Chapter 12
Developing an Energy Security Risk Assessment System

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ABSTRACT

Throughout the last two decades many attempts took place in order policy makers and researchers to be able to measure the energy security of supply of a particular country, region and corridor. This chapter is providing an overview presentation of the Energy Security Risk Assessment System (E.S.R.A.S.) which comprises the Module of Robust Decision Making (RDM) and the Module of Energy Security Indices Calculation (ESIC). Module 1 & 2 are briefly presented throughout section 2 and the application of Module 2 in nine case study countries is discussed at section 3. Finally, in the last section are the conclusions, which summarize the main points, arisen in this chapter.

INTRODUCTION

Energy planning and energy security of supply became one of the most important topics in the field of global economy. Recent problems that emerged due to the sudden energy supply disruptions pointed in the most emphatic way that further research and development must take place in order to mitigate problems regarding the smooth supply of energy.

Furthermore, the unstable economic environment that most economies are facing and the high dependency that most countries have in foreign imports, made essential for the policy makers to focus on the concept of energy security of supply. Energy security can be defined as the continuous and uninterrupted availability of energy, to a specific country or region. The European Union (EU) has many times highlighted as a key priority, the need to assess the current energy system and the risks of energy
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disruptions in order to design and adopt the required policies. The increased dependence on fossil fuel imports, sometimes from politically unstable regions of the world; the increase in the volatility of Primary Energy Supply fuel (P.E.S) prices, especially oil and the significant environmental impacts from their extensive consumption are considered non sustainable on the long term. In the aforementioned statement the three most important concepts that affect the design of security of supply can be summarized. The dependence that an economy has to a particular energy fuel conducts a very important role in the measurement of security of supply and can be identified as supply risk. Accordingly, the risk that an economy faces due to the volatility of P.E.S. prices can be identified as market risk, whilst the global climate change that is caused due to the usage of fossil fuels can be included under the broad category of environmental impacts risk.

A significant number of researchers have focused on the topic of energy security of supply. However, a common point of the existing research work is that the methodologies that were adopted in order to model the parameters that affect the smooth energy supply in a particular country or region, were limited to the development of particular indicators that measure only specific dimensions of energy security, without integrating in their approach the overall set of technoeconomic, social and environmental aspects of national and international energy systems. Notable research has been conducted by the Dutch Energy Research Centre (E.C.N.) (Jansen et al, 2004 and Schaepers et al, 2007). Jansen was the first that utilized the Shannon-Wiener diversity index as basic indicator (Gnansounou, 2008). The second study by ECN and the Clingendael International Energy Programme (CIEP) proposed quantitative indicators for quantifying the concept of Security of Energy Supply. Additionally, they were the first who created a weighting and scoring system for the synthesis of the supply/demand Index (S/D Index) taking into account final energy demand, energy conversion and primary energy supply. Apart from the research work that has been conducted by ECN, other research groups measured the concept of vulnerability that the European energy systems exhibit (Costantini et al, 2007; Gnansounou, 2008; Gupta, 2007, 2008; World Energy Council, 2008). All the aforementioned research efforts used subjective weights in order to derive a composite index (Jansen et al, 2004; Schaepers et al, 2007). Grubb et al, 2006 explored the strategic security of electricity in the context of the United Kingdom electricity system. Using the concept of diversity of fuel source mix they measured the impact of source variability on a second dimension of security, the reliability of generation availability. Additionally, Chevalier, 2005 used several indicators in order to measure the dependency that countries within the European Union exhibit to oil and natural gas. They found that most European countries are exposed to energy availability risks and stated the need for the European Union to develop a common energy security policy.

It can be observed that the existing literature is characterized by the absence of a system which through its sub modules will measure the energy security of supply for a particular country, integrating the concept of vulnerability and using the Principal Component statistical Analysis (PCA) for estimating objectively the weights that will be used for the synthesis of the index, as Gupta (2007) points. In addition, taking into account the long term planning that is required for the energy system expansion, it has been considered that the traditional risk management techniques should be further supported by appropriate Robust Decision Making (RDM) models that could facilitate decision making under deep uncertainty.

Based on the above needs, a system has been developed in order to facilitate the decision making process towards the formulation of energy policy strategies.
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