**Renewable Sources of Energy and Energetic Transformation in the Mediterranean Context**

Nikola Biliškov

According to a recent report by the Union for Mediterranean (UfM), the Mediterranean is recognized as one of the global climate hotspots.[[1]](#footnote-1) The report alarmingly reads that the Mediterranean is warming at a rate 20 % faster than the rest of the world, now reaching a +1.5 °C temperature increase with respect to the pre-industrial age. Even more, with current policies the **temperatures will increase by +2.2 °C with respect to the pre-industrial level by 2040**. In practice, this means that 250 million people are projected to be considered “water and resource poor” within 20 years, which obviously has serious consequences, not only environmental, but also social and security implications.

The report underlines that "recent accelerated climate change has exacerbated existing environmental problems in the Mediterranean Basin that are caused by the combination of changes in land use, increasing pollution and declining biodiversity. In most impact domains (such as water, ecosystems, food, health and security), current change and future scenarios consistently point to significant and increasing risks during the coming decades. Policies for the sustainable development of Mediterranean countries need to mitigate these risks and consider adaptation options, but currently lack adequate information — particularly for the most vulnerable southern Mediterranean societies, where fewer systematic observations schemes and impact models are based.“

Importantly, at the UfM General Forum, UfM Secretary General Nasser Kamel sent a message that "no single nation, no single community, in our region has enough resources to cope with the pace of climate change on its own. Undeniably, in line with the Sustainable Development Goals,[[2]](#footnote-2) our common efforts in the next decade have to focus on facing this urgent issue that goes way beyond climate change and implies reconsidering our approach to the region’s limited resources“[[3]](#footnote-3)

Altogether, these strong warnings call for urgent and determined, focused and coherent joint action of all sectors to ensure the sustainability of the Mediterranean, as a geographic area where millennial historical turmoils took and are still taking place, which testifies to a constant exchange of civilizations, and thus of technologies as well. A historic center of the western civilization, with the reality of the ongoing climate crisis the contemporary Mediterranean became a scene of the most pronounced changes, both natural and social. However, the resilience and adaptability of this area, acquired over the centuries, also gives the strength for a decisive transformation. This is especially enabled by the rapid development of renewable sources of energy and accompanying technologies,[[4]](#footnote-4),[[5]](#footnote-5),[[6]](#footnote-6) as well as the suitable accommodation of the Mediterranean in the northern temperate zone that ensures a very good insolation and winds throughout the year. Thus, from one of the most vulnerable sacrificed zones of the “Western world”, it could become the leader of transformation toward a post-carbon civilization.

Such a global crisis that calls into question the very survival of our civilization is highly inconsistent with an unambitious systematic response of international authorities so far. Even more disappointing is the prolongation of projects focused on the extraction and exploitation of fossil fuels, although they become more and more economically unprofitable in comparison to renewable sources, whose price is continuously depleting. It is worth remembering that the fossil fuel-based power and electric utilities in EU countries collapsed when renewable energy comprised only 14 % of the total market, leaving a heap of stranded assets behind.[[7]](#footnote-7),[[8]](#footnote-8) Fossil fuels thus become stranded assets which will be more and more burdensome in the short run for economies, and all investments in this direction are doomed to failure and actually reflect a poorly run politics without taking into account actual trends and crisis-imposed needs.

As analyzed in detail during other panels of this Forum, the greed for fossil fuels and new rich gas deposits in the Mediterranean leads to significant geopolitical tensions and prolongs long-lasting international conflicts in this area.

It is obvious that the harsh reality of global climate crisis requires nothing less than a united global response of the humanity as a whole. Thus, such a terrible reality is a test for our global civilisation, a wake-up call, but also a singular opportunity for global transformation into a sustainable society. In order to reach these goals, mankind needs to act together. A reasonable start is to declare a state of climate emergency, but systematic action accordingly is crucial. This is the context in which the Mediterranean as an important region should act toward a sustainable global society.

In the wake of a growing global climate movement, as well as alarming reports by IPCC[[9]](#footnote-9), we are witnessing an increasing number of warnings written by scientists around the world.[[10]](#footnote-10) One of the main demands of these movements is the plea for institutions to take heed of what scientists are saying.[[11]](#footnote-11) It may well be argued that scientists are often modest when they publicly communicate their findings and the implications of these findings, which may be attributed to their strict adherence to the rules of the scientific method. However, as climate scientist James Hansen has pointed out: “Caution is a commendable quality, but right now we might consider controlling our restraint as it leads us to a cataclysmic future.“[[12]](#footnote-12) One of the common means of refraining from resolute systematic action has been the view that climate change constitutes a problem but not a crisis.

Bearing all this in mind, more than 550 Croatian scientists have joined that global call for climate emergency by submitting A Plea for Systematic Climate Action to Croatian state authorities in January 2020.[[13]](#footnote-13) In this way, Croatian scientists, in numbers and unity rarely achieved, stepped out from a purely academic to the political field, clearly saying that for them further ignorance of scientific facts to the detriment of future generations became unacceptable. They underlined that only a systematic action, covering all sectors of human activity and all scientific fields, can lead to necessary change. In line with this, energetic transformation is crucial. However, it is not sufficient in itself, but must be based on the principles of justice, which then altogether lead to a positive social change.

It is well recognized that renewable energy sources, accompanying efficient energy storage systems that overcome their inherent production and consumption intermittence, play a crucial role in energetic transformation to a zero-emission post-carbon society. They also have a unique potential to transform our entire way of living. The notion that variable solar and wind energy will require backup conventional fossil fuel power to prevent power lapses for decades to come has become a kind of modern-day urban myth, spread to a large extent by the gas industry. It is simply not true.7 Battery storage and hydrogen fuel-cell storage at rapidly declining costs can easily provide backup power to compensate for the variability of solar and wind generation. Choosing the appropriate mix of solar and wind power, recognizing the variability of each of these energies during different seasons relative to the variability in power demands at different times of the year, also helps maintain a dependable flow of electricity. Better management on the demand side, upgrading the grid code, and accelerating the transition from a servomechanical to a digital grid, making it smarter and more efficient at integrating electricity between base and peak load times, are equally suited to the task of maintaining the stability of electricity demand.[[14]](#footnote-14)

Contemporary state-of-the-art energetic technology[[15]](#footnote-15) and advanced materials[[16]](#footnote-16) enable development of smart grids, conceptually predicted more than 100 years ago by G. Ciamician.[[17]](#footnote-17) Development and increasing market penetration of systems for efficient energy storage by batteries and hydrogen improve the efficiency of renewable sources,[[18]](#footnote-18) opening the space for the development and wide implementation of smart-grid decentralized, distributed and adaptable flexible energy systems throughout. In addition, such smart grid would have greatly enhanced sensory and control capability configured to accommodate distributed resources as well as electric vehicles, direct consumer participation in energy management and efficient communicating appliances. It is also strengthened against cyber security while assuring long-term operations of an extremely complex system of millions of nodes in the so-called Internet of Energy.[[19]](#footnote-19) The phase-in and integration of the five pillars that make up the operating platforms of the Renewable Energy Internet transform the electricity grid from a centralized to a distributed system, and from fossil fuel and nuclear generation to renewable energy.[[20]](#footnote-20) In the new system, each business, neighbourhood, and home owner becomes a potential producer of electricity, sharing their surplus with others on the smart Energy Internet that is beginning to stretch across national and continental landmasses. In this shift from fossil fuels to green energy, hundreds of millions of people become producers of their own energy and electricity where they work and live, sharing it with each other. This is the beginning of the great democratization of power in communities around the world.

The Mediterranean basin now witnesses a number of demonstrational projects in this respect.[[21]](#footnote-21) Literally thousands of islands isolate populations in a wide variety of scales, from very small to big. These locations now serve as perfect platforms for the development of energy independent communities, scalable to the continental and global scale. On the other hand, a vivid academic research community in the Mediterranean and the surrounding countries serves as a strong support for such development.[[22]](#footnote-22) Although there is still a lack of such projects, interfaces between the academic world and the everyday, there are several very active and successful research groups in Croatia dealing with various hydrogen-related topics, from materials science16 and development of Fuel Cells[[23]](#footnote-23) to small-scale hydrogen pump stations[[24]](#footnote-24) and hydrogen-powered vehicles.[[25]](#footnote-25) Still, the collaboration of all these groups should be improved. This would obviously lead to more focused research toward efficient real-world systems, in line with those already implemented throughout the Mediterranean.

The Mediterranean, as a highly dynamic geographic space, faced with the harsh reality of its vulnerability to the climate crisis, cries for a united, focused and ambitious response. It deserves finally to overcome the centuries long international tensions, a united, solidary action toward the common, sustainable future. Although this might sound naïve, such a future is possible, if technological development is managed carefully and responsibly, while taking into account the principles of equity and justice. In fact, the fate of humanity depends on nothing less than that.

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