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Renewable Energy Sources.
Smart cities, Clean Energy and
Innovations

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Renewable Energy Sources.

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I. Introduction

Renewable energy sources (wind, solar energy, hydropower, ocean energy, geothermal energy, biomass and bio fuels) are the main alternatives to fossil fuels that successfully contribute to the reduction of greenhouse gas emissions, diversification of energy supplies and reduce the dependence on unreliable and volatile markets of fossil fuels, especially in terms of oil and gas. The EU has been estimated as a leader in the development of renewable energy sources. It holds 40 percent of the world's patents in the field of renewable energy sources and in 2012 almost half (44%) of global capacity to produce energy from renewable sources (excluding hydropower) was located in the EU. Currently, the sector of energy production from renewable sources in the EU employs about 1.2 million people. EU legislation on the promotion of renewable energy sources has evolved considerably in the recent years. As a main priority in the “Horizon 2020” the EU has included the intelligent transformation of European cities into smart energy hubs. Around 200 million euros would be provided as a program budget for research and innovation in the framework of “Horizon 2020” for funding the smart cities.

Renewable Energy Sources (RES) are a good response to the present and future energetic challenges on a worldwide scale, like security of the energy deliveries

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and the increasing global warming factors. It has been proven that the potential of wind energy, sun energy, biomass, bio fuels and the carbon technologies, will reduce the usage and the amount of thrown out carbon dioxide emissions in the atmosphere, and will provide the countries energetic independence as well as alternative energy generating capacities. At first glance, the production of energy renewable sources is associated with larger capital investments, compared to the energy produced by conventional fossil fuels. This type of investment has been often connected with the usage of considerable infrastructure funds and additional expenses, especially for the establishment of a connection with an existing electricity grid. However RES are an independent and unlimited pure energy resource, that is preventing the risk of environmental catastrophe for the future generations and at the same time it creates solutions to handle the climate changes. The Energy challenges that are ahead of us are designed to support the transition to a reliable, sustainable and competitive energy system on a regional and continental scale.

II. Green and efficient energy

The twenty-first century is definitely a century, in which two main factors are having a dominant role – meeting the energy needs of humanity and protecting the environment. The impact of these factors is significant both in geopolitical plan and at the same time in the realms of the everyday life. For this purpose, the efforts of humanity should be aimed at saving the traditional energy resources by using alternative and rational ways of production and consumption of electricity. In the energy sector, Renewable Energy Sources (RES) and Energy Efficiency (EE) are considered valuable allies in the achievement of reduced energy related costs and increased energy security.

The renewable energy sector is demonstrating its capacity to deliver cost reductions, provided that appropriate policy frameworks are in place and enacted. Deployment is expanding rapidly. Costs have been decreasing and a portfolio of renewable energy technologies has become cost-competitive in an increasingly broad range of circumstances, particularly established technologies such as hydro and geothermal but also, where resources are favorable, technologies such as onshore wind. However, economic barriers remain important in many cases. In general, costs need to be reduced further. Moreover, fossil fuel subsidies and the lack of a global price on carbon are significant barriers to the competitiveness of RES.

Renewable energy sources (RES) combined with rational use of energy are considered the best solution to the problems of security of energy supply, environmental protection and economic development. The benefit of renewable energy economy and ecology is great - provide a range of new energy sources and reducing the adverse environmental impact caused by traditional fuels.

Furthermore, RES has been making a major contribution to the sustainable development of the economy. This branch of industry is one of the fastest growing sectors of the European economy. Nowadays, Europe is at the forefront in the world in the development of renewable energy sources and already has considerable experience in the implementation of a proactive policy in this area. The ongoing and deepening energy deficit of fossil fuels in European countries is increasing. Increases economic dependence on the European economy of the countries - exporters of oil, natural gas and other scarce primary energy sources. In this regard, the development of RES on European soil is already a sustainable ongoing concept, which provides a sharp increase in the share of alternative and renewable sources to meet the energy and fuel needs of the continent.

Energy security and diversification of the energy mix is a major policy driver for RES. Growth of RES generally contributes to energy diversification, in terms of the technology portfolio and also in terms of geographical sources. Use of RES can also reduce fuel imports and insulate the economy to some extent from fossil fuel price rises and swings. This certainly increases energy security. However, concentrated growth of variable RES can make it harder to balance power systems, which must be duly addressed.

There is another new wave of alternative energies that has conquered the public space, i.e. the transition to a green economy. Governmental and non-governmental organizations, media and lobby groups are consistently publicizing the need to ensure the rate of exploitation of natural resources, that will allow the completion of their renewable cycles. It is important to pay attention on the phases and rates of development of green economy, because it is a 100% sustainable type of economy. In social, political and environmental terms, green economy has implemented the principle of gender equality in its core and at the same time ensures equitable distribution of resources and participation in the decision-making process, regardless of gender. In terms of labor market, the transition to a green economy is already establishing “green working environment”. In order for people to benefit from these alternative career opportunities, there should be a better encouragement in terms of seeking proper education, development of skills and professional qualification in various sectors such as: environmental sustainability, transport, RES, as well as, provision of access to the “green working places” throughout a transparent selection, wider awareness of the nature of the work in these sectors and endorsing career opportunities for both genders.

III. Smart cities and innovative methods

By definition “Smart Cities” are cities, where the usage of resource is identified with intelligence and efficiency. In the realms of these “Smart Cities” numerous innovative technologies have been implemented: Cost and energy savings; enrichment of the available services; improvement of life quality, etc. Even though in the last few years there is a tendency when a city has been planned and build as “smart” since the beginning, usually the cities are turning into “smart” by following the gradual approach of smooth implementation of criteria, necessary for this transition.

According to the purposes and objectives of urban planning, “smart cities” can be defined as "cities of knowledge", "digital cities", "cyber cities" or "eco cities". Smart cities in economic and social terms are directed towards a sustainable – green - future development of the countries. They carry out continuous monitoring of the most important infrastructure projects - roads, bridges, tunnels, railways, metro, airports, seaports, communication systems, water supply, electricity supply, even important buildings - for optimal allocation of resources and safety provision. In these cities the number of services provided to the population is constantly increasing, ensuring sustainable environment that supports the welfare and preservation of citizens' wellbeing.

Structurally, the "smart city" represents a system of interacting systems. Such interaction of a huge number of systems requires openness and standardization, which are the main principles of establishing cities with an intelligent interface.

Some of the technologies involved and defining smart cities are high-speed optical, sensor, cable and wireless networks, which are necessary for the

realization of the benefits that could be achieved through intelligent transport systems, smart electrical networks and smart home networks.

The main difference between a smart city and an ordinary one lies in the relationship with its citizens. In an ordinary city, the information and communication services cannot react on the fast pace, coming from the economic, cultural and social conditions, as the provision of services in the smart city. Thus, the smart city, aimed primarily to the convenience of the people, is based on information and communication infrastructure and continuous consideration of the requirements for ecological and economic sustainability.

There are six essential characteristics that should be part of every “smart city” development and urban growth. These are: smart / intelligent economy; smart people; smart governance; smart mobility; smart environment; smart living¹. In order to fulfill the enlisted principles for a sustainable energy production and consumption a “smart city” needs to be built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.

¹Rudolf Giffinger et al., “European smart cities”, Vienna: Centre of Regional Science, 2007, available on: <http://www.smart-cities.eu/>

SMART CITY DEFINITION (EU)

ENVIRONMENT	Reduction of CO2 emissions; Use of renewable energy sources, monitoring on energy consumptions
LIVING	Co-working, Cultural initiatives, Living-Lab, crowdsourcing co-design
MOBILITY	Development of technologies to improve urban mobility, low environmental impact
GOVERNANCE	Starting of processes for the involvement of citizens about topics of public relevance
ECONOMY	Cooperation among public and private actors, development of social incubators and of small and medium enterprises
PEOPLE	Sharing of data, security and protection of sources, networking and communication

1. Smart Economy – this notion refers to an industry in the area of informatics and communicational technologies or an industry, that uses the opportunities of these technologies for commercial purposes through web pages and for establishing contacts with potential business partners, in order to expand the supply of needed goods and sales of own production, worldwide. In this area, we can include the sectors that are considered strategically important for the city and its future development, in which it invests.

2. Smart people – It is the social capital of the city, which has the power to implement the other aspects of the “smart city”. Smart people are characterized with high education and culture, creativeness, tolerance and engagement in the social issues, and on the other hand the city is offering them opportunities for full-time, part-time and remote types of education in different levels, as well as, various online-courses for qualification and prequalification. Apparently in this type of cities an important role takes the establishment of a strong connection between academic circles and business sphere, in order to develop and implement new lines of smart-technologies.

3. Smart Governance – Electronic services, like electronic government, e-municipality, electronic media, electronic voting system and transparent decisions taking, that are concerning the city and its citizens.

4. Smart mobility – This factor could be achieved with intelligent urban planning and governance of the resources. In a “smart city” the focus is being moved from the individual transport to the mass ways of transportation, with wide range usage of information and communication technologies. The main goal of this section is to reduce the amount of time that people spend in travelling from home to their occupation.

5. Smart environment – It includes smart governance of the building fund and energy resources. This could be achieved with the assistance of innovative technologies, the usage of RES, solar and wind energy that could help the improvement of the air quality and the preservation of cleaner and greener urban environment. It is really important to maintain good practices in terms of integrated management of the available resources. As a good example we can use the available technologies for converting the waste materials into pure energy for the households.

6. Smart living – As an essential component here we may stress the improvement of peoples life in the realms of the city. This could happen with a rational plan and by taking gradual steps towards the goal – by increasing the amount of available services, improvement the city image, in order to attract more tourists, encouraging social contacts and safety assurance. Besides the construction of smart buildings related in informational networks, smart/intelligent living includes an establishment of cultural institutions, eHealth, improvement of social services, public safety systems (urban surveillance), electronic services for protection of the citizens – readiness in case of accidents and disasters.

By its definition a “smart city” uses non-renewable energy sources on a minimum scale, reducing the environmental changes, reserves the natural ecosystems and connects people with the environment. The establishment of “smart cities” meets the needs of the present, without jeopardizing the chances of future generations to maintain their needs. Recent analyses concerning the building of smart cities, have led to the conclusion that in order to reach sustainability and reduction of CO2 emissions, we should switch to RES and extract mostly sufficient environmental-friendly energy.

In connection with the above paragraph, the importance of “sustainable construction” should be mentioned as well. Sustainable construction is a system of practices and technologies in the construction field, in which the usage of materials, energy and raw materials are being optimized, with one main purpose – to protect the environment from human insufficient activities. This method relies on technological solutions and a comprehensive review of the involvement of people in the environmental processes.

The concept for “smart cities” carries a huge potential for achieving the long-term goal of sustainable development for our society. In order to qualify one city as “smart”, it must cover the six essential intelligence criteria that have been described: in terms of economics; people; governance; mobility; environment and living.

Today's development of cities and settlements in particular, depends not only on "hard" infrastructure such as roads, water, electric and internet networks. Accessibility and quality of communication skills acquire growing importance , which are usually defined as "intellectual capital" and "social capital". The latter is of crucial importance for the competitiveness and wellbeing of the main cities in general. In this framework, the concept of "smart cities" has been considered as a tool, to cover in a single frame of production factors, as well as emphasizing the importance of information and communication technologies; social networks; environmental and natural potential with the aim of profiling cities and converting them into “smart” ones.

As we have seen in the previous chapters, "smart cities" are those whose resources are used intelligently and efficiently, by applying innovative technologies for cost savings and energy to enrich the available services and to improve life quality. This chapter will have the aim to investigate opportunities, prospects and challenges for the Black Sea region to transform its main coastal cities into “smart” ones.

The implementation of the global concept of “smart cities” and their respective innovative practices will place the Black Sea coastal cities amongst the modern European capitals, and will support their gradual approach towards dynamic economic change, sustainable development and a promotion of synergies

between the states. This target would strengthen the economic cooperation of the region, and would sustain their cultural interlinkages.

It should be noted that in order for the Black Sea countries to optimize the use of limited resources, they need to switch to the modern technology outlook. In this connection the idea of intelligently connecting key systems of a certain city in a working organism could provide each country with tremendous opportunities that is worth to be exploited. The main objective of the whole concept is the improvement of the manner and quality of all available urban services and the quality of life in general. This strategy is expected to reduce the business losses (mainly because it will be able to predict and prevent high risk, by creating risk policy features), it will reduce the air pollution and last, but not least a “smart city” could improve the standard of living in a certain area.

In order to enable the formation of smart cities to become the next stage in the process of urbanization, it is required to introduce a series of new standards, infrastructure and ICT solutions, so that the concept can get a real application. A unified task force on the smart sustainable cities is expected to serve as an open platform for those regions interested in creating smart cities - such as municipalities, academic and research institutions, non-governmental and ICT organizations, as well as industry fora and consortia.

IV. Energy efficiency and policies on a regional level

Energy and energy security have become a key component of domestic and international politics because of the increasing demand for energy sources worldwide. With the discovery of new energy sources and the increasing number of actors in the energy field the competition has become rigid and the issue of energy security has become a much more complex issue for the governments to deal with. Providing a safe and secure energy to domestic markets is no longer a simple transaction among the buyers and the sellers. The governments nowadays need to work on optimized energy policies to meet their energy demands at an affordable, preferably cheaper price. A successful energy policy in today's world requires the establishment of a delicate balance between regional and international factors. Energy policy is a dynamic process that makes it necessary for states and non-state actors alike to monitor the developments around them so that the supply of valuable resources is not interrupted. When it comes to the point of establishing a regional economic hub, which could play a crucial role in the developments of renewable energy sources and the extraction/production of clean energy, Black Sea moves forward as a major actor.

The countries of the wider Black Sea area are characterized by significant differences between the technologies for energy production: fossil fuels, nuclear power and renewables. The different profile and specialization of enterprises in the energy sector and the gradual designation research and innovation activities which they carry, could also be considered differentiated from each other. Energy production from renewable energy sources (wind, water, solar, biomass, geothermal energy) is not a new idea. Based on existing traditions and conditions for their usage, in recent years RES has evolved on different scales and has developed parameters applicable to the technological platforms.

Energetics is undoubtedly one of the most important - priority sectors of the countries from the Black Sea region and their economic prosperity throughout the 21st century. The region in general has been strongly committed to support the European energy strategy and tolerate negatives in potentially non-implementation of agreed intermediate and final goals. Since the technologies that underpin the achievement of these energy objectives have not proved in practice their full potential, they are generating strong financial and market risks and thus are still unattractive for business. In this situation, they would need the active support of the different regional governmental policies.

In practice, the existing strategic framework for the development of the energy sector in each of the countries is not based on a thorough analysis of the established technology base of research units and businesses. It has been estimated that there is a lack of control over the public spending, the received results and guidelines for their implementation, in countries like Bulgaria and Romania for example. On the other hand, sectoral technological chain does not stand in the lens of energy policy in its entirety, quite the opposite actually, because it opposes the stages of production and distribution of energy, as well as the creation and implementation of new technologies.

Unfortunately there is a serious gap between the governments, academic circles and business sector for a shared vision for the future of the energetics and the technological competences. Academic circles and the business sector should create a clear vision for a lasting state cooperation and financial support for the realization of more innovative projects with Renewable energy sources focus and further on unification of smart cities. The change in the mechanisms and financial instruments has been required by the dynamics of the competitive environment and the markets, but the commitment must remain in a long term plan.

Another "feature" of the energy policy is that Renewable energy sources (RES) in a lot of countries are not considered as part of an overall portfolio. Across the Black Sea region, water and wind energy installations are widely spread and mostly used as alternative to the fossil fuels. However, even though their high capacities for a sustainable development, a number of untapped opportunities associated with geothermal energy, biomass and ocean currents still remain on a regional level. For their involvement in the energy balance of each country, there are no provisions for targeted measures and specific incentives. The rapid development and improvement of a new technological knowledge and its advance towards solving political problems occur in terms of increased interaction between the participants in the innovation process and those who create a favorable environment for their business continuation.

The implementation of the commitments and goals of the national energy policy of the different states in the wider Black Sea can only be achieved on the basis of complex measures for the transition to alternative energy sources and foundation of smart cities. The overall energy agenda needs to cover a wide range of financial instruments and non-financial incentives to ensure the impact on energy producers and industrial consumers and the financial sector in general. The implementation of financial incentives is expected to encourage the competition between types of technology, rather than artificially prioritizing a particular energy source (wind or solar energy). Their coordinated targeting should exclude duplication of efforts and should seek a multiplying effect by combining them with approaches to non-financial support, familiar to the international practice in this field. Here is a list of important factors that should serve as a guideline towards a faster and sustainable transition to green energy, according to the European Commission:

1. Tax reduction on biofuels;
2. Tax credits for the production of renewable energy;
3. Requirement for blending biofuel derived from petrol oil;
4. Implementation of energy efficiency standards for vehicles, business and residential buildings;
5. Implementation of a standardized classification of vehicles and setting of the fees associated with their use of polluting emissions into the atmosphere;
6. Mandatory requirements for improvement of the energy efficiency in the modernization and replacement urban, intercity railway transport;
7. Certification of buildings and vehicles by accredited organizations, in order to reduce the tax base for the calculation of local and other taxes;
8. Creating a database for production and consumption of energy, as a basis for the introduction of intelligent network management and control of the energy system;
9. Using behavioral effect - the introduction of electronic energy balances in households in order to promote the use of energy efficient appliances and reduce energy consumption;
10. Regionalization of measures, many of which have local character in terms of participants and resources. This requires greater participation and initiative at the local level and can be achieved by a set on the untapped potential of regional innovation strategies;

The Black Sea region is in the process of transformation from a standard energy model based on the use of fossil fuel to a balanced energy mix based on renewable energy sources and energy efficient policies. Its successful incorporation requires the implementation of smart energy policies with strict requirements for participants in the energy market, a clear regulatory framework and a series of transparent rules of interaction between governments, business sphere and the academic circles.

V. Conclusions

The international community is at cross-roads regarding the future of energy. Unprecedented challenges like climate change, volatility of fossil fuels prices, and energy poverty have made our society vulnerable. Energy efficiency and renewable energy sources outline the way to future developments in the power sector. These are means by which economies can grow without seeing an increase in energy consumption in the aftermath of the current crisis.

Renewable energy sources together with energy efficiency contribute to increasing security of electricity supply, competitiveness, promotion of synergies on a regional level, and a sustainable development. Europe has a considerable experience in promoting renewable energy sources and defining adequate legislation. The EU's commitments to reducing CO₂ emissions by 20%, producing 20% of its total energy (transport, heating, cooling & lighting and electricity) from renewable sources and improving energy efficiency by 20%, all by 2020, represent a considerable challenge for the energy sector of today. For the electricity grid, the triple commitment is even more challenging as it means that approximately 35% of all electricity will be generated from renewable sources. In

addition, more electricity applications will appear in the future, such as the electrical vehicles and heat pumps coming into use today. This will have a considerable impact on the electricity grid.

Regional responses have been insufficiently explored. Coordinated policies and correlated endeavors could make the difference in achieving targets set at national and regional level. The Black Sea region faces a range of specific energy related opportunities and challenges. Its vast fossil resources make it attractive but also controversial and prone to instability due to competitive, if not clashing interests. The Black Sea region could provide solutions for energy supply diversification because of its unexplored potential on renewable energy capacity. Solar, wind and waves energy could make the region emerge as a key element of Europe's energy strategy for the following decades. The gap between use and potential is large in the Black Sea region and requires swift action towards the prevention of risky conditions. On this basis, regional countries should promote regional ownership and develop meaningful cooperation on energy from renewable sources, in order to support the sustainable development of the Black Sea region and have an access to its full potential.

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