	Decrease [absolute]	Increase [absolute)
Materials	kg	1474	1470	0		
Energy	MJ	26493	30731	116		5109
Water	m^3	56.9-59.7	28-29.8	50	28.9-29.8	
Pesticides	mg	650	650	100	0	1950
Fertiliser	kg	0.07	01.03	50	0	0.035
Consumables	kg	44		120	0	20
Durable	pieces	3.6	7.2	200	0	3.6
Household sewage	m^3	5-7.3	2.5-3.65	50	2.5-3.65	
Solid Waste	mg	250-300	125-150	50	125-150	
Emissions	-					

Freight transport	tkm	310	232.5	75	77.5	
Personnel travel	km	316	237	75	79	

4.2.6 SW analysis of High-Tech Rural Garden

Strong points	Weak points
- increasing consumption of fresh, unprocessed products - ratios of eating out increases - efficient machinery, alternative energy use (fuels) - more efficient water management - high-tech production-systems - quantity of pesticides increases - new types of GM plants - use of fertilisers will increase - transport decreases - small gardens cuold be multifunctional - distance of travel can be longer - efficient waste management	-16 % increase in power - antidotum is necessary - no human toxicity, bio-diversity is known - quick-tests, wide range controlling is necessary - more travel

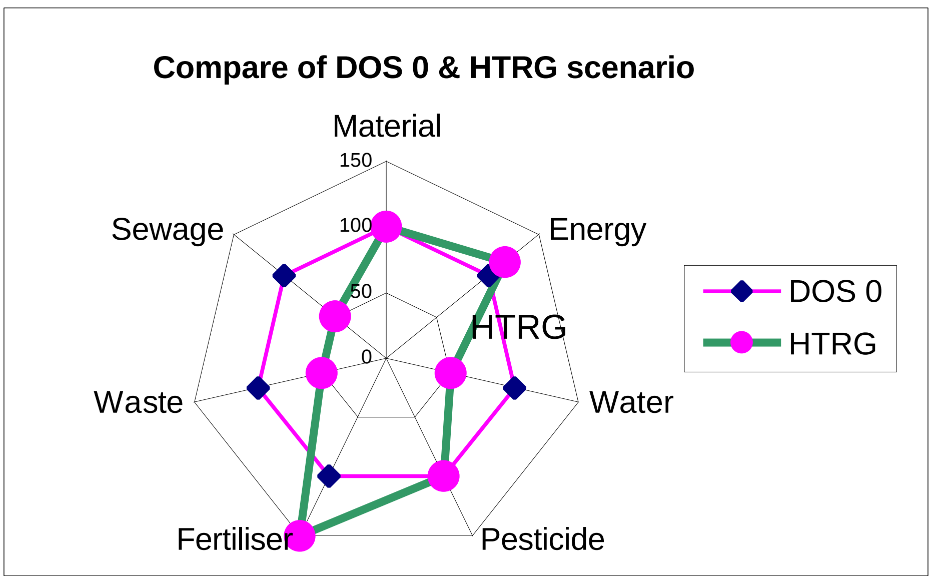


Figure 11 Comparison of current situation and HTRG scenario

4.3 Robo-Kitchen High-Tech Green (RKHTG)

4.3.1 Essential characteristics

This scenario is based on a high quality food system with environmentally friendly and very effective mass production. It meets the high-tech appliances equipped households. Shopping in super-, hyper- and megastores is a complex family programme including entertainment. This family shopping is done once a week or even once a month travelling to the site by electric cars. The consumers store the food at home. Big storage rooms are electronically monitored, cool storage are heavily used.

Changes in Robo Kitchen High-Tech Green compared with present situation

- cooking is international, which means that there are not local specialities. Widespread types of foods dominate (e.g. pizza, spaghetti, sauces, goulash, seafood, hamburger, fast food, smart food, snacks);
- programmed kitchen machines can quickly prepare the food while also maintaining their nutrition value; kitchen machines have display to show the actual change in nutrition values of food while it is prepared; computerised cooking technology is adjustable, controllable and safe; computer programs promote the creation of healthy menus; everybody can prepare his or her favourite dish;
- people can choose out of many dishes at home, but can go to restaurants or order food via the Internet as well;
- time of meals and the way they are eaten can be varied according to the needs of the family members: when, what and where they want to eat; according to customer demands, alternative recipes are provided for healthy and/or functional menus; eating in and eating out can be conveniently varied depending on the conditions;
- selective waste collecting and handling is common, which is organised by local communities and authorities; household uses less packaging and decomposable polyesters; waste and garbage handling solved at a high technical level and in an environmentally friendly way;
- time spent on cleaning or washing up after meals is minimal; built-in waste handling and waste recycling systems are working in the flats; there is no waste problem: everything is mechanised.

4.3.2 Consumption of food

Table 39 Expected consumption per household in the future

	Present situation Quantity of foods per household *, [kg]	Robo Kitchen 2050 [kg]
Meat and meat products	156.25	
Milk and dairy products	340	
Eggs	37.5	
Fats and oil	90	
Cereals	220.5	
Sugar	94	

Potatoes	165.5	
Vegetables	220	
Fruits	150	
Total	1473.7	
Nutrition E MJ/ year	11 245	

4.3.3 Production phase in 2050

- food production is globalised; food spread mainly from the sustainable food chain; very efficient mass production with energy saving; energy demand less than today; pesticide, fertiliser and GMO usage are controlled and labelled; large increase in competitiveness of firms by developing revolutionary new product-market combinations (for example producing the products with detector [indicator] together);
- small/large possible disadvantages if the firms cannot change in today's core capabilities - it must change to biotechnological methods; must control the additives into the production process etc.;
- large intensification of the existing firm structure - the largest multinational monopolies can apply first of all the monitoring system because they can apply in big mass the newer and newer additives

4.3.4 Use phase

4.3.4.1 Acquisition phase

The food, consumable and durable can be purchased on large scale (small shops, super- and hypermarkets, megastores, virtual trade. Very developed telecommunication, well organised logistic system. There are totally new ways for the shopping. The transportation has less environmental effect. The value of it will be 70 %.

4.3.4.2 Storing and preparation of food

Entirely new technology - automatic storing-cooking program, meal choosing, nutrition value controlled, additive detection at home. The preparation phase is often contact to the retail sector. It has a very simple, very efficient cooking method.

4.3.5 After consumption phase

Waste treatment

There a lot of new technologies have been adopted for reuse, recycling and energy production of solid and liquid waste.

4.3.6 SW analysis of Robo Kitchen High-Tech-Green Diet scenario

Strong points	Weak points
- highly processed food - 25% decrease in power - more efficient water management - less transport - efficient waste management	- fertiliser-use doubles - GM products

Table 40 Summarising data of indicators for Robo Kitchen High-Tech Green Diet scenario

	Quantity [kg]	Energy [MJ]	Water [m3]	Pesticides [mg]	Fertiliser [kg]	Transport [tkm]	Durable [pieces]
Production	***1474***	***10604***	***45***	***325***	***0.035***	***155***	***not inc.***
Import food	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Acquisition	**1474**	**-**	**-**	**-**	**-**	**1**	**-**
Use	1422	8924-9608	3.0-4.85				3.6
Preparation	<1422	360	0,7	-	-	-	06
Storing	1071	317-713	--	-	-	-	17
Cooking	860	8215	0,5	-	-	-	1.29
Cleaning	n.a.	32-320	1.8-3.65	-	-	-	0.01
Waste disposal	**180-185**	**-**	**-**	**-**	**-**	**-**	**-**
Recycling	60	-	-	-	-	-	-
Bio-composting	96-101	-	-	-	-	-	-
Landfill	5	-	-	-	-	-	-
Incineration	9-19	-	-	-	-	-	-
Total		**16448-17132**	**49.5**	**325**	**0.035**	**155**	

Table 40 Summarising data of indicators (continue)

	Quantity (kg)	Consumable (kg)	Household sewage (m^3)	Emission	Personal travel (km)	Waste (kg)
Production	***1474***		***-***		***-***	
Food industry		14(detergents, disinfectant)	-	Water, steam , BOI_5, airpollution , CO_2, CO, C,	-	-
Agriculture.		disinfectant	-	300 kg (CH_4), CO, NOx, SO_2, NH_3	-	-
Home GF		see above	-	CO_2, , NH_3, C (dust)	-	-
Import food	***-***	***-***	***-***	***-***	***-***	***-***
Acquisition	***1524***	***-***	***-***	***negligible***	***180***	***-***
Use			3-4.85		**-**	**-**
Preparation	<1414	-	0.7	-	-	-
Storing	1187	-	-	-	-	-
Cooking	1000	-	0,5	CO_2, CO, SO_2, C, steam, odour	-	-
Cleaning	n.a.	30 (detergent)	1.8-3.6	-	-	-
Waste disposal	***180-185***	***-***	***-***	***air pollution***	***-***	***180-185***

Recycling	60	chemicals, detergents	no data	-	-	n.a.
Bio-composting	96-101	-	-	-	-	-
Landfill	5	-	-	-	-	n.a.
Incineration	9-19	-	-	air pollution, NOx, dust, biphenils, dioxine, heavy metals (Pb, Zn, etc.)	-	n.a.

Table 41 Comparison of Robo-Kitchen High-Tech Green Diet (RKHTG) scenario and current situation (DOS 0)

Indicator	Unit	Current situation	Robo kitchen	Change, current= 100 %	Decrease (absolute)	Increase (absolute)
Materials	kg	1473	1473	100	--	-
Energy	MJ	26493	19870	75	25	
Water	m^3	56.9-59.7		70	30	
Pesticides	mg	650	650	100	0	
Fertiliser	kg	0.07	0.14	200	-	0.07
Consumables	kg	44	44	100	0	
Durable	pieces	3.6	7.2	200	-	3.6
Household sewage	m^3	5-7.3	1.5	30	70	
Solid Waste	kg	250-300	62.5-75	25	75	
Emissions	-					
Freight transport	tkm	310	217	70	30	
Personnel travel	km	316	284	90	10	

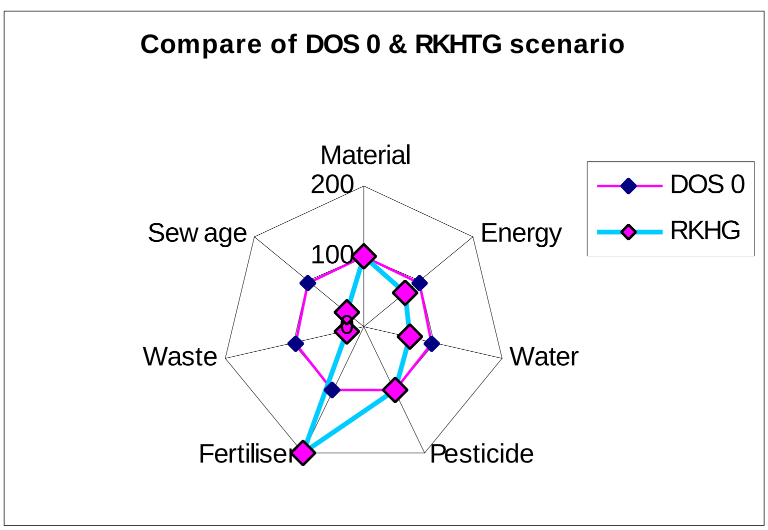


Figure 12 Compare of RKHTG scenarios & current situation

5 Conclusion Comparison of DOSs

Table 41 Environmental gains (profit) of DOSs as a result (DOS 0 scenario=100 %)

	DOS 1 Local and Green Diet	**DOS 2 High-Tech Rural Gardens**	**DOS 3 Robo-Kitchen High-Tech Green Diet**
Materials	~100	~100	~100
Energy (fuels)	? ? ?	?	?
Water	?	? ?	?
Pesticides	? ?		
Fertilisers	? ?	? ?	? ? ? ?
Waste	? ?	? ?	? ? ?
Sewage	?	? ?	? ? ?
Transportation	? ?	?	? ?
Travel	? ?	?	?

? = 0-25 % decrease, ? = 0-25 % increase

Conclusions could be drawn with respected to environmental assessment of DOSs:

- It seems that the best is the Local and Green Diet scenario in energy requirement because it is the lowest, but the other two scenario have also environmental benefits due to the use of alternative energy sources. These two scenarios fulfil also the factor 20 with connection of non-renewable energy sources.
- The pesticide use decreases in Local and Green Diet scenario because of the green or bio production. In other two scenario the use of the quantity of pesticides do not change but the pesticides changes (bio-pesticide or new software helped pesticide with anti dotum, which help decrease the environmental effect to zero level). These pesticides necessary to protect mainly the quality of corps and human health from fungi-toxin.
- In HTRG and RK HTGD can use a lot of GMOs It could be a new green revolution and the biggest changing in the agriculture and food processing. The irrigation decreases because the modified plants demand less water.
- Efficiency of water economy increases in every DOSs. The sewage will decrease the biggest in the Robo-kitchen - new cleaning method without water.
- The waste decreases 50 % in every DOSs. New technology can develop for it. The best treatment connects to the RKHTG scenario.

The Hungarian Shopping, Cooking and Eating environmental assessment has shown that the three developed scenarios could done some reduction in current environmental impacts. Of course the assessment contents some uncertainties because the DOSs were implemented on base of current knowledge, statistical data and expected trends. But the 50 years is too long distance from the nowadays. Probably the DOSs could be implemented in the future only partly, the elements of DOSs might mixed. The effect of new information and biotechnological revolution might much more and stronger changes as the researchers and stakeholders could think.

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Appendix 1

Calculation method for the energy content of food

One of the most important environmental indicators is the energy. We have not correct data about allocation of energy using in food industry by products. But we know the total energy consumption of the food production in Hungary: 26692 TJ (1996) The domestic consumption from total food is 61.2 %. We can calculate the quantity of the share of energy for the households on the following ways:

Way A

$$E_{fi} = \frac{\textbf{Total energy requirement x Domestic consumption rate}}{\textbf{Number of households}}$$

E_{fi}: Energy demand of food from food industry per one household

N_h : Number of households (4011 x 10^3)

Domestic consumption rate: 100 - export %

Every country uses these statistical data and this very simple method. It might calculate the nutrition energy easily. The allocation of resources also known.

Table 1 Resources of energy in food industry 1996

	Total	Coal	Coke	Petrol	Gas&Oil	Fire oil	Gas	Electric
Terra Joule	26692	35	415	274	1812	532	3310	20320
Per cent	100	0.1	1.5	1.02	6.78	1.99	12.4	76.13

Sources: CSO Environmental statistical data 1996, 1998

On this way the following data have been calculated the used energy of food industry per households.

Table 2 Resources of energy in food industry per household 1996

	Total	Coal	Coke	Petrol	Gas&Oil	Fire oil	Gas	Electric
E_{fi} [MJ]	4070	4.07	61	41.5	275.9	81	504.7	3098.5

Way B

26 692 TJ direct energy needs to produce food in the food industry The gross value is 945519 million HUF (4960 million ECU). So 1 HUF food production requires 0,02823 MJ energy (1 ECU food production equivalent 5,38 MJ energy).

The average expenditure of one household for food is 87 573 HUF. The calculated energy requirement of food per household is only 2472,2 MJ on this way, together with beverages and tobacco it takes 2877,8 MJ/household.

Uncertainty, that the 87 573 HUF expenditure contents the import foods direct consumed agricultural products and processed foods but it does not contents the home growing produced food.

Way C

The quantity of the main processed food products was 7758010 ton in 1996. This quantity of food demanded 26692 TJ energy, so 1 kg processed food required 3.44 MJ. If one household consumed 655 kg food from food industry, it takes 2253.2 MJ energy/household.

Uncertainty that this 7758010 ton product includes also the animal feeds, which requires higher energy usage.

Way D

On base of industrial data we got other result. Data have been collected by PRs. 1kg food processing requires 4,676 MJ energy. The total quantity of consumed food per household 655 kg from the food industry. It is requires 3062,8 MJ/household.

- A 4070.0 MJ/household
- B 2877.8 MJ/household
- C 2253.2 MJ/household
- D 3062.8 MJ/household

Appendix 2

Industrial data

Table 3 Energy use in dairy industry 1998

Products	Production [t/1000 l]	Electricity [KW/h]	Gas [m3]	Water [m3]
1. Milk	455907	28106700	7413000	1076000
2. of which in box	95740	8158000	2281500	312100
3. UHT. Milk	102676	9521100	3382100	363500
4. Flavoured milk	31820	3269800	914200	125100
5. of which in box	1910	225000	62900	8600
6. Yoghurt	50915	5359300	1498900	204700
7. Other soured milk products	64098	7004000	1958800	267300
8. Cream	9336	898500	294500	40200
9. Cottage cheese	34393	12339900	6901600	378300
10. Cheese	44269	15889000	8878100	487000
11. Condensed milk	2971	655900	523200	88800
12. Milk powder	4071	3312500	1538700	14574200
13. Butter	10515	1171600	932400	66100

Table 4 Energy usage in the meat industry1998

Products	Production [tons]	Electricity [KW/h]	Gas [m3]	Water [m3]
1. Pig ,slaughtered	671000	11051370	4059000	1838540
2. Beef slaughtered	112000	6425440	677600	753860
3. Lard and fat processing	201300	10258248	6069200	418704
4. Export cutting up	199535	2350527	12000	119721
5. Bowels processing	391500	113210055	35430700	33140475
6. Dry products	21246	10623212	1954600	174004
7. Sausage, salami	332559	66006310	14200300	4619245

Table 5 Energy usage in poultry industry1998

Products	Weight (tons)		Electricity [KW/h]		Gas [m3]		Water [m3]	
	Export	*Production*	*Export*	*Production*	*Export*	*Production*	*Export*	***Production***
1. Chicken slaughtered, cut up		41903		1.508508		1.089478		2.514180
2. Chicken innards, giblets		56163		2.021868		1.460238		3.369780
3. Chicken, total	*55021*		*1.980756*	3.530376	*1.430546*	2.549716	*3.301260*	**5.883960**
4. Turkey slaughtered, cut up		13225		2.473175		1.811825		370300
5. Turkey innards, giblets		15960		2.984520		2.186520		446880
6. Turkey total	*21512*		*4.022744*	5.457595	*2.947144*	3.998345	*602336*	**817180**
7. Goose slaughtered, cut up		578		108086		79186		16184
8. Goose innards, giblets		7939		1.484593		1.087643		222292
9. Goose, total	*22793*		*4.262291*	1.592679	*3.122641*	1.166829	*638204*	**238476**
10. Duck slaughtered, cut up		2034		138312		101700		20340
11.Duck innards, giblets		4503		842061		616911		45030
12. Duck, total	*15882*		*1.079976*	980373	*794100*	718611	*158820*	**65370**

Appendix 3

Table 6 Indicators of total energy consumption of households 1996

Fuel	Energy/household [TJ]	GJ/m^2	GJ/person	HUF/m^2	HUF/person
Electricity	31 912,6	1,401	29,859	1 275	27 710,8
Crude gas	117 607,5	0,148	3,149	388,1	8 269,5
PB-gas	8 676,2	0,822	18,620	509,0	11 523,8
Heating oil	871,5	0,092	1,900	176,6	3 638,6
Distance heating	55 500,0	0,223	4,245	728,2	13 851,8
Black coal	4 954,4	1,276	26,691	1023,8	21 413,9
Coke	1 156,8	0,963	20,574	712,2	15 214,0
Firewood	51 370,0	0,660	14,082	667,2	14 228,2
Other	30 580,5	0,728	14,332	389,1	7 663,8
Total	302 629,4	0,752	15,088	553,2	11 101,0

Note:100 HUF=0,42 GBP; 0,49 ECU;1,09 NLG;0,99 DM;1010 LIT
Source: CSO Consumption of energy in the household 1998

Table 7 Energy sources and heating value TJ

Fuels	Heating value	
Electricity	3.6	MJ/kWh
Crude gas	34.0	MJ/m3
PB-gas	47	MJ/kg
Heating oil	34.86	MJ/litre
Black coal	23	MJ/kg
Coke	2324	MJ/kg
Other	15	MJ/kg
Firewood	12.5	MJ/kg
Petrol	30.66	MJ/l
Diesel	34.86	MJ/l

Source: Office of Energy 1998