# GREEN ENERGY: PRACTICE AND EXPERIMENT IN THE BLACK SEA REGION

*This article presents a comparative analysis of Green Economy development in the Black Sea region in the context of global trends seeking to reduce fossil fuels exploration through expanding utilization of renewable sources of energy. A comparison is made between the state of renewables development in Germany and Turkey, and the wider Black Sea region countries of Azerbaijan, Bulgaria, and Ukraine. In addition, the article brings into focus the impact of a renewables-based economy on the natural environment and its negative effects experienced by the above-mentioned regional countries.*

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Green means life and it is the color of our times, an evidence of positive change, and a reminder of the generic bond existing between man and the natural environment. Its message is clear and simple: natural resources are the ultimate reserve for our existence, while their exploitation is a delicate business. As such, their usage requires control and adaptive management, sound legal frameworks, government support, and multi-billion dollar investments.

Within the next decade, the modern world is determined to increasingly go green from food products and construction materials to social services and power generation. As a concept, "Going Green" is not new and has been long developed by market practitioners. At a certain point of time this established trend fell in line with leading UN and EU initiatives targeting climate change mitigation and greenhouse gas emissions reduction. In 2008, at the height of the global financial and economic crisis, the UN announced its Green Economy Initiative, and the grounds for Green Economy development were laid down by the UNEP Global Green Deal Report.[1] The European Commission as well has become increasingly focused on the issue and in its Europe-2020 strategy defined ecological innovations and Green Growth as the prime contributors to European economic growth.[2] Green Economy is high on the agenda of the Rio+20 Summit scheduled for 2012 and is to be one of the two main topics for discussion.

### *German Experience with RES*

"Renewable energy sources," or RES, here signifies energy that is capable of being renewed by the natural ecological cycle, such as wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogases.[3] While biomass, hydro, geothermal, solar, and wind energies are increasingly utilized for power generation, sophisticated application of technologies for ocean thermal, wave, and tidal action have yet to appear on the market.

While RES are naturally replenished and are virtually inexhaustible in duration, some of them –geothermal and biomass– are stock-limited and deplete from over-usage, over decades or perhaps centuries. Still, renewables have limited capacity in terms of energy flow, e.g., the amount of energy available per unit of time, while their production is difficult to control and renewable power generation is problematic to accurately forecast.

[1] "UNEP Report: Global Green New Deal," *UNEP,* 2009, www.unep.org.

[2] "The European Green Deal: The green modernization under crisis," *Wuppertal Institute for Climate, Environment and Energy,* www.wupperinst.org/uploads/tx_wibeitrag/.

[3] *Directive 2003/54/EC,* http://eur-lex.europa.eu/.

Nevertheless, when senior German executives were asked by a major economics newspaper to name the type of business with the greatest future potential, three quarters cited renewable energy.[4] Germany, the largest European economy, is a pioneer of Green Energy development. During the past decade, the RES electricity share of Germany's gross electricity consumption has almost tripled to reach over 14 percent. By 2020, the country is expected to generate at least 30 percent of RES electricity, while after 2030 more than half of its electricity supply will be accounted to RES production.[5]

Germany's success in RES development is duly attributed to its well established legal frameworks and the government's continuous focus on matters of energy efficiency as well as alternative and renewable sources development.

***Turkish RES Development***

In 2010, the Turkish electricity market sustained 210 tWh and its generation capacity was made up offossil fuels by more than 70 percent, by hydro energy –by no more than 25 per cent and by wind and other RES– by two per cent only.[6] As is apparent, Turkey depends heavily on fossil fuels consumption and this dependence could be decreased through alternative and renewable energy utilization.

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Renewables have a good potential to save Turkey from its overdependence on imported oil and gas: the country is one of the windiest and sunniest places in Europe and can reduce its fossil fuels dependence very quickly through using its domestic renewable potential at a cost much lower than continuing reliance on the fossil fuels and developing nuclear power.

The European Wind Energy Association believes that Turkey has huge potential for generating electricity from wind power with estimates ranging from 50,000 to as high as 150,000 mW that could meet up to 20 percent of its demand assuming the current average eight percent annual growth in power consumption. Still, only about 2,000 mW were generated by wind plants in operation in Turkey in 2010.[7]

[4] "Our Planet", *UNEP,* December 2008, http://www.ourplanet.com/.
[5] Ibid.
[6] *USAK Energy Review,* No 3, 22 January 2007, www.turkishweekly.net/energy.asp.
[7] Ibid.

The existing potential is apparently waiting to be realized. Turkey finally adopted the Renewable Energy Law on 16 May 2005 to establish the feed-in tariffs for RES generated electricity and provide certain purchase guarantees for the wind power production. The legislation finally created a broad basis for the emerging Turkish RES industry that in 2009 alone contributed to boosting the installed capacity by growing by more than 75 percent (from 450 mW to 800 mW) while creating a sound potential to reach the production target of 20 gW in 2023.[8] Another contribution to the ongoing process was the new Regulation on Licensing the Wind Power Generating Plants[9] enacted in September 2010.

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Solar energy is the fastest-growing sector worldwide and it has a high potential for Turkey as well: bordering the Aegean, Black and Mediterranean Seas, the country has an average of more than seven hours of sunshine a day, In summer 2011, plans for the establishing of Turkey's first solar energy power techno-park in Antalya were announced. With its hotel industry on the rise, Antalya could introduce substantial cost saving by switching to renewables, primarily solar energy. Currently around 15 percent of the hotel expenditures go to energy consumption.[10]

***Green Power Generation in Turkey's Neighbors***

Generation of RES electricity alone could allow the Black Sea countries to reduce dependence on imported energy: just the hydropower potential of the Western Black Sea Region stands at around 220 tWh. Still, only 24 percent of it is used,[11] while, globally, hydroelectric power stations account for 20 percent of the world's electrical supply; and 88 percent of them work on RES.[12]

Wind and solar energy have substantial potential for regional development as well, though in a still more distant prospective. Unlike traditionally exploited hydropower, wind and solar energy lack a prior commercial experience which can aid in future

[8] *USAK Energy Review,* No 3, 22 January 2007, www.turkishweekly.net/energy.asp.
[9] "Turkish Energy Market Regulatory Authority," *EMRA,* http://www.emra.org.tr/web/guest.
[10] "Turkey to become one of world's leading solar energy hubs," *Today's Zaman,* 5 June 2011.
[11] "United States Energy Association Data Base," *USEA,* November 2009, http://www.usea.org/.
[12] "Renewables Global Status Report 2006 Update," *REN21,* 2007, http://www.ren21.net/globalstatusreport/.

marketing of the two. Strained financial conditions prevailing in many Black Sea countries remain one of the major reasons for lack of required investment in wind and solar energy development.

### *Ukrainian Engagement with RES*

Ukraine has an energy-intense economy posing a big danger to the natural environment. The energy intensity of the Ukrainian GDP exceeds the U.S. levels by more than 12 times, by 26 times that of Japan, and by more than 11 times the world average.

Ukraine's approach to RES development is cautious and still at an experimental stage. Nevertheless, the national government tries to develop RES frameworks. The feed-in tariffs were adopted in Ukraine during the past decade,[13] and as a result, a sufficient legal base for RES development was created, though a working mechanism to effectuate these legal instruments remains lacking.

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Still, there are currently 52 RES power producers listed by the Ukrainian Power Sector Register. In 2010, they generated 269.076 mln kWh of RES electricity and had a total installed capacity of 141.63 mW.

In the future, Ukraine is expected to actively engage in RES development considering its ambitious plans to approximate the EU economies' level of energy efficiency by 2030, change the structure of national production through engaging in "smarter" energy production, and reduce the energy sector's overall negative impact on environment.[14] Nevertheless, the success would largely depend on socio-political stability in Ukraine, a country still engulfed in the processes of the post-Soviet transformation, and its priorities of interaction with the EU and Russia in the sector of conventional energy in particular.

### *Azerbaijani RES Experience*

Another post-Soviet economy, Azerbaijan, has been traditionally focused on oil and gas resources development to eventually result in serious ecological problems. This

[13] "Ukraine," *Washburn University School of Law,* http://www.washlaw.edu/forint/europe/ukraine.html.
[14] "Ukraine's Energy Strategy to 2030," *ESBS Ukraine,* http://www.esbs.kiev.ua/en/energy-sector-cooperation-and-reforms/ukraine-s-energy-strategy-to-2030.

focus alone could produce by 2025 a nearly two times hydrocarbon atmospheric emissions increase in comparison with the 1990 levels.[15]

During the past decade, Azerbaijan recognized an urgent need to switch to clean production technologies and certain legal instruments were developed, while a research was carried out[16] to reveal its potential in wind, solar and hydropower energy, as well as biogas and thermal power.

It has been established that the available hydropower potential provides for construction of small HPPs to annually generate 2.4-3 bln kWh of electricity. The Azerbaijani rivers assessable hydropower capacity totals to 16 bln kWh, while 5 bln kWh of them could be generated by small HPPs. Potential exploitation of medium, small and micro HPPs in the Nakhichevan region is especially beneficial, since no connection exists between Nakhichevan and the national power grids.

Conducted tests have also revealed the annual wind energy potential of 800 mW, while preliminary estimations account for2.4 bln kW of electric power.[17] It means that this extremely powerful potential, if taken advantage of, could provide for an annual generation of 2.5-4 bln kWh electricity.

Azerbaijan's climatic conditions also provide for solar power generation. Annual solar hours in the U.S. and Central Asia sustain around 2,500-3,000, in Russia, 500-2,000, and in Azerbaijan, 2,000-2,800 hours,[18] which is roughly the same as in Turkey. Also, solar intensity is generally high in comparison with other countries, and in particular in three regions of the country, i.e., the island of Pirallahy, and the Mingachevir and Nakhichevan areas.

Azerbaijani RES sector development is currently at the initial stage and is largely focused on establishing legal frameworks and researching the national RES potential. It remains necessary for Azerbaijan to create incentives for RES utilization, as well as to upgrade the RES knowledge and expertise of the market professionals and energy consumers.

### *RES Experience of Bulgaria*

Bulgaria accounts for a more progressive RES development. Exploration of locally available energy resources is a top priority for Bulgaria, which is tied up to the Russian gas imports that go for power generation by up to 70 percent.

[15] Ibid.

[16] *State Program for the AES and RES Utilization in Azerbaijan (2004), National Program for Sustainable Economic Development and Poverty Eradication in Azerbaijan (2008), etc.* (in Russian), http://www.az.spinform.ru/main_law.html.

[17] "Azerbaijan energy sector research" (in Russian), http://www.profi-forex.org/news/entry1008076795.html.

[18] Ibid.

Bulgaria's currently installed power capacity stands at 12,668 mW and includes its thermal, nuclear, and hydroelectric resources. In line with the EU obligations, by 2020, Bulgaria has to secure 16 percent of its total generation by RES electricity, while its target for 2010 stood at 11 percent. In 2005, Bulgaria had 9.4 percent of its total electricity production coming from renewable resources.[19]

During its process of EU accession, Bulgaria developed the necessary legal base to provide significant incentives for RES electricity generators, and passed, on 26 April 2011, its Renewable Energy Law to regulate the application of the feed-in tariffs.

In terms of RES potential, Bulgaria has a developed hydropower sector. The promising prospects for its wind energy development were already acknowledged back in 1982 at the Northern Black Sea coast, the central mountain range and the South-western Rhodop mountain region whose accumulated resource potential sustained 2.2-3.4 million mW.

Although development of wind power generation capacity has started just recently, it stands today at 86 mW produced by 25 wind farms. It is expected that in the upcoming years Bulgarian wind power generating capacity would reach 1,000 mW.[20] Nevertheless, the country's EU obligations encourage its national government to balance RES development with nature protection and conservation that often runs contrary to the plans and initiatives of the business community. As such, the wind energy potential development could be expected to slow down, if such procedures as a prior environmental impact assessment are finally introduced.[21]

Bio-mass is another renewable with good potential for usage in Bulgaria. Second after hydro power, bio-mass accounts for a sizable share of Bulgaria's power generation. The estimated level of power generation through bio-mass was around 10 mln kWh in 2007. Considering that approximately 90 percent of the country's land is arable, agricultural lands, along with forests, provide good opportunities for the development of bio-mass projects with the identified technical potential of 3.4 million mW.

Bio-diesel production is another emerging RES business in Bulgaria. While its consumption in 2008 and 2009 accounted to 4,260 tons and 6,566 tons respectively, it has registered a staggering increase in 2010 amounting to 38,911 tons.[22]

[19] *EBRD Renewable Energy Initiative,* www.ebrdrenewables.com/sites/renew/countries/Bulgaria/.

[20] Ibid.

[21] In 2009, the Bulgarian Government tried to introduce certain restrictions on the unimpeded development of the wind energy sector but met a strong opposition of the energy lobby and failed.

[22] *EBRD Renewable Energy Initiative,* www.ebrdrenewables.com/sites/renew/countries/Bulgaria/.

By national forecast, foreign investment into the hydro-power sector, specifically into the small and micro HPPs, may be well expected to rise greatly in the coming years. In June 2011, Bulgaria was for the first time rated by Ernst & Young as a nation favourable to RES investment and was ranked 32nd, – ahead of Austria and Czech Republic.[23]

### *The Back Side of RES Development*

Every coin has two sides, and renewable energy is no exception. While helping people to save on the immediate cost of living, mitigate the noxious effects of global climate change and reduce hazardous atmospheric emissions, intensive RES development is prone to inflict lasting damage to the environment.

### *Experience with Hydro Power*

Construction of water dams –due to their reservoir requirements– often results in submerged areas of land destroying biologically rich and productive lowlands and riverine valley forests, marshland and grasslands. Thus, studies have shown that dams along the Danube and Kura rivers have reduced sturgeon or salmon populations by preventing their access to the upstream spawning grounds. The Anadromous[24] fishes are harmed no less in the process of migration to the sea when forced to pass through the plant turbines.

Power generation process significantly and irreversibly affects the downstream river environment, including endangered species, and hampers the natural seasonal freezing processes. Due to the effect of hydroelectric project, water mass could significantly diminish, leading to rivers slowing down, becoming shallower, and diverting their course, as it happened with the Kura River in Azerbaijan in the 1990s.

Passing through turbines, the water largely loses its contained suspended sediment and this increases the potential of scouring of river beds and loss of riverbanks,[25] which cause siltation and erosion not only of the river itself but of the receiving water body as well. One of the broadly known examples of such negative outcome is the case with the Iron Gate I and II dams on the Danube River, where the construction of the dams brought a serious change into the Danube sediment supply (up to 50 percent) to the Black Sea resulting in erosion of beachesin the area of Mamaia[26] on the Romania's Black Sea coast. The beach shoreline retreated by up to 59 meters in 1966-1988, while the beach surface eroded by 88,900

[23] Ibid.

[24] Anadromous fish live in the ocean/sea mostly, and breed in fresh water.

[25] *Sedimentation Problems with Dams,* www.internationalrivers.org.

[26] Mamaia's beaches are built by alluvial sediments brought by the Danube River to the Black Sea.

square meters.[27] Despite costly protection measures taken (the six-meter long shore breakwaters and artificial nourishment), the shoreline retreat continues up to date, though slower, and a major damage has been inflicted on the whole Mamaia recreation area.

Hydroelectric dam construction could also require relocation of people living where the reservoirs are planned. It was estimatedin February 2008 thataround 40-80 million people worldwide were already physically displaced in its direct result.[28] Often, no compensation can replace ancestral and cultural attachments to places that have spiritual value to the displaced population. Additionally, historically and culturally important sites can be flooded and lost. These problems occurred during the construction of Ilısu and Atatürk dams in Turkey, for instance.

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***Development of Wind Plants***

Wind and solar energy are considered safer for nature protection than hyrdo power. Whereas this is often not the case: energy production by the wind-turbine plants constructed in locations where the wind conditions are suitable for operation could be environmentally unfriendly considering that huge forested lands have to be cleared for the purposes of erecting wind turbines support structures. Apparently, this changes the natural landscape and –more importantly– intrudes on the wild life by ruining the bird migration routes in particular (e.g., birds easily get killed by flying into the rotors).

Noise from the wind turbines negatively affects humans, as well, by keeping them awake at night and even causing stress and psychological disorders. Though the issue is vigorously disputed by the wind industry professionals, Germany and Denmark,two countries which originally embraced wind energy, have already legislated a minimum "setback" distance of two kilometers from residential settlements having faced numerous "noise pollution" issues.

[27] Iona Postolache and Cristina Nenciu, *National Black Sea Environmental Priorities Study forRomania,* (Constanta: *BSEP GEF, Romanian Marine Research Institute, 1997).*

[28] *Briefing of World Commission on Dams,* www.internationalrivers.org.

No similar legislation exists today in the Black Sea countries, where wind farms business is on the rise,and its extensive development has already caused damage in certain areas such Balchik and Kaliakra, located on thenorthern Black Sea coast of Bulgaria – and these sites are home to certain globally threatened birds, animals, and plants, which are listed in the the Annexes of the EC Habitats Directive[29] and Appendices of the Bern Convention as having exceptional value.[30] The on-going wind farm construction there is seen as creating a huge barrier on the Via Pontica migration route of birds.[31]

Deeply concerned with the situation, the Bulgarian Government tried in November 2009 to impose a temporary moratorium on the wind and solar farms development until the Strategic Environment Assessment of the National Plan for Development of Renewable Energy was adopted, but failed to do so due to a strong opposition of the energy sector.[32] On the other side, the attempted government move instigated investor activity in pursuing new wind energy projects, and just months later, projected constructions of more than 1,000 wind turbines in Dobrudzha[33] were announced.

Also, investigations are due to start shortly into the feasibility of the offshore wind farms operation at the Black Sea and, if operations are undertaken, the Black Sea aquatic life will be negatively affected by vibration and destruction of the benthic habitats,[34] not to mention that the offshore farms would strongly influence migration of fish and mammals. It is worth recalling that the Marine Strategy Framework Directive[35] includes "noise" as one of the descriptors which need attention when "good environmental status" is identified for marine water bodies and requires to contain the "…underwater noise… at levels that do not adversely affect the marine environment."

Regardless of all the concerns expressed, wind farms have already become a regular sight in the landscape of the Black Sea region since they cause no pollution and pay for themselves within three months of installation by the energy generated. Their produced electricity is cheaper than nuclear power, the environmental impacts are less than fossil fuels; and as such, they have a potential to become the cheapest power within the next few years.

[29] *Directive 92/43/EEC* of 21 May 1992, http://eur-lex.europa.eu/.
[30] "Nature Documentation," *Council of Europe,* http://www.coe.int/t/dg4/cultureheritage/nature/Appendices_en.asp
[31] "Bern Convention Documents," *Council of Europe,* https://wcd.coe.int/wcd/com.instranet.
[32] *Bulgarian mass media,* November 2009.
[33] The Dobrudzha region situates in North-Eastern Bulgaria between the city of Varna and the border with Romania.
[34] Different organisms live on the surface or in the sediments of the sea bottom together with their abiotic environment.
[35] *Directive 2008/56/EC* of 17 June 2008, http://eur-lex.europa.eu/.

***Renewables or no Renewables?***

The current global attraction to RES is far from new: wind and hydropower are among the oldest forms of energy generation. Wind energy already propelled boats along the Nile River as early as 5000 B.C., while water wheels, the first form of hydro power, were used for irrigation in the Far East around 2000 years ago. In the 19th century, the first water turbines were created and the first hydropower station began to produce electricity in 1881 in the U.S. Today their number exceeds 2,000 in the U.S. only.

At the same time, RES popularity has always fluctuated depending upon the price of fossil fuels. Thus, when fuel prices fell after World War II, interest in wind power waned. But when the price of oil skyrocketed in the 1970s, so did the worldwide interest in the wind turbine generators. Wind turbine technology research and development that followed the oil embargoes of the 1970s refined old ideas and introduced new ways of converting wind energy into useful power.

The current affection with RES, and wind energy in particular, is directly linked to the vital necessity of reducing energy costs, on the one hand, and mitigating the global climate change aftermath, on the other. This is of particular relevance for the Black Sea countries still engaged with transforming their post-Soviet energy-intensive economies tied to the imports of natural gas, oil, and coal into the market oriented societies. For them, RES is a domestic energy reserve which is cheap, easily accessible, and secure in terms of uninterrupted supply, not to mention its potential to reduce the indoor pollution. At the same time, RES technologies are still highly expensive and often unaffordable for the largely financially strained Black Sea economies, while building of the newly established legal frameworks is a lengthy and time consuming process.

Thus, regardless of the pros, renewables still account just for a tiny fraction of per country energy production in the Black Sea region and will –most probably– remain as such for a foreseeable future.