

Education, training, tools and services to enhance sustainable household consumption

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Abstract

Household consumption (housing, mobility, food, goods and services) accounts for about 70% of the carbon footprint of Finland (i.e. greenhouse gas emissions caused by the domestic final use of products). The Final Draft of the IPCC 2014 report on climate change mitigation emphasises the need for diverse actions across sectors that are required to limit global warming to 2 degrees Celsius. Changes in human behaviour and consumption patterns are recognised as important parts of the mitigation acts to cut emissions. These changes in consumption are essential also because of the possible rebound effect, i.e. that the technical improvements can be offset by increased consumption.

Ecological sustainability of consumption, and especially housing, was the focus of the Finnish Ecohome project. The aim of this project was to help households decrease their energy consumption and carbon footprint. The project consortium identified four main target groups to work with. Professionals and small and medium-sized enterprises (SMEs) providing maintenance and renovation services for households and housing corporations, teachers of general education, regional advisory centres for energy and environmental issues, and non-governmental organisations (NGOs) that guide ordinary people towards more sustainable consumption. The target groups were seen as important intermediaries to support households in increasing energy efficiency and reducing their carbon footprint.

Practical outcomes of the pilots include the following: educational tools and programmes for the professional audience and young people (in schools), support for SMEs to develop business models related to energy-efficient maintenance and renovations of residential buildings, energy expert activities and interventions in blocks of flats, carbon footprint calculation tools for ordinary people, tool-supported action models for discussing carbon footprint and mitigation measures with people, and cooperation to advocate sustainable lifestyles. SMEs gain knowledge and tools to develop their business models and better respond to the need to increase the energy and cost efficiency of housing. NGOs and teachers of general education acquire tools, data and support to strengthen sustainability and carbon footprint perspectives in their work. These activities were also designed to support and supplement Finnish program for sustainable consumption and production, aimed at decreasing climate and other environmental impacts of consumption.

This article summarises the results of the pilots and experiments and it discusses the learning and potential for further application and spreading these kinds of educational approaches, tools and action models.

1 Introduction

Household consumption (housing, mobility, food, goods and services) accounts for about 70% of the carbon footprint of Finland (i.e. greenhouse gas emissions caused by the domestic final use of products (Seppälä et al., 2011)). The Final Draft of the IPCC 2014 report on climate change mitigation (IPCC, 2014) emphasises the need for diverse actions across sectors that are required to limit global warming to 2 degrees Celsius. Changes in human behaviour and consumption patterns are recognised as parts of the mitigation acts to cut emissions. Girod et al. (2014) have reviewed carbon footprints of products in five consumption categories (food, shelter, travel, goods and services) and conclude that changes in consumption have the potential to significantly contribute to reach the climate target limiting global warming to 2 ° C. Changes in consumption patterns are essential also because of the possible rebound effect, i.e. that the technical improvements can be offset by increased consumption (see e.g. Adato energia, 2013; Chitnis et al., 2013; Ajanovic et al., 2012). The change in consumption patterns may also have (positive) spill-over effects (Hertwich, 2005).

Housing typically accounts for roughly one-third of all greenhouse gas emissions from Finnish households (Seppälä et al., 2011). Therefore, housing and energy consumption, and especially heating, typically offers the highest potential for reducing a household's carbon footprint. In addition to regulations related to energy and material efficiency, behavioural aspects and the energy efficiency of appliances have a role in the reduction of housing's carbon footprint (Ministry of Environment, 2012). Food and car travel are the other two major contributors to citizens' environmental impacts when several environmental impact categories are considered (Seppälä et al., 2011; Saarinen et al., 2011; Ministry of Environment, 2012). The composition of average per capita greenhouse gas emissions in terms of private consumption per capita in Finland is presented in Figure 1.

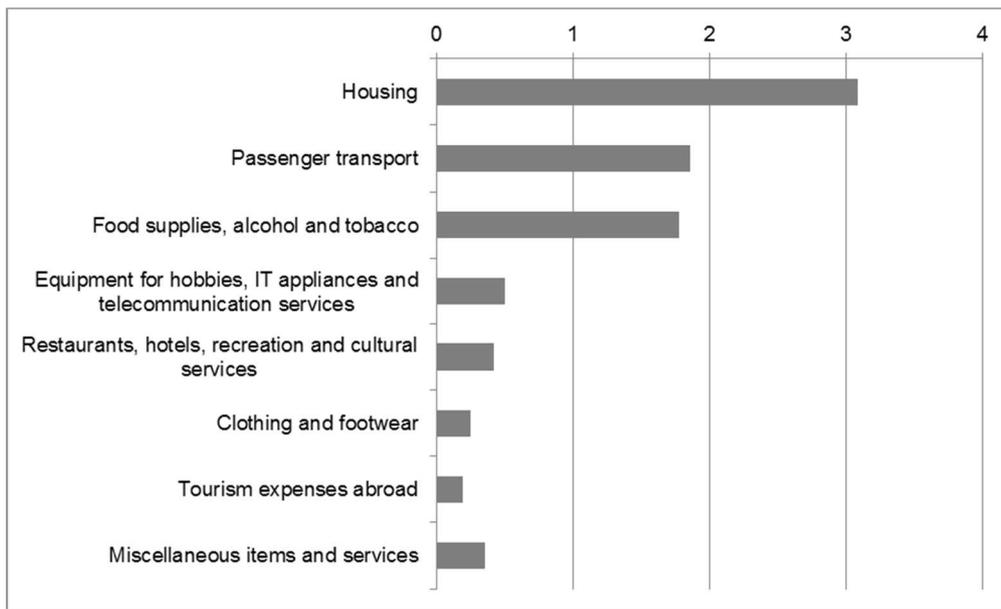


Fig. 1. Greenhouse gas emissions from private consumption in tonnes CO2 equivalent per person in Finland in 2005. Based on data from Seppälä et al., 2009.

According to an EU-wide survey (Eurobarometer, 2013), 84% of the Finnish population considered climate change to be a fairly or very serious problem. This represents an increase of three percentage points compared to 2011 (Eurobarometer, 2011). In 2013, 57% of the Finnish population indicated that they had personally taken action to tackle climate change. The respective figure for 2011 was 65%. In a Finnish study on housing choices, the environment seemed to be the least important factor affecting decisions on location and the type of a residence (Strandell, 2011). Eurobarometer results indicate that Finnish citizens are worried about environmental issues and are at least in some way ready to change their consumption patterns and lifestyles. The question is how to convert the willingness to take action into changes in everyday life.

The role of intermediaries or middle actors (Parag and Janda, 2014) is considered to be important in relation to household consumption. In this paper NGOs, municipal energy offices, private enterprises (e.g. retail stores and SMEs) are considered as potential intermediaries or middle actors. The listed agents are all involved in the everyday lives of households or decisions on consumption and housing.

This article looks into the experiences of the Finnish Ecohome project. Its aim was to help households to decrease their energy consumption, and reduce the carbon footprint through less carbon-intensive consumption patterns, changes in lifestyles, and renovations improving the energy efficiency at home.

2 Context of the study

There are 2.1 million households in Finland. The means to reduce households' energy consumption and carbon footprint are, at a general level, widely applicable for all households: reducing heating energy and electricity consumption at home, reducing the demand for travel and switching to low carbon modes of transport (active travel, public transport and low emission vehicles), decreasing the amount of meat and dairy products in one's diet, and minimising food waste. The relevance of consumption categories and the applicable tools and solutions to make changes in the consumption patterns varies between households, however. For instance, 44% of Finnish households live in flats, 40% in detached houses, and 14% in attached houses, and the rest (approximately 2%) in other types of housing (Statistics Finland, 2014). The share of housing stock built before 1990 is 73% for detached houses and 77% for blocks of flats (Statistics Finland, 2014). Consequently, measures to tackle the energy consumption of existing housing stock are important in order to achieve reductions in the carbon footprint of the Finnish housing sector.

When developing energy saving concepts for detached houses and blocks of flats, there are certain housing type-specific technical and administrative characteristics that need to be taken into account. Households living in detached houses are typically responsible for taking care of their house, while for flats and attached houses the housing companies are responsible for arranging maintenance and major renovations. Blocks of flats are typically managed by a housing board and a professional house manager. The housing board consists of elected representatives of the flat owners. The role of the board and the manager are essential when major renovations are prepared and the guidelines for the maintenance work are set. The flat owners are collectively responsible for the costs of major renovations and maintenance. Space heating energy (typically also including centrally heated water) in the whole building and the electricity used in common areas are usually collectively paid for by the owners. The electricity used in the flats is paid by the users. The owners of detached houses are exclusively responsible for the maintenance and renovations of their premises. Knowledge and skills among house owners vary. When major renovations are needed, there is a need for unbiased information, independent from any single technical solution, to find the best solution for the house.

Citizens and relevant stakeholders need relevant information and motivation to take action to be able to make informed decisions and choices. The effectiveness of the information distribution alone can be questioned, because environmental action is affected by the personal and shared values of the community, situational factors and the type of motivation (Ahonen, 2011; Barr, 2003). When designing interventions to encourage pro-environmental behaviour, the following questions can be helpful (Steg and Vlek, 2009):

1. Which behaviours should be changed to improve environmental quality?
2. Which factors determine the relevant behaviour?
3. Which interventions could best be applied to encourage pro-environmental behaviour?
4. What are the effects of the interventions?

Information and advice about sustainable choices are already provided by municipal energy offices, NGOs, and the energy and waste management companies in Finland. The information is available on the internet, by phone and in person. The challenge is to provide the right information when decisions and choices are made, in a format that the citizens find interesting, useful and trustworthy.

3 Design of the project

In this chapter, the design of the project and expected outcomes are described. First, the more specific scopes and preliminary targets of each pilot are described. Then, an overview of the process developing and improving the action models during the process is provided. The word "pilot" refers here to the activities taken to test new tools, educational programmes and business concepts, for example. The phrase "action model" describes reproducible concepts based on the learnings of the pilots.

3.1 Defining the scopes of the pilots

To meet the general aim of the project, partners of the project defined a more specific scope, based on their specific area of expertise (i.e. training; advice and support for households; energy-efficient construction, renovation and maintenance; web-based tools). The action models need to tackle significant elements of a household's carbon footprint and develop measures included in proposed policy instruments to decrease the carbon footprint of households (Nissinen et al., 2014), and the action models must have the potential to be further used or developed by either the project partners or other stakeholders following the end of the project. Three of the pilot projects focused on housing issues. The other two had a broader focus on everyday consumption patterns and behaviour related to energy use. In total, the project focuses on both everyday consumption patterns and more effective but much less frequent actions, e.g. the changing of a heating system. The following working titles and questions for pilots were used as a starting point for the four pilots.

- Training programme for professionals for supporting house owners and managers in major renovations and maintenance and related business models

How can homeowners facing the need for major (energy) renovation access unbiased information on the potential and suitable options? How can home owners be made more aware of the costs of different choices when the whole lifespan of the system is taken into account?

- Energy management of housing companies

How inhabitants in blocks of flats and attached houses and key persons of housing boards could be encouraged actively save energy through better maintenance and behaviour changes?

- Tailored advice for households based on the measured consumption data and tailored advice by eco-trainers

Can household-specific and real-time measurement systems, together with tailored advice, help households change their consumption patterns and reduce their carbon footprint? How can various professionals that visit homes, like cleaning and other service providers advice also for sustainability at home?

- Web-based tools and face-to-face communication to improve the sustainability of everyday lifestyle choices

How can a web-based carbon footprint calculator and related activities be used to raise awareness of one's carbon footprint and actions to reduce it? How to use calculator in discussion with ordinary people about carbon footprint and mitigation measures?

The business-related pilots focused on SMEs. The potential role of SMEs in energy efficiency improvements in the existing housing stock is recognised in the literature, as well as the challenges related to the fragmented nature of the sector and the markets (e.g. Killip, 2013; Heiskanen et al., 2011).

In order to provide meaningful and understandable information for households, the project team needed to choose key concepts to be used when communicating with the households. The concepts of carbon emissions and footprints, as well as direct energy consumption at home, were the most commonly used units of measurement in the project. A person's carbon footprint connects personal consumption with global environmental change. A carbon footprint also allows for the comparison of the relevance of different consumption sectors with each other. Direct energy consumption and the costs of energy were also important where the energy efficiency and costs of renovation options were concerned. Indoor air quality, general quality of housing and the value of the house can be used as motivational factors. Other aspects of sustainable consumption (i.e. eutrophication related to food items, social aspects) were also discussed in relation to everyday sustainability issues.

3.2 Process of planning the pilots and developing the action models

The approach used in the Ecohome project took ideas from action research (Ottosson, 2003). The project team took part in the activities in roles such as developer, participant and observer. The advantages of participation action research include rapid feedback from the field. Working with the target groups in person may help to understand unspoken needs and demands.

In the early phase of the project, the preliminary versions of action models were presented in a stakeholder workshop before starting the fieldwork. The idea was that the concepts were to be further developed during the project based on the experiences and feedback. There were three main sources of feedback to be taken into account: (1) two expert and stakeholder workshops, to review the action models and experiences so far; (2) practices to develop the concept together with participants, and the constant spontaneous and written feedback until then; and (3) the project advisory board consisting of experts from various fields related to the project, and the network of the Finnish Programme to Promote Sustainable Consumption and Production (KULTU).

The first expert and stakeholder workshop, which hosted 44 participants, was organised at the beginning of the project. The preliminary action models were presented, and sessions for separate working groups were held to get feedback and identify possible missing stakeholders who should be involved. The second workshop, with 33 participants, was organised after the majority of the fieldwork had already been conducted, but the action models could still be further developed during the project. A third meeting, a panel discussion, will be organised at the end of the project. The action models and the preconditions for the more extensive use of the results will be discussed with relevant policy-makers and other stakeholders.

The viable future demand and supply of the services and actions developed during the project depend on how relevant and useful the target groups consider them to be. This means that the pro-environmental behaviour needs to be considered as meaningful from the households' point of view, as a viable business for entrepreneurs, and that it supports NGOs in raising sustainability aspects on their agendas. A critical aspect to be studied during the project is the funding of the action models. In other words, is there a willingness among entrepreneurs to pay for the training and among households for the services? What kind of service concept is cost efficient yet still provides meaningful information for customers? Are there policy instruments that the public sector should introduce to enhance the demand for the services?

The role of participants in the pilots was twofold: they tested the actions but they also took part in the development. Understanding the energy end-user's perspective is essential (Heiskanen et al., 2013), because all action models are based on voluntary changes in everyday practices, and for business models it is essential that the people and companies are engaged from the very beginning. Communication activities to raise public awareness of the availability and advantages of developed tools, services and actions are important. In addition to communicating to the general public, cooperation with the key stakeholders to spread the word within their own networks is crucially important. Cooperation with stakeholders provides an opportunity to better specify the message for a certain audience, and increase the credibility of the message.

4 Results and discussion: The action models

In this chapter, a more detailed description and key findings of the pilots along with the related action models is given. We also present the challenges faced during the pilots and a discussion on the prerequisites, and the incentives to further spread the action models.

4.1 New training and business models for energy efficiency improvements

The potential of retrofitting in reducing greenhouse gas emissions of housing is recognised in the literature (e.g. Girod et al., 2014). The starting point for this particular action model was the challenge faced by homeowners of detached houses: how do you find unbiased information and support when replacing an old heating system or preparing for some other major renovation on the premises (Nissinen et al. 2014)? On the other hand, SMEs working in the field of construction, renovation and maintenance would benefit from the increased business opportunities and new service models related to energy-efficient and low carbon solutions.

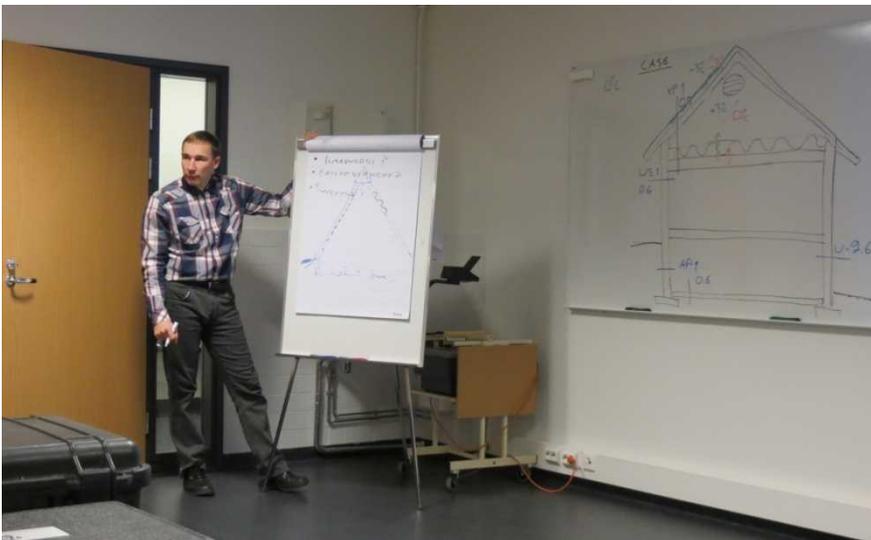


Fig. 2. The lack of reliable and competent third party information on energy renovations was identified as a challenge from detached house owners' perspective. In this figure technical details are being explained by one of the experts in energy efficiency training programme.

The development of a new training programme and service concept was started with a group of 15 professionals from the previously mentioned fields. The preliminary training programme was developed in cooperation with the Environmental School of Finland (SYKLI) project team and the participants. It consisted of 12 days of contact lessons, as well as project work to be completed mainly at home. The contact lessons consisted of theory and practical examples of construction physics, heating and ventilation technologies, including hybrid solutions and air quality, practical aspects of a field survey and calculations on energy efficiency, as well as marketing and the implementation of a new service model. The themes discussed were divided (where necessary) into detached houses and housing companies, as several professionals concentrated on only one of these housing types, and the characteristics of the buildings can be quite different. After the pilot, the length of the training was reduced to 10 days by eliminating overlaps and concentrating on more in-depth theoretical knowledge. The attendants will receive an Excel-based tool for calculating the present state energy consumption, and for calculating and optimising the energy-saving potential and payback times. This tool is applied to a real case as part of the training.

There are three aims for the training programme: (1) participants increase their current knowledge; (2) a network of experts is established; and (3) participants are provided with tools and a concept to conduct energy efficiency surveys of residential buildings. Project work, where an energy efficiency (EE) survey is conducted at a chosen location, is part of the completion of the training. After refining the programme based on feedback from the pilot training, it will be offered as a training product by SYKLI and/or other providers. The above-mentioned aims respond to typical challenges SMEs face in the renovation sector (see e.g. Killip, 2013).

From a customer point of view, the advantages the training provides is threefold: (1) it provides unbiased support to a variety of technical solutions to help identify required renovation measures and potential options, as at least three options are always given for any location; (2) the service concept is cost efficient, taking into account the limited financial resources of the detached house owners (and housing complexes); and (3) it offers a reliable network of professionals with a wide range of expertise. The first experiences from customers are that the energy efficiency survey did help them to make an educated choice for both new heating system as well as other necessary renovations. It was helpful to notice that it is not necessary to tear down a functioning system, but sometimes a supportive system can be installed. By adding some extra insulation, the energy requirement may be dramatically reduced. Most importantly, the customer learns of the price, the potential savings, the required maintenance and other practical information on various solutions.

The importance of the expert network was emphasised by the participants of the pilot training. In addition, the participants welcomed the idea of compiling an online case database, which would contain the information of the conducted energy efficiency surveys and would be available to all the members of the network. The database would offer experts (and with a wider audience, laymen of housing boards as well) insight on what types of solutions were chosen in different locations, and this gives added value and new ideas to the people working on such surveys. The specifications of the database are yet to be defined.

During the pilot, three main challenges for this action model were recognised. (1) What should the minimum level and type of education and experience for the participants of the training programme be? It is clear that a certain level of prior knowledge and expertise is required. (2) How can we ascertain and communicate to the clients the high quality of the service provided by the members of the network? Setting up a certification system would be expensive, and it is crucial to keep the costs of the service low. (3) How much are the clients willing to pay? Especially in those households living in detached houses, it might be challenging to find paying customers for planning, instead of the installation of products and technical systems. Incentives, i.e. extending the tax reduction from installation to planning, could encourage house owners to use the service. A Danish study (Mortensen et al., 2014) suggests that comfort, indoor environment and architecture are important motivational factors for retrofits, as energy saving may not be enough. These motivational aspects were recognised in this project. Further development of the training programme and service concept should continue to take the variety of motivational factors into account.

Potential demand for the service was studied by SYKLI and Ecolabel Partnership in cooperation with the Finnish House Owners' Association. A web-based survey was sent to members of the association, residing in the provinces of Uusimaa, Häme, Pirkanmaa and Etelä-Savo. A total of 1,051 responses were received. The main outcome of the survey was that nearly half of the respondents were willing to pay for this type of service, whereas the other half did the work themselves or were otherwise uninterested. The results also indicated that proper planning is important to house owners, but the extra costs are unwelcome. Nevertheless, by supporting energy-efficient planning and allowing incentives for the consumers, it is possible to improve the existing building stock as well as standards of living and limit the energy costs of housing. Furthermore, the service providers could successfully offer a planning service as a package, with other more desirable services.

Services also exist which could be supplemented with the proposed energy efficiency plan. Currently an energy performance certificate is mandatory when a detached house or a flat is sold or rented. The mandatory document must be prepared by an authorised consultant. The purpose of the document is to provide information about the energy performance of the building (see also Brounen and Kok, 2011). The document also includes suggestions about energy efficiency improvements. These suggestions are typically very general, however. A description of the physical state of the building is not a compulsory document, but it can be bought by either the seller or buyer of a detached house. The energy efficiency plan would supplement the description of the physical state by proposing actions based on the current state of the building. In addition to the above-mentioned service concept, the further development of the existing electronic housing maintenance record book concept (e.g. Stata Oy, 2014; Omakotiliitto, 2014; HuoltoOptimi, 2014) could be one option to encourage more systematic maintenance of detached houses.

4.2 Model for energy management and 'energy experts' in housing companies

This action model focuses on the energy efficiency of housing companies with their specific features related to managing renovations and maintenance, as well as the allocation of energy costs. Most of the participating companies own real estates constructed in the 1960s and 1970s building boom. Energy efficiency can be improved and the related carbon footprint can be reduced in three ways: 1) through major energy renovations (e.g. roof and wall insulation, replacing windows or installing heat recovery system). Energy efficiency improvements are compulsory when conducting a renovation that requires permission (Ministry of Environment, 2013); (2) ensuring the best possible energy efficiency of the current HVAC system through check-ups and adjustments; (3) encouraging energy savings through behaviour changes.

Knowledge related to the energy efficiency, energy efficiency renovations, and operations and maintenance of HVAC systems are included in the training programme described in section 4.1. In the programme, there was specifically-planned content for professionals working with housing companies. The action model described in this section takes into account the previously mentioned elements and in addition the potential of behaviour changes of the residents by using the energy expert concept. The concept of an energy expert was originally developed by Motiva Ltd, a state-owned company offering services in consulting, training and communications, especially in the field of energy efficiency. Energy experts are trained members of the housing company board who are familiar with energy- and water-saving potential. Energy experts have a role in communicating with other residents, the housing manager and the housing board. This helps coordinate activities in large housing companies. Depending on the level of adjustments and maintenance, consumption can be 20% higher or 10% lower than the

baseline. Behaviour changes may increase or decrease energy consumption by 5% (Virta and Pylsy, 2011, according to Talokeskus).

One challenge for housing companies, compared to detached houses, is that typically residents do not pay for space heating and water consumption according to their real consumption, because there are no separate meters for each flat. This metering practice might be one reason why in the Helsinki region, for example, water consumption per capita is higher in flats than in detached houses (HSY, 2014). According to the current regulations, installing water meters for each household is compulsory in new buildings and in the older housing stock when renewing the piping system.

This particular action model aims to activate members of the housing board, the housing managers and the residents of the house to decrease energy consumption, while maintaining or increasing the perceived comfort of living. The action model consists of three elements: (1) training voluntary energy experts on the company boards with the understanding of energy and water usage and consumption reduction possibilities; (2) conducting energy efficiency studies to locate deficiencies and define the energy-saving potential; (3) supporting the housing companies in implementing the measures defined based on the energy efficiency study, systematic maintenance, and long-term plans.



Fig. 3. Energy experts were trained to enhance energy saving activities in housing companies. This figure shows a practical lessons in heating systems and their operation.

Energy efficiency studies were conducted in 15 housing companies and 150 energy experts were trained during the project. In addition, videos about conducting check-ups in different parts of the HVAC system were produced and distributed via the internet. Long-term follow-up will show how these measures affected energy and water consumption.

The complicated decision-making process in the housing companies often hinders the progress of energy efficiency. The role of the housing manager is essential. A Finnish study based on interviews with housing managers and the energy performance of buildings managed by them suggests that attitudes and practices of the managers have an impact on the energy performance of the buildings (Kyrö et al., 2012). According to experiences in the Ecohome project, the value of the energy efficiency study is not always fully appreciated by the board members. The lay board members therefore require education, explicit examples with life cycle calculations and consultation support. This would help to communicate to and convince board members about the potential benefits of the energy efficiency study and energy expert activity.

4.3 Policy instruments for promoting energy efficiency improvements in detached houses and housing companies

Girod et al (2014) list policies that can support the shift in consumption patterns. Especially the financial incentives, standards and consumers' capacity to weight future savings with initial investment are discussed in relation to experiences from the Ecohome project. The fieldwork and trials related to the energy efficiency renovations and other service concepts aiming at increasing energy efficiency and quality of housing underlined the need to further develop existing policy instruments promoting energy

efficiency improvements. House owners are reluctant to pay for consulting services, despite the opportunities to save in the life cycle cost. There are not many small consultant companies or individual experts that can cover the essential aspects of an energy efficiency improvement: housing technology, renovation construction and the prevention of moisture and mould risks. Furthermore, the consultants do not always have the skills for properly communicating the technical alternatives to the average house owner and family members. Therefore, the training of experts and support in development of networks is essential.

In housing companies, renovations are extensive projects where consultancy services are used throughout the projects. The existing regulatory framework also sets guidelines on energy efficiency improvements. Carrying out ambitious energy efficiency improvements exceeding the minimum level set by the regulations would require advocacy from a board member or a consultant to motivate the board and flat owners concerning the advantages of the energy efficiency improvements.

The key points for housing renovation interventions in detached houses are: situations where a new owner purchases an old house or situations faced by a present owner where an urgent need for repair arises because of moisture/mould damage, the end-of-life phase of building parts such as the roof, floor or bathroom, or a life phase that reduces the capabilities of the residents, etc. Another point of intervention is the phase where the owner applies for permission for significant renovations or where the owner needs an energy efficiency certificate for selling or renting the house. These points of intervention for public actors are also opportunities for those offering private consultancy services to the house owner, seller or buyer.

The policy instruments to support the demand and supply of the proposed energy efficiency study and renovation services can be divided into three groups (see also CORPUS 2014; Nissinen et al., 2014).

Regulatory instruments

Recently stipulated regulations require house owners to prove that their renovation project (e.g. renewal of roof) will also improve the energy efficiency of the building (Ministry of Environment, 2013). To prove this, the applicant of a construction permit must provide appropriate energy calculations or other verification. The energy efficiency study described in section 3.1 could provide the required data for this verification. The implementation of these regulations in case of detached houses is facing problems, because of the very limited resources in municipal offices.

A more radical policy instrument which has provoked some discussion is a mandatory regular "inspection" of buildings by some authorised service provider covering fire safety, moisture and mould risks and an energy efficiency audit.

Economic instruments

Household service tax deductions are regarded as a significant incentive for energy efficiency improvements in detached houses. Taxpayers can currently deduct from their taxes 45% of the value of household service or maintenance work conducted at the taxpayer's or his/her parent's home, up to a maximum value of €2,000 per year (€4,000 for a couple) (Suomen yrittäjät, 2014). The deduction is an excellent example of green tax policy. Vendors of energy technology have utilised this incentive by pricing their work high and equipment low. The energy efficiency study has not been eligible for this deduction so far, because it is only partly work done at the residence. Interpretation of the guidelines might be changed to make this eligible.

Families on lower incomes or retired residents cannot utilise this deduction to its full extent. Some policy experts have proposed that in such cases, income tax should be negative, i.e. a compensation could be paid. Social grants can be applied for house renovations, but the budget allocated for this is scarce and restricted mainly to older people and those with limited mobility. Subsidies for energy renovations are also available for housing companies.

Informational instruments

Information about solutions, exemplar cases and calculations of saving potential assist in preparations for major renovation projects as well as raising knowledge about potential behaviour changes. There are many web-based and personal advisory services promoting energy efficiency and sustainable consumption. The budget for these services is usually project-based and this poses a question about

continuity. The public and free information services can rarely go into detail for an individual house owner. This is why there is a niche for commercial advisory and consulting services, even for individual house owners.

Municipal authorities or public advisory services cannot officially recommend named companies or consultants, unless there is a public list of authorised experts. Such a list on certain public websites would act as a meeting point for service users and providers. What building permit authorities in municipalities could do is to generally advise the permit applicants to use a qualified consultant for conducting the energy efficiency study – without naming anyone specifically. The same applies to relevant NGOs in this field.

One option for financing public advisory services is to encourage power companies to outsource their obligation for providing energy efficiency information to their clients. EcoFellows Ltd in Tampere, Finland, is an example of such a public agency with financing coming from the municipal power company and the municipalities. This model could be replicated to other regions.

The project has identified the need for one or two interactive websites for transferring know-how on energy renovations. One site would serve as a “case bank” for small energy consultants: the energy efficiency plans and feasibility calculations for typical cases would be accumulated here. It would provide quality control through peer review and it would improve the cost efficiency of preparing the plans. The site would also facilitate networking between experts, each with specific skills. Similarly, house owners could have a site for peer support where simplified case studies could be posted. In the future, the site could also promote the pooling of service users who could pool together to hire an energy expert or call for tenders of specific energy-related equipment and installation work, for example. Stakeholders are needed to coordinate such pooling of house owners. Model agreements and calls for tenders could also be published on this site.

4.4 Household-specific metering and tailored advice by eco-trainers

A total of 18 households volunteered to participate in the project. The households were different in terms of type of housing, family size and background. During the first visit, real-time energy monitors were installed to measure electricity consumption and provide information about the related greenhouse gas emissions. The families' cars were provided with a real-time tracking device to collect information on driving habits. The families were also instructed on how to perform the measurements concerning their use of other means of transportation, water use and waste amounts. The data was fed into a web interface that enabled the families to follow their consumption patterns in all areas. During the first or second visit, the families were interviewed about their consumption habits. Based on the data, tailored expert advice was provided and discussed in private meetings with the households. With some families, different subjects were discussed in great depth, and as much time as necessary was allocated for each visit. Each home was provided with two or three visits. The visits lasted approximately two hours, depending on the family's ability to provide the information needed, the time it took to install the energy monitors and the amount of advice given. The measurements were conducted twice during the pilot over a minimum of four weeks, at the beginning and before any activities or advice was given. The second period of measurements took place after the households had met with the expert and had been given some time to change their behaviour and consumption patterns.

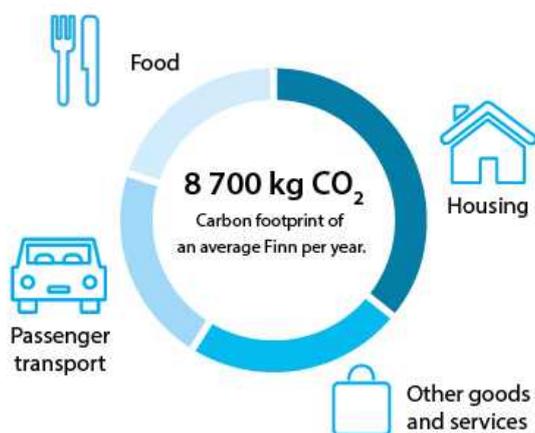


Fig 4. Illustrative information was produced to communicate about household carbon footprint. E.g. this figure shows the relevance of different consumption categories on an average carbon footprint of a Finn.

Throughout the project, the households were provided with information about the energy efficiency and other environmental aspects through newsletters and a Facebook group, as well as personal e-mails. In addition, meetings for the whole group of 18 households taking part in the pilot were arranged, to create a sense of community and peer support.

The analysis of the results is still ongoing. In the current development stage, the measurement system being used is too expensive and unreliable to be installed for the sole purpose of providing data for sustainability advice. The potential of measured household-specific data is, however, important. The amount of data collected on personal consumption patterns (e.g. electricity consumption, transport choices, shopping, etc.) is increasing, and holds the potential to also be used as a basis for personalised advice. It should be kept in mind that because of the limited number of measuring devices, the period of measurements in this project was limited to four weeks for most households.

The preliminary analysis shows that the role of the expert in interpreting the consumption data and highlighting the most important actions to be taken is crucial to achieving changes in behaviour. The data collected through the measurements was in many cases quite insignificant to the households without the interpretation and in-depth explanations of the advisor. For example, collecting data about a family's driving, consumption and eating habits has no relevance, unless it can be put into perspective through comparison with other households, by calculating possible savings and explaining the environmental effects of the actions. Energy use is usually more interesting in itself, because of its high cost and a wish for financial savings.

Earlier research suggests that computerised monitoring and feedback on energy use has the potential to reduce households' energy consumption (Abrahamse et al., 2007; Brandon and Lewis, 1999). But according to Hunter et al. (2006), calculators and tracking consumption may not be enough to encourage behaviour change. The advantage of real-time measurements is that it provides a feedback mechanism to be very close to real life actions. The pilot shows, however, that it is quite difficult to achieve changes in behaviour by merely installing monitors and measuring consumption. From the advisors' point of view, the interviews with the families provided a real insight into the possibilities for change and made it possible to give relevant advice.

In London, a study into a home energy visit programme designed to encourage reductions in household carbon emissions and water consumption was criticised for having visiting times that were too short, and for the level of expertise of energy advisors working on short-term contacts (Revell, 2014). Both of these issues were taken into account in the Ecohome project and the time allocated for each visit was about two hours, double that of the London case. The visitors were also the project workers of the Ecohome project and were motivated to achieve high quality and development from the visits.

The energy advisors of Valonia, a regional energy and sustainability office, were responsible for conducting visits during the pilot. Another aim of the Ecohome project was to pilot a new eco-trainer action in which entrepreneurs who are already in contact with households (e.g. cleaning, house maintenance and professional organising services) provide environmental advice to create added value to their services. The entrepreneurs can integrate sustainability services into their existing business idea or offer eco advice as a separate service to their customers. The above-mentioned entrepreneurs who already provide their services are potential middle actors in the field of sustainable consumption patterns and energy efficiency.

4.5 Web-based carbon footprint calculator and its use in discussions with ordinary people

The goal of this particular pilot was twofold: First, to use a web-based carbon footprint calculator to communicate the difference that households can make with their consumption and life-style choices; and second, to develop tool-supported action models for discussing carbon footprint and mitigation measures with ordinary people in different occasions. Cooperation with NGOs, companies and other stakeholders was an important part of the work, in order to raise the knowledge about the calculator among households and connect the calculator and related activities with stakeholders' own agendas and activities.

The carbon calculator *Ilmastodieetti* ("Climate diet") was the main tool in this action model. The calculator was first published in 2010, and there have been more than 50,000 users since the launch. The calculator takes into account different aspects of housing (especially energy use at home), personal transport, food and consumption of goods and services, and it calculates an individual's personal carbon

footprint for one year. During 2013 the calculator was updated, and improvements were made to provide more detailed information about the result of each consumption section as well as the input by the user.

Inputs by users and their results are saved in a database. This dataset can be used for research purposes to understand what kind of people use the calculator, and also the level of their knowledge. One can insert quite detailed data about energy consumption and features of cars and its usage into the calculator. The calculator also provides estimates, e.g. in cases where the user does not know about their heating and electricity consumption at home. According to the preliminary analysis of the data, the median carbon footprint of Ilmastodieetti users was 6.5 tonnes of CO₂ equivalent per person per annum. This is lower than the average of 8.7 tonnes in Finland (Seppälä et al., 2011). Around 60% of the users so far have been women. The dataset indicates the knowledge of the users in terms of how much people are aware of their energy consumption and heating types, as this data can be either inserted in a detailed manner, or one can use estimates provided by the calculator.

One of the advantages of tools like Ilmastodieetti is that they provide results and advice based on one's real consumption and lifestyle patterns instead of information about average figures (Whitmarsh et al., 2011). In addition, the relevance of different consumption categories is visualised and this enables users to focus on the most important sectors in their consumption to reduce the carbon footprint (Chatterton et al., 2009; Hunter et al., 2006).

Free to use web-based tools have a potential to reach large audiences. The importance of partners in spreading the word about the calculator and motivating the users was considered important. The role of partners is also essential in linking the carbon footprint concept to their own work related to e.g. energy saving at home or food choices. Important stakeholders in this respect were partners that provide activities, support, education, and goods or services for households. These include NGOs working with households, companies providing goods and services for households, municipal energy and sustainability advisors, and teachers. No special event for marketing the calculator was arranged, but activities took place at locations where people go for other reasons, i.e. grocery stores, shopping centres, fairs, family café meetings, and seminars for teachers. The motivation for this was to ensure contacts with people, who are not already particularly environmentally aware.

During the pilot, activities were introduced together with two NGOs, two municipal energy and sustainability agencies, one retail chain and three teachers' federations. Methods used in developing activities included: workshops with members and key persons of the organisations, surveys for members of the organisations, and observations and feedback from various events. The activities included events in grocery stores and shopping centres, discussions in meetings with families with small children, and workshops for teachers. The number of people contacted was not limited to face-to-face contacts since the events were in many cases presented on the news in radio, newspapers, web and television.



Fig. 5. Material and calculation tools were used in several contexts with ordinary people to gain experience and feedback for further development. The picture presents an example of “weighting” the carbon footprint of the contents of a shopping bag in Kamppi shopping centre.

The strength of the calculator is its comprehensiveness. It is also a challenge, however. For audiences already motivated to take a closer look at their lifestyle and carbon footprint, comprehensiveness is highly valuable. Teachers have also found the calculator useful to demonstrate and provide exercises for their students related to the carbon footprint issues. But in situations where people are busy (i.e. shopping centres), it was more easy to approach people with a simple message of i.e. asking to take part in a short sustainability quiz, but to continue with fulfilling the calculator together was more of a challenge. Often people were just asked to continue with the calculator at home. Thus it was important to give a card or a brochure to remind later about the calculator.

Another recognised challenge was the carbon capability (Whitmarsh et al., 2011) of the target group. The whole concept of a carbon footprint calculator is meaningful only for audiences with certain existing knowledge of climate change, and its linkages to the carbon footprint of consumption choices.

There are many web-based carbon and other calculators available. The challenge is to make people aware of them and motivate usage. In addition, the mere calculation results may not be enough to bring about changes in consumption patterns (e.g. Chatterton et al., 2009). Therefore, personal communication and interpretation of results are important. Also stakeholders who could use the tool in their own work would benefit from advice and tips, on how they can use the calculator to help communicate issues and choices related to carbon footprint. Approaching ordinary people with their busy everyday life has its challenges, however. How to get a contact and sustain it? In the long run, what could be the most efficient way or media to raise awareness of the carbon calculator?

Learnings from cooperation and campaigns with NGOs and companies include: (1) the importance of partners who have close contacts with households and share an interest in sustainability but who are not environmental experts themselves and would benefit from tools and advice on how to use them; (2) the need to carefully take into account the capability of the audience and the type of situation to receive the message. Who and in what kind of situation has the capacity to look into a tool like a carbon footprint calculator?; and (3) What kind of other, more simple materials and methods can raise the interest to use web-based tools later on at home.

5 Conclusions

This paper focused on the potential role of intermediaries and middle actors to support change in consumption patterns and to increase energy efficiency in households. The country- and context-specific aspects as well as some of the potential actors may vary but the action models and learning from this study can be applied and further developed in other countries too.

The approach of developing the action models together with the target groups was considered beneficial for learning about the practical conditions, constraints and expectations in the field. The experiences and feedback were used during the project, and these can be taken into account for further development.

Ambitious targets, regulations and supporting policy instruments set the framework for available options and economically viable practices to improve energy efficiency and affect consumption patterns. Public awareness and recognition of the relationships between consumption patterns and environmental impacts is needed. The regulatory framework together with a decent level of awareness is a prerequisite for the demand for more sustainable products and services, as well as interest in sustainable practices. To meet and create the supply of these kinds of services and practices, enterprises need to have expertise, proper technical solutions, good communicational skills and a viable business model.

This paper compiled the experiences, potential and challenges of action models to increase energy efficiency and quality of housing, and change consumption patterns. The long-term implications remain to be seen and would be an interesting topic for further studies.

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