

PIU Energy Review

SECURITY – INITIAL SCOPING NOTE

Reference: Security 1 v1.0

Date: August 2001

1. PURPOSE OF THIS NOTE AND WAY FORWARD

- 1.1 This note sets out to review the state of current thinking on the issue of energy security. It discusses the wide-ranging ideas that surround the idea of security and poses questions that might be addressed.
- 1.2 This note deliberately refers to energy ‘security’ rather than ‘security of supply’ because of the possible implication in the idea of security of supply that any problems of security should be tackled by means of supply side measures alone, whereas demand-side policies may also contribute to better security.

<p>Readers should not assume that the PIU has in any respect closed its mind. Propositions are made, and questions are put, in order to draw responses.</p>
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- 1.3 We will be taking forward discussion of the questions and propositions raised in this note over the next two months.
- 1.4 This will be done via bi-lateral meetings with key stakeholders. We are also likely to arrange a workshop involving all key stakeholders where views on the key issues can be exchanged and debated, probably during October.
- 1.5 The PIU has already invited all interested parties to put submissions to it by 10th September on all aspects of the PIU Energy Review. Interested parties are invited to respond in their submissions to the questions and propositions raised in this scoping note.
- 1.6 We would also be grateful if interested parties could let us know as soon as possible if they consider this note overlooks key questions, if any of the questions posed, or propositions put, are fundamentally mis-conceived, or if the note contains any factual errors.

2. BACKGROUND

- 2.1 Concern about energy security has a long history. In the post-World War II period, there were concerns in the late 1940s and 1950s about the adequacy of UK coal supplies, at a time when international energy trade was limited. In the 1973/4 period, and again in 1979/80, there were oil price ‘shocks’ (as well as a limited oil embargo) that had large economic and industrial impacts in the industrialised countries, including the UK.
- 2.2 Since the last oil shock, EU and OECD countries have retained a strong interest in energy security, but – especially since the mid-1980s – world fossil fuel markets have generally been weak and oil prices historically low. During this period of apparent abundance in fossil fuel supplies, the UK and other Governments have mostly been able to pursue energy security with limited policy intervention, as market or political threats to security seemed limited. Since the late 1990s, however, energy security has been rising back up the agenda of more active policy-making. The Government’s 1998 White Paper¹ placed ‘secure, diverse and sustainable supplies of energy’ at the heart of its energy policy agenda, and implemented changes in electricity market structures as well as a temporary ‘stricter consents’ policy on gas-fired generation to ensure that diversity was not artificially reduced by market distortions.
- 2.3 There can also be threats to security from industrial action, for example the strikes by power station operators and coal miners during the early 1970s. Such events can influence subsequent energy policy and the industrial action of the early 1970s may have been a factor behind the energy liberalisation policies of the 1980s and 1990s.
- 2.4 In the last year or so, there have been further security issues. These include the impact of the blockade at oil product supply terminals in late 2000, the tripling of the world oil price, the repercussions of the electricity supply crisis in California, and growing concern in the UK about the consequences of a probable return to a position of being a net importer of energy within a few years. It is therefore a good moment to review the idea of energy security at a quite fundamental level and to examine possible policy approaches to enhancing security.
- 2.5 Notwithstanding the concerns outlined above, the major source of physical disruption to energy supplies in recent decades has been interruptions to electricity supplies arising from problems on local distribution networks, often due to adverse weather (high winds or snow).

¹ Department of Trade and Industry *Conclusions of the Review of Energy Sources for Power Generation and Government Response to fourth and fifth Reports of the Trade and Industry Committee* Cm 4071, October 1998

3. WHAT IS ENERGY SECURITY?

3.1 There is no simple or universally agreed definition of energy security. Its most widespread operational meaning in the last 30 years has been concern that imported fossil fuel supply (mainly oil) might be, or become, ‘insecure’. This insecurity has both a short-term and a longer-term component:

- In the short-term the concern has been that oil may be *physically* unavailable from exporting countries;
- In the longer-term, the worry has been that oil might become scarce, due to resource exhaustion, market power or political action, so causing a steeply rising, or volatile, *price* of oil.

These potential risks are often referred to as *strategic* and policy responses at a geo-political level have been common.

3.2 However there have also been other concerns about security in relation to energy networks. Here the risk is that energy is not reliably delivered to final consumers because of an inability of a network – typically electricity wires, gas pipes or petrol delivery infrastructures – or key piece of infrastructure, such as a gas terminal or major refinery, to perform as planned.

- Short- term elements to this kind of ‘insecurity’ also involve *physical* disruption, to petrol, electricity or gas supplies. Causes include bad weather, inadequate capacity or industrial action.
- Long-term elements involve the possibility that insufficient investment may take place either in the network, or in production facilities such as power plants or oil refineries, threatening long-term continuity of supply and probably putting sharp upward pressure on prices.

These are often referred to as *system* risks and tend to elicit quite different policy responses than those applied to strategic risk.

3.3 However there is evidently a continuum between strategic and system risk. Both are essentially about the overall process of delivering energy from its original source to consumers, and the simplest way of thinking about the whole process is in terms of identifying the ‘weak links’ between original source and consumer.

Question: *what is the appropriate balance between emphasis on short-term physical elements of security and longer-term price elements, bearing in mind that as we look further into the future, security seems increasingly to resemble long-term economic objectives?*

Question: *bearing in mind other objectives of energy policy, especially economic (achievement of low costs) and environmental (especially tackling climate change), what priority among policy objectives should be given to the idea of security?*

Question: *what are the weak links in the supply and delivery chains for the different sources of energy?*

- 3.4 Because of the wide-ranging nature of ‘security’ it may be more useful and precise to express ‘security’ issues in terms of *risks*. ‘Security’ questions then turn into more clearly defined problems such as the risk of a new OPEC oil embargo, or the risk of an electricity supply network having inadequate capacity. Security can never be absolute and the amount of security required depends on the extent of risk aversion. In general, increases in security will require increased costs.

Question: security policy is sometimes framed in terms of an insurance analogy: policy may involve the payment of a set of ‘risk premiums’ in order to guard against a range of possible future events. Is this a useful approach to thinking about security?

- 3.5 There is an important conceptual distinction between strategic and system risk in terms of quantification. Strategic risk is more or less by definition impossible to express quantitatively: it is not meaningful to argue that the chance of a strategic supply shock is X%. However, some kinds of system reliability are capable of being expressed in a quantitative framework more credibly. Under the old nationalised electricity system in England and Wales, the planners had a specific ‘generation security standard’ to aim for, amounting at one time to the probability that in 3 winters per century there would be a shortfall in capacity and therefore limited blackouts.

Question: if there is a quantifiable framework in which to gain some idea of the ‘insurance’ benefits of paying a system security insurance premium, but no such framework for making the same calculation in the case of strategic security, how can policy-makers reach conclusions about the right balance of effort to give to insuring against strategic rather than against system risks?

- 3.6 Different types of security risks would affect different classes of consumer in different ways. Some events might be faced rather randomly by a whole population (for example, events which led to rolling electricity blackouts). Though there is likely to be special provision for emergency services etc., the risks are therefore likely to be borne more or less equally across the society, as will the costs of raising security levels. However, for other risks the level of security may well vary by customer group. For example, rural consumers may well suffer disproportionately from electricity blackouts in bad weather because of the vulnerability of rural supply lines, while some industrial consumers may suffer less because they have made their own provision for emergency supplies. This raises the issue of who pays and who benefits from policy measures designed to improve security levels.
- 3.7 Related to 3.6, it is often pointed out that different consumers would like, if their preferences could be expressed, to have different levels of security, and would pay more or less accordingly. It is sometimes suggested that the problem with existing system security standards is that for some industrial and domestic consumers security may be too *high* rather than too low. In such situations, it may be possible to charge some consumers less for their energy in return for more frequent interruptions, and others may be charged more and

get a more reliable supply. It is certainly already true that some industrial and commercial consumers do negotiate interruptible tariffs at lower levels whereas others who require a higher level of security install their own back-up facilities. The problem with extending this principle across other consumer groups may be that it would be politically difficult to reduce security standards (it seems to imply technological retrogression) and also politically difficult to attempt to have different security standards for different domestic consumers. There may also be practical, network-based obstacles to delivering different levels of security to small consumers in an integrated system.

Question: *is it (a) practical and (b) desirable for there to be different security standards for different consumers? To what extent should energy suppliers be encouraged to offer a range of products with varying degrees of security?*

4. WHY DOES ENERGY SECURITY MATTER?

- 4.1 Risks are pervasive in energy as in many other areas, so there is a serious question as to why energy security risks matter so much. There are two parts to the possible answer.
- 4.2 First, there is a huge asymmetry between the costs associated with securing a unit of energy and the costs – social and economic - associated with failing to secure it. The economic and social consequences of unsupplied energy are vast when the interruption is unanticipated or where there is a total loss of supply to a consumer². In the former England and Wales electricity market (the Pool) the value placed on a unit of ‘lost load’ (unserved electricity) was put around 100 times as high as the cost of buying the same unit when available.³ Even a quite small risk, multiplied by so large an economic consequence, naturally draws attention to the need to minimise risks of interruption.
- 4.3 The second part to the answer is that governments have commonly argued that it is necessary for policy interventions to reduce risks. This however is not axiomatic. Some economists and analysts regard competitive markets as the best guarantor of sufficient security (or adequately low risks). However, others point to a number of ‘market failures’ which suggest that markets will tend to under-supply security relative to a socially desirable level, and because of which governments frequently intervene, normally with the intention of improving security.
- 4.4 Among the imperfections or failures that are sometimes argued are:
- The existence of regulated ‘natural monopolies’ in electricity and gas networks

² With warning, consumers can reduce non-essential energy use with relatively little loss of welfare and such reductions may be enough to balance demand and supply. Where a consumer loses all supply, such as a household suffering an electricity supply interruption, both high and low value electricity uses are foregone.

³ Department of Trade and Industry, op. cit. para. 4.3, p.23.

- The inability of small consumers to express their preferences in relation to security under the existing market structures
- The collective risk aversion of company decisions that determine the overall security of an energy system may be different from collective societal risk aversion. Such corporate risk aversion may be less than societal risk aversion if some of the economic and social consequences of supply interruptions can be passed on to consumers.

There are also the political problems that governments often disallow the price spikes that might otherwise resolve short-term shortages and that the observable consequence of energy supply disruptions seems to be that governments are in the end held accountable for the failure. For a variety of these reasons governments tend to take a relatively active policy stance over energy security.

Question: do existing, mostly competitive, energy markets deal adequately with risks to energy security?

Question: are market failures large enough to suggest that existing markets do not provide the 'right' levels of security?

Question: if these market failures are large enough, can we be confident that Government interventions to correct for the failures will generally have the desired results, especially bearing in mind the difficulties of measuring the risk reduction/cost trade-off?

5. STRATEGIC SECURITY: CURRENT ISSUES

- 5.1 The most central concern to the EU in strategic security is the prospect of import dependence rising from 50% to 70% by 2030,⁴ coupled with the prospect of limited numbers of supplying companies (market power) and a limited number of supplying countries of limited stability (political risk). 'Import dependence' can also be fairly described as increasing participation in trade, which UK and EU policy generally regards as beneficial. The issue is therefore not so much trade, which in competitive conditions would seem desirable, as the potential exercise of market or political power on the part of trading partners.
- 5.2 For the UK the prospect of moving from a position of net exporter to net importer of fossil fuels is a principal concern. According to Wood Mackenzie the UK will likely import between 55% and 90% of its gas needs by 2020⁵. On the other hand, the UK used to import up to 25% of its gas as recently as the late 1980s, without any apparent concern. All this gas was from Norway

⁴ Commission of the European Communities *Towards a European strategy for the security of energy supply* Green Paper, COM (2000) 769 Final, Brussels 29.11.00, p.9.

⁵ A summary of the Wood Mackenzie report is at Annex C of the October 1998 DTI White Paper, Cm 4071.

and this suggests that the nature of UK concern is not potential market power, but the possibly erratic use of political power on the part of other prospective suppliers. These gas imports were also at a time when gas was not much used for electricity generation and thus constituted a smaller part of the UK's overall energy needs.

- 5.3 The UK is fortunate in having access to substantial reserves of fossil fuel that have enabled the country to be a net energy exporter in recent years. Some of our major competitors, notably Canada and Australia are in a similar position and may remain net exporters for longer. However, most of our major competitors are already net importers of energy. The USA imports about 20% of its energy needs, France and Germany both import about half their needs whilst in Italy and Japan imports meet about 80% of energy needs.

Question: to what extent should we be concerned about importing a proportion of our energy needs? Where there is concern about security of supply from a particular set of overseas suppliers, how far should we be concerned with market power (limited number of suppliers) or with political unreliability, or are the two inextricably linked in the cases of, say, gas supply and Middle East OPEC oil supply?

6. SYSTEM SECURITY: CURRENT ISSUES

- 6.1 The main issues of current concern in the UK in system security relate to adequacy of investment in either production or transmission capacity in the gas and electricity networks. Two factors have led to concern about adequacy of the incentives for investment in electricity generation. First, there is the crisis in the electricity system in California, where a substantial surplus of plant turned into a deficit in only five years. Second, there has been the change in electricity trading rules (from the Pool to NETA). In the new system, there are no capacity payments and new entry may be more risky than before. In these circumstances, close consideration is being given to electricity security issues on the side of generation, and a new OFGEM/DTI committee will monitor security issues of this sort, alongside gas security issues, on a continuing basis.
- 6.2 The second issue concerns the adequacy of the transmission networks themselves. Two particular concerns exist. First, there is a potential issue over the adequacy of the gas network. The Transco network has had to handle very large increases in gas volumes in recent years, to which has been added the large interconnector to Belgium. In a situation where gas may increasingly have to be imported, there have been worries whether the present price control regime covering Transco's pricing takes adequate account of these large and long-term issues and the investment needs associated with them. In particular, there is currently some unease over long term investment in entry capacity to the National Transmission System. The second network where actual vulnerability has been exposed recently is the motor fuel road network, where a blockade last autumn led to shortages of fuel within a relatively short time.

Issues here include the just-in-time system of industrial organisation: deliveries that arrive ‘just in time’ save stock costs, but may leave systems more vulnerable to disruption.

Question: is the current regulatory regime for electricity and gas networks, led by OFGEM, adequate to minimise risks of power or gas shortfalls due to inadequate production capacity or network inadequacy?

7. POLICY APPROACHES TO SECURITY: GENERIC IDEAS

- 7.1 The Government’s 1998 White Paper laid stress on the importance of ‘diverse and secure supplies’. It discussed diversity at length, and argued that diversity was a major element in ensuring security. Diversity will clearly in many circumstances promote security, both of strategic and system types, by simply ‘having fewer eggs in one basket’. Diversity is a property of a system rather than of a particular option, technology or policy, and so the same policy or market trend may lead to greater diversity in some circumstances, and to less in others. In the 1990s adding gas to the UK generation system represented an increase in diversity (because there was no gas generation in 1990) while in future it will reduce diversity (because it is now the largest fuel in generation).
- 7.2 Diversity will often assist strategic security by increasing the number of supplying companies, countries or fuels, and can also assist system security, by adding more technologies or fuel types. Diversity can be to a degree measured, for example by the Shannon-Wiener index, combining sub-indices of variety (number of options), balance (proportion of system represented by each option) and difference (a more subjective measure of the ‘distance’ between one option and another).
- 7.3 However, diversity and security are not completely overlapping ideas. Diversity is perhaps best seen as a general hedge against uncertainty, rather than only against risks of physical supply interruption or high prices. Some increases in diversity may lead to similar or lower levels of security (eg adding intermittent electricity technologies to a system may lead to an increased risk of system breakdown) and equally there are many policies to improve security that are unconnected to diversity (eg stockpiling a particular type of fuel).
- 7.4 It is sometimes argued that markets will provide adequate levels of diversity if competitive enough, as firms will provide variety and choice to customers. On the other hand, the private electricity generation market in England and Wales appeared first to add to diversity, and then to reduce it, by investing in the same, single favoured gas-using technology, albeit with gas being mainly obtained from a variety of UK sources.

Question: can we rely on private competitive markets to promote adequate levels of diversity to ensure security, or do we need policy interventions to correct for ‘market failure’ in diversity?

- 7.5 Other related ideas are often invoked as generally useful in pursuit of security. These include notions of robustness, flexibility and responsiveness as system properties. While all of these ideas are related, all are slightly different, and they all have the disadvantage compared to diversity of being very difficult to measure with any degree of accuracy. Flexibility and responsiveness are often associated with competitive market behaviours, while robustness has a more engineering-based origin and is often held to be present in such areas as power system planning, where robustness might be promoted by running a large margin of spare plant capacity.

***Question:** how far are generic ideas like diversity, robustness and flexibility a useful starting point for analysis of the risks against which security policies are designed to protect?*

8. SPECIFIC POLICY APPROACHES

- 8.1 Specific policy initiatives in energy security usually operate either on the demand for energy or the supply side. However, there are a few issues which transcend the demand/supply divide. The most important one is ‘subsidiarity’ – what is the appropriate level of action (sub-national, national or international) in pursuit of security. For strategic security, international bodies like the European Union and the International Energy Agency can clearly play a role in providing common approaches, and increasing bargaining power, although they may also have a role in encouraging free trade and market liberalisation. For system security, international action may also be helpful eg the extension of interconnectors which allow larger quantities of network energy to flow in trade. For system security some policy actions work best at national and possibly devolved and regional levels (eg reinforcement of local networks in ‘energy importing’ or rural areas).
- 8.2 A second area, cross-cutting demand and supply, is innovation and technical development. The International Energy Agency (IEA) was set up in 1974 largely to promote better OECD strategic security, and a major part of its activity has been the promotion of energy R&D, aiming at developing new technologies and fuels on both demand and supply sides, to add to the diversity of energy choices available in the longer term.

Supply side approaches

- 8.3 There is a very wide range of approaches and policies available on the supply side to reduce risk of physical energy interruption or rapidly rising prices. They are generally aimed mostly at strategic security though a few will also promote system security. Some of the most important are:
- In a market-based framework there are two ways of trying to secure supply in the longer term. One is to sign long-term contracts for physical supply at agreed prices, and the other is to hedge in relevant forward or futures

markets. The relative merits of these two approaches is disputed: neither offers guarantee of long-term physical supply.

- Within a market or a policy framework, fuels may be stockpiled beyond the commercially required inventory (as in the 90 days' oil reserve under IEA organisation)
- Again within a market or policy framework, electricity generation may be fitted with multi-firing capacity, so that fuelling can be rapidly switched among two, three or even four fuels (at rising cost)
- Within policy frameworks, incentives may be provided within regulatory systems to encourage firms to invest in production or network assets
- Preference may be given to domestic sources of energy production, even where these are at higher costs than imports (Germany's protection of its coal industry is a clear case) on the grounds that 'home' energy will be more secure. In practice it is not always certain that domestic sources are always more reliable than imports.
- Promotion of market liberalisation can help to ensure that existing infrastructure is used as efficiently as possible and reduce the risk of assets remaining unused at times of system stress.

At the purely political level, there may be dialogue processes with energy producers, designed to make supplies more secure. These are often pursued internationally, and the Energy Charter Treaty with the former Soviet Union formalises the dialogue process to a high degree, and involves agreements about detailed issues of investment in the former Soviet Union.

Demand-side approaches

8.4 On the demand side, sometimes relatively neglected, approaches and policies generally are useful simultaneously for strategic and system security

- A wide range of energy-saving, energy-efficiency or energy conservation measures will tend both to help strategic security (via needing fewer imports) and system security (by reducing pressure on systems, especially at peaks.) For short-medium term system security, measures which cut peak demand in electricity are especially useful⁶.

Two particular cases of demand side approaches are:

- Interruptible contracts for larger users (and in principle for smaller users) are a particular case of a demand-side measure which can reduce the height of peak demands
- Efforts to encourage modal shifts in transport energy demand away from road towards the more energy efficient rail transport.

Question: what is the appropriate balance between market-based and more 'political' approaches to security?

Question: what is the appropriate balance between instruments and approaches on the supply side and the demand side?

⁶ In the longer term, capacity would tend to downsize to match the lower demand peak and replacement capacity might still be required.

Question: among all the instruments described, which are the most appropriate in the UK's situation?

Question: is there a risk that government measures to improve security would undermine provision of security by the market, perhaps in the way that insurance might reduce the incentive to avoid risks?

Question: what sort of government measures are most likely to add to the security that the market would otherwise have provided?

9. CROSS-CUTTING ISSUES, CONFLICTS AND SYNERGIES

- 9.1 Finally it is worth looking at the relationship between security objectives and other objectives. It is often argued that pursuit of security, while purchased at a premium, is in harmony with pursuit of environmental improvement including mitigation of climate change. However the range of possible approaches and policies to security is very broad and while many policies that help security also benefit the environment, not all can do so.

Question: how far is it true that pursuit of security and of environmental objectives are synergistic?

Question: should we only use security policies that harmonise with environmental objectives compared to those which do not?

- 9.2 Another way of looking at the relationship between security and other objectives is to ask the following question: how far will market developments, or pursuit of policies designed to achieve other objectives than security, impact on security risks? It is worth listing three broad areas of market and policy issues where this question is relevant at present in the UK and where the answer may not be unambiguous:

- Competitive markets are good for security by reducing market power, encouraging producers to pay attention to consumer needs, and encouraging consumers to think more about what their needs are and consider alternative ways of meeting them. However they may produce short-term investment behaviour that adheres to a single low-cost option that may reduce diversity. In addition the lack of any co-ordinating body in a liberalised market requires that market signals for investment work effectively. In capital-intensive industries subject to intervention to cap high prices, this may not always be achieved easily;
- OFGEM explicitly takes into account the investment needs of the gas and electricity transmission companies when setting their price controls. However close attention to immediate needs and past experience that companies have spent less on capital than they expected, may lead to so stringent a view of future investment needs that security may be compromised. OFGEM are working to develop ways to improve understanding of the demands for network services and incentives for network providers to respond to those demands.

- In recent years there have been moves towards a wider dissemination of small-scale renewables and generally towards more local ('distributed') generation sources including combined heat and power. This may be good for security in that local consumers have access to local supplies but bad for security in that intermittent distributed sources may lead to lower system reliability.

Question: in these three areas, is the net result of market developments to lead to greater or lesser security, or is it impossible to judge?