Final Report

Dissemination of energy efficient electric and electronic equipment (5E) in European universities – Technical issues and policy options for procurement strategies

SAVE 2002-083 "5E in Universities"

April 2005

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COPERNICUS-Secretariat
Brandschachtstrasse 2
44149 Dortmund (Germany)

SAVE 2002-083, “5E” in Universities

Dissemination of energy efficient electric and electronic equipment (5E) in European universities – Technical issues and policy options for procurement strategies

Abstract

A collaborative programme of research involving fourteen European Universities and the Austrian Energy Agency has shown that PCs and Monitors used for Third Level Education in Europe consume 3.4TWh of electrical power per annum. It has also shown that the performance of existing equipment is between medium and best technology in terms of energy efficiency whilst its use is between medium and worst practice, also in terms of energy efficiency.

Recommendations produced in the course of the project aim to improve procurement practice through the use of specific energy consumption data that enable total cost of ownership, including cost of energy, to be accurately evaluated during tender assessment. It is estimated that savings of approximately 40% in energy consumption will result from the proper implementation of these recommendations.

Guidelines for implementation of power management controls produced by the researchers show how to optimize the use of these increasingly important energy conservation devices. It is estimated that savings of up to 35% can be achieved through the optimum use of these controls – bringing the total potential saving to something in excess of 75%.

The work draws attention to the need for changes in existing energy-labeling systems and for developments in related industry standards. It also highlights the need for accurate information about usage patterns to improve the precision of total cost of ownership calculations.

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ABBREVIATIONS

5E – Energy Efficiency Electric and Electronic office Equipment
ACPI - Advanced Configuration and Power Management
APM – Advanced Power Management
AUA - Agricultural University of Athens
CRT – Cathode Ray Tube
EU – European Union
EVA - Austrian Energy Agency
GUB - University of Ghent, Belgium
GUS - Göteborg University, Sweden
HWU – Heriot Watt University
ICT – Information and Communications Technology
IS – Information Services
IT – Information Technology
PC – Personal Computer
PROST - Public Procurement Of energy Saving Technologies
SAVE – European Union-wide programme promoting energy efficiency
TCD – Trinity College, Dublin
TCO – Total Cost of Ownership
TFT – Thin Film Transistor (LCD)
TUC - Technical University of Catalunya, Barcelona
TUG - University of Technology, Graz
UC - University of Coimbra
UH/KP - University of Helsinki/Kymenlaakso Politechnic
UVA - Universiteit van Amsterdam
WLC – Whole Life Cost

1. Introduction

This project set out to assist universities in Europe in the critical social roles of training and research and raising awareness in areas relating to the energy-efficiency of electric and electronic office equipment – “5E”. The project had four main objectives:

1.1. To collect information about current university purchasing procedures relating to electric and electronic office equipment;

1.2. To assess the implications of current EU directives about energy labelling and public procurement on these procedures;

1.3. To raise awareness at all university levels about developments relating to energy efficiency of electric and electronic equipment; and

1.4. To undertake a European Union wide pilot action involving 14 universities in the development, testing and optimisation of a procedure for the procurement of energy-efficient office equipment. This procedure was intended to be suitable for adoption by all other universities in Europe and also for use as model for other (public) sectors and product groups.

The project was funded by the European Commission within the framework of the SAVE II program.

2. Participants

A list of the participants and the reports, recommendations and guidelines produced in the course of the project is set out in Appendix A.

3. SAVE Programme

The following material has been copied from the SAVE website at http://europa.eu.int/comm/energy/en/pfs_save_en.html for information.

The SAVE Programme is the principal focus of the Community's non-technological action on energy efficiency. It is the only Union-wide programme dedicated exclusively to promoting energy efficiency and encouraging energy-saving behaviour in industry, commerce and the domestic sector as well as in transport through policy measures, information, studies and pilot actions and the creation of local and regional energy management agencies.

4. Work programme

The programme kicked off at a meeting held in Dortmund on 3-4 April 2003 and was completed in April 2005. The work carried out during the project was undertaken in the following phases;

4.1. Stocktaking, analysis and assessment

The main objectives here were;

4.1.1. The identification and analysis of the key factors relating to the development and implementation of green procurement processes in the universities of the “5E” project

These factors include national, European and Industry guidelines, procedures, directives and standards relating to procurement, energy consumption and climate change and related studies and promotional activities.

4.1.1.1. The PROST project

The importance of considering energy-saving during the procurement process was identified by the PROST project. This project was originally conceived as a study on Public Procurement of Energy Saving Technologies in Europe, hence the acronym PROST. Although all the areas covered in the PROST report are subject to public procurement legislation, the study deals with energy efficiency in the (European) public sector as a whole, ranging from day-to-day product purchasing to building energy management and investments. The study was carried out by a seven country team under the auspices of the European Union's SAVE programme. It identified barriers and opportunities for public sector energy efficiency. This report argues in favour of harnessing the power of the public purse and emphasises that energy efficiency in the public sector goes far beyond energy savings and climate protection. It states that energy efficiency is a strategy to deal with scarce public funds while at the same time addressing serious energy and climate challenges. The timing of the “5E” project is particularly opportune in this regard as universities throughout Europe are facing unprecedented funding difficulties, energy prices are rising at unprecedented rates and concerns about climate change have reached unprecedented levels.

The executive summary of the PROST project can be found at; http://www.eceee.org/library_links/downloads/procurement/PROST/PROSTExSummary.pdf.

4.1.1.2. New Directives on Public Procurement

The following extract from the European Commission’s webpage on Green Public procurement summarises the elements of the new legislative framework enabling integration of environmental considerations into public procurement.

The main purposes of the new public procurement Directives adopted by the Council and the European Parliament on 31 March 2004 are simplification, clarification, and modernisation (notably through the introduction of electronic or e-procurement). Basic principles of non discrimination and transparency remain the core of public procurement law. New provisions concern essentially simplified thresholds, electronic procurement, more transparency at selection and award stage, more clarity about valid award criteria exclusion of candidates or tenderers which have been the subject of a conviction for money laundering, corruption, fraud and participation in a criminal organisation, new flexible instruments and procedures such as framework agreements and competitive dialogue.

Recitals refer to Article 6 of the EC Treaty, underlining the purpose of the Directives to clarify how contracting authorities may contribute to the protection of the environment. They consolidate recent jurisprudence of the Court of Justice in this field (C-448/01 "Wienstrom" of 4/12/03 and C-513/99 "Finnish Buses" case of 17/9/2002), expressly referring to the latter in the first recital. As such, they stress the possibilities the Commission had indicated in its Interpretative Communication of 4/7/2001 on the possibilities for integrating environmental considerations into public procurement.

Relevant provisions in relation to "green" public procurement :

- *The definition of technical specifications, which includes environmental performance standards and production methods. This enables contracting authorities to ask for products with an environmental friendly production methods or to award extra points for products manufactured as such (on the condition that the method contributes to characterising the product, even without there being a visible effect, think for example of "green" electricity or organically grown food)*
- *The possibility to define technical specifications in terms of performance or functional requirements, including environmental characteristics.*
- *Environmental characteristics in terms of performance or functional requirements may be defined in tender documents by using the specifications as defined by European or (multi) national eco labels (under certain conditions regarding scientific basis, accessibility and stakeholder consultation).*
- *Member States may oblige contracting authorities to make sure that candidates or tenderers are informed of obligations relating to environmental protection.*
- *Possible exclusion of candidates who have been the subject of a definitive judgement or a decision having equivalent effect for non-compliance with environmental legislation, on the condition that it constitutes an offence concerning the professional conduct or grave misconduct under national law.*
- *Possibility for contracting authorities to ask for environmental management measures as a means to proof a tenderers' capacity to execute a specific works or service contract (for example in a works contract to build a bridge in a nature reserve, implying the need of continuous environmental management, and adoption of specific protection measures during the works).*

- *Explicit preference for EMAS (and equivalent means of proof) when asking for environmental management measures, as a way to certify the measures put in place*
- *Environmental characteristics listed as a possible award criterion : it follows from the wording of the relevant provision that environmental criteria may be of qualitative (emission level for example) or economical nature (energy consumption for example), and it doesn't have to bring a direct advantage to the contracting authority itself. (for example if additional points are awarded for timber products stemming from environmentally sustainable harvested woods). Award criteria should always be linked to the object of the contract (which excludes criteria related to the operation of environmental management schemes because such schemes cover a wide variety of measures, most of which won't be related to the object of the contract). All technical specifications (including environmental performance standards, environmental production methods..) can be translated into award criteria.*
- *Environmental considerations can be included in the conditions relating to the performance of a contract (for example a requirement to deliver the products in bulk), if not discriminatory and no disguised technical specifications or selection criteria.*

Further information about the new public procurement Directives is available at http://europa.eu.int/comm/environment/gpp/legal.htm#new.

Whilst the participants in the “5E” project were all aware of the need to consider energy-efficiency when procuring office equipment the absence of a properly developed and fully understood industry/sector-wide method for doing so presented the greatest difficulty in this regard. This difficulty manifested itself in the two key areas of;

a) transparency during tender assessment

This is needed to ensure that the industry understands and accepts the methods used to assess tender submissions. The absence of accepted methods gives rise to the possibility of dispute and litigation if new methods that more accurately reflect overall economic performances are adopted; and

b) calculation of “economic advantages”

This is needed to conclusively demonstrate the differences in the overall economic performance of the items under consideration throughout their useful life. This is vital where the most economically advantageous tender is not the lowest price submitted. These calculations need to be based on fully understood performance criteria and operating regimes that can, if necessary, form the basis of contractual claims against performance warranties. Anticipated savings in operating costs must be “bankable” if they are to be used to justify the selection of items that do not represent the least initial cost. This can be achieved by using TCO (total cost of ownership, i.e. the investment cost plus operating cost for energy, maintenance, service etc.) to identify the most economically advantageous tender.

The requirements here are for agreed sets of related definitions and agreed sets of operating procedures.

4.1.1.3. General guidelines

The most commonly used guidelines applying to energy-efficiency in this sector at present is the EnergyStar database for PCs. This is a valuable, constantly updated, tool that can be used to compare the power demands of various PCs. There are, however, a number of important omissions/flaws with the current database. The most important being the non-mandatory nature of the figure for on-idle power consumption. This was found to be of critical importance as far as energy-efficiency is concerned in real operating conditions. The awarding of star ratings on the basis of sleep-mode performance alone is also less than satisfactory as is the use of outdated APM standards for operating modes. This important tool is currently in the process of being reviewed.

The European EnergyStar headquarter has advised that “at the moment an EU expert group (chaired JRC) and US EPA is developing new Energy Star standards for PC's, to be implemented probably end 2006/beginning 2007 (for Tier I) and 2009 (Tier II). For Tier I values for on-mode, sleep-mode and off-mode and a stricter definition of these modes are being discussed. For Tier II the discussion is about a duty-cycle/benchmark which would also allow the evaluation of a more sophisticated Power Management.”

4.1.1.4. Industry standards

There are currently two main industry standards applying to energy-efficiency in PCs. These are used to define different operating modes. They are;

c) the older American Standard APM; and

d) the newer ACPI standard

ACPI distinguishes working, several sleeping-modes (stand-by, sleep) and off-modes. The ACPI working-mode describes the situation for “normal” processor power activity. Unfortunately, there is no further differentiation of the working-mode in ACPI which in reality varies very significantly between on-max (maximum processor operation) and on-idle (processor waiting status). However, 5E-investigations have shown (see 4.3.3.3) that the on-idle mode is the most representative mode for real usage of PCs.

4.1.1.5. National and regional campaigns

There was little evidence for national or regional campaigns dealing with energy efficiency of office equipment. It rather seems that this issue so far has not been actively addressed in many countries and thus there is little experience which could be used as an input to the “5E” project. Some of the few national project examples are given below.

In Belgium a procurement guide which also considers the purchasing of office equipment is provided for the French speaking part of the country.

In France a “greening of the government” initiative has been taken in 1997, but it was not acted upon efficiently and there was no follow up. In this initiative a greening project chief and a project team was to be constituted for each administration unit who should develop actions and communication concepts. The green government policy had no impact on the procurement of the University of Bordeaux since no support was provided to staff responsible for the procurement. No advice on the design of procurement contracts and criteria was given.

In Germany there exist well known labelling initiatives which also consider office equipment, like for example *Blauer Engel* and *Gemeinschaft Energielabel Deutschland* (GED). GED is a community of organisations from several federal states in Germany, which measure energy consumption of devices and provide a product ranking.

For Austria two programs dealing with procurement issues have been reported which are called *Eco-Purchasing* in Vienna, *Ökostadt 2000-Konsummuster*. Another national program called *Klima:Aktiv* will be started this autumn. For this program two projects are planned which deal with public procurement of appliances but also address retailers of appliances as important gate-keepers for green procurement.

In the Netherlands some national as well as regional instruments and activities were identified which may be relevant to the “5E” University activities at a national level. The Energy Programme Subsidies Decree (BSE) is a financial support which is accessible for public organisations and is attempted to support the application of energy efficient technologies. BSE for example is applicable for feasibility studies and dissemination projects. However the program requests high quantitative improvements of energy efficiency which may not be realised with office equipment. Another program is EINP, an instrument for investment allowance which allows organisations to deduct a percentage of energy efficiency investments before taxes. Only costs for consulting are eligible in this program. Furthermore long-term agreements on

improving energy efficiency have been contracted in the Netherlands with a large number of non-profit sectors. These voluntary agreements are between the specific sectors and the minister of economics. The majority of Dutch universities have already been involved in agreements. However targets set in 1996 have not been reached so far. Other instruments used are various guidelines for procurement which also consider energy efficiency of office equipment.

Thus in the Netherlands but also in other countries several instruments exist which could – but not necessarily do at the moment – support the improvement of energy efficiency of office equipment.

4.1.2. The examination of internal factors in the participating universities affecting the procurement of office equipment

4.1.2.1. Related projects and initiatives

Only a few universities had carried out projects which were related to the issue of the “5E” project. Almost all project partners already had undertaken various measures to improve the efficient use of energy in their institution. However the priority was put on activities which were thought to yield the highest energy savings like for example improving energy efficiency of buildings as well as lighting and heating-systems.

At the university of Helsinki both the EMAS and ISO14000 environmental auditing scheme had been introduced which also included energy efficiency as a major issue.

Some universities have more experiences related to the energy efficiency of office equipment. For example Trinity College invited tenders for PCs which included a provision for testing all the computer systems offered. Power consumption was considered as a test criterion. One of the results of this test was that it would pay off to switch from CRT to TFT-monitors. Furthermore a study was conducted to analyse the efficiency of different power switches for ICT-networks. This investigation showed that CISCO switches are more efficient than 3COM both in respect to network power consumption and ventilation of communication rooms. The green pages web-site of Trinity gives some basic information on general aspects of energy saving.

A change to Cisco switches was also done at the University of Maribor.

The research group at the University of Applied Sciences in Aachen had commenced developing an energy reporting system which was intended to consider the energy consumption of office equipment.

Some other projects related to the issues of “5E” had been done by the University of Bordeaux 1. These projects show the development of a procurement/buyers guide for energy efficient equipment, labelling of energy efficient scientific appliances as well as the recycling of CRT-Monitors and life cycle costing. Both the buyers guide and the CRT-project can provide helpful input to the “5E”-project.

At the Kymenlaasko Polytechnic inventories of the age, lifecycle, electronic waste and saving opportunities related to office equipment had been taken. The data was also used for the environmental management program. Moreover so called “green procurement matrices“ which contain compact information on environmental issues are applied.

At the University of Catalunya an awareness-raising-program was conducted in which office equipment also was considered. The main elements of the program were an information campaign on energy efficiency issues, articles in UPC reviews and a web-site. Pencil cups containing information were used as a means for the information campaign. Overall the campaign was well received. Pencil cups and articles were rated to be more effective instruments than the web-site. 40% of the university staff addressed in the project responded that they had changed at least one of their habits due to the campaign.

At the University of Edinburgh also an awareness raising campaign was launched including a monitoring of overnight electricity consumption. The investigations showed that responsibilities for switching off of equipment needs to be established. Further studies are planned aimed at rationalising the number of individual printers, copiers etc. via co-operation of departments. Moreover an internet platform on sustainability issues has been established and campaigns including advise on computer use and switching off lights have been launched. These are some of the project examples available to date. In general it can be concluded that the energy consumption of office equipment so far has not been a major issue at the partner universities of the “5E” project and thus was not addressed by many activities and programs yet. There is relatively little information and experience from previous projects available which could be used within the “5E” project.

At the University of Technology, Graz (TUG) up to 2003 the procurement of PCs was based on benchmark tests performed by the university’s CIS (Central Information Services). These tests primarily focused on the technical functionality, not directly on energy efficiency. However, CIS edited valuable information how to use power management facilities and gave practical instructions how to install and how to choose proper settings.

4.1.2.2. Procurement practices and methods

Current procurement procedures in the university sector are generally aimed at;

e) achieving properly informed competitive tendering;

f) fully transparent tender assessment; and

g) identifying the most economically advantageous terms submitted.

Structures and processes for these procedures in the case of office equipment in the participating organisations differ quite markedly. Even within a single university more than one procurement process may be encountered which are applied for different product categories like PCs and copiers or depending on the type of funding. Table 4.1.2.2.1 shows some characteristics of the procurement processes/structures encountered in the different partner institutions of the “5E”-project.

University	Definition of order	Responsible for tender	Evaluation of tender and choice	Centrally managed	External public agency
University of applied sciences Aachen (D)	Net Administrator of departments	Administration office	Administration office	Yes	no
University of Amsterdam (NL)	Departments	Departments. Partly ICT.	Departments. Partly ICT	Partly	no
University of Bordeaux 1 (F)	Commission of users/experts	Procurement Commission	Commission of users/experts and President	Yes	Partly UGAP
Universidad de Coimbra (P)	User, head of department	User, head of Department	User, head of Department	No	no
Univerditat Polytecnica de Catalunya (S)	User Department	Adiminstation office partly	Adiminstation office Rector, partly	Partly	Yes (80% of new computers)
University of Dublin, Trinity College (I)	Information System services (ISS)	Procurement officer	Procurement officer ISS	Partly	no
University of Ghent (B)	Employee, superviser	Director ICT/ Departments	Director ICT/ Departments	Partly	no
University of Technology Graz (A)	Institutes	Central information services, Institutes	Central information services, institutes	Partly	Since 2004
Kymenlasko Polytechnic (F)	Department	Administration Director	Administration Director +Rector	Yes	no

Table 4.1.2.2.1

In most cases a centrally managed procurement process dominates where a central unit of the institution is responsible for the preparation and evaluation of the tenders. In this case the order of the departments/institutes is put forward to an administrative unit or ICT unit which then is responsible for most aspects of the process.

Contrary to this in some universities the process is completely decentralised which means that the individual institutes are responsible for the purchasing of office equipment.

There is a third situation observed where institutes can either purchase via a centrally managed process or individually if the procurement is financed by projects and extra funding.

In some universities the procurement is either centralised or decentralised depending on the type of product (PCs, Copiers etc.).

There are other special situations where the procurement is partly out-sourced to external companies.

Thus it becomes evident that there is no common procurement process which is similar for all universities.

In general the order for new equipment is made by the users or by the heads of the departments or even by the network or ICT-administration. These orders are passed on to the administration offices responsible for the preparation of tenders. The evaluation of the tenders normally is done by the administration office often in co-operation with experts from the ICT-departments or the ordering department. Thus functional criteria are mostly specified by the users in the ordering departments or buy the ICT department and economic criteria are set and evaluated by the administrative office responsible of the tender.

Generally - as also specified in European procurement directives - the procurement procedure also depends on the purchasing value, which means that below a specific value organisations can freely select the suppliers. For higher procurement values a limited tender (few suppliers involved) or an open tender is necessary.

In some cases agreements between universities and manufacturers/importers/distributors exist which lead to benefits like reduced prices or better service contracts. It is also reported from partners that there exist long term contractual agreements and standing offers at a regional and national level. For example in Scotland a number of agreements for the different product categories exist and the procurement is managed by the purchasing and supply department on the basis of these contracts. Departments can also order goods themselves providing they adhere to the various contractual arrangements. There is also a trend that the department responsible for procurement restricts orders to a few pre-qualified sources.

In some universities there is a tendency to a stronger centralised procurement (Graz, Amsterdam). For example the University of Technology Graz formerly had different types of procurement processes depending on the financial resources used (also third party financing etc.). From 2004 onwards all purchasing activities are managed by an external nation-wide acting procurement agency. This has the advantage of a common procurement platform but may also have the disadvantage that the criterion of purchasing costs will be overemphasised.

In cases where a more or less centralised procurement process is established it should be comparably easy to implement the consideration of green procurement criteria. Organisational units to be addressed would either be the responsible ICT department (if involved in the decision process) or the administrative unit responsible for the tenders. In cases where a large part or all procurement of office equipment is done in a decentralised way by individual departments or institutes however there will be no easy way to implement green procurement at the level of the whole organisation. As stated in some reports the user or the head of department would be responsible for the integration and consideration of ecological criteria in decentralised procurement structures.

Thus no overall strategy and best way to introduce green procurement can be suggested but the solutions will have to be adapted to the individual situations.A flexible 3-level guideline was developed to assist the partners in their pilot actions. Reference to HWU's guideline document which includes EVA's 3-level guide and measurement method, also an appendix on power management.

4.1.3. The evaluation of current stocks of computer equipment and the estimation of present energy consumption rates and amounts

4.1.3.1. Present stock

Surveys were carried out by the participating universities to determine current stocks of PCs, laptops, servers, printers and scanners in their institutions. The results of these surveys are shown in table 4.1.3.1.1 below.

University	PCs	Laptops	Server	Total	Students	PC/Students
Ghent	6,500	500	3,500	10,500	27,000	39%
Catalunya	7,150	280	1,010	8,440	30,186	28%
Kymenlaakso	1,516	0	50	1,566	3,800	41%
Athens	534	40	16	590	3,000	20%
Bordeaux	4,036	155	126	4,317	10,000	43%
Amsterdam	7,000	0	200	7,200	22,000	33%
Maribor	4,595	405	100	5,100	21,500	24%
Dublin	6,282	614	133	7,029	14,849	47%
Graz	2,650	0	154	2,804	8,500	33%
Edinburgh	4,000	614	300	4,914	5,850	84%
Coimbra	7,235	670	187	8,092	21,864	37%
Totals	51,498	3,278	5,776	60,552	168,549	36%

Table 4.3.1.1.1

These data were used to determine an average or typical ratio of PCs (including laptops and servers) to student. The resultant average was 0.36:1. This average was applied to the total student body in all European third level institutions using data obtained from Eurostat to produce an estimate of the total number of PCs currently being used in third level education in Europe.

The number of students in third level institutions in Europe is 16,887,300. Using this figure the resultant estimate of **the total number of PCs in use in third level institutions in Europe is 6,079,428**.

4.1.3.2. Present turnover in stock

The practical life-span of this equipment is currently in the region of 3.5 years (TCD), 5 years (TUG) and 3-5 years (UVA). Applying an average life-span of 4.25 years to the above figure gives **a total annual procurement rate of 1,430,454 units**. Assuming a current unit cost of c.€1,100 this represents **an annual spend in the region of €1.5Bn**.

4.1.3.3. Present energy consumption rates and amounts

Annual energy consumption is markedly influenced by the efficiency of the unit, the numbers of hours used and the presence and use of power management control. This is illustrated by the "5E" PC-Energy Cost calculator developed by TUG in the course of this project. It can be seen from this that annual power consumption for a PC and monitor ranges from 120kWh/Annum (best technology, best use) to 1,927kWh/Annum (worst technology, worst use). Several studies were carried out in the course of the project to determine typical current consumption rates for PCs alone excluding power used for related air conditioning. The results of these studies ranged from 480kWh/Annum (HWU, 12 hours per day) to c.300kWh/Annum (TCD, 8 hours per day). A detailed analysis of the results obtained during these studies and those carried out at ISR-UC indicated that current university equipment and operating practice can best be described as being between medium and best technology and medium and worst use. The "5E" PC-Energy Cost calculator developed at TUG indicates that these standards of equipment and operating practice result in an annual power consumption of 657kWh/Annum for each PC and monitor and related air conditioning. Applying this to the entire European stock of 6,079,428 units gives **a total power consumption of 3,395 GWh per annum**. Assuming a current unit cost of €0.1/kWh for electrical power this represents **a current spend of €340M per annum on electricity**.

4.1.4. The determination if existing equipment is being used in an energy-efficient way.

4.1.4.1. Energy efficiency and procurement

There was agreement amongst the participants in the project that **energy-efficiency is not currently a significant factor in the procurement of this equipment** in European universities.

Whilst many of the universities concerned were evidently striving to incorporate energy-efficiency considerations in the development of curriculum design, engineering, procurement and estate management, the dominant concern of the procurement agencies and individuals involved was clearly initial capital cost and functionality. Indeed there was some resistance to the incorporation of energy-efficiency considerations in the procurement process because of concerns about the lack of legally accepted standards and definitions relating to the formulation of energy-efficient requirements. **Where energy-efficiency was considered, EnergyStar ratings were the guiding factors used**.

Despite this the PCs purchased in recent times by the participating institutions were amongst the most energy efficient available. This more a reflection of the importance attached to energy-efficiency by the manufacturers of the equipment rather than the requirements of the procurement agencies involved.

4.1.4.2. Energy efficiency and operation

The key issues here are the number of hours each PC is on and the status of the power management control system.

4.1.4.2.1. Operating hours

Typically these PCs are on between 8 and 12 hours per day for 200 normal working days a year and in various states for the rest of the time. In the best cases the PCs are switched off during lunchtime, at night and during weekend and holidays. In the worst case 90% of the PCs were on for 24 hours a day. The comment here that energy conservation is “just a theory” as far as office equipment is concerned is probably a realistic reflection of the current situation on the ground in a large proportion of European universities.

4.1.4.2.2. Power management control

Typically power management control systems were disabled. The savings that can be achieved through proper use of power management control systems were shown to be in the region of 40% in buildings without air conditioning and 50% in buildings with air conditioning.

4.2. Strategy development

After the initial stocktaking and analysis a programme of pilot actions for the remainder of the project was drawn up mainly by E.V.A. with the following objectives;

4.2.1. To obtain comprehensive precise information about current energy consumption rates for PCs

In this case, the working group decided, not to start a new study about the energy consumption, but to use existing studies and information about this topic.

4.2.2. To review related existing standards and labels.

After long discussion within the group, it was agreed that it is not within the object of the working group, to develop a new kind of label. So an overview about existing labels was part of the discussion. According some studies[1], the ENERGY STAR was recognized as a useful label to promote energy efficiency.

4.2.3. To determine the feasibility of incorporating energy-efficiency as a key factor in the procurement process

There were quite o lot of discussion with the persons in charge of the procurement process, to get an idea about the process and of the possibilities to use the energy consumption of even 5 years as a key factor. The interest on this topic was low, and quite often the argument, that it is against an European or national regulation was used.

[1] **Market Analysis on the Dissemination and Use of the *Energy Star* Energy Efficiency Label in Austria, by Herbert Ritter and Bernd Schäppi (E.V.A.). Franz Reichel (TB Reichel), Energieverwertungsagentur, Vienna 1/2003**

4.2.4. To undertake “field” trials to determine the practicality of improving operating efficiency

This work was allocated to the participating institutions with experience, expertise and interests most relevant to the work involved. The Austrian Energy Agency played a leading role during this strategy development phase. They developed a flexible 3-level guideline to assist the partners in their pilot procurement actions titled “*Criteria for Pilot Procurement of PCs and Monitors in 5E-Universities*”. They also provided guidelines for measurement of power consumption in the on-idle mode titled “*Guidelines for Measurement of power consumption of PCs in on idle Mode*.”. Heriot-Watt University developed these further to form a set of “*Guidelines for green procurement of PCs and Monitors*”. Copies of these documents are appended for information.

The work done by others is summarised in the paragraph below and reported in detail in the attached individual action reports.

4.3. Pilot actions

4.3.1. Heriot Watt University, Edinburgh, UK, (HWU)

4.3.1.1. Pilot Procurement Action

The procurement function here is centralised but with devolved order processing. The university is participating in specialist collaborative joint ventures with Proc-HE (UK Higher Education) Proc-NIC (Scottish and Northern Irish Consortia) for all major procurement exercises. One of the outcomes here are existing contractual agreements and standing offers that restrict the purchasing of PCs restricted to one or two suppliers. The “5E” pilot procurement action set out to introduce green procurement within the framework of above contracts and offers. This was in line with overall policy because the university is striving to incorporate sustainable development in curriculum design, engineering, procurement and estate management. A “5E” working group was established to determine if whole life cost (WLC) analysis could support green procurement in the case of PCs.

4.3.1.2. Power Management Study

Original research was carried out on the effect of remote control of power and the use of LCD screens instead of CRT on energy consumption. A set of three-level guidelines for whole life cost analysis (WLC) were developed. These include statements to be incorporated in tender documents covering specifications for on-mode and sleep-mode consumption; ratings for power consumption in various power modes and optional pre-activation of defined power mode settings. A mini-tender was implemented involving two suppliers. Both suppliers offered PCs that complied with Energy Star rating with estimated daily energy consumptions of 1,450 and 1,410 Wh/Day. The standard power management policy of setting default to 24 hours on to allow updating at night was changed to allow remote waking up. This was done in batches to avoid power surges. Also, PCs in buildings that are empty were powered down. This was shown to reduce annual energy consumption from 480 kWh per annum to 400 kWh per annum.

4.3.1.3. LCD monitor study

A study of savings that can be made by the introduction of LCD monitors involving an eight week experiment was initiated. Results from this study will be available in May 2005.

4.3.2. ISR-University of Coimbra, Coimbra, Portugal (ISR-UC)

4.3.2.1. Pilot Procurement Action

A pilot procurement exercise was carried out by the Department of Electronic Engineering and Computers. The Department drafted the procurement documentation and took part in the tender evaluation process. Tenders were sought for 20 PCs and 20 TFT monitors. The tenderers were given a number of specific energy-related requirements and asked to mention other energy-related features. The evaluation method was based on typical usage patterns which were used to comprehensively assess the performance of each unit. The estimated daily consumption of electricity ranged from c.1,500 to c.1,800 Wh/day.

4.3.2.2. Power Management Study

The effectiveness of power management methods was investigated by comparing electricity consumption in the Department of Electronic Engineering and Computers with that of the Informatics Department. It was found that twice as much electricity was consumed by the Informatics Department. Two main factors were found to be the cause of this situation – leaving equipment on at night and weekends (70% of users) and disabling power management control (65% of users). It was shown that the proper use of power management would reduce electricity consumption by 350 MWh per annum.

4.3.2.3. Guidelines and Dissemination

A guide for the **purchase of Energy Efficient Office Equipment** was published and a **Dissemination Brochure** produced for use as part of a major energy conservation campaign initiated in the course of the project.

4.3.3. University of Technology, Graz, Austria (TUG)

4.3.3.1. Factors influencing procurement decisions

Factors influencing procurement decisions were reviewed. Buyers were found to be motivated by labels or images relating to energy efficiency; the EnergyStar label for example. This is particularly important in the case of private buyers with concerns about the need for energy efficiency. In the case of professional/commercial buyers there is a need to determine economic performance or return on investment to justify additional expenditure on the grounds of energy-efficiency.

4.3.3.2. Total cost of ownership (TCO)

Rapid technical development in the design of PC hardware and software is reducing the useful lifespan of office PCs. It is proposed that the total cost of ownership (TCO) is considered when purchasing replacement units. This is difficult to achieve in large organizations where the purchaser is not the user. The TUG team examined factors effecting power demands and annual energy cost of PCs and **developed an energy cost calculation tool for use as an aid during procurement**.

4.3.3.3. Importance of on-idle mode

By means of long term measurements it was found that during normal operation (e.g. office applications) PCs operate for more than 95% of time in the on-idle mode. It also emerged that there is a large difference in the power demand between on-max and on-idle, however the time duration with higher processor power is extremely short. As was found by questionnaire, in the well managed departments of TUG the sleep-mode is rarely used (PCs are switched off at night and weekends). It was concluded that **on-idle power consumption is of critical importance to the assessment of energy-efficiency. Unfortunately the on-idle mode is not defined in the ACPI standards and is not considered by EnergyStar in the star rating.**

4.3.3.4. Pilot action

As a pilot action the TUG team cooperated with the external national procurement agency. The agency already uses the TCO approach. However, in the agency’s TCO definition for PCs energy cost was not included – only maintenance, services, necessary software-updates etc. The agency was willing to introduce energy cost, however only under the strict condition that there must be a standardized referenceable measuring method. Due to missing standards and the above mentioned momentary non-applicability of EnergyStar in the PC-sector the planned pilot action up to now could not be realised. TUG plans to realize the TCO approach including energy in a smaller frame at the university in the near future.

4.3.4. Universiteit van Amsterdam, Amsterdam, Netherlands, (UVA)

4.3.4.1. Analysis of factors affecting energy-efficiency of office equipment

A comprehensive review and analysis of the factors affecting energy-efficiency of office equipment was undertaken by the UVA team. This showed that whilst energy-efficiency is an important part of the overall environmental policy of the university this part of the policy had not yet been applied to the procurement and operation of office equipment.

It was estimated that office equipment in the university is currently consuming c.2.8 GWh of power per annum. Procurement is normally controlled by a central office. Procurement of PCs is dominated by initial cost and functionality with little importance being given to energy-efficiency. Lack of awareness about energy efficiency was seen to be an obstacle here as was the decentralised nature of the organisation structure of the university. A major structural re-organisation is in process which will change this situation.

4.3.4.2. Communications and Dissemination

The “5E” project resulted in increased co-operation between the central procurement office, the ICT-department of the UvA and the Department of Health, Safety and Environmental Management (HSE Department) in the area of energy-efficiency. Meetings were held with all relevant stakeholders and a university-wide workshop was held to discuss energy saving measures for electric and electronic office equipment. Also, contact was made with the national network of environmental coordinators of Dutch universities in preparation for the dissemination of the results from this project.

4.3.4.3. Pilot Procurement Action

Arising from the “5E” project, the ICT-centre IVAM UvA BV conducted an overview of energy standards along with technical and financial standards. The results of the analysis showed that several specific energy requirements could be incorporated, based on the labels such as the European Ecolabel and the Energy Star label. It was, in fact, proposed that the new 2005 EnergyStar standards should be used for the pilot project. However, as both these labels are in the process of being updated it was decided to proceed using the 2004 standards.

4.3.4.4. Mini-review

The report on this pilot action contains a useful “mini-review” of the organisational, administrative and user driven factors that are critical to the process of implementing energy-efficiency policies in this area. These are clearly of equal, if not more, importance in this regard as the related financial and technical factors.

4.3.5. Trinity College, Dublin, Ireland, (TCD)

4.3.5.1. Existing situation

Further measurements were taken following the initial stocktaking and review process to improve the accuracy of the estimates of power consumed by PCs in the university. Based on these measurements the estimated power consumption of desktop PCs was revised from 85W to 50W for the on-idle mode. The amount of power consumed by PCs (not including monitors) was calculated to be 6.5% of the total amount of power consumed by the university. This large proportion a reflection of the number of PCs in use (estimated 6,200) and the fact that many of them are left running continuously.

4.3.5.2. General Trends

Three general trends were observed.

Flatscreen monitors (35W) are replacing CRT monitors (100W). This is the result of the PC tender specifying flatscreen as the default option.

Power consumption of PCs appears to be increasing with increased PC performance. (40W has increased to 60W).

System standby power consumption has fallen significantly (2.5–4W now compared with 40-60W previously)

4.3.5.3. Pilot Procurement Action

TCD conducted a joint PC tender for up to 1,600 units in collaboration with the University of Limerick. Energy efficiency criteria were included in the tender under the Physical Environment section of the Technical & Certification Requirement. The report on this pilot action describes this action and the outcome in detail. The main unforeseen critical finding that emerged from this exercise was the importance of the standby functionality. If this is not properly suited to the requirements of the managers and users of equipment it will almost certainly be disabled during installation.

4.3.5.4. System stand-by implementation guidelines

When the importance of the proper implementation of a system stand-by policy, leading to reductions of power consumption of up to 50%, became clear it was decided to draft a set of guidelines to aid this implementation. These are appended to this report.

4.3.6. Technical University of Catalonia, Spain, (UPC)

4.3.6.1. First Pilot Procurement Action

A pilot procurement action was carried out in May 2004 under the university's ICT investment plan. Tenders were sought for 1,062 PCs and 816 monitors. Energy consumption was assessed using the EnergyStar energy calculator tool to produce approximate whole life costings. The power consumption of the tendered items ranged from 221 kWh to 419 kWh per annum per PC; 68.7 kWh to 220 kWh per annum per monitor. These did not have a significant weight or impact in the adjudication of the winning bid.

4.3.6.2. Second Pilot Procurement Action

A second pilot procurement action was initiated in February 2005. Tenders were sought for 565 PCs with TFT monitors, 406 PCs for classrooms and 174 laptops. The assessment criteria included recommendations arising from the "5E" project. Technical assessment factors will have 4.5 of 35 points in the category allocated to environmental considerations. Environmental factors will have 3 of 15 points in this category – i.e. 20%. Factors relating to energy consumption will be based on WLC. This will be one of the first such tenders where energy-efficiency will have an impact on the adjudication of the winning bid.

4.3.7. Ghent University, Belgium, (GUB)

4.3.7.1. Procurement Procedure

A call for tenders for the supply of computer equipment was prepared during the spring of 2004. The procurement officer in charge of this process was alerted to the preliminary findings of the “5E” project and invited to consider the feasibility of incorporating energy-efficiency as one of the assessment criteria. Whilst clearly concerned about energy-efficiency he advised against the formal incorporation of this as one of the assessment criteria because of because of the lack of legally accepted standards and properly developed assessment methods. He was also of the opinion that current EnergyStar criteria are unsuitable for this purpose as the only impact on the most inefficient of products. He further suggested that standard desktops should be specified with LCD monitors, system managers should be encouraged to make maximum use of power management controls and the use of laptops should be promoted.

4.3.7.2. Tender Action

Seven tenders were submitted. The outcome of the tender is reported in detail in the pilot action report. Whilst energy-efficiency was not one of the criteria used the selection procedure resulted in the choice of energy efficient equipment.

4.3.7.3. Calculation of potential energy savings

Detailed calculations were made of the potential for energy savings resulting from the adoption of LCD monitors, improved use of power management controls and the promotion of laptops. The overall resultant saving was estimated to be 265 MWh per annum – 0.6% of the total power consumption of the university.

4.3.8. University of Helsinki/Kymenlaakso Polytechnic, Finland, (UH/KP)

The Helsinki University Kotka unit took part in a pilot action based on Kymenlaakso Polytechnic using the polytechnic's green procurement guidelines. This was against a background where the HU/Kotka unit had participated in the introduction of environmentally friendly procurement procedures and in the drafting of an Environment Management System at Kymenlaakso Polytechnic.

The report on this action describes the background here and the procurement procedures which make use of a database called Hymonet created by Efektia Ltd., a consulting and research company owned by the association of Finnish Local and Regional Authorities.

4.3.9. Agricultural University of Athens, (AUA)

The pilot action of the Agricultural University of Athens included an appraisal of existing stock and current procurement procedures and the purchase of 20 PCs and monitors using energy-efficiency as one of the assessment criteria. It was evident from the reaction of the suppliers that this was a pioneering project in Greece as they had received no previous enquiries about energy-efficiency. The project met with a positive response within the university generally and served as an important introduction to energy-efficiency in the context of procurement and operation of office equipment.

4.3.10. Göteborg University, Sweden, (GUS)

The final report from Göteborg University sets out the background to procurement in the university with particular reference to environmental standards. It also describes a pilot procurement action carried out within the context of the "5E" project.

5. Main results – energy and cost saving potentials

The project has established some key facts relating to the scale of the operation of PCs in third level institutions throughout Europe.

There are a total of c.6M units currently in use consuming c.3.4 TWh of electrical power per annum.

The current procurement rate is c.1.43M units per annum representing an annual spend of c.€1.5Bn.

These figures are very significant indeed. The CO_2 emissions associated with the generation of this power amount to something in the region of 2.8M tonnes per annum. This is the environmental equivalent of the permanent destruction of 560,000 Ha of tropical rain forest. These are statistics that will undoubtedly be of major interest and concern to all.

Without intervention these figures are likely to increase because of increased penetration of PC technology generally and rapidly increasing processing power/performance and related electrical power consumption.

The project identified two key factors that have a major impact on power consumption. These are the technical efficiency of the equipment itself and management/operating efficiency. The studies carried out in the course of this project suggest that the current performance of universities can best be described as between best and medium technical efficiency and medium and worst operating efficiency (the assumption made at 4.1.3.3 above).

The **effect of adopting the most efficient technology** would change this to somewhere between best technology and medium/worst operating efficiency. This would result in a **reduction in power consumption of 1,403GWh per annum (41%) and savings of €140M per annum**. This would be **solely the result of introducing a procurement policy with energy-efficiency as one of the key factors**. These savings would **require no changes in operation and can, therefore, be "guaranteed"**.

Adopting best technology and best operating efficiency, which is not realistic, **would result in a reduction in power consumption of 2,596GWh per annum (76%) and savings of €260M per annum.**

There was a general consensus that the introduction of energy-efficiency as one of the key assessment criteria used for the selection of this equipment will result in the adoption of best technology. For this to happen it will be necessary to develop and adopt a generally accepted method for carrying out this assessment as existing methods fall far short in a number of critical areas. With this in

mind, the “5E” team led by TUG, HWU and ISR-UC have developed a simple and effective prototype assessment tool called the “5E Energy/Cost Calculator”. This is currently available on the project website. The proper use of this tool throughout Europe is the most effective way to encourage the industry in its endeavours to produce energy-efficient products. With time this will eventually lead to the adoption of best technology throughout Europe and an associated overall reduction of over 40% in power consumption.

There was also general agreement that the promotion of the proper use of power management systems is now vitally important. These systems are generally disabled at present because of a number of relatively minor difficulties relating to their use. With this in mind, the “5E” team led by TCD developed a set of guidelines for the proper implementation of these systems. These guidelines are currently available on the project website. The adoption of these guidelines generally would represent a major step towards best operating efficiency and an associated reduction in power consumption of more than 75%.

6. Conclusions and dissemination

This is, without doubt, the most important part of this project. There is abundant evidence of the widespread interest and concern of the people of Europe about depletion of finite energy resources and, probably more worrying now, climate change caused by CO_2 emissions. All of the institutions involved in the project have signed-up-to or adopted mission statements, declarations of policy, development strategies and the like that include aspirations about green procurement, concern about the environment and setting exemplary standards for society in general to follow. These are, however, only somewhat pious aspirations in the case of office equipment at the moment.

This project has demonstrated the hugely significant impact of office equipment in universities on energy consumption and atmospheric CO_2 concentrations and has shown how universities can make major improvements in this regard. What remains to be done now is to ensure that all concerned are aware of this situation and encouraged, or required, to take the matter in hand. With this in mind it is proposed to inform key university administrators, government officials, politicians and, probably most important of all, university students about these findings. This will be done by issuing email messages to key individuals and inviting them to consult the project webpage. It is also proposed, subject to the agreement of the Commission, to issue a press release to the energy and environmental correspondents of the main national newspapers to inform the general public about the matter.

6.1 Rationale for the procurement of energy efficient office equipment: - Arguments to be used in the further dissemination of the project results

One critical result from the pilot procurement actionis that it is important to find the right arguments to convince the administration in universities to address the issue of “green” procurement, in particular with regard to the purchase of energy efficient office equipment. In many cases administrators are not aware about the cross-cutting importance of a good housekeeping of a university. They are only obliged – due to existing bureaucratic regulations – to execute the legislation in the pure sense. Furthermore, and this seems to be a critical obstacle in order to raise the awareness, the administration is not enough involved in the overall discussion process on good governance and housekeeping, which means modern management, of a university. It should be not underestimated, however, that administrators are interested and do have the competence to deal with such issues. Therefore a cooperative approach is strongly advised to consider the university administration as critical partners in the process. In this context the need for a good housekeeping or for “greening the campus” should be emphasized.

Apart from the economic and energy benefits of energy efficient equipment for offices in general like universities have extra reasons to be energy efficient. Spending tax payers' money carries a responsibility towards community objectives, too. Saving energy and the environment are enshrined in the EU policy of Security of Supply, Climate Change, etc.
Furthermore, when EU Member States are trying to achieve policy-aims in the field of IT, incorporating energy and environment should come naturally. In this way, when public institutions —at whatever level— are chasing the goals of the eEurope 2005 programme, including E-Governement, E-Learning, E-Business and E-Health, energy saving criteria must be taken into the consideration.

Two strings of arguments:

In general we can conclude that universities must be perceived as models for society in the pursuance of sustainability. They are critical social multipliers in achieving sustainable production and consumption patterns. Universities are important actors in the community, as employer, purchaser and service user. Universities are also businesses where prudent use of resources saves money and safeguards reputations.

Therefore we can identify basically two different strings of arguments that are overlapping and in many cases interconnected with each other:

1. Firstly, it is the **social responsibility of universities** in the sense of good governance or corporate social responsibility (CSR) addressing the moral obligation universities have in our society. Arguments to be used in this

category are strengthening the role of universities as important social multipliers, enhancing the reputation of the institution, reducing CO_2 Emissions, and compliance with legislation (in particular EU directives).

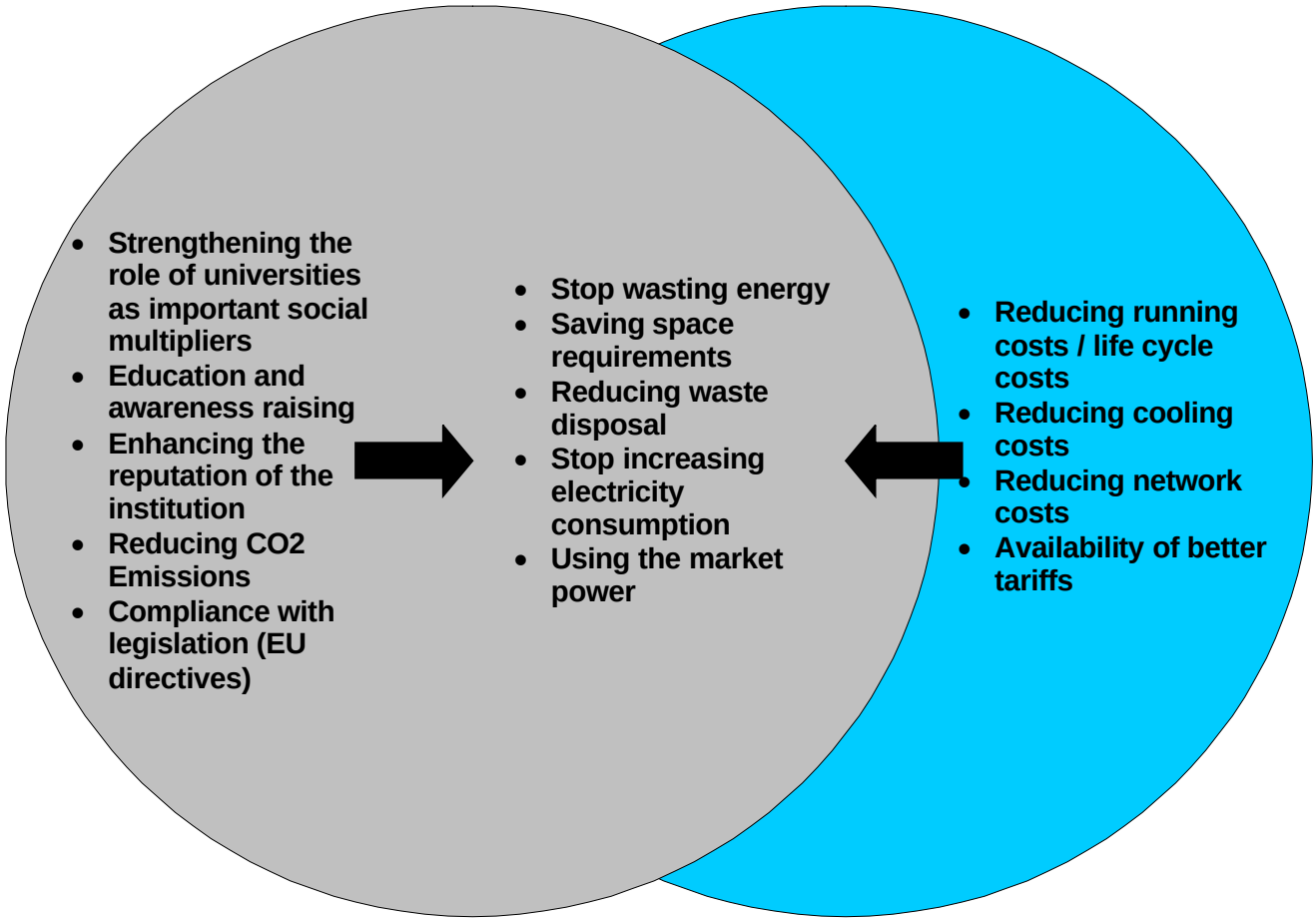
2. Secondly, **using the available financial resources more effectively** is the other area that must be addressed in the argumentation. Universities must use the limited financial resources they have as efficiently as possible. They have a duty to their "stakeholders": the students they train, the public authorities that provide their funding, the labour market which uses the qualifications and skills they transmit and society as a whole, for whom they fulfil important functions related to economic and social life. The objective must be to maximise the social return of the investment represented by this funding. There are many signs which show that it is not currently used in the most efficient way. The worsening under-funding of European universities jeopardises their capacity to strengthen the excellence of their research and teaching activities. Given that it is highly unlikely that additional public funding can alone make up the growing shortfall, ways have to be found of increasing and diversifying universities' income. One option that has to go in-hand with the search for new sources of income is the use of available financial resources in a much more effective way by reducing the costs of operations. Cost reducing strategies have been applied in other sectors of society such as industry and must be introduced even more in higher education institutions. Reducing running costs / life cycle costs, reducing cooling costs, reducing network costs, and the availability of better tariffs are important arguments in this context.

In addition to that there is a third category of arguments in between the two strings described above which results from the overlapping of the two areas. Mainly it shows that even the "soft" arguments can have a cost reducing relevance and vice versa. Arguments used in this context embrace issues such as stop wasting energy, saving space requirements, reducing waste disposal, top increasing electricity consumption and using the market power.

In order to facilitate the discussion on how to use the arguments inside universities on the implementation of energy efficient procurement strategies, the two areas including the different arguments and their connectivity are shown below:

Social Responsibility for a University

Cost-effectiveness



6.2 Draft proposal for a « 5E Universities Procurement Code »

In order to facilitate the dissemination of the results of the SAVE project and to develop a tool that could be adopted by other universities after the SAVE project, it is suggested herewith to draft a self-commitment statement for universities. This « 5E Universities Procurement Code » should be perceived as a code of conduct in which universities across Europe adopt an agreement on a voluntary basis to incorporate energy criteria in their procurement process.

A first draft version of the « 5E Universities Procurement Code » is given in the Annex for further consideration.

Annex