RISK-BASED ASSESSMENT OF ENERGY SECURITY A CASE FROM EUROPE

Boyko Nitzov
Agency for the Cooperation of Energy Regulators
+386 (0)8 2004 606 Boyko.Nitzov@acer.europa.eu[i]

Overview

The paper suggests a risk-based approach to assessing energy security in the context of the European Union's framework, in particular Regulation (EU) No 994/2010 which deals with security of natural gas supply. The objective of the paper is to highlight the inherent cost-benefit tradeoff of choosing a certain level of energy security which would satisfy the formal requirements of the regulatory framework and at the same time be cost-efficient. The suggested analytical framework is applied to the case of a Member State of the European Union.

Methods

The paper proceeds from the premises of the formal regulatory requirements, in particular the N-1 rule. To arrive at the required risk-based assessment, the paper suggests a model using a four-step procedure. First, the capacity needed for achieving compliance to the N-1 rule is assessed. Next, the cost of achieving compliance is evaluated. Next, the diversity of natural gas supply, the key element of security, is assessed by calculating the enhanced Shannon index. Finally, the probability of interruptions in gas supply is assessed based on actual events observed over a certain period of time, and the assessed probability is used in conjunction with the Shannon index as input to a Gambler's Ruin type of analysis. Cost is assessed on the basis of investment required to reach acceptable levels of the N-1 indicator and the enhanced Shannon index, and benefits are assessed as the avoided cost of natural gas supply interruptions.

An important element of the analytical frame is the sub-sector approach, i.e. energy security is assessed at the level of a given kind of primary energy (in this instance, natural gas) rather than at the level of the entire energy sector. Such an approach allows to pinpoint the specific sources of potential threats to energy security and also to assess the associated costs and benefits on a narrower range of values.

The output of the model allows for an estimate of the maximum cost of enhancing energy security which would be economically justifiable under the specific conditions of a country or a region, i.e. an assessment of the breakeven point beyond which "buying" more security is not efficient. An example of such a cost-benefit assessment of energy security based on the actual case of a member state of the European Union is provided.

Results

As far as Country Y is concerned, results demonstrate that it cannot achieve compliance to Regulation (EU) No 994/2010 without diversifying gas supply, and that to assure compliance, the minimum new gas supply capacity should be about 13 mcm/d without demand-side measures and about 10 mcm/d with demand-side measures, from a source and via a route which is different from the current import ones.

At this time, Country Y's enhanced Shannon Index for security of energy supply is about 1.13 for all fuels, 0.7 for fossil fuels, and only 0.02 for natural gas. This is low by all measures, strikingly so for natural gas. As a result, Country Y carries an unacceptably high risk of experiencing total cut-off of gas supply. In monetary terms, given the history of gas supply interruptions, the size of the economy and its gas business, carrying such risk is equivalent to losing about $70 million every year. Country Y has a fair chance (just under 80%) to "go broke" in five years time if it continues playing dice with energy security.

In order to achieve economic gains by reducing its risk exposure, Country Y must reduce the risk of experiencing complete cut-off of gas supply many fold from its current level, and do this by project(s) that will become operational within about five years. Failing to diversify gas supply and comply to EU regulations within this relatively short time horizon is likely to result in spending money on investment in diversification of supply later on and still carrying excessive risk of complete cut-off of gas supply at least once in the meantime, i.e. becoming a "ruined" gambler.

The results of the analysis also allow projects to be ranked by using multicriteria analysis. For example, in Country Y any economically justifiable diversification project in the light of Regulation (EU) No 994/2010 must meet certain criteria (minimum capacity with and without demand-side measures, maximum cost, time to commissioning, and independence by source, route, and supplier ("SRS" independent project).

Conclusions

One of the features of the results of our analysis is that they are quite time-dependent. For example, if the same analysis is to be carried out in several years time, many of the variables used in the model will have different values. It would also be possible to use a different period of time for determining the values instead of the one used in the case (2001-2011). There are also similar considerations related to the choice of rates used for discounting, a topic which is beyond the scope of this paper.

What is probably most important to understand is that energy security is not an absolute value, but one which changes over time, and that there are clearly possible cases where the cost of bringing up energy security to match a certain regulatory requirement may be greater than the benefit provided by achieving improved energy security. For these reasons, discussing energy security without taking into account the specific circumstances of a country or a region in terms of patterns of supply and use of energy, prices, physical deliverability limitations, and other fine-print type of data is prone to making costly mistakes.

One may argue, of course, that buying "excess security" by investing in infrastructure that would diversify supply beyond what is actually reasonable in economic terms is still better than underinvesting, which may expose the country or region to bullying by suppliers and dangers beyond the economic remit. Nevertheless, a risk-based assessment of the economic costs and benefits associated with investing in new natural gas infrastructure, for the purpose of contributing to energy security, is a must in an informed decision making process.

References

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[i] Boyko Nitzov is TSO Cooperation Officer at the European Union's Agency for the Cooperation of Energy Regulators (ACER). The views expressed in this paper are the views of the author and do not necessarily reflect the official position of ACER or any of its Boards.