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A Critical Analysis of Energy Security Models and their Applicability in the Indian Context

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Abstract: *Authors examined numerous models of energy security reflecting both long-term and short-term security challenges, as well as contemporary work on the topic and often mentioned approaches to the problem. When evaluating the singular issue of oil security with regard to both short- and long-term oil security, the authors found that all the models, with the exception of IEA's MOSES and Oil Venerability Index (OVI), contain inadequate indications or parameters. Authors recommended the IEA Model of Short Term Energy Security (MOSES) as the "best fit" model in the Indian context to ascertain the short term energy security profile of each energy component of the nation based on a careful study of these models. The author also made the claim that the policy makers would benefit from the knowledge from the profiles of the various energy constituents in developing long-term energy security plans. It is also advised to periodically analyze the energy components in this model in order to adjust the long-term strategy as needed..*

Keywords: Short Term Energy Security

I. INTRODUCTION

OPEC's oil embargo has lasted more than 40 years, but energy security is still a hazy idea. Energy security has no precise definition that can take into account the perspectives of both producers and consumers. Energy security has several meanings depending on the context in which it is used.

According to the Indian viewpoint, (IEP, 2006) defined energy security as "...ensuring the continuous availability of commercial energy at competitive prices to support its economic growth....."

The terms "Continuous Availability" and "Competitive Price," which point to supply-side economic dynamics, are the major takeaways from the definition.

Strategies based on emergency action plans and stock management were suggested as short-term strategies and diversification of sources, energy-saving and efficiency measures, and understanding between producing and consuming areas as long-term strategies to ensure supply side energy security (Harris et al. 2008).

In their report to the Norwegian Ministry of Foreign Affairs, (Tnnesson and Kols, 2006) emphasized the significance of energy security for India's and China's foreign policy agendas. Although a "Resource War" is conceivable given the countries' increasing reliance on imported oil, they are currently engaged in economic competition to improve each nation's standing on the global energy map. According to a report, India has established a four-pronged strategy to ensure its long- and short-term energy security, which includes

Diversification of import source
Acquisition of equity oil
Building of strategic petroleum reserves (SPRs)
Increased domestic exploration, and production

(Cherp et al, 2007) suggested robustness, sovereignty, and resilience of energy systems as the three pillars of energy security, where resilience is linked to diversity of options for infrastructure and supply, redundancies and spare capacity, and institutions capable of effectively adjusting to disruptions and flexibility in demand. According to the report, nations like China, India, and Japan have started spending heavily abroad in order to export fossil resources back to their home continents.

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The 10 key energy security factors recommended by (Deloitte, 2013) for the long-term energy security of the nation included diversity of energy sources, supplier diversity, level of imports, security of trade flows, geopolitics and economics, reliability, market/price volatility, affordability, energy intensity, and feasibility.

II. ANALYZING ENERGY SECURITY- MODELS

The process of quantifying energy supply security and creating monitoring indicators may act as a guide for policymakers as they build long-term policies that will lessen current vulnerabilities and minimize risk to the energy supply.

The authors looked at the currently accepted model of energy security and attempted to find the "best fit" model to create an energy security profile of India for each individual energy component, with an emphasis on oil security in particular.

(Jain et al, 2010) studied the idea of energy security for India via a poll that evaluated the value of energy security on 16 aspects, and found that the availability of fossil fuels, R&D in new technologies, and centralized energy systems stood out as crucial factors in guaranteeing the nation's energy security.

A national energy security index was proposed by (Sovacool et al., 2011) to assess the performance of the 18 nations in terms of availability, affordability, technological development, sustainability, and regulation. The 1990–2010 time period was used to build the model, which broke these qualities down into 20 components and correlated them with 20 measures. The authors noted that, in 20 years, the energy security profiles of Japan, Brunei, and the United States would rank as the top three performers on these indices, while Vietnam, India, and Myanmar would rank as the poorest performers. However, the model does not provide a stand-alone security assessment of each energy component. Retail unleaded gasoline prices and energy stockpiles are the two variables that, when examined separately, may be linked to oil security.

The Asia Pacific Energy Research Center (APERC, 2010) proposed the 4 A's Framework, which includes Availability, Acceptability, Affordability, and Accessibility as the four pillars of energy security in the twenty-first century. The model offers four indicators of energy security: the degree of primary energy diversification on a scale of 0-100, the degree of supply import dependence by identifying two clusters, the degree of diversification toward alternative fuel sources, and the identification of potential risks related to the acquisition of oil supply sources. The research conducted a case study for oil supply security, looking at variables of per capita oil consumption, oil demand elasticity, economic import risk, political import risk, and refining capacity. indicators of the capability of domestic resources, industry structure, SPR, and the conversion to non-carbon fuels. Report gives a relative assessment of the 10 APEC nations based on these metrics, falling short of creating a country-specific profile for oil security.

In order to assess the relative oil vulnerability of 26 net oil-importing countries for the year 2004, (Gupta, 2008) developed a composite oil vulnerability index (OVI) of selected countries based on four major risks divided into seven parameters or indicators. Based on these indicators, the relative oil vulnerability of 26 net oil-importing countries for the year 2004 was assessed, and it was found that India had emerged as the third most oil vulnerable country in the world. Oil is one of the most common and portable energy sources, and the model gives useful information on the risks related to it.

A tiny portion of the energy model created by is the willingness to pay model, which is based on four variables: dependence on oil and gas, the proportion of fuel in the overall basket, the amount of energy used per unit of GDP, and investments made to increase the degree of energy security.

(Bollen et al, 2010). However, the model aims to express in monetary terms the willingness to pay in order to avoid energy supply risks rather than identifying the status of the energy system or the security of the energy supply.

(Roupas et al, 2009) Compare the 27 nations that make up the European Union (EU27) in terms of the degree of oil vulnerability that their economies have shown between 1995 and 2007. For an illustrative scenario of low oil and high price estimates, the future vulnerability until 2030 is evaluated. Principal component analysis (PCA) was used to build the synthetic index since net energy import reliance has become the most significant element determining vulnerability. According to research, each nation's relative oil vulnerability is shown for each year up to 2007.

(Jansen 2004), suggested the Shannon index as the most accurate measure of diversity and introduced four new factors for the security of long-term energy supply: diversification of energy supply sources, diversification of imports with

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regard to imported energy sources, long-term political stability in regions of origin, and the resource base in regions of origin, including the home region/country itself. These variables were used to assess the regional energy security using 2030 as the reference year. As was the case with related studies cited in the study publication, the paper did not give adequate analysis to determine the energy profile of each ingredient.

(IEA, 2011) The Model of Short Term Energy Security (MOSES) is a numerical instrument based on a collection of metrics that assesses energy security in terms of;

Risk of supply disruption and

Resilience to cope with such disruption

In MOSES, risks and resilience connected to both domestic and foreign sources are taken into account.

MOSES examines how the security of 2 secondary fuels (oil products, liquid biofuel) is impacted by the vulnerability of 7 fundamental energy sources (crude oil, natural gas, coal, hydropower, nuclear power, biomass and waste, and geothermal energy). It measures the susceptibility of various energy system strata using the whole value chain. In MESES, four dimensions—domestic risk, domestic resilience, external risk, and external resilience—were examined using 35 indicators. Each indication has a connection to one or more of the four aspects of energy security. The energy security profiles of the 28 IEA members are categorized and evaluated. For each energy source or fuel, countries are categorized into 5 energy profiles. From lower risk/high resilience profile (greater energy security) to higher risk/lower resilience profile (lower energy security), the energy security profiles are denoted by the letters A through E.

III. CRUDE OIL SECURITY PROFILE-MOSES MODEL

The analysis of crude oil using MOSES is based on eight indicators as below

	Risk	Resilience
External	Import Dependence Political stability (supplier)	No of Ports No of P/L Diversity of suppliers
Domestic	Share of Offshore Pro. Volatility of domestic Pro.	Av. Storage level

Source-IEA

Limitation of MOSES and applicability

MOSES focuses on energy security for the near time (days to weeks), eliminating factors that are only important from a long-term viewpoint, such as environmental effect, high demand growth, and resource depletion. MOSES avoids economic concerns relating to affordability and the unpredictability of energy costs by concentrating on physical interruptions.

Indian Context MOSES Application Assessment Methodology India

From A to E, the IEA divided the world's nations into five categories, each with a unique crude oil security profile. A similar technique is used to evaluate India's profile for oil security. According to the evaluation of the aforementioned 8 parameters, India was assigned to Group C by (Chopra, 2013) for the reasons listed below.

Import > 80%

9 Crude Oil Ports

High supplier diversity (HHI=0.101)

51 days of crude oil storage

IV. FINDING AND DISCUSSIONS

Despite the MOSES model's limitations, authors have found through literature reviews of other models that MOSES is a useful model for assessing the energy security profile of each component of the energy basket, as opposed to other models that rely on the measurement of the energy profile as a whole or undertaking relative index.

The model, even if it is only short-term, may be a crucial tool in creating the nation's long-term energy security policies on the various energy components, which is something that seems to be lacking in other models examined during the literature review.

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