DEPARTMENT OF NATIONAL DEFENCE

CANADA

OPERATIONAL RESEARCH AND ANALYSIS ESTABLISHMENT

DIRECTORATE OF STRATEGIC ANALYSIS

ORAE PROJECT REPORT NO. PR. 207

THE IMPACT OF ENERGY ON STRATEGY: MAINTAINING THE NUCLEAR OPTION? SOME STRATEGIC CONSIDERATIONS

by

Dr. Erik Solem

OTTAWA, CANADA JANUARY, 1983

THIS DOCUMENT IS ISSUED UNDER

ORAE PROJECT 96132

FORECASTS OF REGIONAL DEVELOPMENTS AND STRATEGIC

ISSUES OF CANADIAN NATIONAL SECURITY INTEREST

Approved by: _____, Director

for Chief, OPERATIONAL RESEARCH AND ANALYSIS ESTABLISHMENT

ABSTRACT

Nuclear power is a necessary, probably irreplacable source for the future energy supply of the world. Neither it nor the issue of non-proliferation would be well served if the nuclear option were to be suppressed by major developed countries, such as Canada.

RÉSUMÉ

L'énergie nucléaire est une source d'énergie nécessaire et probablement irremplaçable du monde de demain. Si des pays très industrialisés, comme le Canada, venaient à supprimer l'option nucléaire, cette cause tout comme celle de la non-prolifération n'en seraient pas plus avancées.

TABLE OF CONTENTS

LIST OF TABLES

PAGE

LIST OF FIGURES

PREFACE

The controversy over nuclear power - which has been going on for some time in the Western world - shows no sign of dying. If anything, indications are that by now the anti-nuclear lobby has achieved an influence far in excess of its real representative base. Some of the questions and concerns raised by this debate are, as the present paper tries to show, important and in need of resolution. Others are perhaps more spurious, for reasons which will be shown. Most important, perhaps, some concerns have been largely lacking from the debate, and the most conspicuously lacking question is that of the link between the nuclear option and strategy. To what extent does security and freedom of action depend on the maintenance and proper utilization of the nuclear option? It is to some of these concerns that this report addresses itself.

Others are aware of these concerns. In his famous article on "Nuclear Energy and the Freedom of the West" in the Bulletin of Atomic Scientists, June 1978, Andrei Sakharov turned to the lack of accurate information and the political shortsightedness of anti-nuclear activists. He correctly concluded that the whole problem of nuclear energy production should be considered from more than just the economic or technical points of view. Policy-makers always assume that one of the many factors in determining the political independence of a country, its military and diplomatic strength and its international influence is the level of economic development of a country and its economic independence. Sakharov found this assumption to be doubly valid in the case of two world systems opposing each other. The level of a country's economy is determined by its energy technology; ie. the utilization of

oil, gas and coal at present; of uranium and thorium in the near future; and perhaps deuterium and lithium in the more distant future, at a time when the complex technical problems of controlled thermonuclear synthesis have been solved.

The penultimate argument of his article is particularly relevant to the West:

> "Therefore I assert that the development of nuclear technology is one of the necessary conditions for the preservation of the economic and political independence of every country - of those that have already reached a high development stage as well as those that are just developing. For the countries of Western Europe and Japan, the importance of nuclear technology is particularly great".

INTRODUCTION

1. The world's stability, i.e. the absence of war, and hence international security is related to stability in both the developing and developed countries. For a variety of reasons Canada has a vested interest in maintaining such a stability, and stands to benefit from it. As we shall see, Canada is also capable of playing a special role in this respect. One of the major problem areas and a source of potentially very serious conflict lies in the field of energy resources: their availability, development and distribution. A properly speaking 'global' energy strategy is still nowhere in sight, although sorely needed, but it must be based - and presupposes - effective and workable national energy policies, as well as the development and utilization of appropriate long-term planning in order to help avoid some of the 'inevitabilities' which during recent years have seemed so evident. Elsewhere the argument has been made about the need for doing this in some greater detail, and ways have been proposed in which such a strategy could possibly be arrived at.* In this present paper we would like to focus on the nuclear option and discuss it more fully in the general context of world energy future(s). The paper aims at demonstrating how nuclear energy must, of necessity be included in the picture held of the future politico-economic and security system, if this system is to resemble the one which is known. As Andrei Sakharov, among others, have pointed out, nuclear energy and national security are closely intertwined**. It will also be shown that nuclear power is a necessary-probably irreplacable-

---

* See Erik Solem; "Energy Resources and Global Strategic Planning" in IMPACT of Science on Society (UNESCO, Paris), Vol. 26, Nos. 1/2, January-April, 1976.

** See Sakharov, A. "Nuclear Energy and the Freedom of the West", in Bulletin of the Atomic Scientist, Vol. 34, No. 6, 1978.

source for the future energy supply of the world. Of course several political, economic and social consequences flow from this, and these will be discussed further.

2. It is probably no longer necessary to acquaint the average reader with the existence of the energy problem, sometimes misleadingly referred to as the energy crisis. However, two phenomena should perhaps to stressed. First, the problem of the earth's energy reserves, and for how long they might meet demand, has been present for many years and has been raised sporadically throughout history. As for the oil shock, however, it is less than a decade old, and much has happened since 1973. For one thing, long-range planning and 'global terms' did not really mean anything very concrete in the energy world until then. Institutional as well as national planning for future activities, several of which were in fact strongly energy dependent, simply went on in the absence of such facts and foresights. The sharp oil price increase of 1973-74 should have forced the West to realize that what was prone to be considered as a 'crisis', i.e. clearly delineated in time, fixed in one or more ways and subject to perhaps some quick solution was, in fact, part of a much larger problem where energy, more specifically oil, was the more easily identifiable aspect. The fact of the matter is, as is now becoming clear somewhat late in the day, that in order to understand properly the importance of energy within the general context of the problems of growth and its limitations, it is necessary to bear in mind the close relationship between energy, other resources and their possible depletion, science and technology, and the formulation of public policy. The last includes, as has been argued*, of necessity an examination of certain public values and of complementary or competing norms.

---

* See Solem, Op. cit.

3. Secondly, the crisis - by which is meant the events in the early - 70's - pushed to the fore, albeit slowly at first, the recognition that the world is fairly tightly interconnected. This helps explaining why the construction of appropriate energy policies is such difficult task. It is, nevertheless, one which the West has to get on with, and the sooner the better.

4. The energy problem, and we shall shortly turn to the nuclear side of it, has two aspects one of them national and the other international. Policy and decision-making often continue to be carried out in rather separate compartments with only slight co-ordination between them. The trouble is that quite frequently these two dimensions may become so interconnected as to be nearly indistinguishable in terms of cause and effect. In an important sense most, or nearly all, national problems have an international dimension to them and most, but not all, international problems have domestic repercussions. And so it is that policies carried out on one level quite frequently have impacts on other levels. Commodity prices in general and oil prices in particular are very good examples of these types of modern interactions. Add to this the potential problem that Western countries (including Canada) may in the future be committing themselves to undertake national measures, from which they will all feel the effects, in order - at least in part - to counteract international trends, which they, presently at any rate, may not control. Regarding energy an example would be Canada's commitments to the sharing formula of the International Energy Agency, whereby she could feel the impact quite strongly. Certain problems, then, are at the same time both national and international and require policies and measures to be taken at both levels simultaneously. Here it is necessary at least to be able to feel that one has some control over what happens. Chances are that, unless some quite specific paths are followed, a

particular country (such as Canada) will not be able to take control fully in 'her own house'. This, in short, means that her future is not her own. The argument here, for preventing this type of scenario from developing, carries with it the need to keep ones arsenals ready. What is needed, it shall be argued, is to keep as many energy options open possible. Under any circumstances the really important ones, such as nuclear power must not be abondoned.

ENERGY AND SECURITY

5. There are three major observations to be made regarding the future energy supply for the next 2-3 decades:

First - No substitute for oil is likely to be available in sufficient quantity to displace it as the primary commercial fuel for most states, be they industrialized or LDCs.

Second - Apart from a small handful of industrial states - Norway, Canada and possibly the U.K. - the majority will continue to remain significantly dependent upon imported oil.*

Third - There is no prospect that in the near to middle future the Middle East could be displaced as the main supplier of oil. This will probably remain so even if new findings are made and brought to market, such as the Arctic, offshore China, and the northernmost parts of the North Sea. The situation will remain so even if the industrial world, especially the U.S. and the USSR, successfully start to exploit fully their

* See, Strategic Implications of Recent Oil and Gas Developments in the North Sea, ORAE Project Report No. PR, 208 by Dr. Erik Solem, Ottawa, December 1982.

domestic resources, hence bringing forth additional energy supply from a variety of sources.

6. Now, why is the industrial world - with only a few exceptions - locked into this situation, with little or no hope of change? It would seem that that the reason is the timing factor, i.e. the time it takes to bring on other energy sources on a required scale. Exploration for new conventional resources is still to some extent hindered by problems of capitalization, materials and manpower. Now, some of these obstacles could probably be removed. However, even if technology, capital and management skills were to become available to the extent required, which is doubtful, environmental and safety concern could continue to limit what can be done. Hence the lead time remains a major critical variable in any major energy development, and for energy - security considerations. *

7. Whereas the longer-range prospects for North America may be poor, for Western Europe and Japan they are worse. Even if the U.S. were to exploit her domestic resources on an unprecedented scale and to diversify her sources of imports away from the Middle East, Japan and Western Europe will most

---

* For further details, see The Impact of Energy on Strategy: A Consolidated Report, ORAE Report No R64, June 1977 by LCol. J.H. Storr, Dr. Erik Solem, and LCol. M.V. Cromie, as well as subsequent papers produced throughout this project. This author is grateful for research discussions on this and related topics with Mel Conant (U.S.) Tony Scanlan (U.K.) and John Gellner (Canada), all of which proved most helpful. Whereas their ideas and views are shared to a large extent, the author takes full responsibility for the present paper.

likely remain greatly dependent on oil imports in general and on Middle East oil in particular. Also, the picture is complicated by continued price cutting and over-production in some OPEC states. Warnings have been issued by the Gulf Cooperation Council (GCC) against "irresponsible behaviour" by some states. Seemingly, there is plenty of oil, however - as will be shown - this situation is abnormal and it is dictated by a temporary and quite misleading "glut" in the world oil picture*.

8. The OECD states continue their heavy dependence on Middle Eastern oil. Add to this the fact that the USSR and China will in the future become new claimants for oil, and that several LDCs - including OPEC - will probably continue to escalate their demand for oil. There is, therefore, a need to know that the supply will be adequate, forthcoming on a regular basis and at affordable prices. Concerning this last point, there is very little disagreement among energy experts.

9. The danger faced by the industrialized West is also obvious from the fact that in weight it consumes 50% more than it produces; one half of the raw materials consumed comes from Third World, mainly Africa and Asia; they are moved in some 3,000 ships which at any one time are at sea; and that any interference with the movement of these raw materials would seriously affect Western economies to the point of crippling them. For example, 30% reduction of raw material imports would increase unemployment in West Germany from the recent less

---

* See, Strategic Implications of the World Oil Glut, by Erik Solem, ORAE Project Report No. PR 209 January 1983.

than 3 million or some 10.2% of the labor force, to an unsupportable eight million or almost 30% of the labour force.*

10. The strategic importance of both the Middle East and the oil routes is - or should be - clearly understood by all. Take the Strait of Hormuz, for example. Prior to the Iran-Iraq war an average 16 million bbl/d passed through it (now 15 million bbl/b due to cut-back caused by the war and stepped up production by Saudi Arabia). This constitutes about 35% of the non-communist world's oil consumption; 40% of the world's total imports of oil; and almost 60% of the imports of Western Europe, Japan and the United States (26.5 million bbl/d). The former two regions would be in economic ruins within a few months in the event of the Strait of Hormuz being closed. Whereas the U.S. would survive such a blow (it gets only 15% of its oil from the Persian gulf), she would suffer nevertheless. Some other OECD countries dependence on oil import for their total energy needs are: Denmark 77%; Japan 73%; Italy 64%; West Germany 51% United States 22%; Great Britain and Canada less than 10%**.

---

* See presentation by Dr. Theo Sommer, editor-in-chief of DIE ZEIT, at the SACLANT symposium SEA LINK 80 (U.S. Naval Academy, Annapolis, 16-19 June 1980. Dr. Sommer showed the enormity of the danger which the industrialized West faces. We are grateful to John Gellner (Canada) for putting this particular context to our attention, during the Workshop on Energy Resources and Centre Periphery Relations: Canada and Europe, European Politics Group of the Canadian Political Science Association, Banff December 1980. See also Strategic Implications of Resource Policy, by Erik Solem, ORAE Project Report No. PR 167, August 1981.

** See Gellner, Op. cit.

11. The Middle East remains a chronically unstable region, with several states mistrustful of each other whilst simultaneously undergoing profound shocks to their cultures. For various deepseated, ancient historical and political reasons the prospects of stability are dim. Those who believe that the resolution of the Israeli issue could automatically bring stability to the region, both underestimate the historical obstacles of the problem as well as engage in wishful thinking.

12. The situation is also aggrevated by the fact that external powers have, for a variety of economic and political reasons, taken a very strong interest in the region. Often this has meant complications, since external involvement has led outside powers to side with one Arab state, then another; and vice versa. Other problems will rise from separate and at times conflicting pursuits of Western powers, among them U.S.; Germany, France as well as Japan. At present there seems to be no agreement among these states and other allies as to what strategy should be adopted in the face of those very serious problems.

13. Would oil obtained on a government-to-government basis be more secure by virtue of private company interests having been removed? This seems a dubious proposition. Only in very extra-ordinary circumstances, with an extremely high level of consensus and quite clear and present danger obvious to all concerned, could it work. It seems to us that it is much more likely that it would <u>not</u>. At any rate there are no examples of government-to-government deals having resulted in assured supply and lower prices on a long-term basis.

14. A central piece of this argument has been that the volume of oil exported by the producing nations will-within the time period considered - be insufficient to meet demand, and a

gap could open up, the reasons for which have already been discussed. Despite the present temporary glut of oil, a sort of bubble in the system, oil will tend to be conserved for its further greater value. It will also tend to be conserved since surplus revenues obtained from oil sales probably cannot be invested without an eventual loss in value due to inflation. It is not inconceivable that production could, and probably would, be cut so as to put pressure on importers for selected political purposes.* It is well known but at times forgotten that this has been attempted by several producing states, for example Iran, Iraq, Algeria, Libya and Nigeria, for a variety of reasons. Finally, another reason to suppress export would be the straightforward economic one of supporting price.

15. So far, it seems that importing countries have dreaded a confrontation with OAPEC** member countries. Therefore no co-ordinated policy exists to deal with this, increasingly important, contingency. Of course, long term results of the lack of such a policy or plan is pure folly. It remains absolutely clear that - in the absence of credible policy co-ordination and agreed upon principles to face this political contingency, each Western state will remain vulnerable in a situation of potential chronic shortage. Presently the situation is further confused by a (temporary?) drop in the price of oil. Also, it must be kept in mind that if there is a collapse of the price system, some very special and serious strategic problems could arise.

16. Oil, it should be clear by now, has been the major catalyst for recent energy developments, it has put into motion forces which only are dimly perceived. The West's reliance on

---

* Eg. U.S., Israel and/or South Africa.

** Organization of Arab Petroleum Exporting Countries.

oil in general and on Middle Eastern or other imported oil in particular ought to be, and by now perhaps it is becoming, a subject of special concern. It still relies on oil too much despite government policies to the contrary. Whereas the U.S. gets some 25% of its oil import from the Middle East, Canada gets 55% and the Japanese rely on the Middle East for 85% of their oil import. This means, of course, that Canada's flexibility is correspondingly limited, whereas the opposite applies to the U.S. When dealing with OPEC the West should, perhaps, be aware of the fact that she is - to a certain extent - dealing with 'nations without a need for money'! This, among other things, ought to be a sobering thought.

THE NUCLEAR OPTION

17. One cannot get 'off oil' completely nor should this be attempted. Oil is, still, in many ways the most appropriate, cleanest energy source for some very specific functions. But what the West must do is to diversify her energy portfolio and to try to get off imported sources. This translates into alternate sources, renewables and conservation, many of which have specific costs and pay-offs. Although they will not be reviewed here, it should be stated that fusion and solar power do constitute energy options, certainly in the long run, but that there are some very serious drawbacks and difficulties connected with them as medium-to-long term given present technology. Capital cost obviously constitutes a major obstacle as well, as it does with other non-traditional energy sources.

18. The International Energy Agency (IEA), to which Canada belongs and to whose 'sharing agreement' she subscribes, has expressed similar doubts and worries about the Middle East as those discussed above. Alternative sources of energy are still

clearly needed by the year 2000. The IEA is relatively optimistic that these alternatives can materialize, reducing oil imports into IEA countries from 24 million barrels per day to 17 mbd by the year 2000. This assumes a tripling of coal production and use, and a five-fold increase in nuclear power. By 2000, according to this argument, nuclear would comprise 15% of total energy requirements, as against 4% in 1980.* This is perhaps too optimistic. It seems that dwindling public confidence is the greatest threat to nuclear energy. Restoration of public acceptance would require steps to assure safety, choosing a system for disposing of wastes and an assessment of the economic consequences of not having nuclear power. The failure of meeting nuclear power goals is unlikely to be made up by any other energy source, and would almost certainly result in lower economic growth.

19. Now, the two central questions concerning nuclear energy in any form are; 1: Is nuclear energy really necessary? 2: Is it, or can it be made acceptable? By posing the questions in this form, and by demonstrating the affirmative of both, the central burden of what follows is made easier and the task may be achieved in an analytically satisfactorily manner. It is of course, theoretically at any rate possible to ignore the nuclear option, as it was done in Austria as opposed to, say Sweden and Switzerland.** In this case, the burden of the argument will fall on the opponent. The questions will then become: Which implications will follow from this i.e. the ruling out of nuclear energy and how can it be coped with, economically as well as politically?

---

* See Ulf Lantzke, "The Role of the Nuclear Energy in the Year 2000", in OECD Observer, No. 107. November 1980. 42-44.

** See, Strategic Implications of Resource Policy, by Erik Solem ORAE Project Report No. P.R. 167, August 1981.

20. The U.S. Institute for Energy Analysis may provide a useful illustration here. When considering the economic and environmental implications of a U.S. nuclear moratorium 1985-2010 it found that the U.S. could weather a limited moratorium with a loss of .5% in GNP. This moratorium would allow completion of all reactors under construction in 1985, but no new reactors would be built after that. Such a moratorium, it would seem, would put great pressure on coal and imported oil, each of which option carries particular problems. Furthermore, it has been estimated that between 18 - 27 billion tons of coal would be needed by 2010 to fuel those stations that would serve in place of the nuclear plants not being built. If a similar approach were to be undertaken by Canada, one would have to engage in this type of analysis which, as far as is known, is not being carried out.

21. Despite the extraordinary accomplishments of some 530 nuclear reactors operating today in 36 states, the first nuclear era seems to be drawing to a close in many countries, such as Austria, possibly Sweden, the U.S. and Canada, although in some countries nuclear energy continues to grow e.g. France, Japan and the USSR. The most plausible energy future will probably require nuclear energy. As to whether or not there will be a second nuclear era it would perhaps depend largely upon what Alvin Weinberg calls the public's dread of low levels of radiations, as well as the relatively remote possibility of a worst-case accident.* Such a probability could possibly be reduced by improved siting policies and by incremental technical improvments. An example offered would be the experience of air transport, which has showed that accidents tend to diminish as experience is gained. This, however, is

---

* See Alvin M. Weinberg: "The Future of Nuclear Energy", in Physics Today, 34:3, March 1981, 48-56.

far from the last word. By now it is, or should be quite clear that this particular area of public concern often generates more heat than light. It seems that the nuclear controversy can no longer be resolved by the industry simply giving out accurate scientific and technical data, after which a public verdict is to be expected. Too much is involved, on both sides, at this stage and the stakes are too high. Disquiet about nuclear energy is only a part of a more general and profound disquiet about the effects on society in general of all advancing technologies. Put more simply, the debate on nuclear energy and public opinion has been transferred from the technical and scientific arena into one of social and political activity. Nuclear energy it seems, now acts as a lightening rod for a variety of social dissent, and will probably continue to do so for some time. Part of the problem continues to be a lack of understanding by the average person. As Dr. Francis from the World Council of Churches put it during the Salzburg Conference on Nuclear Energy and Its Fuel Cycle: "Most people are not familiar with probability concepts, so even a one-in-a billion chance of catastrophe makes them uneasy".*

22. Not only does the public have a right to obtain technically proven correct information, but it must also be protected against the dissemination of myths, including some from the ecologists-non-nuclear proponents. In the present climate of doubt and worry regarding nuclear energy it is at least essential to try to keep one's head clear and the dialogue open.

---

* See, Salzburg 77 and Beyond: Nuclear Energy, Safeguards and Related Questions, by Erik Solem, ORAE Memorandum No. M. 92, January 1978.

23. The arguments against nuclear power are easy to put forward, and they are often done so forcefully. Safety and safeguards, including waste-disposal is a major argument. Secondly, there is the question of capital costs (against assumptions of lower requirements for additional power generation). Thirdly, there is the problem of delays in selection and approval of sites (which to our mind is related to points 1 and 2). Finally the questions of proliferation where it is assumed, quite wrongly as far as we see it, that nuclear power and nuclear weapons are somehow automatically connected. To dissect and destroy this particular myth would require additional time and space and is quite possibily the subject of a study by itself.

24. Now, over 50 nations have active civil nuclear programs underway: Iran being the only nation which has actively terminated its commitments. At present nuclear power supplies approximately six per cent of the world's electricity. However, as has been shown, this share could increase sharply to some 45% by the year 2000, assuming that present commitments are made, and assuming further a reasonable projection of additional undertakings amounting to 6 per cent annually in the 1990's.*

CONCLUSIONS

25. One could single out some countries for more rapid nuclear development, such as France, Japan, Korea and Germany. The French case consists, at least until recently, of a national program which could bring one reactor into operation every two months until 1985. Will M. Mitterand cut or slow down this process? If he does, presumably economic growth in France will be affected, possibly seriously. He may be prepared to go through with such a policy, although it remains to be seen.

---

* The author is indebted to Mel Conant on this point.

26. Recently there has been fairly extensive media coverage of a "prematurely" released government report on the state of Canadian nuclear industry. With or without massive aids, the nuclear industry is in trouble, according to some sources. If those reports are correct, virtually all firms in the industry may be out of business by the mid-to-late 1980s.* There are some possible 'options' such as stepped-up domestic programs with more Federal - aid, promoting export sales with more flexible marketing efforts which could ease Canada's severe safeguards against weapons proliferation etc. The latter probably makes sense from an economic as well as technological point of view. Can it be sold politically? It is possible that it could be done, provided the right kind of explanation is given. On a comparative basis the nuclear safeguards clauses surpass anything designed by the International Atomic Energy Agency and/or EURATOM in stringency and intrusiveness. Seen from another country's point of view, they may look very intrusive indeed. Does Canada in fact 'impinge' on their sovereignty in some of her claims? It is quite possible that she does. If so, should this be continued? If it is continued, one should not expect easy sales of nuclear technology and/or material.

27. As has been stated elsewhere, neither the world's future energy needs nor the issue of non-proliferation would be well served if the nuclear option were to be suppressed by major developed countries, such as Canada. The results of such a strategy would in all likelihood lead to the following quite disasterous results: first, the developed countries (still the motor of industrialization and global growth) would be subject to serious aggravation concerning energy resources and then

---

* See, for example "With or Without Aid, A-industry is in Trouble" in The Globe and Mail, Toronto, June 2, 1981.

utilization. Secondly, a very aggressive and potentially quite vicious competition for alternative energy resources would result, which could lead to renewed, increased pressure for nuclear expansion from within those countries whose participation is required for successful non-proliferation which- after all- is what one is trying to achieve. For that reason alone, if not for others as well, prudent international policies and strategies of co-operation are required in the future development of nuclear power. If such a strategy were followed, it could well be that the great export resource which Canada has in her uranium could in fact become one of her more valuable energy assets, to say nothing of a domestically useful commodity. To achieve this, there is quite a way to go. It will be both hard and, at times sluggish, with no immediate results to be easily seen.

28. Whereas Canada is in possession of advanced technology, in addition to her supplies of uranium, export markets for the former continue to be uncertain and difficult to penetrate for at least the next decade or so. Strong competition persists, as does excess capacity in domestic markets among competing states, which appear to be better organized, better funded and - in some cases- more experienced. However, her system has some comparative advantages, primarily in the performance record and possibility of autonomy and diversification in electricity production which is offered potential clients. For these reasons alone, as well as the longer term evolution of the global energy situation and the potential beneficial results for Canada arising out of her ability of solve part of the problem, the efforts may very well be forth it.

POSTSCRIPT

29. According to Gallup, fewer Canadians approve of nuclear energy today than at any time during the past six years. A survey, carried out in November 1982 posed the following question: "At present, very little of the total electricity used in Canada comes from nuclear power generation. What do you think should happen?" The replies as compared to previous surveys carried out by the Gallup Corporation, were as follows:

	Nov 1982	Oct 1981	May 1980	May 1979	Oct 1978	Sept 1976
They should increase nuclear generation	20%	21%	30%	23%	35%	41%
They should not develop anymore than at present	35	27	27	34	29	20
They should stop nuclear generation	31	23	27	29	15	14
Don't know	14	19	16	14	21	25

A second question asked was the following:

> "What would you do if a nuclear power station were to be built in your area - could you agree to its being built, would you not oppose it although you would feel anxious about it, or would you oppose it?"

The replies, and also compared to previous surveys, were as follows:

	1982	1981	1978	1977	1976
Agree to its being built	15%	19%	24%	24%	28%
Not oppose it, though would feel anxious	20	21	26	29	23
Would oppose it	57	49	39	34	35
Don't know	8	11	12	13	14

30. One could ask oneself whether or not these replies are seriously influenced by international nuclear disarmament demonstrations, fears of a nuclear holocaust, an assortment of media pressures and publicity or (as is likely) a combination of some or all of the above. The fact of the matter is that, unless George Gallup is spectacularly wrong - which is unlikely - Canadian support for nuclear power between 1976 and 1982, i.e. in six years, has been reduced by some 50 per cent, as only 20 per cent of those surveyed believe that Canada should increase her nuclear power generation. It does not take too much to imagine that should this trend in public opinion continue, the Canadian nuclear industry may be on its way towards being killed off.

To our mind, and for reasons which have been demonstrated, this would be a very regressive step indeed. For strategic, if for no other, reasons it would be a definite advantage to maintain the nuclear option, and to utilize it in the best way possible.

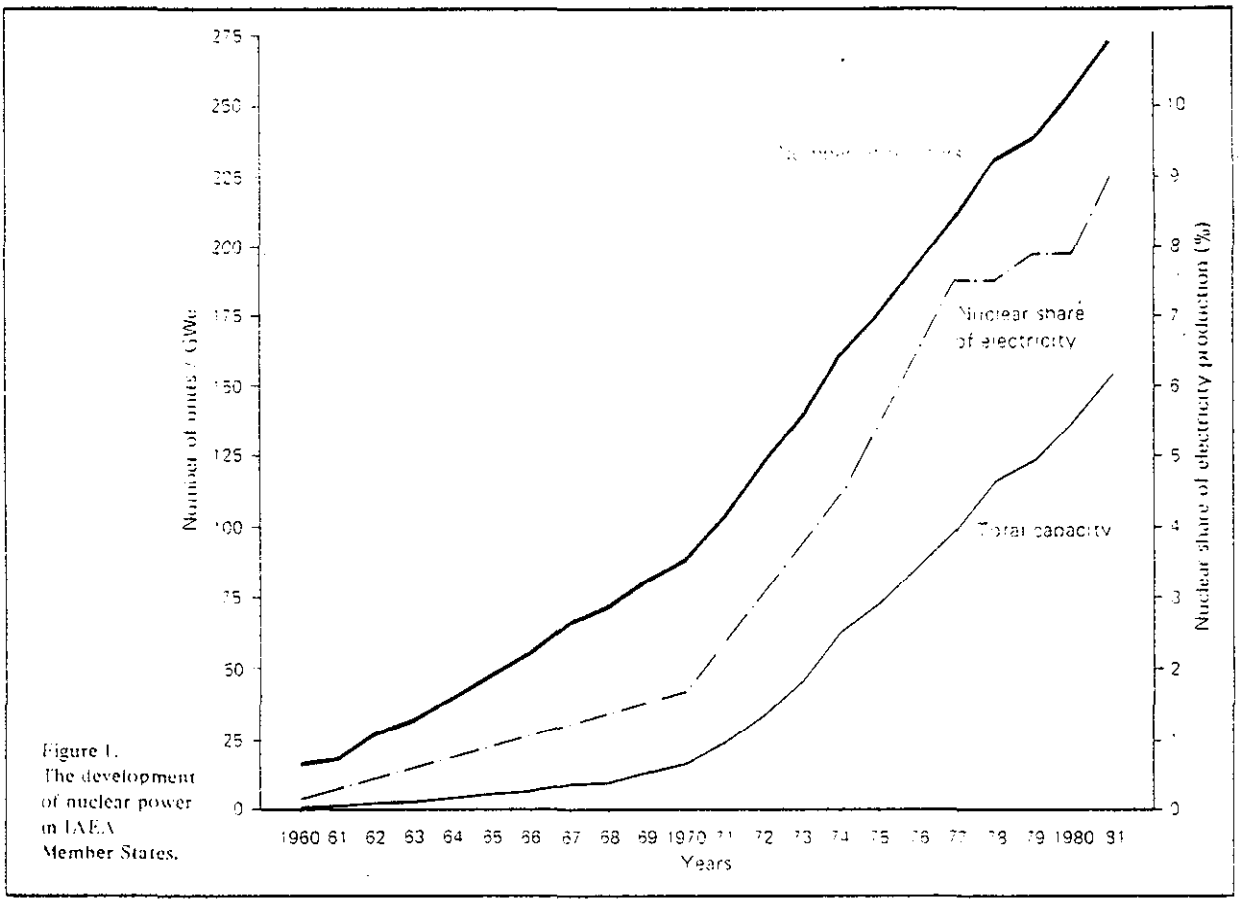


Figure 1.
The development of nuclear power in IAEA Member States.

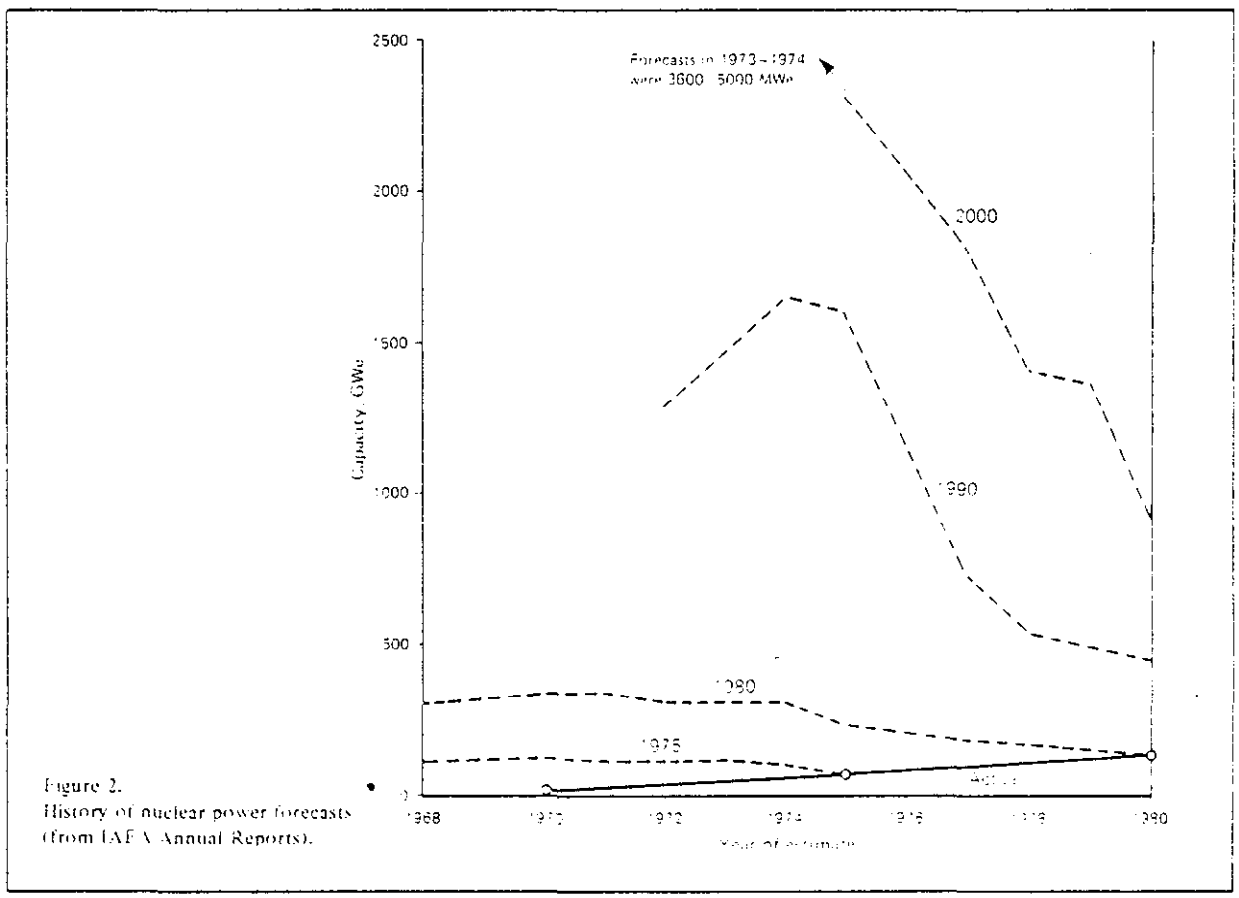


Figure 2.
History of nuclear power forecasts (from IAEA Annual Reports).

Source: International Atomic Energy Agency Bulletin, Supplement 1982.

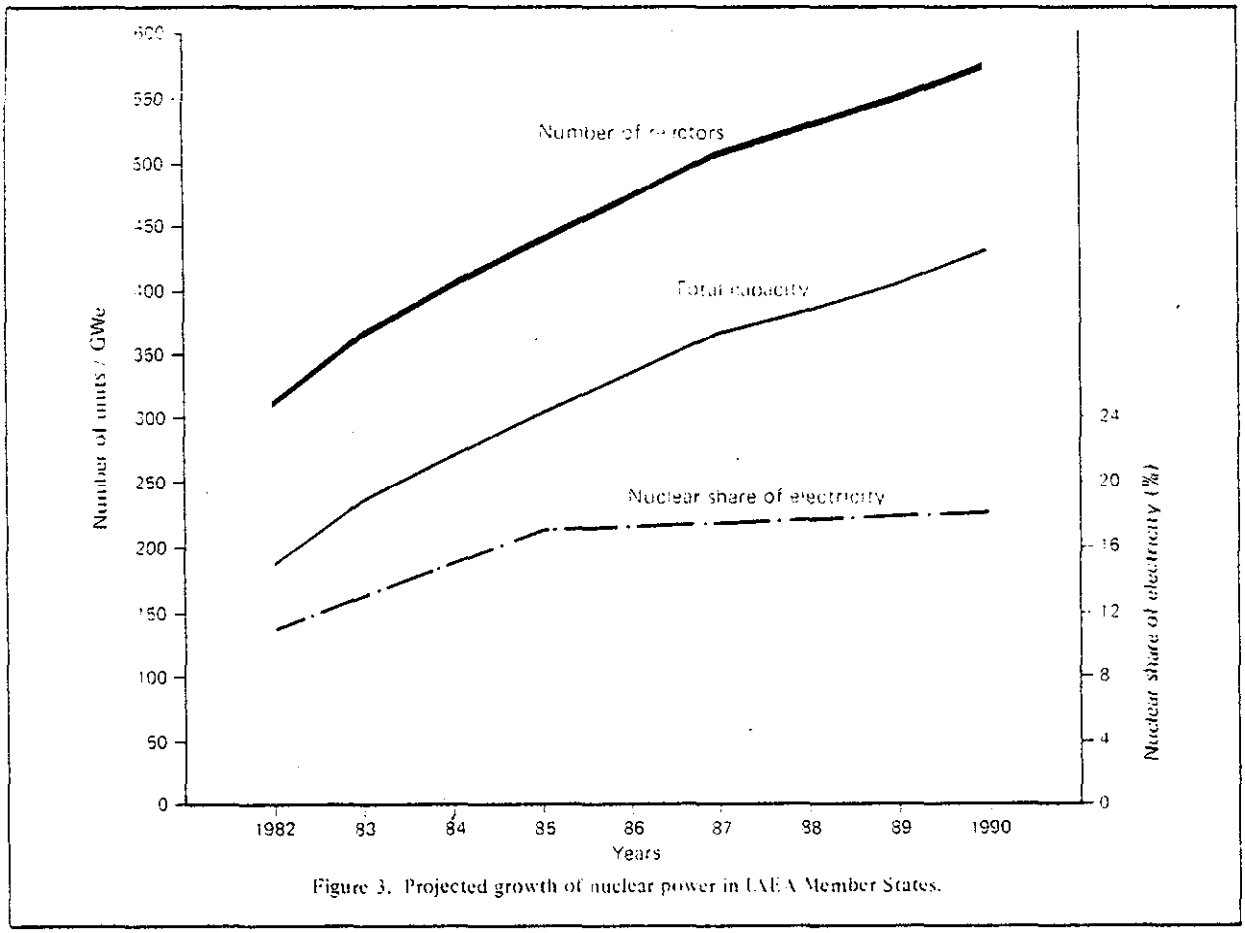


Figure 3. Projected growth of nuclear power in IAEA Member States.

Table 1: Estimates of total and nuclear electricity generation by main country groups (TWh)

Country group	1981			1990			2000		
	Total	Nuclear	%	Total	Nuclear	%	Total	Nuclear	%
Market economy industrialized countries	5662	667	12	8 600	2000	23	12 100	3600	30
CPE Europe	1955	104	5	3 600	485	13	5 700	1200	21
Developing countries outside CPE Europe	1134	22	2	2800	150	5	5800	700	10
World total	8751	793	9	15 000	2600	18	24 600	5600	23

Figures for 2000 are averages of high and low estimates

Source: International Atomic Energy Agency Bulletin, Supplement 1982.

TABLE 2
CANADA'S DOMESTIC NUCLEAR POWER PROGRAM

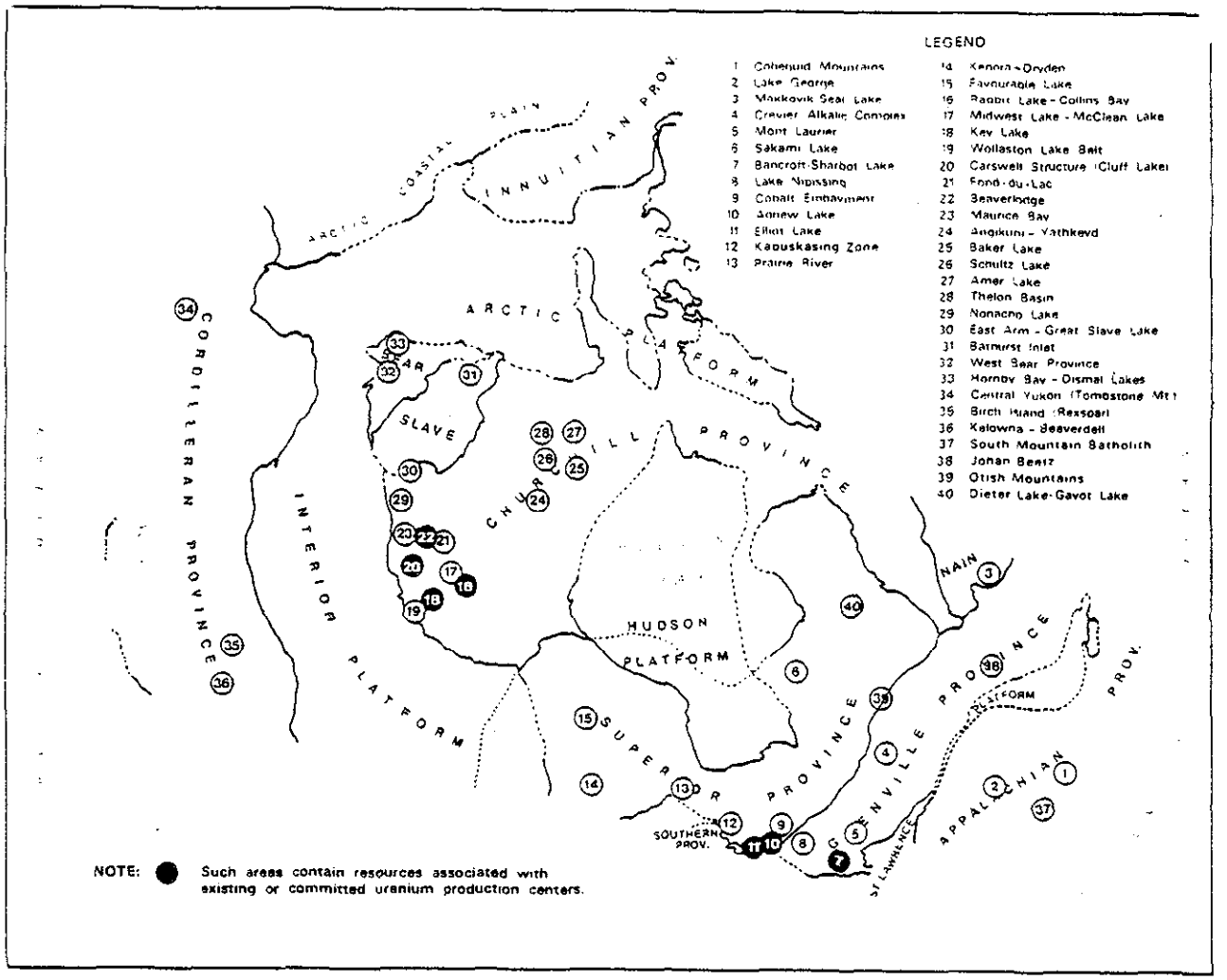
Reactor or Station	Capacity, MWe	Ordered	Operational
NPD	22	1955	1962
Douglas Point	200	1959	1966
Pickering A 1,2	4 x 515	1964	1971
3,4		1967	1972-73
Bruce A	4 x 746	1969	1977-79
Gentilly II	637	1973	1982
Point Lepreau	630	1974	1982
Pickering B	4 x 516	1974	1983-84
Bruce B	4 x 756	1975	1983-87
Darlington	4 x 881	1978	originally 1984-87
			now 1988-90

TABLE 3
SUMMARY OF EXPORT SALES

COUNTRY	DATE OF ORDER	DATE OF OPERATION	TYPE
India	1956	1960	NRX-type research reactor (CIRUS)
India	1963	1972	200 MWe power reactor (RAPP 1)
Pakistan	1964	1970	125 MWe power reactor (KANUPP)
India	1967	1981	200 MWe power reactor (RAPP 2)
Taiwan	1969	1971	NRX type research reactor
Argentina	1974		600 MWe power reactor (CORDOBA)
Korea	1976		629 MWe power reactor (WOLSUNG)
Romania	1979		629 MWe power reactor (CERNAVODA -1)
	1981		(CERNAVODA -2)

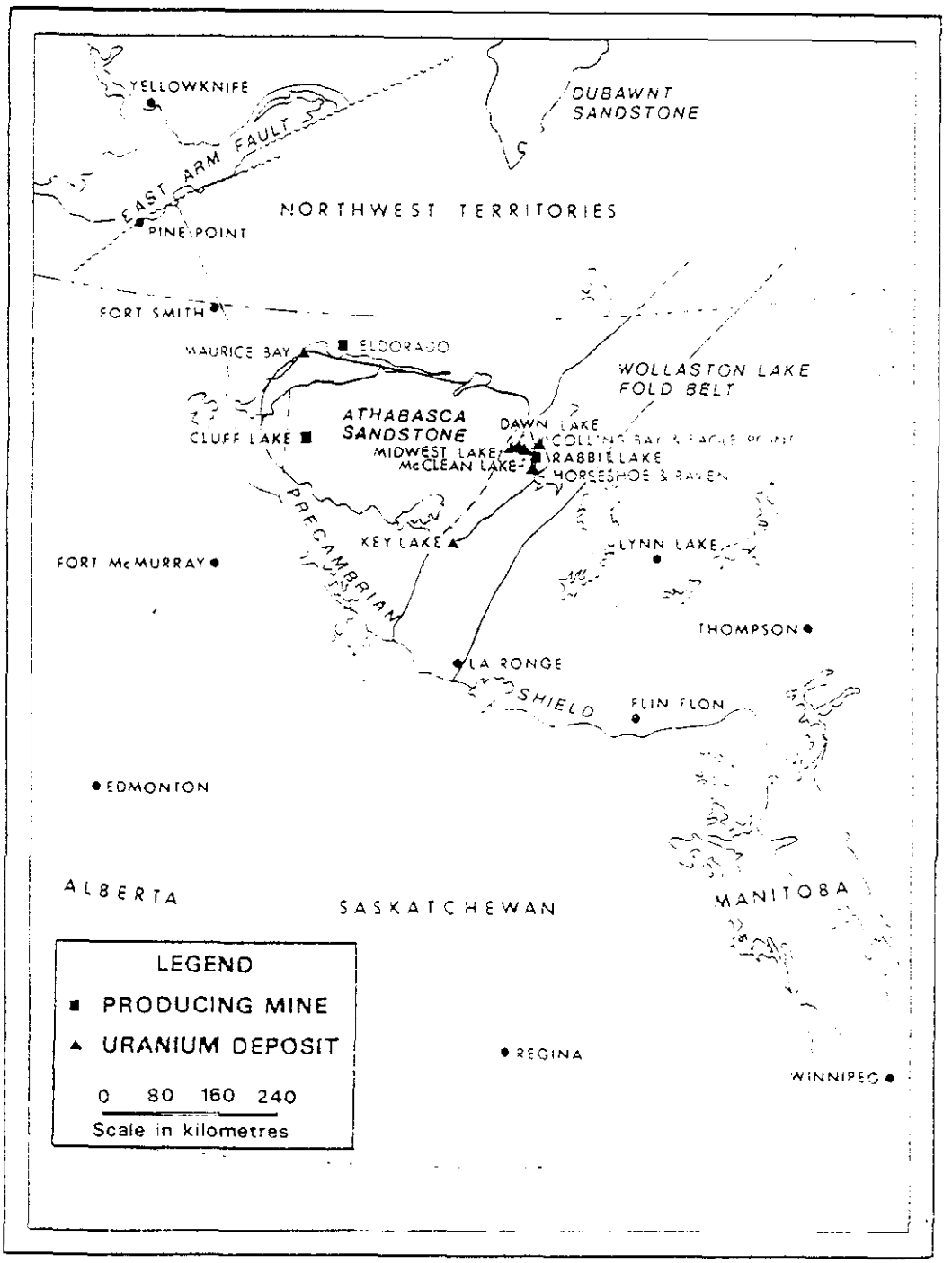
Source: Nuclear Industry Review, Problems and Prospects 1981-2000, Energy, Mines and Resources Canada, 1982.

Figure 4: Areas in Canada with uranium resources associated with identified deposits.



Source: Uranium in Canada 1980 Assessment of Supply and Requirements, EMR Report EP 81-3, September 1981.

Figure 5: Principal Uranium Deposits in Saskatchewan



Source: Uranium in Canada, Op. cit, Ibid.