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REZUMATUL TEZEI DE DOCTORAT

- Limba engleză -

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CLUJ-NAPOCA

2019

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THE ROLE OF RENEWABLE ENERGY IN THE NEW PARADIGM OF THE OPTIMUM ENERGY MIX

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2019

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KEY WORDS:

renewable energy, energy policy, energy security, sustainable development, optimal energy mix, energy potential, support schemes;

REZUMAT

Energy is, along with information, one of the key elements of economic and political life of the 3rd millennium, an indispensable resource of contemporary economy, and also an instrument for geopolitical negotiation, being often used for the consolidation of political relations between states, but also has the potential of generating major military conflicts.

As key element of human activity, energy has a major role for assuring a climate favourable to development. In the context of a sustainable development, however, the conventional natural resources which were at the basis of production of energy will have to be spared for various reasons: exhaustible nature, renewable rate net inferior to consumption pace, emissions of noxious fumes following the energy valorisation processes and negative impact on environment. Many authors quoted in this work approach the subject of environmental protection in parallel with the issue of supply of energy, the overwhelming majority shows worrying increases of emissions of hothouse gases and their effects on climate and global average temperatures. It is remarkable the correlation pattern of development level with the pattern of emissions of hothouse gases and in general the pollution; from this point of view, we accepted the reasoning by which in the first stage there is an evolution of economic growth and pollution degree to the same extent, but the continuation of economic development phenomenon after a certain level brings the increase of requirements and concerns of population for the quality of life; an important component of these concerns is the awareness of the pollution danger and negative effects associated with it; completed by a marked civic spirit specific to developed economies, they press the public authorities to take measures.

We find plenty of energy in universe under various forms (kinetic, potential, chemical, electric, , thermal, radiation, nuclear etc.), but on Earth the availability of elements which contain potential

of primary energy easy to fructify is limited, which shows the economic nature (exhaustible) of energy resources available to the human society. We claim that these resources are available to the human society because the influence level of man exerted on environment in the last 250 years, from the industrial revolution until now, has led to the adoption by a series of authors such as Zalasiewicz, Crutzen, Williams or Steffen of the term *Anthropocene* – used to define the *age of man* (Zalasiewicz et. al, 2010). Noticing the remarkable role of man as species able to change essentially the environmental conditions in which he lives and affect directly and indirectly all the other species of the planet, we consider that this name is suitable for the meaning mentioned.

Considering that traditionally, to obtain and valorise energy, we use primary resources such as coal, natural gases or fossil fuels, which by combustion give off hothouse gases, the anthropogenic climate change is an important characteristic of Anthropocene. The increasing need for energy of mankind has determined an exponential evolution of the demand of energy and implicitly the emissions of carbon dioxide (increase by 40% compared to pre-industrial age), methane (increase by 150%), respectively nitrogen oxide (increase by 20%) in atmosphere, unprecedented changes in the last 800,000 years, according to Intergovernmental Panel on Climate Change (IPCC, 2014).

The negative imprint of anthropic activity on air by intensification of hothouse effect is not the only form of pollution. Waters, soils, ecosystems in general are also disturbed, especially in extreme cases of ecological accidents; either we talk about nuclear energy (by the examples of Chernobyl or Fukushima), the oil energy (the oil discharges from the Golf War or the accident of British Petroleum in Mexico Golf), chemical industry etc., all these cause changes in environment, sometimes irreversible.

The deterioration of environment by the mainly irresponsible actions of human society puts its own future paradoxically, in danger. The security of mankind depends to a large extent on the security of its supply with energy. The transition to an energy system based to a large extent on renewable sources would generate the advantage of assuring a higher degree of security and predictability of supply with energy. The volatility of prices on crude oil, natural gases and coal market, but also the availability of these products is often the effect of non-economic factors, but rather political, geo-political, social factors, which represent a major threat to energetic security. The problem of energetic security is intensely studied and debated all over the world, there are

many authors who dedicate an important part of their research activity to this subject. This work will try to make a synthesis of conception expressed in some reference works in the field, in search of the essence of this ”polysemantic” and ”slippery” notion (Chester, 2010). Although there is no wide consensus in specialised literature regarding a unitary definition of the energetic security concept, most of authors validate the principles of Yergin (2005), with focus on the most important of them, the diversification of energy sources, a *sine qua non* condition for consolidation of energetic security. However, in real economy we encounter, even in case of European Union, situations with major vulnerabilities from this point of view; for example, this work revealed that UE28 has a dependence on the import of energy of 40%, and these imports come especially from Russia. Given the recent geopolitical tensions generated by the support of Separatists in East Ukraine, the occupation of Crimea or the involvement in the Syrian conflict, materialised by the imposition by USA and European Union of sanctions, including economic sanctions to the Russian Federation, a situation of dependence of European Union states on the import of energy products from Russia is risky.

The climate changes are definitely the greatest challenges of the current generation, and European Union has created the image of a world leader in promotion of environmental protection actions. The energy strategy of European Union approaches two dimensions: on one hand, it emphasizes the importance of rational consumption of energy, noting also the opportunity of initiation of investments in this respect and implicitly, the creation of new jobs, and on the other hand, it draws to our attention the need for a real transition from an energy market based on conventional sources of energy to an energy market based on the fructification of sources of renewable energy, which is abundantly found in the known universe, with a practically indefinite availability.

SUMMARY OF MAIN PARTS

CHAPTER 1. RENEWABLE ENERGY IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

Energy is an indispensable element in the present economic life, with a vast power to generate both political alliances and especially conflicts, even of military nature. The total dependence of world economy on energy cannot be avoided, so apart from the efforts of rationalization and restructuring of consumption, it is natural that we identify efforts of finding alternatives to conventional sources of energy, which have – as we well know – an exhaustible nature in a not too far horizon of time.

One of the solutions to the problem of availability of energy sources is the valorisation of renewable sources. By using a higher quantity of energy coming from renewable sources we can hope to decrease the dependence on the world stock of fossil fuels. The problem of assuring the energetic security is one which can have an answer in this change of paradigm in the supply with energy, as well as sustainable development, if the investment in green renewables sources is stimulated, the green renewable sources which have a low imprint on environment.

The transition to an economy based on the consumption of energy from renewable sources is characterised by many challenges, such as the variability of production (nocturnal/diurnal or seasonal), certain market entry barriers such as the high entry cost, administrative difficulties (connection to the national energy system) or even social costs (negative impact on communities, rejection such as NIMBY).

However, there are different infrastructures for valorisation of renewable energy, but they can be used individually or concomitantly depending on the particularity of area in which they are installed or the consumption behaviour, so that they have a minimal impact on environment (both ecologically and aesthetically). The costs of initial investment and the operating costs, included in the category of risks, record important decreases in the studied intervals of time, so that there are premises that the functioning of plants for production of energy from renewable sources, especially solar and wind energy, becomes efficient even without subsidises. Therefore,

it confirms one again that the new technologies are not always efficient from the start, they become efficient most of times after use.

CHAPTER 2. STRATEGIES, INSTRUMENTS AND SUPPORT PROGRAMMES FOR RENEWABLE ENERGY

The energy need of mankind is on the increase, the evolution of the last 30 years showed an ascending trend of consumption; except for the years 2008-2009, as echo of the shock of financial markets crisis. From the point of view of world regions, Asia Pacific recors spectacular evolution in the consumption of energy, under the pressure of accelerated development of China and India; for the year 2017, in this area they consume almost half of the total energy consumed on the globe.

From the point of view of energy consumption evolution depending on sources, renewable energy is on a relatively constant positive trend, unlike other conventional energy sources which have important oscillations, especially the coal and oil. These evolutions change the world energy mix, bringing renewable energy in the year 2017 to a weight of over 10% of the total consumption of energy.

There is a wide variety of instruments for stimulation and support for investments in renewable sources, both on the research-development-innovation component and on investment component. We mention here the fiscal instruments, financial instruments and the assurance of a coherent legislative framework favourable to investors. All this has the clear role of increasing the degree of use of renewable energy in the energy paradigm of the world.

We approached here an original subject, the optimal energy mix, and I am trying to define it as the ***maximal result which can be obtained as ratio between the energy consumption and present (operating) costs and future costs (degradation of environment) which result from the consumption of energy.*** In the definition of this optimal result, I introduced the need for consultation of relevant references: historical, national and geopolitical context (regional and international), development level (and even the evolution of perspective on sustainable development across time), the structure of own natural resources, the dependence level of national economy on these, especially the imports of natural resources. The rather qualitative

dimension of these references, to the detriment of the quantitative dimension, make more difficult their introduction in an objective mathematical function which assures the balance in any national economy on which it is applied. The proposal to tackle the issue in empirical manner, by the model of European Union, by establishing intermediary objectives regarding the weight of renewable energy in the energy mix, impact analysis, followed by the establishment of new weights and the repetition of these steps until the identification of the version which offers the best economic and ecological solution.

Efforts in this respect are materialised by various political mechanisms and civic actions. Some of the most visible efforts on world level are the conferences of the Framework Convention of United Nations Organisation on climate changes. Initiated in 1992 after the organisation in Rio de Janeiro of ”Earth Summit”, the high level meetings generated across time a series of documents and positions regarding the need that the mankind protects the natural patrimony it disposes of. Now, the Agreement signed following the conference of Paris is the legal instrument by which the signatory states undertake to respect the principles of sustainable development and environmental protection, matters with direct impact on the activity of stimulation/support of investments in renewable sources as instrument of achieving the objectives of Agreement.

We notice across the interval studied a restructuring of consumption in favour of renewable energies, as a result of these efforts. Even if the investments in these energy sources now generate higher costs than conventional energy, they are often supported by subsidies and other stimulation programmes, having an important advantage on long term, much lower future (environmental) costs.

CHAPTER 3. STRATEGIES, PROGRAMMES AND POLICIES FOR A SUSTAINABLE FUTURE BY RENEWABLE ENERGY – EUROPEAN UNION MODEL

European Union is definitely in the avantgarde of actions regarding renewable energy. The multitude of challenges that each of the 28 member states encounter led to the elaboration of a vast legislative package and a thorough strategic documentation, which have the versatility necessary for a wide applicability among members.

The multitude of financing methods for both the research-development-innovation component and the investments themselves in the construction of production capacities creates an active, effervescent market. The European model is successfully imported by the Chinese partners, with remarkable results, following an ”interactive learning” process.

Following the evaluation of the vast legislative framework which governs the energy policy of the community block, and the increased interest of many stakeholders of the market, both in the research area and business, political environment, civic organisations and public opinion as a whole, we can confirm the hypothesis from which started the analysis of the current chapter: the European Union is definitely in the world avantgarde of changes in the field of energy, both from the perspective of increasing the energy efficiency and the reason of energy consumption, especially in the changing of production paradigm, distribution and energy consumption, from an economy based on fossil fuels, to an economy based on a balanced mix of conventional and renewable sources of energy.

In fact, the whole European institutional construction has among its basic pillars the problem of energy, which is recognized unanimously as one of the indispensable raw materials in the modern economy and the first forms of European collaboration were The European Coal and Steel Community, then the European Atomic Energy Community. The consolidation of these multi-national European associations in what today European Union is has led to a stronger inclination of member states to the energy supply problems. The identification of new sources of energy and the supporting of investments necessary for research and exploitation in efficient conditions, which assure the future of economic development beyond the nearer horizon of exhaustion of stocks of conventional resources, have become dominant subjects of discussions from Brussels or Strasbourg with the publication by the European Commission of the *White Charter* **– *An Energy Policy for European Union*** in the year 1995. After it, a series of similar documents were drawn up, White or Green Charters, which established the strategic directions to follow for achieving the energy policy objectives of European Union. One of these objectives, in this case the energy security is far from being reached because UE28 records a high level of energy dependence; on average, the member states of European Union imported in 2016 more than half of the necessity of energy consumption, mainly natural gases from Russia and the ex-Soviet space, but also crude oil from the Middle East states.

The documents which were at the basis of substantiation of chapter three are the most relevant in the attempt to capture the evolution of the way in which the European Union (or the organisations which preceded it) promoted at world level the need for passage to an economy consuming renewable energy. After the coagulation of these official positions, the attention to renewable energy and its role in the energy policy of the European Union – and also other states of the world – has increased.

The legislative framework which developed following this concentration of public agenda in the energy field on renewable sources of energy is very complex and important for the sustainable future of the construction of European Community block. Among them, the Directive 2009/28 of European Commission was the object of a distinctive subchapter, considering its importance in the definition of Europe 2020 Strategy. Structured on five priority axes, it has the purpose to reduce the emissions of hothouse gases by at least 20% compared to the levels recorded in the year 1990, to increase the energy efficiency by at least 20% and to have a weight of the consumption of renewable energy in total consumption of energy of at least 20% until 2020.

Of course, all these ambitious targets require major investment efforts, so that in the European Union, the access to financing for investments in renewable sources both in research, development, innovation and construction of new production capacities is relatively easy. The most important channels in this respect are the European Investment Bank, the European Bank for Reconstruction and Development, as well as the Northern Investment Bank. We identify also non-refundable financing lines of the European Commission, either by European Regional Development Fund or by Connecting Europe Facility or the Research and Innovation Programme of European Union ”Horizon 2020”. There are an important number of such mechanisms and financing schemes at European level and in each member state, all these instruments stimulate the markets in the pursued strategic direction, taking into account the existence of coercive measures directed against the states which do not make progress for achievement of objectives set for the year 2020.

The progresses mentioned are visible, and the European Union constantly consolidates its position of pioneer in the avant-garde of research and development of technology in the field of renewable sources of energy, but also in legislative innovation and energy policy.

Apart from versatility, another important characteristic in the mix of influence factors of mainly positive results of implementation of EU strategy in energy field is represented by the obligation of respecting the duties undertaken by PNAERs by each state, with sanctions for non-fulfilment. This is preserved with an extra rigourosity for the next strategic period, 2030, to assure a deeper integration of national energy systems of members in what Energy Union wants to be.

The European Union is a firm supporter of the Agreement of Paris, document which continues to be a world reference in the fight against pollution effects, in spite of the exit from it of the largest economy of the world, USA. In fact, EU recalibrates its focus to the strategic perspectives 2030 and even 2050, by preparing the new principles, criteria and objectives to be reached for the future, which will perfect the Energy Union, since the first years of the second decade of the new millenium with the publication of the Green Charter - *A framework for 2030 for energy and climate policies* and also *The Strategic Perspective of 2050*.

CHAPTER 4. COMPARATIVE ANALYSIS BETWEEN DENMARK, UNITED KINGDOM AND ROMANIA: STRATEGY FOR RENEWABLE ENERGY – ENERGY POLICY INSTRUMENTS AND IMPLEMENTATION EFFECTS

When the Directive 2009/28/EC came into force, the member states of European Union had the obligation that until 30 June 2010 they formulated and undertook a National Plan of Action for Renewable Energy. We chose these three countries which will make the object of comparison in this chapter because they were at that time in different hypostases in relation to the green energy obligations as follows:

Denmark had already over 20% renewable energy in total consumption, and many initiatives in the field of research and implementation of wind farm technologies. Also, there was a vast awareness of environmental issues among the population, but also a legislative framework which since 1992 promoted sustainable development principles.

The United Kingdom, on the other hand, consumed green sources of energy to a much lesser extent, about 3.7% of total consumption of energy, even if it was an economy which invested in technology for valorisation of renewable energy both wind energy and biomass or marine energy. However, the much higher industrialization level than the other two countries makes that

as a whole the energy consumptions are much higher and implicitly, the emissions of hothouse gases are more important.

Romania was the best placed statistically with a quota of renewable sources of energy already used in consumption very close to the target, 23.4% compared to the objective of 24% for 2020, but strongly dependent in this respect on the production of hydro-energy and old infrastructure in the field. At the level of the other renewable technologies, the volume of investments and installed capacities was relatively low.

This section aims, therefore, to test the versatility of the European framework of support for renewable sources of energy, by capturing the route of the three EU member states in the achievement of objectives undertaken for 2020. We will tackle the issue starting from the state of fact before the adoption of PNAERs, analysing then the internal legislative framework and instruments used, with highlight of progress made, the effects of those measures for the national economy and also the local particularities.

Although they start from different hypostases in the pursue of objectives for the year 2020 in energy strategy matters, the three EU member states studied manage to improve the situation for the problem of renewable sources of energy and energy efficiency in the studied interval.

Two of them, Romani and Denmark, will probably manage to achieve most of objectives, some of them were already overcome now; we are talking about the weight of renewable sources of energy in the total consumption of energy, but the numbers seem to indicate favourable situations regarding the weight of renewable sources of energy in transportation and production of electricity. The United Kingdom, from this point of view, will probably be unable to achieve the targets mentioned, but the progress is remarkable considering the different scale of energy and distribution of market consumers.

The legislative volatility of Romania can affect to a certain extent the progress in implementation of PNAER, but the stronger inclination to the household consumers and the opening of new opportunities in becoming *prosumers* can offer a certain stability in the increase of weight of renewable sources of energy in consumption.

Denmark establishes by far the most ambitious objectives for the future after 2020, with plans to eliminate completely the diesel cars or to assure the whole consumption of energy from

renewable sources of energy until 2030. We can state that the work hypotheses are favourable to the achievement of these targets, as we have shown in this chapter.

The uncertainties generated by Brexit affect and will probably affect the British economy, but it seems that the United Kingdom will continue its efforts for increasing the energy efficiency and using renewable sources of energy in the consumption of energy even outside of European Union.

Undisputably, the efforts made to achieve the energy strategy objectives have led to positive results from many points of view. The renewable sources of energy have managed to assure an important number of jobs and to generate plus-value in all the analysed states.