MANAGERIAL CONSIDERATIONS ON NONCONVENTIONAL TECHNOLOGIES TO CAPITALIZATION OF THE ENERGY RESOURCES

Simina Mariș[1],Lavinia Cernescu[2], Gabriela Victoria Mnerie[3] and Luisa Dungan[3]
[1]Ioan SlaviciUniversity Timisoara, siminamaris@gmail.com
[2]Ioan SlaviciUniversity Timisoara, cernescu.lavinia@yahoo.com
[3]Ioan SlaviciUniversity Timisoara, gabi.mnerie@gmail.com
[4]Politehnica University Timisoara, luisa_izabel36@yahoo.com

ABSTRACT: The continuous development of industry demands increasing amounts of energy. Hence, there is a quest for obtaining and promoting nonconventional technologies by renewable energy whichfuels the quest for non-conventional technologies used in the field of energy. There are international regulations concerning the management of energy resources in general, which can be applied in managing the renewable energy resources. Romania joined the international efforts in the area of promoting renewable energy resources. The targets assumed (24% of the total energy produced in Romania by 2020 should come from renewable sources) can be achieved if the current regulations and management methods are followed.
KEY WORDS: non-conventional technologies, energy sources, management, Romania state of art, 2020 target

1. INTRODUCTION

Energy is the key of every action that is happening in our days. The technological progress demanded extensive usage of existing energy resources, as well as a continuous quest for newsources and types of energy.

Nowadays, we distinguish between conventional and non-conventional sources of energy.

The exploitation of non-conventional resources strongly requires the development of non-conventional technologies for energy production, storage, processing or transport.

Conventional sources of energy [1] are represented by these resources which had been used for a long time: coal, traditional biomass, petroleum, natural gas, water power, nuclear power. As it can be observed, they are mostly fossil fuels. Using conventional energy sources leads to increased greenhouse gas emissions and, hence, produces non negligible environmental damage. With the exception of water, all the conventional energy sources are exhaustible.

Conventional energy sources are also expensive to exploit, maintain, store and transmit, as they are found in certain geographical areas, but are used worldwide.

On the other side, non-conventional energy resources [1], also called renewable energy resources, are inexhaustible and generally pollution free. Non-conventional energy resources include solar power, wind power, tidaland hydro power, biogas, modern biomass and geothermal energy.Moreover, renewable energy do not require high expenditure, and can be renewed with a minimum of effort and money.

Renewable energy is used to replace conventional resources in areas like electricity generation, heating or cooling purposes (heating water and space), fuels and household off-grid energy generation [2].

Renewable energy provided an estimated 19% of global final energy consumption in 2012, and continued to grow strongly in 2013. Of this total share in 2012, traditional biomass accounted for about 9%, and modern renewables increased their share to approximately 10%.[3]

The combined modern and traditional renewable energy share remained about level with 2011, even as the share of modern renewables increased. This is because the rapid growth in modern renewable energy is tempered by both a slow migration away from traditional biomass and a continued rise in total global energy demand.

However, due to the fact that the renewable energy area is still under development, international regulations are needed in order to increase energy efficiency, reduce costs and improve performance [4]. This is achieved by ISO50001:2011 - Energy management systems – Requirements with guidance for use, a standard issued by the International Organization for Standardization in 2011.

In the following, we will describe the renewable energy resources in use at the moment worldwide, in EU and Romania, their management and possible improvements in their regulation.

2. RENEWABLE ENERGY RESOURCES

2.1 Solar energy

Solar energy is the energy received from the Sun. It can be converted either in electrical energy, or in thermal energy. While every place on the surface of earth receives energy from the Sun, the solar power can be produced efficiently only in specific areas, and is subjected to weather conditions. Once generated, the storage of solar energy can be a challenge.[1]

The conversion of solar energy to electricity occurs either using photovoltaic cells, which convert sunlight into electricity, or solar power plants, which use the solar energy to produce steam and operate an electrical generator.

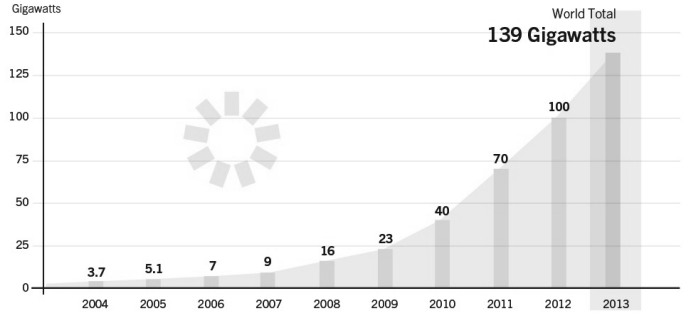

Figure 1. Solar photovoltaic total global capacity (source: [2])

At the level of 2013, the top 10 countries using solar photovoltaic energy were Germany, China, Italy, Japan, United States, Spain, France, United Kingdom, Australia and Belgium.

The solar thermal energy usage increased exponentially during the last years, especially in Spain and United States.

2.2 Wind energy

Wind energy is the energy produced by the wind, while it powers turbines and is converted directly in electrical energy. Wind turbines can be placed anywhere and occupy small areas on the land. However, they are noisy and can be used efficiently only in specific areas (windy areas). [1]

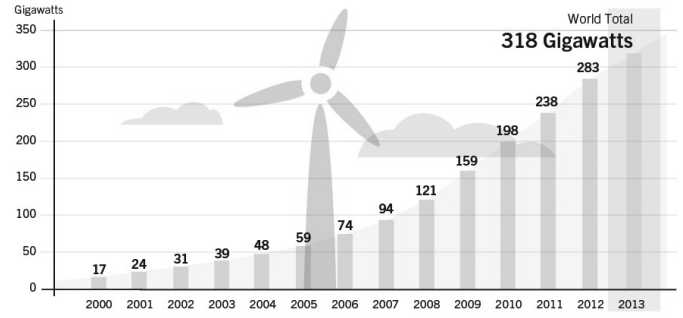

Figure 2. Wind power global capacity (source: [2])

The top 10 countries using wind power were, in 2013, China, United States, Germany, Spain, India, United Kingdom, Italy, France, Canada and Denmark.

2.3 Tidal and hydro power

Energy can be produced from water either inland (rivers) or on the oceans. Hydropower plants are constructed on rivers and force water (which is stored in a reservoir) through a dam, and back into the river. Thus, a turbine is turned, which further turns a generator to produce electricity. [1] Tidal power plants use the tides to produce electrical energy. While hydropower plants can be constructed virtually on every river, tidal power plants are suitable especially in areas where the tidal differences are large.

2.4 Biogas

The term "biogas" refers to a mixture of gases which result from the breakdown of organic matter in the absence o oxygen. The sources of biogas are mainly agricultural and human wastes, which can be processed using anaerobic bacteria or by fermentation. Biogas is a mixture of methane, carbon dioxide and small amounts of other gases (like hydrogen sulphide) and its quality is given primarily by the amount of methane contained. [5]

2.5 Modern biomass

Modern biomass is solid, liquid or gaseous and its combustion is less polluting. Moreover, while traditional biomass may not be harvested in a sustainable manner, the modern biomass is sustainable. Opposing, traditional biomass is solid biomass that is combusted in inefficient, usually polluting equipment's, typically in rural areas of developing countries. [2]

Depending on the conditions of available land and the environmental challenges, various types of crops and plantations are available to produce biomass. *Brassica rapaoleifera* (rapeseed) with a life cycle of just 40 days and is fit for a quick profit, is used for bio fuel. It offers a better soil protection against erosion than other short-term crops, can be used as rotation crop with other plants, such as wheat, sorghum or beans and is tolerant to soil salinity.[6]

Short rotation woody crops of *Salix viminalis* (Energy Willow) achieve maturity in 2 years and can be harvested up to 25 years after maturity. It can be cultivated on soils that are not appropriate for other types if crops (such as marshes), offering soil protection against erosion and is one of the most efficient plants that can be used to deactivate heavy metals [7].

Hybrid *Paulownia Tomentosa* × *Fortunei* (also known as Kiri Maximus [8]) achieves maturity in 6 years and can be harvested up to 12 years after maturity. Despite the long time to maturity, the volume of wood production over 10 years is

comparable to the wood production of Energy Willow, and it is also suitable for noise and air-pollution reduction.

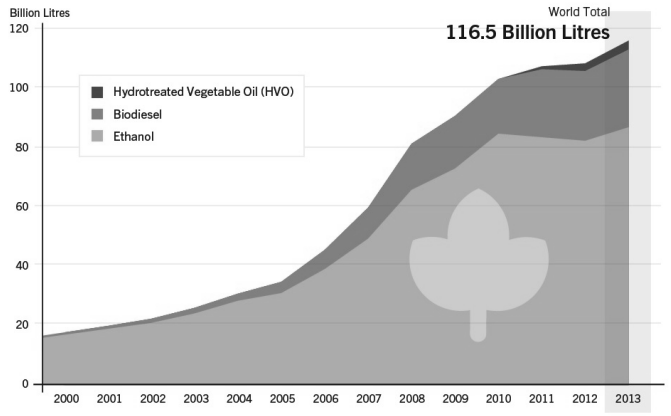

Figure 3. Ethanol, biodiesel and hydrogenated vegetable oil global production (source: [2])

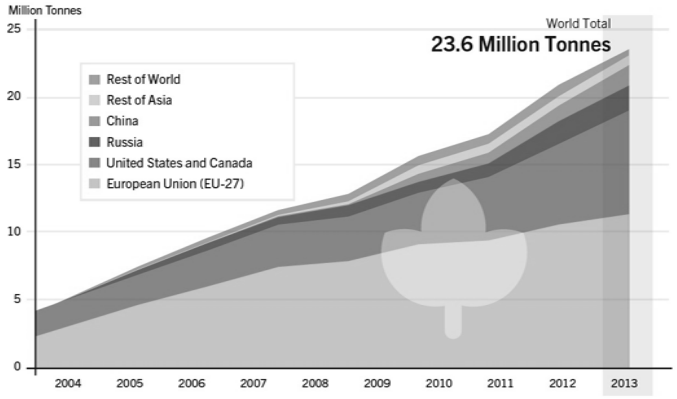

Figure 4. Wood pellet global production (source: [2])

2.6 Geothermal energy

Geothermal energy is the energy generated by the core of the Earth. It can be exploited efficiently particularly near tectonically active areas. Geothermal power is usable either at an individual level (heat pumps) or by using dry steam or hot water to generate electricity. Geothermal plants do not use fuel to combust, hence they release no greenhouse gas emissions.[2]

At the level of 2013, the top 10 countries using geothermal energy were: United States, Philippines, Indonesia, Mexico, Italy, New Zealand, Iceland, Japan, Turkey and Kenya.

3. INTERNATIONAL REGULATIONS FOR ENERGY

There is no international standard which refers strictly to the management of renewable energy sources, but there is a standard which regulates the management of all the energy systems.

Recognizing the need of an effective tool when coping to the climate change and national energy management standards, the United Nations Industrial Development Organization (UNIDO) requested an international standard regarding the energy management. A committee was created in 2008 and, based on their debates, the international standard ISO50001 was adopted in 2011.

ISO50001 provides standards and management strategies to increase the energetic efficiency, reduce costs and improve performance, as stated in its introduction[9]:

"*The purpose of this International Standard is to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use, and consumption. Implementation of this standard is intended to lead to reductions in greenhouse gas emissions, energy cost, and other related environmental impacts, through systematic management of energy. [...] This International Standard specifies requirements of an energy management system (EnMS) for an organization [...]based on the Plan-Do-Check-Act continual improvement framework and incorporates energy management into everyday organizational practices.*" [9]

The Plan-Do-Check-Act framework is described as follows [9]:

- **Plan:** conduct the energy review and establish the baseline, energy performance indicators (EnPIs), objectives, targets and action plans necessary to deliver results in accordance with opportunities to improve energy performance and the organization's energy policy.
- **Do:** implement the energy management action plans.
- **Check:** monitor and measure processes and the key characteristics of its operations that determine energy performance against the energy policy and objectives and report the results.
- **Act:** take actions to continually improve energy performance and the EnMS.

Among the objectives of ISO 50001 are:

- to efficiently assist organizations towards a better usage of existing energy-consuming assets
- to facilitate a transparent communication whilst managing energy resources
- to promote best practices regarding energy management
- to assist the evaluation and implementation of new energy-efficient technologies
- to be a framework for promoting energy efficiency throughout the supply chain
- to contribute to the reduction of greenhouse gas emissions by efficient energy management
- to integrate energy management with other organizational management systems

At the global level, countries established renewable energy targets. In order to achieve these targets, there are two sets of support policies regarding

renewable energy: regulatory policies and fiscal incentives and public financing.

Among the regulatory policies are: feed-in tariff / premium payment; electric utility quota obligation / RPS (renewable portfolio standard); net metering; tradable REC (renewable energy certificates); tendering; heat obligation / mandate; biofuels obligation / mandate.

The fiscal incentives and public financing refer to: capital subsidy or rebate; investment or production tax credits; reductions in sales, energy, CO_2, VAT, or other taxes; energy production payment; public investment, loans, or grants.

As a direct result of these policies, it can be observed that the average annual growth rates of renewable energy at the level of 2013 are similar to the corresponding multi-annual growth ratesat the level of 2008-2012.

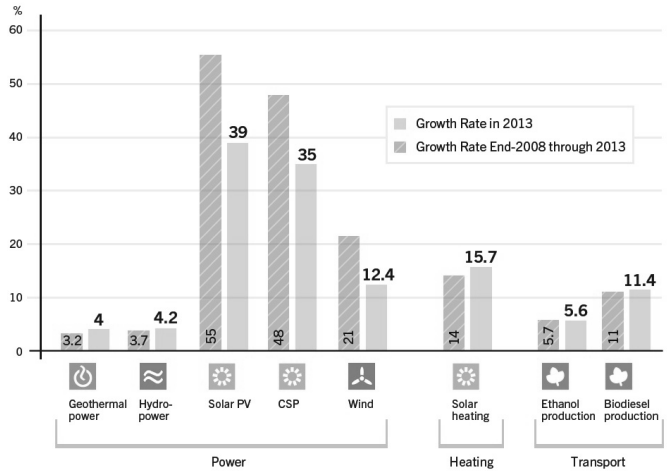

Figure 5. Average Annual Growth Rates of Renewable Energy Capacity and Biofuels Production, End-2008-2013 (source: [2])

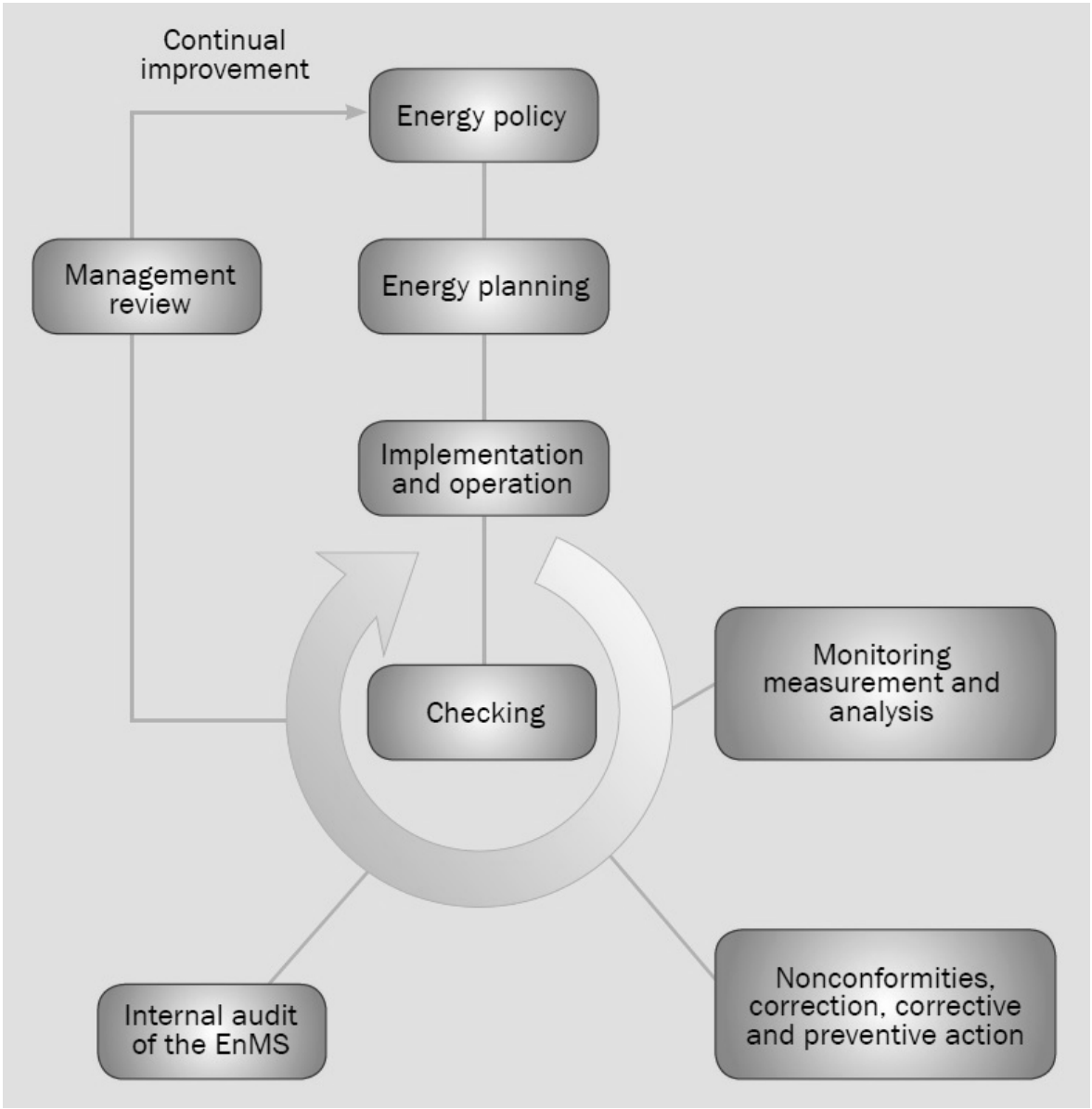

Figure 6. Energy management system model (source: [9])

Table 1. Renewable energy support policies at the level of EU-27

Country	Renewable energy targets	REGULATORY POLICIES							FISCAL INCENTIVES AND PUBLIC FINANCING				
		Feed-in tariff / premium payment	Electric utility quota obligation / RPS	Net metering	Tradable REC	Tendering	Heat obligation / mandate	Biofuels obligation / mandate	Capital subsidy or rebate	Investment or production tax credits	Reductions in sales, energy, CO2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants
Austria	○	○			○			○	○	○			○
Belgium	○		●	●	○	○		○	★◆	○	○		
Bulgaria	○	○						○					○
Croatia	○	○						○					
Cyprus	○	○		★		○		○	☒				
Czech Republic	○	◆			○			○	○	○	○		
Denmark	○	○		○	○	○		○	○	○	○		☒
Estonia	○	○						○				○	○
Finland	○	○			○			○	○		○	○	
France	☒	☒			○	☒		○	○	☒	○		○
Germany	○	☒					○	○	○	○	○		○
Greece	○	☒		★				○	○	○	○		○
Hungary	○	○						○	○		○		○
Ireland	○	○			○	○	●	○					
Italy	○	☒	○	○	○	☒	○	○	○	○	○		○
Latvia	○	○		★		○		○			○		
Lithuania	○	☒	○					○					○
Luxembourg	○	○						○	○				
Malta	○	○		○					○		○		
Netherlands	○	☒		☒	○			○	○	○	○	○	○
Poland	○		○		○	☒		○			○		○
Portugal	☒	☒	○			○	○	○	◆	◆	○		◆
Romania	○		○		○			○					○
Slovakia	○	☒			○			○			○		○
Slovenia	○	○			○	○			○	○	○		○
Spain	○			○	○			○	○	○		○	
Sweden	○		○		○			○	○	○	○		○
United Kingdom	☒	☒	○		○		○	○	☒		○	○	○

Legend: ○existing national; ●existing sub-national; ★new;☒ revised; ◆ removed/expired;⬥ sub-national

Source: Renewables 2014 Global Status Report

4. ROMANIA AND ENERGY MANAGEMENT

In the case of Romania, there are established regulations regarding renewable energy in the following areas: electric utility quota obligation / RPS (since 2008); tradable REC; biofuels obligation / mandate; public investment, loans, or grants regarding renewable energy. [2,10, 13]

Electricity obtained from renewable energy sources is promoted mainly through a quota system, but also through the Romanian Environmental Fund and the National Rural Development Programme. Grid operators are obliged to connect renewable energy plants and transmit the collected electricity as a priority. Moreover, there is a recommendation concerning the usage of renewable energy sources in new buildings which exceed 1000m^2 in surface (Law No. 372/2005).

In the field of heating and cooling, the current policies in Romania promote the installation, usage and usage of renewable energy sources.

The Intelligent Energy Europe project "BUILD UP Skills Romania – ROBUST" is focused on developing a national strategy for qualification of workers in the field of energy efficiency and renewable energy use in buildings.

In the field of transportation, it should be mentioned that fuel retailers are obliged to ensure that a prescribed quota of their profit is obtaining by selling biofuels (Decision No. 935/2011).

At the end of 2013, Romania produced 2600MW by using wind turbines, from which 695MW represent the 2013 addition.[11]

The amount of solar energy produced in 2013 is 1150MW; from which 1100MW represent the 2013 addition.[12]

Also, in the field of biomass and biofuels, there it can be observed an increased interest. It is estimated that a total of 8-12 MW will be generated by solid biomass by 2020, i.e. 17% of the renewable energy resources. [14]

Also, Romania adopted targets referring to the renewable energy usage. Thus, by the end of 2020, it is expected to be covered by renewable energy:

- 24% of the final energy generated
- 43% of the total electricity generated (from 25% at the level of 2012)
- 22% in total heating and cooling supply
- 10% of the transport final energy demand

5. CONCLUSIONS

The nonconventional resources of energy tend to hold a more important quota of the total resources of energy currently used. Nowadays, there are 6 types of non-conventional energy sources in use. Romania has policies that promote the usage of renewable energy resources, and hence of the non-conventional technologies related to them. Taking into account the exponential development of the renewable energy sector during 2008-2013, we can only conclude that, continuing with these management policies, Romania will achieve the target quota of renewable energy utilised in economy by 2020.

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