



Assessment of Energy Reduction Campaign

An Analysis of the Behavioral and Attitudinal Impacts of an
Environmental Initiative in the Danish Municipality of Lyngby-
Tårnbæk

An Interactive Qualifying Project to be submitted to the faculty of Worcester
Polytechnic Institute in partial fulfillment of the requirements for the Degree of
Bachelor of Science

Submitted by:

Andrew Keating
Andrew Labak
Valentina Polyakova

Submitted to:

Project Advisor:

Prof. Guillermo Salazar

Project Liaisons:

Tina Reinicke, Lyngby-Tårnbæk City Hall and Agenda21
Michael Søgård Jørgensen, Technical University of Denmark and
The Science Shop

May 11th, 2009

Abstract

This report, prepared for The Science Shop, reviews the impact of an energy reduction campaign upon the attitudes of city employees in the Danish municipality of Lyngby-Tårnæk. This assessment was accomplished through the analysis of energy consumption records from five different municipal buildings, interviews with key informants and information gathered through an internet survey. The campaign had a significant impact upon the attitudes of many municipal employees, although this did not result in energy savings in all cases.

Acknowledgements

We would like to thank Professor Guillermo Salazar for his continued guidance throughout our project and his mentoring during our time in Denmark. We would like to thank Professor Scott Jiusto for his lecturing and guidance during the preparation phase of our project. We would like to thank Professor Michael Jørgensen and the Science Shop, as well as Tina Reinecke and the Lyngby-Tårnbæk City Hall, for sponsoring and assisting with our efforts. We wish to thank Professor Peder Pedersen and Tom Thomsen for their outstanding efforts in running the Copenhagen project center and for establishing our project, as well as providing us with background of Danish culture and history. Lastly, we would like to thank Mogens Larsen for introducing us to Copenhagen and the Danish language.

Authorship Page

All group members—Andrew Keating, Valentina Polyakova, and Andrew Labak—contributed equally to this project.

Contents

ABSTRACT	II
ACKNOWLEDGEMENTS.....	III
AUTHORSHIP PAGE.....	IV
CONTENTS	V
LIST OF FIGURES	VII
LIST OF TABLES	VIII
CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: BACKGROUND.....	5
2.1 CLIMATE CHANGE	5
2.1.1 <i>Natural Variability and Human Factors</i>	5
2.1.2 <i>Future Climate Change Projections</i>	6
2.2 CONTROLLING CLIMATE CHANGE.....	7
2.2.1 <i>Global Energy Reduction Programs</i>	7
2.3 ENERGY CAMPAIGNS	8
2.3.1 <i>Framework for Energy Campaigns</i>	8
2.3.2 <i>Common Components of Energy Campaigns</i>	9
2.4 LYNGBY-TÅRBÆK MUNICIPALITY.....	10
2.4.1 <i>Basic Municipality Information</i>	10
2.4.2 <i>Research and Innovation: The DTU Climate Change Technologies</i>	11
2.4.3 <i>The Science Shop</i>	11
2.4.4 <i>Lyngby's "Green" Efforts</i>	12
2.4.5 <i>The Lyngby-Tårnbæk Energy Reduction Campaign</i>	12
2.5 ATTITUDINAL ASPECTS OF ENERGY REDUCTION	15
2.5.1 <i>Relationship between Attitudes and Energy Reduction</i>	15
2.5.2 <i>The Psychology of Energy Usage</i>	17
2.5.3 STRATEGIES FOR ALTERING ENVIRONMENTAL BEHAVIOR	18
2.5.4 SUCCESSFUL CAMPAIGN: TECHNIQUES FOR PROMOTING ENERGY CONSERVING BEHAVIOR	18
CHAPTER 3: METHODOLOGY	21
3.1 ASSESS ENERGY SAVING CULTURE.....	22
3.1.1 <i>Surveys</i>	23
3.1.2 <i>Perform Key Informant Interviews</i>	25
3.1.4 <i>Perform systematic observations</i>	26
3.1.5 <i>Interpret Results</i>	27
3.2 ASSESS ENERGY SAVINGS	28
3.2.1 <i>Gather energy usage statistics</i>	28

3.3 INSTITUTION STRATEGIES	28
3.3.1 Kongevejen Skole	28
3.3.2 Børnehuset Papillon	29
3.3.3 Stadsbiblioteket	30
3.3.4 Rådhusets Personaleafdelingen	31
3.3.5 Virumhallen	31
3.3.6 City Hall Technical Managers	32
CHAPTER 4: RESULTS AND ANALYSIS.....	33
4.1 OVERVIEW OF THE 5 INSTITUTIONS	33
4.1.1 Specific Building Information	33
4.1.2 Campaign Effectiveness Index	35
4.2 KONGEVEJEN SKOLE	37
4.3 BØRNEHUSET PAPILLON	41
4.4 STADSBIBLIOTEKET	45
4.5 RÅDHUSET PERSONALEAFDELINGEN	50
4.6 VIRUMHALLEN	53
4.7 ANALYSIS OF ENERGY CONSUMPTION DATA	56
4.8 SURVEY DATA.....	58
4.9 SURVEY DATA CONCLUSIONS AND ANALYSIS OF BEHAVIORAL PATTERNS	64
CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS	66
WORKS CITED	71
APPENDIX A: CAMPAIGN MATERIALS.....	76
APPENDIX B: SURVEY EMAIL (DANISH).....	77
APPENDIX C: SURVEY EMAIL (ENGLISH)	78
APPENDIX D: SURVEY QUESTIONS (DANISH).....	79
APPENDIX E: SURVEY (ENGLISH).....	82
APPENDIX F: COMPLETE SURVEY RESULTS	85
APPENDIX G: INTERVIEW QUESTION SET	90
APPENDIX H: CAMPAIGN FEEDBACK EMAIL (DANISH)	93
APPENDIX I: ENERGY REPORT FOR BØRNEHUSET PAPILLON	95

List of Figures

Figure 1: Greenhouse gas concentration stabilization projections [38]	7
Figure 2: Program planning cycle [27]	9
Figure 3: Campaign element – motivational poster	13
Figure 4: Model describing precursors for environmentally relevant behavior [21]	16
Figure 5: Methodology flowchart	22
Figure 6: Internet survey	24
Figure 7: Informational focuses of data gathering methods.....	27
Figure 8: Kongevejen Skole.....	29
Figure 9: Børnehuset Papillon	30
Figure 10: Stadsbiblioteket.....	30
Figure 11: Rådhuset	31
Figure 12: Virumhallen	32
Figure 13: Campaign poster in the main hallway of Kongevejen Skole.....	38
Figure 14: Kongevejen Skole energy usage statistics	39
Figure 15: Small campaign sticker on a copy machine	42
Figure 17: Energy-wasting playhouse with air conditioning unit	43
Figure 16: Børnehuset Papillon energy usage statistics	43
Figure 18: Motion-activated water tap	44
Figure 19: Campaign poster in the office space of the library	46
Figure 20: Multitude of overhead lights turned on during the day	47
Figure 21: Stadsbiblioteket energy usage statistics.....	48
Figure 22: Campaign "Fuzzy Mascot" and energy-saving reminded mounted on a light switch..	50
Figure 23: Rådhuset energy usage statistics	51
Figure 24: Virumhallen energy usage statistics	53
Figure 25: Unoccupied lounge on the main floor. The lights are switched off during the day. ...	54
Figure 26: Energy statistics of the five institutions for January, February and March of 2008 and 2009.....	57
Figure 27: Survey question measuring impact upon knowledge	59
Figure 28: Survey question measuring social norms	60
Figure 29: Survey question measuring behavior change related to lights	61
Figure 30: Survey question measuring behavior change related to computers	61
Figure 32: Measure of consciousness of an environmental problem	62
Figure 31: Measure of consciousness of relevance of one's behavior	62
Figure 33: Level of effectiveness of the campaign on the change in behavior	63
Figure 35: Greenhouse gas emissions food pyramid.....	69
Figure 36: Børnehuset Papillon energy rating.....	95

List of Tables

Table 1: Targets of survey prompts	25
Table 2: Institutions' areas and energy usage per area	35
Table 3: Overview of Campaign Effectiveness Index Grading Criteria	36
Table 4: Kongevejen Skole Campaign Effectiveness Index	41
Table 5: Børnehuset Papillon Campaign Effectiveness Index	45
Table 6: Stadsbiblioteket Campaign Effectiveness Index.....	49
Table 7: Rådhuset Campaign Effectiveness Index	52
Table 8: Virumhallen Campaign Effectiveness Index.....	56
Table 9: Campaign visibility	85
Table 10: Attitude measurements	86
Table 11: Energy use habits	87
Table 12: Behavioral change.....	88
Table 13: Personal appliance use.....	89
Table 14: Shared appliance use	89
Table 15: Thermostat, light and window access	89

Executive Summary

There is a large amount of evidence that global warming, and all the dangerous implications of global climate change, is a result of carbon emissions for human sources. This being accepted, efforts to reduce carbon emissions can be found worldwide. Denmark has a long history of reducing carbon emissions going as far back as 1976, when the Danish Energy Authority was created. These efforts have persisted in recent times, as portrayed by the Energy Consumption Reduction Campaign that has been taking place in the municipal buildings of Lyngby-Tårnby. This project sought to determine the effects of this campaign, which started on January 1st 2009, on the attitudes and behaviors of municipal employees. This was achieved through performing interviews and systematic observations at five municipal buildings, as well as gathering information from thirty-six municipal employees via an internet survey.

The five observed locations represent the spectrum of the different types of municipal buildings utilized in Lyngby-Tårnby—a library, kindergarten, school, sports arena, and the city hall. Each location had a set of characteristics, challenges and circumstances unique to their use. The research was comprised of formal interviews with key informants at each location, where we asked questions to create an understanding of these circumstances, as well as gather some information about the personal attitudes of the individuals interviewed and their colleagues. At these locations we conducted systematic observations, taking note of key ways in which the campaign's informational materials were visible, and the extent to which it was being embraced by the municipal workers.

In addition to the visiting of the five locations, an internet survey was used to reach a larger group of municipal employees. The survey included scaled response questions designed to measure attitudes with regard to the campaign, and to identify the general attitudes of municipal workplaces with regard to reducing energy usage. It also included free response

questions where the survey taker could fill in more detailed responses to questions about what they have done, felt, or thought in respect to the campaign.

From the analysis of this data, several strong points of the campaign were identified. Overall the campaign's informational materials were very well received among employees. Nearly all those surveyed had both a basic knowledge that a campaign was currently underway and some understanding of what was being done as part of the campaign initiatives. Also most had seen the various campaign materials around their place of work. We also discovered that among those interviewed and surveyed the majority found that the campaign had affected them in a positive way. Most reported that due to the campaign they were more likely to shut off lights when leaving a room.

Despite the campaign's positive impact upon employee attitudes, we only observed reductions in energy consumption at two of the five locations. Additionally, one of the two energy-saving locations attributes their savings to recent building upgrades, an effort unrelated to the campaign. This finding led us to conclude that positive attitudinal changes cannot necessarily be correlated with savings in energy usage.

While the campaign had strong points, it also exhibited some limitations. Notably, we found that the weekly campaign-related messages sent by electronic mails were often ignored once they had become common place. These may have been more effective if they had been sent less frequently. We also found that municipal buildings did not receive any information or tips to reduce energy consumption which were directed specifically at their organization. As a result, the organizations were forced to be creative in their energy reduction efforts—something that which not embraced at all of the municipal buildings.

The vast majority of the municipal employees we encountered already held strong environmentally-conscious attitudes prior to the campaign. As a result of the preexisting positive attitudes, the campaign—which strove to improve the attitudes of the employees

towards the environment—often had only a small effect in the positive direction. A more effective campaign strategy might have been a focus upon spreading building-specific energy reduction information and providing lesser-known energy reduction tips, in the opinions of several of our interviewees. After analyzing the campaign’s impacts, we drafted a set of recommendations which could be utilized in future attitudinally-targeted energy reduction efforts.

Chapter 1: Introduction

Mass coastal flooding, drought, food shortage, severe storms—these are all very real consequences of global climate change [1]. A major factor in climate change is the concentration of greenhouse gases in the Earth's atmosphere [4]. These gases, among which carbon dioxide (CO₂) and methane (CH₄) are the most significant, prevent heat from escaping the atmosphere, which results in rising air temperatures [2]. In their naturally-occurring concentrations, these gases play a vital role in maintaining the Earth's normal climate. However, human activities such as the burning of fossil fuels cause extra emission of greenhouse gases, which has led to unnatural atmospheric concentrations [1]. This is the primary source of the environmental phenomenon known as global warming and its highly undesirable effects.

Although the Earth's climate exhibits some natural fluctuation [4], there is an abundance of evidence tying human behavior to increases in the Earth's temperature [2]. Additionally, warming trends are predicted to persist and even grow more severe [6]. This puts humans in a crucial position—in order to counteract the damage we have inflicted upon the planet, there is a need for widespread efforts ranging from international energy policies to personal behavioral modifications. Failure to respond to this global threat could prove to be devastating.

Many of the world's industrialized countries began taking significant steps towards national climate policies after the Intergovernmental Panel on Climate Change (IPCC) published a collection of alarming measurements and projections in a 1990 report [3]. The IPCC's findings were a major motivation for efforts by the United Nations to combat climate change at the international level, highlighted by a number of emissions reduction goals embodied in the

Kyoto Protocol [5]. Denmark, however, had already been working toward the goal of reducing emissions since the establishment of the Danish Energy Authority in 1976, a governmental body which is still prevalent in energy-reduction efforts in Denmark today [32]. Denmark is among the world's leaders in the response to alarming human-caused greenhouse gas emissions. Denmark's Kyoto Protocol goal—a 5% reduction in the emission of greenhouse gases by 2012—has already been met and is projected to be surpassed with an additional 18.8% reduction [33]. By investing in renewable energy sources, Denmark has become one of the key trend-setters in the fight against global climate change. It is the world's leader in wind power, and the numerous environmentally-focused organizations in Denmark perform extremely important research in the areas of increasing energy efficiency and utilizing renewable energy.

In 2007, Connie Hedegård, the Danish Climate and Energy Minister announced a nation-wide initiative called the “One Ton Less Campaign.” This campaign called for cities and towns across Denmark to come together and reduce each of their CO₂ emissions by one ton annually. In October 2008 the One Ton Less Campaign received an award “for the best practice in European communication of the EU's ‘Green Spider’ network,” [39] an international network focused upon propagating information from environmental agencies. [44] A mid-term evaluation of the campaign has showed that 17% of Danes have reduced their emissions since the campaign started. According to a recent Copenhagen Post article, “more than 78,000 employees have agreed to reduce their greenhouse gases” [40] and the number of participants is expected to increase. [40] The campaign will continue until the end of 2009 and “new figures show that both energy consumption and carbon dioxide emissions dropped last year as a result of concerted efforts” [41].

The Danish municipality of Lyngby-Tårnby responded to this initiative by setting goals of its own. Rolf Ågård-Svendsen, Lyngby's mayor, promised to achieve a 2% reduction in CO₂ emissions in municipal buildings by the end of 2009, showing full support of the One Ton Less Campaign. Recognizing electricity usage as a major cause of greenhouse gas emissions, he made an additional commitment to reduce electricity usage in municipal buildings by 3%

annually. It is possible that the mayor will enter into future commitments to reduce emissions and electricity usage among the entire municipality, and not just municipal buildings. However, this introduces additional complications, as it would require the cooperation of all municipality citizens.

Generation of electricity and heating are the two most significant emitters of greenhouse gases in most industrialized nations, and Denmark is no exception to this. A common strategy for reducing emissions is to implement energy reduction campaigns which may involve technical improvements to the buildings. A successful campaign must incorporate innovative energy-efficient technology in conjunction with taking action to promote energy efficient behavior among energy users. Behavioral Aspects of Energy Conservation & Sustainability [34], an energy reduction campaign at the University of Michigan, strayed from a common pitfall of past campaigns—too great of a focus on simple number crunching. A number of factors affect energy usage, but one which is commonly overlooked is the social aspect of human attitudes and behaviors. Noticing this, Schipper commented that "...those of us who call ourselves energy analysts have made a mistake...we have analyzed energy. We should have analyzed human behavior." [35] The efforts of the Michigan researchers have set solid groundwork regarding the task of measuring the behavioral aspects of energy conservation. However, their research focused on just one location—a single university's population. When attitudes are sought to be assessed and compared on a larger and more diverse population, the factors which affect them become more numerous and complex.

A team consisting of representatives from Lyngby-Tårnbæk's city hall, the Agenda21 organization and The Science Shop at the Technical University of Denmark has begun working toward Mayor Ågård-Svendsen's goals by creating an energy-reduction campaign. The campaign—spanning from January to May of 2009—seeks to educate municipal employees of their individual significance in the effort to reduce energy through informational posters, weekly municipality-wide email updates (a sample can be seen in Appendix H), and training sessions, among other efforts. They hope to create an energy-conserving culture among the

employees in which they are aware of and genuinely concerned with their energy usage at work. Thus campaign initiatives have been carefully designed to affect the attitudes and subsequent behaviors of its targets. This energy campaign is just a small step in the effort to combat global climate change, but these concerted energy conservation efforts on a smaller municipality scale are essential for making a global change. In our project we performed a detailed assessment of how successfully the campaign has affected the attitudes of municipal employees, and we analyzed which aspects of the campaign were particularly effective.

When a campaign's objective is to affect human attitudes and create an energy-conserving culture, the task of assessing effectiveness is both crucial and complex. Attitudes can't be gauged by merely measuring energy usage statistics, so in our analysis of the campaign we addressed the human aspects of the campaign by speaking with the individuals who the campaign targeted. By selectively identifying key informants we performed an assessment of the overall energy savings observed during the campaign and attempted to identify its effects upon the energy-saving culture of Lyngby-Tårnbæk's municipal employees. We utilized surveys, interviews and systematic observations to achieve this goal, and identified attitudinal and behavioral patterns which we related back to specific campaign initiatives. Our assessment of Lyngby-Tårnbæk's energy reduction campaign, especially with its unique attitudinal focus, puts the municipality in a good position to continue reducing energy usage far beyond the end date of the campaign. Additionally, our findings are certainly not limited to use within the municipality—they should prove to be useful for anyone striving to conduct or assess energy reduction efforts.

Chapter 2: Background

This chapter briefly reviews the topics of climate change, energy conservation and attitudinal studies while providing some insight into the municipality in which the project will be completed and our affiliate organizations. Additionally, this chapter provides an overview of the energy campaign which we assessed.

2.1 Climate Change

The Earth's climate—a measure of meteorological factors such as temperature and rainfall over a period of time, is undeniably being affected by human behavior [2]. Warming trends have been observed across the planet, and consequences such as drought, food shortage, severe storms and mass coastal flooding are very real threats for the future [1].

A number of factors influence the Earth's global mean climate, which is “determined by incoming energy from the Sun and by the properties of the Earth and its atmosphere, namely the reflection, absorption and emission of energy within the atmosphere and at the surface” [1].

2.1.1 Natural Variability and Human Factors

Measuring human effects upon climate change is a difficult task, due to the range of natural variability in climate. The Earth's climate fluctuates naturally, “just as weather fluctuates from day to day” [4]. Additionally, it is impossible to exactly calculate natural climate variability due to “sparse spatial coverage of existing data” [4]. Various uncertainties in climate system components including “aspects of the roles played by clouds, the cryosphere, the

oceans, land use and couplings between climate and biogeochemical cycles” [1] are difficult obstacles in the effort to fully understand the Earth’s complex system of natural climate change. However, by analyzing concentrations of greenhouse gases trapped in air within ice cores dating as far back as 650,000 years, it is clear that the present-day atmospheric concentrations of these gases “far exceed pre-industrial values” [1].

The effects of human activities can be clearly seen by increases in concentrations of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), water vapor (H₂O), ozone (O₃), and chlorofluorocarbons in the Earth’s atmosphere [4]. Compared to “a blanket ‘round the planet,” [2] greenhouse gases trap heat in the Earth’s atmosphere via the absorption of infrared radiation, causing air temperatures to rise in a phenomenon known as global warming.

2.1.2 Future Climate Change Projections

Despite efforts by many developed nations to reduce greenhouse gas emissions, EPA projections predict continued increases in emissions. Between the years of 1995 and 2005, greenhouse gas emissions steadily increased by roughly 1% per year [6], and future projections show little promise of improvement.

The Intergovernmental Panel on Climate Change (IPCC) has developed several long-term scenarios which project changes in greenhouse gas emissions over time. Each scenario predicts an increase in atmospheric CO₂ concentrations throughout the 21st century, ranging from 41% to 155% increases [5]. The following figure portrays the grim reality of the Earth’s climate change situation—even in the most optimistic emission stabilization projection (GTSP 450), we face a 2°C temperature increase [38]. These scenarios all require global cooperation in the pursuit of renewable energy sources and subsequent reduction upon the reliance of fossil fuels for energy production [38].

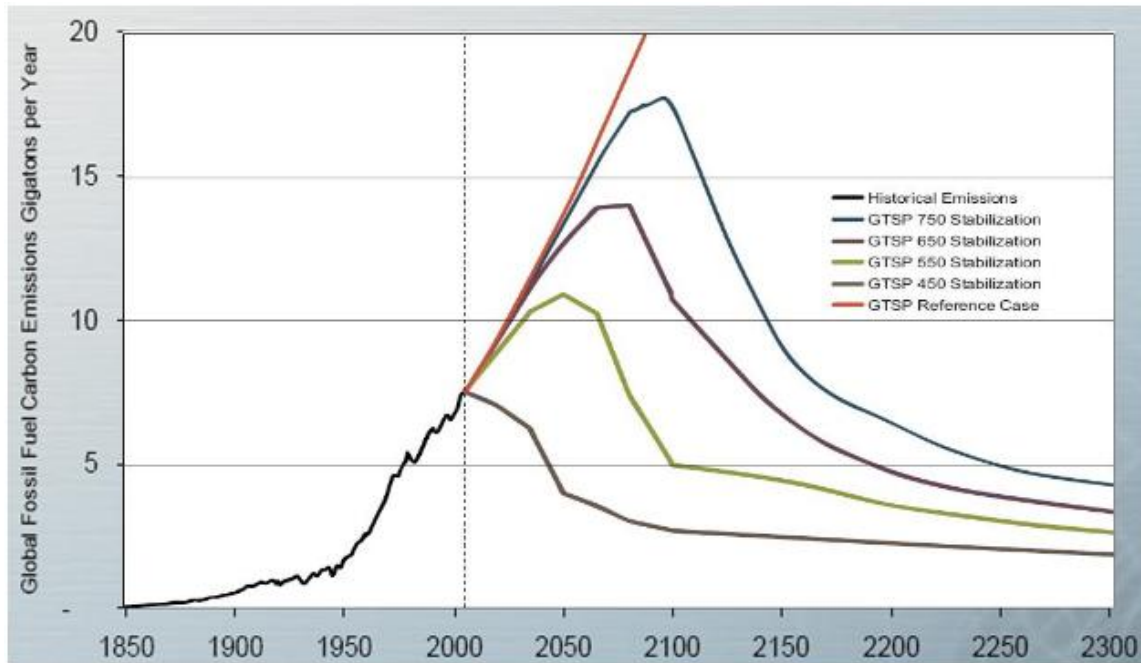


Figure 1: Greenhouse gas concentration stabilization projections [38]

2.2 Controlling Climate Change

Global population is expected to continue increasing over the coming years, reaching 9 billion by 2040 according to the U.S. Census Bureau [31]. At the same time the list of industrialized countries is ever expanding. Given these two factors, a future increase in the demand for energy and directly related greenhouse gas emissions is anticipated.

2.2.1 Global Energy Reduction Programs

The IPCC's alarming reports motivated nations to enforce policies to counteract climate change on an international level. In May of 1992, the United Nations Framework Convention on Climate Change was adopted with the objective of "[achieving] stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system" [3]. This treaty was initially signed by 154 nations, which included an agreement to hold annual conferences in an effort to continuously improve efforts

of minimizing climate change. At the third annual conference in Kyoto, Japan in 1997, numerous emissions-reducing policies were enacted on a per-country basis. These policies came to be known as the Kyoto Protocol.

Under the Kyoto Protocol, the greenhouse gas emissions-reducing commitments of the UNFCCC members were significantly strengthened. Industrialized nations, referred to as Annex 1 nations by the Protocol, entered into legally binding commitments to “aim to achieve at least a 5% reduction” [5] in greenhouse gas emissions for the period of 2008-2012, compared to 1990. Included in this list of Annex 1 nations was Denmark, who already had a long history of energy conservation measures in place following the establishment of the Danish Energy Authority in 1976. In 2005, Denmark reported a 9.8% reduction in total aggregate anthropogenic (human-caused) emissions of greenhouse gases, far surpassing the Annex 1 party average of 4.6% [7].

2.3 Energy Campaigns

Energy campaigns can encompass a large range of initiatives all with the common goal of decreasing energy consumption. A successful campaign impacts the behaviors of its targets, creating energy-conserving habits. By decreasing energy usage, the costs of electricity and resulting greenhouse gas emissions are reduced. The following sections provide some insight into how these campaigns are commonly structured.

2.3.1 Framework for Energy Campaigns

A thorough survey of energy reduction programs concludes that there are many features and strategies employed in nearly all campaigns. Starting at the lowest of levels, programs go through a simple cycle as presented by Vine, seen below [27]. This exact cycle can

be seen in use in many organizations. BC Hydro, the Bonneville Power Administration, and the Energy Trust of Oregon are just three examples of groups that implement this basic cycle [27].

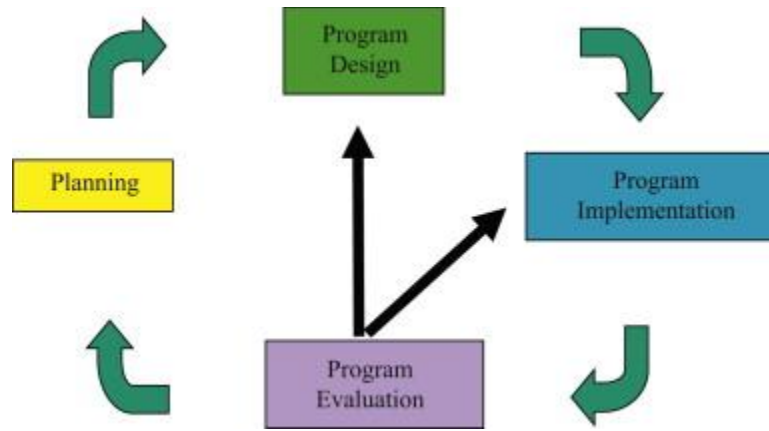


Figure 2: Program planning cycle [27]

First, there is a planning phase, where it is decided what is needed to be accomplished. Then formal strategies and details are decided during the program design. This is followed by the implementation phase. Finally, there is an evaluation stage, where the strategies and details, decided upon and enacted in the previous two stages are gauged on their effectiveness.

2.3.2 Common Components of Energy Campaigns

Following the most basic similarities held by all programs, there are more detailed similarities based on the individual components that are employed. In the review of studies performed by Abrahamse [13], there is a logical breakdown of the majority of common components present in energy campaigns. The methods he presents are commitment, goal setting, information, and workshops. Two methods missing from this list are presented by Govindarajulu—rewards and feedback [15].

2.4 Lyngby-Tårnæk Municipality

The municipality of Lyngby-Tårnæk has established itself as one of the leaders in Denmark's efforts to minimize greenhouse gas emissions. The following section provides basic municipality information, including descriptions of the organizations which contribute to its environmental efforts.

2.4.1 Basic Municipality Information

Lyngby-Tårnæk is an economically privileged municipality located 13 kilometers north of Copenhagen. Its green residential areas, fields, woods and lakes make the town a welcoming and attractive place to live. Lyngby has numerous laws and regulations in place which act to preserve the natural beauty of the landscape. Many companies have chosen to locate their businesses in Lyngby-Tårnæk, making the municipality industrially and commercially developed.

The Technical University of Denmark, or DTU, is the educational center of the municipality. Much of the research performed at DTU is focused on benefitting the community, often with regard to environmental issues and the technology surrounding them [8].

Describing the political structure of the Lyngby-Tårnæk's local government is important for understanding how energy laws and regulations are passed in the municipality. The council consists of 11 committees and 4 departments of which the Town Planning Committee, Environmental Committee, Technical Committee and Environmental Department are directly responsible for environmental planning. The Environmental Department develops laws and regulations and motivates local companies to implement new technologies to address the environmental concerns of the municipality. Lyngby's governmental focus upon environmental initiatives establishes it as a very "green" community [9].

2.4.2 Research and Innovation: The DTU Climate Change Technologies

Climate Change Technologies—a DTU research program—consists of a series of workshops and conferences which focus on introducing new technological solutions to climate change issues. The program's eight workshops each address difficult problems in energy technology and climate adaptation. Many of these workshops emphasize the importance of collaboration between universities, industries and government as a crucial factor for successful environmental change [10].

The DTU Climate Change Technologies research program is a great example of how scientific research is brought to the community through collaborative efforts. When public authorities and companies are willing to participate, implement new technologies and take advantage of university resources, practical solutions can be developed and adopted efficiently. This partnership allows the community to reduce energy consumption and CO₂ emissions in industrial production, contributing to the welfare of the community and the Earth [11].

2.4.3 The Science Shop

The Science Shop at DTU was originally developed as a link for interconnectivity between the university research sources and the members of the community. It provides students with the resources and guidance needed to become directly involved in environmental research.

The projects performed by the Science Shop mainly address environmental issues and social attitudes, and their direct dependence on each other. The initiatives of the citizens to contribute to the environmental safety are analyzed and evaluated through research and survey projects. Students at DTU who choose to become involved with The Science Shop get a chance to apply their scientific knowledge to address many central issues including urban

ecology, handicap equipment, organic food production, city and traffic planning, sustainable energy and external environment [11].

2.4.4 Lyngby's "Green" Efforts

In December of 2007, Lyngby committed to reduce CO₂ emissions by 2% per year during the years 2008 and 2009. This commitment goes hand-in-hand with Danish Environmental Minister Connie Hedegård's One Ton Less Campaign—a call for Denmark to emit one ton less CO₂ per capita annually. Lyngby is the third such Danish municipality to make this commitment, and their trendsetting has received much praise from environmental organizations such as The Danish Society for Nature Conservation. The motivation and resources for these initiatives are in no small part due to the assistance of green-focused organizations such as The Science Shop and Agenda 21. These organizations play an integral part in the municipality's efforts to reduce greenhouse gas emissions and conserve energy.

2.4.5 The Lyngby-Tårnbæk Energy Reduction Campaign

As mentioned previously, the generation of energy is a major source of CO₂ emissions. In working toward the commitment of reducing greenhouse gas emissions, the Lyngby-Tårnbæk municipality has made an agreement with the Danish Electricity Savings Trust to reduce electricity consumption by 3% at the end of 2009. Considering the municipality's history of environmentally aware policymaking and previous energy reduction efforts, this is an ambitious commitment.

The campaign, targeted at affecting the attitudes and behaviors of municipal employees, is informational in nature. It seeks to establish and reinforce a sense of personal responsibility with regard to energy conservation and its effects upon environmental issues. The campaign began in January of 2009 with a series of training sessions for a selection of

technically-oriented municipal employees, coordinated by Agenda21 representative and project liaison Tina Reinicke. In addition to training sessions, information packets containing tips on reducing energy consumption at work were distributed to municipal employees, and energy-conscious posters have been hung in municipal buildings. The posters remind employees to exhibit vital energy-saving behavior such as turning off lights upon exiting a room, and remembering to shut down a computer when it is no longer in use. An example of one such poster can be seen in Figure 3 below. Translated to English, the poster reads, “‘Are you aware of how busy I am?’ Forget the bad excuses. Remember to switch off the lights when leaving a room.” A larger collection of campaign posters and their translations may be viewed in Appendix A.



Figure 3: Campaign element – motivational poster

Municipal employees have been encouraged to remind each other to practice energy-saving behavior at work. By encouraging coworkers to give each other helpful reminders, this establishes an energy-saving culture where environmentally-conscious advice is coming from peers and friends, not just from policymakers and superiors.

Another campaign element is a weekly email sent to all municipal employees with helpful tips and reminders to save energy. Workers are reminded to modify their personal behavior by always remembering to turn off unused computers. Included in these emails is a set of comparative feedback regarding different municipal buildings' success in the campaign. For example, one such piece of comparative feedback reads, "Thus far, The Leisure and Youth Club reduced electricity consumption by 18.5% in 2009 compared to 2008." This allows

employees of each institution to get an idea of how they are influencing the campaign's progress, which is a morale booster for those who are conserving large amounts of energy, and serves to motivate stragglers to improve their efforts.

Additionally, the campaign includes monetary rewards for municipal employees. Organizations have been given the opportunity to compete for a prize of up to 10,000 Danish kroner (about \$1,800)—500 kroner per employee—by submitting a description of personal efforts made with regard to “Technical Management, Nature and the Environment.” There are also a number of rewards for top-performing departments, schools and institutions, in which they are treated to parties for exhibiting extraordinary energy saving behavior. Another reward has been promised for each month's “best energy saver,” whose innovative efforts to reduce energy consumption are compensated with “a basket of fruit delights,” worth 550 kroner.

In addition to the aforementioned attitude and behavior-targeting initiatives, the municipality has performed, and plans to continue performing, a number of energy-saving upgrades to its buildings. While building upgrades are not direct results of the energy campaign, they are clearly motivated by the municipality's concern with energy savings. These renovations include installation of energy-saving lighting systems, replacement of inefficient boilers, and improved wall and ceiling insulation. The investments required for performing these upgrades are expected not only to reduce the municipality's emissions by increasing heating and electricity efficiency, but they will also yield significant financial savings in the long term. For example, an upgrade of motion-activated lights in a school library which cost 37,000 kroner is expected to save up to 11,500 kroner annually, paying for itself in just over 3 years.

2.5 Attitudinal Aspects of Energy Reduction

Changes in behavior are vital to the process of energy reduction. The following chapter discusses how human attitudes are an integral part of modifying behavior and ways these considerations can be included in a campaign.

2.5.1 Relationship between Attitudes and Energy Reduction

When addressing the problem of energy consumption the question of why more energy is being consumed than is necessary often comes to the forefront [13]. Such a far-reaching inquiry has a multitude of possible answers and factors which all contribute to the end result. Technology in all its aspects and uses, social structure and norms, education, and financial concerns all play contributing roles [13]. However, these aspects are measured through two different approaches.

The first approach is to determine the change in the quantitative values regarding the subject. Small scale programs and initiatives to promote more environmentally friendly behavior often focus on the most readily available and tangible results. In most cases this breaks down into measurements of carbon footprints or energy consumption. The strength of such information is that the data is precise, simple to interpret, and results oriented. The weakness of this method is less apparent, and it does not necessarily provide information about attitudes, as energy consumption can be reduced by standard upgrades unrelated to the attitudes of those involved or affected.

The second approach is from a more psychological basis and focuses on the changes in individual motives and attitudes. This is notably a more difficult tactic, which without the proper planning and knowledge can lead to vague or incorrect results [14].

Although studying the motives and attitudes presents a challenge, the information obtained is vital in understanding how best to reduce energy consumption. As stated by Govindarajulu, any program that fails to address human motives and attitudes will be “seriously compromised” [15]. Concrete evidence of this comes from multiple studies, which have found that without affecting the attitudes and goals of those involved lasting results cannot be expected [16]. Similar points have been made by other researchers. A cultural change—a general change in the attitudes of those involved—is vital to the implementation of reduction programs [17]. Ramus makes the point that in order for a program to be successful, positive attitudes and values must be supported [18].

As Geller concludes, a thorough analysis of the problem of promoting environmentally related actions must be conducted [19]. This can be achieved through a succinct presentation of how an individual makes decisions related to energy reduction. Matthies provides a model for environmentally relevant behavior, seen below, which establishes a sound baseline for relating end results to the human motives behind them [20].

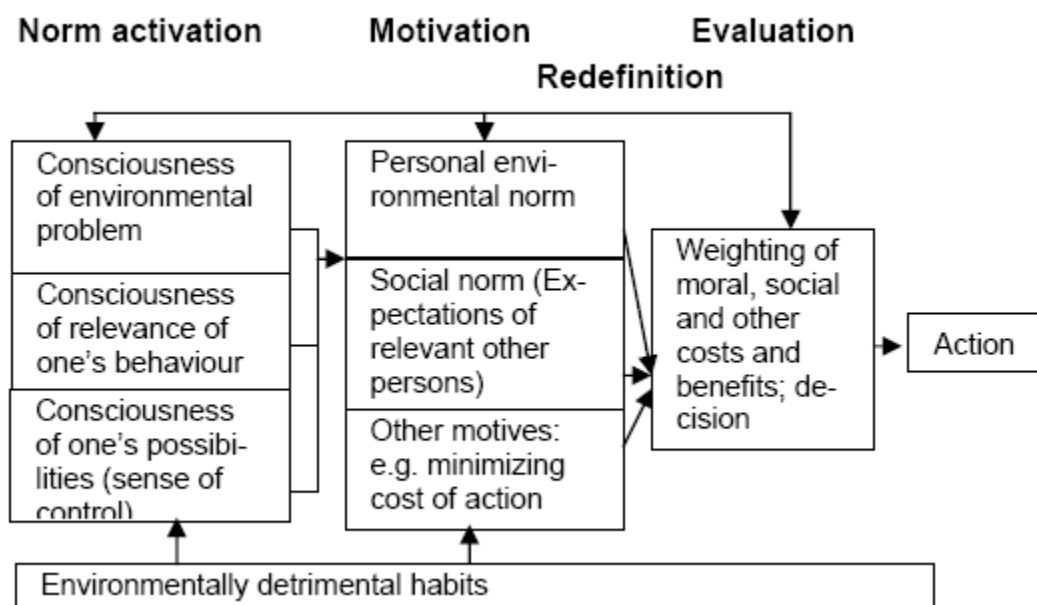


Figure 4: Model describing precursors for environmentally relevant behavior [21]

To understand the process of altering behavior, we examined the precursors of environmental behavior—consciousness of environmental problem, personal environmental norm and pro-environmental behavior intentions. The norm activation is the first step to changing one's behavior in which the person must realize the importance of the environmental problem and become conscious of their personal behavior. This leads to the second step—motivation—where one's personal environmental norm is affected and “a person enters into a process of weighing and evaluating different motives in order to reach a decision on how to act” [37]. This eventually leads into activation of social norm where pro-environmental behavior is exercised by co-workers and employees tend to change their behavior to make it more “socially desired” [37]. Finally, the weighing of moral, social and other benefits results in the evaluation and behavioral intentions to adopt pro-environmental behavior. This is the final precursor to taking action and exercising energy-conserving behavior [37].

2.5.2 The Psychology of Energy Usage

The factors which influence environmental behavior are numerous and complex. A successful energy reduction campaign should identify and address these factors with respect to the campaign's targets. Based on the research of L. Steg, et. al [22], the factors which motivate environmental behavior can be divided into two distinct groups—cost-benefit weighing and moral concerns.

The Theory of Planned Behavior [23] expands upon the basic premise that people make decisions based upon reason, providing a key link between attitude and behavior. It follows that we choose our actions based on the desire to gain the greatest benefits at the least expense. The application of this theory serves to explain environmental behavior such as choosing to use energy-saving light bulbs, perform household recycling, and other environmental actions [22].

Moral concerns play an important role in making environmentally-conscious decisions [24]. It should come as no surprise that a sense of moral obligation with regard to the environment is significant in “explaining low-cost environmental behavior and ‘good intentions’ such as willingness to change behavior” [22]. However, as the cost or inhibiting aspects of these behaviors increases, the ability to predict environmental behavior based upon moral concerns decreases [25]. Therefore, this model is only applicable for low-cost, or more convenient environmental behavior.

2.5.3 Strategies for Altering Environmental Behavior

The consideration of these two classifications of behavioral factors is important for energy-reduction campaigns. By engineering energy reduction strategies which target specific behavioral factors, “one can try to promote attitude changes towards particular pro-environmental behavior [22].”

Informational strategies can increase environmental awareness and potentially affect moral concerns, but they have proven to be relatively ineffective on their own [22]. The combination of informational and commitment strategies have yielded more promising results, specifically the use of goal-setting and regular feedback [26].

2.5.4 Successful Campaign: Techniques for Promoting Energy Conserving Behavior

One of the most successful techniques for the promotion of energy conservation behavior is commitment/goal setting. “Commitment is a written or an oral pledge to reduce energy consumption” by a particular percentage, made by the participants of a campaign [13]. The significance of setting a goal was demonstrated by Becker, who concluded that a more difficult goal (20% reduction in electricity use) was more effective than an easier goal (2%

reduction). In his study, the group which received the more difficult goal reduced energy consumption by 15.1% while the group with the easy goal did not show any significant decrease in energy consumption [13]. Therefore, setting a realistically attainable goal is an important measure for an energy reduction campaign.

Information about the importance of executing energy conserving behavior may be conveyed through informative workshops, conferences and posters, among other methods. Informational efforts are utilized to raise environmental consciousness among campaign targets and to emphasize the importance of adopting energy conservation behavior. The information presented may have various levels of specificity. It has been established that workshops with specific energy-saving tips have been more effective in altering behavior than general information sessions, which can lead to "an increase in attitudes and knowledge" but not necessarily in a "reduction of energy use" [13]. Therefore, the specificity level of the information must be considered when developing information sessions, with a greater emphasis on specific advice and examples of energy conservation behavior [13].

Feedback on energy consumption is an important tactic which can be employed to promote energy conservation behavior. Receiving feedback about energy savings is an effective method for influencing behavior because it gives an evaluation with respect to a previously established goal. Feedback can be given daily, weekly or monthly, however "the more frequent the feedback is given, the more effective it is" [13]. A greater effect can be achieved through giving comparative feedback where one's performance is evaluated in relative to others. A study by Siero (1996) concluded that employees who "received comparative feedback saved more energy" and linked the results to the social comparison theory [28]. "By giving comparative feedback, a feeling of competition, social comparison, or social pressure may be evoked," inducing a positive change in energy consumption behavior [13].

Rewards can serve as motivation for exercising energy saving behavior. One will be more likely to change their behavior if a financial reward is promised for achieving the goal

established by the campaign. The reward can be in form of a refund, where the funds flows back to the institution to promote energy saving practices, and can be given as a bonus to the monthly salary if the goal established by the campaign has been achieved. The reward has been known as the most effective measure for changing one's behavior. However, long term effects have not been sustained and the energy consumption patterns change once the promise of the reward is no longer in effect [13].

Chapter 3: Methodology

This project sought to assess an energy conservation campaign aimed at public institutions in the Danish municipality of Lyngby-Tarbaek. The following objectives were established for this endeavor:

- To assess the campaign's effect upon the municipality's energy saving culture
- To analyze energy savings in relation to the campaign's efforts

These objectives fit into the "Program Evaluation" step of the energy campaign framework previously introduced in Figure 2. After planning and implementation are complete, evaluation takes place to improve future campaign efforts. As illustrated in the Methodology Flowchart, the campaign's impact upon the municipality's energy saving culture was assessed through surveys, interviews and systematic observations. The graphic continues to illustrate our methods of measuring energy savings—we collected energy consumption data from 2008 and 2009 and compared them, accounting for outside factors as needed.

The overall effectiveness of the campaign was then evaluated, and conclusions about the relationship between the people's attitudes and energy savings were established. The most effective campaign initiatives were identified and a synopsis of recommendations for the future campaigns was developed.

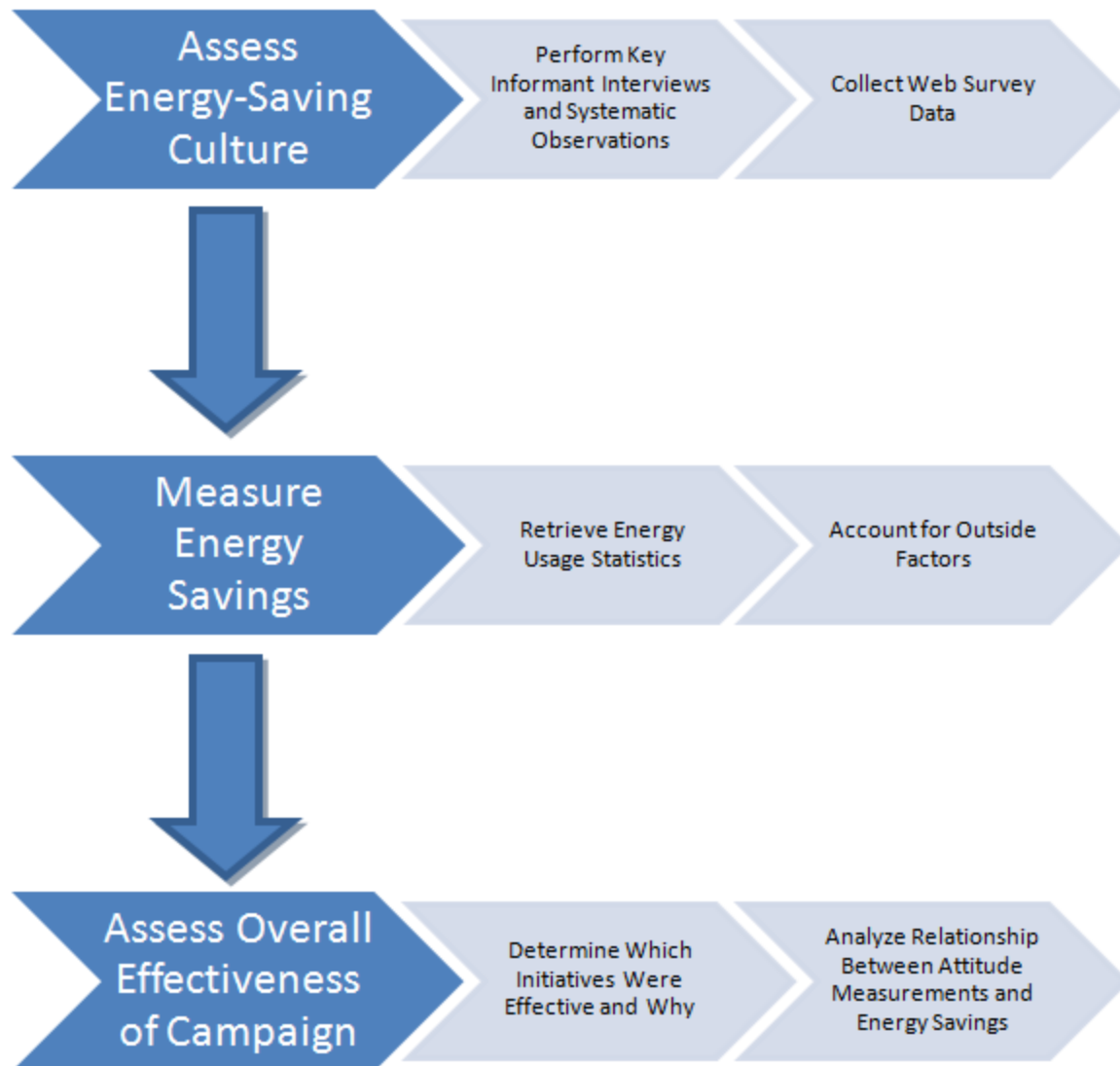


Figure 5: Methodology flowchart

3.1 Assess energy saving culture

Human attitudes and knowledge create the motives behind individual actions and long-term behaviors. Sensorial perception and cognitive processes associate with these motivational factors to produce observable behaviors. To ignore the human aspect of energy conservation would be naïve at best. Thus, our assessment has analyzed the attitudes and behaviors of municipality employees with regard to energy consumption. By measuring different aspects of knowledge and attitude and observing behavioral patterns of municipal employees, we have

developed an assessment of the campaign's impact upon the energy saving culture among municipal employees. Each location we visited had a unique history and background, which were analyzed at each site to provide a context for the data gathered.

The study involved data gathering efforts at five of the three hundred municipal buildings in Lyngby-Tårnbæk. Each location was a sample of a different type of public organization within the municipality. These locations were Kongevejen Skole (an elementary school), Børnehuset Papillon (a children's daycare), Stadsbibliotek (the main public library), Lyngby Rådhuset (Lyngby's city hall), and Virumhallen (a sports arena).

3.1.1 Surveys

Internet surveys are an easy and effective method of gathering large amounts of data [29]. An internet survey containing questions relating to the campaign was constructed and administered to a group of employees at each institution we visited. The visual appearance of the survey can be viewed in Figure 6. Distribution was handled by our initial contacts, who then propagated the survey to their coworkers. The survey was also sent to 28 additional buildings within the municipality, most of whom did not complete the survey. These additional contacts were collected from the municipality's website [8]. The email we sent to these organizations can be viewed in Appendix B (Danish) or Appendix C (translated to English).

The questions asked in the survey were a mixture of rating scales and free answer questions. The rating scale questions provided a large amount of quantitative data, with which we could gather and calculate average values from the responses of many people. The open response questions complemented this data nicely, allowing for more detailed and insightful information. The rating scale questions addressed issues related to the individual's attitudes on energy conservation, the campaign effectiveness, and knowledge about the campaign. The free response questions allowed the individuals to answer in more length on the subjects of personal actions taken, opinions about the campaign, and observed actions of others.

2. Svar venligst på disse spørgsmål

	Nej	Ja
Har du kendskab til en energispartekampagne i Lyngby-Taarbæk Kommune?	<input type="radio"/>	<input type="radio"/>
Vidste du, at din afdeling kan vinde op til 10.000 kr for ekstraordinær indsats i denne energikampagne?	<input type="radio"/>	<input type="radio"/>
Har du lært noget af kampagnens materiale?	<input type="radio"/>	<input type="radio"/>
Siden kampagnen startede (den 1. januar), har du bemærket nogle ændringer i forhold til dine kollegers energiforbrugsadfærd?	<input type="radio"/>	<input type="radio"/>
Har du set en plakat som den, der er vist nedenfor?	<input type="radio"/>	<input type="radio"/>



3. Vurder dine følelser ud fra følgende

	Helt uenig	Uenig	Ikke sikker/Ingen udtalelse	Enig	Helt enig
At bespare energi og naturlige ressourcer er vigtigt for mig.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bestræbelser på at reducere energiforbrug på arbejdspladsen er et vigtigt skridt mod at løse globale miljøproblemer.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jeg vil gerne ændre min daglige rutine for at reducere forbruget af energi.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Energispartekampagnen har motiveret mig til at ændre min daglige adfærd (hvis den har, vær	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 6: Internet survey

Based on Matthies' model discussed previously (Figure 4), precursors of environmental behavior are consciousness of environmental problem, personal environmental norm, pro-environmental behavioral intentions and self-reported behavior [30]. The following table lists each of these precursors and the corresponding survey questions which aim to measure them. For example, question 3b, which asks prompts the survey taker to rate the level to which they agree with the statement "Efforts to reduce energy consumption at work is an important step towards resolving global environmental issues," aims to measure the consciousness of relevance of one's behavior.

Information Targeted	Corresponding Questions in Survey
Consciousness of Environmental Problem	3a
Awareness and Visibility of the Campaign	2a, 2b, 2e, 3d, 6
Consciousness of Relevance of One's Behavior	2c, 3b
Consciousness of One's Possibilities	2c
Personal Environmental Norm	3c, 5
Social Norms	2d
Individual Actions and Behavior	3d, 3e, 5, 6, 7, 8
Others Actions and Behavior	4, 7, 8, 9

Table 1: Targets of survey prompts

3.1.2 Perform Key Informant Interviews

Interviews provide valuable insight into individual awareness, motivation, and behavior with regard to energy consumption, and specifically the campaign at hand. The first step in the interview process was to identify individuals whose opinions would be relevant to the study, and who were available and willing to be interviewed. We performed a multi-tiered analysis of attitudes and behaviors by interviewing administrators, employees and facility users. Our interviews were with a key individual, either an administrator or a technical employee, who has significant sway over energy usage. At each location one interview was conducted with either one or two key individuals, the specifics of which are noted below.

Once a complete list of individuals to be interviewed has been constructed, we arranged and conducted an interview at each location from a set of predetermined questions, found in Appendix G. Each interview was set for a goal length of between 15 and 30 minutes, with possible follow up interviews as needed. Interview were led by one team member and note taking was conducted by the other two team members to ensure an accurate representation of all data gathered.

The interviews took place at the workplaces of our interviewees, and therefore the exact setting of each interview was different. The timing of each interview was solely dependent on the schedule of the interviewee, with a range of times during the normal working hours of 9am to 5pm, all of which took place during weeks three through five of the project.

Similar to the surveys, the questions asked during the interviews were targeted at gathering information relevant to different subsections found in Figure 4. The following set of guidelines was used in the construction of the question set:

- Questions were to be open-ended, or contained expectations of longer answers than could be gathered via surveys.
- Questions would represent and contain as little bias or “leading” as possible.
- In order to help keep leading questioning out of interview, questions would start broad and become increasingly specific over course of the interview.

3.1.4 Perform systematic observations

To verify the validity of the qualitative results, a series of non-intrusive systematic observations were performed. This increased the reliability of results gathered from surveys and interviews. The observations entailed recording behaviors with respect to lighting, use of windows and thermostats, and behavior regarding energy-consumption equipment including computers, space heaters, electric fans, radios and cell-phone chargers. Several photographs were taken to verify our observations.

This was an important step in determining whether our perception of the employees’ attitudes was accurate and whether the self-reported behavior was comparable to the actual behavior. For example, if the results of the survey indicated that most employees claim to be very concerned with energy wasted from leaving electronic devices powered on while unattended, yet we observed empty rooms with running computers, then there would be an evident inconsistency. Social norms tend to pose certain obligations on the interview and survey

respondents, making them more likely to report a pro-environmental behavior. Thus it was concluded that systematic observations would be a very valuable source of data gathering and validation.

3.1.5 Interpret Results

Once all of the data was gathered, it was important to analyze and attach relevance to the information. Each method through which we gathered data measured a certain set of variables surrounding energy consumption behavior. The breakdown of methods and variables can be seen in the figure below.

	Surveys	Interviews	Behavior Observation
Consciousness of environmental problem	X		
Consciousness of relevance of one's behavior	X	X	
Consciousness of one's possibilities		X	
Personal environmental norm	X	X	
Social norm (expectations of relevant other persons)		X	
Other motives: minimizing cost of action		X	
Individual actions and behavior	X		X

Figure 7: Informational focuses of data gathering methods

This allowed us to analyze all the data, regarding each variable separately, and use these developed pieces to create a thorough analysis of the situation. Naturally, it was crucial to first identify the patterns and trends that are present. The various aspects of the campaign were clearly identified and then their effectiveness was assessed. Each component's assistance to the overall campaign goals was gauged as best as possible. With this thorough interpretation of the results a more complete mapping of how the campaign has progressed was established.

3.2 Assess energy savings

An indirect method of measuring the campaign's success involves analyzing hard energy usage statistics and determining whether the goal of reducing energy consumption was attained. Since the campaign did not explicitly have a goal of attempting to reduce actual consumption, but instead was trying to affect the attitudes of employees, at most this analysis would provide some evidence of a correlation between energy consumption and attitudes.

3.2.1 Gather energy usage statistics

All public institutions within the municipality of Lyngby-Tårnbæk keep very careful records of energy usage. Current usage figures for the months of the campaign were provided to our group via our contacts at each location that was visited. In addition to recent usage statistics, we also obtained the previous year's records, in order to perform comparisons. Energy usage was represented on a per-month basis, with figures reported in kWh, or kilowatt-hours (power in kilowatts multiplied by time in hours).

3.3 Institution Strategies

Multiple data gathering strategies were employed for each of the institutions based on the institutions' histories and the respective interviewees. We conducted brief informal interviews with each of our primary contacts to establish context and history for each of the facilities, which we used to create institution-specific data gathering strategies.

3.3.1 Kongevejen Skole

Our primary contact at Kongevejen Skole was the school's deputy manager, who we met with on Wednesday April 15th at 9:00AM. We were able to ask her the questions found in

Appendix G over the course of a 35 minute interview. We obtained energy usage statistics for Kongevejen Skole, and following the interview we were able to spend over an hour making systematic observations of the energy consumption practices of the school. Additionally, we inquired about the number of students and teachers who use the school. We asked for an overview of normal activities which take place on a daily basis, and whether they are significantly different from the previous year (so we could better analyze energy usage statistics from both 2008 and 2009).



Figure 8: Kongevejen Skole

3.3.2 Børnehuset Papillon

Our primary contact at Børnehuset Papillon was the manager, who we met with on April 21st. During a 20 minute interview we were able to ask this individual the questions presented in Appendix G. Following the interview we were given a tour of the facility after which we were allowed to remain at the location to make further systematic observations. We performed systematic observations over the course of 30 minutes on location. Additionally, we asked for an overview of the energy consumers at the kindergarten—the teachers and students.



Figure 9: Børnehuset Papillon

3.3.3 Stadsbiblioteket

Our primary contact at Stadsbiblioteket was the library's technical service manager, who we interviewed on April 27th using the standard set of questions found in Appendix G. After the interview we obtained the energy statistics and performed systematic observations around the library. In addition to the previously referenced question set and some inquiries about the library's employees and uses, we made a number of inquiries based on the computers and lighting we noticed upon entering the building.



Figure 10: Stadsbiblioteket

3.3.4 Rådhusets Personaleafdelingen

Our primary contacts at the City Hall were two employees at the human resources department. During our interview we have asked questions found in Appendix G and performed systematic observations in the human resources department.



Figure 11: Rådhuset

3.3.5 Virumhallen

Our primary contact at Virumhallen was the technical service manager. We met with both the technical service manager as well as his assistant on Tuesday April 7th at 10am. We were able to ask the personal the set of questions presented in Appendix G over the course of a 30 minute interview. As a part of this interview, we were able to obtain the energy consumption data for Virumhallen, a similar sports arena, and two soccer clubs that are all under the direction of the technical service manager we met. After this interview we were given a tour of the facility and then allowed to perform systematic observations on the location. Given the very limited number of offices present in at this location, the systematic observations were focused on the public spaces which made up the vast majority of Virumhallen. We performed systematic observations over the course of an hour in the facility.



Figure 12: Virumhallen

3.3.6 City Hall Technical Managers

We also had an interview with two technical managers who are concerned with the resource consumption and environmental aspects of all three hundred municipal buildings. We had a brief, 15 minute, interview with them on April 28th. The information that we gathered from these two individuals was basic facts about the buildings we visited, including their environmental ratings, and the energy consumption data from the City Hall.

Chapter 4: Results and Analysis

The following section contains a thorough account of all data collected at each of the five locations that were central to this project, including the unique situations and relevant histories of each location. We have gathered all the electricity consumption data for the five institutions where we performed interview and systematic observations. The data is presented in energy consumption graphics for each particular institution, and compared for January, February, and March of 2008 and 2009. Additionally, the online survey data is presented and analyzed, and changes in behavior are identified.

4.1 Overview of the 5 Institutions

This section addresses some information we gathered regarding the buildings at each of the five institutions visited. Additionally, it introduces the Campaign Effectiveness Index, a rating system used to assess the overall impact of the campaign at each municipal organization we studied.

4.1.1 Specific Building Information

On April 28, we conducted a 15-minute interview with two of the municipality's technical managers, whose job it is to oversee all aspects of resource consumption and environmental issues within Lyngby's 300 public buildings. They are responsible for performing building upgrades and technical improvements to the buildings, and they were able to share some of this information in the context of the five institutions. During this interview, we discussed the municipality's policies regarding technical building upgrades, changing political policies on environmental issues and an energy rating report from one of our primary sites.

The technical managers informed us that none of the buildings we have visited utilize electric heating. The buildings in the Lyngby municipality are usually heated by natural gas and Virumhallen, Stadsbibliotek and the City Hall have condensing boilers which are more energy-efficient. Therefore the electricity consumption figures presented in the report do not include the energy used to heat the buildings and factors such as weather can be excluded from our analysis. The Stadsbibliotek uses electricity for cooling but this factor can be excluded from our analysis because it would have an effect on electricity consumption figures only during the summer (we only analyzed figures from January, February and March, in order to maintain campaign relevance).

The technical managers presented the report on the energy ranking of the Børnehuset Papillon. The energy ranking of the kindergarten was low (F) and the report contained a list of suggested changes and technical improvements which they are required to implement by law over a specific period of time. An overview of this energy report can be viewed in Appendix I. The energy ranking and detailed reports were not available for the other institutions because official evaluations of the buildings have not yet been performed.

Electricity usage is largely dependent on the type and use of the building, and the larger buildings with more technical installations (computers, projectors, etc.) are expected to have significantly greater electricity consumption. For example, there are more technical installations and lights at the library than at any of the other buildings resulting in a greater electricity usage per meter squared. This doesn't hold true for all cases, as in the case of Papillon, where the energy usage per area is high because of the fact that this location cooks food on the premises daily. The exact numbers of total area (in square meters) and then kilowatt hours per meter squared can be found in Table 2. A more thorough analysis would have to be performed to normalize the electricity consumption in terms of square footage of the buildings. However, the analysis is beyond the scope of this project because the specific energy ranking reports are not available for every institution.

Institution	Total Area (m ²)	kWh/m ²
Statsbiblioteket	5759	81.5
Børnehuset Papillion	414	65.4
Virumhallen	6108	45.5
Kongevejens Skole	7145	27.6
City Hall	8350	48.9

Table 2: Institutions' areas and energy usage per area

4.1.2 Campaign Effectiveness Index

The Campaign Effectiveness Index was developed by combining the previously-introduced models of Abrahamse and Govindarajulu from The Journal of Environmental Psychology. This hybrid model addresses and rates four very important campaign elements—commitment, information, feedback and reward. It is utilized later in the chapter to rate the effectiveness of the campaign at each of the five municipal buildings we inspected.

For each of these four campaign elements—a letter grade (either A, B, C, D or F)—is assigned. In this grading scheme, 'A' represents an excellent level of campaign effectiveness; 'F' represents a very poor level of campaign effectiveness, and the other grades fall between the two. For added precision, grades may also be assigned with a plus sign, indicating slightly higher campaign effectiveness than the letter without the plus sign. Thus, the highest attainable campaign effectiveness grade is A+.

It is important to note that the Campaign Effectiveness Index is not a rating of the participation of the municipal organizations. Rather, it is just as the name suggests—a measurement of how well the campaign was able to reach and impact the organization.

Therefore a low grade does not necessarily reflect poor energy consciousness at an organization, but rather slightly misguided or improvable campaign initiatives.

The following table outlines the criteria on which we based the campaign effectiveness grades. This served as a somewhat rough guideline for assigning grades, since the campaign's effectiveness was so dependent upon extraordinary participation from individuals and organizations, often resulting in non-standard campaign efforts. As a result, it was impossible to create a fully standardized grading system across all organizations, but we attempted to maintain consistent grading in all cases, awarding additional credit for extraordinary efforts and unique situations where deserved.

Campaign Component	Criteria
<i>Commitment</i>	<ul style="list-style-type: none"> - Setting of Energy Related Goals - Meeting These Goals - Appointment of Ambassador(s) - Level of Commitment from Ambassador(s) - Spreading Awareness of Campaign within Organization
<i>Information</i>	<ul style="list-style-type: none"> - Attendance of a Training Session - Visibility of Campaign Materials - Usefulness of Campaign Information for Employees
<i>Feedback</i>	<ul style="list-style-type: none"> - Availability of Energy Usage Statistics On-Site - Employee Awareness of Energy Usage - Familiarity with Weekly Campaign Emails - Employees' Attention to Each Others' Energy Behavior
<i>Reward/Funding</i>	<ul style="list-style-type: none"> - Knowledge of 10,000DKK Reward's Existence - Participation in "Best Energy Saver" Competition - Knowledge of Available Funds for Building Upgrades - Utilization of Building Upgrades During Campaign

Table 3: Overview of Campaign Effectiveness Index Grading Criteria

4.2 Kongevejen Skole

The Kongevejen Skole (in English, this means “Royal Road School”) is a large school which has a capacity for 605 students from first to ninth grade and 47 teachers [42]. At the start of the campaign, the school’s deputy manager received an email from the campaign’s coordinator with a request to appoint campaign ambassadors—individuals at the school who would take responsibility for promoting the campaign. The facility manager and a teacher have been appointed as campaign ambassadors and took initiative to make the campaign successful at their location. As part of the campaign, the facility manager of the school attended a technical information session, at which he received training and learned about energy-saving methods.

The ambassadors have been very committed to coming up with inventive campaign initiatives of their own creation. To introduce the campaign to the students, they have developed a fun and interesting information pamphlet, which has been distributed and posted around the school.

The school has additionally created an educational campaign initiative targeted at its students. Teachers have been instructed to set aside some time to discuss the importance of energy conservation with respect to global environmental issues. Additionally, the teachers were asked to explain why the campaign is being conducted and what efforts can be taken to make it more successful. The deputy manager noted, “Children seem to be very interested in the subject. I hope it will bring them on the right way and make them more environmentally conscious.”

Campaign materials such as the poster in Figure 13 have been posted around the school, serving as a constant reminder to conserve energy by means of turning off unnecessary lights and computers, among other efforts. In addition to the materials the school was given, they have utilized small post-it notes to remind students and teachers to turn off the lights when

leaving a room. This poster in particular targets the norm activation of its readers by making them conscious of the relevance of their personal behavior to the environmental problem. Additionally, it aims to affect behavior associated with an extremely low cost—simply turning off a light switch—increasing the likelihood that the reader will be motivated to comply. The deputy manager also regularly patrols the school's grounds, placing new post-it notes to mark the lights which have not been turned off.



Figure 13: Campaign poster in the main hallway of Kongevejen Skole

The importance of feedback was not overlooked by the campaign ambassadors, and feedback graphics which depict the effect of the campaign on energy usage have been placed around the school. Feedback is important so that teachers and the students are able to observe whether their efforts have been successful in reducing energy consumption.

Another of the school's unique campaign initiatives involved a competition between classrooms to see who can exhibit the best energy-conserving efforts. The competition is planned to be held during the last week of April, with a prize and other details to be announced at a later date. The goal of the competition is to raise awareness among students in a fun and interactive way.

The Kongevejen School has made a tremendous effort to make the campaign successful, going above and beyond the municipality's expectations. When we asked what the municipality

could have done differently in executing the campaign, the deputy manager expressed a few concerns. Firstly, she felt the campaign had a very short notice. If the school knew about the campaign back in May of 2008—when they designed the schedule for the upcoming academic year—the school leaders would have a chance to devote a larger time frame and make the campaign more effective. Secondly, she thought the campaign lacked specific instructions and the appointed ambassadors had to take initiative to come up with their own ideas for the campaign. She also felt that if the informational emails contained more specific energy-saving instructions, the campaign may have been more effective.

The building was last renovated 5 years ago, but more recently (October 2008), energy-efficient lighting systems were installed. The hallways were equipped with motion-activated light sensors, and the computers are set on a timer to switch off automatically at 7 PM. All the electronic equipment—such as printers, scanners and fax machines—is switched off during the weekends. Computer monitors are configured to shut off when they are not in use. Recently, interactive boards have been installed in every classroom and unfortunately they are frequently left turned on. However, recognizing this issue in the spirit of the campaign, the staff is trying to be more proactive about turning off the boards when they are not in use.

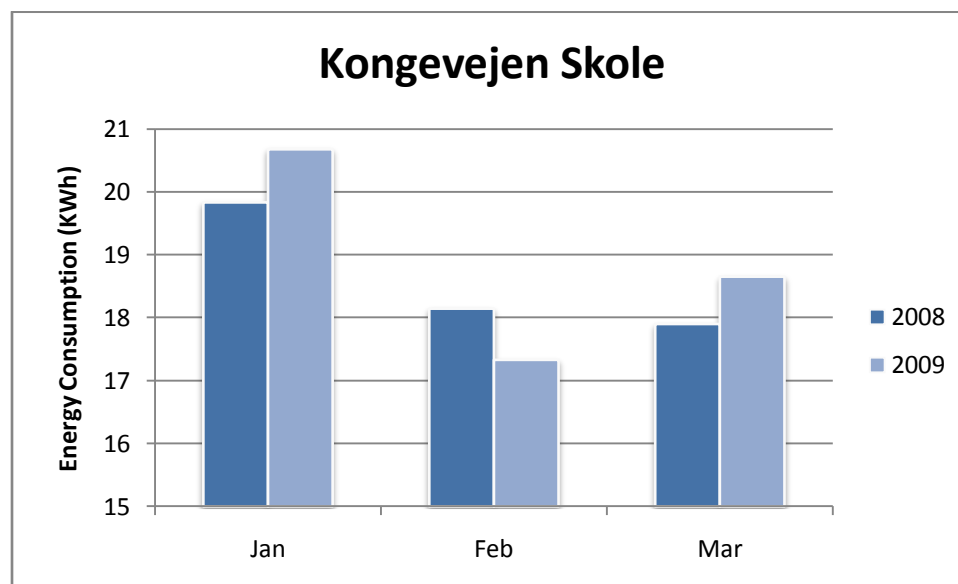


Figure 14: Kongevejen Skole energy usage statistics

The energy consumption statistics for Kongevejen Skole are presented in Figure 14 above. As depicted by the graph, the school consumed 0.849kWh more energy in January of 2009 than 2008, an increase of about 5%.

In February, Kongevejen Skole's electricity consumption decreased by 0.815kWh, or about 4.5%. However, the next month, the school saw yet another increase in energy usage, this time by about 4.3%.

There are a number of factors which may have contributed to the increase in energy consumption during January and March. During the month of January, the campaign was just getting off the ground, so it may have taken some additional time for campaign initiatives to come fully into effect. Regarding March, the timing of the Easter holiday may have caused a significant impact upon usage statistics in this case. Note that in Denmark, the Easter holiday generally consists of several days off from school for students and teachers. In 2008, Easter occurred at the end of March, whereas in 2009 the Easter holiday fell during the beginning of April. The result is several days where consumption occurred in 2009 and not 2008. We will keep this factor in consideration while analyzing all statistics for the month of March.

The following table is the Kongevejen Skole's Campaign Effectiveness Index report. As the grades and comments reflect, the campaign was extraordinarily effective at the Kongevejen Skole, despite the lack of energy reduction. They particularly excelled in the Information campaign component, far surpassing the expectations and guidance of the campaign. By creating unique campaign materials and extending the reach of the campaign to not only the school's teachers, but also the students and their parents, the campaign's effect was truly superb there.

<i>Campaign Component</i>	<i>Comments</i>	<i>Grade</i>
Commitment	Energy goals set, but only partially met. Ambassador appointed. Training session attended. Additional campaign pamphlets developed.	A
Information	Campaign materials HIGHLY visible. Information delivered to students during lectures by teachers. Information delivered to parents via note sent home. Post-it notes on lights.	A+
Feedback	Feedback graphics portraying the school's energy consumption were visible in the main hallway. Teachers were also informed of campaign progress at staff meetings.	A
Reward/Funding	Could have easily contended for the 10,000 DKK prize, but they weren't aware of it. However, they set up their own in-house reward system.	B+
Overall	Outstanding participation and effectiveness. Seems like the campaign had a really positive impact upon the attitudes of the teachers, and was even able to reach students and parents!	A

Table 4: Kongevejen Skole Campaign Effectiveness Index

4.3 Børnehuset Papillon

Børnehuset Papillon is a lovely kindergarten which accommodates 56 children who are supervised by 10 teachers. Our contact at this institution—one of the teachers—was informed about the campaign through emails from the City Hall, and regularly discusses the campaign with her colleagues at their monthly meetings.

The campaign materials received from the City Hall have been placed around the kindergarten's facilities. When questioned whether these materials have been effective in reminding people to conserve electricity, our interviewee replied: "Maybe. In the beginning, when you first post it. But after a while people stop noticing. They are too small." As portrayed in Figure 15, the blue sticker placed on the printer is much smaller than the large blue posters we have observed in the other institutions.



Figure 15: Small campaign sticker on a copy machine

At this institution, we observed a moderate level of awareness about global climate issues prior to the campaign, as reported by our interviewee. However, our interviewee reluctantly admitted that "this year [they] have used a little more" energy than in the previous year. As is visible in Figure 16, 2009 has yielded a significant increase in energy consumption at this institution during each of the first three months of the campaign.

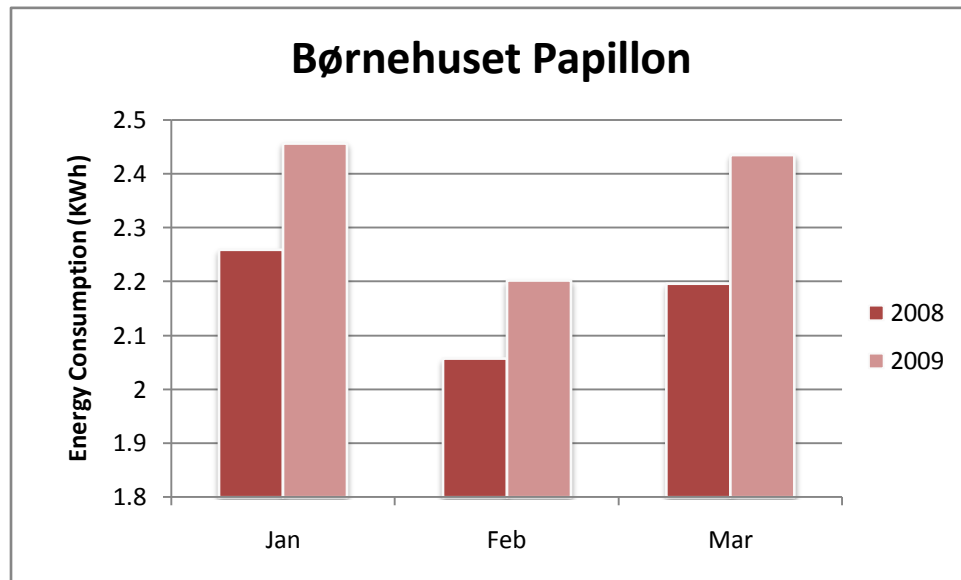


Figure 16: Børnehuset Papillon energy usage statistics

Børnehuset Papillon is the smallest institution which we visited, and they have very few computers. Thus they do not expend a great deal of energy from lighting and computer use, which are the major sources of electricity use at the other buildings. However, one unique aspect of Børnehuset Papillon is that it has a kitchen which is used to prepare food for the students on a daily basis. Additionally, there is a wooden playhouse behind the school (visible in Figure 17), which requires electricity to control its temperature during the summer.



Figure 17: Energy-wasting playhouse with air conditioning unit

The kindergarten's staff members have looked into reducing utility bills. For example, as pictured in Figure 18, motion-activated taps have been installed on the sinks in an effort to conserve water. But no technical upgrades have been made in an effort to reduce electricity. We suggested that replacing the light bulbs could result in significant reduction in energy bills. Our interviewee was not aware of the fact that the city hall might be willing to fund such a project. We brought to her attention that, if she shares her concerns with the City Hall and proposes a project for reducing electricity bills, the City Hall will consider it during the next budget distribution and may allocate funding to help the kindergarten to reduce electricity usage. These building modification funds are available independently from the campaign therefore the proposal for project can be filed during or after the campaign.



Figure 18: Motion-activated water tap

The following table is Børnehuset Papillon's Campaign Effectiveness Index report. The campaign's most significant impact here is visible through the Commitment and Information campaign components. By appointing a campaign ambassador and distributing campaign informational materials, this organization saw significant improvements in employees remembering to turn their computers off at the end of the day. Being reinforced through mentions at monthly staff meetings—an impressive extra effort by Børnehuset Papillon—the campaign's effect was better established.

Campaign Component	Comments	Grade
Commitment	No ambassador. Aware of wasted energy on playhouse, but not proactive in doing anything about it. However, allocated time during monthly meetings to discuss the campaign.	C
Information	Few campaign informational materials visible. Especially helpful for informing some of the older employees of the importance of turning off the computer.	B+
Feedback	Energy statistics available, but not visibly posted. Reminded employees that the entire computer needs to be turned off, not just the monitor. Energy use discussed at meetings.	B-
Reward/Funding	Aware of 10,000DKK prize, but no intentions of competing for it, and had not heard of anyone else competing for it. Unaware of potential funding from city.	D
Overall	There are only 10 employees here, so it should've been easy to reach all of them. However, the lack of institution-specific information and instructions really hurt here, so the campaign's effectiveness was somewhat limited.	C

Table 5: Børnehuset Papillon Campaign Effectiveness Index

4.4 Stadsbiblioteket

Stadsbiblioteket is the larger of two public libraries in the municipality. We interviewed the library's technical service manager, who has been appointed as a campaign ambassador, taking personal responsibility for the campaign's execution at the library. He attended the informative workshop, where he reports to have learned some good energy-saving tips. While

he was already aware of some of the information presented at the workshop, he did find it useful and discovered new ways to save energy. For example, he initiated a project to install energy-saving light bulbs in the library. This project was expensive, but he is convinced that the long-term benefit and reduction in energy consumption will result in lower electricity bills.

There are approximately 70 employees at the library and the campaign was mainly targeted toward them. As is visible in Figure 19, campaign posters have been hung in the library's upstairs office space. Our interviewee believes that the campaign has affected the employees' behavior and that people will be more likely to turn off the lights as a result of the campaign. He placed other campaign materials, such as the campaign's fuzzy mascot with the energy message, on computer monitors and he noticed that people are a bit more likely to shut the computers off when they are done using them.



Figure 19: Campaign poster in the office space of the library

The library building, which has several windows, was very well lit by natural light. Despite this, a multitude of overhead lights were turned on in the main area, as is visible in Figure 20. We commented about the seemingly unnecessary lighting, to which our interviewee replied that the library's primary concern is the comfort level of library users: "People like to have a lot of light when they read so there is nothing I can do about that."



Figure 20: Multitude of overhead lights turned on during the day

Our interviewee provided the energy statistics which can be seen in Figure 21. A slight decrease in energy consumption for January is followed by a large increase for February and March. The library is a type of institution where the number of users is constantly changing from month to month and from year to year therefore there are multiple factors effecting energy consumption which can be included in our analysis.

The library does not use electrical heating; therefore weather is not a major factor. However there may have been more dark days in the winter of 2009 which required additional lighting of the facility. Additionally, the size and the amount of technical installations should be considered. The library has a large amount of lights and computer equipped workspaces therefore while the library is not the largest of the five institutions (5759 m^2) it has the largest electricity consumption per square meter (81.5 KWh/m^2).

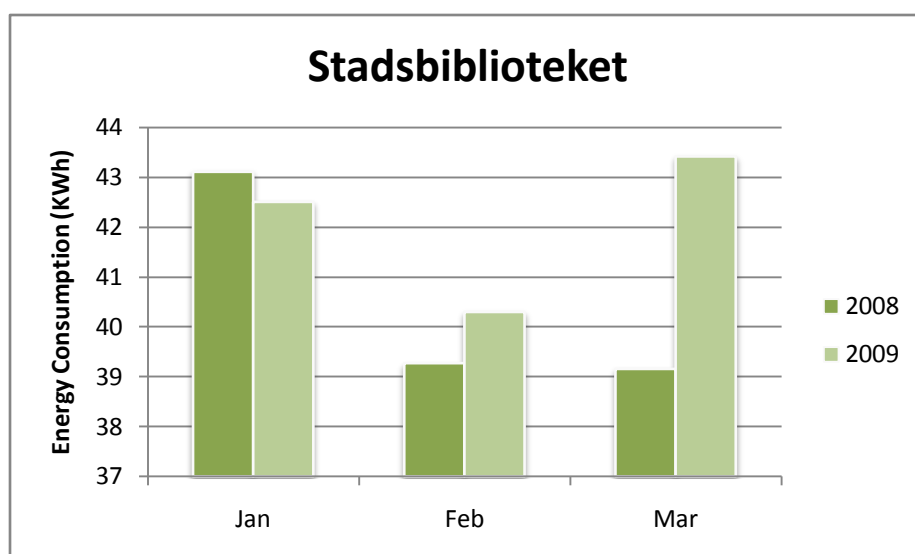


Figure 21: Stadsbiblioteket energy usage statistics

The library has not set any particular goals to reduce electricity consumption but the technical service manager has taken a personal stand on making the campaign a success. Cleaners and other staff often use the library after normal hours of operation. Our interviewee commented that he usually comes a few hours before the library opens and finds that the cleaning staff has forgotten to turn off the lights: "I am after the cleaning staff. When they clean they often forget to shut off the lights but I have been personally reminding them and I think they have gotten better."

When we asked what particular recommendations he can make for the future campaigns he said that it would have been helpful to have more campaign information when it has just started. Overall, he was very fond of the frequent energy emails sent by Tina Reinicke and he thinks that the campaign leaders have done a great job. The campaign has definitely made a difference at the library and made people more aware of global warming and the importance of energy saving.

Some of the systematic observations mentioned previously are the unreasonably bright lights on the main floor which seemed excessive because enough light was coming through the

windows. However, we also observed light sensors in the basement which have been installed before the campaign. The ventilation system is set on the timer and is turned on only during the hours of operation. Many of the computer screens on the main floor were tuned on while no one was using them—we recommended they be placed on a shorter timer. The following table displays the library’s Campaign Effectiveness Index report, which reflects the campaign’s impressive impact at the library, mainly due to the high visibility of informational materials and the campaign ambassador’s extraordinary participation and dedication to energy saving.

<i>Campaign Component</i>	<i>Comments</i>	<i>Grade</i>
Commitment	Ambassador appointed. Training session attended. Made commitment that all newly purchased bulbs will now be energy-efficient.	B+
Information	Campaign materials highly visible. The information session was highly praised by their technical manager.	B+
Feedback	Highly conscious of energy usage statistics and working hard to lower them, though not visible posted. Cleaning staff was given feedback upon their energy consumption, which affected their behavior positively.	B
Reward/Funding	Utilized funding to install motion-activated lighting in the basement. Aware of 10,000DKK prize, but not competing for it.	B+
Overall	The campaign seems to have been very effective here, mainly due to the efforts of the library’s ambassador.	B+

Table 6: Stadsbiblioteket Campaign Effectiveness Index

4.5 Rådhusets Personaleafdelingen

At Rådhusets Personaleafdelingen (this is the City Hall's Human Resources department), we interviewed Tina, who started working at the human resources in April and previously worked in the IT department. We also interviewed Tomas who initially worked at the Administration Department and currently works with advisors concerning employment issues at the Human Resources department.

Both interviewees expressed the opinion that emails concerning the campaign have been much too frequent and some people have started to disregard the messages. This explains why neither of the employees had heard of the competition for the department which proves most active in promoting energy-saving practices. Tina and Tomas note that they are not aware of anyone who is competing for the prize. On the other hand they believe that the weekly energy emails are good reminders about the campaign. Tomas notes: "If you are constantly reminded you will remember to turn off the lights and to change your behavior." They "have seen the blue posters on the back of every door" and they believe that these large information posters serve as good reminders about the campaign. They have also seen the feedback graphics on how much energy has been used each month. These are usually placed next to time-cards and are very visible for everyone. Other campaign materials have also been utilized and as can be seen in Figure 22, "fuzzy campaign mascot" with an energy saving reminder has been mounted upon a light switch.



Figure 22: Campaign "Fuzzy Mascot" and energy-saving reminded mounted on a light switch

As portrayed by the usage statistics in Figure 23, the City Hall has done quite a good job at reducing their energy consumption during the campaign. The month of January saw an 11.317kWh decrease in usage compared to 2008, which is about a 26% decrease. February was another successful month at the City Hall, with a 6.053kWh or 17.7% reduction in electricity consumption. While they weren't quite as successful as reducing energy in March—where a 16.1% increase occurred—it is still clear that the campaign has had a significant effect upon the energy consumption at the City Hall. The campaign coordinator insists that March's increase is almost entirely related to the Easter holiday. Additionally, no recent technical upgrades can be attributed to the decreased electricity usage. Combined with the pro-environmental attitudes of the employees and highly visible campaign materials, this provides a strong argument for the campaign's effectiveness at the City Hall.

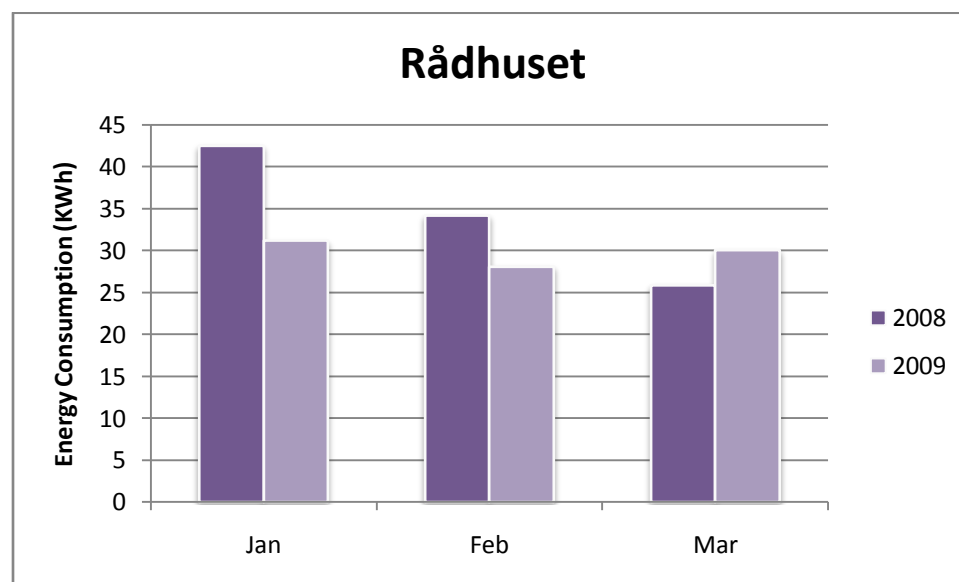


Figure 23: Rådhuset energy usage statistics

Tina notes that “the campaign has made a big difference for [her] personally” and Tomas believes that most of his colleagues “seem to care about global warming.” The campaign has not taught them any new ways to conserve energy but they believe that the well-known practices have been much reinforced. “People have become more aware and they will

remember to close things and to turn off the computers.” When we asked if the people will remember to maintain their behavior after the campaign has ended they said that most will probably remember. The subject of the importance of global warming is reinforced on daily basis. For example, Tomas notes that local politicians are in the process of trying to pass a new, stricter requirement for all new building to be very energy efficient. This will make them 30% more expensive initially, but in the long run they will benefit financially on energy savings.

The following table is the City Hall’s Campaign Effectiveness Index report, showing extremely high ratings in the Information and Feedback components. This location showed the best feedback performance, which may have contributed to their impressive energy reductions during the months of January and February.

<i>Campaign Component</i>	Comments	Grade
Commitment	Employees reminding each other to turn off lights and computers.	B
Information	Abundance of visible campaign materials—posters, stickers, fuzzy mascots. However, emails admittedly ineffective.	A
Feedback	Energy usage statistics highly visible (next to time cards). Reduction goals made very clear to employees.	A
Reward/Funding	Aware of 10,000DKK prize, but not competing for it.	B
Overall	As the campaign is more or less “headquartered” at City Hall, it comes as no surprise that it was quite effective there. Visibility is excellent, and it seems to be having a real impact upon attitudes and behaviors of employees. They have also done exceptionally well at actually reducing energy use.	B+

Table 7: Rådhuset Campaign Effectiveness Index

4.6 Virumhallen

Virumhallen is Lyngby's largest athletic facility, with a total area of 6108 m². The City Hall has been encouraging Virumhallen to save electricity by replacing the light bulbs and installing energy efficient light controls. Six months ago, the light bulbs in the entire facility were replaced with new energy saving light bulbs which last ten times longer and consume significantly less power. As is visible in Figure 24, the technical upgrades resulted in a large decrease in the electricity, and better energy efficiency (45.5 KWh/m²) than the other larger institutions. We observed what other modifications have been made in two major sport auditoriums, in the basement which hosts table tennis and kick boxing facilities, the dressing rooms and the corridors. We have also observed what campaign initiatives have been taken at Virumhallen to promote energy-saving behavior among employees.

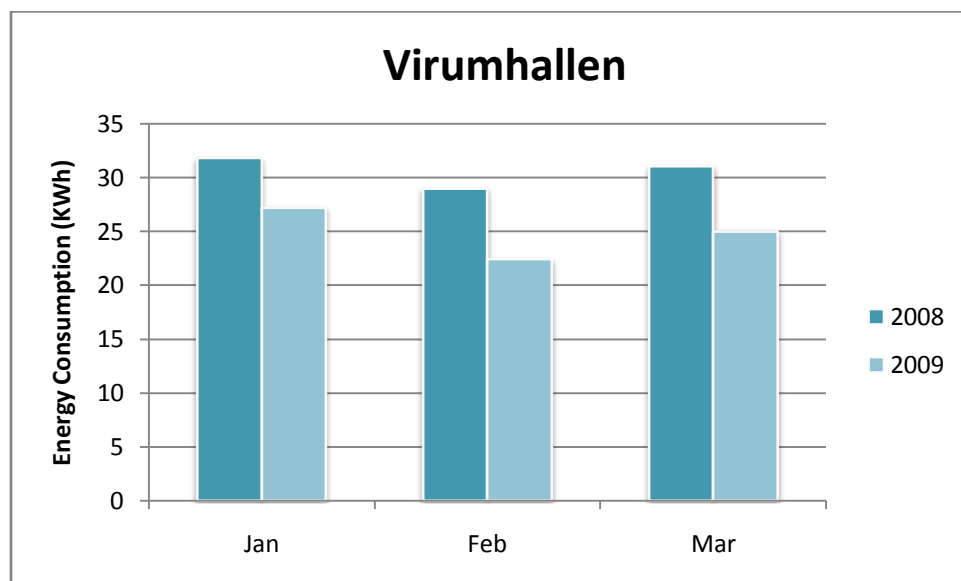


Figure 24: Virumhallen energy usage statistics

The two major sport auditoriums are mainly used for tennis and basketball practices, but during the weekends they are used for major games and competitions which require bright lighting for TV-reporters and the audience. A special switch panel through which the brightness of the lights can be manually controlled has been installed in both auditoriums. The panel

allows reducing the lights to a minimum of 20 LUX (LUX is the SI unit of luminous emittance) and this setting is used when the facility is cleaned. The 750 LUX setting is only used during some weekends when major games take place and the TV reporters are present. The setting normally used during regular practices is 300 LUX.

The basement is equipped with light detectors which turn on automatically when someone enters the room. Similar light sensors were also observed in the dressing rooms, the table tennis and kick boxing facilities and in the basement corridors. As is visible in Figure 25, a sufficient amount of light is coming in through the windows during the day and lights were turned off.



Figure 25: Unoccupied lounge on the main floor. The lights are switched off during the day.

The central ventilation system is computerized and a time-saver for the week is set up according to the building operation hours. The ventilation is turned on only when the hall is occupied. The ventilation in the basement is poor and needs improvement especially in the kickboxing facility, but the funds for such improvements have been limited and the renovation projects have been placed on hold. The insulation around the windows needs improvement as well. The heaters are located directly below the windows and the hot air escapes because the insulation is poor.

The staff at Virumhallen had very limited knowledge of the campaign and no action has been taken to promote energy saving behavior among employees and users. The campaign ambassadors have not been appointed, we have not observed any posters, feedback graphics or other campaign information around the building. However, as is visible in Figure 24, the electricity consumption has decreased significantly. The staff attributes this large decrease is to the technical modifications such as the energy-efficient light bulbs and the light brightness control panel. Therefore the technical modifications are extremely effective in reducing electricity consumption but the energy figures do not necessarily correlate with a change in attitudes and behaviors.

The following table displays Virumhallen's Campaign Effectiveness Index report. The overall grade of 'D' may be surprising to some, as Virumhallen is clearly an environmentally-conscious institution. However, we must reiterate that the Campaign Effectiveness Index is not a rating of an organization's commitment to sensible energy use and reduction. Rather it solely measures how effective the campaign was at achieving its goals in a particular location. With Virumhallen, an attitudinal campaign proved to be quite ineffective, as their mainly-technical staff held preexisting energy-related concerns, and closely monitored energy use prior to the campaign. Their initiative to encourage employees to bike to work instead of driving—which was in fact motivated by the campaign—is an excellent idea which we praise highly, but unfortunately it doesn't result in any energy savings. However, it raises awareness for the larger environmental concerns of global climate change.

<i>Campaign Component</i>	<i>Comments</i>	<i>Grade</i>
Commitment	Although they have not taken part in many of the more traditional campaign activities, they are certainly committed to being as energy-efficient as possible. As an extra commitment motivated by the campaign, Virumhallen employees have been urged to ride their bikes to work instead of driving.	C
Information	Virumhallen had no visible campaign information materials on-site. However, they claimed to read campaign emails regularly.	C
Feedback	Usage statistics were available, but they were not visible on-site.	D
Reward/Funding	Employees were unaware of the campaign competition. Additionally, they were unaware of potentially receiving funding for much-needed building upgrades.	F
Overall	The campaign was a particularly poor fit at Virumhallen. There existed very little need for attitudinal changes among the employees.	D

Table 8: Virumhallen Campaign Effectiveness Index

4.7 Analysis of Energy Consumption Data

As seen in Figure 26, there are a wide range of changes in energy consumption data from the last year into this year. While the weather could have been a large factor in energy consumption, each of the locations we are studying use natural gas as their source of heating, and therefore heating is not a factor for electricity consumption. Given this information the only effect that weather might have played would be if there was a significant difference in the

number of dark or cloudy days, compared to last year, when more lights would be needed to light a room compared to sunny days.

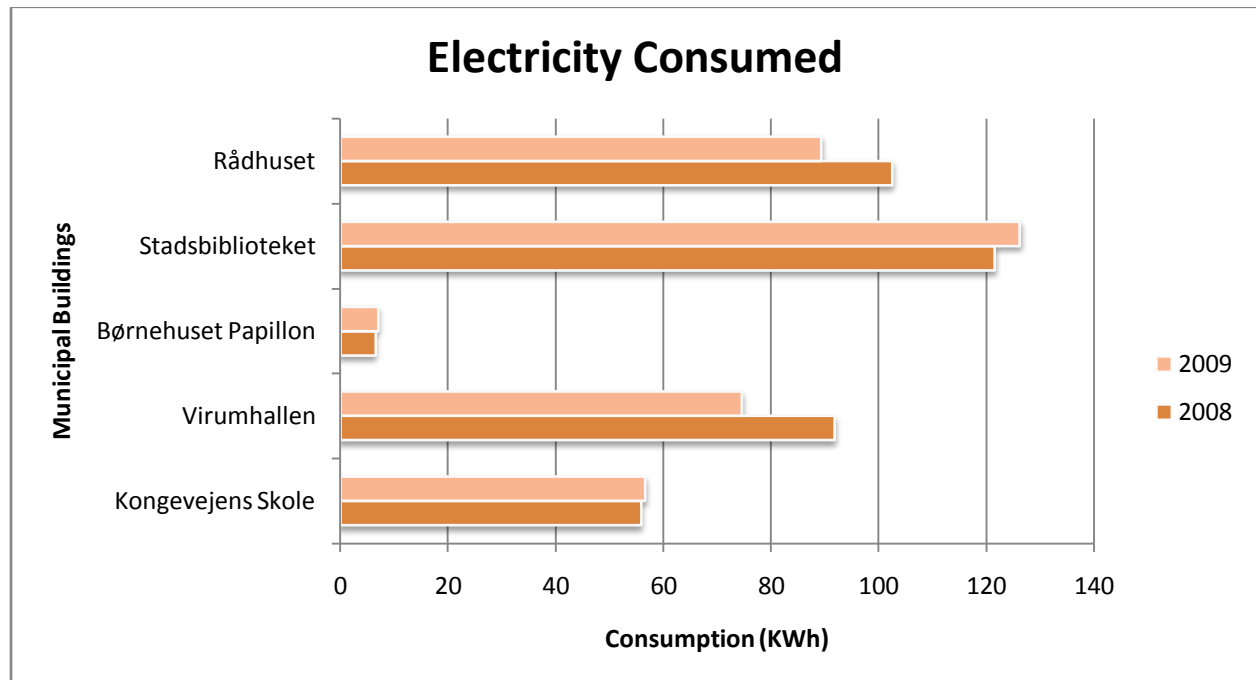


Figure 26: Energy statistics of the five institutions for January, February and March of 2008 and 2009

As mentioned the locations also had certain contextual factors that need to be addressed when examining this data. When looking at the data connected to Virumhallen it is crucial that one notes that the facility had all its light bulbs changed to energy saving models in August. Therefore the marked decrease in energy consumption has an origin in this upgrade, unrelated to the campaign.

Similarly the Kongevejen School recently had electric media boards installed in their classrooms. The use of these represents a new source of energy consumption that had not existed in previous years – and therefore could in part explain the increase noticed from 2008. Furthermore most of the locations had the factor of number of users or amount of use that could easily have changed from year to year. While there was no large change in number of personal or students at either Kongevejen School or Børnehuset Papillon, even the change in

one student or a change in personal with different attitudes could have a noticeable effect on the consumption over the course of a month. At both Virumhallen and Stadsbiblioteket the number of users is constantly in flux and changes daily, monthly, and yearly. Furthermore, at Virumhallen, there is a shifting competition schedule, such that as compared to last year, it could be the case that the facility was open on fewer weekends for competitions.

4.8 Survey Data

The results from the surveys will be presented in the following section. We gathered responses from 36 different individuals using an internet based survey. The individuals that responded to this survey were from a range of locations – including most of the five locations that were visited. Below the results from these surveys have been organized into graphs to visually represent the significant findings. The survey responses were used to inspect the attitudes of municipal employees, and any measured changes or trends. This is followed by an analysis of the behavioral patterns discovered.

The survey question “Have you learned anything from campaign materials” was used to evaluate the level of awareness of the campaign and the effectiveness of the campaign materials. Also this question measured the change in “consciousness of one’s possibilities.” Any person who responded with a “Yes” reported that the campaign had an effect of that particular precursor to environmental decision making. As can be seen in Figure 27, 57% of municipality employees have responded “Yes” to this question. From this we were also able to conclude that the campaign materials had been informative to the majority of employees and had been quite visible.

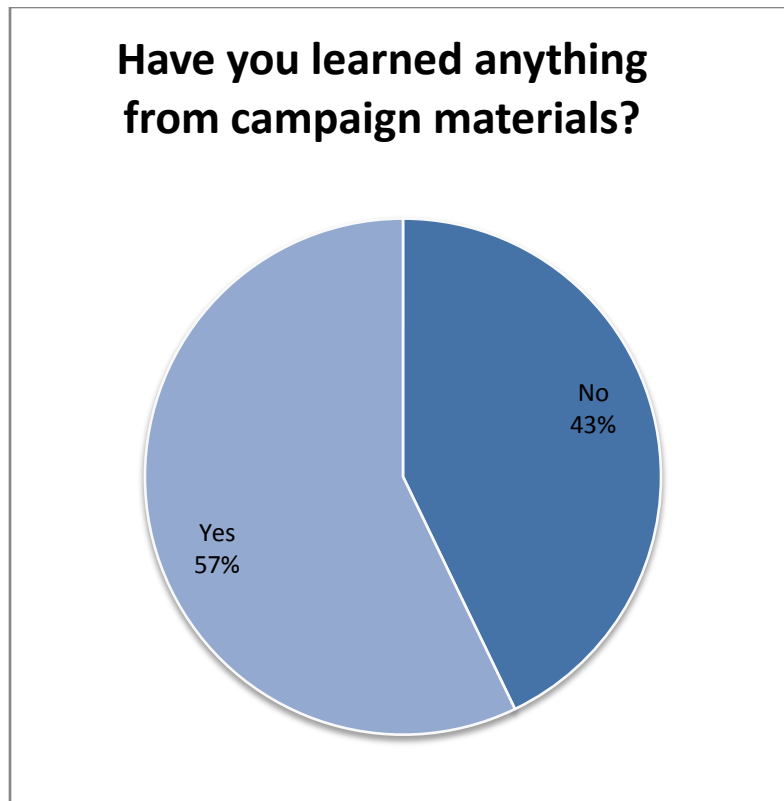


Figure 27: Survey question measuring impact upon knowledge

Additionally, as can be seen in Figure 28, 53% responded that they have been able to observe a change in behavior in coworkers. This relates to the measuring of “Social Norms” and this majority represents that the campaign had been effective in changing the “Social Norms,” another of the components from the Matthies flowchart of behavior (Figure 3).

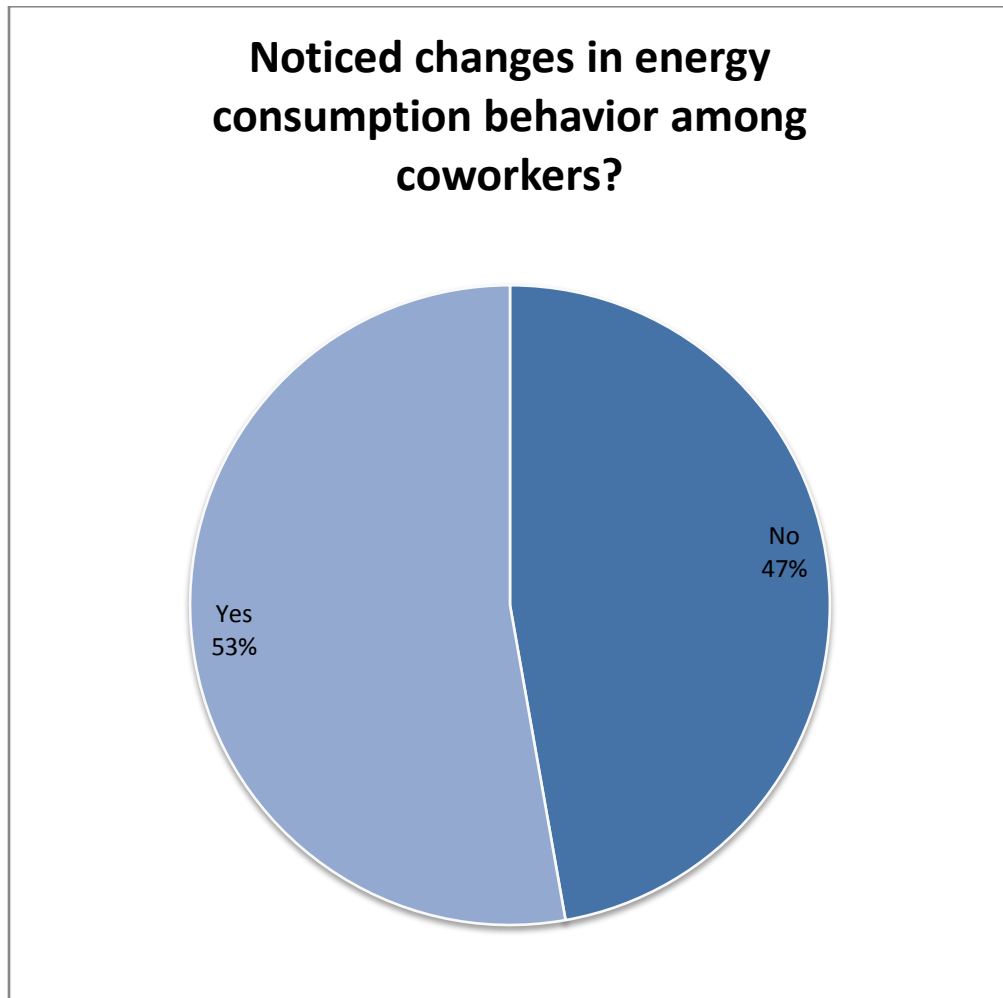


Figure 28: Survey question measuring social norms

As depicted in Figures 29 and 30, 31% of surveyed reported that they are more likely to turn off the computer and 39% responded that they are more likely to turn off the lights when they leave the room. These two questions were measuring the “Personal Environmental Norms” and the way that the campaign affected them. From these responses it can be noted that about a third of those polled had had their “Personal Environmental Norms” changed in a positive way. This is a sizable amount affected, especially given the fact that a negative response, “Just as likely,” could correspond with very environmental conscious behavior.

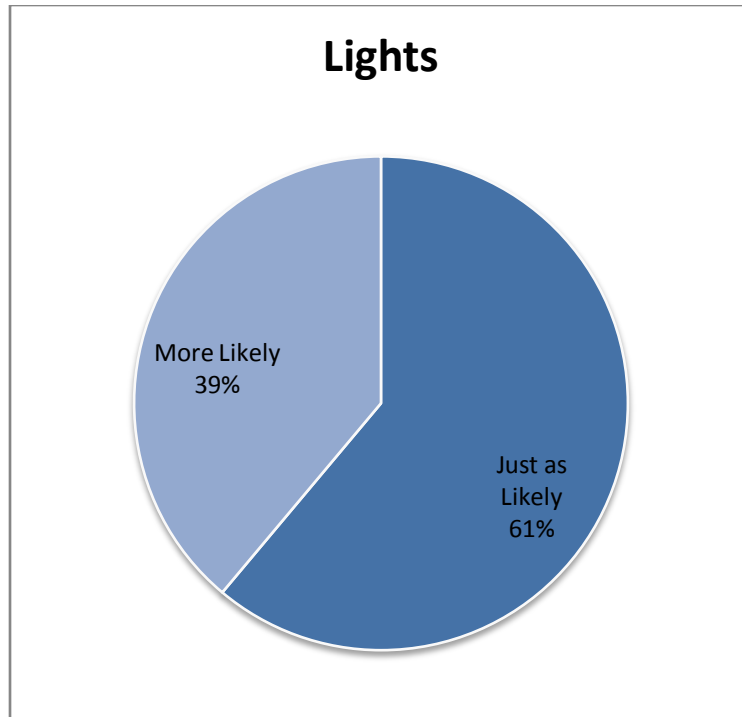


Figure 29: Survey question measuring behavior change related to lights

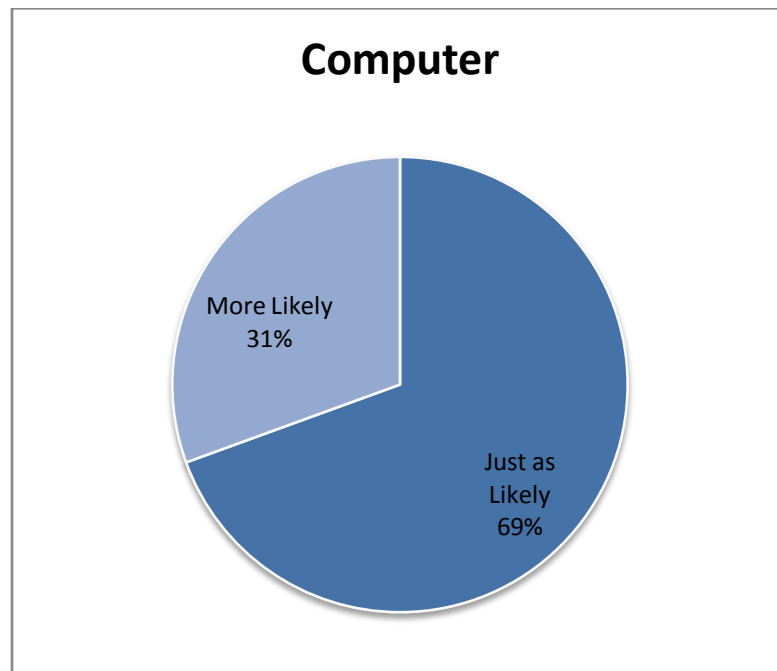


Figure 30: Survey question measuring behavior change related to computers

In Figure 31 we have represented the results of the question that was directed to measuring the “consciousness of relevance of one’s behavior.” In Figure 32 we have represented the results of the question that was directed to measuring the “consciousness of an environmental problem.” The results of these two questions show that those polled had very high environmental attitudes, even without the effect of the campaign.

I would change my daily routine to conserve energy

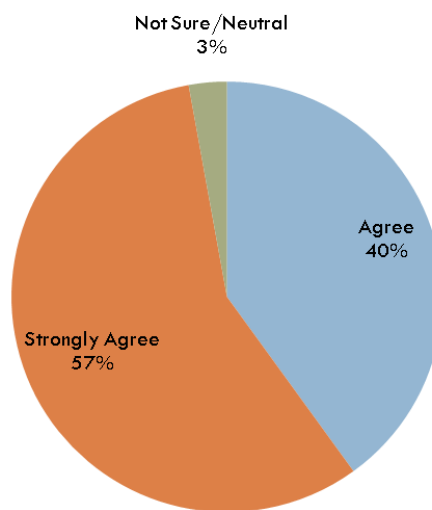


Figure 31: Measure of consciousness of relevance of one’s behavior

Conserving energy and natural resources is important to me

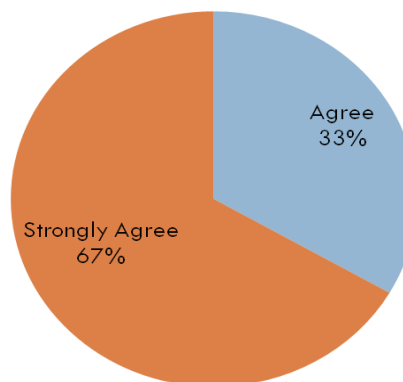


Figure 32: Measure of consciousness of an environmental problem

Figure 33 depicts the extent to which the campaign has been effective in changing “Individual Actions and Behavior” as described in the Matthies flowchart. The responses indicate that 40% Agree and 31% Strongly Agree with the statement that “The energy reduction campaign has motivated [them] to change [their] daily behavior.” More than half of employees, therefore, had been affected in a positive way by the campaign. Again this is quite an encouraging result for those who did not notice a change in their behavior could have already had environmentally conscious trends.

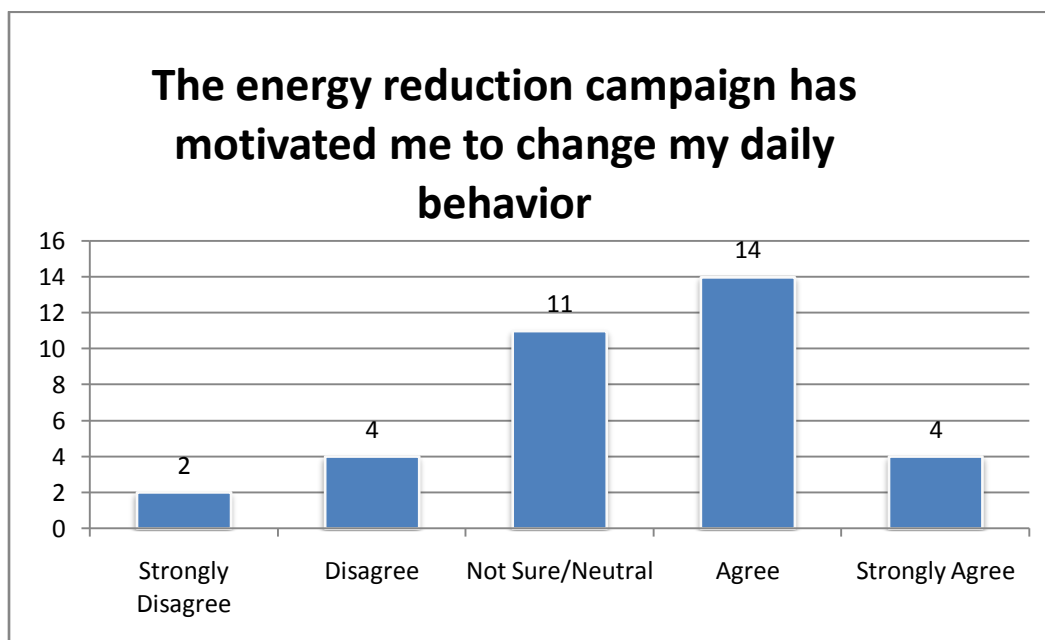


Figure 33: Level of effectiveness of the campaign on the change in behavior

The survey contained an open response question asking for any additional comments regarding the energy reduction campaign. Some of the responses to this prompt were rather thoughtful; two in particular provided significant insight into employees’ views of the campaign (translated from Danish):

- “I already had a major focus on energy conservation prior to the campaign – turning off lights and computers, turning off the faucet, closing the refrigerator. Since the

campaign started, I have been more proactive in reminding staff and administration to save energy.”

- “I think the campaign could have been more effective if we had more advanced notice to make changes. We could have really benefitted from qualified lecturers coming in to talk about energy reduction. Additionally, if campaign materials were targeted specifically toward our institution and not the municipality as a whole, it could have had a larger influence.”

4.9 Survey Data Conclusions and Analysis of Behavioral Patterns

When inspecting the aggregated attitudes of all those who were interviewed, surveyed and were informed about through the interviews, strength and frequency of the responses are crucial to verify. However, prior even to looking at the responses regarding the changes in attitudes can be examined; the attitudes that were present before to the campaign should be considered. When this is done some valuable data is removed. Nearly all of those who were polled agreed that they felt that the environment was important, and environmentally conscious behavior was important. When analyzing the responses about changes later, this would mean that even when there was reported no marked change in attitude it is has a likely cause in the fact that the individuals who did not see a change in themselves or others were already very environmentally minded. As such they could have not been significantly affected by the campaign.

From the interviews that were conducted we came across a range of attitudes. The least concerned was Virumhallen, where there are few municipal employees working and the involvement with the campaign has been mostly the simple activities that were asked of them. The most concerned was Kongevejen School, a significant number of employees have gotten involved in the campaign, taking an active role, even beyond the initial scope of the campaign.

The other institutions fell somewhere between these two examples, as seen in Figure 34. This data signifies that the campaign has been fairly successful. Even at the institution that was the least involved with the campaign, there was a positive response by the employees and the material and suggestions were not simply ignored.

In the analysis above, the change in attitudes was in a positive direction yet in three of the cases, out of the five examined, there was not a marked decrease in the energy consumption. This shows that there is not necessarily any correlation directly between the energy consumption and the attitudes. As explained in the previous section, this can be accounted for numerous outside factors which are constant factors to changes in energy consumption. It could be the case that without the campaign there would have been even larger increases in consumption as compared to last year. In order to truly develop accurate energy consumption results that would be able to be connected to the changes in attitudes a system of normalization would be need to be developed for each location. This would require that all the different factors be accounted and quantified at each location so that they could be used a calculation for what the use in electricity consumption would be without any changes in attitudes and behavior.

Chapter 5: Conclusions and Recommendations

The goal of Lyngby-Tårnbæk's energy reduction campaign was to affect the attitudes and behaviors of municipal employees with regard to energy consumption. The results from this study indicate that the campaign has been moderately successful.

The campaign had the goal of changing the attitudes of the municipal employees in order to make a more environmentally conscious community. In this respect the campaign did find success. All municipal employees who we interviewed were at least somewhat affected by the campaign—most reported being more likely to turn off the lights or computers since the campaign started. However, while there was a measured positive response to the campaign, in most cases the effects were not large shifts but reinforcements. Employees were motivated prior to the campaign to be very environmentally concerned and their participation in the campaign strengthened these attitudes.

While the campaign did not have any specific goals on reducing the energy consumption of the municipal buildings, it was hoped that through the efforts of the employees some changes would be noticed in consumption. Despite the campaign's effect upon municipal employees, only two of the five buildings yielded reductions in energy consumption compared to the previous year. It is also significant to note that one of the two buildings with energy reductions is Virumhallen—the organization which we judged to have the least participation in the campaign. Their energy reduction can be attributed primarily to building upgrades, specifically energy-efficient lighting. Thus it is clear that positive attitude changes cannot be correlated with reductions in energy consumption.

One strong point of the campaign was its visibility—most employees had seen campaign materials at their workplaces. However, while the campaign as a whole had high visibility, its specifics often went unnoticed. Most employees reported having seen posters reminding them to turn off the lights after leaving the room, but few said they actually take the time to read the campaign’s weekly email updates.

Based on feedback from municipal employees and our own observations, we would like to present the municipality with a set of recommendations which may prove useful in future energy reduction efforts:

- Weekly emails should be replaced by more effective methods of communication. For example, if each municipal institution appoints an ambassador to remind his/her coworkers about ways to reduce energy use at staff meetings, the information could be spread much more effectively. Also, reducing the frequency of emails may increase the chance that they will be read. It was a common opinion that after a few weekly emails, they are often assumed to contain the “same old message” about saving energy, so they begin to go unread. Thus monthly emails containing more information and appealing subject lines may be the superior delivery method.
- Many of the municipal employees already had very environmentally-conscious attitudes prior to the energy reduction campaign. Therefore, attitudes may not be the best target for a campaign. Better results may be yielded from a campaign which is strictly informational in nature. Several of the employees considered themselves to be very concerned with conserving energy, already regularly performing actions such as shutting down their computers after use. However, many of them were unaware that keeping a laptop charger plugged in while the laptop is not being charged wastes energy. By focusing the campaign around providing information about less commonly known methods of reducing energy, its efforts could be significantly less redundant and more effective.

- As noted by Abrahamse in the Journal of Environmental Psychology [13], the specificity level of the materials in an informational campaign is crucial—more specific energy-saving advice generally yields better results. Though it would require additional effort during a campaign’s planning stages, we feel that campaign material should be targeted toward specific institutions—at least the major ones, such as large schools or the main library. As an example of this, we have created a sample set of institution-specific materials:
 - At Kongevejen Skole, an entire generation of future energy savers lies within the reach of the campaign. The teachers have been very proactive in adding energy saving lectures to their courses. However, as noted by the deputy manager of the school, they could have benefitted from having qualified lecturers come in to educate students and teachers about the importance of saving energy, and the big-picture concern of global climate change.
 - At Børnehuset Papillon, food is prepared for 60 children on a daily basis. In response to this, a food pyramid prepared by two students at the Technical University of Denmark [43] could prove to be very informative and useful. The food pyramid, pictured below in Figure 35, organizes foods commonly served in Danish cafeterias according to their greenhouse gas footprints (for the entire lifecycle of the food products). Although it doesn’t directly relate to energy reduction, it may raise awareness in a relatively uncommonly-considered source of greenhouse gas emissions: food. It may motivate employees to switch over to a lower-emissions menu, and at very least will create awareness that the different foods we consume have varying greenhouse gas footprints.

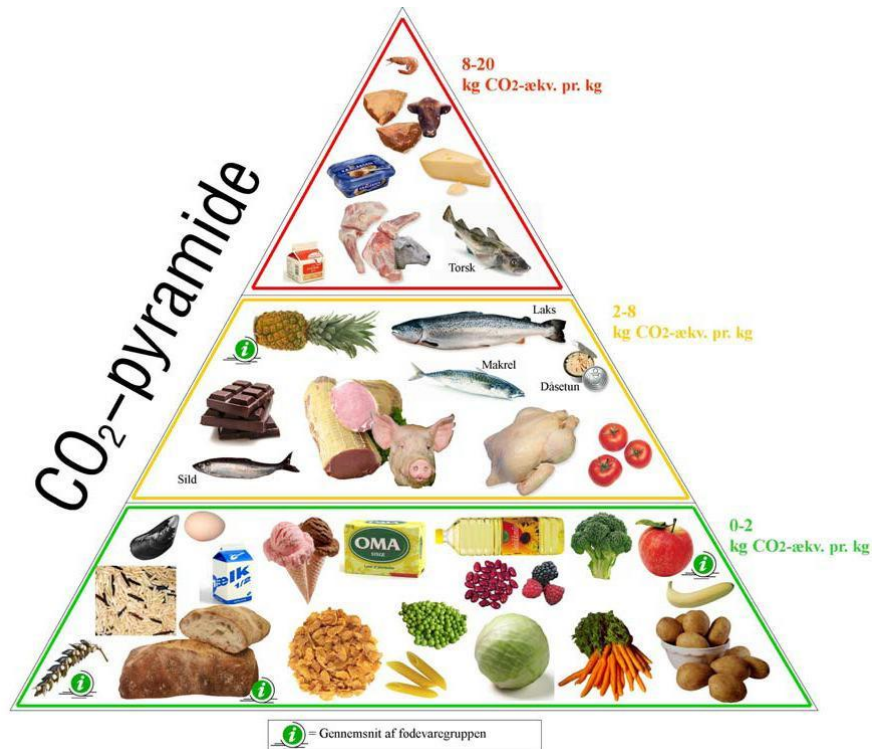


Figure 34: Greenhouse gas emissions food pyramid

- At Stadsbiblioteket, a helpful piece of campaign material could be bookmarks containing energy-saving tips. These could first be distributed to all employees, in their mailboxes or during a staff meeting. Then to increase the campaign's reach to the users of the library, they could be handed out for free when borrowing books. The library has numerous computers available to the public, as well as others utilized by employees. It would therefore be beneficial to provide them with literature regarding energy-conserving processors and power supply units for computers, which could be considered when performing computer upgrades.
- Personaleafdelingen is a typical office environment, unlike any of the other locations we investigated. They could benefit significantly by focusing on informing employees of some lesser-known ways to conserve energy, such as unplugging phone and laptop chargers when they are not in use.

- At Virumhallen, the majority of the employees are technical staff members who are already well aware of the importance of conserving energy. To extend the reach of the campaign to the users of the facility, they could have utilized additional campaign posters to be hung in the locker rooms, reminding facility users not to waste water or energy by taking unnecessarily lengthy showers.

We feel these recommendations should be considered by the municipality for future energy conservation efforts. However, their potential applications are by no means limited to use by Lyngby. We feel that they can be extended to any organized efforts which aim to address energy consumption.

Works Cited

- [1] IPCC. Summary for Policymakers. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller, editors, *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pages 1{18. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007.
- [2] UNFCCC. Uniting on Climate, 2007. Retrieved February 1, 2009, from http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/pub_07_uniting_on_climate_en.pdf
- [3] United Nations. United Nations Framework Convention on Climate Change, 1992.
- [4] Cicerone, R.J., E.J. Barron, R. E. Dickinson, I. Fung, J.E. Hansen, T.R. Karl, R.S. Lindzen, F.S. Rowland, E.S. Sarachik, and J.M. Wallace (2001). *Climate change science: An analysis of some key questions*. National Research Council, Washington, DC. 28 pp.
- [5] Morlot, Jan C, Organization for Economic Cooperation and Development. *National Climate Policies and the Kyoto Protocol*, 1999.
- [6] Linda Steg, Lieke Dreijerink, Wokje Abrahamse, Factors influencing the acceptability of energy policies: A test of VBN theory, *Journal of Environmental Psychology*, Volume 25, Issue 4, December 2005, Pages 415-425, ISSN 0272-4944, DOI: 10.1016/j.jenvp.2005.08.003.
- [7] United Nations Framework Convention on Climate Change. National greenhouse gas inventory data for the period 1990-2005. United Nations Office at Geneva, Geneva, Switzerland, October 2007.
- [8] Lyngby Radhus. About the Municipality of Lyngby-Tårnbak, August 2007. Retrieved January 26, 2009, from [http://www.ltk.dk/composite\(31\).htm?doc id=150#nav](http://www.ltk.dk/composite(31).htm?doc id=150#nav).

- [9] Workshops and Conferences." DTU - Danmarks Tekniske Universitet. 01 Feb. 2009
<<http://www.dtu.dk/subsites/klima/English/TechnologicalSolutions/WorkshopsAndConferences.aspx>>
- [10] VidenskabsButikken DTU. 01 Feb. 2009 <<http://www.vb.dtu.dk/index.php?id=10>>.
- [11] "Collaboration between companies." DTU - Danmarks Tekniske Universitet. 01 Feb. 2009
<http://www.dtu.dk/subsites/klima/English/TechnologicalSolutions/BusinessCollaboration.aspx>
- [12]
- Graph: *Reference*: (1) SGM Energy Modeling Forum EMF-21 Projections, Energy Journal Special Issue, in press, reference case CO₂ projections. (2) Non-CO₂ emissions are from EPA's Global Anthropogenic Emissions of Non-CO₂ Greenhouse Gases 1990-2020.
- [13] Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology*, 25, 273.
- [14] Dowling, G. R. (2001). The alpha, beta, gamma approach to measuring change and its use for interpreting the effectiveness of service quality programs. *Australian Journal of Management*, 26(1), 55. Retrieved from Academic OneFile database.
- [15] Govindarajulu, N., & Daily, B. F. (2004). Motivating employees for environmental improvement. *Industrial Management & Data Systems*, 104(4), 364.
- [16] Mankoff, J., Matthews, D., Fussell, S. R., & Johnson, M. (2007). Leveraging social networks to motivate individuals to reduce their ecological footprints. *Proceedings of the 40th Hawaii International Conference on System Sciences*, Hawaii.
- [17] Kitazawa, S., & Sarkis, J. (2000). The relationship between ISO 14000 and continuous source reduction. *International Journal of Operations & Production Management*, 20(2), 225.
- [18] Ramus, C., & Steger, U. (2000). The roles of supervisory support behaviors and environmental policy in employee 'ecoinitiatives' at leading-edge european companies. *Academy of Management Journal*, 8, 605.
- [19] Geller, E. S. (2002). The challenge of increasing proenvironment behavior. In R. G. Bechtel, & A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 525). New York: Wiley.

- [20] Matthies, E. (2005). How can psychologists improve their outreach towards practitioners? A suggestion for a new, integrative model of environmentally sound everyday practice. *Umweltpsychologie*, 9(1), 62.
- [21] Fischer, C. (2007). Influencing electricity consumption via consumer feedback. A review of experience. Berlin, Germany.
- [22] Steg, L., Vlek, C., Encouraging pro-environmental behaviour: An integrative review and research agenda, *Journal of Environmental Psychology* (2008), doi:10.1016/j.jenvp.2008.10.004
- [23] Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- [24] De Groot, J. I. M., & Steg, L. (2007). Value orientations and environmental beliefs in five countries: validity of an instrument to measure egoistic, altruistic and biospheric value orientations. *Journal of Cross-Cultural Psychology*, 38, 318–332.
- [25] Bamberg, S., & Schmidt, S. (2003). Incentives, morality or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz and Triandis. *Environment and Behavior*, 35, 264–285.
- [26] Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, J. A. (2007). The effect of tailored information, goal setting and feedback on household energy use, energy related behaviors and behavioral determinants. *Journal of Environmental Psychology*, 27, 265–276.
- [27] Vine, E. (2008). Strategies and policies for improving energy efficiency programs: Closing the loop between evaluation and implementation. *Energy Policy*, 36, 3872.
- [28] Siero, F., Bakker, A., Dekker, Van den Burg (1996). Changing organizational energy consumption behavior through comparative feedback, *Journal of Environmental Psychology* 16 (1996), pp. 235–246.
- [29] Rea, Louis M. *Designing and Conducting Survey Research: A Comprehensive Guide*. San Francisco: Jossey Bass, 2005.
- [30] Scherbaum, Charles A., Popovich, Paula, Finlinson, Scott. (2008). Exploring individual-level factors related to employee energy-conservation behaviors at work, *Journal of Applied Social Psychology*, 38, 818-835.

- [31] U.S. Census Bureau, Population Division. (2008). *World population: 1950-2050.*, 2009, from <http://www.census.gov/ipc/www/idb/worldpopgraph.html>
- [32] Danish Energy Authority, Copenhagen, Denmark. Energy Statistics 2006, 2007.
- [33] European Environment Agency. Greenhouse gas emission trends and projections in Europe 2007 | Denmark country profile. EEA Report No 5/2007, Office for Official Publications of the European Communities, Luxembourg, November 2007.
- [34] Behavioral Aspects of Energy Conservation & Sustainability: A Pilot Study. University of Michigan. Referenced from <http://www.isr.umich.edu/energypilot/> Feb 23, 2009
- [35] Cherfas, J. 1991. Skeptics and visionaries examine energy savings. *Science* 251:154-56
- [36] Marshall and Rossman, *Designing Qualitative Research*, 3rd Ed. London: Sage Publications, 1999, p. 115
- [37] Fischer, Corinna. "Feedback on household electricity consumption: a tool for saving energy?" *Energy Efficiency* 1 (2008): 79-104.
- [38] Edmonds, JA., Wise, MA., Dooley, JJ., Kim, SH., Smith, SJ., Runci, PJ., Clarke, LE., Malone, EL., Stokes, GM. Global Energy Technology Strategies: Addressing Climate Change, Executive Summary. May 2007.
- [39] "Null." *Energi i Danmark: produktion, forsyning og forbrug - Energistyrelsen*. 14 Apr. 2009 <<http://www.ens.dk/sw76426.asp>>.
- [40] "Small Business climate initiatives." *The Copenhagen Post* 16 Feb. 2009. 11 Apr. 2009 <<http://www.cphpost.dk/climate/91-climate/44777-small-business-climate-initiatives.html>>.
- [41] Reduced Carbon Dioxide Emissions." *The Copenhagen Post* 20 Mar. 2009. 11 Apr. 2009 <<http://www.cphpost.dk/climate/91-climate/45127-reduced-carbon-dioxide-emissions.html>>.
- [42] Kongevejen Skole. Accessed April 19, 2009.
<http://www.ko-ltk.dk/Infoweb/Designskabelon9/Rammeside.asp?Action=&Side=&Klasse=&Id=&Startside=&ForumID=>
- [43] Philip G. Lund and Lars K. Madsen (2008): Måltiders klimapåvirkning. Kortlægning af fødevarers CO₂-udledning og reduktion af CO₂ fra måltider. Videnskabsbutikken DTU

[44] Green Spider Network

http://ec.europa.eu/environment/networks/greenspider/index_en.htm. Accessed May 5, 2009.

Appendix A: Campaign Materials



"Are you aware of how busy I am?"
Forget the bad excuses. Remember to switch off the lights when leaving a room.



"I thought I heard someone else"
Forget the bad excuses. Remember to switch off the lights when you're the last in the room.



"I've heard it's not good to switch my PC on and off."
Forget the bad excuses. Remember to turn off your computer.

Appendix B: Survey Email (Danish)

Hej.

Vi er en gruppe af studerende, der arbejder med Tina Reinicke på Lyngby-Tårnbæks Rådhus og Videnskabsbutikken på DTU. Vi undersøger virkningerne og resultaterne af en miljøkampagne i Lyngby Kommune. I det tilfælde at din arbejdsplads er i Lyngby-Tårnbæk Kommune har vi lavet denne online undersøgelse og det vil glæde os, hvis du vil tage dig tid til at besvare vores spørgsmål. Den kan findes her ([SurveyMonkey URL](#)). Vi vil sætte pris på, hvis du vil sende den videre til dine medarbejdere.

Hvis du er særligt interesseret i denne kampagne, vil yderligere oplysninger glæde os og vi besøger gerne dit arbejdssted for et interview.

Tak for din tid.

Andrew Keating

Andrew Labak

Valentina Polyakova

Appendix C: Survey Email (English)

Hello,

We are a group of students working with Tina Reinicke at Lyngby- Tårnbæk City Hall and the Science Shop at DTU. We are trying to learn about the effects and results of an energy reduction campaign in Lyngby's municipal buildings. If your workplace is a Lyngby- Tårnbæk municipal building, we have created an online survey that if possible we would like you to take. It can be found here ([SurveyMonkey URL](#)). If you could pass this along to your coworkers we would appreciate it.

If you are particularly interested in the campaign we welcome any additional information and would be willing to come to your place of work for an interview. Thank you for your time.

Andrew Keating

Andrew Labak

Valentina Polyakova

Appendix D: Survey Questions (Danish)

Alle svar er valgfrie. Resultaterne af denne undersøgelse er fortrolige – dit svar vil på ingen måde være bundet tilbage til dig personligt.

1. Hvis du har lyst, kan du give information om din arbejdsplads og job nedenfor. Dette er dog fuldstændig valgfrit – du er velkommen til at lade disse kasser stå, hvis du ønsker at bevare din anonymitet.
 - a. Arbejdssted
 - b. Jobposition
2. Svar venligst på disse spørgsmål
 - a. Har du kendskab til en miljøkampagne i Lyngby-Tårnbæk Kommune?
 - b. Vidste du, at din afdeling kan vinde op til 10.000 kr for ekstraordinær indsats i denne energikampagne?
 - c. Har du lært noget af kampagnens materiale?
 - d. Siden kampagnen startede (den 1. januar), har du bemærket nogle ændringer i forhold til dine kollegers energiforbrugsadfærd?
 - e. Har du set en plakat som den, der er vist nedenfor?
3. Vurder dine følelser udfra følgende
 - a. At bespare energi og naturlige ressourcer er vigtigt for mig.
 - b. Bestræbelser på at reducere energiforbrug på arbejdspladsen er et vigtigt skridt mod at løse globale miljøproblemer.
 - c. Jeg vil gerne ændre min daglige rutine for at reducere forbruget af energi.
 - d. Miljøkampagnen har motiveret mig til at ændre min daglige adfærd (hvis den har, vær venlig at uddybe hvordan nedenfor)
 - e. På hvilken måde(r) har du personligt reageret på kampagnen?

4. På hvilke måder (hvis nogen) har du set eller hørt andres reaktion på kampagnen?
5. Med hvilken hyppighed udfører du følgende handlinger? (aldrig/nogle gange/ofte/altid/ikke relevant)
 - a. Hvor ofte slukker du lyset, når du er den sidste, der forlader et rum på din arbejdsplads?
 - b. Hvor ofte slukker du lyset, når du er den sidste, der forlader et rum i dit hjem.
 - c. Hvor ofte slukker du din computer på din arbejdsplads, når du er færdig med at bruge den.
 - d. Hvor ofte slukker du din computer derhjemme, når du er færdig med at bruge den.
6. Overvej hvordan din adfærd har ændret sig siden den 1. januar (mindre sandsynligt/det samme/mere sandsynligt/usikker)
 - a. Sammenlignet med sidste år, hvor sandsynligt er det, at du slukker din computer, når du forlader dit arbejde ved dagens slutning?
 - b. Sammenlignet med sidste år, hvor sandsynligt er det, at du slukker lyset, når du forlader et rum?
7. Hvilke af følgende produkter har du på dit kontor eller din arbejdsplads til personlig brug (aldrig eller sjældent brugt af andre end dig selv)? Marker alle relevante.
 - a. Stationær eller bærbar computer
 - b. Printer
 - c. Varmeapparat
 - d. Ventilator
 - e. Elektrisk ur
 - f. Køleskab
 - g. Mikrobølgeovn
 - h. Kaffemaskine
 - i. Radio
 - j. Lampe

8. Hvilke af følgende produkter, som deles med andre, ville du normalt have på dit kontor eller på din arbejdsplads?
- a. Stationær eller bærbar computer
 - b. Printer
 - c. Varmeapparat
 - d. Ventilator
 - e. Elektrisk ur
 - f. Køleskab
 - g. Mikrobølgeovn
 - h. Kaffemaskine
 - i. Radio
 - j. Lampe
9. Hvilke af følgende har du kontrol over på din arbejdsplads?
- a. termostat
 - b. lys
 - c. vinduer

Appendix E: Survey (English)

All responses are completely optional. The results of this survey are confidential - your responses will in no way be tied back to you personally.

1. If you would like to, you may provide information about your organization and job below. However, doing so is completely optional - feel free to leave these boxes blank if you wish to remain anonymous.

a. Organization

b. Job Title

2. Please respond to these questions (Yes/No)

a. Are you aware of an energy reduction campaign in the Lyngby-Tårnbæk municipality?

b. Did you know that your department can win up to 10.000DKK for extraordinary participation in the energy campaign?

c. Have you learned anything from campaign materials?

d. Since the campaign has started (January 1), have you noticed any changes in energy consumption behavior among your coworkers?

e. Have you seen a poster like the one pictured below?



3. Rate your feelings based on the following prompts

- a. Conserving energy and natural resources is important to me
- b. Efforts to reduce energy consumption at work is an important step towards resolving global environmental issues
- c. I would change my daily routine to conserve energy
- d. The energy reduction campaign has motivated me to change my daily behavior (if it has, please elaborate below)
- e. In what way(s) have you personally responded to the campaign?

4. In what ways (if any) have you seen or heard about others responding to the campaign?

5. Choose the frequency which you perform the following actions

(Never/Sometimes/Usually/Always/Not Applicable)

- a. At work, how often do you turn the lights off if you're the last person to leave a room?
- b. At home, how often do you turn the lights off if you're the last person to leave a room?
- c. At work, how often do you turn off your computer when finished using it?
- d. At home, how often do you turn off your computer when finished using it?

6. Please consider how your behavior has changed since before January 1 (Less likely/Just as likely/More likely/Unsure)

- a. Compared to last year, how likely are you to turn off your computer when leaving work at the end of the day?
- b. Compared to last year, how likely are you to turn off the lights when you leave the room?

7. Which of the following items do you normally have in your office or at your workstation for PERSONAL use (never or rarely used by anyone other than yourself)? Check all that apply

- a. Desktop/Laptop Computer
- b. Printer
- c. Space Heater
- d. Electric Fan
- e. Electric Clock

- f. Refrigerator
- g. Microwave
- h. Coffee maker
- i. Radio
- j. Lamp

8. Which of the following items do you normally have in your office or at your workstation for which are shared among others?

- a. Desktop/Laptop Computer
- b. Printer
- c. Space Heater
- d. Electric Fan
- e. Electric Clock
- f. Refrigerator
- g. Microwave
- h. Coffee maker
- i. Radio
- j. Lamp

9. Which of the following do you have control over in the workplace?

- a. Thermostat
- b. Lights
- c. Windows

Appendix F: Complete Survey Results

Total surveys completed: 36

Note that all survey responses were optional, and some respondents skipped questions.

	No	Yes	Skipped
Are you aware of an energy reduction campaign in the Lyngby-Tårnby municipality?	1 (2.8%)	35 (97.2%)	0
Did you know that your department can win up to 10.000DKK for extraordinary participation in the energy campaign?	16 (44.4%)	20 (55.6%)	0
Have you learned anything from campaign materials?	15 (42.9%)	20 (57.1%)	1
Since the campaign has started (January 1), have you noticed any changes in energy consumption behavior among your coworkers?	17 (47.2%)	19 (52.8%)	0
Have you seen a poster like the one pictured below?	9 (25.7%)	26 (74.3%)	1

Table 9: Campaign visibility

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree	Skipped
Conserving energy and natural resources is important to me	0	0	0	12 (33.3%)	24 (66.7%)	0
Efforts to reduce energy consumption at work is an important step towards resolving global environmental issues	0	0	1 (2.8%)	13 (36.1%)	22 (61.1%)	0
I would change my daily routine to conserve energy	0	0	1 (2.9%)	14 (40%)	20 (57.1%)	1
The energy reduction campaign has motivated me to change my daily behavior	2 (5.7%)	4 (11.4%)	11 (31.4%)	14 (40%)	4 (11.4%)	1

Table 10: Attitude measurements

	Never	Sometimes	Usually	Always	N/A	Skipped
At work, how often do you turn the lights off if you're the last person to leave a room?	0	3 (8.3%)	8 (22.2%)	25 (69.4%)	0	0
At home, how often do you turn the lights off if you're the last person to leave a room?	0	1 (2.8%)	6 (16.7%)	29 (80.6%)	0	0
At work, how often do you turn off your computer when finished using it?	2 (5.6%)	4 (11.1%)	3 (8.3%)	26 (72.2%)	1 (2.8%)	0
At home, how often do you turn off your computer when finished using it?	0	2 (5.6%)	8 (22.2%)	25 (69.4%)	1 (2.8%)	0

Table 11: Energy use habits

	Less Likely	Just as Likely	More Likely	Unsure	Skipped
Compared to last year, how likely are you to turn off your computer when leaving work at the end of the day?	0	25 (49.4%)	11 (30.6%)	0	0
Compared to last year, how likely are you to turn off the lights when you leave the room?	0	22 (61.1%)	14 (38.9%)	0	0

Table 12: Behavioral change

Which of the following items do you normally have in your office or at your workstation for PERSONAL use (never or rarely used by anyone other than yourself)?

Item	# Who Checked Yes
Computer/Laptop	24
Printer	12
Space Heater	11
Electric Fan	3
Electric Clock	1
Refrigerator	3
Microwave	3
Coffee Maker	3
Radio	5
Lamp	21

Table 13: Personal appliance use

Which of the following items do you normally have in your office or at your workstation for which are shared among others?

Item	# Who Checked Yes
Computer/Laptop	23
Printer	31
Space Heater	19
Electric Fan	6
Electric Clock	2
Refrigerator	25
Microwave	13
Coffee Maker	24
Radio	6
Lamp	27

Table 14: Shared appliance use

Which of the following do you have control over in the workplace?

Item	# Who Checked Yes
Thermostat	18
Lights	34
Windows	30

Table 15: Thermostat, light and window access

Appendix G: Interview Question Set

Building Information

- The air conditioning system
- Age of the building
- Type of building
- Materials of the building
- Floor height (smaller building—lower energy consumption)

Building Upgrades

Has any electricity-efficient equipment—particularly lighting—been installed as a part of the campaign?

Did the building already have energy-efficient light bulbs or a motion detecting light activation system installed before the campaign?

Have hours of the facility changed compared to last year?

Since last year, have there been any changes in the number of people who use the facility?

Have there been any significant changes in electrical equipment such as computers in the past year?

Knowledge of campaign

What response, if any, has this facility (or any other facilities you work with) taken to the campaign?

Did you go to one of the training sessions?

If yes, did you find the information useful?

If yes, have you implemented any of the energy saving techniques introduced at the information sessions?

Have you seen posters around the workplace which are promoting energy saving?

Have you seen this poster? How has it affected your behavior?



Did the poster grab your attention?

Were you ever reminded of the poster before leaving a room in which the light was on?

Do you know of any other institutions which have made changes due to the campaign efforts?

Have you observed any changes in the attitudes of your co-workers with respect to energy conservation, since the beginning of the campaign?

What about any noticeable changes in their behaviour?

Attitudes toward global warming

Do you think global warming is an important issue?

Do you believe that efforts to reduce electricity consumption at work, such as remembering to turn off unnecessary lights or computers, are important in the fight against global climate change?

At work, how frequently do you turn off the lights if you're the last one in the room?

What about at home?

At work, how frequently do you turn off the computer if you're the last one using it?

What about at home?

Electricity Usage Statistics

Have you been collecting the electricity consumption statistics since the start of the campaign?

You have been advised to post these statistics in the building so the employees have feedback on their energy usage. Have you done this?

Do you have any general comments regarding your interpretation of the figures—any insight upon the effect that the campaign or any other factors has had upon them?

Appendix H: Campaign Feedback Email

(Danish)

UGE 9

Endnu en solstrålehistorie

Så er vi godt igang med 2. måned af vores interne energisparekampagne, og der spares på livet løs rundt om i de forskellige forvaltninger og institutioner. I Fritids- og Ungdomsklubben Vænget har de i januar 2009 f.eks. sparet 18,5% af elforbruget i forhold til forbruget i januar 2008.

Klubleder Tommy Olivenlund fortalte ved kampagnestart personalet om kampagnen, om husets nuværende forbrug, og lidt om hans egne ideer til nedsættelse af forbruget.

Tommy's ideer var:

- At etablere skumringsrelæ på ejendommens udebelysning.
- At udskifte huset pære til sparepære.
- At drøfte sparekampagnen på det ugentlige personalemøde.
- At nedsætte produktionen af varmt vand i nattetimerne.
- At opfordre personalet til at fortælle husets medlemmer om brugen af EL.

Personalet var ivrigt lyttende og bød selv ind med flere gode ideer.

Personalets ideer var:

- At lave egen posters til ophæng i institutionen. Posters som kunne minde kolleger, børn og unge om at slukke for lyset, når lokaler ikke blev benyttet.

- At minde sine kolleger om - gerne dagligt,- hvilken virkning det at sparere får for institutionen og for miljøet.
- At være opmærksomme på at slukke elektriske apparater efter brug. F.eks. Strygejern, Tv, Video, Computere og Dvdafspillere m.m.
- At være bevist om brugen af husets vaskemaskine og tørretumbler.
- At se til, at alt lys og el-forbrugende maskiner er slukket ved arbejdsdagens ophør.
- At huske at rose sine kolleger, når de husker spareforslagende.

Både Tommy's og personalets ideer er etableret med stor succes.

Appendix I: Energy Report for Børnehuset Papillon

Energimærkning

SIDE 1 AF 11



Energimærkning for følgende ejendom:

Adresse: Gl. Bagsværdvej 53
Postnr./by: 2800 Lyngby Kommune
BBR-nr.: 173-006772-001
Energimærkning nr.: 200002311
Gyldigt 5 år fra: 03. august 2007
Energikonsulent: Jørgen Urskov Jacobsen



Firma: FORCE Technology

Energimærkningen oplyser om ejendommens energiforbrug og mulighederne for at opnå besparelser. Energimærkningen udføres af beskikkede energikonsulenter for handel, service og offentlige bygninger og er lovpligtig.

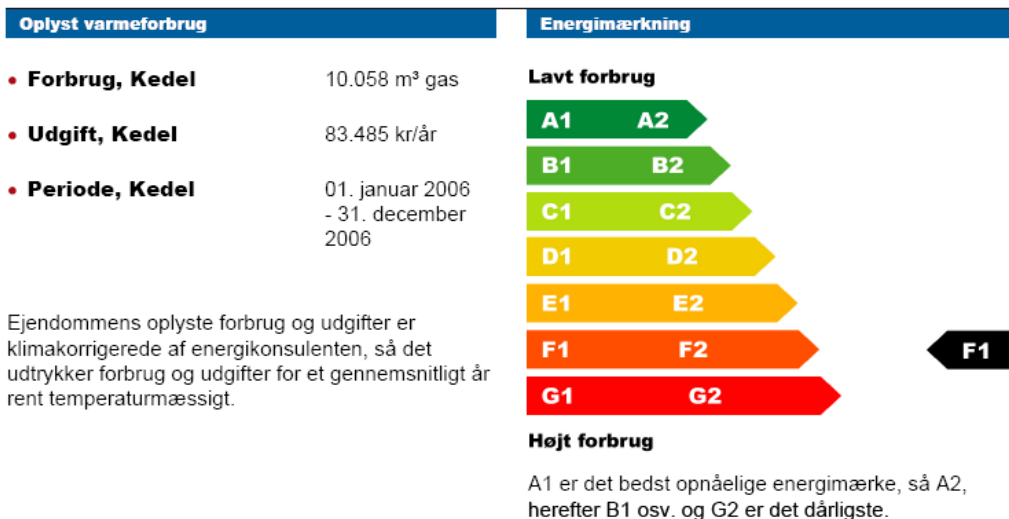


Figure 35: Børnehuset Papillon energy rating