Ministry of Digital Transformation of Ukraine

UKRAINIAN GLOBAL INNOVATION STRATEGY 2030

SECTOR STRATEGY: GREEN TECHNOLOGIES

(GREENTECH)

UKRAINIAN GLOBAL INNOVATION STRATEGY UNTIL 2030

CONTENTS

ABBREVIATIONS AND DEFINITIONS

KEY DEFINITIONS

STRATEGY	UKRAINIAN GLOBAL INNOVATION STRATEGY UNTIL 2030
GreenTech	GreenTechnologies

ABBREVIATIONS

AI	Artificial Intelligence
CAGR	Compound Annual Growth Rate
CCUS	Carbon Capture, Utilization and Storage
CHP	Combined heat and power plant
COP	Coefficient of Performance
ESG	Environmental, social, and governance
EU	European Union
HEI	Higher Educational Institution
HPP	Hydro Power Plant
ICE	Internal Combustion Engine
IOT	Internet of Things
NRFU	National Research Foundation of Ukraine
RES	Renewable energy sources
SPP	Solar Power Plant
TPP	Thermal Power Plant
UN	United Nations
WPP	Wind Power Plant

STRATEGY RESUME: GREENTECH IN UKRAINE

UKRAINE IS ABLE TO PLAY A SIGNIFICANT ROLE FOR ENERGY SECURITY AND GREEN TRANSFORMATION IN EUROPE

Ukraine future role in the European energy sector has considerable potential, given its natural resources and climatic characteristics. Subject to international cooperation and technology development, Ukraine will contribute to energy security and green transformation of the entire European region

UKRAINE FUTURE ROLE IN THE GLOBAL GREENTECH INDUSTRY

AN ELEMENT OF THE EUROPEAN ENERGY ECOSYSTEM

By developing renewable and nuclear energy while implementing a green industrial transition, Ukraine has the potential to play an important role in the green transformation of Europe. Adopted in 2023, the Energy Strategy of Ukraine envisages a course towards clean energy production alongside with the realization of the solar and wind energy production potential of 140 GW

REGIONAL HYDROGEN EXPORTER

Ukraine is well positioned to become a key supplier of hydrogen to Central Europe. According to the draft Hydrogen Strategy of Ukraine until 2050, over the next two decades, low-carbon hydrogen production is expected to increase to 1.3 million tons in 2035 and 3.0 million tons in 2050, with an export share of up to 50% of the total produced

BIOFUEL SUPPLIER

Because of its climate and well-developed agricultural sector, Ukraine has great potential in bioenergy, including energy from biomass, as well as biofuels and biogas production. It is estimated that Ukraine's potential for biomethane production reaches up to 21.8 bn cubic meters per year, biodiesel - up to 580 thousand tons of oil equivalent[1] per year and bioethanol - up to 860 thousand tons of oil equivalent per year

CONTRIBUTION TO THE EU GREEN TRANSFORMATION

By developing domestic extraction and processing of materials critical for green transformation, like lithium and rare earths, Ukraine can contribute to meeting the EU needs for critical raw materials. This will support the achievement of the target of providing 10% of domestic production and 40% of domestic processing of the EU total needs for critical materials

[1] Thousands of tons of oil equivalent

PROMOTING GREENTECH INNOVATION WILL ENSURE THE ACHIEVEMENT OF THE GOALS SET IN GREEN TRANSFORMATION, CLIMATE, AND ENERGY EFFICIENCY

STRENGTHS

- Existing cooperation programs with the EU provide access to funding mechanisms for energy and climate research
- High potential for wind and solar power development due to favorable climate, as well as bioenergy based on a strong agricultural raw material base
- A strong base of qualified nuclear specialists for further modernization of this area

WEAKNESSES

- Lack of energy management mechanisms due to manual dispatching of the power system
- Low interest of households in energy efficiency development due to the subsidy system
- Dependence on imports of a significant part of key components of green technologies

OPPORTUNITIES

- Establishing cooperation with leading countries in energy innovation to share experience in energy modernization
- Development of bioenergy, biomethane, bioethanol thanks to a strong base of agricultural raw materials
- Financial incentives for households and businesses to implement green transformation technologies

THREATS

- The energy sector remains at high risk of destruction in the context of the ongoing full-scale war
- China’s dominant role in green technology supply chains may reduce demand for Ukrainian innovations
- Emergency condition of buildings and building energy networks due to degradation of traditional housing managers

HAVING REALIZED ITS GOALS, UKRAINE WILL BE ABLE TO ACHIEVE ITS STRATEGIC GOALS IN THE GREENTECH AREA

IMPLEMENTING THE GREENTECH STRATEGY INVOLVES A NUMBER OF TASKS:

ECONOMIC TASKS

- Provide financial incentives for projects aimed at green innovations
- Hold talks with the EU on the integration of Ukraine's state policy in the industry with EU initiatives, in particular the Critical Raw Materials Law
- Provide informational and organizational support for the participation of startups and other innovative companies in green transformation support programs from partners

INFRASTRUCTURE TASKS

- Create a excellence center for the use of AI for energy security, efficient dispatching, and the development of smart grids
- Digitalize the process of monetizing energy subsidies
- Organize professional development programs for professionals working in the energy sector

1

SECTOR STRATEGY: GREENTECHNOLOGIES (GREENTECH)

1.1

GLOBAL GREENTECH SECTOR OVERVIEW

GREENTECH IS GAINING POPULARITY AND GROWING POTENTIAL IN THE GLOBAL MARKET WITH THE LARGEST TECHNOLOGY INVESTMENTS IN CHINA, AND THE USA

Green Technologies (GreenTech) is an umbrella term that describes the use of technology and science to reduce human impact on the environment. Green Technologies cover a wide range of research areas, including energy, atmospheric science, agriculture, materials science, IT, and hydrology. GreenTech includes technologies that are designed to reduce the negative impact on the planet through the economical use of resources, waste reduction, energy efficiency and innovation

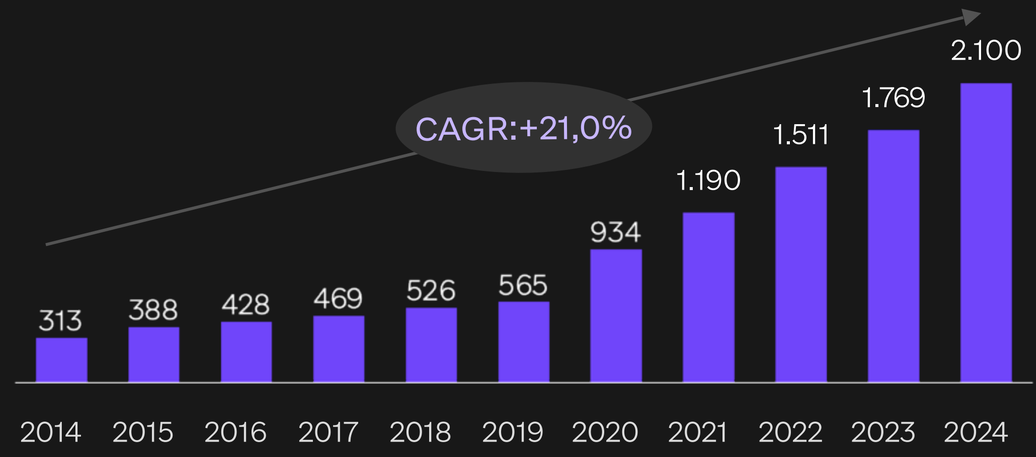
CURRENT STATE OF THE INDUSTRY

- In 2023, the global investment in the energy transition was estimated at $1.769 billion
- The market is demonstrating some positive dynamics due to increased investments by key players in the development of innovative solutions and services in the field of GreenTech, as well as due to the scaling of existing technologies. The most popular GreenTech segments in the world are electric transport, RES, energy grids, and others

FUTURE DEVELOPMENT OF THE INDUSTRY

Investments in the energy transition are projected to continue to grow and reach $3,000 bn in 2030. Growth will be driven by regulatory initiatives and requirements, technological breakthroughs, the use of AI, cost reduction of existing technologies, demand for energy efficiency and independence, etc.

INVESTMENTS IN ENERGY TRANSITION[1] , $ BN



TOP 5 COUNTRIES BY INVESTMENT IN GREEN TECHNOLOGIES IN 2023, $ BN

675,9 303,1 95,4 73,9 55,5

[1] Energy transition - the process of shifting to low-carbon and zero-carbon technologies and/or transitioning from traditional energy sources to renewable ones

RENEWABLE ENERGY AND ELECTRIC TRANSPORT ARE THE LARGEST INVESTMENTS IN GREEN TECHNOLOGIES IN THE WORLD

Electric transport and renewable energy are the largest areas of investment in the global energy transition[1] , each receiving more than $600 billion in 2023. Together, these two sectors accounted for almost three-quarters of total investment in the energy transition from traditional to alternative energy sources in 2023. At the same time, the share of electric vehicles in all auto sales in the world in 2023 amounted to 15.8%, which is 11.6 percentage points higher than its share in 2020

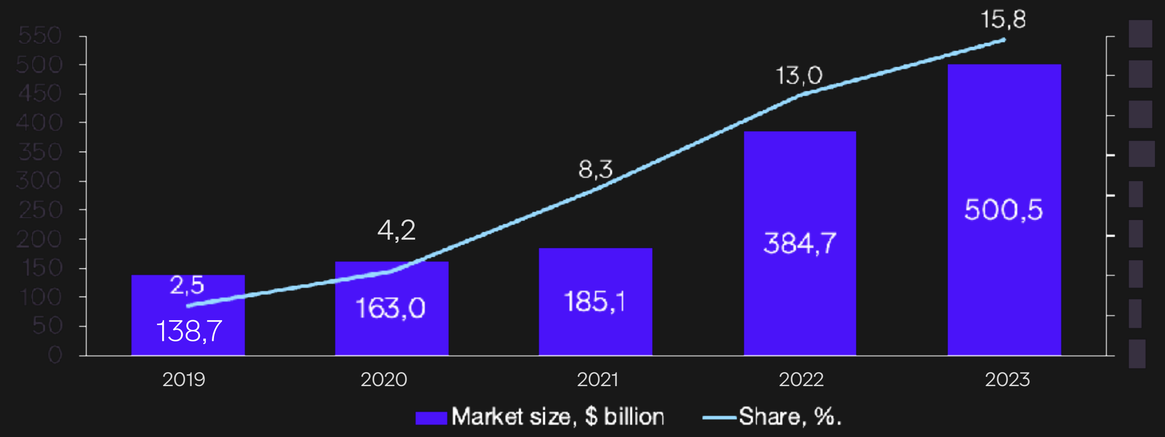
Hydropower is the most widespread green energy technology, accounting for more than 50% of all RES energy produced in 2023

TWO INDUSTRIES ACCOUNTED FOR ALMOST 72% OF GLOBAL ENERGY TRANSITION INVESTMENTS IN 2023

INVESTMENTS IN ELECTRIC TRANSPORT IN 2023

$632 BN

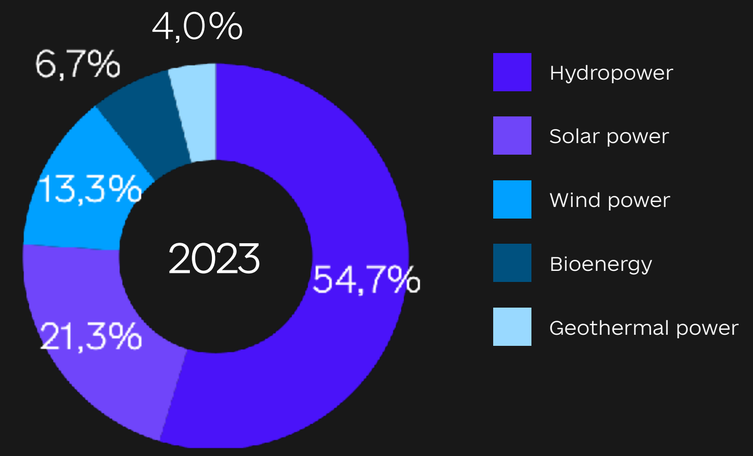
Size of the electric vehicle market, $, and the share of electric vehicles in all car sales, %



INVESTMENTS IN RES IN 2023

$623 BN

Distribution of RES in the world by volume of energy produced, %



[1] Energy transition - the process of transition to low-carbon and carbon-free technologies and/or transition from traditional energy sources to renewable ones

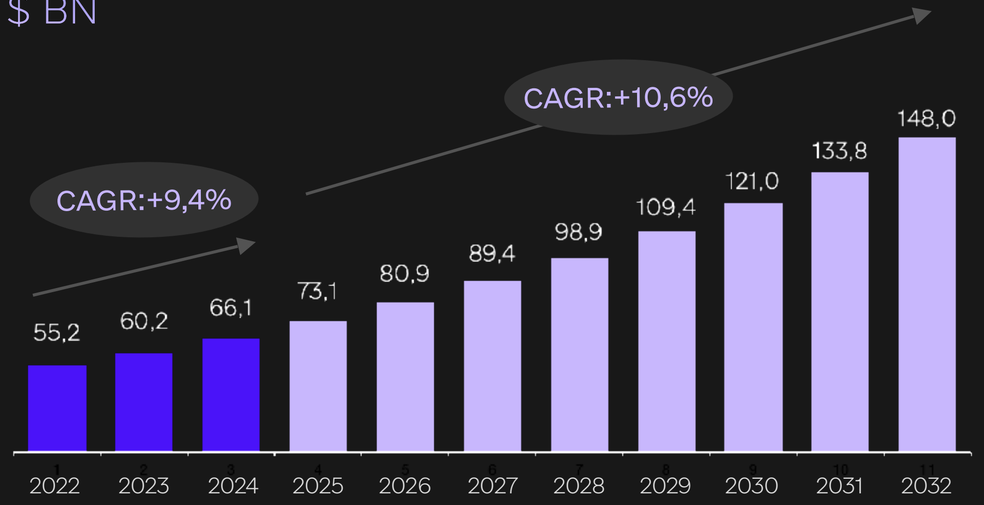
«SMART GRIDS» AND «SMART BUILDINGS» ARE THE PROMISING AREAS OF GREENTECH FOR DEVELOPMENT IN TERMS OF THEIR EFFICIENCY AND MARKET POTENTIAL

In 2024, the global market for smart grids was estimated at $66.1 bn. Increasing global demand for energy due to population growth and urbanization, as well as industrial growth and technological advancements, will drive the rapid adoption of smart grids and grow the market to a projected size of $148 bn in 2032

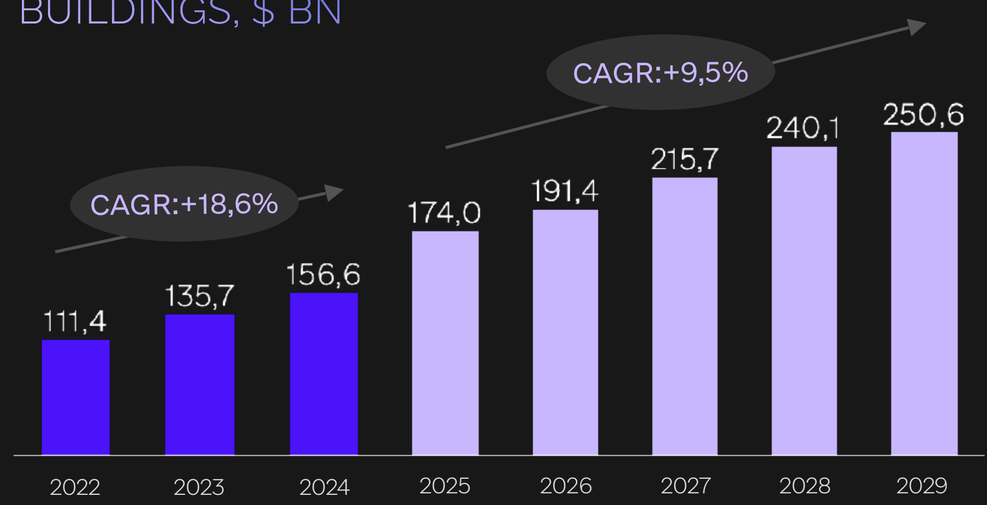
The smart buildings industry is also developing due to similar drivers and is projected to grow from $156.6 bn in 2024 to $250.6 bn in 2029, showing a CAGR of +12% over the same period

GLOBAL MARKET FOR SMART GRIDS AND BUILDINGS

GLOBAL MARKET SIZE OF «SMART» GRIDS, $ BN



GLOBAL MARKET SIZE OF «SMART» BUILDINGS, $ BN



A LOT OF GLOBAL REGULATORY DOCUMENTS AND INITIATIVES THAT HAVE AN IMPACT ON THE DEVELOPMENT OF GREEN TECH

MAIN REGULATORY DOCUMENTS THAT HAVE AN IMPACT ON THE GREEN TECH SECTOR

1997

191

🌍 KYOTO PROTOCOL

An international agreement that legally obliged industrialized countries to reduce their greenhouse gas emissions to 1990 levels

2016

194[1]

🌍 PARIS CLIMATE AGREEMENT

Agreement under the UN Framework Convention on Climate Change to regulate measures to reduce carbon dioxide emissions from 2020 and keep the increase in global average temperature well below 2 °C compared to the pre-industrial levels

2021 >>> 2050

27

🇪🇺 EUROPEAN GREEN DEAL

A series of EU policy initiatives aiming to make the European continent climate neutral by 2050. A number of fundamental documents are currently being developed to achieve this ambitious goal in areas such as climate, affordable and clean energy, circular economy, green agriculture, biodiversity conservation, zero pollution, sustainable and smart mobility, and environmentally friendly transport solutions

2023

27

🇪🇺 CARBON BORDER ADJUSTMENT MECHANISM

The Carbon Border Adjustment Mechanism (CBAM) is an EU tool for setting prices for carbon emissions when importing goods. It will prevent "carbon leakage" when companies move production to some countries with weaker climate policies

2023-2025 - transitional period of the implementation (reporting only, no payments); 2026 and beyond - full implementation of the mechanism including the financial commitments

X — Number of participating countries

[1] January 21, 2025, the United States withdrew from the Paris Climate Agreement

NEW TECHNOLOGIES AND URGENT NEEDS OF THE GREEN TRANSITION DRIVE THE DEVELOPMENT OF GREENTECH IN THE WORLD

KEY TRENDS OF THE GREENTECH GLOBAL MARKET

IMPROVING SOLUTIONS FOR RES

Increasing the efficiency of RES, including improving energy storage solutions to address intermittent generation, makes them more competitive with traditional sources

TRANSPORT ELECTRIFICATION

Reducing greenhouse gas emissions, air pollution, and dependence on fossil fuels. As rechargeable battery technologies improve and charging infrastructure develops, electric vehicles are becoming more and more viable

CIRCULAR ECONOMY AND WASTE REDUCTION

Circular economy practices reduce environmental impact by reducing waste and conserving natural resources, extend the life cycle of products, and lead to resource efficiency in the economy

SUSTAINABLE AGRICULTURE AND PROCESSING

Conserving water, reducing pesticide use and minimizing land degradation in food production. Sustainable agriculture supports environmental protection and food security

GREEN BUILDING AND SMART INFRASTRUCTURE

Promoting the reduction of energy and water consumption, the use of environmentally friendly materials, waste reduction, and the improvement of environmental performance using smart technologies. This is the trend of the future urban infrastructure development

SMART GRIDS AND INTEGRATION WITH IOT AND AI

Optimizing energy consumption, increasing the efficiency of energy supply, and reducing the environmental impact of energy systems through more efficient use of clean energy through innovative solutions based on smart grids including IoT and AI

RENEWABLE ENERGY, ELECTRIC TRANSPORT AND COAL GAS CAPTURE ARE KEY TECHNOLOGIES FOR GREEN TRANSITION

KEY TYPES OF GREENTECH TECHNOLOGIES

CARBON (CO_2) CAPTURE, UTILIZATION AND STORAGE (CCUS)[1]

Technologies for capturing carbon dioxide from fossil fuel-based industrial plants. If the carbon dioxide is not used on-site, it is compressed and transported (by pipeline, ship, railroad, etc.) for use (fertilizer production, synthetic fuels) or injected into deep geological formations (oil and gas reservoirs)

GREEN ENERGY STORAGE

Energy storage technologies are an essential part of green energy. They help compensating for uneven generation and provide constant access to the energy produced. The main energy storage solutions are battery (lithium-ion, sodium-ion, lead-acid, redox-vanadium), mechanical (accumulation of energy for lifting and lowering, air compression), chemical (production of green hydrogen) and thermal (accumulation of heat in materials, such as salt)

RENEWABLE ENERGY SOURCES

The main sources for RES are solar energy (using solar panels), wind energy (using wind turbines), geothermal energy (using thermal energy from the Earth's interior), water energy (HPP on rivers), ocean energy (using waves, currents and tides), bioenergy (burning biomass - wood and agricultural products, or producing gas through fermentation)

ELECTRIC TRANSPORT

Use of innovative technologies to equip buildings to optimize energy efficiency, provide intelligent automation and control of systems and communications (power supply, lighting, security, water supply, heating, air conditioning and alarm systems). They create networks based on installed sensors that allow them to effectively monitor the environmental impact of building operation

[1] Carbon Capture, Utilization and Storage - technologies for capturing, utilizing and storing carbon dioxide

EMISSIONS AND WASTEWATER TREATMENT, WASTE MANAGEMENT, SUSTAINABLE INDUSTRIAL PRACTICES WILL CONTRIBUTE TO ENVIRONMENTAL PROTECTION

KEY TYPES OF GREENTECH TECHNOLOGIES

EMISSIONS AND WASTEWATER TREATMENT

Emission treatment technologies are aimed at removing impurities from exhaust gases before they are released into the atmosphere, or at preparing gases for their use as chemical raw materials. Purification of exhaust air generated in industry reduces the greenhouse effect. Wastewater treatment technologies are aimed at removing contaminants from water before it is returned to natural water bodies or reused

SUSTAINABLE AGRICULTURE

Technologies for sustainable farming practices to protect the environment, conserve and enhance natural resources, and make the best use of non-renewable resources. Examples include organic farming technologies to reduce damage from soil depletion, innovations in cattle feed to reduce methane emissions, and others

WASTE MANAGEMENT AND RECYCLING

Waste recycling helps to conserve resources by reusing them. Household waste recycling technologies include smart containers, automated food waste tracking systems, and automated optical scanning technologies. Industrial waste recycling includes technologies for the reuse of metals, waste rocks (in the chemical industry, construction, etc.), agricultural residues (as fertilizers or for biofuel production), etc

SMART BUILDINGS

Use of innovative technologies to equip buildings to optimize energy efficiency, provide intelligent automation and control of systems and communications (power supply, lighting, security, water supply, heating, air conditioning and alarm systems). They create networks based on installed sensors that allow them to effectively monitor the environmental impact of building operation

THE MOST FAMOUS GLOBAL COMPANIES DEVELOP INNOVATIVE SOLUTIONS IN THE FIELD OF GREENTECH, INCLUDING SOFTWARE FOR ENERGY EFFICIENCY

KEY PLAYERS IN THE GREENTECH GLOBAL MARKET

SOFTWARE TECHNOLOGIES FOR ENERGY EFFICIENCY NEEDS

MICROSOFT CORP.

It is a software and cloud computing company. The AI for Earth initiative supports environmental projects in AI-based carbon capture. The Cloud for Sustainability platform helps businesses monitor and reduce carbon emissions

IBM CORPORATION

A technology company that has many environmental initiatives in sustainable agriculture, clean energy, water management, sustainable cities through the IBM Sustainability Accelerator, IBM Environmental Intelligence, Green Computing and other programs

SCHNEIDER ELECTRIC

A corporation specializing in digital automation and energy management. Areas of expertise: AI and IoT-based software for energy efficiency, RES and energy storage, charging stations for electric vehicles, etc

SIEMENS SMART INFRASTRUCTURE

A division of Siemens that develops solutions for smart grids and energy-efficient building automation systems. It implements projects like Smart City in cities around the world, such as Singapore and London

SAP

Software developer. The SAP Sustainability Footprint Management product is designed to measure and reduce carbon emissions at all stages of the production cycle

HUAWEI DIGITAL POWER

A division of Huawei specializing in RES and smart grids. The company implements large international projects, including a 400 MW solar microgrid in Saudi Arabia and carbon neutrality solutions

APPLICATION

- Agriculture
- Recycling of waste
- RES
- Energy storage
- Energy efficiency
- Smart grids and buildings
- Carbon capture
- Electric transport

ENERGY EFFICIENCY OPENS UP NEW OPPORTUNITIES FOR INNOVATIVE COMPANIES, ENSURING THEIR GROWTH THROUGH THEIR SOLUTIONS

KEY PLAYERS IN THE GREENTECH GLOBAL MARKET

SOFTWARE TECHNOLOGIES FOR ENERGY EFFICIENCY NEEDS

FAST-GROWING COMPANIES

🇺🇸 UPLIGHT

A company founded in 2019 that has developed artificial intelligence-based software for energy companies, helping to improve their efficiency by analyzing energy consumption data and optimizing energy consumption in buildings. The platform also enables private and business customers to receive personalized energy reports that help them save energy and purchase energy-efficient devices

🇺🇸 CLIMAVISION

Founded in 2021, it is an American company that specializes in creating ultra-accurate weather forecasts by combining a private network of radars and satellite/climate models to predict extreme weather events, which is critical for the energy industry

🇨🇳 SUNGROW

Specializes in the production of inverters for solar power plants and energy storage systems. In 2021, the company joined the European Association for Energy Storage (EASE) to promote research and innovation in the field of optimal solutions for energy storage

APPLICATION

- Agriculture
- Energy efficiency
- Recycling of waste
- Smart grids and buildings
- RES
- Carbon capture
- Energy storage
- Electric transport

SOLUTIONS BY LEADING GLOBAL COMPANIES IN THE RENEWABLE ENERGY STRENGTHEN THE DEVELOPMENT OF GREEN TECH AND CONTRIBUTE TO GREEN TRANSITION

KEY PLAYERS IN THE GREENTECH GLOBAL MARKET

RES SECTOR

🇺🇸 NEXTERA ENERGY

An energy company with approximately 58 GW of generating capacity, of which more than half is from renewable energy sources such as solar and wind. The company main operations are concentrated in the United States, in particular through its subsidiary Florida Power & Light, which serves more than 5 million customers in Florida

🇩🇰 VESTAS

One of the largest manufacturers of wind turbines for RES. At the end of 2024, the company installed more than 188 GW of wind turbines in 88 countries

🇨🇳 JINKOSOLAR

The world's largest supplier of solar panels. The company has achieved record deliveries of 43.8 GW. JinkoSolar serves customers in more than 194 countries

🇺🇸 FIRST SOLAR

A manufacturer of solar panels and photovoltaic installations for public use. Also engaged in SPP construction, maintenance and recycling of panels

🇬🇧 SSE RENEWABLES

SSE Renewables, a subsidiary of SSE plc, develops, builds and operates wind and hydroelectric power plants

🇩🇰 ØRSTED

Danish energy company that has transformed from a fossil fuel supplier to a global leader in wind energy. It has more than 15 GW of capacity and plans to expand to 50 GW by 2030

APPLICATION

- Agriculture
- Recycling of waste
- RES
- Energy storage
- Energy efficiency
- Smart grids and buildings
- Carbon capture
- Electric transport

GREENTECH IS NOW A GROWTH AREA FOR COMPANIES INVESTING IN INNOVATIVE SOLUTIONS AND RENEWABLE ENERGY PROJECTS

KEY PLAYERS IN THE GREENTECH GLOBAL MARKET

RES SECTOR

FAST-GROWING COMPANIES

🇨🇳 CHINA NATIONAL NUCLEAR CORP

The state-owned enterprise, traditionally known for its nuclear energy activities, is actively expanding its presence in renewable energy. In particular, in 2024, the company began construction of China's largest solar power plant with a capacity of 2 GW. At the time of the announcement, it was reported that the project would be connected to the state grid in September 2024, and reach full capacity in 2025

🇬🇧 OCTOPUS ENERGY GENERATION

Octopus Energy, a division of the British company Octopus Energy, which invests in energy projects and energy conversion companies covering 20 countries and 18 technologies, manages more than 270 green energy projects with a total capacity of 3.9 GW. The company plans to invest $20 billion in clean energy projects around the world, with a focus on Europe by 2030, including the construction of offshore wind farms, to generate 12 GW of renewable electricity annually

🇳🇱 SOLARDUCK

A company that develops innovative floating solar power plants for installation in the open sea, which allow generating solar energy in difficult marine conditions. In 2024, SolarDuck successfully installed the 0.5 MW Merganser pilot floating solar power plant off the coast of the Netherlands, and also realized and commissioned Japan's first offshore floating photovoltaic power plant

APPLICATION

- Agriculture
- Recycling of waste
- RES
- Energy storage
- Energy efficiency
- Smart grids and buildings
- Carbon capture
- Electric transport

ELECTRIC TRANSPORT AND ENERGY STORAGE SYSTEMS ARE DEVELOPING STRONGLY IN THE WORLD DUE TO COMPLEX SOLUTIONS FROM WORLD TECHNOLOGY LEADERS

KEY PLAYERS IN THE GREENTECH GLOBAL MARKET

ELECTRIC TRANSPORT AND ENERGY STORAGE

🇺🇸 TESLA

Developer and manufacturer of electric vehicles (1.77 million electric vehicles in 2024) and clean energy (solar panels and energy storage systems, such as the Tesla Powerwall, a compact home battery that stores energy generated from the sun or the grid)

🇨🇳 BYD

BYD is China's leading manufacturer of electric vehicles, including cars, buses and trucks (4.27 million units of electric vehicles in 2024). BYD also produces solar panels and energy storage systems, contributing to the development of RES and energy efficiency

🇨🇳 CATL [1]

It is the world's largest manufacturer of batteries for electric vehicles. In 2024, the installed capacity of CATL batteries increased by 47.2% to 246 GWh, which corresponds to a market share of 45.5%. The company also invests in energy storage technologies and develops solutions for integration with RES

🇰🇷 LG ENERGY SOLUTION

A subsidiary of LG Corporation, which is a supplier of batteries for automakers around the world, such as Hyundai-Kia, Volkswagen, Stellantis and others. LG also develops energy storage systems and participates in energy efficiency projects

🇯🇵 PANASONIC

Supplies batteries for electric vehicle manufacturers such as Tesla, Mazda, Toyota, and others. It produces solar panels, energy efficiency solutions for buildings, and participates in smart grid projects

🇰🇷 SAMSUNG SDI

It is a subsidiary of the Samsung Group, specializing in the production of batteries for electric vehicles and energy storage systems, such as Samsung Battery Box (SBB) 1.5 - an updated containerized energy storage solution with a capacity of 5.26 MWh

APPLICATION

- Agriculture
- Recycling of waste
- RES
- Energy storage
- Energy efficiency
- Smart grids and buildings
- Carbon capture
- Electric transport

[1] CATL – Contemporary Amperex Technology Co., Limited

YOUNG COMPANIES ACTIVELY DEVELOPING IN THE GREEN TECH SECTOR PROVIDE INNOVATIONS FOR ELECTRIC TRANSPORT AND ENERGY STORAGE SYSTEMS

KEY PLAYERS IN THE GREENTECH GLOBAL MARKET

ELECTRIC TRANSPORT AND ENERGY STORAGE

FAST-GROWING COMPANIES

🇨🇳 NIO

A premium electric vehicle manufacturer known for its innovative solutions, such as a battery swap system. It is exploring opportunities to integrate its cars with smart grids and energy storage systems. In 2024, NIO began sales in Europe, including new models with battery-as-a-service capabilities

🇬🇧 ARRIVAL

Founded in 2015, it is a British startup that is actively developing in the field of Electric transport. It is implementing an innovative model of "microfactories" for local energy-efficient production of electric vans and buses. It has partnerships with Hyundai and UPS, which confirms its potential in sustainable transportation. Arrival is also working on solutions for energy efficiency and waste recycling in its production processes

🇨🇳 XIAOMI EV INC

A well-known electronics manufacturer. In 2021, Xiaomi announced the establishment of a subsidiary Xiaomi EV Inc. with more than USD 10 bn for the development of electric vehicles over 10 years. In March 2024, the first model of the Xiaomi SU7 electric car was presented, positioned as a competitor to the Tesla Model 3. It also invests in smart buildings, energy-efficient devices, and the Internet of Things (IoT)

APPLICATION

- Agriculture
- Energy efficiency
- Recycling of waste
- Smart grids and buildings
- RES
- Carbon capture
- Energy storage
- Electric transport

IN RECENT YEARS, TECHNOLOGY COMPANIES HAVE LAUNCHED NEW PRODUCTS AND INITIATIVES FOR ENERGY EFFICIENCY AND ENVIRONMENTAL PROTECTION

LATEST PRODUCTS LAUNCHES

DECEMBER 2022

In December 2022, Vestas presented a prototype of a 15 MW wind turbine. Its Performance Coefficient was over 60%

MAY 2023

ENGIE has unveiled the largest agro-voltaic park in Italy, which generates energy and improves land use efficiency by placing solar panels at high altitudes to enable field cultivation. The solution combines solar generation with the electricity needs of agricultural production

FEBRUARY 2024

Microsoft has introduced Microsoft Sustainability Manager, an AI-powered tool to support sustainability goals. It helps industrial companies to effectively monitor their emissions, waste, and water usage, and find ways to reduce their environmental impact

MARCH 2024

Schneider Electric has launched new energy management systems based on the Wiser Home app with AI for smart homes. This allows users to reduce their energy use and carbon footprint

MARCH 2024

General Electric has launched Predix, an industrial Internet platform that provides analytics and information to optimize the operation of renewable energy facilities. The platform improves grid management and operational efficiency across a variety of industry sectors

MAY 2024

Climeworks' Mammoth plant for the direct capture of carbon dioxide from the air and its storage has started operating in Iceland. The plant can capture up to 36 thousand tons of carbon dioxide annually and store it underground in basalt formations

COUNTRIES LEADING IN SUSTAINABLE DEVELOPMENT SET AMBITIOUS GOALS FOR ZERO CARBON EMISSIONS BY 2030-2050

SOME EXAMPLES OF GREEN TECH IMPLEMENTATION IN THE WORLD

🇩🇰 DENMARK

- The country has set a goal of achieving carbon neutrality by 2050. Since 1996, Denmark has already halved its carbon dioxide emissions
- According to the estimates specified in the Strategy, the share of RES should be about 39% by the end of 2022 (22% at the time of the Strategy's approval in 2011). In 2022, Denmark ranked 4th among EU countries in terms of the share of energy from renewable sources, reaching 41.6%
- The Danish capital, Copenhagen, reduced its carbon dioxide emissions by 42% between 2005 and 2024 through initiatives such as the introduction of district heating systems and the promotion of cycling

🇸🇪 SWEDEN

- Sweden aims to completely abandon the use of fossil fuels by 2045
- The 2020 targets stipulated that 50% of final energy consumption should be covered by renewable energy sources
- In 2023, RES provided 63% of Denmark's electricity supply. This growth was driven by a significant 53% increase in solar energy production compared to 2022
- The Swedish Hybrit initiative, launched in 2016, aims to produce steel using hydrogen as a fuel instead of coal and reduce carbon emissions. The technology is expected to be implemented by 2035

🇫🇮 FINLAND

- Finland aims to transition its economy to the principles of circularity and achieve carbon neutrality by 2035
- According to Finland's National Renewable Energy Action Plan, it was planned to achieve a target of 38% share of energy from renewable sources by 2020. In 2022, 42% of all energy comes from RES, and wind energy accounts for 55% of green generation
- The country is actively implementing green innovations: wind turbines and solar panels adapted to cold climates, the deepest geothermal plant, and waste recycling and utilization technologies

RENEWABLE ENERGY, ELECTRIC TRANSPORT AND FOSSIL FUEL REPLACEMENT WILL MAKE GREEN TECH LEADING COUNTRIES ACHIEVE THEIR GOALS

SOME EXAMPLES OF GREEN TECH IMPLEMENTATION IN THE WORLD

🇨🇭 SWITZERLAND

- Switzerland aims to achieve zero emissions by 2050. In particular, it was planned to achieve a 50% share of RES in gross final energy consumption by 2035
- In 2020, the share of renewable energy was 27% of total energy consumption, which is 10% more than in 1990
- Switzerland has one of the most efficient and environmentally friendly public transportation systems, as it runs mainly on RES
- Thanks to an innovative waste recycling system, Switzerland recycles 52% of its waste. According to the requirements, citizens pay for garbage bags that cannot be recycled

🇳🇴 NORWAY

- Norway plans to achieve carbon neutrality by 2030
- in 2025, 98% of all energy will come from RES, with hydropower accounting for the largest share. Norway has exceeded its National Renewable Energy Action Plan by 2020. Back in 2014, the share of energy from renewable sources in final energy consumption was already 69.2%
- Norway has banned the sale of cars with internal combustion engines since 2025 and is encouraging the purchase of electric vehicles
- The country invests heavily in research and ocean cleanup projects to preserve the ocean

🇩🇪 GERMANY

- The country plans to phase out coal-fired electricity by 2038 and increase the share of RES to 65% by 2030. In the first quarter of 2024, the share of RES in Germany reached a record high of 58.4%
- Wind and solar energy are the main sources of RES. In 2023, their share together amounted to about 75% of all installed RES
- Germany is one of the leading manufacturers of electric vehicles in the world (ranked 2nd in the world after China). Thus, in 2023, Germany produced 1.27 million cars (electric and hybrid), which is 30% of all cars produced in the country

THE BEST GLOBAL PRACTICES OF TRANSITION TO CLEAN ENERGY TO ACHIEVE CLIMATE GOALS AND A SUSTAINABLE ECONOMY

SOME EXAMPLES OF GREEN TECH IMPLEMENTATION IN THE WORLD

🇬🇧 UNITED KINGDOM

- The United Kingdom is actively working to increase the share of renewable energy sources (RES) in its energy balance. In 2024, the Clean Power 2030 Action Plan was published, which aims to ensure at least 95% of electricity generation from clean sources by 2030
- In 2023, the share of electricity generated from RES reached 60%, which is a significant increase compared to previous years
- In 2024, the last coal-fired power station was closed, marking the end of 142 years of coal-fired power in the UK and emphasizing the transition to cleaner energy sources

🏴 SCOTLAND

- In 2011, Scotland set a goal to achieve 100% of its electricity generation from RES by 2020. By the end of 2020, 97.4% was achieved, which is a significant achievement
- By 2030, the Scottish Government plans to have renewable energy sources provide 50% of electricity, heating and transportation needs
- Scotland is investing 800 million pounds in the construction of three of Europe's largest energy storage systems with a capacity of 1.5 GW, which will facilitate the integration of RES and ensure energy stability

🇨🇳 CHINA

- China is actively moving towards the transition to renewable energy sources (RES), setting ambitious goals and demonstrating significant achievements in this area
- According to the government's goal proposed in 2021, it was planned to exceed the capacity of renewable energy sources over fossil fuel capacity by 2025
- in June 2023, the share of renewable energy sources in China's electricity generation structure reached 50.9%, which is higher than the target for 2025

1.2

GREENTECH SECTOR’S OVERVIEW IN UKRAINE

RENEWABLE ENERGY TECHNOLOGIES HAVE THE POTENTIAL TO RESTORE UKRAINE'S ENERGY INDEPENDENCE BY REPLACING THE DAMAGED CAPACITIES

Over the past few years, the green technology market in Ukraine has been developing rapidly, despite the challenges posed by the war and economic uncertainty. One of the most widespread green technologies is RES and electric transport

RENEWABLE ENERGY

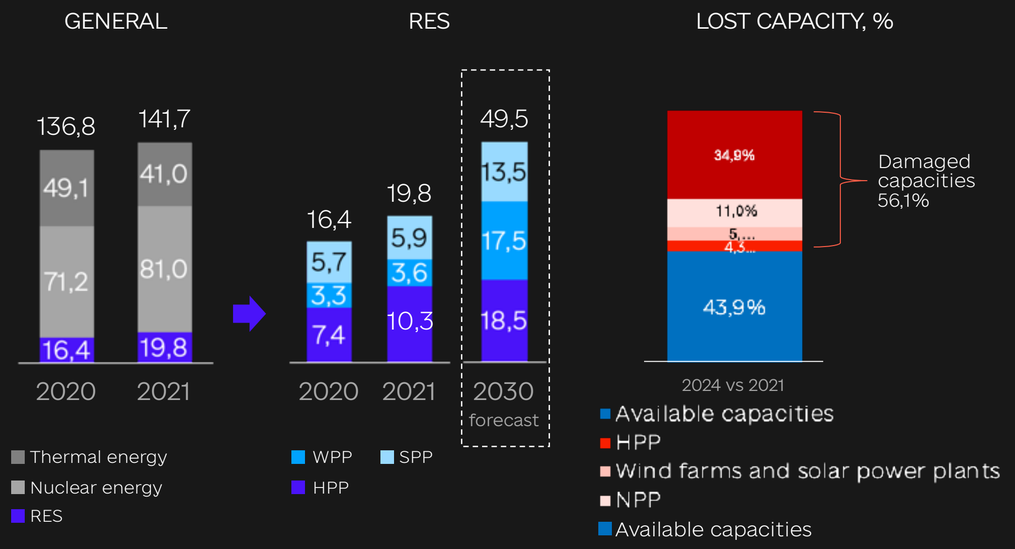
At the beginning of 2024, the installed capacity of renewable generation facilities in Ukraine reached 8.7 GW, which is by 238 MW more than in 2022. In 2023, the share of RES in the structure of electricity production was 22% (e.g., in Europe, it was 42%). According to the National Renewable Energy Action Plan for the period up to 2030, the share of RES should be 27% of total electricity production

ELECTRIC TRANSPORT

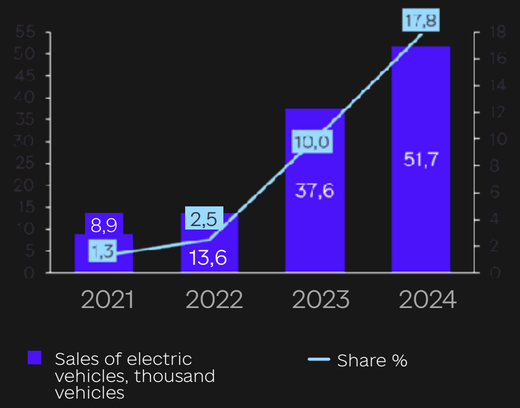
In 2024, 51.7 thousand electric cars were sold in Ukraine, which is 38% more than in the previous year and almost 6 times more than in 2021. The share of electric vehicles is almost 18% of all autos sold

In 2023, the network of charging stations amounted to 4.8 thousand stations. The ratio of electric vehicles to charging stations was 14.6/1 (in the EU, it was 11.5/1, with plans for 2030 at 7.3/1)

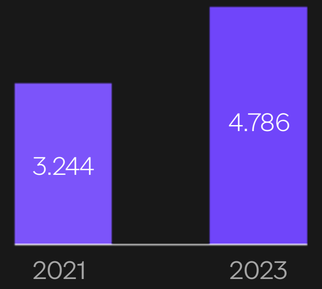
ELECTRICITY GENERATION IN UKRAINE, BN KWH



SALES VOLUME AND SHARE OF ELECTRIC VEHICLES IN TOTAL CARS IN UKRAINE



CHARGING STATIONS IN UKRAINE



WASTE RECYCLING, ENERGY STORAGES AND BIOFUEL PRODUCTION CONTRIBUTE TO DECARBONIZATION AND SUSTAINABLE DEVELOPMENT OF THE COUNTRY

RECYCLING OF WASTE

- Waste recycling in Ukraine is at a low level of development and requires legislative regulation and significant investment. Only 5%-10% of household waste is recycled, while in European countries this figure is up to 30%-60%
- In 2023, there were 6,000 landfills in Ukraine, only 19 of which had degassing facilities and 34 had sorting lines. For comparison, Germany has 400 recycling plants and 135 waste management companies. In 2023, the Law of Ukraine "On Waste Management" came into force, which establishes a priority-based waste management procedure.

BIOGAS AND BIOFUELS

- In 2023, there were 22 bioethanol plants in Ukraine, producing up to 380 thousand tons of biofuel per year. Currently, 3 new plants are under construction to increase the total capacity to 600 thousand tons per year. Starting 1 May 2025, 5% of bioethanol must be added to all fuels, which will significantly increase demand and incentives for the industry
- Also, in 2024, 83 biogas plants with a total capacity of 140 MW were operating in Ukraine
- Ukraine potential for biomethane production is 21.8 bn cubic meters per year, but as of 2024, only biomethane plants with a capacity of 6 mln cubic meters per year were in operation. In 2025, 2 Ukrainian holdings (MHP and Vitagro) exported biomethane to Europe for the first time, in the amount of 95 thousand cubic meters

ENERGY STORAGE

- The first industrial energy storage battery in Ukraine was built in 2021 on the territory of Zaporizhzhia TPP with a capacity of 1 MW, and in the same year a 1 MW unit from KNESS was launched
- According to experts, Ukraine needs up to 800 MW of energy storage capacity today. In 2025, it is planned to build energy storage systems with a capacity of 311 MW (Ukrenergo) and 200 MW (DTEK). For comparison, in the EU, 4.5 GW of capacity appeared in 2022 alone (95 GW are planned for 2050)

HYDROGEN PRODUCTION

- According to the draft Hydrogen Strategy of Ukraine for the period up to 2050, hydrogen production is expected to reach 1.3 mln tons in 2035 and up to 3.0 mln tons in 2050. Domestic consumption can be up to 50%, with the rest being exported
- In 2024, hydrogen production in Ukraine will reach about 360 thousand tons per year, which is mainly used for ammonia production (this is only 0.5% of global hydrogen demand)

LEADING UKRAINIAN COMPANIES IMPLEMENT RES AND ENERGY STORAGE TECHNOLOGIES, MAKING A CONTRIBUTION TO THE DEVELOPMENT OF GREENTECH

UKRAINIAN GREENTECH MARKET PLAYERS

ENERGY GENERATION, RES AND ENERGY STORAGE

LEADING COMPANIES

DTEK

Energy company that also specializes in wind and solar power plants with a total installed capacity of 1.1 GW

NAFTOGAZ

Naftogaz is actively developing renewable energy projects, focusing on solar and wind generation. It has solar power plants in Zhytomyr and Kharkiv regions with a capacity of 33.3 and 0.99 MW

UKRHYDROENERGO

Specializes in Hydro Power Plants and is actively working on the implementation of new RES technologies. They are also implementing energy storage projects, such as the installation of 212 MW of energy storage[1] as part of the Energy Storage project

MEDIUM-SIZED COMPANIES

KNESS

The company is engaged in the construction of solar power plants (1.2 GW), solar generation (34 MW) and energy storage, as part of which the first industrial energy storage system with a capacity of 1 MW was developed in Vinnytsia

CLEAR ENERGY

Energy production from biogas and biomass (21 MW), solar energy (3.5 MW) and landfill waste sorting (15 degassing projects)

ECO POWER

Development and implementation of renewable energy projects. They are engaged in the installation of solar and wind power plants

APPLICATION

- Main / Additional activities
- Operating business / Pilot projects

- Biogas and biomethane
- RES
- Recycling of waste
- «Green» hydrogen
- Energy efficiency
- Carbon capture
- Energy storage
- Electric transport

[1] Energy storage system

INNOVATIVE UKRAINIAN STARTUPS SHAPING THE FUTURE OF RENEWABLE ENERGY AND ENERGY-SAVING TECHNOLOGIES

UKRAINIAN GREENTECH MARKET PLAYERS

ENERGY GENERATION, RES AND ENERGY STORAGE

INNOVATIVE STARTUPS

IKNET

The engineering company was founded in 2018, which implements projects throughout Ukraine in RES (solar, wind, biogas and biomass) and Energy storage, within which, in cooperation with the concern Galnaftogaz, it designs plants with a capacity of up to 20 MWh

SOLARGAPS

A startup founded in 2015 that specializes in the development and implementation of smart blinds for windows with built-in solar panels. In 2019, it received a €1 million Horizon 2020 grant from the EU. The company implements projects in Ukraine and abroad, for example, it has implemented a 23 kWh project in a hotel in Cyprus

SIROCCO ENERGY

A Ukrainian startup founded in 2016 that develops an innovative wind panel with linear motion of blades moving along a closed track. In 2018, the company patented its wind turbine technology

In 2022, Sirocco Energy was preparing to launch an industrial version of a silent flat wind turbine with a capacity of
5 kW, which can be installed on the roofs of high-rise buildings

APPLICATION

- Main / Additional activities
- Operating business / Pilot projects
- Biogas and biomethane
- RES
- Recycling of waste
- «Green» hydrogen
- Energy efficiency
- Carbon capture
- Energy storage
- Electric transport

INNOVATIONS IN GREEN TECHNOLOGIES FOR THE AGRICULTURAL SECTOR AND WASTE PROCESSING ARE BECOMING ANOTHER PROMISING AREA FOR BUSINESS

UKRAINIAN GREENTECH MARKET PLAYERS

AGRICULTURAL SECTOR AND WASTE RECYCLING

LEADING COMPANIES

MHP

An agricultural holding engaged in the construction of biogas and biomethane production facilities. As of 2025, it has the Oril-Leader plant in Dnipro region with a capacity of 11 million cubic meters per year and is considering a project for a plant in Vinnytsia region with a capacity of 24 million cubic meters per year. In February 2025, MHP made its first biogas supply abroad, to Germany, in the amount of 27.4 thousand cubic meters of gas

NAFTOGAZ

A state-owned gas supply company that is actively developing bioenergy. It has projects for the construction of biomass and solid secondary fuel CHP in Zhytomyr and Lviv region with a capacity of 90 MW of heat and 11 MW of electricity, as well as CHP in Okhtyrka. Naftogaz plans to build at least 9 bio-CHP and bio-boiler plants with a capacity of 250 MW of heat and 52 MW of electricity

MEDIUM-SIZED COMPANIES

RECYCLING SOLUTIONS

It is engaged in waste processing in the metallurgical, energy and coal industries. In 2020, the company sold 1.82 million tons of metallurgical waste to 22 countries. Recycling Solutions is also actively engaged in the processing of ash and slag materials, helping to reduce the man-made impact on the environment

WASTE MANAGEMENT CENTER

A licensed company engaged in waste sorting and recycling (food, rubber, vehicles, electrical equipment, etc.) In 2020, it introduced the processing of expired dairy products into biogas together with Danone

APPLICATION

- Main / Additional activities
- Operating business / Pilot projects

- Biogas and biomethane
- RES
- Recycling of waste
- «Green» hydrogen
- Energy efficiency
- Carbon capture
- Energy storage
- Electric transport

УКРАЇНСЬКІ СТАРТАПИ УСПІШНО РОЗВИВАЮТЬ ІННОВАЦІЇ У СФЕРІ ПЕРЕРОБКИ ВІДХОДІВ, ЩО МАЮТЬ ПОПИТ НА ВНУТРІШНЬОМУ ТА МІЖНАРОДНИХ РИНКАХ

UKRAINIAN GREENTECH MARKET PLAYERS

AGRICULTURAL SECTOR AND WASTE RECYCLING

INNOVATIVE STARTUPS

ECOLA

A tech startup founded in 2018 that offers innovative solutions for sorting and recycling waste. The company offers a convenient service for households and businesses, including a mobile application and a chatbot that help users sort waste and find collection points. ECOLA has offices in Kyiv and London, which demonstrates its international presence

GREEN FARM

A company founded in 2023 in the Volyn region that produces fertilizers from spoiled vegetables and animal manure. The company main product is vermicompost made with the help of California worms

In November 2023, the company received a €10,000 grant from the European Union to scale up its vermicompost production

APPLICATION

- Main / Additional activities
- Operating business / Pilot projects

- Biogas and biomethane
- RES
- Recycling of waste
- «Green» hydrogen
- Energy efficiency
- Carbon capture
- Energy storage
- Electric transport

ELECTRIC TRANSPORT IN UKRAINE CONTRIBUTES TO THE REDUCTION OF EMISSIONS AND THE DEVELOPMENT OF NEW INFRASTRUCTURE

UKRAINIAN GREENTECH MARKET PLAYERS

ELECTRIC TRANSPORT

LEADING COMPANIES

OKKO

It cooperates with the Ukrainian network of TOKA charging stations, installing chargers at its filling stations. In April 2025, OKKO acquired a 50% stake in TOKA

DTEK

DTEK has launched its own 50 kW STRUM high-speed charging network for electric vehicles across Ukraine, which allows charging electric vehicles in 25-50 minutes

MEDIUM-SIZED COMPANIES

TOKA

The company has deployed a network of charging stations with network management via a cloud platform. It has a mobile application for users

ELLEK

Ukrainian manufacturer of electric bikes used in both the civilian and military sectors

INNOVATIVE STARTUPS

OCTA ENERGY

Ukrainian developer and manufacturer of charging stations for electric vehicles

EMGO TECHNOLOGY

Develops and manufactures electric vehicles and green energy solutions. It also develops a line of energy storage devices

APPLICATION

- Main / Additional activities
- Operating business / Pilot projects

- Biogas and biomethane
- RES
- Recycling of waste
- «Green» hydrogen
- Energy efficiency
- Carbon capture
- Energy storage
- Electric transport

UKRAINIAN COMPANIES IMPLEMENT PROJECTS IN LOW CARBON HYDROGEN AND CARBON DIOXIDE CAPTURE, CONTRIBUTING TO THE GREEN TRANSITION

UKRAINIAN GREENTECH MARKET PLAYERS

CHEMICAL INDUSTRY

LEADING COMPANIES

UKRHYDROENERGO

On October 24, 2023, the state-owned company Ukrhydroenergo signed a memorandum of cooperation with the Austrian company Andritz Hydro GmbH on the development and implementation of green hydrogen production projects in Ukraine

MEDIUM-SIZED COMPANIES

REGIONAL GAS COMPANY (RGC)

A leading Ukrainian company specializing in natural gas distribution. It is a member of the Ready4H2 consortium, which brings together leading European distribution system operators working to prepare gas distribution networks for the use of hydrogen as part of achieving climate neutrality

INNOVATIVE STARTUPS

CARBOMINER

Developer of modular Direct Air Capture technology for local carbon dioxide capture near the place of use (e.g., greenhouse)

HYDROGEN UKRAINE (H2U)

Specializes in the development of green hydrogen production projects. There are 2 hydrogen valleys in Odesa region and Zakarpattia with a capacity of 100 MW each. Launch in 2026-2028. The company is a member of the Ukrainian Hydrogen Council and the European Clean Hydrogen Alliance

APPLICATION

- Main / Additional activities
- Operating business / Pilot projects
- Biogas and biomethane
- RES
- Recycling of waste
- «Green» hydrogen
- Energy efficiency
- Carbon capture
- Energy storage
- Electric transport

1.3

GREENTECH STRENGTHS AND WEAKNESSES IN UKRAINE

RES AND BIOFUEL POTENTIAL, DEVELOPED IT INDUSTRY AND INTERNATIONAL COOPERATION ARE FAVORABLE FACTORS FOR GREEN TECH DEVELOPMENT

STRENGTHS OF UKRAINE FOR GREENTECH DEVELOPMENT

DEVELOPMENT POTENTIAL OF RES

The country vast territory with diverse climatic zones creates favorable conditions for the development of RES, like solar, wind and hydroelectric power

INTERNATIONAL COOPERATION

Ukraine status as a candidate for EU membership opens up access to European mechanisms for financing energy and climate research. In particular, the Horizon Europe Office based at the NRFU[1] promotes deeper international cooperation by providing access to programs with a budget of €95.5 bn for 2021-2027

DEVELOPED AGRICULTURAL SECTOR

Ukraine has a large resource base that can be used for the production of bioenergy and biofuels from agricultural waste (farming and livestock)

DEVELOPED IT INDUSTRY

Ukraine is an IT hub and a global leader in IT outsourcing, which allows for the creation of smart monitoring systems in the energy sector and AI solutions to optimize energy consumption and energy efficiency. The number of GreenTech startups is also growing in Ukraine

THE POTENTIAL OF THE HYDROGEN SECTOR IN UKRAINE

With nuclear power, a developed gas transportation infrastructure, a scientific base in hydrogen technologies, as well as international cooperation and existing initiatives, Ukraine has the potential to develop low-carbon hydrogen produced, among other things, by nuclear power

R&D AND SCIENTIFIC POTENTIAL

Ukraine has a potential for research and development of green technologies, which is being developed by both scientific institutions and business communities: energy industry leaders, technology parks, and green tech startups

[1] National Research Foundation of Ukraine

OBSOLETE INFRASTRUCTURE, LOW LEVEL OF ENVIRONMENTAL CULTURE AND HUMAN RESOURCES DEFICIT ARE THE KEY WEAKNESSES OF GREENTECH IN UKRAINE

WEAKNESSES OF UKRAINE FOR GREENTECH DEVELOPMENT

LOW AUTOMATION AND DIGITALIZATION OF ENERGY EFFICIENCY MANAGEMENT

Lack of effective energy management mechanisms and tools due to manual dispatching of the power system. Low level of implementation of smart grids, buildings and cities due to outdated infrastructure

INSUFFICIENT NUMBER OF QUALIFIED PERSONNEL

The lack of well-qualified personnel is one of the key barriers to RES implementation in Ukraine. According to the EUEA survey[1] (2020), 89.2% of energy employers believe that the vocational education system does not provide sufficient human resources. The war has worsened the situation due to the outflow of personnel, mobilization and reorientation of specialists to other industries

OUTDATED HOUSING STOCK AND INFRASTRUCTURE

Outdated residential buildings and networks have low energy efficiency and require energy audits and improvements. Low level of energy management in district heating

OUTDATED PRODUCTION BASE AND LOW COMPETITIVENESS

The high cost of capital for investments in the production base for green technologies reduces the competitiveness of Ukrainian producers in international markets and leads to dependence on imports of a significant part of key components

INSUFFICIENT LEGISLATIVE AND TAX INCENTIVES FOR GREEN TECHNOLOGIES

Insufficient legislative requirements for energy efficiency and lack of tax incentives for developers hinder the introduction of innovations in green technologies. Lack of effective economic incentives for the collection and recycling a significant amount of waste

ENERGY CONSUMERS ARE NOT MOTIVATED TO MAKE TECHNOLOGICAL CHANGES

Low interest of households in developing energy efficiency due to the existing subsidy system. Deterioration of incentives for RES installation due to lower prices and growing green tariff debts

[1] European-Ukrainian Energy Agency

1.4

BARRIERS AND OPPORTUNITIES TO BOOST THE GREEN TECHNOLOGIES IN UKRAINE

REGULATORY UNCERTAINTY, BUREAUCRACY, ECONOMIC INSTABILITY AND LACK OF DOMESTIC PRODUCTION OF EQUIPMENT CONSTRAIN THE GRENTECH DEVELOPMENT

BARRIERS FOR GREENTECH DEVELOPMENT IN UKRAINE

REGULATORY UNCERTAINTY

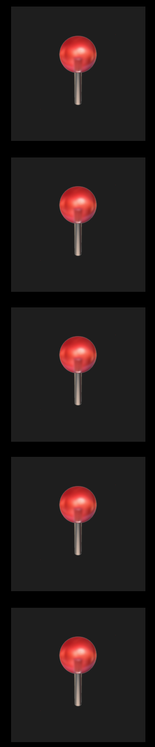
Price caps for electricity sales in Ukraine were changed three times in 2023-2024. In addition, most contracts do not exceed one month. This regulatory uncertainty creates risks for investors and complicates the planning of GreenTech projects

LACK OF EFFICIENT WASTE MANAGEMENT MECHANISMS

Despite a number of positive changes, the lack of opportunities for consumers to choose their own waste management service administrators and the lack of responsibility for non-compliance with waste sorting principles restrain the demand for GreenTech solutions in this area

ECONOMIC INSTABILITY AND MILITARY RISKS

Economic instability and limited access to finance due to military operations in the country. High risks deter investors from financing worthwhile GreenTech projects



CHALLENGIES IN LAUNCHING NEW FACILITIES

Launching new RES facilities requires significant capital investment and a large number of permits, the process of obtaining which can take about six months. That's why investors are mostly interested in ready-made sites with permits, while launching new projects lacks funding

LACK OF LOCAL PRODUCTION OF EQUIPMENT FOR GREENTECH

Due to the lack of domestic production of components and equipment for GreenTech projects, Ukraine is forced to import them from abroad, while the lack of large-scale insurance mechanisms discourages suppliers from cooperating in the face of increased security risks

RES, BIOENERGY AND BIOFUEL PRODUCTION HAVE GREAT POTENTIAL AND OPPORTUNITIES FOR THE DEVELOPMENT IN UKRAINE

KEY OPPORTUNITIES TO FACILITATE THE SECTOR DEVELOPMENT

01

DEVELOPMENT OF BIOENERGY AND BIOFUELS

- Construction of bioethanol, biomethane and biogas facilities and factories for the production of biofuels using biomass from agricultural and household waste and wood
- Creation of government programs to stimulate and support research and development of biofuel technologies, as well as support for biofuel producers
- Cooperation with international organizations and companies to develop and improve biofuel production technologies (including financing), as well as to establish its export

IMPROVING ENERGY EFFICIENCY AND DEVELOPING SMART GRIDS, BUILDINGS AND CITIES

REDUCING CARBON EMISSIONS AND WASTE RECYCLING

02

DEVELOPMENT OF RES AND THE PRODUCTION FACILITIES FOR RES

- Development of SPPs that can partially replace the destroyed TPP and HPP capacities, especially in the southern regions of the country with high solar activity
- Development of WPP in the promising areas of the steppe part of the country, the Black Sea coast and waters, and the Carpathians
- Launching the production of key components for renewable energy, such as inverters, metal structures, power and industrial electronics, gearboxes, and other technological elements

REDUCTION OF ATMOSPHERIC EMISSIONS, IMPROVEMENT OF ENERGY EFFICIENCY AND WASTE RECYCLING ARE IMPORTANT AREAS FOR GREEN TRANSITION

KEY OPPORTUNITIES TO FACILITATE THE SECTOR DEVELOPMENT

IMPROVING ENERGY EFFICIENCY AND DEVELOPING SMART GRIDS, BUILDINGS AND CITIES

- Development of “smart” grids: Integration of RES and energy storage systems into the general grid, use of "smart" control and management systems for energy distribution
- "Smart” buildings: integration of RES, implementation of IoT and AI to control heating, lighting, ventilation, etc.
- Development of “smart” cities: introduction of electric transport and charging station networks, traffic management, energy and water consumption control systems
- Implementation of state programs to improve the energy efficiency of outdated housing stock and district heating systems

DEVELOPMENT OF BIOENERGY AND BIOFUELS

DEVELOPMENT OF RES AND THE PRODUCTION FACILITIES FOR RES

REDUCING CARBON EMISSIONS AND WASTE RECYCLING

- Legislative regulation and implementation of tax incentives for emissions reduction and waste sorting and recycling
- Launching government programs to stimulate and support research and development of carbon dioxide capture and storage technologies and green hydrogen production
- Implementation of precision farming practices in agriculture to preserve organic carbon
- Construction of waste sorting and recycling plants using the latest technologies

HUMAN CAPITAL CRISIS IN UKRAINE CAN BE OVERCOME THROUGH SYSTEMATIC COOPERATION BETWEEN THE STATE, BUSINESS AND EDUCATIONAL INSTITUTIONS

KEY OPPORTUNITIES TO FACILITATE THE SECTOR DEVELOPMENT

WAYS OVERCOMING THE PERSONNEL CRISIS

Implementation of modern educational programs that meet international standards and market needs, with an emphasis on engineering and IT competencies for traditional and renewable energy, energy efficiency, circular economy, etc. Analyzing and updating curricula in cooperation with energy companies to bridge the gap between theory and practice

Development of dual education and practical training. Scaling up dual education, which combines studying at an educational institution with practical training at enterprises, will allow students to adapt to real working conditions faster and increase their motivation to stay in the industry

Promoting energy professions among young people. Conducting career guidance events, information campaigns, presentations and workshops to raise the prestige of energy professions and attract young people to the industry

Retraining and reskilling of adults and veterans. Launching special retraining programs for veterans and other groups willing to work in the renewable energy sector (e.g., the Veterans RE:Skil project, already being implemented by UN Global Compact Ukraine with the support of FCDO[1]). Intensive courses, trainings, individual development plans, and employment support for demobilized workers and others wishing to change their profession

Deepening cooperation between business, education and the state. Creating platforms for ongoing dialogue between companies, educational institutions, and government agencies to jointly analyze labor market needs, develop cooperation roadmaps, and attract investment. Involvement of business in the development of educational standards, practices, and financing of educational initiatives

[1] Foreign, Commonwealth & Development Office

2

KEY PROJECTS: GREENTECH

THE GREENTECH STRATEGY PROVIDES FOR 9 PRIORITY AREAS AND IDENTIFIES 3 TOP PROJECTS TO BE IMPLEMENTED IN UKRAINE FIRST

PRIORITY AREAS

- RES IN THE BASIC GENERATION
- RES IN THE LOAD-FOLLOWING GENERATION
- WASTE MANAGEMENT AND RECYCLING
- "SMART" NETWORKS AND BUILDINGS (INCLUDING AI-BASED ONES)
- ENERGY EFFICIENCY
- ELECTRIC TRANSPORT AND CHARGING STATION NETWORK
- HYDROGEN PRODUCTION
- BIOFUELS
- CRITICAL MATERIALS MINING

ТОППРОЄКТИ

BIOFUELS

PRODUCTION OF KEY COMPONENTS FOR GREEN ENERGY

AI CENTER OF EXCELLENCE FOR GREENTECH

2.1

TECHNOLOGY DEVELOPMENT PRIORITIES: GREENTECH

DEVELOPMENT OF RES FOR THE USE IN BASE AND LOAD-FOLLOWING GENERATION WILL CONTRIBUTE TO THE ENERGY INDEPENDENCE OF UKRAINE

PRIORITY AREAS OF TECHNOLOGY DEVELOPMENT

01 RES IN THE BASIC GENERATION

DEVELOPMENT OF SOLAR, WIND AND SMALL HYDRO POWER PLANTS ALONG WITH THE INTRODUCTION OF ENERGY STORAGE SYSTEMS TO ENSURE STABLE LOAD COVERAGE IN THE POWER SYSTEM

BENEFITS

- Ensure the gradual reorientation of Ukraine's energy sector to RES to contribute to the achievement of sustainable development goals and European integration
- Able to ensure stable energy supply through the development of energy storage systems
- Contribute to increasing the country energy independence by diversifying energy sources in the basic generation

KEY ACTIVITIES

- Launch of joint projects of the state and private business for the construction of SPP, WPP and small HPP
- Developing international cooperation with leading energy companies to attract investment in RES
- Organize local production of certain components for RES in Ukraine and reduce the tax burden on imports of energy storage systems

02 RES IN THE LOAD-FOLLOWING GENERATION

DEVELOPMENT OF BIOGAS PLANTS AND BIOFUEL THERMAL POWER PLANTS, WHICH ARE FLEXIBLE SOURCES OF RES AND CAN BE LAUNCHED TO QUICKLY RESPOND TO CHANGES IN THE POWER SYSTEM

BENEFITS

- More environmentally friendly energy sources compared to fossil fuels, which contributes to the decarbonization of energy
- Allows SPP and WPP to balance the power system during peak consumption hours and/or unfavorable weather conditions due to the ability to quickly start up at times of capacity shortages
- Contribute to a closed resource cycle by converting organic waste into energy

KEY ACTIVITIES

- Providing tax incentives to private businesses for equipment for biogas and biofuel plants
- Simplification of licensing procedures for the construction of biogas plants and biofuel thermal power plants
- Modernization of energy infrastructure to integrate bioenergy into the balancing system

DEVELOPMENT OF WASTE RECYCLING AND MANAGEMENT, INTRODUCTION OF SMART GRIDS WILL SIGNIFICANTLY INCREASE ENERGY EFFICIENCY IN THIS COUNTRY

PRIORITY AREAS OF TECHNOLOGY DEVELOPMENT

03 WASTE MANAGEMENT AND RECYCLING

TECHNOLOGIES TO PREVENT WASTE GENERATION, PREPARE IT FOR REUSE, RECYCLING, OTHER UTILIZATION (E.G., ENERGY PRODUCTION) AND DISPOSAL, ACCORDING TO THE HIERARCHY OF PRIORITIES[1]

BENEFITS

- Reducing the amount of waste in landfills and in the environment
- Reuse of materials significantly reduces the need for new resources
- Reduction of greenhouse gas emissions due to lower energy consumption for processing compared to the production of new materials

KEY ACTIVITIES

- Develop infrastructure for waste recycling and sorting, including recycling centers, sorting containers and stations, etc.
- Introduce tax incentives and preferential loans for waste collection and recycling companies
- Encourage waste sorting through the introduction of tax incentives and fines for consumers

04 "SMART" NETWORKS AND BUILDINGS (INCLUDING AI-BASED ONES)

INTELLIGENT POWER GRIDS THAT AUTOMATICALLY REGULATE ENERGY CONSUMPTION AND INTEGRATE RES, ENSURING THE RELIABILITY AND RESILIENCE OF THE POWER SYSTEM

BENEFITS

- "Smart grids are able to quickly detect and eliminate power outages, improving the reliability of the power system
- Efficient management of RES generation and consumption ensures grid stability and maximum utilization of renewable energy
- Optimization of distribution and reduction of technical losses of electricity increase the efficiency of the power system and contribute to the reduction of CO_2 emissions

KEY ACTIVITIES

- Development of AI CoE (Center of Excellence) and R&D hubs for testing technologies and developing smart grids
- Implementation of technologies for managing and monitoring energy consumption in real time
- Harmonization of Ukrainian legislation with EU standards in digitalization of networks and microgrids

[1] The priority is established in accordance with Directive No. 2008/98/EU on waste, which has been implemented by the Law of Ukraine 'On Waste Management' dated 9 July 2023
[2] Programs providing partial reimbursement for the cost of RES equipment and expenses for energy efficiency measures

IMPROVE ENERGY EFFICIENCY OF HOUSEHOLDS AND INDUSTRY THROUGH INFRASTRUCTURE MODERNIZATION AND ENERGY CONSUMPTION OPTIMIZATION

PRIORITY AREAS OF TECHNOLOGY DEVELOPMENT

05 ENERGY EFFICIENCY

IMPROVING HOUSEHOLD ENERGY EFFICIENCY BY MODERNIZING OUTDATED INFRASTRUCTURE AND INTRODUCING TECHNOLOGIES TO REDUCE ENERGY CONSUMPTION. IMPROVING INDUSTRIAL ENERGY EFFICIENCY BY OPTIMIZING PRODUCTION PROCESSES AND USING TECHNOLOGIES THAT REDUCE EMISSIONS AND ENERGY CONSUMPTION

BENEFITS OF ENERGY-EFFICIENT SOLUTIONS FOR HOUSEHOLDS

- Improving energy efficiency, including through building insulation, installation of IHS[1] and energy-saving lighting, reduces energy costs for households, which saves money
- Optimization of heat and electricity consumption by households will reduce the environmental impact

KEY ACTIVITIES FOR HOUSEHOLDS

- Increase economic incentives for the purchase of electric vehicles: subsidies and soft loans
- Development and scaling of charging station networks for electric transport in cities and on highways
- Creating a digital platform to bring together owners of free electricity capacity and potential investors in charging stations

BENEFITS FROM ENERGY-EFFICIENT SOLUTIONS FOR INDUSTRY

- Efficient management of generation, including RES, and energy consumption ensures the stability of the enterprise power system and the sustainability of production processes
- The introduction of energy-efficient technologies helps to reduce production costs and increase profitability, which in turn increases competitiveness in the global market

KEY ACTIVITIES FOR INDUSTRY

- Modernize industrial facilities through the launch of government support mechanisms, such as compensation programs, soft loans and grants, to introduce energy-efficient equipment, automation and transition to renewable energy sources
- Develop and implement mandatory standards for industrial enterprises, including requirements for equipment, energy consumption and regular energy audits

[1] Individual heating point

ELECTRIC TRANSPORT AND LOW-CARBON HYDROGEN TECHNOLOGIES WILL ACCELERATE THE ACHIEVEMENT OF EMISSION REDUCTION TARGETS

PRIORITY AREAS OF TECHNOLOGY DEVELOPMENT

06 ELECTRIC TRANSPORT AND CHARGING STATION NETWORK

WIDESPREAD INTRODUCTION OF PASSENGER ELECTRIC TRANSPORT: ELECTRIC CARS, ELECTRIC BUSES, ETC. AND DEVELOPMENT OF THE RELEVANT INFRASTRUCTURE

BENEFITS

- Significant reduction of greenhouse gas emissions and improvement of air quality
- Possibility to optimize costs by using a night tariff or own RES for charging
- Until 31 December 2025, Ukraine has a preferential customs clearance regime for electric vehicles, which provides for exemption from VAT and customs duties

KEY ACTIVITIES

- Develop infrastructure for waste recycling and sorting, including recycling centers, sorting containers and stations, etc.
- Introduce tax incentives and preferential loans for waste collection and recycling companies
- Encourage waste sorting through the introduction of tax incentives and fines for consumers

07 HYDROGEN PRODUCTION

LOW-CARBON HYDROGEN PRODUCED BY NUCLEAR POWER (PINK HYDROGEN) AND RES (GREEN HYDROGEN) CAN BE USED TO STABILIZE THE POWER GRID AND STORE ENERGY FROM RENEWABLE SOURCES

BENEFITS

- Reducing CO_2 emissions
- Energy storage from RES, which allows to stabilize the power system during periods of excess energy and peak loads
- Potential for exporting hydrogen to international markets, which could become an important economic asset for Ukraine

KEY ACTIVITIES

- Developing a legislative framework and national strategy for the development of pink hydrogen by 2050
- Development of infrastructure for local consumption of hydrogen as a way to accumulate energy from RES
- Use of ammonia as a way to store and transport hydrogen, which will help reduce infrastructure costs
- Introduce preferential lending and attract investors to finance hydrogen projects

BIOFUEL PRODUCTION AND CRITICAL MATERIALS MINING CAN BE USED FOR DOMESTIC NEEDS AND EXPORTED

PRIORITY AREAS OF TECHNOLOGY DEVELOPMENT

08 BIOFUELS

USE OF ORGANIC MATERIALS SUCH AS PLANTS, AGRICULTURAL AND FORESTRY WASTE TO PRODUCE BIOFUELS (BIODIESEL, BIOETHANOL)

BENEFITS

- Use of available and accessible resources and agricultural waste for biofuel production
- Possibility of biofuel production at the local level, which will contribute to balancing energy sources and increasing energy security
- Export potential of biofuels will contribute to Ukraine economic recovery

KEY ACTIVITIES

- Reducing administrative barriers (licensing conditions) to launching bioenergy production
- Introduction of tax incentives and interest compensation programs for the construction of biofuel plants by agricultural enterprises
- Development of infrastructure for biofuel distribution and storage, including the creation of a gas station system

09 CRITICAL MATERIALS MINING

LOW-CARBON HYDROGEN PRODUCED BY NUCLEAR POWER (PINK HYDROGEN) AND RES (GREEN HYDROGEN) CAN BE USED TO STABILIZE THE POWER GRID AND STORE ENERGY FROM RENEWABLE SOURCES

BENEFITS

- Critical materials mining can improve the Ukraine energy security by reducing dependence on imports of strategic resources
- Promote the development of local production of equipment and components for RES, reducing dependence on imports
- Opportunity to occupy a global niche and generate revenue from the export of rare earth metals

KEY ACTIVITIES

- Development of infrastructure for the extraction, processing and transportation of critical materials
- Investing in scientific R&D to improve production and processing technologies
- International cooperation on financing and technologies for the extraction of critical materials

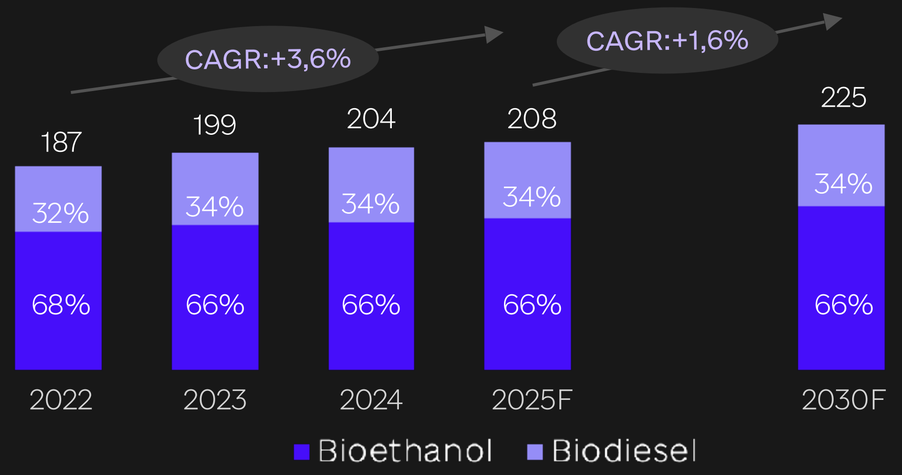
2.2

TOP PROJECTS: GREENTECH

TOPPROJECT 1 — BIOFUEL PRODUCTION

DEVELOPMENT OF THE BIOFUELS SEGMENT IN THE WORLD

BIOFUEL PRODUCTION IN THE WORLD, MLN MTN [1]



Biofuels are widely used as RES because they are derived from vegetable feedstocks: vegetable oils, agricultural and forestry waste. The main types of biofuels include bioethanol, biodiesel, and biogas

The global market size of biofuels in 2024 amounted to $148.83 bn. Revenue in the biofuels market is expected to grow steadily at a CAGR of +5% during 2025-2032, reaching ~$219.9 bn in 2023

The volume of global biofuel production in 2024 amounted to 204 million tons. At the same time, in 2023, biofuel consumption in the world amounted to 197.47 mln MT of fuel [1] . According to forecasts, by 2030, global biofuel consumption is expected to reach 224.58 mln MT of fuel [1] , growing at a CAGR of +2%

The projected growth in demand and production of biofuels in the world is based on the spread of government green transition policies to stimulate the transition to biofuels, as part of the decarbonization plans adopted by most countries

ПРИКЛАДИ ВИРОБНИКІВ БІОПАЛИВА У СВІТІ

🇪🇸 CEPSA TA BIO-OILS

Building the largest second-generation biofuel plant in Southern Europe (from inedible biomass) with a capacity of 500,000 tons per year. The launch is scheduled for 2026

🇺🇸 LANZAJET

In 2024, the world's first commercial jet fuel plant for ethanol was opened, with an annual capacity of 10 million gallons

🇧🇷 ACELEN

Investing $2.44 bn in a bio-refinery scheduled to be launched in 2026. The company will produce green diesel and jet fuel from hydrotreated vegetable oil (HVO)

[1] Million metric tons

TOPPROJECT 1 — BIOFUEL PRODUCTION

LEADING COUNTRIES IN GLOBAL BIOFUEL PRODUCTION

🇺🇸 USA

2023

$31,9 BN

38,8% Global production

In 2023, the U.S. remained the world's leading biofuel producer with 54.5 mln MT of production The U.S. is also the largest consumer of biofuels in the world, consuming 72.1 mln MT of biofuels in 2023, with a large share of bioethanol. The US leadership is explained, among other things, by the implementation of the Renewable Fuel Standard, which requires the addition of 10% ethanol to gasoline and up to 20% biodiesel to diesel. An important factor is also the widespread use of corn and soybeans as a stable raw material base for ethanol and biodiesel production

🇧🇷 BRAZIL

2023

$11,7 BN

21,9% Global production

Brazil holds the second place in the world in biofuel production thanks to a strong sugar cane processing industry, which is the main source of ethanol. In 2023, the country produced about 35.4 mln MT of biofuels, accounting for 21.9% of global production. The country's biodiesel consumption is growing, among other things, due to the mandate to blend 27.5% ethanol and 14% biodiesel with gasoline and diesel, respectively

🇮🇩 INDONESIA

2023

$4,2 BN

9,4% Global production

Indonesia ranks third in the world in biofuel production, mainly due to the use of palm oil for biodiesel production. The introduction of the B35 program in 2023, which requires 35% biodiesel blending in diesel fuel, helped boost production to 11.6 million MT, or 9.4% of global biofuel production

🇩🇪 GERMANY

2022

$9,6 BN

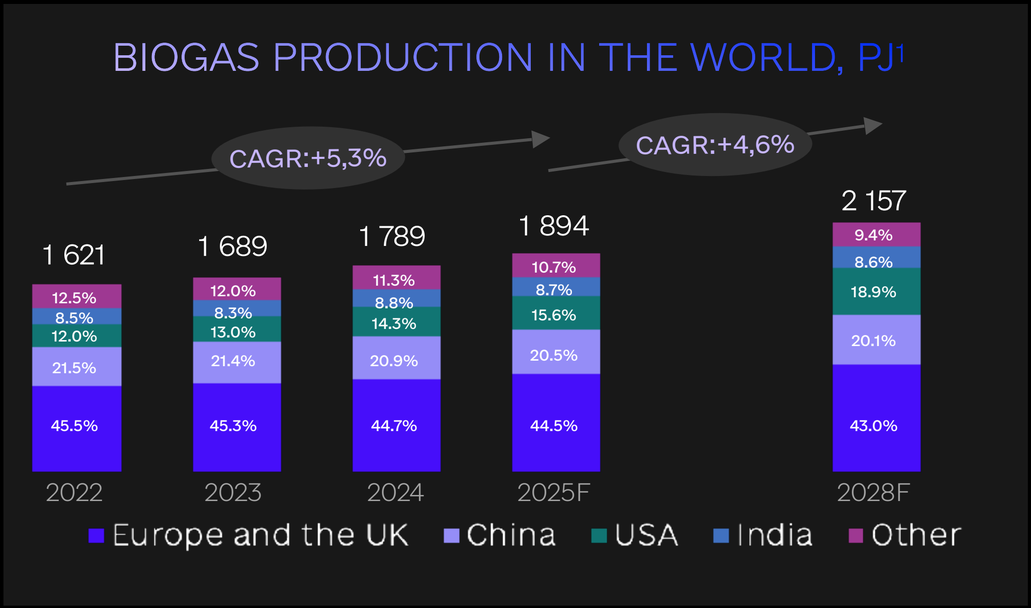
3,5% Global production

In 2023, Germany produced approximately 3.6 mln MT of biofuels, becoming one of the five largest producers in the world with a 3.5% share and the leader in biofuel production in Europe. An important factor was the introduction of mandatory quotas for renewable energy in the transportation sector, as well as the presence of large biodiesel plants, such as Cargill in Frankfurt. In addition, the active use of rapeseed as the main feedstock is an important factor in the country stable biofuel production

[1] Million metric tons

TOPPROJECT 1 — BIOFUEL PRODUCTION

DEVELOPMENT OF THE BIOGAS PRODUCTION SEGMENT IN THE WORLD



Biogas is the main by-product of the anaerobic digestion of wet biomass. It can be processed into biomethane to replace natural gas, or it can be used locally for heating or electricity and heat production. It is one of the ways to reduce fossil fuel consumption and contribute to the transition to zero-energy systems

In 2023, the GLOBAL MARKET for biogas was estimated at $65.5 bn, with a forecast of growth to $87.9 bn by 2030, with a CAGR of +4.2%

Global biogas production in 2024 amounted to 1,789 PJ, which is significantly less than the target for achieving carbon neutrality by 2050, according to which biogas production should be ~6,600 PJ by 2030

Global demand for biogas is projected to grow at an accelerated rate, increasing by 30% by 2030 compared to 2024, due to increased demand for products in various segments, including heat, electricity, automotive fuel, and cooking gas

LEADING COUNTRIES IN BIOGAS PRODUCTION

Almost half of biogas production is concentrated in Europe, with Germany accounting for ~20% of global consumption. Currently, biogas is used in Europe mainly for electricity and heat, but the projected growth is expected to come from the use of biomethane in the transportation sector

China produces about 21% of global biogas production. The main uses are in the residential sector, commercial and public services, for cooking, heating and lighting

in 2024, the United States will account for 14% of global biogas production. The US biogas market is expected to grow the fastest, thanks to government support policies, in particular the IRA law[2] , which provides tax incentives for production and investment in biogas facilities

[1] Petajouli
[2] Inflation Reduction Act, 2022

TOPPROJECT 1 — BIOFUEL PRODUCTION

DRIVERS OF GROWTH OF BIOFUEL PRODUCTION IN THE WORLD

ENERGY SECURITY

Increasing energy security concerns are an important driver of growth in the global biofuels market. The production of biofuels from renewable sources allows countries to reduce their dependence on imports of oil and other fossil fuels, ensuring a stable supply of energy

DECARBONIZATION OF TRANSPORT

Through the use of biofuels, in particular for heavy transport, aviation, and shipping, countries can achieve their transport decarbonization goals. Biofuels are an important alternative in reducing CO_2 emissions in sectors where electrification is difficult or not feasible

GROWTH DRIVERS IN THE WORLD

TECHNOLOGICAL INNOVATIONS

Innovations in waste processing play a key role in increasing biofuel production capacity, in particular through the possibility of using alternative feedstocks such as agricultural, municipal waste and algae. According to the IEA[1] , in 2021, biofuels from waste and non-food crops accounted for only 9% of total demand, but by 2030 this share is projected to grow to 40%, thanks to the introduction of new technologies

GOVERNMENT POLICY AND REGULATION

More than 50 countries have introduced mandates for blending biofuels with fossil fuels. The EU approved the Renewable Energy Sources Directive (RED II), which set a target of at least 14% RES in the transport sector by 2030, in particular through increased use of biofuels. The introduction of mandates, combined with other measures such as tax incentives, creates guaranteed demand and stimulates the development of production capacity

TOPPROJECT 1 — BIOFUEL PRODUCTION

GLOBAL PRODUCTION ENABLING AND CONSTRAINING FACTORS FOR THE DEVELOPMENT IN UKRAINE

ENABLING FACTORS FOR THE DEVELOPMENT IN UKRAINE

- Availability of large amounts of agricultural raw materials and waste for biofuel production
- Export potential of biofuels, due to the growing demand for RES in Europe and other regions
- In 2024, a law was passed introducing mandatory use of biofuel components in the amount of 5% in the transport sector starting from 1 May 2025. This creates demand for biofuels in Ukraine

CONSTRAINING FACTORS FOR THE DEVELOPMENT IN UKRAINE

👉 LOW COMPETITIVENESS

The cost of biofuel production in Ukraine is often higher than in countries with developed bioenergy sectors due to less efficient technologies and lack of large-scale investment

👉 HIGH COST OF INVESTMENT

The construction and launch of biofuel plants, especially of the second generation (based on waste or unconventional feedstocks such as organic waste or specially grown crops for biofuels), requires significant capital investment

👉 TAXATION OF CO_2 EMISSIONS FROM BIOMASS

In Ukraine, companies producing energy from biomass and biogas are obliged to pay a tax on CO_2 emissions, just like traditional fossil fuel producers. This puts biofuels at a competitive disadvantage, despite the fact that biomass is carbon neutral in most EU countries

👉 INSUFFICIENT STATE SUPPORT

The lack of government incentives, such as tax breaks or subsidies, reduces the attractiveness of investing in the biofuel industry. Ukraine is heavily dependent on imports of fuel for road transport and is focused on securing stable supplies from abroad, while not paying sufficient attention to the development of domestic alternative energy sources

TOPPROJECT 1 — BIOFUEL PRODUCTION

ASSESSMENT OF THE POSSIBILITY TO IMPLEMENT THE TOPPROJECT IN UKRAINE

MEASURES REQUIRED

DEVELOPMENT OF REGULATORY AND LEGAL MECHANISMS

- Adapting biofuel quality standards and certification systems to EU requirements
- Development of a national biofuel accounting system to ensure market transparency

INFRASTRUCTURE SUPPORT AND INNOVATION

- Development of infrastructure for storage, transportation and processing of biofuels, including terminals, warehouses, plants for the production of bioethanol and biodiesel
- Financing R&D in the field of new types of raw materials (agricultural waste, algae, household residues)

FINANCIAL INCENTIVES

- Exemption from the tax on CO_2 emissions from biogas plants to stimulate the transition to RES, as has already been implemented in a number of EU countries: Sweden, Denmark and Portugal
- Reducing financial barriers for investors through tax incentives and compensation for the cost of processing raw materials for biofuels

EXPECTED TIMELINE OF THE TOPPROJECT

Long-term

4-5 YEARS

EXPECTED EFFECT

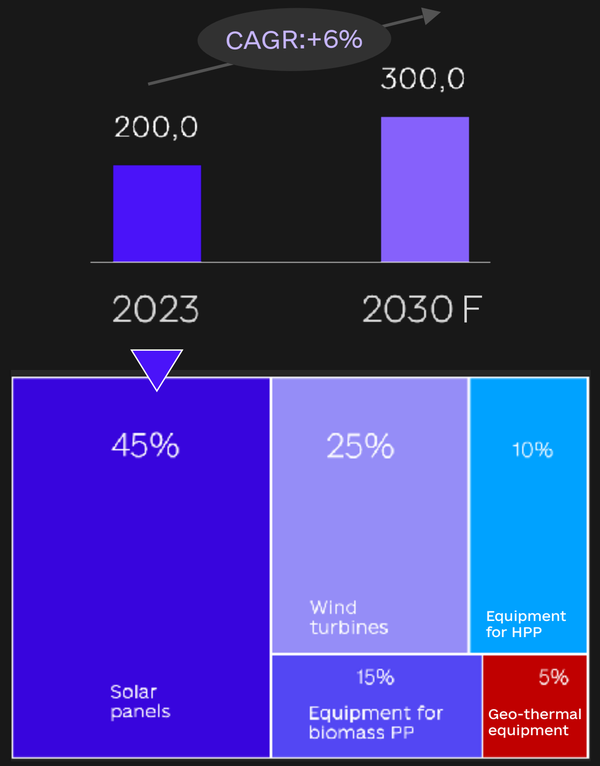
- ✓ Development of biofuel capacities will strengthen energy independence by reducing dependence on imports of traditional fuels
- ✓ Reducing greenhouse gas emissions by supporting the decarbonization of the energy sector
- ✓ Improving the quality of biofuels by adapting Ukrainian standards to EU requirements, in particular the RED II directive and EN 14214 standard for biodiesel, will facilitate product certification and open up access to European markets

TOPPROJECT 2 — PRODUCTION OF KEY COMPONENTS FOR GREEN ENERGY

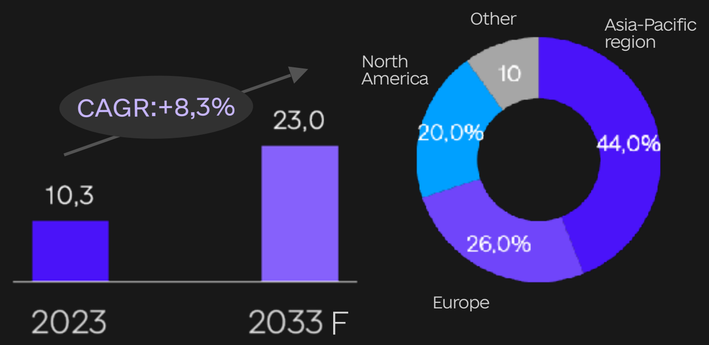
DEVELOPMENT OF THE RENEWABLE ENERGY EQUIPMENT MARKET IN THE WORLD

The global market for RES equipment, in particular in the segment of individual components, is actively developing amid the global transition to decarbonization, large-scale government support and growing investment in clean energy. The renewable energy equipment market covers technologies and components used for generation, transmission and energy storage from clean sources, including solar panels, inverters, wind turbines, batteries and control systems

GLOBAL MARKET FOR RES EQUIPMENT, $ BN

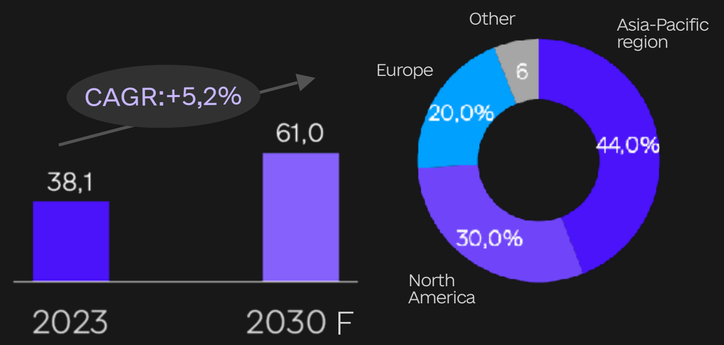


GLOBAL MARKET FOR SOLAR INVERTERS, $ BN



Inverters are key elements for solar power plants. Asia-Pacific dominates global shipments with China as a key producer with large capacity companies such as Huawei, Sungrow, and others. Europe and the United States accounted for 26% and 20% of the global solar PV production, respectively, with companies such as SMA Solar Technology, SolarEdge Technologies, and Enphase Energy

GLOBAL MARKET FOR POWER ELECTRONICS, $ BN



Power electronics provide efficient management of energy flows from RES. Asia-Pacific is the largest producer of power electronics, with key players such as Mitsubishi Electric Corporation, Fuji Electric, Toshiba, and others. The United States holds 30% of the market, particularly in the drives and inverters segments, with General Electric being the largest market player

TOPPROJECT 2 — PRODUCTION OF KEY COMPONENTS FOR GREEN ENERGY

DRIVERS OF RENEWABLE ENERGY EQUIPMENT GROWTH IN THE WORLD

INCREASING RES INVESTMENT

Growing public investment in RES and green energy policies in many countries are driving the global industry. Governments around the world are introducing a number of incentives to support the development of RES, including tax benefits and subsidies. This is driving the global demand for renewable energy equipment

INCREASING RENEWABLE ENERGY CAPACITY

The expansion of green energy generating capacities in the world and the active deployment of offshore and onshore solar and wind power plants is driving demand for the relevant RES equipment

GROWTH DRIVERS IN THE WORLD

TECHNOLOGY DEVELOPMENT

Global companies are integrating GreenTech solutions with new technologies such as AI, advanced analytics, IoT, blockchain, cloud computing, cybersecurity, big data, and others. These technologies expand the capabilities of equipment manufacturers and help speed up production by increasing efficiency

LOCALIZATION OF PRODUCTION AND INFRASTRUCTURE DEVELOPMENT

Protecting supply chains in green energy, optimizing the cost of RES components, and ensuring fast installation, maintenance, and repair of generating facilities are factors that accelerate the deployment of local production of RES equipment

TOPPROJECT 2 — PRODUCTION OF KEY COMPONENTS FOR GREEN ENERGY

GLOBAL PRODUCTION ENABLING AND CONSTRAINING FACTORS FOR THE DEVELOPMENT IN UKRAINE

ENABLING FACTORS FOR THE DEVELOPMENT IN UKRAINE

- Availability of natural resources, like silicon, aluminum, copper, which are necessary for the production of components for RES
- According to the DNAP 2030[1], Ukraine aims to reach 27% share of RES in total final energy consumption in 2030
- Introduce initiatives to support green energy, in particular through the provision of "green" tariffs and subsidies

CONSTRAINING FACTORS FOR THE DEVELOPMENT IN UKRAINE

👉 HIGH INITIAL PRODUCTION COSTS

Significant upfront investments to build modern facilities for the production of key green energy components, the high cost of modernizing existing facilities, and the inability to obtain short-term financial benefits discourage companies from building production facilities, especially in times of economic and political instability

👉 DEPENDENCE ON IMPORTED COMPONENTS

Ukraine is critically dependent on imports of high-tech components for the production of solar panels, batteries, etc., which makes domestic production vulnerable to price fluctuations on world markets and changes in exchange rates

👉 LACK OF QUALIFIED PERSONNEL

There is a shortage and outflow of well-qualified professionals, scientists and engineers in Ukraine, particularly in the field of RES, which may slow down the deployment of mass production of green energy components and the development of innovative technologies in the energy sector

👉 LIMITED EXPORT POTENTIAL

High competition from high-tech companies from the US, EU, and China, as well as the need for certification for compliance with international safety and quality standards, hinder Ukrainian manufacturers' entry into the global green technology market

[1] Draft National Action Plan for the Development of Renewable Energy until 2030

TOPPROJECT 2 — PRODUCTION OF KEY COMPONENTS FOR GREEN ENERGY

ASSESSMENT OF THE POSSIBILITY TO IMPLEMENT THE TOPPROJECT IN UKRAINE

MEASURES REQUIRED

STIMULATING LOCAL PRODUCTION

- Establish quotas for the share of Ukrainian-made components in RES projects with state support to stimulate domestic production and create sustainable demand

INVESTMENTS AND FINANCING

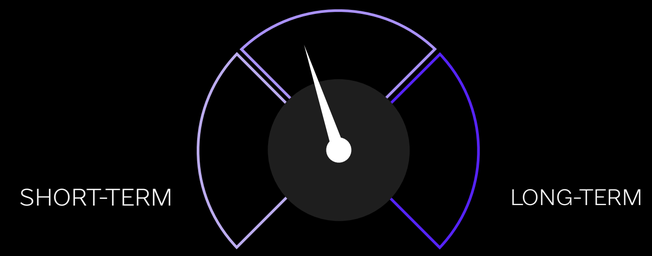
- State and international subsidies for RES component manufacturers, preferential lending and financing
- R&D funding for power electronics, inverters and other RES components

HUMAN RESOURCES DEVELOPMENT AND INTERNATIONAL COOPERATION

- Creation of training programs for specialists for the production of RES components
- Cooperation with international companies to transfer advanced technologies and share experience in developing the production of components for RES

EXPECTED TIMELINE OF THE TOPPROJECT

Medium-term
5-7 YEARS



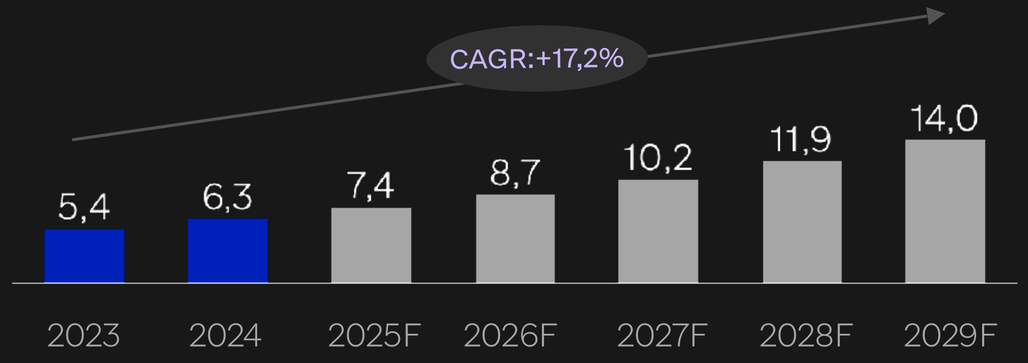
EXPECTED EFFECT

- ✓ Increase the share of local production of RES components and reduce import dependence
- ✓ Attracting investment and creating new high-tech jobs
- ✓ Improving energy security through localization of critical technologie
- ✓ Access to modern technologies and production practices necessary for the development of innovative potential in the field of green energy

TOPPROJECT 3 — AI CENTER OF EXCELLENCE FOR GREENTECH

DEVELOPMENT AND INTEGRATION OF AI IN ENERGY SECTOR AND SMART GRIDS

GLOBAL MARKET OF AI IN ENERGY, $ BN



EXAMPLES OF CENTERS OF EXCELLENCE FOR THE USE OF AI

AI for Decarbonisation's Virtual Centre of Excellence (ADViCE)

is part of the government AI for Decarbonization Programme initiative, which accelerates the development of innovative AI technologies for decarbonization programs to support the UK transition to Net Zero

Mohamed bin Zayed University of Artificial Intelligence (UAE) in cooperation with IBM has launched the AI Center of Excellence

aimed to implement AI and promote sustainable development. The center will develop carbon-neutral solutions for existing energy sources and fight climate change

The use of AI in the energy sector improves energy efficiency and grid economics and minimizes the impact of unstable RES generation. AI-powered forecasting of energy consumption and grid conditions helps to predict and reduce grid disruptions due to extreme weather or cyberattacks, increasing resilience and ensuring a stable power supply

AI Centers of excellence is a team of technical and business experts that brings together developers, researchers, businesses, and the government to coordinate research and innovation for the development of AI and its integration into the energy sector, and ensures compliance with strategic goals.

The main tasks of AI Centers of Excellence are to develop a strategy for integrating AI in the energy sector and implement it, integrate AI into energy processes (generation and energy storage, distribution and transmission, etc.) and technologies (RES, smart grids, etc.), use analytical data and digitalization, ensure cybersecurity of energy systems, organize training and competence development, international cooperation, etc.

In February 2025, the WINWIN AI Center of Excellence was launched, a center of excellence for the development and integration of AI into government processes and key areas of life: defense, medicine, education, and business, which can serve as an example for the Center of Competence for the Use of AI in Energy

TOPPROJECT 3 — AI CENTER OF EXCELLENCE FOR GREENTECH

DRIVERS OF AI GROWTH IN THE ENERGY SECTOR WORLDWIDE

INCREASED DEMAND FOR ENERGY SECURITY

The growing number of cyberattacks and malicious acts on energy systems is driving the development of new technologies to protect against threats. AI helps to identify and detect anomalies in real time, which increases the level of security

DEVELOPMENT OF SMART GRIDS

Smart grids involve the integration of numerous sensors and IoT devices to monitor and control energy flows. AI plays a key role here, analyzing large amounts of data in real time and ensuring efficient network management

GROWTH DRIVERS IN THE WORLD

INNOVATIVE INVESTMENTS

Increased investment in R&D of new technologies, including AI, is contributing to the creation of new centers of competence. Companies and governments are actively supporting the development of these technologies to ensure competitiveness in the global market

INCREASING THE EFFICIENCY OF DISPATCHING

The world's power systems are becoming increasingly complex, requiring efficient integration of RES into general grids, energy demand management, increasing the COP of power plants, forecasting, detecting system failures and overloads, and more

TOPPROJECT 3 — AI CENTER OF EXCELLENCE FOR GREENTECH

GLOBAL PRODUCTION ENABLING AND CONSTRAINING FACTORS FOR THE DEVELOPMENT IN UKRAINE

ENABLING FACTORS FOR THE DEVELOPMENT IN UKRAINE

- The startup ecosystem is actively developing in Ukraine, particularly in the AI sector. Support from the state and investors facilitates the introduction of the latest technologies and innovations
- Ukraine has a strong research and development base and high-quality technical education, which allows it to train high-level specialists in AI and energy
- Ukraine actively cooperates with international partners, which can facilitate the exchange of experience and access to advanced technologies

CONSTRAINING FACTORS FOR THE DEVELOPMENT IN UKRAINE

👉 IMPERFECT REGULATORY FRAMEWORK AND LACK OF COMMON STANDARDS

The lack of a clear legal framework and standards for AI use in critical infrastructure is a major deterrent to the implementation of the Excellence center, along with lengthy procedures for approving and implementing innovative projects

👉 INSUFFICIENT DEVELOPMENT OF TECHNOLOGICAL INFRASTRUCTURE

Ukraine's outdated energy and technology infrastructure makes it difficult to integrate modern technologies. The creation of AI Centers of excellence requires sensor systems, IoT solutions, and data centers, which are in short supply in Ukraine

👉 MILITARY RISKS AND CYBERSECURITY

Due to the high risk of destruction and damage to energy infrastructure facilities and equipment, the introduction of the latest technologies and AI makes the energy system vulnerable to cyberattacks

👉 LIMITED FUNDING

Limited public and private investments may hinder the implementation of developed AI solutions in the energy sector within the Excellence Center

TOPPROJECT 1

TOPPROJECT 2

TOPPROJECT 3

TOPPROJECT 3 — AI CENTER OF EXCELLENCE FOR GREENTECH

ASSESSMENT OF THE POSSIBILITY TO IMPLEMENT THE TOPPROJECT IN UKRAINE

MEASURES REQUIRED

CREATING AN ORGANIZATIONAL STRUCTURE AND PARTNERSHIPS

- Determining the organizational structure, forming a team and attracting specialist
- Ensuring cooperation with HEI, R&D centers, startups and international organizations

INFRASTRUCTURE DEVELOPMENT

- Identifying goals, areas and directions for AI application in the energy sector
- Building a technological base and collecting and managing data
- Attracting public and private funding for research and projects

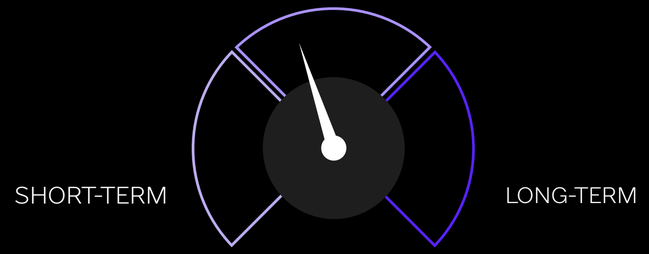
BOOSTING THE ACTIVITIES

- Conducting information campaigns to attract AI companies to cooperate
- Conducting seminars with energy companies, identifying pilot projects on AI integration in the energy sector

EXPECTED TIMELINE OF THE TOPPROJECT

Medium-term

3-5 YEARS



EXPECTED EFFECT

- ✓ A space for testing AI solutions that will optimize the process of their implementation in the energy sector, avoiding possible risks
- ✓ Implementation of advanced AI solutions in the energy sector thanks to the established cooperation with AI developers within the Competence Center
- ✓ Implementation of energy efficiency and optimization of energy system processes, energy saving
- ✓ Reducing greenhouse gas emissions in the energy sector