Review paper

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THE EUROPEAN GREEN DEAL AND ITS IMPLEMENTATION IN THE REPUBLIC OF CROATIA

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Abstract: The European Green Deal represents a transformative strategy for economic growth, aiming to create a fair, prosperous, and resource-efficient Europe with a competitive economy and net-zero greenhouse gas emissions by 2050. The energy sector, as the largest emitter of greenhouse gases, is central to achieving these objectives, and renewable energy sources (RES) play a pivotal role in decarbonization. The Republic of Croatia, despite its favorable geographic potential for solar energy, remains underutilized in terms of solar electricity, heating, and cooling generation. This paper examines the potential of solar energy and other renewables to contribute to sustainable economic growth in Croatia, emphasizing energy efficiency, distributed generation, and the creation of green jobs. Demonstration projects indicate that expanding photovoltaic and solar thermal systems could generate up to 20,000 jobs while reducing carbon dioxide emissions and enhancing energy independence. The study also highlights the need for interdisciplinary approaches, integrating technical, social, economic, and environmental perspectives, to ensure a coordinated and sustainable energy transition aligned with EU and global climate goals.

Keywords: European Green Deal, renewable energy, solar energy, sustainable economic growth, energy transition, Croatia, photovoltaics, solar thermal collectors, energy efficiency, green jobs, climate neutrality, decarbonization.

1. INTRODUCTION

The European Green Deal is a new economic growth strategy through which the European Union aims to transform Europe into a fair and prosperous society with a modern, resource-efficient and competitive economy, in which there will be no net greenhouse gas emissions by 2050 and where economic growth is decoupled from resource use.

The energy sector represents the largest source of greenhouse gas emissions, while climate change constitutes one of the greatest threats to contemporary humanity. The energy sector is responsible for more than 77 percent of harmful emissions in the European Union, and in order to reduce these emissions, the first step toward this goal was the adoption of the European Green Deal, intended to achieve the decarbonisation of the energy sector by increasing the share of renewable energy sources.

President of the European Commission, Ursula von der Leyen, stated: “People are at the heart of the European Green Deal and of our vision to make

Europe climate-neutral by 2050. The Green Deal brings substantial investment needs which we will turn into investment opportunities. The plan we present today will show the direction and unleash a wave of green investment."

The Republic of Croatia meets, on average, only 50 percent of its primary energy needs, while the remainder is imported, and these energy imports increase year after year. Croatia imports 100 percent of its coal, over 90 percent of its oil and oil products, more than 60 percent of its natural gas, and around 35 percent of its electricity, depending on hydrological conditions. In the near future, the Republic of Croatia would become highly dependent on the import of fossil fuels (coal, oil, gas) and electricity. As a result, Croatia would have to pay more than 2 billion euros annually for these energy imports, depending on global oil prices and electricity prices on European and international markets. For decades, Croatia has not built a single power plant that could ensure any degree of energy independence.

The Intergovernmental Panel on Climate Change (IPCC) calls on all governments worldwide to adopt urgent and decisive measures to prevent global temperature increase from exceeding 1.5 degrees Celsius, in accordance with the Paris Agreement. As a step in this direction, the European Green Deal was adopted, and on 27 May 2020 the European Commission also released its Recovery and Resilience Plan, which establishes the foundation for economic revitalisation in accordance with the principles of the Green Deal, that is, of a sustainable green economy.

Through the Recovery and Resilience Plan and the accompanying "NextGenerationEU" budget, the funds made available to Member States for recovery offer an opportunity to simultaneously contribute to mitigating the third global crisis — the climate crisis — following the refugee crisis and the crisis caused by COVID-19. The impending climate crisis, if not addressed urgently and systematically at the level of each individual state, will in the long term lead to even more drastic consequences for the economy and humanity than those brought about by the COVID-19 pandemic. A green recovery is therefore the only viable path which, in addition to contributing to the resolution of the climate crisis, enables the creation of new jobs, reduces healthcare costs, and ensures a rapid and effective transition into a new, low-carbon present without inequalities and with a resilient and competitive economy.

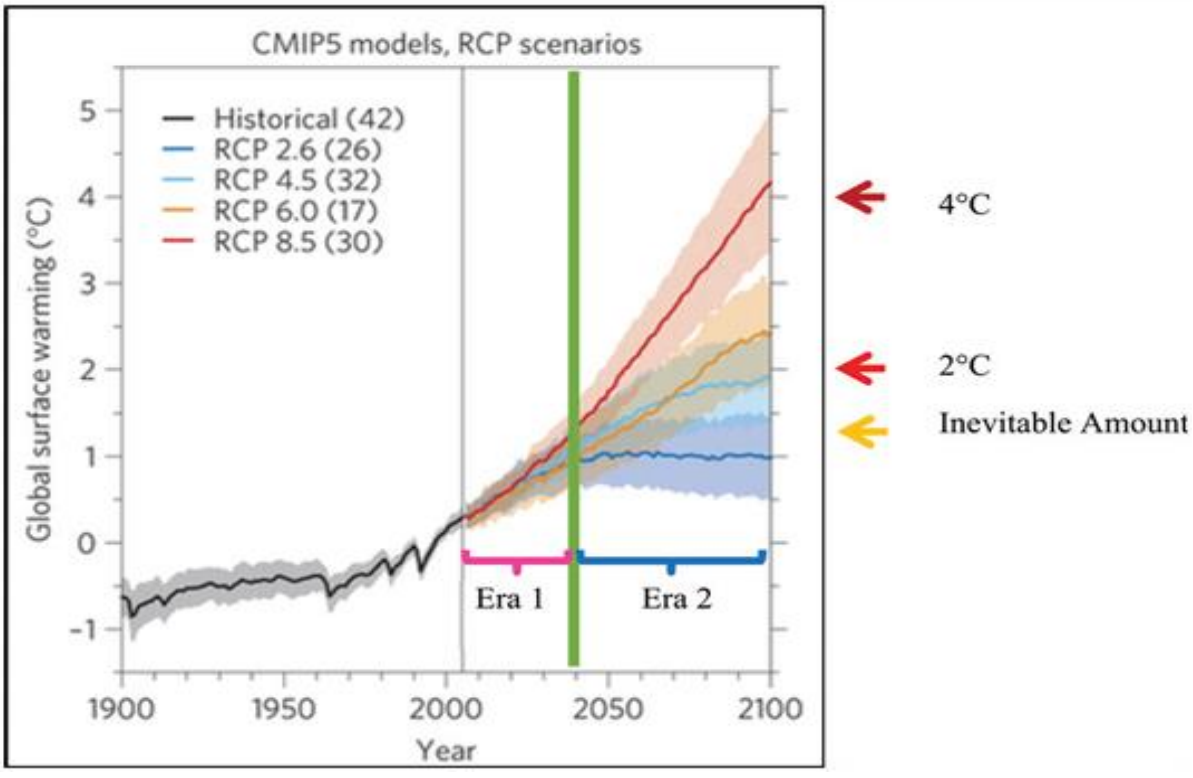

Figure 1. *Possible Increase in Global Temperature by the Year 2100*

2. THE CONTRIBUTION OF RENEWABLE ENERGY SOURCES TO THE SUSTAINABLE ECONOMIC DEVELOPMENT OF CROATIA

The Republic of Croatia possesses significant potential for the use of renewable energy sources, which can make a major contribution to the country's sustainable economic development. Legislative and sub-legislative acts explicitly reflect Croatia's positive stance toward renewable energy sources and environmental protection. In addition to solar and wind energy, biomass and biofuels, small hydropower, and geothermal energy can also play an important role in Croatia. It is worth noting that, in recent years, increasing attention has been given to tidal and wave energy, ocean and marine currents, as well as hydrogen.

The potential for using renewable energy sources in Croatia is largely aligned with the European Union's 2030 targets: a 45 percent share of renewables in gross final energy consumption, 32.5 percent energy efficiency, and a 55 percent reduction in greenhouse gas emissions. All of this can be achieved through improved energy efficiency and by increasing the share of energy derived from renewable sources.

The sustainable economic development of the Republic of Croatia can and must be achieved alongside reductions in greenhouse gas emissions by 2050, in accordance with the Paris Agreement and EU objectives, as well as the goals of the UN Framework Convention on Climate Change in terms of mitigation and adaptation to climate change. To achieve this, energy efficiency and renewable energy play a crucial role in overall energy consumption. From an economic standpoint, these developments create new so-called green jobs, contributing to local significance and local development.

Enhancing energy efficiency is the measure that can most effectively reduce thermal, cooling, and electricity consumption in the general sectors (households, services, agriculture, and construction). Measures such as photovoltaic systems, solar thermal collectors, biomass boilers, and heat pumps are essential for meeting the required standards for nearly zero-energy buildings (nZEB).

A major contribution of renewable energy sources to Croatia's sustainable and balanced economic development lies in encouraging the production of renewable electricity at the point of consumption, up to the capacity of the connection, where electricity is produced primarily for self-consumption, with only surplus energy being fed into the grid, based on a one-calendar-year settlement period and a bidirectional electricity meter.

Distribution system operators are increasingly expected to ensure and create the preconditions on the electricity market for the active participation of small energy producers–consumers (prosumers). Efforts should indeed be directed at increasing the share of renewable energy sources, but without introducing special subsidies that would burden end-users through higher renewable energy surcharges.

To create a stable business environment for project implementation, clear and unambiguous regulatory provisions must be in place. In particular, Croatia's Spatial Planning documents, the Energy Strategy, the Low-Carbon Development Strategy, the Strategy for Climate Change Mitigation and Adaptation, and the NATURA 2000 ecological network must be harmonised, achieving a balance between various constraints and the greatest possible societal benefit.

Croatia has set clear decarbonisation and energy transition objectives, as outlined in the Integrated National Energy and Climate Plan (NECP) for the Republic of Croatia for the period 2021–2030. Every two years, EU regulations require Member States to prepare an NECP Progress Report. The first such report from the Republic of Croatia was submitted to the European Commission on 15 March 2023. In the context of energy sector development, Croatia should leverage its geostrategic position and develop renewable energy sources in a way that enables the transfer of this technology and know-how to neighbouring countries.

3. CONTRIBUTION OF SOLAR ENERGY TO THE SUSTAINABLE ECONOMIC GROWTH OF THE REPUBLIC OF CROATIA

The Republic of Croatia, despite having a significantly more favorable geographical position in terms of solar irradiation compared to other European Union countries, does not sufficiently utilize solar energy for electricity, heating, and cooling production.

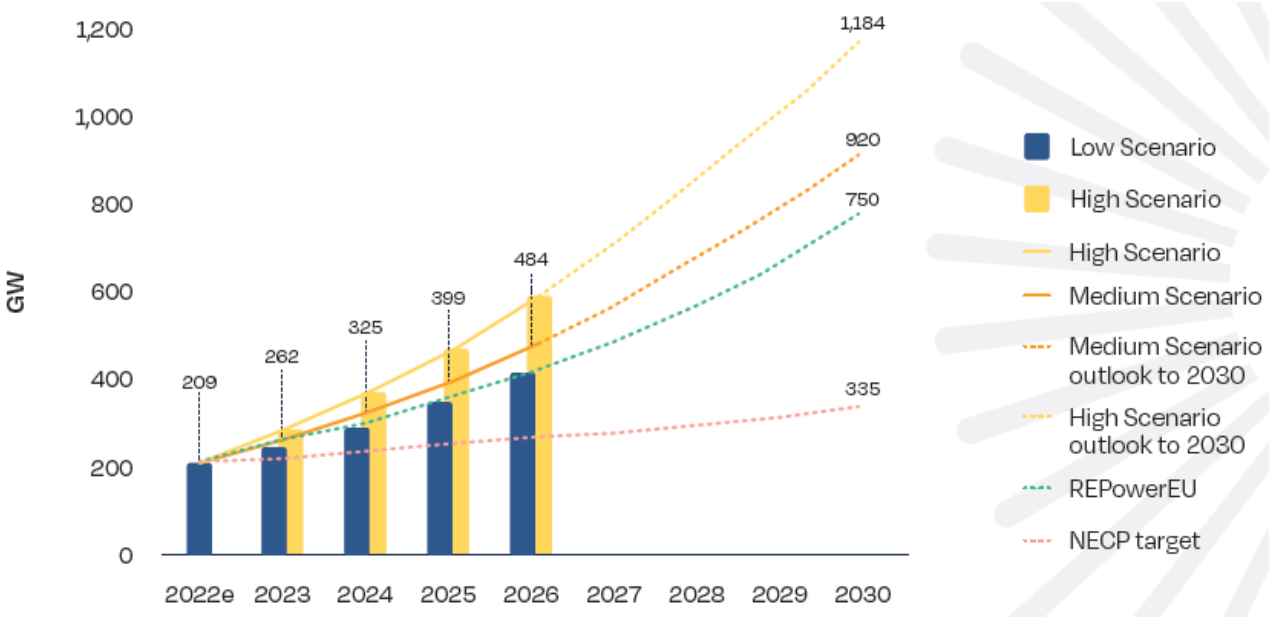

Figure 2. *Installed Photovoltaic Systems in the EU-27 under Various Scenarios for the Period 2022–2030*

The share of electricity generated from solar power plants in European Union countries in 2024 was 9%, while in Croatia it amounted to 5%. If Croatia were to achieve the same share of total electricity consumption, approximately 1,300 MW of solar power plants would already need to be installed, compared to the current capacity of around 800 MW. Small-scale solar power plants, up to the building's connection capacity and primarily intended for self-consumption, are of great importance for both the Republic of Croatia and its electricity system. Such systems could already be installed with a total capacity of 2,000 MW without any significant impact on the electricity distribution network.

4. SUSTAINABLE ECONOMIC GROWTH THROUGH THE SOLARIZATION OF THE REPUBLIC OF CROATIA

The European Photovoltaic Industry Association (EPIA) has provided clear guidance and projections for the development of photovoltaic technology up to 2030, with a perspective extending to 2040. EPIA forecasts that solar photovoltaic technology will cover 15% of electricity consumption in the European Union by 2030, and as much as 30% by 2040. They estimate that by 2030, approximately 2.5 million people will be employed in the photovoltaic sector. According to a report by the European Solar Thermal Industry Federation (ESTIF), in the European Union countries and Switzerland, there is already an installed thermal capacity of around 40,000 MWth in solar collectors.

Based on the currently installed solar thermal collectors in European Union countries and Switzerland, as well as the total installed collector area and capacity per 1,000 inhabitants in the EU (with the European average being around 100 m²/1,000 inhabitants), it is proposed that Croatia install 1.5 m² per capita by 2030, which equals 1,500 m²/1,000 inhabitants. Some EU countries already have nearly 1,000 m²/1,000 inhabitants today. By 2050, the target should be 5 m² per capita, or 5,000 m²/1,000 inhabitants. At that point, Croatia would have 20,000,000 m² of solar thermal collectors.

To achieve sustainable economic growth, by 2030 Croatia would need to install 2,300 MW of photovoltaic power, of which 75% would be building-integrated up to the building's connection capacity, primarily for self-consumption, to reach the EU average of 15% electricity coverage from photovoltaics. By 2030, at a minimum, 1 kWp per capita should be installed, which translates to 4,000 MW of photovoltaic capacity, with 75% integrated for self-consumption at the building level.

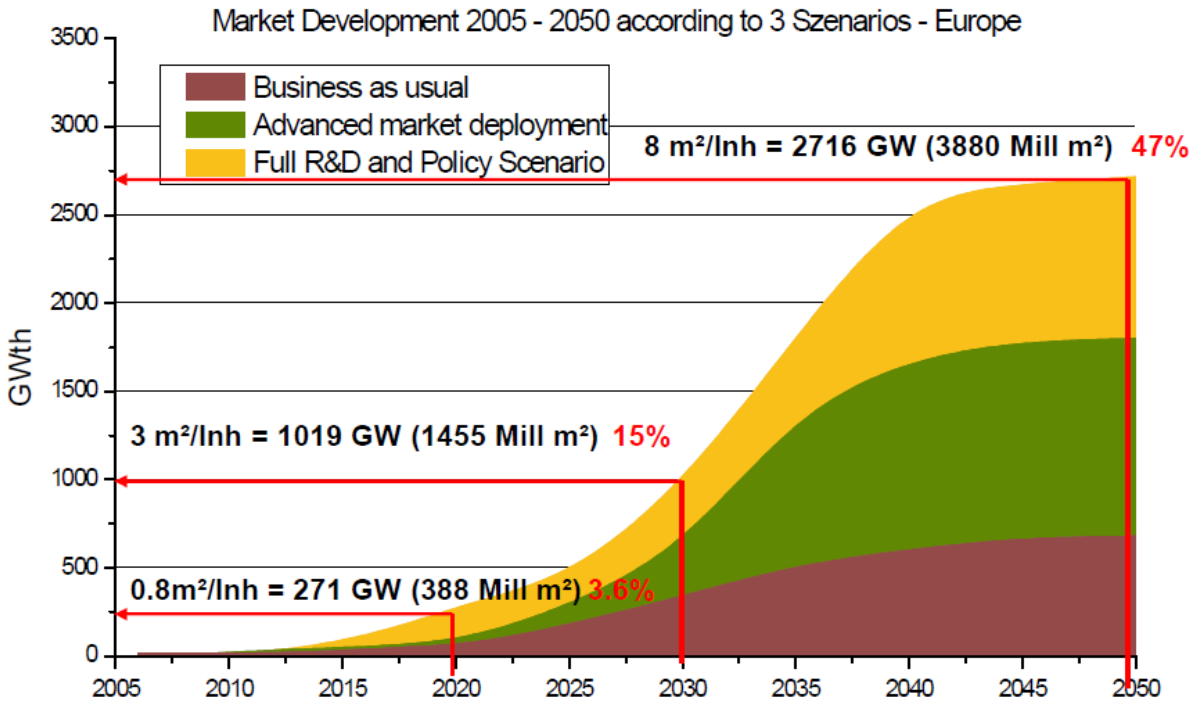

Figure 3. *Contribution of Solar Collectors to Thermal Energy by 2050 under Three Scenarios in EU Countries*

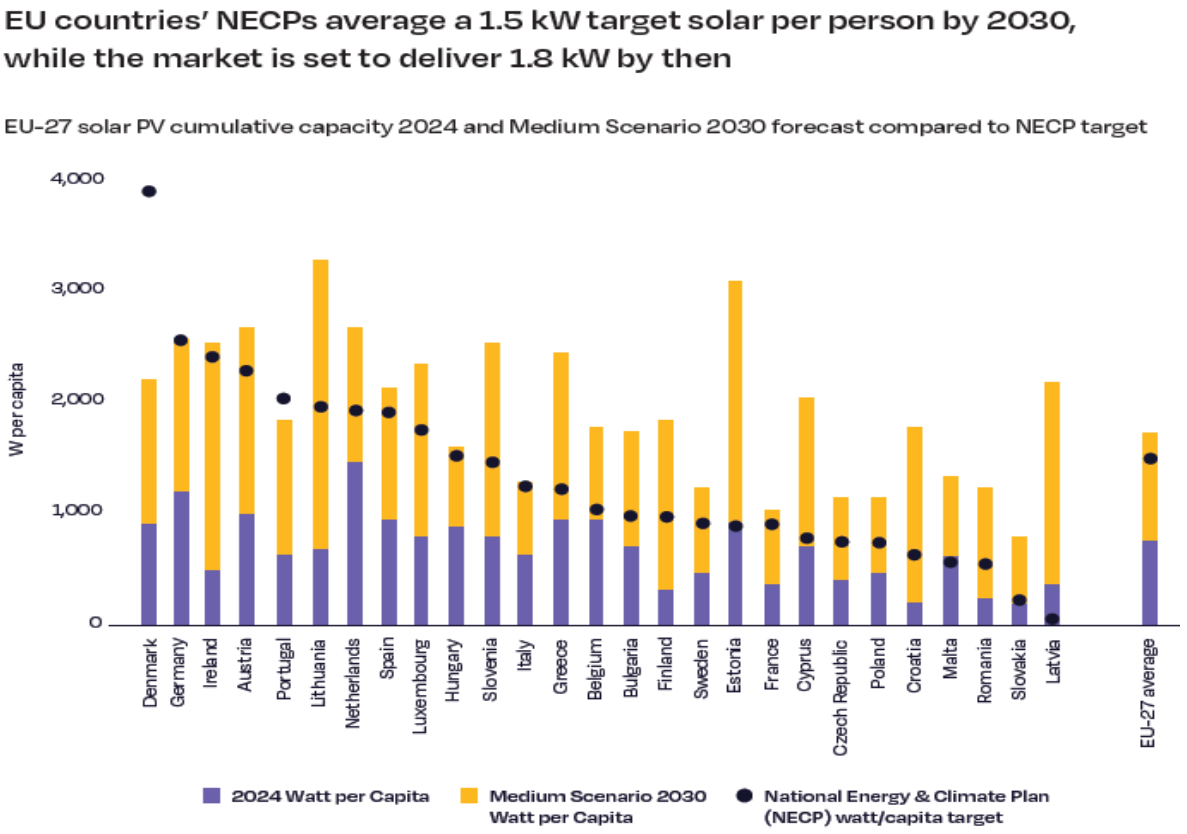

Figure 4. *Total Photovoltaic Capacities in 2024 in the EU-27 and Mid-Scenario Projection to 2030 Compared with NECP Targets*

Figure 4 shows the per capita photovoltaic shares in EU countries and the target average of 1.5 kW per person by 2030 according to the National Energy and Climate Plans (NECP), while the market is expected to deliver up to 1.8 kW per capita by that time.

According to SolarPower Europe, by the end of 2024, three EU countries had more than 1 kW of installed solar energy per capita: the Netherlands, Germany, and Austria (Figure 5).

Based on a series of demonstration projects of solar systems and precise measurements of generated thermal, cooling, and electrical energy, as well as reductions in carbon dioxide emissions, it can be concluded that the production of energy from solar thermal collectors and photovoltaic systems could create up to 20,000 jobs in manufacturing, design, installation, supervision, commissioning, maintenance, marketing, and promotion of solar thermal and photovoltaic systems. Ultimately, this would drive economic recovery through the creation of new jobs in green technologies, particularly for young people, while fostering the overall development of Croatia and environmental protection—an outcome of critical importance not only for the Republic of Croatia but for the entire world.

5. CONCLUSION WITH A FORWARD-LOOKING PERSPECTIVE

It is essential to use natural resources wisely and to produce energy from renewable sources in a prudent and scientifically grounded manner, based on proven technical and technological knowledge. By embracing the logic of knowledge and the expertise of competent specialists—so-called visionaries with a forward-looking perspective—who act in the interest of environmental and nature protection, the European continent can become a region with minimal dependence on imported energy and fuels.

Moreover, in projects involving renewable energy, energy efficiency, and environmental protection—an inherently interdisciplinary field—other sciences beyond technical disciplines will play an increasingly important role, including social and humanistic sciences, economics, law, philosophy, sociology, psychology, and others. It must be clear to everyone that sustainable development and the survival of planet Earth are only possible through the coordinated efforts of all scientific disciplines.

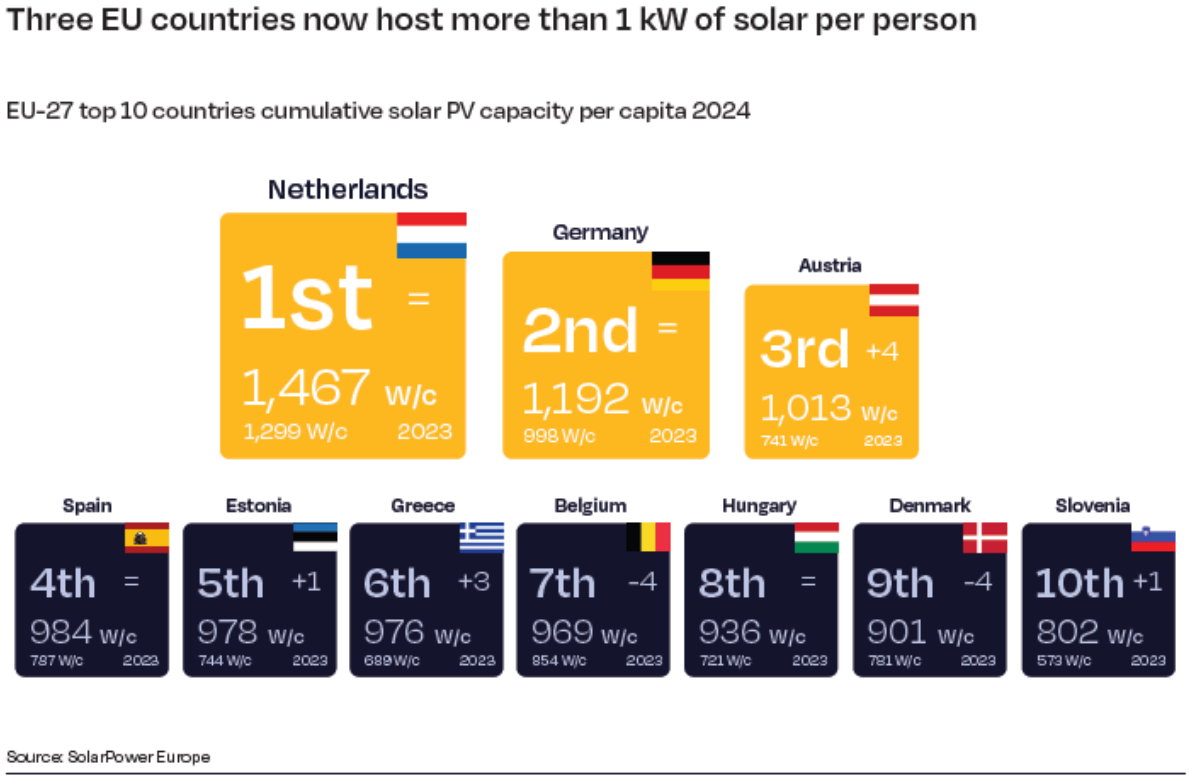

Figure 5. *Total Solar PV Capacity per Capita in the 10 Largest EU-27 Countries at the End of 2024*

Figure 6. *European Energy Transition to 100% Renewable Energy Sources*

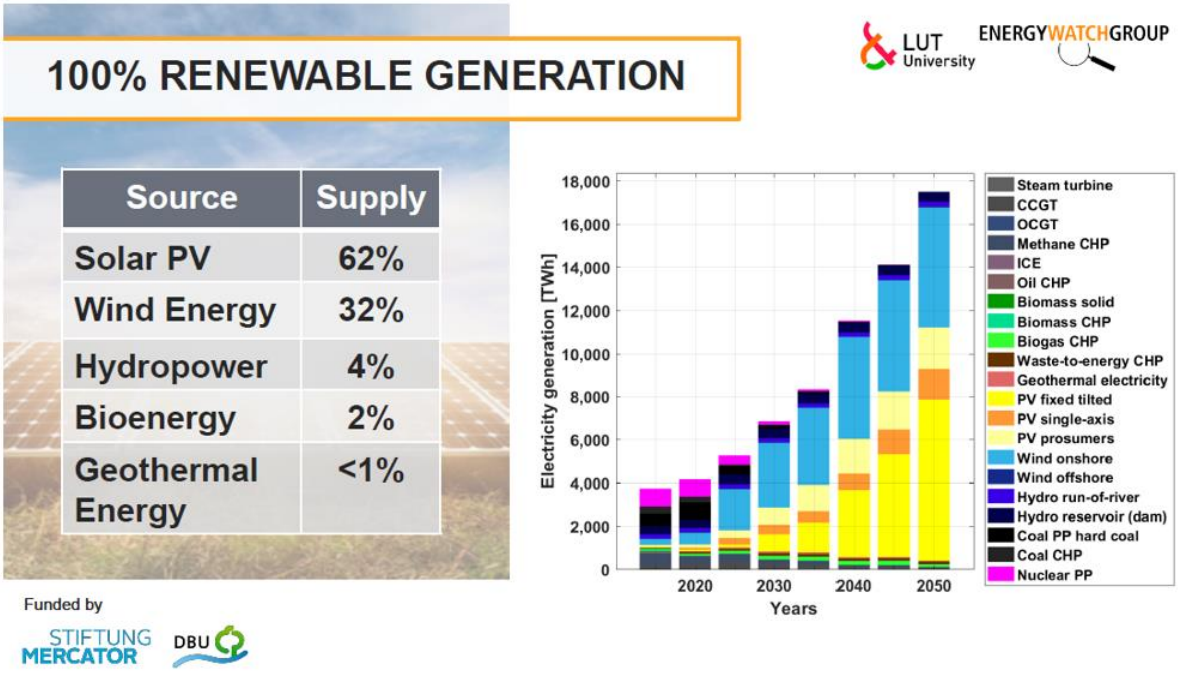

Figure 7. *Share of Individual Renewable Energy Sources in 2050*

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EUROPSKI ZELENI PLAN I NJEGOVA PRIMJENA U REPUBLICI HRVATSKOJ

Sažetak: Evropski zeleni sporazum predstavlja transformativnu strategiju ekonomskog razvoja, sa ciljem uspostavljanja pravedne, prosperitetne i resurso-efikasne Evrope sa konkurentnom ekonomijom i nultom neto emisijom gasova sa efektom staklene bašte do 2050. godine. Energetski sektor, kao najveći emiter gasova sa efektom staklene bašte, ima centralnu ulogu u postizanju ovih ciljeva, pri čemu obnovljivi izvori energije (OIE) imaju ključnu ulogu u dekarbonizaciji. Uprkos povoljnom geografskom potencijalu Hrvatske za solarnu energiju, njena iskorišćenost za proizvodnju električne energije, grijanja i hlađenja ostaje ograničena. U radu se analizira potencijal solarne energije i drugih obnovljivih izvora da doprinesu održivom ekonomskom razvoju u Hrvatskoj, sa naglaskom na energetsku efikasnost, distribuiranu proizvodnju i stvaranje „zelenih“ radnih mjesta. Demonstracioni projekti pokazuju da proširenje fotonaponskih i solarno-termalnih sistema može stvoriti do 20.000 radnih mjesta, uz smanjenje emisije ugljen-dioksida i povećanje energetske nezavisnosti. Rad takođe ističe potrebu za interdisciplinarnim pristupima, integrišući tehničke, socijalne, ekonomske i ekološke aspekte, kako bi se obezbijedila koordinirana i održiva energetska tranzicija u skladu sa ciljevima EU i globalnim klimatskim obavezama.

Ključne riječi: Evropski zeleni sporazum; obnovljivi izvori energije; solarna energija; održivi ekonomski razvoj; energetska tranzicija; Hrvatska; fotonaponski sistemi; solarni termalni kolektori; energetska efikasnost; zelena radna mjesta; klimatska neutralnost; dekarbonizacija.

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