



Report

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MEASURING AND EVALUATING THE SOFT ENERGY EFFICIENCY MEASURES

FINAL REPORT



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Measuring and evaluating the soft energy efficiency measures Report

FOREWORD

This study discusses how to quantify the energy savings related to the Finnish energy companies' aims to enhance their customers' energy efficiency. This is one of the targets in the Action Plan for Energy Services in the Energy Efficiency Agreement for the Industries. The focus of this study is in the evaluation of 'soft' measures, in other words those measures given by energy utilities that principally rely on communication Instruments. This study has been funded by the Finnish Energy Industries and the Ministry of Employment and Economy. A steering group consisting of representatives of the Finnish Energy Industries (Sirpa Leino, Mirja Tiitinen), Motiva Oy (Pertti Koski, Lea Gynther), Vattenfall (Airi Laakkonen) and Helsingin Energia (Rauno Tolonen) has been guiding the work.

The project has been carried out by a team consisting of members ÅF Industry , ÅF-Consult Ltd together with Adato Energia Ltd. The project team would like to thank the steering group for valuable comments and guidance.

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LIST OF ABBREVIATIONS

AMR	Automatic Meter Reading
BU	Bottom-up
CER	Commission for Energy Regulation
EDRP	Energy Demand Research Project
EED	Energy Efficiency Directive (Proposal 6/2011, under negotiation)
EEI	Energy Efficiency Improvement
EMEEES	Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services (project)
ESD	Energy Services Directive
EST	Energy Savings Trust
EU	European Union
IEE	Intelligent Energy Europe
RTD	Real-time display
TD	Top-down
TOU	Time-of-use

EXECUTIVE SUMMARY

This study discusses how to quantify the energy savings related to the companies' aims to enhance their customers' energy efficiency which is one target in the Action Plan for Energy Services in the Energy Efficiency Agreement for the Industries. In Finland, a majority of the energy utilities have signed this action plan and are providing their customers services to improve their energy efficiency. Dissemination of information is the most widely used service to the customers and it is provided in a number of ways including printed material, annual energy report, and an internet tool to access and report hourly measurements. Some of the internet tools cover electricity, district heat and water.

The focus of the study is in the evaluation of 'soft' measures; in other words, those measures given by energy utilities that principally rely on communication instruments. However, monitoring the impact of information and communication is far from easy. Carrying out a properly designed evaluation of programmes aiming on enhanced energy efficiency is difficult. Evaluation of the impact of a magazine article on energy efficiency is even more challenging, costly and therefore also rare.

Distribution of information as measure to enhance energy efficiency is an important part of EU's energy policy but what are the ways and even more so, are there ways to actually quantify these savings? There has been excessive work by the member states and research institutes to find a common and robust methodology within the EU to evaluate and quantify energy savings from technical measures. The ex-ante and ex-post results from these evaluations can however differ considerably, e.g. the expected energy savings from installing air to air heat pumps in Denmark did not deliver the expected energy savings. The problems with finding a common robust methodology become even more visible when the 'soft' measures are put under the evaluation loop. The 'soft' measures that aim to achieve behavioural change have not so far been covered by these methods. The recent year's research from Great Britain and Ireland has managed to identify statistically significant results from measures very similar for those carried out by the Finnish energy utilities.

In this study, a number of domestic and international empirical studies and evaluations have been assessed, reviewed and used as a basis for suggesting a way to quantify the energy savings that are obtained with the 'soft' measures in Finland. The chosen method to evaluate the impacts of 'soft' measures is based on the available national data, the literature study and the general information available today on the proposed EU Directive on Energy Efficiency.

According to our findings, reliable numeric data of the energy saving effects of the 'soft' measures on energy demand in Finland does not exist. Therefore, the evaluation based on saving percentages established in international studies is suggested to be regarded as a first step towards when developing system. Even internationally only a few studies with statistically proficient empirical design were found, most of the studies are less reliable because the sample size is small, test durations are short or the studies lack sufficient experimental design. According to the reviewed studies, hourly metering of the energy use alone does not provide changes in customer energy use and

energy efficient technology alone does not deliver energy savings. In order to receive significant effects there is a need to combine these with relevant information. Multiple interventions, such as advice with feedback or advice with installation of efficiency measures, has proven to give better results than single interventions.

The percentages for reductions or effects are from recent studies carried out in Denmark, Ireland and Great Britain. These international studies are carried out in statistically proficient way, with adequate sample size to handle the variation among the population and with a control group to quantify effects that would have happened anyway. Further, the information given is focusing on the same type of measures that are in focus also in Finland; that is, the “smart” metering and consumption feedback would reach 1% energy savings although the manner of how the information is given differs in some of the cases. The international studies have covered the different manners to give the information. The results show that the most efficient manner to give information was a combination of metering the energy use and providing additional short and tailored information would give 3% energy savings. An interesting question is; how well the Finnish utilities work with ‘soft’ measures corresponds to the reviewed international studies? The provided information on energy efficiency in Finland is not in all cases as personal or tailored as in the international studies but it does have the same components. It is also given by an energy company with a customer relation, not by a public body. It covers not only general information, that raises general awareness, but also important measures found in the international studies - such as smart metering combined with additional energy saving information. Surely, this information has had its effects on the energy use of Finnish consumers.

Our judgement based on the available data is that the estimates from these international studies around 1-3% can be used as estimates for the soft measures impact as a first step. When the percentages are calculated to energy in GWh the energy saving effects on the households energy use equals around 200-800GWh. Approximately same level of energy savings are reached when bottom-up approached is used and each measure is analysed separately.

In future work, national studies could be carried out in order to improve the data that the evaluations can be based on. The national reporting system for the different measures could be developed so that the energy quantities become more accurate. One possible measure to start with as a pilot is to connect the measuring with the on going process of rolling out smart meters. Finland has been in the forefront in EU in implementing this and it would be interesting to quantify it. This evaluation could be done with help of e.g. a control group to exclude the changes that would have happened anyway. In the long term, the targets of evaluation have to be determined taking into account also the development of EU policies. This is naturally not a requirement as such but it will help Finland and the Energy Industries to advocate for the 'soft' measures that are seen as an effective and socially accepted policy in Finland. Especially when the international ex-post analysis has shown that by only focusing on technical measures the expected energy savings from them will not be realised.

TIIVISTELMÄ

Asiakkaiden energiatehokkuuden edistäminen on osa elinkeinoelämän energiatehokkuussopimukseen kuuluvaa energiapalvelujen toimenpideohjelmaa Suomessa. Valtaosa suomalaisista sähkön ja kaukolämmön myyjistä ja jakelijoista kuuluu tämän toimenpideohjelman piiriin. Yleisin näiden energiayhtiöiden tarjoama energiatehokkuuspalvelu on tiedon jakaminen muodossa tai toisessa. Esimerkkejä ovat painetut esitteet ja lehdet, vuosittainen asiakaskohtainen energiankulutusraportti ja Internet-pohjainen tuntikulutusta osoittava energiankulutuksen seurantatyökalu. Osa internet-pohjaisista työkaluista kattaa niin sähkön, kaukolämmön kuin veden kulutuksen seurannan. Tässä työssä määrittelemme kuinka näitä suomalaisten energiayhtiöiden yksityisasiakkaille tuottamia energiatehokkuuspalveluiden vaikutuksia voidaan kvantifioida.

Työssä keskitytään niin sanottujen 'pehmeiden toimenpiteiden' arviointiin. Pehmeillä toimenpiteillä tarkoitetaan sellaisia energiayhtiöiden toimenpiteitä, jotka perustuvat pääasiassa tiedottamiseen ja vuorovaikutukseen asiakkaiden kanssa. Erilaisten tiedotukseen ja neuvontaan perustuvien energiatehokkuus- ja säästökampanjoiden tai lehdessä julkaistujen tietoiskujen monitorointi ja toimivuuden arviointi on vaativaa ja kallista ja siksi harvoin toteutettua.

"Informaation" säästäviä vaikutuksia osana energiatehokkuuden edistämistä pidetään tärkeänä osana EU:n energiapolitiikkaa. Vaikka yhteisen ja kestäväen laskentatavan löytämiseksi energian säästöjen kvantifiointia varten on tehty laajaa työtä EU:ssa, 'pehmeiden toimenpiteiden' kvantifioinnin ohjeistus on edelleen hajanaista. Viime vuosina tehdyt laajat tutkimukset Iso-Britanniasta ja Irlannista ovat onnistuneet löytämään tilastollisesti merkittäviä tuloksia toimenpiteille jotka muistuttavat paljon niitä toimenpiteitä, joita Suomen energiayhtiöt tarjoavat asiakkailleen.

Tämän raportin puitteissa olemme arvioineet joukon kotimaisia ja kansainvälisiä empiirisiä tutkimuksia ja kirjallisuuskatsauksia. Niistä saatujen tuloksien ja energiayhtiöiltä saadun tiedon perusteella sekä uuden Energiatehokkuusdirektiivin laskentaohjeiden mukaan olemme arvioineet/laskeneet suomalaisten energiayhtiöiden tuottamien pehmeiden toimenpiteiden vaikutuksen.

Tutkimuksen mukaan tuoretta ja numeerisesti luotettavaa tietoa, jota voisi käyttää pehmeiden toimenpiteiden määrittelemiseksi, ei Suomessa ole, joten tässä työssä tehty säästöarvio perustuu kansainvälisten tutkimusten tuloksiin. Tanskassa, Iso-Britanniassa ja Irlannissa tehdyt tilastollisesti luotettavat tutkimukset toimivat työssä tehdyn numeerisen määrittelyn pohjana. Näissä tutkimuksissa on riittävän otoskoon ja kontrolliryhmän käytön lisäksi painotettu samanlaisia toimenpiteitä ja kommunikointimenetelmiä kuin Suomessa. Tällaisiin toimenpiteisiin lukeutuvat kulutus palaute ja älykäs mittarointi. Tehokkaimpia tuloksia on saatu yhdistämällä älykäs mittarointi tiiviiseen, personoituun informaatioon. Näiden tutkimusten perusteella voi pehmeistä toimenpiteistä saatavan säästön arvioida sijoittuvan 1-3 % luokkaan. Vaikka eroavaisuuksia tiedon jakamistavoissa ja kulutustottumuksissa Suomen ja edellä esitettyjen tutkimusmaiden väliltä löytyy, antavat ulkomaiset

tutkimukset hyvän pohjan pehmeiden keinojen kvantifioinnin arvioimiselle ja palveluiden kehittämiseksi myös Suomessa.

Näkemyksemme on, että kansainvälisiä vaikutusarvioita voidaan käyttää Suomen pehmeiden toimien vaikutusten ensimmäisen vaiheen arviointiin: Jatkossa tulisi käyttää omia tarkempia vaikutusarviointeja. Energiayksikköinä laskettu vaikutusarvio on samaa suuruusluokkaa riippumatta mitä metodologiaa käytetään (Top-down tai Bottom-up). Pehmeiden toimien energian säästövaikutus kotitalouksille on noin 200-800GWh. Tulos on hiukan pienempi käytettäessä Bottom-up metodologiaa jossa laskenta kattaa keskeiset käytössä olevat toimenpiteet ja vaikutus on arvioitu toimenpidekohtaisesti.

Jotta suomalaisten kuluttajien käytöksestä saataisiin tarkempaa tietoa arviointien ja kvantifiointien tueksi, tulisi Suomessa toteuttaa koesuunnittelun pohjalta toteutettuja suorittaa tilastollisesti päteviä, riittävän laajoja vaikutusarviointeja. Kansallista raportointijärjestelmää tulisi kehittää niin, että ainakin keskeiset tiedot kuten vaikutuksiltaan tärkeisiin toimenpiteisiin liittyvät energiamäärät tarkistettaisiin.

Kirjallisuuskatsauksen perusteella harkittavaksi ehdotetaan hanketta, jossa arvioidaan tuntimittauksen ja sen mahdollistamien keinojen vaikutusta. Suomi on tuntimittaukseen siirtymisessä EU:n edelläkävijöitä. Jos tämän muutoksen vaikutus halutaan arvioida kokeellisesti, se on tehtävä nyt, kun Suomessa vielä on talouksia vuosimittauksen piirissä. Itse tuntimittaus ei näytä tuovan säästöjä, mutta tuntimittaus näyttäisi ulkomaisissa tutkimuksissa lisäävän muiden toimien vaikutusta. Suomi on ollut edelläkävijä EU:ssa näiden mittareiden edistämiseksi ja on varmasti kiinnostavaa yrittää arvioida tämä edelläkävijän merkitys.

Pitkällä aikavälillä, arvioinnin tavoitteiden määrittelyssä tulee ottaa huomioon myös EU:n politiikoiden kehitys. Tämä ei toki itsessään ole tavoite/vaatimus mutta edesauttaisi Suomea ja Suomen energiateollisuutta pehmeiden toimenpiteiden merkityksen painottamisessa. Pehmeät toimenpiteet ovat Suomessa koettu toimivaksi ja sosiaalisesti hyväksytyksi energian säästötoimenpiteeksi. Lisäksi ex-post arvioinnit ovat osoittaneet, että keskittymällä ainoastaan teknisiin toimenpiteisiin niiden odotetut energian säästöt eivät toteudu.

1 INTRODUCTION

1.1 DEFINITION OF THE PROJECT

Large majority of Finnish energy utilities that operate in electricity distribution, electricity sales and district heating sales are committed to enhancing energy efficiency of their customers. They have signed up to the Action Plan for Energy Services within the Energy Efficiency Agreement for the Industries. The aim of this study is to quantify the energy savings that are obtained with so called '**soft**' measures by these companies. Later on, the energy savings calculation method is intended to be used to quantify the effects of soft measures in energy units for national purposes and offer an option for reporting to the European Commission.

The '**soft**' measures refer to energy efficiency measures the companies take together with their customers to enhance the efficiency of customers' end-use of energy. The measures taken are in following areas, advice, communication, consumption feedback and billing. The customers that receive this type of service are end-users, mainly households. The assistance is free of charge. Both electricity and district heating companies provide these services, but their focus is slightly different as the customers of district heating companies are often landlords or maintenance personnel rather than end-users. The services provided by district heating companies can be even more "hands-on" service.

The Member States of the European Union (EU) are required to report to the European Commission on the actions and the consequent energy savings according to the Energy Services Directive (ESD). The reporting takes place through the National Energy Efficiency Action Plans (NEEAP) to be submitted in 2007, 2011 and 2014. Information on impacts of energy saving measures are vital input in the assessment of the ongoing activities and programmes and preparation of future measures on both national and EU level.

In June 2011, the EU Commission proposed a new set of measures for increased energy efficiency in its proposal for an Energy Efficiency Directive (EED). This directive will after entering in force repeal the ESD. The new EED proposal includes also measures that are aimed at electricity distribution, electricity sales and district heating sales and the end-customers' energy efficiency.

Finnish energy companies are in the forefront of implementing some of the measures included in the proposed Energy Efficiency Directive. The installment of hourly meters is well under way. As a result all customer bills will be based measured energy, when the earlier practise was to read the meter of the small residential customers once a year. Further, the companies now provide their customer an annual report on energy consumption. This is typically sent with the bill. The hourly measurement data is now available to number of customers, typically via internet. The use of all these measures is reported in system developed to monitor the implementation of the Energy Efficiency Agreements. These, in general, have been considered as a successful instrument to improve energy efficiency in Finland.

1.2 LIMITATIONS

None of the EU Commission recommended calculation methods for the second NEEAPs included energy savings calculation methods for '**soft**' measures. In the second NEEAPs no Member State claimed savings for '**soft**' measures which are targeted in this project. Due to the missing methodology, lack of data and uncertainties the impact assessment '**soft**' measures in energy units has not been performed so far. In general the monitoring methods for energy efficiency policies are still being researched and developed. For this reason, much attention is paid in this study to the behavioural aspects of energy savings and methods for evaluating the impact of '**soft**' energy efficiency measures provided by companies. A number of domestic and international empirical studies and evaluations have been reviewed in order to find information that helps to suggest a way to quantify the energy savings obtained with the '**soft**' measures.

1.3 APPROACH

The study was carried out in four phases this is also reflected in the report.

Phase 1 provides the background information to understanding the need for this study.

Phase 2 includes review of most relevant international and national studies. The methods used to evaluate the impact of energy efficiency measures, and the results of these methods have produced, are described and assessed.

Phase 3 includes the theory for empirical research and description of commonly applied statistical methods in empirical research on e.g. behavioural change. The theory for measures and evaluation methods is reviewed and challenges connected to evaluation of energy efficiency measures are recognised. The role of '**soft**' measures in enhancing energy efficiency by investments is described. Finally, criteria that the evaluation methods should meet are identified. The phase also includes an estimation of the energy savings that are obtained due to the soft measures within the Action Plan for Energy Services.

Phase 4 includes description of the potential use of the results and the needs for future improvements.

2 BACKGROUND: WHY MEASURE AND EVALUATE SOFT MEASURES?

2.1 ENERGY EFFICIENCY TARGETS: THE EU AND FINLAND

The Directive on energy end-use efficiency and energy services (Energy Services Directive, ESD) came into force in 2006. Since the introduction of ESD, the EU has announced a common goal of 20% increase in energy efficiency by 2020.

The ESD sets Finland an indicative target for energy savings. Finland is to strive during the period 2008-2016 to achieve annual energy savings by 2016 amounting to 9% of average annual energy consumption during the period 2001-2005. This is equivalent to annual energy savings of 17.8 TWh. The directive covers all uses of energy in Finland apart from marine shipping, air traffic and industrial facilities covered by the emission trading system, EU-ETS.

Information on impacts of energy saving measures is a important input for assessment of ongoing activities and programmes and preparation of future measures on both national and EU level. The ESD requires the Member States to report to the EU Commission on their actions and the consequent energy savings through national energy efficiency action plans submitted in 2007, 2011 and 2014. Thus, the ESD requires Member States to assess the energy saving impacts of the measures that have been taken. According to the reporting template and guidelines by the EU Commission for the second NEEAP, Member States were free to choose the calculation methods recommended by the Commission or their methods modified to fit the national data, measures and programmes. (Ministry of Employment and the Economy 2011)

The EU Commission proposed a new set of measures for increased energy efficiency on 22 June 2011 in its Proposal for a Directive on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC (EED). The aim of the proposal is to meet the energy efficiency target for year 2020.

2.2 ENERGY EFFICIENCY AGREEMENTS AND ACTION PLANS FOR ENERGY SERVICES IN FINLAND

The Energy Efficiency Agreements are a key instrument in Finland for the fulfilment of the obligations under the Energy Services Directive. Energy efficiency is one of the main goals of the National Long-Term Climate and Energy Strategy from year 2008. Energy Efficiency Agreements were recognised both in the strategy and the government's decision as important means in achieving energy efficiency targets. Finland has adopted two amendments to energy legislation that are focused on enhancing energy efficiency. The first is the Government's regulation of electricity supplies and the inventory count (Valtioneuvoston asetus 66/2009). The law will come into force on December 2013. The second law is the Law on energy efficiency services for companies operating on the energy market.(FINLEX 1211/2009) This law defines the energy companies obligation to promote efficient and sparing use of energy among their customers. The law entered in force on January 2010. This law regulates the billing according to actual use, reporting of the energy use and

information of possible energy efficiency measures for all kind of energy customers. Even district heating and cooling customers are covered by metering as long as metering is technically possible and economically viable.

The Energy Efficiency Agreement scheme that started in 2008 is a continuation of the energy savings agreements that Finland started already in 1997. Motiva which operates as an affiliated Government agency promoting efficient and sustainable use of energy and materials is responsible for the implementation of this policy measure. The current agreements will be in force until the end of 2016 and they cover the following sectors:

- industries (industrial, energy and private service sectors)
- municipal sector
- oil sector (oil heated buildings and distribution of liquid heating and transport fuels)
- property sector
- transport (goods and public)
- farms

There are two Action Plans for the energy sector within the Energy Efficiency Agreement for Industries – one for energy production and another for energy services. The companies that have signed up to the Action Plan for Energy Services cover nearly 90% of Finland's total electricity distribution, approximately 94% of electricity sales, and 80% of district heating sales. 87 companies have signed up to the Action Plan for Energy Services. More than 130 operating premises are covered by the Action Plan and out of these premises, just under a third are electricity sales premises, approximately one-third are district heating premises, and the rest are electricity distribution premises.

Companies that have joined the Action Plan for Energy Services and conduct the transfer and distribution of electricity and the sale of district heating, have obligations both for their own energy use and a target to enhance their customers' energy efficiency. Companies have an energy saving target of at least 5% on their own energy use by 2016. In addition the Action Plan includes a target for the companies to implement energy-efficiency measures to be offered to their customers to enhance their energy efficiency. These energy efficiency measures are meant to provide considerable help in achieving the indicative 9% energy saving target of the ESD. Customer groups that are not otherwise covered by the energy efficiency agreement activities, e.g., households are the target group. (Ministry of Trade and Industry 2007).

The companies report annually on measures aimed at improving the energy efficiency of their customers. The monitored measures are aimed at action in the following areas: advice, communication, consumption feedback and billing. The reporting has to also include quantitative information about the implementation and target groups of each measure. (Ministry of Trade and Industry 2007).

Energy companies in Finland have a long tradition of implementing measures aimed at customers. The measures aimed at customers and reported in the annual reports in 2010 as implemented by the companies are set out below. Similar data exists also for the previous years of the agreement, 2008 and 2009. The number of measures

implemented during the 2008–2016 agreement period and their intended target group will increase greatly and vary over the whole agreement period. (Ministry of Employment and the Economy 2011)

According to the annual reporting by companies, energy saving advice, energy saving communication, consumption feed-back and measures related to billing are all very common measures. Energy-saving advice aimed at customers is implemented by 99% of the companies that have joined the agreement. The companies favour the following measures:

- Energy-saving advice by telephone;
- Lending consumption gauges;
- Advice via e-mail or the Internet;
- Energy-saving advice on premises;
- Events for customers and interest groups.

Energy-saving communication is being implemented in the agreement period by 96% of the companies that have joined. The companies' measures are focused on:

- Writing about energy savings in the customer magazine;
- Energy-saving matters on the Internet;
- Printed material for customers concerning energy savings;
- Participation in the Energy Savings Week.

Consumption feedback is being provided by 98% of the companies. The most popular measures are:

- Opportunity to monitor one's own consumption on the Internet;
- Use of remote readings;
- Energy consumption monitoring report sent to customers.

Measures relating to billing, which affect customers' energy use, have been reported to be implemented by 88% of the companies. The majority of companies that have joined the Energy Efficient Agreement scheme bill customers monthly based on actual consumption. (Ministry of Employment and the Economy 2011).

Finland's second National Energy Efficiency Action Plan (NEEAP-2) that was finalised in June 2011 includes calculations of the energy conservation effects for a total of 36 energy efficiency activities. In addition, the plan also includes approximately 50 other activities to promote energy efficiency. In Finland's first energy efficiency action plan (June 2007) savings were calculated for 14 measures/sets of measures. (Ministry of Employment and the Economy 2011).

Regarding the Action Plan for Energy Services, the impact on savings of the measures aimed at the companies' own energy use has been calculated. No energy savings were calculated for the measures taken to improve customers' energy efficiency. The energy services offered to customers are mainly "soft" measures. Considerable uncertainties are associated with evaluation of the impact of this type of measures. (Ministry of Employment and the Economy 2011). According to the information

gathered in the frame of Concerted Action for Energy Services Directive (CA ESD¹), energy savings for soft measures were not either reported by other Member States in their second NEEAPs.

¹ <http://www.esd-ca.eu/>

3 LITERATURE REVIEW

3.1 CONTENT

The third phase of this study was to find empirical studies to work as a base for the proposed quantification methodology and to identify the appropriate sources of national data and research on measuring the impact of '**soft**' measures and utilize it in our evaluation. The literature has been analysed not only to design the methodology but also to give a general picture of the impacts of energy efficiency measures and their measuring. The literature review also provides information on how to develop the evaluation of the '**soft**' energy efficiency measures.

This chapter has been divided into four parts. Part one (Chapter 3.2) consists of a review on international studies with results which are applicable also to evaluation of soft measures in Finland. Part two (Chapter 3.3) consists of some specific evaluation issues arising from the international literature review. Part three (Chapter 3.4) shows additional international material. Part four (Chapter 3.5) consist of an evaluation of relevant national studies. The actual use and applicability analysis of the studies to the purpose of this study is done in Chapter 4.

3.2 STUDIES WITH APPLICABLE RESULTS FOR EVALUATION OF SOFT MEASURES IN FINLAND

Only a few statistically proficient empirical field experiments were found for further evaluation. The chosen studies have good empirical design with control group. A number of other studies and reports that proved to be less relevant in this context were also reviewed during the course of the study.

The Irish Commission for Energy Regulation (CER) established the Smart Metering Project Phase 1 in late 2007. The goal was to set up and run large-scale smart metering trials for gas and electricity and assess their costs and benefits. (CER 2011)

Over 5,000 residential electricity consumers throughout Ireland participated in the electricity residential customer behaviour trial (CBT). The participants were allocated across different test groups and a control group. The benchmark period lasted for six months and the testing (measurements) period for one year. Measures used included the use of smart meters in combination with a number of informational stimuli (i.e. detailed billing on a bi-monthly and monthly frequency, in-home displays, an overall load reduction (OLR) incentive and Web access) and time of use tariffs. The statistical evidence from the residential electricity CBT claim that the deployment of these smart metering enabled informational stimuli in combination with time of use tariffs results in a reduction in overall electricity consumption of 2.5% and peak electricity consumption of 8.8% (both results are statistically significant against the electricity CBT control group at a 90% confidence level).

Circa 2 000 residential gas consumers throughout Ireland participated in the gas residential customer behaviour trial. The participants were allocated across different test groups and a control group. The benchmark period lasted for six months and the

testing (measurements) period for one year. Measureable reduction in customer demand was achievable through the use of smart meters in combination with a number of information stimuli (i.e. detailed billing on a bi-monthly and monthly frequency, in-home displays) and a variable seasonal tariff. The statistical evidence from the residential gas CBT is that the deployment of the smart metering enabled informational stimuli results in a *reduction in overall gas consumption by a statistically significant average of 2.9%*. Each of the four stimuli combinations tested was found to reduce usage by a statistically significant amount.

The Energy Demand Research Project in Great Britain has tested consumers' responses to different forms of information about their energy use. The focus of the study was on customer behaviour. In the project, four energy suppliers each conducted trials of the impacts of different interventions between 2007 and 2010. The project involved over 50 000 households, including 18 000 with smart meters. Measures were generally applied at household level but one supplier also tested action at community level. The energy suppliers each divided their trials into a number of trial groups to test the impact of different interventions. The EDRP trailed a range of methods of providing customers with improved feedback on their energy consumption, including:

- smart electricity and gas meters
- real-time display devices, which show energy use in pounds and pence
- more accurate and more frequent bills
- energy saving information
- community engagement

Smart meters were essential for successful results. With two exceptions, there was no significant reduction in energy use without a smart meter. In these two cases it was only one of the trial companies that found a significant reduction (in electricity use only). The effect was small (around 1% savings). The other trials did not find statistically significant effect of real time displays (RTD), energy efficiency advice (paper/online), historic feedback (paper/online), self-reading of meters or financial incentives to save energy without smart meters.

Interventions with smart meters were successful more frequently and with larger percentage savings in energy use. Using RTD's brought electricity savings of generally 2-4% higher than with a smart meter only. The effects were persistent to the end of the trial. Generic advice and historic feedback (along with a smart meter) resulted to savings only in one of the trials. The results are consistent with the literature insofar. Savings were reported in a case where information was provided in "simple, short statements, over a period of time – minimal but well presented and easy to absorb a little each month". No reliable or persistent effects or evidence of other incentives (such as financial incentives, web-based billing information and historic feedback (delayed by only a day but not real-time feedback), load shifting, population segment effects) were found in the study.

The Energy Saving Trust's (EST) EU Life + Water and energy project (EST 2009) explored the feasibility and success of integrating water efficiency messaging into the communication methods commonly used by energy efficiency or household

engagement initiatives. These methods included phone calls (inbound and outbound calls), postal mailing, events (shopping centres, festivals) and home visits

The Pilot provided water saving advice to the public through the Energy Saving Trust Advice Centres. The goal was to find out which communications approaches worked best and how people could be motivated into saving energy and water. The water advice services pilot lasted for a year (September 2009-August 2010), even though a deeper advice programme that focused on tailored in-home engagement in October 2010 - April 2011. The primarily used evaluation method was a quantitative telephone survey of Advice Centre customers that had received water advice. Five separate surveys were made: a baseline (for benchmarking purposes), three core Waves (Waves 1-3) and Wave 4. A targeted selection of people who had received EST advice was included also in qualitative research.

Most (74-80%) of respondents recalled contact with the Advice Centres during the first three waves. For general energy saving advice typical recall of contact was in the range 65-70%. In the fourth wave everyone remembered the home visits. However, respondents specifically recalled being given advice about water were from 41% to 65%. The evidence indicates that the advice provided throughout the Pilot raised the awareness of the importance of saving water. Among the key findings of the evaluation is a suggestion that 'tailored', in-home engagement methods have the best impact on recall of advice given, uptake of advice given and potential energy, water, carbon and financial savings."

Table 3-1 summarises the international field studies reviewed in this study.

Table 3-1 Summary of reviewed international field studies

Title	Year	Country	Sample size	Measures	Estimated avg. savings (total use)	NOTE
CER: Smart metering project phase 1- Information paper 4. 2011	2008-2010	Ireland	5000 hh	Smart meters in combination with a number of information stimuli (e.g. detailed billing, in-home displays...)	Reduction in overall electricity consumption by average 2.5%	Good statistical design.
CER: Smart metering project phase 1 - Information paper 5. 2011	2009-2011	Ireland	2000 hh	Smart meters in combination with a number of information stimuli (e.g. detailed billing, in-home displays...)	Reduction in overall gas consumption by average 2.9%	Good statistical design.
Ofgem: Energy Demand Research Project. 2010	2007-2010	UK	60 000 hh. 18 000 smart meters	Smart meters, advice, historic use feedback, engagement targets, RTD, other media, financial incentives		Good statistical design. Sample size huge.
EST: EU Life + Water and energy project. 2010	2009-2011	Great Britain	Depending on project phase (at most 9000 hh)	Phone calls, postal mailing, events, home visits	Tailored. in home engagement methods have the best impact on recall of advice given. uptake of advice given and potential energy, water, carbon and financial savings. Gave % of augmented awareness and CO2 cost reduction estimates per household	Good statistical design

3.3 EVALUATION CHALLENGES

Sample size

Typically, the size of samples and test durations of field studies are quite small and/or the design is not good enough to give reliable results in terms of energy savings quantifications. The methodology for sampling affects the reliability of results. Large enough sample size is crucial for obtaining statistically significant results. The population standard deviation of energy use is large and thus the required sample sizes are large. The studies with relevant results should also include a control group in the study design.

Sample size is an important factor when using results from empirical studies as sources. As an example, we give a Danish experiment (Hansen Kjaerbye. V et al. 2008) where the research team analysed the effect of SMS and text messages as means of giving feedback of electricity consumption on the level of total household consumption. 1452 households were invited to participate in this experiment. 733 accepted and 701 completed. The study is of good statistical design. However, even with a refined statistical design, the variance among the experiment group is so large that no significant energy savings results can be obtained. Variance "drowns" the small change in consumption which is why the sample sizes need to be large enough for the results to be statistically significant.

Large enough sample size takes into account the variation of energy use, behaviour, attitudes, etc among the customers so that reliable estimates can be obtained. In the research field Automatic Meter Reading (AMR)-Visualization within Elforsk ELAN III programme (2007-2009), three studies were conducted with the aim to quantify how the increased information would enable households to reduce their energy use. The outcome did not produce any significant results due to wide variation among the target population. (Pyrko 2009.)

Individual misconceptions of energy behaviour

Another obstacle with the evaluation is the human nature, how we see ourselves and how we wish to be seen. In the surveys, we may receive "proper" answers instead "honest" answers. Further, the formulation of questions and their order is of importance. The Swedish measurement study combined with behaviour studies can illustrate this. The Swedish Energy Agency carried out a large measuring campaign (total 400 households) to measure the households' electricity use at end-use level (Zimmermann 2009). This study was combined with smaller behavioural studies (Karlsson 2008). The household members were asked to keep a diary of their activities and also to answer to an enquiry. The measured data (electricity use for each appliance in short interval) showed that the diary entries did not correlate with the measurement data. This was the case for e.g. TV that was on far longer than given in diary entries. Similar behaviour is likely to affect the surveys made in Finland.

The role of measuring the energy demand before for the baseline and after an activity is crucial. But measuring only among participants will not give a reliable estimate for the impact of the measure. A control group is needed.

3.4 OTHER INTERNATIONAL STUDIES REVIEWED

The **literature review** by Sarah Darby (2010) done for the **Energy Demand Research Project**² is probably one of the vastest international literature reviews done in the past years. Darby (2010) has reviewed large amounts of trials; however, the emphasis has been on those that have been carried out in the most ‘real life’ conditions.

Among the key findings of Darby’s (2010) literature review are that there is no one way reduce energy demand among the customers, there is rather a set different measures that can reduce the energy use, but there is a lack of a standardized approach to researching impacts. According to Darby (2010), the single most significant message is “that improved feedback is necessary for good understanding of energy use and effective action to reduce it, but not always sufficient”. Darby (2010) argues that there is strong qualitative evidence that feedbacks benefits raising awareness. However, this does not always lead to beneficial action. Experiments and trials that have included in-home displays have shown promising results in the short to medium term. In most cases these have been found with already-motivated customers but sometimes also with uninterested customers. Darby (2010) also concludes that sometimes the displays can cause frustration (if the information cannot be used to improve the situation) and sometimes conflicts if members of the household do not agree on the measures that should be taken. Widening the motivation to understand energy use, maintaining interest and using displays as a part of wider programmes bring challenges in the future. Darby (2010) also points out that not all population subsets can be expected to respond to feedback similarly (e.g. low-income young people versus high-consuming owner-occupied households). According to Darby’s (2010) research “multiple” interventions, such as advice with feedback or advice with installation of efficiency measures, will tend to give better results than “single” interventions.

Energy Agencies from 10 Member Countries participated in the **BEHAVE-project** (2007-2009)³ where around 100 examples of behaviour change projects and programmes concerning energy use of individual consumers and households in the EU were reviewed. 41 of these projects were analysed in more detail. The cases consisted of awareness campaigns, educations, design, community approach and financial instruments. (IEE 2010; Smits 2011)

Among the main findings from the BEHAVE – programme (2007-2009) are that theory-based approaches and research/scientific methods are used seldom. Market

² The Energy Demand Research Project (EDRP) was a suite of large scale trials across Great Britain. The aim was to understand how consumers react to improved information about their energy consumption over the long term.

³ The purpose of the BEHAVE programme was to “improve the impact programmes and projects, aimed at influencing energy use of individual consumers and households” in the EU

segmentation is not specific and in half of the cases no ex-ante evaluation or analysis had been done. The results of the study indicate that there is limited evidence of purposeful accumulation of knowledge and experiences, even within individual implementing bodies. The main findings also include that there is "little" evidence that programmes result in real, significant, durable and cost-effective results". (IEE 2010; Smits 2011.)

In 2008, as a part of the **HEAT'07**⁴ by Finland's environmental administration project report (SYKE 2008), an extensive literature addressing different feedback forms in terms of energy saving was made. The HEAT'07 project group has made a thorough literature review in the analysis and review of 18 studies (mostly international). The studies that were analysed were conducted between 1977-2007, many of them being scientific articles. Among the reviewed papers is an extensive article review (38 articles) done by Abrahamse et al (2005) and another review (40 articles) done by Darby (2000). The sample sizes of the studies summarised in the HEAT'07 report are without a few exceptions less than 300. Many are less than 100.

The literature analysis of the SYKE (2008) concludes that the effect of consumption feedback on energy savings varies in most cases between 5-15 %. Not all energy savings experiments have induced energy savings but usually the studies that included consumer feedback and a personal approach where the most effective. The study also argues that according to the literature it can be concluded that giving feedback of energy consumption in some form is necessary, if the goal is to reduce energy use. The form of the feedback does not seem to matter even though direct feedback⁵ seems to be slightly more effective than indirect feedback (e.g. Darby 2006). The denser the feedback, the more it has effect (also a conclusion of Abrahamse et al. 2005). An interesting conclusion is that in most studies the review period is quite short and in only few studies a follow-up period has been arranged after the experiment period. Reliable results with quantifiable data of long-term effects of consumption feedback do not exist. The conclusion is similar to the project review-results of the BEHAVE-project (IEE 2010; Smits 2011).

In 2008, **Helsingin Energia** carried out a literature review on consumption feedback and energy savings information related studies conducted in Finland and in the Nordic countries especially after 1993 (Helen 2008). The literature review consists of 17 studies. The review does not include evaluation of the empirical methodology used in the studies. Key findings in the evaluation done by Helsingin Energia include the following: "Generally it can be said that consumption feedback has had a positive effect on energy saving in majority of the studies. However, in different studies results vary even quite considerably" and "qualitative research states quite unanimously that in the consumers' opinion consumption feedback and other political instruments based on information contributes to energy saving and are found positive by the consumers."

⁴ The HEAT'07 project "was designed to improve household energy efficiency and mitigation of climate change impacts, and to improve the means available for consumers to get information on their electricity consumption. The objective was to test the BaseN-developed real-time measurement and visualization technology, collect user experiences and suggestions for improvement, and to further develop a Website dedicated to presenting household-specific data on electricity consumption"

⁵ Direct feedback is when the feedback is given immediately e.g. on a display, whereas the indirect feedback is processed by someone before it is given to customer a typical indirect feedback is the energy bill.

Among the main arguments is also that the differences in the sample sizes, experiment durations and experiment environments complicates the comparison of different studies. In addition, empirical studies are mostly done with people that are interested in energy saving to start with. This may lead into too optimistic results. (Helen 2008.)

3.5 NATIONAL REFERENCES AND SOURCES

The goal of the project was to find if and how the energy guidance services of the Finnish Energy Companies affect the energy consumption of Finnish consumers. The compiling study by Helsingin Energia (2008) states that only little numeric information on consumer behaviour regarding consumption feedback and energy saving exists in Finland. According to our research on available literature, this applies also to other '**soft**' measures. To conclude, according to the research done for this study, no statistically reliable recent Finnish studies exist, the results of which could - de facto - be used as a base for this quantification.

There have been studies that give some qualitative information and indication on the behaviour and views of Finnish consumers that can be used in developing the evaluation and monitoring system in Finland. The summaries of Finnish studies that were found interesting for the purpose of this study can be found in Table 5-2. They focus on general project descriptions as not all the studies have been presented in similar level of detail as the international studies have. Furthermore, the benefits are not on energy saving but rather on qualitative issues where the market barriers can be identified and addressed with appropriate policy/measures.

Two studies are of greater importance to this study and they have been presented in more detail than the others summarised in Table 3-2. The most important one is Kosurnova's doctoral dissertation in 2010. It was done before the metering reform but it describes a situation at the market with customers who generally see that to save energy is "the right thing to do". However, they have difficulties in acting upon it. There are multiple reasons like:

- Energy use, and especially electricity use, is a result of a many small daily decisions and the feedback to these decisions is not direct.
- The structure of the electricity market and its mechanisms are unclear to the consumer. This lack of knowledge and information is a classical market barrier.
- The energy companies have been promoting energy efficiency for the customers but they have experienced difficulties in communicating to the customer in a trustworthy manner. The companies wish to promote energy efficiency as a part of company profile towards sustainability, but not by criticising the consumers.
- The customers do desire feedback based on actual consumption but it has to be served to them as they are not interested enough in energy issues to look for the information by themselves.
- Information needs to be tailored.

The lack of interest among many and the problems of understanding one's own energy use, the type of information and ways to receive it are issues that have been raised also in other studies (e.g. Rouhiainen 2011).

The second study presented in more detail is a study by Motiva (2009): a recent attempt to quantify the soft energy efficiency measures in Finland. In order to develop a uniform manner to be able to report the energy savings related to the 'soft' measures targeted to the energy companies' customers in the framework of the Action Plan for Energy Services in the Energy Efficiency Agreement for Industries, a project to quantify the effect was set up by Motiva in co-operation with the Finnish Energy Industries. The final report "Energiayhtiöiden asiakkaille suuntaamien palvelujen säästövaikutus Energia-tehokkuussopimusmenettelyssä" was reported in 2009 (Motiva 2009).

Information was gathered from three different sources: literature analysis, customer survey (700 participants), expert survey (45 experts replied). The primary purpose of the customer survey was to find out how much consumers estimate the 'soft' measures of their energy companies to reduce their electricity, heat and water use. The purpose of the expert survey was to acquire more detailed information on the energy savings of different measures. The experts were also inquired about on how to weight the impacts of different measures. One could say that the nature of the expert survey was more a qualitative study as the rationale was to specify energy savings evaluations and get an in-depth analysis of the research question. After having results of survey, the weights of different measures were analysed and estimated based on consumer and expert surveys and the results were presented in a calculation matrix. The calculation matrix was piloted in two companies but will not be presented in this review in more detail, as using the matrix in estimating savings was seen controversial.

According to the study, the customers had estimated the energy use to be 1.5% lower than without the 'soft' measures (electricity: 2%; heat: 1.4%; water: 1.1%). The consumer survey value of 1.5% was calculated as a weighted average of Finnish households' consumption distribution of electricity, heat and water. Taken into account the large number of customers responding to the survey, the results seem reliable when investigating consumer awareness. However, the fact that a baseline is not established and no control group was used implies that the results from this study alone cannot be used to quantify the impact of soft measures in energy terms.

Motiva's (2009) study also had an interview part with energy experts to support the customer responses and the obtained energy saving. A problem with the expert responses was the fact that the experts were partly evaluating themselves and therefore the objectivity on their response would always be questioned.

It is also worth noting that the customer opinions of the relative efficiency of the 'soft' measures correspond to those found in empirical studies with control groups (CER 2011; Ofgem 2010). Though the formulation of the question in the questionnaire has additionality built to it, it is possible to argue that consumers cannot distinguish the additional savings properly.

Table 3-2 Summary of reviewed national studies

Title	Year	Project	Key Findings
Korsunova. A: Encouraging energy conservation with "no hard feelings".	2010	The thesis combines different approaches to seek the best description of the current situation in Finland. The focus is on customer –company relation and how it can enhance energy efficiency and energy conservation. It gives a theoretical background for the energy markets and it participants in Finland. The customer. Have lack of knowledge, interest and possibility to react on the advice they are given by the energy company. It also investigates how the companies perceive the customer reaction. The empirical background part presents the development of sustainable or consumption the role of consumers and the ways to involve them to energy conservation. The empirical part has a has mixed approach where both quantitative and qualitative data is gathered with surveys from customers and with both surveys and in-depth interviews from the energy companies.	Gives a picture of how the electricity market is functioning and identifying some of the market failures and barriers such as low interest on energy issues although energy saving s is seen as important. Lack of knowledge among the customers about their own energy use. And energy companies that are afraid to inform the customer of means for them to save energy as they do not want to criticize the customers. Analysis of the data shows that much of energy conservation communication is aimed at improved customer relationship building, while the effectiveness of energy conservation communication is undermined by a deadlock of factors that reinforce each other. For more sustainable energy use barriers should be addressed, and involvement of other actors and factors than energy providers are needed.
Rouhiainen. V (Adato): Wattitalkoot – loppuraportti	2011	Test and diagnose problems related to an energy guidance concept that is created based on educating voluntary participants on efficient energy use. Get feedback on the used tools and ideas to develop them further. Despite extensive recruitment effort including 400 direct invitations and story in major local newspaper ,only 21 participants were found.	Customers are mainly interested in energy efficiency feedback that is connected to costs. Recruiting voluntaries to partake is hard; problem: lack of interest in energy efficiency in general
Motiva:Sähkölämmityksen tehostamishjelma ELVARI	2010	To gather information on the customer knowledge of their own electricity consumption.The energy savings measures and the understanding of them, and where to find information on energy saving, guidance and billing related issues. To assess the success of the respondents energy company in energy savings issues to gather voluntary feedback from the respondents of the survey.	Views of customers on their • knowledge on energy use and incentives on reducing energy use • opinions on different ways of how and what kind of information should be provided of energy use • opinion on consumption based billing and whether it has effects on reducing energy use. See Appendix 1. For results.
Motiva: Energiayhtiöiden asiakkaille suuntaamien palvelujen säästövaikutus energiatehokkuussopimusmenettelyssä	2009	The goal of the project was to quantify the effect of soft measures targeted to energy companies' customers and to develop a uniform manner to report these energy savings. Information was gathered from three different sources: literature analysis, customer survey (700 participants), expert survey (45 experts replied). The primary purpose of the customer survey was to find out how much consumers estimate the "soft measures" of their energy companies to reduce their electricity, heat and water use. The weights of different measures were analysed and estimated based on the consumer and expert surveys and the results were presented in a calculation matrix. The calculation matrix was piloted in two companies	According to the study, the customers had estimated the energy use to be 1.5% lower than without the "soft measures" (electricity: 2%; heat: 1.4%; water: 1.1%). The consumer survey value of 1.5% was calculated as a weighted average of Finnish households' consumption distribution of electricity, heat and water.

Vesalainen. M: Säästöpuoroista kasvaa säästövirta. 2004	2004	Analyse attitudes towards energy (household electricity and water) saving guidance in a condominium. Handout of printed guidance. 26 households replied (49 % of all).	Attitudes towards guides were positive, information was thought useful.
Haakana et al. Long time effect of feedback and focused advice on household energy consumption. LINKKI- kuluttajien käyttäytymisen ja energiansäästön tutkimusohjelma.	1998	Follow-up study to the one published in 1996. The goal of the follow-up study was to evaluate how consumption had developed in households who participated earlier for 17 months in an interactive monitoring of consumption in space heating, household electricity and water. Special emphasis was given on the increase or decrease of energy saving habits concerning those different fields of energy consumption. Of the original number of 105. 79 households were reached.	Nearly half of the households had tried to decrease their consumption at least in one of the fields. Voluntary monitoring of consumption was still frequent and more frequent in households that managed to decrease electricity and water consumption. The saving manners adopted during the monitoring phase were still in use. However, heating energy consumption increased 4% since monitoring. Household electricity consumption and water consumption had increased 1-3 % since the monitoring. Conscious intentions or changes in manners did not necessarily result in savings in water and electricity consumption.
Haakana & Sillanpää: The Effect of Feedback and Focused Advice on Household Energy Consumption	1996	The aim was to monitor the effect of focused advice on householders' behaviour with regard to energy consumption. 105 district heated single-family houses participated. Use of control group. Type of measures: Comparable consumption feedback. Written/video guidance	By giving comparable consumption feedback the electricity consumption was reduced by 17-21 %. Focused advice did not intensify the savings at all. Electricity savings potential varies much between households but the average is 12-18 %. Heating energy consumption decreased by average of 5 %, when the households began to read their meters. Consumption feedback increased the savings (reduction of 3.9 % in space heating compared to the same months of the previous year) but focused advice did not
Arvola. A: Billing feedback as means to encourage household electricity conservation: A field experiment in Helsinki	1993	The goal was to determine the effects of consumption feedback on residential electricity consumption. 700 families living in detached houses participated in the project. Use of control group. Type of measures tested: Billing based on actual consumption. Consumption feedback. Comparative feedback. Saving tips	Billing according to actual energy use had effects on consumption. Feedback increases the savings. Feedback alone and feedback with tips had the same effect on energy savings. The consumption changes that were achieved were moderate (<5 %).

3.6

KEY FINDINGS OF THE LITERATURE REVIEW

There are only a few empirical field experiments that can be seen to provide statistically relevant results for the purpose of defining the methodology in this study: CER (2011); Ofgem (2010); EST (2010). Typically, the size of samples and test durations are quite small or the studies lack sufficient experimental design to give reliable results in terms of energy savings quantifications. Quite often, the smaller the sample is, the greater the estimated savings are. Also, only little information on long-term effects of savings exist (see e.g. Helen 2008).

According to the reviewed studies, metering alone does not provide change in customer energy use and technology alone does not deliver energy savings; it needs to be combined with information (CER 2011; Ofgem 2010). Also, multiple interventions, such as advice with feedback or advice with installation of efficiency measures, seem to give better results than single interventions (Darby 2010). Smart metering and billing accordingly provide approximately 1% savings (Ofgem 2010). Smart metering and billing accordingly together with tailored information will provide approximately 3% energy savings (CER 2011; Ofgem 2010).

The interesting result from the EDRP (Ofgem 2010) is that in the current situation in the Great Britain, no significant reduction in energy use was found without a smart meter. And in the trial that got results, the effect was small (around 1% savings in average). This would suggest that the average consumer already knows about the traditional ways of saving energy and additional savings that can be gained come from more detailed data and information on own consumption. The smart meter itself is not producing savings but the possibilities of providing more tailored information. This strongly suggests that the current way and contents and timing of given advice and information should be reviewed and revised in order to meet the different needs of household segments. The segmentation includes end-user practises and preferred formats of received advice. The well-designed statistically proficient empirical studies we have summarised (Ofgem 2010 and Darby 2005), support the findings of Korsunova's (2010) doctoral dissertation: energy advice needs to be customized and/or with personal contact.

According to our research on available literature, actual, reliable numeric data of the effects of the "soft measures" on energy consumption in Finland does not exist. The studies with statistically sound measurement concerning savings percentages / amounts have been done outside of Finland. However, market studies and qualitative research on barriers of adopting energy efficient practices exist. This information can be valuable for follow-up of existing work done by the energy companies and also further improvement of the work.

4

QUANTIFICATION OF THE SOFT ENERGY EFFICIENCY MEASURES IN FINLAND

4.1

THEORETICAL ASPECTS OF MEASURING ENERGY EFFICIENCY: BOTTOM-UP OR TOP-DOWN?

Traditionally energy efficiency policies are evaluated with bottom up models which describe technology in great detail and derive total energy consumption by summing up the end-uses. This is often called the engineer approach. The alternative is top-down approach which attributes the total energy consumption to determinant variables (e.g. an energy saving technique, prices or behaviour). Top-down means starting from aggregated data like national statistics for energy consumption or sales of equipment, and then going down to more disaggregated data when necessary and correlating the realized energy savings with energy efficiency improvement (EEI) measures. This approach is also called the “economic approach”. Figure 4-1 provides a good overview of the two approaches.

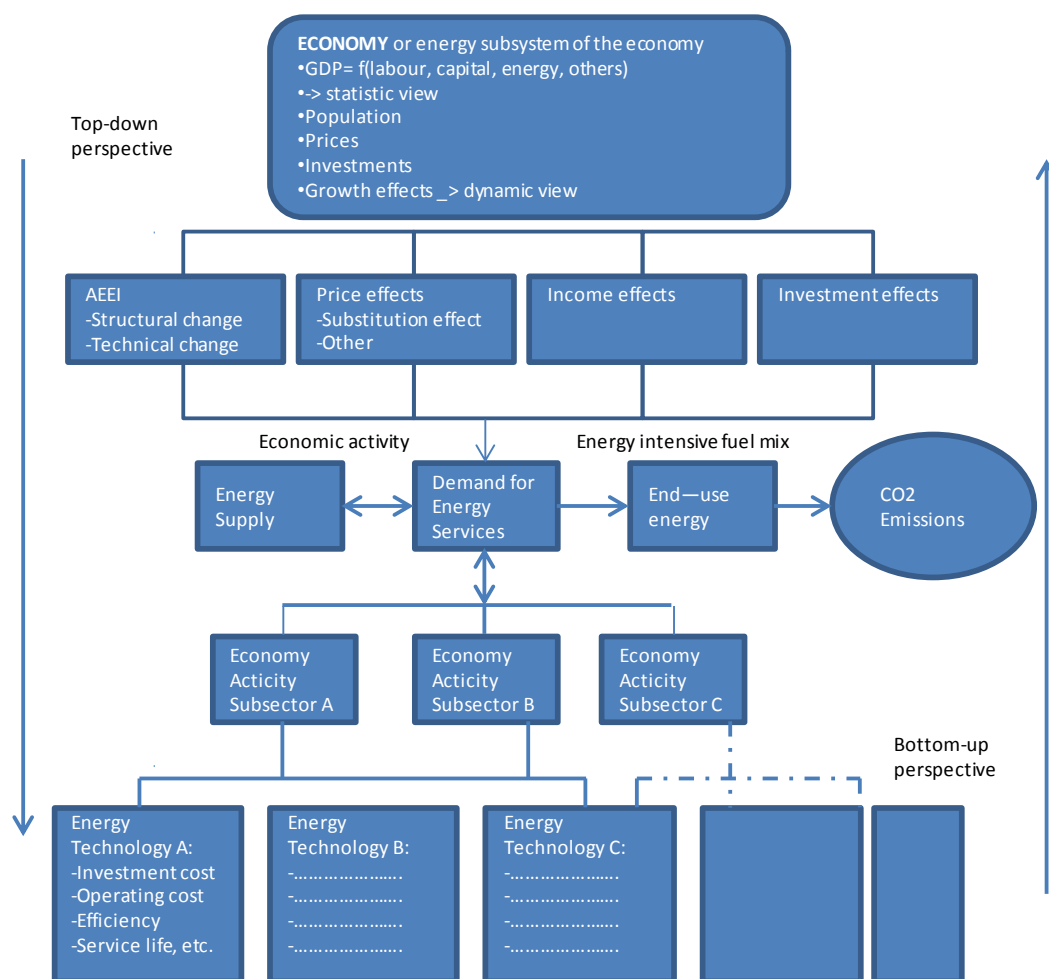


Figure 4-1 The two main methodologies used to calculate energy efficiency potential in the economy (from Kavgić et al. 2009). The Top-down models start sectoral aggregate time

series data and describe economic effects as well whereas the Bottom-up approach takes energy end use technologies as a starting point and use given activity volumes.

Figure 4-2 is a simple way to describe both the differences in the modelling approaches and the economic dynamics leading to the disappearance of the expected savings. The areas do not reflect the size of the effects. The engineering estimate of the energy saving is based on comparison of the energy efficient and present technology.

Engineering estimate of energy saving	Actual energy savings		
	Economy wide rebound effect	Indirect rebound effect	Secondary effects
			Embodied energy
		Direct rebound effect	Income output effect
			Substitution effects

Figure 4-2 Classification scheme for rebound effects (Herring 2011)

Actual savings is the figure which one observes when one compares the realized energy consumption before and after taking the efficiency improvement. But sometimes the “expected energy savings” with a given technology are not reached. The difference is attributed to the rebound effect and is the result of market dynamics. This is then broken down further to distinguish the effects at the actor and economy level (Herring 2011).

Recent empirical ex-post studies establishing and discussing the difference of expected engineering estimates and observed actual savings include Kjaerbye et al. (2011), Rogan & Gallachoir (2011) and Christensen et al. (2011). The first two discuss the expected and realized effect of building codes. The last one discusses the effect of air-to-air heat pumps.

The last is used as an example. Consider air to air heat pumps. The engineering estimate of electricity savings obtained in heating is about 5000 kWh. At actor level, observed before and after savings are in average about 2500 kWh. So the direct rebound effect in dwellings is around 2500 kWh. Some of the households installing the heat pump reduce the amount of wood used in heating (substitution effect), some use the appliance for cooling, some put it in previously unheated area and some increase the room temperature (income effect). At the economy level, rebound effects include the energy used in the manufacture and installation of heats pumps (embodied energy) and indirect rebound effect includes the other multiplier effects – e.g. the increased demand resulting from more employees in heat-pump sector – on the economy.

“Receiving at least the same or better comfort or energy service by using less energy as an input” is the main definition of energy efficiency. In many areas such as domestic appliances this is already happening. Even so, the energy use in the society has not decreased. This is due to the rebound effect. A general definition for the rebound effect is that by using less energy in an area, releases more resources to be used in another area (European Commission DG ENV, 2011)

The size of the rebound effect is currently being discussed. They are very hard to separate from other economic development. However, in some areas they should be observed. In a recent article Fouquet and Pearson (2011) discusses the issue using and analysing 200 years of data for lighting. They show that the rebound effect varies at different phase of economic development. They also argue that their approach using the concept of lighting – an energy service - in the analysis is better suited to analysis the rebound effect than the earlier econometric specifications using the concept of commodity – the amount of energy bought.

In general, rebound effect means that at a consumer (or micro) level increased efficiency and related energy savings can be established, yet on the macro level energy use may continue its increase. This observation raises two issues:

- 1) The use of energy efficiency as a policy instrument in reducing carbon emissions. For further discussion see e.g. Herring (2011).
- 2) Policy evaluation. If increased energy efficiency does not result in decreased energy use, how are we to evaluate the results of the energy efficiency policies?

The traditional bottom up model overlooks the economic dynamics⁶. This choice implies that the rebound effect is not thought important. This is a fair simplification, if energy efficiency per se is the policy goal or if energy efficiency is seen as means of achieving economic growth. In context of CO₂ reduction, this is less straight forward. (Herring 2011).

The basic bottom up model has an additive structure. Yet, sometimes the combined effect of two measures is greater than the effect of the measures evaluated separately. This synergy is typical feature of soft measures (see p. 20), where combination of measures typically yields better results than either of the measures alone.

Another effect that is also very hard to quantify is the spill over or (ripple) effect. The spill over effect is when the desired information is transferred further by the first target group. E.g. a positive response to saving energy in lighting or reducing heat is transferred further within a consumer’s social network.

The major advantage of bottom-up evaluation methods (as compared to top-down methods using already existing and officially approved statistics) is the fact that they allow a direct monitoring of the energy savings that are due to specific EEI measures. This approach can thus achieve greater accuracy and may offer additional advantages like development of benchmarks and a better programme control. A potential

⁶ In practice number of bottom up models have economic features. Similarly a number of top down models include detailed description of technologies. Though tempting increasing the model complexity needs to be considered carefully as the more complex the model the more difficult it is to build and maintain.

drawback of bottom-up evaluation, however, is the potentially high costs of data collection, if a high level of accuracy is deemed necessary. The challenge is how to adapt these methods to be used for information such as ‘soft’ measures.

In addition to top-down models, a class of “energy efficiency indicators” called “top-down indicators” exist. These use existing statistics and statistical techniques to derive indicators describing the development of energy efficiency.

Table 4-2 describes the development of the end-use electricity consumption of households in Finland. These numbers can be used to derive specific end-use consumptions, which are often called top-down indicators. They are discussed to show the complexities of evaluation and to illustrate the concepts discussed.

Two end-use categories show decrease in consumption namely cold appliances and cooking. In cold appliances this development is due to increased energy efficiency of the appliances. In cooking the behavioural change is more important. The volume of cooking is decreasing because the use of bought meals and eating out is increasing. The effect is accentuated by this practice being more common in small households, which are increasing in number. Efficiency gains in cooking brought by the use microwave ovens and new technologies like induction play a minor role.

The dishwasher is an example of an appliance the consumption of which is increasing in volume, but not in share. The share of households owning a dishwasher and thus the number of dishwashers is increasing. At the same time the average consumption is decreasing because the size of households owning the dishwasher is getting smaller⁷. The average consumption is also reduced by the appliances becoming more efficient.

The discussion above shows that if one is to measure energy efficiency in strict terms i.e. producing similar service with less energy and do this in the field, one needs to account a number of factors and this will not be an easy exercise.

⁷ In apartments 35% of the households owned a dishwasher the average consumption of the appliance being 144 kWh/annum. In single family houses 78 % of the households owned a dishwasher the average consumption of the appliance being 217 kWh/annum. The difference in ownership and consumption reflects the difference of the average household size. The average number of occupants in 2006 was 2.65 in single family houses and 1.63 in apartments.

Table 4-1 the end-use electricity consumption of households in Finland for the years 1993 and 2006 (GWh/a) and the relative contribution of each end-use to the total household electricity consumption (Adato & TTS 2008)

Appliance category	1993		2006	
	GWh		GWh	
Cold appliances	2 215	30%	1 461	13%
Cooking	796	11%	653	6%
Dish washing	125	2%	261	2%
Washing and drying laundry	316	4%	391	4%
Television and related appliances	537	7%	834	8%
PCs and related appliances			407	4%
Electric sauna stoves	606	8%	852	8%
Heating and ventilation equipment	483	6%	621	6%
Electric floor heating	0	0%	206	2%
Car heating	226	3%	218	2%
Lighting (inside)	1 541	21%	2 427	22%
Lighting (outside)			89	1%
Other equipment	623	8%	2 572	23%
Total	7 468		10 992	

4.2 QUANTIFICATION OF THE SAVINGS OF THE 'SOFT' MEASURES

4.2.1 The quantification of the savings and monitoring of the soft measures

The quantification of the savings and monitoring of the 'soft' measures in the Action Plan for Energy Services is assessed here from three perspectives:

- Quantification can strengthen and help to establish the position of 'soft' measures as measurable and in energy terms quantifiable energy saving policy measures a line with other measures in practice within the European Union. Possible quantification methods and guidelines for methodology for energy savings calculation in general were found from EMEES project that strived to define a common methodology and the proposed EED directive. The later proposed a common methodology for energy saving calculation and for the first time the soft measures are named.
- Meeting the internal goals e.g. improving the services and quantifying its effects in energy terms, this might increase the companies' motivation on participation programme involvement.
- The costs of the assessment.

In practice a balance between the costs and the requirements needs to be found.

The common calculation methodology and consensus is in the process of being defined. Following points seem to be emerging from the draft issued on EU 20120417 Commission non-paper):

- Within the European forum the bottom-up methodology seems to be the preferred choice. ESD advocates that an explicit and increasing amount of savings should be reported with bottom up models. In EED, the alternatives listed in article 6 are all variations of the bottom up model.
- Bottom-up methodology is natural choice for quantifying savings from individual measures and thus it fits well with the EED proposed requirement that the savings must result from new individual measures.
- Further, the EED proposes that the savings should be a result from the measures of the Member States, not from rolling out EU legislation.
- Further, savings that would have happened anyway must be excluded.

The EED draft provides some guidelines to calculation of energy savings. The directive draft also requires that if a Member State will adopt an alternative policy measure like a voluntary agreement, it shall explain how an equivalent level of savings with the energy efficiency obligation scheme will be achieved. This explanation needs also to cover monitoring and verification.

Presently, the savings of the soft measures for the Action Plan of this voluntary agreement programme are not included in the Finnish report to the EU (NEEAP2 Finland. 2011)⁸. The reason for this is the lack of reliable methodology for quantification of the energy saving effects from the soft measures. If a reliable quantification methods is found then even these energy savings can be included. With this in mind, it may be beneficial to at least use the same definitions and try to adjust the guidelines and methodology to those recommendations or guidelines from the European Commission. This would help the communication and make the comparison of the results easier.

4.2.2 An example of bottom-up quantification with the report system data

In light of the expected EU legislation, bottom up methodology is the obvious choice for quantification. This chapter illustrates how such quantification can be achieved and what issues need be addressed. The numbers of this example should not be considered as exact facts.

The energy companies that have joined the Action Plan for Energy Services report annually about all the measures that they have taken to enhance their customer's energy use and which quantity of energy the measures cover. In this chapter the information of the type of measures and the energy those measures covered is used for quantification for the most used measures. The energy saving effects is based to the international studies, if such a study is available.

The measures are evaluated in the context of the proposed requirements of the EED (EU 20120417 Commission non-paper). The proposal may not be implemented as

⁸ Interview with Heikki Väisänen (Ministry of Employment and the Economy) in April 2012.

such. Nonetheless, the example serves the purpose to illustrate how deeply ingrained the present EED proposal is in bottom up approach, though this approach to quantification is likely to be more costly than the alternatives.

The measures chosen for quantification are those most often used by the companies. Table 4-2 shows the measures chosen for quantification, gives the estimate of the effect at present and the associated references. The last column shows the issue of EED admissibility. This highlights the need to evaluate individual instead of grouped measures.

Table 4-2 the measures chosen for quantification and issues needing resolving

Energy efficiency measure	Effect at present		EED admissibility	
	Size	Source	MS Measure	New Measure
Energy saving info on webpage	Small	EDRP	yes	Yes
Articles in customer magazines	Small	EDRP	yes	Yes
Energy saving week	not available		yes	Yes
Printed material to customers	Small	EDRP	yes	Yes
Advice by telephone	not available		yes	Yes
Advice in premises	not available		yes	Yes
Advice via e-mail or internet	Small	EDRP, DK	yes	Yes
Lending of consumption gauges	not available		yes	Yes
Annual consumption report	1 %	EDRP	no	
Internet service on consumption	small to 2 %	EDRP/CER	yes	Yes
Remote meter reading in use	enabler, not to be quantified			
Billing frequency	Small	EDRP	no	
Instruction on use of DH equipment	not available		yes	Yes
Change to DH of existing buildings			no?	Yes
New buildings to DH			no?	Yes

Abbreviations used: EED = Energy Efficiency Directive, DH = District heating, CER = Commission for Energy Regulation, EDRP = Energy Demand Research Project, DK=Hansen, Kjaerbye & al 2008

Two of the items do not fulfil the requirement of being Member State measures in the EED. Annual consumption report and the increased billing frequency are both roll outs of EU legislation. The second requirement of new action is fulfilled under the interpretation that new actions of existing schemes and will thus be admissible. The question of the life time of these actions remains to be resolved.

The column “Effect at present” gives two pieces of information an estimate of the size of the effect and source for the estimate. Only two actions can be assigned a savings percentage directly and for the action internet service for following consumption this

percentage is varies from small to 2%, the former being the result from Jurek Pyrko (2009) and the latter from EDRP/CER⁹. Five actions have been assigned the effect small. This means that the action has been trialled in the reviewed literature but no effect was found. Five actions remained in the class for which quantification from the surveyed literature could not be found.

The studies in the literature review were evaluated with respect to their methodology and only estimates of studies with large data sets and appropriate experimental design were accepted as a basis for quantification. This choice is based on the following considerations:

- EED requires that the savings can be attributed to the measures in question. In field studies, the control group is used to account for development stemming from other sources. As the directive also calls for measurable and verifiable effects introducing this requirement seems natural.
- Staniaszek & Lees (2012) also present this requirement making explicit reference to soft measures. They write “If behavioural or advice measures qualify toward the target, or in the case of measures with a small impact that would be difficult to measure accurately, it may be appropriate to undertake a survey of the energy savings subsequently attained by scheme participants; it is good practice to have a control sample of those who did not receive the behavioural and/or advice measures to discount any behavioural changes occurring naturally or for other reasons in the wider population.”
- Similar requirement is also found in table 6.1 of EMEES report distinction of energy efficiency improvement measures by type of appropriate evaluation method (Eichhammer 2008.)
- Use of control groups is an established practise of analysing effects in good experimental design. It is used in number of disciplines to establish quantitative effects of e.g. a medical treatment.
- Studies with large random samples and control groups usually show smaller effects than studies with small samples without control groups. Though this may be an indication of larger potential effect existing, the use of conservative estimates seems more appropriate in this kind of evaluation.

Unfortunately, the recent national empirical studies are of small scale and have not used control groups¹⁰. From the EED perspective, the use of estimates based on good quality foreign studies seems a better first choice. It emphasizes that the methodology is likely to count. To improve the estimates one can later carry out national studies on the measures one wishes to evaluate.

Table 4-3 shows the next steps in the analysis for electricity. The first four measures are grouped as one. These measures are general information on the internet, articles in the customer magazines, participation on the energy saving week and other printed material to the customers. If the volumes associated with these measures in system are summed together, the total volume will be thrice the consumption volume of the

⁹ EDRP and CER did in fact investigate displays. In Finland, companies are offering free internet service and a few are offer displays at an extra cost. Recently the free alternative has been advertised as an alternative to this display. As the difference in results could result from customer disinterest, this slight extension of results is hopefully excused.

¹⁰ Fortum has commissioned a master thesis investigating the effect of hourly metering and more frequent billing in Sweden. The preliminary results show no effect. The plan is to do a similar study with Finnish data.

households. To avoid double counting the volume needs to be decreased and here it is assumed that the whole clientele is provided information.

The measure “remote meter reading in use” is interpreted as an enabler for more frequent billing which the measure is resulting in savings. The enabler is not quantified.

Table 4-3 an example quantification for electricity

Energy efficiency measure	Base of Quantification	Number	Volume GWh	Effect Range	Savings estimate Lower GWh	Upper GWh
Energy saving info on webpage	Whole customer base	combined class	20000	0 – 0,5 %	0	100
ES articles in customer magazines	Whole customer base					
Energy saving week	Varies					
Printed material to customers	Amount of material					
Advice by telephone	Number of customers	90000	630	1 - 2%	6	13
Advice in premises	Number of customers	62000	434	1,5 - 2,5 %	7	11
Advice via e-mail or internet	Number of customers	32000	224	0 - 0,75 %	0	2
Lending of consumption gauges	Number of customers	10000	70	3 - 7 %	2	5
Annual consumption report	Number of customers	1500000	10500	0,75 - 1 %	79	105
Internet service on consumption	Number of customers	700000	4900	0,5 - 2 %	25	98
Remote meter reading in use	Number of customers	400000	2800	enabler for more frequent billing, will not be quantified separately		
Billing frequency	Number of customers	200000	1400	0-0,5%	0	7
Total					118	340

Sources: For energy efficiency action, volume, number Energy services operational programme, Finnish Energy Industries. The effect range and energy savings are own calculations or estimates based on the data from the Energy Industries but and results from the international studies.

For the other measures the number of customers is determined by adding up the respective volumes reported by the electricity sales and distribution. For a real evaluation exercise one should check that the same service for one customer is not counted twice. The volume is achieved by multiplying the number of customers with

an average electricity consumption of a household, which in this example is taken to be 7000 kWh¹¹.

The last step is to decide on the effect range. Table 4-2 lists the sources for the estimates available from literature. In the quantification following principles are used:

- If the effect is small i.e. the empirical studies show no effect a range from 0 to 0.5 or 0 to 0.75 is assigned.
- If the effect exists then it is determined on the basis of the empirical studies.
- The three measures for which data is not available a guestimate is formed. Because direct contact is considered more effective than other forms of information and because people actively seeking advice are more likely to act upon it, the guestimates are slightly higher than the estimates from the literature study. The highest guestimate is given to the measure (or an action) which takes a most effort on the customer's part. Guestimates are indicated with the reddish background.

The three measures with the highest savings are those with the highest volumes. One of these is not admissible because it is a result of a roll out of EU legislation.

Table 4-4 shows the quantification for district heat. Information measures are again grouped together and the volume is that of the customer base. Effect range is similar to electricity. Quantification of advice is also similar to electricity. The number of customers receiving advice is taken from the reporting system. The associated volume is calculated by multiplying the number with the average consumption per building i.e. 130 MWh/building. This implies that we assume all customer groups are similar in their propensity to ask for advice and the average per building consumption describes the customers asking advice.

The volumes for the consumption report and internet service are determined with similar logic. However, effect range is adjusted to reflect the fact that the largest residential district heating volume is in apartment buildings where the resident end-user has no direct access to the report or to the internet system. It is assumed that the effect of indirect information is half of that of the direct information and the effect ranges are then weighed with respective volumes. The adjustment is indicated with cursive.

The measure "remote meter reading in use" is again interpreted as an enabler for more frequent billing which is the measure resulting in savings. This is quantified with the logic described above. Only one of the district heat specific measures is quantified – the instruction of use of DH equipment. The number of customers for this is estimated by assuming that the share of residential sector is similar to that of advice given in customer premises, as no data for the share of residential sector was available. The effect is a guestimate, which is indicated by the reddish background. As the other two measures are not soft measures, they were not quantified.

¹¹ The data for the average consumption in the system shows considerable variation and should be validated against company statistics before it is used. The reported volume of electricity distributed to the household sector by the companies is 21 926 TWh's (Motiva 2011). The consumption figure from the official statistics for the sector is 23 679 TWh i.e. the reported figure is 93 % of the total. This is slightly higher than the reported program coverage.

Table 4-4 example quantification for district heat

Energy efficiency measure	Base of Quantification	Number	Volume GWh	Effect Range	Savings estimate Lower GWh	Upper GWh
Articles in customer magazines	Whole customer base	combined class	16500	0 – 0,5 %	0	83
Energy saving week	Varies					
Printed material to customers	Amount of material					
Advice in telephone	Number of customers	9731	1260	1 - 2%	13	25
Advice face to face	Number of customers	2093	270	1,5 - 2,5 %	4	7
Advice via e-mail or internet	Number of customers	271	35	0 - 0,75 %	0	0
Annual consumption report	Number of customers	19115	2400	0,4 - 0,6 %	10	14
Internet service on consumption	Number of customers	19000	2400	0,3-1,20 %	7	29
Remote meter reading in use	Number of customers	8515	11000	enabler, will not be quantified separately		
Billing frequency	Number of customers	11817	15300	0-0,5%	0	77
Instruction on use of DH equipment	Number of customers	520	70	3 - 7 %	2	5
Change to DH of existing buildings	Number of customers	Not eligible nor data for quantification				
New buildings to DH	Number of customers	Not eligible nor data for quantification				
Savings total					36	239

The bottom up evaluation of the most often used soft measures in residential sector indicates savings range of 118 to 340 GWh for electricity and of 36 to 239 GWh for district heat when all actions are evaluated individually. As noted in literature study, the effect of a combination of actions is observed to be higher, so leaving out these interaction will result in too a low estimate. Interactions can be defined and calculated. For instance, information is shown to have more effect in those household receiving frequent feedback using internet service. Assume this added effect is 1 % and the volume for electricity for this service is 4900 GWh. This gives an extra saving of 49 GWh. It is easy to see, that this type of calculation can get very complex.

An alternative approach for the estimation would be simply to use the total energy demand for electricity and heat in the residential sector as a starting point and then use the literature review to set a “maximum effect of soft measures”. This assumption of all households being part of the program is not too far from reality. The literature study gives the effect of soft measures to be around 1-3% of the total electricity consumption. According to the international studies pure informational measures contribute less than 1%, installing the smart meters in combination of other methods contributes around 2-3%. Applied to the rough 20 TWh of the households’ electricity consumption in Finland, this gives an estimate of savings between 200-600 GWh. Households’ district heat consumption in Finland is approximately 16-19 TWh depending on the weather. Thus, if the savings percentage was 1%, the total energy savings could be estimated at 270- 800 GWh.

As one can see the results of the two approaches are not that different, though the effort needed in calculation clearly is. The choice depends on the use of the results. As noted earlier, one proposal for the EED directive excluded measures being roll outs of EU legislation. If this is to be taken into account, a separate estimate is needed. As the bottom up analysis shows excluding the annual consumption report the would reduce the electricity savings to 39 - 235 GWh.

4.2.3 Problems with using international data in quantification

The examples presented in the previous chapter outline how bottom-up quantifications could be achieved. The results are far from exact.

First, they are based on studies from other Western European countries. These countries have similar EU regulation with e.g. labelling and minimum performance standards for electrical appliances. A number of the domestic appliances are the same in the EU market. Yet, one can argue that the level of knowledge on energy use and the baseline energy efficiency level affect the level of savings that can be achieved. If the baseline in a country is that people behave in an energy saving manner to start with, making reductions from the current situation is harder compared to a case of a more-spending consumers making savings.

Further, the number of other differences complicates the transfer of results. The use of a control group eliminates the effects of other influencing variables¹² within the country, but not necessary cross country differences like the energy performance of the existing housing stock, historical energy saving attitudes and energy price and its history. In the Great Britain there has been since long time programmes to diminish fuel poverty and some of energy advice are still targeted to combat it.

Also the share of energy costs of total household expenses in different countries varies, which might affect the outcome. The results of the EDRP state that in the case of Great Britain, no reliable or persistent effects or evidence of the effects of financial incentives were found (Ofgem 2010).

¹² Another way to account for these is with models e.g. using covariates in variance analysis.

Table 4-5 Example of the parameters showing the differences/ similarities between the countries

	Finland	Great Britain	Sweden
Share of energy cost for hh total expenses excluding transport	Only electricity share is 3.6% for hh in electric heated homes and 1.4% in others (Mäenpää 2010)	7,5%-2,9% (DECC 2011)	4.0% (2002) (4.5% 2009)
Heating systems	49% district heating. 18% electricity (Energy Industries 2012)	Approximately 90% (of the buildings are heated with gas). But 15% of buildings are outside of the gas grid and can be a part of the fuel poverty group. (Defra 2012)	District heating system 58% of all houses followed by electricity that dominates in single family houses (Energimyndigheten, 2011)
Size of households	2.08 (Statistics Finland 2012)	2.3 (2005) (Uteley. 2008)	2.1 (Statistics Sweden 2012)

Further, the problem of time variation needs consideration. Say Korsunova (2010) is right in her analysis and the vicious circle is broken by introduction of hourly metering, more frequent billing, real time access to meter data and more information on electricity market. Larger group of people would then be interested in the advice, seek it and act upon it. Present estimates of the action effects would become obsolete.

The technical development is seen as continuous and its parameters are re-estimated from time to time, but when the circumstances change even the behavioural response changes. Therefore, empirically determined savings are no more time invariant than are the technical estimates. They need be re-estimated from time to time. Bottom-up methodology will require regular updates of the estimates used. In the development phase estimates from abroad can be used as a starting point, but should in due course be replaced with national estimates.

4.3

MONITORING FOR PROGRAMME DEVELOPMENT

Tiedeman and Sulyma (2011) describe in their article key learning's from implementing voluntary programmes in industry. They base their analysis on the Canadian programme CIPIEC and show it has been very cost effective. Among the things they point out are the following:

- Adjust the programme to reflect new opportunities and challenges in the market.
- Conduct adequate market research to understand market barriers and drivers.
- Collect base line data to the extent feasible and practical to allow for impact analysis of the extent to which a programme is meeting its objectives and achieving efficiency and effectiveness in delivery.
- Establish systems to key metrics as well as changes in the metrics.
- Report programme progress against programme objectives, and make suitable corrections if key objectives are not being met.

These points show a need to adapt to changes in circumstances and this is the relative strength of voluntary programmes in comparison to regulation. Further, they suggest market research is needed to understand market barriers and drivers. E.g. Korsunova (2010) has identified consumer disinterest as a barrier to adopting energy efficiency advice. It is worth noting that much of the Finnish research with small data sets whether they test new technologies or behavioural approaches in the field can be classified as market research. They play an important role in developing energy efficiency measures, but they cannot be used to derive estimates of population behaviour. An efficient programme will need both.

The three last points are connected. When defining metrics one needs to know objectives, but also the baseline or the starting point is needed. Further, indicators could be considered. In addition to performance indicators, so called early warning indicators could be used. The first indicate whether key objective are being achieved, the latter warn on failure.

Data for indicators can be obtained from the system or it can be collected separately or in the context of customer satisfaction survey. The data available from the system will be discussed first.

Figure 4-3 demonstrates one of the possible indicator variables – the interest customer show and the volume of the service. The numbers are taken from Motiva reports (Motiva 2010, Motiva 2011). The potential refers to the number of customer that can follow their consumption in internet. Active user show the number of active user accounts. The numbers for electricity distribution are logical. The volume is increasing and so is the number of active users though the small changes do not show well in the figure. In electricity sales, the volume is decreased heavily and this probably has to do with the definition of the service. Given that this is likely to be the service with most effect (see Table 4-3), ensuring the data quality is important whether one is using the system numbers as indicators or basis for quantification of the savings.

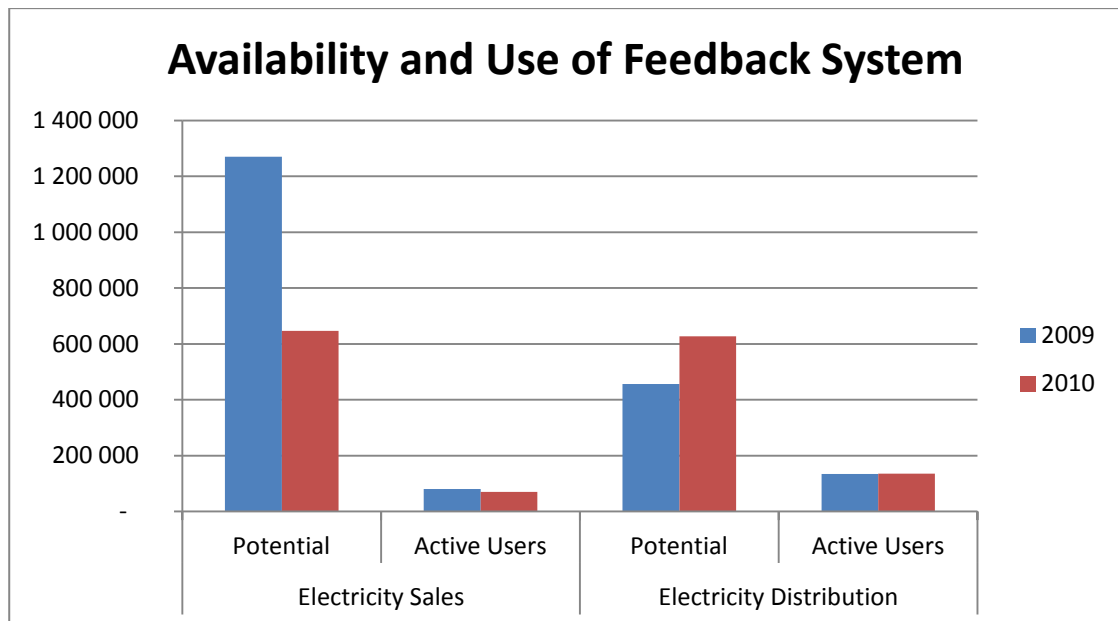


Figure 4-3 Possible indicator variables and data quality data source: (Motiva 2010 and Motiva 2011).

Figure 4-4 shows the volume development of two other services, one showing an upward trend and the other showing a downward trend. The trend of telephone advice suggests that the demand for advice is increasing. The trend for meter loans suggests the opposite. Obviously two years of data is too little to determine a trend¹³. Yet, use of indicators helps one ask good questions, although the answers may need to be found elsewhere.

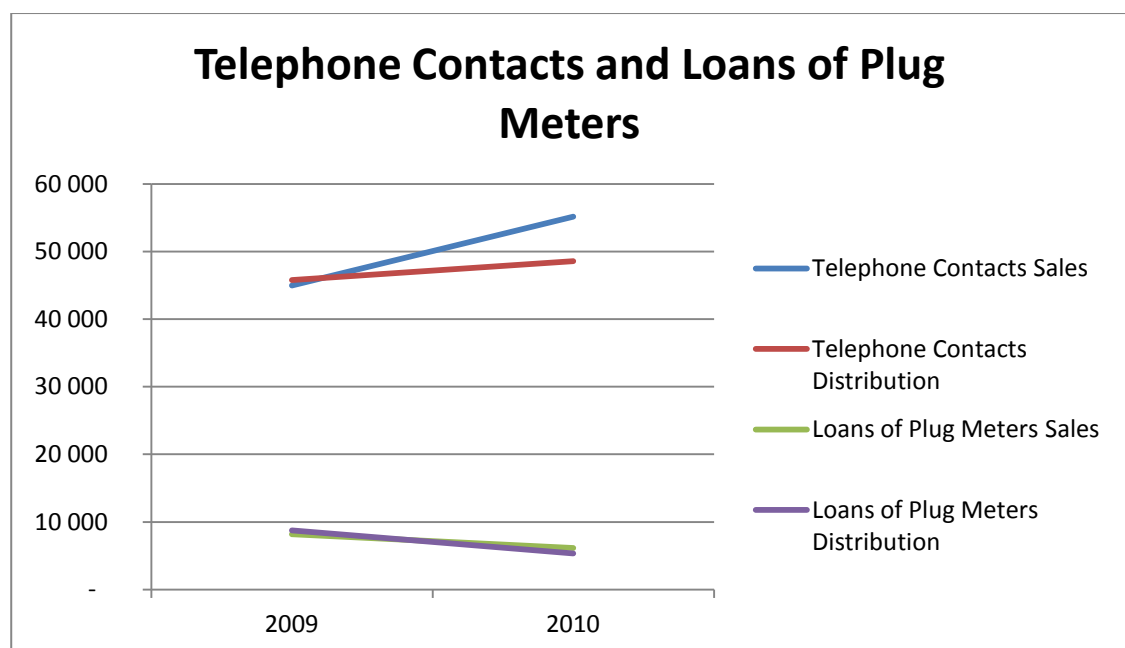


Figure 4-4 Examples of development of two service volumes data source (Motiva 2010 and Motiva 2011).

¹³ For the present the data is available only these two years data.

Complementing the system data is also worth considering. For instance, companies that contact the customer after they have used service could ask what prompted them to call the company and whether they found the advice given useful. This type of information collection need not be constant, but can be tailored to provide answers to the questions the indicators or other research raise.

Finland as all other Member States is required to report to the EU Commission on the actions and the consequent energy savings according to the Energy Services Directive. The Energy Efficiency Agreements are in Finland a key policy instrument to improve energy efficiency. Evaluation of the impact of so called 'soft' measures, in other words the measures that energy companies committed to the Action Plan for Energy Services in the Energy Efficiency Agreement for Industries, take in order to improve their customers' energy efficiency, has so far been excluded from the Finnish reporting to the EU. This due to a lack of adequate methodology for quantifying the savings.

There are two main reasons for monitoring and evaluating the energy savings obtained from soft measures. The first reason can be the ability to count these results as a part of national savings in an EU energy policy context. The second reason is that the monitoring offers a way to continuously develop the Action Plan for Energy Services and thereby to keep its content, methods and tools as updated and relevant for the customers as possible.

However, the monitoring and evaluation of the soft measures is not an easy task. The soft measures are aimed to enhance a change in customer behaviour so that awareness, knowledge, habits, attitudes, values, choices etc lead to energy savings. This is done by using the communications tools, articles in magazines, billing and comparative information of own energy use e.g. a report per year or online information. The measuring methodology needs to be considering various aspects; consumers, companies, type of measures and the actions taken by the customers. In general, the soft measures address four elements leading to behavioural change namely knowledge, awareness, attitudes and action but these interrelations are highly complex and it is difficult to find a reliable way to monitor and evaluate the causes and the effects, unless the baseline is clearly defined and monitored and the monitoring of the effects is also using control groups.

General awareness can be monitored by surveys. It is not possible to transform this information to reliable evaluation of the effects of e.g. a campaign without a control group that does not receive the same information. Also, a clear starting point (baseline) indicating the awareness level before the action is needed. Furthermore, the energy consumption of customers is a result of small individual daily decisions and the message of energy saving can be overlapped by other for the moment more important issues for the customer. The sample needs to be large enough to handle the large portion of variation in individual habits and the effectiveness of the information could be controlled with a control group very homogeneous with the sample population.

It is worth noting that small pilot studies, whether they test new technologies or behavioural approaches in the field, play an important role in developing energy efficiency measures. They cannot be used to derive estimates of population behaviour, but they certainly give an indication which approaches are worth of a larger study.

The soft measures increase the awareness and even change behaviour at least when it comes to heating, lighting and even water use (Mabin 2009). However, it is harder to change energy use that is a result of cooking or entertainment (Mabin 2009). Long term information can change habits but the problem when evaluating these long term effects can be that customers do not recall who gave the advice that changed their behaviour or that they do not recall their previous behaviour (Darby 2006). Soft measures are designed to influence behaviour and attitudes and thereby the deployment of efficient technology. In order to reach actual energy savings, there needs to be technical development, energy efficient behaviour and change in attitudes and social norms.

In basis of the evaluation our opinion is that quantification is possible, however presently the estimates contain a large element of uncertainty.

- In order to reduce this uncertainty we recommend to:
 - 1) Conduct local large enough field experiments with appropriate experimental design (at minimum include a control group)
 - 2) Choose the measures for trials on basis of literature study focusing to those measures that seem to be working best elsewhere, e.g. short frequent messages outperformed other types of information, proceed first with a pilot to handle the uncertainties in execution and then proceed to large trial to establish the effect.
- Consider of introducing indicators:
 1. Analyse the available market survey studies in order to identify possible indicators. Such as use active users of internet pages, percentage of households understanding of /or knowing their energy use in the kWh etc.
 2. Indicators could also be used to decide when further development is needed or what could be a new area of advice or a new approach to communication.
- Present reporting system principles suit well a Bottom-up based calculation of the effects of the soft measures:
 - 1) Perform a project for quality assurance of the reported input data for the measures – if not all at least the ones that are in widest use and potentially most effective
 - 2) Develop the monitoring system to include parameters that can be used for quantifying the effects of the soft measures.
 - 3) Develop calculation logic for quantification of the soft measures.

CONCLUSIONS AND RECOMMENDATIONS

Based on our knowledge of the Finnish system and the systems in practice internationally, we have made conclusions and recommendations in order to strengthen the role of soft measures in the energy policy context and for Finland to meet the requirements with national policy and continue to deliver high quality services - even if the establishing of the results of energy savings in future would become more data based.

The need to evaluate savings reached with 'soft' measures is commonly recognised, but the precise methodology is still to be defined. According to our research on available literature, reliable, recent numeric data of the effects of the 'soft' measures on energy consumption in Finland is not available and thus cannot be quantified per se. A few studies with statistically sound measurement concerning savings percentages/ amounts have been done in other countries (see Ofgem 2010; CER 2011, Hansen 2008). These studies providing energy saving estimates are empirical studies with proficient experimental design with baseline measurement, control group and a large enough sample size to handle the variation among the target population with respect to energy use. However, what needs to be considered is that such empirical estimates are not stable as they vary in time and with changes in the society. They should be updated when needed or if possible with regular basis (e.g. every third year). Updating in regular basis would even give time series.

This study has shown an example for quantifying soft measures with bottom-up calculation combining empirical data from studies done outside of Finland and data collected through the monitoring system in Finland. In addition to the bottom-up calculation being favoured in the EU policy context the approach also involves clear benefits. The bottom-up approach allows a direct monitoring of the energy savings that are due to specific measures. Thus, this approach can achieve greater accuracy than the top-down approach. It also has additional advantages, as it enables the development of benchmarks and a better programme control. A potential drawback of bottom-up evaluation, however, is the potentially high costs of data collection - if a high level of accuracy is deemed necessary. This means that one could focus on quantifying those measures with highest effects. Bottom up approach requires control for avoiding double counting. Thus optimal use of the bottom-up methods needs be evaluated in a national context.

One way to fulfil the continuous development targets of the energy efficiency agreement scheme and especially the Action Plan for Energy Services would be to introduce a set of monitoring indicators focusing on the identified market barriers and most important single measures (e.g. feedback service). This, however, would require quality assurance of the input data. The present monitoring system in Finland produces data, on the basis of which indicators could be built, though the reliability requires that data quality needs to be checked. Along with developing the monitoring system, to get best possible results, the way and contents and timing of given advice and information should be reviewed and revised in order to meet the different needs of household segments. The segmentation includes end-user practises and preferred formats of receiving advice.

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