



# Economic growth, energy consumption and sustainable development: The case of the Union for the Mediterranean countries<sup>☆</sup>



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## ABSTRACT

Since the late 1970s, developed countries have realized that their material prosperity, based on intensive use of natural resources was threatened by the energy crises (oil shocks of 1973 and 1979). This awareness was the trigger of many empirical researches that studied the relationship between energy consumption and economic growth. As the industrial development model, based on non-renewable resources, is perceived as unbearable, it is essential to implement a new one that brings new challenges: Sustainable Development. In this strategy, energy saving and promotion policies are priorities. How can we maintain economic growth while respecting the rights of future generations to achieve their own development? Thus, we studied the relationship between energy consumption and economic growth. Our study focuses on a panel of 38 UFM (Union for the Mediterranean) countries, from 1980-to-2010. Using production model and recent econometric techniques ECM (Error Correction Model), a bidirectional relationship between energy consumption and economic growth has been identified in the long and the short term for the whole panel.

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## 1. Introduction

Since the Meadow report publication in 1972 and the oil shocks in 1973 and 1979, developed countries have become aware of their growth model fragility, which is based on intensive use of exhaustible natural resources.

In 1992, the Rio Conference marked a turning point in the way of thinking about development. Indeed, infinite growth model is incompatible with exhaustible available resources. Therefore, it is no longer possible to consider development and neglect environmental issues. Models and development strategies previously used are being questioned. Environmental policy was added to economic policies. To achieve sustainable development, it became not only necessary to ensure economic, environmental and social integration aspects but also to develop strategic tools for this purpose. Beside, the sustainability problem, the fairness issue arises. Indeed, developing countries seek to achieve a similar level of growth in industrialized countries, however, and due to the

ecological and climate crises, the environment destruction could be a great threat.

In fact, our development, based largely on non-renewable resources, is considered particularly unfair towards future generations. It is therefore essential to implement a new mode of growth and development in response to new challenges, “sustainable development”.

In sustainable development strategy, the energy issue is a priority. Most countries are now adopting energy savings policies and incentive development of renewable energy technologies. Such policies normally rely on analyzes of the relationship between energy consumption and economic growth. How can we maintain economic growth while respecting the rights of future generations to achieve their own development? What is the impact of Policy to control energy on economic growth in the short and long term? Does energy saving policy threaten economic growth?

The Mediterranean region presents benefits in terms of energy due to the extreme diversity of its resources. The share of production capacity in the Mediterranean region over the world capacity is 11.4% [1]. Even if the countries of the Mediterranean region are inequitably resourced,<sup>2</sup> they quickly

<sup>2</sup> Algeria, Egypt, Syria and Libya provide 22% oil and 35% gas across the 43 Mediterranean countries [57].

<sup>☆</sup> UFM countries refer to countries belonging to UFM organization.

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expressed the need to organize their cooperation in this area, by creating the Maghreb Electricity Committee (Comelec) in 1972. It includes electricity–gas production–distribution public company in Morocco, Algeria and Tunisia. The other obvious inequality characterizing the Mediterranean region is the North–South energy disparity. In 2009, energy consumption per capita in the north of the Mediterranean was the double of the south Mediterranean countries, 2.7 toe and 1.2 respectively.

Will energy be the strategic element of the partnership between both shores of the Mediterranean countries?

The existence of a very important renewable energy potential unexploited, ensures that the social and economic development of the Mediterranean region needs a common energy strategy on different energy issues of energy savings, substitution of renewable energy and appropriate infrastructure. The energy issue is at the heart of the challenges of sustainable development in the Mediterranean region.

The creation of an international intergovernmental organization the UFM (Union for Mediterranean) countries in 2008 fits into this framework since it aims to enhance cooperation between the 28 European countries and countries bordering the Mediterranean. The main objectives of this cooperation focus on energy and environmental issues.

Several initiatives have been recorded with the aim to create common energy market; the latest in date is the MSP (Mediterranean Solar Plan). It is a flagship project of the UFM. It aims to ensure Europe energy security by promoting and exploiting solar and wind energy potential existing in MENA (Middle East and North Africa) area. Such a project cannot be limited to energy import–export, but requires harmonization and convergence of energy policies. To what extent UFM countries react similarly to energy policies?

The literature review classifies empirical studies that examined the relationship between energy consumption and economic growth [2–8] in two categories. The first one used the energy demand function, especially Masih and Masih [9], Asafu-Adjaye [4], Fatai et al. [10], Oh and Lee [11], Javid and Qayyum [12] and Bashiri Behmiri and Pires Manso [13], related to GDP (gross domestic product) and consumer prices index, as an indicator of energy prices, the second one used the production function aggregate considering energy as production factors as well as capital and labor. These include the work of Yu and Choi [14], Masih and Masih [3], Glasure and Lee [15], Yang [16], Soytas and Sari [17], Shiu and Lam [18], Paul and Bhattacharya [19], Morimoto and Hope [5], Lee and Chang [20], Stern and Enflo [21] and Bloch and all [22]. This latter approach is a revolution compared to Solow traditional growth model.

The various empirical results show the existence of three types of causalities; unidirectional causality, bidirectional causality and lack of causality. The unidirectional causality can be seen either from energy consumption to economic growth or vice versa. In other words does energy use cause economic growth or does economic growth imply increasing energy consumption? In the first case, energy saving policy is likely to have a negative impact on economic growth. However, if causality goes from economic growth to energy consumption, the implementation of energy saving policy has no effect on economic growth. The presence of bidirectional causality means that energy consumption and economic growth are complementary and that reducing energy consumption by adopting an energy conservation policy may cause contraction effects. The absence of causality allows energy policy implementation without affecting economic growth [23].

The main objective of energy policy is to reduce energy consumption without impacting negatively economic growth. To achieve this aim, we can use energy conservation and energy efficiency. Nevertheless it is important to understand the difference between the two concepts even if both can reduce energy use, GHG (greenhouse gas) emissions and consequently increase environmental quality and sustainability.

The energy conservation is defined as the reduction of the amount of energy consumed. It refers to a rational use of energy and reduction of waste with no need to new investment but through behavioral change. While the energy efficiency means the increase of productivity of energy, since you can provide the same service using less energy. It is normally achieved through innovation and clean technologies investment.

In this context, an analysis of growth–development–energy relationship, allows to assess our development process and to guide the industry organization in order to save thermodynamic energy policy, particularly by transition energy with promoting renewable energy. Therefore, our work aims to contribute to existing debate on the place of energy in the production function [11,21,24–27]. We choose to analyze the causal relationship between energy consumption and economic growth in UFM countries since it is new organization of countries, never taken in to account in such literature before.

The rest of the paper is organized as follows: in the first section we present the theoretical framework and the model. Unlike many previous studies that used bi-various models, we propose a multivariate model that details the properties in the second section. The last section is reserved to the empirical interpretation findings and the resulting recommendations.

## 2. The model

Considering ecology and natural resources in economic theories is not recent approach. Indeed, in 1976 Georgescu-Roegen [28] based on entropy principle (thermodynamics) showed that economic process is neither isolated nor independent since “it can't function without a continuous exchange which alters the environment cumulatively and without being influenced by these changes back”.

Some new biophysical economic models are exclusively based on the energy and consider it as the only primary production factor. It requires that real energy stock is deteriorated during the economic process. These models ignore the law of energy conservation and assume that available energy in each period is exogenous. In addition, many ecological economists [29–32], argue that energy used to produce intermediate resource inputs such as fuels increases as the quality of resources (such as oil reservoirs) declines. Therefore, the increase in energy prices, resulting in increased use value will influence resource scarcity [33]. Indeed, the consideration of energy as the only primary production factor, given the availability of other resources, has created conflict. Brown and Herendeen [34] argued that resources are determined by their internal geological and solar energy. Thus, change in resource quality causes a change in the embodied energy resources, rather than a change in the input–output coefficients.

Unlike conventional economists, ecological economists believe that the economic sphere is not isolated from the natural world from where it draws the needed natural resources and in which it throws the garbage, but it is actually integrated and dependent. They consider that the economic system is a subsystem of the ecosphere as shown in the following graph.

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