

Co-operative Procurement of Innovative Copiers

Dr. Bernard Aebischer, Energy Analysis Research Group,
Swiss Federal Institute of Technology, CH-8092 Zürich, Switzerland

(Invited contribution at the International Seminar "Optimizing Energy Efficiency in Office Equipment & Consumer Electronics" in Stockholm, September 11-13, 1996)

Challenge

The challenge of the copier procurement project is an accelerated market introduction of innovative copiers with very low standby-mode and short recovery time in the medium speed market segment. If strong market pull helps to advance market introduction by two years, annual energy savings are estimated to be in the order of 100 to 1000 GWh/year during some 15 years. The savings depend mainly on the long term market penetration of this innovative copier and on the power management of the copiers with today's technology (figure 1).

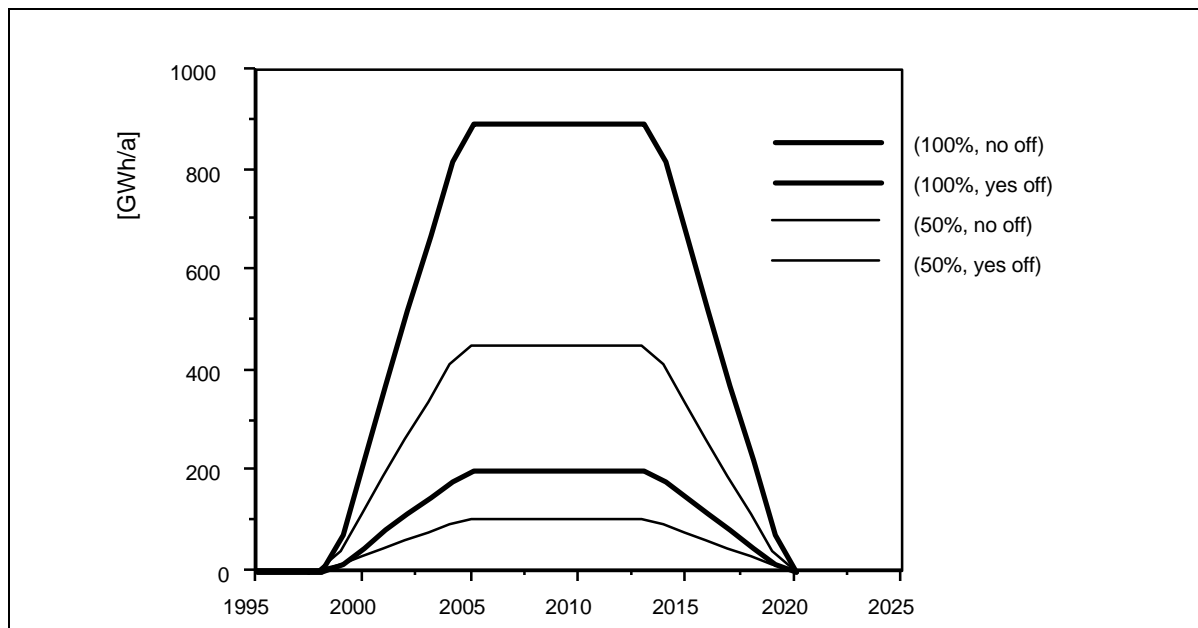


Fig. 1: Annual energy saving if the innovative copier is introduced on the market two years earlier than in the reference case (without procurement). The lines shown in the figure differ by two parameters (a, b), e. g. (100%, no off) for the first line. "a" designs the supposed market penetration of the innovative copier (with and without accelerated introduction) in the year 2015 and "b" describes whether the copier with traditional technology is turned off (or not turned off) during non-working hours [own calculation].

The cumulative energy savings, if a two years anticipated market-introduction is achieved, would amount world-wide to 1500 - 15000 GWh, and the reduction in energy costs would be

somewhere between 200 and 2000 million USD (.15 USD/kWh undiscounted). The cumulative reduction in CO₂ emission is of the order of .8 to 8 million tonnes of CO₂.

1 Annex III of IEA-DSM-Agreement "Co-operative Procurement of Innovative Technologies"

Procurement of innovative technologies is not unknown in the industrial sector in general and is a common procedure e. g. in the defence and aerospace industry. Usually there are very few players involved: one buyer and few manufacturers, and the aim is mainly to increase performance and reduce costs. Energy efficiency is an important criterion for some equipment used in energy intensive industrial processes. For several years, co-operative procurement has been used in some countries – e. g. by Nutek in Sweden and by a consortium of utilities SERP (Super Efficient Refrigerator Program) in the U.S. in the "Golden Carrot" Program – as a Market-Pull measure with the aim to accelerate innovation in energy efficiency of equipment and appliances. What has hardly ever been done is a cooperative procurement at a multinational level. Going international can strengthen the market pull signal (more buyers) in traditional market segments (appliances and equipment), and open new domains for technology procurement activities in international market segments, such as office equipment and consumer electronics. International coordination is an important factor for a strong market-pull.

The objective of IEA-DSM-Agreement's Annex III is to develop a procedure for cooperative procurement of innovative DSM technologies at a multinational level and to demonstrate that it can work.

Annex III procurement projects can be characterised by:

- Acceleration of innovation mainly with respect to energy efficiency and pollution reduction.
- Cooperation of buyers in different countries.
- Some development work is usually needed; the result is a new competitive product on the market.

Multinational cooperation, the most prominent aspect of Annex III procurement projects, is not always easy. Barriers and problems can include:

- Different laws and regulations regarding procurement and regarding products.
- Technical barriers (110 V, 230 V).
- Cultural differences (e. g. horizontal/vertical axis washing machine).
- Different strategies and priorities in energy/environment policy.
- Pressures, especially on public agencies, to buy from domestic sources.
- Tradition/experience in co-operative activities.
- Communication (language, distance).

The countries participating actively in Annex III are: Denmark, Finland, Netherlands, Spain, Sweden, UK and the U.S.. The activities are followed closely by Australia, The Commission of the European Union and the World Bank. The operating agent is Dr. Hans Westling, Nutek, Sweden.

Many technological areas were considered for a cooperative procurement project. Five were selected for further investigation: lighting, wet appliances, copiers, home electronics and vending machines. The innovation in lighting is to develop a competitive energy efficient long life incandescent lamp. For the heat-pump laundry drier the major challenge is price-reduction. In the copier project, the main concern is energy efficiency, paper saving and pollution reduction.

2 Why Copiers? What Strategy?

In the industrialised countries, office equipment is the fastest growing energy consumption segment. In a study commissioned by the European Commission [OT3 1994], the annual increase in electric load in Western Europe was estimated to some 2000 MW for computers (1000 MW for personal computers) only.

Only in recent years were attempts started to slow down the increase in energy consumption of office equipment. Several countries were involved. Their strategy consisted mainly in promoting reduction of standby losses by:

- Information and motivation campaigns with the message to turn off the equipment when it is not used.
- Labelling programs (Energy Star in the U.S., Energy 2000 in Switzerland) for easy identification of energy efficient equipment.
- Commitment of governmental organisations and private companies to purchase labelled (energy efficient and environmental friendly) equipment whenever possible.
- Target value agreement between manufacturers and the Swiss government.

The impact on energy consumption of these measures is difficult to measure. An increasing amount of new equipment satisfies the requirements of the labelling programs, but little is known whether the energy saving features are effective in practice.

Energy consumption of copiers and opportunities for saving energy are discussed in detail in a paper prepared for the IEA Conference on Market-Pull Activities and Cooperative Procurement in Paris, November 29-30, 1994 [Har 1994]. Copier machines account for 10-30% to the total energy consumption of office equipment. Energy cost per copier machine varies widely between some 20 USD per year for a slow desktop machine to more than 200 USD per year for a fast copier used by several people. With most copiers, more than 75% of the energy is consumed when the machine is not used – in idle, standby or off modes. Energy embodied in paper is an important factor.

At the Paris workshop a list of possible procurement activities were considered [HAR 1994]:

- Smart auto-off controls for existing equipment.
- Redesigned copier with enhanced implementation of the energy-saving features emphasised by current labels.
- Additional advanced copier technologies and features, e. g.
 - low-power sleep mode with fast recovery,
 - alternative toner materials and fusing strategies,
 - better designed paper-handling for duplex copying,
 - auto-sensor for single/duplex originals.

With the limited resources of Annex III, work was confined to a topic which fitted the major objectives of Annex III, the development of a procedure and the demonstration that it works. The selection had to be based not so much on the potential energy savings but on the interest it would get from buyers and from manufacturers. The following led to the decision to concentrate on low power sleep mode with fast recovery:

1 Smart Switch

Smart auto-off controls on existing equipment became available on the market in Switzerland. These controls are installed on demand by some sellers and leasing companies. No detailed analysis of energy savings exists, and the price of some USD 200 (including installation costs) is quite high.

2 Direct vs Embodied Energy

A comparison of direct energy consumption and energy embodied in paper is shown for different usage patterns in figure 2 for a typical copier with a capacity of 40 copies per minute. Not shown is the energy which was used to produce the machine and all energy needed for recycling and disposal (together embodied energy of the order of a few ten percent of the direct energy consumed over the life cycle). Direct energy consumption is almost independent of the number of copies, but varies strongly with the number of hours the machine is turned on. Two situations are shown: the copier is never turned off (max) and the machine is on only during working hours, 8 hours on 5 days a week (min). The quantity of energy embodied in the paper is in the contrary independent of the running hours but (supposed constant duplexing fraction) of course strongly dependent on the number of copies.

Direct energy savings are attractive for all users independent of the usage pattern. Most modern copiers in the higher speed segment, where the paper saving is most attractive, have duplexing facilities. Little is known about their use. There are some barriers to use them more: default setting is "single side", higher frequency of paper jamming, and slower copying rates. The problem of using all kinds of recycled paper is also unsolved. Differences between

countries in quality of recycled paper is an example of an additional difficulty in a multinational project. Buyers and leasing companies we contacted were sceptical about the effectiveness of technical means (presettings, sensors) to encourage duplexing. The cost of paper, volume and weight are considered as the strongest argument for duplexing.

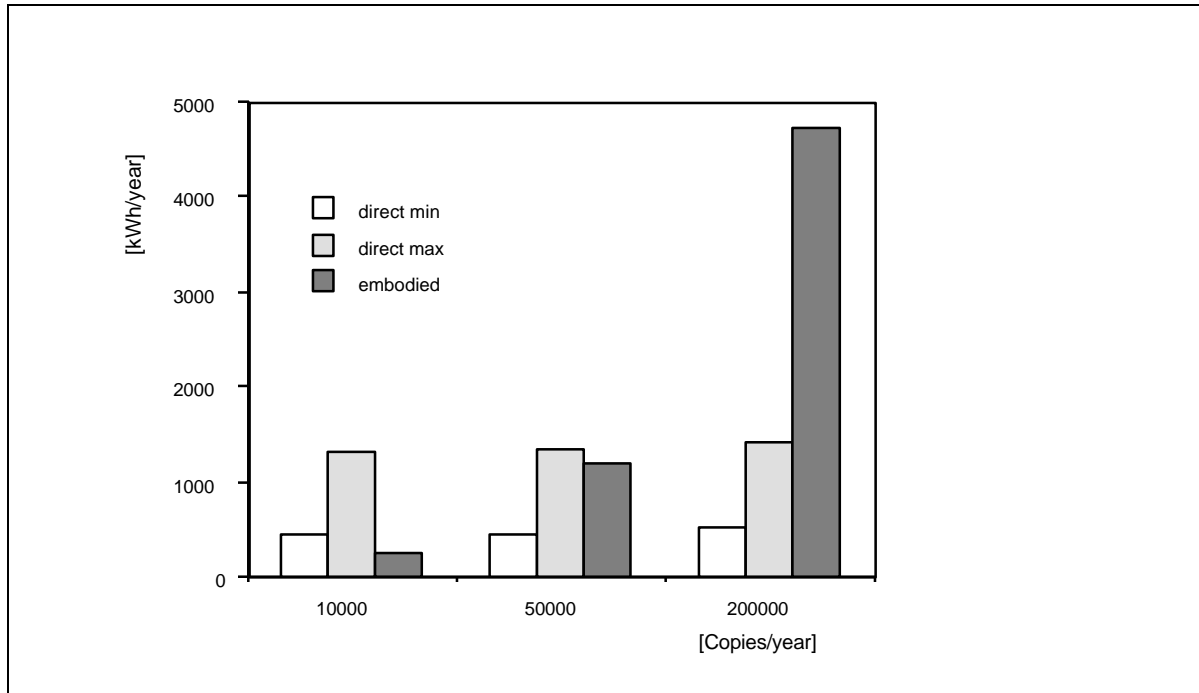


Fig. 2: Annual consumption of direct and (in paper) embodied energy of a typical copier with a copying capacity of 40 copies per minute (own calculation)

3 Warm-up Time

The most important barrier to reduce direct energy losses is the time it takes to get the equipment ready again (warm-up-, connecting-, login-time) from the standby-, sleep- or off-mode. A few seconds to get the copier ready is considered by most people as the maximum acceptable warm-up time. The Energy Star specification (Tier II) for copiers uses a maximum warm-up time of 30 seconds. With the technology used in most copiers this means keeping the temperature of the drum at more than 100 °C and consuming a mean power of some 200 W for a medium speed copier (40 c/min). Power consumption in standby-mode of a selection of copiers on the market in Switzerland in 1994 is presented in figure 3.

4 New Developments

Recently developed new copier machines in the low speed segment (up to 20 copies per minute) have a low power idle mode. They use an "instant-on" fuser with only marginal power consumption in the idle mode and virtually no recovery time.

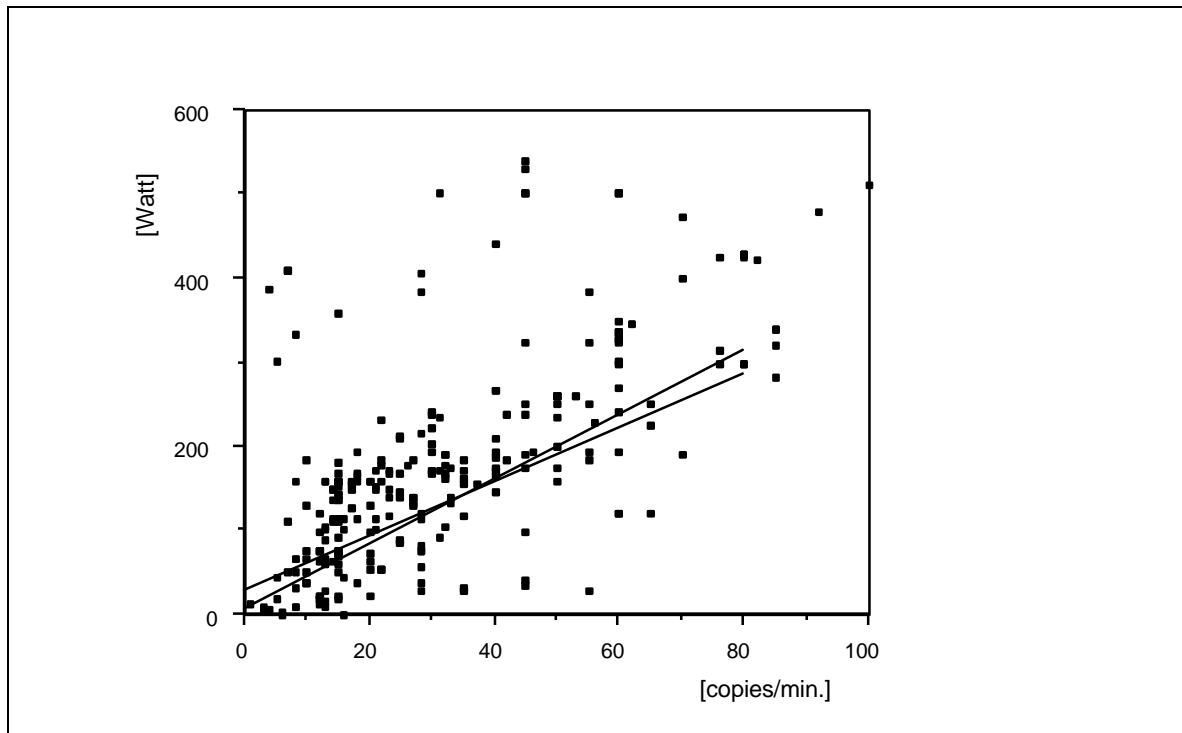


Fig. 3: Power consumption in standby mode of copiers on the market in Switzerland in 1994. The 2 lines indicate the limit for Energy Star (Tier 2) and Swiss Energie 2000 Label. (Most of the copiers with a capacity of more than 20 copies/min and a power consumption much below the two lines have a recovery time exceeding 30 seconds)

Several arguments were in favour of a procurement of an innovative medium size copier with low standby mode and fast recovery time:

- In recent years new copier machines with a low power idle state became available for increasing fast copiers. But more technical development and investments seem to be needed to introduce these technologies in the medium-speed copier segment (21 to 44 copies per minute). A strong signal from the market could contribute to accelerate market introduction of equipment with a low power mode in the medium-speed segment.
- The medium-speed segment represents an important fraction of the market (around 1/4) and of the direct energy consumption (1/3). Saving potential is high for all users, independent of the usage pattern.
- The medium speed copier is typically found in offices with irregular usage pattern and little tolerance for long recovery times. The saving potential of a low power mode with short recovery time is therefore most important.
- Additional functional requirements, e. g. duplexing facilities, can be added during a later phase.

In autumn 1995 and summer 1996, the Annex III experts accepted the following strategy:

- Concentrate on one objective at a time.
- Preliminary focus on the procurement of an innovative copier in the medium speed segment with a low power sleep mode and a short recovery time.
- Prepare a feasibility study with help from an independent expert.
- Go/no go decision after feasibility study.
- Additional criteria (ecology, paper saving, price, quality) should be worked out by buyer groups at a later stage.
- Buyer groups organised on a national level.
- Whenever possible, use existing buyer groups: professional associations, NGOs, consumer associations.

The feasibility study by Dr. Jeanmaire [Jea 1996] was based on a survey of recent patents in the area of electrophotographic fixing units. A first interesting result is the observation that the number of patents in that domain has increased remarkably in recent years: 110 patents per year (1980-1989), 293 patents per year (1990-1993), 617 patents per year (1994-1996). This evolution can be interpreted to some extent as a reaction of the industry to initiatives of governments and buyer groups for a reduction of energy losses by office equipment in standby mode. Regarding low power sleep mode with short recovery time, Jeanmaire showed that several different technological solutions have been proposed by different companies. A summary of these solutions is given in figure 4 [Jea 1996].

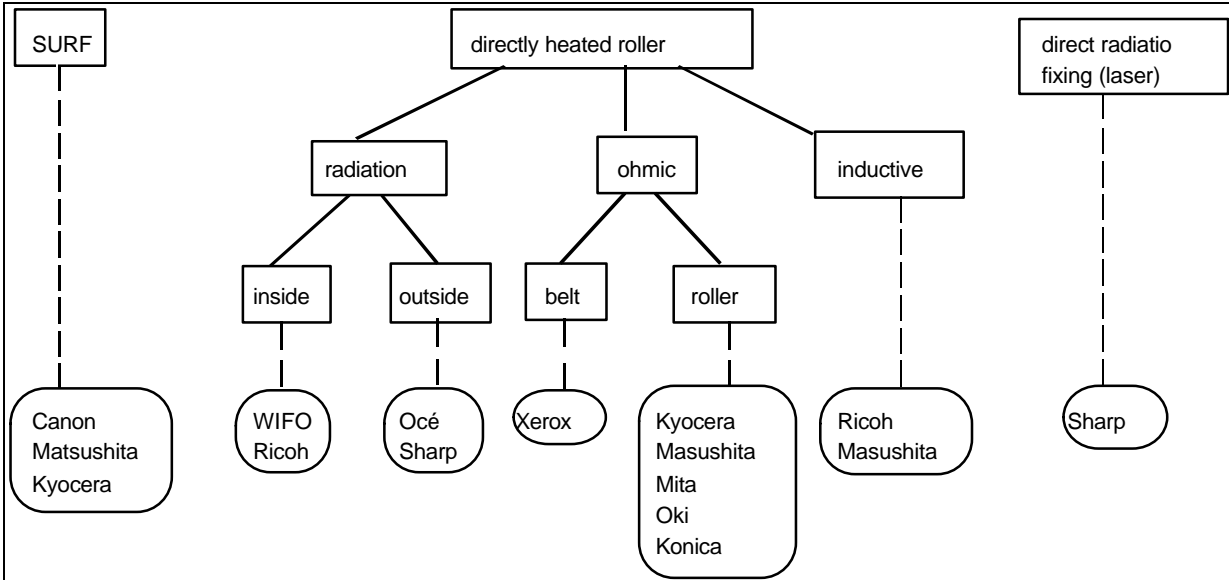


Fig. 4: Genealogy of patents related to low energy standby mode fixing [Jea 1996, Rep. 2, Fig. 1]

An informal technical meeting with manufacturers in September 1996 confirmed Jeanmaire's observations but participants were (of course) more reserved regarding unsolved technical problems and market introduction in the coming years.

3 Procurement Process

A schematic view of the procurement process developed by Hans Westling is given in the next figure [Wes 1996, Fig. 2]. Four phases are distinguished:

- Preparation
- Tendering (specification, bid, choose manufacturer(s))
- Development (prototype)
- Market acceptance (penetration, target values, labels, market transformation)

The principal actors are:

- Buyers
- Manufacturers
- IEA, Nutek, event. leading buyers
- Supporting organisations/activities (for market acceptance, market transformation)

The time needed (from feasibility study to market introduction) is estimated to be of the order of three to four years.

The copier project is still at the very beginning of the procurement process. Feasibility is being investigated and discussed with manufacturers. Prior to discussion with manufacturers, the intended procurement of copiers was published in the supplement of the official E.C. journal.

The involvement of buyers has started in parallel with the feasibility study. The copier project was presented at the UNEP conference "Implementing Environmental Commitment in the Insurance Industry" in May 1996 in London. Four important companies from the insurance and banking sector showed interest and two companies (Swiss Reinsurance and Swiss Bank Corporation) are participating as first leading buyers. Contact with potential buyers and organisation of buyer groups in five countries (Finland, Netherlands, Sweden, Switzerland and UK) is the main task of a recently established international working group. In Switzerland, the procurement project is supported by Ö.B.U. (association for an environment conscious management), an association of more than 200 important industrial and commercial companies. Most of the largest buyers of copier machines in Switzerland are members of the association. A first meeting with selected companies is scheduled for early November. Two kinds of questions will be discussed:

- What additional functional requirements should be specified in the tender document? What are the priorities regarding environmental improvements?

- The purchasing of copiers is organised in very different ways in the individual companies. What could a common procurement on a national and on an international level look like and how should it be organised? Is a commitment by companies possible, are there alternatives to a legal contract with manufacturers?

Fig. 5: Schematic view of procurement process [WES 1996, Fig. 2]

Similar meetings will take place in other countries. Government agencies such as Nutek (Sweden), Novem (Netherlands), Motiva (Finland), BRE (UK) are involved, and in some countries experiences from previous national procurement activities can be used.

It is planned that preliminary specifications will be discussed at a buyer-manufacturer meeting in early 1997. Final specifications could be ready by the end of 1997, and the tendering process could start immediately afterwards. It is unknown how long the development work will take. As soon as a first prototype exists, promotion can be intensified. It is very likely that buyers' interest will be much easier to attain with a prototype. We hope for market introduction in 1998 or 1999, but we still have a long way to go. The real challenge of "organising buyers for a product which does not exist" is ahead of us.

First contacts with companies show that many of them are potential buyers of an innovative copier, but are unlikely to commit themselves to a legal contract. Does this mean that co-operative procurement is not possible? We don't think so. We believe that for equipment like copiers with very heterogeneous buyers, many different decision and purchasing pattern and a fast moving market, we have to find other ways than written contracts to reduce the risk for manufacturers for market introduction of innovative products. Many small signs of interest in different countries could be as significant a market signal as a contract with one large buyer. What is really important for the manufacturer is the market acceptance or market penetration of the new product. By its multinational activities, the copier procurement project can initiate market preparation for this new copier. We are convinced that an innovative copier in the medium speed segment, with low standby mode and short recovery time, will get strong support from governmental and NGO's efficiency programs. Standby power consumption of this new product could be used as a long term target value for all future energy efficient copiers.

References

- [Har 1994] Jeffrey Harris et al., Developing Markets for Energy-Efficient Copiers, Workshop Issue Paper, Paris. November 29-30, 1994
- [Jea 1996] Peter Jeanmaire, Feasibility of Zero Energy Standby Mode (ZESM) for Electrophotographic Engines with copy speed in the range of 20 to 40 copies per minute or higher, Expertise on behalf of IEA (Annex III internal report), May 1996
- [OT3 1994] OT3E Work Group (Jacques Roturier et al.), Energy-efficient Office Technologies in Europe, Study commissioned by EC-DGXVII, Brussels, January 31, 1994
- [Wes 1996] Hans Westling, Co-operative Procurement. Market Acceptance for Innovative Energy-Efficient Technologies, Nutek, Stockholm, 1996