

Market Transformation by Technology Procurement and Demonstration

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The market can be transformed in three ways: by preintroduction of products into the marketplace, by acceleration of their penetration to the market, by enlargement of the market share. Governments can influence all these ways but should restrict themselves firstly to get the best value from money invested and secondly to get the actors in the market to act in the same direction from their own best interest. Nevertheless the government must have the full perspective and support energy efficiency activities through-out in order to see its good intentions through.

The strategy should be, at the same time, both comprehensive and flexible and from that perspective more business-like than traditional government-like. Market transformation is however useless unless it aims at creating "a demand pull". Market transformation does not mean support for one, or a group of, manufacturers but support to the customer to get good value for the money.

Technology procurement and supporting activities undertaken by the Swedish National Administration range from hardware (such as household equipment, lighting equipment and windows) to software (such as training, distributed demonstration and organization of relations between utilities and customers).

Market Transformation

The market can be transformed in three ways:

- by preintroduction of products into the marketplace
- by acceleration of their penetration to the market
- by enlargement of the market share

Preintroduction means that the product is delivered to the market earlier than anticipated under a "laissez-faire" scenario. Acceleration means that the distribution of the product is made more quickly than would otherwise occur and thus the market reaches its saturation faster. Enlargement means that the penetration of the product reaches higher levels of saturation. Throughout this paper it will be argued that preintroduction and acceleration can be successfully and significantly affected by governmental programs for technology procurement and demonstration. Enlargement, however, is a matter for the companies on market alone since they will have best position and can act in their own interest. Governmental engagement in market enlargement will tend to be costly and less cost effective.

Confidence and Challenge

In a sense, technology procurement is a way to establish confidence between manufacturers and customers that inventions and innovations, in new products, is worth

trying. Technology procurement is for this reason based on two important assumptions:

- The purchaser of equipment must be directly involved in the process and to a reasonable extent share the risk for the new products. It is the existence of purchasers and the prospect of large deliveries that makes the supplier interested
- The major costs for development should be carried by the manufacturers and the products should be made available to the market without lengthy delay. It is the ability of the supplier to deliver and to take responsibility for the function of products that makes the purchaser interested

Both parties basically know that technology can be improved and that it is more a matter of timing to make the technology competitive and massproduced. The challenge is to find the right time and the right partners to do it. The aggregate and articulate demand from important purchasers speeds the process. Thus the challenge is given by the customers and taken by the suppliers.

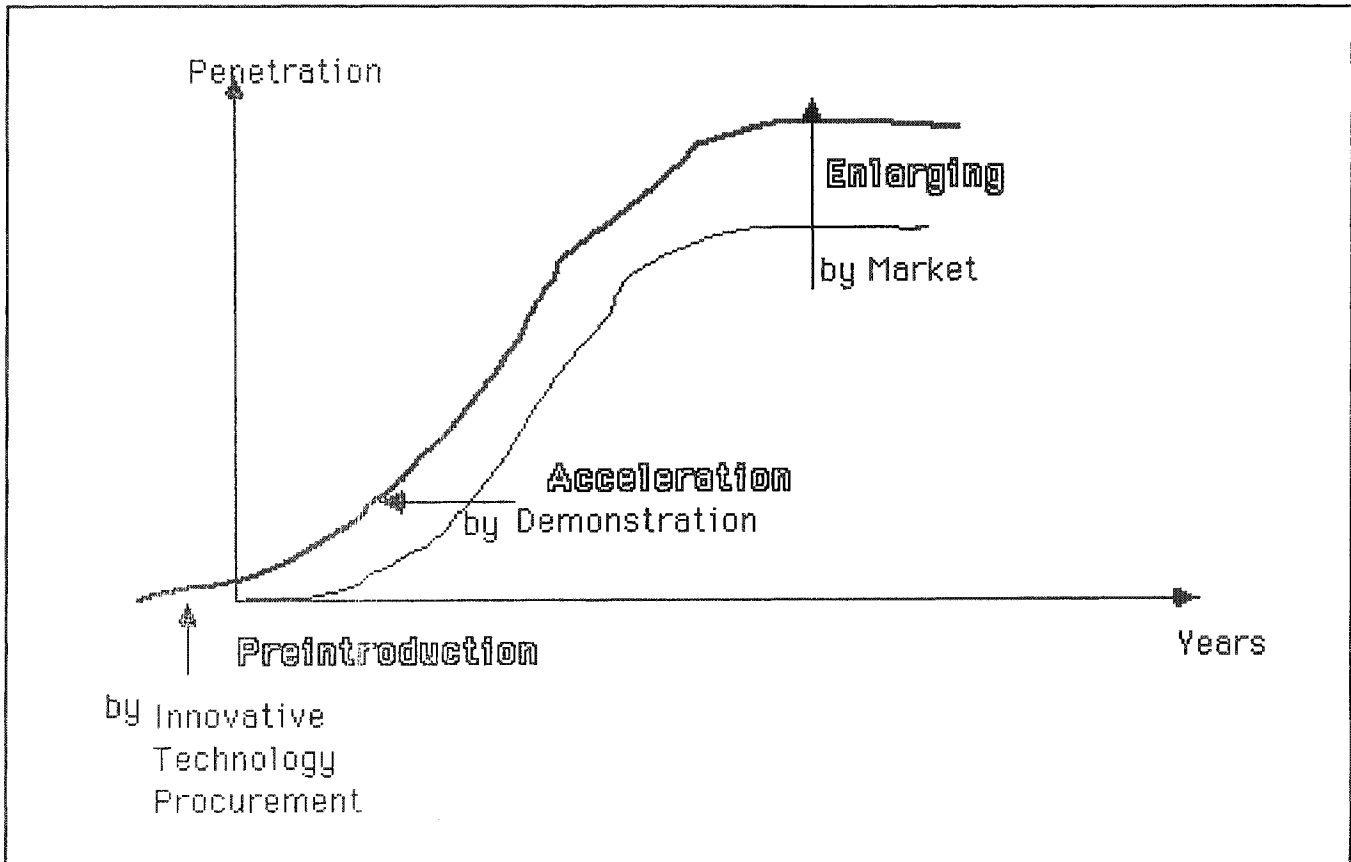


Figure 1. Market Transformation

Supply Push or Demand Pull?

Which is the more important? Is it the product, the market or the customer? Normally everything depends on everything else, in at least two ways! The penetration of a product to a market involves both supply push and demand pull.

In the Swedish program for the improvement of energy efficiency we have identified the following items to be addressed:

I. The product as a technological problem from energy efficiency point of view. The basic activity is to have less energy intensive products

II. The actors on the market (infrastructure) dealing with distribution and maintenance of the products. Unless this structure works the demand for the less energy intensive products will be limited to small groups of customers with special interest in advanced technology.

III. The competitiveness of the product as perceived by the customer. This includes all the non-energy aspects on the product, such as design, comfort, economy, environment impact, etc.

The product characteristics (I) influence the potential for efficiency and the infrastructure (II) and the competitiveness (III) influence the acceptance for new technology. These two factors together form the formula to assess market impact:

$$\text{Impact} = \text{Potential} * \text{Acceptance}$$

Rules of Thumb for Technology Procurement

Technology procurement is a process to introduce to the market new products. Not all products are suitable for this process. To determine the cases a checklist has been made in a study by Westling 1991 :

- The market
 - There should be a potential for adequate recurring demand for the product
 - It is advantageous to have a societal interest in the product, e.g., environmentally based
- Support
 - Clearly expressed by the top level of those responsible to implement regulations and programs
 - Coordination of several major purchasers' efforts to draw up Requests for Proposals (RFP)
 - Cooperation with known lead users with acknowledged know-how
 - Cooperation between relevant authorities
- Goals
 - Well defined objectives stated as soon as possible
 - Initial studies made to define relevant and specific needs
 - Functional requirements laid down for each subsector
- Development work
 - Adequate potential for increased efficiency
 - Project organization with dedicated individuals and leaders
 - Possibility to have competition in supply
 - Suppliers must have access to technological expertise
 - Measuring methods defined
 - Prototypes should be tested in full scale and in realistic environment
- Financing
 - Financing for pre-studies, cooperation, prototypes and test series

As can be seen from the list the technology itself is not the main issue. Rather it is the likelihood to make a substantial impact on the market. This is further demonstrated by cases below.

Technology Cases

A program to influence the technology in a market needs an incentive system with a delivery mechanism and

preparations to build up market volume. There is also a need for an outlined process to bring the necessary parties together.

Incentive System

A technological objective (a bench-mark and associated performance criteria) is needed for the evaluation of tenders to participate in the procurement program. The criteria should preferably promote performance beyond what is necessary for acceptance. Then at least two levels ought to be identified: The mandatory level for acceptance of tender as meeting the requirements and the desired level for high performance.

For the evaluation it is also necessary to define a reference procedure for testing.

Delivery Mechanism. If necessary decide a tender-compensation for companies who give tenders meeting the mandatory or the desired requirements. These criteria for companies who can get this compensation should also take into consideration the company ability to deliver the products asked for in the quantities necessary.

Decide appropriate volume and specific incentive for the winner according to established performance criteria. The incentive is paid to the purchaser of the winning product.

Be prepared to issue smaller amount of funds for the development or testing of certain characteristics which could be of great importance to the purchaser even if it is not clearly stated as a performance criteria.

Prepare for Market Volume. Negotiate for an optional volume of winning products in order to keep up the total volume and lower the production costs.

Be prepared for subsequent supporting activities to support the introduction of winning products or recently developed products meeting the performance set up in the competition. This can speed up market penetration and to justify larger volume which translate into lower production costs.

Process

A powerful purchasers group is the cornerstone. Formation of such a group is made by a general procurement agent (GPA) who takes the responsibility for necessary assessments and keeps the process working. This agent is in most cases not buying but only acting on behalf of the buying parties. There must also be a contact with the

suppliers in order to show commitment and to find out how far it is reasonable to push the requirements of the procurement programs. In Sweden the National Energy Administration acts as GPA.

Procurement of Combined Refrigerator and Freezer

This procurement was initialized by some of the major building companies in Sweden which have a large stock of

flats built during the sixties and now in need for thorough retrofit. The companies equip the flats with combined refrigerator and freezer though the tenants are responsible for the costs to operate the equipment. In spite of this split incentive many of the companies argue that when they are providing the equipment they want it to be modern and to comply with a general view of environmentally friendliness.

Facts about the procurement:

POTENTIAL, MARKET:

Units installed (Millions)	1.5-2.0
Units sold per year (Thousand)	100-150
Energy Use (of total electr. end-use)	appr. 1%
Energy use in units:	
Average in installed	2.0 kWh/liter,year(*,**)
Average in sold today	1.4 kWh/liter,year
Best in market 1990	1.18 kWh/liter,year

MARKET STRUCTURE

Centrally influenced, 3-5 companies and major organizations have influence on the choice for about 80% of the demand by procurement or by recommendation

CRITERIA AND RESULT IN PROCUREMENT

Mandatory level	1.0 kWh/liter,year
Desired level	0.9 kWh/liter,year
Winning model	0.79 kWh/liter,year

INCENTIVES

Tender compensation (SEK/Company)	100,000 (***)
Specific incentive for the first 500 units:	
Meeting mandatory level (SEK/unit)	1000
Meeting desired level (SEK/unit)	1500
Entries (Companies)	5
Accepted entries (Companies)	3

COST FOR PROGRAM

Tender compensation (SEK)	300,000
Specific incentives (SEK)	1,200,000 (****)
Administration and testing (SEK)	appr. 500,000
Incremental cost for unit (SEK)	< 1200

BENEFIT FROM PROGRAM

Customer savings per year and unit (SEK)	80-150
Potential savings:	
-Minimum in every years sold units (Best in market replaced with winning model):	
Electricity (GWh)	10
Customer expenditure (SEK)	7,000,000
-Max. in a saturated market	
Electricity (GWh)	500
Customer expenditure (SEK)	350,000,000

EXPLANATORY NOTES

- * Adjusted volume=Refrigerator volume+2*freezer volume
- ** 1 liter is approximately 0.1 cubic foot
- *** 1 Swedish Crown (SEK) is approximately 0.16 USD and 0.13 ECU
- **** 800 units were accepted

COMMENTS

Recently we have also learnt that other major manufacturers in Europe plan to market products with performance basically similar to that of the winner of this competition.

Major contractors have decided to only install equipment meeting the best performance on market

There has been a spin off from the contest in that the winning company has applied the same technology for stand-alone units of fridges and freezers and adopted a pricing rule of max 2-3 years pay back of the extra investment in comparison to their second best model.

Procurement of Windows

Approximately 30% of the heating energy leaks through windows. There are 4 millions Swedish households of which 1 million were built during the 60s in a housing program which will be thoroughly refurbished in the decade to come. These homes are normally equipped with two-pane windows and normally changed two three-pane windows.

The market is very interested from both supply and demand side in improved windows. The users, the demand side, are interested is not only of energy economy but also for aspects such as architecture, noise reduction, installation, maintenance etc. From the supply side the interest is connected to profit in a more valuable product and in image of companies which can master good technology.

POTENTIAL, MARKET:

Households in Sweden (Millions)	> 4
Target for refurbishment (Millions)	appr. 1
New housing built (Thousand/year)	50
Market for residential building (m ² /year)	1,000,000
Windows available:	
Average U-value in installed	3 W/m ² , °K
Best in market 1990	1.2-1.5 W/m ² , °K

MARKET STRUCTURE

Centrally influenced, by both the major companies owning the flats, the building contractors and by some bigger companies building prefab single family homes

CRITERIA AND RESULT IN PROCUREMENT

Mandatory level	0.9 W/m ² , °K
Desired level	0.8 W/m ² , °K
Winning model	0.73 W/m ² , °K

INCENTIVES

Tender compensation (SEK/Company)	
Meeting mandatory level	75,000 (*)
Meeting desired level	150,000
Improvement activities	150,000 (**)
Specific incentive for the first 5000 m ² : (SEK/m ²)	500
Entries (Companies)	16
Accepted entries to test (Companies)	9

Entries meeting mandatory level (Companies)	6
Entries meeting desired level (Companies)	2

COST FOR PROGRAM

Tender compensation (SEK)	600,000
Improvement of design (SEK)	300,000
Specific incentives (SEK)	2500,000
Administration and testing(SEK)	appr. 500,000
Incremental cost (SEK/m ²)	< 500

BENEFIT FROM PROGRAM

Customer savings per year and m ² (SEK)	40-60
If radiator can be omitted (SEK/window)	2500
Potential savings:	
-Minimum in every years sold units (Best in market replaced with winning model:	
Energy (GWh)	10
Customer expenditure (SEK)	5,000,000
-Maximum in a saturated market	
Energy (GWh)	500
Customer expenditure (SEK)	300,000,000

EXPLANATORY NOTES

* 1 Swedish Crown (SEK) is approximately 0.16 USD and 0.13 ECU

** The two winning companies had to redesign to improve the daylight transmission, a factor partly beyond their control and depending on glass quality

COMMENTS

Supporting activities involved separate architectural assistance to the purchasers in their evaluation of the tender. This also showed a need for further architectural work in visualizing how improved windows could add new qualities to the building and the installations.

The program also negotiated for options of 10, 000 m² from each of the winners giving the same price as for the original 5000 m². This extra amount were two weeks after that the winners were awarded covered to 75%.

If the building is more thoroughly retrofitted or new construction is the case, the cost effectiveness is even better since also the heat distribution system is affected. In best case the radiator can be omitted and replaced by other systems which approximately means that 2500 SEK or more for the radiator can be substituted by 500 SEK for a better window.

High Frequency (HF) Ballasts for Fluorescent Tubes

HF-ballasts means less losses and potential for control according to occupancy and day-light in rooms. There are improvements to make also in better quality, in terms of reliability and environmental impact.

Almost all of the existing luminaries are equipped with traditional electromechanical ballasts. Changing to

POTENTIAL, MARKET:

Installed luminaries (Millions)	30-50
New and replacement (Millions/year)	2
HF-ballasts delivered 1991 (%)	2-3
Target for HF-ballasts (%)	50
Potential savings from losses (TWh/year)	2-3
Potential savings from control (Twh/year)	1-2

MARKET STRUCTURE

Centrally influenced. The lions share of luminaries shipped are equipped according to specification from the purchaser. Luminaries delivered on the counter are highly influenced by what is deemed to be standard procedure with major purchasers such as the Swedish General Services Administration (GSA), major hospital administrations and major insurance companies.

CRITERIA AND RESULT

The evaluation should compare energy efficiency. The main goal for the procurement was to improve energy efficiency and lighting (from an ergonomical point of view) at the same time. Mandatory and desired criteria concerned life time, electric and magnetic fields and harmonics. The tender called for ballasts in the size 32 W and 50 W both for single tubes and fortwin tubes.

Guarantees will be 5 years compared to normally 1 year. Purchasing will be made by the end-user instead of normally the supplier of the luminaries

INCENTIVES

Tender compensation (SEK/Company)	100,000 (*,**)
Specific incentive for 26 000 units: (SEK/saved kWh,year)	1.5
Entries (Companies)	8
Accepted entries (Companies)	2

COST FOR PROGRAM

Tender compensation (SEK)	200,000
Specific incentives (SEK)	1,500,000
Administration and testing (SEK)	appr.200,000

BENEFIT FROM PROGRAM

Prices for the ballasts came down 10-40% compared to best known price before and prices the year before the procurement.

EXPLANATORY NOTES

* 1 Swedish Crown (SEK) is approximately 0.16 USD and 0.13 ECU

** if the tender contained explicit solutions for development of technology concerning control of lighting

COMMENTS

The specific incentive, 1.5 SEK per yearly saved kWh, roughly represents 60 SEK per ballast (2*32 W). The calculation is based on 2000 operating hours a year.

Optional volumes were negotiated and prices were asked for quantities 50%, 100% and 150% bigger shipments than the actual supported volume.

The payback time for HF compared to electromechanical ballasts today is typically in the order of 10 years which means that they are justified from a LCC point of view.

Technology Dissemination and Procurement

Volume, The Case of Water-Heaters

In Nacka, outside Stockholm, a small utility had a problem with potential overload in transformer and cables and considered the possibility of DSM as an alternative to

investments in the distribution network. An experiment was planned in an area where analysis had shown that the age of houses and the quality of the water-heaters indicated an opportunity for savings.

The 440 owners of single family houses were individually offered to take part in a joint procurement of water heaters. Of these 270 owners volunteered from the

beginning and during the process another 30 owners joined which resulted in a participation rate of close to 70%.

Buying a water heater over the counter, installation included, cost 12,000 SEK. The tender for delivery of 300 new water heaters stopped at 7000 SEK per heater. The total work of Nacka Energy to administer the procurement was approximately 300 hours which added 200 SEK to each heater. The entire operation saved 5000 SEK per customer or 1,500,000 SEK totally.

The new heaters had losses of 1.7 MWh less per heater compared to their predecessors. This means another benefit to the customers of 1000 SEK per year.

By administering the DSM operation, Nacka Energy created a win-win-win situation. The economic gains from the volume of joint procurement paid for the costs incurred by Nacka as an administrator. The customer gained in lower investment, lower operating costs and a secure installation by the professional assistance from the utility controllers. The winner of the tender gained a business opportunity he had never dreamt of having in such a small town.

Delivery, The Case of Lamp Leasing

Uppsala Energy has adopted the position of being "a guide towards energy efficiency". Their aim is not to make DSM a profitable activity but to give their customers more options. Uppsalas involvement in delivering hardware to households is more symbolic. A deeper involvement might, however, be of interest as far as the commercial and industrial sectors are concerned. Lamp leasing to households is performed as a test case for a delivery mechanism. This includes having hardware billed in installments along with the energy on the electricity bill.

Each household is given the opportunity to buy up to 6 Compact Fluorescent Lamps (CFL) and have them billed in six installments on their regular electricity bill in order to lower the high first cost which normally acts as a barrier. The lamps are delivered through the retailers of electricity equipment in Uppsala of whom the vast majority are participating. The customer presents his coupon to the retailer who gives him his CFLs and sends the coupon to Uppsala Energy for billing. Uppsala Energy has negotiated for an unusual low cost of these lamps from two manufacturers. The "pseudo retailer" price for the offer is only 65% of the price before the campaign. The system for delivery has two distinct advantages.

- Substitution of energy by equipment providing equivalent energy service shows up on the bill and gives the customer the possibility to easily choose the service
- The existing delivery infrastructure is used as the delivery of service.

A test marketing was made with 2500 customers in late 1991. Of these 10% took the offer and ordered on the average 5.4 CFLs per household. The free drivers appeared on the market and it was reported that in some shops a 50% addition to the mentioned eligible market occurred from customers paying cash on the counter. Through March 92 the customers have spent 1,200,000 SEK on CFLs replacing power worth more than 5,000,000 SEK. The program cost for Uppsala Energy is in the order of 800,000 SEK which however includes a change in the billing system which will be used in future activities. An important effect for the utility is the good-will and the campaign has had a tremendous effect in terms of visibility and improved attitudes from customers. More than 40% of the customers are reported to have taken the offer into positive consideration either buying or stating their intention to buy.

Demonstration, The Case of "Light Corridors"

The Swedish Department of Energy Efficiency (DOEE) has launched a program to demonstrate energy efficient lighting in offices through the utilities. A utility is offered to install, with a customer of his or on his own premises, energy efficient lighting in 5-15 cellular offices and their adjoining corridor. They are given an incentive of 5,000 SEK per room and 15,000 SEK for the corridor which covers some 25% of the investment for the installation. In total the support ranges from 40,000 to 90,000 SEK. DOEE aims to have 50 participants which means that the entire program is in the size of 2 to 4.5 MSEK.

The utilities are also offered four different solutions to choose from. All the solutions are using HF lighting and are designed for 12 W/m². The existing lighting should be scheduled for retrofitting to ensure that the replacement represents an opportunity which would have been lost if retrofitting should have been made with conventional technology. All the local project managers must attend a 3-day course in lighting technology. Measurements will be made before and after the installation on all sites both in terms of energy and in terms of perception and ergonomics. The manufacturers of fixtures will be asked to attend special meetings to follow the project and its results.

The goal is that throughout Sweden there will be modern installations to show and interested staff to argue the advantages and disadvantages of modern lighting.

The Chain Gang

The commercial sector has an enormous potential for efficiency improvement in lighting, ventilation and the use of computers and copiers, as well as in restaurant kitchens and in freezers. This sector is largely controlled by a few big "chains" such as public service, insurance companies, hotels, restaurants, super-markets etc. The strategy is to pick out some of the leading companies from the most strategic sectors because of their use of energy and their opportunities for savings and make them operators. Together with these companies new standards will be established in terms of general levels for the use of energy. Standards which have to be challenging for the management, the engineers, and the economists. A price-tag is then fixed to the improvement if it is shown to meet the new standard and finally a total sum is fixed to the project in order to make it big enough to give significant results. The operators are then asked to use their own skill to buy the systems which will best meet their overall needs. Thereby not only different solutions will be generated according to actual needs but also a broad impact on the market including both consultants and manufacturers will be obtained. This mix of operators from different subsectors, having a common formulation of what there is to be achieved technically, will quite naturally create a rather strong signal to other actors and to the market.

Needless to say the new standard if proven good will be subject to replication within the operators chain.

DOEE has negotiated separate contracts with major purchasers on the market. The biggest purchaser is the government agency (GSA) which represents the majority of all state-owned installations. There are also the four biggest municipalities with their school buildings, four (of 24) hospital administrations and the four biggest insurance companies. Together they have the opportunity to pay for extra costs in experimental installations up to a total amount of 25 MSEK and are promised another 25 MSEK if they make the experimentally achieved solutions standard practice in their operations. This standard is set to 10 W/m² in new lighting and 1.5 kW/m³, sec. for ventilation. Both values representing approximately 20-50% lower use of energy in buildings than the current best and average solutions.

Conclusion and Experience

There must be the interest in a market to promote energy-efficient technology. The advantages of the new products must be identified and verified. The actors must be identified and have shown a will of their own to take a risk in the hope that a market should will increase. A lot of government money have been spent just because the technology was thrilling or the cause morally justified.

The key element in a market is the customer. Unfortunately the customer is often unable to ask for better products from the suppliers. This does not mean that the customer is doing badly but that he could be doing better by joining forces with other purchasers and even better by having the resources to more thoroughly dig into new technological concepts.

The good news to the manufacturers in the markets is that the markets confidence is established for a product with desirable performance in a manner that is neutral and fair. The bad news is that some established methods for cooperation between parties in the market are challenged.

Government programs should mean support to a market instead of to manufacturing companies. Market transformation does not mean support for one, or a group of, manufacturers but support to the customer to ensure good value for the money. The manufacturing companies often have good technological resources which can be used in the interest of all actors if the customer helps to focus his actual needs more clearly.

Does it work? Yes the initial phases, as here described, do and there is evidence of more widespread positive response for improved energy efficiency. In the market government force is less attractive to companies. Competition is not always fun to all the companies, but it is at least the normal way of living. Technology procurement and the associated activities is a way to use the force of competition.

References

Technology procurement for innovation in Swedish construction, Hans Westling. Swedish Council for Building Research. BFR D17:1991 Stockholm.