Changing Canadian Electricity Markets and the Future Role of Government

MARK JACCARD

The roles of two arguments from neoclassical economics for government intervention in the electricity industry, based on the existence of natural monopoly and public goods, have been diminishing, while the need to deal with negative environmental externalities has been given increasing attention. In recent debates over appropriate policy responses, these rationales have frequently been treated in a confusing manner and one encounters policy proposals that focus on one of the arguments while ignoring the others. The evolution of these rationales is described and its implications for policy formation are considered. The paper concludes with an illustration of how this analysis suggests a certain range of policy solutions, combined with substantial room for distinct choices within that range.

Deux argumentations d'inspiration économique néoclassique, en faveur d'une intervention gouvernementale dans le secteur de l'énergie électrique, qui s'appuient sur l'existence d'un monopole naturel et sur la notion de biens publics jouent un rôle de moins en moins important alors qu'on prête de plus en plus attention au besoin de traiter les problèmes externes liés aux conséquences négatives de l'industrie sur l'environnement. Au cours des récents débats sur l'élaboration de politiques appropriées en réponse à ces problèmes, ces arguments ont souvent été abordés de manière confuse et on rencontre des propositions de politique qui se focalisent sur un des arguments et ignorent les autres. L'article expose l'évolution de ces logiques d'argumentation et traite de leurs implications en matière d'élaboration des politiques. En conclusion, il illustre la manière dont une telle analyse suggère qu'il existe un certain éventail de solutions en matière de politiques et en même temps qu'une marge de manoeuvre substantielle permet d'effectuer des choix distincts.

The appropriate role for government in the electricity market has recently emerged as a highly contentious issue. Although arguments for government intervention have existed since the electricity industry's beginning a century ago, in recent decades two notable rationales that have dominated for most of the century are diminishing in importance, while a new rationale is emerging. In the terms of neoclassical economics, the first two rationales centre around the concepts of *natural monopoly* and *public goods*; the more recent rationale is based on *negative environmental externalities*. The first objective of this paper is to step back from the day-to-day debate in order to discern these broader trends in the rationales for government intervention in electricity markets, and to assess their separate and combined implications.[1] However, while the analysis of intervention rationales is generic to the electricity industry throughout the world, the appropriate policy response depends on the specific characteristics of each region or country. Thus, the second objective is to assess the implications of these industry-wide trends for government intervention in Canadian electricity markets. Of particular concern is the extent to which the

Mark Jaccard is Chairperson and CEO of the British Columbia Utilities Commission and Associate Professor in the School of Resource and Environmental Management, Simon Fraser University, Vancouver. An earlier version of this paper was presented at the *International Seminar on Regulation: Energy, Environment and Finance* at the University of Mexico, August 16-18, 1994.

1/ Note that the issue addressed in this paper is not simply one of public versus private ownership. The concern here is with the broad question of the appropriate degree of government intervention in all its forms.

current trends will either force convergence toward a single industry model or continue to allow for the regional diversity that has historically characterized the Canadian electricity industry. Analysis suggests that there are both forces for convergence and possibilities for divergence, implying that some changes will be similar, but that the level of government ownership and regulation can still vary considerably. In particular, private competitive electricity generation markets will emerge throughout the industry, as will more stringent environmental regulation, but the degree of government ownership and the form of environmental regulation may differ significantly.

1. Past Rationales for Government Intervention in Electricity Markets

The approach in this paper is to explain government intervention in capitalist market economies in terms of standard concepts of neoclassical economics. This approach offers certain advantages in terms of clarifying the underlying fundamental issues in public debate. But it should not be assumed that politicians explicitly carry out this type of analysis when making policies. The approach here is interpretive rather than descriptive.

Neoclassical economics defines conditions under which markets are unlikely to maximize social welfare.[2] These conditions are generally defined as market failures, and they provide a rationale for government intervention in a given market.[3] Two market failure rationales for government intervention in electricity markets have existed since that industry emerged at the beginning of the century. The first is based on the concept of natural monopoly, the second on the argument that electricity exhibits some of the characteristics of public goods. A third argument, not discussed in as much detail here, does not relate to the market's failure to be efficient, but to a social equity goal: the belief that the almost universal provision of electricity at a common price is socially desirable.

1.1 Natural Monopoly

In some industries, the lowest possible production costs can be achieved only if there is one firm in the market. This type of market is called a natural monopoly in order to distinguish it from markets in which an 'artificial' monopoly exists, in that, if it were to be replaced by several competing firms, prices would fall.[4] In the electricity market, a capital intensive distribution system is required and it is readily apparent that redundant distribution systems owned by competing firms would entail much higher costs. Also, until recently it was assumed that economies of scale in generating units meant that one large unit would have a lower cost of production than two or more smaller units.

For society to capture the benefits of natural monopoly, the general assumption is that government intervention is required in order to ensure that the monopolist operates efficiently and does not garner excess profits.[5] Governments have generally opted for one of two major forms of intervention in electricity markets. One is to countenance a private monopoly, but to regulate it with a public utility commission. The other is to establish a publicly owned monopoly — in Canada a crown corporation — overseen by one or more of direct ministerial control, cabinet appoint-

2/ According to economists, social well-being (or welfare) is maximized if consumers can freely determine their consumption and if productive resources are allocated to satisfy these consumption demands in the most economically efficient manner possible. Economists specify several conditions, including perfectly competitive markets, that will lead to welfare maximization.

3/ There is no guarantee that government intervention will bring society closer to the social optimum, which is why some argue against government intervention even where market failure is obvious.

4/ See Berg and Tschirhart (1988) for a formal definition.

5/ Excess profits are here distinguished from normal profits, the latter being a return to capital commensurate with the investment risk.

ment of the utility's board of directors, or a parliamentary review committee.

The dominant approach in Canada has been to create crown corporations. Over 80% of electricity generated in Canada is by vertically integrated crown corporations owned by provincial governments (Table 1). However, the Canadian model varies from province to province, with only Alberta, Nova Scotia and Prince Edward Island dominated by private ownership, and with many provinces and territories having special characteristics, such as small privately owned utilities or municipal utilities. Ontario Hydro, for example, delivers power to over 300 municipal utilities (Natural Resources Canada, 1993).

In its emphasis on public ownership, the dominant Canadian model is similar to that of Europe. In contrast, in the US, as in Alberta, most major generating utilities are investor-owned, regulated by public utility commissions.

Neither the regulation of private monopolies nor the creation of crown corporation monopolies have been free of criticism as solutions to the natural monopoly problem. In the case of regulated, privately-owned utilities, two criticisms have been particularly salient.

One criticism is that there is a tendency in regulation to award excessive returns to capital, thereby providing an incentive for utilities to over-invest and to bias their investments toward capital and away from labour and other productive inputs (Averch and Johnson, 1962). The second criticism emphasizes the difference between regulatory theory and practice. It is suggested that regulatory agencies are at risk of "capture," such that they eventually confuse the objectives of the regulated entity with those of society (Stigler, 1971; Posner, 1974). Both of these theories are difficult to prove or refute, and efforts at empirical analysis have tended to show that the regulatory process is much more complex than either critical model would suggest (Joskow, 1974).[6]

Over the years numerous reforms have been suggested and implemented. These tend either toward more careful scrutiny of utility management decisions or toward efforts to better integrate market mechanisms into the regulatory process. The latter approach includes *price caps*, which encourage greater efficiency effort by the utility because cost decreases allow higher profits in the period between cap reviews, and *franchise bidding*, in which the monopoly franchise is open to competitive bid at regular intervals.[7]

As for the public ownership model, two criticisms stand out (Vickers and Yarrow, 1988; Laffont and Tirole, 1993). The first relates to the economic inefficiency that may result when political concerns and the self-interest of utility managers interfere in investment and operating decisions. The second relates to the problems for democratic societies due to the concentration of power in the hands of managers of large publicly owned corporations. Positions in the debate about public ownership are, however, often determined by broader ideological perspectives. Those with a propensity to favour market intervention will tend to be more open to public ownership, and the converse, though this dichotomy does not always hold with respect to electricity, as shall be seen below in the discussion of public good.

The debate about investment efficiency is almost impossible to resolve empirically (Berg and Tschirhart, 1988). Even if the publicly owned monopoly were shown to have lower prices, a non-interventionist would likely be able to cite evidence of public subsidy, as these frequently exist in the form of public debt guarantees or low returns to public equity. Conversely, if a private regulated monopoly were shown to set lower prices than a publicly owned monopoly, an interventionist might argue that the publicly owned monopoly had simply done a better job of incorporating other

6/ Kahn, A., (1988) and most other texts on electric utility regulation review the inconclusive research results.

7/ See Joskow and Schmalensee (1983) and Moorhouse (1986) for detailed analysis of the options for reforming utility regulation. Demsetz (1968) presents the case for franchise bidding and Shepherd (1984) provides a counter argument to this approach.

Table 1: Electricity Supply and Mode of Government Intervention

	Electricity Demand (Twh)	Electricity Supply Source		Ownership of Generation	Rate Regulation
Newfoundland	10.7	hydro	95%	predominantly public	provincial cabinet
PEI	0.8	fossil fuel	100%	private	utility commission
Nova Scotia	9.9	fossil fuel	89%	private	utility commission
New Brunswick	13.9	fossil fuel nuclear hydro	49% 30% 19%	public	provincial cabinet
Quebec	164.6	hydro	96%	public	provincial cabinet
Ontario	139.4	fossil fuel nuclear hydro	22% 48% 29%	public	provincial cabinet
Manitoba	18.4	hydro	99%	public	provincial cabinet
Saskatchewan	14.6	fossil fuel hydro	77% 22%	public	provincial cabinet
Alberta	45.9	fossil fuel	94%	predominantly private	utility commission
British Columbia	57.3	hydro	95%	predominantly public	utility commission

relevant cost or equity considerations into its decision making, suggesting that social welfare was optimized even if commodity prices were higher. Moreover, it can be argued that since neither private nor public monopolies face the discipline of the competitive market, the key determinant of efficiency performance is to set effective management incentives.

1.2 Public Good and Social Equity Concerns

The natural monopoly rationale alone is a compelling reason for government intervention in electricity markets. However, the specific character of that intervention is influenced by other factors. First, the propensity to favour public or private ownership will differ. Second, electricity is also seen as having other special properties that invite government intervention. Notably electricity is sometimes treated as if it were a public good and as a necessity that should be provided to all as a principle of social equity.

A public good is defined as a good characterized by *non-exclusivity* and *non-rivalry*. Non-exclusivity means that the benefits of the good cannot be withheld from anyone. Non-rivalry means that use of the good or service by some does not diminish its benefit to others. Thus, for example, a lighthouse is a public good. It is difficult or impossible to prevent particular ships from benefiting from the services of a lighthouse (non-exclusivity), yet their use of that service in no way diminishes the benefits received by others (non-rivalry). Because private economic agents cannot capture in market transactions all of the benefits of public goods, public goods will generally be under-provided

by markets.[8]

While it is difficult to describe any good as a perfect public good, goods can be ranked along a continuum with pure public goods at one end and pure private goods at the other. Electricity, the argument goes, is somewhere along this continuum, closer to a pure private good but nonetheless sharing some of the attributes of public goods. These attributes especially relate to the strategic importance of the choice of resources and technologies used in producing electricity, in that they influence the general character of the economy. Proponents of intervention have apparently perceived a jointly-consumed return to society from having government influence the choice of resources and technologies used to produce electricity. Similarly they see a public benefit from government's control of electricity-related debt. Governments have frequently decided that these public good attributes of electricity compel their involvement in this sector. This sort of argument is especially relevant for hydro and nuclear power, but it can also be a factor with oil or coal.

Hydro dams confer benefits in addition to electricity, including irrigation, domestic water supply, flood control, navigation and recreation. Also, their costs can extend beyond the simple costs of the physical structures, notably with their impacts on migratory fish and animals. In the past, the general assumption was that the unaccounted for benefits far exceeded any unaccounted for costs, meaning that hydroelectric power would be under-provided by the private market in the absence of public intervention.

Nuclear power is another technology with potential public good characteristics because of its impact on the technological character of economic development. A domestic nuclear power industry results in a unique set of technological skills, linkage industries and export opportunities. Thus, the preference in France today for the continued key role of publicly owned nuclear power hinges primarily on the emphasis on its public good attributes (Bouttes and Lederer, 1991; De Paoli and Finon, 1993). Others have agreed that nuclear electricity has public good attributes, but have argued that these are mostly negative. Lovins (1977), for example, argued that nuclear electricity is associated with greater risk of nuclear weapons proliferation and security requirements that condone excessive police power.

These special characteristics of hydro and nuclear power have influenced the character of public intervention in Canada and elsewhere. In all six Canadian provinces in which hydro and nuclear power predominate, the generation system is primarily publicly owned (Table 1). In three of the remaining four provinces, based mostly on thermal power, the generation system is primarily privately owned. Even in the US, with its preference for privately owned generation utilities, the two major publicly owned generators were created in the 1930s in order to develop the hydropower resources in the Appalachians (Tennessee Valley Authority - TVA) and in the Pacific Northwest (Bonneville Power Authority - BPA). In the US, nuclear power is privately owned, but in recent years private utilities have ceased to expand nuclear capacity. Elsewhere, nuclear is generally associated with public ownership; this includes the UK, where a major privatization campaign left nuclear within the public domain.

Even decisions about oil and coal use in electricity generation have been seen to involve broader public interest issues. The oil embargo and price shocks beginning in the 1970s fostered an energy security concern among oil importing countries, and this in turn led to government involvement in generation decisions. This was a major reason for the French decision in 1974 to opt for nuclear. It also played a key role in the generation choices in Japan and, to a lesser degree, in most industrial countries. Domestic coal resources are also perceived as offering public good benefits, as has been the case in Germany, either because of energy independence or internal macroeconomic effects.

Finally, with any of the large scale tech-

8/ Public goods can also be defined in terms of externalities, as discussed further below. See Randall (1983) for a fuller description.

nologies, electricity generation investments can represent a significant portion of total investment and increments in the debt of a country or region. The timing and magnitude of such decisions may have implications for counter-cyclical macroeconomic policies, as well as for trade and debt balances. This too can be viewed as involving a public good and it invites government involvement; that is, by influencing these financing decisions the government can create net benefit that would not be created by leaving the decisions totally to the private sector.

Governments have also been influenced by the argument that electricity is an essential component of modern society and that, as a matter of social equity, the electricity grid should be extended to all regions and prices should be the same (within broadly defined customer classes) regardless of differences in the costs of providing service. Such a policy requires either subsidies across customers or subsidies from taxpayers. Satisfying a social goal in this way produces an outcome that can be far from economically efficient and this argument is thus generally at odds with the other two rationales.

1.3 Intervention in the Canadian Electricity Sector

Given the diversity and complexity of factors motivating government intervention, it is not surprising that the outcomes have varied significantly, even within a single country. Thus, while natural monopoly inevitably invites public intervention, it is the public good rationale and the propensity for market intervention within a particular national or regional society that tends to determine the choice between public and private ownership in the electricity sector. Canadian history illustrates this point. Public ownership is usually associated with the principal electricity production technology (notably nuclear or hydro power) and with the effort to provide electricity service to hinterland areas.[9]

British Columbia is one example. Prior to 1960, Vancouver was served by the privately owned BC Electric, while hinterland areas of the province were served by the publicly owned BC Power Commission. Although the Social Credit government of the 1950s and 60s would qualify as a non-interventionist government, it perceived large-scale hydropower development as a precursor to economic development in the province's hinterland regions. To realize this objective, the government nationalized BC Electric, creating BC Hydro in 1962, with monopoly status over most of the province, and proceeded with simultaneous development of the Peace and Columbia Rivers.

In Quebec, the motivating factors for nationalization also had public good overtones, although the specific issues were quite different. The nationalization and consolidation of the electricity sector was perceived by the reformist Liberal government of the 1960s as a key component in Quebec's effort to master its economic destiny. In recent decades, Hydro-Québec served this objective by undertaking major hydro-electric development in the James Bay area.

Alberta provides a third variation. The historical preference for non-interventionist government in that province, and the key role of thermal resources, have together contributed to the development of an Albertan model that closely resembles that of the US, a predominantly private utility sector with regulation by a utilities commission.

In contrast, Saskatchewan has traditionally been noted for interventionist politics. Thus, even though its electricity generation resources are also predominantly thermal, its electricity sector is publicly owned.

As examples in the US and elsewhere have shown, government objectives can be realized almost as easily with private ownership as with public ownership. Thus, government efforts in research and development, in addition to other support, can influence private sector choices, as has occurred in support of nuclear development in the US, Germany and Japan. Utility commissions also provide an opportunity for the inclusion of various public values related

9/ For further background see Vining (1981).

to electricity's public good attributes and to broader social equity concerns. Thus, utility commissions throughout the US, and in Canada where applicable, have been supportive in the past of utility rates and policies that, among other things, (1) applied uniform tariffs within customer classes regardless of cost of service differences, (2) subsidized uneconomic extensions of service, (3) provided special tariffs and services for low income customers or troubled industries in regions suffering from economic recession, and (4) explicitly favoured the development of particular generation technologies over others.

2. Emerging Forces of Change

Seen from the perspective of the 1990s, the three decades following World War II were relatively stable, at least in terms of the fundamental characteristics of the electricity industry and consequently with respect to the rationales for government intervention. However, by the 1980s the cumulative effect of technological evolution and changing public and political concerns began to shift the debate about the rationale for intervention in the electricity industry. While the conventional rationale focused on natural monopoly and public goods, an emerging rationale relates to another form of market failure — environmental externalities. In addition, the strength of the two traditional rationales have been eroded by developments and changing public perceptions about the desirability of market intervention. These changes have set off a broad ranging debate about the appropriate roles for government and industry in the electricity market, and have led to substantial uncertainty about the future character of that industry.

2.1 Environmental Concerns: the Externality Rationale

Economists refer to most environmental impacts as externalities — a negative or positive effect of some activity that is experienced by a third party but is not accounted for in an associated purchase transaction or payment for damage. The above discussion of public goods dealt with positive externalities; the focus here is on negative environmental externalities, which have been a key concern in the electricity sector.[10] Because negative externalities are costs that are not incorporated in final product prices, the private market will produce more of the externality-causing good or service than is optimal for society.

Rising environmental awareness in the late 1960s and early 1970s had important implications for the electricity industry. Indeed, virtually every major electricity generation technology has been under an environmental challenge since the 1970s, with new concerns emerging as earlier ones have been partly addressed.[11]

Since the 1970s, the safety aspects of nuclear power have been aggressively questioned, in particular fuel transportation, plant operation and waste disposal. This has become a political issue in many countries, and Canada is no exception.

Major hydro-electric projects are now examined more rigorously and critically for their environmental and social impacts and for the non-market values of the land lost to reservoirs. Recent hydro projects in Alberta, BC and Quebec have all been associated with major controversy because of their potential environmental and social impacts.

Combustion of fossil fuels in the generation of electricity is now recognized as a significant contributor to regional and local air pollution. Acid rain, partly caused by electricity generation has been a regional problem in eastern Canada and the northeast US.

Depending on plant sitings, the nitrous oxide emissions from fossil fuel-based electricity

10/ Negative *social* externalities have in some cases also been very important. An example would be uncompensated social impacts suffered by Cree Indians from Hydro-Québec's James Bay projects, or the negative effects suffered by British Columbia aboriginals and non-aboriginals due to the development of the first Kemano project in northwest BC in the 1950s.

11/ For details on the period prior to 1980, see Roberts and Bluhm (1981).

production can also contribute to urban air pollution. Nitrous oxide is a precursor to low level ozone, a critical air pollutant in the Windsor to Quebec City corridor and in metropolitan Vancouver.

The most recent environmental concern from electricity generation is the risk of global climate change associated with greenhouse gas emissions. Fossil fuel-based electricity generation technologies are again at issue, in this case primarily because of their CO_2 emissions.

Governments have responded to these environmental concerns in various ways. In part this diversity is a result of differences in technology, but it is also explained by differences in public perceptions and differences in preferred regulatory mechanisms.

In response to the concerns about nuclear power, governments and regulatory agencies have increased safety measures and conducted detailed public reviews, resulting in substantial cost increases for nuclear power in many jurisdictions. In the US, these cost increases have seriously undermined nuclear power's ability to compete for new capacity requirements. In Europe there have also been intense public debates about nuclear power, with several countries, such as Denmark and Sweden, ruling out future use of that technology. Less anti-nuclear sentiment has been evident in countries such as France and Belgium. Ontario Hydro has no active plans to construct another nuclear plant, although it is difficult to separate public policy intent from the consequences of an economic downturn.

With few exceptions, most industrialized countries are no longer willing to further exploit their remaining large-scale hydropower potential.[12] Moreover, the full costs of past projects are being re-assessed, notably because of corrective expenditures and foregone generation benefits (spilling water) required to mitigate losses to other economic sectors, such as the fishery. The most striking example is the major action taken to correct losses to fish resources caused by earlier hydropower projects of the BPA along the Columbia River system.[13]

Growing concerns for acid rain in eastern North America and central and northern Europe also led to regulatory responses that increased the cost of electricity from fossil fuels, especially coal. In the US, this concern culminated in the federal government's Clean Air Act of 1990, which set targets for total acid gas emission from electricity generation and established a tradeable permit system in an effort to achieve the reduction targets at lowest total cost. In Europe, the EC has set new emission standards for generating plants, and is currently attempting to encourage or subsidize similar technological developments in eastern Europe. The Canadian federal government and provincial governments have also tightened their emission standards.

In terms of the local air quality impacts of electricity generation from fossil fuels, regional authorities in the Los Angeles basin are playing a leading role, setting targets and devising implementation mechanisms to reduce local air emissions. This strategy has implications for the choice of electricity supply technologies, the siting of new generation plants, the retrofit of existing plants, and dispatch decisions from existing plants. Standards throughout the US are set by the Environmental Protection Agency. Similar efforts are underway or contemplated in southern Ontario and the Vancouver region.

The climate change issue has only recently become a serious concern of governments. Most countries have now made general commitments with respect to stabilizing or reducing CO_2 emissions, but only a few specific policies have so far been enacted. In addition to these policies focused directly on the externality problem, the recent shift in electric utility regulation toward

12/ Quebec is an exception, but this policy is seriously challenged by environmentalists and some of the aboriginal peoples living in the area of greatest hydropower potential, James Bay.

13/ The concern to correct damages to fishery resources, combined with major misinvestments in nuclear plants, provided a dual impetus for the creation of the Northwest Power Planning Council by the US government in 1980. Its general mandate is to promote conservation in the planning processes of the BPA and the region's utilities, and to find options for the recovery of fish stocks.

encouraging energy efficiency is also seen as a key policy response. While many would argue that the energy efficiency initiatives among utilities in the US in the 1980s were not initiated for environmental reasons, these actions have nonetheless had profound implications in the debate about the appropriate government response to the externality issue.

During the 1980s, US utility commissions began to shift their focus from the least-cost provision of electricity, the commodity, to the least-cost provision of the services provided by electricity, such as lighting, heating, motive force, refrigeration, etc. Least-cost analysis of electricity service provision frequently leads to the conclusion that investments in efficiency would be more profitable than investments in new supply. Programs to incite such investments are referred to as demand-side management (DSM). The process to ensure fair comparison of supply and DSM options is referred to as integrated resource planning (IRP). Utilities in most states in the US are now mandated to conduct IRP and to implement those DSM measures that are least-cost relative to supply alternatives. Increasingly, the IRP process includes public involvement via interest group participation.

The causal factors for the regulatory shift in the US are complex. First, many utilities had over-invested in new capacity in the late 1970s and early 1980s, and in some cases significant shareholder losses were incurred when utility commissions refused to allow complete recovery of these investments through rate increases. Utility managers were, as a consequence, more receptive to planning approaches that reduced the risk of unrecoverable investments. Public interest groups that had resisted major supply investments, and subsequent price increases, were generally enthusiastic in their support of efforts to find alternatives to such investments. Secondly, an underlying current in the debate around these phenomena was the recognition by many that there could be significant environmental benefits from an emphasis on energy efficiency.[14]

A third important factor was that many utility commissions and participants in the regulatory process became convinced of the existence of several additional market failures (or *market imperfections*) affecting energy markets.[15] Independent engineering and economic analysis suggest that some consumers' decisions about electricity consuming equipment are non-optimal from the consumers' own perspectives, and certainly non-optimal from a social perspective. Several market imperfections have been suggested as the cause of this apparent non-optimal behaviour. They include lack of information, high transaction costs, unnecessary risk aversion and imperfect capital markets, among others.[16] This third factor — market imperfections in consumer choices — provided the rationale for greater intervention in electricity markets, in this case to influence consumer behaviour instead of the behaviour of the utility.

Although the indirect environmental benefits of DSM are frequently recognized — less generation means less pollution — many utility commissions in the US have also focused directly on environmental externalities through their ability to regulate the choice of electricity generation technologies. In this sense, they have taken over much of the market intervention role that in other countries might be performed by national and regional governments. Through the IRP process, utility commissions are experimenting with various mechanisms to influence the choice of generation technology, including (1) applying percentage *adders* to the cost of

14/ Lovins (1976) played a critical role in the development and popularization of the argument that promoting energy efficiency is a key component of a sustainable energy future. See E. Kahn (1988) for a review of the development of IRP in the US utility regulation process.

15/ While some have used the term *market failure* in this context, others have preferred *market imperfection*, so as to make a distinction between these problems and the more conventional cases of market failure involving externalities.

16/ There is an extensive literature on market imperfections. See, for example, Fisher and Rothkopf (1989) and Krause *et al* (1993).

environmentally damaging supply technologies, (2) estimating monetary values for negative externalities and *internalizing* these into the cost of supply technologies when deciding between technologies, and (3) establishing *renewable set-asides*, to ensure that a certain percentage of incremental supply will be from renewable, environmentally benign, electricity generating technologies, regardless of their cost (Rose, Centolella and Hobbs, 1994).

There have been several criticisms of the efforts of government and regulatory agencies to deal with externalities in the electricity market.

A general criticism, leveled by many economists, is that governments have tended to overlook the possible economic efficiency benefits of using market instruments to achieve environmental objectives. Ideally, the economist would like to see environmental outcomes result from the internalization into market prices of externality costs. However, most economists admit that it will be a long time, if ever, before market values for all externality costs can be determined and effectively internalized, and even if that were to be achieved there is uncertainty as to whether individual consumption behaviour would lead to environmental outcomes that are considered optimal by most members of society. However, even if society instead chooses to determine the desired level of pollution (or pollution reduction) by some other means, economists argue that it should still rely on economic instruments to achieve that desired level at minimal costs. Pollution taxes and tradeable pollution permits are frequently cited as examples of such economic instruments.

But economists have not been the only group disenchanted with government responses to environmental externalities. Ecologists and epidemiologists, in particular, have noted that many of the effects of pollutants may not be statistically detectable or may only emerge years later. Moreover, non-linearities and critical thresholds in ecosystems can make it extremely difficult to develop reliable estimates of the relationship between different levels of a pollutant and the associated incremental changes in environmental damage. As a consequence, these scientists, and environmentalists in general, argue that the government response to the externality market failure should be guided by the *precautionary principle*. According to this principle, the burden of proof shifts so that actions possibly affecting the environment are disallowed unless it can be demonstrated with reasonable confidence that no negative externality is likely. This argument calls for a much greater government intervention in the economy, in this case in a preemptive manner. It would support, for example, policies to favour specific technologies (e.g., certain types of renewable electricity generation technologies) simply because these pose less risk to the environment.

The rationale for DSM has come under criticism, especially from economists. Some have questioned the market imperfections listed in support of DSM activity, arguing that estimates of economic energy efficiency potential will tend to overstate the achievable potential to the extent that they ignore important intangible costs and consumer surplus differences between products (Sutherland, 1991).[17] Others have argued that estimates of economic efficiency potential are exaggerated because of a failure to account for the full costs of utility implementation of DSM and because, in estimating savings, real world results should be used instead of best practice engineering simulations (Joskow and Marron, 1992). Economists are more supportive of DSM if it is offered as one

17/ This large debate can only be treated superficially here. The argument is that estimates of economic efficiency potential generally fail to account for (1) differences in consumer surplus between products that ostensibly provide the same service and (2) intangible costs of more efficient technologies. If the light of an incandescent bulb is preferred to that of a compact fluorescent bulb, there is a difference in consumer surplus between these two goods. Intangible costs relate to additional perceived risk and/or transaction costs because the more efficient product is generally newer, less well known, less tested for reliability, and therefore likely to be more troublesome (hence costly) to find, ship, install, operate and maintain.

of the means of responding to environmental externalities or to correct the tendency of regulators to set electricity prices at average cost instead of marginal cost (assuming the latter exceeds the former).

Finally, a key criticism of utility led IRP processes as a response to environmental externalities is that they may inadvertently result in a worse outcome. The argument is that actions at the state or provincial utility commission level may actually decrease social welfare because utility commissions only have jurisdiction over certain energy forms and certain energy companies. For example, an effort to favour renewable, environmentally benign, electricity generation technologies may drive up the price of electricity such that consumers switch to an alternative for a particular end-use (say oil for space heating) that happens to have an externality impact over its life cycle even greater than the life cycle impact of electricity as currently generated.[18]

2.2 Erosion of the Natural Monopoly Rationale

The second force for change in recent times has been an outcome of both technological evolution and regulatory changes. As noted above, the costs of conventional, large scale, electricity supply technologies increased as a consequence of regulatory responses to environmental concerns, especially for nuclear and fossil fuel-based technologies. In many jurisdictions, the costs of nuclear also increased because of unforeseen operating problems. Finally, these technologies also experienced a general decrease in the rate of advances in technical efficiency (Joskow, 1987; Hirsh, 1989). At the same time, advances with other technologies have shifted the cost advantage from large-scale back toward small-scale technologies. This holds true especially for natural gas-based generation technologies, the least polluting of the fossil fuels, but it is also increasingly true for alternative, renewable technologies, notably wind, biomass, small hydro, geothermal and, in some cases, solar. Among thermal technologies, there has been a dramatic improvement in relative unit costs for smaller scale units that use a *combined cycle* for electricity generation and/or *cogenerate* steam for industrial or domestic uses.

Taken together, these technological developments imply that past assumptions about economies of scale in electricity generation are less and less valid. Considerably smaller units are now economically viable. This is especially the case in private electricity markets, such as the US, where the long amortization periods required by large scale technologies, such as nuclear, are seen as more risky by private investors. The full implications of this economic shift are the subject of lively debate in the US and now increasingly throughout the world.

The electricity supply industry consists of three components: generation, transmission and distribution. The broadest possible implication of lost economies of scale in electricity generation is the elimination of the natural monopoly rationale for electric utilities, at least for generation.[19] As a consequence, it is now increasingly argued that private competition at the generation level is the market structure that best maximizes social welfare. This would replace the vertical integration model of the electricity market structure with the model that is emerging in the North American gas industry, one in which transmission and distribution utilities are separate from commodity supply companies.

However, this argument for private competitive markets in generation is not universally accepted. Positions in the debate depend on how one trades off the decline in the natural monopoly rationale against the other rationales for intervention in electric markets.

18/ Life cycle costing is a methodology that incorporates all costs from production through to waste disposal of a particular commodity or service.

19/ Ruff (1994) argues that the vertically integrated electricity firm includes an additional natural monopoly function, that of coordinating short-run supply dispatch in order to ensure instantaneous market clearing at all times; this is of particular concern because of unique properties of electricity transmission and because electricity cannot be stored.

In particular, even if the natural monopoly argument for a monopoly in generation has diminished, this may be offset by a continuation of the public good rationale, or by the emerging environmental externality rationale. According to some analysts, these latter may be sufficient rationales for continued public monopoly ownership of Electricité de France (nuclear) or the Bonneville Power Authority (hydro).[20]

An additional issue is whether the technological trends that have undermined the natural monopoly rationale in generation will eventually have similar effects for the remaining major components of the electricity industry, transmission and distribution. Some analysts speculate that the improving economics of smaller and smaller generation units, notably combined cycle turbines, fuel cells and solar-based technologies, may in future favour on-site electricity generation ("distributed generation") such that the monopoly position of transmission and distribution monopolies will also be reduced (Flavin and Lenssen, 1994).

Developments in the US have played a key role in this erosion of the natural monopoly rationale, although more radical market experiments are now being conducted in other countries, notably the UK, Norway, New Zealand and Chile. In 1978, the US federal government passed the Public Utility Regulatory Policy Act (PURPA), forcing electric utility monopolies to take supply from non-utility generators if these were at lower cost than the utilities' own planned supply units. While the PURPA initiative was motivated in large part by concern in the US about the use of imported oil for electricity generation, the implications for the natural monopoly rationale have been considerable. The experience of the following decade demonstrated a clear shift in the economics of electricity generation, with smaller scale technologies proving to be competitive with conventional large utility supply projects.

Although PURPA initially required utilities to pay private generators a price that reflected the cost of electricity from the utility's next, proposed generation project (its avoided cost), it soon became apparent that non-utility supply exceeded demand at this price. Utility commissions began to recognize the benefits to customers of establishing bidding mechanisms to ensure supply at the lowest possible price, adjusted for various non-priced factors such as risk and in some cases externalities. Competing suppliers included *independent power producers* (IPPs) and other utilities with surplus capacity. Under this *wholesale electricity competition*, the utility functions as the monopsony purchaser of electricity on behalf of its customers, but the utility must accept the best bid for incremental electricity supply, subject to various constraints or other regulatory objectives. Because the industry has grown little in the last decade, the wholesale competition model has only experienced limited testing thus far. However, wholesale competition has now been accepted by the US federal government as at least a minimum requirement in the evolution of the electricity industry, as outlined in the Energy Policy Act of 1992.

In the last few years, the debate about the implications of lost scale economies has been carried further, leading some to criticize even the wholesale competition model and advocate a retail competition model in its place. According to this argument, the wholesale competition model still fails to maximize social welfare because it substitutes the preferences emerging from the utility commission regulatory process for the preferences of individual consumers. If the electricity market is now truly a competitive market like any other, the argument goes, then consumers should be allowed to make utility maximizing decisions just as they would in any other market (Galloway, 1994). We return to this debate in Section 3.

20/ In France one still hears the argument that the time horizon of private investors is too short to arrive at socially optimal electricity generation investments. Nuclear investments, even if optimal from a holistic social perspective, will tend to be overlooked by the private sector on its own because the investments are so capital intensive and require such a long time for recovery of the initial investment (Bouttes and Lederer, 1991).

2.3 Erosion of the Public Good Rationale

The third force for change in recent times is the erosion of the public good rationale for government intervention in electricity markets. This has been driven by mishaps with publicly owned electric utilities, technological and economic changes, and shifting political values.

A fairly extreme position is that governments and regulatory bodies are virtually ineffective in directing investments in electric and other markets to best satisfy the long-run public interest. Thus, the argument goes, private ownership is almost always preferred to public ownership. Even in natural monopoly markets, private ownership is preferred and regulation should be minimized by the use of incentive mechanisms such as price caps. As one might expect, the rise to power of non-interventionist political parties in some industrialized countries, has been accompanied by various privatization initiatives. The UK is the quintessential case, where the privatization campaign touched many sectors of the economy, including ports and airports, aerospace, airlines, oil and gas, telecommunications, automotive, and electricity.

The argument against government ownership and other forms of intervention can be explained in terms of the *principal-agent problem* (Vickers and Yarrow, 1988). According to this concept, the publicly owned corporation is an agent of government assigned to meet the government's objectives. However, the agent may have different objectives than government and as a result may frustrate or at least fail to achieve the latter's objectives.[21] Thus, even with acceptance of the view that governments are generally motivated to maximize social welfare, and also that certain sectors of the economy exhibit significant market failures, concern over the principal-agent problem may still lead one to conclude that public ownership is an ineffective tool for addressing most legitimate arguments for market intervention.

While one's sense of the costs and benefits of public ownership will undoubtedly be influenced by ideological predispositions, there has, in addition, been a general decline in enthusiasm for public ownership in recent years in most industrialized countries. One argument is that public ownership has not succeeded as well as open regulatory processes in involving the public in the major critical decisions about electricity investment. Substantial debates on this issue have occurred in recent years in France, the UK, Canada, and several other western countries. In publicly owned electric utilities, key decisions are frequently made by technocrats or political advisors without meaningful opportunities for public participation. Major projects may be favoured because of their political or technological attractiveness, not because they maximize social welfare when tested against the full range of legitimate alternatives, with estimated public values on external costs and benefits incorporated.

The experiences of the three largest Canadian utilities are noteworthy. In the late 1970s, British Columbia Hydro was increasingly criticized for planning large hydro-electric projects throughout the province without fairly evaluating financial and environmental risks, smaller scale supply opportunities, and energy efficiency alternatives. The largest and most critical investment decisions in the province were being made by a group of technicians and bureaucrats, with virtually no opportunity for public input or review. Mounting public concern that the *agent* was not at all serving the interests of the *principal* convinced the government to place its publicly owned utility under the regulatory control of the provincial public utility commission. This created the somewhat unique situation in which a publicly owned utility is regulated by a public agency. In effect, one could say that the publicly owned utility was created to address the natural monopoly and public good market failures, while the layer of utility commission regulatory control was added to address the principal-agent problems of publicly owned corporations. In spite of its unconventional design, this institutional model

21/ One can take the concept back one step further, with the populace as the principal and government as the agent, arguing that here too there will be a discrepancy in terms of the inconsistencies between the agent's and the principal's interests, and hence the desirability of as little government as possible.

has proven to be very successful compared to other Canadian jurisdictions. BC Hydro has been generally ahead of its Ontario and Quebec counterparts in being responsive to public concerns and in adjusting to new technological and market developments of the kind outlined in this paper. In particular, BC Hydro has been an innovator in Canada in exploring demand-side management options and incorporating risk and other environmental and social factors into its electricity planning framework.

In Quebec and Ontario, the legitimacy of decisions by publicly owned utilities has been especially challenged in the last few years.[22] As recently as the late 1980s, both of these utilities were still following the large project, supply-focused path of the 1960s and 1970s. This is exemplified by planning decisions in the late 1980s (1) to continue with an electricity supply vision dominated by large scale nuclear power projects in Ontario and (2) to continue with massive hydropower projects in Quebec. Indeed, by the late 1980s, these two Canadian utilities were virtually the only large utilities in the US and Canada whose plans were still dominated by electricity supply megaprojects. For many, it is no coincidence that these remain the only two large, vertically integrated utilities in the US and Canada that are not openly and fully regulated by a utilities commission.[23] Not surprisingly, both provincial governments have recently initiated review processes that examine options for addressing the principal-agent concern, with the options ranging from shifting to the British Columbia model to full privatization.

In addition to the principal-agent concern, there is another reason for the erosion of the public good rationale. It is increasingly suggested that the public good attributes of electricity have diminished in recent years. In particular, the perception of electricity's public good character has diminished in part because of the changing assumptions about economies of scale in generation; the same factors that undermine the natural monopoly rationale can also undermine the public good rationale.

First, it appears that the electric industry may be less critical in the future in determining the pace of economic development, at least in industrialized countries. Once the electric grid covers most of the country, the issue shifts from access to electricity to the linkage between electricity and economic growth. While electricity consumption and economic growth will remain correlated, past assumptions about an extremely tight causal relationship have been undermined by evidence since the 1970s (National Research Council - US, 1986).

Second, as the scale economies of generation technologies shift in favour of smaller units (and perhaps DSM), electricity generation investments will have less impact on the economy. The slow-down and reduction in total industry investment has allayed past concerns about the effects of utility debt and utility technology choices on the aggregate cost of capital, the technological options for the rest of the economy, and the consequences for counter-cyclical macroeconomic objectives.

Third, there is unlikely to be any significant development of large scale hydropower resources in industrialized countries in the future, while nuclear remains important in only a few countries. This reduces the rationale for public intervention in new electricity generation development, although there remains the dilemma of whether or not existing hydropower facilities are best managed by the private or public sector. Thus far, it appears that the general preference in the US will be to retain public ownership of the major hydropower entities, BPA and TVA.

Fourth, since the mid-1980s oil independence has declined in importance as a national security issue. While governments in the 1970s and 1980s intervened in electricity markets in order to influence the fuel choice away from oil, changing economics have since favoured natural gas and, in any case, the oil market is

22/ See McKay (1983) for a review of interest group mistrust of Ontario Hydro up to the 1980s.

23/ Ontario Hydro's rates are reviewed in public hearings by the Ontario Energy Board, but the Board has no ratemaking authority and simply makes recommendations to cabinet.

less vulnerable to political manipulation.[24]

Fifth, in developed countries the electricity grid has now been widely extended such that access to electricity is no longer the social equity issue it once was. However, the appropriate pricing strategy for electricity remains a key issue, with much of the public still supporting uniform prices within each customer class, regardless of location and the cost of providing service. In developing countries, in contrast, both grid extension and electricity pricing are still critical issues relating to government intervention in electricity markets. The issue hinges on the trade-off between the benefits that a publicly owned utility can provide by subsidizing the nascent stages of economic development, and the potential drain on the economy that such utilities can become if they are extremely inefficient and make decisions for short-term political expediency with no clear social welfare maximizing objective. This issue has become more pressing as the World Bank has begun to demand reform of the electricity sector in developing countries as a precondition to continued financial support.[25]

3. The Future: Convergence or Flexibility?

The thesis presented in Section 2 can be summarized with the help of Figure 1. On each axis the diagram shows one of the three major rationales for public intervention in electricity markets: natural monopoly, public good and environmental externality. The other end of each axis represents the absence of such a rationale. The thesis of this paper is that there has been a shift from the lower right to the upper left of Figure 1 as a result of changing technological conditions and public perceptions. While these perceptions vary between countries and individuals, a general shift has occurred because of the widespread emergence of the externality rationale and the erosion of the natural monopoly and the public good rationales.

3.1 Conflicting Models of the Future

This evolution is creating fundamental challenges to current institutions and policies, but there is no consensus on the appropriate government response to these challenges. Indeed, very different positions are being advocated.[26] Here are four distinct positions.

1) Competitive generation markets are not desirable because of the continued importance of the public good rationale and the emerging externality rationale.[27]

2) While the demise of the natural monopoly rationale implies the need for competition in generation, this should be wholesale competition regulated by utility commissions, in order for the electricity sector to be able to effectively address the emerging externality rationale.[28]

3) The demise of the natural monopoly rationale implies the need for break-up of the vertically integrated monopoly, introducing retail competition in generation because this has the greatest potential to fully meet consumers' needs. Moreover, because externality issues are endemic to the entire economy they should be addressed by different means, not by misusing market intervention mechanisms that were developed more appropriately to address na-

24/ The issue of fuel choice and political independence has not completely disappeared. In Europe there is a concern that competitive electricity markets would favour natural gas which increasingly must be imported into Europe from unstable countries like Russia and Algeria.

25/ See, for example, World Bank (1993).

26/ For a detailed analysis of some specific models of industry structure, see Tenenbaum *et al* (1992).

27/ This argument still dominates in France, where it is believed that only this model can assure the long run benefits of a technology as complex and significant as nuclear power (Bouttes and Lederer, 1991). This type of argument is still vigorously advocated throughout other industrialized and developing countries as support for the continuation of publicly owned utilities.

28/ This argument is currently associated with Ralph Cavanagh of the Natural Resources Defence Council in the US. See, for example, Flavin and Lenssen (1994) and Gegax and Nowotny (1993).

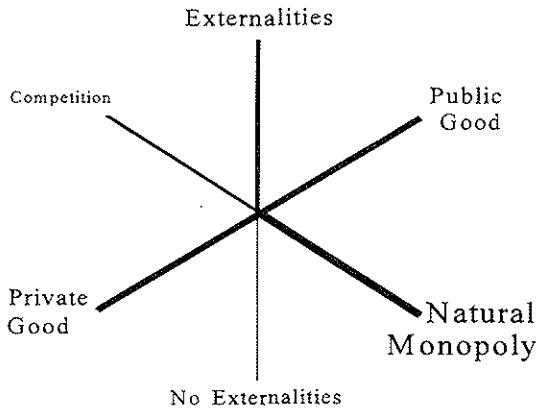

Figure 1

tural monopoly.[29]

4) The demise of both the natural monopoly rationale and the public good rationale implies the need for both privatization and deregulation of the entire electricity sector. Environmental problems should be taken care of separately.[30]

It is the thesis of this paper that these wide ranging positions on the appropriate response to the evolving rationales for market intervention are explained in large part by the ideological predispositions of the advocates of each position. In particular, many of these advocates seem to develop arguments that focus especially on change that has occurred with just one of the rationales for intervention, while ignoring or down-playing what is happening with respect to the other rationales. Thus, for example, the argument that the decline of the natural monopoly rationale in electricity generation must imply privatization assumes away the potential importance of the other two rationales for intervention. Similarly, the argument that retail electricity competition must be stopped under all circumstances, implies that it is not possible to develop alternative means of dealing with externalities or other aspects of the long-run public interest. Finally, the argument that the erosion of the natural monopoly rationale in electricity generation eliminates the ability to mandate IRP neglects the crucial fact that a natural monopoly will still exist in transmission and distribution, and that DSM and IRP remain desirable as part of the package of cost-effective policies for addressing environmental externalities.

The goal for this final section of the paper is to speculate on what these developments should imply for the future character of government intervention in electricity markets. The speculations are broad because each society will weigh and trade-off the issues according to its own values and priorities. But hopefully the public policy decisions that shape electricity markets in the future will be well informed ones, mindful of the full set of rationales for government intervention and of the evolving justification in support of each rationale. The critical question, therefore, is whether the changes in rationales for intervention described in this paper imply that only one model is appropriate for future government regulation — regardless of differences in each society's institutions, technologies, resources, economic system, political concerns, or interventionist predisposition — or if several alternative models may be appropriate.

The answer is both yes and no. Yes, the shifts in intervention rationales imply forces of change that will impact everywhere. These are referred to below as *forces of convergence.* However, the forces of convergence will not be strong enough to require every country or region to follow an identical model of government intervention. There is flexibility that will allow each country or region to significantly shape the overall character of its electricity market interventions. These are referred to below as *margins of flexibility.*

Figure 2 portrays on a continuum some possible outcomes of these converging and differentiating trends. The left end of the

29/ This is the argument expressed in support of the California Public Utility Commission's recent decision to implement retail competition in electricity. See, for example, Galloway (1994).

30/ This was a common sentiment in the U.K. privatization initiative, and in part explains the minimalist approach to regulating the transmission and distribution segments of the U.K. electricity industry. In Canada, the argument is associated with Energy Probe, a non-governmental interest group organization in Ontario.

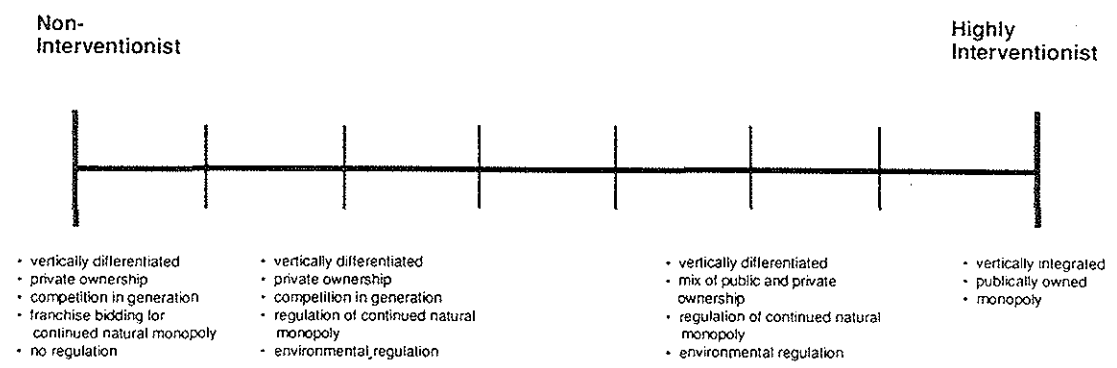

Figure 2: Models of Government Intervention in Electricity Markets

continuum represents a minimalist approach to market intervention. The right end represents a strongly interventionist approach. While these two extremes are possible outcomes, it is more likely that the forces of convergence will push most countries toward the middle of the continuum. However, in the middle area there should remain considerable room for flexibility among the approaches taken by different countries and regions.

3.2 Forces of Convergence

These are some of the key forces of convergence that will tend to push governments toward similar policies.

COMPETITIVE GENERATION POTENTIAL WILL CREATE PRESSURE FOR ALLOWING ELECTRICITY COMMODITY COMPETITION

The change in the economics of electricity generation, if the trend persists, will create a strong pressure on governments to allow private generation competition and direct commodity transactions between producers and consumers. A key reason relates to the principal-agent problem. There is a strong preference in most industrialized countries — and increasingly in other parts of the world — for consumer choice over central planning. To the extent that competitive markets are feasible, governments with a predisposition to non-intervention will shift to competitive markets, and this will be difficult to overturn, even by subsequent governments with a penchant for intervention. A second reason relates to market disequilibrium. It is currently argued in the US that planned electricity supply can lead to the same low costs as private competitive electricity supply. This could be possible if cost structures were perfectly predictable. But they are not. In private markets just as in planned markets, there will continue to be mis-investments. But in a private market it is the investor who loses out as new investors are able to enter the market and sell at lower prices. In planned supply markets (regulated private ownership or public ownership), there will be a greater tendency to make the customer cover part of the costs of mis-investment via higher rates.[31,32]

31/ Cost recovery from customers is not always guaranteed; the *regulatory compact* was in part broken when utility commissions in the US in the 1980s did not allow full recovery of nuclear plant costs, sometimes even when these very commissions had earlier approved plant construction. However, it is generally easier in the regulated context to make the customer help pay for mis-investments.

32/ One hears the arguments that there would be no interest in competition today in the US if not for the mis-investments in nuclear power, and that once these are amortized or written off the interest would dissipate. But electricity markets are always more likely to be in disequilibrium than equili-

FREE TRADE AGREEMENTS WILL HINDER THE ABILITY TO PREVENT PRIVATE GENERATION COMPETITION

Countries with a predisposition to retain publicly owned monopolies in generation will be under pressure to adjust their position at least somewhat by free trade protocols. Thus, for example, Electricité de France will be under pressure from the organizations of the European community to allow some form of competition in its generation market. Examples of other countries that will also experience this kind of pressure are Mexico and Canada.

INTERNATIONAL ENVIRONMENTAL AGREEMENTS AND DOMESTIC PUBLIC PRESSURE WILL REQUIRE CONTINUED ELECTRICITY MARKET INTERVENTION

Governments will be under domestic and/or international pressure to address the environmental externalities of electricity generation.[33] Intervention policies may focus on several objectives, including energy efficiency, fuel switching, emission reductions, lifestyle changes, and infrastructure design. Categories of policy instruments include regulations, taxation, subsidies and information campaigns. All of these will undoubtedly be used in one manner or another. Pressure for cost-effectiveness in policy will continue to push governments to seek synergies among intervention mechanisms. The ability to find synergies will depend, however, on the relative importance each government places on each of the three rationales for intervention.

brium.

33/ This obligation may seem the least obvious today in the U.K., where electricity generation competition has coincided with environmental benefits as natural gas substitutes for coal. However, there is no reason why this convenient coincidence will continue indefinitely; even natural gas electricity generation has environmental costs.

CONTINUED NATURAL MONOPOLY IN TRANSMISSION AND DISTRIBUTION WILL REQUIRE CONTINUED INTERVENTION

A strong rationale for intervention in electricity markets exists as long as there is natural monopoly in transmission and distribution. While approaches to intervention can be minimalist (e.g., a price cap), there will be pressure to ensure long run economic efficiency and to prevent high monopoly profits by private electric utilities.[34] Also, even with a minimalist approach there will be pressure to require IRP processes and develop DSM programs at the transmission and distribution level in order to address environmental objectives. Programs may be restricted to those that do not affect the rates of non-participating customers. But even if the programs did increase the transmission (and/or distribution) service rates of non-participating customers, such expenditures would be possible even under a scenario of full retail competition. Only in extremely rare cases would the slightly higher transmission service charges of a utility engaged in prudent DSM programs be sufficient to be the determining cause in the decision of large industrial customers to self-generate or build transmission bypass.

ENERGY EFFICIENCY WILL REMAIN A USEFUL TOOL FOR ADDRESSING ENVIRONMENTAL EXTERNALITIES

Governments will continue to recognize that

34/ Woolf (1994) describes some of these pressures on the recently established regulatory agency in the UK. The extreme contrast between micro-management and incentive approaches to regulation is frequently over-emphasized. It is possible to develop hybrid regulatory approaches that award specific returns on equity but that use various adjustment formulas and other incentives to keep detailed regulatory hearings down to about once every three years, thereby giving the regulated company time to pocket some of the profits from legitimate efficiency efforts. Innovations in this direction are currently under development in the US and Canada.

energy efficiency will play a critical role in the public policy response to concerns over environmental externality. In some cases, governments will establish separate energy efficiency agencies or funds, as has occurred in New Zealand, France, the UK and other countries. However, in many cases governments will also follow the model developed in the US, in which regulated utilities implement IRP processes that include cost-effective DSM targets and implementation mechanisms. The lesson from the US experience is that a utility-led marketing focus on energy services can reveal significant opportunities for relatively low-cost environmental benefits, and that increasingly DSM programs can be implemented in ways that inform rather than bribe or otherwise manipulate consumer choice. Moreover, as noted in (4) above, IRP processes and DSM programs can be implemented by utilities even when the industry is no longer vertically integrated, with the regulated transmission and/or distribution utility responsible for IRP.[35]

MAJOR WORLD LENDING INSTITUTIONS WILL INFLUENCE MARKETS IN DEVELOPING COUNTRIES

Dependence on foreign capital will intensify the pressure on developing countries to allow private generation competition and will restrict their freedom to override economic efficiency objectives using the public good rationale. Thus, previous assumptions that grid and distribution expansion increased social welfare, regardless of cost, will be restrained by more rigorous lending criteria. In addition, the construction and operating costs of electric utilities will be more tightly controlled, in part by exposing publicly owned monopolies to competitive forces. This could have many variations, including (a) subcontracted private construction and operation with public ownership retained, (b) private construction and regulated private ownership, and (c) franchise bidding for private operation and ownership with negligible regulation, and (d) independent regulation of publicly owned utilities.

35/ While some analysts suggest that the US 1992 Energy Policy Act was inconsistent in encouraging generation competition along with greater utility directed IRP, that policy is consistent with the approach described here.

3.3 Margins of Flexibility

These are some of the key margins of flexibility that will allow governments to vary their response to electricity market failures in accordance with their country or region's specific institutions, technologies, resources, economic system, political concerns, and predispositions regarding intervention.

PREDISPOSITIONS TOWARD MARKET INTERVENTION WILL VARY

The political predisposition to intervene in markets will vary in time and space. For example, if the Conservative party had not retained power after 1988, the UK electricity market would probably be very different today. In contrast, there is still a consensus among major political parties in France that a publicly owned, vertically integrated natural monopoly is in the long-run public interest. To the extent that other market attributes allow for flexibility in the choice or degree of market intervention, this predisposition factor will play a role.

TECHNOLOGIES AND RESOURCES HAVE SPECIAL ATTRIBUTES

Nuclear power is a technology that tends to require state intervention. There is a reciprocal aspect. Jurisdictions that have a propensity for electricity market intervention, like France, will be more willing therefore to opt for nuclear power. Jurisdictions that now have nuclear power may be required to retain government intervention even if they would rather not, as is the case in the UK. Hydropower is an example of a special resource. The US federal government retains ownership of BPA and TVA even though it generally prefers private ownership in electricity generation. Public ownership is much more significant in Canada

where hydro-electricity predominates, even though the Canadian natural gas industry is almost completely privately owned and publicly regulated like its counterpart in the US.

ALTERNATIVES FOR DEALING WITH THE TRANSMISSION AND DISTRIBUTION NATURAL MONOPOLY

In spite of the emphatic arguments on both sides, there is not a strong argument today favouring either private or public ownership of electricity transmission and distribution. The natural monopoly rationale for intervention still exists, and there is no compelling evidence that private, but regulated, systems are more or less efficient than public systems. Thus, governments are unconstrained in their decision to opt for one or the other form of intervention, which will therefore probably be determined by some other factor, notably the government's general predisposition toward public or private ownership.

OPTIONS FOR DEALING WITH EXTERNALITIES AND FOR FOSTERING ENERGY EFFICIENCY

As noted in the previous section, there are many options available to government for dealing with externalities and for fostering energy efficiency. Governments can pursue policies that require direct participation by firms in the electricity sector, an example being the approach advocated in the US Energy Policy Act of 1992, involving IRP, DSM and resource bidding for electric utilities. Or, governments can develop separate agencies, funds and policy instruments, an example being the US Clean Air Act of 1990. Again this means that other factors will determine the outcome in each country or region.

DEVELOPING COUNTRIES HAVE SPECIAL NEEDS

Finally, in spite of the increased influence from international finance agencies, the needs in the electricity sector of each developing country will be different, perhaps even of each region within a developing country. For example, in the eastern regions of China a significant private sector role may now be appropriate. The transmission grid has been extended to many regions and, with the recent dramatic economic growth, there are opportunities for profitable private investment in generation, with appropriate government regulation, including the pursuit of environmental objectives. In more isolated regions of China, as in many developing countries, grid extension and even generation resources may still require a significant role for the public sector, or at least private sector initiatives that are subsidized and/or closely regulated in order to coordinate them with government economic development plans.

3.4 Reconciling Environmental, Public Good and Competition Imperatives in the Canadian Context

Decisions about public intervention in electricity markets will depend on how each society weighs the three main rationales for intervention outlined in this paper. This can lead to very different models depending on the unique circumstances facing each country or region. No one model should be presumed to be universally applicable; each society will make its own choice.

In making that choice, it is important that a focus on one rationale not lead to muddled thinking about the other rationales. Many questions therefore need to be addressed in each jurisdiction and the responses may differ substantially from one region/country to another. Here are some of the key questions.

- What other intervention mechanisms exist or will be created to address environmental externalities?
- What other intervention mechanisms exist or will be created to encourage cost-effective energy efficiency?
- How important is consumer choice for maximizing social welfare in the case of electricity?
- What are the most favorable supply technologies, and what are their optimal investment and operating requirements?
- What are the technical and economic

advantages of centralized monopoly control of electricity supply in each jurisdiction?
- What are the options for competitive electricity supply?
- What institutional arrangements are required for competitive electricity supply, and how effective can they be?
- What is the likelihood of failures or abuses of various types of public intervention mechanisms?
- What is the current level of economic development of the country or region, and what is required for future economic development?

As a conclusion to this paper, the review exercise suggested by the above questions is conducted for the electricity sector in British Columbia. This provides a concrete example of what the approach advocated in this paper might lead to in terms of scanning policy recommendations for a specific jurisdiction.

The model depicted in Figure 3 represents an attempt to balance the current and likely future realities of the three rationales for government intervention in the electricity sector. In particular, it is based on the following conclusions.

1) PRIVATE MARKET COMPETITION FOR INCREMENTAL GROWTH IN GENERATION IS DESIRABLE.

In BC, the generation assets of BC Hydro could be separated from transmission and distribution (T&D), with the existing assets competing with IPPs for either wholesale sales to the T&D utility or retail sales to customers, if allowed. In one scenario, all increases in generation assets could be restricted to the private market in a competitive process regulated by the BC Utilities Commission and managed by BC Hydro, in the case of wholesale competition, or decided by consumers, in the case of retail competition. In another scenario, BC Hydro would be allowed to compete with IPPs for new generation, but in this case the regulation of this process and of BC Hydro must ensure that there are no cross subsidies from existing assets and that resource selection is unbiased. In addition, BC Hydro's power in the generation market for the foreseeable future would require continued rate regulation.

If retail commodity competition were permitted, effective means must be in place to deal with the externality issue. Environmental controls on IPPs, via the environmental review process and the energy project certificate requirements (or any other comparable government policies analogous to the US Clean Air Act), should be designed to ensure that no IPP is initiated or captures market share solely because of externality costs that have been ignored.

2) HYDRO AND NUCLEAR GENERATION ASSETS COULD BE PRIVATIZED, BUT THERE ARE PUBLIC GOOD ARGUMENTS AGAINST THIS.

The operation and maintenance of existing hydro and nuclear power generation assets retains public good attributes (or public liability attributes in the case of most UK, US and Ontario nuclear facilities), suggesting that the rationale for public ownership is still fairly strong. Since most of BC Hydro's generation assets are hydropower facilities, there is a case for retaining public ownership, provided that the cabinet has an effective external control system to ensure efficient management. In BC this is provided by the regulatory overview of the BC Utilities Commission and by the Crown Corporations Secretariat, an advisory oversight agency of cabinet.

3) T&D REMAINS A NATURAL MONOPOLY, AND COULD BE PUBLICLY OR PRIVATELY OWNED.

The T&D assets and the short-run market coordination function remain natural monopolies. Whether private or public, the T&D utility should be regulated by the BC Utilities Commission in order to prevent the capture of monopoly rents (in the public ownership case, regulation is also intended to address the principal-agent problem). The T&D utility would function as a common carrier (retail competition) or as a purchasing agent (wholesale competition), in either case with published and regulated transmission and distribution

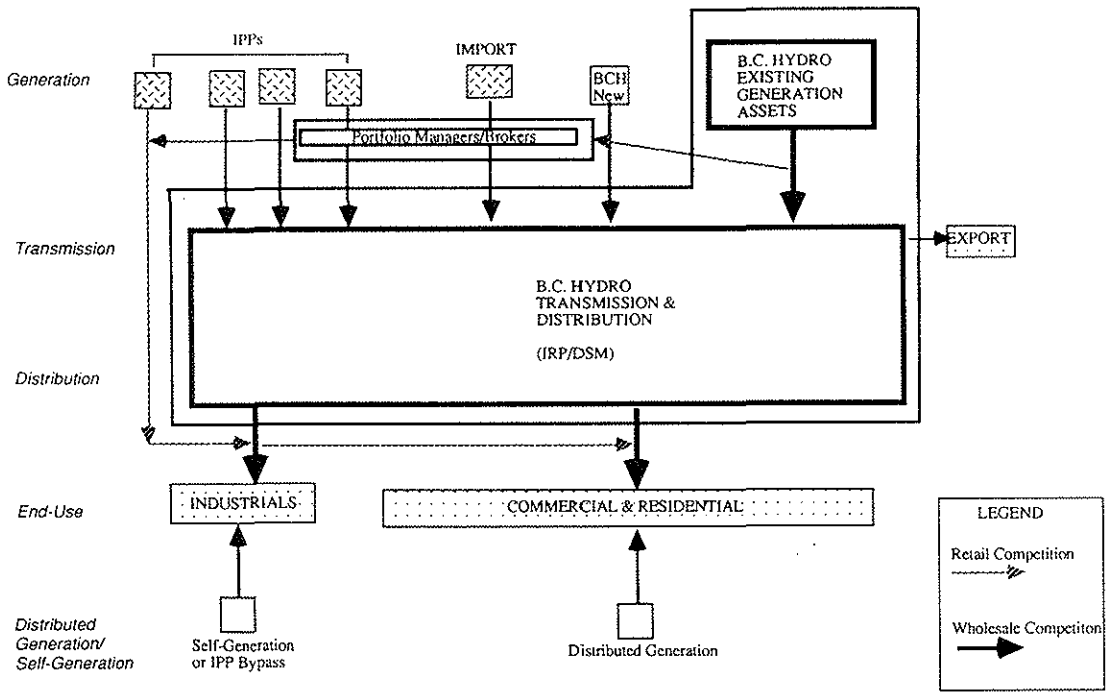

Figure 3: A Sustainable Model for BC's Electricity Industry

tariffs. The T&D component could be either a single entity or divided into a transmission company and a distribution company. This latter option may be desirable especially if there are perceived public good and/or environmental benefits to greater regional control of distribution systems. This split was carried out in England as part of the privatization initiative, while in Norway and Denmark, for example, the regional/local utilities remain publicly owned, generally at the local level.

4) THE T&D UTILITY CAN BE RESPONSIBLE FOR IRP/DSM.

The assessment of energy service cost-effectiveness from the customers' perspectives need not be conducted by a regulated utility because the issues of IRP extend beyond the regulated utility sector to include consumption of other energy forms (oil, coal, biomass, etc.) and consumers who are not served by the utility (isolated regions or communities). However, there is a counter-argument that utilities are best placed to assist customers in assessing their energy service options, and that governments interested in the environmental benefits of energy efficiency would want to continue to encourage utility-led IRP/DSM. Thus, IRP/DSM activity could remain the domain of the T&D utility, including, however, coordination and collaboration with more broadly applicable initiatives of the energy and environment ministries. Costs of IRP/DSM can be recovered from a levy on T&D service charges. However, DSM initiatives should probably avoid cross-subsidies between customer classes and attempt to minimize cross-subsidies between participants and non-participants within customer classes in order to reduce the risks of load displacement investments that are triggered simply to avoid IRP/DSM costs.

5) REGULATION, WHETHER OF PUBLIC OR PRIVATE T&D ENTITIES, SHOULD SEEK TO ENSURE THAT INCENTIVES FACED BY UTILITY MANAGEMENT ARE CONSISTENT WITH SOCIAL WELFARE OBJECTIVES.

All regulation is incentive regulation in that it creates a framework of incentives for utility management. Regulation of the T&D utility could provide incentives for operating efficiency. One mechanism is to establish price adjustment formulas, tied to inflation and productivity factors, that reduce the need for frequent, detailed regulatory review, and allow utilities to keep short-term profits garnered from accelerated productivity gains. Regulation of the T&D utility could also remove incentives to build the rate base where that is not the optimal utility action. One mechanism is to decouple utility short-run profits from commodity sales. A complementary mechanism is to provide additional rewards for desired activities, such as assisting customers with least-cost energy service evaluations and measures.

This sketch of policy options in British Columbia has some elements that apply specifically to that province, but it also has many generic elements that could be applied to other Canadian provinces. For example, in Ontario the assets that are likely to remain in public ownership are hydro and nuclear generation, while in Quebec they would be hydro generation. Also, in both Ontario and Quebec, the principal-agent problem with publicly owned corporations suggests the need for regulatory control by an independent agency with a responsibility for public involvement. Ontario would also be faced with additional transitional challenges in moving to this proposed model. Presumably, the government would want to protect current high cost generation assets from full IPP competition. In the UK, nuclear assets have been protected by a special levy on all electricity consumption, although this is slated to decrease or disappear over time.

In Alberta and some other provinces, the same extent of public ownership either does not exist or is not necessary. In any case, the T&D utility must still be regulated. However, Alberta may prefer that all energy efficiency and environmental externality issues be dealt with outside of the utility commission regulatory process. This may work as long as there are effective mechanisms using other government instruments.

In summary, while this concluding section obviously does not purport to resolve the issues of future government intervention in Canadian electricity markets, it sketches some of the salient features of likely models based on an assessment of the interplay of the forces of convergence, the margins of flexibility, and some of the unique characteristics of Canada's regions.

Rationales for government intervention in electricity markets have evolved substantially in recent times, and this has engendered a period of debate, experimentation and considerable confusion. Sorting through the issues in order to arrive at good public policies will not be easy. But the outcome is especially in doubt if the issues and rationales are not clearly understood. The goal of this paper is to contribute to that understanding so as to facilitate better public policies.

References

Averch, H. and L. Johnson (1962) 'Behavior of the Firm Under Regulatory Constraint,' *American Economic Review*, 52:1052-69.

Berg, S. and J. Tschirhart (1988) *Natural Monopoly Regulation* (Cambridge University Press).

Bouttes, J. and P. Lederer (1991) 'Electricity Monopoly versus Competition,' *Utilities Policy*, 19:3:212-27.

Demsetz, H. (1968) 'Why Regulate Utilities?,' *Journal of Law and Economics*, XI:55-65.

De Paoli, L. and D. Finon (1993) 'Implications of Community Policy for the Electricity Industries,' *Utilities Policy*, July:209-22.

Fisher, A. and M. Rothkopf (1989) 'Market Failure and Energy Policy,' *Energy Policy*, 17:4:397-406.

Flavin, C. and N. Lenssen (1994) *Powering the Future: Blueprint for a Sustainable Electricity Future*, Worldwatch Paper #119, (Worldwatch

Institute).
Galloway, G. (1994) 'A Response to Scott Hempling: The Role of IRP Under a Retail Competition Regime,' *The Electricity Journal*, 7:5:2.
Gegax, D. and K. Nowotny (1993) 'Competition and the Electric Utility,' *Yale Journal on Regulation*, 10:63-87.
Hirsh, R. (1989) *Technology and Transformation in the American Electric Utility Industry*, (Cambridge University Press).
Hotelling, H. (1938) 'The General Welfare in Relation to Problems of Taxation and Railway and Utility Rates,' *Etrica*, 6:242-69.
Jaccard, M., Nyboer, J. and T. Makinen (1991) 'Managing Instead of Building: BC Hydro's Role in the 1990s,' *BC Studies*, 91-92:98-126.
Joskow, P. (1974) 'Inflation and Environmental Concern: Structural Change in the Process of Public Utility Regulation,' *Journal of Law and Economics*, 17:291-327.
Joskow, P. (1987) 'Productivity Growth and Technical Change in the Generation of Electricity,' *The Energy Journal*, 8:1:17-38.
Joskow, P. and D. Marron (1992) 'What Does a Negawatt Really Cost? Evidence from Utility Conservation Programs,' *The Energy Journal*, 13:41-74.
Joskow, P. and R. Schmalensee (1983) *Markets for Power: An Analysis of Electric Utility Deregulation* (The MIT Press).
Kahn, A. (1988) *The Economics of Regulation* (The MIT Press).
Kahn, E. (1988) *Electric Utility Planning and Regulation* (American Council for an Energy Efficient Economy).
Krause, F., Haites, E., Howarth, R. and J. Koomey (1993) *Energy Policy in the Greenhouse*, Vol. II, Part I, (International Project for Sustainable Energy Paths).
Laffont, J.J. and J. Tirole (1993) *A Theory of Incentives in Procurement and Regulation* (The MIT Press).
Lovins, A. (1977) *Soft Energy Paths, Toward a Durable Peace* (Ballinger Publishing Company).
McKay, P. (1983) *Electric Empire: the Inside Story of Ontario Hydro* (The Alger Press Limited).
Moorhouse, J. (1986) *Electric Power: Deregulation and the Public Interest* (Pacific Research Institute for Public Policy).
National Research Council (US) (1986) *Electricity in Economic Growth* (National Academy Press).
Natural Resources Canada (1993) *Electric Power in Canada 1992* (Natural Resources Canada).
Posner, R. (1974) 'Theories of Economic Regulation,' *Bell Journal of Economics*, 5:335-58.
Ramsey, F. (1927) 'A Contribution to the Theory of Taxation,' *Economic Journal*, 37:47-61.
Randall, A. (1983) 'The Problem of Market Failure,' *Natural Resources Journal*, 24:130-48.
Roberts, M. and J. Bluhm (1981) *The Choices of Power: Utilities Face the Environmental Challenge*, (Harvard University Press).
Rose, K., Centolella, P. and B. Hobbs (1994) *Public Utility Commission Treatment of Environmental Externalities* (National Regulatory Research Institute).
Ruff, L. (1994) 'Stop Wheeling and Start Dealing: Resolving the Transmission Dilemma,' *The Electricity Journal*, 7:5:24-43.
Shepherd, W. (1984) 'Contestability versus Competition,' *American Economic Review*, 74:572-87.
Sutherland, R. (1991) 'Market Barriers to Energy-Efficiency Investments,' *The Energy Journal*, 12:3:15-34.
Stigler, G. (1971) 'The Economic Theory of Regulation,' *Bell Journal of Economics*, 2:3-21.
Tenenbaum, B., Lock, R. and J. Barker (1992) 'Electricity Privatization: Structural, Competitive and Regulatory Options,' *Energy Policy*, 20:10:1134-60.
Vickers, J. and G. Yarrow (1988) *Privatization: An Economic Analysis*, The MIT Press.
Vining, A. (1981) 'The History, Nature, Role and Future of Provincial Hydro Utilities,' in Tupper, A. and B. Doern (eds.) *Crown Corporations and Public Policy in Canada* (Institute for Research on Public Policy).
Woolf, T. (1994) 'Retail Competition in the Electricity Industry: Lessons from the United Kingdom,' *The Electricity Journal*, 7:5:56-63.
World Bank (1993) The World Bank's Role in the Electric Power Sector (World Bank).