Evaluation of Options for Reduction of Greenhouse Gas Emissions by Changes in Household Consumption Patterns

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SUMMARY

The Dutch government aims at fulfilling the international commitments with respect to a reduction of the nation wide emissions of greenhouse gases (GHG). Reduction of the energy consumption is an important option to reduce these emissions. The awareness of the necessity of energy conservation led to several conservation programs. Most of these programs only consider the potential for energy savings at the level of individual production sectors and individual consumption items. Implementing energy conservation potential into one specific sector (on the micro level) may lead to increased energy consumption elsewhere within the production and consumption chain. For instance, the production of cars with a lightweight material composition (high content of aluminium or magnesium) in order to reduce the energy requirements whilst driving, results in a higher energy requirement and higher GHG-emission levels in material production sectors. This so-called problem shifting and burden shifting effect is a widely known problem, which results from micro level optimisation approaches. Therefore, in order to research energy reduction potential on the national scale, a more integrative approach is required, which addresses the macro level relationships between various sectors and the relation between production and consumption.

Over the last decade, methodological approaches have been developed to study such energy use patterns at a national scale. These approaches adopt the central assumption that all production activities take place to serve consumption. This assumption implies that all energy used within an economy can be allocated to final consumers. The collective household sector forms the main final consumption sector. Therefore, the energy used in various production sectors in the economy is re-attributed to the households in accordance with the amounts of goods and services purchased by those households. From this methodological perspective, two flows of energy into the households are distinguished. Firstly, direct energy requirement, which sums up the energy used by the households in the form of energy carriers such as natural gas, electricity and petrol. Secondly, the indirect energy requirement, which sums up the energy attributed in the production and distribution of goods and services purchased by the households. The total energy consumption of a household is the sum of both indirect and direct totals.

During the first phase of the National Research Programme on Global Air Pollution and Climate Change (NRP-1) the Lifestyle project was performed (Biesiot & Moll, 1995). In that project the methodological approach mentioned above was developed and elaborated to several methodological tools used to quantify the direct and indirect energy-flow patterns in the economy, and to calculate the energy requirements related to household consumption items and the entire household consumption pattern.

The total energy requirement of the average Dutch household amounted 240 GJ in 1990. This amount is split up in 110 GJ direct energy requirements and 130 GJ indirect energy requirements. It was also found that large differences exist between households (differences of up to 25% were found). It was concluded that a substantial reduction potential existed for the household energy requirement.

This conclusion generated new research questions: what are the possibilities of implementing this potential and what are the effects of such policies on the household, the production sectors and society in general. Analysis at two levels is required to answer these questions. At the household level the consequences for household behaviour and their related acceptance for low energy consumption patterns should be determined. At the national level it is necessary to study the effects of changes within the household consumption patterns on the rest of the economy as well as the effect of changes in production and service sectors on the total energy requirement of households. In the GreenHouse project these questions were studied applying methods and knowledge from both energy analysis as from household analysis. Besides the CO2 emissions that occur mainly from fossil fuel combustion also emissions of other greenhouse gasses are taken into account.

In practice this means that a large number of changes within the present household practices are identified that may lead to reductions of GHG-emissions. These changes could include change in purchase behaviour (other products) change in household behaviour (apply line drying) or a combination (change of menu composition). These changes were designed in such way that impact on household behaviour was relativity small (instead of change to a complete vegetarian lifestyle just less meat was suggested).

In the next step the options considered were quantified: the reduction of GHG-emissions due to implementation of options by all households was calculated.

In the following step only options that lead to larger reductions than 0.5-1% of the emissions were taken into account. These options are mentioned in table 1. This

overview shows that reductions can be achieved in nearly all activities within the households varying from purchase of other presents, longer wearing of clothes and change in menu composition.

The effect of implementation of all these options into all Dutch households was calculated using an input/output model. It was found that implementation of all the options resulted in a 27 % reduction of the GHG-emissions at the national level.

From a national perspective, reduction of GHG-emissions can occur via two routes: via changes in the households, but also via changes in the production sectors. Households cannot affect production sectors, but improvements in these sectors affect household consumption since indirect energy requirements of products purchased decrease. When efficiency improvements in the production sectors are taken into account a 30 % reduction of national GHG-emissions is achieved. The combination of both results in an over 54 % reduction of the national GHG-emissions. This is a remarkable result since it shows that by introducing a large number of small changes in household behaviour a large reduction of the national GHG-emissions can be achieved.

The actual reduction that can be obtained via this route depends on the number of households that are willing to change their behaviour (implement the suggested options). This was studied in the final part of this project, through a survey among 350 households.

This survey showed that none of the options scored high levels of acceptance. The highest scores of acceptance are at a level of 30%. Options with a moderate acceptance level demonstrate some common characteristics; they increase the energetic efficiency (through modified appliances and lightning systems) and their implementation has few behavioural effects; or they intensify behaviour already present in the household (eating one more vegetarian meal per week in households which have already adopted a partly vegetarian diet). Important options with a (very) low acceptance level concern shifts in the mobility pattern or the abandonment of appliances, which already present in the household.

These findings imply that the current reduction of GHG-emissions, as a result of changing consumption patterns, lies in order of 5% (assuming that when households mention that they are accepting some options, they will definitely implement these).

This relatively low acceptance of options was analysed in more detail. Households vary substantially in their activity patterns used to fulfil basic needs. Many options are

therefore only relevant to a small minority of the households. Scarcity of resources, or the lack of relevant facilities within a specific household, impedes the effective implementation of options in many cases. In addition, lack of information and absence of relevant knowledge was found, primarily with regard to indirect energy embodied in products, which impede the households in making well-founded choices from an energy-reduction perspective.

The present behaviour of a household is explained by the tendency to optimally apply the available household resources to attain a certain standard of living. Lack of acceptance of household behavioural change asked for environmental reasons should not be interpreted as a capricious, indolent or stubborn rejection of necessary transformation, but should be analysed as a source of conflicts with the current household strategy to meet its standard of living.

The adoption of environmental friendly behaviour fits generally with the social norm to conserve the quality of environmental systems in order to guarantee the liveability of the world for present and future generations. However this socially accepted environmental norm competes with many other social cultural norms, rooted deeply in present society. For instance, GHG-emission reduction options which imply an increase of labour in the household or decrease the efficiency of the household organisation, are conflicting with the general trend of labour saving and efficiency increase in the society and with the high emphasis on maintaining enough time for leisure, sport and personal development. Another conflict is found with regard to options affecting mobility and holidays. The present social norm with regard to mobility, also embedded in the present infrastructure, is the free availability of car mobility. The norm with regard to holidays, also supported by the aviation tariffs, is the expansion of the personal horizon to a global level. So we can understand the low acceptance of the 'mobility and holiday' options in the research. In these cases the social norms with regard to mobility and holidays dominate totally the environmental norm.

Although for methodological reasons all emissions are attributed to consumption (=households), this does not imply that households are fully responsible for the total energy requirements related to household consumption, and that the households should carry the full burden of reducing energy use and GHG-emissions. The other sectors in society must attribute their share. As long as environmental norms are of limited importance within in society as a whole, individual households have not

enough opportunities for an environmental friendly behaviour and reduction potentials will never be reached.

Concluding remarks and recommendations

The research done within the GreenHouse project showed that a large potential for change exist within in the present household practices. When both in the consumption as in the production sectors energy efficient changes are incorporated an over 50% reduction of the GHG-emissions at national level can be achieved. However, the present situation in household makes that on the short term the expected reduction is much smaller. This is due to the fact that households face several limitations for adopting suggested changes. In the first place it is shown that necessary knowledge is lacking in the households. Secondly it is shown that households are willing to purchase efficient household appliances, but that their accessibility is limited. And at the third place that present infrastructures limit households in their opportunities to chose an energy efficient lifestyle. Results found are in accordance with other studies on this subject.

To increase the feasibility of reduction options designed in this project the following recommendations are made: Households should have access to tailor made advise with respect their energy use (both direct and indirect). The production of energy efficient household appliances should be promoted. In decision processes with respect to infrastructure the effect on household practices should be included.

Table 1 Overview reduction options

Feeding
No greenhouse vegetables
Less meat
More vegetarian
Shopping on bicycle
Use delivery service
Refrigerate/freezer to cellar
More efficient refrigerator/freezer
Change from electric to natural gas
Wash dishes by hand
Less rinsing
More efficient dishwasher

Clothing
Change from synthetic to cotton
Longer wearing of shoes (better quality)
Less frequent washing
More efficient washing machine
More efficient tumble dryer
Apply line drying
Sharing appliances other household
Lifetime extension appliances

Housing
Efficient heating and hot water systems
Lower room temperature
Efficient lighting
Natural floor covering
Lifetime extension furniture
Less cut flowers as decoration

Other consumption
Sharing daily and weekly papers with other household
Sharing tools
Sharing cars
Driving less
Sharing caravan
Holiday nearby
Holiday by train
Other accommodation than hotels