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THE IMPACT OF GLOBAL ENERGY POLICY ON CLIMATE CHANGES

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Abstract: *In a present that is limited by carbon concentrations and the near future that will face the serious consequences of climate change due to the overuse of fossil fuels. We cannot say for sure about the quantities of fossil fuels in the earth's crust, and the world still relies on them. On the other hand, the need for an increasing amount of electricity is increasing every day, especially in developing countries, and lately in underdeveloped countries. The energy systems of all countries of the world are undergoing a series of transformations, and all of them are actively looking for ways to decarbonize and produce energy while maintaining market competitiveness and continuity of economic growth. This energy transformation from fossil to alternative and renewable sources is necessary and indispensable if we want to deal with climate change and the consequences caused by man. The world needs to move quickly from fossil fuels to clean, low-carbon energy systems. This would limit the increase in average global temperatures of two degrees in relation to its level before the first industrial revolution. In different parts of the world we have different climate and energy policies, which must be harmonized, unified and become a single global policy in the fight against climate change. This paper aims to show the current general energy situation in the world, as well as trends in climate change. then, current global policies to reduce CO2 emissions will be presented with the accompanying technological transformations from gray to green energy that are inevitable to develop in the IV Green Industrial Revolution. Tendencies of major economic forces in energy transformations and energy production. If we accept that climate change is a global crisis and that both the climate and energy challenges of the 21st century are the key transformative challenge we need, then worries about the amount of carbon emitted into the environment raise new problems in the fight against climate change.*

The paper will only raise questions that have been asked many times so far, but will also open up some new questions: What is the future of the planet in terms of global warming and climate change? ; What is the future of fossil fuels? ; Should foil fuels be left in the earth's crust or should we continue to use them with

technological innovations and gradual transitions to existing alternatives to fossil fuels? ; Why is nuclear energy a potential alternative to fossil fuels? ; In some sources, are the negative effects of nuclear energy equated with the negative effects of renewable energy sources? ; Why is climate change a global - collective problem, so is it necessary for governments to insist on investing in the transition from a fossil fuel economy to a renewable energy economy? ; Are renewable energy sources the solution to climate change? ; How can we stay within the limits (emission limit values) and meet all the necessary climate change mitigation goals?

Keywords: *climate change, nuclear energy, renewable energy sources, fossil fuels.*

INTRODUCTION

The climate crisis is a reality of the 20th and 21st centuries. This is most clearly stated in the Intergovernmental Panel on Climate Change (IPCC) in the Climate Assessment Report for 2014 (fifth report) [1], which states that with 98% certainty, anthropogenic CO2 emissions are the cause of rising global temperatures. The first convention[2] on climate change was in 1992, when the result of global policy and thinking was - the Kyoto Protocol and all future meetings of the creators of global climate policies COP (Conference of Parties). Since that turning point in 1992, we have seen a rise in global temperature of 1°C. So, when we talk about trying to prevent an increase in average temperatures of 2°C, but we see that the possibility of realizing this is less and less given that the latest data[3] show that we are very close to an increase in temperature by more than 2°C, indicated that if we have an increase in global temperatures by 2-2.5°C, we can no longer stop climate change and global melting of the ice sheet - the climate regulator on the planet.

How far we have come in terms of climate change and global temperature rise, we can best see in Figure 1, which clearly shows that we are not only close to the limit of 2.5 oC, but that we have largely stepped into the red zone, ie the zone from which we can hardly withdraw without serious consequences.

If we are serious about climate change, then most of the coal, oil or gas currently inside the land will have to stay there. Because, if we perform uncontrolled burning of fossil fuels, ie. without the application of modern technological solutions such as "capture" and "extraction" of carbon in exhaust gases, we will exceed our global maximum concentration of carbon in the atmosphere.

1 https://www.ipcc.ch/report/ar5/syr/
2 https://unfccc.int/resource/docs/convkp/conveng.pdf
3 https://climateactiontracker.org

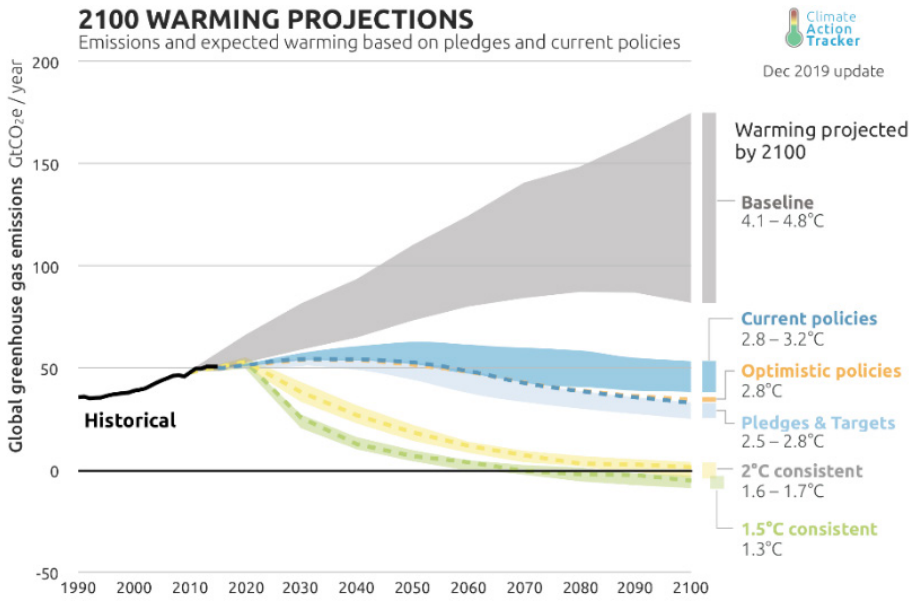

Figure 1. Predictions of an increase in the average global temperature to 2100 (Source: https://climateactiontracker.org/global/temperatures/)

"How can we stay within our limits and meet the necessary goals of climate change mitigation?" This is a basic question that all industry and global climate and energy policy makers should ask themselves on a daily basis. Is the answer to this question - nuclear energy or renewable energy sources or something else? Nuclear energy is considered a low-carbon energy source compared to fossil fuels. However, there are numerous shortcomings of nuclear energy that make its application more difficult than we already have worldwide today. Therefore, we must seriously consider the application of this alternative energy source with all its advantages and disadvantages.

Renewable energy sources, RES, represent an industrial milestone. RES are the policy tools and levers that have helped renewable sources, such as wind, solar, geothermal, tidal energy, as well as sea currents, to grow and apply more where their potential is highest.

International cooperation is the key point in global climate and energy policies because most of the global greenhouse gas emissions are generated for global energy production and consumption. Economic policy makers are in a very difficult position because it has not yet been clarified how to keep fossil fuels in the land for

as long as possible without a negative impact on the global economy, with even less negative impact on international relations and policies. Therefore, a critical response to the climate crisis depends on the ability of each individual and their government policies to work together to influence changes in energy markets and international governance. And that leads us to the fact that from year to year we realize that a radical change in the way of structuring the global economy is urgently needed.

First of all, here we have to reconsider agricultural production and forestry, which account for about 25% of greenhouse gas emissions, ie. reconsider how much these 25% really affect the drastic deterioration of climate change compared to the remaining 75% of greenhouse gas emissions (Figure 2). This is primarily important because we cannot prevent natural biological averages in animals from emitting methane, and on the other hand we know that heavy agricultural machinery can be supported by SUS engines which as such must use oil because hybrid, electric and fuel cell vehicles still they cannot meet the needs of agricultural machinery.

On the other hand, considering organic agricultural production with all its health benefits and environmental review in terms of GHG (greenhouse gas) emissions and reduced use of chemicals - which has been shown to have much less harmful effects in the segment of emissions of these gases primarily CO2, still with its quantitative capacities and time frames for the conversion from conventional to organic agricultural production it can in no way satisfy the world's food needs.

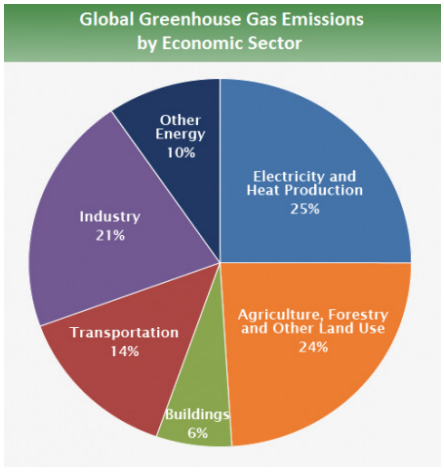

Figure 2. Share of global greenhouse gas emissions from different sectors of the economy (Source: https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data)

1. THE FUTURE OF FOSSIL FUELS

In a future that is limited by carbon and the consequences of climate change, we cannot say with certainty about the amount of fossil fuels in the earth's crust, and yet the world still relies primarily on them. On the other hand, the need for an increasing amount of electricity is increasing every day, especially in developing countries. While in economically developed countries there is talk of a complete cessation of the use of fossil fuels and the transition to alternative and renewable energy sources (this is the case with Germany, which plans to completely switch electricity production to RES by 2050, and already in the first half of 2019 they are at 47.3 % - Figure 9.).

Predictions about the state of rise in global temperatures, if we continue with the current behavior, ie. scenario in terms of energy production and if we change our scenario and switch to green technology and green energy production is best described in Figure 3. According to the Austrian Academy of Sciences, if we want to change climate change, more precisely global warming, we need to make appropriate limits for cumulative CO2 values. If we want to keep temperatures below 2 degrees, compared to the pre-industrial level, we must remain in the range between 820 and 950 billion tons of CO2, and humanity in the period 1870-2013 had emissions of a total of 530 billion tons of CO2 and that if we want to stay within these limits, we must reduce CO2 emissions by 5.5-8%[4] annually. This indicates to us that until 6 years ago we spent half the limit of the total amount of CO2 thanks to fossil fuels planning their future earnings. However, if we suddenly and completely switch to alternative energy sources and RES, it would have multimillion damages for these companies in the economic sense.

If we add to that the fact predicted by scientists from the University of London that in the next 20-30 years the share of oil and gas in energy production would be around 50%, where gas would increasingly be a substitute for oil, we will have an even worse situation than this has been the case so far as GHG quantities will continue to grow. However, such a gradual transition from one fossil fuel to another would still be positive for the state of the environment and the consequences of climate change, ie an increase in CO2 emissions into the atmosphere would be used until a long-term solution is found. However, the idea of zero carbon emissions (relative to the global economy) still seems like an impossible mission because looking at the world's largest companies worth millions of dollars.

4 https://www.science.org.au/learning/general-audience/science-climate-change/4-how-do-we-expect-climate-change-to-evolve

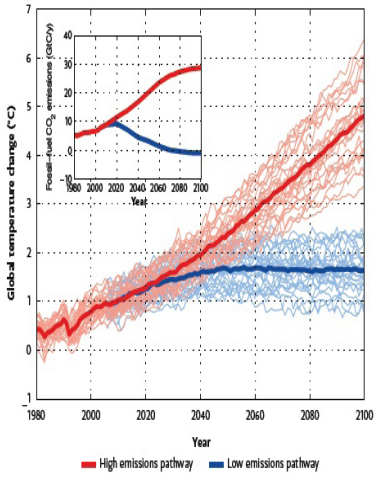

Figure 3. Climate change scenarios with high and low CO2 emissions (Source: https://www.science.org.au/learning/general-audience/science-climate-change/4-how-do-we-expect-climate-change-to-evolve)

This would have a very negative impact on the economic growth of humanity in terms of the way we power cars, factories, houses, offices, etc., e.g. it is impossible to completely stop the production of SUS engines at once and it is inevitable that such engines will be on the market for some time to come. Different ways of using SUS engines must be considered, for the first time by combining them with different forms of fuel, increasing efficiency - which is now done with hybrid vehicles, and electric vehicles are also widely represented. The goals we now see and set for ourselves can be achieved and met - while retaining a very strong role for fossil fuels. But there are some things that are much harder to get out of the system than others. If we look at the energy sector, there are certain possibilities for displacing the most carbon fuels that we have relied on so far, and that refers precisely to the sector of industry and production of motor vehicles. Although there is a certain kind of populist rise and trend of electric and hybrid vehicles that can be found in the fleet of light vehicles - we are not moving from the deadlock yet or we have moved very little.

One possibility is that fossil fuels do not have to remain in the earth's crust and we can continue to exploit them by applying modern technologies and developing new ones, such as capturing and storing CO2 below the earth's surface (CCS - Carbon Capture and Storage) - more precisely to return the carbon to where it came from. CO2 capture and storage would be on an environmentally friendly scale, and we could continue to use the coal, gas and oil deficits currently in the country from the

ground. This is one of the possible solutions that appeared and in the last 15-20 years caused great interest, but so far this solution has not found economic acceptability, so this type of comparative use of fossil fuels could be waited for some time. The International Energy Agency (IAE) gave its opinion on this at the UN Intergovernmental Panel on Climate Change (IPCC) in 2015, emphasizing that by 2050 the world must reduce CO2 emissions by 5GT (giga tons) per year, which is equivalent to CO2 emissions from 10,000 factories. On this occasion, they stated that the application of CCS technology can eliminate 14-17% of CO2 emissions.

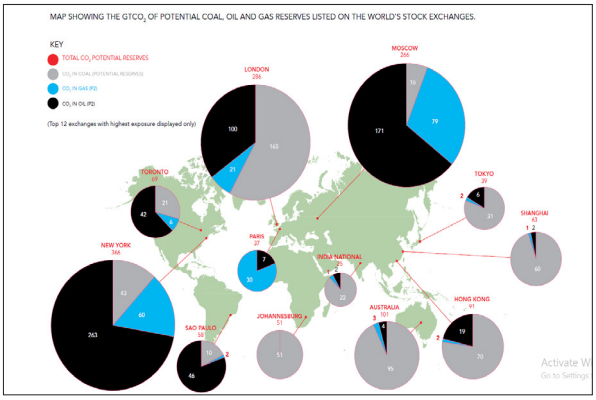

Figure 4. Distribution of fossil fuel reserves, amount of CO2 emitted due to fossil fuel combustion (Source: http://carbontracker.live.kiln.digital/Unburnable-Carbon-2-Web-Version.pdf)

In this case, we face three potential and major challenges:

1. The Global Institute for Carbon Capture and Storage published a study in 2019 that shows that CCS is necessary to solve the problem of climate change, and that this technology raises new hopes for the fight against climate change. Those who support this technology, e.g. The United States put a lot of pressure on the development of this technology a few years ago, but then withdrew the funds, at that time the European Commission and the British government had a great interest in CCS. However, today there are 19 large carbon capture and storage plants in the world, 28 are in various stages of construction, and in 2019 the construction of 4 new plants began. The United States is now the leading country in decarbonizing the atmosphere with this method. What is real and currently unfeasible is the inefficiency of investment in technology that would be required for the adequate application of these technologies. The potential of this technology is largely untapped. Such technologies can be

implemented and there are great opportunities for CCS, ie. use and storage of carbon, development of different types of carbon-based aggregates and other, technological development that would allow us to sequence and use CO2 in ways that were not previously considered possible. However, the preparation of new fossil fuel technologies, at least CCS, is something that the OECD should definitely consider and prioritize as a temporary solution.

2. Management of the agricultural sector and carbon absorption - creation of a kind of gas balloons from which biogas would be produced, which would have a multiple role. As agricultural production is a great source of carbon and greenhouse gases, then agricultural flooding can take a high position in the fight against climate change, because the production of biogas in this way would eliminate carbon atoms from the atmosphere.

3. And finally, no less important item are the oceans, which are acidified by the emission of greenhouse gases because they act like a sponge. By eliminating harmful gases and reducing the amount of fossil fuel combustion, we would prevent the acidification of the oceans.

2. NUCLEAR ENERGY - A HAZARD OR AN ALTERNATIVE TO FOSSIL FUELS?

We can use nuclear energy in civilian and military applications. When we talk about the civil application of electricity, it can be noticed that the one obtained from nuclear power is produced in a similar way as the one produced by burning fossil fuels. That is, a nuclear reactor generates heat that heats the water to the boiling point, creating water vapor that drives the steam turbine and produces electricity. The difference is that heat is generated by controlled nuclear fission, ie. by fission of the nuclei of uranium or plutonium isotope atoms, and thus there is a reduced emission of carbon into the atmosphere.

Debates on nuclear policy have been going on for a very long time, and it is very controversial on the part of both proponents and opponents about the use of nuclear energy. Serious discussions about the use of nuclear power plants and military weapons took place even before the Second World War. Even then, Albert Einstein wrote a letter to Theodore Roosevelt in which he opposed the use of uranium for any purpose because he believed that it was an incredibly dangerous weapon that could destroy the planet. After the Second World War, when the technology was developed in the military, it turned to civilian use, and then nuclear energy experienced an expansion

in the application of electricity production.

Many countries, such as France, the United States, China and Japan, have a large number of nuclear reactors as a strategic source of energy to reduce dependence on fossil fuels. In the process, nuclear energy received significant financial and political support. In Figure 5[5], we can see the share of electricity production from nuclear reactors compared to all other energy sources, and that share is about 10.15% (according to the Report on the Status of World Nuclear Energy dated 2018)[6].

When we talk about the effects of nuclear energy in the first place are major global nuclear disasters such as Chernobyl (1986) and Fukushima (2011) which had a huge negative impact not only on the environment, biodiversity and human health but also on the energy sector because it is disabled the use of a large amount of electrical energy obtained in nuclear reactors (Figure 6). However, the negative effects of energy include blasting the land for uranium extraction and processing, where we have a huge emission of carbon, then decontamination, transport and storage of nuclear waste from the reactor. These are mainly negative effects on the environment and the economy, because a large amount of carbon is emitted in each segment of the life cycle. So just this shows that nuclear power is not low-carbon energy, but it can be a good alternative with less carbon than burning coal, and that carbon footprint is lower than the one left by RES - and that's best seen in Figure 7[7].

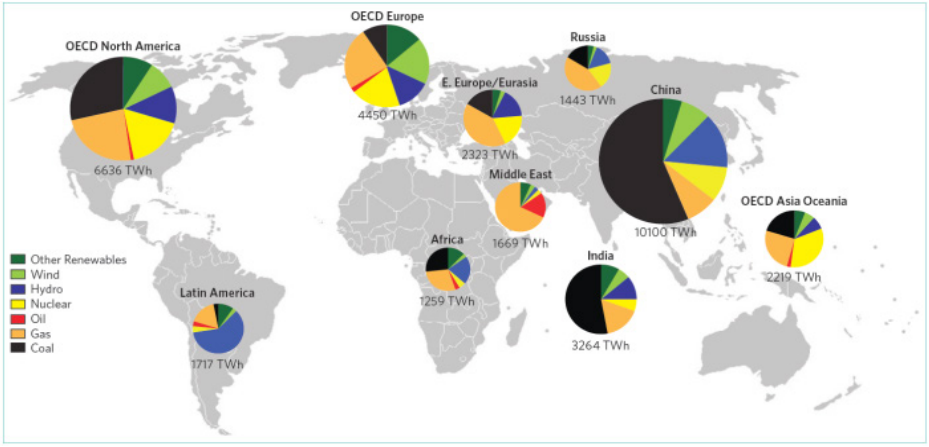

Figure 5. The share of nuclear energy in electricity production globally compared to fossil fuels and RES (Source: https://jojomio.files.wordpress.com/2013/01/scott-et-al.png)

5 https://jojomio.files.wordpress.com/2013/01/scott-et-al.png
6 https://www.worldnuclearreport.org/
7 https://utexas.app.box.com/s/kavxa4peaq3qtcs8l4yacqc8k39ftloz

In times of anthropogenic climate change, many see nuclear energy as an important source in electricity production, given its lower carbon emission profile compared to fossil fuels and its other alternatives - renewable energy sources. In large countries (India[8]) and largely economically developed countries (China[9] and Russia[10]) which are in the process of building a large number of new nuclear reactors. They want to have a diverse energy source, where they want to meet growing energy needs that can only be supported by nuclear energy. And they believe that supplying households with electricity from this source is one of the solutions. Today, we have an evident Japanese energy mix, which proves that Japan will produce more nuclear energy in 2020 than it did before the 2011 Fukushima disaster[11]..

If we leave aside the danger of excavation, decontamination, transport and storage of nuclear waste that we see in nuclear energy, it is inevitable that this is a thousand-year-old energy source that is practically inexhaustible, and does not depend on any natural, renewable factors. it is not limited by the length of the day, nor by the strength of wind or water, as is the case with renewable sources, but it is also a 24/7 potential time bomb and requires constant investment in the reconstruction of these reactors. Such information leads us to start looking at this more from an economic point of view, and this results in the costs related to nuclear energy being on the rise and representing a more expensive investment than renewable energy sources (whose costs are decreasing on a daily basis) [12]..

An additional cost and location problem is that such power plants must be located far from large cities and large centers of use of this energy, so it is necessary to install and enable transmission lines and transformers that are strong enough and able to distribute this electricity where needed. However, this is no less of a problem than renewables, in particular wind farms or solar power plants that also require large areas, pose a serious threat to biodiversity, and carbon emissions from the construction or storage and transport of energy produced from renewable sources.

8 https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx
9 https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx
10 https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/russia-nuclear-power.aspx
11 https://www.nippon.com/en/features/h00238/japan%E2%80%99s-nuclear-power-plants.html
12 https://www.forbes.com/sites/amorylovins/2019/11/18/does-nuclear-power-slow-or-speed-climate-change/#e30b4c506b40

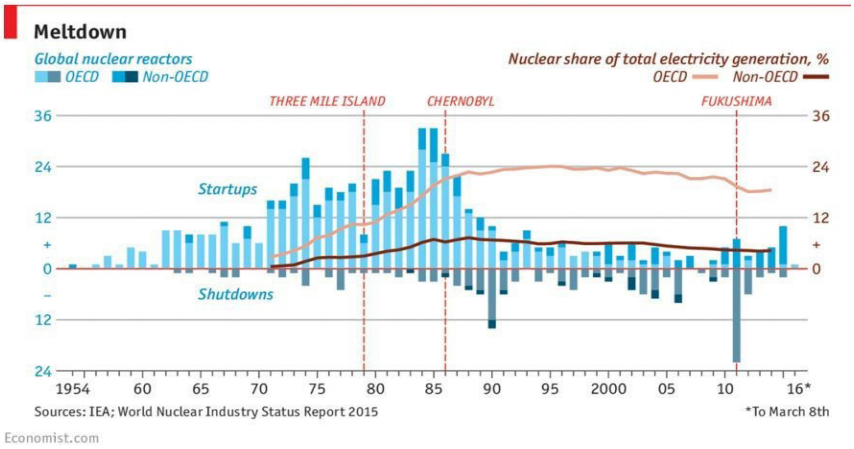

Figure 6. Impact of nuclear disasters on the economy, operation of nuclear reactors and opening of new nuclear power plants (Source: https://www.weforum.org/agenda/2016/03/5-years-after-fukushima-world-nuclear-powerhouses/)

If we look at nuclear energy from a negative perspective, then a very reasonable question arises: "Why is nuclear energy a potential alternative to fossil fuels, given that in some sources the negative effects of nuclear energy are equated with the negative effects of RES?"

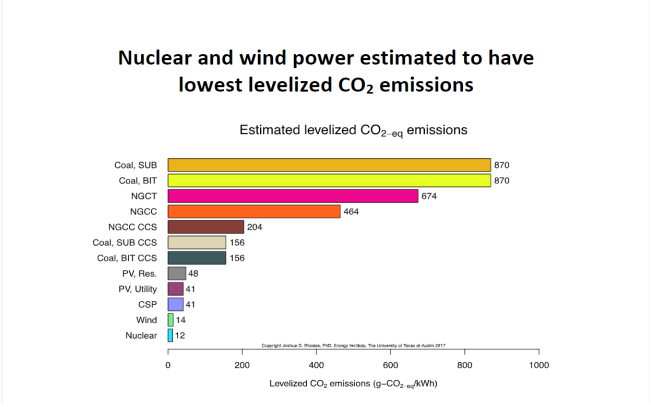

Figure 7. Carbon footprint left by different energy sources (Source: https://utexas.app.box.com/s/kavxa4peaq3qtcs8l4yacqc8k39ftloz)

The answer to this question can only be given by practical solutions, which certain developed economies around the world are already applying, ie. they decided to abolish this type of civilian nuclear weapon and switch to green energy, ie RES. They have established software technology that is an alternative to nuclear. It is based on renewable loads, with little carbon, although in China one can fully understand the desire to build nuclear reactors as part of wider opportunities for energy production. Simply because China's energy needs are growing so fast that there are legitimate concerns about the safety and reliability of producing sufficient quantities of (nuclear) energy.

The future of nuclear energy in the world is very unpredictable, because nuclear energy could have a very positive impact on energy potential in terms of providing enough energy to supply an increasingly energy-hungry market. From this point of view, too, nuclear energy has a bright future. For certain energy needs and loads that need to be met this nuclear power can provide. There are also potential technological solutions, which are currently being tested, with smaller reactors, that can reduce the financial risk of large plants and nuclear fission by using thorium (Th) instead of enriched uranium (U) and plutonium (Pu) as a way to solve many safety concerns. issues related to nuclear energy. However, it will be very difficult to integrate nuclear systems into systems with a large amount of renewable sources that can be exploited and meet market needs.

Those who are energy policy makers, investors and technologists will have to face this dilemma and problem in the next few years, and this will be very important, especially because we are in a time of intense fight against climate change. And already now, around the world, the governments of countries are giving the strongest possible arguments about the need to decarbonise and mitigate climate change. These countries are really changing their energy policy and economy, and taking a zero carbon source from a combination of different energy sources. In support of this, we have the latest data that after the end of the heating season 2019/2020 after Belgium, Sweden and Austria shut down the last fossil fuel power plant, which proves that it is necessary to find a green solution for energy production. [13]

13 https://www.energylivenews.com/2020/04/20/austria-moves-towards-climate-neutrality-with-shutdown-of-last-coal-plant/

3. RENEWABLE ENERGY SOURCES - A SOLUTION TO CLIMATE CHANGE?

When it comes to renewable energy sources as new entrants to the energy market, the possibilities are numerous. Although hydropower plants have been used to produce electricity since the late 19th century, and today are the most used renewable energy source in the world, while the use of wind turbines and photovoltaic systems is a newer technology, the latest and least used renewable sources include geothermal energy, wave energy, tidal energy and low tide and energy of sea currents (this type of energy has the greatest potential, because it does not depend on any climatic and weather factors). With policies creating demand for mass-produced wind turbines and photovoltaic panels combined with technological improvements and reduced construction costs, more and more solar and wind power plants have been installed worldwide with higher electricity generation capacity than before.

Investments in new renewable energy infrastructure, exceeds investments in new fossil fuel infrastructure. According to Bloomberg New Energy Finance[14] "Global electricity markets are transforming at an unimaginable rate compared to ten or even five years ago. The growth of renewables creates new jobs, reduces local air pollution and requires less water consumption than established ways of producing electricity. "This statement is best evidenced by the chart in Figure 8, which shows how EU countries are gradually increasing their tendency to switch. on RES, and some countries have already exceeded their targets for 2020 in 2018. The entire EU aimed to reach a share of 20% of energy from RES in 2018, but still remained at 18.9%, while that share in means of transport amounted to 8.3%[15].

RES are now definitely much more competitive than the use of fossil fuels. Today, we have knowledge and technology, but the problem is the momentum of the existing global system and it needs political intervention of governments, because climate change is a global, collective problem, so governments need to insist on investing in the transition from fossil fuel economy to renewable energy economy. Why? We currently have a well-established and established system of using fossil fuels to the extent that meets the needs of the market, and the transition to renewable systems is long, and it takes a certain period of time (10-20 years) to show its economic viability. However, RES will be able to surpass fossil fuels only when the costs of climate change remediation are included in the costs of electricity production. Even

14 https://about.bnef.com/new-energy-outlook/

15 https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics&oldid=447221

then, changes in habits will not be fast enough and efficient enough to completely decarbonize the atmosphere, and there will be some improvements in the state of the environment, or a reduced greenhouse effect.

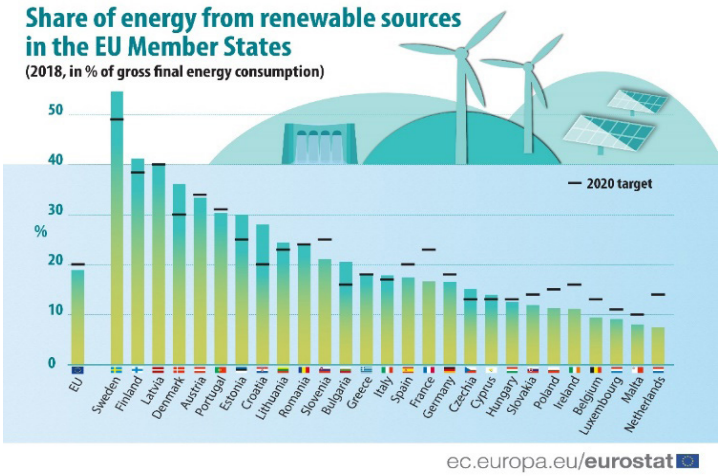

Figure 8. Share of RES in electricity production in Europe (Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics&oldid=447221)

Political and legal tools and levers that help the share of electricity from renewable sources grow, and that is where political interventions are necessary and sometimes the only possible solution is - regulatory coercion, that is. prohibitions, penalties, and tax burdens or reliefs. Globally, if we focus on the countries of the European Union, there is a whole range of legal and economic regulations in the taxation of greenhouse gas emissions, and above all carbon. And such regulations, economically speaking, work in such a way that it becomes more profitable for polluters and governments of certain countries to switch to the production of energy from renewable sources. In that way, renewable sources are becoming more and more competitive, because tax reliefs and carbon taxation are such that it is definitely more profitable to wait for the result of those 10-20 years than to pay fines and penalties that would be paid immediately due to allowed fossil fuel levels. This creates differences in payments between the direct cost of electricity from fossil fuels and electricity produced from RES. The key idea of the subsequent ie. The penal tariff for carbon emissions was to force energy producers to use renewable energy sources in order to be more competitive with coal and gas. As electricity produced from renewable energy is

gradually equated with the cost of energy from other sources, then both sanctions and policies will be gradually mitigated. This is a particularly important segment because of developed and developing countries in relation to the least developed countries, because it is important to establish a single system that could be applicable to all countries, regardless of their economic development.

The key policy levers needed are to equalize renewable energy playgrounds with the other two. There are many indirect subsidies that are still directed to the production, distribution and use of fossil fuels. Global politics has to deal with that somehow. That is, to calculate the price of carbon in the system, because the effects of pollution on climate change are not paid by the people who run energy plants (utility companies), nor by the people who buy and consume electricity. Therefore, it is necessary to have such carbon prices so that producers and consumers at the local level feel the global environmental impact of energy production. This requires transparency and an economic and environmental view of the level of tariffs for investments in renewable energy sources. This view of taxes and benefits for countries that produce energy from renewable sources is nicely presented in the report "Taxes and benefits for renewable energy 2013-2030" made by the auditing company KPMG International and it shows the annual trend of increasing the amount of fines per unit of energy produced[16].

Supply chain - distribution, consumption and basic economics of renewable technologies make a lot of work for local and global climate policy makers so that their environmental and moral values have been declining over the last few years (precisely because economic viability is shown only after at least 10 years of installation renewable systems). It is in this segment of understanding, and the necessity of accepting renewable technologies, that policymakers must do that. find a way to incorporate renewable technologies into the existing electricity grid. This is very difficult in some cases because it is not at all easy to place a new system in the area of exceptional natural features and values of a certain area that is ideal for building a renewable energy system. However, the construction of solar panels on the roofs of houses and buildings does not ecologically disturb natural landscapes, and the same applies to the installation of mini windmills in households for their own use.

But, looking at large industrial systems that have different technological roles, e.g. at the wind turbine. The whole system of installing a wind generator is now very cheap in areas where the factors of its capacity are very high, the wind can really re-

16 https://assets.kpmg/content/dam/kpmg/pdf/2014/09/taxes-incentives-renewable-energy-v1.pdf

place fossil fuels. Energy use should also be adjusted when it is available. It is true that renewable energy sources are not the most efficient because they are interrupted, that is. we do not have every renewable energy source available at all times. However, if we have a sufficiently large and developed global network of renewable energy sources, then it is less interrupted and we have a certain continuity - e.g. if the wind does not blow with sufficient force in one area, then it blows with sufficient strength somewhere else, it is the same with the Sun, because it always shines somewhere on the planet and is always more accessible in one hemisphere. So, there are solutions to cut off renewables - then there are technological solutions and also economic solutions to structure the market. And that is where global policies have a very specific role.

A good example of this is JinkoSolar - currently the world's largest company in the production of solar systems, based in Shanghai, China, (in 2018, they produced 11.4GW of electricity worldwide). The Chinese plan to have a 15% share in energy production by 2030 from solar energy. This is very ambitious given the volume of consumption, the growing energy demand in China. So in China, the policy is ready to support industry, research and development, in positive tax breaks and loans. The result of such a policy is a huge increase in the production and establishment of wind and solar energy production. The role of regulators in energy markets will be absolutely crucial in initiating a low-emission GSB (greenhouse gas) transition. And the biggest pressure will be placed on companies such as JinkoSolar, Canadian Solar and others, that they have to feed the energy-hungry market in a very short period of time.

A global transformation of the business model of utility companies around the world is needed, where their losses from the reduction of energy production from fossil fuels will be a means of supporting renewable energy sources. The private technology sector is aggressive in energy production by increasing technology to stay a step ahead utility companies that cannot keep up with modern technology.

Renewable energy is the largest area of growth we see within the global energy economy. These trends are extremely positive, especially when it comes to the aspect of energy economy, ie. the way in which the costs of building technological plants from renewable sources have fallen over the last 5 to 10 years. Now, these technologies will continue to guarantee some support, and allow RES to gradually take precedence in the energy sector of most countries, especially in Europe.

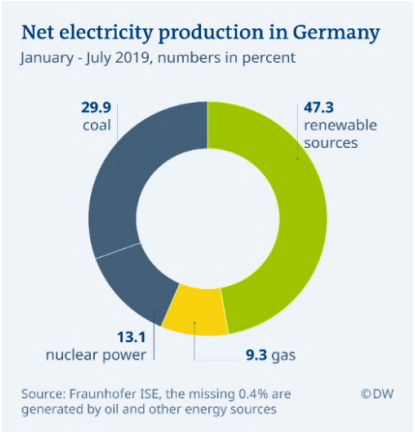

Figure 9. Electricity production in Germany from RES compared to other sources (Source: https://sweetcrudereports.com/germanys-power-industry-sees-a-drop-of-14-3-in-deal-activity-in-q4-2019/)

CONCLUSION

The range of technologies we have at our disposal, the possibilities of social change and different understandings of the way we produce and consume energy are still present. However, the ecological crisis really comes from the impossibility or weak connection of problems resulting from global temperature rise, climate system disturbances, impacts on food sources, impacts on resource scarcity, climate migrants and, of course, financial issues arising from these impacts. This has resulted in green technologies that can significantly affect the amount of carbon we actually emit.

We have different policies in different parts of the world, which must be harmonized, united and become a single global policy in the fight against climate change. We saw the first signs of that in the Paris Agreement and in the COP (Conference of Parties) agreements, and as Euroactive announces, we are currently working on stopping the production of electricity from coal in the Czech Republic, Spain and Northern Macedonia.[17]

If we accept that climate change is a global crisis and that both the climate and energy challenges of the 21st century are the key transformative challenge we need,

17 https://www.euractiv.com/section/electricity/news/austria-becomes-second-eu-country-to-exit-coal/

then worries about the amount of carbon emitted into the environment raise new problems in the fight against climate change.

At the political level, it is necessary to find the most cost-effective way to resolve this crisis. If we remain to aim for global mean temperatures to rise above 2°C, above pre-industrial levels, we will need to look at the role of both nuclear and renewable energy, using a broader ecosystem approach that includes critical issues such as energy storage and consumption. inevitable regardless of the mode of energy production. Because although there are supporters of both renewable energy sources and nuclear energy, the world is in a constant dilemma as to what is better, because both alternatives to fossil fuels have their advantages and disadvantages.

An additional advantage in energy production, distribution and use is the centralized system. It is a very rigid system and the introduction of renewable energy sources on it can obviously cause problems. In the global south, there are areas where people do not have access to electricity at all. And that is actually possible to perform, that is. build from scratch to the full distribution of an energy system that gives people access to the energy and quantity they need without using the fossil fuel reserves we have.

Large energy companies are sufficiently developmentally, technologically and scientifically ready to take advantage of the opportunity that goes hand in hand with subsidized tariffs, especially now in the 21st century when RES have become a core part of every business because these technologies challenge creating a balance in climate change mitigation. These companies are very aware that with the application and creation of new technologies in this area, they are actively participating in the IV Industrial Revolution, more precisely - the Green Revolution.

REFERENCES

1. https://www.ipcc.ch/report/ar5/syr/
2. https://unfccc.int/resource/docs/convkp/conveng.pdf
3. https://climateactiontracker.org
4. https://climateactiontracker.org/global/temperatures/
5. https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
6. https://www.science.org.au/learning/general-audience/science-climate-change/4-how-do-we-expect-climate-change-to-evolve

7. https://www.science.org.au/learning/general-audience/science-climate-change/4-how-do-we-expect-climate-change-to-evolve

8. http://carbontracker.live.kiln.digital/Unburnable-Carbon-2-Web-Version.pdf

9. https://www.globalccsinstitute.com/

10. https://jojomio.files.wordpress.com/2013/01/scott-et-al.png

11. https://www.worldnuclearreport.org/

12. https://jojomio.files.wordpress.com/2013/01/scott-et-al.png

13. https://www.weforum.org/agenda/2016/03/5-years-after-fukushima-world-nuclear-powerhouses/

14. https://utexas.app.box.com/s/kavxa4peaq3qtcs8l4yacqc8k39ftloz

15. https://www.weforum.org/agenda/2016/03/5-years-after-fukushima-world-nuclear-powerhouses/

16. https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx

17. https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx

18. https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/russia-nuclear-power.aspx

19. https://www.nippon.com/en/features/h00238/japan%E2%80%99s-nuclear-power-plants.html

20. https://utexas.app.box.com/s/kavxa4peaq3qtcs8l4yacqc8k39ftloz

21. https://www.forbes.com/sites/amorylovins/2019/11/18/does-nuclear-power-slow-or-speed-climate-change/#e30b4c506b40

22. https://www.energylivenews.com/2020/04/20/austria-moves-towards-climate-neutrality-with-shutdown-of-last-coal-plant/

23. https://about.bnef.com/new-energy-outlook/

24. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics&oldid=447221

25. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics&oldid=447221

26. https://assets.kpmg/content/dam/kpmg/pdf/2014/09/taxes-incentives-renewable-energy-v1.pdf

27. https://sweetcrudereports.com/germanys-power-industry-sees-a-drop-of-14-3-in-deal-activity-in-q4-2019/

28. https://www.euractiv.com/section/electricity/news/austria-becomes-second-eu-country-to-exit-coal/