

Chapter 1

Introduction

1 ► Introduction

Humans in households use energy for their activities. This use is both direct, for example electricity and natural gas, but also indirect, for the production, transport and trade of other goods and services.

The main objective of this thesis is to gain insight into the energy requirement associated with household consumption patterns, with a focus on (I) the quantification of the energy requirement of the present consumption pattern and its various components, (II) differences in the energy requirement between groups of households and, (III) the development of the average consumption pattern in the past and future. The underlying motive stems from the interest in reducing or limiting the energy requirement of society to contribute to a more sustainable world. The total (direct plus indirect) energy requirement of consumption patterns will first have to be quantified before an answer can be given to the question of how the energy requirement caused by consumption can be decreased.

This chapter will first explore the relationship between human energy requirement and the pursuit of sustainability. This will be followed by the motivation for choosing consumption patterns to describe society's energy requirement. The chapter will end with the thesis objective and outline.

2 ► Energy requirement and sustainability

The availability of energy allows many people to enjoy unprecedented comfort, mobility and productivity. In industrialised countries humans now use 100 times more energy than in the past, i.e. before they had learned to exploit the energy potential of fire (WEA, 2000).

In Agenda 21, the United Nations and its member states strongly endorse the goal of sustainable development (UN, 1992), a concept that implies meeting the needs of the present generation without compromising the needs of the future generations (WCED, 1987). Sustainable development is also required for the global energy system. Energy is very important in maintaining economic activities and the accompanying consumption level. In the World Energy Assessment (WEA, 2000) sustainable energy is defined as energy that is produced and used in ways that support human development in the long term with all its economic, ecological and social dimensions. Today's energy system can be concluded as not being sustainable. This is due to equity issues, and environmental, economic and geopolitical concerns, with implications reaching far into the future. According to WEA (2000), the following aspects in the current energy system reflect unsustainability:

- Energy carriers such as fuels and electricity are not universally accessible,
- The current energy system is not sufficiently reliable for widespread economic growth, and
- Negative local, regional and global environmental impacts of energy production and use are threatening to the health and well-being of current and future generations.

WEA (2000) mentions the use of renewable energy sources, next-generation technologies and greater energy efficiency as options to address these aspects of unsustainability. WEA's interpretation of 'greater energy efficiency' is related to the improvement of products and processes in technical or operational terms. However, energy consumption may not only be limited or reduced by improving the energy efficiency, but also by changing consumption patterns. IPCC (2001) mentions change in consumption patterns as a possible option for alleviating the effects of climate change.

Changes in consumption patterns normally go hand in hand with changes in the economic structure of society. According to IPCC (2001), the option of 'changing

consumption patterns' is insufficiently explored. Analyses outlined here should be helpful in exploring the feasibility of changing consumption patterns.

3 ► Energy requirement from the perspective of consumption patterns

All products and services produced by an economic system are ultimately meant for consumption, mainly by households. Even if the products or services concerned are not directly meant for consumption in households, they do lead to investments or other products to make consumption in the future or later in the production–consumption chain possible. If consumption patterns change, the economic structure will also change. As economic activities vary in energy intensity¹, changes in economic structure may very well affect the energy requirement of society.

In this thesis the choice was made to examine the energy requirement of society from the household perspective to give insight into the possibilities of reducing or limiting the energy requirement of society through changing consumption patterns. Contrary to the traditional sector approach, here, we are required to look at an alternative cross-section of the economy, where all the energy required by society is allocated to the products, 'consumed' by consumers living in households.

The allocation of the required energy to the products and services that consumers purchase can be done using an input–output analysis or by applying process analysis. Energy input–output analysis as a method to achieve this aim was described and applied long ago, for instance, by Wright (1974) and Bullard and Herendeen (1975). Using an input–output analysis, Schipper et al. (1989) calculated that about half the energy requirement of households in the USA in 1986 was indirect. The respective calculations for the Netherlands in 1987 and 1990, made by

¹ The energy intensity of a product/service is defined as the required primary energy for the product/service divided by the costs of the product/service in monetary units. Energy intensity can be expressed, for instance, in megajoules per Euro.

Van Engelenburg et al. (1991) and Wilting (1996), also showed that about half the household energy requirement is indirect.

An input–output analysis gives a good view of the total required energy for household consumption, providing a breakdown into main consumption categories such as food, dwelling or transport. However, to observe the effect of more detailed changes in the consumption pattern on the energy requirement, a more accurate method such as process analysis (see e.g. Boustead and Hancock, 1979) is required for analysing the energy requirement of consumer products. Since the application of process analysis is very labour intensive, we applied a hybrid energy analysis method combining input–output analysis and process analysis. A hybrid energy analysis, also suggested by Bullard et al. (1978), combines the rapidity of the input–output analysis and the accuracy of the process analysis.

4 ► Objective and outline of this thesis

The main objective of this thesis is to gain insight into the energy requirement associated with household consumption patterns, with emphasis on:

- Quantification of the energy requirement of the present consumption pattern and its components;
- The household characteristics responsible for differences between the energy requirements due to the consumption patterns and
- The development of the consumption pattern in the past and trends for the future.

The underlying motive is the interest in reducing or limiting the energy requirement of society to contribute to a more sustainable world.

The main objective gives rise to the following specific research questions:

1. How do the energy intensities (defined as the ratio of the primary energy requirement to the consumer price) for the different consumer goods/services for Dutch households differ from each other? If the energy intensities related to consumer goods/services differ sufficiently, changes in consumption patterns can lead to a significant change in the energy requirement of society.
2. What is the average composition of the present Dutch household consumption pattern in financial and energetic terms, and which consumer goods or services are

the most important in determining the energy requirement of consumption? To develop a strategy to reduce society's energy requirement by changing consumption patterns, it is important to know, on average, which consumer goods or services contribute more and which contribute less to the total energy requirement.

3. Do individual Dutch consumers have a choice in influencing their consumption patterns and the accompanying energy requirement? To find out how large the reduction in the energy requirement can be by changing consumption patterns, it is important to have a view of how large the reduction in energy requirement can be if alternative consumer products are chosen. This question will be dealt with only briefly in this thesis.

4. Do the consumption patterns of Dutch households and the resulting energy requirements of various groups of consumers differ from each other? We may be able to learn from groups of consumers who require more or less energy than the average consumer. What household characteristics mainly determine the total energy requirement of consumption? It will be especially interesting to learn to what extent consumer values have influence on the energy requirement.

5. How have the average Dutch household consumption pattern and the resulting energy requirement changed in the past decades, and how can the consumption pattern change in the coming decades? More knowledge on changes in the consumption pattern in the past and possible changes in the future will provide important information on how easy or difficult it will be to realise changes.

Chapter 2 describes the hybrid energy analysis method, and reviews its suitability for calculating the energy requirement of consumption patterns. By calculating the energy requirement of consumption patterns, the energy requirement for the complete life cycle for all consumed products and services have to be taken into account. This includes the energy requirement to extract, refine and transport the energy carriers themselves.

Chapter 3 contains a case study on the energy reduction potential as applied to one single consumption category², flowers, which can be achieved by changing consumption patterns (research question 3). The aim of this chapter is to examine how households can reduce their primary energy requirement for the decorative and gift functions provided so far by cut flowers without reducing their consumption level, also taking into account the financial cost.

Chapter 4 answers the research questions 1 and 2 in an overview of the energy intensities of all consumer goods in Dutch households in 1990. The consumption patterns of these households are also presented here, including an outline of the influence of several important variables determining the total energy requirement of consumption (research question 4).

Chapter 5 outlines how the energy requirement varies, due to differences in consumption patterns of consumer groups (research question 4). The consumer groups are distinguished according to their values, problem perception or motivation to save energy. In addition to the method used in Chapter 3, the energy requirement here has been largely assigned to consumption on a physical basis, which is more accurate than consumption on a financial basis.

Research question 5 is answered in Chapters 6 and 7. Chapter 6 presents the development of the average consumption pattern of households between 1948 and 1992, a period in which the indexed household consumer expenditure approximately tripled. Chapter 7 shows, for two widely accepted scenarios, how the average consumption pattern and the energy requirement due to this consumption pattern can develop autonomously between 1995 and 2030.

² A consumption category is a group of consumer goods or services which belong together.

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