International Energy Agency

GAS EMERGENCY POLICY: WHERE DO IEA COUNTRIES STAND?

INFORMATION PAPER

James Simpson and Kyung-Seok Min

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This information paper was prepared for the IEA Governing Board meeting in May 2011. It was drafted by the Emergency Policy Division. This paper reflects the views of the International Energy Agency (IEA) Secretariat, but does not necessarily reflect those of individual IEA member countries. For further information, please contact James Simpson or Kyung-Seok Min at ***james.simpson@iea.org*** *and* ***kyung-seok.min@iea.org****.*

2011 May

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea (Republic of)
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The European Commission also participates in the work of the IEA.

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Introduction

In the final communiqué of the meeting of the IEA Governing Board at Ministerial Level in October 2009, Ministers agreed that:

"The IEA can play a strong role in helping member countries improve their preparedness for possible gas supply disruptions, and co-ordinate their actions in case of an emergency, when appropriate". More specifically, "With respect to emergency response capabilities for natural gas, we [Ministers] agreed […] to endorse a role for the IEA to monitor progress in gas market and gas security policy of its member countries."

This Information Paper summarises the results of a questionnaire on natural gas emergency policies and practices, developed by the IEA in co-ordination with the European Commission. All responses were received by November 2010.

Background

The questionnaire aimed to collect information on the emergency preparedness of IEA member countries in general and, more specifically, to assess and improve the natural gas emergency preparedness of these countries and of the IEA as a whole. It also sought to provide the IEA Secretariat with a better understanding of the functioning of countries' gas markets in times of crisis.

To clearly assess a given country's exposure to a potential gas supply disruption, it is important to have detailed information – both qualitative and quantitative – on key infrastructure aspects, as well as a strong understanding of government's and/or industry players' options and abilities to react quickly to disturbances in their domestic markets. There is no simple or single solution for addressing a country's gas security concerns; a variety of measures are available, spanning both external resilience (*e.g.* diversification of supply routes and suppliers) and internal resilience (*e.g.* storage).

The IEA Secretariat developed a "scorecard" to assess and compare the levels of preparedness according to certain numerical criteria. When individual country responses proved to be insufficient in terms of data disclosure or quality, the Secretariat also used information available from the data submissions that are made to the IEA.[1]

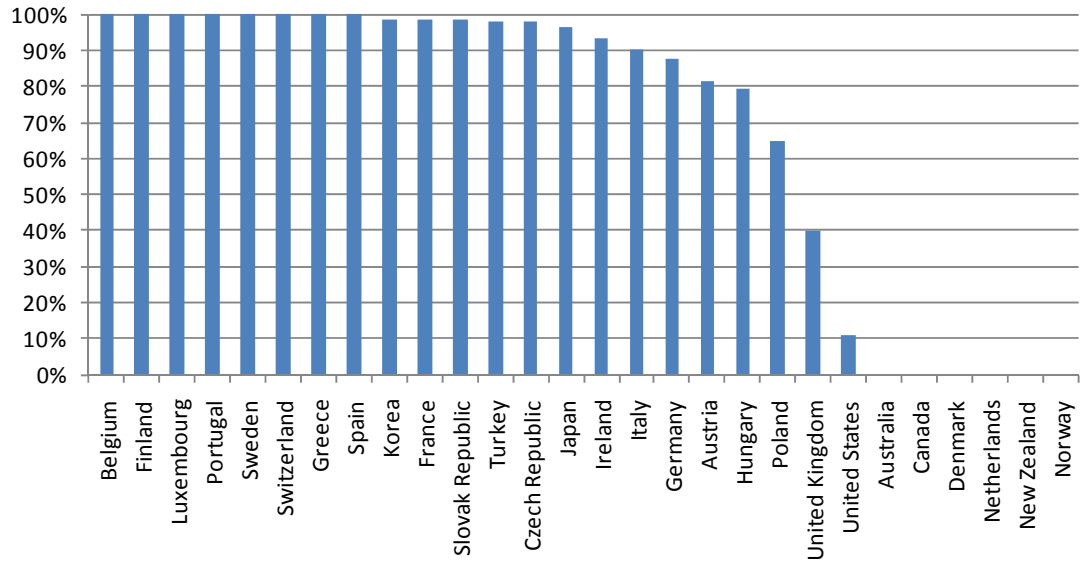
Supply

Most IEA member countries depend on imports to meet their domestic gas needs. Only six member countries are not dependent on imports; of the six, five are net exporters.

On the opposite end of the spectrum, 8 member countries are 100% import dependent while 16 have an import dependence exceeding 90%. On a regional level, high levels of dependence on foreign gas are mainly found in most of Europe and Asia (Japan/Korea). Member countries in North America, Oceania and the peripheral European countries of the North Sea are relatively well-endowed in terms of gas resources and thus not exposed to the same inherent import risk.

1 Regarding specific policies mentioned in the questionnaire, a lack of response is assumed to mean that such a policy does not currently exist in the country.

Figure 1. Natural gas import dependence



Note: All figures in this document are based on 2010 data, unless indicated otherwise.

Source: IEA Monthly Gas Statistics.

Only 2 member countries report an increase in their domestic supplies in the upcoming 5 to 10 years, whereas 16 countries indicate that their dependence on foreign imports is set to grow. Of note, over the past five years, the United Kingdom has moved from being almost self-sufficient on an annual basis to a situation in which 40% of its annual demand is imported. Only the United States has reduced its import dependency in recent years, due to the impressive growth in unconventional gas production.

On a more positive note, most IEA member countries benefit from relatively diversified sources of imported gas. This is particularly the case for countries dependent on liquefied natural gas (LNG) supplies, in both Asia and Europe, where specific policies have been put in place in order to limit import reliance on any one country. The greatest exposure to a single supplier is in Eastern Europe, where countries from the Baltic to the Balkans show a common structural infrastructure reliance on Russian gas imports.

Demand

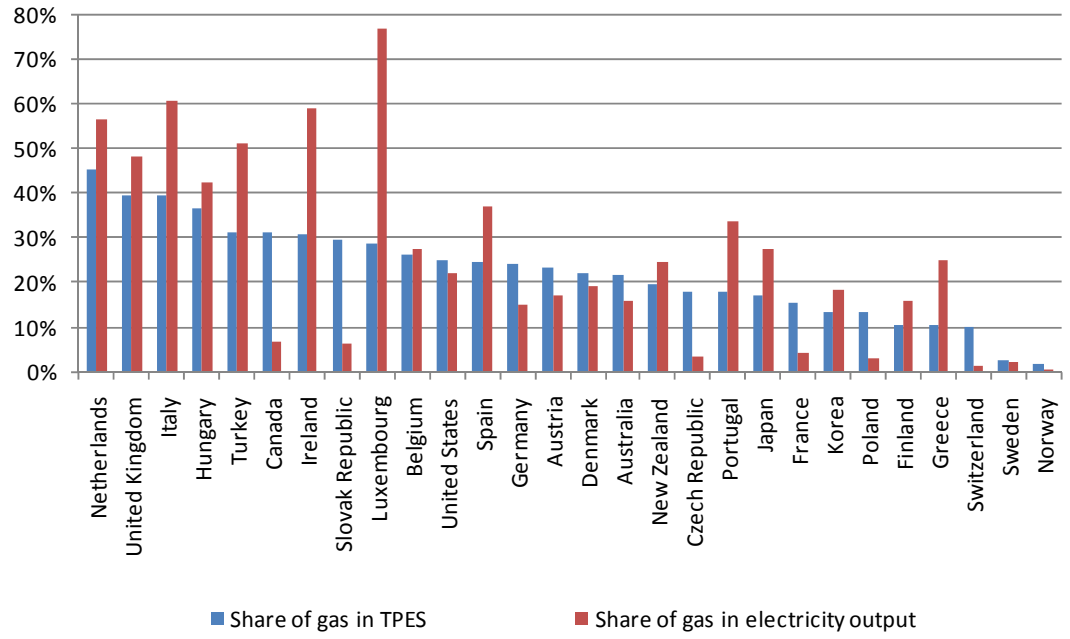
Gas accounts for over 10% of total primary energy supply (TPES) in 26 out of 28 IEA member countries: 16 of these countries are dependent on gas for more than 20% of their TPES; in seven countries, the share of gas exceeds 30%.

In many IEA member countries, the power sector is particularly dependent on natural gas, and this dependence is growing. Gas accounts for over 20% of power generation in 14 countries, and over 30% in 9 countries; five countries rely on gas for over half of their power generation.

More importantly, 17 IEA member countries expect their demand for gas to increase in the future. This is notably because natural gas carries a lower carbon footprint than other fossil fuels and its flexibility (both technically and economically) as back-up generation is highly desirable as a means of counterbalancing the growing share of variable renewable energies. In effect, gas and

electricity security are becoming enmeshed. Combined with the fact that a similar number of countries expect their dependence on foreign imports to grow, this highlights the need for countries to address the dual pressures of growing demand and import dependency.

Figure 2. Importance of natural gas in the energy mix of IEA member countries



Source: IEA Monthly Gas Statistics.

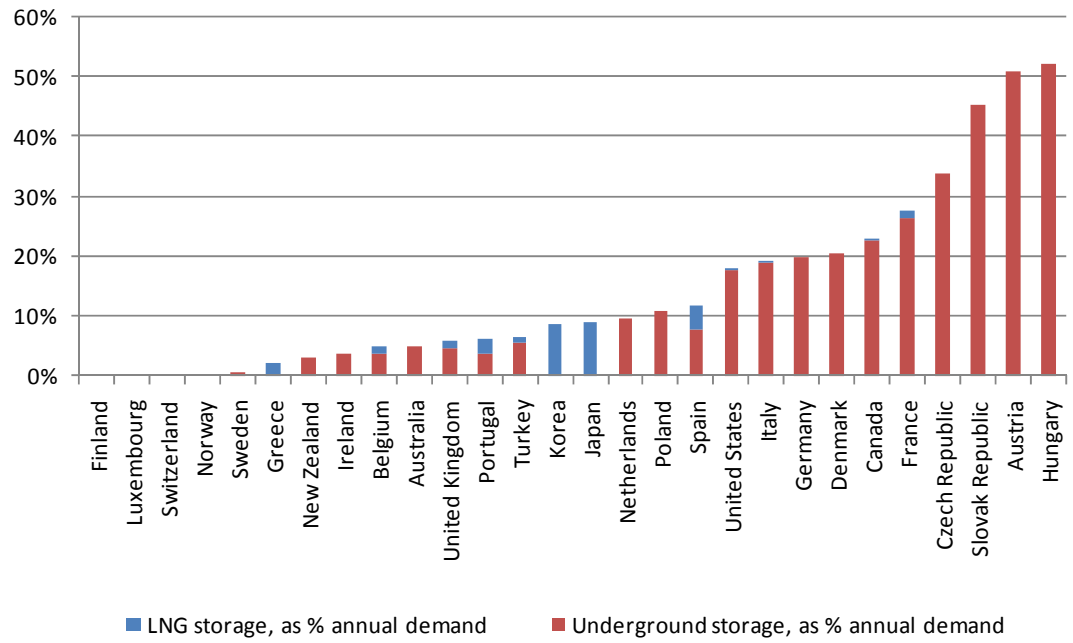
Peak demand exceeds average demand by more than 50% in 25 of 28 IEA member countries, and exceeds average demand by a factor of as much as 100% for more than one-third of IEA member countries. This can be due to seasonal factors where heating is the main end use; in France, for example, January demand can be four times August demand. This volatility of demand can be exacerbated by the increasing role of gas in power – especially where such power meets peak demand, fills gaps when other plants are unexpectedly unavailable, and/or is increasingly used as back-up for variable renewables – resulting in quite sharp demand peaks for gas. Regions with these demand patterns will need flexible arrangements to ensure secure supply, including differing types of storage (including storage with quicker drawdown rates to meet power sector needs), as well as the more traditional long-term supply contracts. Flexible infrastructure and markets will also be especially important in these cases.

Storage

Storage is a valuable tool for responding to demand swings. Of note, Hungary has a dedicated stockholding agency with 1.2 billion cubic metres (bcm) of gas held as government-controlled strategic storage as of 2010, and seven other European countries have imposed some form of gas storage obligation. In some countries, the transmission system operator (TSO) books a share of the country's commercial storage capacity to meet its security standards. These storage measures provide a powerful tool for correcting acute, short-term market shortages.

More generally, commercial storage has been developed in the vast majority of IEA countries, as a means of addressing both seasonal variations in demand and situations of peak demand. Underground storage (UGS) remains the most common option, but the possibilities of developing it vary according to the geology. Some countries have resorted to developing LNG storage as an alternative, although this is much more costly and therefore limited in size.

Figure 3. Storage capacities, as percentage of annual demand

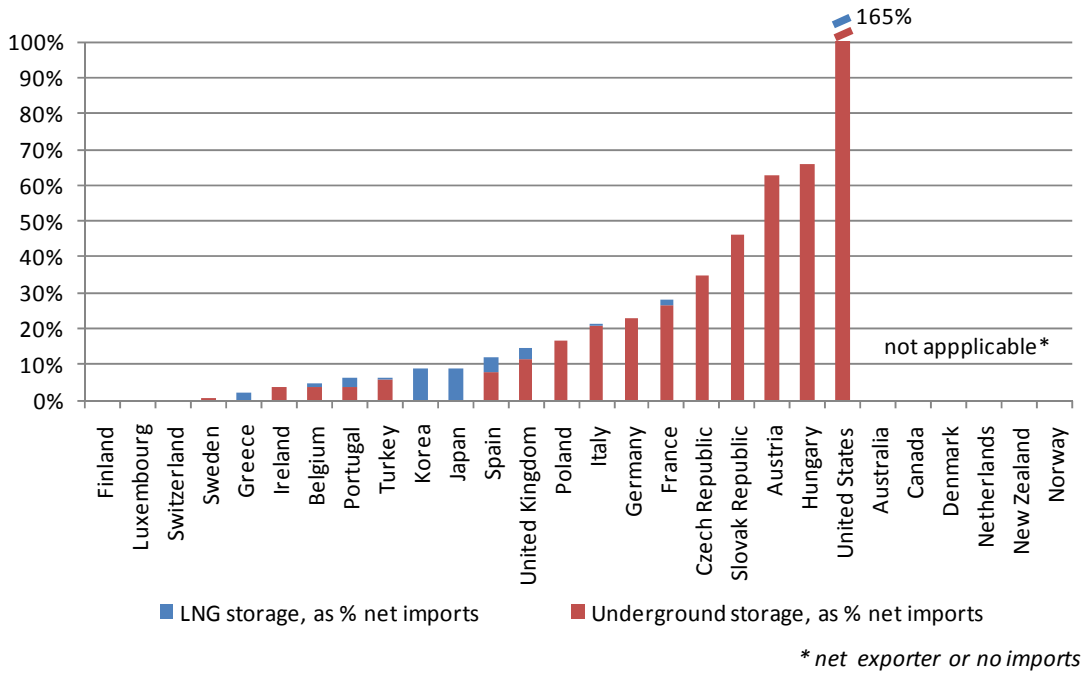


Source: IEA Monthly Gas Statistics.

Four IEA member countries have no gas storage facilities at present. Norway is a large net exporter of gas and consumes only small volumes itself. Luxembourg is very well connected to its surrounding countries, which provide the necessary storage. Switzerland has opted for a policy that obliges gas importers to hold volumes of heating oil stocks equivalent to 4.5 months of the total gas consumed by dual-fired installations on an annual basis. Finland requires all non-industrial players to hold three months of alternative fuels.

The number of LNG regasification terminals has grown significantly within IEA member countries in recent years, providing both a means of stable, flexible and diversified gas supplies, and a source of short-term storage at the terminal site. Of note, 100% of storage capacity in Japan, Korea and Greece is held at LNG regasification sites; both Japan and Korea have built a large number of LNG terminals across the countries, thus forming a highly resilient basis of their gas supplies. LNG storage also accounts for a large share of national storage capacity in Spain (33%) and Belgium (25%). The United States has built numerous LNG terminals, but at present most are significantly under-utilised because of the boom in domestic gas production. The low level of import dependency in the United States means that domestic storage already provides a very high level of resilience (Figure 4).

Figure 4. Storage capacities, as percentage of net imports



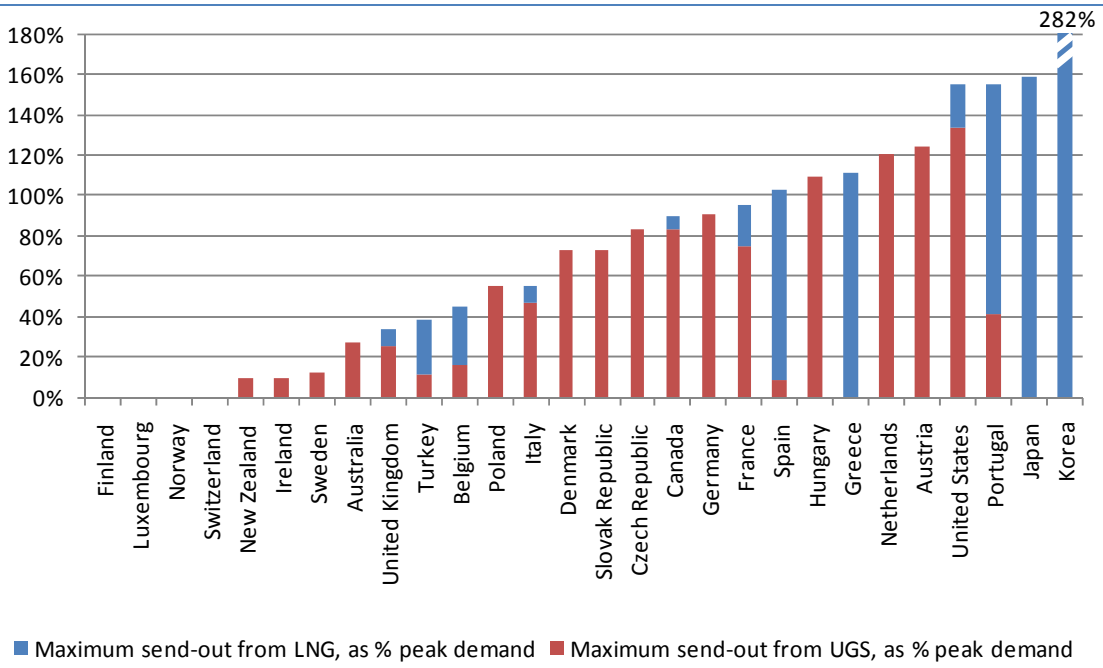
Source: IEA Monthly Gas Statistics.

Taking both underground and LNG storage capacities together, 12 countries have storage capacity that can meet at least 10% of annual demand; storage capacity surpasses 20% of annual demand for eight countries. Only two countries – Hungary and Austria – have gas storage capacity that surpasses 50% of annual demand. In Hungary, this has been achieved through government-designed public stockbuilding; Austria's high gas storage levels are commercially developed depleted fields.

The IEA Secretariat was unable to collect precise data from all countries, but available data suggest that 13 of member countries could meet 80% or more of their peak demand by means of a theoretical maximum drawdown on their storage. Nine countries could theoretically cover all of their peak demand in this way. These figures are based on two key assumptions, notably: that their storage capacities would be filled to their maximum level (usually only true at the beginning of winter), as storage send-out capacities decline when storage is emptied; and that the dispatch of these volumes could be delivered to the area in which the demand originates.[2]

[2] Note that in Northern Europe, some storage and gas networks are L-gas, whereas most are H-gas.

Figure 5. Storage send-out capacities, as percentage of peak demand



Note: Defined as the maximum forecast daily demand under current market conditions, as indicated by each member country in their questionnaire response.

Source: IEA Monthly Gas Statistics

External infrastructure resilience

Developing domestic storage capacity is not the only way to enhance gas security: establishing interconnections with neighbouring countries is another key means of improving a country's resilience. Indeed, it is worth noting that some countries (*e.g.* Czech Republic Luxembourg, Slovak Republic, Sweden and Switzerland) are connected to storage sites located in neighbouring countries.

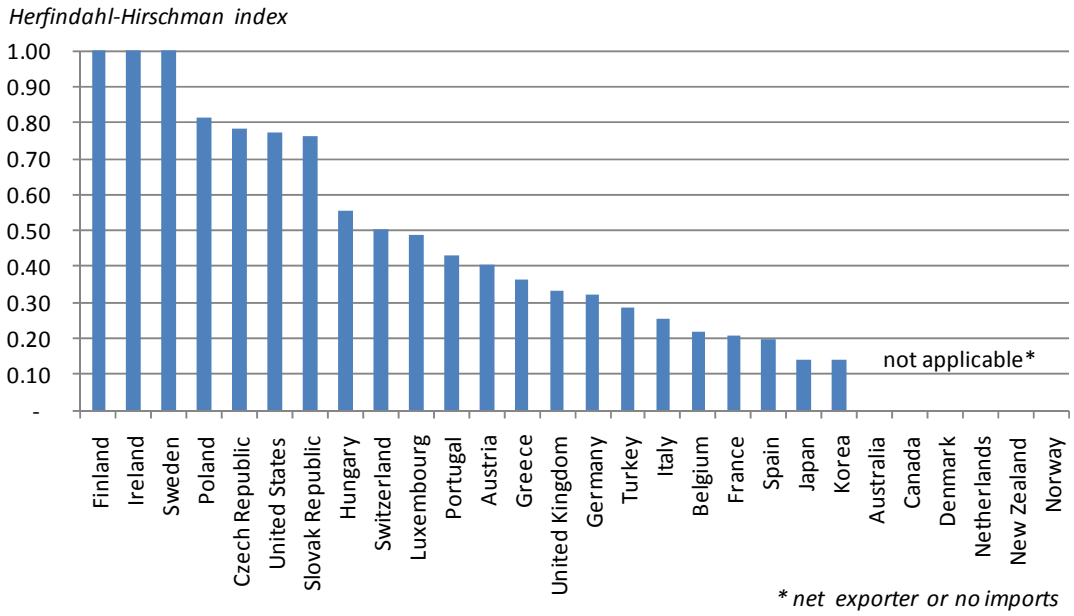
Eight IEA member countries have a maximum inflow pipeline capacity that exceeds their peak demand, thus providing a large degree of security of supply; maximum inflow capacity could theoretically cover more than 70% of peak demand in 11 countries. It should be noted, however, that the pipeline infrastructure in most of these countries is well-developed because they often serve as transit routes. As such, although the capacities are high, the totality of the gas transiting through these inflow points cannot be considered accessible to the countries themselves.

Not all member countries are reliant on pipeline supplies, however; as mentioned above, LNG regasification capacity has seen strong growth in IEA member countries in recent years. This has allowed for a strong increase in LNG imports into OECD Europe, which grew by 30% between mid-2009 and end-2010. LNG supplies are of vital importance for otherwise isolated gas markets such as Japan and Korea, but have also served an important role in strengthening the resilience of the gas markets of Western Europe. Five countries (Greece, Japan, Korea, Portugal and Spain) theoretically could cover their peak demand with their LNG import capacity alone.

Diversification of entry points and supplies is a key measure of external resilience, although the ability of a country to diversify its supply sources depends significantly on its inherent geography. The external resilience of certain Central and Eastern European countries is inherently weak, with many depending on just one dominant entry point and supplier (namely, Russia). Interestingly, a similar weakness is seen in Finland (depending on Russia) and Sweden (depending on Denmark),

both of which are 100% dependent on a single entry point and supplier. Many European countries are currently investing in making key gas pipelines reversible, so as to provide additional resilience in the event of a crisis.

Figure 6. Import diversity of supplies



Note: The Herfindahl-Hirschman Index, an economic concept widely applied in anti-trust and competition law, is defined in this context as the sum of the squares of the market shares of the countries of imports for any given country. The index ranges from 0 (high diversified supplies) to 1.0 (one monopolistic supplier).

Source: IEA Monthly Gas Statistics.

The vast majority of IEA member countries identified their largest entry point. Reassuringly, some 24 countries indicated that their system would be able to cope, at least in the short-term, if this key entry point were disrupted ("N-1" measurement). Predictably, the inherently less diversified countries of Central and Eastern Europe would experience the most difficulties in sustaining gas supplies in such an "N-1" infrastructure environment in the longer term.

Policies and emergency measures

To date, 21 IEA member countries have taken specific steps to develop natural gas emergency policies. A similar number have designed a gas-specific National Emergency Strategy Organisation (NESO) or dedicated emergency organisation structure for dealing with gas disruptions. Countries that have not designed any such policies or NESO structure are for the most part either gas exporters and/or have highly resilient systems with numerous entry points (*e.g.* North America and Japan/Korea).

Based on the questionnaire responses, nine IEA member countries have specific policies designed around implementing interruptible contracts, or have based the resilience of their systems partly on flexible interruptible contracts. Six IEA member countries have developed fuel-switching policies. It should be noted that the percentage of gas-fired plants that can switch fuels has decreased over the last decade, reflecting the progressive roll-out of combined cycle gas turbine (CCGT) plants. Indeed, the higher efficiencies from these plants mean that they are less flexible and thus less able to switch fuel easily.

One interesting conclusion to be drawn from the questionnaire responses is that a number of IEA member countries (all of which are in Europe) have placed some form of stockholding obligation on their gas industry. Seven countries have placed a gas stock obligation on their domestic players,[3] and seven countries have imposed an obligation on certain gas-consuming industry players to hold stocks of an alternative fuel (*e.g.* gasoil, for gas-fired power plants) to be used in the event of a gas disruption. Combined with Hungary's public stocks at its disposal, half of the IEA's member countries have developed specific stockholding measures related to gas that would provide strong resilience in the event of a disruption.

Figure 7. Overview of gas emergency policies in IEA member countries

	NESO for gas disruption	Able to cope in an N-1 situation	Policy promoting interruptible contracts	Policy promoting fuel switching	Government/ agency stockholding	Gas stock obligation	Alternative fuel obligation
Australia	yes	yes					
Austria	yes	yes					
Belgium		yes					
Canada		yes					
Czech Republic	yes	yes					
Denmark	yes	yes				yes	
Finland	yes	yes					yes
France	yes	yes	yes				
Germany	yes	yes					
Greece	yes	yes	yes				yes
Hungary	yes	yes		yes	yes		
Ireland	yes		yes	yes			yes
Italy	yes	yes	yes	yes		yes	
Japan		yes					
Korea		yes					
Luxembourg	yes						
Netherlands		yes					
New Zealand	yes	yes	yes	yes			
Norway		yes					
Poland	yes	yes	yes			yes	
Portugal	yes	yes				yes	yes
Slovak Republic	yes	yes				yes	
Spain	yes	yes	yes			yes	
Sweden	yes						
Switzerland	yes	yes		yes			yes
Turkey	yes		yes	yes		yes	yes
United Kingdom	yes	yes	yes				yes
United States		yes					
	21	**24**	**9**	**6**	**1**	**7**	**7**

Source: Questionnaire responses from countries.

[3] In Denmark the gas stockholding obligation is only placed on the transmission system operator.

The IEA emphasises three overarching principles with regards to gas security, so as to minimise the consequences of a gas disruption:

a) it is in every country's interest to seek to maximise its diversification of sources of supply, both in terms of entry points and suppliers;

b) because of the inherently less-fungible nature of natural gas compared to oil, an adequate and resilient infrastructure network (both external and internal) and a flexible market that can speedily redeploy gas are of vital importance; and

c) all countries should aim to develop a well-balanced and flexible set of emergency policies that can be implemented quickly and effectively in the event of a gas disruption.

The findings from this questionnaire demonstrate that most IEA member countries are developing policies in this area, and overall emergency preparedness for gas crises is improving.

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