

TAMPERE POLYTECHNIC
Environmental Engineering

Final Thesis

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**METHODS TO REDUCE CO₂ EMISSIONS FROM OFFICES AND PUBLIC
EVENTS IN FINLAND**

Supervisor
Commissioned by
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TAMPEREEN AMMATTIKORKEAKOULU

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TIIVISTELMÄ

Yksi aikamme merkittävimmistä ympäristöongelmista on voimistunut kasvihuoneilmiö ja siitä johtuva ilmastonmuutos. Hiilidioksidi on eräs voimakkaimmin kasvihuoneilmiötä lisäävistä yhdisteistä.

Suomen WWF on ollut yhdessä Motiva Oy:n ja TTK Dipolin kanssa kehittämässä hiilidioksidilaskuria, jonka tarkoitus on lisätä yleistä tietoisuutta hiilidioksidipäästöjen haitallisesta vaikutuksesta ilmastoon, ja keinoista, joilla hiilidioksidipäästöjä voidaan vähentää.

Hiilidioksidilaskuri tullaan sijoittamaan internetiin. Se on suunnattu pääasiallisesti toimistojen ja yleisötapauksien käyttöön, mutta muutkin tahot, esimerkiksi yksityiset ihmiset, voivat sitä hyödyntää. Hiilidioksidilaskurin avulla on mahdollista laskea hiilidioksidipäästöjen määrä sekä saada tietoa hiilidioksidipäästöjen vähentämisestä.

Tämän työn tarkoituksena oli koota yhteen erilaisista lähteistä tietoa hiilidioksidipäästöjen vähentämismahdollisuuksista toimisto-organisaatioissa ja yleisötapauksissa. Tutkimusalue rajattiin käsittelemään sähköä, lämmitystä, matkustamista ja kuljetuksia, ja paperin kulutusta. Nämä samat tekijät on otettu huomioon myös hiilidioksidilaskurissa asiantuntijaryhmän niin päätettyä.

Jotta ihmisen toiminnasta johtuvia hiilidioksidipäästöjä voitaisiin vähentää ja siten ilmaston lämpenemistä estää, on tärkeää, että kaikki mahdolliset tahot saavat tietoa ilmastoon vaikuttavista tekijöistä sekä keinoista toimia ympäristöystävällisemmin. Tämän työn sekä koko hiilidioksidilaskurin päämäärä on tavoittaa mahdollisimman monta ihmistä, koska jokainen voi vaikuttaa puhtaamman ilmakehän puolesta.

TAMPERE POLYTECHNIC

Environmental Engineering

Ahonen, Saana Methods to reduce CO₂ emissions from offices and public events in Finland

Final Thesis 58 pages

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ABSTRACT

One of the most significant environmental problems of our times is the enhanced greenhouse effect, and the climate change resulting from it. Carbon dioxide is one of those greenhouse gases that are promoting this effect.

WWF Finland in co-operation with Motiva Ltd and Dipoli at Technical University of Helsinki has developed a CO₂ counter, which aims to increase general knowledge on the harmful effect of carbon dioxide emissions to the atmosphere. Also the methods to reduce CO₂ emissions are provided.

The CO₂ counter will be placed in the Internet. It is aimed mainly to act as a tool for offices and public events, but it can also be used by others, even by the public. The CO₂ counter can be used to calculate the amount of CO₂ emissions and to get information on emission reduction possibilities.

The aim of this thesis was to gather information how to reduce CO₂ emissions from offices and public events from different sources. The survey area was determined to concentrate on electricity, heating, travelling and transportation, and paper consumption. The same factors were taken into account in the CO₂ counter.

In order to decrease the CO₂ emissions caused by human actions and thus to prevent climate change, it is important that information is given about the factors affecting the atmosphere and ways how to act more environmentally friendly. The aim of this thesis and the CO₂ counter is to reach as many people as possible, because everyone can act for a cleaner atmosphere and a more sustainable future.

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1 INTRODUCTION

1.1 Background information

Environmental problems are among the biggest challenges to be met in the future. While the industries and markets are growing and the population of the world is expanding, there is all the time more and more evidence that also the effects on the environment are increasing. One of the most important environmental issues today is the climate change. There is strong evidence that the actions of humans, especially certain emissions to air, cause a phenomenon, which is called the climate change.

One of the main substances that contribute the climate change is carbon dioxide, CO₂. In certain amounts carbon dioxide is essential to the life on earth, for example plants need CO₂ for photosynthesis. However, the excessive amounts of CO₂ from the use of fossil fuels, industry, and other mainly human-made sources have led to a situation where the amount of CO₂ is so big that it causes changes in the atmosphere. The changes, which are caused by carbon dioxide and other pollutants, can be seen for example as temperature warming and extreme weather conditions. As climate change has the potential to have an impact on the life of every living thing, it is important that we humans, as the source of CO₂ and many other pollutants, try to carry out our responsibility to reduce those emissions that can cause unwanted changes to the environment. CO₂ being one of the most important, or most dangerous, substances that can alter the balance of the atmosphere, it is necessary to try to figure out ways how the CO₂ emissions could be decreased.

1.2 Objectives and definition of the research area

The main purpose of this thesis is to present ways to reduce CO₂ emissions coming from offices and public events. Because there are many different ways to cut the emissions from these sources, this thesis will not go into every detail of them, but tries to offer a broad view of the possible methods of emission reduction, and also to give examples where to get further information. The information how to reduce the carbon dioxide emissions is scattered in many different sources, for example it is quite easy to find facts how to save electricity, but

the information how the emissions can be compensated by carbon offsets is on the other hand more difficult to achieve. That is why the aim of this work was to make a coherent entity of the information available including all the subjects needed from background information on climate change to the methods how to reduce the emissions. This report gives information on:

- Climate change
 - What it is
 - Why it is important to reduce CO₂ emissions from offices and public events
- Methods to reduce CO₂ emissions from offices and public events
 - Electricity
 - Heating
 - Travelling and transportation
 - Paper

The group of experts, which were involved in developing the CO₂ counter, defined the research area. They agreed that electricity, heating, travelling and transportation, and paper were the most important sources of CO₂ emissions from offices and public events. The opinions of potential users were also taken into account by doing a marketing enquiry before the development of the CO₂ counter.

The objectives of this work were met by collecting the scattered information of the relevant subjects from various reliable sources, selecting the best information and then formatting it to an appropriate shape to this report. This report is a part of the CO₂ counter project, which is developed by WWF Finland, Motiva Ltd, and TKK Dipoli, which is the lifelong learning institute of Helsinki University of Technology. The CO₂ counter project is designed mainly for offices and public events, and that is why also the information in this report concerns those same parties. The CO₂ counter is also a part of an EU funded project, which aims to develop a handbook how to organise a public event in an ecoefficient way. This report is designed to be a background material for the CO₂ counter project. Parts of the report will also be used directly in the counter as a theory, giving information to the users of the CO₂ counter on how to reduce the emissions. It will be published in the Internet, and parts of it will also be translated into Finnish and summarised so that it will be easier to read.

1.3 Research methods and sources

The research method that has been used in this final thesis is qualitative. In a qualitative research it is important to study the subject with a holistic approach. The Qualitative Research Method is very flexible. It is typical for this method that the research plan changes and takes its final shape during the research process. A method called inductive analysis is typically used in the qualitative research, and in this the researcher is trying to reveal unexpected facts about the subject. Because of that, the target is not to test a theory or hypothesis, but to study the subject in a comprehensive and detailed way. It is said that the inductive analysis summons individual findings to common meanings / 32 /. The inductive analysis has been used to some extent in this thesis. It lists the ways how offices and public events can reduce their CO₂ emissions, and tries also to introduce new and innovative ways to do so.

The information in this report has been collected by researching and studying the existing literature and other sources on the relevant subjects. In addition, interviews of some specialists in the fields concerned have been used in the collection of information. In this report the information on how to reduce CO₂ emissions coming from offices and public events is collected together to a sort of a guideline. Because this report is mainly aimed at offices and public event organisers, one objective was to present the information in such a way that it is easy to understand although the reader might not be familiar with all the issues beforehand. Because of that, this final thesis differs from the others by the language used, and also how the information is presented.

1.4 The basic concepts related

1.4.1 The CO₂ counter

WWF Finland in co-operation with TKK Dipoli and Motiva Ltd is developing a CO₂ counter, with which organisations can evaluate the amount of CO₂ emissions their activities emit and get information on how to reduce their emissions. The CO₂ counter will be a www-based service mainly for the use of offices and public event organisers, but it can basically be used

by all organisations that do not belong to the European Union's emission trading scheme, as well as individuals who are interested in how much CO₂ their consumer choices, for example travelling, emit. The aim of the counter is that users could evaluate their CO₂ emissions coming from the consumption of electricity and heat, travelling, transportation, and the amount of paper used. The users will also be given information and examples of emission reduction methods. / 47, 20 /

The CO₂ counter is developed to make it easier for organisations to realise the effects that their actions have on the climate change. Understanding the connection of consumption habits, CO₂ emissions, and the climate change is important so that organisations would be more aware of their possibilities to take responsibility for preventing pollution and the climate change through their actions. By giving information and increasing knowledge the CO₂ counter aims at decreasing the negative impacts that CO₂ has on climate and reducing the use of natural resources by increasing the *eco*efficiency of companies, and promoting sustainable ways of working and living. / 20 /

The European Union's emission trading directive puts obligations mainly to energy production and industry. The principal goal of the CO₂ counter project is to give an opportunity to the organisations, which do not belong to this directive to take part in preventing the climate change by reducing emissions. It also educates individuals through working environments and public events about more environmentally friendly and less climate changing consumer choices. The aim is that the service would affect the attitudes of the users and would make them become motivated to develop the *eco*efficiency of their organisation, and thus change their and the whole organisation's working methods to a more sustainable direction. The direct impacts of the CO₂ counter in preventing the climate change are probably minor, but it can have important indirect impacts through education. / 47, 20 /

The CO₂ counter offers a ready made model to evaluate and calculate CO₂ emissions, to recognize the biggest factors causing emissions, and ways to reduce them. The organisations using it can get various benefits from it. Firstly reducing the emissions can lead to savings in costs, for example saving electricity reduces electricity bills, and shifting towards electronic data management will cut the amount of paper needed, make the business faster and reduce the workload. Nowadays people are becoming more aware of environmental issues, and often

companies working in a sustainable way are supported. Taking care of their emissions will improve a company's image and also create trust among clients. The CO₂ counter can also be helpful when doing an environmental report or creating an environmental management system. It can for example give companies new benchmarking opportunities. If the employees become interested in changing their behaviour and working methods to a more ecoefficient and environmentally friendly way, the company can benefit greatly from it.

1.4.2 Ecoefficiency –what it is and how organisations can benefit from it

The first definition for ecoefficiency was given by the Business Council of Sustainable Development (BCSD) in United Nations meeting in Rio 1992. According to the definition ecoefficiency can be achieved by decreasing the amount of materials and energy used in the production, usage, and waste management of a product, while securing the quality of the product. By functioning in an ecoefficient way the negative ecological effects during the lifecycle of the product are decreased to a level, which is tolerable by the environment. According to BCSD the methods to achieve these goals include minimising the energy intensity of products and services, minimising toxic emissions, promoting recycling, maximising the use of renewable natural resources, and increasing the lifetime of products. / 38 /

Basically the concept of ecoefficiency means to get more out of less. The use of natural resources can be reduced by acting ecoefficiently, and thus also the amount of emissions and waste decreases. Eco-efficiency is a strategy for sustainable development and also a way of protecting the environment. / 39 /

Studies indicate that the growth of consumption in the industrialised countries does not increase the welfare of people. Contamination of the environment because of the increasing use of natural resources in fact decreases the quality of life in many ways. Preserving the nature and its resources does not necessarily mean the decrease of benefit or welfare –but vice versa, it can improve both / 39 /. In the past a common opinion was that promoting sustainability and environmental protection was costly and unprofitable for an organisation.

However, ecoefficiency offers a possibility to make savings and even to move towards a more profitable business by using fewer natural resources more effectively / 37 /.

Ecoefficiency is a challenge for offices and public event organisers. They can increase their ecoefficiency for example by making better consumer choices, decreasing unnecessary use of materials and saving energy. In offices these changes also usually decrease the costs. For instance durable and high-quality office equipment will be more profitable in the long run, and energy savings decrease electricity bills. In addition to reducing costs, offices and public event organisers can take responsibility for their emissions, protect the environment, and make an influence also by showing the way for others. / 37 /

The concept of ecoefficiency has been kept in mind throughout the making of this thesis. Making an organisation function more ecoefficiently reduces its contribution to the environment and its emissions, also CO₂. This thesis presents methods to reduce CO₂ emissions coming from offices and public events. The methods introduced will also lead an organisation to function in a more ecoefficient way. All of them are relatively easy to implement and will not require lots of time or money. The key point is, though, that to make it really work it is important that everyone in the whole organisation does it. The responsibility for environmental issues should not be placed on the shoulders of a person or two, but every worker should be involved from the very beginning. Reducing carbon dioxide emissions and moving towards ecoefficiency require usually only minor changes with some training. It can take a little time for the employees to get used to them, but in the end the new ways will not take more time than the old ones and they are beneficial in many ways. / 37 /

1.5 The structure

The theory for this thesis is presented in chapters 2 and 3. In chapter 2 the concept of the climate change and its consequences are explained more thoroughly. The effects of CO₂ emissions and other human activities on the climate change are discussed in chapter 3, and the reasons why carbon dioxide emissions from offices and public events should be minimised are presented.

The results of this work are in chapter 4, where the methods to decrease the amount of carbon dioxide coming from offices and public events are presented. This chapter is built to be used directly in the CO₂ counter, and that is why the chapters are written to offer the users of the counter the most appropriate knowledge in a compact shape as well as tips where to get more information.

The Conclusions and suggestions for further studies from the data in this report are drawn up in chapter 5, which is followed by the list of references.

2 THE CLIMATE CHANGE

2.1 What is the greenhouse effect

The earth receives continuously solar energy from the sun through the atmosphere. For the temperature of the earth and its atmosphere to stay at a constant level, the incoming solar energy has to be balanced by the same amount of outgoing energy. Majority of this outgoing energy is reflected by the surface of the earth. Most of the solar radiation that is not reflected back to space is degraded into infrared radiation, which is experienced as heat. As it is important that part of the solar energy reaching the earth is reflected back, it is also essential that part of it stays and warms the earth and troposphere, the innermost layer of the atmosphere. / 34 /

Some substances, called the greenhouse gases, reduce the flow of heat back into space. The main greenhouse gases are carbon dioxide, water vapour, methane, nitrous oxide, and ozone. The greenhouse gases help warming the earth by acting somewhat like the glass in a greenhouse, allowing the build-up of heat. The greenhouse gases absorb some of the infrared radiation reflected from the earth's surface, which causes their molecules to vibrate and transform the absorbed energy into longer wavelength infrared radiation into the troposphere. It is natural that these substances are present in the atmosphere, in fact without this natural greenhouse effect the earth would be too cold for the life that there now exists. / 34 /

2.2 How the climate changes

Changing climate is not a new or unusual phenomenon. The earth's climate as well as its surface temperature has been changing during its past, sometimes slower over hundreds or even millions of years, and other times more quickly even over decades. What captures the attention is that the changes in climate in the near past have happened in a relatively short time period / 34 /. Climate models and other available evidences indicate that the average mean surface temperature of the earth increased by approximately 0,6°C between the years 1860 and 1995, which can be seen from graph 1 / 33 /.

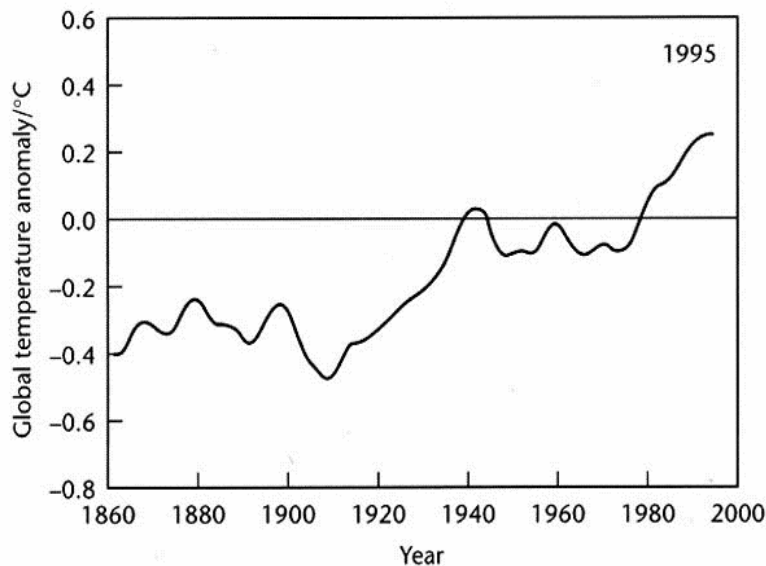


Figure 1. Global temperature change/°C from 1860-1995 / 33 /

The 1990s was probably the warmest decade of the millennium in the Northern Hemisphere, and the year 1998 is likely to have been the warmest year. It is possible that the rate and duration of the temperature warming in the 20th century has been greater than any other time during the last 1000 years (UNFCCC 2002, www 26). The changes in temperature may seem small, but it is important because even minor alterations in the average global temperature can have serious effects and cause perturbations in the world's climate / 33 /.

The average surface temperature of the earth is approximately +15°C. If the natural greenhouse effect were acting by itself, the mean surface temperature would be about 54°C.

However, there is also a natural cooling process that helps balancing the climate. The natural cooling effect is caused by the evaporation of surface water and cloud formation / 34 /. In addition to that, some human-caused emissions, for example aerosols, increase the natural cooling effect. Still, these cooling effects are not enough to compensate the heating, which has happened in the recent decades mostly because of the increased greenhouse gas emissions / 33 /.

As a consequence, there has been an increase in the net radiative forcing in the latter half of the 20th century. Part of this increase can be caused by the natural alteration of the climate, for example an increase in the output of sun, but there is strong evidence that most of it is due to the greenhouse gas emissions released by human activities. From the main greenhouse gases carbon dioxide is the one that has been found to have the largest contribution to the increase in radiation, as can be seen from table 1. / 33 /

Table 1. The contributions of the main anthropogenic greenhouse gases to the total increase in radiative forcing from 1980 to 1990 / 33 /

Gas	Contribution/%
Carbon dioxide	55
CFC-11 and CFC-12	17
Methane	15
Other CFCs	7
Nitrous oxide	6

The rising levels of the emissions contribute the global warming by causing a thicker blanket of the greenhouse gases in the atmosphere, which creates an *enhanced* greenhouse effect / 34 /. Since the thicker blanket of the greenhouse gases reduces the amount of energy that is reflected back to space, the climate has to adjust somehow to the changes in order to maintain the balance between the energy arriving from the sun and the energy escaping back into space. Warming up of the earth's surface and the lower atmosphere is the simplest way to get rid of the extra energy. Climate models have predicted that the global temperature will rise by about 1,4 – 5,8°C by the year 2100, if no efforts are made to limit the greenhouse gas emissions. This temperature change would be much larger than any climate change experienced over the last 10 000 years / 26 /.

2.3 Evidences of the global warming

Temperature measurements from the atmosphere as well as from different levels in the earth's surface, and analysis of ice core samples show considerable evidence that the effects of global warming can already be seen:

- The 20th century was the hottest in the past 1000 years.
- Temperatures have been increasing at the earth's poles and in Greenland causing the melting of ice caps and the floating of ice.
- Glaciers have been shrinking on the tops of the mountains for example in the Alps, Andes, and Himalayas.
- The average global sea level has risen 10-20 centimetres over the past 100 years because ocean waters are expanding from their increased average temperature and the input of water has increased from the melting of glaciers.
- Some tree, fish, and other species have been migrating to more north than before to find more optimum temperatures.
- In many parts of the world spring has been arriving earlier, and autumn frosts later / 34 /.
- Snow cover in the mid- and high latitudes of the Northern Hemisphere has declined by approximately 10% since the late 1960s.
- Precipitation has increased in some parts of the world, for example in the Northern Hemisphere, while the frequency and intensity of droughts seem to have worsened in some parts of Africa and Asia / 26 /.

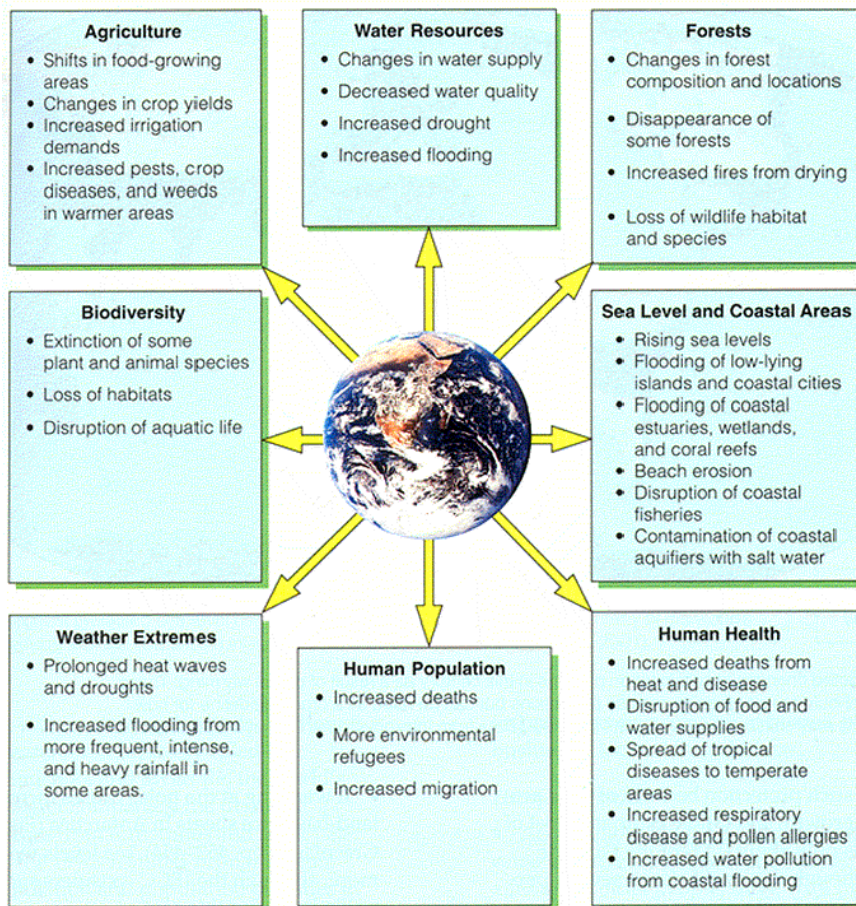
There is a possibility that some of the changes listed above could have occurred because of natural climate fluctuations, but it is more likely that changes in the climate because of human activities is the major cause. Also the combination of both of these factors could be the cause. Despite what causes it, climate change and its consequences can have serious effects on human life, wild life, and the world's economy / 34 /. For that reason it is essential that the human influence on climate change is reduced as much as possible.

2.4 Future effects of the climate change

It is probable that the earth continues to warm if nothing is done to the amount of the greenhouse gases that are continuously released to the atmosphere. A couple of degrees of temperature change can sound a minor change. There is often that much of a change in the temperature between May and July, or even between yesterday and today. Yet the key point is that these changes are not just normal swings in local weather, but a projected *global* change in climate. If the average surface temperature of the earth keeps increasing, it can cause a large number of effects on humans, other species, and ecosystems. Some of the projected effects based on current climate models are / 34 /:

- Rising sea levels, which can lead to increased flooding
- Changing ocean currents, which can affect the climate in near-by regions, such as weakening of the Gulf stream
- More rainfall in some areas, especially in higher latitudes
- Less rainfall in other areas, causing more droughts and expansion of deserts
- More intense warming over land and in higher latitudes than at sea or lower latitudes; global warming will not be the same everywhere
- Shifts in climate regions, affects food-growing areas and the ranges of some animal and plant species
- Loss of habitats, and migration of some species to new areas, for example species that are used to warmer weather conditions
- More frequent and intense extreme weather conditions such as hurricanes, typhoons, and tornadoes
- Increase of the area in the world affected by malaria and other tropical diseases / 33, 34 /

In addition to the list above, more possible future effects of the climate change are presented in picture 1.



Picture 1. The possible effects of a warmer atmosphere / 34 /

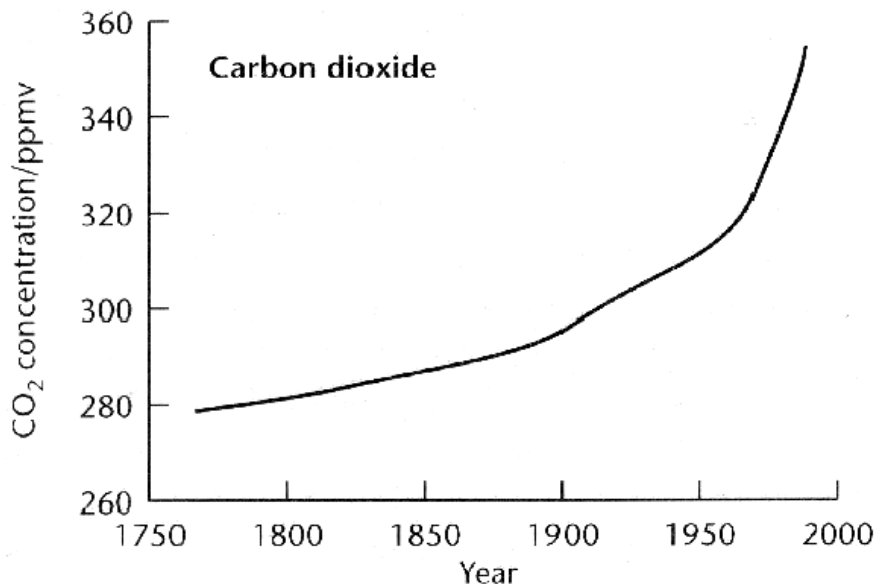
There are though a couple of uncertainties concerning these projected changes that the climate change could cause. The problem with the current climate models is that they cannot make reliable projections about *where* the changes might take place and how long could they last. / 34 / That implies that the climate change really has to be taken seriously.

3 CARBON DIOXIDE –THE MOST HARMFUL GREENHOUSE GAS

Carbon dioxide is considered as the most harmful of greenhouse gases. Its concentration in the atmosphere is the highest, and at the moment it is responsible for over a half of the enhanced greenhouse effect. Currently the annual emissions of CO₂ are over 23 billion tons,

and the CO₂ concentration in the troposphere is higher than it has been in 420 000 years / 26, 34 /.

The atmospheric levels of CO₂ seem to have varied by less than 10% during the 10 000 years before the industrialisation. However, in the 200 years since 1800, the levels of carbon dioxide have increased by approximately 30%, which can be seen from graph 2. Even though half of the CO₂ emissions created by human actions are absorbed by the oceans, land, and vegetation, the atmospheric levels of CO₂ continue to rise by over 10% in every 20 years if nothing is done to the amounts of human-caused emissions. / 26 /



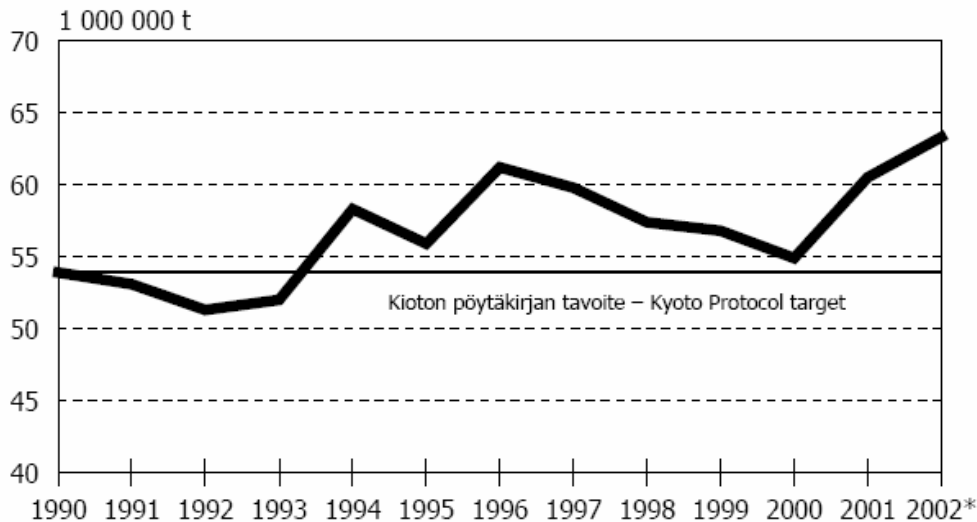
Graph 2. Trends in the atmospheric concentration of carbon dioxide / 33 /

3.1 Total CO₂ emissions in Finland

As can be seen from graph 3, the CO₂ emissions in Finland have been rising in the recent years. In the year 2002 the CO₂ emissions were 63 million tonnes. The increase in the CO₂ emissions was mainly because the low production of hydropower in that year was compensated by energy produced in coal and peat power plants. Although the energy production has become less CO₂ intensive since 1990 because the increased use of renewable energy and the increased capacity of nuclear power, Finland still has a lot to do to achieve the

targets set up in the Kyoto Protocol. Finland's target in reducing the CO₂ emissions is the 1990's level, 54 million tonnes. / 25 /

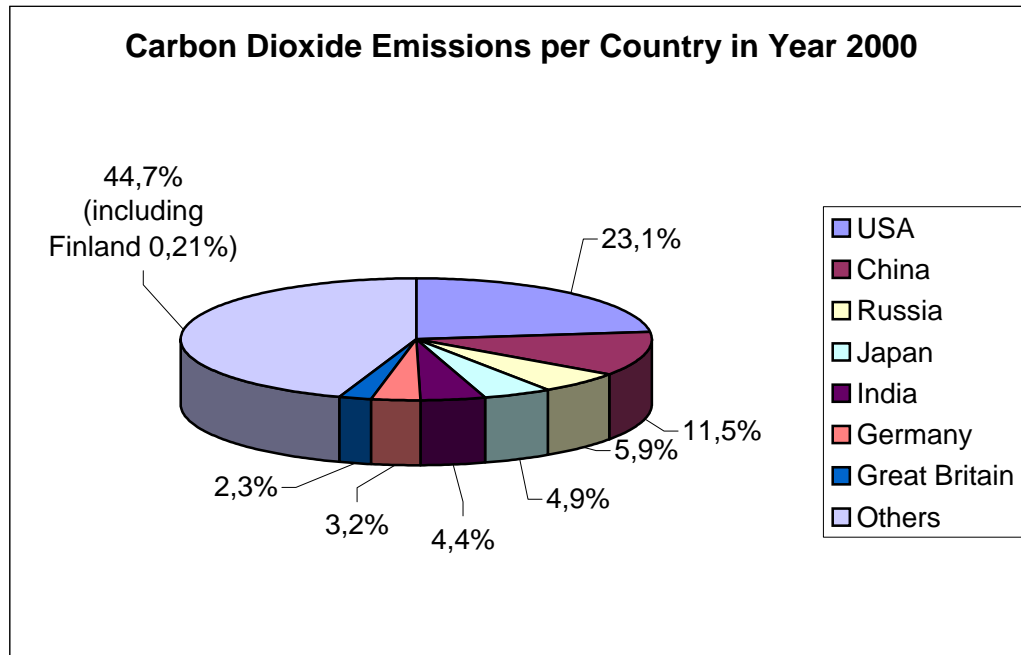
Hiiidioksidipäästöt 1990–2002*
*Carbon Dioxide Emissions 1990–2002**



Graph 3. The CO₂ emissions in Finland 1990-2002 / 25 /

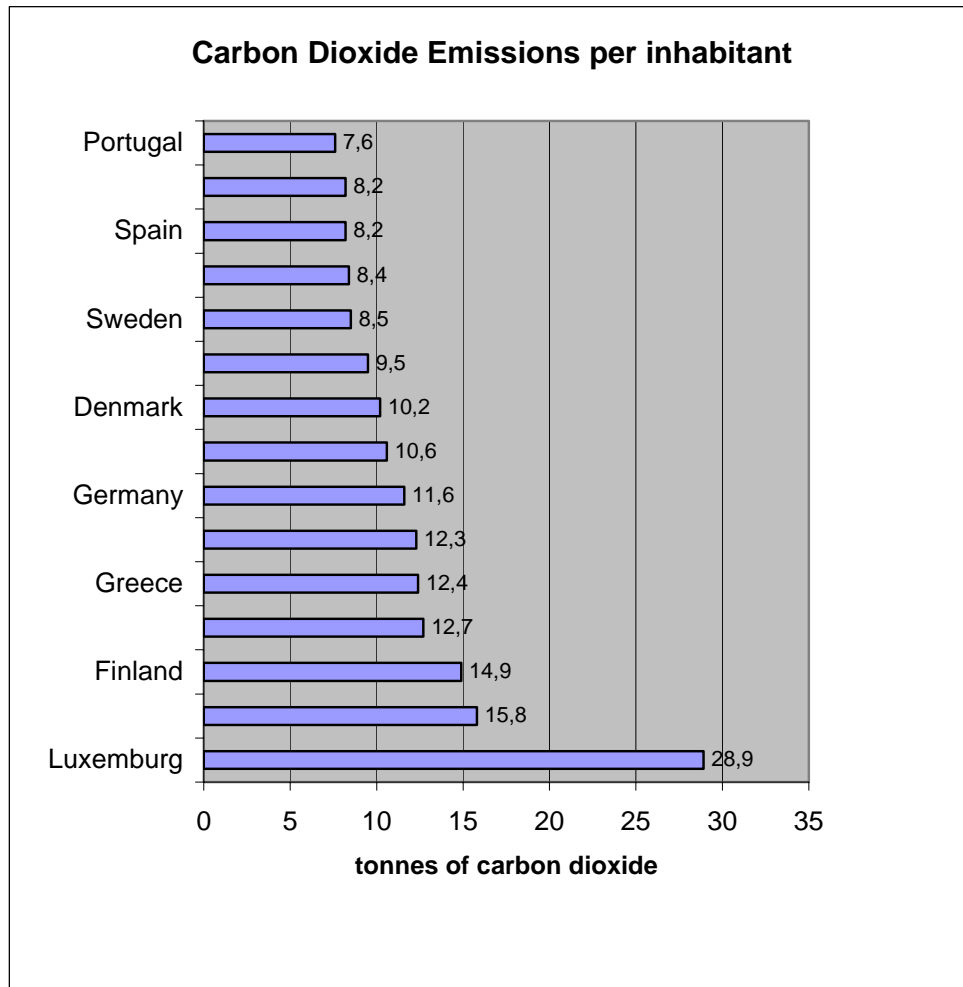
3.2 Comparing the CO₂ emissions of Finland with other countries

The carbon dioxide emissions produced by the human activities are not equally divided between countries. As can be seen from graph 4, in the year 2000 the United States was emitting the largest amounts of CO₂ when measured per country, having a huge share of 23,1% of the world's CO₂ emissions. The second biggest emitter was China with a share of 11,5%, mainly because of its huge economic growth in the recent years. The following five were Russia, Japan, India, Germany, and Great Britain. Finland is included in the others column having only 0,21% share of the carbon dioxide emissions per country. / 36 /

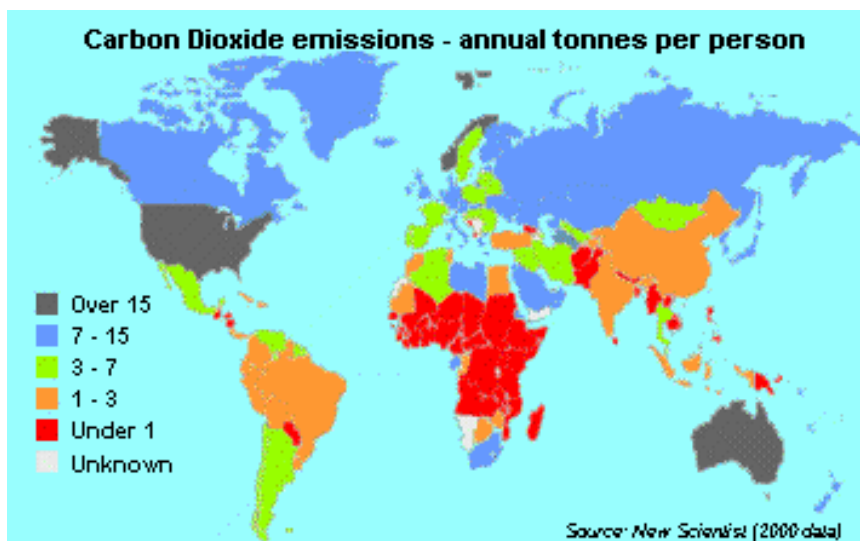


Graph 4. Carbon dioxide emissions per country in the year 2000 / 36 /

On the other hand, when the carbon dioxide emissions are measured per inhabitant, Finland's share is much bigger. When 15 EU countries are compared, Finland is the third biggest emitter of CO₂ per person, after Ireland and Luxemburg (graph 5). So when the population is taken into account, Finland is actually doing quite bad compared to our small population. The amount of the CO₂ emissions per person in Finland is bigger than in many other EU countries with larger population, for instance Germany or Great Britain. That is something that should be considered when discussing how important it is to cut the CO₂ emissions in Finland / 35 /. In addition, picture 2 gives an idea of the CO₂ emissions per person of all countries. It is possible that in the future Finland will have to pay more attention to the high amounts of CO₂ emissions, and the emission reductions will become a more important issue than it is today. Ways for offices and public events to reduce their emissions are introduced later in this thesis.



Graph 5. The carbon dioxide emissions per person of 15 EU-countries / 35 /



Picture 2. The CO₂ emissions per person / 14 /

3.3 How the human activities release CO₂

Many important human activities release greenhouse gases. Emissions have been rising since the beginning of the industrial revolution in the 1800s. At the same time there was a sharp rise in the use of fossil fuels, which release great amounts of pollutants, including carbon dioxide. Many activities that emit greenhouse gases are unfortunately nowadays a part of the modern life and the global economy. For example, two largest contributors to the current CO₂ emissions are the world's numerous coal burning power and industrial plants and the more than 700 million gasoline-burning motor vehicles. / 34 /

The burning of the fossil fuels is the largest single source of the greenhouse gases, including CO₂. Bulk of the energy that is used to produce electricity, run automobiles, heat houses and power factories come from oil, natural gas, and coal. Approximately 80% of the human-caused CO₂ emissions are because of the fossil fuel burning. The remaining share of CO₂ comes from deforestation, agriculture, and other changes in land use. / 26 /

Future CO₂ levels, as well as levels of the other greenhouse gases, depend on various factors: the world's population, economic, technological, and social trends. The effect of population is probably the clearest. The more people the higher emissions. The impact of economic development is not so clear. The richer countries usually generate more emissions per person than the poorer countries, but much depends on the sources of energy used, the geographical position, and the efficiency with which energy and natural resources are used. / 26 /

3.4 What can be done to reduce the human effect on climate change

To be able to slow the rate and intensity of the climate change from the increased greenhouse gas emissions, there are a couple of basic things that need to be changed. First of all using fossil fuels as an energy source should be minimised, relying more on cleaner, renewable energy sources such as solar and wind power. In addition, wasting less energy by improving the energy efficiency can reduce the amount of the CO₂ emissions and also save money. Though actions of even one individual are important, government actions are needed to be able to reduce the greenhouse gas emissions significantly. / 34 /

The governments can contribute to the amount of the CO₂ emissions produced by phasing in carbon taxes, for instance on each unit of CO₂ emitted. Essential would also be that the governments would start to support and subsidise renewable energy sources and their development, as well as other sustainable ways of functioning, such as cleaner transport choices. However, probably the most important thing would be to establish international agreements to reduce the greenhouse gas emissions, like the Kyoto Protocol. / 34 /

The Kyoto protocol was a result of a meeting of the United Nations Framework Convention on Climate Change (UNFCCC), which is an international treaty established to offer evidence that human activities are contributing the climate change, and to promote international research and co-operation on how the problem should be solved. The Kyoto protocol was set up in an UNFCCC meeting in Kyoto, Japan in 1997 / 33 /. It requires developed countries to cut their emissions of six key greenhouse gases at least 5% below 1990 levels by 2012. These six gases are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PECs), and sulphur hexafluoride. However, the Kyoto treaty is concerning only the developed countries, it does not require the developing countries to make any cuts to their emissions. The Kyoto protocol allows emission trading among the participating countries as a way to reach their goals / 26 /.

The Kyoto Protocol is a big step forward, but in practise it has not yet come into force. The treaty will not enter into force until it is ratified by 55 developed countries, whose emissions cover at least 55% of the greenhouse gas emissions from all developed countries. Some countries, including the biggest greenhouse gas emitter the United States, have announced that they will not approve the treaty. However the European Union is politically committed to the emissions reductions whether the Kyoto Protocol comes into force or not. / 36 / Finland has agreed to reduce its greenhouse gas emissions to 1990 level by the year 2012 / 20 /.

The truth is that even if the Kyoto Protocol came into force, it would not be able to prevent the climate change itself, because the emission reductions of only the countries committed would not be enough compared to the emissions of the whole world. However, it would be extremely important that the Kyoto treaty would be ratified, because it would be a proof that the countries have admitted the need of emission reductions and are ready to implement them and develop the progress further / 36 /. It would also promote sharing of the information on

national climate change programs, co-operation on scientific and technical research, and education and training about the climate change. / 26 /

According to the Kyoto Protocol, the developed countries should lead the emission reduction process, because they are responsible for most of the greenhouse gas emissions. However, also the emissions from the developing countries are now growing at a rapid speed because of their industrialisation. According to IPCC, Intergovernmental Panel on Climate Change, it would require 60-70% cuts to CO₂ emissions to be able to stop the global warming / 20 /. In order to do so, it would require all countries to make cuts to their emissions. Yet, it is unlikely to happen in the near future. / 36 /

Although the Kyoto Protocol if ratified is not enough to completely prevent the climate change, it is an important tool to decrease the amount of the greenhouse gases, and also lead the way to other hopefully more effective climate and environmental treaties. As the European Union is committed to the Kyoto Protocol, it will have a great opportunity to show the way in reducing the emissions, since it has now a considerable share of the emissions to be decreased to reach the goals of the Protocol. It is important that the EU countries including Finland will show that the emissions should be reduced, and that it can be done without any remarkable economic losses. In addition it is essential that more research on the climate change and its effects is carried out, as well as learning ways how to reduce the emissions.

3.5 How offices and public events emit CO₂

Usually we think of the industry and large chimneys with black smoke coming out when we are considering the major sources of carbon dioxide. However, offices account for a surprisingly large part of carbon dioxide emissions, and it is important to understand the relation between them and the climate change. Offices and public events consume the products of industry and that way their consumer choices direct the production of industry and the amount the emissions. / 45 /

The most significant CO₂ emissions from offices come from the consumption of electricity and heat in the office, travelling to work, business trips of employees, and material purchases and consumption, the most important being paper. / 45 /

The most important sources of CO₂ from public events are the consumption of electricity and heat, transportation of constructions and materials, material purchases and consumption, waste of the event, travelling, and participators spending nights in hotels and other temporary places. In addition public events are usually planned in an office space, so basically public event organisers can also utilize all the information. / 45 /

As a conclusion, the most significant sources of CO₂ from both offices and public events are:

- Consumption of electricity and heat
- Transportation and travelling
- Consumption of materials, especially paper

3.6 Why it is important to reduce the CO₂ emissions from offices and public events

It is widely recognized that the industry is the largest contribution to the atmospheric CO₂ amounts, which enhance the global climate change. Other major factor causing CO₂ emissions is traffic. Because of that there are a lot of statistics gathered on emissions of the industry and traffic. Besides those, it is difficult to find any statistics about other sources of CO₂. For example, there are no available statistics on CO₂ emissions from offices or public events, and at least in Finland the emissions from those sources have not been followed.

Most of the international climate treaties like the Kyoto Protocol and their emissions reduction targets are basically aimed at industry. So although industry is not the only factor emitting CO₂, there are no legal or other requirements for offices, public events, or other factors that are left outside those target groups to decrease their emissions. Because of the fact that the existing climate treaties are not enough to stop the climate change, it is important to spread the information and knowledge also to those parties that do not belong to the emission reduction requirements. Even though offices and public events are not obligated to reduce their CO₂ emissions, many of them could be interested to do so voluntarily, if informed properly about the importance of reducing CO₂ emissions and their possibilities to do so.

The industry is the biggest source of CO₂ emissions, but it is the customers of its products that have the power to direct the production. Offices and public events are consumers of

various products of industry, for instance electricity, heating, and paper. If the customers of the industry demand for more environmental friendly and less polluting products such as green energy, the industry has to shift the production into that direction to attract customers and to make profit.

In addition to that, offices and public events are consumer intense organisations and therefore an important group tackling climate change. By reducing their CO₂ emissions offices and public events can give their customers a possibility to decrease the impact that their consumption habits have on the environment. Also the consumption choices of people have a great opportunity to affect the amount of pollution coming from the human actions. Thus the organisations that are closer to consumers have the potential to affect the consumers' opinions and consumption habits to a less polluting direction.

4 THE METHODS TO REDUCE CO₂ EMISSIONS FROM OFFICES AND PUBLIC EVENTS

4.1 Electricity

4.1.1 Decreasing the electricity consumption

Offices as well as other workplaces utilize lots of electricity demanding techniques and appliances. Decreasing the electricity consumption is one of the most important environmental matters at workplaces. It reduces emissions from energy production and also decreases costs. A third from the electricity consumption in offices is used for computers and their peripheral devices, another third for lighting, and the remaining third for other office equipment and air conditioning. In addition offices require energy for heating. If saving of electricity is taken into account in workplaces and when purchasing materials, the amount of electricity that office equipment use can be cut down to half or even to third. Decreasing the electricity consumption in an office is easy to carry out and will have beneficial effects on the environment as well as on the working community. / 37 / Ways to save electricity in offices:

Computers, screens, and printers

- Turn off the computers and other appliances after use

Computers, printers, copying machines and other appliances should be turned off if they are not used for a longer time, for example for nights and weekends / 37 /. The electricity consumption of a computer can be cut down to even a fourth if it is turned off after use / 43 /. A computer screen should be shut down even for a couple of minutes, because it consumes a lot of electricity and turns on quickly. Turning off the appliances does not consume extra energy or harm them. / 37 / The computer systems of organisations should be designed so that it is possible to turn off the computers without causing for example a security risk.

- Use portable computers

A portable computer consumes only tenth of the amount of electricity that a regular PC consumes. / 43 /

- Connect the computers into a network

Even a simple network, for example two computers and a printer, will save electricity. / 37 /

- Avoid using stand-by functions

Often the computers and other electric appliances are kept in a stand-by state. It means that it consumes electricity even though it is not used. A lot of energy can be saved if the appliances are shut down when they are not needed. / 37 /

- Use power management features

Most of the modern office appliances including computers have power management features, which helps to save energy. If the appliance has not been used for a while it will go into standstill mode. It will save electricity, increase the life of the appliance, and decrease the need for reparation / 37 /. Using power management features can decrease the electricity demand of a computer screen from 85 W to 5 W / 43 /.

- Use a power saving programme instead of a screensaver

Screensavers, which bring a moving object on a screen of a computer do not save electricity, but instead prevent power saving programmes from turning on.

- Avoid unnecessary printings

Do proof readings on a computer, learn how to use paper saving techniques, for example print two-sided papers, file documents electronically, and use e-mail whenever it is possible. / 37 /

Lighting

- Plan the lighting

Use an expert in planning the lighting so that it would be efficient and directed correctly. The best lighting is achieved by taking into account the employees and their tasks when planning the lighting. Correctly planned and installed lighting can save even 50 % of energy.

- Use automatic lighting

Energy is saved when lighting is turned automatically on or off according to the needs. For example lighting, which functions with motion sensors or timers can be used in offices as well as in public events.

- Take advantage of natural light

Natural light is more powerful and more comfortable than artificial light. Utilize natural light by placing desks near windows and keeping windows clean. Lights can be even turned off in a clear day.

- Use fluorescent lamps

Fluorescent lamps save energy. They consume 75 % less energy than bulbs, and last even eight times longer. However, dust and dirt can decrease the efficiency of fluorescent lamps by 20 %, so it is important to keep them clean.

- Light should not be reflected to the eyes

Lighting should be directed so that it will not reflect from the surfaces and disturb employees. Too big differences in colour and brightness of the surfaces should be avoided.

- Lights should be turned off when they are not needed

If you use fluorescent lamps, turn off the lights if the room is not needed in 10 minutes. With bulbs turning off the lights is worthwhile even for few seconds. Turning the lights off and on again does not do any harm to the lamps. Place notes on switches in order to remember to turn the lights off. / 37 /

Other office equipment

- Organise training for the employees

The employees should be trained to use the office appliances efficiently. / 51 /

- Purchase devices with multiple functions

Nowadays different functions can be included in one office appliance, one example being a combination of a printer, a fax, and a scanner. Consider also attaching a fax card to a computer. With a fax card you can send and receive faxes directly without having to print them first. Appliances with multiple functions save electricity, space and money. / 43 /

- Use energy efficient modes on devices

If an office appliance has an energy efficient mode, use it. Also consider purchasing timers for appliances so that they will switch off automatically when not in use for example during non-office hours. / 45 /

- Do copying more efficiently

Use two-sided copying, make the text smaller to save space, and do all the copying at once. You will save electricity and paper / 37 /.

- Consider leasing

Leasing appliances is a good alternative for buying. In that case the deliverer is responsible for maintenance of the device and also for recycling it after use. Leasing also extends the life of office appliances. / 51 /

- Use all electricity consuming devices efficiently

In addition to office appliances, most offices have coffee machines, a dishwasher, a refrigerator and others that should also be used efficiently. For example do not keep a coffee

machine on all day long, use thermos to keep coffee warm and wash only full loads on a dishwasher.

- Recycle and support equipment that create little waste and are recyclable

It decreases transportation and waste management needs. / 37 /

- Buy energy efficient products and products with eco-labels

They are more profitable and environmentally friendly. / 43 /

4.1.2 Renewable energy sources

The sources of renewable energy are solar, wind, and hydropower, bio energy, geothermal energy, and tidal energy. In Finland solar, wind, and hydropower, and bio energy are used to produce electricity, and geothermal energy to produce heat. Possibilities for tidal energy in Finland are quite minor, and that is why it is not used. Energy produced from peat is classified as a slowly renewable biomass fuel in Finland, but it is usually left out from the renewable energy statistics. / 12 /

In 2003, the domestic renewable energy sources produced 22 % of the energy consumed in Finland. The aim of the Finnish energy strategy is to further increase the use of renewable energy. The biggest reason for it is that it would also reduce the amount of the greenhouse gas emissions. Neither solar, wind, nor hydropower cause any CO₂ or other greenhouse gases when produced. Compared to other energy sources renewable ones have the least negative impacts on the environment. / 42 /

The renewable energy sources are the cleanest, safest and most sustainable way to produce electricity. Nowadays consumers can have an effect on how their electricity is produced by buying green electricity, which is produced by the renewable energy sources. By using green electricity consumers express their opinion how electricity should be produced, and take part in reducing the harmful emissions, including CO₂. / 27 /

In practise all electricity regardless of how it is produced is mixed in electrical networks. So the electricity coming out of the plug is in fact same for everybody. By buying green electricity consumer can however affect how large amount of the electricity running in networks is produced by the renewable energy sources. Also the money spent in green electricity is used to develop the use and production of renewable energy. If the demand for green electricity increases, it means that the use of renewable energy production has to increase, and the use of non-renewable, more environmental harming energy sources decreases. / 27 /

4.1.3 Green certificates

The green certificates are a market-based way to increase the use of renewable energy sources in the electricity production. In the green certificate mechanism the electricity produced and the environmental values of the production are separated and sold in different markets. Electricity produced is sold as “grey” electricity to consumers, and the environmental values from the use of renewable energy sources are sold as green certificates. / 13 /

In Finland it is voluntary to take part in the green certificate business. If a consumer wants to support energy produced by renewable sources, the possibilities are either to buy green electricity or green certificates. The purpose of the green certificates is to increase the use of renewable energy sources where it is the most cost efficient and where it can remove the burden of transferring electricity from one place to another. The green certificates prove that a certain amount of the electricity is produced with renewable energy. The amount of the green certificates equals the amount of the electricity produced: 1 MWh of electricity equals one certificate. / 13 /

Currently, the customers who are buying green certificates in Finland want to promote the use of renewable energy sources or to use the greenness of their electricity in their marketing activities. In addition to voluntary actions, some countries are preparing obligation-based systems. In these systems some of the stakeholders from the electricity market, typically the end customers, have an obligation to prove that some percentage of their electricity supply is

produced with renewable energy. This obligation can be met with obtaining green certificates.
/ 4 /

A consumer does not have to make a new electricity contract when wanting to buy green certificates, it is enough that the consumer buys certificates equal amount (or a certain share) than the electricity consumed. The effect that the green certificates have on electricity production is quite similar than the effect that the green electricity has. Every purchase of a green certificate increases the demand for electricity produced by renewable sources, which furthermore promotes more environmentally friendly energy production and reduces the amount of the greenhouse gases as well. / 13 /

When buying green certificates a consumer pays only for the environmental values, which are included in the certificate. In practise the consumer buys “grey” electricity and in addition to that green certificates. The advantage is that the consumer can buy the electricity for example from a local producer, and then buy the green certificates from another. This mechanism makes it possible to sell electricity and certificates separately, which often creates cost savings for the consumer. It also benefits the producer, who will get revenue from two sources: from the ordinary customer and from the customer who buys the green certificates. Green certificates are especially a good option for those who can not make a green electricity contract if for example electricity is already included in the hire contract. / 13 /

4.1.4 Replacing an aggregate with network electricity

Aggregates are generators with combustion engines, and they are often used in public events. Usually they are used to produce electricity. As electricity is one of the most energy requiring aspects of a public event, it is important where the electricity comes from. An aggregate needs fuel to produce electricity, some of them function with gasoline, and others require diesel oil / 1 /. The electricity production with an aggregate produces more CO₂ than if the network electricity is used. The network electricity can also be bought as green electricity, which means that the electricity production does not cause CO₂ emissions at all. Often aggregates are used in public events because the need for electricity is only temporary, and it is thought that because of that there is no use for connecting the site to an electricity network.

However doing so would usually not raise costs, but would reduce the CO₂ emissions of the event efficiently. / 51 /

4.1.5 Nuclear power

In order to reduce the CO₂ emissions, it is inevitable that the use of fossil fuels in energy production will be reduced and replaced by alternative energy sources. When carbon dioxide emissions are concerned, nuclear power is a cleaner energy source than fossil fuel burning, in practice the production of nuclear power causes insignificant amounts of CO₂ and other greenhouse gases. / 8 /

However, nuclear power has other problems. Firstly, some of the materials used in the nuclear power production are radioactive and thus dangerous to the environment. The entire chain of the nuclear power production from mining and transportation of the raw materials to operating nuclear power stations and handling of the nuclear waste include dealing with radioactive substances, and there is always a possibility of leaks and contamination of the toxic matter to the environment. / 28 /

Another problem with nuclear power is that its production creates toxic waste that needs special handling. For example the existing four nuclear power plants in Finland create approximately 70 tonnes of highly radioactive nuclear waste every year / 31 /. Still there is no acceptable solution for long term storage of radioactive wastes and closed nuclear plants. In the past nuclear waste has been stored for instance in the bedrock and in the bottom of oceans / 34 /. Because the radioactivity of nuclear waste takes a long time to decrease, and it can still be deadly dangerous after 100 years, it is not certain if these storages are safe in the long run. Some risky choices have also been made, for instance in the Kola Peninsula region in Northeast Russia old nuclear submarines in bad condition are used to store nuclear waste / 21 /.

Though accidents in nuclear power plants are rare, they are possible, and always very serious. One of the most catastrophic nuclear accidents in Chernobyl, Ukraine in 1986 affected millions of people and left about 160 000 square kilometres highly contaminated with

radioactivity. The consequences of the accident still affect the lives of many people, and the Chernobyl power plant remains one of the most dangerous places on earth. / 34 /

Despite these problems, nuclear power can still be a better choice than energy produced by fossil fuels when the climate change is concerned. But it is not the solution to the climate change or to a cleaner environment. A better choice than replacing fossil fuel energy with nuclear power would be to invest in the renewable sources of energy.

4.1.6 Compensation of emissions

Reducing the CO₂ emissions of a company is challenging. Even after all agreed reduction efforts you may find the company's goals are still not reached. If that is the case, there is an opportunity to reduce the CO₂ emissions by purchasing carbon offsets. An offset is an emission reduction or removal project outside the company that helps another organisation reduce their CO₂ emissions. Offsets are especially beneficial if the company's goal is zero emissions or if the company wants to compensate emissions from employee commuting and business travel. Carbon offsets reduce the CO₂ emissions to the atmosphere regardless where the actual reduction is done, but buying Finnish carbon offsets reduces Finland's total CO₂ emissions. / 45, 48 /

Compensating emissions with offsets is a new, supplementary way to reduce emissions. Especially if a company can not reduce their emissions itself, compensating emissions is a good option. The enquiry that was made by WWF Finland to the potential users of the CO₂ counter showed that the compensation of emissions interests people. According to the enquiry 80 % of the interviewed people were willing to pay 1 euro more for a public event if the emissions of the event were compensated. / 50 /

4.2 Heating

4.2.1 Decreasing the consumption of heat

The amount of energy needed for heating can be reduced by the following techniques:

- Adjust the temperature correctly

The most comfortable room temperature is +20 - +22°C. A too warm temperature hinders the concentration and lowers the humidity of air. A suitable relative humidity is 25-45 % in wintertime and 45-65 % in summertime. If the temperature is lowered by only 1°C, the energy consumption reduces by 5 %.

- Use lower temperatures when the premises are not needed

If it is possible, during the heating season lower the temperature when the office or workplace is not used, for example during weekends. If the office is empty, a suitable temperature is +16°C.

- Eliminate leaks from windows

It is worthwhile to check the windows and the seals for leaks in every autumn before it starts getting cold. Often the temperature is set too high because the windows are leaking.

- Use curtains and sun blinds

Covering windows with curtains and sun blinds during nights and weekends improves the heat insulation capacity as much as an extra window. It also keeps the rooms cooler during the summer.

- Place the furniture so that it does not prevent the heating system from working.

Furniture should not cover radiators and prevent the heat from getting into the room. / 37 /

- Taking heat from the outgoing ventilation

Warm air from the outgoing ventilation can be utilised in heating. / 51 /

4.2.2 Heat produced with renewable energy

4.2.2.1 Geothermal energy and heat pumps

Geothermal energy is heat energy that is stored in the ground, rocks or water. Geothermal energy is used to produce electricity and to heat buildings. Geothermal energy is a renewable energy form, though geothermal reservoirs can be depleted if heat is removed faster than the natural processes renew it. However, the potential supply is so vast that it is classified as a renewable energy source. / 34 /

Heat is produced from geothermal energy with a heat pump. A heat pump collects the heat stored outside and transfers it inside the building to warm up the water in the heating system. The heat is collected by a piping system, which can for example be drilled to rock or placed in the ground or in a water system. Heat pump and its accumulator require only a little room, approximately the size of a normal fridge, and the noise that it creates is also similar to the humming sound of a fridge. / 12 / The most common sources of heat for a heat pump are ground, water systems, outside air, and the outgoing air from ventilation. A heat pump collecting heat from the ground is the most popular type in Finland / 18 /.

Heat from geothermal energy is a profitable and an environmentally friendly alternative. Its CO₂ emissions are minor because the heating system itself does not emit CO₂ and it requires electricity only when the heat is transferred from outside into the building. Other advantages are that it offers a secure and steady source of heat, and after the installation it is inexpensive to use. Heat pumps use only environmentally friendly refrigerants, which do not deplete the ozone layer. Heating with geothermal energy does not cause much pollution, or otherwise disturb the environment if it is planned and installed by a professional. A heat pump is an especially recommendable option for heating in a construction phase of a building. In Finland the use of geothermal energy in heat production is increasing, in the end of year 2000 there were 27 500 heat pumps in use in Finland. / 12 /

4.2.2.2 Biomass

Biomass energy is the energy produced by the combustion of organic matter. It is a diverse potential energy source. Biomass of variable origins can be converted by a variety of techniques into heat, fuels, and raw materials / 33 /. In Finland wood has the largest share of biomass fuels used in energy production. In 2001 75 % of energy produced by biomass fuels was from wood. Peat has the second biggest share, in 2001 24 %. Wood had the share of 19,5 % and energy from peat 6,2 % from all energy produced in Finland in 2001. Finland is one of the leading countries in the world using peat in energy production. Peat is actually classified as a slowly renewable energy source, because of the long time that it takes for a swamp to renew after it is cleared from peat / 12 /.

The share of other biomass fuels like wood chips and biogas from the biomass energy was only about 1 % in 2001. They do not have a big effect on the energy production in Finland, but they are becoming more important when alternatives are needed for fossil fuel / 12 /. The advantage of the biomass energy is that they do not increase CO₂ in the atmosphere, because carbon dioxide, which is released when the biomass is burned, would in any case be released when the biomass decomposes / 17 /.

In Finland there are over 100 entrepreneurs producing heat with biomass energy. It is called local heat production; usually the used biomass fuel is wood from own or local forests. The entrepreneur is responsible for the functioning of the heating plant and gets revenue from the energy, which is produced for certain buildings or for a heating network. The biomass energy offers a possibility to utilize local energy resources. It creates new jobs and is a good target for investing. It also promotes the national climate strategy and reduces CO₂ emissions. / 12 /

4.2.3 Green certificates

As well as with electricity, if heating is produced with energy sources, which release CO₂ and other pollutants, and the user is not capable or willing to change his source of heating, buying green certificates is one opportunity to reduce the emissions. It promotes the use of the

renewable energy sources, and by buying them the customer can compensate the emissions that the production of heating he uses creates.

4.2.4 Compensation of emissions

Reducing the CO₂ emissions of a company is challenging. Even after all agreed reduction efforts you may find the company's goals are still not reached. If that is the case, there is an opportunity to reduce the CO₂ emissions by purchasing carbon offsets. An offset is an emission reduction or removal project outside the company that helps another organisation reduce their CO₂ emissions. Offsets are especially beneficial if the company's goal is zero emissions or if the company wants to compensate emissions from employee commuting and business travel. Carbon offsets reduce the CO₂ emissions to the atmosphere regardless where the actual reduction is done, but buying Finnish carbon offsets reduces Finland's total CO₂ emissions. / 45 /

Compensating emissions with offsets is a new, supplementary way to reduce emissions. Especially if a company can not reduce their emissions itself, compensating the emissions is a good option. The enquiry that was made by WWF Finland to the potential users of the CO₂ counter showed that the compensation of emissions interests people. According to the enquiry 80 % of the interviewed people were willing to pay 1 euro more for a public event if the emissions of the event were compensated. / 50 /

4.2.5 District cooling

It is nowadays common that also in Finland the inside air of premises needs cooling. Though the demand for cooling energy is the biggest in summer, more and more premises need cooling throughout the year. For instance the lighting, the computers and other office equipment and sunlight through windows make the temperature of inside air to increase. / 6 /

District cooling means the centralized production and distribution of cooling energy. In district cooling cooled water from an energy production plant is delivered through a piping

system to buildings for cooling energy of the air conditioning. District cooling is used in public spaces, for example in offices or stores, and also in industrial premises. / 30 /

The cooling energy from one production plant can meet the demand for cooling of numerous premises. District cooling can replace conventional compressor cooling systems, which require lots of electricity and the use HCFC-compounds, which are harmful to the environment. Centralizing the production of cooling energy to large production plants increases the energy efficiency and reduces the amount of electricity needed for cooling even for 90 %. Using district cooling instead of the conventional methods reduces significantly the electricity demand of premises. In addition, the amount CO₂ and other pollutants reduce. / 6 /

Compared to the conventional cooling systems of single buildings district cooling is a more environmental friendly alternative and it is also able to compete with the prices. The greatest benefit that the users of district cooling get is savings in electricity. Other benefits are that when separate cooling machines are not needed anymore, the noise that they make is avoided, more space is available, and there is no need for reparations or maintenance of the cooling machines. / 30 /

4.3 CHP –the combined heat and power production

In CHP heat and electricity is produced in the same process. Usually heat is in the form of water vapour or hot water. A CHP power plant functions either by turbines or gas motors. Natural gas is the most common energy source used in combined heat and power production, but also renewable energy sources and waste can be used as a fuel. In CHP the excess energy from electricity production is used to produce heat instead of just getting rid of it. For example in a conventional power plant fumes are normally removed through chimneys, but in CHP they are cooled down first, and the energy is transferred to a hot water circulation. After that the cooled fumes are directed outside through chimneys. / 3 /

Finland is one of the leading countries in the world using combined heat and power production. Almost 80 % of production of district heating and a third of the whole electricity production is done by combined heat and power production. In the whole EU area combined

heat and power production produces only 9 % of the electricity. Because of the emissions reduction targets of the Kyoto Protocol, the European Union has agreed to double the share before 2010. Also in Finland the share of CHP will grow further. Combined heat and power production is seen as one of the important methods to reduce the greenhouse gases. CHP is estimated to decrease the use of fossil fuels approximately 20 % . / 29 /

The energy efficiency of combined heat and power production plants can be even 90 %, so it is also a way to save energy in heat and electricity production. In addition it is beneficial in the environmental point of view, because the entire emissions are reduced when electricity and heat is produced in the same process. Also using natural gas is better than other fossil fuels because when burned it releases less CO₂ and nitrogen oxides than oil or coal. If renewable resources are used as a fuel, the emissions are even less. Other benefits of CHP are that it offers possibilities to start new companies and it suits well to isolated areas or areas at a far distance. / 3 /

4.4 Travelling and transportation

Traffic is one of the basic demands of a modern society. Traffic includes travelling of people and transferring of goods from one place to another. Functioning traffic makes an effective society possible. Travelling is a part of every day life for many people, but at the same time traffic is one of the biggest reasons for environmental problems. Noise, air pollution, health effects, and accidents are problems related to traffic. Most of the emissions from traffic have decreased after 1990, when emission requirements tightened and cleaner fuels and catalysts were introduced to the markets. However, these methods do not decrease the CO₂ emissions from traffic. Instead the emissions have been growing when other the emissions from traffic have decreased in the recent years. A fifth of all CO₂ emissions in Finland come from traffic. The CO₂ emissions can be decreased by reducing the volume of traffic and choosing vehicles that consume fuel as little as possible. / 9 /

There are numerous ways how offices and public events can reduce CO₂ emissions from traffic. At workplaces it can be choices that individuals make, or options offered or

recommended by the employer. Ways to reduce CO₂ emissions from offices and public events are presented in the following chapters.

4.4.1 Way to work

4.4.1.1 Walking and bicycling

If the workplace is not very far, a good alternative is to walk or to bicycle. For 39 % of Finnish people the distance between home and the workplace is under 3 km. Walking and bicycling do not create any emissions instead it is a way to save in travelling expenses and to take care of your health. A 15 minute walk or cycle twice a day is enough to keep oneself in a good condition. Outside air refreshes and gives a good mood and exercise relaxes and helps to concentrate and to tolerate stress. / 37 /

Bicycling is also the fastest way to travel in city centres with lots of traffic. One does not have to stand in traffic jams or look for a parking place. If you use your own bicycle to go to work or for other business matters, you can get tax-free compensation on the travelling expenses. Employer can promote bicycling by arranging bicycle stands and showers to the workplace. Giving a bicycle as an employment benefit is also an option. The employer benefits from walking and bicycling of employees because parking lots or employment benefit cars are not needed and the employees are healthier when they exercise on a daily basis. / 37 /

4.4.1.2 Using public transport

Public transport is an easy and a reasonable priced way to travel to work. If more people would use public transport it would also reduce traffic jams in the mornings and afternoons. A bus carries 16 times more people than a passenger car. The time spent on way to work can be used more comfortably when using public transport, for example by reading a good book or by just relaxing. The energy consumption of a passenger using public transport is significantly lower than of one using a passenger car.

The benefits of public transport are undeniable, besides that it reduces travelling expenses it is more environmentally friendly than passenger cars. If the use of public transport increases there will be less traffic jams, air will be cleaner, there will be less noise and the greenhouse gas emissions including CO₂ will decrease. If passenger cars become even more common the effects are opposite. Besides being better for the environment, public transport is also often faster. When a passenger car is still stuck in a traffic jam, a train or a subway is already there.

An employer can promote the use of public transport by offering for example a monthly ticket for public transport as an employment benefit. It could be an alternative for employment benefit cars. The company can subtract the expenses from employment benefit tickets in taxation. The employee using the ticket has to pay taxes the same way as with other employment benefits. Still an employment benefit ticket for public transport would decrease the travelling expenses of an employee, and it could of course be used for private journeys as well. / 37 /

4.4.1.3 Using passenger cars more environmentally friendly

Though using a passenger car creates more CO₂ emissions than walking, bicycling, or using public transport, there are ways to use a car more environmentally friendly.

- Fuel consumption

The CO₂ emissions of a car are directly proportional to its fuel consumption. Every burned litre of fuel during driving causes about 2,5 kg of CO₂. Diesel cars emit less CO₂ than benzene cars, but benzene cars emit less fine particles. So the fuel consumption of the car should be taken into account when buying a car or choosing an employment benefit car. The consumption is normally lower with new cars. Other factors affecting fuel consumption are the type of the motor, the volume of the motor, and the weight of the car. Most of the extra equipment for cars are useful and can improve the safety, but they also increase the weight of the car, which increases the emissions. That is why also the extra equipment of a car should be chosen carefully. / 9 /

- Economical driving

The driver of a car has also a remarkable effect on the actual fuel consumption. Most of the drivers consume on an average 10-15 % too much gasoline. By taking an economical driving course it is possible to reduce the fuel consumption approximately by 5-10 %. Economical driving also saves money, increases safety and comfort, and reduces the need for reparations. If a company offers its employees employment benefit cars, it would be beneficial to also offer a possibility to take an economical driving course. Most driving schools offer economical driving courses. / 9 /

- Vehicle equipment and the new technology

New motor techniques have decreased the emissions of cars remarkably, but it has to be used correctly in order to make it work. The emissions of new, energy saving motors are almost as high as older cars during the first kilometres if the motor is cold when started. When a new motor has warmed up the emissions are only a fraction of an old car. That is why it is important to warm up the motor. It should be done already at +5°C / 9 /. New technology vehicles like electric cars and hybrid cars will decrease the emissions. Hybrid cars are already in the markets, electric cars are planned to be introduced to the markets in five years / 37 /.

- Alternatives for buying a car

If the use of a car is occasional, alternatives for buying a car should be considered. Public transport is efficient in the city areas, taxis are an option, and for longer distances a car can be rented.

- Car sharing services

In Helsinki there is a company called City Car Club, which offers car sharing services for individuals. The customer of the company gets to use a car when he needs it according to his reservation, and he only has to pay for the hours that he has used the car and for the kilometres driven. It is a good opportunity if a car is not needed daily. / 37 /

- Planning the trips

A good way to save fuel and decrease the emissions is to plan your trips. Short trips with a car should be avoided because even the newest cars pollute the most on short trips since catalysts do not work until the motor is warm. Especially starting the car and the first 3-5

kilometres pollute the most. Organise your trips beforehand so that they are multipurpose, which enables you to maximise your trip productivity. Avoid traffic jams. The shortest distances can be made by foot. Besides reducing the emissions it will save money. / 40 /

- Travelling together

Travelling together is also a good way to share cars in working environments. If someone has a car, it is beneficial for all that he collects co-workers living near and drives them to work. Everybody saves money if the gasoline needed is bought together, and the car is being used as effectively as possible / 40 /. The employer can encourage travelling together by arranging for example a notice board where people can inform about their travelling.

4.4.1.4 Distant working

An alternative to commuting is distant working. It means working at a distance from a workplace using communications technology. The development of the information technology and electric data management has made distant working possible and attractive for both employers and employees. If the job does not require being present at the office every day, distant working could be done for example for a couple of days per week or per month. Distant working makes the employee more independent and free to choose the working hours. It makes it easy to plan the work and free time, and reduces time spent at the way to work. For these reasons distant working motivates the employer. The company benefits from distant working because when the employee becomes more motivated he works more effectively and produces more. If the whole workday is done as distant working, it reduces traffic, energy consumption and emissions from traffic / 40 /. The potential capacity for distant working in Finland is estimated to be 20 % of all employees / 5 /.

4.4.2 Business trips inside Finland

4.4.2.1 Choosing a vehicle

Depending on the vehicle there can be big differences in the energy consumption and the emissions created as can be seen from table 2.

Table 2. The emissions per 1000 km of different vehicles / 10 /

Vehicle	CO (kg)	Hydrocarbons (kg)	NO _x (kg)	CO ₂ (kg)	Energy consumption
Long-distance train	0,01	0,001	0,03	125	180
Passenger car	2,5	0,2	0,7	485	690
Passenger car (new)	0,3	0,04	0,05	470	670
Jet plane	0,3	0,1	1,1	1517	2164
Ferry	0,5	0,2	6,7	2102	2994

Table 2 shows the emissions (carbon monoxide, hydrocarbons, nitrogen oxides, carbon dioxide) and energy consumption of five different vehicles from a 1000 km journey. In this table a long distance train means an electricity operated train, a passenger car is a regular gasoline using car, and a new passenger car is a car with a catalyst, the numbers of a jet plane are from domestic flights, and a ferry is a car ferry. / 10 /

The table shows the fact that a long-distance train is clearly the best choice for business trips inside Finland. It is the most energy efficient and the least polluting alternative, especially compared to a jet plane or a ferry / 10 /. Most InterCity trains have also plugs for portable computers, so working is possible also during the journey / 37 /. Because of the catalyst a new passenger car has clearly lower carbon monoxide, hydrocarbon, and nitrogen oxide emissions than an older car without a catalyst, but the energy consumption and the CO₂ emissions have not decreased significantly. / 10 /

Flying is getting more popular though its energy efficiency is low compared to other forms of travelling and it pollutes a lot. Large passenger planes fly so high that the emissions get directly into the stratosphere, which is a very sensitive layer of the atmosphere. Flying is not even always the fastest way to travel in Finland because the airports are usually located far from city centres and normally you have to be at the airport at least 30 minutes earlier than

when the flight departs. Flying is also the only form of traffic that does not have to pay taxes of the fuel it uses. / 37 /

Ferries are very popular in Finland for leisure but also for business trips. A lot of conferences and meetings are held on ferries every year. However, from the five vehicles compared in table 2 a ferry is the worst choice for business trips. Ferries are the least energy efficient and they pollute most per passenger, for instance they release huge amounts of CO₂ to the atmosphere. The speed of the ferry affects the amount of emissions, the higher the speed the greater the emissions. / 10 /

According to the CO₂ emissions in table 2 the best alternative for business and other trips inside Finland is a train. It is five times more ecoefficient than a passenger car, 15 times than a jet plane, and over 20 times than a ferry. In addition going by rail is comfortable, fast, and relatively cheap way to travel. / 10 /

4.4.2.2 Alternatives to business trips

In many cases a business trip is not the only choice to take care of businesses. New technology offers a range of alternatives to travelling, for example audio and video conferences, web meetings, and e-mail. New methods of business does not only save money and the environment, but also time and effort. Planning the schedules and making decisions becomes easier and faster when travelling does not take extra time. / 37 /

- Audio conferencing

An audio conference can be done with an ordinary telephone; there is no need for extra equipment. The conference is ordered beforehand from the provider of the service, for example Sonera is one company providing audio conferences in Finland / 24 /.

- Video conferencing

A video conference requires relatively expensive equipment, but you do not necessarily have to buy it, it can also be rented. A studio owned by a teleoperator can also be used for videoconferencing. In this case the expenses include the rent of the studio, the phone bill, and

the possible foreign country increase / 37 /. In Finland at least Elisa has provided video conferences / 2 /.

- E-mail

E-mail is also a practical way to communicate. If a mailing list is used, only one address is needed to send an e-mail to all the members of the list.

- E-meetings and chatting

Computer programs, which enable people to discuss with each other on computers, are becoming more popular. For example Windows has a program called NetMeeting. To use NetMeeting you only need to know the IP address of the computer you want to make a connection to, and then you can discuss and send documents to the user of the computer. Microsoft Messenger is also a common program used in communicating with other computer users.

- Web conferencing

Sonera has an Internet conferencing service, which can be used to share software and documents, arrange real time conversations, and enquiries. It can be used alongside with audio conferences, and in the future videos and sounds can be added. A web conference can be done with a regular Internet browser. / 23 /

- Distant conferencing in public events

Sonera has also a service designed especially for public events that combines audio and Internet conferencing / 22 /. In public events distant conferencing methods make it possible that all of the audience or participants do not have to travel to the place where the event is held, and still they can follow and be part of it.

4.4.2.3 Environmentally friendly tourism

An alternative to business trips and recreation trips made by working groups is sustainable tourism. Instead of taking a ferry trip or flying to Lapland, there are possibilities to more environmental friendly tourism. The aim of sustainable tourism is that its effect on the

environment is as little as possible, and that it benefits the local society / 19 /. Environmental friendly tourism can be for example trekking in some of the numerous national parks in Finland if it is just a recreational trip of a working group. If a conference or meeting is wanted to be held outside the office, there are for instance many farms in Finland that offer tourism services also for companies. In that case the best way would be to choose an ecological farm that offers tourism and conferencing services. Going by train to a beautiful and peaceful place outside the city to keep a conference is a better and more relaxing choice than to take part in a 24 hour cruise on a ferry and to try to keep the conference there.

4.4.3 Transportation in public events

Public events cause usually increased traffic to the location. Some tips to avoid traffic jams and rising emissions from vehicles are:

- Inform about public transport

Public event organisers can affect the means of conveyance used by informing about the public transport beforehand. For example the organiser can place timetables of buses and trains to the website of the event or to the advertisements. / 40 /

- Arrange extra public transport shifts during the event

It is recommendable for the organiser of the event to negotiate with the public transport companies to organise extra shifts during the event. / 51 /

- Include public transport to the entrance ticket

When large events are organised a possibility is to include public transport to the entrance ticket. / 7 /

- Organise transportation

It is worthwhile to organise transportation from the nearest cities to the event and back. / 40 /

- Mark the parking areas so that they are easy to find.

Organise enough parking spaces and mark them to avoid traffic jams.

- Economical directing

Parking should be more expensive than public transportation in order to reduce the use of private cars and to promote the use of public transport.

- Support cleaner ways of travelling

Arrange guarded parking places for bicycles and inform about them beforehand. / 7 /

4.4.4 Transportation of goods and people

The CO₂ emissions of traffic in Finland are about 11 million tonnes, which is over 17 % of all carbon dioxide emissions. Approximately 40 % of the emissions from traffic come from the transportation of goods and people. The energy consumption of transportation companies comes mainly from the fuel consumption, which is also the principal cause for the CO₂ emissions. At the moment there are voluntary energy saving contracts for transportation companies to cut their emissions and to improve their energy efficiency. There are energy saving contracts for buses and trucks, and for taxis there is an environmental management system called Ecotaxi, which is developed by The Finnish Taxi Association and Motiva Ltd in co-operation. / 44 /

Energy saving in the transportation sector is important because it is a way to reduce the emissions significantly. For example if a truck with a trailer is driven 120 000 km per year and it saves 5 % in energy consumption, it consumes 2 700 litres less fuel and emits over 7 tonnes less carbon dioxide / 41 /. Offices and public events use often transportation services for goods and also for people. The consumers can have an effect on the emissions that the transportation they require causes by using a transportation company who takes care of the environment and tries to reduce the emissions. Factors that should be taken into account when choosing a transportation company are:

- An environmental management system or an energy saving contract

Check if the company has an environmental management system, for example EMAS or ISO 14001 or an energy saving contract. Methods how emissions are reduced should be included in the environmental management system. However, the existing environmental management system does not guarantee that emissions are reduced. A more important factor is that the company monitors its performance on environmental issues. On the other hand also companies that do not have an environmental management system can have environmental issues taken care of.

- The education of drivers

The way of driving affects the energy consumption. Economical driving has an effect on safety as well as fuel on the consumption. In addition it increases the life time of the vehicles and reduces the need for repair. Educating drivers to economical driving creates 5 % permanent savings to the fuel consumption. The education should be monitored and it should be continuous.

- The vehicles

The vehicle used should be as energy efficient as possible. Usually the newer vehicles have better techniques. For trucks there is an EU grading system, which tells the energy efficiency of the vehicle. It is also important that the company chooses more energy efficient vehicles when old equipment is replaced by new ones. The vehicles should be taken care of by regular maintenance.

- Does the company follow the fuel consumption

The best factor to measure the energy efficiency is to follow the fuel consumption. It should be measured for example litres/100km or litres/1000 km. Continuous follow-ups are important, because they can show the trends of the fuel consumption.

- The logistics of the transportation

Traffic jams and road works can slow down transports. Good logistics can reduce the journeys and save time. It is especially important with trucks. However the logistics is difficult to measure, though it is an important factor of efficiency. / 49 /

4.4.5 Compensation of emissions

Reducing the CO₂ emissions of a company is challenging. Even after all agreed reduction efforts you may find the company's goals are still not reached. If that is the case, there is an opportunity to reduce the CO₂ emissions by purchasing carbon offsets. An offset is an emission reduction or removal project outside the company that helps another organisation reduce their CO₂ emissions. Offsets are especially beneficial if the company's goal is zero emissions or if the company wants to compensate the emissions from employee commuting and business travel. Carbon offsets reduce the CO₂ emissions to the atmosphere regardless where the actual reduction is done, but buying Finnish carbon offsets reduces Finland's total CO₂ emissions. / 45 /

Compensating the emissions with offsets is a new, supplementary way to reduce emissions. Especially if a company can not reduce their emissions itself, compensating emissions is a good option. The enquiry that was made by WWF Finland to the potential users of the CO₂ counter showed that the compensation of the emissions interests people. According to the enquiry 80 % of the interviewed people were willing to pay 1 euro more for a public event if the emissions of the event were compensated. / 50 /

4.6 The use of paper

4.6.1 How to reduce the amount of paper used

80-90 % of office waste is paper. An office worker takes about 7000 copies and uses about 60 kg of paper per year. Most offices also subscribe newspapers and magazines, use toilet paper and tissues, and some even use disposable mugs and plates. Reducing the amount of paper used will create savings in paper supply, posting, and storage expenses. It also saves forests, energy, water, and chemicals, which are used in the production of paper. It decreases the emissions and waste waters that are caused by the production of paper. The amount of paper used in an office is easy to reduce by changing the working habits / 37 / . Some ways to consume less paper are:

- Printing
 - Avoid unnecessary printing
 - Edit documents so that the whole paper is used efficiently: Use thin marginal and small font
 - Print two-sided paper
 - Print two or more pages to one A4

- Copying
 - Avoid unnecessary copying
 - Take two-sided copies
 - Make the text smaller in order to fit more text into one paper
 - Make instructions about copying so that everybody knows how to do it in a way that saves paper

- Communication
 - Use e-mail whenever it is possible
 - Reduce unnecessary posting, update your posting lists regularly
 - Send faxes directly from your computer
 - Use e-mail and intranet in internal communication
 - Circulate newspapers, magazines, and documents at work place

- Filing
 - File documents electrically

- Paper supply
 - Use recycled paper
 - Use paper that has not been bleached with chlorine. It is more environmental friendly, and every paper factory is able to produce it, though only 10 % does it. It depends on the demand.
 - Use only paper that can be recycled after use
 - Replace tissues with towels in toilets and in kitchen
 - Use real tableware instead of disposable cutlery / 37 /

4.6.2 The recycling of office paper

The recycling of paper saves the environment as well as money. The production of paper from recycled paper fibre requires less energy, water, and chemicals than using unprocessed raw material in the production. The expenses of paper recycling are significantly less than the charges of dumping sites. The recycling of paper reduces considerably the money that offices spend in waste disposal, because paper has the biggest share of office waste. / 37 /

Paper collecting companies, like Paperinkeräys Ltd, collect recyclable paper from companies free of charge if it is sorted correctly and if the collecting bins are located in a place that is easy to achieve. The companies only have to pay if they want to rent collecting bins or that sorted papers are collected from inside the office / 37 /. Paperinkeräys Ltd with its partners has also created a service called Roskajoukko, which helps public event organisers to plan the waste management and reduce the amount of waste as well as recycle in the event / 16 /.

In offices paper should be sorted into three groups: white office paper, newspapers and magazines, and cardboard. It is important that paper is sorted correctly, because the products that can be made from different kinds of recycled paper vary. For example recycled toilet paper is made of white office paper, and newspaper is made of magazines and advertisements. Paper can not be sorted afterwards, and mixed paper is usually burned. / 46 /

The recycling of paper is easy to carry out if all the workers are educated how to do it correctly. To do it successfully in an office, it requires that every room has individual collection boxes for different kinds of paper. There should also be bigger collection tanks in different floors where the smaller ones could be emptied. Instructions on how to recycle paper should be placed near every collection tank. / 37 /

Paperinkeräys Ltd has conducted the following instructions how to recycle office paper:

- White office paper
- Computer papers and prints
- Copies and typing paper
- White cross-ruled paper

- Rivets and paper clips do not have to be removed!

- Newspapers and advertisements
 - Newspapers and magazines
 - Brochures
 - Advertisements
 - Coloured copies

- Cardboard
 - Corrugated cardboard and craft paper
 - All envelopes
 - Cardboard cans (juice, milk etc)
 - Paper bags
 - Wrapping papers

- Must not be put among any recyclable paper
 - Carbon paper
 - Wet or dirty paper
 - Stickers, tape
 - Plastics
 - Rubber bands
 - Tissues

Confidential material can be cut up by the company itself or the service can be ordered from another company. For example Paperinkeräys Ltd offers that kind of services. It can be recycled if it does not make dust or contain plastic. / 15 /

The most common reasons why the sorting of different kinds of paper does not succeed are that people do not care and that people do not know how to do it. A reason why sorting fails in an office could be that in offices paper is sorted differently than in households. In households white office paper is collected with magazines and advertisements. In offices they are collected separately because the amount of white office paper used is so much bigger that it is profitable to be collected separately. Adequate education about recycling of paper is

needed to avoid these problems. It would be good that the person responsible of the environmental issues would continuously guide the other employees how to recycle. A method to increase the motivation of the employees to reduce the use of paper and to recycle is to use the money saved to stimulate the workers, for example by organising sports days or by offering coffee and buns to the department who has succeeded best in the recycling.

5 CONCLUSIONS

There is a lot of evidence that the climate of the earth is changing. The average surface temperature has risen; glaciers have been melting and sea levels rising in the recent years. There is also strong evidence that humans and their actions contribute the changes in the climate. The human caused emissions have been rising dramatically after the beginning of the industrialisation. While the amounts of carbon dioxide and other pollutants in the atmosphere have increased, the climate has been changing rapidly. The temperature warming in the 20th century has possibly been greater than any other time during the last 1000 years. Carbon dioxide is one of the most dangerous substances polluting the atmosphere.

Though the emissions of CO₂ and the other greenhouse gases are not equally divided between different countries, the climate change is everybody's problem because it will affect every part of the world. Even though some of the consequences of the changing climate have been predicted, it is not sure where they will happen. The changes that different countries might face are not dependent on how much emissions that country has caused. Mostly it is uncertain which areas will suffer the most because of the changes in climate. That is why it is important that every country admits the problem that the greenhouse gases cause in the atmosphere and that the emissions of those substances should be reduced. The European Union has done a remarkable job being one of the first areas where emission limits will be taken into use even though the Kyoto Protocol has not come into force. Though it is important that some progress has been made, it would be essential that all the countries would start to reduce their emissions, the developed as well as the developing countries. Even the smaller ones matter, Finland is one of the smallest countries in the European Union when population is concerned, but it emits more CO₂ per person than many of the bigger countries.

There is no doubt that industry is the biggest source of the carbon dioxide emissions. It is important to reduce the emissions from industry, and the emission limits are a good way to do so. However, it would be important to identify also other causes of CO₂ emissions, and especially to recognize the reasons why industry causes so much carbon dioxide. In fact the reason is that there is a great demand for the products of industry. So the consumers of industry who create the demand have a big role in the emission reduction. Identifying the real causes of the emissions is the only way to reduce them significantly.

According to the concept of ecoefficiency, the emissions and other negative effects on the environment could be decreased by organising the production in such a way that it uses as little natural resources as possible and by reducing the negative effects on the environment. Ecoefficiency can be achieved by decreasing the amount of materials and energy used in the production, usage, and the waste management of a product, and by increasing the energy efficiency. Ecoefficiency could probably be a good tool for reducing emissions and decreasing the harmful impacts of the human actions on the environment, but it is not the only solution to the climate change or other environmental problems.

Reducing the emissions and the use of natural resources in individual processes does not help tackling environmental problems if the consumption keeps growing. The growing consumption is typical for our times and actually it is the reason for many environmental problems from hazardous wastes to air pollution. The consumption is the factor that actually should be reduced because if the consumption decreases then also the production decreases. If the production decreases, the emissions including CO₂ decrease.

To achieve this goal, every party involved including offices and public events should be educated about how to reduce their consumption and that way the emissions, which are created because of their consumption needs. Also the studies and follow-ups of the CO₂ emissions should not be limited only to industry and traffic, but also the emissions from offices and public events as well as from other consumers. The most important thing is to educate people about the climate change and what causes it, and give information how CO₂ and other emissions can be reduced. Often the measures that have to be done in order to reduce the emissions do not take much time or money, like in offices and public events. Everybody from a producer to a consumer of a product is responsible of the emissions that

their actions cause. Educating and giving information is an important way to reduce the emissions. Everyone is responsible for the future of our planet.

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