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Swedish Energy Realities

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There is a general belief throughout much of the world that Sweden is in the process of dismantling its nuclear sector. The last Swedish reactor is supposed to be turned off in the year 2010. No political party has yet officially insisted that nuclear energy will be required after 2010, but there are excellent economic reasons why these installations may not — and probably even will not — be closed down.

In this light, the purpose of this note is to provide a brief introduction to what might be called 'the Swedish energy dilemma,' concentrating on the relationship between energy policy and certain key social and economic considerations. Some of the opinions presented in this piece have been alluded to in my earlier work; my intention here is to correct certain erroneous beliefs that many observers entertain about the Swedish nuclear scene.

One of the difficulties in analyzing the Swedish dilemma is that, with the Swedish economy in full retreat, changes that are occurring in the attitudes of many people toward nuclear energy may not prove to be durable. Until a year or so ago it was widely

believed — not only in Sweden, but also in the rest of the world — that two of Sweden's 12 reactors would be shut down by 1995-96; and it was a certainty that the remainder would be abandoned by 2010. But one of the latest public opinion surveys has claimed that 58% of Swedes desire nuclear power after 2010, while 65% feel that stopping the first two reactors should be delayed if economic conditions indicate that Swedish industry must continue to have inexpensive power. One does not have to be a weatherman to comprehend which way the economic winds are blowing in Sweden: as a result of such things as large budget deficits, increasing immigration, and declining industrial production, it is almost unthinkable that Sweden will become a non-nuclear country (except in the case of a serious accident in the Swedish nuclear sector, or perhaps a serious accident in a neighbouring country).

Lenin once remarked that socialism should be defined as communism plus electricity. The implicit assumption in Sweden after the Social Democratic Party assumed power was that something called the 'welfare state' was social democracy plus electricity. The way this was supposed to work is quite simple: a high electricity intensity, combined with the technological skill created by a modern educational system, would lead to high industrial productivity, which in turn would generate a steady increase in both physical wealth and social security. A highly relevant question at the present time is whether a hundred years of social democratic aspirations can be kept afloat if some of the most modern electricity generating facilities in the world are discarded for what many students of the Swedish economy believe to be short term political considerations. Here it is also useful to know that the Swedish price of electricity to industrial users is the lowest in Europe. This is one of the reasons why, until recently, the Swedish industrial sector was described as a "powerhouse" by such publications as the *Economist* of London and *Business Week*.

Nuclear reactors to be replaced with natural gas

Closely tied to the issue of a nuclear withdrawal, is the identity of the energy medium that will replace nuclear power. At the present time it apparently has been decided that Sweden is to join the rest of Europe in using as much natural gas as possible. Despite the not too commendable efforts of a number of experts, from both energy firms involved in the North Sea and the academic world, to convince potential customers that the purchase of high priced Norwegian gas makes economic sense, the end of the Cold War could mean that Norwegian gas is considerably less attractive than supplies originating in the former Soviet Union, and perhaps the Middle East. Additional coal will also be used, but before the exact amount is specified, more information will have to obtained about the ability of new plants to burn coal in an environmentally acceptable manner.

With regard to safety, either the nuclear installations scheduled for premature scrapping are safe, or they are not. If not, just about everyone agrees that they should be levelled immediately. But if they are safe, then some very serious people want to know what is the point of deliberately throwing away billions of dollars that, in the not too distant future, might be desperately needed to keep such things as the sagging Swedish health system from falling apart. The simple truth is that all the nuclear designs originating in the western industrial world are safe. On the other hand, it is definitely possible that one of the sloppily constructed and operated nuclear plants in some other part of the world might blow up tomorrow. As early as 1979 the Swedish nuclear safety authorities warned politicians that Soviet reactor construction and operational procedures left a great deal to be desired, and they were not optimistic that the situation would improve in the near future. Somewhat later the reactor at Ignalina, which is less than half the distance of Chernobyl from Sweden, was cited as being far below Swedish safety standards.

In these circumstances it might be suggested that, instead of being dismantled, the Swedish nuclear sector should focus on nuclear safety, and the transfer of state-of-the-art technology to those countries which have unfortunately gotten into the habit of operating dangerous nuclear facilities. (Something like this has been officially proposed for utilities in Eastern Europe using brown coal). Furthermore, if necessary, this technology could be transferred free of charge, since it probably makes more sense to give this sort of aid to Eastern Europe, than to provide Third World countries with cash that, to a considerable extent, is squandered. In fact, for a country like Sweden, which is losing many industries to other countries, such things as nuclear safety, pollution suppression, and energy conservation could become valuable industrial and export activities.

Developments on the European Energy Scene

Attitudes towards coal

More than at any time in the past, Sweden is being influenced by attitudes and activities in Western Europe. Coal was well on its way to claiming a substantial portion of the Swedish energy market when continental and Swedish environmentalists began advancing claims that the burning of coal is totally unacceptable from an environmental point of view. Not only do stack emissions from existing coal plants send millions of tons of carbon into the atmosphere every year, as well as a surfeit of sulphur dioxide and nitrogen oxides, but there also seems to be some evidence that background radiation from coal-fired power stations is palpably higher than from nuclear facilities.

Even so, in Holland the construction of a coal gasification combined-cycle plant is being included in the new electricity

plan, and apparently with the blessing of many environmentalists. The claim there is that coal gasification, together with combined-cycle electricity generation, is an environmentally and economically satisfactory option, although there is a fringe of the Dutch environmental movement which insists that the burning of coal in any form should be avoided. My own position in this imbroglio is that, while innovative technologies capable of neutralizing the toxic sulphur and nitrogen compounds that make coal objectionable are now available, the cost of 'safe' coal is still fairly high. Some potential users of coal are prepared to do anything possible to avoid paying this cost (including the misrepresentation of the environmental dangers of coal). Their behaviour, in some ways, is reminiscent of that of energy company lobbyists who have spent so much time and effort trying to convince potential customers and governments that it makes sense to buy high priced Norwegian gas, that some of them have even started believing it themselves.

At present, natural gas is moving into position to become the energy medium of choice among European environmentalists. It is useful to consider the economic background that seems to justify their selection. Assuming that the Russian economy does not collapse, by 1996 six new pipelines from the Yaml Peninsula in Northern Russia (each of which will be 1420 millimetres in diameter and will operate at 75 atmospheres) should be nearing the western borders of the former Soviet Union (FSU). There is likely to be substantial excess capacity in these pipelines, and given the size of the reserves at the input end, it could turn out that a very considerable fraction of the additional gas reserves that Western Europe will require in the next decade could be transported through them.

The role of Iranian natural gas

By the same token, the energy event of the last decade of the century may soon be underway. This is the entry of large quantities of Iranian gas into the European energy economy. There are a number of delivery options here, but the most economical may turn out to be pipelines from Iran, through the FSU, and on to Eastern and Western Europe. Of course, another widely discussed alternative is the consumption by the FSU of much more Iranian gas, with the diversion of more of their own supplies to the West.

Equally important as the growing availability of natural gas reserves is the near 'revolution' taking place in gas burning equipment; just now attention in Europe is being directed toward large, or very large, combined-cycle gas burning plants. An often-cited example is the gigantic Futtsu plant of the Tokyo Electric Power Company (Tepco), which is divided into two 1000 MW sections, each with seven gas turbines. The capacity of each sub-unit is 143 MW, and thus in theory at least, the entire installation can carry loads from 143 MW up to 2000 MW, building up

in 143 MW increments. Another important Japanese installation is the Shinohita plant of Kyushu Electric, where a huge new combined cycle installation is to add 1560 MW to Japan's electricity supply. Assuming that these installations function satisfactorily, it is only a matter of time before many similar installations appear in Europe.

Just as Swedish voters rejected a nuclear future a decade ago, Italian voters have also made it clear that they are in no hurry to give the go-ahead to nuclear energy, despite some estimates by ENEL (Italy's state electricity corporation) that nuclear-based electricity is much less expensive than any practical alternative. It seems that many Italians have become convinced, and correctly, that another Chernobyl or Three Mile Island is possible at any time, and that there is no such thing as operator training and operating procedures that can prevent such shortcomings as complacency on the part of management, operator error, and corruption in the acquisition and installation of building and other materials. They also seem to understand that in some nuclear power stations, equipment is being used that should have been demolished as soon as it left the factory where it was produced.

What they are now in the process of learning, however, is that there may be such a thing as an 'inherently safe' reactor, where the human component of the operating cycle can be circumvented in times of crisis: human operators would control the reactor only while it was running within safe limits; in the event of a deviation from these limits, the reactor would automatically be shut down. (The Swedish PIUS design, with a core that is always under water, is an example of this kind of equipment.) One problem, however, is that present designs of 'safe' reactors tend to involve equipment that is smaller on average than conventional equipment; assuming that there are scale economies to nuclear power production, the cost of electricity from these inherently safe reactors could be higher.

Waiting for inherently safe reactors

For an economist, it is probably more difficult to design a correct energy strategy than to predict the price of oil in the near future, but, given present trends, it appears that Europe now has the possibility to freeze its nuclear buildup until more work has been done on safe reactor designs. This is so because, in the short run, increased electricity requirements can be met by raising the proportion of natural gas in the electricity generating system. In the very long run, however, nuclear energy is going to be more important than ever; among other things, electricity may be needed to transform biological resources into such things as motor fuels. In fact, the claim by some observers that the next energy crisis will be an electricity crisis should not be discounted.

Some Unpleasant Details and a Conclusion

The Swedish energy scene is filled with surprises, some of which verge on the unusual. In 1978, all the major political parties in Sweden agreed that the nuclear controversy was getting in the way of more important business, and should be removed as a political issue by holding a national referendum. The electorate was asked to choose between a more-or-less immediate closing of as many nuclear plants as possible, or a gradual phase-out that was to be complete by 2010. The electorate chose the latter option.

Mistaken energy policies threaten a broad range of other societal goals

In my view, through the medium of this referendum, the Swedish people indicated a willingness to accept a program that is completely inconsistent with their 'revealed' preferences. The great majority of Swedes want full employment, pensions, high-quality health care and education, a great deal of leisure that includes foreign travel, public order, and efficient defence. They have also shown themselves willing to subsidize a high level of immigration, and to spend almost 1% of the gross national product on what they think of as aid to developing countries. All of these goals — laudable and otherwise — are in the danger zone if the wrong kind of decision is taken about Sweden's energy supply. As bad luck would have it, this kind of decision is still possible, because the present deteriorating economic climate in Sweden is not conducive to clear thinking. For instance, it is widely recognized in Sweden that raising the energy efficiency of homes and other structures can yield sizeable economic gains, but high expenditures associated with various economic and social policies of the Swedish government have greatly reduced the scope for investment in energy conservation (as well as in health and education).

Sweden is also a country in which there is too much 'internationalism,' both in politics and in the thinking and background of various energy celebrities. One result of this is that the role of energy in the Swedish productivity picture is either unknown or poorly taught at all levels of the Swedish education system. What has to be understood is that in Sweden, even more than in the United States, increases in productivity (measured by output per head) have tended to feature the substitution of energy and machines for labour.[1] It is a lack of familiarity with the details of this phenomenon that has led many politicians and energy economists in Sweden to believe, mistakenly, that output can be raised indefinitely while the energy intensity of produc-

1/ While energy intensity does not seem to have steadily risen with respect to output in all countries, it does usually rise with respect to the use of capital and labour.

tion falls. But as Schurr (1984) has demonstrated in a brilliant article, the situation in the United States is such that the total energy use in what he terms the "business" sector has more than doubled over the period 1920-1973, and in relation to capital increased by 50%. The (slight) fall in the energy intensity of output was due to technical change (largely activated by energy intensive outputs) increasing output by so much that, percentage-wise, output increased by more than energy consumption. Schurr has also hypothesized that electrification has meant a flexibility in industrial operations that would not be possible with any other form of energy, and this was the cardinal reason for productivity growth. Equally as important in the future, electricity will be essential for the optimal employment of computers and robotics — this time working with the computer and computer chip, rather than the electric motor.[2]

I want to conclude with an important observation: the Swedish welfare system, which is one of the greatest social innovations of all time, cannot function without an enormous amount of electricity. There is admittedly in Sweden a mature comprehension that growth does have its limits, and that eventually increases in quality must replace increases in quantity as a prime goal of economic life. What is not understood, however, is that this may require more energy, not less, and that to keep Swedish industry — which is the foundation of Swedish welfare — from shifting the bulk of their operations southward, Swedish industrialists may require some ironclad guarantees about the future prices of energy. Whether they get these guarantees or not, and whether they will be sufficient, remains to be seen, but one thing is certain. None of us will be able to ignore the relationship that the Nobel Prize winning chemist, Frederick Soddy (1912), called the most important in all economics: "The dependence of human social and economic systems on energy consumption."

References

Schurr, S.H. (1984) 'Energy Use, Technological Change, and Productive Efficiency: An Economic Historical Interpretation,' *Annual Review of Energy*.

Soddy, F. (1912) *Matter and Energy* (London: Norgate Publishing Limited).

2/ An example that fits nicely into this discussion relates to the attempt to offset that part of the 'greenhouse effect' caused by the discharge of freon gases, in particular from the use of refrigerating equipment. Several years ago scientists working for the Swedish firm Electrolux claimed that they already had a solution to this problem, but that its realization will require huge amounts of electricity.