ENERGY POLICY

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Summary

Broadly defined, energy policy addresses the economic, environmental, political, planning, and social aspects of energy supply and utilization that confront decision-makers, corporate planners, managers, consultants, politicians, and researchers. Frequently, energy measures will have some effect on most, if not all, of these

objectives with contradictory outcomes. In such a case a choice has to be made on the relative weight to be given to these respective policy objectives.

Energy is of considerable importance given its strategic relevance as a raw material for industry, particularly energy intensive industries, for the quality of life, and for the creation of jobs. The level of energy prices is a critical factor in production costs and prices, and consequently has an important impact on government policy relating to sustainable economic growth, job creation, and prosperity. However, energy use based upon combustion of fossil fuels has given rise to significant environmental problems, the solution to which is to reduce, either directly or indirectly, energy services from such sources. Thus, there is a conflict between energy as a driver of economic growth and energy as a major source of environmental degradation.

The aim of this article is to provide a background on the theory and application of policy as it relates to the energy sector, particularly with respect to market failures and potential policy remedies to the energy/ environment dilemma.

1. Introduction: An Historical Review

The use of energy by mankind has been an essential element in the supply of food, physical comfort, and the development of an organized society since the dawn of human existence some 4 million years ago. For most of this period, energy requirements were relatively modest, generally limited to the use of fire for warmth, cooking, and basic materials. In addition, wind and human "energy" permitted transportation by water, whilst the invention of the wheel gave similar advantages on land. However, it is only in comparatively recent times (that is, the last 2,000 years) that wind and water power have been harnessed to provide significant sources of power.

Perhaps the first significant increase in mankind's energy requirements came with the dawn of the Neolithic revolution. This period witnessed mankind's change from a dependence on hunting and gathering to the development of primitive agriculture, involving interrelated developments such as cultivation of plants, domestication of animals, settlement of communities, and the development of pottery and improved tool-making. However, with a relatively small human population and modest per capita consumption of heat and power, it was generally possible to maintain an approximate balance between renewable energy sources and demand.

The development of mechanical equipment based upon water and wind power led to a substantial increase in the power that could be harnessed. Water mills were used initially for irrigation and for grinding cereals, but by Roman times their use had been extended to other mechanical tasks such as driving sawmills. Windmills were used for similar tasks, although their value was limited by their intermittent operation. However, the energy component in the final product was very low, and it was not until the development of metal technology that power supply sufficient for the output of "energy intensive" products was required.

Copper was the first metal to come into widespread use. Although it is not very abundant, its reduction temperature is fairly low and the metal can be separated from its

ore with relative ease. Iron, whilst being more abundant than copper, is much more difficult to "win" from the ore due to the much higher reduction temperature that is required. Furnaces based upon charcoal as a fuel that could be used to smelt iron were not developed until about 1100 B.C. However, the new high-temperature technology, combined with widespread availability of iron ore and forests to provide charcoal, made it possible for the use of the metal to develop on an unprecedented scale. New tools made from iron transformed farming practices across Europe, although not without significant environmental impacts in England, the prime supplier of iron and iron products.

By the early Middle Ages, the forests of England had become badly depleted and production of iron ore declined for a period of time. Domestic consumption of wood also declined, as a result of increasing prices brought about by its relative scarcity. Its place in household use was taken by coal, despite resulting pollution from impurities in the coal (the same impurities that made it unsatisfactory for use in iron smelting). Rising household demand for coal stimulated the development of coal mines and mining technology, and production increased dramatically in England during the sixteenth and seventeenth centuries. By 1800 annual production amounted to 10 million tons, the vast majority of which was consumed in households. Demand for coal was further stimulated in the early eighteenth century by the discovery that coal's impurities could be removed by heating, making the resulting product (coke) ideal for reducing iron ore.

Expansion of the coal mining industry and the requirement to continuously pump water out of coal mines raised an urgent need for a new form of mechanical power. The subsequent development of the coal-fired steam engine formed the basis of Britain's industrial revolution of the eighteenth century, and witnessed the development of an energy-based technology that was to greatly influence the economic and social development of the world.

Development of another energy-based technology of global significance came about in the mid-nineteenth century with the evolution of the internal combustion engine. Development of the automobile and other road transport was associated with corresponding growth in the petroleum industry, and oil rose to join coal as the dominant fuels of the twentieth century.

Development of coal-fired generators in the 1890s witnessed the growth of a market for electricity. Electricity provided a new way of generating power, heat, and light. Although initially electricity was very expensive, limited to small areas on the network, supplied to varying standards, and subject to interruptions, further technological developments led to the creation of a very homogeneous, reliable, and time saving energy source. This new form of energy supply initially extended the importance of coal, but in the last quarter of the twentieth century nuclear power and natural gas grew in importance. Thus, despite the thermal losses associated with transforming fossil fuels into electricity, households and many forms of economic activity have tended to become increasingly electricity-intensive.

The twentieth century has also witnessed growing public concern over the impacts of large-scale energy use on the environment, although many of the concerns were evident

in more localized areas for some hundreds of years. Anecdotal evidence indicates that air pollution had been a concern in England as early as 1352 when a ban was introduced on coal burning in London.

Historically, regulatory instruments have been the basic mechanism for enacting environmental policy throughout the industrialized world. Environmental quality is seen as a public good that the state must secure by preventing private agents from damaging it. Direct regulation involves the imposition of standards (or even bans) regarding emissions and discharges, product or process characteristics and so on, through licensing and monitoring. Legislation usually forms the basis for this form of control, and compliance is generally mandatory with sanctions for non-compliance.

The proposal to impose taxes on pollution, whilst more recent, is also far from new, having been proposed at the turn of the century by the famous British economist Professor Arthur Cecil Pigou as a means of reducing London's famous fogs (or smogs). Pigou observed that pollution imposed uncovered costs on third parties that were not included in ordinary market transactions. His proposal was to tax pollution by means of a so-called externality tax in order to internalize within ordinary market transactions the damages caused by pollution.

Historically, therefore, energy policy has largely been driven by governments reacting to energy concerns, that are either direct (for example, scarcity) or indirect (for example, pollution), on an ad hoc basis. This is not surprising as the characteristics of every country's energy mix are unique, and thus the policy objectives of individual countries have varied correspondingly. For example, a country such as Norway that relies heavily on hydropower for domestic power, but is also a major exporter of oil and gas, would have very different energy concerns and thus policy priorities from Japan, which is poorly endowed with fossil fuel reserves and therefore has major security of supply concerns.

The first consolidated international approach to a major energy policy issue occurred in July 1957, when eighteen countries ratified the Statute of the International Atomic Energy Authority (IAEA). Although this move was initially designed to control the proliferation of nuclear weapons technology, the IAEA has also played a significant role in encouraging the adoption and safe operation of nuclear power electricity generating facilities. Subsequently, events surrounding the oil embargo, and the rapid oil price increases of 1973–4, led to the establishment of the International Energy Agency (IEA) by major developed nations of the world (all of whom at the time were major importers of crude oil). The primary role for the IEA was to coordinate energy security objectives and design oil-sharing agreements that could be invoked in the event of a future crisis. Since then, it has developed a far more broadly based work program reflecting changing global energy concerns.

Contemporary energy policy issues are dominated, directly and indirectly, by major concerns at both local and global levels of environmental degradation arising from combustion of fossil fuels. Even countries with relatively modest fossil fuel requirements, such as the poorer nations of Africa, Asia, and the South Pacific, could experience significant, if not catastrophic, consequences if the world's requirement for

energy from fossil fuels does not abate within a relatively short time frame. Consequently, the economics of renewable energy technologies has a core position in energy policy formulation over the foreseeable future.

2. Global Energy Markets

The most persistent trend in the world economy over the last two decades of the twentieth century has been the globalization of markets. Regional markets, with their specific characteristics as regards both consumer behavior and needs, are becoming less important. There are numerous driving forces behind globalization, the most important of which are far reaching changes in communication, transport, and technology. Similarly, there are numerous consequences of globalization, of which intensified world-wide competition is one of the most important.

The global aspects of energy markets are reinforced by the significant strategic aspects related to energy policy, in particular as regards security of energy supplies, and the considerable international trade in energy products, due to resources often being located in one region and markets in another.

The trend towards globalization of the energy sector has been reinforced by recent political changes, particularly in the countries of Central and Eastern Europe and of the Community of Independent States. At the economic level, the signing of the World Trade Organization Agreement signaled a strong commitment by the major economies to trade liberalization and market-oriented policies. Also of major significance was the signing of the Energy Charter with its commitment to the liberalization of trade and investments in the energy sector.

At the global level, world consumption of commercial energy is forecast to grow to around 13 billion tonnes of oil equivalent by 2020 (roughly 50 percent higher than in the year 2000). Notwithstanding this overall growth in demand, the physical availability of energy is unlikely to pose a constraint in the foreseeable future. Past concerns regarding available oil reserves have been eased by the pace of technological developments in exploration and production. It is therefore expected that the real price of oil, and consequently all energy supplies, will remain relatively stable, even if prices are occasionally volatile. Much of the world's vast reserves of solid fuel can be brought to market at considerably lower unit cost than the other main sources of primary energy and consequently coal can be expected to maintain its share of global energy supply due to its inherent price advantage. Gas will be the fastest growing fuel in the medium term. In the developed world, its environmental advantages combined with the lower capital costs associated with its use will make it the first choice in non-transport sectors, particularly electricity generation. The future share of nuclear power in world primary energy depends upon national program decisions yet to be taken. However, the prospects for growth for nuclear power in Asia are significant.

3. What is Energy Policy?

Policy is the response of government to the prevailing circumstances in a particular sphere of activity in a society. Government has a choice either to maintain the

prevailing circumstances because they need to meet certain social objectives, or to change those circumstances so as to ensure that certain social objectives will be met. Thus policy may consist of positive actions by government or simply the maintenance of the status quo.

Energy policy is also recognition that economic factors alone do not determine the outcome in the energy sector. Governments take on a responsibility for ensuring that the outcomes in the energy sector are consistent with a range of social objectives. If the only objective was economic efficiency in the energy sector then it could be argued that the only role for government is the maintenance of competition or the regulation of natural monopoly.

The energy sector however does not sit isolated from other spheres of activity in a modern society. In addition, within the energy sector itself competition is not sufficient even to produce efficiency outcomes where problems of externalities are involved.

Thus energy policy has to be concerned with not only efficiency but also concerns associated with social equity and the issues associated with environmental impacts of energy use, as well as long-term sustainability of the energy resources available to society. In addition, energy policy has to be made consistent with policy in other policy areas such as transportation, the built environment, industry policy, and taxation policies.

Increasingly energy policy conducted by national governments has to be operated in an international context. The prevailing perspective is one of the "global common," in which the energy policy actions of one country spill over in to positive or negative impacts on other countries. Thus national governments are not free to conduct energy policy in isolation from each other. The greenhouse issue in particular has given rise to a requirement for coordinated energy policies between countries so as to achieve not just national policy objectives, but also international policy objectives.

A range of "instruments" is available to governments to enable them to achieve their policy objectives. However, even if energy policy objectives are well defined, the instruments for achieving such objectives may not be so well defined. In addition, as the value of policy objectives changes continuous evaluation is required in order to ensure the effectiveness of the policy instrument "mix" available to the government. These evaluation processes raise the question as to which groups participate in the policy-making processes and the role of consultation by government over energy policy issues.

Energy policy can be considered on a number of levels. At the deepest level are those fundamental values that seek to address questions such as: what sources of energy should be used; who should own energy resources; and how should energy resources be utilized. This can include issues such as whether the government should promote a highly integrated energy supply system or a more diffused energy supply system. In the latter these fundamental value questions may be addressed by a range of individuals and groups according to their own preferences rather than through a centralized energy supply authority.

At another level there is scope for a genuine public debate over the choice of energy policy instruments to achieve objectives for which there may be general agreement. Examples may include debate of the merits of nuclear energy as a solution to the greenhouse problem, or subsidies for renewable energy technologies with the same intention.

Energy policy, therefore, is not just a matter of economics. It traverses the entire spectrum of concerns in society and highlights the role of government as the body established by society and empowered to deal with these concerns.

4. Energy Planning, Policy Instruments, and Constraints

4.1. Energy Policy Objectives

Energy policy objectives are the outcomes sought through the use of energy policy instruments. There is a range of policy objectives including:

- economic efficiency in the supply of energy
- efficiency in energy use
- diversity in the sources of supply of energy
- consistency between energy policy objectives and other policy objectives, especially environmental policy objectives
- energy security
- the cost and availability of energy resources to low income groups
- conservation of energy resources
- research in energy supply technologies
- the sustainability of energy supplies.

All of the above policy objectives will be discussed at greater length in this essay, commencing with the important issue of the guarantee of supply of energy to a country.

4.1.1. Security of Supply

An energy policy objective of paramount importance is the requirement to ensure continuity of supply. In a long-term perspective, policy needs to ensure that for all fuels there is a reliable and economic supply. In a shorter-term perspective, instruments are necessary to meet sudden supply interruptions. In the aftermath of the oil crises of the 1970s, IEA member countries introduce crisis measures that remain very much in evidence a quarter of a century later. Even if decreased diversification of fuels has limited the potential impact of future oil disruptions, some sectors of activity, such as transport, still remain heavily dependent on oil. Moreover, given the link between oil prices and other fuel prices, the consequences of another oil crisis would be rapidly communicated to all other energy sectors.

The increased use of natural gas and the import dependence of many OECD nations on pipeline gas or LNG has raised the question of security of supply for this fuel too. However no sector is so reliant on gas as the transport sector is on oil, whilst gas

resources are far more diversified than oil and thus alternative sources of supply are generally available.

A regular supply of solid fuels to the electricity sector is necessary to ensure a sufficiently diverse fuel mix for the generation of electricity. For many OECD nations, coal is the dominant fuel for electricity generation and the large diversity of suppliers means that the risk of a persistent interruption of supply, even in the long-term, is minimal.

Energy security is an essential consideration of some countries that have chosen to develop a large-scale nuclear power capacity because of their limited domestic energy sources, notably France and Japan. Ensuring security of supply of nuclear fuels is a fundamental objective for those nations who have little or no domestic access to uranium resources. Although there are very large global inventories in various forms, due mainly to dismantling of nuclear weapons, over-reliance on this source of supply would discourage world uranium production. This is undesirable, since the inventories are generally beyond the control of both operators and public authorities in the consuming country. As a result, uranium suppliers and consumers generally adhere to agreed long-term trade obligations and well-defined and rigorously controlled trade practices.

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Biographical Sketch

Anthony Owen is currently Associate Professor of Economics at The University of New South Wales, where he has been employed since 1974. He was Director of the Centre for Applied Economic Research (CAER) from 1989 to 1995, and has been Director of the University's Energy Research Development and Information Centre (ERDIC) since 2000. He has almost thirty years of research experience in the fields of econometrics, energy economics, and environmental economics, and currently serves on the International Editorial Boards of Energy Policy and Energy Economics. He was Conference Chair for the 23rd Annual International Conference of the International Association for Energy Economics, held in Sydney in June 2000. He has had extensive consulting experience with the Organization for Economic Co-operation and Development (OECD), and the Governments of Australia, Norway, and the United Kingdom. Professor Owen is the author of four books, five monographs and more than fifty papers published in academic journals. He is a Fellow of the Royal Statistical Society (FRSS).