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PRELIMINARY REPORT

Decarbonization of the energy sector with reference to the transport sector

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Abstract: The transition of the energy sector is largely reflected in transport, which is an important a link in the economy. The decarbonization process, which is an integral part of this entire transition of the energy sector, began much earlier by finding new fuels in order to replace the already well-known and well-established fossil fuels. In order to protect the environment, many scientific research institutions and manufacturers of transport vehicles are looking for alternatives to fossil fuels. The development and transition to means of transport whose power is carried out by electric motors, i.e. where the driver of these means of transport is electricity, accumulated in batteries, is not the optimal solution, which in return caused a rapid development of various technologies and models in the last decade whose primary objectives encompass obtaining hydrogen and its use in all types of transport from road, rail, naval to the air force.

Keywords: energy sector transition, decarbonization of the energy sector, hydrogen as a propellant, application of hydrogen in the transport sector.

INTRODUCTION

The transition of the energy sector under the condition of constant reduction of CO_2 emissions is a major challenge and is related to all participants in the energy sector, from production, transportation and consumption, and applies to all economic entities and the population as a whole. In order to adopt legislation and ensure secure supply of energy and energy products under market principles, and in order to attract significant investments in the energy sector (primarily in renewable energy sources), the Energy Community was formed between the EU and the countries of Southeastern Europe, of which Bosnia and Herzegovina and therefore the Republic of Srpska is a member.

As one of the basic postulates of this Treaty is the obligation of the signatories of the Treaty, the implementation of EU legislation in domestic legislation, especially focusing on the process of liberalization of the market and the decarbonization of non-energy production.

On the basis of such commitments undertaken from the Treaty, all countries signatory to the Treaty are also obliged to undertake a series of activities in the segment of rational use of energy, i.e. to pay full attention to energy efficiency as well as the use of incentive measures in order to increase the production of energy from renewable energy sources.

When it comes to The Republic of Srpska and Bosnia and Herzegovina as a whole, quite ambitious short-term goals have been set for increasing energy efficiency and the use of renewable energy sources. The preparation and harmonization of strategic documents for the area of decarbonization, which includes the areas of energy and climate strategy and whose time validity is until 2030, is in progress.

Bearing in mind that Bosnia and Herzegovina is a very complex community, where the energy sector jurisdiction falls under independent jurisdiction of the entities and where very different levels and types of regulation of the energy sector are present, the adoption of these strategic documents at the level of BiH is slow and often delayed, in return making fulfilling of its obligations under the provisions of the Treaty significantly more difficult.

DECARBONIZATION

One of the key topics of the transition of the energy sector is the process of decarbonization, i.e. reduction and elimination of harmful emissions of gases, especially carbon dioxide (CO_2) emissions. This process has been ongoing for years, starting with the Kyoto Protocol, then the Paris Agreement of 2015, which determined the intention of the signatory countries to limit global warming to significantly below the 2°C above pre-industrial levels and to continue efforts to limit it to 1.5 °C – partly by achieving net carbon neutrality by 2050.

Reducing global greenhouse gas emissions (including CO_2) will limit the rise in global temperature. In practice, achieving net-zero emissions requires a shift from fossil fuels to alternative low-carbon energy sources.

With the European Green Deal, the European Union has set additional targets for member states to guarantee the decarbonisation of the EU. These targets are further strengthened by the Fit for 55 package, which ensures that the EU's objectives are in line with climate goals.

The European Union has imposed sanctions on energy imports from the Russian Federation, oil and gas in response to developments in Ukraine. The new situation has resulted in a profound change in energy markets, with major supply disruptions and energy insecurity due to volatility of prices, which has caused a general global economic crisis with high inflation rates.

Given the recognised large impact of fossil fuels on Member States, the European Union is introducing a new package of measures with its "REPowerEU" aimed at reducing dependence on fossil fuels, thereby encouraging additional decarbonization. In such a complex energy-political situation, alternative solutions are being sought through significant electrification of motor vehicles, using liquefied natural gas (LNG), compressed natural gas (CNG), liquefied petroleum gas (LPG), and lately more and more emphasis has been placed on green hydrogen, as one of the possible fuels that will encourage faster decarbonization of various sectors. Using these initiatives, ambitious reductions in greenhouse gas emissions are expected by 2030.

In addition, in early November 2022, a meeting of global leaders representing governments, the private sector and civil society was organized at the 27th session of the COP (Conference of the Parties/ United Nations Conference on Climate Change – UNFCCC). Since the last meeting, awareness has been growing about the important contribution to decarbonization that needs to come from the private sector, with discussions about increasing investment in new technological solutions that could help accelerate decarbonization. Although hydrogen is referred to as a decarbonization technology, it is often not clearly explained what exactly it means and what the positive applications of this technology are.

HYDROGEN AS AN ALTERNATIVE FUEL

It is a well-known fact that hydrogen is the most abundant element in nature and it is a dilemma in itself why we do not use the resource of which we posses the most. When we look at the production and use of hydrogen recently, it can be concluded that hydrogen is increasingly used, especially in conjunction with renewable energy, i.e. solar and wind energy. This approach enables the increasing integration of interminent energy sources into the daily energy supply and use in the network.

The use of hydrogen essentially represents the transition of the use of fossil fuels to hydrogen as the energy source of the future, which constitutes the essence of the transition and decarbonization process in the energy sector. Last year, most EU countries adopted hydrogen strategies defining the transition from fossil fuels to hydrogen.

Hydrogen is an essential element of the EU Green Deal, an EU strategy aimed at reducing dependence on fossil fuels that are mainly imported into EU countries. Hydrogen is very important both for mitigating climate change and for reducing environmental pollution.

It should be noted that hydrogen is not a source of energy, but a carrier of energy. As a way to store electricity, hydrogen can be used to balance the production of electricity from renewable sources of electricity and facilitate the long-term use of electricity that could not be integrated directly into the electricity grid especially in the case of high-renewable generation. Not all hydrogen is equally acceptable. It is important to distinguish the methods of its production, and different colors are used for marking, so there is: gray, blue and green hydrogen. Gray hydrogen is produced from fossil fuels, and green electricity from renewable sources. Blue hydrogen is one that, like gray, is produced from fossil fuels, but with the use of carbon extraction and storage procedures – Carbon Capture and Storage (CCS).

For the current transition, it has been planned to use exclusively green hydrogen, although today the most used is the gray hydrogen derived from natural gas. Green hydrogen, which today is mostly produced using electricity from renewable energy sources, i.e. from solar and wind farms provides the solution to the problem of 'volatility' of these sources, i.e. the production of electricity. The surpluses of production can then simply be used to produce hydrogen by electrolysis, and this hydrogen can be used for various purposes. The hydrogen produced can be transported to any place, where, by means of fuel cells or other means, the accumulated energy can converted into electricity and heat. The production of green hydrogen by electrolysis of water is the process of separating water into oxygen and hydrogen. The oxygen that is obtained, can be and is used in a significant part in various areas of life, industries and medicine.

The production of hydrogen by electrolysis of water is a clean technology whose main problem is an efficient electrolyzer. The reaction takes place using electricity and requires high purity of water for hydrogen to be produced. Therefore, before electrolysis is carried out, water is treated so that minerals and ions are removed.

Hydrogen produced from renewable sources (green hydrogen) as a substitute for fossil fuels and raw materials in sectors that are not easily decarbonised can contribute to reducing greenhouse gas emissions before 2030, economic development and achieving a climate-neutral economy by 2050. Hydrogen from renewable

sources is a unique opportunity for both research and innovation, and the creation of economic growth and jobs throughout the value chain.

Bearing in mind the fact that the production of green hydrogen requires resources that are already at the disposal of the Republic of Srpska and BiH, such as water and the commitment to the construction of solar power plants and wind farms, means that significant amounts of electricity from intermenent sources will be disposed of. It is therefore necessary to simultaneously encourage and develop the production, distribution and use of green hydrogen in BiH.

APPLICATION AND USE OF HYDROGEN

According to significant analyses and predictions, hydrogen could and should find wide application in certain industries in the coming period, especially in the process industry as a substitute for fossil fuels. The use of hydrogen is particularly interested in segments of the economy such as the petroleum industry, chemical industry, iron and steel industry, and industrial heat, and based on the characteristics and characteristics of hydrogen, especially green hydrogen, many utility companies are considering its application in the production of thermal energy for heating residential buildings and public institutions.

In addition to its use in industry and economy, hydrogen will play a significant role in the decarbonisation of transport and mobility, especially in the segments of road transport as well as sea and aviation transport. When it comes to road traffic, the fact is that freight trucks are significant potential consumers of hydrogen because when compared to electric vehicles, their range is significantly higher. If we take into account the fact that road transport vehicles produce six percent of total emissions, this percentage will be significantly reduced by substitution of petroleum products with hydrogen.

In the coming period by 2030, maritime transport should record significant growth, and the use of hydrogen as a renewable energy source in this sector would be very important, and mostly for cargo ships. In the power system, hydrogen has a high chance of being used as a medium for storing energy derived from renewable sources.

The use of hydrogen in aviation is increasingly causing interest of individual investors and research and scientific institutions, but it is important to emphasize the fact that the application of this technology requires and requires significant investments.

Recently, an increasing number of the most important companies from the aviation industry have been investing significant funds in research and the possibility of using green hydrogen as a propellant, putting decarbonization in the foreground. Swiss startup Destinus is developing a hypersonic passenger plane with hydrogen engines.

Fig. 1. New model of hypersonic aircraft of the company "Destinus"

The aircraft will have a capacity of about 25 passengers and is expected to be put into service by 2030. By developing a hypersonic ultra-long-range aircraft that would easily integrate into already existing air traffic with a set goal, creating far less noise. A statement by the company's representatives said that the flight from Sydney to Frankfurt, which takes about 20 hours, would be shortened to only 4 hours, which indicates that the speed of the aircraft should be up to Mach 5, which is more than 2 times the speed that the supersonic passenger plane "Concorde" could have developed.

The use of hydrogen for aircraft propulsion would be environmentally more sustainable as well as from the aspect of economy compared to today's solutions and the use of kerosene as a propellant, with significant technological improvements in energy use.

In addition to this development, other companies are planning and developing new types and models of aircraft that would use alternative fuels. By comparison, Boeing plans to test a jet engine that would use hydrogen as a propellant by the mid-2020s, and Boom Supersonic has plans for supersonic flights in the U.S. Hermes is also working with NASA and the U.S. Air Force to develop new aircraft engines that would use hydrogen as fuel. Venus Aerospace, a Houston startup, is also known to be developing a hypersonic spacecraft that would speed up to Mach 12.

Successful application of hydrogen in the aforementioned branches will depend on the production price of green hydrogen, which will be conditioned by the price of electricity obtained from renewable energy sources, then the price of the electrolysis process itself, which largely depends on the technological development and improvement of electrolysis technology, as well as on the prices of CO2 emission units. Significant investments in the development and improvement of these tenologies will contribute to the increased competitiveness of green hydrogen, By 2050, green hydrogen can be expected to account for 10% of total energy consumption.

DIRECTIONS OF FURTHER DEVELOPMENT

Based on the analysis done by Deloitte in 2022, more than 150 projects related to hydrogen production and its application in various fields have been announced in Europe. Of these projects, more than 50% are related to green hydrogen projects. Based on the commitment and

significant reduction of the possibilities for the use of fossil fuels in the EU, a significant increase in the number of these projects can be expected in the future. In order for green hydrogen to be widely used in all segments of economic activities, it is necessary to ensure its accessibility to potential users, and therefore it is necessary to provide significant funds for investments in infrastructure that will enable this. The European Union has planned to provide around 27 billion euros as part of the REPowerEU project, which will be available to member states.

In addition to the significant impact on decarbonisation, the production and use of hydrogen can have a major impact on the provision of new jobs in all segments from highly sophisticated jobs in the research and advanced technologies sector to jobs in manufacturing and transport as well as in various industries that need to develop new products for the needs of this sector. According to estimates, the European Union predicts that by 2030, for every billion euros invested, about 10,000 new jobs will be created related to green hydrogen. The picture below clearly shows the orientation of EU countries when it comes to investing and investing in hydrogen as the energy source of the future.

2. it is necessary through the adoption of positive legal regulations to facilitate and enable the financing of projects and harmonize legislation, all with the aim of shortening the administration of permits.

Define the technologies that will decarbonise individual sectors most appropriately and successfully, while supporting the adoption of hydrogen as the fuel of the future.

4. The decision of investors to harmonize and reconstruct the plants used in the industry today in accordance with the new trend, i.e. the acceptance and adoption of new hydrogen technologies, for the simple reason that certain plants can still function intensively.

5. Cooperation, between all interested entities from manufacturers, consumers, public institutions of government, financial and technological organizations can contribute to the development of the necessary projects of high value.

Based on the above facts and set goals, through strategic documents, with the condition of fulfilling the set goals, from these documents, it is realistic to expect that hydrogen will have a significant impact on economic development in all segments in the coming period, as well as in the process of transition and decarbonization of the energy sector and therefore in environmental protection.

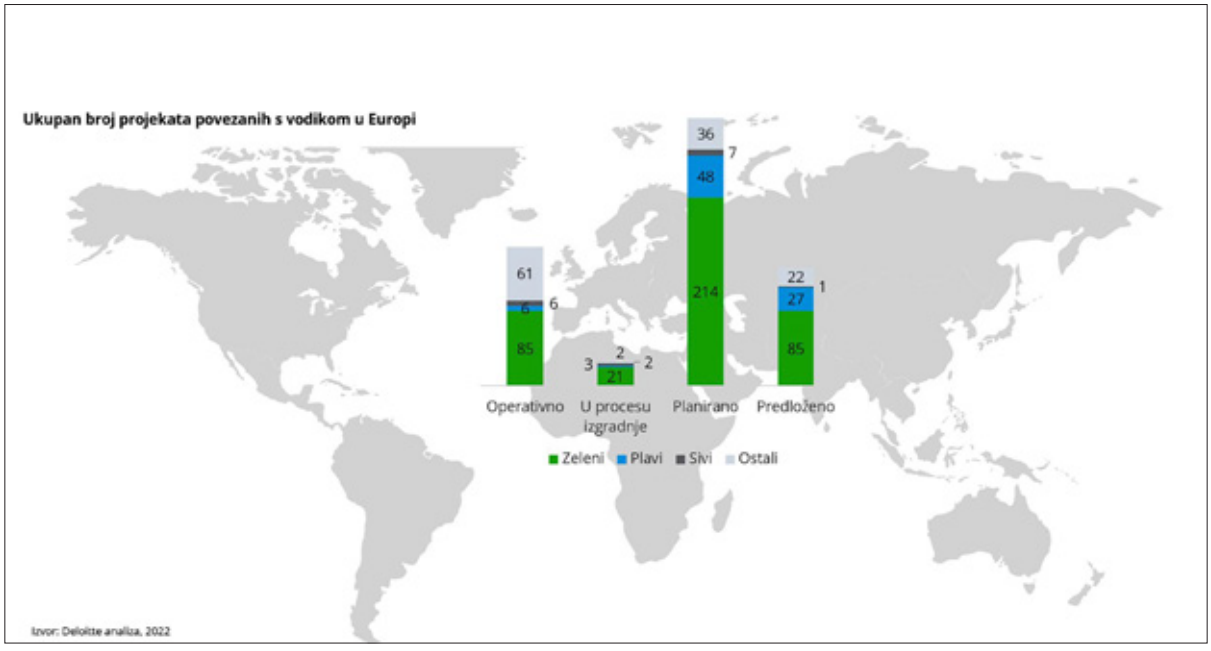

Fig. 2. Structure of development projects in the EU for hydrogen production

INSTEAD OF A CONCLUSION

The most important factors that will influence the greater use of hydrogen can be expressed in five key assumptions and facts, namely:

1. hydrogen demand, which is related to three factors namely:

- the possibility of creating profits for business entities and consumers a high level of control by the company, and
- low price growth for the consumer.

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