What is happening with the Swedish Technology Procurement Program? A condensed version of the procurement program's first process and impact evaluation.

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1. SYNOPSIS

Energy-efficient refrigerator/freezers, better windows, high-frequency lighting, heat pumps, auto shut-down monitors and better washing machines etc are procured, introduced and established on the market.

2. ABSTRACT

The program of innovative technology procurement is a government program designed to introduce and promote energy-efficient products and systems. This program has now been in effect in Sweden four years and appears to be successful. This paper deals with different procurement projects, such as the refrigerator/-freezer, the 4-pane window, high-frequency lighting etc. It discusses the process, how it is started, with whom and with what. With different projects as examples, we discuss what type of support the process needs, such as experts, demonstration, standards and information. The ultimate goal of the process is to produce a market transformation, i. e. to consolidate and strengthen market forces which increase the production, acceptance and distribution of more energy-efficient technology. The paper also discusses the difficult issue of how much of the market transformation can be attributed to the procurement program and how much would have taken place without the program. It also deals with the issue of how cost effective the program has been. Finally, we discuss briefly the problem of measuring total market transformation.

3. INTRODUCTION

The Swedish Technology Procurement Program (STPP) is one part of a program set up by several political parties in and outside the government, at first in 1988 and then in a second step in 1991. The initial main goal for STPP was to introduce new products and systems for the efficient use of electricity; in the second step the program was extended to cover all types of energy carriers. The other parts of the program administered by NUTEK consist of investment subsidies to cogeneration plants using biomass and support to wind power and solar heating. All four programs were given a five year budget in 1991, with 22, 23, 6, 1 MECU/year, respectively.

3.1 Background

Programs for energy efficiency are usually motivated by the positive impact they have on the environment and to reduce the need for new, expensive power production and costs. Dependency on imported fuels/energy is also an important consideration. In Sweden most of the programs which were started in the mid-seventies were designed to reduce oil consumption. In conjunction with these programs to save oil, investments were made in nuclear power production and 12 plants were built. As a result of this, around 50% of the country's electricity is now nuclear-based.

In 1980 a Swedish referendum decided that nuclear power was to be abolished by the year 2010. The vast investment in electricity production capacity and a decline in the rate of increase for the demand for electricity have put Sweden in a position with surplus capacity. Resulting low electricity prices and dependence on these from the industrial and heating sectors has once again raised doubts. The difficult question remains unanswered in the minds of many: are we really going to abolish all nuclear power by the

year 2010?

The last question is becoming a key issue in motivating the procurement program. The environmental situation, for example, with the exception of the transport sector, has improved considerably since the seventies. Dependency on imported oil has also to a large extent been eliminated. Furthermore, many are of the opinion that a major nuclear accident can be avoided, that the reliability of power production can be maintained and that demand for electricity will not increase significantly in the near future. The national forecasts now indicate no need for new power production until around the year 2000.

3.2 Program goals and methods

As was indicated in the background above, an initial program for energy efficiency was established in 1988 with an aim to:

- use the available potential for efficient electricity use and switching from electricity that is technically as well as economically motivated up to the year 1997
- maintain and strengthen flexibility in the use of electricity and prevent increased use of it in areas where such an increase is not motivated economically for the nation as a whole
- use the long-term potential available to reduce the need for and to switch from electricity, especially in areas such as heating and electricity-intensive industry

The method to be used in the program was to be technology procurement, i e economic support for orders to purchase products which use electricity efficiently or switch from electricity. The aim of the system of subsidies is to decrease the economic and commercial risks faced by the buyer. According to the regulations established by the government, this support can be used for the whole process, including studies of new technology and the development and evaluation of new products and processes. Initial funding was set at 45 MECU for a five-year period.

To administer the program, the Department of Energy Efficiency was established. An advisory group called the Council for Electricity Use was designated to lead the work. This council consisted of director generals from the different government agencies involved in implementing the program.

In 1991 the program was revamped and a new five-year program was initiated. This program was designed to stimulate the efficient use of all energy, not just electricity. The procurement program was allocated 85 MECU for the new period, and support programs for the demonstration of energy-efficient products in the housing, service and industrial sectors were also established. All in all, nearly 110 MECU was allocated. Also included in this was a program for information to non electricity-intensive industrial sector. The Council for Electricity Use was expanded and renamed the Council for Energy Use.

The Department of Energy Efficiency has set as a goal for the program to reduce the need for electricity by 10 TWh by the year 2000. That is to say, of a total of 60-70 TWh produced by nuclear power, 10 TWh is to be replaced by the more efficient use of electricity and by switching during this period. This is to be done not with a general system of subsidies for the purchase of energy-efficient products, but by a market transformation so that normal, everyday purchases will become energy efficient ones, even in the future. The program has also set up as a goal to remain neutral in influencing the market: no particular suppliers or manufacturers will be favoured by the technology procurements.

The demand for electricity is forecast to continue rising, although at a significantly lower rate than during the eighties. Even when normal, autonomous efficiency improvement is included, the national forecast indicates that demand will still increase by around 1.5 % per year between now and the year 2000. This means that the program could be evaluated economically on the basis of its effect on delaying the need to build new power plants and providing energy efficiency which is more cost effective than new production. This is a common method of evaluation, but as has been pointed out before, the program has other goals as

well. One important goal is a long-term transformation of the market, i e it should assist the market in accepting new products, and in making sure that the new energy-efficient products will be a natural choice at the point of purchase. Another important issue is that of environmental aspects, such as carbon dioxide etc.

In the 1993 Budget Bill, a proposal has been presented which extends the STPP by two years, while maintaining the same total appropriation.

4. PROGRAM METHODS USED

As has been mentioned earlier, the basic method used in the program is technology procurement. This method consists of providing the market with energy-efficient products. The buyer of the energy-efficient products should be and, in fact, often must be consumers who normally use the product. The product itself can either be new or one which is more efficient than the one already existing on the market. These products are both specific items as well as systems. This method can also be used on energy switching. In this case, from electricity to another energy source.

Technology procurement is initiated by identifying "strong actors" on the market, purchasers as well as suppliers. If a product or a system is identified as one with a potential for being more efficient than those available on the market, the program then tries to identify and interest purchasers who represent a significant portion of the market. A "purchaser group" is formed. With assistance from technical and economic experts, this group formulates technical and economic specifications for the product they would like to see on the market. The STPP has as its primary objective to minimise energy use in a cost-effective way. In addition, new products should be provided with all the other important functions and features deemed necessary by the purchasers. The cost of making the product energy efficient cannot exceed the value of the total energy savings provided in the form of lower energy costs When a specification is agreed upon, it is presented as an international proposal to buy a certain amount of the product and is, in effect, an order from the purchaser group. The first purchase is subsidised by the STPP and defrays a portion of the buyers' cost. The size of this purchase is generally very small, although still large enough to interest any normal supplier. The supplier must be prepared to change a product from his product line so that it fulfils the specifications laid down by the purchaser group. Why and how are companies operating on the market interested in this? First, a tradition exists on many product markets of making new products more energy efficient than the products they replace. This is the natural or autonomous trend in technical development caused by rising energy and environmental costs. Secondly, the purchaser group is strong enough so that if it is satisfied with the new product it will continue to buy products of this type, possessing equal or superior energy-efficiency characteristics. This means that a strong market for this type of product will be opened.

To strengthen this new market even more, the STPP has signed general agreements with certain actors on the market. These actors are representatives for buyers who, at the point of purchase, can be influenced in their choice of energy-using products. They can, for example, be managers or owners of large commercial premises or multi-family housing companies, large industrial companies or utilities. These general agreements have certain key stipulations, such as in the case of new office lighting, where installed power cannot exceed 10 W/m2. If this is accomplished, the company will receive an economic subsidy of around 0.17 ECU per yearly saved kWh. For every new project, an agreement must be signed after an exact specification, such as the aforementioned, is judged to be technically feasible.

The general agreement is made in two steps. In the first step, the purchaser in the agreement assumes part of the risk of installing and testing a new product. In the second step, STPP requires that the new product specifications tested in the first step become standard in future product selection. In addition, these specifications are standard throughout the entire organisation. The installation of less efficient products at a later date has proven to be unusual, as awareness of the benefits of the new products increases. In all general agreements, the level of energy efficiency resulting from procurement projects is used, but nothing is said about any certain supplier or product. That is, every effort is made to make sure that other suppliers can enter the market.

The second method used in the program is demonstration of cost-effective ways to use energy more efficiently. Good examples are set, and the products demonstrated are very often those products which have resulted from the procurement program. This is different from the general agreement in the sense that specific products are demonstrated due to the fact that the purchaser is often unable or too small to sign a general agreement.

5. PROGRAM SUBGOALS

As was mentioned before, the program has multiple goals. From an evaluation point of view, these goals are still very new.

Subgoals established are:

- To identify potentials on the market for energy efficiency
- To identify strong actors on these markets
- To involve some/enough strong actors to such an extent that market transformation has a possibility of occurring
- To set up several procurement projects and follow them until the new product is on the market, measuring initial effects on the market

6. EVALUATION METHODS

A suitable evaluation must be based on the needs and requirements decided upon by the initiator or financier of the program. In this particular case, the initiator is the Swedish Government. Unfortunately, not many of the needs and requirements are clearly specified in the Government directive, making it difficult to use them as evaluation benchmarks or goals. A strong interest is usually shown in evaluating investment programs by using short-term cost-efficiency criteria. However, when the goals established consist of such things as using the available potential for energy efficiency, strengthening the flexibility of the energy system, and using the potential available for energy switching, the Council for Energy Use has interpreted this to mean that potentials are to be calculated and methods for turning these potentials into savings are to be evaluated.

Before the discussion continues, it is important to observe the following:

- a savings potential can be separated into a technical possibility and acceptance of this technical potential (SP=TP x A)
- energy use can be separated into activity, structure and intensity, i e energy use has three explanatory variables: (EU= f(A, S, I))

The first relationship proposes to show that the technical efficiency potential is not equal to the real potential, but wise use of the technical potential can make the two move toward convergence. In the second function, it is proposed that technology can impact on energy intensity, sometimes on structure but rarely and only indirectly on activity.

Based on the above mentioned assumptions and on the knowledge that the STPP is a relatively new program, this evaluation has been restricted to the process, i e basically to an evaluation of the subgoals set up. To extend the discussion further, we address the issue of how much a program such as this can contribute to a market transformation, how to evaluate cost-effectiveness for the program and how to measure actual market transformation.

As a basis for such an evaluation, some of the procurements which have been implemented are presented, as well as the major supporting programs used.

7. PROCUREMENT PROJECTS

To define the limits of the evaluation, the major procurement projects undertaken thus far in the program are presented here. The presentation is divided into technology, actors on the market, the purchaser groups and their choice of technology, results and follow-up programs. The projects are not presented in chronological order, but rather in such a fashion as to give interesting views on both successes and failures. The first procurement is presented more in detail than the others, in order to permit a better understanding of the process used.

7.1. A combined refrigerator/freezer

Combined refrigerator/freezers have had strong growth in numbers and size since they were introduced on the market. The rate of growth has now decreased dramatically, however. Since the mid-seventies, energy use has been an issue for manufacturers in this branch. As a result of this, energy efficiency has improved considerably. Still, three years ago, experts were able to propose specifications for a model which reduced the specific energy of such appliances by nearly half. This was done by using better insulation, heat exchangers and compressors.

The market for refrigerator/freezers in Sweden is divided nearly equally into a professional and a private sector. The professional market consists mainly of multi-family housing management companies who provide their apartments with all basic kitchen and washing appliances. In effect, they rent out not only the apartment, but also all major appliances such as refrigerators, freezers, electric ranges, washing machines and sometimes dishwashers. On this market, there exists an organisation for procurement which covers a large portion of publicly-owned multi-family houses. It is known as HBV. HBV is believed to be the largest procurement organisation in the world for kitchen appliances and washing machines. Internationally, these products are produced by a number of companies, some of which manufacture and sell world-wide.

The existence of large companies, combined with a tradition of working with energy efficiency, made it possible to form a purchaser group consisting of HBV and a number of smaller multi-family housing management companies. Discussions in the group were focused on the choice of a common product and common specifications for a procurement. The choice fell on a combined refrigerator/freezer, mainly for use in small apartments intended for households consisting of one or two persons. According to available statistics, growth has been strongest for households of this size. Experts provided by STPP, together with the purchaser group, set as a goal the development of a product which was 40 - 50% more efficient than existing products on the market. To be more precise, a level was set at 1.0[1] kWh/liter adjusted volume per year and another at 0.9[1] kWh/liter a.v.per year. The group also requested reduced environmental impact by decreasing greenhouse gases and by energy labelling of the procured product when it was sold on the private market.

A proposal was made and promulgated internationally, whereby the purchase of 500 units would be guaranteed, followed by a declaration from the purchaser to continue to buy the product. Two companies presented products that fulfilled the requirements. A negotiation followed which included price-setting. The winning company had two proposals: one with an efficiency of 0.79 kWh/liter per year and one with 0.53. Both were lower than required. The choice fell on the first due to price and the fact that the technology here was more established.

The 500 units are now in use and performance is being monitored. The product has also been introduced on the private market and exports to Germany have begun. Other manufacturers have introduced their own models and these are now competing on the same market. The technology used in the original concept has been introduced to other kitchen appliances such as freezers and refrigerators. The purchaser of the 500 units received a grant amounting to 170 ECU per unit or about 20% of his purchase price.

The follow-up program consists, among other things, of educational material directed toward dealers. STPP provides this material at cost. In another follow-up, STPP is also involved in a project aimed at measuring energy use for all major types of appliances in single-family houses. Around 80 houses are involved in the study. After the first year, a number of appliances have already been replaced with energy-efficient appliances as the former wore out, were discarded and replaced by energy-efficient models. STPP is also working with dynamic energy standards and energy labelling. An increasing part of the program's resources are now being used in studies of how market transformation is progressing.

7.2. High-frequency lighting

High-frequency lighting technology has been in use for a number of years. Instead of the standard frequency of 50 or 60 Hz, an electronic device raises the frequency to around 30 000 Hz. This increases the amount of light per energy unit and reduces heat loss from the ballast. All in all, it increases efficiency by about 30%.

The market for high-frequency lighting was relatively small in Sweden in 1991, but the market as a whole for lighting was, of course, quite large. The purchaser group consisted of multi-family house owners and managers, public health authorities in certain areas and one Swedish multinational company. The procurement in this particular case focused on market acceleration and maximising the benefits of falling marginal production costs. Criteria for evaluating proposals were, among other things, energy efficiency, reliability, burning life, electromagnetic fields, disturbance on the electric grid, lighting control, new features and price.

Ten companies came up with a proposal, of which eight were international companies. A low price and a number of new control features were important factors in choosing the winner. A general agreement was signed which included a contract to purchase up to 26 000 ballast's and an option on twice that number at a fixed price.

The market did grow and production costs and price fell by more than 50% during this process. A program for demonstration of the procured technology was established at utilities, offices and schools, following the procurement.

7.3. Hot water heaters

Electric hot water heaters dominate in the production of hot water in single-family houses in Sweden. Reduction of heat loss from tanks and use of time-of-use rates are ways of lowering costs and increasing efficiency in this area.

The market for hot water heaters is complicated because most single-family houses are privately owned. The key problem is to create groups of owners which can be reached quickly and effectively. In the case at hand, utilities were used to solve this problem. Utilities in Sweden have a tradition of providing their customers with advice on energy efficiency. However, as many of them do not have their own electricity production, the traditional hard incentives for them to use DSM are missing. Incentives can in certain cases be found in better use of the grid (peak loads) and as a customer service. The idea from STPP in this particular case was to find ways, especially lasting market incentives, for utilities to work with DSM in the private housing sector.

In the example of hot water heaters, the purchaser group consisted of representatives from a housing area and from the local utility. The goal was to purchase the best product available on the market, but at the same time reduce the purchase price by organising and implementing a large, local order. This would hopefully lead to further increases in market shares for the product, and further increases in production.

The impact on costs and on the market was even greater than expected. Profit margins increased enough to allow the formation of new distribution and marketing forms. Although monitoring of the full effects on costs and savings has yet to be carried out, indications are that there will be a 50% reduction in electricity

consumption. The savings potential in other areas with similar needs is, furthermore, well documented. The follow-up program consists of offering utilities general agreements which include this type of technology. A stipulated level of performance is included in the contract, but the buyer is free to choose his own manufacturer.

7.4. Small solar heating units for single-family houses

Solar heating was one of the areas specifically pointed out by the Government as an interesting area for the STPP. Sweden is, however, located far up north, so solar heating's technical potential is relatively limited. It is possible, however, to cover most of the need for heating hot water with solar heating panels during the summer and, to cover space heating needs during the early fall and late spring.

The market for solar heating consists of private house owners on the user side and a number of small companies on the producer side. These companies specialise in making complete do-it-yourself systems. The purpose in applying STPP here is to lower production costs and the price to the consumer by enlarging the market. In this case, however, it was difficult to form a purchaser group. Instead, an agreement was made with a non-profit interest organisation that gave grants to applicants who installed systems which met certain technical and economic requirements. Time was used in limiting the number of systems.

One result of this procurement was a standardised test procedure. This procedure has been successful and is still in use. The number of solar heating systems sold has also increased, and nearly all installed systems in Sweden received a grant during this time. The market, however, was very weak. Furthermore, STPP is not intended for giving widespread subsidies where there is not a clear and present potential for spreading the technology in question. Instead, the government introduced a grant which covers 25% of the investment cost of solar heating systems which pass fulfil certain requirements. This program is to last five years and is not part of the STPP.

7.5. Windows

Windows are one of the main sources for heat losses in houses in Sweden. To reduce this loss, it is possible to use, among other things, a better frame, extra panes of glass and low emission film on the pains.

A purchaser group consisting of HBV, building construction companies and other multi-family housing owners and managers, was set up. They decided that a window which could be used for both renovation and new construction was needed. The over all U-value was stipulated to be 0.9 W/m2 °C at the most, and preferably 0.8 W/m2 °C. The market for new buildings during the late eighties was very expansive, but showed signs of slowing down at the beginning of the nineties. However, the need for renovating the many buildings constructed during the sixties and early seventies is very large and will provide a market for efficient windows.

Three companies were able to produce windows with U-values with 0.9 while two others had 0.8. The latter were selected as winners in the competition(shared first place) and received a guaranteed market of 5000 m2, including a grant to the buyer. The window had a production cost which was 20% higher than the market average but which was 50% more energy efficient. Both of the winners had four-pane windows.

When the current economic recession began, the building sector declined dramatically. Renovations haven't taken up this shortfall, so this product, as well as other windows have shown very weak sales figures the past few quarters To stimulate interest, STPP continues to display energy-efficient windows at trade fairs and to spread information on them. STPP has also financed follow-up studies, with building demonstrations wherein the heat source usually needed under the window can be left out. This is expected to reduce building costs considerably.

7.6. Auto shutdown monitors

Monitors used with office computers often stay on all day long without being used. In some cases a "screen

saver" is used, but even here the monitor continues to run at full effect. This problem can be solved by using an auto shutdown system. This works as a screen saver but has the additional advantage of completely turning off the monitor. In this procurement, two requirements had to be met: (1) the screen is activated as quickly as when a screen saver is used and (2) the life of the monitor is not shortened by the auto shutdown function.

The market for monitors is spread over a vast number of companies and government authorities. The number of manufacturers, distributors and buyers is very large. However, an interesting feature of the Swedish market is that the Central Government procurement organisation is large enough to be in a position to set informal standards. The technology used in the auto shutdown function is very cheap. The difficulty in making this function standard is that most manufacturers produce for a world market and not just for the Swedish market. Another feature is reduced electric and electro-magnetic fields. These are now measured and reported by a Swedish authority. If a monitor is shut down, it does not produce such fields. These features of the Swedish market presented no major technical obstacles for manufacturers. The only obstacle was in convincing the Central Government procurement organisation to introduce requirements for monitors with this new function. This was followed by a demonstration program. The results have exceeded expectations. 50% of the manufacturers selling on the Swedish market now have this function as a standard feature. The shutdown function is also being copied for laser printers. The specifications developed in Sweden have now been copied in EPA's Green PC Program. This has strengthened the market even more.

7.7 Low energy lighting

Compact florescent lamps have been introduced in Sweden during the past five to six years.

The market for this technology is rather fragmented, especially for the non-government sector. It is mainly this market that STPP has tried to support and strengthen. The commercial premises market has already shown considerable success due to the premium given the lamp's extended lifetime, as well as the larger savings potential.

This product was one of the first to be used in a DSM-project run only by a utility. STPP also conducted a follow-up study of the project which consisted of a test of alternative efficient ways to set up a DSM program. The results indicated no cost effectiveness. The method used was to stimulate the market through directed advertising, including various rebates. But the cost of advertising was not covered by increased revenues on the part of the utility. A second try was made to distribute the product at a local dealer and to bill the buyer via his utility bill. The idea was to allow the electricity customer's reduced electricity bill to cover the instalment payments for the purchase of the lamps This proved to be an effective way of implementing this type of DSM. However, due to the high costs incurred in reprogramming the utility's billing system, this individual project was not cost effective Now, when the billing system is reprogrammed and the billing system can be replicated for other utilities and other energy-efficient products, such projects are making this type of DSM not only cost effective, but very popular. The procurement has been subject to a follow-up study. This will be described later in this paper.

7.8 Fuel switching from direct electric space heating to a non-electric energy source

Direct electric space heating is the most common way of heating single-family houses built in the last twenty years in Sweden. It is also quite common in multi-family houses. The purpose of this procurement was to stimulate new systems and to develop simpler/cheaper systems for switching from electricity. No specified technology was mentioned. This area was carefully pointed out in the STPP.

Even in this case, it was difficult to formulate a purchaser group. Therefore, STPP, in collaboration with Värmeverksföreningen, (a national organisation for district heating companies) made a request for proposals from interested parties. The object was to find both test objects and technology. Certain requirements had to be met, including economy, simplicity and maintenance, environmental impact and technology dispersion potential.

Nine offers came in. Some of these were for switching to district heating and others were for bio-fuels. None of them, however, was actually cost effective. The most promising ones were for converting multi-family houses to district heating in conjunction with a major renovation. Two demonstration objects of this type have now been successfully converted. Conversion to bio-fuel is also under way in an area of single-family houses. As a result of this experience, STPP has notified the Government that projects of this type will have to wait until higher electricity prices make conversion more cost effective. Until that time, work will be confined to demonstration projects aimed at reducing conversion costs and to procurement projects for peripheral technology in conversion and partial conversion.

7.9. Heat pumps for single-family houses

Heat pumps are usually used in houses with hydronic heating systems as the primary means of distributing heat. In this procurement, a heat pump was used in direct electrically heated, single-family houses. No specific technology was stipulated, but peak performance during the coldest days of the year was mentioned as being important.

The market is fragmented even here. The purchaser group consisted of four utilities which, with support from the STPP, had agreed to encourage each of 25 homeowners to purchase the product which eventually would be procured. The results weren't especially promising. Several proposals were received, but delivery prices were too high. Finally, 100 heat pumps were installed. More important, however, was the fact that the project encouraged manufacturers to consider what other types of heat pump systems could be manufactured for about a third of the then current price. This was actually proposed, and one of the manufacturers made two prototypes, both without economic support. These products are now on the market and sales figures point toward the thousands. Both prototypes cover only part of the total heating requirement, but both can also be used in direct electrically heated, single-family homes. In addition, they can be used equally well in hydronic systems. The efficiency improvement with the heat pumps installed has yet to be measured.

7.10. The washing process: from dirty to clean and dry wash, effectively

In multi-family houses in Sweden, it is not unusual to have appliances for washing and drying laundry in a common, shared facility. Before the ambitious program of the seventies , during which large numbers of single-family houses were built, most households living in multi-family houses were families with children. This has changed considerably, and most of these apartments are now occupied by households consisting of one or two people. This change has occurred during the past twenty to thirty years or so, but the washing and drying machines used in the common facilities are still dimensioned for larger families. This means that the machines are too large, and tend, therefore, to use too much water, too much laundry soap and too much energy. The technical savings potential in such facilities is, therefore, large when it comes to reducing the amount of electricity used per kilo washed and dried laundry.

The purchaser group here was basically the same as for the refrigerator/freezer procurement. Two offers resulted from the project. The efficiency improvement was nearly 50%. These products will be introduced on the Swedish market in the autumn of 1993.

7.11. Electric and hybrid vehicles

Electric and hybrid vehicles have constituted one possible way of powering motor vehicles since they were first introduced over a hundred years ago. During the seventies, the electric vehicle was discussed a great deal due to the oil crisis. During the late eighties it was again discussed, although this time it was due to the environmental impact of fossil fuel driven vehicles. Lately, due to a number of new laws in California, manufacturers and authorities all over the world have taken a new interest in such vehicles. Companies which normally manufacture gasoline-driven vehicles have begun preparing for the new market. Concrete measures are being taken to prepare new models for electric and hybrid systems from earlier concepts. Measures are also being taken to secure safe and reliable technology in the form of batteries and other electrical components. Many countries appear to be increasing their support for demonstration programs for

such vehicles.

Against this background, STPP has conducted market research which indicates that several new models have been introduced on the Swedish market. There are also strong indications that it is possible to form a relatively large purchaser group consisting of private as well as public companies.

Work on this procurement is now being concentrated on a car for personal use, probably a station wagon and on a light duty truck/minibus. The purchaser group plans to form two consortia during the spring of 1993 and to accept tenders in August, 1993.

7.12. Systems or system components

In many cases it is not the technology, itself, which is the cause of a misallocation of resources. In many cases, such as motors and fans, system dimensions are unnecessarily large. This leads automatically to excessive use. This is very common in industry, basically because of the importance placed on the reliability of production lines and systems. This can be addressed by demonstrating that such large dimensions are not necessary. These findings can then be integrated into consulting and building companies' databases for use in choosing components. At present, it is too early to draw any conclusions from the project except for the fact that the choice of components is often based solely on earlier experience rather than on calculations concerning optimal energy uses and needs.

8. SUPPORTING PROGRAMS

As was mentioned earlier, the procurement process is supported by a number of other programs. One reason for this is to encourage other manufacturers to introduce their own products and to compete with those which have been developed as a result of the procurement . Another reason is simply to spread information about the new products and to bring the existence of the new products to the attention of important purchasers.

8.1. General agreements

General agreements are signed with strong actors such as property owners and managers, both public and private and for use in industry. Recently, utilities and a number of industrial companies have participated. The agreements are made in two steps. In the first, the agreeing party accepts the responsibility of installing and testing new technology. Often, the technology introduced has to reach a specified level of efficiency. In the second step, the agreeing party accepts STPP's demands that the efficiency level of the new technology be made a standard in choosing components.

General agreements are not signed with all companies in a sector but rather with those who come first and show the most interest. STPP makes no claim to being an advocate or agent for general subsidies for particular technologies or measures. The purpose of STPP is to stimulate the market in the right direction and then let market forces do the rest of the work.

8.2. Demonstration of new technology

Demonstration of a new technology usually follows a procurement. In addition to newly procured products, these demonstrations include other examples of energy-efficient technology. Important purchaser groups from around the country can in this way see new products. Demonstration programs for certain user groups are now being produced. These include, among other things, general advice on the new technology.

8.3. Information

Information in the form of pamphlets and brochures directed at certain user groups is also produced. This is especially important when the results of procurements have recently been presented. The STPP, together

with the companies who fulfil the requirements set by the procurement, also spread this information at large exhibitions and trade fairs in Sweden. STPP provides these companies with educational material at cost.

8.4. Standards and labelling

The STPP has also been instructed by the government to work with standards and labelling, especially for household and kitchen appliances The work is conducted in collaboration with other national and international authorities, as well as in close co-operation with the European Community.

9. SWEDEN IN AN INTERNATIONAL PERSPECTIVE

The STPP program was introduced as part of a program designed to facilitate a phase out of nuclear power. The methods used here can, however, be applied in other countries as well. The purpose in this case is often to stimulate more efficient uses of energy, as well as to reduce the cost of new power production and reduce environmental impact.

Sweden is a very open society, with a long tradition of negotiating and co-operation. For this reason it is quite easy to persuade competing companies, such as property owners, to join forces in a procurement program such as those discussed above. The environment is usually an important point on the agenda, even in the midst of a deep recession.

10. EVALUATION

10.1. Is the timing of the program right and how strongly intertwined is it with the decision to phase out nuclear energy?

Timing is a question often mentioned in Sweden. Are we really prepared to phase out nuclear power and if so, what do we replace it with? The STPP is one of the programs that has as its objective to show how much energy production can be replaced by energy efficiency. Or, to put it another way, how much production capacity will never have to be produced. In most cases, energy-efficient technology involves a normal replacement process. This process cannot be speeded up to any great extent by higher electricity prices. This means that when an appliance or other product has reached the end of its functioning life, it has to be replaced. A more efficient appliance should be on the market and the buyer should be aware of energy efficiency's costs and benefits. These are crucial issues at the point of purchase. In most cases, such products have a life span of more than ten years. In the refrigerator/freezer case, the entire stock is normally replaced every twenty years. Lighting and heating systems/equipment have about the same time span. It often takes a long time to convince the market that a new product will become established. This time span can be several years.

The above suggests that if efficiency improvement is to be accomplished at the national level, one has to start working with the market ten to fifteen years before significant results can be demonstrated. In light of this, we are inclined to conclude that the timing of the program is not wrong and that it is not too early to start such a program. The STPP needs time to show its efficiency. The STPP's own life span must also be long enough to allow implementation of the program. This is estimated to be at least five to ten years. Another important discovery is the fact that the same strong market actors who participate in one procurement are also part of other procurement projects. This means that their time is often very limited. The refrigerator/freezer and washing process procurement, for example, involve the same persons/purchasers. Due both to the limited time of the persons involved and to the enormous public/company attention which is focused on the procurements, two such processes should not be conducted at the same time. In addition to this, it often takes years to realise all the savings potential released by such a procurement.

Another thing which can also be said in conjunction with the phase out of nuclear power is that even if Sweden were not to go through with it, the current national forecasts indicate the need for new power

within ten years. If the STPP proves to be efficient, the construction of new production capacity can be postponed. The STPP has, in fact, demonstrated efficient ways for reducing the demand for energy rather than building new production to meet increased demand. This process and these methods can be used in other situations.

In conclusion, we find the timing of the program to be right, and the positive effects of the program will persist and prove to be substantial, even if the phase-out is not carried through as planned.

10.2. How are potentials for energy efficiency found and can new technology be introduced into these sectors effectively by using a procurement process near the market?

During the past ten to fifteen years, a great deal of work has been done in Sweden, both within the government and privately. The purpose of much of this was to find out how energy is used. This work has generated many new ideas. As a result of this, when the STPP started, it had a great deal of knowledge to build upon. One question which evolved was in regard to the choice between different technologies. another was the issue of the technical potential's limitations, and how this can be realised only if there are enough interested purchasers. That is to say, acceptance of a technology is as important as the technology, itself. What we have discovered from working with the procurement program is that the initial working/purchaser group-concept has proven to be a strong and effective way to probe new areas to work within. All the persons involved focus their attention on energy use and can, therefore, see areas other than those in which they are working. This means that both questions of technology and market acceptance can be solved initially within these working groups. This almost insures that optimal conditions for a market introduction will be found. Another interesting discovery is that it is very rare for new technology to be suggested to STPP by inventors. Instead, it has been shown that small changes in existing technology and the synthesis of several different existing technologies are the real keys to success.

10.3. Who are the strong actors, why are they interested and how are they made more interested?

Strong actors can be found among both purchasers and producers. The secret to activating them, however, lies in their common interest in energy and other questions related to their operations. Strong actors interested in testing new processes can be found in every niche of society. Their interest can be strengthened further by the opportunity to discuss questions other than energy in their purchaser groups. Environmental issues have, as a result of this, become increasingly important in STPP. Both manufacturers and purchasers point out the fact that their children insist that they work with reducing environmental impact.

10.4. What is a market transformation and how large a part of this transformation can be attributed to STPP?

A really difficult question is what market transformation really is and how to measure it. What the STPP does is to introduce new products in conjunction with a substantial and well timed purchase. The purchase is often only a small percentage of the market's annual sales and normally consists of only one of the manufacturers products. This means that STPP does not have any immediate impact on most new products sold.

One way to measure market transformation is by the speed and breadth involved in the introduction of other manufacturers' competing products. Another is to measure sales for this and similar products. A third is to measure purchasers' interest in the energy/environmental aspect of the product. If the first measure is used, the procurements a, b, c, e, f, g and j have been successful thus far. If the second measure is used, it is still too early to judge success. However, in the case of a, b, e, g and i, products from the procurements are being sold without financial support from STPP. The last question is the most difficult one. It is in the process of being analysed. As environment and energy remain questions of great interest in Sweden, a program like STPP has a good possibility of being efficient as a result of the positive contribution it makes in these areas.

Table 1. ***A summary of the findings by STPP so far.***

Product	Time for RFP[1]	Market introduction (winner announced)	Strong actors used or found	Efficiency improvement versus best on the market[2]	Program support (MECU)	Program efficiency[3]	Market transformation[4]
Refrigerator/freezer	April -90	Sept -91	YES	40 %	0,23	0,3 (2)	YES
High- frequency lighting	Sept -91	(March -92)	YES	30%	0,28	0,4 (2)	YES
Hot water heaters	spring - 90	(spring -90)	NO	0%	0,05	-	-
Small solar appliances	Jan -90 - June -91		NO	0%	0,34	-	NO
Windows	May -91	summer -92	partly	50%, than normal	0,41	-	YES
Auto shut down monitors	April -92	autumn -92	YES	0-50%	0,17	0,9 (0,5)	YES
Low energy lighting			NO	80%	0,27	-	YES
Heat pumps	May -90	Oct -92	NO	-	0,11		?
The washing process	Nov -91	Sept -93	YES		0,23	0,5 (1,3)	?

1. RFP- request for proposal.
2. Partly calculated.
3. (ECU/MWh_{el}, 2010) (Realised potential in TWh) A very preliminary figure: planned total financial support times an investment made 20 years in advance/yearly efficiency potential for the product 2010. provided that the new products are cost effective for the purchaser. The investment cost for a power plant is often 1100 ECU/kW or about 15 ECU/MWh (6000 hour/year, 20 year and 5% real interest rate).
4. Defined as if the product has been sold without support after the initial program and also that other manufacturers have followed.

Finally, how much of the market transformation can be accounted for by STPP? What STPP really can achieve is to strengthen and speed up the transformation. This is done partially through the media, where STPP as well as the companies involved present the project and its purpose. In simple cash terms, it is always possible to measure the effect of the program in terms of economic support expenses divided by the amount of products purchased during the initial purchase. This is a rather limited view and is therefore beyond the scope of this paper.

10.5. Would the process of technology synthesis and transfer inherent in innovative procurement have taken place without the program?

The question of whether the process would have occurred anyway is very difficult to answer. One thing is fairly certain, and that is that the process would have gone more slowly. This is due partly to the fact that the manufacturer seldom really "talks" with the purchaser. This is often done through a dealer or through market research, where brief interviews of the purchaser are carried out. There is no dialogue here, and, most important of all, the energy issue is seldom of any great importance.

10.6. How cost effective is the STPP program?

The cost effectiveness of the program has yet to be determined. However, a first attempt at this is made in table 1. Compared with the in table 1 mentioned 15 ECU/MWh, the program appears to be effective, but in these calculations, the costs of general agreements, demonstrations, etc. are not included. Even with these figures included, the program seems cost effective. If the 109 MECU results in a realised potential of 10 TWh by the year 2010, it would mean a cost at a level of 29 ECU/MWh. This seems high, but there is no cost for the production of energy included in the 15 ECU/MWh figure. This is at least 11 ECU/MWh more.

11. FUTURE WORK

Other technologies emerging into the process are: ventilation systems, refrigerator/freezers at food stores, small private washing machines, motor control systems, spotlights, laser writers, etc.

ENDNOTES

1. The volume is a weighted value of two times the volume of the freezer plus the refrigerator volume.

REFERENCES

Energipolitik inför 90-talet, Regeringens Proposition, 1987/88:90.

Summary of Government Bill 1990/91:88.

Utvärdering av programmet för effektivare energianvändning, NUTEK R 1993:5 (in swedish).

Westling Hans, Technology Procurement for innovation in Swedish construction, BFR D17:1991, ISBN 91-540-5367-6.