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Overview on ensuring a sustainable future for renewable energies in cities

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Abstract: Saving energy is a key point and is the first basic component for achieving a sustainable energy supply. Saving energy contributes to environmental objectives, reduces the energy bill, improves the competitiveness of Dutch businesses, and boosts employment.There are numerous opportunities for achieving significant energy savings in the built environment. The basic principle is that individuals and businesses have an interest themselves in saving energy and will shoulder responsibility for doing so. A combination has therefore been chosen of information provision, awareness-raising, reducing the burden, and funding support. Industry, agriculture, and the commercial sector as a whole see increased energy efficiency as an opportunity to boost the competitiveness of energy-intensive businesses, to create employment, and to achieve climate objectives in a costeffective manner. The energy-intensive sector of industry aims to become an international leader in energy efficiency. An independent centre of expertise will be set up to assist businesses and funding bodies in identifying the most effective measures in the area of energy efficiency in industry and agriculture. Cities today have the opportunity and the means to provide sustainable services and quality of life to their citizens. Urban areas account for more than half the world's population, as well as 65% of global energy demand and 70% of energy-related carbon dioxide (CO2) emissions. Cities, therefore, need to take action to meet the rising needs of their populations while maintaining a healthy living environment, combatting poverty and avoiding catastrophic climate change. Romania has an important potential of renewable energy resources and has introduced a functional mechanism for supporting their development based on a system of mandatory quotas for electricity, combined with trading a number of green certificates, but all the costs are transferred to the consumers.This system may carry an overcompensation for the investors and also an excessive burden on the consumers. Most investments were made in wind and hydro, the fewest in solar and biomass. While the potential for renewables is high, it varies greatly depending on each city's characteristics. Population density, growth prospects and demand profiles in cold versus hot climates all shape the opportunities to introduce renewables, including the vast growth potential for uses in urban buildings and transport. Accordingly, deployment strategies must be tailored to technology options and enabling policy frameworks for each city.

Keywords: green, renewable, resource, wind, solar, biomass, hydro.

1. INTRODUCTION

Mayors and municipal governments are playing an increasingly central role in accelerating the switch to renewable energy. While many policies are still enacted at the national or regional level, this report examines the many ways in which cities are taking control of their own renewable futures, with encouraging results[1]. The steps to be taken to obtain satisfactory results have are:

- **Target setting**

Cities can set their own renewable energy targets to align stakeholders behind common goals. A small but growing number of cities are planning to switch to 100% renewable energy, with zero net carbon emissions.

- **Regulation**

Based on their legal competence, cities have a powerful regulatory role to unlock renewable energy potential whether through building codes, grid connection rules, technical

standards, land-use planning, public housing programmes, and through specific measures such as solar ordinances.

- **Operation**

In some cases, cities are owners and operators of municipal utilities including energy utilities. As such, they may influence the energy mix as well as develop and invest in renewable power plants, district heating/cooling networks and sustainable transportation infrastructure.

- **Consumption**

Cities without utility ownership remain large energy consumers in their own right, and can demand that the power they use for hospitals, schools, offices, street lighting and public transportation comes from renewable sources. They can act as aggregators of demand, procuring electricity in large quantities to cover the combined needs of residents and businesses, thereby increasing competition and reducing risk and prices.

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● **Financing**

Cities act as financiers, influence taxation and can offer incentives or low-interest loans to promote the uptake of renewable energy solutions. In some countries, municipal energy companies are among the most important investors in renewable energy projects.

● **Advocacy**

Cities serve as powerful advocates, able to influence the behavioural choices of citizens and businesses by raising awareness about the benefits of renewables. Municipal authorities can also strengthen local capacities and skills through dedicated training programmes on renewable energy [2].

2. THE ROLE OF RENEWABLE ENERGY IN CITIES

Because of this growth, any decisions made for the future of energy and climate need to build on a robust understanding of urban energy systems. As we learn more, we are better able to categorise different urban energy system types, and design policies specific to them.

- **Negative impacts of rising energy use**

Rising energy use in cities has lifted billions of people out of poverty. However, it has also come at a cost due to the increased use of fossil fuels. Cities account for 70% of man-made CO_2 emissions, making them a major contributor to climate change. Cities are also likely to suffer the brunt of climate change effects. Some cities in developing countries are particularly vulnerable due to relatively high rates of population growth. They also lack infrastructure and planning capacity, and have limited financial resources. Increasing energy use has also led to skyrocketing urban air pollution. Of people living in urban areas, more than 90% cope with air quality levels exceeding the World Health Organization limits (WHO, 2016). In low and middle-income countries, this rises to 98% [2] .

Fuel-driven transport creates high levels of noise pollution. An estimated 65% of EU citizens living in major urban areas are exposed to high noise levels, with 1-2 million disability-adjusted life years (DALYs)1 lost to environmental noise in the EU each year (European Commission, 2015). In developing world cities with high population densities, the effects are likely to be more severe.

- **Energy efficiency and conservation**

Energy efficiency is one major route to reducing projected energy use by 2030. The largest potential for savings exists in buildings. New buildings in growing cities can be designed with the latest technology, which follows minimum energy use standards. Modernising the existing building stock in established cities is more challenging. It is important to avoid investment in marginally more efficient technologies, so as not to create a “technology lock-in”. While most developed countries have ambitious targets for achieving low energy use in buildings, and already have mandatory building energy efficiency codes in place, this is not the case in many developing countries. These often suffer from a lack of information and knowledge on energy efficiency options, poor enforcement of building codes and standards, and misalignment between national and local governments in implementing and enforcing policies.

Efforts to conserve energy in the transport sector include technological innovation and modal shift. Such innovations include more fuel-efficient internal combustion engines, smaller and lighter cars, and zeroemission electric vehicles. More important is the move towards electrified transport that, in turn, can drive a higher share of renewables in the energy supply mix. Modal shift includes the promotion of more sustainable transport modes, such as public transport but also walking and cycling. Generally, the share of sustainable transport is higher in cities with high population density (UITP, 2015a) (Figure 1) [1].

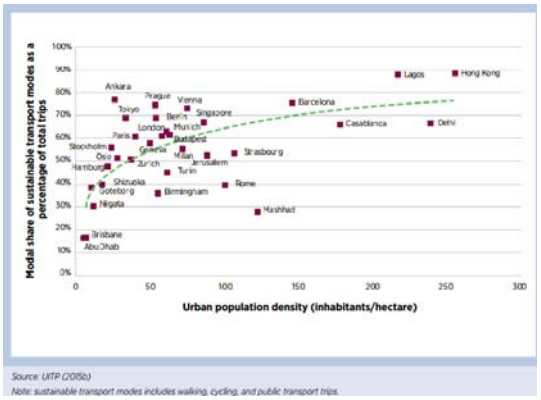

Fig 1. : Share of sustainable transport modes versus population density in cities

3. PROSPECTS AND DEVELOPMENT OF RENEWABLE ENERGIES IN THE CITIES OF ROMANIA (3)

Renewable energy in Romania has been developed at a fast pace, in line with the objectives and targets set by the EU and objectives of our national energy strategy. This development was supported by the following favoring factors: 1) Important and diversified potential of the renewable energy sources: hydroenergic, technical arranged at approximately 32,000 GWh/year, providing more than a third (35.7%) of the country's electricity production, wind , installed capacity of 14,000 MW (17% of total) photo voltaic (12% of total), biomass (agricultural and forest origin) representing 7% of primary energy demand. 2) Improvement of the legislative framework, which considerably increased the interest in this type of investment. Based on the favorable opinion given by the European Commission, it was adopted Goverment Emergency Ordinance no. 88/2011, amending and supplementing Law no. 220/2008 , to make the Commission's support measures compatible with our legislation. This Ordinance may be considered the unlock signal for green energy projects, fundings and transactions

designed to support Romania's efforts to achieve, by 2020, the renewable energy targets [3] .

Renewable energy is supported in Romania by a 10 billion euro scheme, implemented through a system of mandatory quotas for electricity, combined with trading a number of green certificates. The supporting mechanism works as follows: the producers of electricity from renewable sources may sell the electricity to suppliers (distributors) of electricity, under the same conditions as any other producer of electricity but in order to cover the production costs, per MWh delivered in the network, they additionally receive a certain number of green certificates depending on the technology used and the type of energy promoted. In Romania, most investments were made in wind and hydro, the fewest in solar and biomass.

Wind power lies the first, as a share of all projects in progress (40% according to the IHA Annual Activity Report), hydropower (in the hedged incomplete segment of microhydro plants) holds 39%, biomass 16%, solar energy 5%. According to an ANRE report, in 2010 Romania registered 65 manufacturers licensed in renewable energy, of which 32 in hydropower, 28 in wind power, 3 in biomass recovery and one in photovoltaic energy with an installed capacity of 520.4 MW. Such economic operators had produced 20.264 TWh, representing 35.24% of the total gross electricity consumption of Romania. For the year 2012 it was planned to reach an installed capacity of min. 2000 MW, of which aprox.1400 MW wind energy. The most advantageous internal rate of return was recorded at solar, biomass and ferment gas, i.e. the renewable energies where it was invested the least money. The lowest internal rate of return was recorded for old hydro-plants, because they were not retrofitted or included in the support scheme regulated by the Law no.220/2008.

Most of the amount of green electricity is generated by large hydropower plants, but there is still a high potential that may be harnessed by micro hydropower plants. Article 3 of the Law no.220/2008 sets that the system to promote electricity, produced from renewable energy sources, is applied to electricity supplied to consumers and produced in hydropower plants with an installed capacity of up to 10 MW, as far as wind energy, solar, geothermal, biomass, bioliquids, biogas, landfill gas, for which there is no upper limit capacity [3].

Therefore, the Romanian legislation favors, directly, the small renewable energy production capacity, in the case of hydro, while for the rest of renewable energies there is no restrictions on capacity size. This aspect influences the investments in the segment of small hydro plants, which are unlimited in other green energies. Although it was confirmed that wind power is the first choice of investors in Romania, with more than 1,600 MW put into operation (according to data published by Transelectrica, in 15 November, 2012), in the last time solar energy has become the main actor on the Romanian market for renewable energies.

Photovoltaic projects tend to overtake on the wind projects, due to several factors/comparative advantages: shorter periods for the return of investment, about 5 years compared with 8 years; the support scheme provided by the State, under which for one MWh of generated electricity based on solar radiation are allocated 6 green certificates, while for each MWh produced and delivered by the wind producers, shall be allocated only 2 certificates until 2017, and one certificate from 2018; considerably lower specific investment costs as compared to the wind, including the lack of moving parts; limited negative impact on biosystem as against wind energy, high reliability over a period that may exceed 25 years; solar panels may provide both electricity to remote areas and in cities where they are easily mounted on any structure, occupying areas that usually are not used[2].

For Romania, turning into good use of the high potential of renewable energies is meant to increase the security of energy supply through diversification and decrease of imports of classic energy resources, aiming at a sustainable development of the energy sector and also at environmental protection. Reducing dependence on imported energy is a a very important goal as the strategic documents in the field (including the Energy Strategy of Romania from 2010 to 2035) have advanced the prospect of an increased dependence on energy imports from about 35-40% today to 60-70% in the medium term, given that the structure and dynamics of current consumption will remain unchanged.

Green energy subsidies may distort the market because they are too high in relation to the cost of the technologies that have been reduced to less than half in the recent years. Authorities have assimilated with some delay this message, announcing the intention to diminish the aid scheme for energy from solar sources. Most likely, from January 1, 2013, the number of green certificates was supposed to decrease from 6 to 4 for each MW, produced from solar sources and delivered in the system [2].

The reason is, as already mentioned, that the photovoltaic industry has greatly expanded, leading to a dramatic decrease of production costs. Therefore, although legislation sanctiones (post factum) the cases of overcompensation, it is recommended that the promotion of green energies to be made on the basis of an (ante-factum) cost-benefit analysis and through the more rapid adjustment mechanisms in the number of green certificates, so as to avoid inflation of projects with high costs for households and the achievment of quick profits for investors. In other words, for Romania will matter at what costs will be able to achieve the targets set by the EU regarding the share of renewable energy in total energy consumption.

Romanian authorities have finally realized that the law on granting green certificates should be amended, mainly to provide opportunities for the most important Romanian power producers, which should not be sacrificed for the sake of renewable industry. On one hand there are the households who support the electricity bill, on the other hand there are

industrial consumers, which in turn cannot bear anymore the high cost of green certificates included in the final product costs.

4. CONCLUSIONS

Future energy system with low emissions of greenhouse gases, will be based, most likely, on a combination of energies, vectors of energy converters, which will be found in different forms in different regions of the world. Several major trends of our energy future could be as follows:

- Energies based on fossil fuels will continue to be used many decades, being favored low-carbon energies such as natural gas. Dependence on imports from Middle Eastern countries, which hold 65% of current oil reserves will increase. After 2020-2030 years, economic and political tensions could lead to a reduction of fossil resources easy to exploit and to a shift to politically unstable areas, which may harm the security of supply of EU countries and not only of them.
- Capturing and stocking carbon dioxide under economically acceptable technology is the only option likely to allow the use of fossil resources, while limiting CO2 concentration in the atmosphere, in anticipation of major technological advances.
- Increasing the share of renewable energies is quite sure and almost indispensable, but their importance will depend on the cost reduction and progress in improving existing technologies in the sense of increasing the size of offshore wind turbines, resizing the blades to capture more wind energy, enhancing photovoltaic panels to collect more solar energy and especially creating massive storage capacities of electricity, which is a prerequisite for integration into electric networks of large amounts of electrical energy produced and distributed discontinuously[1].
- Romania ranks a high place on the EU energy map and has a significant potential in developing the renewable energies. In 2012, Romania imported only 21% of primary energy resources in order to cover their consumption, which places us among the least dependent MS on energy imports. The rate of EU dependency on energy imports was 54% in 2011.
- Romanian legislation favors, directly, the investments and energy production from renewable sources, like wind, solar, biomass, without capacity restrictions and only in small capacities in the hydro case [2].
- Eolian energy is the first choice of investors in Romania, with more than 1,600 MW put into operation, but lately, solar energy is becoming the main actor on the Romanian renewable energy market.
- The large number of green certificates allocated mainly to wind and solar energies was established by the Parliament in a desire to encourage their development, but the result was an overcompensation for the investors, although the production costs have emphasized fallen for both sources, also leading to high losses for the consumers, raising up the costs of green energy in Romania. It is also advisable that the promotion of green energy to be made on the basis of a (ante-factum) cost-benefit analysis and by faster adjustment mechanisms in the number of green certificates so as to avoid the inflation of projects with high costs for households and quick profits for investors [3] . Achieving the targets set by the EU regarding the share of renewable energy in the total energy consumption may involve high costs for consumers. Although on short term, we are witnessing an increase in energy prices due to increased costs required to purchase annual "green certificates", on medium and long term investments in renewable energy will bring major benefits by eliminating the excessive dependence on conventional resources, reducing CO_2 emissions and increasing the safety in power supply to industrial consumers and households, diversification of energy production sources and beneficial social impact from the development of rural areas where wind plants are built.

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