Department of Civil and Structural Engineering

Attitudes and behaviour of residents within the framework of energy efficiency

Noora Valkila

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Attitudes and behaviour of residents within the framework of energy efficiency

Noora Valkila

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Abstract

The goal of this study was to determine how Finnish energy policies are realised and the attitudes of consumers regarding energy issues. Further research was done to study if the attitudes of residents and their behaviour regarding energy issues are inter-related. A goal was also to study if place of residence affects attitudes and behaviour. Are residents willing to improve their efficiency in terms of energy consumption?

The range of applied research methods was diverse. A literature review was performed and experts operating in the energy industry were interviewed. Ordinary energy consumers, i.e. residents, were studied using interviews and measurements and by forming consumer panels. Content analysis and statistical methods were used for analysing the results.

Based on this study, Finland should strive to utilise more diverse energy sources and engage in closer co-operation with different stakeholders. Resident attitudes on energy matters must be influenced. The most effective influencing methods are peer groups, communication, media, training and education, perceptions and visions. Age and the location of residence influence people's attitudes and behaviour with respect to energy issues, whereas their life satisfaction level does not. For example, research subjects that reside in a more densely populated suburban area are more concerned with climate change and more willing to give up driving than research subjects that live in more scarcely populated residential areas. Residents are willing to improve their energy behaviour, although young and elderly people are more willing to make environmentally friendly choices than the middle-aged demographic. There is a gap that needs to be bridged between attitudes and behaviour. If the attitudes of residents were to become more active and positive towards energy, they could lead to the desired energy-efficient behaviour.

This study does not aim to make generalisations regarding Finns. Instead, it wishes to explain the energy-efficiency phenomena with respect to attitudes and behaviour within a Finnish context.

Keywords Energy efficiency, climate change, residency, attitudes, behaviour, readiness for change.

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Tiivistelmä

Tämän tutkimuksen tavoitteena oli selvittää, millaisena Suomen energiapolitiikka näyttäytyy ja miltä kuluttajien asenteet energia-asioita kohtaan vaikuttavat. Edelleen tutkittiin, ovatko asukkaiden asenteet ja käyttäytyminen energia-asioissa yhteydessä toisiinsa. Tavoitteena oli myös selvittää, vaikuttaako asuinpaikka asenteisiin ja käyttäytymiseen. Entä ovatko asukkaat valmiita tehostamaan energiankäyttöään?

Käytettyjen tutkimusmenetelmien kirjo oli monipuolinen. Tutkimuksessa tehtiin kirjallisuusselvitys ja haastateltiin energia-alalla toimivia asiantuntijoita. Tavallisia energiankäyttäjiä, asukkaita tutkittiin niin haastatteluin, mittauksin kuin muodostamalla kuluttajapaneeleita. Analyysitapoina käytettiin sisällönanalyysiä, sekä tilastollisia menetelmiä.

Tämän tutkimuksen perusteella Suomen on pyrittävä moninaisempien uusiutuvien energianlähteiden käyttöön ja tiiviimpään yhteistyöhön eri tahojen välillä. Asukkaiden asenteisiin energia-asioissa on vaikutettava ja tehokkaimmat vaikutuskeinot ovat vertaisryhmät, tiedottaminen, media, kasvatus ja koulutus, mielikuvat ja visiot. Asuinpaikalla ja iällä on vaikutusta ihmisen asenteisiin ja käyttäytymiseen energia-asioissa, elämäntyytyväisyydellä ei. Tiheämmällä esikaupunkialueella asuvat tutkimushenkilöt ovat esimerkiksi huolestuneempia ilmastonmuutoksesta ja valmiimpia luopumaan autoilusta, kuin väljemmillä asuinalueilla asuvat tutkimushenkilöt. Asukkaat ovat halukkailta tehostamaan energiakäyttäytymistään, tosin nuoret ja iäkkäät henkilöt olivat valmiimpia tekemään ympäristöystävällisiä ratkaisuja kuin keski-ikäiset. Asenteiden ja käyttäytymisen välillä on kuilu, jonka välille olisi rakennettava siltaa. Jos asukkaiden asenteet muuttuisivat energia-aktiivisemmiksi ja -myönteisemmiksi, niin ne saattaisivat johtaa toivottuun energiatehokkaaseen käyttäytymiseen.

Tämän tutkimuksen perusteella ei pyritä tekemään yleistyksiä suomalaisiin, vaan selittämään asenteiden ja käyttäytymisen energiatehokkuusilmiötä Suomikontekstissa.

Avainsanat Energiatehokkuus, ilmastonmuutos, asuminen, asenne, käyttäytyminen, muutosvalmius.

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1st November 2013 Noora Valkila

Role of the researcher

This doctoral dissertation has been prepared within the research team of Construction Management and Economics at the Aalto University between 2010 and 2013. The important role of supervising and instructing has been allocated to the signatory, Professor Arto Saari.

The scientific ground for this dissertation has been laid by the researcher, who has extensively and solely studied the relevant literature.

The partial results and early conclusions of this study were published at five journal articles, which have been co-authored by the researcher (as a prime author) and the supervisor. Each of the articles has been attached to this dissertation. All five part studies (articles) have been innovated together by the researcher and the supervisor. The researcher has then prepared the detailed research plans, selected the research subjects, implemented the field studies, and written the first drafts of the articles. The foregoing has been instructed and commented by the supervisor.

I hereby declare that the role of Noora Valkila in this study fully complies with the criteria for the independence as set for a dissertation.

21st May 2013 Arto Saari
Supervisor

List of Publications

Papers I-V

This dissertation consists of an overview and the following publications, which are referred to in the text by their Roman numerals. The publications are presented in their published format in the following order at the end of the doctoral dissertation.

I Valkila, N., Saari, A. (2010). Urgent need for new approach to energy policy: The case of Finland. *Renewable and Sustainable Energy Reviews* **14**, 7, 2068–2076.

II Valkila, N., Saari, A. (2013). Experts' view on Finland's energy policy. *Renewable and Sustainable Energy Reviews* **17**, 283–290.

III Valkila, N., Saari A. (2012). Perceptions Held by Finns Energy Sector Experts Regarding Public Attitudes to Energy Issues. *Journal of Sustainable Development* **11**, 5, 1–14.

IV Valkila, N., Saari A. (2013). Attitude-behaviour gap in energy issues: Case study of three different Finnish residential areas. *Energy for Sustainable Development* **17**, 1, 24–34.

V Valkila, N., Saari A. (2012). Consumer Panel on the Readiness of Finns to Behave in a More Pro-Environmental Manner. *Sustainability* **4**, 1561–1579.

Attitudes and behaviour of residents within the framework of energy efficiency

1 Introduction

Swift action must be taken so that the effects of environmental catastrophes caused by climate change can be limited and prevented. The level of energy efficiency associated with constructing and living in homes must particularly be improved within the Finnish energy sector so that the resulting greenhouse emissions can be reduced.

Energy conservation measures carried out in the areas of industry and legislation are not sufficient. In order for Finland to successfully meet its energy conservation target and to fulfil the requirements and goals set in the international and European Union plans for improving energy efficiency, regular customers, i.e. residents, must practice energy conservation in their everyday lives.

In order for energy behaviour to become more energy efficient, people must have accurate, accessible and understandable information about energy issues. As a result, they would develop a more positive attitude towards energy and modify their behaviour to improve energy efficiency. Of course the effect is not so simple and linear; there is a considerable amount of research which demonstrates much more complicated, even conflicting link between people's attitudes and behaviour.

It is also important to study if certain types of people have different attitudes towards energy issues based on factors such as their place of residence, age or life satisfaction and if these attitudes affect their actual behaviour. In addition, in order for actions to improve in terms of energy efficiency, it is important to know what types of things people are willing to give up and what types of things are not subject to change. Information is needed on the current situation as a whole and on the individual level so that correct actions can be directed at the right demographic as soon as possible.

There is attitude-behaviour gap in energy issues. This gap needs to be bridged between attitudes and behaviour. Right information does not always lead straight to attitude change, which in turn will not always lead to similar behaviour change. These are still the steps which need to be carefully considered. Noteworthy is that

popularly increased awareness and a more positive attitude may have a significant impact on changing behaviour so that residents will become more environmentally friendly. In this way, residents' behaviour with respect to energy efficiency could be improved and individual consumers could assume an important role in the work to control climate change.

2 Literature review

This literature review first examines climate change and the resulting drivers for change, particularly in the energy sector, that produce a lot of greenhouse emissions. In addition, a review is conducted on the brief Finland's energy policy and directives that regulate the activities of the Finnish construction sector. Then, the thesis discusses why and how residents should be studied within the framework of energy efficiency. Finally, it focuses on how the attitudes and behaviour of people are evident within the context of the goal of improving energy efficiency.

2.1 The drivers for change caused by climate change

The climate change process, which is an undisputed and serious threat to the planet, is already taking place. The mean temperature of Earth has increased by approximately 0.8 degrees from the time before industrialisation to the present (IPPC, 2007).

In its entirety, climate change is a complex phenomenon, which has always involved great uncertainty (e.g. Bord, Fisher & O'Connor, 1998; Lorenzoni & Langford, 2001). Although climate change cannot be halted, reducing emissions would crucially improve the ability of future generations and nature's organisms to survive on Earth.

The emission trends of the next few decades will significantly affect whether or not the climate change process can be limited to a tolerable level. Global warming is a result of greenhouse gases (GHGs) entering the atmosphere. Simply put, greenhouse gases that enter the atmosphere cause global warming, which in turn lead to a dangerous phenomenon: climate change. Now we must urgently plan and implement actions to reduce greenhouse emissions and adjust to the impacts caused by climate change (e.g. IPCC, 2007; Giddens, 2008; Heltberg, Siegel & Jorgensen, 2009; Jorgensson & Clark, 2011).

It has been estimated that up to 80% of harmful greenhouse gases entering the atmosphere are caused by the energy sector, meaning the production, transfer, distribution and consumption of energy (Hansen et al., 2000). Both the climate and on-going climate change thus create significant pressure for a change in operations in the energy sector. Changes in the climate may result in radical changes in both the demand for energy and in the diversification of energy production methods (Amato et al., 2005). Entities working in the energy sector must consider the accelerating rate of climate change and react to the challenges it presents. In the future, the effects of climate change will inevitably affect the energy field's internal operational cycles, such as energy production, transfer, distribution and consumption.

A central issue with respect to climate change in the future is the potential effects of climate change. Experts predict that major global catastrophes related to climate change will occur during the 21st century along with considerable negative effects on the global economy as a result of accelerating climate change (Changnon, 2005). At the end of the century, global warming may have already resulted in negative effects on international agriculture. The outcome may be severe. The scarcity of water may be particularly devastating (Cline, 2007).

Changnon (2005) accurately states that economic issues play a significant role when studying the effects of climate change and planning actions to control it. Economic factors greatly affect land use and greenhouse emissions and, therefore, the climate. The same widespread uncertainty that prevails in the current global economy also affects efforts to launch international, effective measures to reduce climate change. The causal relationship also operates in reverse: it is impossible to estimate how devastating climate change may be for the global economy over the next few decades. Due to these complex relationships between climate change and the global economy, the scope, effects and measures limiting climate change remain highly unpredictable.

Amato et al. (2005) state effectively that a majority of climate change research has focused on the negative effects that the energy sector has caused and is causing to the climate. Very few studies take an interest in the reversed causal

relationship. What type of effect will the ever-accelerating rate of climate change have on the energy sector in the future? Research interests focusing on identifying the changes that have already occurred may well be motivated by the aim to identify regional impact differences, infrastructure effects, socioeconomic impacts and different types of energy use profiles. As more knowledge is gained in these areas, it will be possible to conduct more effective research on how climate change may potentially change the entire energy production field in the future.

International collaboration to control climate change is crucial, but every country must also review its own policies and how they affect climate change and energy consumption on a national level. Amato et al. (2005) justify this need in the following way: first, global climate change can be predicted by looking at separate geographical effects. Second, regional energy infrastructures differ from one another, at least in terms of the efficiency with which they use energy sources and systems and manage the energy supply and conversion, the age of energy transfer and distribution networks, the adopted technologies and the characteristics of energy users. Third, energy demand and climate change sensitivity are always affected by comprehensive regional arrangements, such as the operations of the country's residential, transport and industrial sectors.

Although the effects of climate change are already evident and actions have been taken to reduce climate change (IPPC, 2001), more research and rapid action are necessary. Finland's adaptation to global warming requires extreme preparedness for change and new thinking in many different areas of life (Ministry of Environment, 2010).

Characteristic of Finland's electricity consumption is the high proportion attributable to energy-intensive industries and the impact of heating and lighting demand over the long winter period. The country's electricity supplies will continue to be based on a distributed system that relies on a diversity and multiplicity of energy sources and is distributed because of the strong role of combined heat and power generation. In building Finland's own capacity, priority

will be given to power plants that have no or low greenhouse gas emissions, such as combined heat and power plants using renewable fuels.

Research has concluded that the most important changes necessary in the energy system in Finland are as follows (Koljonen et al., 2008): increase in the use of renewable energy sources, nuclear power and afforestation, the latter having proved effective for Finnish circumstances. Development work should also focus on carbon capture and storage (CCS) technology, as it is felt that this will be significant in the future.

Finland, for its part, has already made a number of key energy policy decisions. In Finland and at EU level there are many different projects aimed at improving the state of the environment. Finland's Long-Term Climate and Energy Strategy was approved by the Government in November 2008 (Finnish Government report, 2008). The strategy sets out climate and energy policy measures in some detail for the period to 2020, and in broad terms up to 2050. The aim is to increase the share of renewable energy to 38% by 2020. The Finnish Government's publicly declared position is that the focus of future energy policy will shift increasingly to renewable energy forms. Most significant among these are wind and hydro power, biomass, solar energy and geothermal energy.

Despite the praise, the Finnish Government has not been able through tougher legislation to fully meet the energy challenges of climate change. Changes are happening slowly, as there is little desire to give up benefits to which contemporary society has become accustomed. To implement changes, however, it will be necessary to accept the economic realities and the indirect costs, and political commitment will be needed. An increase in operating efficiency is desirable, but the goals must be carefully specified in order that the profitability of investment in technological solutions can be properly assessed.

In addition to the overall operations of the energy sector, the construction sector, which also uses a great deal of energy, should especially implement changes. Buildings' share of energy consumption and carbon dioxide emissions in the EU and Finland is approximately 40 per cent. In Finland, the share of energy used in

buildings and construction exceeds 40 per cent of the final energy consumption and nearly 40 per cent of the greenhouse emissions (Martinkauppi, 2010). Seppänen and Goeders (2010) note that many EU member states have actively implemented measures to improve the energy efficiency of existing buildings in recent years. This can be seen in the form of rapidly changing regulations requiring improved energy efficiency, research and policies that support more effective energy use.

Finland is a member of the EU and aims to fulfil the national goals set by the EU to fight climate change. Finland is experiencing significant pressure to improve the energy efficiency of its construction sector. Finland currently sets national directives, which can be used to fulfil the climate goals of the EU. The directives are renewed and actively adjusted every few years so that they will continually support the shared European and national goals.

With the EU directive 2010 (EU Directive, 2010), Finland took a step toward low-energy construction at the beginning of 2010. The new directive enforces this goal with construction requirements that are 30% more restrictive. With these new directive measures, a reduction of 5-6 per cent is expected in the consumption of final energy in the EU. A 4-5% reduction in carbon dioxide emissions is expected by 2020.

In mid-2012, the construction regulations were amended again (RakMK, 2012). These new building regulations aim to improve the energy efficiency of buildings by an average of 20 per cent. It is notable that new construction regulations now take into account total energy consumption. An energy assessment is already done when designing the building. For example, all of the heat, electricity and cooling energy needed throughout the year are included in the energy consumption calculation for the building. The energy efficiency of the building is stated using the format set out in the energy performance certificate provision: the building's efficiency rating (ET rating) and energy efficiency rating are both recorded (ET Class A–G). Starting in the year 2020, all newly constructed buildings must comply with nearly null-energy consumption standards.

It is central to understand that a majority of the world's energy is produced and consumed in a manner that cannot continue if the goal is to limit climate change and reduce energy consumption. Most technologies that are currently in use result in significant greenhouse emissions and are not energy efficient. Every county should urgently improve their overall energy efficiency levels (Hoffert et al., 2002; Kaygusuz, 2009). As a result, more comprehensive and current research is needed on real energy needs and new technologies (Hoffert et al., 1998). Every country should assume responsibility for developing its climate policies and improving its energy efficiency.

2.2 Studying residents within the framework of energy efficiency

Human actions are the cause of global warming. As a result, it is feared that global warming will reach catastrophic levels by the year 2080 (IPCC, 2007). Therefore, there is reason to assess emission trends that lead to climate change and to study energy consumption from the perspective of the average consumer, not only from the perspective of large, bureaucratic sectors, the construction sector or the energy field in general. Many of people’s everyday functions associated with basic living produce and promote harmful greenhouse gases that enter the atmosphere in varying degrees.

The connection between climatic factors and people's energy use has been subject to study already for long period of time, for decades even, in the United States, China and different parts of the world (Warren & LeDuc, 1981; Downton, Stewart & Millers, 1988; Badri, 1992; Lam, 1998; Yan, 1998; Pardo, Meneu & Valor, 2002; Hill et al., 2009). The findings have helped develop an understanding of energy consumption and have provided effective potential solutions for energy suppliers. The central subjects of interest, however, have been matters that apply to the macro level, such as the demand for energy, the capital requirements on national economies and the expenditures caused by fighting climate change.

In contrast, there is little scientific research on the micro level and little guidance on how average energy consumers, i.e. residents, could positively affect the goal of reducing global warming through their form of living and everyday actions in different areas of life. Therefore, more studies and research reports are needed on how residents consume energy and what types of energy sources they utilise (Amato et al., 2005).

Naturally, studying residents and how they live is already in itself an interdisciplinary science. Living and residents are an area of interest to professionals, experts and researchers in different industries, such as history, geography, environmental sciences, architecture, the social sciences, political science and economics. Each stakeholder is interested in living and resident matters from their own perspective. Accordingly, Kemeny (1998) states that studying living offers meaningful approaches for understanding differences in various societal groups from cultural, ideological and political perspectives.

Different sciences usually focus on only studying specific resident groups, based on their own needs for answering questions in the field of living. Economists, for example, are interested in the prices of homes (e.g. Engelhardt, 1996; Kosuke, Proudman & Vlieghe, 2004; Campbell & Cocco, 2007), home financing issues (e.g. Buckley, 1996; Stephens, 2003; Harrison, 2011) and supply and demand (e.g. Dipasquale, 1999; Mayer & Somerville, 2000; Saiz, 2008). Geography researchers focus on studying living from regional perspectives and study, for example, divergence and urbanisation of living (e.g. Charles, 2003; Song & Knaap, 2003; Ham & Manley, 2010; Hedman, 2011), the local supply of homes (e.g. Muellbauer & Murphy, 2008; Meen & Nygaard, 2011), the revitalisation of cities (e.g. Atkinson, 2004; Lees, 2008; Doucet, van Kempen & van Weesep, 2011) and the migration flows of residents (e.g. Foulkes & Newbold, 2008; Lee & Waddell, 2010). Architects focus, for example, on design, the selection of construction materials and resident needs (e.g. Osmanin, Glass & Price, 2008; Smith, Ferrari & Jenkins, 2011). Different sciences that study living from different perspectives may engage in overlapping and even shared research, as no one can comprehensively research the complex field of living.

Therefore, there is reason to study living within the framework of climate change using many different approaches. Worrisome weather changes and climate extremes are largely affected by societal factors, which are all related to living. When assessed internationally, up to 40 per cent of total energy consumption is somehow associated with living and construction (Omer, 2008).

The amount of energy consumed by people via the way they live has increased in welfare states. Changnon et al. (2000) listed in their research the three most significant factors in the United States that increase people's energy consumption based on the way they live. These include: i) the increased wealth of people and the increased value of their property per square metre, ii) changes in demographics and urbanisation, and iii) an aging infrastructure and the rigidity of building standards.

The actions taken to reduce climate change have and will continue to have an impact on the lives of average consumers. In order to fight climate change, an increasing amount of changes will take place in the way local infrastructure is arranged, in living arrangements, in available services, in energy use, in how public transport is organised and public health maintained, and in practicing environmentally friendly lifestyles (Ruth & Kirshen, 2001).

Within the field of living, particularly in cities, the continuous effects of climate change and global warming must be considered. Not only may resident activities in cities increase global warming, but there are also other trends associated with urban living that cause climate change. There are several studies that have identified significant issues associated with city living that have contributed to increasing temperatures in cities throughout history (Wilby, 2003; Gaffin et al.; 2008; Fujibe, 2011). The studies also provide an indication of interaction networks and chains of events in cities that may lead to alarming levels of pollution, water shortages, energy shortages and ecologically unsustainable levels of living (Rosenzweig & Solecki, 2001).

Taking care of the environment is a shared collective responsibility, where every resident is responsible for caring for the city in which they live (e.g. Jorgenson,

2003; Downey, 2006). Research on the energy use of city dwellers and its effects on climate change is diverse and several processes must be considered. Therefore, most studies approach the subject from a specific, closely defined perspective, such as the amount of air pollution caused by city residents (Athanassiadou et al. 2010), energy consumption (Franco & Sanstad, 2008), the economic effects (Hallegatte, Hourcade & Ambrosi, 2007) or food habits (Changnon, 2003; Carlsson-Kanyama & González, 2009).

The energy behaviour of urban populations plays a significant role in climate change. The amount of energy distributed to urban residents and their energy use appears to have a significant effect on the rate of future climate change (Lemensu et al., 2013).

In terms of improving the energy efficiency of individuals, households will play a significant role in reaching the goals (e.g. Bertoldi, Ricci & de Almeida, 2000; Herring, 2006; Stern, 2007; Yamaguchi, Shimoda & Mizuno, 2007; Abrahamse & Steg, 2009; Andreassi et al., 2009). The OECD (Organisation for Economic Co-operation and Development) already a decade ago estimated that the share of household consumption varies between 15 and 20 per cent of total consumption (Biesiot & Noorman, 1999). It is difficult to provide detailed figures, but at least a 10% reduction in emissions could be established by individuals changing their energy use behaviour in regular households (Abrahamse et al., 2005; Darby, 2006).

When studying more closely the amount of energy consumed in homes both in the United Stated and in European countries, a majority of the energy consumed is done as a result of living and sources that increase living in comfort (Gardner & Stern, 2002). These include the amount of energy consumed for heating, warm water, refrigeration and freezing, lighting, cooking and air conditioning.

Maddison, Rehdanz and Narita (2013) provide a reminder that the impact of household activities on the climate can be measured in the immediate sense. However, if the assumption is made that the activities of households have already affected climate change, the measurements depend on the direction of the cause

and effect chain. An appropriate way to measure this is to identify the minimum compensation that should be paid to households so that they would accept negative climate change. In contrast, the maximum amount that residents would pay to improve the climate should also be surveyed. Together, these two measurement methods should facilitate a willingness to take monetary action at the potential expense of well-being; this will need to be studied.

Climate change and the actions taken to reduce it affect people differently, including economically. The most vulnerable households are those households whose livelihoods are being affected by climate change. In addition, households with the lowest incomes are also in the high-risk group (Heltberg, Siegel & Jorgensen, 2009).

Abrahamse et al. (2005) focus on an important question in their studies: Why does energy consumption in welfare nations continually increase? Marco-level factors, such as technology improvements (e.g. energy-intensive equipment), economic growth (e.g. increase of household income), demographic factors (e.g. population growth), institutional factors (e.g. government policies) and cultural change (e.g. emancipation, increased mobility of women) all play a part in the increase of energy consumption for the individual, but why is it increasing so rapidly?

2.3 Attitudes and behaviour of people with energy issues

Over the years various different models have consequently been devised to try to explain the energy-efficient and energy-inefficient behaviour of households (e.g. Ajzen & Fishbein, 1980; Blake, 1999; Hungerford & Volk, 1990; Kaplan, 2000; Stern, 2000). Consensus model or theory has not been found. Attitudes and behavior of residents is still one of the key areas, and the goal of combating climate change will undoubtedly require immediate and substantial changes to the way in which we conduct our everyday lives.

Environmentally friendly and sustainable developments in construction and living can be roughly divided into two groups: technical sustainability and behavioural

sustainability (Youngentob & Hostetler, 2005; Willliams & Dair, 2007; Hostetler & Drake, 2009). Improving technical sustainability alone is not sufficient for improving energy efficiency to a desirable level (Darby, 2006). To support it, sustainability improvements are also needed in households with people that use energy and their attitudes need to be changed (Hostetler & Noiseux, 2010).

Changing household patterns of energy consumption have an enormous potential to support the fight on global warming. Appropriate political decisions and regulation frameworks can considerably promote behaviour that supports energy conservation (Holden, 2004; Williams & Dair, 2007). The sustainable ecological behaviour of households always goes hand in hand with well-planned alternative choices (Williams & Dair, 2007). However, in order to establish permanent change, considerable change is required not only in the amount of potential information available and the actions taken, but also in the environmental attitudes of people so that more environmentally friendly attitudes will help regulate environmental behaviour (Hay, 2005, 2006).

In order for environmentally friendly and energy-efficient sustainable behaviour to be improved as intended, attention must be paid to the daily choices that people are offered (Talen & Ellis, 2002; Youngentob & Hostetler, 2005; Hostetler & Noiseux, 2010). The confusing array of environmental information and doubts about the effectiveness of one's own behaviour may act as obstacles that prevent people from starting to conserve energy. Therefore, focus should be placed on delivering just the right type of information in order to affect the attitudes of people (e.g. Davis, 1993; Carlsson-Kanyama & Linden, 1999). Therefore, behavioural sustainability could be improved by distributing to residents clear, current and appealing energy information. This would improve people's attitudes towards the environment, which in turn might affect their behaviour in the desired manner and cause them to want to reduce their carbon footprint.

Martinkappi (2010) reminds people that even the equipment in buildings must be simple enough to maintain that it does not cause problems to residents who want to conserve energy. The right attitude of consumers, and therefore the significance of correctly using the equipment, becomes a key factor in energy

conservation once the larger investments have been made. Confidence must be placed in consumers and their desire to create a demand for energy-effective solutions. This will further increase industrial product development, creating additional business opportunities. Due to the fact that different types of classification systems for areas and buildings are becoming more common, consumers will learn to compare the energy efficiency of buildings and demand more quality.

People's attitudes are complex and have been the subject of much scholarly study. In fact, up to half of all environmental psychology research is somehow associated with studying people's attitudes (Kaiser et al., 1999). Environmental attitudes are unique to the individual and subject to change. A well-known environmental psychologist, Milfont, who has published a great deal of academic literature on the subject, describes people's environmental attitudes as being psychological tendencies that the individual uses to describe his or her views or beliefs in relation to the environment (e.g. Milfont, 2007). These tendencies have been created as a result of evaluation and affect the quality of behaviour either favourably or unfavourably.

Modifying attitudes is a complex field. Values are mostly closely related to attitudes: usually they guide the individual's thinking, choices and actions. A person's attitudes reflect often his/her values. Attitudes are made up of cognitive, emotional and functional elements. A consumer's knowledge of a particular company may influence his/her feelings and actions (Allard, 1983; Rannikko, 1995; Bergström & Leppänen, 2007).

It is clear that studying people's attitudes is not simple. Attitudes cannot be accurately measured, as they may continually fluctuate, and it may be that the individual in question cannot accurately describe his or her own attitude. According to Uusitalo (1990), although people's environmental awareness has quickly increased in several countries in recent years, environmental issues are continually becoming more complex. In addition, inconsistencies between attitudes and behaviour are evident. People want several overlapping things simultaneously, while their preferences and alternatives constantly vary.

Recently, researchers have favoured research methods such as interactive interviews and different types of conferences over the traditional top-down data gathering methods. The goal of these methods is not necessarily to establish unified views but to address environmental attitude questions directly with the consumers and discover how they potentially see the threat of global warming and will potentially react to it. Some of the researchers, such as Petersdorff et al. (2006), highlight the need for interdisciplinary research. Heltberg, Siegel and Jorgensen (2009) discuss the benefits of longitudinal research methods and provide ideas for conducting panel studies in households. Anable et al. (2006) conclude that consumers should be asked questions directly about climate change with the goal being to ascertain their attitudes, both evident and covert, toward it.

The threat of global warming is real and a sensitive subject to many people. What they know about climate change and their attitudes towards it may affect their behaviour. In their studies, Heltberg, Siegel and Jorgensen (2009) focus on identifying the significant gaps that would appear to exist between climate knowledge and actual environmentally friendly behaviour. In particular, they assess people's susceptibility and vulnerability within the context of climate change. The researchers propose a new type of framework, which can be used to study the risks people experience, how they adjust to them and their sense of vulnerability when faced with climate change. This type of framework, a lens, could potentially guide households to engage in environmentally friendlier behaviour and could help prepare society to try to reduce climate change on an individual level.

The methods that regular consumers adopt to handle their everyday chores at home and elsewhere is a central issue; it is one that could have significant and immediate positive effects on the fight against global warming. Different types of models have already been developed for decades to help explain the energy inefficient behaviour of residents who show no concern for the environment (e.g. Ajzen & Fishbein, 1980; Blake, 1999; Hungerford & Volk, 1990; Kaplan, 2000; Stern, 2000).

Global warming's social and economic effects on people are not always sufficiently considered, even though in reality it has a profound effect on many people through different direct and indirect means (IPCC, 2007; Cline, 2007). Direct means are easier to observe and study, but the more indirect means can be difficult to predict, even though they may well have the worst effects. This refers to, for example, a person being worried about climate change and feeling saddened by not being able to invest in fighting it by purchasing more energy-efficient equipment.

In their research, Gardner and Stern (2002) divided behaviour associated with energy conservation into two groups: efficiency and reduction. Efficiency behaviour includes instances of individual behaviour that lead to, for example, the purchase of energy-efficient equipment, such as supplies needed for insulating the home. Reduction behaviour consists of repeated efforts to reduce energy use, such as adjusting the thermostat that regulates the temperature of the home to a lower setting.

Geller (2002) states that the first step in planning action regarding the energy use of an individual involves conducting a thorough diagnosis of the energy efficiency of the home. The pain points of environmentally friendly behaviour must first be accurately identified and then targeted interventions on those points should be carried out. The goal is to offer people new possibilities, which will lead to behaviour that improves energy efficiency, making it more attractive, impelling and possible.

Brandon and Lewis (1999) studied what significance feedback appears to have on increasing the energy efficiency of people. According to their research, feedback does not seem to play a significant role in improving the energy efficiency of individuals. In their studies, comparison groups consisting of households received four types of feedback on their energy conservation activities: comparative feedback, where energy savings could be compared to the energy savings of others, personal feedback, feedback on their financial savings and feedback concerning their environmental impact. In addition, one comparison group of households received feedback via brochures and another group received

feedback via computer technology. The difference between the comparison groups (that received different types of feedback) and the control group was not significant. Therefore, receiving feedback did not significantly increase the energy efficiency of people.

Peer groups and peer support, however, seem to play a significant role in improving the energy efficiency of individuals. In their research in the Netherlands as part of the Eco Team Program, Staats, Harland and Wilke (2004) found that a small group consisting of, for example, neighbours, friends or family that met once a month to exchange information on energy conservation would appear to play a significant role in improving the energy efficiency of people. For two years, the study followed these Eco Team groups that met once a month and found that their energy-efficient behaviour improved in terms of gas and electricity consumption, water consumption, transport, food consumption and recycling. In the control group, which did not meet monthly to exchange information with others and receive feedback on their own energy conservation efforts, no increase in energy efficiency was evident during the observation years.

Measuring the energy behaviour of people is a difficult and sensitive issue. Maddison, Rehdanz and Narita (2013) have described the problem with measuring the effect of climate change in the everyday life of consumers. They reiterate that it would be logical to measure the effect of climate change on the cost of living or direct changes in the values and behaviour of people and consumer behaviour, but that is very difficult. This is due to the fact that climate is only one potential research unit among countless others that address the flow of factors in products and services, which makes it impossible to isolate and observe.

Even investing in energy-efficient equipment does not always improve people's energy consumption as desired. Berkhout, Muskens and Veldhuijsen (2000) accordingly state that acquiring energy-efficient equipment does always reduce the energy consumption of residents, as they may use this equipment quite frequently, which leads to the so-called rebound effect. Implemented energy savings actions do not always directly describe the improvements in the energy

efficiency of people. Abrahamse et al. (2005) accordingly state that the money saved from household energy conservation may be used to purchase energy-intensive products, which require a great deal of energy use in their supply chains. In contrast, people may also save energy in such areas that are not measured in research, which prevents this so-called spill-over effect from being measured.

According to Moisander and Pesonen (2002), an essential discovery is that green consumption, which refers to environmentally friendly behaviour and energy conservation, is also a moral statement for people. Even if people were offered external energy-effective solutions, such as an environment built in an environmentally friendly manner, the problem would still not be resolved (Hostetler & Noiseux, 2010).

An environmentally friendly attitude and the behaviour of an individual must come from within. It could also produce personal well-being. Frey and Stutzer (2002) find that people's sense of well-being is always a highly subjective experience. Increases in material well-being during the past decades have not made people any happier in Western countries (Bacon et al., 2010). Maybe improving eco-efficiency and adjusting personal environmental attitudes and behaviour could offer people a more subjective sense of well-being and an opportunity to make moral, cultural and social statements.

Uusitalo (1990) reiterates that the eternal conflict, which affects the environmentally friendly behaviour of a lot of people, is evident in the form of a dilemma between personal gain and collective well-being. Despite a person potentially wanting collective good and the best for the environment, human nature drives people to aim for the most personally satisfactory and convenient alternative without having a desire to make sacrifices regarding personal well-being.

Social considerations, i.e. following what others do or do not do, are also probably an important reason why many people are not taking more active steps to influence energy issues. It is easy to assume the role of bystander when faced

with the complexities of the climate problem. The consequence of this, at worst, is that all participants, including political decision-makers, stay rooted to the spot, waiting for the solution to arrive from somewhere else (Retallack et al., 2007).

Ecologisation, which is defined as an attitude shift to greener values, seems to be taking place in Finnish society. During the past years, a general heightened interest in environmental themes and the will to assume responsibility for one's own environmental behaviour have been observed. The changes are most evident in the increased interest in recycling (e.g. Ministry of the Environment, 2008; Statistics Finland, 2006), green building and living trends (Heinonen et al., 2006) and the increased popularity of organic and local food (Isoniemi et al., 2006; Mikkola & Ahokas, 2009; Roininen et al., 2006).

Finnish values seem to also be shifting from 'what you do' to 'who you are' (Heinonen et al., 2006; Jenning 2005; Thackara, 2005). A natural and authentic existence may be more important than effective levels of achievement. Growing herbs may feel like a better attitude and behaviour alternative than driving a sports utility vehicle to the supermarket to buy foreign herbs. When considering all factors, it seems that it is very important for Finns to create a future society that is as energy-effective as possible (Koskela & Vinnari, 2009).

The problem still remains that favourable attitudes do not always lead to concrete action to control climate change. Likewise, positive attitudes towards environmental protection do not necessarily give rise to any kind of political movement (Leiserowitz et al., 2006).

Many research studies have identified critical gaps and barriers between expressed values or attitudes and actual behaviour, at both the individual and the collective level (Blake, 1999; Kollmuss & Agyeman, 2002; Stern, 2000). However, there are differences of opinion over the relative responsibilities of the different actors (individuals, communities, business, government, environmental groups) and over the most effective means to translate environmental concern into pro-environmental behaviour and thus overcome the 'value-action gap' (e.g. Eden, 1993; Harrison et al., 1996; Hinchliffe, 1996; Burgess et al., 1998).

Modeling attitude and behavior theory is sensitive. The 'ABC' model is widely shared theory. It derived from strand of psychological literature. The paradigm of 'ABC' grounded in theories of planned behaviour (Ajzen, 1991) and in variously rational concepts of need (Gatersleben & Vlek, 1997). According to this model for the most part, social change is thought to depend upon values and attitudes (the A). These attitudes are believed to drive the kinds of behaviour (the B) that individuals choose (the C) to adopt.

According to Shove (2010) this well known paradigm of 'ABC' has also blind spots. For example, in effect, the idea that desires and attitudes drive behaviour produces a blind spot making it impossible to see how the contours and environmental costs of daily life evolve. Shove also argues that nowadays policy documents bring a huge weight of behaviour-change literature. And at the same time they bear on a surprisingly limited set of goals that have to do with encouraging certain styles of purchasing, avoiding waste, promoting efficiency by adopting green technology and occasional restraint.

The assumption that attitudes can influence people's environmental behaviour has been critically examined. People often behave in a complete information vacuum, daily routines tend to control behaviour, and the cultural framework within which we live guides our choices along familiar paths. Indeed, the attitude-behaviour paradigm takes no account of the interaction between people's behaviour and the structures of society or micro-level factors and processes (Massa & Haverinen, 2001). What is more, attitudes are not formed in isolation from the rest of life but are likely to be affected by a host of different factors and competing viewpoints (Erwin, 2001). Although studies show that the link between attitudes and behaviour is not a strong and direct link, favourable environmental attitudes are nevertheless likely to have some effect on behaviour via feelings of moral responsibility, a wish to identify with the role of green consumer, and through social norms (Moisander, 1996).

Clearly, much work remains to be done, at different levels and using various methodologies, to identify and understand the key relationships between sustainability values, attitudes and behaviour, and to apply such knowledge in an

effort to ‘bend the trend’ and accelerate the transition towards sustainability (Leiserowitz et al., 2006).

3 Research questions

The research project aimed to answer the following research questions:

1. How can the effects of climate change be reduced and prevented in Finland?
2. How are Finnish energy policies evident, according to energy experts?
3. How are consumer attitudes evident, according to energy experts, and how can they be influenced?
4. i) Does residency location affect the attitudes and behaviour of people?

   ii) Are attitudes and behaviour inter-related?
5. i) Are residents willing to modify their energy consumption?

   ii) Do personal traits, such as age and residency location, affect the will to improve energy consumption efficiency?

The goals of the five studies associated with this dissertation are listed in detail in each published article, which are included at the end of this summary.

4 Research methods

The research methods of the five studies included in the dissertation, the progress of the studies and the analysis of them are briefly summarised here, highlighting their main points. All of the most important research methods and issues associated with carrying out the research and conducting the analysis are presented in free-format text, so that a clear understanding can be created about how information was collected from individuals involved in the study and how and how this data was subsequently handled.

The approach of this dissertation was abductive. The process progressed on a step-by-step basis where the energy industry field was studied using a comprehensive literature review. Next, select energy industry experts were approached to obtain deeper and more detailed information about events in the energy industry in Finland. Then, the research targeted the attitudes and behaviour of private Finnish individuals by studying both individuals and by organising group panels. This made it possible to examine the themes of interest even more accurately and thoroughly.

More detailed discussion of the reasons, methods, research steps and analysis are included in each published article, which are included as references.

Publication I: 'Urgent need for new approach to energy policy: The case of Finland'

The study was conducted via a literature analysis of topics and issues relevant to the research and raised in the research questions. The researcher studied a large amount of industry literature and numerous published articles.

Therefore, the research method consisted of assembling and reviewing literature and scientific research on the energy industry. Using the information gathered from published research and books, a diverse and informative article was

assembled on the current energy industry in Finland from the perspective of energy efficiency.

Publication II: 'Experts' view on Finland's energy policy'

Eight energy industry experts were interviewed in the study. All of the research subjects were knowledgeable about energy and climate issues due to their occupation.

The energy experts were selected in a manner in which their occupation represented one of two pre-defined groups. These two groups were formed in a manner where one supported more so-called green values (nature) and the other supported efficiency values (commercialism and industry). From both of these relatively opposite value groups, representatives were further selected from different industries. The representatives included lobbyists, members of different ministries and media representatives. In addition, opinions were gathered from one unbiased energy expert, who could not be classified in any of the aforementioned groups. (See Table 1 of the published article in question in the appendices on page 284).

Once the groups and classes were designed, consideration was given to which individual in each group and class would best be suited as the research subject on the grounds that he or she would best represent these classifications. This allowed as many views as possible to be obtained from individuals in as many different professional positions as possible in the Finnish energy sector. The selected person was contacted via email or telephone and the research objectives were explained to the subject and an interview time was set up at the interviewee's workplace. All eight subjects that were selected gladly accepted the invitation to participate in the study.

The interviews were always conducted by the same interviewer, following a predetermined question template (Appendix 1). The themes were Finnish energy policy in general, current Finnish attitudes towards energy issues, influencing Finnish energy attitudes, and actions and the future. The duration of the

interviews fluctuated between 60 and 120 minutes. Every interview was recorded. The identities of the research subjects were closely guarded, so that their identity could not be determined during any part of the research.

The interviews gathered information and expert views on the current state of the Finnish energy environment, the factors that affect the Finnish energy sector and the future outlook of the Finnish energy industry. The interviews were conducted utilising a predetermined framework of questions. In addition, time was left at the end of the interviews for free expression of thoughts and opinions.

The research material was compiled and coded into word-for-word transcript files. This study was interested only in those sections of the interviews in which the participants discussed the current Finnish energy sector environment, factors affecting the Finnish energy sector and the future outlook of the Finnish energy sector. These included in particular the following themes: theme 1, Finnish energy policy in general, and theme 4, The future. Therefore, the sections of the interviews that discussed other themes were not included in this analysis.

The interviews were converted into word-for-word transcripts and the text was analysed using content analysis methodology. Similar frequently recurring themes and observations, along with differing views, were identified from the material. While analysing the material, it was divided into increasingly specific components, which made it possible to conduct a more accurate and detailed analysis.

Publication III: 'Perceptions Held by Finnish Energy Sector Experts Regarding Public Attitudes to Energy Issues'

The study utilised the same research material as the previous article, Publication II*, 'Experts' view on Finland's energy policy'*.

This study analysed portions of the material related to four specific themes from the word-for-word transcribed texts of the 60 to 120 minute interviews of the eight energy experts. The interviewer had asked specific detailed questions about the selected themes (Appendix 1). The themes were Finnish energy policy in

general, current Finnish attitudes toward energy issues, influencing Finnish energy attitudes, and actions and the future.

In addition, the analysis considered all of the transcribed interview texts that discussed the themes in question in another context or at the end of the interview, where the interviewee was allowed to freely discuss their views and thoughts on the discussed subjects and on other potential issues that occurred to the them. The analysis of this study focused particularly on the themes in question framework 2, Current Finnish attitudes toward energy issues, and question framework 3, Influencing Finnish energy attitudes and actions.

The research material was compiled and decoded into word-for-word files, which were analysed using content analysis. Similar frequently recurring themes and observations, along with differing views, were identified from the material. While analysing the material, it was divided into increasingly specific components, which made it possible to conduct a more accurate and detailed analysis.

Publication IV: 'Attitude-behaviour gap in energy issues: Case study of three different Finnish residential areas'

The study gathered data from people living in different types of residential areas. Three residential locales were pre-selected, using specific reasoning. They were all located in Southern Finland.

The first research locale, Herttoniemi, is a model example of a densely populated area in the Finnish capital, Helsinki. Homes in Herttoniemi are relatively old and the public transport services are excellent. The area hosts a comprehensive and diverse network of services.

Another research area, Kirkkonummi, is a municipality with its western border adjacent to the capital metropolitan region, meaning that it is relatively close to Helsinki. Kirkkonummi is a residential area that has grown significantly in size over the past few years. The area has excellent train connections, as well as many frequent buses. Kirkkonummi hosts a good selection of shops and services, as well as ample possibilities for outdoor activities.

The third research area of the study was Nurmijärvi, which, of the three research areas, is located the furthest away from the centre of Helsinki. Nurmijärvi is a model example of a Finnish municipality that is located close to nature in which most of the homes are single-family detached homes. The municipality is well-known among Finns and is a rapidly growing area. The use of automobiles is very common in the region and many people who live there have long daily commutes. The residential area does not have a rapid transit system (metro) or train connections and bus traffic is relatively scarce.

Ten research subjects were selected from each research area to participate in the study. The selection of the research subjects can be considered random. The research subjects were selected for the study in a manner where the researcher travelled to the research areas in question during several different times of the day and went out into the streets and public areas to ask people if they were willing to participate in the study.

A total of 30 research subjects, 10 from each research area, participated in the study. Each research subject was over 18 years old. No one was paid to participate in the study. The identity of the individuals participating in the study was protected, so that none of them can be recognised by external parties at any phase of the study.

Prior to beginning the study, the researcher had tested the effectiveness of the research method and the estimated amount of time for the study on volunteers living in a few different residential areas. The pilot study was found to be effective, so the prepared research method was deemed effective and applicable.

The actual research events varied from between 30 and 60 minutes in duration. The researcher always asked the same questions in a pre-determined sequence and used the same pre-defined methods in the same manner with every research subject.

Three different types of research methods were used with each research subject during a research session: 1) energy interview, 2) a life satisfaction questionnaire

and 3) a carbon footprint questionnaire. The following paragraphs briefly describe the methods:

1.) Energy interview. The energy interviews aimed to gain an understanding on the research subject's energy attitudes by asking questions in accordance with the pre-determined question framework (Appendix 2). The duration of the interview varied from between 10 and 20 minutes. The researcher had previously used a similar personal research approach while studying the job profile of healthcare workers taking care of seniors (Valkila & Saari, 2011) and had found the informative nature of the to-the-point personal interviews to be fruitful. These energy interviews contained questions on the following four themes: possible concern about climate change, position on energy issues, their own perceived energy behaviour and their thoughts about how active to be in the future in relation to energy matters.

The interview responses were transcribed later into text files, which were read thoroughly multiple times. As the analysis process progressed, similar attitudes towards the environment were beginning to become evident. Therefore, these attitudes were decoded and arranged into simple classifications using pre-defined criteria so that it would be easier to compare them. Class 0 represents a negative or indifferent attitude and classes 1, 2 and 3 represent increasing levels of interest or levels of activity with respect to the energy issues in question.

2.) Life satisfaction questionnaire. The life satisfaction of the research subject was measured using a life satisfaction questionnaire (Appendix 3). The life satisfaction questionnaire is based on the well-known and frequently used Satisfaction Life Scale (SWLS) method developed by Diener et al. (1995), where five statements pertaining to personal conditions in the research subject's life can be used to evaluate their current level of satisfaction with their life. The following 1–7 point scale was used to rank the statements: 1=strongly disagree, 2=disagree, 3=slightly disagree, 4=neither agree nor disagree, 5=slightly agree, 6=agree, 7=strongly agree. The five statements that the research subject responded to were as follows:

1. In most ways, my life is close to my ideal.
2. The circumstances of my life are excellent.
3. I am satisfied with my life.
4. So far, I have the important things I want in life.
5. If I could live my life again, I would change very little.

In addition, the questionnaire had space for open responses following each statement in the event that the research subject wished to provide further explanation about their responses or otherwise add something pertaining to their level of life satisfaction.

The responses to the life satisfaction questionnaires were later decoded and arranged into tables, which could be used to calculate the mean numerical value used to describe the research subject's life satisfaction value. This personal life satisfaction value was always between 1 and 7. The greater the value, the greater the satisfaction with one's life. The mean life satisfaction values of the respondents in different residential areas were also calculated, so that these could be compared.

3.) Carbon footprint questionnaire. The carbon footprint left by the research subject was calculated using the Finnish public carbon footprint calculator published on the Internet in 2010. It quantifies an individual’s burden on the environment based on their lifestyle. Using the calculator, the user can measure their personal emission output from living, transport, food, consumption behaviour and recycling. The results can also be saved. Therefore, the service can be used to conveniently monitor how changes in lifestyles affect personal emission quantities. The calculator can be used, for example, to see how much giving up a flight or switching to green electricity reduces one’s carbon footprint. The popular application was designed by the Turku chapter of Junior Chamber International and it has been implemented in co-operation with the Helsingin Sanomat newspaper. Gaia and Nordic Offset, co-operation partner companies that

support the reduction of climate change and offer expertise in the energy sector, also contributed to the design and implementation of the calculator.

The Finnish carbon footprint calculator application was selected from many alternatives due to the fact that it produces quick and reliable results. The results were easy to understand and compare, as the programme also stated the carbon footprint against the Finnish average, which is approximately 10 tonnes per resident. Furthermore, by using the free application the research subject had the option to even follow the development of their own carbon footprint monthly, if they so desired.

The 74 questions of the carbon footprint calculator, along with their response alternatives, were copied into a written format and the entire calculator was printed on paper (Appendix 4). This made it possible for the research subject to use a pen to circle the best alternative response that described the respondent or to provide a numeric response for each question on paper. The data from the paper versions were kept in printed format and they could be utilised as background information and for more detailed analysis during the study.

The questions (74) of the carbon footprint questionnaire were divided into four sections, which discussed housing, travel, nutrition and lifestyle. In the event that the research subject was not sure about a question, the researcher asked the respondent to select the alternative that would best describe the respondent or to provide a response that was as close as possible to the truth, so that no questions were left unanswered. On a few questions, it was also possible to select the ‘I don’t know’ alternative.

The researcher later transferred the respondent's written responses into the Internet application. The application, utilised in this manner, automatically calculated the estimated carbon footprint left by each individual using the same principles. The system also provided a carbon footprint of each individual, divided into four categories based on housing, travel, nutrition and lifestyle.

In addition, all of the results obtained using the three research methods, and the analysis based on them, were collectively processed using statistical analysis. Standardised SPSS software was used so that statistical analysis could be performed. The analysis included data correlations and distributions and potential statistical connections and their significance between different variables.

Publication V: 'Consumer Panel on the Readiness of Finns to Behave in a More Pro-Environmental Manner'

The study was conducted in the same way at two separate research sites: Herttoniemi and Nurmijärvi. Both research sites are located in Southern Finland.

The greatest differences between the residency areas are the distance from the centre of the Finnish capital, Helsinki, types of housing, population density and the functionality of the public transport system. There are numerous other residential areas in Southern Finland that share characteristics with the selected research areas. The selection of the research areas was also affected by the fact that the researchers had previously conducting research on energy attitudes and behaviour and had selected research subjects from these same residential areas. Therefore, the background of the selected research areas was familiar to the researchers. The previous study provided inspiration to study the energy attitudes and potentially environmentally friendlier behaviour of the residents in these residential areas in more detail. Consequently, the residential areas were included in the study.

The study divided people into three age groups: young people (6–26 years), middle-aged people (34–54 years) and elderly people (63–83 years).

The research subjects were selected for the group discussions after the researcher had first identified the Finnish-speaking schools in the area. In the Herttoniemi area, six potential locations for conducting the eco-panel with young people were identified. In Nurmijärvi, 22 potential locations for conducting the eco-panel with young people were identified. Next, the researcher identified the playgrounds and day-care centres located in the area. They identified seven potential locations to

conduct the eco-panels with middle-aged people in Herttoniemi and 21 potential locations to conduct eco-panels with middle-aged research subjects in Nurmijärvi. Finally, the researcher identified the assisted living facilities and other possible meeting places for the elderly in the area. They identified four possible locations to conduct an eco-panel among the elderly in Herttoniemi and nine possible locations to conduct an eco-panel among the elderly in Nurmijärvi.

The researcher always randomly selected one location from among the potential alternatives. The researcher then travelled to that location. The researcher selected a four-member group to participate in the group discussions from among the individuals volunteering to participate in the study at the selected location.

For both research areas, one group for each selected age group (young people, middle-aged people and elderly people) was collected. Therefore, the researcher conducted an eco-panel study, in group discussion format, which consisted of six groups with four participants each. In total, the study included 24 research subjects (see Table 2, page 1565 of the original publication included in the appendix).

In the research situation, those participating in the consumer panel engaged in discussion, led by the researcher, for approximately 90 minutes following a pre-planned method. The researcher had used a similar panel study method previously when studying services desired by the elderly (Valkila et al., 2010) and had found the applied four-member research group to be a good size for generating discussion on several levels. At the very start of the study, each person in the group wrote down their gender and age on a piece of paper and placed it in front of them so that it was easier for the researcher to follow the discussion and take notes, in addition to recording the discussion.

During the group discussion, each consumer panel discussed the same four themes by following the same instructions and discussing them in the same sequence. Prior to discussing each theme, the researcher distributed a piece of paper to each group member, which stated the subject of the theme and provided some scientific research results on the subject; after this, the researcher asked 1 or

2 specific questions that addressed the research subject's personal attitude toward the theme in question.

The research subject was presented with a few potentially thought-provoking facts on each theme (Appendix 5), which could be used in their evaluation process and in the responses they provided. The four themes and their major drill-down questions that were used as the framework for the group discussions are listed below.

1.) Urban Structure

Place of Residence: *Would you be willing to live in an apartment building in the suburbs?*

Infill Development: *Would you be prepared to have a new house, approximately the same size as your house, built on the lot next to yours (provided that it would fit on the lot)?*

2.) Household Energy Consumption

Compromising on Living Comfort: *Would you be prepared to drop your indoor temperature by 2 degrees, thus reducing your heating energy consumption by approximately 10%?*

Investment in Improving Household Energy Efficiency: *Would you be prepared to make such an investment?*

3.) Mobility

Routine Mobility: *Would you be prepared to give up your car right now, or* do so *hypothetically if you had a car?*

Recreational Mobility: *Would you be prepared to give up flying for vacations?*

4.) Lifestyle

Consumption: *Would you be prepared to cut your level of consumption?*

The research subjects were always given a moment to study the distributed paper, after which each participant was given an opportunity in random order to describe, for approximately one minute, their emotions, attitudes and opinions on the theme and the factual information provided on the paper about the subject. Next, using drill-down questions for the different themes, each research subject in turn provided a numerical value using a scale of 1–4 (1=Not at all ready, 2=Not very ready, 3=Quite ready and 4=Very ready) on how willing they would potentially be to improve their environmentally friendly behaviour in terms of the theme in question.

Once every member of the panel had briefly stated their views and provided numeric assessments, the panel members were allowed to freely discuss the theme for approximately 10 minutes. Throughout the free discussion, the research subjects were allowed to keep the paper in front of them with select facts on the theme and drill-down questions. If free discussion did not occur, the researcher would stimulate it by presenting pre-determined further questions to the panel members in order to generate discussion. Finally, if a consensus had not already been reached during free discussion, the eco-panel would try to find a relatively unanimous direction or response on what they, as a group, believed about the presented questions.

The results of the study were analysed so that the numerical values provided by the research subjects in response to a question about a particular theme (or a single question in theme 4) were recorded and encoded later. These numeric values were used to assess the possibility of altering one's behaviour in a more environmentally friendly manner and mean value tables were created and compared against the different age classes and residential areas.

The recordings of the group discussions were transcribed into word-for-word text. These transcribed text files were closely examined several times. The text files were gradually analysed in a manner where all of the opinions and issues that were repeated several times were underlined. Similarly, all notable discrepancies that occurred during the discussions were underlined. Finally, an attempt was made to construct the group's collective opinion on the drill-down questions and

the most significant and highlighted issues with respect to the questions were summarised.

5 Results

Publication I: 'Urgent need for new approach to energy policy: The case of Finland'

According to the literature review, the fluctuation in oil prices and economic development are crucial points where changes must occur. This would allow Finland to strive for desired progress in the energy sector.

In contrast, it also seems that changes in the values and attitudes of consumers are the essential forces that can improve the nation's energy efficiency.

A greater diversity of energy sources and using them in more diverse ways is crucial if catastrophic global warming is to be avoided. In particular, the use of renewable energy sources must be increased. The possibilities for utilising nuclear power, wind, solar and hydro energy, forestation activities, biomass, carbon dioxide capture and storage (CCS), and nano-bio technology are available.

The activities and co-operation of all parties in the Finnish energy sector must be improved. Attention must be paid to the efficiency of energy production and transport and distribution and the supply chain should be improved, if necessary.

Finnish national energy policies and actions must be improved. The necessary changes and improvements would appear to take place most effectively through detailed proposals and policies, as well as through international co-operation.

Based on a review of the existing literature, more care should be exercised when planning different types of energy strategies. Different factors constantly have an impact on the energy field and different types of cause and effect relationships are created. The implemented actions also include several different types of functional chains. All of these issues hinder the work to reduce global warming, so they should already be considered when planning energy strategies. This would make it possible for future energy sectors that are striving to improve their energy efficiency to also have an opportunity to succeed.

Publication II: 'Experts' view on Finland's energy policy'

As a part of the study, eight Finnish experts operating in the energy industry were interviewed. According to the interviewed experts, a significant part of the problem is that current Finnish energy policies consist of numerous unrelated parts and contain inconsistencies. Economic uncertainty is one of the most significant threats to the nation's energy sector.

According to the interviewees, the most significant opportunities for improving the Finnish energy industry's performance involve focusing on exporting Finnish products, services and expertise that are based on Finnish energy efficiency and conservation.

In the future, the focus areas of Finnish energy production should be to develop renewable energy sources and diversify energy production technologies.

Based on the expert interviews, other conclusions cannot be made about the use of nuclear power in the present or the future, as the opinions of the research subjects conflicted significantly. Therefore, the outcome was that consensus was not achieved on the use of nuclear power.

According to the energy industry experts, the most significant changes in improving the energy efficiency of Finnish lifestyles would be found in travel, living and recreational activities. Improving Finnish energy attitudes so that people would be more environmentally friendly would seem to play a significant role in achieving the targeted energy efficiency improvements set for Finnish consumers.

Publication III: 'Perceptions Held by Finnish Energy Sector Experts Regarding Public Attitudes to Energy Issues'

The study interviewed eight Finnish experts operating in the energy industry. According to the interviewed experts, Finnish energy attitudes seem to be rather complex.

It is not easy to define the potential link between energy attitudes and energy behaviour. The type of connection that exists between energy attitudes and behaviour may be reasonable, direct, conflicting or cumulative. The connection may also be quite irrational, which eliminates the possibility of making reliable predictions.

According to the experts, the energy attitudes of citizens are susceptible to change and revision. In order to change energy attitudes, methods that include personal, social and practical dimensions should be employed.

According to the expert interviews, Finns with neutral energy attitudes are the most critical group. Urgent efforts should be made to change their energy attitudes. The best methods for reaching and influencing them were to prod and manipulate them into taking an active interest in energy efficiency.

According to the experts, the decision-makers in the Finnish Government and other authorities influence citizens most directly. The most effective practical network for improving Finns' energy efficiency consists of Finnish politicians and the decisions they make.

According to the experts, it is possible to achieve the desired change in Finnish attitudes and behaviour. They considered peer groups, communication, the media, education and training, and mental images and perceptions to be the most central and effective influencing methods for changing attitudes and behaviour.

The opinions of the experts also revealed that some households made energy decisions that more directly affected their energy attitudes than others. These were the potential energy-efficient solutions associated with living, travel and eating.

Publication IV: 'Attitude-behaviour gap in energy issues: Case study of three different Finnish residential areas'

The study included 30 residents from three different residential areas. According to the residential survey, residency location would seem to have a great impact on the attitudes and behaviour of an individual in terms of energy issues.

The concern for global warming, people's attitudes about energy issues and their level of energy-awareness behaviour were significantly higher among Herttoniemi residents than among residents of the two more scarcely populated residential areas, Kirkkonummi and Nurmijärvi.

The residency location also affected the actual behaviour of the research subjects in relation to the energy themes: living, transport and carbon footprint.

The living area (m_2/person) was clearly smaller among the research subjects that lived in Herttoniemi than among those that lived in Kirkkonummi or Nurmijärvi.

When compared to others, the average monthly driving distance was significantly higher among research subjects who lived in Nurmijärvi. The average driving distance of Nurmijärvi residents was nearly twice that of Kirkkonummi residents and nearly three times as much as the average for Herttoniemi residents. In addition, the research subjects living in Nurmijärvi had the least number of passengers per vehicle. A majority of the research subjects that lived in Nurmijärvi travelled alone a lot using their own car.

The results of the study indicate that the average annual carbon footprint, when all factors are included, is the smallest among research subjects living in Herttoniemi, an average of 10.3 tonnes CO2-e. The equivalent figures for the Kirkkonummi and Nurmijärvi participants were on average 14.4 tonnes CO2-e and 12.4 tonnes CO2-e, respectively.

The average annual carbon footprint from transport was also the smallest among research subjects living in Herttoniemi: 5.2 tonnes CO2-e. The equivalent transport-related carbon footprint figures were 7.2 tonnes CO2-e for those living in Kirkkonummi and 7.0 tonnes CO2-e for those living in Nurmijärvi. The

smallest individual carbon footprints (0.1 tonnes CO2-e) were left by research subjects H_2 and H_{10}, who lived in Herttoniemi, and research subject K5, who lived in Kirkkonummi. The greatest transport-related carbon footprint (14.5 tonnes CO2-e) was left by research subject H_3, who also lived in Herttoniemi.

The measured life satisfaction among the research subjects was the highest among the participants living in Nurmijärvi (average 6.1). The second highest level of life satisfaction was reported by those living in Herttoniemi (average 5.5). The lowest measured life satisfaction was reported by research subjects living in Kirkkonummi (4.4). The measured life satisfaction did not significantly correlate with a home's floor area, people's position on energy issues, their perceived energy behaviour, whether or not they travelled by car and their carbon footprint.

Therefore, the residency location significantly affects the attitudes and behaviour of the residents regarding energy issues. Statistically significant correlations were found between residency location and a home's floor area, people's level of climate concern and their perceived energy behaviour. The following paragraphs discuss these issues in more detail.

A significant correlation was found between residential area and floor area (r=.312*). The study participants who lived in more sparsely built residential districts, Kirkkonummi and Nurmijärvi, have sparser housing than the study participants who lived in Herttoniemi, which is a densely built residential district.

A significant correlation was found between residential area and concern about climate change (r=−.747**). The study participants who lived in Herttoniemi reported being more concerned about climate change than the study participants who lived in Kirkkonummi or Nurmijärvi.

A significant correlation was also found between residential area and the participant's position on energy issues (r=−.396*) and their perceived energy behaviour (r=−.495**). That is, the closer to the centre of Helsinki the study participants lived, the more concerned they were about climate change, the more active they were in relation to energy matters and the more they perceived their behaviour to be energy friendly.

However, the residential area did not have a significant correlation with actual public transportation use (r=.235), the size of the carbon footprint (r=.176) or measured life satisfaction (r=.190). With regard to the 'actual' variables, the residential area had a significant correlation only with the number of kilometres driven by car (r=.600**). In other words, the further away the study participant lived, the more he/she travelled by car.

According to the study results, the research subjects' attitudes and behaviour regarding energy issues did not correlate. There is a gap between people's attitudes and behaviour, meaning that having a positive attitude towards energy issues does not lead to behaviour that is consistent with that attitude. This is referred to as an attitude-behaviour gap in energy issues.

Publication V: 'Consumer Panel on the Readiness of Finns to Behave in a More Pro-Environmental Manner'

A total of 24 persons were interviewed in four-member consumer panels as part of the study. The research subjects mainly seemed willing to improve their energy use and to reduce unnecessary consumption.

Age played a part in the extent to which people expressed a desire to make energy-effective energy choices. The young and elderly were more willing to make environmentally friendly choices than middle-aged people. In particular, the elderly groups (Group HE and Group NE) were very willing to give up driving and flying completely. In contrast, the middle-aged groups (Group HM and Group NM) were not at all willing to give up driving. Young research subjects (Group HY and Group NY) were the most willing to allow supplemental construction in the neighbourhood, while middle-aged groups (Group HM and Group NM) opposed the idea the most.

The research subjects living in Nurmijärvi were more willing to invest money in solutions, such as more energy-effective geothermal pumps, than research subjects living in Herttoniemi. Nurmijärvi residents were also more willing to give up vacation flying than Herttoniemi residents.

Research subjects living in Herttoniemi were more willing to give up travelling by car than research subjects living in Nurmijärvi.

Clear differences were not identified between the residential areas for certain factors. For example, research subjects living in both Nurmijärvi and Herttoniemi were, on average, equally willing to reduce the indoor temperature a few degrees.

6 Discussion

Based on the literature review, the use of renewable energy sources must be increased so that the release of harmful greenhouse gases into the atmosphere can be reduced in accordance with the set objectives. All parties that operate in the Finnish energy industry, including organisations, associations, ministries and others, must work together more closely so that the national and international environmental goals associated with climate change to be reached.

For individual consumers, changes in their attitudes and behaviour are central and influential forces in reaching the nation's energy efficiency improvement goals. The same point is made by researchers such as Hay (2005, 2006): consumer attitudes must change in order for environmentally friendlier and more energy-efficient behaviour to occur on an individual level.

Based on the interviews with the experts operating in the energy industry, Finnish energy policies seem inconsistent. According to them, people’s attitudes and behaviour towards energy issues varies. The connection between attitudes and behaviour may be direct and reasonable, but it may also be conflicting and cumulative. The same indications of inconsistencies between attitudes and behaviour have been identified already by Uusitalo (1990), among others, long ago.

According to the experts, consumer attitudes can, and should be, changed. Finnish political decision-makers and other authorities have an important role in changing attitudes. According to the experts, the most central ways of altering the perceptions of residents include peer groups, communication, media, education and training, and mental images and perceptions. The same observations about how to influence people have also been identified in several other studies. Geller (2002) provides a reminder that improving an individual's energy efficiency must be perceived as attractive, motivating and possible by the individual. For example, a peer group or politician that is respected by an individual may inspire quick and permanent change by setting an example. Staats, Harland and Wilke

(2004) have also found in their research that peer groups play a significant role in improving the energy efficiency of individuals. Through their research, Holden (2004) and Williams and Dair (2007) further highlight that political decisions and regulation frameworks may significantly promote behaviour aiming to achieve energy efficiency.

Numerous research subjects, including both the interviewed experts and the studied residents, highlighted that individual citizens are not solely responsible for improving energy efficiency. Is the responsibility of decision-makers to guide Finnish energy behaviour in a better direction, using well-planned incentives and consequences? Appealing and understandable information on energy behaviour alternatives for the individual consumer should also be distributed more effectively. Therefore, the use of alternative energy production should be made easier, cheaper and more attractive to citizens. This would allow people to, for example, exchange their electricity supplier for one that produces green energy and to increase the use of solar power in their homes and summer cottages.

Based on the views of the experts interviewed as a part of this study, a group of people with neutral attitudes towards energy issues was identified. Within this context, neutral refers to people who are completely unaware of energy efficiency issues or indifferent to them. This group of people with neutral attitudes was rather large and moulding their attitudes may be an effective way of improving energy efficiency levels. If the group with neutral attitudes were informed and encouraged to change their behaviour to become more environmentally friendly, there most likely would be a rather quick and extensive increase in people's energy-efficient behaviour in general. The best way to influence this group of people with neutral attitudes would be through a call to action as well as through manipulation. Peer groups and public opinion influencers also play a significant role in influencing the attitudes of individuals with neutral attitudes so that they would feel more positive about conserving energy.

Based on the observations and resident questionnaires collected from three different residency locations, the place of residency affects the resident's attitude towards and behaviour regarding energy issues. The residency location

significantly affects at least the resident's living area, their concern for the climate and their energy behaviour. The degree of life satisfaction experienced by the resident does not significantly affect the resident's attitudes towards energy issues or their energy behaviour. There is a gap between the attitudes of residents and their actual behaviour.

Therefore, the residency location may offer opportunities to increase an individual's energy efficiency or it may hinder it. Upon examining the research subjects' perceptions of their energy behaviour, it became evident that the residents living in Herttoniemi were considerably more active and efficient in seeking new energy solutions for their lives than the residents of Kirkkonummi or Nurmijärvi. Naturally, this is partially caused by the home density being typically greater in Herttoniemi. In addition, when compared to the more scarcely populated urban areas, public transportation is easier to use in Herttoniemi. Shared accommodation arrangements and other special arrangements associated with living or year-round cycling, may be easier to organise in Herttoniemi due in large part to the shorter distances.

The attitudes of people towards energy issues do not always lead to matching behaviour. Instead, there is a gap between attitudes and behaviour. The carbon footprint left by the research subjects of this study did not match their own estimates of their energy behaviour. For example, many research subjects that participated in the study described their environmental attitude as very positive, even though they were not willing to accept or use solutions that would reduce their carbon footprint. There were also research subjects that openly expressed their indifference towards energy issues and did not find it at all necessary to improve their energy efficiency.

While ecologisation can be observed among residents, their actual behaviour is changing more slowly. According to this study, residents know how they could improve their energy consumption. However, it seems that they are, for example, too prone to comfort or too indifferent to make real changes in their level of energy consumption. Similar observations have also been made in other studies in this research area. For instance, Heltberg, Siegel and Jorgensen (2009) identified

gaps between people's knowledge of energy issues and their behaviour. Likewise, Moisander and Pesonen (2002) found that energy-efficient behaviour signifies a moral position. Against this background, the research subjects in this study were not interested in taking a moral stand on environmental issues. This study provides indications that if the attitudes of people do not change, the desired energy-efficient behaviour as a continuum of attitudes will also not occur. If so, the Finnish goals to improve energy efficiency will not be realised as desired.

Based on the consumer panel studies carried out at two separate locales among different age groups, residency location was found to affect some energy solutions. For example, Herttoniemi residents, who live in a more densely populated area, said that they are more willing to give up driving than research subjects that live in more scarcely populated Nurmijärvi. This is certainly affected by Herttoniemi having a significantly better public transport system than Nurmijärvi. In addition, when it came to improving their energy efficiency, Nurmijärvi residents were more willing to make financial investments than research subjects from Herttoniemi. This may be explained by Nurmijärvi appearing to have residents who are more financially wealthy and who live in large single-family detached homes, while Herttoniemi seems to have a lot of single inhabitants, unemployed people, young people and students as residents.

The residency location does not affect all types of energy behaviour. Residents in both Herttoniemi and Nurmijärvi were willing to adjust their indoor temperature a few degrees lower, so this was unaffected by residency location. In their research, Gardner and Stern (2002), describe this type of repeated effort, such as adjusting the thermostat to a lower setting, as a curtailment activity. People may be very willing to take such actions, unlike with efficiency behaviour, which requires greater one-time efforts or actions that incur much more financial loss.

According to the consumer panel study, the age of the resident plays a part in whether or not they make energy-effective choices: young people and elderly people are more willing to make environmentally friendly choices than middle-aged people. This could be explained by the greater amount of free time, eagerness and activity levels among young people and elderly people than among

middle-aged people, who are in the midst of the rush of everyday life. In particular, the elderly are quite willing to give up driving and flying altogether. This could be explained by the physical limitations often brought by age. Middle-aged people are not ready to give up driving at all. Young research subjects are most willing to allow supplemental construction in their neighbourhood, while the middle-aged group opposed it the most. It may be that it is exactly the middle-aged Finns that know how their personal energy use could be reduced, but are too prone to comfort or too indifferent to make changes in their level of energy consumption. They might not be as concerned about the potentially environmentally catastrophic conditions of the world outside their homes and they may have more money for meaningful recreational activities, which reduces the amount of passion and energy left for other issues.

During the consumer panel study, it was observed that residents can approach energy issues from many different perspectives and that a consensus cannot be reached on many issues. There are many correct alternatives, variations, prioritisations and focuses in both people's attitudes and in their behaviour.

Recently, researchers have expressed the need for an interdisciplinary study (Petersdorff et al., 2006) and the possibility of a household panel study (Heltzberg, Siegel & Jorgensen, 2009), as well as the need to collect data directly from consumers on climate change and how to prevent it (Anable et al., 2006). This study was able to take into account all of the above mentioned concerns.

The way in which regular consumers handle their everyday chores is a central area of change in building a more energy-efficient society. These behaviour patterns stem from somewhere. Studies have sought to explain, in a negative way, why people do not assume responsibility for caring for the environment and seek to improve energy efficiency by changing their own behaviour (e.g. Ajzen & Fishbein, 1980; Blake, 1999; Hungerford & Volk, 1990; Kaplan, 2000; Stern, 2000). This study does not aim to find the reasons for such behaviour, or rather, the lack of it. Instead, it goes directly into studying the connection between attitudes and behaviour. More diverse, energy-related alternatives must be made available to people. The connection between the availability of alternatives and

behaviour becoming more environmentally friendly and energy efficient has been established in many studies (e.g. Talen & Ellis, 2002; Youngentob & Hostetler, 2005; Hostetler & Noiseux, 2010). Therefore, good and energy-efficient alternatives must be added so that the attitudes that control behaviour become more positive.

The following pages discuss the reliability of this study. This study applied both quantitative and qualitative research methods, as the intention was to test and examine different types of events and issues associated with the energy industry sector. Due to the relatively small population of research subjects in each study, the results are not used to make generalisations. Instead, they aim to make sense of and explain the research themes of the study and explain the individual research subject's experiences with energy matters.

All of the approaches, research methods and analysis methods have been explained and described in detail. All of the conducted studies can be repeated at different times and locations and with different research subjects, if necessary. No research subjects were given any compensation for participating in the study, eliminating the possibility of compensation acting as a motivating factor for participation and thereby compromising reliability.

The validity of a study, meaning its reliability and soundness, refers to the ability of the selected research methods to adequately explain the motivations and behaviour of the subject (Robson, 2002). When evaluating validity, attention is usually directed to how well the research approach and applied methods correspond to the phenomenon being studied. Expressed differently, did the study adequately explain the issues in question? Therefore, since the study should answer the intended research questions, the validity of this study can be considered good. In order to be valid, the applied research approach should be correct for the nature of the phenomenon and the question framework. For this study, information was gathered using various methods and experiences were collected on themes of interest associated with the energy field.

The reliability of the study, which refers to the reliability of the methods or measurements, is assessed based on the research method's ability to produce non-random results. Alternatively put, reliability refers to the ability to achieve the intended results using the research methods and applied measurement tools. For this to be successful, the design and implementation of the study is important (Miles & Huberman, 1994). The questions presented to the research subjects and the collected measurements must be clear and easy to understand. Researchers in the field must present the questions and collect measurements in a simple and neutral manner. In this study, the field work consisted of the interviews with the individuals and the measurements that were collected during each phase of the study using the same method; hence, the methods did not vary within the study with any of the research subjects. The same individual completed all of the field studies, so the researcher always closely followed the pre-determined protocol with every research subject and conducted the interviews and took the measurements systematically and always in the same manner. The field work for each study (following the planning and potential pilot measurements) was always carried out swiftly, within a few weeks, so that the conditions and other variables could be eliminated as much as possible. In addition, careful consideration was given to what to measure with each study in the field, so that pre-determined routines could be followed in the field to ensure that the desired things were measured. When discussing reliability, it is pertinent to mention that one of the published sections of this doctoral dissertation, *Publication IV*, utilised two other measurement tools, designed by other researchers, which were used with each research subject, in addition to the researcher's interviews. These measurement tools were the Life satisfaction questionnaire (Appendix 3) and the Carbon footprint questionnaire (Appendix 4). The reliability of these measurement tools, however, has already been positively established by those who first planned, implemented and used it (e.g. Shevlin, Brunsden & Miles, 1998; Vassar, 2008).

The identity of each research subject that participated in the study was closely guarded. The research subjects were told at the beginning of the study that the identity of all participants would remain secret during all stages of the study and

this promise was also kept. Written materials and recorded interviews were stored in a locked cabinet at a secure facility at Aalto University.

All the studies have in common that the main author of the study also conducted the field research. The researcher, however, did receive instructions, guidance and confirmation from her thesis advisor and colleagues throughout the process. It is always theoretically possible that the personal assumptions of the researcher or that other human errors, such as fatigue or a lack of care, could have affected the field research, analysis or reporting, even though the neutrality of the researcher can be considered good.

When evaluating the usability of the studies, it is first good to review all of the limitations and reasoning associated with the studies. The studies included in this doctoral dissertation have certain limitations, which have been identified already when planning the research framework, but they have not prevented the studies from being conducted, as they are more like observations than limitations that compromise the credibility of the studies. However, the limitations have been continually considered and openly disclosed.

None of the research subjects in the studies associated with this doctoral dissertation were completely randomly selected. Instead, random sampling was applied once consideration had been made as to what type of group of Finns the research subject population would consist of. The method was utilised to ensure that the gathered information would fulfil the needs and limitations of the studies. The following pages briefly review the limitations that applied to the selection of research subjects in each of the four studies.

In the interviews with Finnish energy experts *(Publications III and IV)*, the aim was to gather information and individual expert opinions on pre-determined themes. For the studies, careful consideration was made in advance about different types of expert groups that worked in the energy industry with different goals and job descriptions. As the groups differed from one another, one individual was randomly selected from the group for the interview. The research results, therefore, include the personal thoughts and perspectives of the eight

energy experts that were interviewed. Naturally, as the sample population was relatively small, the results cannot be used to draw societal conclusions. Instead, the research results describe how the interviewed group of experts perceive and experience Finnish energy issues and their associated phenomena.

In studying the energy attitudes and behaviour of Finns *(Publication IV)*, the aim was also to examine whether the energy issues subject to the research areas of this study had region-specific differences. Therefore, the research subjects for data collection and interviews were obtained from three pre-determined locations. All of the areas were located in Southern Finland, so it was relatively easy for the researcher to visit the areas multiple times. In contrast, the sampling from the pre-determined research areas was completely random. The researcher spent time at every research site at both central and more remote locations at different times of the day and stopped people that were passing by and asked them to participate in the study. Research subjects were not found, for example, by using newspaper advertisements, which may have resulted in a very active group of people being selected.

In the consumer panel studies *(Publication V)*, the aim was to collect data from people of different ages living in different residential areas. Therefore, two different residency locations in Southern Finland were selected. The selection was influenced by the researcher already having studied three Finnish residential areas when studying resident attitudes towards and behaviour regarding energy issues; thus, the researcher had already collected data on the locations. Therefore, it was natural to select some of the same residency locations for this research, which could be considered as further research in the same area. Two research locations were selected as the residency locations: Herttoniemi and Nurmijärvi. The residency areas are not close to one another. There is approximately 45 kilometres between the two residency locations. The consumer panels were also intended to obtain views from people of different ages, so the age groups were classified in advance as young people, middle-age people and elderly people. Once the two residency locations and three age groups had been defined, the researcher travelled to the area to see where the potential research subjects of

each class may be located. The researcher went to these locations, schools, kindergartens, and assisted living facilities to spend time and collect volunteers from among the people located there for the group panels of the discussion groups.

One general limitation that applies to all of the studies included in this doctoral dissertation is that all of the studies only focused on Finnish citizens living in Finland. In the event that the studies conducted in this dissertation were to be carried out in other countries, some specific limitations associated with populations or culture may become evident. For example, typical forms of living or transport may differ significantly, which should be considered by revising the response alternatives of the measurement tools. It may also be that people are not aware of energy issues, due to illiteracy, for example, which could result in the interview questions being difficult to comprehend.

In all of the studies included in this doctoral dissertation, the sample population of research subjects was relatively small. This was already considered when designing the qualitative research framework and when analysing the results. The personal views of the interviewed experts (n=8) *(Publications II and III)* on the attitudes and behaviour of Finnish residents cannot be applied to the Finnish population in general. The results of the resident interviews and measurements on the gap between attitudes and behaviour at three different locations (n=30) *(Publication IV)* cannot be generalised to directly apply to other Finnish locations. The results from the data collected using the consumer panel method (n=24) (*Publication V*) cannot be used to draw conclusions about Finnish attitudes and behaviour among different age groups. Instead, by using a small sample size and a Finnish context, all of the results provide indications of the nature of the studied phenomena.

One factor associated with the studies that were part of this research, which affects the ability to replicate the studies, is the rather labour-intensive recruitment of research subjects. No individual that participated in one of the studies for this research project was given any form of compensation for participating. Research subjects used their own free time, in varying amounts

depending on the study, with no other reward than verbally expressed gratitude. Therefore, recruiting willing research subjects at public areas may take a considerable amount of time.

Within this context, it is also noteworthy that the willingness to participate in the studies, shared by all of the research subjects, may in some way limit the sample population that participated in the studies, which could affect the results. For example, it could be that empathetic and social people agreed to become research subjects, but selfish and shy people did not. The former group may, on average, think of energy issues differently due to their personality. For example, they may be more positive about energy issues than the people in the latter group. However, this type of speculation already requires psychological research. The main point is that, upon recruitment, all subjects were asked to participate in the studies, regardless of their appearance or whether or not they were in a rush, had ample time, looked the researcher in the eye or averted their gaze.

One of the issues that potentially affected the measurement of observations in this study is the natural human trait to project a positive self-image, which is associated with the theory of social identity. People define themselves based on group memberships and aim to achieve benefits and acceptance (e.g. Tajfel, 2010). This tendency may have influenced the results of the carbon footprint calculator results in *Publication IV*, for example. Research subjects were asked to evaluate several types of things about themselves. The respondents, or a portion of them, may have aimed to project a socially more acceptable image by assessing their own energy behaviour as being more efficient than it is in reality. Maddison, Rehnanz and Narita (2013) provide a reminder that measuring energy behaviour is always sensitive, as the climate is only one possible effect variable among countless other thoughts going through a person's mind. Therefore, the emphasis of thought during data collection affects the results. Although the potential effect chains discussed above were known, the carbon footprints of the research subjects in this study were calculated using the subjects' own assessments. The data was treated as the actual energy use of the individual (and

was further compared to the research subject's personal assessments given at the time of the interviews, such as his or her degree of care for the climate).

The psychological tendencies of people to behave in a specific manner may also have affected the study part of this doctoral dissertation in other ways. For example, with consumer panel studies *(Publication V)*, there is always a possibility that the tension or peer pressure of the group causes situations where someone or several people remain guarded or refrain from honestly expressing their opinion in the midst of a large group. In the consumer panels of this study, the ability of each participant to express their opinion and be heard was ensured by, prior to starting the general discussion, allowing each participant to express their opinion in turn on the official discussion subjects of the panel.

This study offers many types of new perspectives and areas for potential further research. The research applied a variety of different types of methods, including new methods, such as expert interviews of people operating in the energy industry and residency studies from different locations and age groups. The research provides perspectives and a new type of vigour to research in the energy industry. There are ample opportunities for doing so. For example, the panel research methods commonly used in commercial research could also be applied in a new way to the field of energy research. Different types of research frameworks and methods can also enrich energy industry research, which traditionally is subject to numerous quantitative research methods. At least they can offer discussion and alternative perspectives for energy research.

Based on this study, a clear area requiring further research is how consumers, as energy users, are approached in as diverse a manner as possible. This study directly approached Finnish energy industry experts and regular energy users in order to obtain their personal opinions. The results of the study may encourage and invite researchers in the industry to directly approach energy consumers and ask them about their opinions, wishes and needs. Through this type of qualitative research, a deeper understanding can be obtained directly from the subjects, especially from individual energy consumers. The information can be applied in a manner where decision-makers in the energy sector can make effective and

agreeable decisions. As Williams and Dair (2007) state in their research, the sustainable ecological behaviour of people requires decision-makers to create well-planned alternatives.

During further research, it would be good to consider the potential diversity of data collected for energy research. The same study can apply both qualitative and quantitative data collection methods *(Publication IV)*. This would make it possible to collect diverse research data on different levels from the same people within a short period of time. This would also help maintain the interest of the research subjects throughout the study, as different researched methods introduce variety to the research situation. Gathering the research subjects as a group around the same table *(Publication V)* to discuss energy issues made it possible to collect deep observations and perspectives, refined by the interaction of the group. The interaction of the group members generated multilateral and interesting discussions, which made it possible for research subjects to discuss issues among themselves that were not even asked about. Particularly during free discussions, the interactivity of the group generated unexpected bypaths, potentially even entirely new ideas. Intensive personal interviews *(Publications II and III)* make personal and close interaction between the research subject and researcher possible, which also makes it possible for the research subject to discuss, in confidence, many types of issues while answering the questions, which may enrich the study or offer new potential areas for further research.

One of the issues to consider during further research is the appreciation of the research subjects. All of the research subjects in the studies included in this doctoral dissertation were given an opportunity to present questions and comments to the researcher after the study as a way of addressing any lingering questions. In particular, the research subjects that participated in the consumer panels found participation in the study meaningful and valuable. They found it nice that their opinions and views were heard in the group. In general, all research subjects (experts, research subjects living in different locations and consumer panellists of different ages) were able to give some of their free time to scientific research and felt that it was meaningful.

7 Conclusions

Changes in people's behaviour will play a significant role in improving Finland's energy efficiency, so that climate change can be reduced and prevented in accordance with the goals. The co-operation of contributors in the energy field must improve and become more effective. In addition, changes in the attitudes of individual consumers and their behaviour are also needed. This will make it possible to develop renewable energy sources in the energy sector. In addition, their use by consumers can be increased, as intended.

The attitudes and behaviour of people may vary greatly on energy matters. It is still important to attempt to influence attitudes so that people would become more aware and positive towards environmental issues and would learn to behave in an energy-efficient manner. Effective methods for influencing attitudes include decisions, both incentives and sanctions, made on energy issues by well-known politicians and decision-makers. Furthermore, it would be important to increase communication on environmental issues in a clear and motivating manner. This would allow people's mental images and perceptions of energy efficiency to become more positive.

Listening to consumers as well as education and encouragement are crucial for improving the energy efficiency of residents. Many of the research subjects in this study felt that their possibilities as individuals to promote the change associated with protecting the environment and reducing climate change were quite minimal and limited. In contrast, the study also revealed that many of the research subjects were also aware of their desire for comfort and laziness. These types of issues have a significant role in the extent to which people are really willing to fight climate change. Therefore, the effort to change resident's attitudes should be targeted at every resident who believes that their environmental actions are significant; residents should be provided with motivations to compromise a little in their level of comfort for the sake of the environment.

Residency location affects the attitudes and behaviour of people. People living in a more densely populated residential area near the centre of Helsinki are more

concerned with climate change and they approach energy issues more actively and with the will to change, and they experienced their behaviour as being more energy efficient than the research subjects that lived in more scarcely populated areas further away from the Helsinki city centre. Research subjects that lived in more scarcely populated areas had significantly more living area per person and travelled significantly more by car, but they were more willing to make financial investments in order to improve their energy efficiency. Therefore, the impact of the residential area should be considered when planning national energy-efficiency improvement measures in Finland. For example, people that live in more densely populated areas and are more interested in energy issues could be offered information and energy saving models. In contrast, people living in more scarcely populated areas could be offered simple and appealing information on how to develop capacities for energy savings. Public transport grids, ride-share programmes and home-office working opportunities must be developed especially in the scarcely populated residential areas. Residents of scarcely populated residential areas should be offered, for example, attractive geothermal heating packages or other investments that would improve their energy efficiency. People living in more densely populated areas can be encouraged to engage in free energy savings efforts, such as cycling to work year round or increasing their level of vegetarianism.

Age affects the attitudes and behaviour of people with respect to energy matters. Projects and workgroups that promote an eco-efficient Finland should consider in their work that young and elderly people would seem, based on the research results, to be more willing to make environmentally friendly choices than middle-aged peopled. In order to improve the eco-efficiency of middle-aged people, distinctly different operational models may be necessary than with young and elderly people. Since young and elderly people are more willing to make environmentally friendly choices than middle-aged people, they should be offered targeted and precise energy advice, while energy conservation should be made attractive to middle-aged people.

According to this study, residents would seem to be willing to reduce their energy consumption as long as it is effortless and does not require financial investment. Therefore, it would be good to plan national relief measures, such as household deductions or tax relief measures, for different types of investments made by private individuals in their homes through the purchase of energy-efficient equipment. Another alternative could be to use public funding to support new construction that aims to maximise energy efficiency. This would allow eco-efficient homes to be available to regular consumers without a large, one-time financial investment. In contrast, all new construction buildings must already comply with nearly null-energy consumption after the year 2020.

A bridge should be built over the gap discovered in this research between attitudes and behaviour. The gap needs to be bridged so that attitudes would lead to actions and energy-efficient behaviour. If the current gap between attitudes and behaviour persists, influencing people's attitudes nationally will not lead to the desired increase in energy-efficient behaviour. This would prevent Finland from reaching its energy-efficiency improvement goals. This would cause the country to lag behind the international treaties and plans. No one can predict with certainty when a potential environmental catastrophe, caused by wasteful and inefficient energy use, will occur or the consequences that it will cause.

A very significant question is, why is there a gap between people’s attitudes and behaviour with respect to energy issues? This study provides indications that residents would gladly start behaving in a more environmentally friendly manner and reduce their energy consumption, yet many did not recycle their waste or use public transport. The behavioural choices of people were most influenced by life being as convenient and pleasant as possible for residents. This dilemma, a pleasure-seeking attitude vs. an effort or behaviour requiring financial investment, must be resolved. If hedonistic pleasure-seeking is more attractive that energy-efficient behaviour, the gap between attitudes and behaviour will remain unchanged. Therefore, the gap must be bridged in a way where active, energy-efficient attitudes create active, energy-efficient behaviour.

References

Abrahamse, W., Steg, L., Vlek, C. & Rothengatter, J.A. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*, 273–291.

Abrahamse, W. & Steg, L. (2009). How do socio-demographic and psychological factors relate to households' direct and indirect energy use and savings? *Journal of Economic Psychology, 30*, 711–720.

Ajzen, I. & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Prentice Hall: Englewood Cliffs, New York, USA.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50,* 179–211.

Allard, E. (1983). *Sociology 1.* WSOY: Helsinki, Finland.

Anable, J., Lane, B. & Kelay, T. (2006). *An Evidence Base Review of Public Attitudes to Climate Changeand Transport Behavior*. Final Report, Department for Transport: London, UK.

Andreassi, L., Ciminelli, M.V., Feola, M. & Ubertini, S. (2009). Innovative method for energy management: Modelling and optimal operation of energy system. *Energy and Buildings, 41*, 436–444.

Amato, A. D., Ruth M., Kirshen, P. & Horwitz, J. (2005). Regional Energy Demand Responses To Climate Change: Methodology And Application To The Commonwealth Of Massachusetts. *Climatic Change, 71*(1–2), 175–201.

Athanassiadou, M., Baker, J., Carruthers, D., Collins, W., Girnary, S., Hassell, D., Hort, M., Johnson, C., Johnson, K., Jones, R., Thomson, D., Trought, N. & Witham, C. (2010). An assessment of the impact of climate change on air quality at two UK sites. *Atmospheric Environment, 44*, 1877–1886.

Atkinson, R. (2004). The evidence on the impact of gentrification: new lessons for the urban renaissance? *European Journal of Housing Policy, 4*(1), 107–131.

Bacon, N., Brophy, M., Mguni, N., Mulgan, G. & Shandro, A. (2010). *The state of happiness: can public policy shape people's wellbeing and resilience?* Young Foundation: London, UK.

Badri, M.A. (1992). Analysis of demand for electricity in the United States, *Energy, 17*(7), 725–733.

Bergström, S. & Leppänen, A. (2007). *Customer Marketing*. Edita: Helsinki, Finland.

Berkhout, P. H. G., Muskens, J.C. & Velthuijsen, J.W. (2000). Defining the rebound effect. *Energy Policy, 28*, 425–432.

Bertoldi, P., Ricci, A. & de Almeida, A. (2000). *Energy Efficiency in Household Appliances and Lighting.* Springer-Verlag: New York, USA.

Biesiot, W. & Noorman, K.J. (1999). Energy requirements of household consumption: A case study of The Netherlands. *Ecological Economics, 28*, 367–383.

Blake, J. (1999). Overcoming the 'value-action gap' in environmental policy: tensions between national policy and local experience. *Local Environment, 4*, 257–278.

Bord, R.J., Fisher, A. & O'Connor, R.E. (1998). Public perceptions of global warming: United States and international perspectives. *Climate Research, 11*, 75–84.

Brandon, G. & Lewis, A. (1999). Reducing household energy consumption: A qualitative and quantitative field study. *Journal of Environmental Psychology, 19*, 75–85.

Buckley, R.M. (1996). *Housing finance in developing countries.* St. Martin's Press: New York, USA.

Burgess, J., Harrison, C. & Filius, P. (1998). Environmental communication and the cultural politics of citizenship. *Environment and Planning A, 30*(8), 1445–1460.

Campbell, J.Y. & Cocco, J.F. (2007). How do house prices affect consumption? Evidence from micro data. *Journal of Monetary Economics, 54*, 591–621.

Carlsson-Kanyama, A. & Linden, A-L. (1999). Travel patterns and environmental effects now and in the future: implications of differences in energy consumption among socio-economic groups. *Ecological Economics, 30*, 405–17.

Carlsson-Kanyama, A. & González, A. D. (2009). Potential contributions of food consumption patterns to climate change. *American Society of Nutrition, 89*(5), 1704–1709.

Changnon, S.A., Pielke, R.A., Changnon, D., Sylves, R. & Pulwarty, R. (2000). Trends in socio-economic impacts related to weather and climate extremes in the U.S. *Bulletin of the American Meteorological Society, 81*, 437–442.

Changnon, S.A. (2003). Measures of economic impacts of weather extremes. *Bulletin of the American Meteorological Society, 84*, 1231–1235.

Changnon, S.A. (2005). Economic Impacts of Climate Conditions in the United States: Past, Present, and Future. *Climatic Change, 68*(1-2), 1–9.

Charles, C.Z. (2003). The Dynamics of Racial Residential Segregation. *Annual Review of Sociology, 29*, 167–207.

Cline, W.R. (2007). *Global Warming and Agriculture: Impact Estimates by Country.Center for Global Development*. Peterson Institute for International Economics: Washington, D.C, USA.

Darby, S. (2006). *The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering*. The Environmental Change Institute, University of Oxford: Oxford, UK.

Davis, J. (1993). Strategies for environmental advertising. *Journal of Consumer marketing, 10*, 19–36.

Diener, E., Diener, M. & Diener, C. (1995). Factors predicting the subjective well-being of nations. *Journal of Personality and Social Psychology, 69*, 851–864.

Dipasquale, D. (1999). Why Don't We Know More About Housing Supply? *Journal of Real Estate Finance and Economics, 18*, 9–23.

Doucet, B., van Kempen, R. & van Weesep, J. (2011). `We're a rich city with poor people': municipal strategies of new-build gentrification in Rotterdam and Glasgow. *Environment and Planning, 43*(A), 1438–1454.

Downton, M.W., Stewart, T.R. & Millers, K.A. (1988). Estimating historical heating and cooling needs: Per capita degree-days. *Journal of Applied Meteorology, 27*(1), 84–90.

Downey, L. (2006). Environmental racial inequality in Detroit. *Social Forces, 85*, 771–796.

Eden, S. (1993). Individual environmental responsibility and its role in public environmentalism. *Environment and Planning A*, *25*(12), 1743–1758.

Engelhardt, G.W. (1996). House prices and home owner saving behavior. *Regional Science and Urban Economics, 26*, 313–336.

Erwin, P. (2001). *Attitudes and Persuasion*. WSOY: Helsinki, Finland.

EU-direktiivi, 2010. Euroopan parlamentin ja neuvoston direktiivi 2010/31/EU. *Euroopan unionin virallinen lehti*, 1–23.

Finnish Goverment report (2008). *Long-term climate and energy strategy.* Government report to Parliament, 6 November 2008. Prime Minister's Office Publications. Helsinki University Print: Helsinki, Finland.

Foulkes, M. & Newbold, K.B. (2008). Poverty Catchments: Migration, Residential Mobility, and Population Turnover in Impoverished Rural Illinois Communities. *Rural Sociology, 73*(3), 440–462.

Franco. G. & Sanstad, A.H. (2008). Climate change and electricity demand in California. *Climate Change, 87*, 139–151.

Frey, B. & Stutzer, A. (2002). What can economists learn from happiness research? *Journal of Economic literature, 40*, 402–435.

Fujibe F. (2011) Urban warming in Japanese cities and its relation to climate change monitoring. *International Journal of Climate, 31*(2), 162–173.

Gardner, G. T. & Stern, P. C. (2002). *Environmental Problems and Human Behavior*. Pearson: Boston, USA.

Gaffin, S.R., Rosenzweig, C., Khanbilvardi, R., Parshall, L., Mahani, S., Glickman, H., Goldberg, R., Blake, R., Slosberg, R.B. & Hillel, D. (2008). Variations in New York City's urban heat island strength over time and space. *Theoretical and Applied Climatology, 94*, 1–11.

Gatersleben, B. & Vlek C. (1997). Household consumption, quality of life and environmental impacts. In T. Noorman & T. Schoot-Uiterkamp (Eds.) *Green Households* (pp. 141–179). Earthscan: London, UK.

Geller, E.S. (2002). The challenge of increasing proenvironment behavior. In R. G. Bechtel & A. Churchman (Eds.), *Handbook of Environmental Psychology* (pp. 525–540). Wiley: New York, USA.

Giddens, A. (2008). *The Politics of Climate Change*. Mass Polity Press: Cambridge, UK.

Hallegatte, S., Hourcade, J-C. & Ambrosi, P. (2007). Using climate analogues for assessing climate change economic impacts in urban areas. *Climate Change, 82*(1), 47–60.

Ham, M. & Manley, D. (2010). The effect of neighbourhood housing tenure mix on labour market outcomes: a longitudinal investigation of neighbourhood effects. *Journal of Economic Geography, 10*, 57–282.

Hansen, J., Sato, M., Ruedy, R., Lacis, A. & Oinas, V. (2000). Global warming in the twenty-first century: an alternative scenario. *Proceedings of the National Academy of Science of the United States of America, 97*(18), 9875–9880.

Harrison, C., Burgess, J. & Filius, P. (1996). Rationalizing environmental responsibilities. *Global Environmental Change, 6*(3), 215–234.

Harrison, M. (2011). A Review of "Housing Boom and Bust: Owner Occupation, Government Regulation and the Credit Crunch" and "The Politics of Housing Booms and Busts". *International Journal of Housing Policy, 11*, 221–227.

Hay, R. (2005). Becoming ecosynchronous, part 1. The root causes of our unsustainable way of life. *Sustainable Development, 13*, 311–325.

Hay, R. (2006). Becoming ecosynchronous, part 2. Achieving sustainable development via personal development. *Sustainable Development, 14*, 1-15.

Hedman, L. (2011). The Impact of Residential Mobility on Measurements of Neighbourhood Effects. *Housing Studies, 26*, 501–519.

Heinonen, S., Halonen, M. & Daldoss, L. (2006). Slow housing–competitive edge for innovative living environments. *International Journal of Geography, 184*(1), 91–104.

Heltberg, R., Siegel, P. B. & Jorgensen, S.L. (2009). Addressing human vulnerability to climate change: Toward a 'no-regrets' approach. *Global Environmental Change, 19*, 89–99.

Herring, H. (2006). Energy efficiency–A critical view. *Energy, 31*, 10–20.

Hill, J., Polasky, S., Nelson, E., Tilman, D., Huo, H., Ludwig, L., Neumann, J., Zheng, H. & Bonta D. (2009). Climate change and health costs of air emissions from biofuels and gasoline. *Proceedings of the National Academy of Science of the United States of America, 106*(6), 2077–2082.

Hinchliffe, S. (1996). Helping the Earth begins at home: The social construction of socio- environmental responsibilities. *Global Environmental Change, 6*(1), 53–62.

Hoffert, M.I., Caldeira, K., Jain, A.K., Haites, E.F., Harvey, D., Potter, S., Schlesinger, M. E., Schneider, S. H., Watts R. G., Wigley T. M. L. & Wuebblles D. J. (1998). Energy implications of future stabilization of atmospheric CO_2 content. *Nature, 395*(29), 881–884.

Hoffert, M.I., Caldeira, K., Benford, G., Criswell, D.R., Green, C., Herzog, H., Jain, A.K., Kheshgi, H.S., Lackner, K.S., Lewis, J.S., Lightfoot, H.D., Manheimer, W., Mankins J.C., Mauel M.E., Perkins M.R., Schlesinger M.E., Volk, T. & Wigley, T.M.L. (2002). Advanced technology paths to global climate stability: energy for a greenhouse planet. *Science, 298*(5595), 981–987.

Holden, E. (2004). Towards sustainable consumption: do green households have smaller ecological footprints? *International journal of sustainable development, 7*, 44–58.

Hostetler, M. & Drake, D. (2009). Conservation subdivisions: a wildlife perspective. *Landscape and urban planning, 90*, 95–101.

Hostetler, M. & Noiseux, K. (2010). Are green residential developments attracting environmentally savvy homeowners? *Landscape and urban planning, 94*, 234– 243.

Hungerford, H. & Volk, T. (1990). Changing learner behaviour through environmental education. *Journal of Environmental Education, 21*, 8–21.

IPCC (Intergovernmental Panel on Climate Change) (2001). *Climate Change 2001: Impacts, Adaptation and Vulnerability, Intergovernmental Panel on Climate Change*. IPCC: Geneva, Switzerland.

IPCC (Intergovernmental Panel on Climate Change) (2007). Climate change 2007: Synthesis report. Contribution of Working Group III to the Fourth Assessment Report. R. K. Pachauri & A. Reisinger (Eds). IPCC: Geneva, Switzerland.

Isoniemi, M., Mäkelä, J., Arvola, A., Forsman-Hugg, S., Lampila, P. & Paananen, J. (2006). *Kuluttajien ja kunnallisten päättäjien näkemyksiä lähi- ja luomuruoasta.* Kuluttajatutkimuskeskus: Helsinki, Finland.

Jenning, L. (2005). Slow is beautiful: Living as if life really mattered. A worldwide movement challenges the cult of speed. *Futurist, 39*, 12–13.

Jorgenson, A.K. (2003). Consumption and environmental degradation: A cross-national analysis of the ecological footprint. *Social Problems, 50*, 374–394.

Jorgenson, A.K. & Clark, B. (2011). Societies consuming nature: A panel study of the ecological footprints of nations, 1960–2003. *Social Science Research, 40*, 226–244.

Kaiser, F.G., Wölfing, S. & Fuhrer, U. (1999). Environmental attitude and ecological behavior. *Journal of Environmental Psychology, 19*, 1–19.

Kaplan, S. (2000). Human nature and environmentally responsible behaviour. *Journal of Social Issues, 56*, 491–508.

Kaygusuz, K. (2009). Energy and environmental issues relating to greenhouse gas emissions for sustainable development in Turkey. *Renewable and Sustainable Energy Reviews, 13*, 253–270.

Kemeny, J. (1998). Schools of Comparative Housing Research from convergence to divergence. *Housing Studies, 13*,161–176.

Koljonen, T., Pohjola, J., Lehtilä, A., Savolainen, I., Peltola, E., Flyktman, M., Haavio, M., Liski, M., Haaparanta, P., Ahonen, H-M., Laine, A. & Estlander, A. (2008). *Suomalaisen energiateknologian globaali kysyntä ilmastopolitiikan muuttuessa.* Valtion teknillinen tutkimuskeskus, Research Notes 2448. VTT: Espoo, Finland.

Kollmuss, A. & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to proenvironmental behaviour? *Environmental Education Research, 8*, 239–260.

Koskela, M. & Vinnari, M. (2009). *Future of the Consumer Society*. Finland Futures Research Centre: Turku, Finland.

Kosuke, A., Proudman, J. & Vlieghe, G. (2004). House prices, consumption, and monetary policy: a financial accelerator approach. *Journal of Financial Intermediation, 13*, 414–435.

Lam, J. C. (1998). Climatic and economic influences on residential electricity consumption. *Energy Conversion Manage, 39*(7), 623–629.

Lee, B.H.Y. & Waddell, P. (2010). Residential mobility and location choice: a nested logit model with sampling of alternatives. *Transportation, 37*(4), 587–601.

Lees, L. (2008). Gentrification and Social Mixing: Towards an Inclusive Urban Renaissance? *Urban Studies, 45*(12), 2449–2470.

Leiserowitz, A., Kates, R. & Parris, T. (2006). Sustainability values, attitudes and behaviors: A review of multinational and global trends. *Annual Review of Environment and Resources, 31*, 413–444.

Lemonsu, A., Kounkou-Arnaud, R., Desplat, J., Salagnac J-L, & Masson, V. (2013). Evolution of the Parisian urban climate under a global changing climate. *Climatic Change, 116*, 679–692.

Lorenzoni, I. & Langford, I.H. (2001). Climate Change Now and in the Future: A Mixed Methodological Study of Public Perceptions in Norwich. CSERGE Working Paper ECM 01-05. CSERGE: Norwich, UK.

Maddison, D., Rehdanz, K. & Narita, D. (2013). The household production function approach to valuing climate: the case of Japan. *Climatic Change, 116*, 207–229.

Martinkauppi, S. (2010) (Ed.). *ERA17 Energiaviisaan rakennetun ympäristön aika 2017.* Ympäristöministeriö, Sitra and Tekes: Helsinki, Finland.

Massa, I. & Haverinen, R. (2001). Environmental policy for everyday life, a preliminary study. Suomen ympäristö 521, Ministry of the Environment: Helsinki, Finland.

Mayer, C.J. & Somerville, C.T. (2000). Residential Construction: Using the Urban Growth Model to Estimate Housing Supply. *Journal of Urban Economics, 48*, 85–109.

Meen, G. & Nygaard, C. (2011). Local Housing Supply and the Impact of History and Geography. *Urban Studies, 17*, 1–18.

Mikkola, H. & Ahokas, J. (2009). Energy ratios in Finnish agricultural production. *Agricultural and food science, 18*, 332–346.

Miles, M.B. & Huberman, A.M. (1994). *Qualitative Data Analysis: An expanded sourcebook* (2nd ed.). Sage: Thousand Oaks, California, USA.

Milfont, T.L. (2007). *Psychology of Environmental Attitudes: A Cross-cultural Study of Their Content and Structure.* University of Auckland: Auckland, New Zealand.

Ministry of the Environment (2008). *Kohti kierrätysyhteiskuntaa. Valtakunnallinen jätesuunnitelma vuoteen 2016.* Suomen ympäristö: Helsinki, Finland.

Ministry of the Environment (2010). *Ympäristöministeriön raportteja, 2010. Ympäristöministeriön hallinnonalan keskeiset tavoitteet ja tehtävät vuosina 2011–2014.* Ympäristöministeriö: Helsinki, Finland.

Moisander, J. (1996). *Attitudes and ecologically responsible consumption.* Research Notes 218, Statistics Finland: Helsinki, Finland.

Moisander, J. & Pesonen, S. (2002). Narratives of sustainable ways of living: constructing the self and the others as a green consumer. *Management decision, 40*(4), 329–342.

Muellbauer, J. & Murphy A. (2008). Housing markets and the economy: the assessment. *Oxford Review of Economic Policy, 24*, 1–33.

Omer, A. (2008). Energy, environment and sustainable development. *Renewable and Sustainable Energy Reviews, 12*, 2265–2300.

Osmani, M., Glass, J. & Price, A.D.F. (2008). Architects' perspectives on construction waste reduction by design. Architects' perspectives on construction waste reduction by design. *Waste Management, 28*(7), 1147–1158.

Pardo, A., Meneu, V. & Valor E. (2002). Temperature and seasonality influences on the Spanish electricity load. *Energy Economics, 24*(1), 55–70.

Petersdorff, C., Boermans, T. & Harnish, J. (2006). Migitation of CO_2 emissions from the EU-15 building stock. *Environmental Science and Pollution Research, 13,* 350–358.

Rannikko, P. (1995). Environmental awareness and environmental conflicts. In T. Järvikoski, P, Jokinen & P. Rannikko (Eds.), *Perspectives on environmental sociology* (pp. 65–91). Publications of the University of Turku's further education and training centre: Turku, Finland.

RakMK (2012). *Rakennusten energiatehokkuus. Määräykset ja ohjeet 2012.* D3 Suomen rakentamismääräyskokoelma D3, Ympäristöministeriö, Rakennetun ympäristön osasto: Helsinki, Finland.

Retallack, S., Lawrence, T. & Lockwood M. (2007). *Positive energy. Harnessing people power to prevent climate change.* IPPR: London, UK.

Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practitioner-Researchers.* Blackwell Publishers: London, UK.

Roininen, K., Arvola, A. & Lähteenmäki, L. (2006). Exploring consumers' perceptions of local food with two different qualitative techniques: laddering and word association. *Food quality and preference, 17*, 20–30.

Rosenzweig, C. & Solecki W.D. (2001). Climate change and a global city - learning from New York. *Environment, 43*(3), 2–12.

Ruth, M. & Kirshen, P. (2001). "Integrated impacts of climate change upon infrastructure systems and services in the Boston metropolitan area". *World Resources Review, 13*(1), 106–122.

Saiz, A. (2008). On Local Housing Supply Elasticity. *Quarterly Journal of Economics, 125*, 1253–1296.

Shevlin, M., Brunsden, V. & Miles, J.N.V. (1998). Satisfaction With Life Scale: analysis of factorial invariance, mean structures and reliability. *Personality and Individual Differences, 25*(5), 911 –916.

Shove, E. (2010). Beyond the ABC: climate change policy and theories of social change. *Environment and Planning, 42,*(A), 1273–1285.

Seppänen, O. & Goeders, G. (2010). *Benchmarking Regulations on Energy Efficiency of Buildings*. Federation of European Heating, Ventilation and Air conditioning Associations: Brussels, Belgium.

Smith, H., Ferrari, S.G. & Jenkins, P. (2011). The role of planning in housing design: design implications of land-use management. *Environment and Planning, 29*(C), 502–519.

Song, Y. & Knaap, G-J. (2003). New urbanism and housing values: a disaggregate assessment. *Journal of Urban Economics, 54*, 218–238.

Staats, H., Harland, P. & Wilke H.A.M. (2004). Effecting Durable Change. A Team Approach to Improve Environmental Behavior in the Household. *Environment and Behavior, 36*(3), 341–367.

Statistics Finland (2006). *Suomen tilastoina 2006.* Tilastokeskus: Helsinki, Finland.

Stephens, M. (2003). Globalisation and Housing Finance Systems in Advanced and Transition Economies. *Urban Studies, 40*, 1011–1026.

Stern, P.C. (2000). Toward a coherent theory of environmentally significant behaviour. *Journal of Social Issues, 56*, 407–424.

Stern, N. (2007). *The Economics of Climate Change: The Stern Review.* Cambridge University Press: Cambridge, UK.

Tajfel, H. (2010). *Social identity and intergroup relations.* Cambridge University Press: Cambridge, UK.

Talen, E. & Ellis, C. (2002). Beyond relativism: reclaiming the search for good city form. *Journal of Planning Education and Research, 22*, 141–153.

Thackara, J. (2005). *In the bubble. Designing in a complex world.* The MIT Press: Cambridge, MA & London, UK.

Uusitalo, L. (1990). Are Environmental Attitudes and Behaviour Inconsistent? Findings from a Finnish Study. *Scandinavian Political Studies, 13*(2), 211–225.

Valkila, N., Litja, H., Aalto, L. & Saari A. (2010). Consumer panel study on elderly people's wishes concerning services. *Archives of Gerontology and Geriatrics, 51*(3), e66–e71.

Valkila, N. & Saari, A. (2011). The productivity impact of the voice link between elderly and nurses: An assisted living facility pilot. *Archives of Gerontology and Geriatrics, 52*(1), e44–e49.

Vassar, M. (2008). A note on the score reliability for the Satisfaction With Life Scale: an RG study. *Social Indicators Research, 86*(1), 47–57.

Warren, H.E. & LeDuc, S.K. (1981). Impact of climate on energy sector in economic analysis. *Journal of Applied Meteorology, 20*, 1431–1439.

Wilby, R.L. (2003). Past and projected trends in London's urban heat island. *Weather, 58*(7), 251–260.

Willliams, K. & Dair, C. (2007). What is stopping sustainable building in England? Barriers experienced by stakeholders in delivering sustainable developments. *Sustainable Development, 15*, 135–147.

Yamaguchi, Y., Shimoda, Y. & Mizuno, M. (2007). Transition to sustainable urban energy system from a long-term perspective: Case study in a Japanese business district. *Energy and Buildings, 39*, 1–12.

Yan, Y.Y. (1998). Climate and residential electricity consumption in Hong Kong. *Energy, 23*(1), 17–20.

Youngentob, K. & Hostetler, M.K. (2005). Is a new urban development model building greener communities? *Environment and Behavior, 37*, 731–759.

Appendices (1–5)

Appendix 1.

Energy expert interview framework

Background information on the expert and employer

Who is your employer?
What type of activity are you involved in within the energy industry?
Operational goals, responsibility and position in the energy sector?
Is your environmental attitude best described as people-centric, technology-centric or eco-centric?

---

1. – THEME Finnish energy policy in general

Have the alarming energy scenarios witnessed elsewhere in the world affected Finnish energy policies?
How significantly are the effects of oil price fluctuations evident in Finland?
How is the connection between the economy and energy consumption apparent?
What is Finland's relationship to EU energy policies?
What is Finland's role in international energy treaties?
What are the greatest energy threats to Finland?

2. – THEME Current Finnish attitudes towards energy issues

How accurately can energy attitudes be measured?
Is the significance of the effect of citizens' energy attitudes acknowledged within the industry?
What effects do these attitudes have on the energy field?
Are attitudes green? What are the reliable measures of being green?
How is a citizen's interest in energy conversation evident?
How could energy conservation be increased?
Do attitudes directly correlate with actions?
Are ethical consumers a growing trend?

3. – THEME Influencing Finnish energy attitudes and actions

Who is responsible for moulding attitudes?
What organisation has the most significance in increasing the energy knowledge of Finns?
How are citizens' attitudes moulded?
What types of guidance methods are possible?
Efficiency ratio?

4. – THEME The future

What does the Finnish future look like in the energy industry?
In what direction are attitudes expected to develop?
Do the attitudes of individual citizens matter?
What actions is Finland taking to meet the energy challenges?

Appendix 2.

Energy interview question framework

Answer the following questions. You can also freely express whatever comes to mind.

---

1. Concern over climate change

Are you concerned about climate change?
Describe your potential thoughts and concerns.
What particularly concerns you or does not concern you about climate change?
What other potential environmental issues concern you and why?

2. Position on energy issues

What is your position on energy issues?
How serious is the situation in the world's energy sector and what is Finland's energy use currently?
Do you take responsibility for your own energy behaviour?
What issues interest you or worry you the most in the energy industry and why?
Do you feel that more efficient energy use by an individual consumer is significant from the perspective of reducing climate change?

3. Perceived energy behaviour

How would you describe your own energy use and energy behaviour?
What do you feel is excessive energy use?
Would you want to be a more energy-efficient consumer, and if yes, how?
Do you feel you are energy efficient when compared to the behaviour of other Finns?
Do your values affect your energy behaviour, and if so, how?

4. Thoughts about how active to be in the future in relation to energy matters

Have you considered making big changes to your energy behaviour in the near future, and if yes, what types of changes?
What issues do you feel people should pay the most attention to in their energy behaviour?
How important is it to you to be active and monitor your energy use?
Do you feel that you receive sufficient information and encouragement to be energy efficient in your everyday life?

Appendix 3.

Life satisfaction survey

Circle the number that best describes your situation for each statement. If you like, briefly explain your answer using your own words after the statement.

	Fully disagree	**Disagree**	**Slightly disagree**	**Do not agree or disagree**	**Slightly agree**	**Agree**	**Fully agree**
My life is primarily close to my ideal. How?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
My living conditions are excellent. How?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I am satisfied with my life. Why?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
To date, I have achieved all of the important things I have wanted in life. What are they?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
If I could live my life again, I would not change a thing. What would you change?	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Briefly summarised:

Public carbon footprint survey, designed by the Turku Chapter of the Junior Chamber International and implemented in co-operation with Helsingin Sanomat newspaper and published online in 2010. Valkila copied the online application in question into paper format (presented here) and used it to measure the carbon footprint of the research subjects.

*****

Carbon footprint survey

Circle the alternative that describes you or complete the missing information in the provided space.

I LIVING

My gender	a) Male b) Female
Age	___ years
Residents in my household	___ person(s)
Home type	a) Single-family detached home b) Row-house c) Apartment building
The living area of my home	___ m^2
The construction or renovation year of my building	a) 1950s or before b) 1960s or before c) 1970s or before d) 1980s-1990s or before e) 2000 or later
Energy use of my building	a) Normal home b) Low-energy home c) Passive home d) Zero-energy home
Electricity supply to my home	a) I don't know b) Regular electricity c) Green or other CO_2-free electricity

Main heating method of my home

a) District heating
b) Electricity
c) Oil
d) Pellets or wood
e) Air or geothermal heat pump

The average temperature of my home compared to the recommended temperature

a) Minus 3 degrees
b) Minus 2 degrees
c) Minus 1 degree
d) Follows recommendations
e) Plus 1 degree
f) Plus 2 degrees
g) Plus 3 degrees

Second homes and vacation homes

Do you have a second home or a vacation home that is heated year-round?

a) Yes
b) No

Living area of second home or vacation home

___ m^2

Main heating method of second home or vacation home

a) District heating
b) Electricity
c) Oil
d) Pellets or wood
e) Air or geothermal heat pump

Entertainment equipment and IT

How many pieces of entertainment equipment and computers are used at your home?

___ units

Do you completely switch off the power when the equipment is not in use?

a) Usually
b) Sometimes
c) Hardly ever

Lighting

How many of your light fixtures are fitted with energy-saving bulbs?

a) Nearly all
b) More than half
c) Less than half
d) Only a small number

Do you switch off the lights when no one is in the room?

a) Usually
b) If I remember
c) Only for the night

Kitchen, refrigeration equipment and their use

My home's refrigeration equipment includes
a) Small refrigerator
b) Refrigerator-freezer combination
c) Refrigerator and separate freezer
d) Several different refrigeration devices

The energy classification of my home's refrigeration equipment and its average age is
a) More than 15 years
b) 5–15 years
c) 1–5 years (AB)
d) New A+ energy class
e) New A++ energy class

Is the equipment ventilation obstacle-free?
a) Yes
b) No

Have you set the refrigeration equipment's temperature correctly: refrigerator +5 and freezer -18?
a) Yes
b) No

Do you defrost the freezers and vacuum the back of the equipment at least once a year?
a) Yes
b) No

How many times a week do you use the dishwasher?
___ times

Washing and drying laundry

… with cold water?
___ times a week
… with 30–40 degree water?
___ times a week
… with 60-degree water?
___ times a week
… with 90-degree water?
___ times a week

The dryer or cabinet dryer is used weekly?
___ times

Is your washer and dryer energy-classified A-C, A+ or A++?
a) I don't know
b) A-C energy class
c) A+ energy class
d) A++ energy class

Use of warm water and sauna

How many times a week do you take a warm shower?
___ times

On average, how many minutes do you spend under running water?
___ min

Do you have a water-conserving shower?
a) Yes
b) No

How many times a week do you take a hot bath? ___ times

How many times a week do you use the electric sauna? ___ times

What is the temperature of the sauna? ___ C°

II TRANSPORT

Flights

One-way flights, with a duration of less than 1.5 hours? ___ flights / mo.

One-way flights, with a duration of 1.5–4 hours? ___ flights / mo.

One-way flights, with a duration of 4-10 hours? ___ flights / mo.

One-way flights, with a duration of more than 10 hours? ___ flights / mo.

Do you fly directly to your destination?

a) Rarely a direct flight
b) Sometimes a direct flight
c) Almost always a direct flight

I take vacation and recreational flights most often using

a) Tourist class
b) Business class

Car

What type of car do you own or ride in as a passenger?

a) Small petrol car
b) Mid-sized petrol car
c) Large petrol car
d) Small diesel car (<2.0 l)
e) Large diesel car (=or >2.0 l)
f) Hybrid car
g) Electric car
h) I don't know the car type
i) I don't own a car or travel by car

On average, how may kilometres do you drive monthly or travel as a passenger in a car? ___ km / mo.

On average, how many people are in the car that you drive or where you travel as a passenger? ___people

Other

How many kilometres do you travel in a month using the following forms of transportation?

Train	___ km / mo.
Long-distance bus	___ km / mo.
Local bus	___ km / mo.
Tram	___ km / mo.
Rapid transit (metro)	___ km / mo.
Motorcycle	___ km / mo.
Ferry	___ km / mo.
High-speed ferry	___ km / mo.

III NUTRITION

What is your diet?

a) Mixed diet
b) Vegetarian diet

On average, I eat weekly (0–20 portions)…

… fish or shellfish (150g)?	___ portions
… beef or veal (150 g)?	___ portions
… pork, poultry or other meat (150 g)?	___ portions
… eggs (50 g = 1 egg)?	___ portions
… cheese (20 g or approximately 3 slices)?	___ portions
… dairy products (200 g or a glass of milk or a yoghurt)?	___ portions
… imported or green-house farmed fruits or vegetables (100 g or approximately 1. 2 dl)?	___ portions
… rice (100 g or approximately 1.2 dl)?	___ portions
… tofu (100 g or approximately 1.2 dl)?	___ portions

IV LIFESTYLE

Annually, how much money do you approximately spend on (€0–5,000)…

… buying home entertainment electronics?	___ €
… buying furniture and carpets?	___ €
… buying clothing and shoes?	___ €
… remodelling your home?	___ €
… newspapers and other periodicals and books?	___ €
… cafes, eating out and hotel accommodations?	___ €
… recreation, sports and culture services?	___ €
… caring for personal hygiene and buying cosmetics?	___ €

Recycling

Do you recycle paper waste?	a) No b) Yes
Do you recycle cardboard waste?	a) No b) Yes
Do you recycle food waste?	a) No b) Yes
As a waste producer, I estimate that I and my household produce	a) Large amounts of waste b) Average amounts of waste c) Small amounts of waste

Discussion themes for the eco-panels

Are you ready… (for eco-efficient solutions)?

Theme 1. Community structure

a) Residency location

Energy consumption depends significantly on the types of homes and density of the homes [1.2]. Distances are great in detached residential housing areas that are far from city centres. Therefore, traffic emissions per person are greater compared than those for apartment building areas near city centres. Naturally, emissions are smaller in cities, due to shorter distances and highly utilised public transportation.

→Are you willing to live in an apartment building in a suburban area?

b) Supplemental construction

Making the Finnish community structure more dense would produce a lot fewer emissions than spreading it out [3]. Supplemental construction creates new homes for existing residential areas and brings in new residents, including families with children. New homes are also better suited for the elderly than the existing homes in the area. Similarly, the new residents will use the existing roads, streets and other infrastructure already in the area. An increase in resident population may also improve the range of services offered in the area.

→ Are you willing to allow a new, similar-sized building be built on the adjacent lot where you currently live (assuming that it would fit on the lot in question)?

Theme 2. Eco-efficiency of the home

a) Heating of home

Due to the colder climate, heating for residential structures consumes approximately 22% of Finland's primary energy [4]. By lowering the indoor temperature by 2 degrees, the heating energy consumption can be reduced by approximately 10%.

→ Are you willing to adjust your home temperature two degrees lower?

b) Geothermal pump

Imagine that you are building a single-family home. A two-story, newly constructed single-family detached home that complies with building codes consumes approximately 152 kWh/(m^2a). In a passive home, the consumption is nearly halved, only kWh/(m^2a). The additional cost, which is incurred from building a geothermal pump, is approximately 130 €/n^2. The payback time on the investment when assuming a 3% real interest rate is 18 years.

→ Are you willing to pay for this investment?

Theme 3. Transport

a) Everyday travel, driving

Driving accounts for approximately 15% of the consumer's carbon footprint [7]. More than 2.5 million passenger cars are registered in Finland. The number of vehicles has increased by approximately a third since the early 1990s. The number of second vehicles per household has increased significantly – 32 per cent of Finns live in households that have at least two cars. [8] When using public transport, emissions are significantly lower than when driving [7,9]: walking or cycling do not cause any harmful emissions.

→ Are you willing to give up your car?

b) Vacation travel, flying

Flight traffic warms the climate 2-5 times more than other carbon dioxide emissions on the ground. In 2000, emissions from flights accounted for 4-9% of all human effects on global warming [11,12]. According to the flight calculator, vacation flights to Thailand for one person generate more than three tonnes of emissions. The amount corresponds approximately to a third of the annual greenhouse emissions of an average Finn. [13]

→ Are you willing to give up flying?

4. Ecological lifestyle: Consuming

In Western culture, the purpose of life, which includes finding satisfaction and gaining acceptance, are often sought through the consumption of goods and services. However, the consumption of goods and services is one of the greatest causes of climate change. The condition of the world is unsustainable – we would need approximately 1.3 Earths to be able to support our current excessive levels of consumption [14]. If everyone in the world consumed as much as Finns, 2.5 Earths would be needed to sustain our way of living. According to recent research, at least a 10% reduction in emissions can be achieved by changing the excess consumption behaviour of residents [16, 17].

→ Are you ready to reduce your consumption?

References

[1] Dodman, D. (2009). Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories. *Environment and Urbanization 21,*(1), 185–201.

[2] Norman, J., MacLean, H., L. & Kennedy, C., A. (2006). Comparing High and Low Residential Density: Life-Cycle Analysis of Energy Use and Greenhouse Gas Emissions. *Journal of Urban Planning and Development, 132*(1), 10–21.

[3] Statistics Finland (2010). Energy statistics yearbook 2010. Statistics Finland: Helsinki, Finland.

[4] Lahti, P. & Moilanen, P. (2010). *Kaupunkiseutujen yhdyskuntarakenne ja kasvihuonepäästöt. Kehitysvertailuja 2005–2050.* Suomen Ympäristö 12, Ympäristöministeriö: Helsinki, Finland.

[5] TraFi Tieliikenne (2010). Liikenteessä olevat ajoneuvot 2010 [Internet], http://www.ake.fi/AKE/Tilastot/Ajoneuvokanta/Liikenteess%C3%A4+olevat+ajoneuvot+2010/Liikenteess%C3%A4+olevat+ajoneuvot+2010.htm

[6] Seppälä, J., Mäenpää, I., Koskela, S., Mattila, T., Nissinen, A., Katajajuuri, J-M., Härmä, T., Korhonen, M-R., Saarinen, M. & Virtanen, Y. (2009). *Suomen kansantalouden materiaalivirtojen ympäristö-vaikutusten arviointi ENVIMATmallilla.* Suomen ympäristö 20. Ympäristöministeriö: Helsinki, Finland.

[7] Carnegie Mellon University Green Design Institute (2008). Economic Input- Output Life Cycle Assessment (EIOLCA), US 1997 Industry Benchmark model [Internet], http://www.eiolca.net

[8] Federation for Transport and Environment, Climate Action Network Europe (2006). *Clearing the air, myth and reality of aviation and climate change.* Can Europe Publication: Brussels, Belgium.

[9] European Environment Agency (2007). *Annual European Community greenhouse gas inventory 1990–2005 and inventory report 2007.* Technical report 7. European Environment Agency, Office for Official Publications of the European Communities: Denmark.

[10] Lentolaskuri (2011). [Internet], http://www.lentolaskuri.fi

[11] Worldwatch-instituutti (2010). The State of the World 2010 [Internet], http://www.worldwatch.org/

[12] World Wide Fund for Nature (2008). Living Planet Report [Internet], http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/

[13] Abrahamse, W. & Steg, L. (2009). How do socio-demographic and psychological factors relate to households' direct and indirect energy use and savings? *Journal of Economic Psychology*, *30*, 711–720.

[14] Darby, S. (2006). The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering. The Environmental Change Institute, University of Oxford: Oxford, UK.

How Finnish energy policies are realised and the attitudes of consumers regarding energy issues? Are residents willing to improve their energy efficiency?
The range of applied research methods was diverse: A literature review, interviews of experts operating in the energy industry and interviews and group panels of ordinary energy consumers.
The use of renewable energy sources must be increased. Individual consumers could assume an important role in the work to control climate change. Therefore attitude-behaviour gap in energy issues needs to be bridged. The residency location may offer opportunities to increase an individual's energy efficiency or it may hinder it. People must have accurate, accessible and understandable information about energy issues. Urgent efforts should be made to manipulate Finns with neutral energy attitudes. Peer groups, communication, the media, education and perceptions to be the most effective influencing methods for changing attitudes and behaviour.

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