

**RAZOM** WE **STAND**

London, 20 June 2023

# Investing in Ukraine's Renewable Energy: The Key to Future Energy Security

First edition



First edition of the report is dedicated to the event:

London, 20 June 2023.

“Strategic rollout of renewable energy in Ukraine:  
Its Role for Economic Recovery and Potential for International Investments”

**RAZOM WE STAND**

**Razom We Stand** is a civil society organization founded in 2022 in response to Russian aggression, calling for a full and permanent embargo on Russian fossil fuels and an immediate end to all investment in Russian oil and gas companies. We seek to create momentum for a rebuilding of the global economy and significant financial mobilization of investment in new clean, smart and efficient energy systems based on renewable energy sources. We believe that the green post-war recovery of Ukraine should be based on the principles of the Green Deal with a full-scale transition to renewable energy sources.

We extend our heartfelt gratitude to our partners for their invaluable contribution in the preparation of this document.

Ukrainian Wind Energy Association  
Solar Energy Association of Ukraine  
Bioenergy Association of Ukraine  
Global 100% RE Ukraine  
Institute of Renewable Energy of the National Academy of Sciences of Ukraine  
Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine  
The Working Group on Energy Security at the Cabinet of Ministers of Ukraine  
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# Foreword

Russia's invasion of Ukraine and the global energy crisis in 2022 may well be remembered as a turning point in the global power sector transition, as many governments reconsidered their reliance on fossil fuels. Wind and solar reached a record 12% of global electricity generation, up from 10% in 2021. All clean sources (renewables and nuclear) provided 39%. Over 60 countries now generate more than a tenth of their power from wind and solar, with some countries even generating more than a quarter.

In Europe, Russia's invasion of Ukraine triggered record-high gas prices that have forever **changed the perception** of gas as secure, abundant and cheap. The EU's **REPowerEU** plan was developed to rapidly reduce reliance on fossil fuel imports from Russia, largely by accelerating the deployment of renewable electricity and improving energy efficiency. With reduced outputs from nuclear and hydro generation last year adding to the challenge, many European countries saw new records in wind and solar generation last year. Countries like Spain, Germany, Netherlands and the UK generated more than a quarter of their power from wind and solar in 2022. And for the EU as a whole, wind and solar generation **surpassed** that of gas for the first time.

Global gas power declined slightly in 2022 - the second fall in three years. There were concerns that moving away from gas would result in a large increase in coal power, but this was limited by the growth in wind and solar. Instead, there was no large shift from gas to coal generation. Coal generation increased by 1.1% last year, which is in line with the average growth in the last decade. And this year could mark a crucial turning point. Ember's **Global Electricity Review 2023** predicts that planet-warming emissions from the global power sector may have peaked. This would mean a small fall in emissions from the global power sector in 2023, with larger falls in subsequent years. But regardless of when we reach peak power sector emissions, coal power phasedown is in progress, and now the end of gas power growth is within sight too.

Outside of Europe, energy transition momentum picked up pace too. In the US, the Inflation Reduction Act that was introduced in August 2022 directs nearly **\$370** billion of government funding to clean energy, with the goal of substantially lowering the nation's carbon emissions by the end of this decade. And last year other major economies continued to roll-out existing policies, like China's **14th Five-Year Plan** and new **market reforms**.

Additionally, global **investment** in clean energy technologies matched that of fossil fuels for the first time in 2022. Developing economies like **Indonesia** and **Vietnam** secured commitments for international funding in 2022. This funding, from historic high emitters like the UK, US, and the EU, will support countries in displacing coal with renewables and therefore decoupling their economic growth from emissions.

And this investment boom is expected to rise even further. Investment in solar power is predicted to overtake the investment in oil production for the first time ever in 2023, according to the **IEA**.

While 2022 may be seen as the turning point, the impacts of the year's policy developments will be unfolding for years to come. The changes that we have witnessed so far in clean power and electrification are therefore only the tip of the iceberg.

There are risks too, and much remains to be done to build on the momentum of wind and solar growth. Lowering permitting times and solving grid connection bottlenecks are parts of the solution. Increasing financing in the clean electricity sector will also be crucial, with help from historic emitters to developing nations that can help them to transition from coal to clean. And while the energy crisis provided a clear motive for low carbon energy transitions, it also risks locking in some fossil **infrastructure**, with some countries securing long term contracts for gas.

In the case of Ukraine, investment in clean energy sources is most urgent. Low cost, quick to build, and insulated from the many security risks of fossil fuel reliance, solar and wind power will be important both to increase stability in Ukraine's power supplies now, and form the backbone of rebuilding Ukraine's energy system. These projects will have to come from international financing while the war continues. Currently, ongoing Russian aggression is hindering new renewable electricity additions and bringing disruption and security concerns to the present energy infrastructure, resulting in energy and environmental disaster.

Prior to the invasion, nuclear power provided almost 60% of Ukraine's electricity and generation from fossil fuels was around a quarter, while solar, wind and hydro combined accounted for 15%. There is a lot of scope for renewable generation to expand, particularly for solar which generated only 5% of Ukraine's electricity and wind that generated about 1%. Solar is particularly quick to deploy and can provide decentralised power much needed amid disruption to the grid from Russian aggression. Having said that, Ukraine managed to install **more onshore wind power** (114 MW) since the start of war than England did (1MW), which provided enough clean electricity to power about 200,000 homes just 60 miles from the frontline in the southern region of Mykolaiv. Further deployment of solar and wind will also help to meet Ukraine's renewable power target of 30% by 2030 and perhaps it can even bring it in line with many European countries that have higher renewable energy targets. Ukraine's power system synchronised with its European Union neighbours in 2022, and there are further prospects for interconnection. **Ember's analysis** in May shows how a grid connection spanning from Estonia to Bulgaria will make for a cheaper, more stable electricity grid - with the ability to share wind, solar, hydroelectric and nuclear power.

In Europe, and perhaps globally, the past few years have changed the trajectory of energy transition forever. Across many countries and many stakeholders, there is new recognition that fossil fuels harm us, cost us money, and make us more vulnerable. The result is a rapid acceleration towards an entirely different system. The first signs of this are already apparent, but there is much more to come. As Ukraine remakes its power system, it will add to this global shift towards a more secure, more affordable and sustainable energy future.



**Małgorzata Wiatros-Motyka,**  
*Senior Electricity Analyst at Ember*

# Renewable Energy Potential in Ukraine and its Role for Post-War Reconstruction

The Russian invasion has accelerated the global transition towards renewable energy sources, and Ukraine in the post-war recovery process should also embrace these trends to ensure economic development based on the principles of decarbonization. As Ukraine rebuilds, clean energy can become one of the key areas contributing to export revenues and supporting the country's financial stability.

Even before the full-scale invasion, Ukraine had already planned various measures to decarbonize its economy, aiming to ensure energy security and contribute to the climate neutrality of the European continent, in alignment with the goals of the European Green Deal. The key catalyst projects identified for this process included:

- Expansion of interconnectors with ENTSO-E to approximately 6 GW.
- Enhancement of the safety measures of existing nuclear power plants, while maximizing the utilization of installed capacities and increasing electricity production.
- Development of over 30 GW of wind and solar power.
- Commissioning of approximately 3.5 GW of hydro and pumped storage power plants.
- Promotion of biofuels production, including bioethanol, biodiesel, biogas and biomethane.
- Establishment of biomethane exports to the EU.
- Creation of a regional gas hub utilizing Ukrainian underground storage facilities, which rank among the largest in Europe.
- Modernization and re-profiling of the gas transportation network infrastructure.

In order to expedite the deployment of renewable energy sources in Ukraine in a coordinated manner and to align with the EU RED II Directive, the State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE) has **developed** a draft National Renewable Energy Action Plan for the period up to 2030. This plan establishes a new objective to triple the share of energy derived from renewable sources in gross final energy consumption, increasing it from 9% in 2020 to 27% by 2030.

Achieving the goals outlined in the draft National Action Plan will necessitate investments exceeding EUR 20 billion. Specifically:

- EUR 8.4 billion will be allocated towards renewable electricity generation capacities.
- Heat and power facilities, as well as biomethane production plants, will require EUR 11.5 billion.
- An additional EUR 0.3 billion will be invested in bioethanol and biodiesel production facilities.

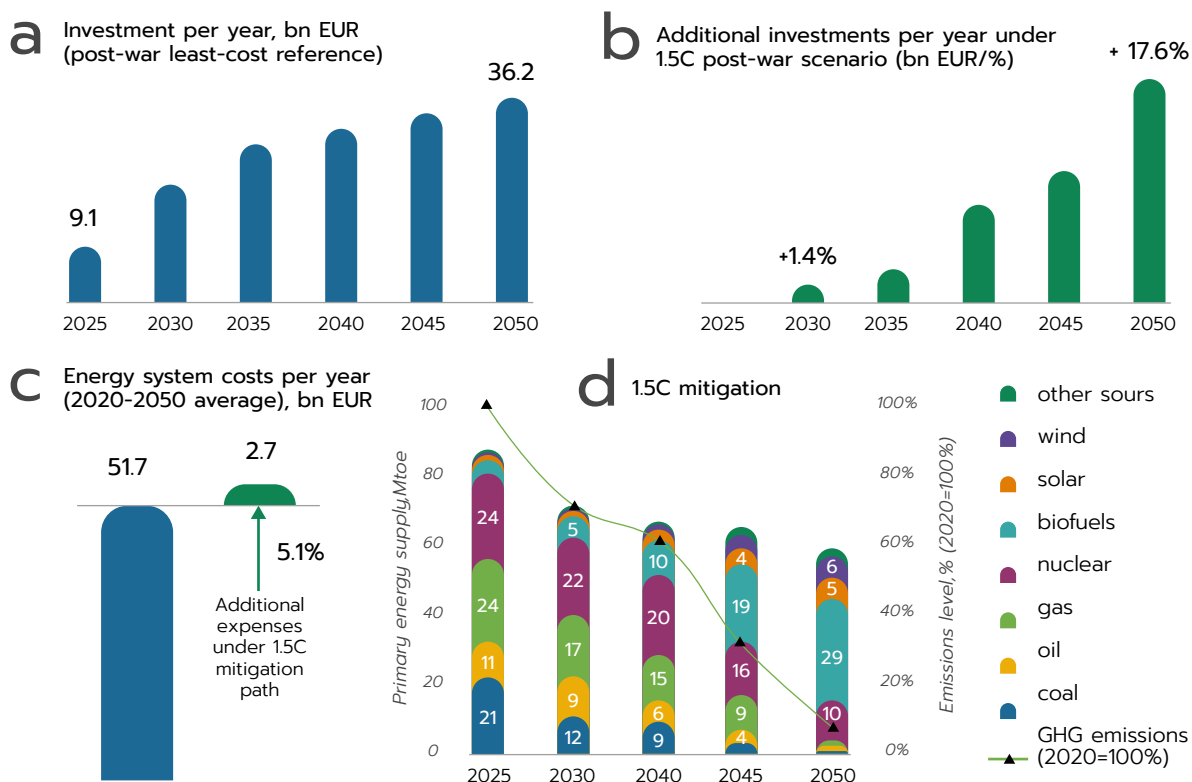
According to the Institute of Renewable Energy of the National Academy of Sciences of Ukraine, the country possesses a total technical potential of 874 GW for renewable energy sources. This includes approximately 250 GW of offshore wind power. The potential for wind power alone can be expanded from the existing 1.5 GW (as of 2021) to over 100 GW. Renewable gases, particularly biomethane production, have the potential to reach up to 10 billion m<sup>3</sup>, equivalent to the import of all fossil gas. Solar generation capacities have the potential to grow up to 71 GW from 7.6 GW in 2021.

**Recent research** indicates that the reconstruction of the economy after the war prioritizing decarbonization will cost only 5% more compared to continued reliance on fossil fuels under most conservative assumptions. The Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine has modeled two recovery scenarios: one involves restoring the pre-war fossil fuel-based economic model, while the other entails complete decarbonization of the economy by 2050, as outlined in the European Green Deal. The modeling demonstrated that Ukraine's post-war recovery based on decarbonization principles will require a 5% increase in investment. However, it will also eliminate Ukraine's dependence on fossil fuel imports, resulting in positive effects on the balance of payments. Additionally, this approach will reduce toxic emissions of ash dust from coal-fired power plants, leading to a decrease in indirect losses caused by environmental pollution, morbidity, and mortality, estimated at 0.7%-1.3% of GDP or USD 1.1-2.1 billion per year. Ambitious decarbonization efforts can be realized without significant additional costs, as modeling results show.

"The war in Ukraine has already become a driving force for accelerating the energy transition in Europe. In Ukraine's case, the war presents an opportunity to move away from outdated fossil fuel-based energy and industrial technologies. Our modeling demonstrates the feasibility of this transition, considering Ukraine's urgent need for investment to rebuild lost and damaged industrial capacities. We should seize this opportunity to restore the economy in an environmentally friendly manner, based on renewable energy sources, and completely phase out fossil fuels, in line with the goals of the European Green Deal. This approach will facilitate economic recovery while minimizing the harmful impact on the environment and human life," explains Oleksandr Diachuk, a leading researcher at the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine and co-author of the study.

Under the baseline scenario, which relies on fossil fuels, the total cost of modernizing the energy system over the period 2020-2050 amounts to €810.7 billion. However, in the decarbonization scenario aligned with the Paris Agreement's goal of limiting global warming to 1.5 degrees Celsius, the total cost increases by €26.3 billion or 3.2% over the same period (at a 5% discount rate). It is important to note that this cost increase is relatively small. Additionally, the decarbonized economy scenario leads to substantial reductions in cumulative emissions of hazardous air pollutants from electricity generation between 2025 and 2050: 69% for fly ash, 54% for nitrogen oxide (NOx), and 45% for sulfur dioxide (SO<sub>2</sub>).

### Economic modelling of Ukraine's energy system development by 2050.



Source: Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine

The authors emphasize that substantial political efforts are required to fully exploit the possibilities of constructing a fossil-free economy. Specifically, there is a need to raise the carbon tax, eliminate cross-subsidization in the electricity sector, implement targeted support programs for the population, and foster the development and expansion of domestic production chains with a strong emphasis on localization (including equipment, spare parts, and energy services). These measures are crucial not only from an economic perspective but also for ensuring energy security.

# Exploring the Potential of Biomethane in Ukraine

Biomethane, serving as a direct alternative to fossil natural gas, offers versatile applications including heat and electricity generation, as a motor fuel for transportation, and as a raw material for the chemical industry.

Biomethane production can cater to both domestic consumption, supplying the gas grid for subsequent domestic use, as well as for export to European countries. At initial stages of development of biomethane capacities in Ukraine exports supported by guarantees of origin can give major incentives to invest in production.

**There are several reasons why biomethane holds promise for Ukraine, as highlighted by the Bioenergy Association of Ukraine:**

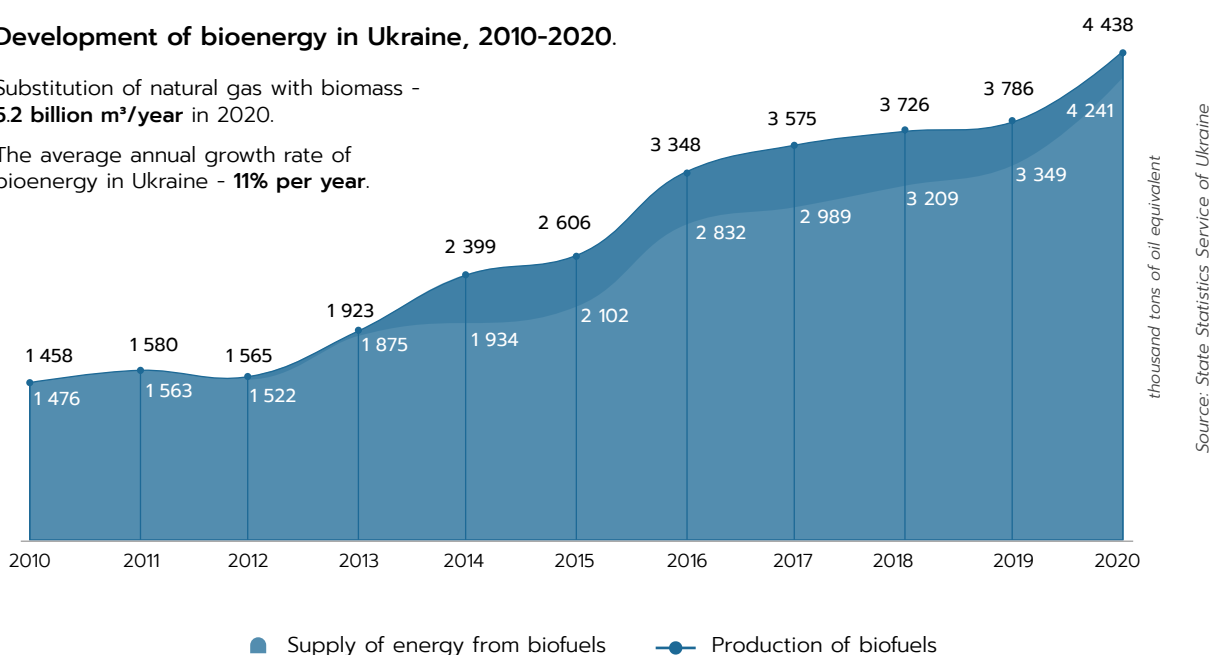
- Biomethane is a renewable and "green" gas that can be seamlessly integrated into the existing gas network today. It shares identical technical characteristics with natural gas.
- Ukraine boasts a well-developed system of gas networks, namely the Gas Transmission System (GTS) and regional Gas Distribution Systems (GDS's), which are fully compatible with biomethane transportation.
- With the largest area of agricultural land in Europe, Ukraine possesses one of the world's most substantial potentials of agricultural feedstocks and by-products (such as straw and other residues), making it highly suitable for biomethane production.
- Biomethane can play a pivotal role in balancing the intermittent generation patterns of other renewable energy sources such as solar and wind.
- Currently, biomethane stands as the most cost-effective renewable gas option available.

Over the period of 2010-2020, Ukraine experienced an impressive average annual growth rate of 11% in bioenergy. In 2020, a significant milestone was reached with the replacement of fossil natural gas with bioenergy, amounting to 5.2 billion m<sup>3</sup>/year.

## Development of bioenergy in Ukraine, 2010-2020.

Substitution of natural gas with biomass - **5.2 billion m<sup>3</sup>/year** in 2020.

The average annual growth rate of bioenergy in Ukraine - **11% per year**.



## Potential of biomethane production in Ukraine, bcm/year

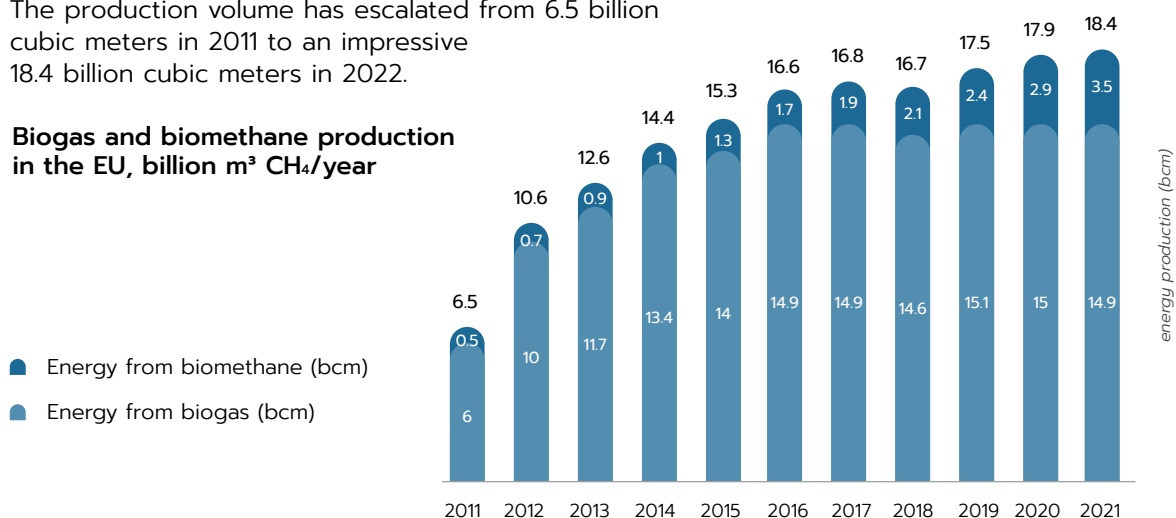
BIOGAS/BIOMETHAN, billion m <sup>3</sup> CH <sub>4</sub> / year	
Biogas for animal waste	0.9
Biogas from harvest residues of agricultural crops	5.2
Biogas from by-products of the food processing industry	0.7
Biogas from solid household waste	0.5
Biogas from sewage sludge (municipal treatment plants)	0.1
Energy plants: biogas from corn silage (from 1 million hectares)	3.8
<b>Biogas from cover crops (20% of arable land)</b>	<b>9.8</b>
Biogas from BM obtained by thermal gasification (10%)	1.0
<b>BIOGAS/BIOMETHAN, total, billion m<sup>3</sup> CH<sub>4</sub>/year</b>	<b>21.8</b>

Source: Bioenergy Association of Ukraine

The number of bioenergy plants in the EU has surged from 181 in 2011 to 1,222 in 2022, resulting in a significant boost in biogas and biomethane production.

The production volume has escalated from 6.5 billion cubic meters in 2011 to an impressive 18.4 billion cubic meters in 2022.

### Biogas and biomethane production in the EU, billion m<sup>3</sup> CH<sub>4</sub>/year



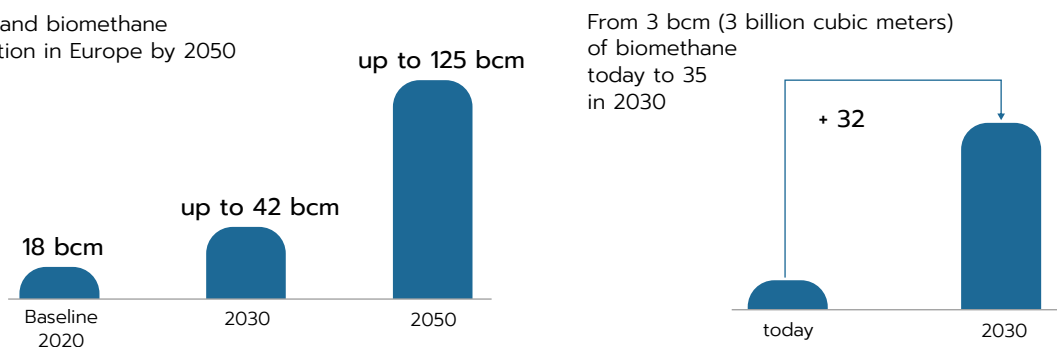
Source: European Biogas Association

The EU has adopted ambitious plans for biomethane production under the [REPowerEU](#), targeting a production volume of 35 billion m<sup>3</sup> per year by 2030. According to the Bioenergy Association of Ukraine, with necessary investments in place we have the potential to provide up to 30% of Europe's biomethane production.

Over the past decade, the number of biomethane plants in the EU has grown significantly, increasing from 181 in 2011 to 1,222 in 2022. This expansion has resulted in a substantial rise in biogas and biomethane production, from 6.5 billion cubic meters in 2011 to 18.4 billion cubic meters in 2022.

## Visualization of REPowerEU's 2030 plan and forecasts of the European Biogas Association until 2050

Biogas and biomethane production in Europe by 2050



Source: Bioenergy Association of Ukraine

The current production of biogas and biomethane, which amounts to 18.4 billion m<sup>3</sup> of CH<sub>4</sub> per year, covers 4.6% of the EU's gas demand. Analysts predict that by 2050, biomethane production could reach 125 billion m<sup>3</sup> of CH<sub>4</sub> per year, representing 30-40% of the EU's current gas demand.

### State of the Biomethane Business Development in Ukraine:

- Gals Agro recently inaugurated the first biomethane plant on April 13, 2023, with an annual production capacity of approximately 3 million m<sup>3</sup>. This plant can supply around 1500 consumers per year. Furthermore, the company plans to launch a 10 million cubic meter project in the Kyiv region.
- According to the Bioenergy Association of Ukraine, several more biomethane projects are expected to come online this year. These projects will have capacities of 3 million cubic meters, 25 million cubic meters, and 50 million cubic meters per year, respectively. One of the plants was built from scratch, while four others were converted to produce electricity from biogas.
- The European Bank for Reconstruction and Development has expressed its readiness to consider providing loans for biomethane projects.

### First Ukrainian Biomethane Plant

**Location:** biogas plant of Gals Agro company (Chernihiv reg.)

**Start of operation:** April 2023

Production of **3 mill m<sup>3</sup> of biomethane/ year** (eq. 1,3 MWe) on the base of existing biogas plant of 6,9 MWe.

**Feedstock:** manure, sugar beet pulp, corn silage

**Upgrading:** membrane technology



For Ukrainian businesses, exporting biomethane is more appealing than selling it on the domestic market. This is because European countries offer a "renewability premium," a financial incentive to reduce greenhouse gas emissions. This premium is associated with the EUR80 per ton CO2 tax imposed in Europe. European buyers are willing to pay a higher price for biomethane to avoid this tax burden.

### Feasibility study of a typical biomethane plant. ROI OF 30%.

Parameter	Dimensionality	Connection to the gas distribution system	Connection to the gas transportation system
Project capacity	m <sup>3</sup> CH <sub>4</sub> / hour	1000	1000
Raw materials	-	Cattle manure 15%, wheat straw/corn stalks 35%, corn silage 50%	
Method of processing raw materials	-	grinding in a bioextruder	
CAPEX	mIn Euro	16.27	17.47
Cost of raw materials	Euro/t	40	40
Pressure in the gas network, at a distance of 0.5 km	bar	up to 8	up to 55
Raw material component of biomethane cost	€ / 1000 m <sup>3</sup> CH <sub>4</sub>	195	
Total present value of biomethane (20 years)	€ / 1000 m <sup>3</sup> CH <sub>4</sub>	523	550
Biomethane sale price	€ / 1000 m <sup>3</sup> CH <sub>4</sub>	900	
NPV	mIn €	32.1	29.86
IRR	%	28.4%	25.7%

Source: Bioenergy Association of Ukraine

However, when combined with high-efficiency cogeneration, biomethane in the medium and long term has the potential to become a crucial element in Ukraine's and the EU's energy transition offering options for seasonal storage and adding flexibility to the power system.

In February 2023, a memorandum of strategic partnership on renewable gases was signed, emphasizing that this collaboration will enhance energy security, support the fight against climate change, and positively impact economic recovery of Ukraine.

The first step towards this goal was the government's approval of the biomethane registry operational procedures and the issuance of guarantees of its origin.

According to the Bioenergy Association, by 2030, Ukraine will have the capacity to completely replace imported natural gas with domestically produced biomethane and solid biofuels, amounting to up to 10 billion cubic meters per year. By 2050, this figure could increase to 26 billion cubic meters, equivalent to the domestic gas consumption in 2021.

*"In 2020, biomass replaced 5.2 billion cubic meters of natural gas. This means that in 2021, we consumed 26 billion cubic meters of gas, whereas without the contribution of bioenergy, the consumption would have been 31 billion cubic meters. Thus, approximately 15% of natural gas in Ukraine has already been replaced by bioenergy. Currently, the average annual growth rate of bioenergy is 11%,"* highlights Georgiy Geletukha, the head of the association.

## Unleashing the Wind Energy Potential

Russia's war against Ukraine has had a devastating impact on the wind energy sector. According to the Ukrainian Wind Energy Association (UWEA), as of December 31, 2022, approximately 1,317 MW out of the total installed wind capacity of 1,755 MW (75%) was offline. Furthermore, it is known that at least 10 wind turbines were damaged during the war, although the actual number may be higher, as wind farm operators currently lack access to most installations located in the occupied territories. Preliminary estimates from the Ministry of Energy and UWEA suggest that losses from destroyed, damaged, or stolen wind farm equipment exceed EUR 50 million. An additional €500 million was lost due to the forced downtime of wind farms. These figures are expected to rise in the near future.

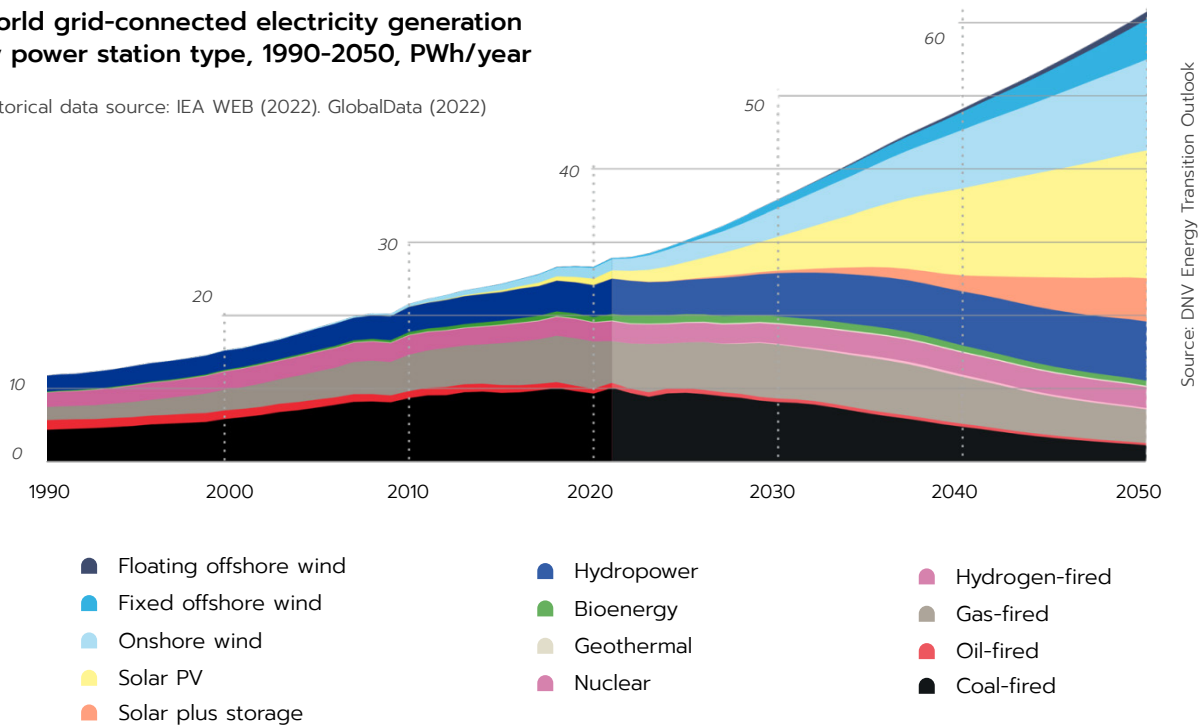
The war has also halted wind projects that were already in the development and construction stages. This affects, in particular, at least 300 MW of wind turbines that were ready for installation at various wind farm sites.

Wind power currently accounts for 15% of electricity generation in Europe, with expectations to increase this share to 43% by 2030, as outlined in the European Commission's REPowerEU Action Plan. This would require a wind power capacity of 510 GW by 2030, compared to the current 190 GW. The European Commission's goal is for wind power to contribute 50% of Europe's electricity by 2050, requiring an installed capacity of 1,300 GW with an average capacity increase of almost 40 GW per year.

Concerns about energy security have intensified the urgent need for more offshore wind capacity worldwide, particularly in Europe. European governments have increased their targets for offshore wind farms, committing to building 165 GW of offshore capacity by 2030. For instance, on May 18, 2022, the heads of government from North Sea countries (Germany, Denmark, the Netherlands, and Belgium) signed a cooperation agreement on the development of offshore wind energy and green hydrogen. They aim to reach a capacity of at least 65 GW by 2030 and 150 GW by 2050.

### World grid-connected electricity generation by power station type, 1990-2050, PWh/year

Historical data source: IEA WEB (2022), GlobalData (2022)



Despite the ongoing war, the Ukrainian Wind Energy Association (UWEA) remains optimistic about the future expansion of wind energy in Ukraine. In recent years, the country's wind energy sector has attracted significant international investment. Prior to the full-scale invasion, investors from countries such as Sweden, Norway, France, the US, Turkey, Germany, China, and Poland were actively involved in developing wind projects in Ukraine. Over the past decade alone, Ukraine's national wind energy sector has received approximately 3.5 billion euros in investments.

The total potential of wind farms in Ukraine exceeds 688 GW, with offshore wind farms accounting for more than a third of this capacity, reaching 250 GW, [according](#) to the Institute of Renewable Energy of the National Academy of Sciences of Ukraine. The steppe zone is particularly attractive for the implementation of onshore wind farms. Additionally, Ukraine's offshore wind power holds significant promise, given the shallow waters of the Azov and Black Seas, the Dnipro cascade, the Dniester reservoir, the Sivash Bay, and other water areas that make it economically feasible to install offshore wind turbines. In 2020, the World Bank estimated the offshore wind power potential in the Black Sea region to be 435 GW, with 250 GW situated within Ukraine's offshore territory. These figures highlight the highly attractive nature of the wind energy sector in Ukraine.

According to the Ukrainian Wind Energy Association, the capacity of wind power can be increased to 18.5 TWh by 2030 by utilizing more powerful generators and establishing onshore wind farms with a capacity of 5.4 GW. Additionally, offshore wind farms are projected to contribute 1 TWh of electricity production in 2030, with an installed capacity of 300 MW.

Andrii Konechenkov, Chairman of the Board of the Ukrainian Wind Energy Association, emphasizes the importance of a modern production base and domestic manufacturing of wind turbine components in order to accelerate the commissioning of new capacities. This would facilitate the goal of adding at least 1 GW of new wind power annually, generating employment opportunities and promoting the development of regions with wind potential, while also reducing dependence on energy imports.

Among renewable energy sources, wind power holds significant potential for green hydrogen production. Therefore, it is crucial to expand wind power capacity to support hydrogen production, which would stimulate industrial growth through new technologies and the production of environmentally friendly steel.

The draft Hydrogen Strategy of Ukraine aims to install 10 GW of electrolyzers and 40 GW of renewable energy generating capacity by 2030. Achieving this ambitious goal requires a widespread adoption of renewable energy sources.

The Ukrainian Wind Energy Association is actively working to foster wind energy cooperation between Ukraine and other countries. An example of such collaboration is the establishment of the Black Sea Offshore Wind Energy Federation (BASOFWED) on October 26, 2022, in Izmir, Turkey. Wind energy associations from Turkey, Ukraine, Bulgaria, and Georgia initiated this federation to promote offshore wind energy technologies in the Black Sea region through mutually beneficial cooperation, respecting national legislation.

These intergovernmental partnerships reflect efforts to concentrate resources and investments in unlocking Ukraine's wind generation potential.

# Harnessing the Power of Solar Generation

According to the "Technology and innovation pathways for zero-carbon-ready buildings by 2030" report, the [International Energy Agency's \(IEA\) NZE scenario](#) projects that approximately 100 million households worldwide will have solar installations on their roofs by 2030. In addition, solar and wind energy are expected to contribute to around 40 percent of electricity consumption in buildings by the same year.

The IEA's plan, "Net Zero by 2050 - A Roadmap for the Global Energy Sector," outlines a global trend of significant growth in installed solar and wind generation capacity. The plan suggests an annual increase of 1,020 GW by 2030, four times higher than the capacity in 2020.

According to the [Institute of Renewable Energy of the National Academy of Sciences of Ukraine](#), the theoretical installed capacity of solar power plants (SPPs) in Ukraine is estimated to be 82,768 MW. Additionally, the annual potential for electricity generation from SPPs in Ukraine is approximately 100 billion kWh per year.

Ukraine enjoys favorable conditions for harnessing solar energy. The average annual solar radiation received on a 1 m<sup>2</sup> surface ranges from 1070 kWh/m<sup>2</sup> in the northern part of Ukraine to 1400 kWh/m<sup>2</sup> and higher in the southern regions.

Solar energy is experiencing significant growth in Ukraine, even amidst the ongoing war. Many households and critical infrastructure facilities are installing solar power plants to ensure backup power supply during outages. Notably, small systems with batteries have gained prominence since the war began.

*"Ukraine has successfully installed 7.6 GW of solar power capacity, and this number is expected to grow continuously. Solar energy offers a valuable opportunity to restore lost generating capacity resulting from the war in a quick and cost-effective manner. Moreover, Ukraine currently boasts 45,000 registered home photovoltaic systems, and according to the Solar Energy Association, the market potential for such systems extends to at least one million households. Recognizing the importance of distributed generation for ensuring energy security, it is crucial to stimulate the development of this market. Therefore, efforts should be made to encourage and support the growth of distributed generation, as it represents a pivotal element in guaranteeing the energy security of the state,"* explains Artem Semenyshyn, Chairman of the Solar Energy Association of Ukraine.

# Legislative Initiatives in Ukraine Promoting Renewable Energy

On May 2, the Verkhovna Rada adopted the joint [Draft Law No. 9011-d](#) "On Amendments to Certain Laws of Ukraine on the Restoration and Green Transformation of the Energy System of Ukraine" in its first reading. This draft law encompasses several important provisions, including:

- Removal of regulatory barriers for the establishment of direct Corporate Power Purchase Agreements (**PPAs**). This will enable industries to directly purchase green electricity, facilitating the decarbonization of production chains in line with the GHG protocol—an international standard for calculating greenhouse gas emissions. This opportunity is particularly relevant for exporters, considering the introduction of the carbon adjustment mechanism (CBAM) by the European Parliament on April 18. For Ukraine, this decision implies that unmodernized enterprises with significant greenhouse gas emissions will be required to pay a fee at the EU border (CBAM) to export products to the EU.
- Support for the development of commercial renewable energy in Ukraine will be carried out through an **auction model**, following best international practices. Specifically, the **model will involve competitive bids for contracts for difference** with a support period of 12 years. Under this framework, renewable electricity producers winning in auctions will receive compensation from the Guaranteed Buyer, representing the difference between the feed-in tariff or auction price and the market value of electricity. This integration into the electricity market will reduce the need for balancing reserves in the system. The lawmakers highlight that approximately 78% of renewable energy facilities in Germany currently operate under the feed-in-premium and contracts for difference, and the generation of "green" electricity reached 50% in 2020, demonstrating the success of this model.
- Introduction of a system for **issuing guarantees of origin** for electricity generated from renewable energy sources.
- Implementation of a net billing system, allowing for monetary settlements between electricity suppliers and consumers, including private households. This system will enable households and utilities to plan the capacity of installed renewable energy sources that exceed their own consumption during specific periods, mainly spring and summer. Consequently, these facilities can generate surplus electricity, supply it to the grid, and receive compensation or mutual settlements for the electricity supplied during periods of low self-generation.

It has come to light that approximately 40% of privately-owned solar power plants in Ukraine have had minimal electricity consumption, amounting to less than 10 kWh per month. As a result, the surplus energy generated by these plants has been supplied to the grid at an inflated [feed-in tariff](#). This highlights the significance of net billing, which not only fosters the growth of renewable energy sources but also enhances the reliability of energy supply to households, small businesses, and utilities without exerting additional pressure on the budget.

Denys Tsutsaiev of Greenpeace CEE emphasizes the necessity of a support system for distributed renewable energy generation. He cites an example of an [outpatient clinic in Horenka](#), Kyiv region, where the installation of a heat pump and a solar station has facilitated smooth operations and achieved savings of over 70% on energy and heating costs.

Such success stories are not isolated incidents. The team at the NGO Ecoclub Rivne has developed 30 preliminary feasibility studies for the installation of solar panels in critical infrastructure facilities like hospitals and water utilities. In December of last year, a solar station was already implemented at a hospital in Zviahel, Zhytomyr region, and they plan to execute nine more similar projects by the end of 2023.

*"When developing the feasibility study, our focus was solely on addressing the fundamental requirements of infrastructure facilities. Currently, the utility sector lacks the capability to supply excess electricity to the grid. If net billing were already implemented, we would have accounted for higher capacity in our planning, allowing the facilities to generate and contribute more electricity,"* explains Dmytro Sakaliuk, an energy efficiency expert at Ecoclub Rivne.

- Introduction of a new category of consumers called the **"group of exceptional consumers"**. These are legal entities that own electricity grids but are not distribution system operators. They use their electricity grids to distribute electricity to other consumers. Additionally, this category includes active consumers (excluding household consumers) who have installed generating and/or energy storage facilities.
- Introduction of the **category of aggregators**, which refers to electricity market participants involved in aggregating capacities of electrical installations owned by other market participants. The purpose of aggregation is to facilitate the production, consumption, and storage of electricity for buying and selling purposes.

*"The implementation of innovative solutions through this law will contribute to enhancing the sustainability of energy supply for households, small businesses, and municipalities, all while avoiding any significant financial burden on the budget. The legislation introduces the practice of conducting auctions for the construction of renewable energy facilities, supported by feed-in-premium models. Additionally, it enables industries to procure 'green' electricity and embark on the decarbonization of their production chains. Companies that utilize green electricity and accurately report their emissions following the GHG Protocol, an internationally recognized standard for calculating greenhouse gas emissions, will gain a competitive edge in accessing international markets and complying with emerging carbon regulations,"* explains Olha Yevstihnieieva, Advocacy Manager for Green Deal reforms and the Green Transition in Ukraine at Razom We Stand.

*"Draft law 9011-d is specifically designed to foster the development of small distributed generation, particularly on the consumer side. It is projected that in 2023 alone, over 5,000 new generation facilities will be launched, with the majority of them being on the consumer side. These facilities are anticipated to have a combined capacity exceeding 500 MW,"* explains Andrii Herus, Chairman of the Verkhovna Rada Committee on Energy, Housing, and Utilities.

*"The implementation of legislative changes aimed at restoring and transitioning to a green energy system will enable Ukraine to take a significant leap towards decarbonizing the energy sector. This will not only drive accelerated economic recovery but also enhance energy security, benefiting both Ukraine and the broader European region,"* stated Andrii Zhupanyyn, Chairman of the United for Recovery inter-factional parliamentary association.

It is worth mentioning that the Ministry of Energy has planned the establishment of a new working group in 2023. This group will focus on developing additional legislation to regulate the legal, economic, and organizational framework for the advancement of offshore wind energy in Ukraine.

Moreover, to facilitate the integration of renewable energy facilities into the power system, the construction of new balancing capacities is an imperative. As outlined in the draft National Renewable Energy Action Plan for the period up to 2030, Ukraine will require 1250 MW of new highly maneuverable capacities capable of swift activation, as well as 640 MW of energy storage systems by 2030. The anticipated private investment volume for these initiatives is approximately USD 2.5 billion. Notably, on 15.02.2022, the Verkhovna Rada of Ukraine passed Law No. 2046-IX, "On Amendments to Certain Laws of Ukraine on the Development of Energy Storage Facilities." This law addresses the regulation of the legal, economic, and organizational framework necessary for the functioning of energy storage facilities within the electricity market. The National Energy and Utilities Regulatory Commission (NEURC) has also made several regulatory amendments to ensure the effective implementation and operation of energy storage facilities in the electricity market, in line with the provisions of the aforementioned law.

On March 17, 2023, Volodymyr Zelenskyy signed into law the "On the Development of Highly Efficient Cogeneration" in Ukraine. This significant legislation grants new powers to the State Agency on Energy Efficiency and Energy Saving of Ukraine while also aligning with the requirements of Directive 2012/27/EU on energy efficiency, thus ensuring adherence to EU standards.

Importantly, the advancement of biomethane and synthetic methane (power-to-gas) technologies holds the promise of enabling high-efficiency cogeneration to achieve carbon neutrality. This breakthrough has the potential to establish a crucial connection within power systems, facilitating the integration of 100% renewable energy sources.

# Overcoming Barriers to Renewable Energy Development

The Russian aggressor's unprovoked war in Ukraine has exacerbated the financial crisis in the country's energy sector, affecting all participants in the electricity market. However, the renewable energy sector has been particularly hard hit, facing an existential struggle. The repayment of debts to renewable energy producers for 2021 was temporarily postponed as settlements with these producers were ongoing. Furthermore, the percentage of payments for electricity supplied in 2022 was reduced during the period of martial law. The situation was further aggravated by the increase in physical imbalances and debts in the balancing market.

The electricity market in Ukraine continues to face significant challenges. Some producers, such as Combined Heat and Power (CHP) plants, have been forced to shut down operations due to a lack of funds to purchase fuel. Others have already been categorized as defaulters because they lack the necessary financial guarantees required for market participation.

A significant financial imbalance exists in the strategic state-owned enterprise Energoatom, which has been entrusted by the Cabinet of Ministers with the vital responsibility of ensuring electricity availability for households. As a result, the disparity between tariffs for households and the price of electricity for the industrial sector has reached a staggering 4-5 times. With the loss of generation capacity at the Zaporizhzhia Nuclear Power Plant, Energoatom is unable to fulfill its special obligations under the Public Service Obligation (PSO) mechanism, which provides affordable electricity for the population.

The total financial losses incurred from the sale of electricity to households, calculated as the difference between the market price and the fixed tariff for households, amount to UAH 140 billion per year. Out of this sum, approximately UAH 100 billion is covered by the income of state-owned companies Energoatom and Ukrhydroenergo in an 85/15 proportion. The remaining UAH 40 billion represents a funding gap with no identified sources.

According to various sources, energy poverty in Ukraine is estimated to range from 11 percent, according to the State Statistics Service of Ukraine, to 13-18 percent, according to the Energy Community. The transformation of the energy sector will play a vital role in significantly reducing energy poverty in Ukraine and assisting the country in reaching and maintaining the European average of 7.9 percent.

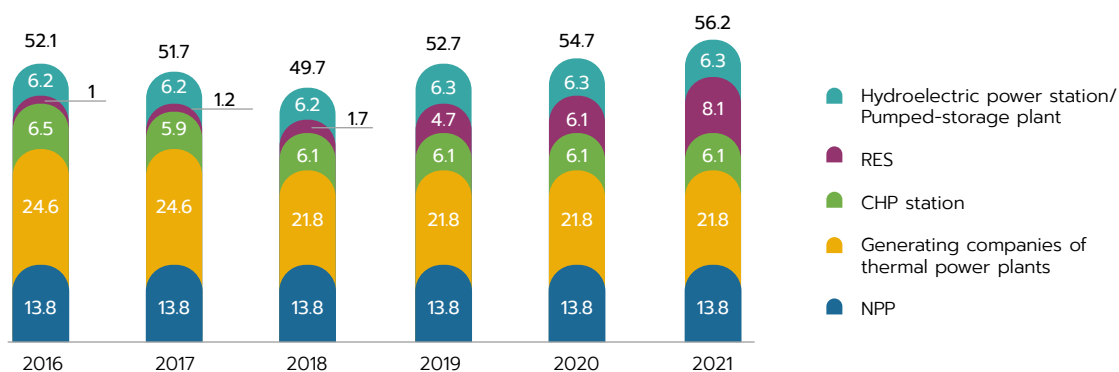
Although there is currently no unified definition of "energy poverty" and "vulnerable consumers" in Ukrainian legislation, the Law of Ukraine "On the Electricity Market" introduces the concept of "vulnerable consumers." These are household consumers who are entitled to statutory support, such as reimbursement of electricity expenses or protection against disconnection during specific periods. Similarly, the Law of Ukraine "On the Natural Gas Market" defines "vulnerable consumers" as household consumers eligible for state aid according to procedures established by the Cabinet of Ministers of Ukraine. The Cabinet of Ministers establishes criteria for identifying vulnerable consumers who are entitled to subsidies for natural gas consumption costs and other targeted assistance. The regulation of this matter is still pending to introduce market mechanisms for the provision of public utilities.

# Status of Ukraine's Energy System Prior to the Full-Scale Invasion

As of December 31, 2021, the total installed capacity of power plants in the Integrated Power System (IPS) of Ukraine, excluding the power generating facilities of the Crimean power system and the temporarily uncontrolled territory of Donetsk and Luhansk regions, reached 56.247 GW. Of this capacity, thermal power plants (including TPPs, CHPPs, and block stations) accounted for 49.7%, nuclear power plants for 24.6%, hydroelectric power plants and pumped storage power plants for 11.2%, and power plants utilizing renewable energy sources (such as wind farms, solar power plants, and bioenergy plants) for 14.5%.

Furthermore, as of December 31, 2021, the connected and electricity-supplying renewable energy facilities in the IPS of Ukraine had the following installed capacities: 1,529 MW for wind power plants (WPPs), 6,365.3 MW for solar power plants (SPPs) (including 1,205.3 MW from household SPPs), 254.2 MW for bioenergy power plants (BioSPPs), and 192.9 MW for micro, mini, and small hydropower plants.

## Dynamics of the structure of the installed capacity of power plants of the IPS of Ukraine\*



\*excluding TOT of the Autonomous Republic of Crimea, Donetsk and Luhansk regions

Source: Generation Adequacy Assessment Report 2021, NPC UKrenergo.

Most of Ukraine's nuclear power plants (NPPs) are equipped with Soviet VVER-1000 series reactors, specifically the B-320 model, which shares similar technical characteristics with pressurized water reactors (PWRs). As of the end of 2021, 12 power units have reached the end of their standard 30-year operational lifetime. Out of these, 11 units have already had their lifetimes extended by 10-20 years, and a decision regarding the extension of one more unit's lifetime is anticipated. In the medium term, the rated lifetime of three additional nuclear power units is set to expire, namely ZNPP-6 in 2026, RNPP-4, and KhNPP-2 in 2035.

New research indicates that Ukraine has the potential to completely replace nuclear power generation with more competitive alternative energy sources by 2050. The findings highlight the significant capital costs associated with nuclear power plant construction, the lengthy commissioning period of 7-10 years, and the continuously unpredictable increase in the cost of nuclear power generation projects. These factors render nuclear power generation less competitive compared to other forms of electricity generation, making it crucial to consider alternative options during Ukraine's post-war recovery.

**The research**, conducted by the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine, includes a sensitivity analysis of various scenarios incorporating technical and economic parameters such as load factors and capital expenditures (CAPEX) for both nuclear and individual renewable generation technologies. The study titled "What is the future of nuclear energy in Ukraine? The role of war, technical and economic factors, and security considerations" provides a substantiated assessment of the future prospects of nuclear energy in Ukraine.

They used the TIMES-Ukraine model to create scenarios for achieving zero greenhouse gas emissions by 2050 under the conditions of further development of nuclear energy and without new nuclear power plant (NPP) capacities, from the point of view of different technical and economic scenarios: cost of NPP construction and capacity factors, levelized cost of electricity (LCOE) for different types of generation, including solar and wind. They also modeled various political decisions regarding the ban on the construction of new large or small nuclear power plants, restricting or extending the life of existing nuclear power plants, and various energy demand scenarios with optimistic assumptions of economic recovery.

*“Decisions about the future of energy depend on both the economic viability and competitiveness (technical and economic factors) of nuclear power and alternative energy sources, as well as on concerns about potential safety issues and long-term environmental consequences, particularly related to nuclear waste. After the Russian invasion of Ukraine and the attacks on nuclear power facilities, additional considerations regarding the security were raised in the whole world and all this is reflected in the planning of new nuclear projects. This should also be a subject of study in Ukraine, especially when we talk about decentralization and the development of distributed energy resources, which is the most reliable solution for the energy system. Even under the conditions of an optimistic scenario of economic recovery of Ukraine, there is sufficient potential of renewable energy sources to meet our own needs,”* says Oleksandr Diachuk, a leading researcher at the Institute of Economics and Forecasting of the National Academy of Sciences, co-author of the TIMES-Ukraine model.

The study revealed that in extreme scenarios, such as a ban on extending the lifespan of existing nuclear power plants (NPPs) or the extensive construction of new NPP power units, the overall cost of modernizing the power system would increase by \$4-5 billion (USD). This amount represents 0.6%-0.9% of the total costs, depending on the assumed baseline. Importantly, restrictions on the construction of new large nuclear power plants do not have an impact on economic growth rates.

# Impacts of War: Losses in the Energy Sector and Shifts in Energy Consumption

The hostilities in Ukraine have had a significant impact on the electricity sector, leading to a notable reduction in electricity demand, estimated at 30-35 percent compared to the consumption in 2021. The consumer base has shifted due to population movements towards the western regions.

Approximately 40 percent of generating capacities have been destroyed, while another 35 percent are located in the occupied territories. Among the affected facilities is the Zaporizhzhia Nuclear Power Plant, the largest in Europe, which operates within the Ukrainian power grid but faces constant pressure from Russian occupiers. This nuclear power plant alone has a production capacity of 6000 MW, accounting for 43 percent of the total capacity of all Ukrainian nuclear power plants.

Around 50 percent of thermal generation, 30 percent of solar generation, and over 90 percent of wind generation have either been destroyed or are located in the occupied territories.

Gas production in Ukraine has also experienced a decline of 10-12 percent since the full-scale invasion. The situation is exacerbated by the fact that no refineries are currently operational, and there are logistical challenges in importing petroleum products from abroad. Prior to the war, domestic production provided approximately 30 percent of the country's petroleum products.

According to the [Kyiv School of Economics \(KSE\)](#), the losses incurred by the Ukrainian energy sector as a result of Russian aggression have exceeded \$8 billion. Russian forces have targeted and attacked thermal power plants (TPPs), hydroelectric power plants (HPPs), and 13 combined heat and power plants (CHPs) under Ukrainian control.

The devastating attacks have caused severe damage, with the main equipment of certain coal-fired power units completely destroyed by Russian missile and drone strikes. As of April 2023, at least 5 turbines have been confirmed as destroyed. However, KSE emphasizes that the actual restoration costs of the lost capacities in thermal power plants could be even higher than estimated. This is due to significant physical wear and tear, as well as technological obsolescence of the damaged and destroyed equipment.

Pre-war data reveals that thermal power plants, including TPPs, CHPs, and block stations, accounted for almost half of the total installed capacity of 56,247 GW. However, by the beginning of 2021, these plants were already **90% worn out**. Additionally, it is important to note that Ukrainian thermal power plants are among the **most environmentally polluting in Europe**.

# Localization of Renewable Energy Equipment Production in Ukraine

Ukraine is keen on developing its own domestic renewable energy equipment manufacturing facilities. This strategic move serves multiple purposes, such as job creation, decreasing reliance on imported equipment, and fostering an economic multiplier effect that will aid in the reconstruction of the energy sector.

*"By 2030, it is realistic to achieve the localization of one-third of wind turbine components production in Ukraine. Previously, steel from Azovstal was exported to Turkey for turbine manufacturing. However, with many companies withdrawing from the Russian and Chinese markets, there is an opportunity for localization near the border with Poland. This would have a significant positive impact on the Ukrainian economy,"* explains Andrii Konechenkov.

In addition to expanding its production capacity, Ukraine must also establish favorable conditions for the future utilization and recycling of renewable energy equipment and batteries. The first solar power plants in Ukraine are scheduled for decommissioning in 2035, with a significant wave of decommissioning expected between 2045 and 2050.

Similarly, mass decommissioning of wind power facilities is anticipated around 2045. Unlike the prolonged and challenging process of decommissioning nuclear power plants, decommissioning renewable energy facilities will not require budgetary expenditures. Instead, it will stimulate production by promoting material reuse within the framework of a circular economy.

The Ukrainian Wind Energy Association (UWEA) advocates for the revival of Ukraine's national machine-building sector and its integration into the European Union market. With favorable conditions, Ukraine possesses the potential to establish domestic production of wind energy equipment and seize opportunities within the renewable energy industry.

According to the [Savills Nearshoring Index 2020](#), Ukraine was ranked first in Europe second among all the forty represented countries in terms of competitiveness as a destination for businesses. This recognition has attracted the attention of global companies, including manufacturers of renewable energy equipment, who are increasingly prioritizing value over simply seeking the lowest cost. They now consider factors such as supply chain reliability and sustainability.

A promising aspect for Ukraine is the growing demand for renewable energy equipment in Europe and globally. The European Commission aims to satisfy this demand by promoting production within EU member states or friendly democratic countries, reducing reliance on imports from China.

In this dynamic landscape, the competition between the United States and the European Union to accelerate the deployment of climate-friendly energy technologies and shift equipment production away from China presents several opportunities for Ukraine to capitalize on.

On February 5, 2023, Ukraine achieved a significant milestone with the inauguration of its first large-scale industrial [production facility for photovoltaic panels](#) used in solar power plants, located in Vinnytsia. Prior to this development, Ukraine had already been manufacturing steel structures and electrical equipment for solar power plants, and in 2016, the country commenced mass production of inverter equipment. With the establishment of the Vinnytsia plant, Ukraine can now proudly assert its position as a manufacturer of all the necessary components, achieving self-sufficiency for the solar energy industry.

# Afterword by Razom We Stand

## Are Ukraine and the world ready for a revolutionary transition to clean energy - economically, politically, and socially?

Razom We Stand is a Ukrainian campaigning organization dedicated to driving the global transition toward clean energy and away from fossil fuels, which contribute to the climate crisis, global conflicts and war. We were established in response to Russia's full-scale war against Ukraine to coordinate the [Stand With Ukraine](#) campaign. Our mission is to catalyze campaigns to end fossil fuelled conflicts and climate chaos, and drive the clean energy revolution in Ukraine and globally. We organize and mobilize various stakeholders to foster the necessary political, legal, and economic conditions for Ukraine and the world to embrace affordable and secure renewable energy systems that benefit all, rather than serving the interests of fossil fuel energy autocrats. Organizing and leveraging creative communication and advocacy campaigns, we strive to influence decision-makers towards building a fossil free, energy-secure, and peaceful future.

The war waged by Russia against Ukraine has resulted in detrimental consequences, including soaring profits for the fossil fuel industry and an unprecedented energy crisis. However, amidst these challenges, there lies an opportunity for Ukraine, as well as other nations such as Europe and the United States, to expedite the shift towards renewable energy sources.

Despite experiencing a second year of full-scale war resulting in over \$135 billion in war-related damages in the energy sector as of February 2023 and a significant economic decline of approximately 31% of GDP, Ukraine remains committed to rebuilding its infrastructure with a strong emphasis on renewable energy in the electricity sector. It is crucial for Western countries, particularly the EU and the US, to also embrace clean energy in order to uphold democracy, peace, and energy security, while also driving a global transition towards clean energy for developing nations. [Ukraine's Recovery Plan](#) and the newly formulated Energy Strategy until 2050 largely align with the goal of transitioning to low-carbon and renewable energy sources, as well as promoting energy efficiency measures. However, there are valid concerns regarding new investments in fossil fuel infrastructure, including involvement from major foreign oil and gas companies, which recorded a significant increase in profits during 2022 and the first quarter of this year alone.

The energy and climate goals for Ukraine's reconstruction may need to be more ambitious, considering the developments taking place in the EU, with which we hope to achieve membership in the near future. The geopolitical turmoil resulting from Russia's war against Ukraine has unexpectedly led to a substantial increase in renewable energy adoption within the EU. In April 2022, the EU adopted the [REPowerEU plan](#) as its energy response to reduce reliance on Russian fossil fuels. The plan aims to raise the proportion of renewables in total final energy consumption to 45% by 2030. Notably, in 2022, solar and wind energy [accounted for over a fifth \(22%\)](#) of the EU's electricity, surpassing fossil gas (20%) for the first time. Solar energy demonstrated the most significant growth, reaching a record 24% increase last year, while wind energy grew by 8.6%. Moreover, in 2022, the EU added 41 GW of solar power capacity, which is nearly 50% higher than the previous year, with almost 20 EU countries setting new solar energy records. Additionally, the sales of heat pumps in Europe exceeded 3 million in 2022, representing a 40% increase compared to 2021. The International Energy Agency (IEA) predicts that, based on the current growth rate, the share of heat pumps in building heating will nearly double by 2030.

A recent report by Oxford University found that the European Union [could completely replace Russian gas with renewable energy and heat pumps by 2027](#) and offset up to 90% of the cost. A significant portion of the required €512 billion investment could be paid for by reducing gas costs. Prior to the full-scale invasion of Ukraine, Russia accounted for almost 50% of the EU's gas supplies, but in one year, the EU has reduced its dependence on Russian gas to 10%.

The world has the money to finance clean energy. Global investment in low-carbon energy technologies **exceeded \$1 trillion for the first time in 2022**, indicating a substantial acceleration from the previous year.

The entire year of 2023 presents a significant window of opportunity for Ukraine during its most challenging period, as well as a critical moment for the revolutionary deployment of clean energy, not only in Ukraine but also worldwide. Regulatory frameworks, permitting processes, economic incentives, international and bilateral financial assistance, and public and private investments into clean energy deployment must become the government's top priorities, following their successful resistance against russian aggression and their efforts to support the population during the full scale russian war against Ukraine. These areas must undergo reform. Rebuilding Ukraine, fully powered by clean energy and rising as the world's first post-war country to achieve not only freedom and democracy but also an independent and secure clean energy sector serves as an exemplary model for other nations held captive by fossil fuel autocracies and dictatorships to emulate.



**Svitlana Romanko,**  
*Founder and Director of Razom We Stand*

**Svitlana Romanko** is Founder and Director of the Ukrainian organization **Razom We Stand**, which grew out of the successful **#StandWithUkraine** campaign to end the global fossil fuel addiction that feeds Putin's war machine. Svitlana launched and coordinated both groups once the russian war against Ukraine began. She has been an environmental lawyer for over twenty years and high-impact climate justice campaigner for a decade. In 2022 Svitlana was awarded the **Rose Braz Award for Bold Activism**. Svitlana holds a PhD in Environmental, Natural Resources, Land and Agrarian Law, and a doctorate on Climate Change Law, Climate Governance and Climate Policy. She worked for **350.org** and the Laudato Si Movement, and has been a senior consultant for a Just Green Recovery and Green Deal in Eastern Europe. She regularly writes for and interviews with international top-tier press as a featured expert.

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# We express sincere gratitude to people who inspired and supported our work

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