

Energy Policy Making: An Old Concept or a Modern Challenge?

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Abstract *The energy policy is directed by the three main objectives, namely the security of supply, the competitiveness of the energy market, and the environmental protection. In addition to this, now the energy policy is developed through a number of social and economical challenges. As a result, a comprehensive and modern energy policy making, which can be characterized by clarity and transparency, is necessary. Even though energy policy making has been the subject of many researchers, comprehensive and modern studies examining the multiple and often conflicting parameters that have to be incorporated is not present in the international literature. In the above context, the purpose of this article is to review and analyze the current concept and the challenges toward the modern energy policy making, based on the three energy policy objectives as well as the impact of the crucial parameters.*

Keywords decision making, energy planning, energy policy

Introduction

In the previous decades, it was highlighted that “the energy policy is not in the forefront” (Bloom, 1982) and that energy constitutes secondary priority of countries that do not lead the developments but are guided from them. In addition to this, governments must pose suitable environmental and economical policies and the free market imposes the necessary energy changes. The examination of the future role of energy policy should be based on the comparison between the failure of policy and the choice of “do nothing policy,” based on economic and other criteria (David and Zhao, 1989). In particular, the progress of the energy policy in the last century is described in the three phases below:

Phase 1—The period of energy abundance (until 1974)/the first oil crisis: The main tendencies were the continuous economic growth, the increase of energy demand, and the increase of oil consumption (Kavrakoglu, 1987). Due to the 1973–1974 oil crisis, the analysis of energy problems as well as energy policy matters were put in the “headlines” (Manne, 1979). State’s intervention in the energy market was strengthened, both in short-term (e.g., political measures) and long-term time horizon (e.g., high investments for exploitation of domestic energy sources).

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Phase 2—The period of energy insufficiency (until 1985)/the need for reduction of energy dependence: All of the efforts focused on the energy saving, the rational use of energy, and the necessity for reduction of exterior dependence from imports of primary energy resources (Doukas et al., 2006).

Phase 3—The period of energy balance (up to 2000): The environmental impact of the energy production and consumption becomes more severe, so the necessity for the relation between the energy policy decisions and the environmental protection is enhanced through the Kyoto Protocol (Park et al., 1998).

Nowadays, the energy policy is directed by the security of supply, the competitiveness of energy industry, and the environmental protection, based on the European Union (EU) energy objectives (Kagiannas et al., 2003a).

In this framework, energy policy should compromise the desirable objectives and encourage the close collaboration between the current “energy players” (state/energy companies/users), towards the confrontation of the various obstacles. Indeed, extensive discussions have taken place regarding how a competitive energy market would promote, indirectly perhaps via forces of the market, the other energy policy objectives and at the same time shifting the center of decisions from the state to the rest of the “players” of the market. This fact caused the intense interest of energy policy analysts and researchers.

Furthermore, the energy policy is developed through a number of social and economic challenges such as the need for improving the reliability and quality of the provided services of the production, transport, and distribution energy companies and the technological and research and development (R&D) efforts in the electricity sector (e.g., co-production of heat, the commercialization of renewable energy, etc.). In addition to this, the changes in living conditions and societies have a strong impact on the energy market since they are related to the increasing consumption of energy (Patlitzianas et al., 2006a; Patlitzianis et al., 2006b).

Moreover, economic uncertainties and conflicts put on the map the important role of the energy market, in spite of its small contribution in the total economic production, which is estimated to be 5–10% (Helm, 2002).

As a result, a comprehensive and modern energy policy making, which can be characterized by clarity and transparency, is necessary. In particular, a modern energy policy making has to counterbalance the three objectives and all the related parameters, avoiding thus unfavorable consequences, e.g., crises, and assuring energy prices stability and accessibility for the consumers.

Even though the energy policy making has been the subject of many researchers, comprehensive and modern studies examining the multiple, and often conflicting, parameters that have to be incorporated is not present in the international literature. In the above context, the purpose of this article is to review and analyze the current concept and the challenges toward the modern energy policy making, based on the three energy policy objectives as well as the impact of the crucial parameters.

Apart from the introduction, the current article is structured along the following parts. The second part describes the advisable role of the energy planning and its relation to the energy policy making. The third part is devoted to the presentation of the objectives/priorities as well as the crucial parameters of energy policy making, respectively. The main points drawn up from this article are summarized in the last part.

From Energy Planning to Energy Policy Making

Nowadays, the energy policy objectives seem to be complicated, with important difficulties that have to be encountered by the “energy players” toward the modern energy policy making (Kagiannas et al., 2001). In particular, the energy policy constitutes a field, which even if it is supported by scientific practices, e.g., the energy planning, it is intensely influenced from the decisions of mainly political persons. The decisions of energy policy always constituted a kind of “black box” in the process of energy analysis. As it is reported “. . . what matters most is not what the ministry writes in its decrees, but what the minister says in his telephone calls” (Ammons and McGinnis, 1985). Moreover, the energy analyses are based considerably on methodologies that will attribute scientifically what decision makers want to hear and not what they really need to know (Saway and Zinn, 1977).

Indeed, energy planning constitutes the most important scientific process of decision making in the energy market. Usually the general objective of energy planning is the optimal cover of the estimated energy demand in the future, where the most optimal scenario results are based on various economical and social challenges. Generally, the basic trends of energy planning are as follows. The first constitutes the traditional definition of energy planning. Progressively the energy planning began to develop in an integrated resources planning, where the most optimal scenario covering demand arises from a combination of choices of supply and the possibilities of demand management. Nowadays, energy planning constitutes a systematic process of information analysis on the energy supply and demand and the presentation of results to decision makers for the formulation of a plan of action (Papastamatiou, 1998).

As it is reported (Lenssen and Flavin, 1996), interest is intense as to how the political decisions influence this process or even how much these forecasts finally correspond in reality and take into consideration all the related parameters. The strong relation between the energy planning and the energy policy is presented in Figure 1.

Indeed, the energy policy provides the objectives and the priorities that energy planning should be based on as well as the basic parameters of analysis, while the results of energy planning target to inform the institutions of policy making for the possible developments in the energy sector and present possible solutions–scenarios on the expected impacts.

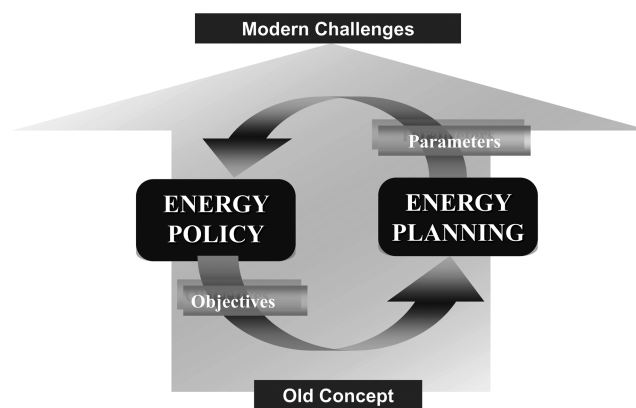


Figure 1. Energy policy and energy planning interactions.

The energy planning constitutes an exceptionally complex process that creates the necessity for simple models, which will give the base for the energy policy making (Park et al., 1985). In the previous years, the aim of the energy planning models that were developed was the optimization of energy demand's cover with economic criteria (Samouilidis, 1982). According to the literature review, the process of energy planning is traditionally supported by a large number of energy models that can be categorized in models of energy demand forecast, cover of energy or expansion planning, demand management, and integrated resources planning (Kagiannas et al., 2006). The main related models are presented in Table 1.

A large number of efforts for the energy planning and the development of energy models (Kavrakoglu, 1987; Manne, 1979; Samouilidis, 1982; Kavrakoglou, 1987) exist.

To the best of our knowledge, some of the main research efforts in energy planning include a generation expansion planning model for electric utilities (Ammons and McGinnis, 1985), a mathematical model for long range expansion planning in electric utility systems (Saway and Zinn, 1977), a modular state-of-the-art capacity expansion software package (Caramanis et al., 1982), a model for planning least-cost investments in generating capacity (Bloom, 1982), a hybrid genetic algorithm/dynamic programming approach (Park et al., 1985), an interactive software developed for integrating engineering experience and judgment (David and Zhao, 1989), a new multicriteria decision (MCD) procedure which combines dynamic programming with a production simulation method (Yang and Chen, 1989), an analytical approach for the production costing model and reliability measure (Park et al., 1998), and a generation planning model that incorporates the outage costs of customers as well as the utility (Wang and Min, 2000).

More recent studies include multi-criteria decision analysis techniques (Voropai and Ivanova, 2002), a power generation expansion planning for small isolated systems (Kagiannas et al., 2002), a practical approach for the integrated resource planning in developing countries (Dortolina et al., 2004), an investment model for power generation and transmission network expansion (Gampala et al. 2005), and a decision support system for regional domestic energy planning (Ramachandra et al. 2005). In addition to this, sophisticated models and methodologies exist, such as a methodology with variables that are deterministic and stochastic in nature (Pokharel and Ponnambalam, 1997), a

Table 1
The models of energy planning

Dimenisions	Models
Cover of energy or growth of expansive script	ELFIN
	UPLAN-E
	WASP
Management of energy demand	COMPASS
	DSMANAGER
Forecast of energy demand	COMMEND
	ENPEP – MAED
	HELM
	MED-PRO
Completed planning of resources	IRP-MANAGER
	MARKAL

methodology under several uncertainty factors such as demand growth, fuel cost, delay in project completion, financial constraints, etc. (Gorenstin et al., 1993), a parallel genetic model that determines the order of newly introduced generation units at each interval of the planning years (Fukuyama and Chiang, 1996), and an energy planning model based on mixed 0–1 multiple objective linear programming (Mavrotas et al., 1999).

It is obvious that the results of the above analytical and sophisticated energy models that support the processes of energy planning provide an abundance of analytical data to decision makers. This fact immediately creates the question of how these results can be used more effectively, since it has to be clearly stated that analytic data and information do not constitute energy policy.

Moreover, the modern tendency of energy markets towards liberalization, particularly in the electricity sector, leads the traditional models of energy planning and more specifically those of planning of extension of production in important readjustments. The philosophy of this model changes from minimization of cost to maximization of profits (Kagiannas et al., 2003a).

However, besides the introduction of new methods of modelling, as it appears in the literature (Gately, 1974; Sherali et al., 1983; Kolstad and Mathiesen, 1991; Haurie et al., 1992; Lucas and Taylor, 1993; Hogan, 1997; Day et al., 2002), important is the parameter that the energy decisions are transferred from centrally to “regionally” by the private individual producers of systems. This can contribute to the more explicit separation between the process of energy planning and the central energy policy making as well as the elevation of the need for a supportive framework of energy policy making, in collaboration with the models of energy planning.

Modern Energy Policy Making

Many times in the past, energy policy making and the solutions that emerge from the free market are considered as conflicting choices (World Bank, 2001; Sioshansi, 2001). However, the crisis of the electricity sector in California during the summer of 2000 and the winter of 2000–2001, as well as the continual growth of the oil prices, brought with the most essential way the energy policy once again in the “headlines,” as it is highlighted from Helm (Kagiannas et al., 2003b). In the above framework, the modern energy policy making is directed by the objectives and priorities taking into consideration the impact of the crucial parameters in each country.

Objectives and Priorities

The energy policy expresses the balance between the state’s actions that ensure the security of supply as well as the environmental protection and a modern market, which operates towards the competition, aiming at the reduction of the energy cost.

Even if each state or geopolitical region pose various energy policy objectives and priorities, depending on the level of economical growth as well as its status (importer, producer, exporter of energy), the three European objectives are described as follows (Patlitzianas et al., 2006a):

Security of supply: The expected important economic growth of developing countries, mainly Asia and Africa, will have, as a result, the redeployment of available primary energy resources. While the importing countries try to cover their energy needs and minimize any dangers that arise from their energy dependence, the producing

countries face the danger of depleting resources. This act leads them in efforts to discover new, difficult deposits but also in the development of modern technologies (Kagiannas et al., 2003b).

Competitiveness of energy market: The energy market was deregulated and a large number of private companies began to participate in the energy production and distribution, thus increasing the competitiveness of the energy sector. Subsequently, the need for the establishment of regulating rules for the growth of competition in the energy sector was created. The impact of the deregulation and the introduction of competitiveness in the energy market constituted the most crucial characteristic of energy policy (Wang and Min, 2000).

Environmental protection: The operation of energy market changes under the influence of the increased importance that has engaged the environmental dimension, mainly through the increased impact of the climate change.

With respect to the above, the modern energy policy has to incorporate the above-mentioned objectives, which are important priorities for all the countries, developed or developing, either importers or producers. Nevertheless, more intense emerges the necessity for the developing countries, since most of them are expected to have rapid economic growth while others are important producers of energy.

In addition to this, the modern tendency of the last years to the reform the energy markets contributes substantially in the removal of energy planning decisions' center from the state to the energy companies/users. However, energy policymaking constitutes an important process that not only has to be overlooked but also intensified for both the developed and developing countries. In particular:

Developed countries: In most of them, which are importers of energy—as for example the member states the EU, the operation of competitive markets, the increasing energy dependence but also the important environmental engagements, can be considered as the main challenges of their energy priorities. The rapid growth of important geopolitical regions and the increase of energy demand are expected to change the international energy market considerably and the role of the developed countries is expected to be particularly important in the promotion of the environmental-friendly energy technologies (Pandey, 2002).

Developing countries: Many of them, which constitute important energy producers (such as Algeria and Nigeria) or even important consumers (such as China), will face important challenges with regard to the role of energy and its dependence on their total economic growth. In any case, the experience of the developed countries' energy policy should be taken into consideration (Patlitzianas et al., 2004).

Crucial Parameters

Based on the current analysis, the energy policy making should take into consideration the impact of the following parameters for each one of the energy policy objectives:

Security of supply: The securing of energy supply does not aim to maximize the independence on energy or to minimize the dependence of a country, but to minimize the dangers involved with this dependence on external supply. Table 2 presents the related parameters of this objective.

Competitive energy market: This objective reflects the capacity for the provision of energy products and services that can compete with the international standards. Table 3 shows the parameters that were related to the analysis of this objective.

Table 2
Parameters of the security of energy supply

No.	Parameters
P1.1	Dependence on imports
P1.2	Dependence on imports of solid fuel
P1.3	Dependence on oil imports
P1.4	Dependence on natural gas imports
P1.5	Differentiation of primary fuel
P1.6	Differentiation of fuel of electrical energy production
P1.7	Differentiation of energy fuel
P1.8	Strategic oil supplies

Table 3
Parameters of the competitive energy market

No.	Parameters
P2.1	Energy intensity
P2.2	Efficiency of energy conversion
P2.3	Efficiency of electrical energy production
P2.4	Transformation of energy sector
P2.4.1	Independent energy regulator
P2.4.2	Private participation
P2.4.3	Dividing of public enterprise
P2.4.4	Energy law for the reforming and privatization of energy enterprises
P2.4.5	Adjustment of energy pricelist
P2.5	Level of competition
P2.6	Per capita energy consumption
P2.7	Per capita electrical energy consumption

Environmental protection: The third objective of energy policy refers to the protection from all external parameters that are influenced by the development of energy. Table 4 shows the parameters of this objective.

Conclusions

Nowadays, the safety of energy market is related to the new geopolitical correlations, the completion of a modern European market, and it depends on the altered structure of world energy demand. Indeed, the energy policymaking constitutes an important process for the development of the energy sector, taking into consideration the energy developments and incorporating multiple and often conflicting objectives and parameters.

Summarizing the above analysis, the main concluding remarks of the modern energy policy making are presented as follows:

- *The three objectives:* The energy policy will supposedly promote the three internationally acceptable objectives: (1) security of energy supply; (2) competitiveness

Table 4
Parameters of the environmental protection

No.	Parameters
P3.1	Percentage of renewable energy sources in the primary energy production
P3.2	Percentage of renewable energy sources in the electrical energy production
P3.3	Indicators of intensity of emitted CO ₂
P3.3.1	Emitted CO ₂ per GDP
P3.3.2	Emitted CO ₂ per gross domestic energy consumption
P3.3.3	Emitted CO ₂ per capita
P3.3.4	Emitted CO ₂ per electricity and steam production
P3.4	Application of Kyoto protocol

of energy market; and (3) the environmental protection. Even if the examination of the international literature can bring to surface individual objectives that are promoted by various national energy policies, a more careful regard proves that the three above objectives cover completely the priorities that should be promoted, in the current context of the energy market.

- *The current energy players:* Even if the modern tendency of the last years to the reform of energy markets contributes substantially in the removal of energy planning decisions center (or “energy player”) from the state to the energy companies/users, it is proved that the energy policy making constitutes an important process that not only has to be overlooked but also intensified for the developed and developing countries.
- *Limited research efforts:* The literature review showed that the research efforts of the modern energy policy making are particularly limited, based on the fact that the researchers’ interest has been focused on the energy planning problems. In addition to this, the literature review showed that the incorporation of the three energy policy objectives from the researchers is non-existent, even if important studies have been realized for individual analysis of each objective.
- *Need for decisions support:* The current analysis proved that the energy policy making constitutes an important process for the development of the energy market, taking into consideration the international energy challenges and developments and the multiple and often conflicting parameters that have to be incorporated (deregulation of the energy market, climate change etc.).

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