THE 'SOFT' IMPORTANCE OF ENERGY MODELLING TOOLS AND THEIR ABSENCE IN ALBANIA'S DELIVERY STRATEGY OF ENERGY SYSTEM

Arber Qystri[1], Marpol Koço[2]

[1]European University of Tirana, Albania

[2]Polytechnic University of Tirana, Albania

Abstract

Energy is essential for all human activities, and its availability is critical to economic and social development. Energy is the engine for the production of goods and services across all economic sectors. Lack of energy is a contributing factor to the poverty of individuals, communities, nations and regions. Energy mix visions and strategies are determining an important part of our world's future prosperity and welfare. Choices made now are important for future generations. Energy trend forecasting, scenarios and system analysis have matured into powerful modelling tools for providing advice on optimizing our future energy solutions. The choice of the model and its effectiveness for developing energy supply strategies critically depend on the underlying vision for achieving a future energy mix. Knowledge advancement and exchange are more important than ever before, because this will stimulate and optimize the vision sharing and further the integration of today's diverse energy strategies. In this regard, in Albania there is an absence in applying this tools. This article aims to demonstrate the vital importance of this tools to create a sustainable future, moreover in Albania where the energy sector is facing financial and management difficulties and lack of vision.

Key words: *energy, energy models, tools, sustainable energy, energy sector, energy strategy*

1. INTRODUCTION

The advent of enhanced computer power and programming capacity and the 1st Oil Crisis of the 1970s created the need for models to quantify the interdependent effects of energy sector changes and economic performance of regional and world markets (R. Weijermars, P. Taylor, O. Bahn, S. Ranjan, Y. Wei, 2012). The focus of early models was on the impact of an oil crisis on the economy and generation of possible options for adaptation. Such optimization models under constrained energy choices were developed in the US (NEMS at DOE), Europe (EFOM at the European Commission) and through international collaboration (MARKAL at the IEA and MESSAGE at IIASA).

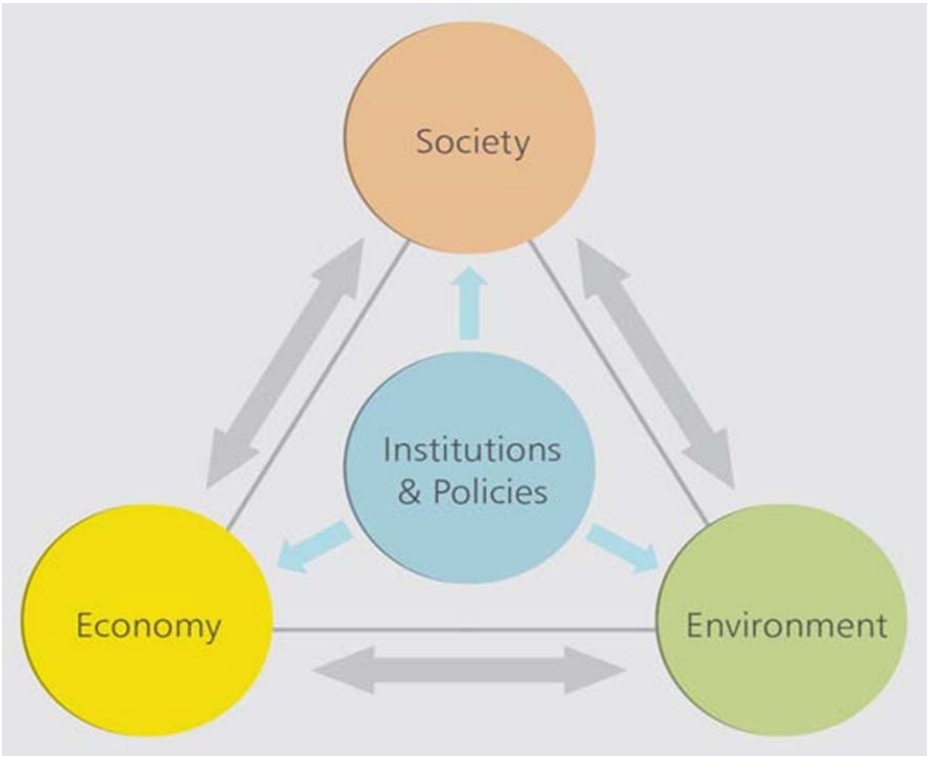
The range of programs developed to model energy systems has expanded over the past few decades. Today's global patterns of energy supply serve the needs of concurrent energy markets (G. Timilsina, 2011). Answering concerns about our future energy demand and supply, requires that we utilize theory, tools and models, on the basis of which we imagine a vision of the future and formulate a strategy to establish the desired energy mix that is suitable for the anticipated future. Energy is the engine for the production of goods and services across all economic sectors. It is vital to the provision of basic civic services in education, health care, clean water supply and sanitation, and also for wealth creation. Lack of energy is a contributing factor to the poverty of individuals, communities, nations and regions. While not an end itself, energy, jointly with appropriate technologies and infrastructure, generates the services modern societies demand (transportation, lighting, air conditioning, information exchange, etc.). Meeting the United Nations Millennium Development Goals can be only accomplished with access to affordable energy services. Concerns over energy resource availability, climate change, and air quality and energy security suggest an important role for nuclear power in supplying energy in the 21 century (IAEA, 2014).

2. ENERGY MODELLING TOOLS

Energy modelling has a long history, (since the early 1970s, a wide variety of models became available for analysing energy systems or sub-systems, such as the power system). Energy modelling has multiple purposes for better understanding of current and future markets – supply, demand, prices; facilitating a better design of energy supply systems in short, medium and long term; ensuring sustainable exploitation of scarce energy resources; understanding of the present and future interactions energy and the rest of the economy; understanding of the potential implications to environmental quality. It is based on different theoretical foundations (engineering, economics, operations research, and management science) and applies different techniques (linear programming, econometrics, scenario analysis) (G. Timilsina, 2011).

The energy system is more than the energy sector, which is a part of the energy system. The purpose of the energy system is to deliver energy services such as illumination, comfortable indoor temperatures, refrigeration, transportation, etc. Energy services are also required for virtually every commercial and industrial activity. The energy system is made up of the energy supply sector and energy end-use technologies, e.g. stoves, refrigerators, light bulbs, computers, milling machines, and associated infrastructure that covert the fuels provided by the energy sector into energy services, e.g., electricity for information technology services. Differently, the energy system consists of a set of chains – often interconnected – to deliver these services. They begin with the collection or extraction of primary energy that may be converted into fuels, such as electricity, diesel oil or bio-fuels suitable for the provision of the desired energy services via the end-use technologies. Energy planning aims at ensuring that decisions on energy demand and supply infrastructures involve all stakeholders, consider all possible energy supply and demand options, and are consistent with overall goals for national sustainable development. The concept of sustainable development encompasses three interdependent and mutually reinforcing pillars: social development, economic development and environmental protection, linked by effective government institutions.

Figure 1: Modelling structure



Source: International Energy Agency

But the key questions remain: How do we know the right energy mix and energy consumption pattern in the future? Which technologies, knowledge, regulations and incentives are needed to support our strategy and develop a balanced energy mix? Which energy vision can guide us in future choices? How do we develop an energy strategy that can be successfully implemented? How well do the various fossil fuels and alternatives compare in bargaining power? Such questions are built into quantitative models used to aid decision-making on an optimal energy mix, as discussed below. The development of energy strategies for nations and regions can benefit from elements of traditional strategy making principles. However, it is important to note the difference between decision making for personal or small-group interest and that of society as a whole. The utility functions for energy optimization at the level of entire nations are not commonly aiming only for maximum corporate profit. Instead, the main concerns are to provide energy at affordable cost price for consumers, in a reliable and safe way and without supply interruptions. A national and globally oriented energy vision must help to cope with:

1. Vulnerability: safety, security of supply, supply interruptions, price stability.

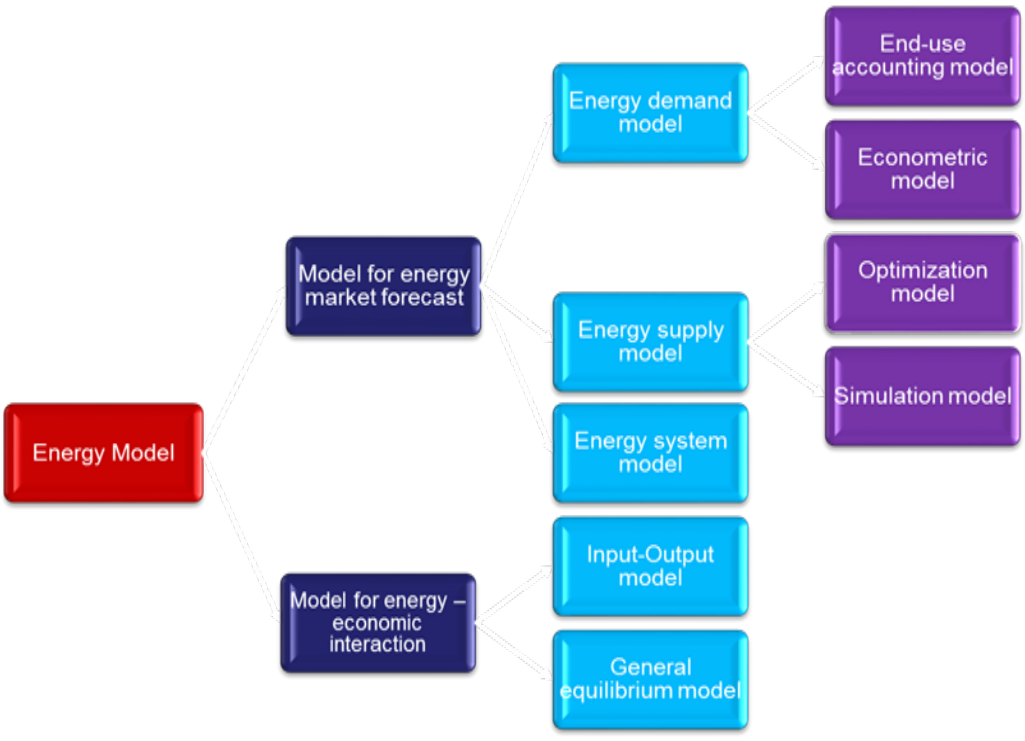
2. Environmental impact: pollution, sustainability issues, biodiversity.

3. Resource constraints: finiteness of lifecycles, competitive cost.

4. Competition for access to energy.

Currently, 2 billion people worldwide lack access to modern forms of energy; 28% of the world's population consumes 2/3rd of our energy; or 3/4th of world's population consumes less than 1/4th of the available energy. The vision must also anticipate, stimulate and support the development of truly relevant innovations and paradigm shifts that can change the future energy landscape. Successful execution of the energy vision requires building a shared passion for the vision and the choices and sacrifices to be made. Most strategies fail, not due to bad strategy design, but due to poor implementation.

Figure 2: Energy modelling diagram



Source: World Bank

The desire for a “crystal ball” to peer into the future has perhaps never been stronger among energy and environmental planners. While the future has always been uncertain, the interconnectedness of modern economic systems serves to enhance the ripple effect of our energy actions. Today's decisions also seem to be made under heightened uncertainty, as demonstrated by the number of recent unexpected events, such as: a prolonged economic recession, an unfolding shale energy revolution, the Fukushima disaster, the Arab Spring, and a notable reduction in photovoltaic costs. Policymakers have historically relied on energy scenarios and modelling to help inform decision making. While there exists a wealth of advanced model, data, and energy scenario options, important questions remain about how to effectively apply these tools to help plan for an uncertain future (T. Mai, J. Logan, N. Blai, P. Sullivan, M. Bazilian, 2013).

2.1 IEA energy tools

An energy planning process starts by taking stock of a country’s or region’s overall energy situation using a set of indicators that encompasses all aspects of sustainable development, and then generating an image of the existing energy system from resource extraction to the provision of energy services consistent with the requirements of the IAEA’s energy analysis and planning tools. The IAEA models are then calibrated to correctly reflect the current energy infrastructure and energy flows. The design of future socioeconomic and technology development scenarios is the next step, i.e. charting a possible long term national outlook on social and economic development of a country or region from which demand profiles for energy services are derived. Finally, an evaluation of all present and future energy supply options is undertaken that can meet demand under certain policy targets or constraints.

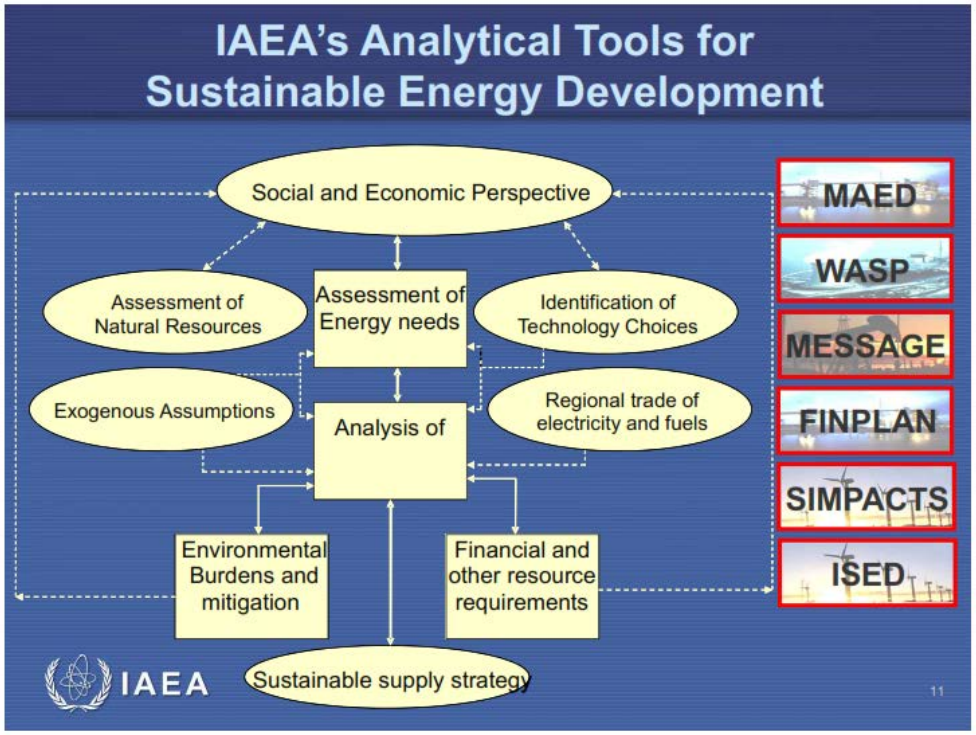
Computer assisted modelling forms the core of the IAEA’s approach to energy analysis and planning. National economic and energy statistics provide the input to the calibration of the models to accurately reflect the current energy system as well as its interaction with the principal drivers of energy demand and supply, such as demographics, economic development, technology change, environment policy, etc. Energy planners or policy analysts design future development trajectories of the principal drivers of the energy system 20 to 50 years into the future, and by using the IAEA energy planning tools, derive profiles of energy service demands and optimal supply mixes. Energy planners can then compare these scenarios (different futures) with their ability to support national development objectives and goals. Critical policy and investment aspects of different energy strategies can be defined, undesirable consequences can be identified, and the most cost effective approach to meeting future energy needs can be determined. The IAEA offers several analytical tools that support energy analysis and planning in Member States.

The Model for Analysis of Energy Demand (MAED) evaluates future energy demand based on a set of consistent assumptions on medium to long term socioeconomic, technological and demographic developments in a country or a region. Future energy needs are linked to the production and consumption of goods and services; technology and infrastructure innovation, lifestyle changes caused by increasing personal incomes; and mobility needs. Energy demand is computed for a host of end use activities in three main ‘demand sectors’: household, services, and industry and transport. MAED provides a systematic framework for mapping trends and anticipating change in energy needs, particularly as these correspond to alternative scenarios for socioeconomic development. The Model of Energy Supply Strategy Alternatives and their General Environmental Impacts (MESSAGE) combines technologies and fuels to construct so-called ‘energy chains’, making it possible to map energy flows from resource extraction, beneficiation and energy conversion (supply side) to the, distribution and the provision of energy services (demand side). The model can help design long term energy supply strategies or test energy policy options by analysing cost optimal energy mixes, investment needs and other costs for new infrastructure, energy supply security, energy resource utilization, rate of introduction of new technologies (technology learning), and environmental constraints(IEA, 2013).

The Wien Automatic System Planning Package (WASP) is an effective tool for power planning in developing countries. It helps to determine 'optimal' expansion plans for power generation within constraints identified by local analysts, which may include limited fuel availability, emission restrictions and system reliability requirements, among others. WASP explores all possible sequences of capacity additions that are capable of satisfying demand while also meeting system reliability requirements. It accounts for all costs associated with existing and new generation facilities, reserve capacity and un-served electricity (IEA, 2013).

The Model for Financial Analysis of Electric Sector Expansion Plans (FINPLAN) is used for financial analysis of electricity generation projects by taking into account financing sources, expenditures, revenues, taxes, interest rates and weighted average capital costs, etc. Since financial constraints are often the biggest obstacle to implementing an optimal energy strategy, the model is particularly helpful for exploring the long term financial viability of projects by preparing cash flows, income statements, balance sheets and financial ratios(IEA,2013).

Figure 3: IAEA's analytical tools



Source: International Energy Agency

The Simplified Approach for Estimating Impacts of Electricity Generation (SIMPACTS) estimates and quantifies health and environmental damage costs, so-called 'externalities', of different electricity generation technologies. This tool is particularly useful for comparative analyses of fossil, nuclear and renewable electricity generation, siting of new power plants or cost effectiveness of environmental mitigation policies. A key strength of SIMPACTS is that it already delivers useful results when only limited data are available (IEA, 2013).

The Indicators for Sustainable Energy Development (ISED) framework provides a flexible tool for analysts and decision makers to better understand their national energy situations and trends, and the impacts of policies and policy changes on the energy system. The indicators reflect the interaction of energy with the economic, social and environmental aspects of sustainable development over time.

The ISED can also be used to monitor progress of policies and strategies for sustainable energy development (IEA, 2013).

3. ALBANIA'S CAPACITY TO BUILD FUTURE ENERGY STRATEGY

Albania is a country which produces electricity using only one source, the hydro, a situation that is in the opposite trend with the policies followed by other countries, where is prevailing the policy of diversification of energy sources, such as to meet internal needs energy, as well as to put a milestone in the approach to energy security (Morina, Fuga, 2013). In these conditions it is important and vital to Albania creating a long-term strategy, based on concrete plans to solve the problem of the dependence of large production of electricity from a single source, by diversifying its production, reducing so high financial costs of electricity imports, with consequences on the Albanian economy. In this regard, Albania has several alternatives for diversifying energy production , through the use of wind potential, solar potential , and the use of fossil fuels (oil, coal, gas) (AEA , 2014). For this reason, it is necessary not only a long-term plan, but also wide, which should have a benchmark process of diversification of energy sources in the country, where the absolute priority should be renewable sources of energy. In this regard, nuclear energy, as one of the alternatives 'quasi' renewable deserves special attention by politicians, as well as by public opinion, since it is at a stage of high technological advancement and trade and ensures production of viable and independent of climatic conditions, compared to other renewable energies (Arbri, Fuga, 2014). However, the ability of Albania to create a long-term energy strategy is limited by the lack of application of 'soft' tools which today find a wide use in the world. Energy sector strategies that are published today in Albania are based on general terms and concepts borrowed from international practices and do not reflect a concrete plan of development. The importance of these tools are related to their ability to construct possible scenarios and to select what is most appropriate. In this context, it is important that policymakers in Albania are 'opened' to these instruments to serve better to a sector which is vital for the sustainable development of a country and its prospects in the coming decades. As Lawrence Wilkinson, co-founder of Global Business Network, said: "The purpose of scenario planning is not to pinpoint future events but to highlight large-scale forces that push the future in different directions. It's about making these forces visible, so that if they do happen, the planner will at least recognize them. It's about helping make better decisions today."

4. CONCLUSIONS

Energy mix visions and strategies are determining an important part of our world's future prosperity and welfare. Choices made now are important for future generations. The choice of the model and its effectiveness for developing energy supply strategies critically depends on the underlying vision for achieving a future energy mix. In this context, having the possibility of using professional and proven over decades tools to shape the future and not to leave it to the uncertainty is crucial for every country in a global scale. The energy planning tools are widely used over the world and they have proven to be essential for long lasting strategy. Albania energy sector is not in the condition to dismiss these tools which does not require remarkable investments and human resources. It is facing some big issues, from technical to managerial and strategic capacity. As the ending, Albania should embrace this tools or 'know how' produced in this decades and incorporate them in a wide, long lasting strategy of energy to serve better to the economy and to the future generation.

BIBLIOGRAPHY

A.Qystri & P. Fuga : Diversifikimi i burimeve energjetike si domosdoshmëri për sigurinë energjetike të vendit: mundësitë dhe dilemat për energjinë bërthamore.

F. Morina & P. Fuga: Nje qasje analitike mbi sigurinë energjetike në Ballkan. “Economicus”, 11, 2014.

G. Timilsina: Sectoral Models for Energy and Climate Policies 2011

Gruenwald, O., Oprea, D.:Optimization model of energy mix taking into account the environmental impact.

International Atomic Energy Agency : Integrated energy planning for sustainable development 2014

International Atomic Energy Agency : IAEA Tools and Methodologies for Energy System Planning and Nuclear Energy System Assessments

International Energy Agency (IEA): Soft Persuasion Through IEA Energy Policy Reviews: Transitions Towards Sustainable Energy?

International Energy Agency (IEA) 2012 : World energy outlook 2012.

International Energy Outlook September 9, 2014; Report: World energy demand and economic outlook; Report Number: DOE/EIA-0484 (2014).

International Atomic Energy Agency (IAEA) 2014: ‘Nuclear safety review 2014’.

MANE6960 - Spring 2013: Energy capacity planning and modeling - with Open Source Energy Modeling System (OSeMOSYS)

R. Weijermars, P. Taylor, O. Bahn, S. Ranjan, Yi-Ming Wei: Review of models and actors in energy mix optimization e can leader visions and decisions align with optimum model strategies for our future energy systems?

T. Mai, J. Logan, N. Blai, P. Sullivan, M. Bazilian: A Decision Maker’s Guide to Evaluating Energy Scenarios, Modeling, and Assumptions