# The Environmental Burden Imposed by the Family's Activities

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*Calculations of the environmental burden from a model family's consumption show that family activities associated with eating make up more than 1/3 of the family's total consumption of resources and discharges to the surroundings. Car transport and residential heating together also account for 1/3 of the family's resource consumption and discharges to the surroundings. The remaining third of resource consumption and discharges to the environment relates especially to the consumption of goods during leisure activities around the home, clothing, hygiene and health as well as cleaning.*

## Introduction

The National Consumer Agency of Denmark and the Danish Environmental Protection Agency have asked I/S ØkoAnalyse to analyse the environmental burdens imposed by family activities inside the four walls of the home (1). The project takes as its basis consumption data from the National Consumer Agency's Family Budget for a family with two adults and two children (2). Data for typical use of electricity, water and oil for heating are added. A simplified life-cycle analysis (LCA) of the environmental factors affecting the consumption of goods by a model family has been undertaken, involving a total of 812 products connected with 22 activities in the family.

The source data for analysing environmental factors are based on, inter alia, the data material from the UMIP Project (Environmental friendly Design of Industrial Products, by the Institute for Product Development) and, with regard to chemical household products, data from the Danish Water Quality Institute (VKI).

*The method*

The method has been described in a self-contained report published by the Environmental Protection Agency (3). The appendices to the methodological report include a disk containing all the data used, in addition to which the results are all available there in the form of database files.

*Model family*

The basis for the project is the National Consumer Agency's Family Budget, which was published for the first time in 1993 (2). The National Consumer Agency's Family Budget is based on a series of model families' consumption patterns, as defined by expert groups for the purpose of identifying the requirements of different family types, assuming "reasonable" consumption. It is not necessarily an expression of the average consumption, therefore. The overall consumption for a number of household types in the budget is slightly above the average. Given this basis for the Family Budget, it represents *an example of the possible make-up of families' consumption.*

*Activities*

In our surveying work, we focus on the environmental burden of activities rather than of individual products, i.e. cleaning instead of cleaning agents. Above all, this has been chosen because it is often impossible to link specific consumption parameters (such as water) to particular products. It can only be done for an activity involving several products or parts thereof.

In the surveying work, the consumption of goods by the model family has been spread over 22 activities, which have been collected into 7 activity groups. Each of the individual activities is linked to the consumption of power, water and heating.

We have chosen to narrow the project down by including only *activities within the four walls of the home plus transport by car and bicycle* outside of the home. As in the Family Budget, the actual house with fixed installations and activities in the garden has not been included. In other words, this is not a total survey of the environmental burden from four persons. That would mean also having to include activities outside of the home, such as e.g. holiday trips, sport, entertainments, teaching and certain parts of working life as well as the infrastructure.

*Environmental data*

In order to work out how activities contribute to specific environmental problems, environmental information has been sourced from the UMIP Project's database for the manufacture of all materials used as semi-manufactures (4). Data for processing, finishing and disposal were also obtained.

The evaluation of resource consumption and discharges to the surroundings has been summarized into a series of environmental parameters and is based on the same underlying dataset used in the UMIP Project. Here, all discharges with the same environmental impact are summarized into a single figure. For example, discharged substances with a greenhouse effect have been converted into the substances' potential contribution as $CO_2$ equivalents.

*The environmental burden computed in person-equivalents*

Potential contributions to the individual environmental parameters have been converted into person-equivalents for the purposes of this presentation. By computing the family's share of resource consumption and discharges as person-equivalents, a uniform yardstick is obtained for various resource consumption and discharges.

A person-equivalent is the mean annual consumption of resources for one person or the mean annual discharge to the environment for one person. As part of the project, person-equivalents have been defined for 14 different resource consumptions and 7 different discharges to the environment. For non-renewable resources and the discharge of substances with a global warming effect, the average was calculated per citizen of the world. For renewable resources and discharges to the environment whose environmental impact is primarily of local or regional significance, the average was computed per Dane.

By way of example, a person-equivalent for dumped waste is 1,350 kg per annum, meaning that 1,350 kg waste per Dane is dumped annually. In the project, the family's annual discharge of waste for dumping is calculated as a total of 1,619 kg. It is converted to 1,619/1,350 = 1.2 person-equivalents.

The use of person-equivalents should be regarded solely as an expression of a measuring method allowing activities to be ranked relative to one another. However, it is still imperative to stress that the computations of the family's shares of resource consumption and discharges include neither evaluation of the specific resource consumptions nor environmental impact assessment of the discharges. The evaluation and the impact assessment are discussed only in the accompanying interpretations of the results.

*The database*

All the data used regarding the model family's consumption as well as the environmental burden from the use of the various materials incorporated in the products have been collected into a comprehensive database. In the database, computation routines have been modelled to compute a series of different results on the basis of data input.

The database will be found to contain the result of the computations right down to individual product level, not only as the weight of the resources used and the substances discharged but also translated into person-equivalents. Finally, average values have been computed for the person-equivalents calculated for resources and discharges, respectively. All the data used and the results computed will be found as a disk appendix to the methodological report (3).

**Main results**

This section presents the model family's contribution to *the average* resource consumption and environmental burden broken down by activity, i.e. a very general picture of the results of the charting work. The subsequent section presents the model family's total contribution to *specific* resource consumption and discharges to the environment. In the result report for the project (1), the results have been *elaborated* by showing the contribution of the activities to all resource consumption and discharges.

Taking the model family's average share of consumption of non-renewable resources and the average share of discharges broken down by the seven activity groups (Figure 1) first, the picture will be seen to be almost identical for the two statements.

**Figure 1:** ***The model family's average shares of resource consumption and discharges*** *broken down by the seven main groups of activity. The average for the resources assigns an equally heavy weighting to all 14 resources. In the average for discharges, only solid waste and air pollution have been included, not discharges to water, since they have not been computed. See the following section also with regard to the concepts of resources and discharges.*

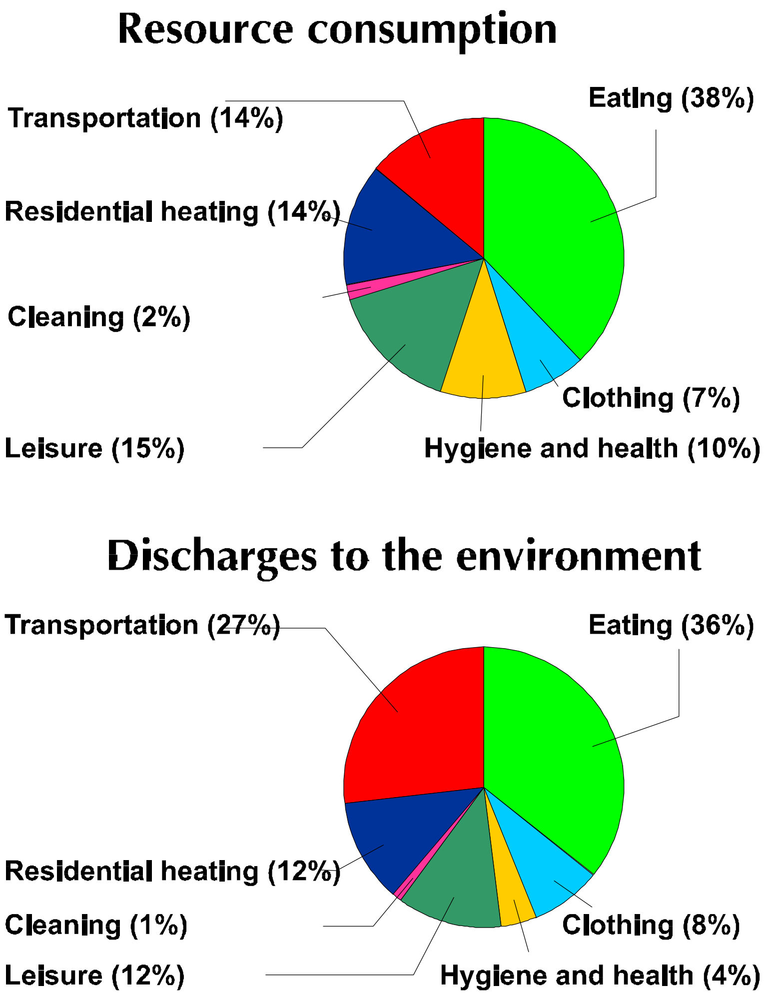


Fig. 1

*Eating generates the heaviest environmental burden*
The activity of eating (food production, shopping by car, storage, cooking and washing-up, etc.) makes up slightly more than 1/3 of the family's total resource consumption and environmental impact.

Car transport (that proportion not pertaining to shopping) and residential heating are approximately equal in size, making up just under 1/3 of the model family's resource consumption and slightly more than 1/3 of the discharges to the surroundings.

Eating, transportation and heating constitute a total of 2/3 of the model family's overall share of resource consumption and 3/4 of the discharge to the environment.

The remaining one third of resource consumption and one quarter of environmental burdens pertain to goods consumed during leisure activities around the home (incl. home furnishing and decorating), clothing (incl. washing), hygiene and health (including bathing, etc.) and cleaning.

Chart 1 on the next page shows the average person-equivalents for resource consumption and discharges, respectively, on which the circular segments in Figure 1 are based. A detailed review of the environmental burden from the individual activities within the principal groups is given in the result report (1).

***Chart 1*** ***The family's resource consumption and discharges***

*The family's shares of resource consumption and discharges computed in average person-equivalents for resource consumption and discharges within individual activities, respectively. These have been ranked placing highest resource consumption first; note that the discharges deviate from this order in few instances only. Note that the underlying data used in the computation method merely provide a basis for conclusions in which might differ by a factor two. Any value in the chart must therefore be twice as high as another in order to constitute a reliable difference, as is also the case for several of the results shown.*

**Eating**

| | | |
|---|---|---|
| Food production | 0.305 | 0.204 |
| Cooking | 0.154 | 0.055 |
| Serving and dishwashing | 0.049 | 0.028 |
| Storage of food | 0.030 | 0.038 |
| Shopping | 0.022 | 0.029 |

**Clothing**

| | | |
|---|---|---|
| Washing clothes, etc. | 0.067 | 0.061 |
| Clothes for the whole family | 0.032 | 0.021 |
| Other maintenance (sewing, upkeep) | 0.002 | 0.001 |

**Hygiene and health**

| | | |
|---|---|---|
| Personal hygiene (bathing etc.) | 0.110 | 0.036 |
| Toilet | 0.043 | 0.001 |
| Miscellaneous (make-up, etc.) | 0.001 | 0.001 |

**Leisure**

| | | |
|---|---|---|
| Television, computer, etc. | 0.086 | 0.040 |
| Furniture, lighting, etc. | 0,068 | 0,053 |
| Leisure at home (papers, pets, toys etc.) | 0.066 | 0.026 |

**Cleaning**

| | | |
|---|---|---|
| Washing floors and cleaning | 0.021 | 0.005 |
| Vacuuming, dusting, sweeping | 0.006 | 0.004 |
| Miscellaneous maintenance (polishing) | 0.001 | 0.000 |

**Residential heating**

| | | |
|---|---|---|
| Residential heating | 0.193 | 0.117 |
| Water wastage | 0.011 | 0.000 |
| Minor maintenance | 0.002 | 0.001 |

**Transportation**

| | | |
|---|---|---|
| Car transport | 0.201 | 0.264 |
| Bicycle | 0.002 | 0.002 |

**Total**

| | | |
|---|---|---|
| Sum of person-equivalents for the model family | 1.472 | 0.987 |

**The model family's total resource consumption and discharges**

This section presents the family's total contribution to specific resource consumptions and discharges to the surroundings. This is done with a view to providing an evaluation of the importance of individual resource consumptions and discharges and highlighting those activities which make the greatest contribution. In the result report for the project (1), the individual activities' contribution to individual resource consumptions and discharges has been worked out in detail.

When viewing the environmental profile in Figure 2, which shows the family's resource consumption and discharges computed in person-equivalents, it is important to remember that the height of the columns is not equivalent to the extent of the environmental problem, but is solely an expression of the family's proportion in the specific resource consumption or discharges to the surroundings.

Note that the proportion which is above the X-axis is the model family's resulting resource consumption or discharge. It has been presented here by deducting any resource recycling from the manufacturing stage and showing the recycling of that resource as a negative value below the X-axis.

*14 resource consumptions and 7 discharges*

11 different non-renewable resource consumptions, 3 renewable resources and 7 different discharges to the environment have been computed.

All the model family's proportions of resource consumption and discharges have been broken down in three phases and presented by manufacture, use and disposal. The use phase includes the use of power, water, heating and petrol about the model family's activities.

In the case of product disposal, allowance has been made for any energy exploited and resources recovered. This has been specifically computed for each individual product. In the case of some results, such as the consumption of aluminium resources (see Figure 2), the proportion of resource consumption due to disposal will therefore be negative.

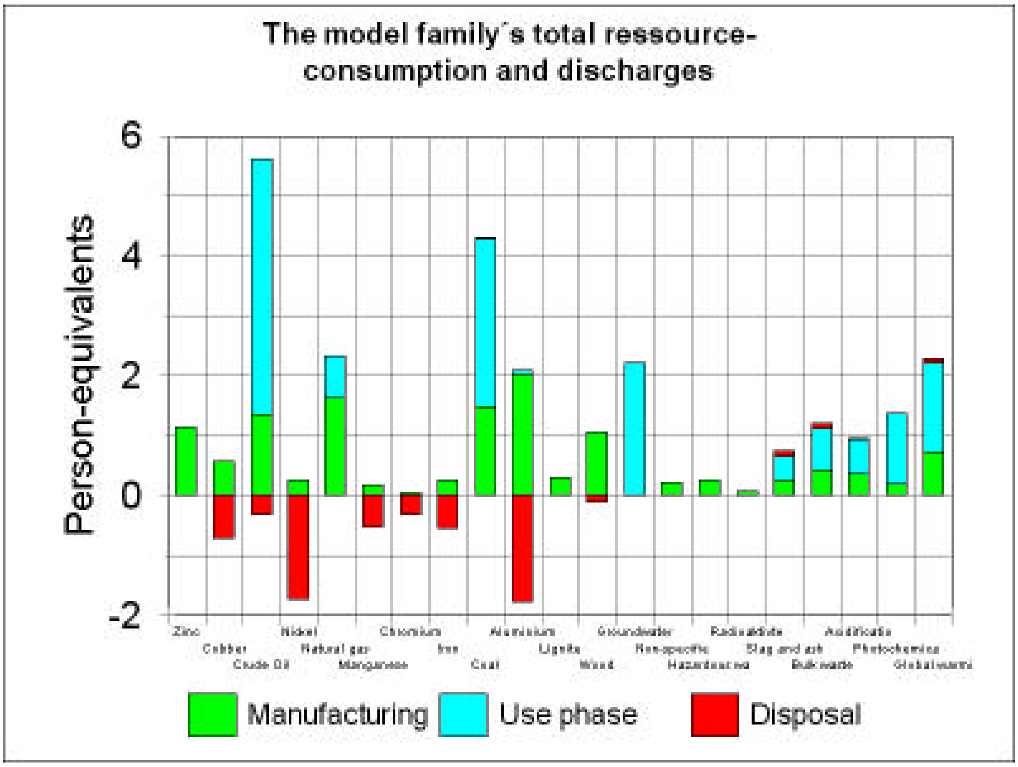


*Figure 2:* ***The model family's total resource consumption and discharges***
*The figure shows the model family's total proportions of 21 different resource consumptions and discharges to the surroundings, calculated as person-equivalents.*

*Resources*
The 14 resource proportions shown have been set out in Figure 2, with the shortest supply horizon first. The supply horizon has been calculated in international statistics. Th e supply horizon has been computed by dividing present global annual consumption int o known reserves which are economically exploitable given present-day technology.

Computed in this way, zinc has a supply horizon of 20 years, copper 36, crude oil 43 , nickel 53, natural gas 63, manganese 83, chromium 105, iron 118, coal 189, aluminium 196 and lignite 400. The res ources of wood, groundwater and non-specified/runoff water have even longer supply horizons, unless overexploited, a s is the case in some areas today.

All supply horizons, of course, whether for non-renewable or renewable resources, ar e beset by great uncertainty. This is primarily due to the definition of the supply horizon, which is based on unchanging consumption and has been defined as elastically as those resources which are economically exploitable given known technology.

There is, then, no way of say ing for sure which resources it is least advisable to consume from the perspective of sustainability. The supply horizon information for individua l resource drains does indicate, however, that supply problems are most likely to aris e quickly for those resources with a short supply horiz on, and hence that it may be desirable to reduce consumption of these resources.

*Energy resources*
The thing immediately noticeable from Figure 2 is that the model family accounts for a significant share of the consumption of energy resources such as crude oil, natural gas and coal during the application phase in particular.

Crude oil consumption is linked to residential heating, petrol for car transport and food production. In the model family, residential heating has been assumed to be an oil-fired boiler. Had some other form of heating been chosen instead, the drain on crude oil resources would have been somewhat smaller, while conversely the proportion of natural gas or coal would have been higher.

Consumption of coal during the application phase is particularly associated with electricity production. For the manufacturing phase, consumption is linked to the use of power in the manufacture of foodstuffs.

The proportion consumed of the energy resource lignite is somewhat smaller than the other energy resources, since this relates exclusively to the model family's use of products manufactured outside Denmark.

*Metals*
The family consumes a certain proportion of the most limited resources such as zinc, copper and nickel. Nickel is used in stainless steel, and a considerable amount of the material and the resources are recycled. It is the production of the model family's car and the manufacture of its entertainment electronics and domestic appliances in particular, therefore, that deplete the limited resources of zinc and copper. The resources used to manufacture the material steel are typically manganese, chromium and iron (as well as energy resources in the form of coal). The model family's part in draining these resources is limited.

The model family's proportion of the resource aluminium is largely due to the use of disposable products such as foil and aluminium packaging, for which reason the family's consumption makes up a sizable proportion of the citizen of the world's average. Considerable volumes of aluminium are involved in a number of other products, though here the metal is largely re-used, so that there is no great loss of resources. The actual resource of aluminium is found in sizable quantities and is today used in relatively small amounts per citizen of the world. The limitation is principally in the cost of the energy used to extract it, amongst other things.

*Renewable resources*
The renewable resources computed here are wood, groundwater and runoff water. The model family's consumption includes the resources of wood and runoff water, particularly from the manufacture of clothing, newspapers and advertising. The consumption of wood and surface water *per se* poses a lesser problem in the North European countries, since these resources are plentiful. The resource of groundwater is more limited, however, since some areas are suffering from overexploitation as well as constraints on usable resources owing to pollution.

*Discharges*
The model family's proportion of discharges to the surroundings has been calculated as seven types: four for waste, two for air pollution and one for climate/greenhouse effect.

The four types of waste cover virtually all kinds of waste in the manufacture, use and disposal of products. Hazardous waste takes in all waste types containing chemicals considered harmfull to the environment under the current EU Directive on Hazardous Substances (5). The model family makes no major contribution to the problems. Radioactive waste has been computed independently. Here the model family's contribution is due primarily to the use of products manufactured outside Denmark.

The waste group of slag and ash includes no major concentrations of hazardous substances, and the waste is often recycled to build roads and other installations. Bulk waste is dumped waste, predominantly household refuse for the purposes of this survey. The model family contributes considerably to both of these groups. A large contribution is generated by the use of products and is particularly attributable to the model family's use of electrical appliances.

*Air pollution*
The two air pollution parameters computed are acidification and photochemical impact. Acidification stunts the growth of forests and field crops. Photochemical impact includes the formation of smog in urban areas, with resultant health problems. In addition, the formation of photochemical oxidants interacting with acidification also affects plant growth. The model family's car transport in particular contributes to the formation of smog.

*Climatic effects*
The model family contributes considerably to the greenhouse effect, especially in the form of the energy consumed in heating, transportation and power production.

There turns out to be no occurrence of discharges with ozone depleting potential (ODP), since for the model family we have chosen new refrigerator and freezer cabinets in compliance with current regulations. Today the use of potentially ozone depleting chemicals in such products is being phased out and banned, though it is still important to prevent the escape of such chemicals when disposing of existing products.

*Impact on the aquatic environment*
Discharges into the aquatic environment have not been included in the presentation of results, since the data material has proved to be inadequate, particularly with regard to food production. Instead, a special survey has been made of the discharges to the environment from chemical household products, as these are often piped off into the aquatic environment (1&3). The results of this show that textile detergents, shampoos, toilet-cleaning agents and all-purpose cleaners have the main impact on the aquatic environment.

**Recommendations**
In conducting this project, I/S ØkoAnalyse has attempted to frame some dimensions for the debate on our environmental responsibility and the scope for action in our daily activities and lifestyle. Those areas where the greatest environmental gains are to be had, however, are areas in which we as consumers exercise great influence over the size of consumption. Yet it does call for us to change our daily usage habits in a number of areas.

Overall, the family's consumption of power, water, heating oil and petrol for transportation makes up more than half the family's consumption of resources and discharges to the surroundings. Production of the family's food is also an area of vital environmental importance.

Those changes in family lifestyle with an essential impact on the environment are thus the foregoing of energy-consuming devices such as tumble-driers and cars. Cutting down our meat consumption in favour of vegetarian food will also considerably enhance the environment, i.e. changes that require a decisive break with our present lifestyle.

Although the main conclusions point to areas in which our actual lifestyle needs to be tightened up in environmental terms, the second part of the report also details a series of proposals for minor changes to the family's actions with a positive effect on the environment.

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