Implementing Differences
Renewable Energy Sources vs Energy-Efficient End Use

Brita Olerup, Stockholm Energi and Lund University

1. SYNOPSIS

Utilities appear better suited to develop energy sources than the end use. State initiatives may, thus, be requested for a successfull realization of energy efficiency.

2. ABSTRACT

The implementation of the two components that form a sustainable energy system differs at the utility level. Two empirical studies suggest that utilities are better placed to develop energy sources than the end use. Although both strategies involved a new cooperation with new actors that required new knowledge, their implications were different. In the renewable case, a utility buys and uses the product itself, while that is the responsibility of the end user in the efficiency case. A utility can only advise on the end use of energy, contrary to renewable sources where it could even manufacture the fuel and, thus, be in control of all production links itself. Required internal changes for handling renewables were also within accustomed limits, while efficiency added a new dimension. As experience on marketing activities is growing, this knowledge could be transferred to energy sources. If utilities let their customers choose fuel in special contracts, their sales and the financing of investments would be better secured. Concerning efficiency, the state may have to be brought back in for a successful realization. Its task would be twofold. First, stimulate the development of energy-efficient end use equipment through its funding of research and development. Second, stimulate the penetration of the energy-efficient technology on the market in its capacity as a big purchaser.

3. INTRODUCTION

A sustainable energy system is composed of two strategies; one is a more efficient use and the other to replace fossil fuels with renewable sources (World Commission on Environment and Development 1987). Several actors are involved in their implementation. I have chosen the perspective of a utility. In the renewable case, utilities are users themselves. Whereas in the efficiency case, utilities could act as middle hands and guide their customers' choice of end use equipment. My intention is to explore whether utilities are more or less apt to adopt one or the other strategy. I limit my analysis to inherent implications of the two strategies and disregard the influence that changing internal or external circumstances may have had on preferences. First, I compare the implementation of the two strategies at a Swedish utility. Second, I discuss policy implications involved in the difference that appeared.

4. TWO SUSTAINABLE STRATEGIES

I depart from two earlier made empirical studies of Stockholm Energi, a vertically integrated utility owned by the City of Stockholm. One is a decision making process ending in a partial investment in renewable energy sources at a district heating plant (Olerup 1994a). The other is an implementation of a different decision - without a decision making process - at the same utility to invest in an electricity-efficient end use (Olerup 1994b). The first process had to be updated as it was at that time only a decision that was about to be implemented. I interviewed a new actor on the scene in August 1994. The two descriptions were also kept apart, but are now put together for a joint analysis. First, I extract decisions made and actions taken during implementation to illustrate their development in volume over time. Second, I compare the internal changes in activities that the two strategies implied.

4.1. Efficiency in Regress - Renewables in Progress

In the efficiency case, an initiating decision was taken in the spring of 1987 aiming at an implementation between 1990 and 1994. Implementation became inferior to plan and was in fact interrupted in mid-1992. In the renewable case, a decision was made in February 1992 aiming at an implementation for the heating season 1993/1994. Implementation so far points at a broadening of the application.

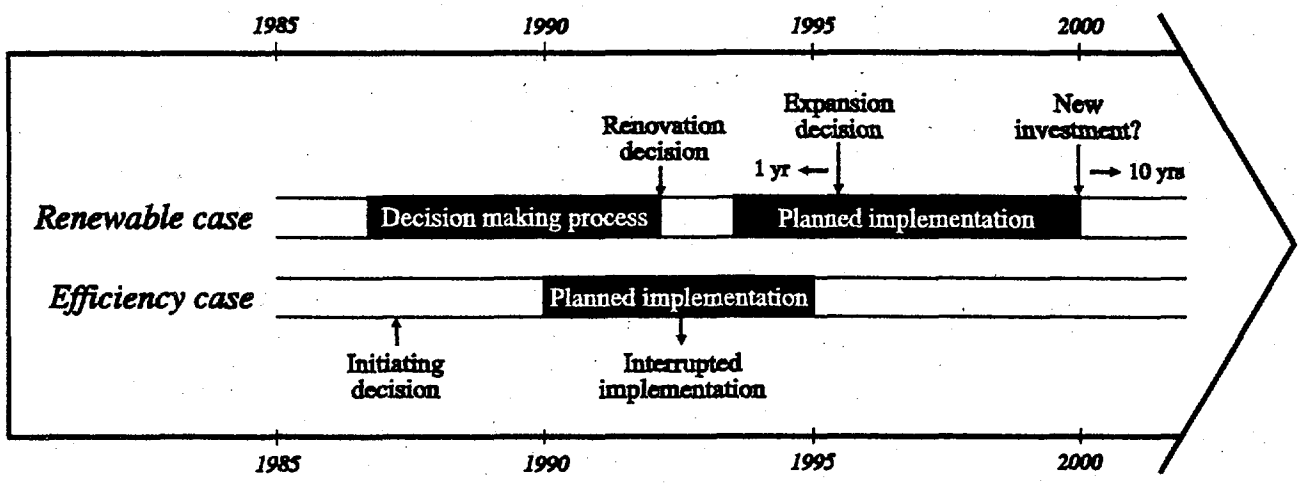

Figure 1. When decisions and actions took place in the two cases.

Concerning efficiency, Stockholm Energi aimed at reducing electricity demands in the City of Stockholm by a total of 600 to 700 GWh - provided an at least sustained comfort for its customers - in five years between 1990 and 1994 with a budget limit set at 65.2 MECU[1] (600 MSEK). The conservation goal implied a reduction by ten percent. Financial means were split into 10.9 MECU (100 MSEK) aimed at having 90 to 100 people employed by the end of the period, i.e. in 1994, dealing exclusively with energy conservation. The remaining 54.3 MECU (500 MSEK) could be invested in conservation measures at the end users.

Conservation ambitions were first reformulated from an energy to a power goal, reduced, and later withdrawn. They did not disappear entirely but lost a value of their own as they became degraded to a side issue with the prime intention to certify energy sales - used if needed, but left out when not needed. When the conservation programme was interrupted midways, Stockholm Energi had conserved 120 GWh, i.e. one-fifth of the total goal and spent 7.1 MECU (65 MSEK), i.e. one-tenth of total means. In other words, each unit conserved only had half the cost of the initially tolerated limit provided that the estimations were correct. Energy conserved is always an ambiguous amount considering that measures undertaken could also increase comfort. About ten people were responsible for energy conservation throughout the implementation. The 54.3 MECU (500 MSEK) for investing at the end users were never used for that purpose. Customers had to finance technical installations in their homes themselves. A minor sum financed campaigns (lighting and white goods) and consultants for undertaking audits. At least one-third of money spent were used for such an enhanced visibility (Olerup 1994c).

Concerning renewables, coal was to be replaced by a mixture of biomass pellets and low sulphur heavy fuel oil in one of three cogenerating boilers concerned at the district heating plant in Hässelby. The other two boilers would use low sulphur heavy fuel oil until further experience was obtained from the pellet experiment. Switching fuels only involved a low investment as the existing plant infrastructure could be maintained. A fuel plant had to be built to secure sufficient amounts of biomass fuel. When subsidies are deducted, each of the two investments - converting one boiler and building the fuel plant - was budgeted at about 2.2 MECU (20 MSEK). The expansion decision was planned to be taken after two heating season, i.e. in 1995. In the year 2000 an investment in new boilers may be needed. Natural gas or burning refuse could then turn into competitors to continued biomass pellets.

Panel 1

The pellet concept had many advantages. The low investment made it flexible towards changing circumstances, e.g. political decisions concerning taxation levels and environmental charges changing the economics and future of different fuels. Nor do refined biomass have the space demands of non-refined biomass. Pellets could, therefore, solve expansion problems also at other plants within Stockholm.[2] According to internal forecasts, biomass could within a decade amount to 1.5-2 TWh, i.e. one-quarter to one-third of the total district heating fuel mix in Stockholm. Burning tests of minor quantities of other biomass variants have also been undertaken at these plants after the decision on Hässelby.

Investments at the district heating plant became cheaper than planned 1.5 MECU (14 MSEK) and the fuel plant more expensive due to construction problems. Conversion of the other two boilers was brought forward one year. It will be a lower investment of 0.9 MECU (8 MSEK) due to the burners not being replaced giving slightly increased NO_x-emissions.[3] Domestic biomass pellets were supplemented by imported olive stones. Tunisian olive stones only have half the price of Swedish pellets. Olive stones will be used in two of the boilers leading to a calculated annual saving of 4.3 MECU (40 MSEK) compared with fuel oil. Other biomass variants cannot be used before the existing mill is modified, which is a larger investment of about 7.6 MECU (70 MSEK) planned for 1995. The final date for investing in new boilers may be postponed ten years. The remaining life length of the old boilers is currently investigated. Only one heating season has yet passed, but if the initial plan is roughly compared with the current plan, the account for the first three heating seasons would be that the biomass volume is expanded by one-fourth and the running cost reduced by one-third.[4]

4.2. Efficiency Forwards - Renewables Backwards

The two strategies entailed changes in relation to core activities. Both involved a new cooperation with new actors that required new knowledge. Figure 2 shows changes in principle. In the efficiency case, Stockholm Energi had to extend its usual business forwards in the production chain to incorporate the end use, while backwards in the renewable case to incorporate the energy source. These changes had different implications at both the strategic and the operative level.

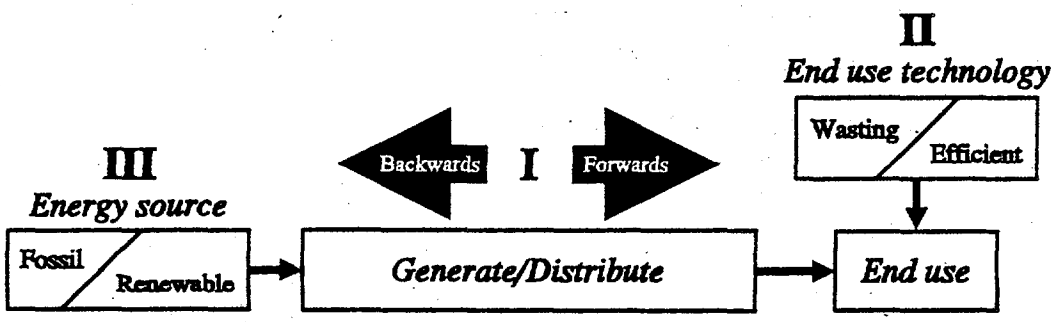

Figure 2. In the efficiency case (II), a utility has to extend its normal business (I) forwards in the production chain, while backwards in the renewable case (III). The Roman numbers give the order in which the two cases occurred. The slanting lines separate the choices in each of the two boxes concerned.

Figure 2 illustrates that the cooperation that was needed to obtain an efficient end use was more complicated than for renewables. A utility does not only have to get in touch with the end users (purchasers and users) but also the suppliers of end use equipment (manufacturers and retailers). Stockholm Energi decided to handle the new task in a new department. Energy efficiency was only a minor part of the endeavours at the marketing department. The department was gradually formed by restructuring existing functions, redefining old functions, and adding new

functions as people dealing with sales, metering, technical installations, installation audits, and telephone service from departments for electricity, district heating, and town gas were put together. Different energy products were no longer to compete with one another, but to cooperate according to what would be the best solution for each customer. Customers should only have to consult one salesperson for all their energy needs. A new concept was introduced *energy service*, i.e. services received from energy like space conditioning, lighting, and mechanical power.

Despite the organizational change, salespeople at Stockholm Energi still sold the original products (electricity, district heating, and town gas). Energy efficiency was treated as one of several quality supplements. As salespeople worked side by side, instead of as previously in different departments, they became more aware of one another and coordinated their work better. Customers, however, did not get one salesperson to fulfill all their energy needs. Conservation activities changed in appearance and target over time. Three principal forms came to succeed one another: first, visible campaigns aimed at residents; second, invisible audits for professional customers in general; and third, secret contracts with high-voltage customers or big low-voltage customers, i.e. a part of the professional group of customers. Campaigns were undertaken in cooperation with manufacturers and retailers, while audits and contracts only involved the end users. All three forms ended in advice with the exception that Stockholm Energi sold a few minor items, e.g. energy-efficient light bulbs, at its customer centre. A utility can only recommend measures, but the customer decides which to undertake. More control - at least over purchases but not the use - may have been obtained if Stockholm Energi had financed installations as initially planned. Its financing would then have to be accompanied by contracts if the customer should choose to turn to a cheaper energy supplier later considering the planned introduction of competition in the electricity market (Governmental Proposals 1991/92, 1993/94).

Similar organizational changes or new goal formulations were not needed for handling renewable sources, but something had to be done to obtain sufficient amounts of biomass fuel. Stockholm Energi started a joint venture with Sågverkens Trädprodukter (SÅTAB) and Graningeverken. The three have together erected a fuel plant in Härnösand with the intention to assemble sawdust from nearby sawmills and convert them into pellets. Stockholm Energi holds 70 percent of the shares. In 1995 the capacity at the fuel plant will be expanded by fifty percent. At the same time the previously mentioned construction problems will be attended to leading to a total investment of 1.1 MECU (10 MSEK).[5] This expansion is below full capacity due to several companies making similar investments resulting in a saturated demand for pellets. In other words, the fuel plant may have been superfluous when judged in hindsight.

Import was an acknowledged option already at the time of the first decision to replace coal by a biomass fuel at the district heating plant. Such an import will be handled through a non-profit organization called EFO[6] started by utilities in mid-Sweden in the 1970s. They wanted to reduce prices by coordinating their purchases of imported fuels. A big customer has a stronger bargaining position. EFO has dealt with fuel oil, followed by coal, ashes, and now biomass. In other words, adding biomass was within the usual cooperation but demanded new knowledge. Different boilers require special qualities of biomass fuel. The situation resemble the one for coal, while fuel oil is a less complicated fuel to handle. EFO's initial lack of knowledge made other utilities bypass it in their purchases of biomass fuel abroad, but Stockholm Energi persisted and also took an active part in the process.

4.3. Summary

Both plans had high ambitions but these ambitions were treated differently. Efficiency aimed high immediately - ten percent of the electricity needed in Stockholm - but the plan had to be revised due to practical constraints to influence customers' preferences. Renewables were potentially expansive - one-quarter to one-third of the total district heating fuel mix in Stockholm - but started with a cautious step by step process - one out of three boilers - which became accelerated and expanded. Both implementations are so far roughly comparable in investment volume and are still minor activities compared to the core business. Both were also less expensive than planned considering output in relation to input. Ordinarily calculations for a favoured alternative more often underestimate than overestimate costs (Jansson 1992). As renewables now are accepted and incorporated into the business, the continued calculations may display a more optimistic tendency.

Investments in end use added a new dimension - the link to customers - while changes for renewable sources were within accustomed limits. Utilities have a technical tradition with an engineering staff concerned primarily with a safe delivery. They are used to adding new fuels and combustion technologies to the production process, but not to marketing work. All links in the production process are also visible, controllable, and relatively easy to measure, contrary to the ambiguous achievements in energy efficiency. Renewables entered automatically into the ordinary billing system, while advice on end use equipment had no similar arrangement. Some audits were charged, but not all of them. A task that could have become routine given the time.

5. POLICY IMPLICATIONS

The course of events related above suggests that utilities are better placed to develop energy sources than the end use due to their different possibilities to supervise the outcome of efforts undertaken. Provided that an intensified permeation of the two sustainable strategies is desirable, which recommendations are implicit in the prolongation of this conclusion? Such an analysis can, evidently, only be speculative. First, I look for a more suitable group of actors for the efficiency case. Second, I examine how utilities could further refine their approach in the renewable case. Third, I discuss whether such a development is plausible considering prevailing tendencies.

5.1. Efficiency - Bring the State Back In

When Stockholm Energi turned energy efficiency into a sales argument in its negotiations with important customers, it adapted its approach to something that agreed with both its safety ambition and its desire to be businesslike. Thus, utilities continue to play a part in efficiency, although a restricted one. Nor can they be expected to advance their position as long as no approach is found capable of reducing uncertainties and enhance short-term flexibility. The safety strategy used for energy sources, i.e. incorporate manufacturing and sales, is inapplicable. Utilities only pay attention to one aspect of that technology, i.e. energy performance, while buyers have numerous other claims.

Swedish utilities' interest in energy conservation emanated from a political decision in 1988 to initiate the nuclear power phase out in the mid-1990s (Governmental Proposal 1986/87). It led to an assumed shortage of supply capacity at the same time as new supply capacity was expected to be considerably more expensive than the existing. Politicians have, in addition, during two decades talked in favour of an energy system compatible with a sustainable development (e.g. Governmental Proposals 1975, 1990/91). Two decisions in 1991 changed the situation. First, the postponement of the initiation of nuclear power in the mid-1990s led to an assumed supply capacity surplus (Three party agreement 1991). Second, the announcement to introduce competition in the electricity market (Governmental Proposal 1991/92).

As the igniting sparks always came from the political process, politicians could perhaps reorient their influence to other parties involved in the end use of energy, i.e. manufacturers and purchasers of end use equipment. These enter in different phases as manufacturers are concerned with the development of new technology and purchasers in buying the existing technology. The state disposes of means to stimulate new products and production processes. The public sector is, in addition, a big consumer of end use equipment. Large orders to manufacturers would reduce their costs and the sales price for customers in general. The distribution of funds encompasses few people, while purchasers are a large number of people to influence. Public authorities also encounter problems when intervening, but they should be less sensitive to the uncertain outcome of conservation efforts as they do not have the simultaneous delivery responsibility of utilities.

5.2. Renewables - Develop Forwards

The efficiency adventure among some Swedish utilities in the second half of the 1980s was not a waste of time and money. It made them, instead, develop their core business and establish a link to customers (Figure 3). Their closer relationship turned especially valuable during the first half of the 1990s due to the at that time approaching competition in the Swedish electricity market (Governmental Proposal 1991/92). The advice given to customers made their choice between a wasting or an efficient end use technology explicit. The same approach could perhaps be transferred also to other parts in the production process. The choice of energy source are made by utilities within the limits of prevailing conditions. Some utilities in Sweden, e.g. Gothenburg and Lund have facilitated for their customers to invest in wind power. These wind power plants are managed in independent economic associations, but the utilities buy a large part of the shares initially to certify the investment. Their shares are sold as soon as possible to customers within the distribution area.

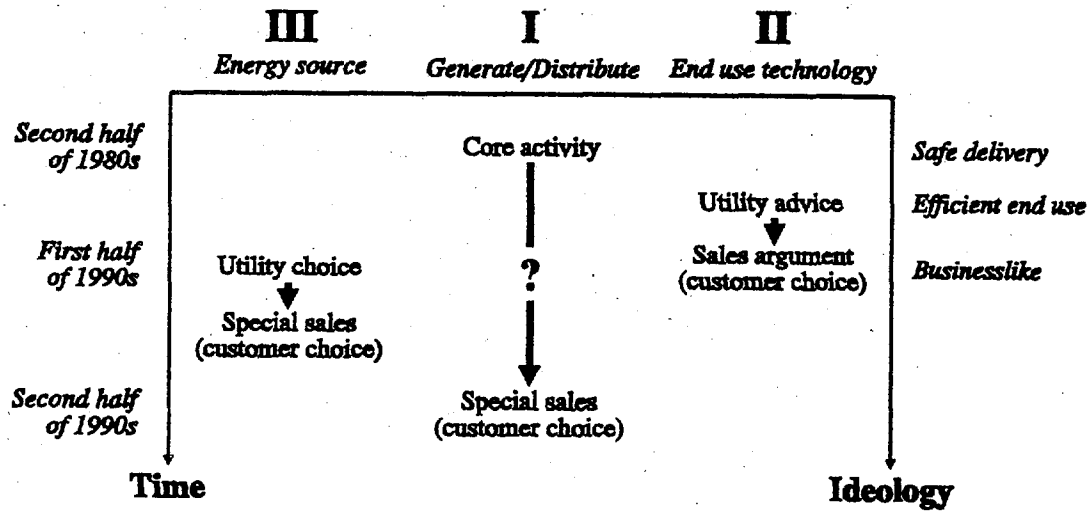

Figure 3. Utilities develop their business. Focus has shifted to other parts in the production chain (horizontal line) over time (left vertical line) possible to divide in periods with different reigning ideologies (right vertical line). The Roman numbers give the order in which the two cases occurred.

Wind power is one possibility when phasing out nuclear power, but the real potential of an alternative is co-generating units suited for different variants of biomass fuel within district heating plants. The choice to customers would, thus, have to be opened one step further (Figure 4). Some of these choices already exist just as all choices will never be possible everywhere due to the extension of the pipe lines.

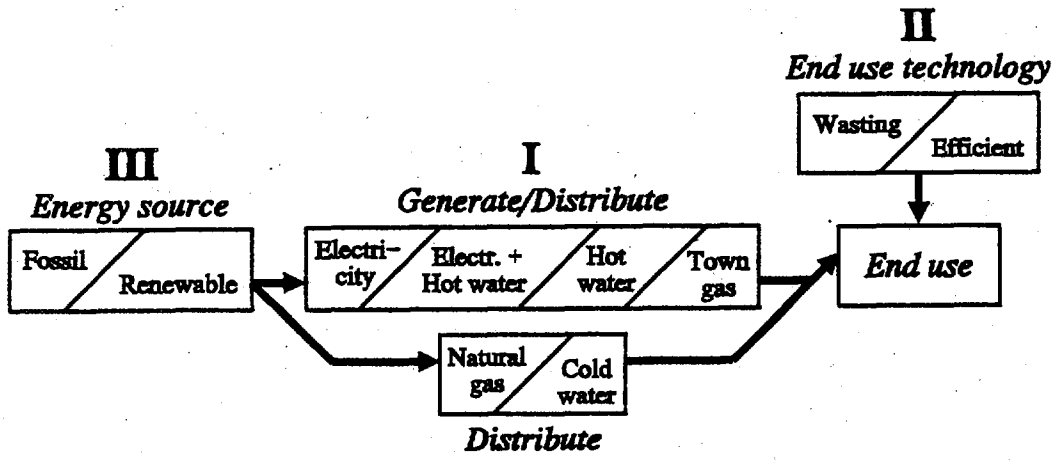

Figure 4. Choices appearing when the remaining box from Figure 2 is opened to customers.

None of the suggestions - state interference for efficiency and special deals for renewables - are exempt from disadvantages. There are at least three angles to consider. First, equity, i.e. special deals for some versus public funding from all. Why should only some pay the burden for caring about the future now in spite of everybody taking part of the advantages? Second, personal involvement in special deals. Freedom of choice has a pleasant ring, but choosing demands awareness that takes both time and effort to obtain. A task that has so far been handled by utilities. Third, credibility for utilities as well as manufacturers. When preferences (efficient versus wasting and renewable versus fossil) are obvious from the start, where is the pressure on costs? Increased costs could be due to someone making profits on an environmental label instead of really spending the money on investments.

5.3 Prevailing Tendency

What is the prospect for these suggestions given prevailing tendencies within the energy business? The most important change during the period studied has been the planned introduction of competition in the electricity market. The announcement did not only influence the ideology within electricity but also district heating and town gas. Although plans are for the time being postponed (Governmental Proposal 1994/95), the energy business continues to prepare itself for the change. Its vision of markets corresponds to the one in neoclassical economics, but this vision made it undertake preparatory actions preventing the same idea from coming alive.

Neoclassical economists assume that a market consists of independent companies that compete with one another on the price signal. Companies are, thus, encouraged to continually revise their production costs, which is to the advantage of customers who obtain lower unit prices. Homogenous products are required for the mechanism to function. This theoretical construction is an ideal that does not correspond to markets in practice. Hägg *et al.* (1982) assume, on the contrary, heterogenous products. Production processes and products are often complicated and need to be tailored to fit special demands. Companies seek alliances with their suppliers and customers in order to learn more in detail about their needs. Efforts are made to solve problems and the heterogeneity obtained gives in return competitive strength.

Electricity is a homogenous product, which could make it into an ideal commodity for a deregulated market. The energy business tries, however, to evade competition through making it special, i.e. heterogenous. The development suggested above for renewable sources is, therefore, in accordance with the prevailing tendency. Its success depends on the demand. One signal in that direction is that the environmentalists recaptured in the election in 1994 the position they lost in the election in 1991. Continuous favourable economic conditions are another important ingredient especially as utilities have already passed the threshold to invest in biomass. In other words, the state's attention is needed for the renewable case just as in the efficiency case.

Concerning efficiency, the Swedish National Board for Industrial and Technical Development (NUTEK) has since 1988 a small group dealing with a procurement program for an energy-efficient end use equipment. It is not concerned with the development of new products, but the accelerated introduction of existing technology in the market. The group focuses on the links between manufacturers and retailers as well as retailers and end users. They are less oriented towards new products and purchasers who are not users themselves. As purchasers do not always coincide with users, a few more targets could be added to the group's approach. Concerning new products, nobody carries the explicit responsibility for giving such incentives.

6. CONCLUSION

Utilities appear to be better placed to develop energy sources than the end use due to their different possibilities to supervise the outcome of efforts undertaken. As I limited myself to inherent implications of the two strategies, and disregarded the influence of internal circumstances within the specific utility studied, my conclusion seems to be valid also for other utilities. Nor do the inclusion of external conditions change my conclusion. If a strategy disagrees with the internal situation, an external pressure only runs the risk of resulting in a symbolic gesture without much substance (Meyer *et al.* 1991). On the other hand, if the strategy agrees but conditions turn unfavourable a development is unlikely. Utilities' efforts in energy conservation have, nonetheless, not been wasted. The marketing knowledge that they thereby achieved could perhaps be transferred to energy sources for an accelerated permeation. If utilities let their customers choose fuel in special contracts, their sales and the financing of investments would be better secured. For the efficiency case, state initiatives may be requested for a successful realization. Its task would be twofold. First, stimulate the development of energy-efficient equipment through its funding of research and development. Second, stimulate the penetration of the energy-efficient technology on the market in its capacity as a big purchaser.

7. ENDNOTES

1. I use 1 ECU = 9.2 SEK throughout the paper despite the fact that the sums given adhere to different years.

2. Stockholm Energi has four district heating networks: Hässelby, Värtan, Hammarby, and Högdalen.

3. Each of these two later converted boilers, thus, had a cost slightly over one-quarter of the first boiler.

4. A simple calculation assuming 5 boiler years (1+1+3) in the first plan against 7 boiler years (1+3+3) in the second plan, a 50 percent share of pellets against 40 percent of olive stones in each of the boilers involved, and the double price for pellets compared with olive stones. The conversion of the boilers at the district heating plant is excluded, but investments in the fuel plant is included in the pellet price.

5. The relation between input and output is, thus, the same for the expansion as the initial investment, i.e. the cost per pellet will remain unaltered.

6. In Swedish, Ekonomisk Förening för Oljeanskaffning (EFO).

8. REFERENCES

Governmental Proposal 1975:30 *om energihushållning m.m.* (in Swedish).

Governmental Proposal 1986/87:159 *om vissa utgångspunkter för energisystemets omställning*, NU 1987/88:7, rskr. 56 (in Swedish).

Governmental Proposal 1990/91:88 *om energipolitiken* (in Swedish).

Governmental Proposal 1991/92:133 *om en elmarknad med konkurrens* (in Swedish).

Governmental Proposal 1993/94:162 *Handel med el i konkurrens* (in Swedish).

Governmental Proposal 1994/95:84 *Vissa ändringar i ellagen, m.m.* (in Swedish).

Hägg, I., J. Johansson. 1992. eds., *Företag i nätverk. Ny syn på konkurrenskraft.* Studieförbundet Näringsliv och Samhälle (SNS), Stockholm (in Swedish).

Jansson, D. 1992. *Spelet kring investeringskalkyler. Om den strategiska användningen av det för-givet-tagna.* Allmänna Förlaget, Stockholm (in Swedish).

Meyer, J.W., B. Rowan. 1991. "Institutionalized organizations: Formal structure as myth and ceremony" in W.W. Powell, P.J. DiMaggio, eds., *The New Institutionalism in Organizational Analysis.* University of Chicago Press, Chicago.

Olerup, B. 1994a. "Deciding on biomass in Hässelby", *Energy Policy*, Vol. 22, No. 5, pp. 415-426.

Olerup, B. 1994b. "Efficient electricity in Stockholm", *Energy Sources*, Vol. 16, No. 2, pp. 209-227.

Olerup, B. 1994c. "The Stockholm lighting programme", *Utilities Policy*, Vol. 4, No. 4, pp. 273-284.

Three party agreement. 1991. Social democrats, Liberals, and Centre Party (in Swedish, *Partiöverenskommelse om energipolitiken*).

World Commission on Environment and Development. 1987. *Our Common Future.* Oxford University Press, Oxford.