GREENHOUSE GAS EFFECT OF

INFORMATION AND COMMUNICATION TECHNOLOGIES

PROJECT STUDY

Edited by Katalin Szomolányi

CONTENT

EXECUTIVE SUMMARY

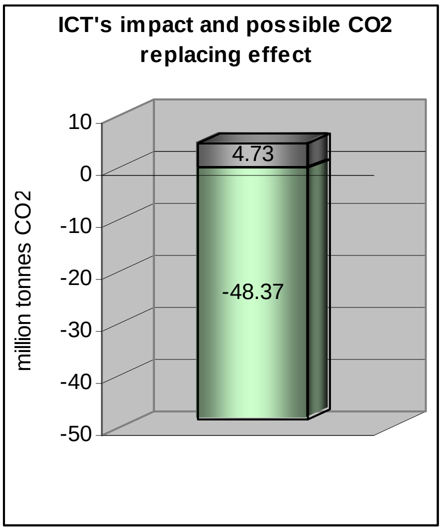
This document is divided into two main parts. In the first part we introduce the environmental impact of information and communication technology (ICT) through the different types of energy consumption, measured by 16 European companies, whose combined turnover represents 53 % of the European telecommunications market. These companies are all ETNO members and signatories of the Sustainability Charter.

We believe our behaviour clearly demonstrates a responsible and significant contribution to the achievement of Kyoto targets and the goals of the climate convention. The report shows how:
- we measure & report our levels of consumption
- we share examples of best practice
- we share examples of implemented energy saving initiatives
- we strive to use, purchase or generate renewable energy wherever possible

In the second part of the report we have summarised the green-house gas replacement effect of a few of our services, which have been certified by independent outside bodies. These examples show quite clearly the environmental benefits that ICT's have and just how these services can serve to replace carbon dioxide emissions. We believe that ICT solutions must be taken into consideration whenever programmes or actions to combat climate change are initiated.

For all the examples given, the supply side technology is readily available. The market is also in a position to deal easily with increased demand for both the current services and for new ones.

We have made some estimates, which may seem to be, in some cases, too optimistic. However, we do not claim that these are 100% accurate and we recognise that numbers of customers can change, as can the CO_2 replacement potential for differing levels of consumptions. Our aim is simply to give an overview of the real opportunities that exist for economic growth whilst combating climate change in the same time.



The comparison of the two parts of the document shows that the environmental impact of the 16 companies' is around 10 times less than the potential reductions to carbon dioxide emissions within the European level that can be achieved using ICT. Even if we take into consideration the other telecommunications actors, we can state that ICT services have a real potential to combat climate change.

This document is evidence of our commitment to:
- Carefully manage scarce resources
- Encourage all companies, regardless of whether they are ETNO members or not, to implement best practice ideas and continue to share knowledge
- Take a proactive approach to EU legislation.

ICT has enormous potential for travel substitution and dematerialisation, and our long-term aim is to raise awareness of customers by promoting the wide ranging benefits of ICT solutions in a way that our customers can understand.

Whenever solutions for reducing CO_2 are found to be too expensive these must be communicated to relevant governmental bodies so a dialogue can be initiated about future rules/legislation that make it possible to implement more sophisticated approaches in order to bring about deep reductions in emissions (this can include measures like tax-breaks, legal change, public procurement guidelines, etc.). We believe that what is needed is a fundamental change in organisational behaviour. So, a mixture of incentives and legislation could assist in take up.

This document is a basis for the ETNO – WWF joint initiative where our follow up goals are to ensure that:
1. ICT is recognised as an important part of the solution for combating climate change in Europe.
2. Key actors have a climate change strategy for ICT.
3. Concrete “ICT-Climate change” programmes are initiated in Europe by 2007.

INTRODUCTION

PROJECT BACKGROUND

The European Network Operators' Association (ETNO) established its Environmental Working Group by introducing the Environmental Charter in 1996. The Sustainability Charter replaced this charter in 2004.

This report contains the published findings of the 'Greenhouse Gas Effect of Information and Communication Technologies' study' initiated by the Sustainability Working Group at the end of 2002.

Project members:
This document was produced by the following companies and experts:
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The chapters in this document include information from 16 companies from 17 countries in Europe. These companies are the following:

BT	(Great Britain)
Czesky Telecom	(Czech Republic)
Cyprus Telecommunication Authority	(Cyprus)
Deutsche Telekom	(Germany)
France Telecom	(France)
KPN	(Netherlands)
Magyar Telekom	(Hungary)
Portugal Telecom	(Portugal)
Slovenske Telekomunikacie	(Slovak Republic)
Swisscom	(Switzerland)
TDC	(Denmark)
Telecom Italia	(Italy)
Telefonica	(Spain)
Telekom Austria	(Austria)
Telenor	(Norway)
TeliaSonera	(Finland, Sweden)

Together, these companies represented 53% of European telecommunications market in 2003, (according to the EICTO information[1]).

OBJECTIVES

The objectives of the project focused on two main areas:
1. Energy-consumption of Telcos: First, we collected information on the energy consumption of each of the member companies. This was then converted into CO_2 emissions. Secondly, we collected and shared best practice examples provided by member companies to further decrease the energy-consumption. Finally we evaluated our situation, and summarised this in a position statement.
2. Products & Services of Telcos: First, member companies provided information on ICT products and/or solutions that have a positive environmental effect on CO_2 emissions. Then we estimated the scaled up subscribers' use, to give an idea of the possible effect in Europe (replacing CO_2 emissions). We also shared easily applicable best practices, which can be used by all telecom operators for environmental valuation of services. Finally, we prepared a statement showing the potential that ICT has for reducing CO_2 emissions, which includes a strategy proposal for implementation of ICT solutions within the EU.

The goal of the project is to see if our products and services are able to replace more CO_2 emission than they generate through resource use i.e. energy consumption.

[1] (Western Europe + New EU Countries excluding Malta and Cyprus); source: EICTO

BOUNDARIES OF THE PROJECT

As the project began at the end of 2002, the information collected refers to 2002. Later on project members did try to upgrade the data. However, it must be stressed that this was not the most important focus and so we did not put any significant effort into this. All consumption data covers the above listed companies' domestic usage only and does not take any international consumption into account. This means that the figures cover the largest network operators in 15 countries in EU-25 plus Switzerland and Norway.

1. ENERGY CONSUMPTION

In this chapter we focus on telecommunication companies' main environmental impact, namely energy consumption and its associated greenhouse gas emissions. We also summarise the efforts and best practice implemented by companies in order to decrease energy consumption and carbon dioxide emissions.

1.1. ENERGY CONSUMPTION OF ICT

As the main negative environmental impact of telecommunications companies is energy consumption, we collected information on the total amount consumed. Similarly, we also collected data on vehicle and heating fuels, and purchase of renewable energy (as another way to decrease green-house gas emissions).

1.1.1. Electricity consumption

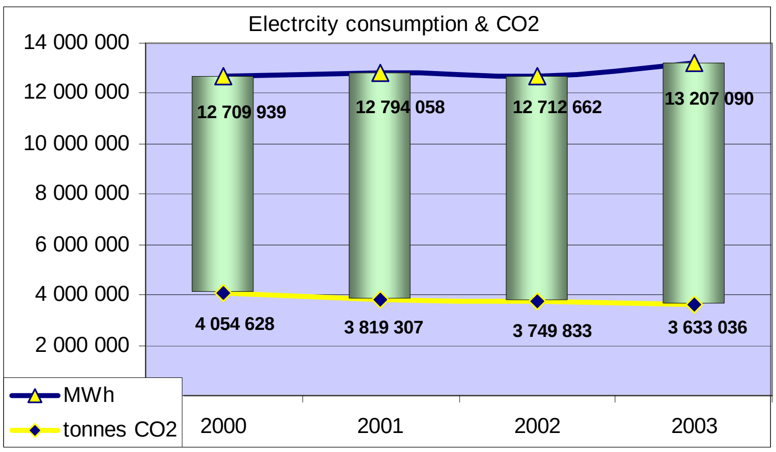
According to the data collected, the electricity used by telecommunication companies can be split into two main areas. By far the largest amount is used within our network building (i.e. buildings used to accommodate telecommunications switching equipment), and accounts for 81.25% of total electricity demand. The other 18.75% of the total electricity used is consumed within our office buildings.

Our total consumption between 2000 and 2002 was just below 13 million MWh. In 2003 it increased to just over 13 million MWh.

	2000	2001	2002	2003	
Electricity consumption	12 709 939	12 794 058	12 712 662	13 207 090	**MWh**

The data collected shows only slight fluctuations in consumption. However, the evidence shows that electricity consumption will increase in the future due to development and increased take-up of e.g. Broadband. In addition, next generation networks will significantly increase the range of products and services available to consumers in the very near future. But, we have shown that it is still possible to reduce carbon emissions, through efficient energy management, purchase of renewable energy and development and installation of more energy efficient network equipment, despite business growth.

	2000	2001	2002	2003	
CO_2 by electricity consumption	4 054 628	3 819 307	3 749 833	3 633 036	**tonnes CO_2**



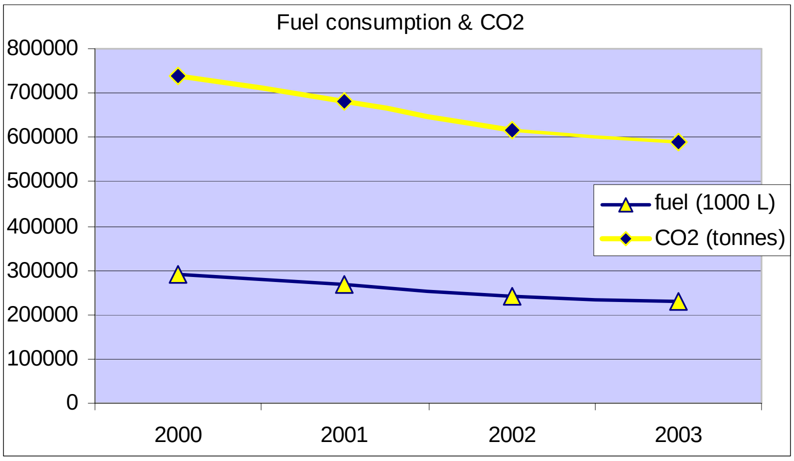
1.1.2. Fuel consumption of vehicles

Another significant impact of the companies is fuel consumption by company vehicle fleets. The consumption of companies between 2000 and 2003 is listed below.

	2000	2001	2002	2003	
Diesel	198 019 191	187 379 919	175 911 451	163 686 191	**Litre**
Leaded petrol	14 071 784	8 554 499	1 525 587	242 954	**Litre**
Unleaded petrol	75 625 581	68 986 329	61 147 586	65 110 203	**Litre**
LPG	2 967 851	1 333 455	1 215 306	892 268	**Litre**
Coal	0	216	0	0	**Tonnes**

The results show that the combined fuel consumption of the companies participating in the survey exhibits an overall and steady decrease. CO_2 emissions are also decreasing.

	2000	2001	2002	2003	
Total fuel	738 730	680 713	616 209	588 431	**Tonnes CO_2**



1.1.3. Heating Fuel

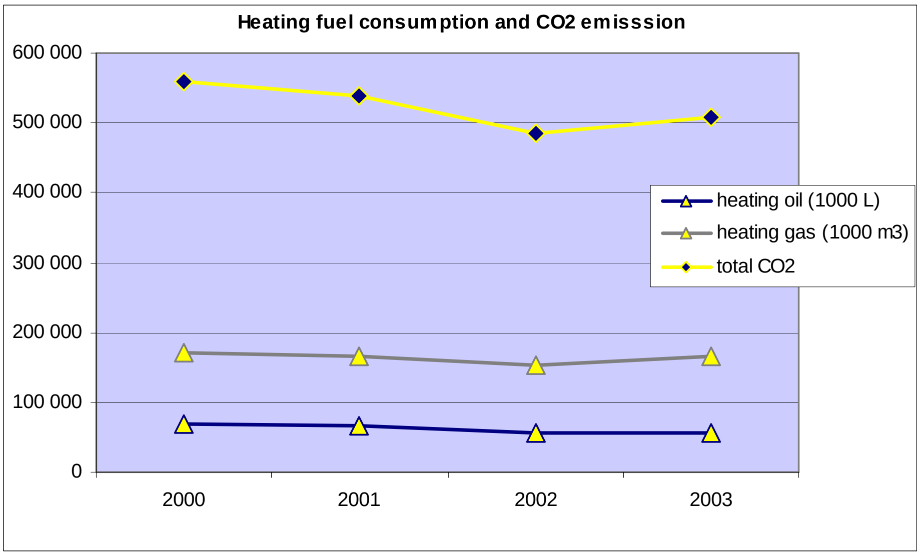
The third impact regarding energy consumption is due to the amount of heating fuel that companies use.

	2000	2001	2002	2003	
heating oil	69 487 746	66 973 992	57 020 380	55 976 874	**litres**
heating gas	171 784 078	165 540 185	153 157 126	165 393 189	**m^3**

While the consumption of heating oil shows a continuous decrease, the consumption of heating gas shows an increase after a three year decrease. This can be explained by the replacement of Oil fired Boilers by more efficient Gas fired types. Note: for the year 2003 consumption data was available only from 14 out of 16 companies. Therefore, for the missing companies we used the consumption data for 2002.

CO_2 emissions move certainly in parallel with consumption. This fact is shown in the following table.

	2000	2001	2002	2003	
heating fuel	559 225	538 255	484 173	509 076	**Tonnes CO_2**

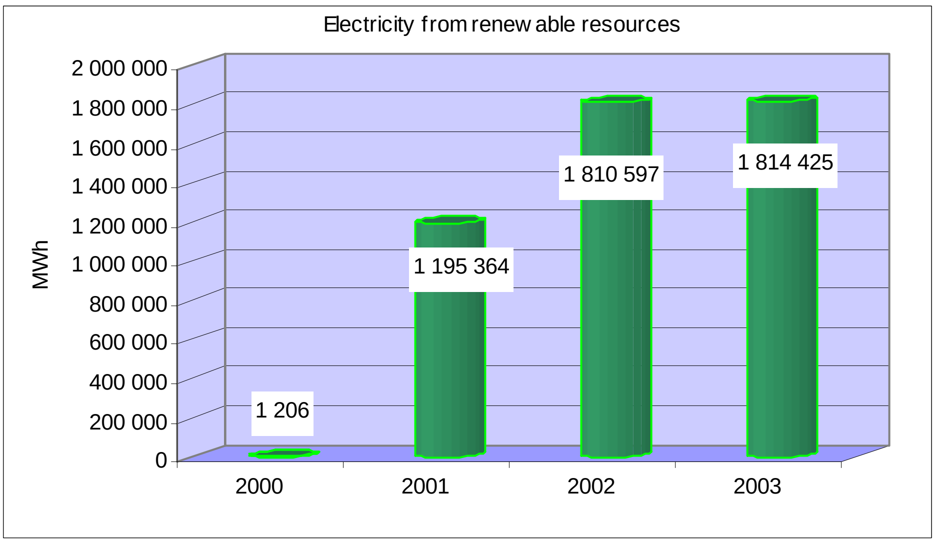


1.1.4. Renewable Energy

In the last few years several pilots and investigations have been introduced in companies for use of renewable energy. In the diagram the increase of electricity from renewable sources shows an obvious improvement. It should be noted that the figures below do not include the consumption of countries where renewable energy is normally available and produced in large quantities like i.e. in Scandinavia, where hydro-electric generation is predominant. This is because the CO_2 emission factors we used, as given by UNEP, already take this into consideration.

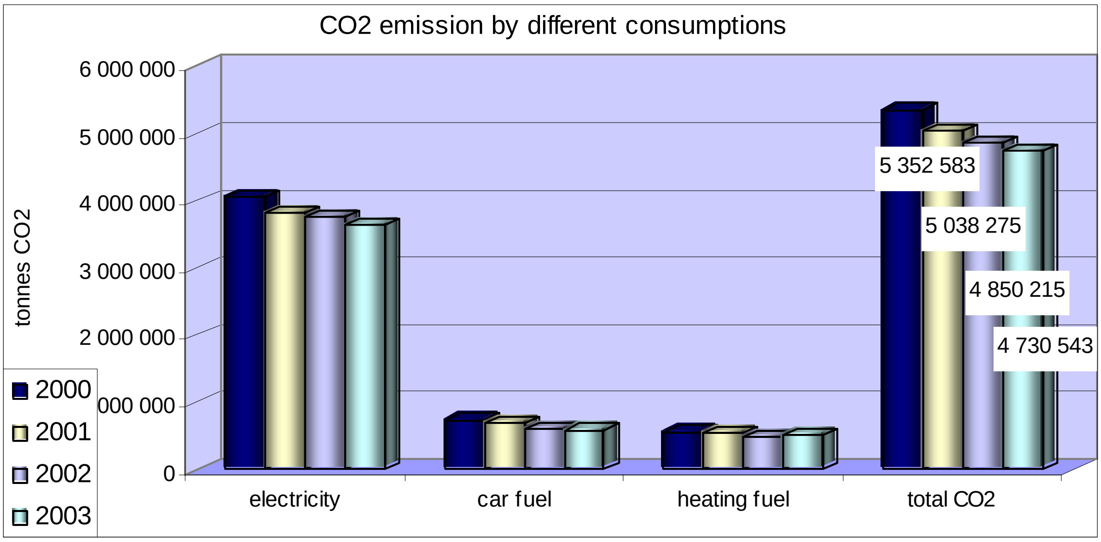
From almost nothing, over just two years, ETNO companies managed to increase the purchase of electricity from renewable sources to 14.24% of the total consumed in 2002. Because the data was primarily collected in 2002, we only updated the data with what was readily available. So, in the case of six of the companies, we assumed that the quantity of renewable electricity purchased had not increased.

The main reason why the amount of renewable electricity purchased jumped initially but has now flattened off again is twofold. First, in many countries the capacity is simply not available and it is our opinion that much needs to be done to increase the amount of renewable electricity generated within the EU. Second, in many countries the renewables market is not mature and so premium charges are applied to renewable electricity purchases. We believe this to be counter productive, acting to suppress the market.



1.1.5. Summary

Together, the sixteen companies that provided information demonstrate real efforts to decrease the negative environmental impact caused by their energy consumption. Together, the amount calculated using UNEP guidelines for 2002, decreased to less than 5 million tonnes of CO_2. This pattern has been consistent over four years.



1.2. Case Studies FOR REDUCING Environmental Impacts

Energy use has a strong economic impact as well as an environmental one. This ensures that telecom companies are committed to environmental protection and our benchmarking work has identified both how companies are investigating potential energy efficiency solutions and what they have done to date to reduce consumption.

1.2.1. Procurement guidelines

Best practice in controlling energy consumption is to address the issue right from the beginning of the equipment life-cycle. Many telecom companies take this opportunity to drive up efficiency. In the following section we have summarised the procurement processes used, by two of the two largest companies, Deutsche Telekom and British Telecom, to improve energy efficiency within the supply chain.

Deutsche Telekom

Deutsche Telekom established specific energy task teams in both of its relevant business units (T-Mobile and T-Com) to investigate the major energy consumption and the possibilities for improvement at both customer premises and its own operational sites. Based on the results, the two business units developed two operationally specific purchasing guidelines. The one at Deutsche Telekom's mobile operator T-Mobile is called the "Greenbook" and the one in use within the fixed net operator T-Com is called "TAU"). Both contain specific requirements on the use of energy and for cooling systems.

Specific requirements are placed on Deutsche Telekom's suppliers regarding the design of communications equipment. This process operates in order to avoid the need for intensive cooling or air conditioning. The construction should also minimize all undesired thermal effects and support the convection principle for cooling by an intelligent arrangement of, for example, high-frequency electronic components and circuit boards. Related energy consumption is also required to be as low as possible. Additionally, the overall energy consumption of new generations of products should also be significantly lower when compared to previous generations.

Furthermore, the Greenbook contains also specific requirements relating to the energy consumption of switching stations, base stations and hybrid drives as well as the opportunity to include renewable energy solutions such as wind and solar where possible.

British Telecom

British Telecom uses the Product Stewardship 'Generic Standard', called GS19, to drive product improvements in its supply chain. All suppliers of electrical or electronic equipment are required to provide information on the type of product to be supplied and, where appropriate, give details of the product's environmental attributes. This includes:

- Current and proposed legislation
- Take back
- Materials content
- Environmental characteristics
- Energy requirements
- Life span

GS19 assists BT in achieving its stated objective of meeting and, where possible, exceeding environmental requirements. It applies Product Stewardship principles to demonstrate BT's commitment to a policy of continuous improvement.

With regard to energy requirements the company asks about:

- primary and secondary energy source
- power requirements for the following modes of operation
  - in standby
  - in power down
  - in use.

1.2.2. Energy rationalisation efforts

As part of the project we collected different best practice examples from the ETNO companies in relation to their energy rationalisation efforts in the network. The data provided showed that the bulk of CO_2 emissions originate from electricity consumption used to power the network i.e. 81.25%. This resulted in around 2,951,842 tonnes of CO_2 emitted during the year 2003.

Deutsche Telekom

- **Energy optimisation in digital exchanges**
  The goal of the project was to implement measures for the overall telecommunications area within the scope of the Scorecard 2003.
  Reduction of power consumption of digital switching systems no longer required (S 12 and EWSD systems):
  1. Disconnection of analogue direct-dialling modules of the digital switching technology. Quantity: 58,302 units (modules affected: S12: DANP, PBA-IDDB; EWSD: SLMA:DIOD)
  2. Disconnection of analogue 8-port subscriber modules of the digital switching technology no longer required. Quantity: 70,872 units (modules affected: S12: ALCP; EWSD: SLMA:FPB)
  Cost: 3,736,696.90 Euro
  Energy saving: 21.8 GWh / year
  CO_2 emission savings: 6,836 t / year (UNEP)
  CO_2 equivalent savings: 13,586 t / year (GEMIS)

- **Use of frequency converters (FC)**
  The main objective of the project was to optimize the air conditioning power consumption.
  The main energy reductions in the field of RLT in Germany are not found in cooling, but in ventilation (approx. 90% of the annual power requirement). In many cases, there are only single-stage ventilation techniques with the possibility of choosing between on and off. However, this represents only a very rough level of control. Using retrofitted FCs, it is possible to change the number of revolutions of the fan, depending on the frequency, and to adapt the actual temperature relationships. e.g. KöHaus Süd Düsseldorf, where the previous power requirement for the devices was reduced by approx. 84%.
  Cost: 11 frequency converters VGB 400-025 by Vectron incl. assembly = 22,000 Euro
  Energy saving: 529,805 kWh / year
  CO_2 emission savings: 166 t / year (UNEP)
  CO_2 equivalent savings: 330 t / year (GEMIS)

British Telecom

- **Fan Replacement Project**
  The International Transmission Switching Centre at Madley is a purpose built building approximately 10 years old housing 2 International switches. The main equipment area, switch room and UPS plant room are air-conditioned primarily by 28 Airdale sensible cooler air-handling units (Type EDFGFC25T). Each unit contains 2 belt driven forward curved fans, controlled via a Building Management System.
  The existing forward curved centrifugal fans, belt driven were replaced with high efficiency backward curved aerofoil bladed fans, directly driven by integral high efficiency motors.
  Cost of the project: £ 37,728 = € 54,779[2]
  Cost savings: £ 17,980 / year = € 26,105.47 / year[3]
  Energy saving: 513,685 kWh / year
  CO_2 emission savings: 220.89 t / year (DEFRA)

- **Fresh Air Cooling in Telephone Exchanges**
  In most BT exchanges, the main cooling medium is fresh air, and air conditioning units only switch in on the hottest of summer days. However, BT has been working with its equipment manufacturers to design for full operational performance over a wide temperature limit. The new cooling system was developed specifically for cooling the 'hot' switching and transmission

[2] According to http://www.xe.com/ucc/ on 10 July 2005 (1 GBP = 1.45192 EUR)
[3] According to http://www.xe.com/ucc/ on 10 July 2005 (1 GBP = 1.45192 EUR)

equipment found in a modern telephone exchange. The novel features of the system are the complete absence of any refrigerant and its very low energy consumption.

BT's Network team worked closely with suppliers to ensure that European Telecommunications Standard Institute standards allowed room temperature fluctuations between -5 and 45°C
The next step was to design a refrigerant-free, low energy cooling system. The temperature of the outside air in the UK rarely goes above 35°C. Outside air would therefore provide ample cooling capacity if blown around a room in sufficient quantity. The biggest problem from an engineering viewpoint was to distribute the air evenly around the room so that no hot spots occurred. The need to switch off air fans in stages to keep energy consumption within target precluded the use of the traditional ventilated ceiling and ductwork for air distribution. The solution was found with the aid of Computational Fluid Dynamics (CFD) modelling software.
A computer model of each exchange room, including such details as equipment suites and their heat dissipation, cooling units, pillars and other obstructions enabled the team to predict the precise movement of cooling air in terms of temperature, speed and direction. Careful positioning of the equipment and cooling units ensures that the installation will stay within the temperature limits required by the European Standard.
BT's new exchanges now require no refrigerants and since the conclusion of this project BT now cools its trunk exchanges using fresh air only.
There are installations where fresh air only cooling can not be deployed due to the lack of space for the air inlet and outlet. In these instances BT has a range of DX/Fresh Air cooling units which for the majority of the year only fresh air cooling is required. During the very warm periods of the summer the DX chilling system operates. To increase the operating savings the chilling on set point for these units has been raised from 27°C to 29°C.
Cost of the project: no implementation cost.
Cost savings: appr. £48,442 / year = € 70,339.50 / year[4]
Energy saving: appr. 968,837 kWh / year
CO_2 emission saving: 416,600 t / year (DEFRA)

- **<u>Highly efficient electrically commutated fans</u>**
  Telephone Exchange Switch room-cooling units typically run a fan at 100% airflow for 24 hours a day 365 days a year. This is to ensure an even temperature throughout and transfer of heat load to the air stream as it passes over telecoms and associated equipment.
  This heat load is either directly rejected to atmosphere through low ambient 'free cooling' periods or, indirectly rejected to atmosphere (via a packaged refrigeration system within the unit) in higher ambient conditions.

  Utilizing free cooling already prevents the refrigeration system running for typically 80% of the calendar year in the UK and northern Europe. The main fan runs continuously throughout the year. New motor technology in highly efficient electrically commutated (EC) fans is utilized to reduce the power absorbed in the order of 50%. A knock on benefit is lower motor temperature resulting in longer use of 'free cooling' and extended fan / motor life.
  Cost of the project: no cost
  Projected cost savings for the first year: £184,245 per year (=267,539.33 EUR[5])
  Energy savings: 7,183 KWh / year / unit
  Total energy savings at BT: app. 3,685 MWh / year
  CO_2 emission savings: 1,586 t / year (DEFRA)

<u>1.2.3. Different solutions for offices</u>

The data provided showed that around 18.75% of the total electricity used by ETNO companies is consumed within office buildings. This resulted in around 681,194 tonnes of CO_2 emitted during the year 2003.

[4] According to http://www.xe.com/ucc/ on 10 July 2005 (1 GBP = 1.45198 EUR)
[5] According to http://www.xe.com/ucc/ on 10 July 2005 (1 GBP = 1.45192 EUR)

Deutsche Telekom

- **<u>Distribution of switchable connector strips, to avoid stand by losses</u>**
  Externally connected equipment such as modems or printers, which have an individual permanent power supply often consuming electricity even when switched off (i.e. standby losses). For example, the consumption of a standard PC workstation at Deutsche Telekom is approximately 21 kWh per year.
  Frequently only the secondary winding of the power supply transformer is switched off, as opposed to the primary winding. This can be changed. An electrical outlet strip with a sufficient number of sockets, equipped with an on/off switch will not only save time and physical energy, since each piece of equipment, such as PC, monitor, modem, printer etc. needs to be switched off individually. At national level, this action resulted in 43,000 switchable electrical strips being distributed in co-operation with the regional environmental representatives.
  Cost: 102.523,0 €
  Current cost savings per year: 76,316.4 €
  Total energy savings at Deutsche Telekom: 898 MWh / year
  CO_2 emission savings: 282 t / year (UNEP)
  CO_2 equivalent savings: 559 t / year (GEMIS)

British Telecom

- **<u>Liquid Pressure Amplification</u>**
  Modern Refrigeration Systems typically work at half their theoretical performance efficiency, therefore add-on benefits can be considered. Liquid Pressure Amplification LPA is a new technology designed to increase the efficiency of refrigeration systems by reducing flash gas. By installing Liquid Pressure Amplification booster pumps into the liquid line of suitable Chillers at main offices, significant energy reductions are possible. Manufacturer's data indicated potential savings. These were backed up by a paper from the Institute of Refrigeration.

  The benefits are dependent of the local ambient temperatures, run times, the size and inherent efficiency of the machine. In the majority of cases the benefit is 30% of the running cost. BT Trials realised savings of 31%. In addition to the Energy savings the compressor load is reduced which increases reliability and reduces noise this is done by lowering the head pressure on the compressor. The use of inverter drives on the condenser fans where available, also increases the savings by giving closer controls on the condenser Temperatures/Pressures.

  Cost: to install LPA pumps systems into 14 various Chillers on site at Adastral Park used by B.T. = £152,350 (= 221,204.25 EUR[6])

  Total cost savings at 4.2p/kWh = £401.970 per year (=583,751.16 EUR[7])
  Total energy savings at BT: 9,571 MWh / year
  CO_2 emission savings: 4,116 t / year (DEFRA)

<u>1.2.4. Renewable Energy - applications and purchase</u>

As we introduced in the beginning, telecom companies have started to investigate renewable energy purchase and have run pilots where telecom equipment is powered directly with the renewable energy generated by equipment installed by the telecom company themselves. The following are practical examples of such applications.

Magyar Telekom

- **<u>Installation of combined solar panel and wind generator</u>**
  In a small village in the Southern part of Hungary a solar panel has been in operation since 1992. It is situated in a telecom container and supplies energy to a Remote Subscriber Unit (RSU). With the extension of the telecommunication infrastructure the solar panel could no longer supply sufficient energy for the RSU, therefore other possible solutions were investigated. Finally a wind generator was chosen to provide the additional energy.

[6] According to http://www.xe.com/ucc/ on 10 July 2005 (1 GBP = 1.45192 EUR)
[7] According to http://www.xe.com/ucc/ on 10 July 2005 (1 GBP = 1.45192 EUR)

This choice was made because in the critical winter months the installation of additional solar panels would not have provided a satisfactory solution. The required power is low enough and the load stable enough to allow a combined renewable solution (solar and wind). For optimum operating efficiency an accumulator for the storage of electricity can be added to the system.

- Maximum capacity of solar panel: 24V / 10A
- Maximum capacity of wind generator: 24V / 1500A
- Power consumption of the exchange: 24V / 1.6 A
- Subscribers connected to the RSU: 260 pcs.

Total energy produced by combined renewable resources: 315.6 kWh / year
CO_2 emission savings: 114 kg (UNEP)

Swisscom

- **Purchase of 'naturemade star' eco-energy**

Swisscom is making a special contribution to reducing the environmental impact of power production. Part of its own energy requirement is covered by 'naturemade star' eco-energy. 'Naturemade star'-certified eco-energy must comply with stringent ecological requirements (installation design, residual flow management etc.). Moreover, a compulsory contribution is levied, which goes towards the restoration, protection or upgrading of the area surrounding hydroelectricity plants or towards the promotion of alternative energies.

Swisscom Fixnet was the first company in Switzerland, which decided to use 'naturemade star' eco-energy on a large scale, and has purchased more than 6,000,000 kWh per year over a three year period.

Swisscom IT Services also purchases some 600,000 kWh of 'naturemade star' eco-energy per year. The environmentally friendly energy is generated by small local hydroelectricity plants, a wind power plant in the Swiss Jura, and by photovoltaic power plants.

Additional cost: about 1 million CHF (=643,091.47 EUR[8]) / year
Total naturemade energy purchased by Swisscom: 11.7 million kWh
CO_2 emission savings: according to Switzerland's energy mix there is not a CO_2-emission savings measure, but rather a measure for risk minimization (less energy from nuclear power plants)

British Telecom

- **Purchase of green energy**

Combined Heat and Power (CHP) and renewables
BT has set a target of sourcing 10% of its energy from renewable supplies by 2010. It has established a sliding scale of interim targets of 3% by 2002 and 5% by 2004. This position was reassessed in 2004, with final stepped increases and the required external targets set to achieve the 2010 target.
BT negotiated two energy contracts in 2002/03, which together, reduced its emissions of harmful carbon dioxide by an estimated 283,000 tonnes – the equivalent of the annual emissions of over 43,000 homes – at the same time as reinforcing its commitment to a long term sustainable energy strategy. The deals built on BT's achievements to date, which include a 63 % reduction in CO_2 emissions since 1991.
The first of these contracts – believed to the largest of its kind in the UK - saw BT purchase up to 75 % of its energy requirements from Combined Heat and Power (CHP) systems. These plants can reduce CO_2 emissions by 40 % compared with power stations and heat-only boilers and the contract for 1.6 TWh will contribute substantially to both BT's and the UK's targets for reducing CO_2 emissions.
The second contract saw BT purchase 17 GWh of green energy. This contract helped BT exceed the ambitious targets for renewable energy use set out by the UK Government in April 2002. These require that 3 % of energy be provided by renewable sources by the end of 2005. BT was already in a strong position having bought 4.6 % of its energy from renewable sources in the period from April 2001 to March 2002 and this contract reinforced that strategy.
CO_2 emission savings: 286,000 tonnes CO_2-equivalent

[8] According to http://www.xe.com/ucc/ on 10 July 2005 (1 CHF = 0.643091 EUR)

1.2.5. Future awareness - NGN

There are several issues associated with the development and installation of Next Generation Networks. These are as follows:

- Parallel operation of two networks
  A Telco's biggest environmental impact is its energy use. Therefore, the biggest issue facing Telco's developing new networks over the next few years relates to increased electricity consumption due to new network technologies such as VOIP.
  When new networks are being installed it becomes necessary to run two networks in parallel for a period of time, dramatically increasing our electricity consumption and CO_2 emissions. It is therefore crucial that we keep network changeover periods as short as possible.

- Procurement of energy efficient equipment
  To keep energy consumption to a minimum it is important that we work with our suppliers during the design stage of new networks. The more energy efficient the equipment is the less impact we will have both during changeover and throughout its working life.

- Increased capacity of the power infrastructure
  To support new networks we also have to increase the capacity of the power infrastructure in our buildings. Power is needed to not only to power the equipment but also to remove the heat created by the equipment. It is crucial therefore that as well as working with our suppliers to reduce the energy footprint of new equipment we also use ETSI compliant equipment for future network deployment in order to reduce the cooling power required. This will also ensure that we can enable majority fresh air-cooling.
  To ensure that we manage energy efficiency and best practice into the network design programme our Power Teams are actively involved in the specifying process.

- Convergence
  As our networks are replaced with VoIP systems, we will face a number of convergence issues. Put simply, convergence means all services being available via one network. This could result in a 'flat rate' for any service scenario e.g. the same flat rate for using mobile, fixed line or broadband services. This could result in an increase in energy consumption and thus CO_2 emissions, because flat rates may inadvertently encourage people to have a service 'on' for 24 hours a day even when not being used. To tackle this problem it is crucial that service providers supply customers with detailed product information advising them of the actions they need to take to avoid additional energy consumption and costs.

- Managing our energy wisely
  Whilst we take all reasonable steps to manage energy wisely by reducing consumption wherever possible the fact is that if our businesses are to grow, one day we will reach the limit of what we can do. However, we believe that small increases in our consumption can lead to large decreases in CO_2 emissions if the "dematerialisation" potential of ICT is to be fully exploited.

1.2.6. Summary

1. As responsible telecommunications companies our behaviour demonstrates a responsible and significant contribution to the achievement of Kyoto targets and the goals of the climate convention (combating climate change):
    - we measure & report our levels of consumption
    - we share the best practices
    - we implement energy saving initiatives
    - we strive to use, purchase or generate renewable energy wherever possible
    - we communicate in a proactive manner how rules and regulations can be changed in order to ensure further reductions
    - we support that the society should aim to keep the global warming stay below 2 °C

2. This document is evidence of **our commitment** to:
   - Carefully manage scarce resources
   - Encourage all companies, regardless of whether they are ETNO members or not, to implement best practice ideas and continue to share knowledge
   - Take a proactive approach to EU legislation

ICT technology has enormous potential for travel substitution and our long-term aim will be to raise awareness of customers by promoting the wide ranging benefits of ICT solutions in a way that our customers can understand. However, in order to ensure that we are seen as credible we must make sure that our own direct emissions are reduced as much as possible as well as engage actively in a discussion on how we can reach a zero emission target. We also recognise that there needs to be a 'willingness' to improve the energy-mix by increasing the share of renewable energy on a voluntary basis. However, this too will be limited in the long-term unless a significant amount of additional 'new green energy' becomes available across Europe.

In parallel with this we have to significantly improve communication and stakeholder dialogue to promote intelligent use of our services (services discussed below).

Whenever solutions for reducing CO_2 are found to be too expensive these must be communicated to relevant governmental bodies so a dialogue can be initiated about future rules/legislation that make it possible to implement more sophisticated approaches in order to bring about deep reductions in emissions (this can include measures like tax-breaks, legal changes, public procurement guidelines, etc.)

Finally, we are seeking to minimise the environmental impacts of our new networks by managing our upgrade programmes to high environmental standards. This will enable us to become credible promoters who can ensure the significant potential that our new networks can bring to our customers, through increased use of sustainable products and services, is realised.

2. ENVIRONMENTAL BENEFITS OF ICT PRODUCTS & SERVICES

In this chapter we focus on the positive environmental impact of information and communication products and services. The main object is to see the ways in which ICT can help to reduce greenhouse gas emission. The question: Is this really an opportunity? Or, is there really the potential to use ICT as a solution to global warming?
Additionally, we have introduced further best practice examples along with analysis of any potential emissions replacement opportunities.

2.1. PROCUREMENT AND PRODUCT DEVELOPMENT GUIDELINES

In chapter 1 we discussed how telecommunications companies are introducing controls to reduce energy consumption for new products and services. In chapter 1.2.1 'Procurement guidelines' we provided examples of how two companies have introduced practices to achieve this i.e. The Greenbook and the Product Stewardship Generic Standard.

In both of the examples previously given the companies focussed on environmental impacts and energy consumption of supplied products and services. However, there is another practice, used by Magyar Telekom, which is used as an integral part of the product development process.

Magyar Telekom

- **Analysis implemented into the product development process**
  The product development process has different steps, starting with the idea and ending when it becomes a real product and following its introduction into the market.
  Idea → Product proposal → Business plan → Realisation → Test → Implementation
  In this process the decision on whether or not the new idea needs to be analysed, is made at the product proposal phase. The analysis itself can be done at the proposal phase provided that sufficiently detailed information is available. If not, it can be completed at the realisation phase.

  Each product/service assessment can use one or more (combined) of the following analytical methods:
  - Simple individual product analysis
  - Product comparison analysis
  - Analysis to assess a product's environmental impact replacement potential
  - Analysis to assess the positive effects on the environment by moving from a product to service

  All analytical methods focus on the positive environmental impacts of ICT as well as the negative.

  <u>1. Simple individual product analysis</u>
  This is a kind of simple life-cycle analysis, but not so detailed as ISO 14040.
  This method is particularly useful when analysing a products, telecommunication equipment, or network elements that are used in large quantities but are not too complex. It can be used to:
  - Identify lifecycle phases where pollution is possible;
  - Identify other environmental sensitive points (environmental hot spots), e.g. where too much energy is consumed;
  - Identify development and improvement possibilities.

  The analysis forms the basic methodology for the each of the other analytical methodologies.

  <u>2. Product comparison analysis</u>
  This analysis method is useful when there are alternative products / equipment available to the subscriber, or where other technical equipment is available that is capable of providing the same service.
  The results can be communicated in the chosen product's handbook.

  <u>3. Assessment of a product's environmental impact replacement potential</u>
  This method is useful where the new service aims to replace other activities that pollute the environment e.g. travelling).
  In this case, two alternatives must be analysed applying a life-cycle approach.

The following things must be estimated: number of potential subscribers, time in use, and optimal operating conditions.

4. Assessment of the positive effects on the environment by moving from product to service

This method can be used as a part of either of the previous two methods described above. However, because of its importance, it should be completed separately.

In this case we analyse the potential in replacing negative environmental impacts and compare alternatives. The next step involves investigation of the dematerialization potential wherever it’s possible to move from a physical product to a network service.

All our products and services have functions that can fulfil the consumers' demands. The environmental benefits possible as a result of the rapid development of our products and services are the subject of much international research. However, the pioneer companies, who carry out research into and use the results in practice, gain both environmental and competitive advantage.

2.2. CASES STUDIES FOR CO_2 REPLACEMENT USING ICT PRODUCTS & SERVICES

In this chapter we summarise different analyses of products and services done by telecom companies. This gives a first overview of ICT's environmental benefits.

British Telecom

- **Flexi-work at BT**

  BT has been assessing the impacts of its flexible work programme for several years. This culminated in BT’s participation in the, EU funded, Sustel project (www.sustel.org) which ran from 2001 to 2003.

  The survey data shows the mean weekly reduction in commute travel to be 178 miles for BT’s flexible workers. The SUSTEL pilot survey found that 27% of respondents felt that teleworking had decreased in-work travel and 13% felt that it had increased it.

  The pilot survey conducted for SUSTEL concluded; “if these values and modal split are typical across the full sample of Workabout registrants, then the total savings would amount to a weekly commute reduction of

  - 424,000 miles (682,216 km) per week of car travel and
  - 190,000 miles (305,710 km) per week of rail travel”, and may be an understatement”.

  This means for the **5,128 registered home workers 147,242.52 kg of CO_2 per week**.

	Commuting miles saved			CO_2 conversion factor (DEFRA)	CO_2 replacement
Car	424,000.00	Petrol	339,200.00	0.33	111,936.00
		Diesel	84,800.00	0.20	16,960.00
Rail	190,000.00	= 305,775.36 km		0.06/km	18346.52
Total kg					**147,242.52**

Certification: Sustel

Typology of teleworkers:

The BT surveys identified the fact that people telework in different ways. Therefore, for the BT studies a simple classification scheme was developed, with seven categories. All bar 3.4% of respondents were able to identify with one of the seven categories indicating that the typology was sufficiently robust.

The fact that all the categories were present is an extremely important point as working styles are important determinants of a number of environmental and social outcomes such as travel and community involvement. The fact is that over half the respondents work at multiple locations and have high levels of in-work travel. This also demonstrated the importance of gaining a more detailed understanding of each of the sub-groups.

Note: Increases in travel occur when BT teleworkers working at home make additional private journeys demonstrating that increased work flexibility can offset some in-work commuting savings.

- **Audio-conference at BT**

For the last survey, during the financial year 2003, a representative sample of BT employees was surveyed about their use of conferencing. The response group is broadly representative of BT in terms of business unit and age, but includes a higher proportion of managers and women.

By a very conservative estimate **each conference call is saving a minimum 22.05 kg of CO_2** and all conferencing calls are saving at least 20,060 tonnes of CO_2

Certification: SustainIT

Note: The BT audio conferencing data above only includes conference calls that 'definitely replaced a meeting'.

Deutsche Telekom

- **Video-conference opportunities by Deutsche Telekom**

The result of the investigation carried out by the Potsdam Institute on Climate Impact Research (PIK), which identified a substitution-potential of 20% for business travel, needs to be screened for its suitability for implementation. This should be done as part of a further project.

The project is based on an investigation completed by the Potsdam Institute on behalf of Deutsche Telekom. The investigations were carried out on a number of major global companies in Germany that had offices in Germany's capital city, Berlin, or that were based in Berlin. Since these global players seemed to be more advanced and more open to new technologies, the potential of 20% travel substitution is more optimistic than investigations carried out on other target groups.

The focus was on those essential factors, which could have a major impact on the use of videoconferences within companies and also on the degree and direction of effectiveness of substitution by videoconference.
Some investigation and estimations have been made for increased up-take in Germany in the future.
The estimation assumes that business travels in 2000 accounted for approximately 163 billion kilometres and 1 person.
That means:

- until year 2015: 5% = 8.15 billion person-kilometre saving potential
- until year 2020: 8% = 13 billion person-kilometre saving potential
- 2020 - 2035: 10% = 16.3 billion person-kilometre saving potential
- 2030: 15.2 billion person-kilometre saving potential
- 2035 - 2050: 11-15% = 18 - 24.5 billion person-kilometre saving potential
- 2050: 24.5 billion person-kilometre saving potential.

The figure of 163 billion kilometres and one person, that was part of the Potsdam investigation, was originally drafted by the "Deutsches Institute für Wirtschaftsforschung (DIW)", otherwise known as the German Institute for Economic Research, who investigated the development of travelling and more specifically business travel from 1976 to 2000:

- 1976: 80 billion Person-kilometre
- 1989: 117 billion Person-kilometre
- 1991: 148 billion Person-kilometre
- 1993: 152 billion Person-kilometre
- 1995: 150 billion Person-kilometre
- 1997: 155 billion Person-kilometre
- 1999: 162 billion Person-kilometre
- 2000: 163 billion Person-kilometre

Based on general traffic data, substitution by videoconference was estimated as follows:

- by the year 2015: 5% = 8.15 billion person-kilometre = 1.3 million tonnes CO_2
- by the year 2030: 2.8 million tonnes CO_2
- by the year 2035 – 2050: 11-15%,

A **20% replacement is equivalent to a 4.3 million tonnes CO_2 emissions saving**.

The estimated improvement obtained by substituting business travel is based on person kilometres, which is estimated as constant: the reason is that the increase of business travel during the time – period will also be substituted by an improvement in social behaviour i.e. that more people do share a car.

Certification: PIK (Potsdam Institute on Climate Impact Research)

- **Online billing at Deutsche Telekom**

The main targets were to increase the use of IC-technology, investigate the possibility of testing various information transmission types and to look at potential savings of natural resources (paper) and potential cost savings.
Calculation: based on 1 million customers/year, the saving is 206 tonnes of recycled paper (including envelopes).
The present status (August 2004) in Germany among Deutsche Telekom customers refers to 2.8 million customers, which means approx. 576.8 tonnes of recycling paper saving.

The CO_2 emission savings can be calculated in the following way, taking only paper as waste into consideration.

Fraction of waste	Waste management	Amounts of waste (tonnes/year)	Conversion factor (tonnes CO_2-equiv./ tonne)	Total tonnes CO_2-equiv. year
Paper and cardboard	**Landfill**	206	4.16	856.96
		576.8		**2399.48**
	Incineration	206	1.45	298.70
		576.8		**836.36**

Calculation according to the production of recycled paper is the following:

Production recycled paper in case of 2.8 m customers (t)	576.8
Energy consumption of recycled paper production (kWh/t)	2750
Electricity production emission factor {Germany} (tCO_2/kWh)	0.000419
CO_2 emission of recycled paper production (t)	**664.62**

In this calculation, as the table shows, there are no calculation relating to the transportation of paper products and bills. Nor was the computers' consumption taken into consideration.

Certification: German Oeko Institute

- **T-Net Box (virtual answering machine) vs. stand-alone answering machine**

The so called T-Net box, is a virtual answering machine in Deutsche Telekom's fixed network and can be used by dialling a cost free access number. This virtual answering machine is accessible via each subscriber's normal phone number all over the world. Faxes may also be stored as an option.
In case of the replacement of all the 15 million answering machines by T-Net boxes t the following savings would be possible:

- o 15 million T-Net-Box customers' impact: 3.9 GWh per Year
- o 15 million answering machines' impact: 656.1 GWh per Year

⇨ Potential savings by T-Net-Box: 652.2 GWh per Year

The actual number of **T-Net-Box users** at Deutsche Telekom is **4.5 million**, which is equivalent to the following **CO_2 replacement**:

- o **150,000 tonnes / year (according to GEMIS[9])**
- o **75,000 tonnes / year (according UNEP Guideline)**

This means the following replacement by each user:

- o 0.033 tonnes / user / year (according to GEMIS)
- o 0.017 tonnes / user / year (according to UNEP Guidelines)

[9] GEMIS: Global Emission Model for Integrated Systems

The number of T-Net Box users will, of course, be higher than those who have answering machines. However, it has been recognised that some customers have never used the T-Net-Box despite initiating the procedure to use it. Therefore Deutsche Telekom considered the number of T-Net Box users to be equivalent to the number of DT subscribers that own an answering machine. This was how the 4.5 million T-Net Box users figure was determined

Certification: German Oeko Institute.

Magyar Telekom

- **Web-tax use vs. paper-based taxation**

  The main objective of the analysis was to define the quantity of CO_2 emissions that can be saved by using web-tax service instead of printing and mailing the tax documents to the tax payers for completion.

  The use of this service results in dematerialization, as people no longer have to complete tax returns and send them to the Tax authority. They are now able to download the documents direct from the web and following completion they can be sent electronically to the Tax Office. Potential savings are paper and fuel resources.

  The analysis proved that 1014.3 g (**1.0143 kg**) **CO_2 equivalent** can be saved **/ year / tax document**. Based on this finding it was calculated, that if 40% of Hungarian population used the on-line tax return, then 40,572 t CO_2 could be saved per year.

  The simplified life cycle analysis (LCA) was prepared by the University of Veszprém, by using the GaBi 4 life cycle software system.

  The boundaries set for the calculation are as follows:

  The main goal of all versions is to meet the requirements of the Tax authority.

  The two different main systems which were analyzed are, on the one hand, the recently available existing methods in which the taxpayer purchases the documentation, and, after filling out it will be sent via post or taken personally to the authority. And, on the other hand, the web-based system in which we have not taken into account the printing of the documentation but have considered the electronic recording as significant. The authority is responsible for recording, and no prints are made.

  Certification: University of Veszprém

2.3. OPPORTUNITIES OF INFO-COMMUNICATION PRODUCTS & SERVICES WITH LARGE SCALE IMPLEMENTATION

Based on the results above, in this chapter we give an idea of the possible effect increased take-up of these services would have across Europe. The following information was used as a basis for the calculations:

- o Population of EU 25 in 2004[10]: 456,863,300
- o Population of European free trade Association (CH, IS, LI, NO) in 2004[11]: 12,266,500
- o Taking whole Europe's opportunities into account, the population is around 813.5 million (According to data Y2002, including Russian Federation).
- o In some cases we use the number of employees in EU-25 from the following sources:

Employment rates in EU

15-64 years	2004q4 (1000)[1]	Margin of error[2]	Men and women			
			2004q4		2004q3	2003q4
EU-25	**193,024**	**± 499**	**63.6**	***± 0.2***	**63.6**	**63.1**
EU-15	**164,171**	**± 490**	**65.0**	***± 0.2***	**65.1**	**64.5**

Source: Eurostat, LFS

2.3.1. Travel-replacing Services

One of the most significant impacts on climate change arises from transportation. The following table that shows the CO_2 equivalent emissions caused by transportation in Europe helps us better understand this impact. According to Eurostat data, in EU25 942 million tonnes of CO_2-equivalent were due to transportation activities.

[10] Source: Eurostat
[11] Source: Eurostat

Greenhouse gas emissions from transport activities (Thousand tonnes of CO_2 equivalent)
(Aggregated emissions of Kyoto basket of 6 greenhouse gases weighted by their global warming potentials (GWPs). Using GWPs, emissions of individual gases are translated into CO_2 equivalents that can be added up to one figure. Weighting factors: carbon dioxide=1, methane=21 and nitrous oxide=310, sulphur hexafluoride=23900. Hydrofluorocarbons and perfluorocarbons comprise a large number of different gases that have different GWPs.)

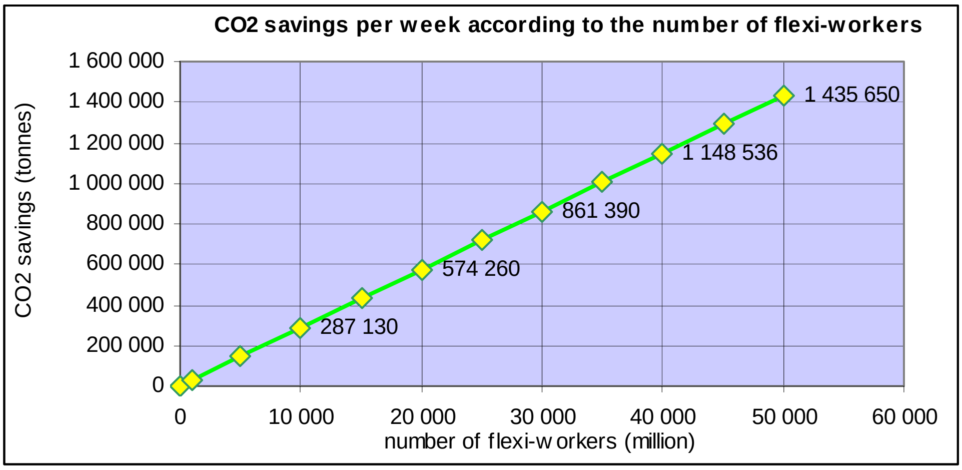
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
EU (25 countries)	792404.54 (s)	818202.79 (s)	824988.54 (s)	830147.08 (s)	837672.93 (s)	858450.59 (s)	868132.56 (s)	896025.78 (s)	921948.45 (s)	917999.53 (s)	931789.41 (s)	941908.43 (s)
EU (15 countries)	727708.94	753186.34	761633.77	765932.14	776203.23	793879.41	803353.11	829386.19	850176.96	851111.46	860067.39	868731.25
Belgium	20889.34	22403.41	22575.38	22368.45	22504.49	22967.78	23220.57	23970.94	24380.10	24906.61	25595.52	25941.84
Czech Republic	7510.91	7602.07	7701.23	7800.38	9159.76	10519.13	12083.49	11254.02	12545.86	11665.37	12647.72	13070.16
Denmark	11146.74	11299.07	11514.91	12002.76	12170.65	12405.76	12567.15	12614.91	12694.90	12571.69	12613.61	12773.31
Germany	170856.17	177044.92	182274.22	178654.59	182618.48	182803.55	183305.81	186481.28	191967.87	187840.32	183394.91	181258.15
Estonia	3094.36	1505.58	1721.54	1530.07	1109.14	1052.76	1218.56	1359.61	1210.06	1035.97	1933.30	2188.02
Greece	19735.85	19942.60	20113.67	20169.76	20155.15	20673.88	21302.07	22957.24	23732.70	22516.08	20562.78	20935.00
Spain	60366.75	63706.70	63017.77	65999.73	67036.64	71748.22	72481.83	79741.12	84761.71	87313.62	91722.09	93956.74
France	124161.73	128887.71	128997.99	130409.36	132602.12	134325.80	136731.92	139078.55	142371.58	141966.15	145482.93	146582.86
Ireland	5397.51	5826.86	5845.69	6088.71	6582.49	7391.20	8063.23	9215.22	10258.49	10639.45	11530.98	11678.31
Italy	106903.17	111345.36	113163.92	113232.30	115185.17	116542.01	118360.63	122475.28	123872.65	124435.24	126861.72	129248.49
Latvia	3204.16	2739.12	2496.69	2322.54	2682.45	2183.61	2192.33	2152.40	2081.40	2303.57	2711.07	2717.35
Lithuania	5616.54	5353.36	5090.18	4827.00	4563.81	4300.63	4037.45	3774.27	3748.15	3722.02	3695.90	3669.78
Luxembourg	3295.92	3225.10	3310.73	3719.04	3459.99	3591.90	3834.94	4038.08	4397.06	5035.44	5285.59	5486.66
Hungary	7382.56	7189.48	7140.78	7211.81	7000.70	6612.20	7741.00	8474.24	9665.88	9025.66	9377.43	9843.60
Malta	364.52	389.18	410.23	430.27	443.40	465.72	476.73	484.32	492.96	499.75	499.75	499.75
Netherlands	29887.13	31144.19	31792.17	31954.79	32745.28	33266.09	33701.40	34793.93	35630.06	35816.01	36097.78	36839.28
Austria	14883.79	14900.38	15101.90	15250.68	15309.45	16911.15	15796.76	17903.03	17282.00	18133.97	19383.42	21333.12
Poland	28361.04	31087.13	28217.10	30099.10	25867.92	28741.80	27272.39	28799.52	32110.59	28902.00	30845.93	30845.93
Portugal	11310.04	12205.00	12672.44	13229.72	13879.78	14558.63	15165.36	16641.22	17520.20	19124.92	19982.60	20464.15
Slovenia	2560.14	2634.63	3041.44	3364.78	3711.23	4312.26	4379.73	3797.32	3636.18	3790.48	3939.38	3964.92
Slovakia	4313.86	4024.56	3970.38	4231.32	4516.11	4590.82	4768.15	5136.51	5002.27	4486.10	5111.94	5830.47
Finland	11985.71	11962.47	11376.51	11793.31	11539.90	11454.66	12023.39	12909.62	13316.94	12940.03	13194.17	13441.34
Sweden	18828.62	19708.23	18864.70	19458.21	19595.11	19402.27	19600.66	19893.10	20293.73	20182.25	20439.66	20972.81
United Kingdom	118060.48	119584.35	121011.76	121600.75	120818.52	125836.49	127197.39	126672.67	127696.98	127689.68	127919.62	127819.20
Bulgaria	6601.37	6515.92	7535.60	6628.99	6931.29	6383.07	5377.76	6543.88	6280.40	5943.25	6071.54	6377.66
Romania	7635.34	9404.97	8299.47	8834.45	8100.12	11408.92	11557.66	10846.11	8560.47	9340.59	10863.72	11961.24
Iceland	736.22	738.55	747.83	752.75	765.18	750.97	798.97	804.32	851.88	862.51	865.11	865.11
Norway	11258.76	11490.91	12136.98	12006.16	12453.82	13151.82	13451.06	13854.05	14517.62	13681.42	14077.58	14126.87

(s) Eurostat estimate

Source: Eurostat

- **<u>Use of Flexi-work</u>**
  Based on BT's results (where the 5,128 registered home workers saved 147,242.52 kg of CO_2 per week) the weekly possible CO_2 replacement potential is as follows:

Number of flexi-workers	1 million	10 million	20 million	40 million	80 million
CO_2 savings (tonnes)	28 713	287 134	574 268	1 148 536	2 297 072



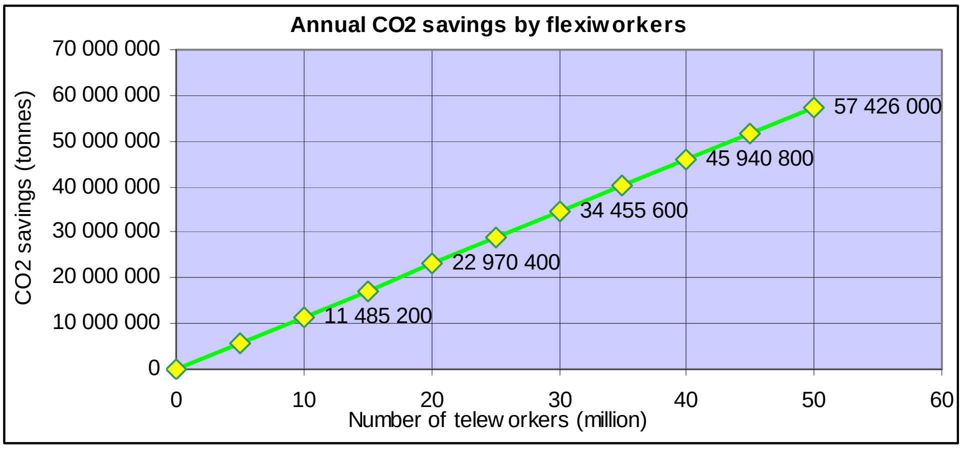
<u>Further calculations</u>:
If 5,128 registered flexi-workers can save the following travel-mix per week:
- 424,000 miles (682,216 km) of car travel
- 190,000 miles (305,710 km) of rail travel

And, if we assume that the car types used are the same as those used by BT, then one flexi-worker could save per week:
- o ~ 133 km car travel
- o ~ 60 km train travel
- o ~ 28.713 Kg CO_2

To scale this up to a year, we have assumed that flexi-workers work for 40 weeks per year, which equivalent to the following savings:
- o ~ 5320 km car travel
- o ~ 2400 km train travel
- o ~ 1148.52 Kg (1.149 tonnes) CO_2

At European level this could result in the following carbon dioxide emission savings per year:

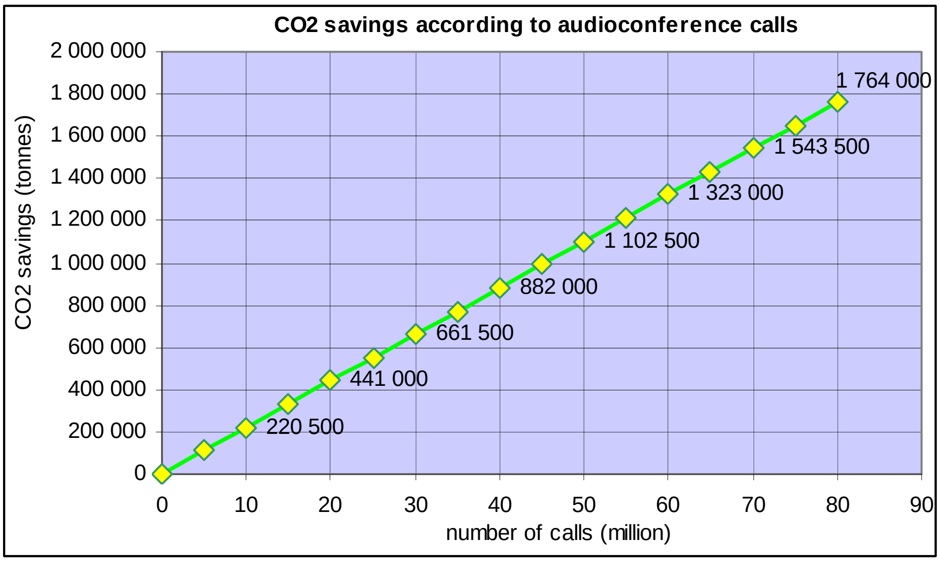
Number of flexi-workers	1 million	10 million	20 million	40 million	80 million
CO_2 savings (tonnes)	1 148 520	11 485 200	22 970 400	45 940 800	91 881 600



<u>Tip</u>: If 10% (19.3024 million) of EU-25 countries' employees were like BT flexi-workers, then 22.17 million tonnes CO_2 could be saved.

- **<u>Use of Audio-conference</u>**
  Based on BT results (CO_2 savings per Conference Call = 22.05 kg CO_2) the CO_2 replacement potential is as follows:

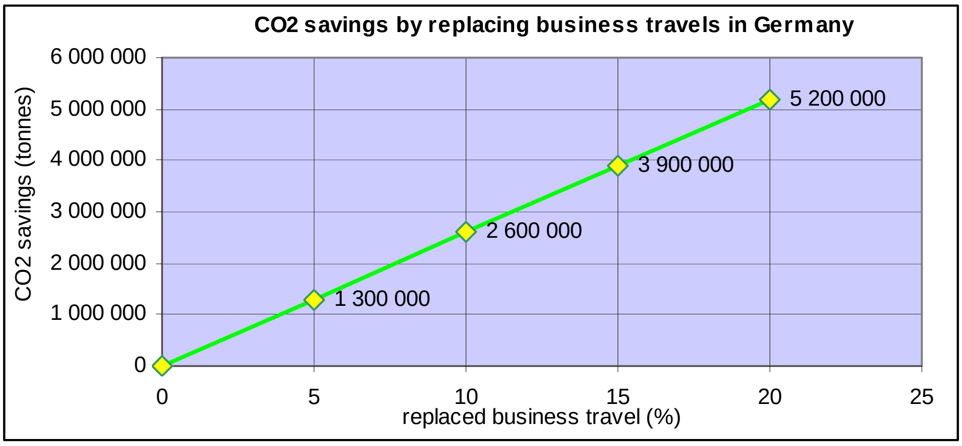
No. calls	1 million	10 million	20 million	40 million	80 million	100 million
CO_2 savings (t)	22 050	220 500	441 000	882 000	1 764 000	2 205 000



<u>Tip</u>: If 50% (96.512 million) of EU-25 countries' employees replaced an average business trip per year with one audio-conference call, then 2.128 million tonnes CO_2 could be saved.

- **Use of video-conference**
  Based on Deutsche Telekom's results, if in Germany general business traffic were decreased using video-conferencing as a possible solution, the following potential savings would be possible:
  - (Until year 2015) 5% business travel replacement = 8.15 billion person-kilometre saving potential = 1.3 million CO_2 savings.
  - year 2030: 2.8 million tonnes CO_2 savings, etc.

  The calculation assumes up to 20% of business travel substituted by video-conferencing by the year 2050 in Germany as follows:



Further calculations:

According to Eurostat's table on "Greenhouse gas emissions from transport activities" Germany's greenhouse gas emission is 19.24% of EU-25 countries' emission.

If we take this estimate and apply it to business travels at the European level, using the same ratio, the calculation yields the following results:

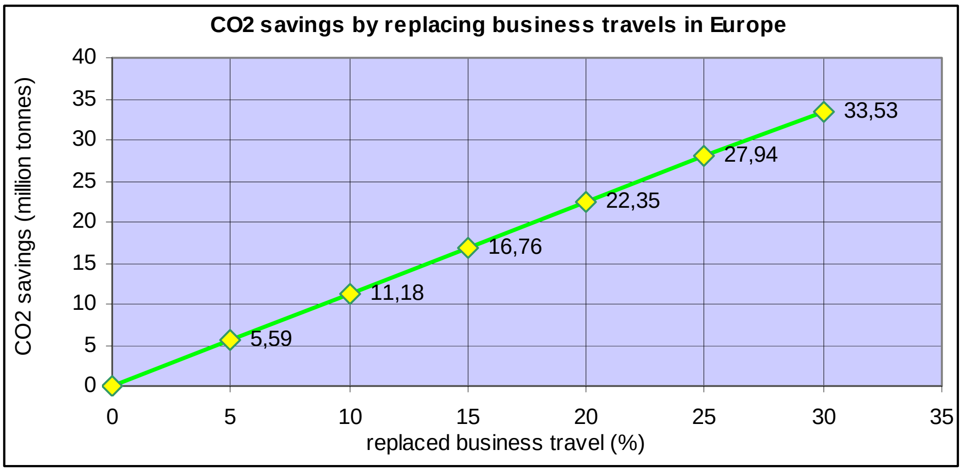
19.24% (Germany's ratio) ⇨ 4.3 million tones of CO_2
100% (EU-25) ⇨ 22.35 million tones CO_2 replacement.

To check if this ratio is accurate the table below shows the passenger transport demand in billion passenger-kilometres in 1997. According to this table Germany's demand was 19.75% of total EU-15 demand. Based on this, we can say that the error rate in our calculation appears to be small.

Member States	**percentage** of CO_2 emissions from fuel combustion caused by transport in 1998	passenger transport **demand** in billion passenger-kilometres in **1997**
Austria	32.6	87.8
Belgium	21.6	112.9
Denmark	21.4	81.9
Finland	21.4	62.9
France	35.7	788.9
Germany	21	872.5
Greece	21.5	87
Ireland	23.3	51.9
Italy	25.6	773.4
Luxembourg	21.6 (1990)	5.5
Netherlands	19.6	180.1
Portugal	33	126.7
Spain	31.9	411.3
Sweden	40.1	109.3
United Kingdom	23.5	710.1
EU 15	26.4	4417.2
source:	UNFCCC	Eurostat, DG

		Transport

replaced business travel in EU-25	1%	5%	10%	15%	20%	25%	30%
CO_2 savings (million tonnes)	1.12	5.59	11.18	16.76	22.35	27.94	33.53



The calculations do not take into account the impact of the services; they only show the potential for CO_2 emission replacement arising from travel reductions. To be more precise, we should know where conference participants are based and how far they would need to travel, but, using a general data-mix, we are unable to give a figure. Additionally, the travel reductions and CO_2 replacement potential also depend on the mode of travel used to reach the meeting venue (e.g. car, train, aeroplane to and from the meeting venue).
To give some idea on the possible ratio, the table below shows data from Magyar Telekom's LCA study on video-conferencing, developed by Veszprém University.

	Duration of the meeting (h)		
	3	4	6
Video-conference ($kgCO_2$)	1.658	2.127	3.066
Travel by			
car ($kgCO_2$/km)	0.519	0.520	0.522
train ($kgCO_2$/km)	0.033	0.034	0.036
airplane ($kgCO_2$/km)	2.003	2.004	2.006

- This table shows that in the given circumstances analysed by the study, in the case of a 3 hour long meeting, replacing 200 km car travel by video-conference, the impact of ICT is only 1.6% of the travel's impact.
- Replacing 200 km travel by train (same circumstances); the impact of video-conference is 25.12% of travel's impact.
- Replacing 200 km travel by airplane (same circumstances); the impact of video-conference is 0.41% of travels' impact.

Emission data for cars, trains, airplanes are based on BUWAL 250 database as follows:

Transport	**g CO_2/km**
Truck	240
Airplane (intercontinental)	1000
Airplane (continental)	200
Passenger Car (petrol)	180
Passenger Car (diesel)	200
Train	30

The CarbonNeutral Company (Futureforests) database (source: DEFRA, 2001) gives data conversions factors of:
Short haul flights (0-3000 km) = > 0.18 kg/passenger km
Long haul flight (> 3000 km) = > 0.11 kg/passenger km
(http://www.carbonneutral.com/calculators/flightassumptions.asp)

The length of a meeting determines the additional sources of emissions, because besides the main burden (the travel), at a conference/meeting there is also waste-water generation (as a result of sanitary, food, drinks usage) lighting and electricity consumption of the projector and other equipment as potential CO_2 equivalent sources. The quantities are of course, dependent on the length of the meeting.

Tip: If 20% of business travel in EU-25 countries was replaced by non-travel solution (e.g. video-conference), around 22.35 million tonnes CO_2 could be saved.

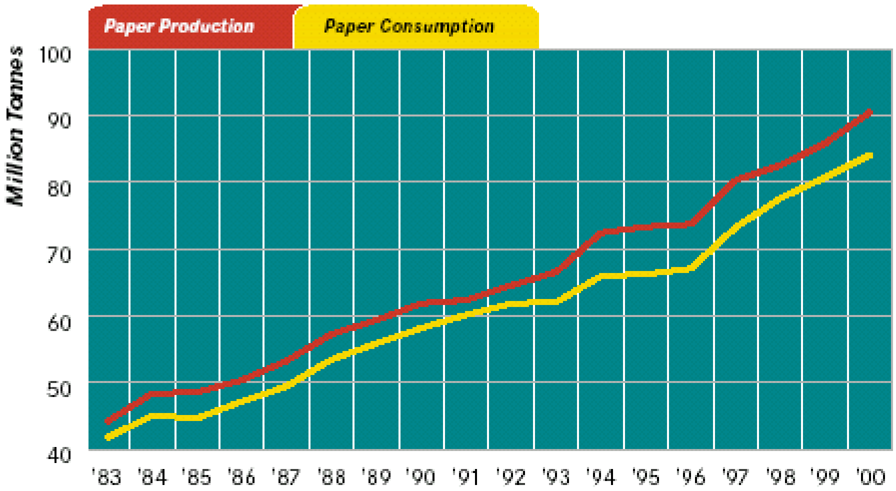
2.3.2. Dematerializing Opportunities of Services

- **Use of Online billing**

Paper production and paper consumption

In the chart below, a continuous increase of paper production and consumption is shown. This demonstrates that despite the fact that use of ICT is increasing, it has not stopped the increase in paper use.

Figure: Paper Production and Consumption in CEPI 1983 - 2000



To operate online-billing the most important service needed is the Internet. The table below shows the Internet access ratio in households in EU and other European countries.

Level of Internet access – households

Percentage of households who have Internet access at home

All forms of Internet use are included. The age range of the population is considered to be 16 to 74.

	2002	2003	2004
EU (25 countries)	:	:	42
EU (15 countries)	39	43	45
Euro-zone	36	40	43
Belgium	:	:	:
Czech Republic	:	15	19
Denmark	56	64	69
Germany	46	54	60
Estonia	:	:	31
Greece	12	16	17

Spain	:	28	34
France	23	31	34
Ireland	:	36	40
Italy	34	32	34
Cyprus	:	:	53
Latvia	:	:	15
Lithuania	4	6	12
Luxembourg	40	45	59
Hungary	:	:	14
Malta	:	:	:
Netherlands	58	59	:
Austria	33	37	45
Poland	:	:	26
Portugal	15	22	26
Slovenia	:	:	47
Slovakia	:	:	23
Finland	44	47	51
Sweden	:	:	:
United Kingdom	50	55	56
Bulgaria	:	:	10
Croatia	:	:	:
Romania	:	:	6
Turkey	:	:	7
Iceland	:	:	81
Norway	:	60	60

Source: Eurostat

<>	**2001 (thousand)**	
Geo		
Eu15 European Union (15 countries)	155,773	s

Source: Eurostat

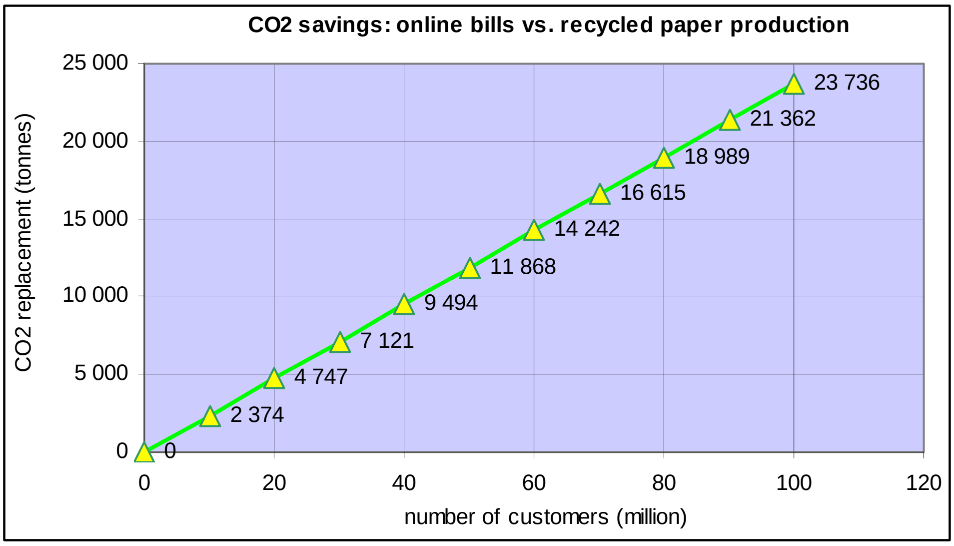
This means that 45% of 156 million households in EU 15 countries can have online bills delivered, which is equivalent to 70.2 million online bills. This number could be much higher if we consider EU25. However, there is no data available for the number of households for the EU25.

In addition to the above, mobile customers can also receive online bills. Mobile subscribers total some 379 million[12]. In this study we have not taken these into account, but we just want to highlight all possibilities. e-banking services could also have the same effect.

Let us suppose that all phone bills are printed on recycled paper. Taking only the **production of recycled paper** into consideration, we can calculate the emission reduction potential as follows:

Production of recycled paper (t) in case of 1 million customer	206
Energy consumption of recycled paper production (kWh/t)	2750
Electricity production caused emission (Germany[13]) (t CO_2/ kWh)	0.000419
CO_2 emission from recycled paper production	**237.36**

[12] See: IP/04/1438
[13] Certainly using Germany's factor regarding CO2 emissions in calculations is not giving a completely clear picture of Europe, as in some countries this factor is lower, and in other countries it is higher.



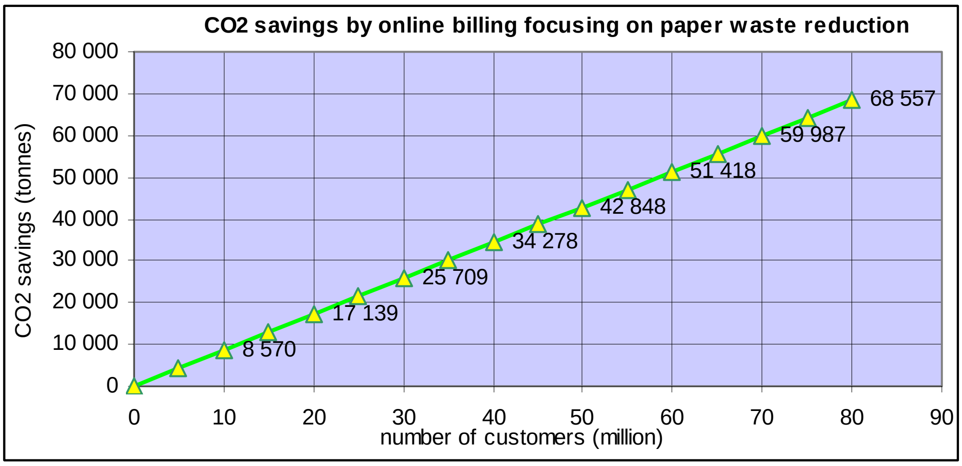
This means that:
- o with 70.2 million households (in EU15): 16,663 tonnes CO_2 can be saved by replacing recycled paper production.
- o with 379 million mobile subscribers (in EU25): 89,959 tonnes CO_2 can be saved by replacing recycled paper production.

Based on Deutsche Telekom's results, where it was shown that 1 million online billing customers per year can save 206 tonnes of recycled paper (including envelopes), considering this amount as wastes, the CO_2 replacement potential in the case of **landfilling** (which is the worst case, but which may happen in some European countries where there is no selective waste management in households) is 856.96 tonnes.

Fraction of waste	Waste management	Amounts of waste *(tonnes/year)*	Conversion factor *(tonnes CO_2-eqv./ tonne)*	Total tonnes CO_2-eqv. year
Paper and cardboard	Landfill	206	4.16	856.96
		575		**2392.00**
	Incineration	206	1.45	298.70
		575		**833.75**

Scaling up this amount the following CO_2 savings are possible:

No. Customers	1 million	5 million	10 million	40 million	80 million
CO_2 savings (t)	856.96	4,284.80	8,569.60	34,278.40	68,556.80



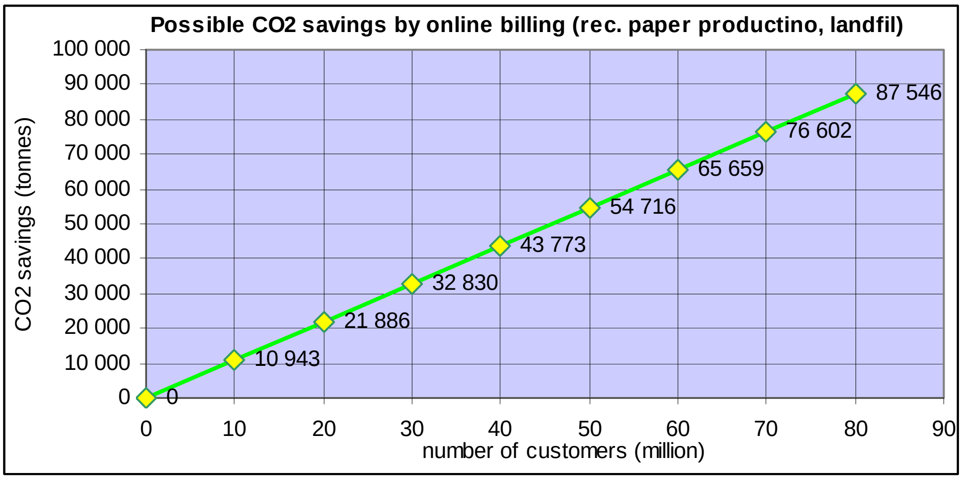
This means that:
- o with 70.2 million households (in EU15): 60,159 tonnes CO_2 can be saved by replacing recycled paper waste landfill, and

- with 379 million mobile subscribers (in EU25): 324,788 tonnes CO_2 can be saved by replacing recycled paper waste landfill.

If we add the **recycled paper production and waste landfill** replacement results, using the number of households in EU15 only, then 1 million online billing customers' could save 1,094 tonnes CO_2.

(The impact on transportation by switching from physical bills was not taken into consideration. Nor were the impacts caused by the increased use of PC's or mobile phones')

number of customers	1 million	10 million	20 million	30 million	40 million	50 million	60 million	70 million	80 million
Saved CO_2 (tonnes)	1 094	10 943	21 886	32 830	43 773	54 716	65 659	76 602	87 546



This means that:
- with 70.2 million households (in EU15): 76,821 tonnes CO_2 can be saved by replacing recycled paper production and waste landfill together, and
- with 379 million mobile subscribers (in EU25): 414,747 tonnes CO_2 can be saved by replacing recycled paper production and waste landfill together.

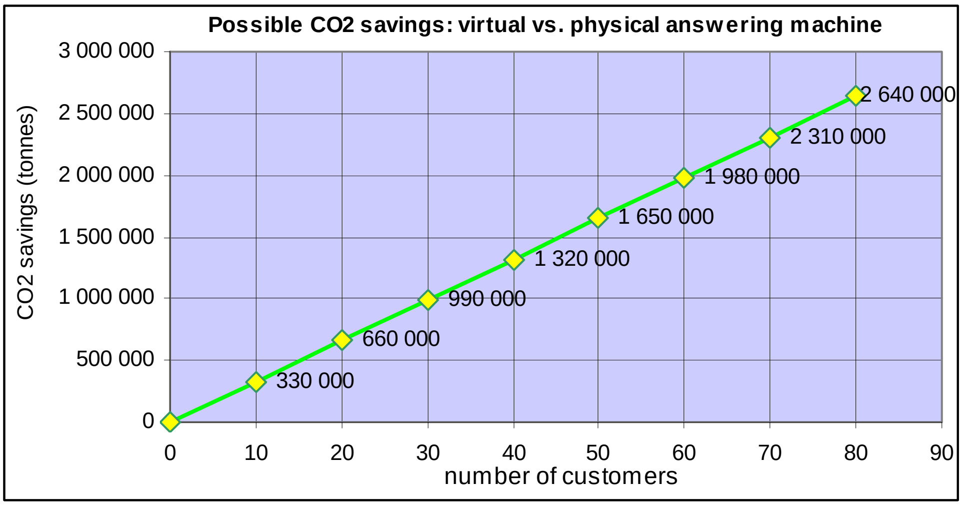
Tip: If all households, which have access to the Internet in EU-15 countries and all mobile customers in EU-25 countries get online bill, then 491.57 thousand tonnes CO_2 can be saved.

- **Use of virtual answering machine instead of physical voice machine**
  Based on Deutsche Telekom results, each user can replace the following amounts of CO_2:
  - 0.033 tonnes / user / year (according to GEMIS*)
  - 0.017 tonnes / user / year (according to UNEP Guideline)

We can scale up the possibilities as follows:

Number of customers	1million	10 million	20 million	30 million	40 million	50 million	60 million	70 million	80 million
CO_2 (tonnes)	33 000	330 000	660 000	990 000	1 320 000	1 650 000	1 980 000	2 310 000	2 640 000

Note: Unlike the calculations we made in chapter 1, where we used UNEP Guidelines for calculating the telecom operators' environmental impacts, in the table above we used the same factor i.e. the factor used in Germany. This is because we were not able to complete the calculations for different users in different countries.



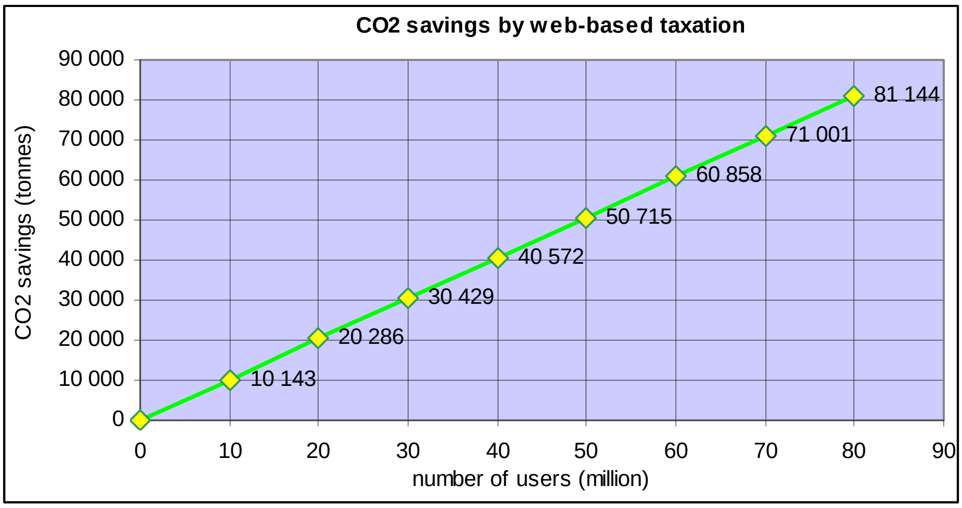
It is difficult to provide estimations of the size of physical answering machine production, as this is no longer a common product. The solution already exists in the case of mobile phones. For the purpose of scaling up, Eastern European countries should also be taken into consideration
.

Tip: If 20% of households in EU-15 countries (31 million) use virtual answering machine instead of physical answering machine, then 1.03 million tonnes CO_2 can be saved.

- **Use of Web-tax**

Based on Magyar Telekom's results, which proved that 1014.3 g (**1.0143 kg**) **CO_2 equivalent** can be saved **/ tax document**, an increase in the number of web-tax users would deliver the following CO_2 emission reductions.

Number of web-taxes	1 million	5 million	10 million	40 million	80 million
CO_2 savings (t)	1,014.3	5,071.5	10,143	40,572	81,144



If tax returns in the EU are all completed via the Internet (which we know is an unrealistic target), then the possible CO_2 replacement would be 195,784 tonnes. This calculation assumes that:

- every individual has to deliver one tax return per year
- each tax return is the same size
- the number of employees in EU25 is 193.024 million (based on Eurostat's 2004 fourth quarter data for EU-25 countries)

<u>Tip</u>: If all employees in EU-25 countries (193 million) deliver the tax return via Internet, then 195.78 thousand tonnes CO_2 can be saved.

2.4. Summary

In this document, we have summarised just a few of the services, which have been certified by independent bodies. These examples show quite clearly the environmental benefits that ICT can bring about and the potential that these services have for replacing carbon dioxide emissions. We believe that ICT solutions must be taken into consideration whenever programmes or actions to combat Climate Change are initiated.

For all the examples given, the supply side technology is readily available. The market is also in a position to deal easily with increased demand for both the current services and for new ones.

We have made some estimates, which may seem to be, in some cases, too optimistic. We do not claim, however, that these are 100% accurate and we recognise that numbers of customers can change, as can the CO_2 replacing potential for different levels of consumptions. Our aim is simply to give an overview of the real opportunities that exist for economic growth whilst combating climate change at the same time.

Summarising estimates:

Flexi-work
- If 10% (19.3024 million) of EU-25 countries' employees became flexi-workers, then 22.17 million tonnes CO_2 can be saved.

Audio-conference
- If 50% (96.512 million) of EU-25 countries' employees replaced one meeting with one audio-conference call per year, then 2.128 million tonnes CO_2 can be saved.

Business travel replacement (video-conference)
- If 20% of business travel in EU-25 countries is replaced by a non-travel solution (e.g. video-conference), around 22.35 million tonnes CO_2 can be saved.

Online-bills
- If all households, that have Internet access, in EU-15 countries, and all mobile subscribers in EU-25 countries get an online bill, then 491.57 thousand tonnes CO_2 can be saved.

Virtual answering machine
- If 20% of households in EU-15 countries (31 million) use virtual answering machines instead of physical answering machines, then 1.03 million tonnes CO_2 can be saved.

Web-based tax return
- If all employees in EU-25 countries (193 million) deliver their tax returns via Internet, then 195.78 thousand tonnes CO_2 can be saved.

If we assume that all our tips are realistic, based on our analyses, the sampled services can save 48.37 million tonnes of CO2 emissions.
The timing depends on political and economic support, on real programs.

We believe that what is needed is a fundamental change in organisational behaviour. So, a mixture of incentives and legislation could assist in take up.

Therefore, our follow up goals are to ensure that:
1. ICT is recognised as an important part of the solution for combating climate change in Europe.
2. Key actors have a climate change strategy for ICT.
3. Concrete "ICT-Climate change" programmes are initiated in Europe by 2007.