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ResearchArticle

# Evaluation of Nuclear Energy in Energy Supply Security for Turkey[#]

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**Abstract:** In this study, energy power plants evaluated with strategic criteria and also availability capacity concept and appraise the energy supply security with the fiction projection. By this concept, problems on energy supply security were discussed that having during the uninterrupted electricity supply. An important solution of the problem is installing of the nuclear power plants that evaluate with relation energy supply security. Energy supply security for Turkey evaluated according to the strategic criteria of energy policy. Different alternatives described and assessed with in terms of the energy expansion of Turkey. The nuclear power program assessed in detailed by the 2023 energy targets of the country. With this study, different energy supply security initiatives of Turkey were clarified and emphasized and evaluated related political security events by using APLUS computer code. It was shown that establishing of the nuclear power plants are most important alternative for the energy supply security.

## 1. Introduction

Energy is the essential argument for the development and it has undeniable and indispensable effects on the world politics. Furthermore, energy is an important indicator for development of the states [1-2]. Energy requirements are estimated from measures of energy expenditure plus the additional energy needs for developing growth of countries.

The global demand on production and thereby the global need of energy is growing with technological improvements, increase on the world's population, industrialization and uprising trend on societies' consuming habits [3]. the need of the human beings for energy is increasing continuously today and the energy policies have reached undeniable and un-ignorable dimensions, which shape the political events as well. Therefore, access to the energy and/or energy resources, in particular providing

energy sources in large scale, has become an indispensable requirement for the countries [4]. The world will need greatly increased energy supply in the next 20 years, especially cleanly-generated electricity. Electricity demand is increasing twice as fast as overall energy use and is likely to rise by more than two-thirds 2011 to 2035. In 2012, 42% of primary energy used was converted into electricity [5].

## 2. Strategic Criteria of Energy Policy

Energy policy mainly developed according to strategic criteria. Strategic criteria consist of geopolitics, diversity and redundancy factors that have crucial effects on the energy policies of the states [4]. These criteria have different importance,

but affected each other and it is shown schematically in Fig 1.

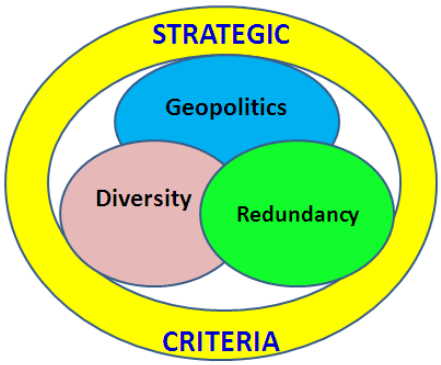


***Figure1.*** *Strategic criteria of energy policy*

Geopolitical criterion may be the leading factor among the strategic criteria. First of all, providing reliable energy, owning reliable energy sources or making reliable energy source connections are required. When the energy resources owned by the countries become insufficient, establishing reliable connections become compulsory. Therefore, the policies and strategies created according to the geography and then geopolitics rise to the forefront.

"Redundancy Criterion" is another important criterion in the formation of the energy policies. Provision of the energy source required from more than one places is meant by this criterion. That means establishing connections with more than one feeder sources in relation with a type of energy source. Therefore, the countries, which demand energy, need to have redundancy for the energy sources. Because, in the event obtaining energy from one source might become a problem, perpetuating the continuity of the supply of the energy source becomes mandatory by either utilizing the other sources or extracting more energy from such other sources.

The last strategic criterion is "Diversity Criterion" that represents the energy production has to be met with more than one energy source types. Therefore, energy policies should not be designed depending on a single source, but many type of source. If any problem or crisis would arise in any one energy source, could be eliminated by emphasizing the alternative energy sources.

## 3. Energy Supply Security

Supply security term is integrated to energy security concept which means sustainable availability of energy in different forms, with enough amounts and financially affordable prices [3,6]. Many of the evaluation and decision making methods for energy policies [7-8].
If the domestic production amount is fewer than the domestic consumption amount, then the supply security would be studied in order to sustain the resource supply (*Supply Security: Production < Consumption).* Since Turkey is one of energy source importer countries in the global market, investigating the supply security would be more consequential.

The term of supply security might have different meanings according to the availability capacity. That concept also impressive for the energy supply security with the fiction projection. Availability of an energy resource is significantly critical in order to meet the possible changes in demand and supply energy curves in a short period of time. Considering the dependence of countries on uninterrupted energy usage and production in all industries, an energy resource which would be available in any time is highly preferred. In energy industry, to express the meaning of availability in terms of numbers and ratios capacity factor can be used. Capacity factor is the ratio of produced electrical energy in a period of time considering the maximum electrical energy that could be produced in the same period of time [9]. Fig. 2 shows the capacity factor of the power plants [10,11].

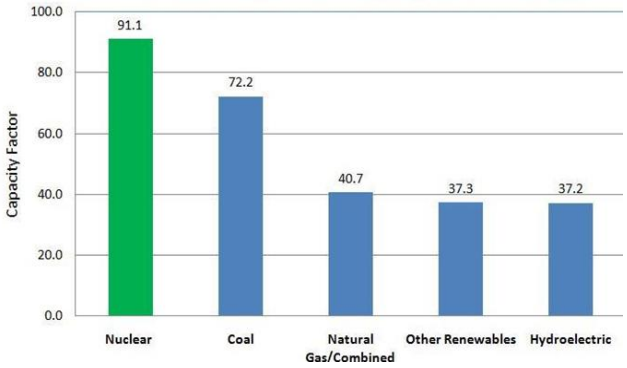


***Figure 2.*** *Capacity factors of the power plants.*

## 4. Evaluation of Energy Supply Security for Turkey

In Turkey, the impact of energy to the current account deficit is unquestionable. As a country depending on abroad energy resources in a large part, such as 72 %, it is obvious that all options should be evaluated to reduce this ratio as much as possible. It is expected that with the nuclear power plant, despite the only energy source that cannot be implemented as yet in Turkey becomes operational

although it is a base load power plant, it will be an important input the obedient energy supply.

Turkey has put construction of Nuclear Power Plants in the agenda. Nuclear Power Plants are characterized as an argument to provide stability to the energy markets. Impact of Akkuyu NPP, which will be the first nuclear power plant in our country, considered to be made on Turkish Energy Market is examined. APLUS computer code was used for predicting of the future projection [12-13]. The impact of Akkuyu Nuclear Power Plant, which will consist of 4 reactors, on the energy market is simulated by APLUS computer modelling program using the predicted commissioning dates of each reactor unit. Fig.3 shows the scheme of the APLUS Computer code and Table 1 shows the parameters of Akkuyu Nuclear Power Plant which were used as APLUS input data.

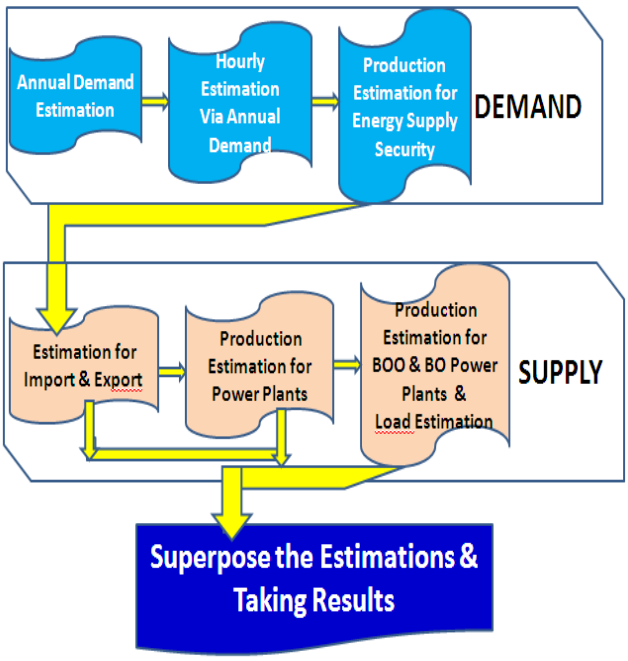


***Figure 3.*** *General scheme of the APLUS computer code*

***Table 1*** *Parameters of Akkuyu Nuclear Power Plant*

| **Properties** | **Explanation** |
|---|---|
| Design | AES -2006 Series (VVER -1200) , 4 Units |
| Total Capacity | 4800 MWe |
| Total Project Cost | 20 billion $ |
| Production Output | 35 TWh/year |
| Plant life | 60 years |
| Capacity factor | 93% |
| Start-up Time | 2023 |

## 4. Results and Discussion

APLUS computer code runs for the scenario of electricity generation of Turkey's nuclear power plant (NPP). It assumed in this study that the first Akkuyu NPP unit generates the electricity in 2021 and other units generating after 2021 year by year. According to this scenario, Turkey's projection for installed power plants is seen in Fig. 4.

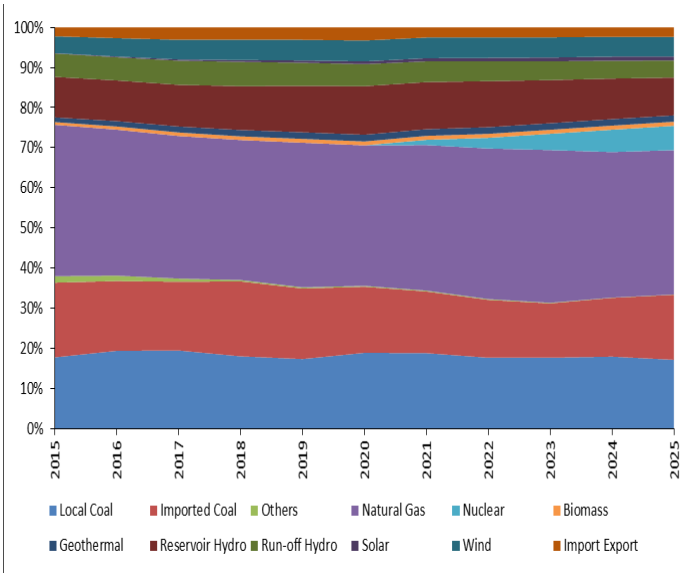


***Figure 4.*** *Energy projection for Turkey by using APLUS computer code*

As shown from Fig. 4, electricity generation from NPP cause the decreasing electricity generation from natural gas power plants. It can be said that electricity generation from other energy source provide their rational rates. Hence, in 2025, electricity generation from natural gas power plant beginning the rising again.

## 5. Conclusion

Turkey's energy supply security risks might be separated as short term and long terms supply risks. Short term supply security contains the risks which might cause interruption of supply for hours or few days such as political weakness, extraordinary weather conditions or technical substructure problems. For eliminate the short term energy supply security nuclear power plants should be installed because of having high capacity factor. Therefore, availability can be provide in the reliable conditions.

Long term supply security contains the risks which might cause not particularly a cut of resource supply, but problems in demand/supply balances, financially and political bottlenecks. NPP also

supply long term energy supply security for Turkey due to decrease natural gas dependency. In here, must be noticed that Akkuyu NPPs are not enough the long term energy security. The new other NPP's should be installed after Akkuyu nuclear power plants.

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