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Economics and Financing of Future Power: Is There a Case for Nuclear?

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Introduction

The International Energy Agency's most recent *World Energy Outlook*, a projection of world energy demand and supply out to 2010, was released in the spring of 1993.[1] Given energy and environmental policies as we know them today, and under a set of assumptions on oil prices,[2] economic growth, resource availability and other factors, the *Outlook* points to a picture of:

- a nearly 50% increase in world energy demand;
- regions outside the western, industrialised world accounting for most energy demand growth, and by the end of the century, consuming the greatest share — more than half — of global energy; and

1/ Only the *Outlook's* implications for electricity are summarized here. For those interested in further details, see (IEA, 1993a).

2/ The *World Energy Outlook* does not forecast oil prices. It looks at two oil price scenarios, while focusing mostly on a scenario of imported oil prices rising to $30/bbl (1993 US$) by 2000, then staying flat out to 2010.

- an energy future increasingly dominated by fossil-fuel, with associated increase in energy-derived CO_2 emissions of 46%.

The *Outlook* sees a world strengthening its dependence on electricity; 42% of the increase in world final energy demand over the next 17 years will be for electricity. The projected growth rate for electricity in the OECD, while down from 3.7% since 1971, will be faster at 2.2% than that of any other form of final energy. Generating capacity under these conditions will have to grow by 1.8%/year on average in the OECD. Fossil-fuel based capacity, especially natural gas, is projected to take up most of this growth.

Within this time-frame, the rate of growth of nuclear power is expected to slow down, and actually decline after 2000 as retirement of old plant exceeds new plant commissioning. The share of world energy requirements provided by nuclear will be about 6% and its share of electricity generated just under 13%. Nuclear took nearly one-third of the growth in world electricity output between 1971 and 1990: it is projected to account for less than one-tenth of the growth out to 2010 (see Table 1). In the OECD region, where nuclear had the greatest share (45.3%) of electricity growth up to 1990, it is projected to have less than 10%, essentially reversing roles with natural gas, which made a very small contribution to growth in the past, but which is projected to capture 45% of growth in electricity fuels out to 2010.

Against this view of a global energy future, this paper examines the factors that will influence the economics of nuclear energy and the ability to finance it. In the next three sections the conditions that might make nuclear viable are reviewed. Because public perception may hinge on future nuclear performance in the former Soviet Union and in Eastern and Central Europe, the IEA's recent work with the World Bank and the European Bank for Reconstruction and Development (EBRD) on the power sector of that region is briefly discussed. Finally, brief reference is made to some of the principal issues that might bear on the role of nuclear power into the 21st century, in particular its relation to environmental policy and the role of natural gas in electricity production.

The Power Sector in a Changing World

Questions of financing in the power sector have to be set within the context of developments in its regulation, ownership and structure — in particular, how its relationship with government is changing as governments increasingly emphasize competition and efficiency within the energy sector generally. In most OECD countries (see IEA, 1993, pp.37-42), parts of Latin America, the Asia-Pacific and now in Eastern and Central Europe, the close relationship between power utilities and government is undergoing dramatic change. Privatization has been referred to as "one of

Table 1: Electricity Output by Fuel; Share of Growth 1971-2010 (%)

Fuel	1971	1990	Past Share of Growth (1971-1990)	2010	Projected Share of Growth (1990-2010)
			World		
Solids	40.3	39.3	38.4	39.4	39.6
Oil	20.8	11.7	4.3	6.3	0.9
Gas	13.4	13.3	13.3	21.8	33.2
Nuclear	2.1	17.0	29.2	12.8	7.2
Hydro	22.7	18.1	14.3	18.6	19.2
Others	0.6	0.6	0.5	1.0	1.7
	100.0	100.0	100.0	100.0	100.0
			OECD		
Solids	38.9	41.5	44.4	39.7	36.2
Oil	21.3	8.6	5.3	4.2	4.1
Gas	13.8	10.4	6.6	22.4	45.0
Nuclear	2.8	23.0	45.3	18.2	9.2
Hydro	23.0	16.0	8.3	14.4	11.2
Others	0.1	0.4	0.7	1.1	2.5
	100.0	100.0	100.0	100.0	100.0

Relation between utilities and governments is changing dramatically

the greatest economic revolutions of the century" (Corcoran, 1993). It is a means for many countries to introduce competitive forces, managerial accountability and the efficiencies and better customer service that can come from private ownership, to stimulate economic growth and reduce government deficits and international debt. With privatization of power utilities comes greater freedom to invest outside their service areas. Indeed utilities can now look at the global market for power equipment, services and opportunities to develop power. And there would appear to be a large market. The World Bank recently reported[3] that power utilities in developing countries alone want to spend up to $745 billion on power projects by the end of the century.

It is important to note that privatization policies which are taking place in both rich and poor countries are mutually reinforcing. In the US changes to the Public Utility Holding Company Act (PUHCA) accompanying the Comprehensive National Energy Policy Act (October 5, 1992), cleared the way for both utilities and non-utilities to bid for building wholesale power plant at home and abroad. Privatization of the UK power sector has freed UK companies to invest abroad. These are just two examples. The global market

3/ Moore and Smith (1990) The $745 billion expenditure was in 1989 dollars. It would likely be more like one trillion dollars in 1993 dollars.

for services and equipment in this sector has changed virtually overnight.

In the developing world, the World Bank's lending policy for the power sector explicitly responds to the serious decline in the sector's financial performance in most countries over the last two decades. This deterioration, measured in underachievement of self-financing ratios, declining rates of return on revalued assets, and rising levels of overdue accounts, is mostly a function of governments' use of power utilities as instruments of social policy. A worsening spiral of rising national debt, increased inflation and the political fear of increasing electricity prices, resulting in interference in day-to-day management and operation of power companies, have led the World Bank to conclude that:

> Neither the developing countries nor the Bank can continue with a 'business as usual' approach to managing the power sector. In the absence of new approaches to restructure and evaluate sector management on the basis of commercial principles, with enterprises distanced from excessive government day-to-day management, and with clear strategies for generating confidence for new entrants, it is unlikely that the required power sector investment can be mobilized in the 1990's. (World Bank, 1993, p.12)

The Bank's response to the need for change will be reflected in its application of five guiding principles to power sector loans:

- transparent regulation;
- importation of services;
- commercialization/corporatization;
- lending based on commitment to reform; and
- investment guarantees.

The trend worldwide is away from a governmental to a commercialized or more corporatized power sector, with increasing competition — among suppliers of fuel, power plant equipment, construction and electricity services. Accompanying this are changes in how and from where financing is raised, and with it, changes in perception of what are acceptable risks and necessary financial rewards. Even the traditional approach to how electricity rates should be regulated will be under pressure due to these unprecedented changes in the sector, a sector increasingly 'marching to the beat of private, commercial drummers.' A key question, then, is whether an increasingly investor-owned power sector would be more or less likely to opt for nuclear, and if so, what conditions would it want to see met before doing so? Moreover, even if it wants nuclear, what would be the response of capital markets?

Will investor-owned utilities opt for nuclear?

Financing

The power sector is one of the most capital intensive industries in industrialized economies. The amount of capital required to generate a unit value of output is several times higher than for manufacturing industries.[4] However, electricity is an extremely marketable product. It provides a myriad of services, is clean in end-use and, so long as there is economic growth, enjoys a growth market. It therefore has high value. It also has very low price elasticity. This looks like a pretty attractive investment. The question is, if there are several ways of producing electricity, and customers have options to use other fuels directly or use much less electricity (for which there is considerable potential), then what would make nuclear the power source of choice?

A recent study by the Edison Electric Institute (1993) analyzed potential financing structures for the next generation of nuclear power plants for the United States. Noting that the objectives of such structures are to minimize overall costs, match participants' risks with their ability and preparedness to bear and control risks, the EEI study examined the precedent for, experience with, and pros and cons of a variety of financing structures. These included historical utility financing, turnkey projects, independent power producers, non-utility ownership during construction with a guaranteed sale, partial government financing, insurance, government guaranties and sale/leasebacks. The conclusion of the study is that there is no one alternative that would appear to meet optimum financing needs: rather, "the next nuclear plant (in the US) will most likely be financed utilizing a combination of the structures examined." It could be a hybrid non-utility or partial utility/wholesale generator project. If so, the financers will have to be as, or more, comfortable with financing a nuclear plant as they would with gas or coal plants.

What comes through in the EEI Study and the responses from key financial analysts in a back-up questionnaire, is that the most important factors or conditions that will influence financing are:

Requirements for finance

- the need to achieve progress with high level waste repository;
- a predictable licensing process and stable regulation; and

4/ Canada's power sector is nearly seven times more capital intensive than its manufacturing sector. This partly reflects the high share of nuclear and hydro which are the most capital intensive forms of conventional power supply. The electric power sector accounted for 34 to 58% of all energy sector investments in Canada between 1972 and 1991, and up to 11% of total investment (all sectors of the economy) and 2.5% (1978) of GDP. Canada is doubly 'electricity-intensive' — in electricity use per unit of GDP and in the share of capital expenditures in electricity capacity as a share of GDP. (See Energy, Mines and Resources Canada, 1991, pp. 74-75.)

- maintaining and improving the high safety and reliability performance of operating plants.

The majority of financial analysts surveyed felt that public acceptance is paramount, that fossil fuels must become unattractive (for supply, security or environmental reasons) and, above all, there must be need for additional base load capacity.

The OECD electricity sector currently generates about $700 billion/year in gross revenue. This could reach a trillion dollars by 2010. Given a projected growth rate of 1.8% in electricity capacity and general patterns of capital expenditure by utilities in OECD countries, where about 40-50% goes for new capacity, one could envisage 50-80 billion dollars being spent by 2010 on new capacity annually in OECD countries.

The answer as to whether the money is available therefore seems obvious. But, there is competition for this money. There are other energy and industrial sectors seeking capital. Where capital eventually goes depends on perceptions of risk and whether the rewards are commensurate with the risks, which in turn depend on many factors.

Put in its simplest terms, the banker asks, "What are the risks of not getting a return on my investment, or of the project going wrong?" Put another way: "If there are risks, are there less risky investment opportunities offering the same returns?" The nuclear industry must be able to sustain these questions. Nuclear has to compete. This is more the case today than it was 20 years ago. Then, for example, there were price and regulatory restrictions that prevented serious competition from natural gas. The coal industry was just beginning to deal with the uncertainty of environmental requirements to control acid gases. Finally, as noted above, privatization and public debt reduction were not yet major policy goals. How utilities raise capital in the future will bear little resemblance to how they did it in the past. In North America, at least, publicly-owned utilities build plant with debt financing; investor-owned utilities rely more on equity financing. These sources of financing rank risks differently. Privatization is changing power utilities' access to, and therefore cost of, capital, and as a consequence utilities are shifting their preferences away from capital-intensive, long lead-time projects.

Changing context for nuclear means change in capital sources

The Policy Environment for Nuclear

Rather than go through the long list of project and market risk elements, it may be useful to identify the set of policy conditions that I think need to be met in order that nuclear can become an attractive investment. These are not new and most were identified in the EEI study (1993).

A principal condition, of course, is that nuclear must be **economic**. The OECD's Nuclear Energy Agency (NEA), jointly with the IEA, carries out periodic assessments of the projected

costs of generating base load electricity. The most recent study (NEA/IEA, 1993) examined coal, gas, nuclear and certain renewables for plants to be commissioned around the turn of the century. This is when our *Outlook* indicates that, in the absence of changes in policies, nuclear power's contribution will decline, that is, unless new plant is ordered — presumably starting in the next year or so to be available seven–eight years hence.

Nuclear advantage sensitive to discount rate

Any relative advantage that nuclear might have over coal is especially sensitive to the assumed discount rate which, for some countries participating in the study, has been increased since the last study in 1989. At a 5% discount rate, nuclear is economic, enjoying an advantage over other fuels in most of the countries covered in the latest study. At a 10% discount rate, nuclear retains a clear advantage over coal in France, Germany (domestic coal), Japan, Hungary and, in the case of a pressurised heavy water reactor, in Korea. The advantage is weaker in Germany (if competing with imported coal), in parts of the United States, and in the Czech Republic and Slovakia. Under this discount rate France and Japan are the only countries where gas, coal and nuclear are compared and where nuclear retains an advantage over fossil fuels. Thus, under the right conditions, nuclear can be economic but only if the price advantage is as great or greater than the perceived risk.

But getting the economics right is only the beginning. Some of the other conditions that need to be met to make nuclear commercially viable include:

- public acceptance and therefore solid political and government support;
- strong institutional support (scientific research support, insurance, independent, competent regulatory agency and adequate educational and industrial back-up);
- high rate of growth of base-load electricity demand and confidence in continued growth after plant comes on stream;
- a clear regulatory process — "a fast track that gets everyone on board, but has no sidings;" and
- where alternatives are not acceptable or, in the case of natural gas, where no major economic gas supply is within sight.

Satisfying these conditions is a tall order, at least for the time being.

There may be exceptions to this list and other factors for some countries. There are countries, for example France, where economic gas supply is available yet nuclear is still lower cost.

Public acceptance is a key issue. Public opinion surveys seem to confirm that as long as there appear to be alternatives, which include reducing demand through DSM programs, even if the market place chooses nuclear, the public may not. Key areas are the public's concern about safety and perceptions that the industry has not solved waste disposal and decommissioning problems. In my mind, the latter (waste and decommissioning)

are communication challenges, not technological challenges. Safety is another matter. The legacy of Chernobyl is real. As has been said by so many, the question of what conditions can make nuclear viable would become almost academic should there be another Chernobyl in Eastern Europe and the former Soviet Union.

Eastern Europe and the Former Soviet Union

Another major nuclear accident in the former Soviet Union could seriously undermine the already fragile public acceptance of nuclear everywhere. That is one of the reasons why the G-7 countries at their 1992 economic summit in Munich requested the IEA to assist the World Bank to assess the electricity outlook in this region and to examine alternatives to continued reliance on those reactors considered (by people other than the users) to be of high risk from a safety perspective. The study took it as assumed that approximately 19 GW's of RBMKs and VVER 440-230s[5] (of a total generating capacity of 300 GW) were the least safe. We set out to try to answer the following question:

> For those countries with higher risk Soviet-designed reactors, what are the alternative supply sources, associated costs and financing requirements to enable shutting down these plants as soon as possible, given resources and other constraints, while meeting future electricity demand reliably and economically?

The main conclusion of the study for the G-7 is that it would be **technically** feasible to replace the so-called risky reactors with alternative supplies and to improve nuclear safety in the countries concerned, without leading to a deficiency of electricity supply. But this needs careful qualification. It is not as simple as many would want it. And it could be very expensive. First of all, this region is not easily amenable to assessments of the nature or detail required to answer such a question, other than in very general terms.

A *high nuclear scenario* which sees continued reliance on nuclear, involving completion of partially constructed units and up-grading other reactors (including RBMK and VVER 440-230s) to meet safety recommendations, would cost some $28 billion. A *low nuclear scenario* involving early closure (i.e., by the mid-1990s) entailing some building of new fossil capacity, could reduce the capital cost to $21 billion. However, this lower scenario would have considerable, extra operating costs — about $1 billion/year over the period — for fuel, primarily natural gas, for the replacement plant. Also, there are important policy difficulties for many countries presented by the lower nuclear scenario, not the least of which

5/ These are acronyms for the Russian names of their home-designed reactors: RBMK is a light water-cooled graphite moderated reactor; VVER is a pressurized water reactor type.

is a major drain, if not overwhelming call, on available finances, especially since the fuel costs would drain hard currency reserves. On a marginal cost basis, there is a lot of old, dirty, inefficient power plant that would merit closure before their nuclear plants. For some, to move to gas or oil would increase their dependence on energy imports from Russia — a dependence which they consider politically unacceptable. As well, there would be significant social implications of the extensive unemployment in what used to be a prestigious industry in single-industry (nuclear) communities.

Policy dimensions of nuclear energy in central and eastern Europe

Nuclear plays several important roles in the energy/economic policies of Central and Eastern European countries. For example, in some countries such as the Czech Republic and Slovakia, nuclear is viewed in an **environmental role**, to replace dirty, aged coal plants using uneconomic local coal. It also plays a **strategic role** for many former COMECON countries, because it reduces reliance on Russian fossil fuel. Conversely, in Russia, nuclear power makes more oil and gas available for export, its largest source of hard currency. Finally, some of these countries see nuclear power playing a future **trade/economic role**, as the basis for power exports to neighbouring countries.

The West is familiar with the many anecdotes suggesting an enormous potential for energy efficiency gains in these countries. It has been claimed, for example, that energy efficiency could totally replace nuclear in this region. There can be little doubt that great potential exists. How fast it can be realized is entirely another question. Expectations that Western experience with energy efficiency programs can be transplanted are probably largely misplaced for now. For example, some of the more advanced and innovative utility DSM programs in North America would likely not fit. These depend upon the availability of a wide range of product choices and a clear understanding of the barriers to their purchase. They also require a utility workforce, not only well-trained on the demand side, but dedicated to the concept of customer service and improved customer satisfaction. Efficiency standards, which work with mixed results in the West, would require stable, mature institutions and governance, and an interest among workers and citizens in abiding by standards.

Moderate expectations for efficiency gains

Opportunities might exist in the 'upstream' part of the demand side; namely, in the transformation sector and in the manufacture of energy-using equipment and appliances. There may be an opportunity now to influence these countries' energy cycles at the transformation/equipment link, during a time when much capital replacement takes place. But we must temper our expectations. Energy efficiency may be our priority: unfortunately it is not yet theirs. And it will not begin to be until they start getting electricity prices close to reflecting economic costs. This is critical. And yet, energy price reform is only one small part of the macroeconomic and institutional reform needed to make the transition to a market economy. Some countries are achieving

progress faster than others.

While it may be technically true that gains in energy efficiency could replace the more risky or even all nuclear in this region, such a theoretical proposition could be a very unsafe basis for considering whether to finance nuclear retrofits, upgrades or new plant in the countries concerned. Faced with such a degree of demand-side uncertainty, overestimating what efficiency gains can achieve in displacing nuclear power plants could lead to the riskier reactors being shut down and not retrofitted (because they were presumed not needed), and then subsequently called upon to satisfy unanticipated electricity demand — demand that was not 'technically' supposed to happen. This could lead to a less safe situation than expected. Ukraine, the home of Chernobyl with its two remaining units, may be a case in point.

These countries need to develop sound energy policies for the long-term, and the IEA is prepared to aid those who want our assistance in doing so. We have the considerable policy experience — successes and failures — of our Member countries to draw on. Besides sensible pricing policies, they need the capacity to measure, monitor, audit and account for energy. Meanwhile, a carefully developed and concerted approach is needed to finance the safety retrofits, or to complete reactors under construction, which could offset need for some of the more risky reactors. It needs to be asked whether we may be forestalling on urgent safety retrofits by assuming that the more expensive Western standards are a minimum. In other words, would 'better' be preferable, if 'best' will not happen because it is too costly?

But financing of nuclear in this region, whether for retrofits or completions, is not obvious. A financing strategy whose principal aim is improved nuclear safety might not necessarily involve nuclear equipment. Given all risk considerations, paying for imported fuel for alternatives might be preferred by financial markets in the end. But any country in this region wishing to work on improving the safety and reliability of its nuclear power system, will likely face the following:

- the need to prepare economically sound projects and proposals (this seems obvious, but in the East it has been very difficult to do so where private ownership issues are not wholly resolved);
- showing that they can generate significant local financing; i.e., self-generated revenue from power enterprises (again, predicated on having a viable and effective pricing policy in place);
- for safety retrofits or upgrades financed from the West, depending on their nature and urgency, countries could draw on the Multilateral Nuclear Safety Account, bilateral programs, export credit agencies (ECA), the EBRD and the European Investment Bank (EIB);
- to complete nuclear units, presumably financing could be sourced from a combination of ECA's, EBRD, EIB and even commercial bank financing; and

conventional plants could attract financing from the above as well as the private sector and potentially the World Bank.

Meanwhile, the greatest uncertainty over the medium-term is the level of electricity demand, and what the rate of growth in demand will be once economic recovery begins. In the absence of reform of energy pricing, all questions of financing will remain theoretical.

Future of Environment Policy and Nuclear

It is sometimes said that the renewed concern for the environment, specifically the issue of global climate change, gives policy makers a compelling reason for maintaining the nuclear option. Indeed, the IEA's Energy Ministers, who recently agreed to a set of **Shared Goals** as a basis for energy policy, acknowledged in those goals that "a number of IEA Members wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide."

Ministers acknowledged that energy-derived CO_2 emissions constitute a major contributor to greenhouse gases from human activities. It is likely that the energy sector will bear a policy burden in response to this issue well in excess of its contribution to the problem. Under these circumstances, the science of climate change aside, no low-carbon or no-carbon options for meeting future energy needs should be rejected as long as there is risk of intolerably rapid global climate change. Nuclear power would be one of the few, if not the only option, second to rigorous controls on energy use, for many countries wishing to reduce **and** maintain levels of energy-related greenhouse gases, especially CO_2. Wind and solar could play a significantly greater role than they do now. But they have yet to prove themselves on a scale sufficient to provide reliable, economic baseload.

The IEA has carried out modelling and other studies to assess the impact of various policies to limit greenhouse gas emissions (see IEA, 1993a and Skinner, 1993). Carbon taxes in the order of $300 per ton of carbon, or rigorous intervention to accelerate energy efficiency improvements, would be required to return energy related CO_2 emissions in the OECD to 1990 levels by 2010. Taxes and efficiency regulations differ in their effects across fuels and end-use sectors. Carbon taxes have equity and distributional effects that call into question whether they offer a realistic approach on an international level to address the problems, particularly given that they have to be very large (in the order of tripling current energy prices) to have any significant impact. Much needs to be understood about the way carbon is actually used and priced in energy markets, its regional and international variability, and the costs and availability of new or alternative — low or no-carbon — technologies, before governments can decide on a comprehensive and effective policy

course.

Electricity generation for the world, in the absence of the climate change issue, was headed for a future increasingly dependent on fossil fuels, especially coal. If plentiful, economic and non-controversial non-fossil fuel choices for electricity generation were assured, the achievement of energy security and environmental goals of OECD countries would be assured. But, for most countries, major hydro options are few, the nuclear option faces strong public opposition, and, as noted above, non-hydro renewables are insufficient to meet demand. Greatly increasing the efficiency of energy use is the option preferred by most governments. Here again, there is much uncertainty. Demand-side management in the electricity utility sector has become popular recently, but its effectiveness in actually reducing demand is difficult to evaluate.

Low carbon options required as insurance

The risk that climate change might require aggressive policies, that carbon taxes and efficiency regulations might not be either acceptable or effective, seems to call for an insurance policy that would see low-carbon or no-carbon options, such as nuclear power, maintained. This, however, is unlikely to be done by the market place. It requires a conscious policy decision by governments.

Natural Gas

Natural gas is considered by many to be the fuel of choice for power generation because it appears to enjoy certain advantages: it is relatively free of acid gases; emits less CO_2 than coal and oil; and involves low capital cost and rapid construction times using new combined cycle technologies with high efficiencies.

Natural gas is seen as a bridge to the future. This may be true. Indeed, a very large share of new-power plant planned and under construction in many OECD countries is based on natural gas. This is not surprising. It is partly a function of the deregulation and privatization taking place in the utility sector. The characteristics of natural gas-fired plants provide a less risky match with the lower and more uncertain projections of electricity demand growth.

There is little doubt that the world has plentiful natural gas resources. As noted earlier, where natural gas sources are already linked to developed natural gas markets, and if the price is right over the life of the power project, gas is attractive. But gas markets tend to be regional and with different characteristics. Major new volumes of gas supply will have to come from increasingly distant and more costly sources. Over three-quarters of the world's gas resources are in Russia and the Middle East, principally Iran. From a financing perspective, major new gas projects, whether LNG or long distance gas trunk lines, have considerable risk — both market risk and project risk. Much like nuclear projects, they are capital intensive, requiring a long period of time for pay-out. The deregulation of gas markets to remove barriers to

competition tends to reduce consumer prices and thereby increases market risk for those producers and transporters counting on higher prices to pay off large investments in major gas transportation systems. Finally, the link between natural gas and oil prices is likely to endure, and the future of oil prices is always an uncertainty.

Conclusions

Change is accompanied by uncertainty: all markets dislike uncertainty. And capital markets are no different. The dramatic change in the structure of the power sector globally, the risks posed by the nuclear program in former communist countries, the policy response to the risk of climate change, and the security implications of dramatically increasing reliance on natural gas — all contribute to uncertainty. Financing in the power sector will be influenced accordingly.

Is there a case for nuclear? In my view there is. Just as much as there is a case for energy efficiency and other fuels or sources of energy, including the continued search for new energy technologies. A principal argument is energy security. By this, I do not mean energy security as it was narrowly perceived in the seventies and early eighties; namely, "off-oil and especially Middle East oil." For one thing, there is not a great deal of scope remaining in the OECD to replace oil in power generation, with the exception of Japan where a very ambitious nuclear program is already in place. Any conceptualization of energy security today must address the world's unavoidable and increasing reliance on oil for mobility. The pursuit of energy security must incorporate solutions to environmental concerns, especially global climate change. It must also address the unsustainable ratios between rich and poor nations in regard to per capita energy consumption, population growth rates and economic opportunity.

Case for nuclear rests on energy security and the environment

A second important reason for retaining nuclear power is that we have few real choices. To reject any option is to automatically acknowledge preparedness to pay higher costs for alternatives, or to run the risks of depending on a few fuels that may only be attractive for awhile. But the market place does not sufficiently account for the longer-term when it makes such decisions. By their very nature they must be addressed as a conscious act of government policy. In the meantime, the nuclear industry's job seems clear-cut — safety, radioactive wastes and public information, accompanied by a concerted effort to ensure that its efforts are not undone by another accident in the East.

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