CHAIRMAN'S INTRODUCTION

SECURITY OF ENERGY SUPPLY FOR ELECTRICITY GENERATION

David Pearce

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The issue

There are several contemporary reasons why OECD countries (or, for that matter, any country) should worry about where their primary energy comes from and what decisions are made within the electricity supply industry (ESI) about the use of fuels:

- The sources of supply may be able to exercise monopoly control over supply, raising its world price above the competitive market price;
- The sources of supply may be subject to political events which cause periodic interruptions in the quantity of primary energy supplied, generating both quantity shortages and price increases.
- The ESI may choose the 'wrong' mix of fuels for generation if it is not sensitive to the vulnerability of primary energy supplies.
- Imported energy contributes to trade deficits.

In an era of generally flexible exchange rates, the trade deficit argument no longer plays such a significant role in discussions about energy security, although it is prominent in some discussions.

These causes for concern have been considerably strengthened as the world experiences new threats from international terrorism and political upheaval. Physical shortages of energy, price increases and price variability can detract from conventional measures of economic wellbeing, e.g. GNP. Both may act as a significant factor in limiting the prospects for economic growth.

The first question that we might address, then, is whether energy security is a problem, and, if so, just how big a problem is it?

Markets and energy security

In years past when OECD countries could claim to have a more *dirigiste* notion of energy policy, one would have expected governments to take energy security into account by deliberately planning the mix of energy supply so as to have a portfolio of supply sources. As energy markets increasingly became liberalised and privatised, the element of dirigisme has declined and supply portfolios have increasingly become defined as whatever the market chooses them to be. The market should, of course, be

sensitive to security risks. After all, if oil or gas supplies are interrupted, or prices rise dramatically, there is the possibility that electricity generating profits will suffer. But the extent to which this happens depends in the degree and nature of regulation. All OECD countries practise some form of market regulation with price formulae that permit pass-on of some or all cost increases. In so far as these pricing formulae insulate the ESI from profit concerns, the industry may still neglect energy security issues.

Decisions within the ESI also affect energy security. If the ESI is not sensitive to security issues, it is likely to choose the wrong energy mix in the sense of choosing a portfolio of energy sources that is not consistent with a welfare-maximising goal.

A second question, then, is whether privatised but regulated electricity generating sectors are themselves at risk from energy security problems, or whether regulatory pricing regimes simply shift the burden to consumers.

Energy security as externality

For more than two decades now, energy and environmental economists have argued that, in a competitive market, energy prices will understate the true cost of supply. Roughly speaking, we might write:

> True cost = Competitive cost + normal profits + environmental externality + user cost + security of supply externality

An *externality* is a third-party effect from an economic decision, where that effect is not priced in the market. Pollution is the obvious example of an environmental externality. Unless electricity generators pay for the pollution they create through a tax or some regulatory restriction, market prices will be too low for overall economic efficiency. There is a very extensive literature addressing the nature of these externalities and their probable size. Self-evidently, the dirtier the fuel, the higher the externality. If these externalities could be incorporated into actual prices, e.g. through a set of taxes or some control over the merit order, then potentially powerful signals would be sent out to indicate that the more polluting fuels will be more expensive. The extent to which price would be raised because of the environmental externality is known as an 'adder', simply because it is like a tax that is added to the market price. Such price increases can act as a powerful incentive to restructure prices and provide an incentive to switch to less polluting technologies such as renewable energy. Nuclear power would also benefit from such a restructured set of prices, especially in respect of greenhouse gases and conventional air pollutants.

Another example usually treated as an environmental externality, but which can also be thought of as a security externality, is the 'scarcity premium', the cost of using energy now in terms of the forgone options in the future - also known as 'user cost' or 'royalty'. The greater the physical scarcity of the fuel, the more likely it is to be exhausted in the near future, and hence there arise a problem of long run supply security. The size of the scarcity premium depends on (a) the substitute or 'backstop' technology and its price, (b) the time within which the backstop technology can be introduced, (c) the discount rate and (d) the extent to which the current market accounts for this (longer run) scarcity.

The convention in this 'externality adder' literature is to express the adder as a sum per kilowatt hour.

A much smaller but parallel literature has developed on the notion of an 'energy security externality' (ESE). ESEs differ from environmental externalities because the effect is *pecuniary* rather than *physical*. That is, restrictions on supply create price or rationing effects which raise costs to the economy in general[1]. The very large literature on externalities in general – whatever their form – has often been used to justify government intervention. In the current context we could say that the resurgence of energy security issues is being used by some to argue for far more intervention in OECD energy markets, in a way turning the clock back to the days of more *dirigiste* energy policy. But interventions have their own costs and it is not always clear that intervention is always warranted. More subtly, it is much less clear as to what form that intervention should take.

A further issue to be addressed is: to what extent does the existence of energy security externalities justify governments intervening in energy markets? Put another way, how far do markets 'internalise' the security externality?

Defining energy security

While the notion of an ESE seems clear enough, the literature shows that precise definitions are not easy. The negative of security, *insecurity*, would seem to be characterised by the following features:

- Physically interruptions of supply such that 'normal' demand cannot be met
- Significant price increases identifiable as being supply-generated or, as noted above, arising from proximity to resource exhaustion
- *Price variability* plays in defining an ESE. Since much of the political concern has been about variability as well as 'high' prices, it seems correct to include variability in the definition. One reason for doing this is that variability makes investment planning difficult in many sectors where energy is a significant fraction of the costs of production.

The literature appears to be divided as to (a) what constitutes a significant or large price increase and (b) whether *forecast* price increases due to supply behaviour constitutes an ESE. In respect of the latter issue, if one has some probability distribution of future prices and quantities of fuel it should be possible to plan ahead. In such circumstances there would appear to be no externality – it has been 'internalised' in the decision-making procedure. But some authors argue that the distinction between anticipated and unanticipated effects is not relevant to whether or not there is an externality.

Two broad contexts define ESE issues:

- ESEs arising from decisions made within the ESI

[1] The economics literature summarises this distinction as being that between a *technological* externality (e.g. pollution) and a *pecuniary* externality. ESEs are pecuniary externalities.

- ESEs arising from factors external to the ESI

There is of course an overlap between these since decisions within the ESI about, say, generation mix may reflect external forces in international energy markets such as wars, monopolistic behaviour by OPEC etc. The issue is the extent to which the ESI correctly reflects those external factors in their decisions. But the 'external' factors may also arise from within-OECD regulation that affects the ESI. A clear example is pollution control which, when the regulation 'bites', may trigger step-changes in demand for cleaner fuels such as gas.

A significant part of the energy security literature is actually concerned with 'within ESI' decisions that are not necessarily linked to international events. Significant buying power ('monopsony') for example raises prices for the purchaser but the increased price is also experienced by other existing buyers so there is a 'monopsony wedge'. Market prices of electricity will be associated with a consumers' surplus which the ESI may not capture because of the difficulties of introducing highly variable pricing policies. Hence ruling prices are below what they could be if all rents were captured – so-called 'incomplete rent capture externality'. Finally, there are impacts on non-electricity markets because of decisions made within the ESI – so-called 'macroeconomic externalities'.

But it seems fair to say that the current focus on energy security is driven mainly by concerns about:

- Physical changes in regional reserves: e.g. European oil and gas supplies
- 'Geo-political' factors such as conflicts in the Middle East and potential political instability in the major new sources of oil and gas supply.

An issue for discussion is exactly what constitutes an energy security externality.

Implementing an ESE policy

Finally, we need to ask what could be done with estimates of ESEs.

The first point to make is that ESEs will vary by location of the ESI. This should occasion no surprise and does not differ in concept from the notion of a location-specific environmental adder. However, it does mean that no very general conclusions about the size of ESEs in OECD countries could be produced.

Second, an ESE will change as the nature of the supply risk changes. A war in the Middle East will raise the ESE, peace will reduce it. The issue then is how one translates ESE estimates into a (hypothetical) tax that could be imposed on fuels for electricity generation. There is likely to be a significant random component of such a security tax. But insurance and financial markets have expanded in recent years to encompass an ever-wider array of risks. The banking and insurance sectors are used to assessing political risk, and new derivative markets, such as those in catastrophe bonds, point the way towards risk assessment of major events.

A further issue is the extent to which we have information sufficient to identify and measure security risks.

Third, while we can estimate ESEs by looking at the counterfactual – what the price would have been had some supply interruption or price variation not occurred – it would also be useful to know how consumers value such effects, i.e. what is there willingness to pay (WTP) to avoid such events? There exists a literature on WTP to avoid outages which generally are not linked to primary supply issues, but more to decisions made within ESIs (e.g. the California experience). If outages can be linked to such events, then one might derive a WTP to avoid the primary supply changes. It is not obvious that the way a decision-maker would value supply effects such as price variability is the same as consumers' WTP to avoid those effects.

Suppose we overcome these problems of *externality measurement*. What kinds of policies might be implemented to take account of them, assuming the market is judged to have left them unaccounted for?

Here we may wish to think about interactions with other externality-correction policies. If environmental externalities are being addressed through measures such as emissions trading schemes (SOx in the USA, CO_2 in the EU), pollution taxes, subsidies to clean technology, renewable energy obligations, and so on, to what extent would ESEs change those measures? For example, would they mean we should have much tighter caps for emissions trading and higher environmental taxes? Technically, an ESE should be additive with an environmental externality, but how much price change will the market bear? Experience in Europe with fuel price taxes in the late 1990s and early 2000s could perhaps be taken as suggesting that there is some 'threshold' price which cannot be exceeded without significant social unrest. Put another way, perhaps there is some political upper bound to fuel prices.

The policy menu for dealing with ESEs is fairly extensive:

- direct regulation of new ESI capacity installation, using some 'security risk' ranking, including deliberately imposing a 'secure portfolio' on the ESI
- fuel taxes that vary with the degree of insecurity
- adapting existing emissions trading schemes for a 'security' factor
- introducing supply obligations for specified low risk fuels, and with the obligations being tradable
- subsidizing low security risk technologies and fuels
- investing heavily in energy efficiency
- investing in longer term storage options at terminals for oil, gas and LNG

If ESEs can be measured, which are the best policies to adopt to internalise them?

No doubt there are many other questions to be addressed. Let me then welcome you all and especially our speakers for what I am sure will be a stimulating day.