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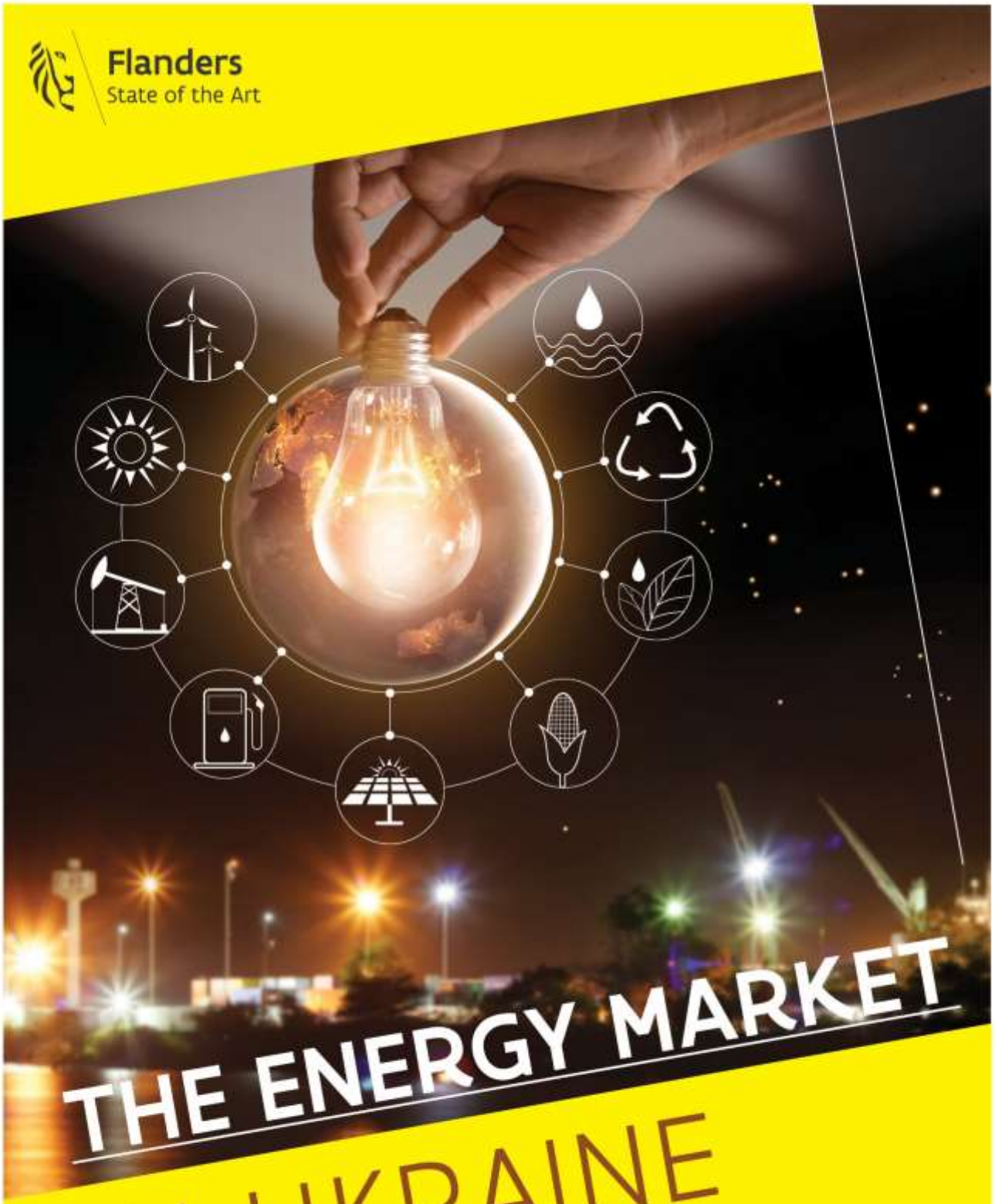


THE ENERGY MARKET IN UKRAINE

FLANDERS INVESTMENT & TRADE MARKET SURVEY

UKRAINIAN ENERGY MARKET

Overview of the sector and future projects

Publicatiedatum / 4.07.2018

ACRONYMS AND ABBREVIATIONS

BCM	Billion Cubic Metres
CHPP	Combined Heat and Power Plant
EPC	Engineering, Procurement, Construction
GDP	Gross Domestic Product
GCal	Gigacalorie
GTS	Gas Transportation System
GWh	Gigawatt-hour
HPP	Hydro Power Plant
HPS	Hydro Power Station
HPSPP	Hydroelectric Pumped Storage Power Plant
IRENA	The International Renewable Energy Agency
kW	Kilowatt
kWh	Kilowatt-hour
MJ	Megajoule
MW	Megawatt
MWh	Megawatt-hour
NEC	National Energy Company
NEURC	National Energy and Utilities Regulatory Commission of Ukraine
NNEGC	National Nuclear Energy Generating Company
NPP	Nuclear Power Plant
PSPP	Pumped Hydroelectric Energy Storage
PV	Photovoltaic
RE	Renewable Energy
RES	Renewable Energy Source
SE	State Enterprise
SHPP	Small Hydro Power Plant
SAEE	the State Agency on Energy Efficiency and Energy Saving of Ukraine
SPP	Solar Power Plant
SPS	Solar Power Station
TPP	Thermal Power Plant
UES	United Energy System
VAT	Value Added Tax
WPP	Wind Power Plant

CONTENT

1. ENERGY SECTOR OF UKRAINE IN KEY FIGURES

1.1 GENERAL OVERVIEW

Energy industry in Ukraine is a huge part of the economy of the country. The energy sector is first in terms of taxes paid (133 bln UAH or 25% of aid taxes) and in 2015 the energy industry ranked fourth in terms of GDP share (162 bln UAH or 8% of GDP). The sector employs 450 thsd people or 3% of the employed population.

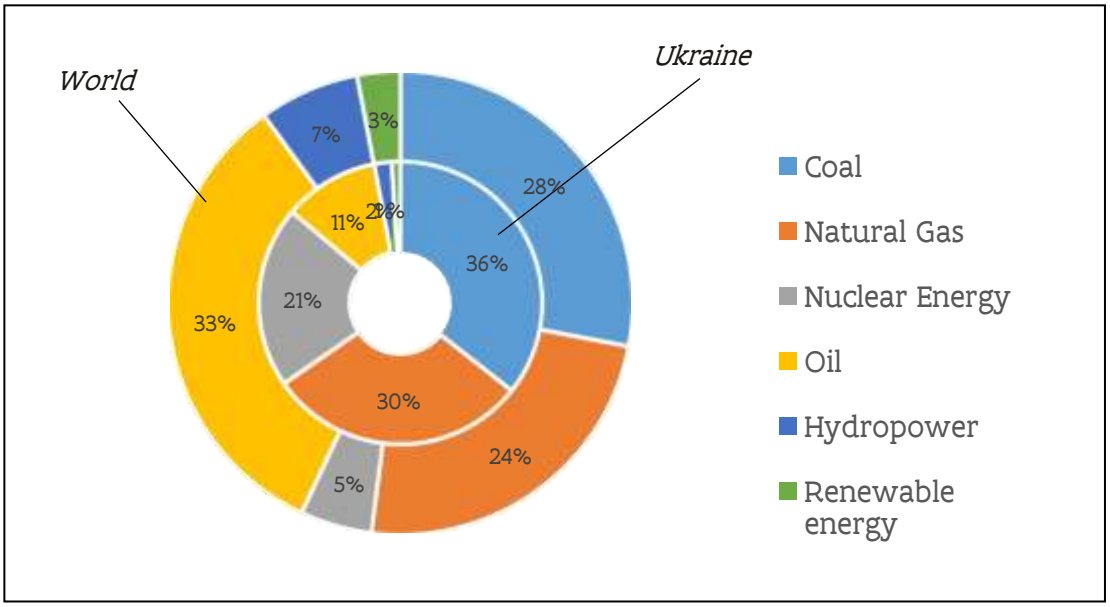
#	Source	% of total usage
1	Oil and gas condensate	19%
2	Coal	27%
3	Gas	33%
4	Oil products	77%
5	Nuclear fuel	100%

Table 1. Energy sources imported by Ukraine
Source: State Fiscal Service of Ukraine, Naftogaz of Ukraine, calculations based on statistics from the State Statistics Service of Ukraine, Aequo, Top Lead

Disclaimer: The data partly used in preparation of the tables, graphs and diagrams in "Ukrainian Energy Market" was provided in the "Energy industry in Ukraine", prepared by the content-marketing agency Top Lead, supported by experts from the American Chamber of Commerce in Ukraine and partners: AEQUO Law Firm, DTEK, Bosch Ukraine, Henry-Bleyzer. Analytical partner – Business Views. Media partners: Naftogaz of Ukraine, Interfax-Ukraine news agency, Enerhoreforma information and analysis portal.

In 2016 Ukraine ranked 28th for energy consumption. Despite this high consumption of energy, Ukraine is 60th in terms of economic volume. This suggests low energy efficiency. Ukraine is among the top 20 least energy-efficient countries in the world. Ukraine spends three times more on energy than Poland.

Figure 1. Energy consumption by source, %



Source: British Petroleum, Aequo, Top Lead

Ukraine ranks 7th in the world in terms of coal reserves, 12th for uranium, and 29th for natural gas. Lack of investment in exploration, processing and energy efficiency, as well as complicated bureaucratic procedures, impede the development of Ukraine's energy sector.

#	Energy Resource	Volume	Number of years for which there will be enough reserves at current production levels
1	Gas	591000 mln m^3	33
2	Coal	34000 mln tons	834
3	Uranium	0.1 mln tons	115
4	Oil	55 mln tons	25

Table 2. Confirmed amount of energy resources in Ukraine at the end of 2016 and their location
Source: British Petroleum, World Nuclear Association, Aequo, Top Lead

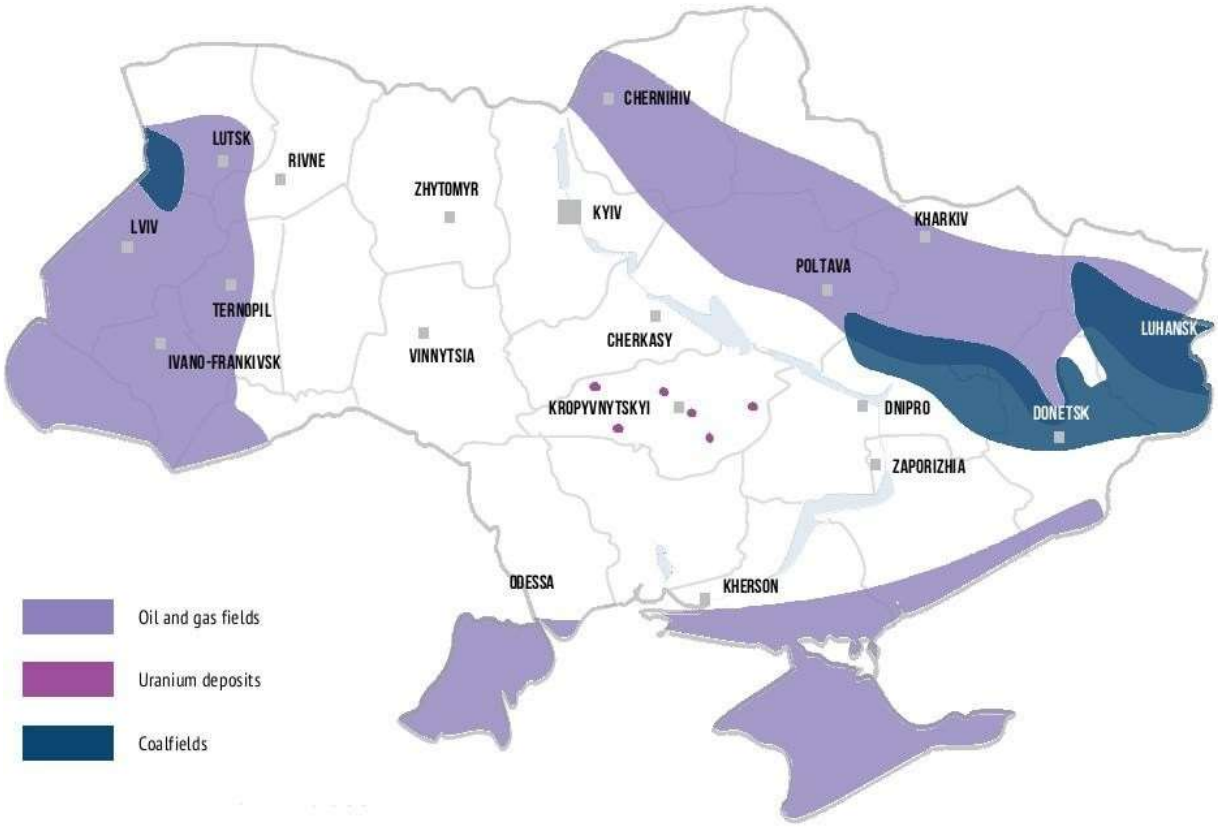


Figure 2. Energy reserves in Ukraine
Source: British Petroleum, World Nuclear Association, U.S. Energy Information Administration, Naftogaz of Ukraine. Prepared by the content-marketing agency *Top Lead*

Energy production

More than half of Ukraine's total electricity is produced in the Zaporozhia, Donetsk and Mykolaiv regions.

Type of energy production plant/Name of plant		Volume, bln kWh
NPP	Zaporizhia NPP	31
	South-Ukraine NPP	17
	Rivne NPP	17
	Khmelnytskyi NPP	15
Thermal power stations	Zakhidenergo	15
	Dniproenergo	13
	Centrenergo	10
	Skhidenergo	9
	Donbasenergo	3
Other	Pumped storage and hydroelectric power plants	9
	Heat plants and isolated generating plants	13
	Wind power station	0,9
	Solar power stations	0,5
	Biomass	0,2
Total		**153,6**

Table 3. Electricity balance. Energy production
Source: SE "Ukrenergo National Power Company", Aequo, Top Lead

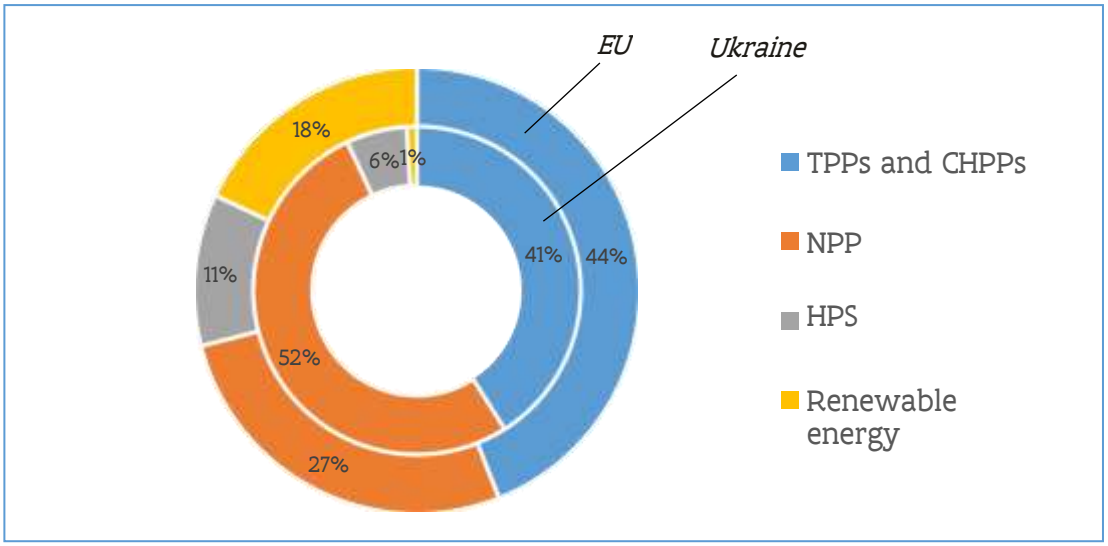
20% of Ukrainian electricity is spent on its own generation and transportation.

Energy consumption by type of expenses and industry		Volume, bln kWh
Expenses	Electricity costs for transportation in distribution networks and for the needs of suppliers at the regulated tariff	13
	Electricity consumption for production (needs of power plants)	13
	Electricity costs for transportation in trunk and interstate networks	4
	Electricity consumption of PSP in pumping mode	2
Industry	Metallurgical industry	29
	Machine building	4
	Food and processing	4
	Fuel	4
	Building materials	2
	Chemical and petrochemical	3
	Other	4
Population		36
Other	Municipal consumers	15
	Transport	7
	Other non-industrial consumers	6
	Farming	4
	Construction	1
Total		**151**

Table 4. Electricity balance. Energy consumption
Source: SE "Ukrenergo National Power Company", Aequo, Top Lead

It is difficult to determine the optimal electricity generation structure. Energy issues in each country have their own characteristics and challenges. There are plans to increase the share of renewable energy sources in Ukraine up to 12% by 2020.

Figure 3. Structure of electricity production in Ukraine and the EU in 2016, %



Source: International Energy Agency, State Statistics Service of Ukraine, Eurostat, Plan of development of the United Energy System of Ukraine for 2017-2026 (project), Aequo, Top Lead

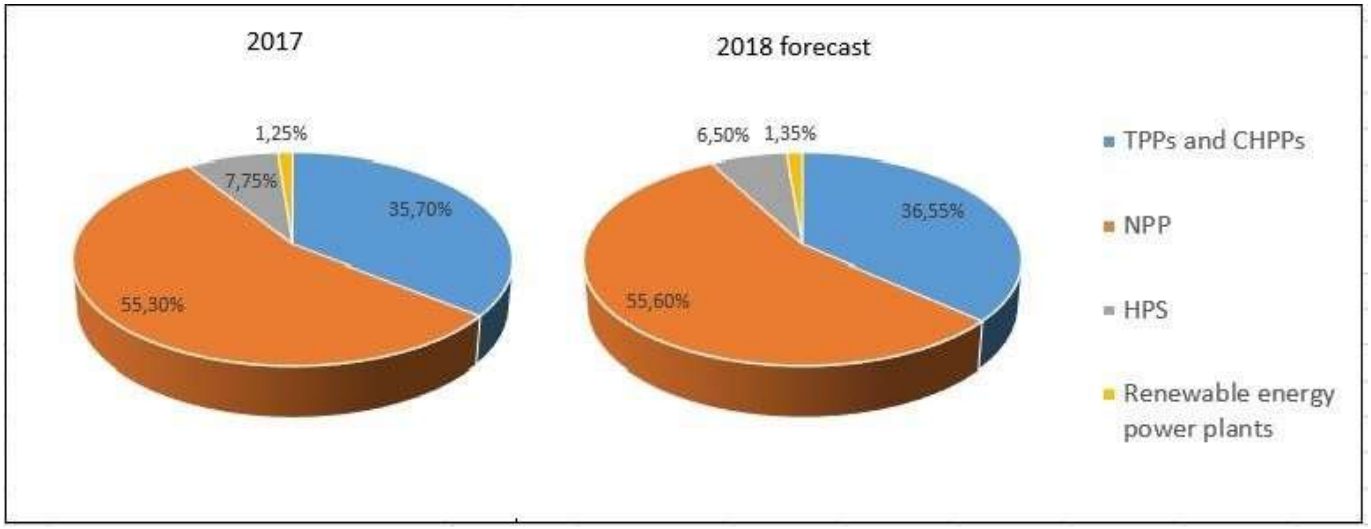


Figure 4. Structure of electricity production in Ukraine in 2017 and 2018 (forecast), %
Source: Ministry of Energy and Coal Industry of Ukraine, State Statistics Service of Ukraine

The key problem of the electric power industry is the high level of wear and tear of electric power equipment, the majority went into operation in the 1960s-1970s and were designed in accordance with the norms of the 1950s.

Years of operation	%
<25	8%
25-30	6%
30-40	22%
>40	64%

Table 5. State of transmission networks lines as of 31.12.2016
Source: Ministry of Energy and Coal Industry of Ukraine, SE "Ukrenergo National Power Company", Aequo, Top Lead

Since 1991, the population has significantly increased the efficiency of heat consumption.

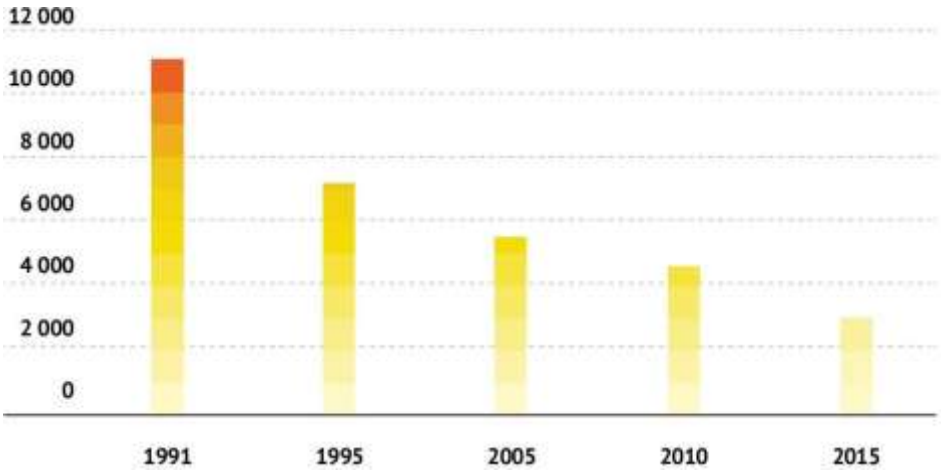


Figure 5. Heat consumption by the population, MJ/person
Source: Eurostat, State Statistics Service of Ukraine, Aequo, *Top Lead*.

Natural gas is responsible for more than 70% of the heat consumption in Ukraine.

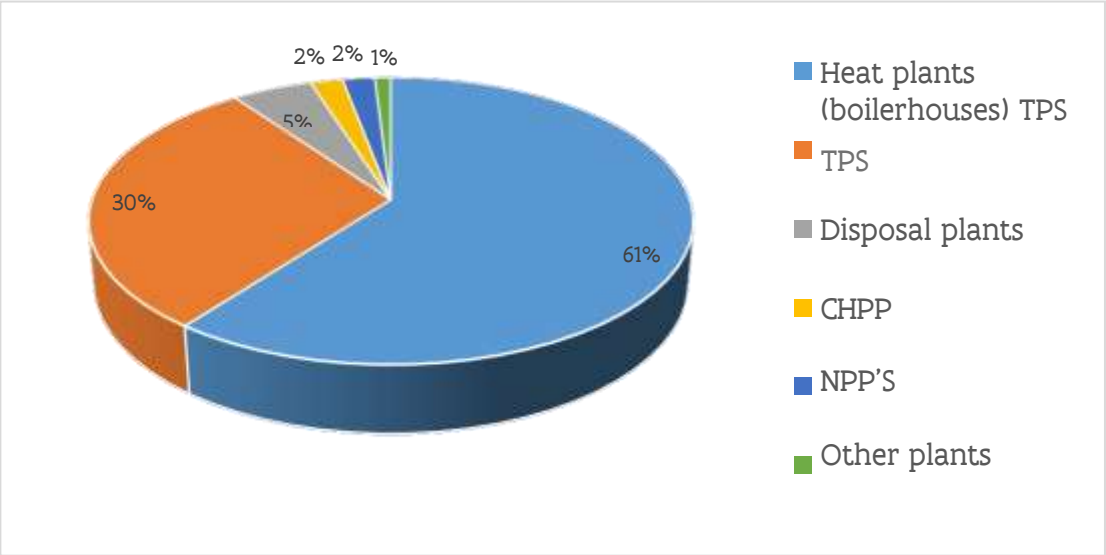
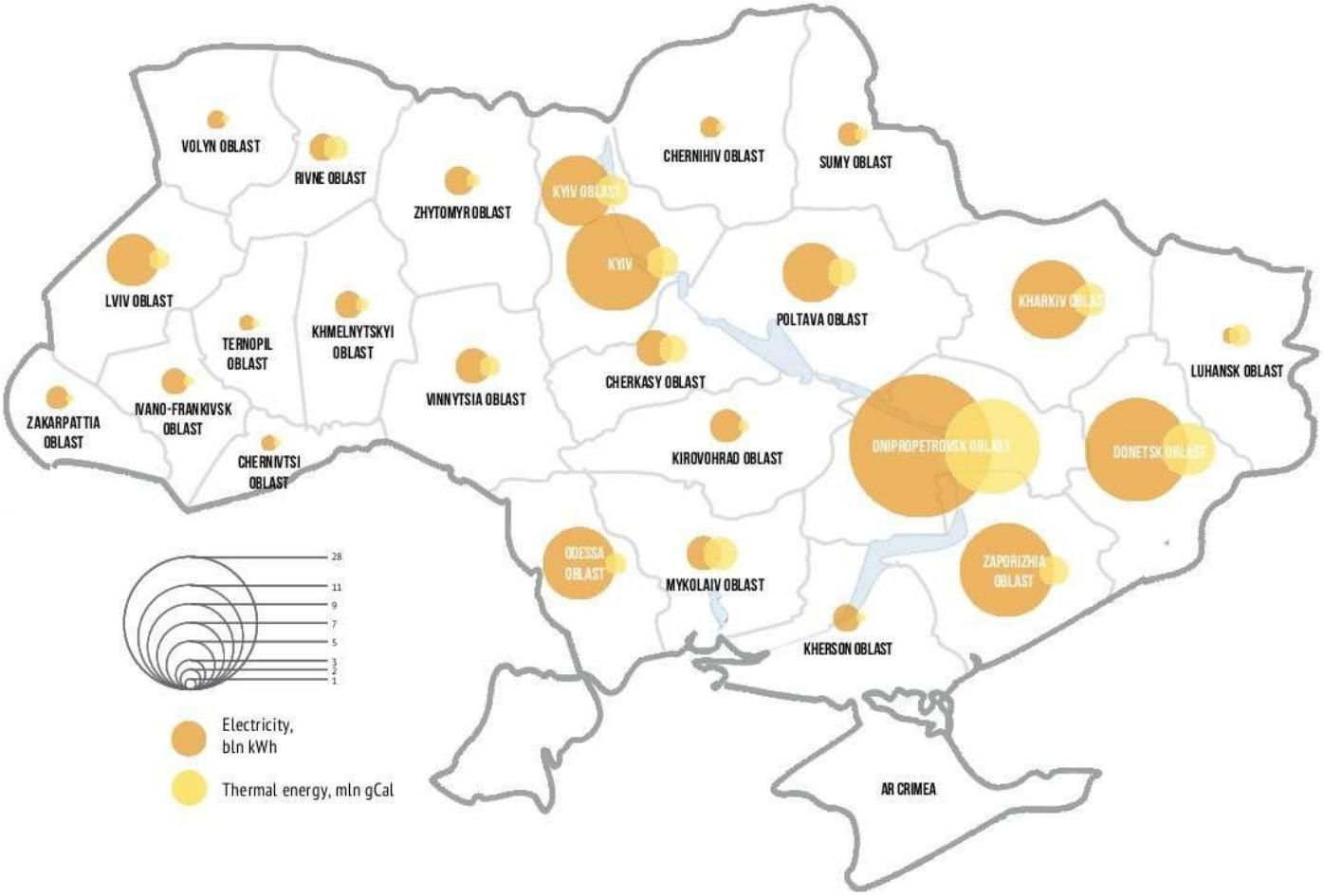


Figure 6. The structure of heat production in Ukraine 2016, %
Source: Eurostat, State Statistics Service of Ukraine, Aequo, Top Lead

Dnipro (Dnipropetrovsk) region is the country's biggest energy consumer. Energy consumption by region does not reflect the level of energy efficiency since it does not take into account the return on this consumption (Figure 7).

Figure 7. Energy consumption by regions 2016



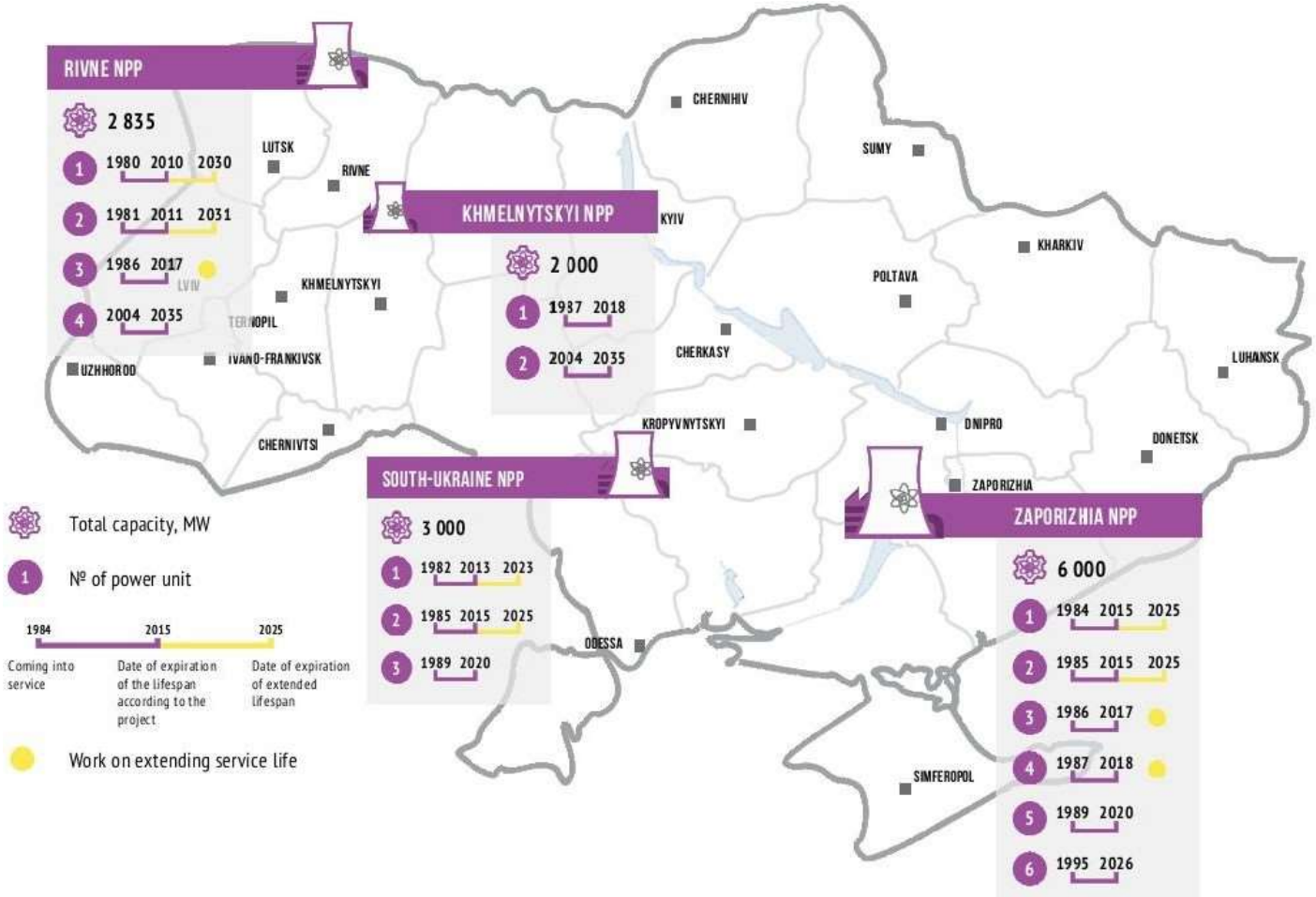
Source: State Statistics Service of Ukraine, Eurostat, State Inspection on Energy Supervision of Ukraine. Prepared by the content-marketing agency *Top Lead.*

1.2 NUCLEAR POWER PLANTS

Nuclear energy generation is very stable and covers the continuous (base) load under normal circumstances. Increased demand periods are covered at the expense of other generating facilities (usually thermal or hydraulic power). In addition to electric power, NPP's produce some volume of thermal energy which is commonly used for heat supply of the neighboring population. Despite the complexity and extreme scientific content of the nuclear plant construction technology, the principle of their electricity production is rather simple and little different from other power plants. Steam-driven electrical generating units are usually the same as at thermal power plants, but at NPP's, the required high-energy steam for their operation is generated by heated bars of fuel elements, where there is a continuing controlled reaction of nuclear decay of uranium atoms.

All the Ukrainian nuclear power plants are operated by the state-owned enterprise NNEGC Energoatom, which includes four nuclear power plants: Zaporizhya, Rivne, South-Ukrainian and Khmelnytskyi. NPP's operating 15 nuclear power units, of which 13 are of the VVER-1000 type and two of the VVER-440 type. The total capacity of these power units is 13,835 MW, or more than 26% of the installed capacity of all the Ukrainian energy generating plants. In 2016, nuclear plants produced 80,950 million kWh and supplied 75,931.4 million kWh to the United Energy System of Ukraine, which is equal to 53.7% of the total electricity supply to the Wholesale Electricity Market. The tariff for electricity produced by nuclear plants of SE NNEGC Energoatom was equal to 41.90 kopecks per kWh from January 1, 2016, and for heat energy production, UAH 53.03 per Gcal.

Figure 8: Nuclear power plants of Ukraine



Source: International Energy Agency, SE "Ukrenergo National Power Company", SE "Energoatom National Nuclear Energy Generating Company", State Statistics Service of Ukraine. Prepared by the content-marketing agency *Top Lead.*

All the Ukrainian nuclear reactors were built in the Soviet times according to respective technologies, and at this moment, the effective term of nuclear power units is extended through modernization and replacement of equipment, and improvement of the operational safety of the nuclear units. After the Chornobyl disaster, safety of Ukrainian NPP's has been confirmed by the positive opinions of unprecedented complex safety audits. In 2010, an uniquely large complex safety assessment in Ukraine under the joint Ukraine-EU-IAEA project. Each of the 15 active power units was assessed for safety status through self-assessment and proper inspection.

1.3 THERMAL POWER PLANTS

Thermal power plants provide flexibility of electricity production. In Ukraine are thermal power plants the second major type of electric power generation after the nuclear power plants. As of 2016, thermal generation is an absolute champion in terms of the installed capacity, with a share of 47.6% of the nationwide resources, while these plants cover electricity production by more than 30%. Their general operating principle involves pulverized coal combustion to obtain high-energy steam bringing into action power generating turbines.

TPP power units with a capacity of 100-200 MW can be effectively used as maneuvering capacities since they account only for 17% of the total generation opposing the 30-35% required under current conditions to guarantee stable and uninterrupted operation of the power engineering sector. The problem is also complicated by the high depreciation of some of these power units (11 units have already worked more than the maximum allowed 300,000 hours). Therefore, the common practice involves using those coal- dust units with a capacity of 300 MW in maneuvering semi-peak modes, which are designed for operation in the base mode and not generally suitable for maneuvering modes.
Such use of power units of thermal power plants, designed for operation in base modes is an additional factor of the increased wear of the equipment and poses an increased risk of accidents. Other hazards of TPP and CHP generation include dependence on black power generating coal, production and supply of which have been significantly complicated over the last years, as well as the "carbon footprint" - these plants generate most of the greenhouse gasses per unit of produced energy. The TPP of the Donetsk region produces 28% of the total electricity production at the TPP's.

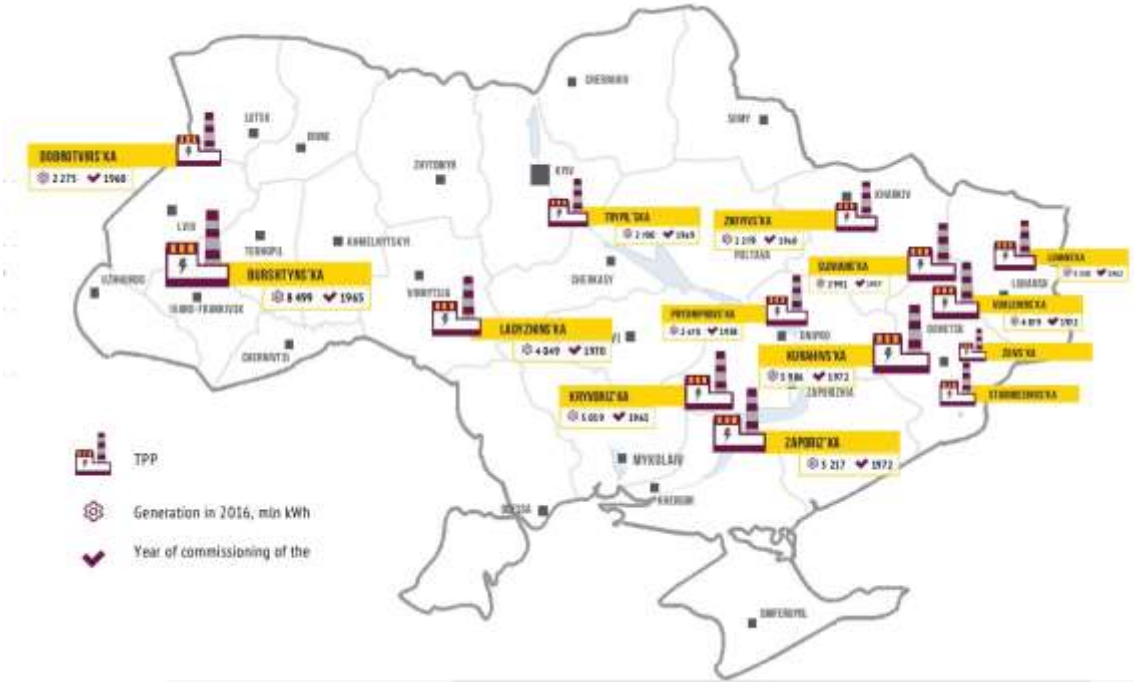


Figure 9. Thermal power plants of Ukraine
Source: International Energy Agency, SE "Ukrenergo National Power Company", State Statistics Service of Ukraine. Prepared by the content-marketing agency *Top Lead.*

Combined heat and power plants (CHP) are cogenerated electricity and heat production systems. On a nationwide scale, they are responsible for approximately 7-8% of the total generated electricity and for 85-90% of the thermal energy. Gas is the main fuel for most CHP's, taking into account the low efficiency of the existing equipment, high cost of gas, control of thermal energy tariffs, and absence of the heat energy market results in higher electricity tariffs established compared to TPP.
Most of the domestic CHP were built and equipped as early as in the 60-70s of the past century, assuming that some CHP's continue to operate turbines and boilers produced as far back as in the 1930s or imported from Germany

after the war as a contribution. According to expert calculations, Ukraine needs to spent approximately EUR 1-1.1 billion for the CHP modernization program.

2. RENEWABLE ENERGY SECTOR

2.1 GENERAL OVERVIEW

Thanks to its size and natural landscape variety, Ukraine has a considerable natural potential for generating energy from most of the renewable sources (RES) - proper solar radiation level, powerful wind potential on the coasts and in the mountains and large-scale resources for biomass production. Ukrainian alternative energy sector is considered by the largest international players as one of the most fast-growing and attractive European market among the developing economies. This is explained, to a large extent, by the advantageous geographical conditions in Ukraine as well as increase in the prices of communal services, such as electricity and heating in the last two years and favorable legal framework.

Active development of renewable energy sources in Ukraine began in 2009 after the introduction of a green tariff. Thus, from 2009, energy production from RES is stimulated through establishing an increased generation tariff for such producers, fixed in Euro ("green tariff"), as well as due to the guaranteed sale of all the produced electricity in the market. In 2016, "green tariff" was established in Ukraine for 127 business entities, which used 227 generating facilities. According to SE Energorynok, the sales volumes within the Wholesale Electricity Market for the said year amounted to approximately 1.8 GW of electricity per annum, while the share of RES in the structure of the wholesale market price for electricity accounted for 4.75% in 2016.

In its 2014 national action plan (Figure 10), Ukraine set the target of producing 11% of its energy from renewable sources by 2020. However, barring a massive influx of investment, it is likely to miss this goal. Renewables have attracted significant interest, but accounted for just 1.3% Ukraine's energy production in 2016, with another 6.1% from large-scale hydroelectric plants. One issue is that the 11% target does not factor in the Russian occupation since 2014 of Crimea and parts of the eastern Donbas, a major setback.

In September 2017 the Energy Strategy of Ukraine until 2035 was presented by the Ministry of energy and Coal Industry of Ukraine. According to this document, the renewable energy industry should play a significant role in the development of the energy sector.

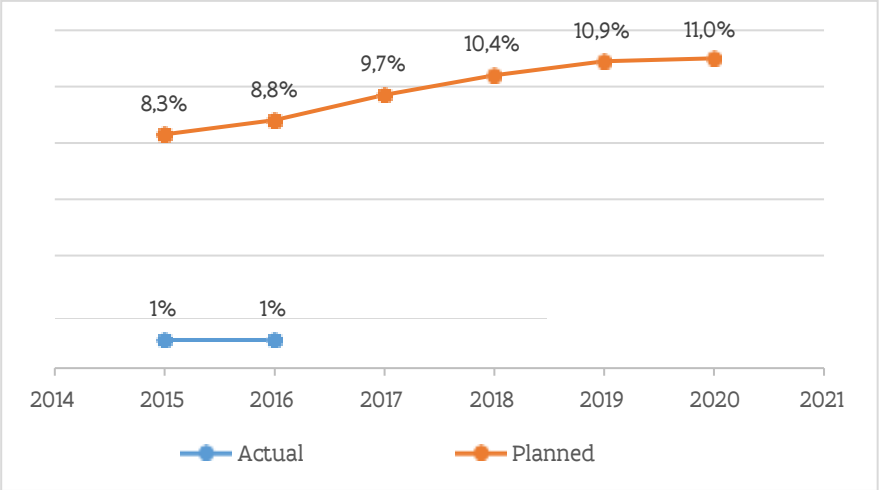


Figure 10. National plan to increase share of electricity generated by renewables
Source: Institute for Social and Economic Research, Kyiv Post

Following a couple of years of relative silence on the alternative energy market in Ukraine, a substantial increase in the number of commissioned renewable energy projects has been observed in 2016 and the beginning of 2017. Thus, a couple of dozen projects, mainly in relation to wind, solar and biomass energy, has already been completed in 2016 or are at their final stages of completion. Many of these projects are carried out by foreign investors, who turned to the Ukrainian market following introduction of legal reforms in relation to feed-in tariff regulation in mid-2015. The plans to construct high capacity solar power stations in the Chernobyl exclusion zone were announced by the Government of Ukraine.

Renewable sources in Ukraine can potentially meet 78% of electricity generation needs.

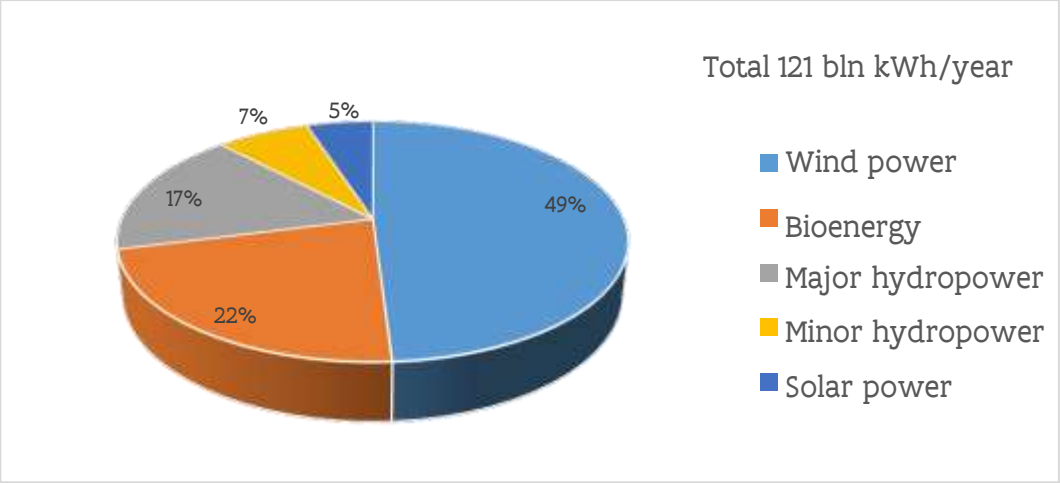


Figure 11. Potential of renewable energy in Ukraine
Source: Ukrainian Association of Renewable Energy

1 775 million kWh of electricity was generated from renewable sources in Ukraine in 2016 which is 183.9 million kWh more than in previous year. Renewable electricity saved about 1.315 million ton of CO2 emission. The RES share in total electricity generation in Ukraine reached 1% in 2016.

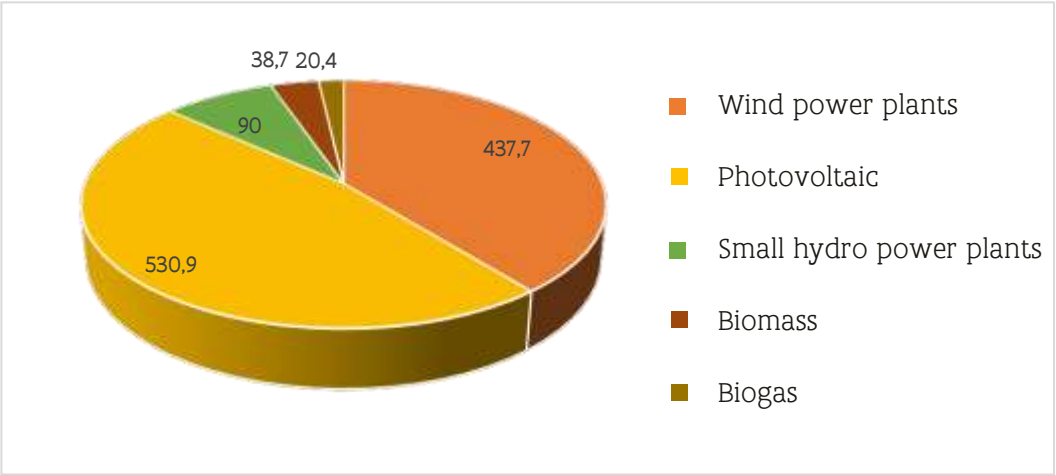


Figure 12. Structure of renewable power generation facilities, mainland Ukraine 2016, MW
Source: Ukrainian Wind Energy Association

As a result of the first half of 2017, 79 new renewable energy facilities with a total capacity of 182.7 MW were built in Ukraine. Total investments in these projects exceeded EUR 210 million. The total capacity of renewable energy facilities in Ukraine exceeded 1.64GW. It is estimated that by the end of the year, this figure may exceed 1.52 GW.

As of June 1, 2017, the total power of renewable energy sources in Ukraine, including solar and wind energy, small hydropower and biomass power plants (biogas), amounted to 1461.7 MW. During the first half of 2017, the total power of solar power stations increased by 132 MW (up 23% compared to January 1, 2017) to 705 MW in Ukraine. During this period, 67 new solar power stations have been constructed.

The capacity of the wind farms has increased during the reporting period by 20.7 MW (+ 4.7% from the beginning of the year) to 458.7 MW (data of the Ukrainian Wind Energy Association, UWEA). The capacities of small hydroelectric power stations make up 120 MW as of June 1, 2017 (+2 MW in the first half of the year). The growth of power facilities of biomass generation electricity was also almost 2 MW - up to 33 MW.
In accordance with the forecasts, in 2017 the Ukrainian market of equipment and services for renewable energy will exceed EUR 400 million. More than 60% of the Ukrainian renewable energy market will occupy the solar energy segment, about 30% in wind power, the remaining 10% accounts for the projects in small hydropower and biomass energy.

According to the experts from IB Centre expert group, will by the end of 2017 the Ukrainian and foreign developers be implementing more than 70 new investment projects in Ukraine in the field of renewable energy with a total installed capacity of more than 430 MW. In particular, in the second half of this year, 57 new large and medium-sized *PV plants,* as well as several hundred small roof solar power stations with a total capacity of around 360 MW will be built in Ukraine.

In the segment of *wind energy* in the second half of 2017, the growth is expected at a level exceeding 50 MW - up to 510 MW. In the segment of *small hydropower* there is expected a slight increase of 0.8 MW. In the *biomass segment*, the forecast of capacity growth is 4 MW to 37 MW for the electricity generation and more than 26 MW to 306 MW for the heat generation of biomass. Thus, according the results of 2017, the total capacity of renewable energy facilities in Ukraine can reach 1.9 GW, which is more than 4.3% in the overall energy balance.

Ukraine became a member of the International Renewable Energy Agency (IRENA) in January 2018. After joining IRENA, Ukraine will be able to increase green investments, get cheap loans for "green" projects, and develop joint mechanisms for financing the preparation and implementation of quality projects.

Application of Green (Feed-In) Tariff in Ukraine

For many years, Ukraine has been making efforts to stimulate financially the generation of electricity from alternative sources of energy. Such stimulations resulted in legislative provision for feed-in tariff, i.e., the guaranteed obligation of the state to purchase generated 'green' energy from producers of alternative energy. In order to foster the operation and development of renewable energy sources in Ukraine, a "green" tariff, or special feed-in tariff as this may be known in other jurisdictions, was introduced in 2009. The feed-in tariff for green projects in Ukraine is one of the highest in the world, which makes investment into this sector very attractive.

On 1 January 2017, the capacity of units generating electricity from renewable energy sources (the RES) in Ukraine and applying the green tariff was 1,118 MW.

The following types of RES are eligible for the green tariff:

- Wind;
- Solar;
- Biomass (originating from wastes, as well as remains of agriculture and forestry sectors);
- Biogas;
- Micro-/mini-/small hydroelectric power plants;
- Geothermal energy.

Below is the map showing the geography of the commissioned and the potential RES projects in Ukraine by types of the RES.

Figure 13. The commissioned and the potential RES projects in Ukraine
Source: Baker&McKinsey

Green tariffs apply to:
Legal entities generating energy from all types of eligible RES (the RES Producers);
Private households generating wind and solar energy with generating capacity not exceeding 30 kW (the PH).
Both new construction projects and existing renewable energy objects are eligible for green tariffs.

The feed-in tariff is fixed in euro until 2030 and is paid in the national currency. All generated electricity, except for volumes for personal needs, shall be paid under the feed-in tariff (except for blast furnace and coke gas, and for hydro plants with capacity of up to 10 MW).
It is the obligation of the wholesale electricity market of Ukraine to purchase "green" energy produced under the feed-in tariff and make full payment for the cost of electricity, regardless of the installed capacity or volume of supply.
The amount of the feed-in tariff depends on the commission date of the object of electricity generation, including construction phase of the electricity station, which produces electricity from alternative energy sources. The feed-in tariff for different types of renewable sources of energy is shown in the table hereunder (Table 6) (in EUR).

Type	Capacity (kW)	Commission date				
		01.07.-31.12.2015	2016	2017 - 2019	2020 - 2024	2025 - 2029
Ground-mounted solar power plant		0.1696	0.1599	0.1502	0.1352	0.1201
Rooftop power plant		0.1804	0.1723	0.1637	0.1475	0.1309
Wind turbine	<600	0.0582			0.0517	0.0452
	600-2000	0.0679			0.0603	0.0528
	>2000	0.1018			0.0905	0.0792
Biomass		0.1239			0.1115	0.0991
Biogas		0.1239			0.1115	0.0991
Hydro plant	<200	0.1745			0.1572	0.1395
	2000-1000	0.1395			0.1255	0.1115
	1000-10000	0.1045			0.0942	0.0835
Geothermal energy		0.1502			0.1352	0.1201
Solar power for private household	<30	0.2003	0.1901	0.1809	0.1626	0.1449
Wind turbine for private household	<30	0.1163			0.1045	0.0932

Table 6. The feed-in tariff for different types of renewable energy sources
Source: DLF attorneys-at-law, International Energy Agency, Energy and Utilities the National Commission of Ukraine

The use of equipment of Ukrainian origin by investors is stimulated by the relevant *premium to the feed- in tariff* (throughout all terms of its validity), if the electricity objects are commissioned by 31 December 2024. Therefore, if equipment of Ukrainian origin is used at least at the level of 30%, the premium to the feed-in tariff shall be 5%. If equipment of Ukrainian origin is used at least to the level of 50%, the premium to the feed-in tariff shall be 10%.

The level of use of equipment of Ukrainian origin at power plants that generate electricity from alternative energy sources is defined as the sum of respective percentages of specific items of equipment. The Law of Ukraine On Electricity provides an exhaustive list of equipment for each type of alternative energy source that qualifies for the feed-in tariff premium. However, it is worth noting that such premium to the feed-in tariff is not applicable to the electricity objects of private households.

Solar panels and private households

According to the State Agency for Energy Efficiency and Energy Saving of Ukraine, the rise in the number of solar panels installed by households is *the latest trend* in the alternative energy sector of Ukraine. This is attributed to the positive legislative changes made in 2015, which allowed private households to not only sustain their electricity needs by means of using renewable energy sources, but also to sell any such excessive energy generated under the feed-in tariff. The trend has been growing continuously for the last two years.

Thus, pursuant to the Law of Ukraine On Electricity, private households are entitled to set up electricity generating facilities with a capacity of up to 30 kW and sell electricity produced from solar or wind energy under the feed-in tariff to the electricity distribution company in the amount that exceeds monthly consumption of electricity by such private households.

Tax benefits

For a number of years, the producers of "green" energy in Ukraine have enjoyed quite substantial tax benefits. However, amendments made to the Tax Code of Ukraine in late 2014 cancelled many tax privileges for producers of electricity from alternative energy sources, specifically in relation to income and land taxation. Currently only those entrepreneurs constructing renewable energy objects in the Chernobyl exclusion zone enjoy tax privileges; the rent for land use in the exclusion zone is paid at 15% (i.e., with an 85% discount).
Nevertheless, some tax benefits are still available for renewable energy producers. Thus, pursuant to the Tax Code of Ukraine, no VAT is applicable to transactions on import to the territory of Ukraine of:
equipment which is functioning on the basis of alternative energy sources, energy saving equipment and materials, means of measuring, control and management of energy resources, equipment and materials for production of alternative types of fuels or electricity from renewable energy sources;
materials, equipment, components for manufacturing equipment, which is functioning on the basis of renewable energy sources; raw materials, equipment and components for production of alternative types of fuels or electricity from renewable energy sources; energy saving equipment and materials, products whose operation provides saving and rational use of energy resources; means of measuring, controlling and managing energy resources.

In addition, pursuant to the Customs Code of Ukraine, the abovementioned goods are exempt from import and export duties, provided that the taxpayer uses them for its own production and that no identical goods with the same qualities are produced in Ukraine. Nevertheless, this tax benefit, while being settled on paper, cannot be actually implemented in practice due to the failure of the Cabinet of Ministers of Ukraine to approve the list of such goods with specification of codes under the Ukrainian Classification of Foreign Economic Activity Products.

Furthermore, the Tax Code of Ukraine provides that any transactions regarding sale of electricity generated by qualified cogeneration units and/or from renewable energy sources are not subject to excise tax.

2.2 HYDRO ENERGY

Hydro energetics accounts for the biggest share of renewable electricity in Ukraine. The electricity produced at the hydroelectric power plants is one of the cleanest as it leaves almost no carbon footprint. Hydrogeneration is renewable, broadly speaking, and forms a class of so-called traditional renewable energy production.

The principle of the operation of the HPP is the conversion of the mechanical energy of the water stream into electricity by creating a concentrated drop (pressure) on the dedicated section of the river. The rolling diagram of the large Ukrainian HPP is characterized by the fact that the pressure on the hydroelectric power station is created at the expense of the level of the river's dam with the formation of a reservoir, which is also used to regulate the flow in order to provide the required mode of operation of the hydroelectric power station. At Dniester HPP, with a capacity of 0.7 million kW, the pressure is 54 m, while at the Kyiv HPP of 0.36 million kW it is reduced to 11 m. In this case, the pumping stations have the possibility of a reverse process of water injection at a considerable height with the help of powerful pumps. Such technology allows to use the surplus of available electricity at minimum cost for the accumulation of kinetic energy of water with subsequent use in periods of peak demand from consumers.

Electricity at the HPP is produced by PJSC "Ukrhydroenergo" and SE "Energoatom". Ukrhydroenergo is 100% owned by the state represented by the Ministry of Energy and Coal Industry and operates 7 HPP's with a total installed capacity of 4501 MW. Energoatom operates 1 HPP (installed capacity of 11.5 MW). The largest hydroelectric power station in Ukraine is DneproGES, the capacity of all units of which is 1539.8 MW. Most of the hydroelectric power plants in Ukraine were built in the second half of the 20th century. Their share is 11% of the total power generation in the country.

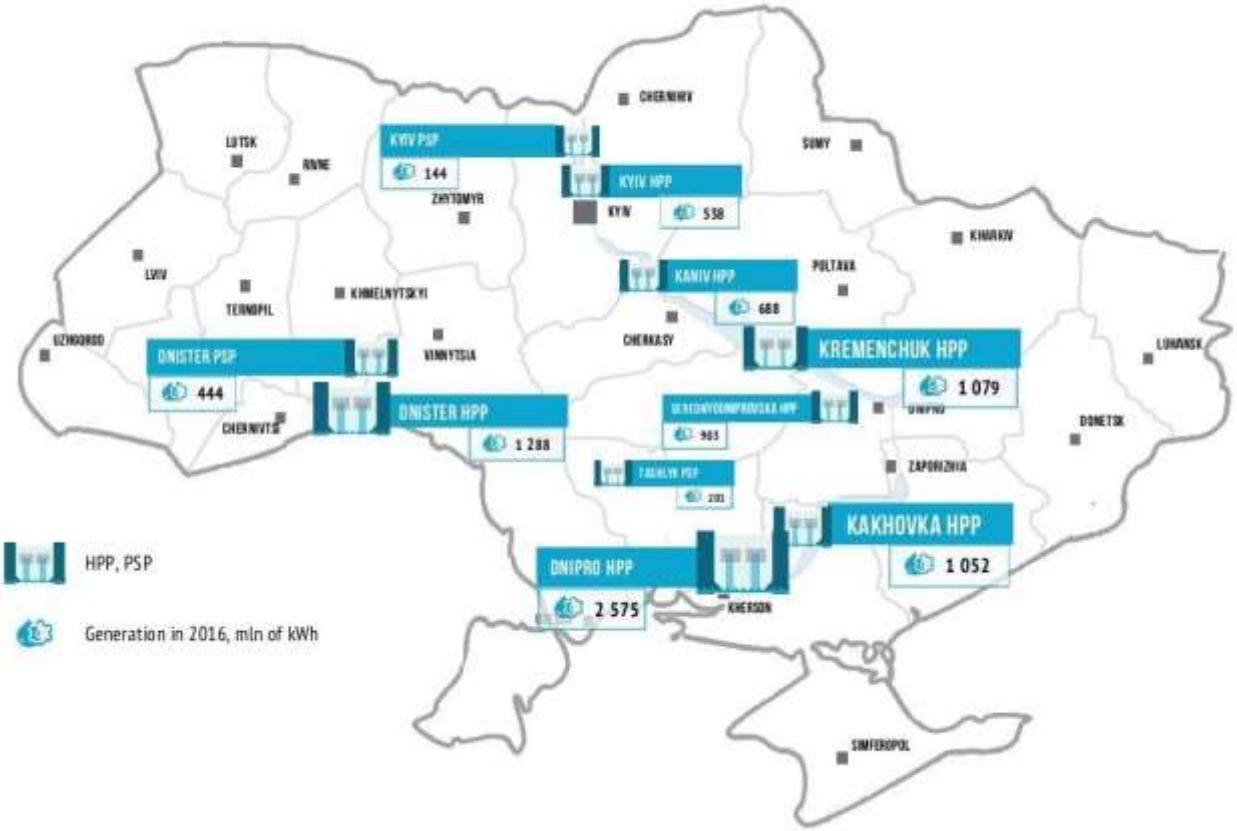


Figure 14. The main rates of HPPs and PSPs in Ukraine
Source: International Energy Agency, SE "Ukrenergo National Power Company", Ukrhydroenerho, State Statistics Service of Ukraine, U.S. Energy Information Administration. Prepared by the content-marketing agency *Top Lead.*

Hydroelectric pumped storage power plants (HPSPP) can operate in two modes: pumping and turbining (generating). In the pumping mode, water from the lower water basin is pumped by HPSPP hydraulic units to the upper water basin. In the pumping mode, HPSPP normally operates at night time, when there is an electricity surplus due to the reduced load in the power grid, which is just consumed by the HPSPP (covers the dip part of the daily load schedule). In the turbining mode, water from the upper water basin is discharged to the lower one through HPSPP units, and the electricity produced is supplied to the power grid to the consumers. In the turbining mode, HPSPPs operate in the periods of the maximum load in the power grid (normally, in the hours of evening or morning peaks in the daily load schedule).

As of 2016, there were 3 large HPSPPs operating in Ukraine (2 plants within PJSC Ukrgidroenergo with an installed capacity of 883.5 MW and one plant within SE NNEGC Energoatom with a capacity of 300 MW). In view of its operating principle, HPSPP is a net energy consumer, because it needs much more energy in pumping in a water unit than will be generated during its further use, but HPSPP's carry out important regulation functions within the power grid in the widest sense with the maximum use of their benefits of the response time and high availability for starting. Therefore, they are operated in various modes with multiple starts and stops during the day, performing the role of the maneuvering capacity when peaking in and out, reactive power compensator, night dip covering means, and the emergency and frequency reserve.

More efficient chemical electricity storage systems have not been widely used in Ukraine yet.

2.3 SOLAR ENERGY

Solar energy is the youngest among renewables in Ukraine

Figure 15. Installed capacity of SPSS, MW
Source: Renewable Energy Institute of the National Academy of Sciences of Ukraine, SE "Ukrenergo National Power Company", State Statistics Service of Ukraine, Ministry of Energy and Coal Industry of Ukraine. Prepared by the content-marketing agency *Top Lead.*

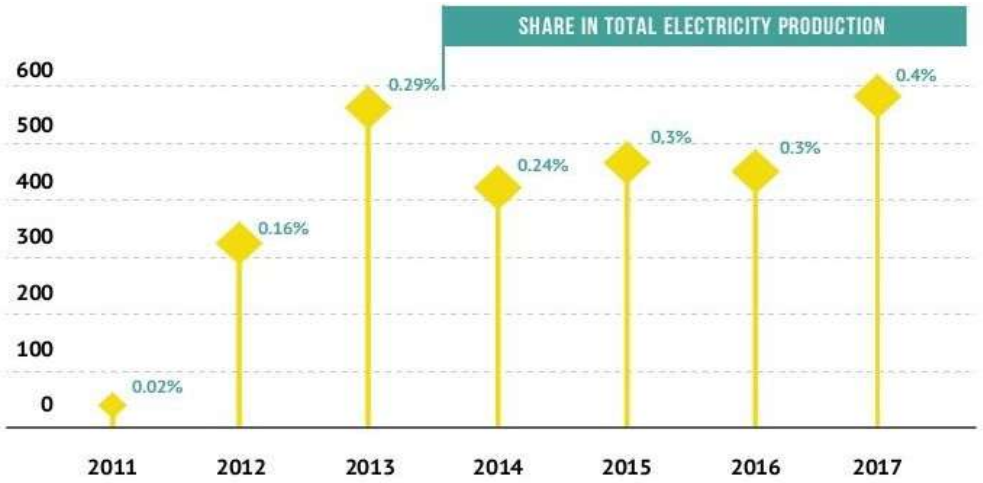


Figure 16. Generation of electricity at SPS, bln of kWh
Source: Renewable Energy Institute of the National Academy of Sciences of Ukraine, SE "Ukrenergo National Power Company", State Statistics Service of Ukraine, Ministry of Energy and Coal Industry of Ukraine. Prepared by the content-marketing agency *Top Lead.*

Since the end of 2014, the capacity of solar power stations of private households in Ukraine has increased by 371 times (as of the end of the third quarter of 2017). The annexation of Crimea has slowed down the development of solar energy in Ukraine, as it is the most promising region for its development.

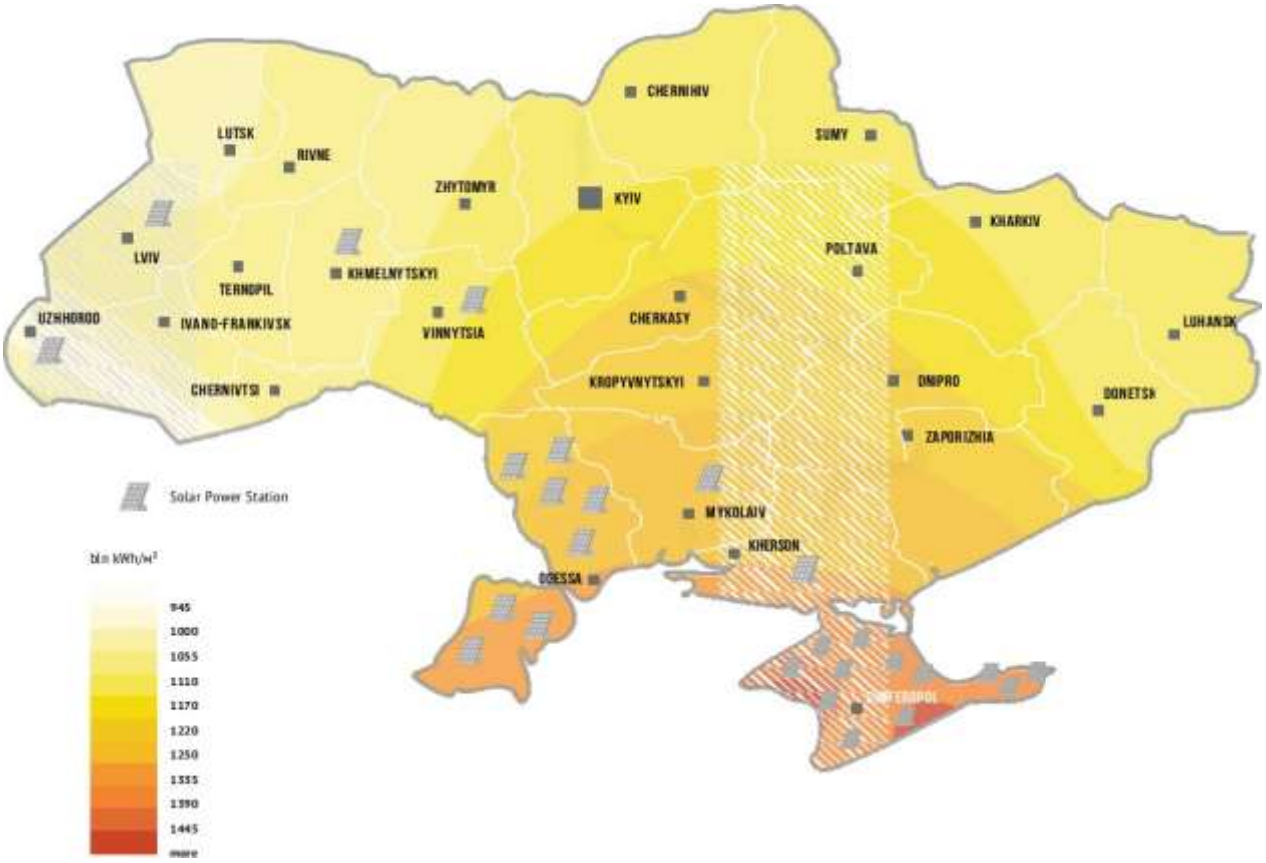


Figure 17. Distribution of specific solar radiation in Ukraine during the year
Source: Renewable Energy Institute of the National Academy of Sciences of Ukraine, SE "Ukrenergo National Power Company", State Statistics Service of Ukraine, Ministry of Energy and Coal Industry of Ukraine. Prepared by the content-marketing agency *Top Lead.*

Solar power plants (SPP), which a few years ago could be found only in the South of Ukraine, have become a widespread new business in all regions of Ukraine. In 2017, according to the State Agency on Energy Efficiency, the total installed capacity of SPP was 211 MW. This is a record for the mainland Ukraine. In 2016, the total volume was about 100 MW.

Prior to annexation, the regional leader in the construction of SPP was the Crimea, where only in 2013 the capacity of all the launched facilities was comparable in numbers to the current record.

Since 2011, Ukraine has built and commissioned SPP for 742 MW. In the total volume of electricity produced in Ukraine, according to SE Energorynok, the solar energy already accounts for 0.53%, while in 2016 - 0.36%. The figures are still low, but among all companies working according to the green tariff, the share of SPP has the fastest growth.

Ukrainian legislation provides quite favorable conditions for green tariff for investors. After decades of dependence on Russian gas, Ukraine set itself the goal of receiving 11% of electricity from renewable sources until 2020. The location of Ukraine makes it attractive. While some countries have rich oil deposits, Ukraine has good indicators for the levels of solar radiation and wind power.

SPP locations in Ukraine

In 2017, about USD 250 million have been invested in Ukraine in solar energy, which is almost 2 times more than in 2016. Accelerated rates of development in many ways are associated with increasing interest from small and medium players. Companies that have commissioned new facilities or just started their construction, usually prepare facilities for 5-10 MW. However, more and more requests are being received for projects with a capacity of 10 MW or more for companies owned by foreign investors.

Major market players in the Ukrainian solar market are: Chinese CNBM (owing 10 SPS Active Solar of total capacity 267 MW, which makes up 1/3 of total SPS capacity in Ukraine) and Rengy Development (operating a SPS park with a total capacity of more than 50 MW).

For investors in choosing the location of SPS, the following factors are important: the presence of solar radiation, the capacity of energy networks and the policy of local authorities. In 2017, the second place in the growth of SPS was Ivano-Frankivsk region. Odessa region is the record holder of the total capacity for all years - 241 MW. The peak of the launch of projects was on 2012-2013. Kherson region is the leader in 2017 in launch capacity - 69 MW. Total capacity of solar stations in the region is 98 MW. In the Vinnytsia region, 128 MW have been installed. The record year was 2016 - 52 MW.

Taking into account the growth of SPS market in Ukraine, the *necessary infrastructure and production facilities* are appearing in the market. In recent years, about ten EPC-contractor operators (Figure 18) appeared in Ukraine, offering integrated solutions to investors. The largest player in 2017 is KNESS, which commissioned 98.5 MW of capacity in a year.

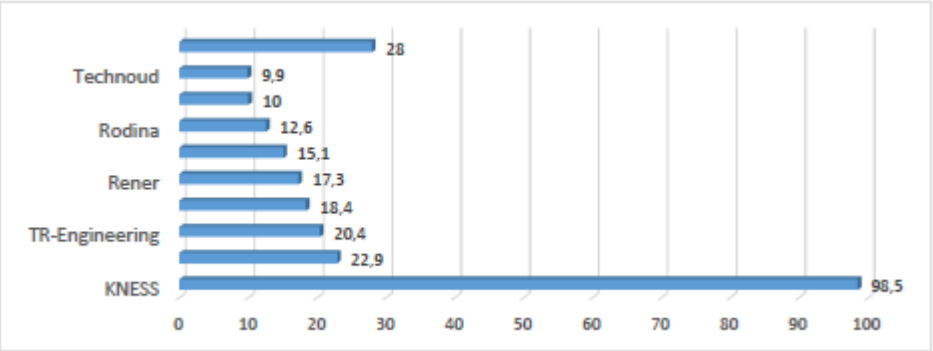


Figure 18. EPC-contractors of SPS in Ukraine, 2017, MW
Source: Liga's research data

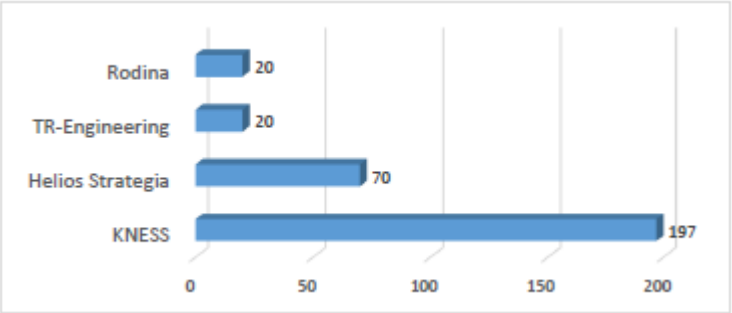


Figure 19. Capacity of constructed SPS, MW
Source: Liga's research data

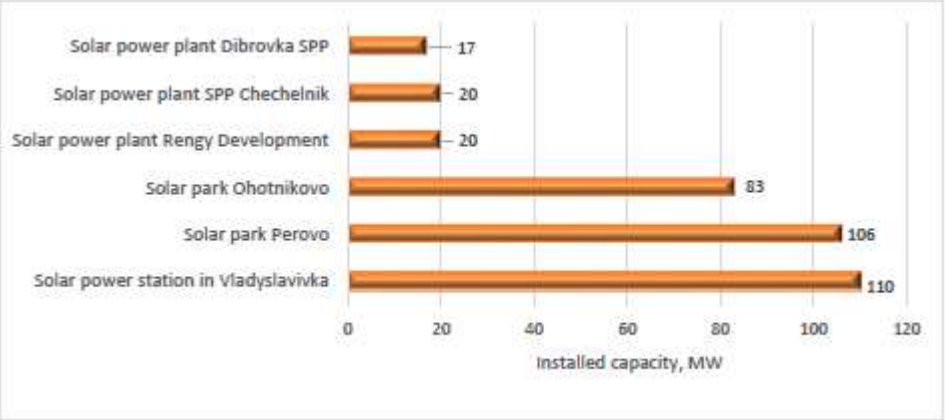


Figure 20. Largest operating solar projects in Ukraine
Source: open sources

2.4 WIND ENERGY

Wind power is one of the cheapest sources of renewable energy in the world.

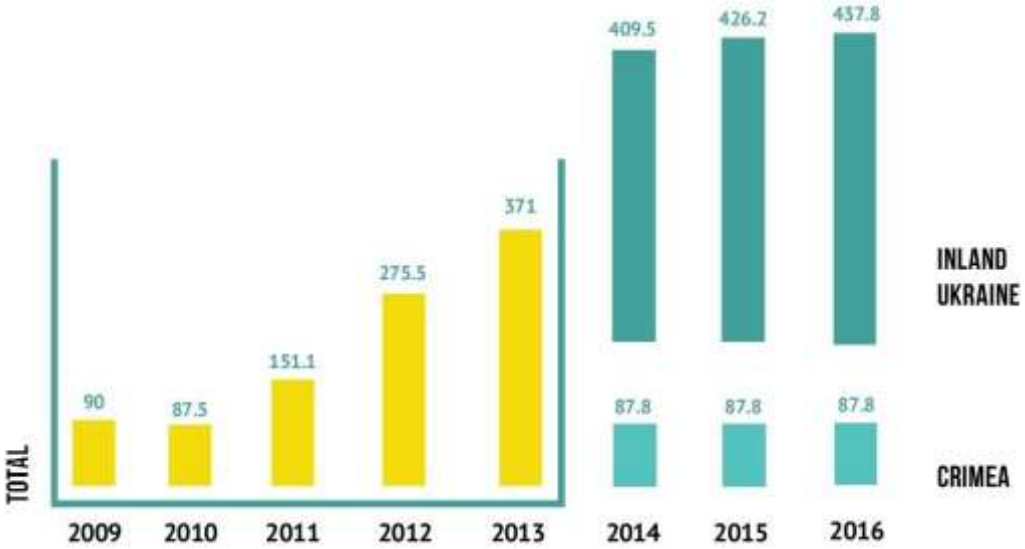


Figure 21. Installed capacity of wind farms, MW
Source: Ukrainian Wind Energy Association, Renewable Energy Institute of the National Academy of Sciences of Ukraine, SE "Ukrenergo National Power Company", State Statistics Service of Ukraine, Ministry of Energy and Coal Industry of Ukraine. Prepared by the content-marketing agency *Top Lead.*

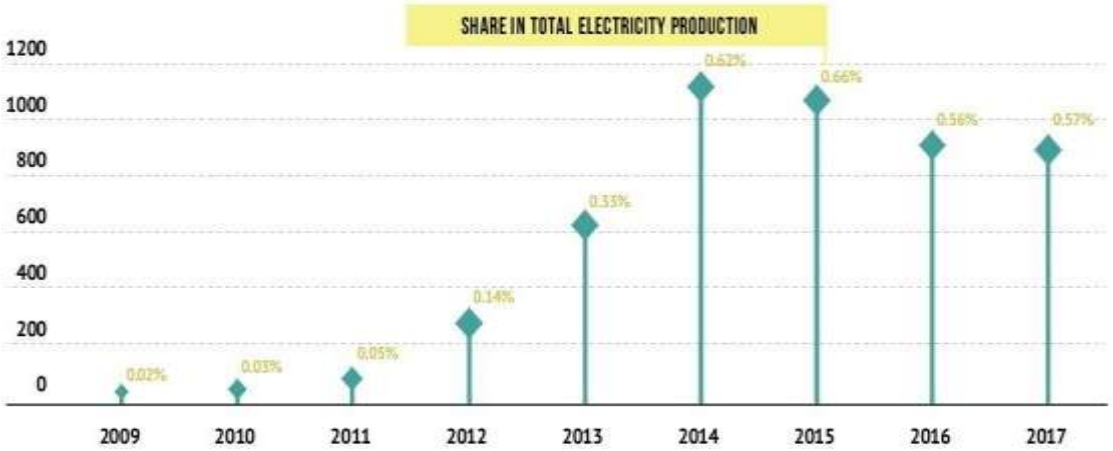


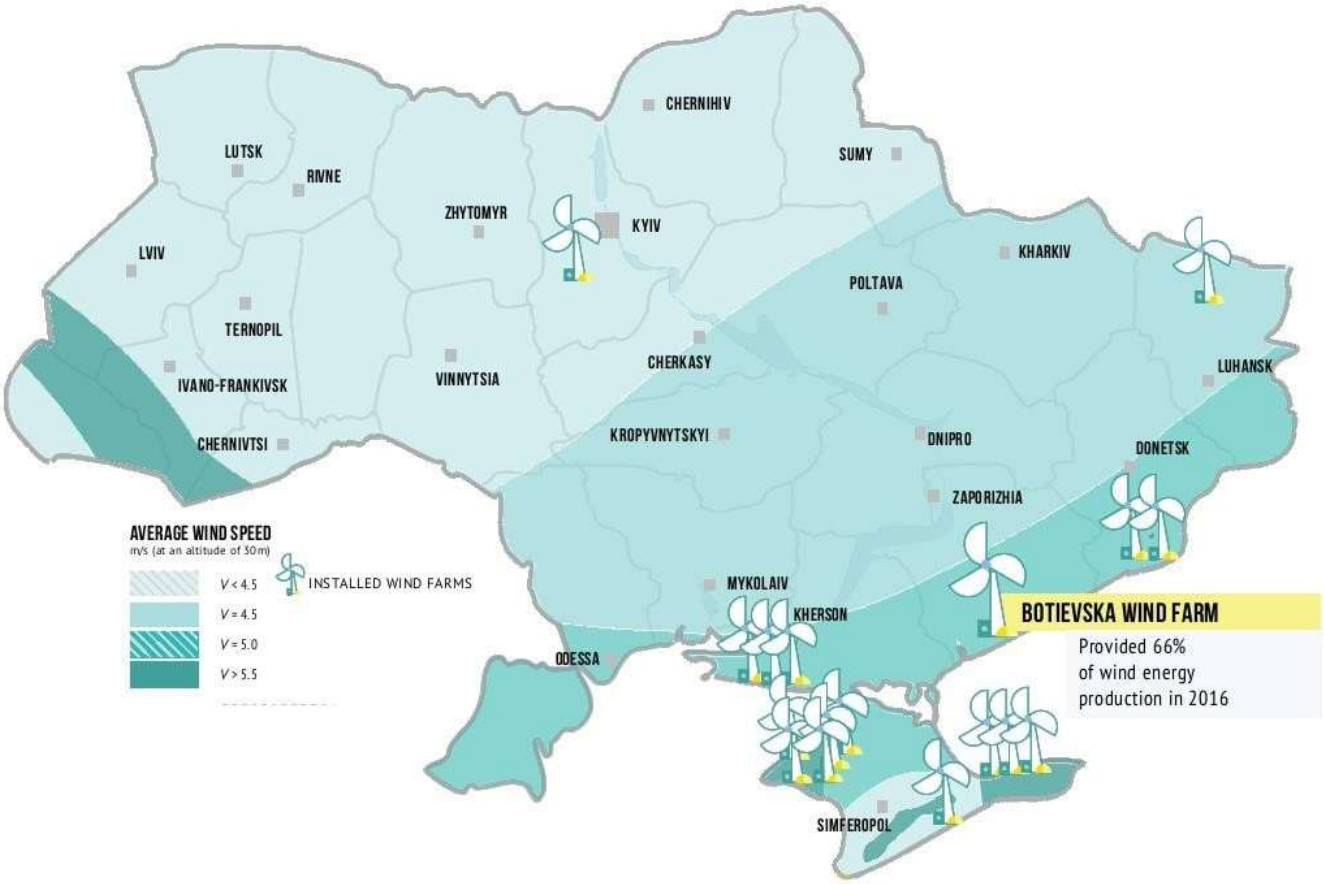
Figure 22. Generation of electricity at wind farms, mln kWh
Source: Ukrainian Wind Energy Association, Renewable Energy Institute of the National Academy of Sciences of Ukraine, SE "Ukrenergo National Power Company", State Statistics Service of Ukraine, Ministry of Energy and Coal Industry of Ukraine. Prepared by the content-marketing agency *Top Lead.*

In terms of total electricity production wind energy was the most effective source of clean energy generation in 2016. All wind turbines produced 1 047,086 million kWh of "green" electricity (including 924,483 million kWh of electricity supplied under "green" tariffs) which made up around 51.52% of the annual electricity production from RES.

The cumulative installed capacity of the wind power plants located in the mainland of Ukraine reached 437,8 MW or 0,8 % of total installed power generation capacity in the Ukrainian mainland. During 2016 wind produced enough electricity for about 260 thousand typical Ukrainian homes with average monthly electricity consumption of 400 kWh.

Ukraine possesses excellent wind power resources to ensure the development of large wind projects. The southern coast of Ukraine, the Carpathians have the best wind potential in the country. Naturally, the wind development has covered all above mentioned regions. Currently, Zaporizhzhya oblast (region) with 200 MW installed across the region, is a leader among other Ukrainian oblasts in terms of total installed wind capacity.

Figure 23. Regions of Ukraine by intensity of wind flows



Source: Ukrainian Wind Energy Association, Renewable Energy Institute of the National Academy of Sciences of Ukraine, SE "Ukrenergo National Power Company", State Statistics Service of Ukraine, Ministry of Energy and Coal Industry of Ukraine. Prepared by the content-marketing agency *Top Lead.*

As shown in the table (Table 7) below wind energy is among the cheapest renewable energy source to produce electricity in Ukraine. According to SE Energyrynok, the share of electricity generated from wind in the cost of electricity bought at the wholesale electricity market in Ukraine is just 2,54% (share of wind in the volume of electricity generated accounted for 0,66%), which is less than shares of electricity generated by PV and SHPP though their shares in the volume of electricity delivered were 0,35% and 0,13% respectively.

Energy source	Share in electricity generation	Share in electricity cost
NPP	53,74%	29,32%
THPP	31,78%	45,96%
HPP *(SPHH excluded)*	6,21%	5,23%
CHP	7,01%	12,51%
SHPP	0,13%	0,56%
WPP	0,66%	2,54%
PV	0,35%	3,38%
Biomass	0,06%	0,24%
Other	0,06%	0,26%
Total	**100,00%**	**100,00%**

Table 7. Share of primary energy sources in electricity generation and cost in Ukraine in 2016
Source: Ministry of Energy and Coal Industry of Ukraine, State Statistics Service of Ukraine

Ukrainian wind capacity reached 437,8 MW by the end of December 2016, out of which 11,6 MW were added in the last three months of 2016: 6,6 MW were commissioned by company Eko-Optima in Lviv oblast and 5 MW – by MC Wind Parks of Ukraine in Mykolaiv oblast. All Ukrainian wind power plants are grid connected.

In 2016 all wind power plants located in the mainland Ukraine supplied 924,483 million kWh of electricity under "green" tariff. Delivery of electricity that's generated by the solar and wind power plants located in the annexed territory of the Crimea to the United Energy System of Ukraine has been stopped since April 2014. At the end of 2016, 12 wind power plants operated in the country (Table 8). The largest Ukrainian wind power farm is 200 MW Botievska WPP located in Zaporizhzhya.

#	Wind power plant	Total installed capacity, 31.12.2015, MW	Commissioned in 2016, MW	Total installed capacity, 31.12.2016, MW
1	Botievska WPP	199,875	0	199,875
2	Wind Park Novoazovskiy	57,50	0	57,50
3	Ochakievska WPP	47,50	5,0	52,50
4	Wind Park Lutuginskiy	25,00	0	25,00
5	Wind Park Krasnodonskiy	25,00	0	25,00
6	Novoazovska WPP	30,53	0	30,53
7	Novorosiyska WPP	9,225	0	9,225
8	WPP Stavky	9,225	0	9,225
9	Beregova WPP	12,30	0	12,30
10	Syvaska WPP	2,92	0	2,92
11	Stariy Sambir 1	6,60	6,6	13,20
12	Legena LLC	0,45	0	0,45
	Total	**426,125**	**11,6**	**437,725**

Table 8. Wind power plants located in the mainland Ukraine
Source: Ukrainian Wind Energy Association

2.5 BIOMASS AND BIOGAS

The National Renewable Energy Action Plan (NREAP) establishes till 2020 the general goals for the development of the renewable energy sources' (RES) sector in Ukraine. According to Ukraine's commitments as an Energy Treaty member, the RES share in the gross final energy consumption should reach 11% by 2020.

Biomass-to-energy usage is among the key conditions for the fulfilment of the goals that were established in the NREAP. The major input for biomass is foreseen to be in the heating/cooling sector; it should be 5,000,000 toe (ton of oil equivalent) per annum in 2020, which constitutes 85 per cent of the total RES input in the given sector. In addition, the installation of energy equipment with capacity of 950 MW_e is planned, which will operate on biomass and will use 390,000 toe of biofuels per annum in the transport sector. This also includes 290 MW from biogas.

However, by the end of 2016, the installed capacity reached only 39 MW for solid biomass and 20 MW for biogas. Altogether, 1,775 GWh of power was produced in 2016, including 4.5% from solid biomass and 5.1% from biogas.

2.5.1 Biomass

Main sources of biomass are forestry and agriculture. Both sectors are well developed in Ukraine. The volume of harvested marketable wood has been 17.5-18 million m^3/yr lately, including firewood 4-5.5 m^3/yr. Felling of wood followed by the wood processing and production of finished products is the source of various wastes and residues. Sustainable potential of wood biomass can be assessed at about 16,282 GWh/yr, the contribution of firewood being the biggest, 65% of the total.

Firewood is completely utilized by population and different enterprises for heating. Wood biomass in the form of chips is also in high demand in the bioenergy market. Felling residues often remain unutilized and sometimes are combusted in forest. At present wood is the mostly used type of biomass for energy production in Ukraine though its resources are comparatively limited. Annual consumption of wood fuel for heating is about 3780 kt which corresponds to 10,500 GWh/yr.

Main by-products of wood-based industries are wood processing waste of different types like sawdust, shavings, lump wood and others. Average annual amount of the waste is 700-750 kt. Part of the waste is used for heating and for the production of pellets and briquettes. Production of solid biofuels is a fast developing and very prospective sector of Ukrainian bioenergy. It has grown rapidly during the past 5-6 years. At the beginning, the main feedstock was wood, then it turned to sunflower, and since 2010 straw has also been used as feedstock for the production of pellets and briquettes. Any reliable information on the use of pellets/briquettes for heating (amount, installed capacity) is not available. Roughly, it can be estimated at 6,360 GWh/yr. Straw and other agricultural residues are one of the biggest and most important sources of biomass for energy in Ukraine.

To meet the targets set by Ukraine's NREAP for biomass by 2020 it is necessary to widely involve energy crops (along with agro-residues) in energy production. For Ukraine, the most suitable energy crops are willow, miscanthus and poplar. The area under energy crops in 2020 is estimated to be over 118,000 ha.

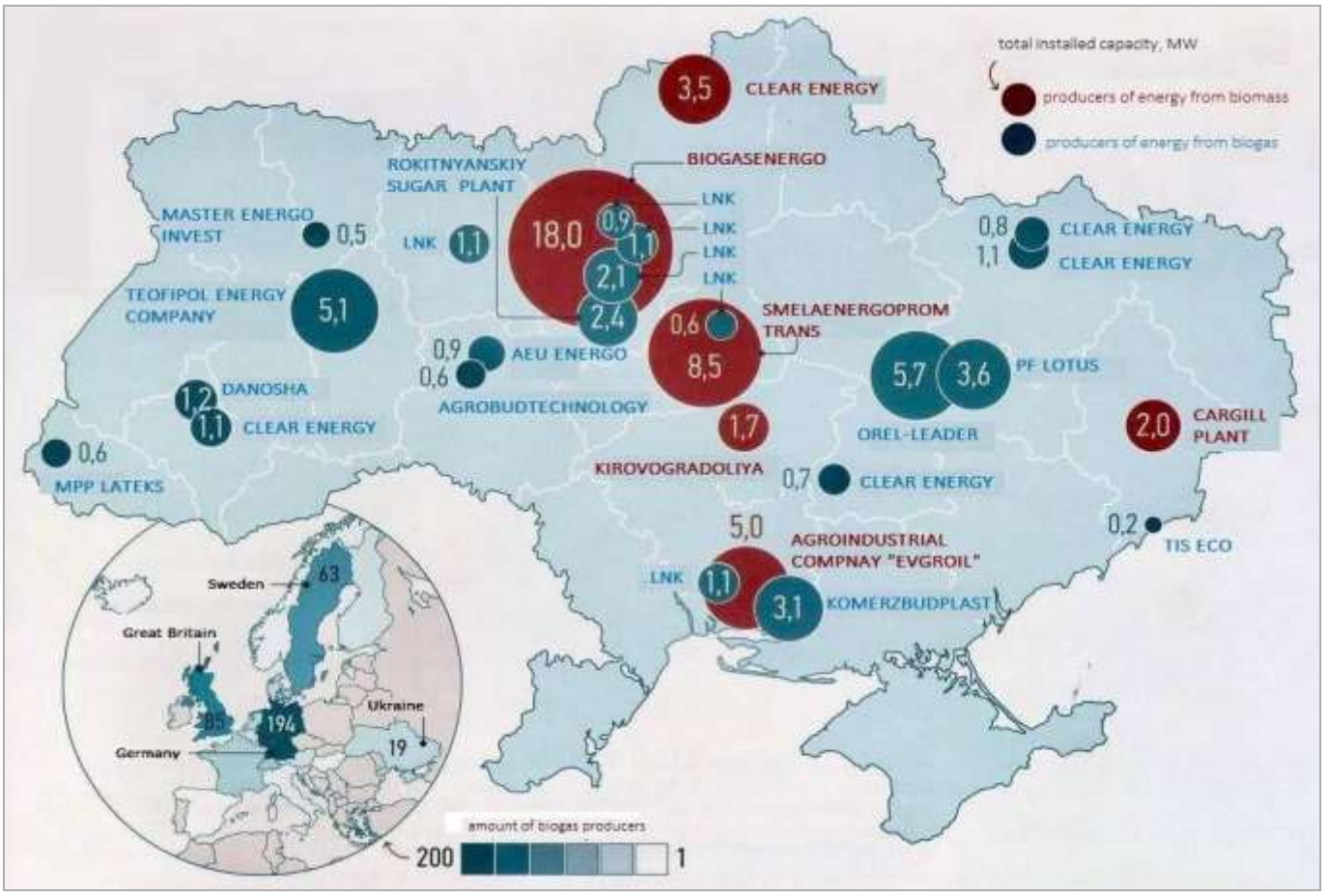


Figure 24. Agroenergy enterprises in Ukraine and Europe
Source: NEURC, EBA

Ukrainian biomass-to-energy market

The supply side of the market is represented by the forestry and wood processing companies and crop and animal farms that are sources of biomass. Pellet producers process available waste into pellets. Boilers for burning biomass are available in the market from either local producers or importers.

Biomass-to-energy facilities produce electricity and/or heat for a variety of users (industrial, commercial, and residential). In some cases, users generate electricity and/or heat for their own use. In others, (private or municipal) electricity/heat producers sell to end-users directly or through the power grid. Biomass-to- energy facilities may use biomass only or in combination (co-fired) with other fuels (oil, gas, or coal).

The demand side is represented by biomass-to-energy facilities:

- Companies or individual users that burn biomass to produce energy (electricity or heat) for in-house consumption. This segment includes industrial companies, crop and animal farms, individual households, schools, and hospitals which install biomass-burning boilers to receive energy. They may use own-sourced biomass or procure it, particularly from pellet suppliers.
- Private and municipal heat suppliers. The former install biomass boilers and sell heat to customers such as schools, hospitals, and small industrial plants. The latter use biomass boilers together with traditional fuel (mainly, natural gas) boilers to reduce the cost of energy.
- Electricity generators. These companies implement projects with the objective of selling electricity to the national grid. For instance, animal farms process biomass into biogas and sell electricity to the grid.

The Ukrainian biomass-to-energy market is rather fragmented. There is a lack of established links in the market between players, which prevents it from smooth functioning.
The most robust segment of the market is that of municipal heat supply. Heat-supplying companies, both municipal and private, are the most active users of biomass for energy generation:

- More than one third (36%) of the heat-supplying companies use biomass boilers. Most of them run both gas and biomass boilers. Combined usage of traditional fuel and biomass (co-firing) is very rare among those polled.
- Another 27% of the total number of heat suppliers have designed a project to install biomass boilers.

Demand for biomass-to-energy initiatives has been growing in Ukraine, being driven by the motivation of cost savings and increased efficiency. In the short term, the share of heat suppliers using biomass boilers could grow up to 63%. Despite the expanding share of municipal heat suppliers using biomass boilers in the total number of companies, the share of biomass in the overall volume of fuel consumed by the entities remains low (14%). The most common fuel is natural gas, with a share of 80% in the total volume of fuel used by municipal heat suppliers.
Competition is intensifying in the heat-supplying segment of the biomass-to-energy market. Nearly a quarter (23%) of the municipal heat suppliers have reported cases of clients switching off the heat supply after installing their own biomass boilers. Schools, hospitals, and other social institutions are those most frequently named for discontinuing municipal heat supply and installing their own biomass boilers. These entities are also the most common clients for private heat suppliers using biomass.
Private heat suppliers have been actively entering the biomass-to-energy market. They install and operate boilers generating heat to be delivered to clients (usually schools, hospitals, and small businesses).
Another important segment of the biomass-to-energy market is industrial enterprises using biomass to produce energy for in-house needs. According to the survey of pellet producers, about 20% of their sales go to industrial enterprises. As a result, industrial enterprises and private heat suppliers are the key domestic customers of pellet producers in Ukraine.

Biomass supplies *(main sources of biomass)*	Biomass processors and equipment providers	Biomass-to-energy producers		
		Energy for own use	Heating energy for customers	Electricity off-take *(electricity for the market)*
Supply and logistics of biomass				
- Forestry - Wood processing - Agricultural companies - Other (i.e. food processing)	- Pellet producers - Boiler equipment producers	- Industrial enterprises - Crop and animal farms - Individual users (households, schools, hospitals)	- Private heat suppliers - Municipal heat suppliers	Energy off-takers such as: - Animal farms producing biogas - Companies collecting biogas and solid waste landfills

↓

Electricity supply to the grid

Figure 25. Biomass-to-energy market structure in Ukraine
Source: IFC

Although agricultural companies have direct access to biomass, they are not its leading users for energy production. In total, 11% of the agro-companies use their agricultural waste for burning in their own boilers. About 14% have considered using crop residue in boilers to reduce energy cost; 13% of the big farms have considered installing a biogas plant, but only 2% have designed a project to install a biogas plant. Agricultural companies are reluctant to sell their agricultural waste to pellet producers. Currently, 14% of the agro-companies reported that they cooperate with pellet producers and only 8% of them plan to start doing so. In the meantime, 7% of the companies have already started their own pellet production and 18% are going to do so. These companies are motivated to produce pellets to use them for their own energy needs, as opposed to selling them widely to the market.

Electricity generation projects are very rare in Ukraine. Implementation of these projects requires large initial investments in equipment, additional investment in the electricity grid, technical risks, significant operation costs, and the instability of green tariff regulation. In addition, co-firing of biomass with other fuels does not qualify for the renewable feed-in tariff. Financial constraints are the key impediment to further development. They include a high bank loan interest rate, the need for a large initial investment in equipment, and the need for additional investment in logistics and storage capacities for biomass. Additionally, the shortage of biomass of required quality is considered the main risk when it comes to implementing biomass-to-energy projects. The shortage of biomass and the growing demand for it pushes prices up, which increases the cost of a project and the uncertainty regarding the investment payback period.

The current biomass supply in Ukraine is unbalanced, which may lead to an even greater biomass shortage in the future. Wood, including raw wood, unprocessed wood, and wood pellets, is the main type of biomass currently used in Ukraine. The usage of agricultural waste is limited. This imbalance creates the risk of unsustainable forest management and regional limits in implementation of biomass-to-energy projects (they are mainly implemented in regions with greater availability of wood).
Adjustment of the supply of biomass to meet the growing demand for it will require:

- Investments in collection and treatment of biomass, its storage, and logistics at all levels of the supply chain, including raw biomass suppliers, and
- Closer links and cooperation between market players, particularly among the agricultural companies and pellet producers.

2.5.2 Biogas

There are several examples of agricultural biogas plants in Ukraine. They include biogas plants at animal farms and at sugar factories. There are also some food industries which get biogas from wastewater treatment. Some examples of landfill gas projects were also developed on municipal solid waste landfills.

Despite the, so far, limited number of implemented Ukrainian biogas plants, the technical scope covers a wide range of industries and different types of raw material for biogas production. For example, Ukrainian biogas plants are already implemented at pig, cattle and chicken farms; at sugar plants; breweries and other food production enterprises, using a broad diversity of raw materials such as pig and cattle manure, chicken litter, maize and sugar sorgo silage, sugar beet pulp, food treatment waste and wastewater.

Ukraine has the largest area of agricultural land in Europe and also one of the highest agricultural areas per capita. The total amount of arable land area accounted for 32.4 million hectares. The total biogas potential from agriculture waste, MSW, municipal and industrial wastewater is estimated at 3.2 billion m^3 CH_4 per year. Several assessments of the potential for methane production, from energy crops in Ukraine, varied in a broad range from 3.3 till 27.4 billion m^3 of CH_4.These variations mainly depended on the agricultural land use and the crop yields. The most popular crop for biogas assessment is maize silage. Among other possible crops are sugar beet, sugar sorgo, grain crops and grasses.

The most powerful and effective support mechanism is a “green” tariff for electricity generated from RES. The tariff rate for biogas is 0,1239 EUR/kWh. Therefore, it can be deducted that there is still a considerable untapped potential for a wide spread implementation of biogas and potentially biomethane projects.

The current biogas market of Ukraine

Despite the enormous potential of biogas-to-electricity in Ukraine, the market is not well developed yet. There are currently about 10 larger electricity-producing biogas plants in Ukraine, with a total installed capacity of 35 MW (end of 2016). Some of them are:

- Biogas plant of Ecoprod in Volnovas;
- Biogas plant in the Obukhov district Kyiv (biogas from waste deposit);
- Biogas plant Seaside landfill in Mariupol, Donetsk region;
- Biogas plant of the Rokitnyansky sugar factory (Kyiv region);
- Biogas plant of the Globyno sugar factory, belonging to Astarta Holding, plans to add electricity production from biogas;
- Biogas Plant of Myronivsky Hliboproduct (MHP), handling the dung of the Oril-Leader Poultry Farm in the region of Dnipropetrovsk;
- Biogas plant of Danosha Company, handling pig manure (Danosha plans to set up more biogas plants for other pig farms);
- Biogas plant for waste water treatment in Lviv (under construction).

There are more biogas plants of smaller size in Ukraine, belonging to small and medium-size livestock farms, and around 10 smaller biogas plants related to the production of biogas from municipal waste deposits in various regions. Small biogas plants in Ukraine, as in other countries, are rather producing heat for the farm where they are installed. The production of electricity from biogas on small plants is not viable.

The experience of the larger biogas plants in Ukraine is a successful one. Myronivsky Hliboproduct (MHP), with an installed capacity of 5 MW, plans a new biogas-to-electricity project with an installed capacity of 20 MW. The Rokitnyansky sugar factory plans to extend the capacity of its biogas-to-electricity plant from its current 2,4 MW to 19 MW.

The potential of the biogas market in Ukraine

In general, biogas market in Ukraine can be considered as forward-looking, with a fairly wide awareness of the participants. As the last amendment to the green tariff system included a significant increase of the tariff for biomass/biogas projects and scrapped some barriers such as the restriction of raw materials, it is expected that the number of biogas plants will increase sharply in the coming years.
Ukraine has the right prospects for biomethane production. There is a high local consumption of natural gas and Ukraine has a critical dependence on gas supplies from external markets. The presence of a significant number of agricultural holdings also provides the financial and land potential for large-scale biomethane biogas projects. Ukraine has developed a transport infrastructure for NG which includes both main pipelines and a distribution pipeline network. Ukraine also has a tradition of using compressed NG as motor fuel for trucks and buses, hence the presence of a developed network of CNG filling stations.

Under conservative considerations, the State Agency on Energy Efficiency and Energy Saving of Ukraine sees a potential for biogas plants in the agricultural sector alone of around 5.000 plants with an average installed capacity of 3 MW per plant. These plants could cover 5.7% of the energy consumption of Ukraine.
Not included in the estimation of the State Agency on Energy Efficiency and Energy Saving of Ukraine is the potential for biogas plants related to urban waste deposits (landfill), water (sewage) treatment and the food industry.

In figures only available from 2013, Ukraine has 60 sugar mills, 51 breweries, 58 distilleries, 5079 cattle farms, 5634 pig farms, 785 integrated poultry productions, and maize silage production of over 40 Mio tons. Technically, Ukraine has the potential to produce up to 10% of its energy consumption from biogas alone. The enormous potential for biogas production in Ukraine raises the interest of biogas planning and construction companies and investors from many countries, including Chinese power companies. In summer 2017, Shandong Qingneng evaluates the establishment of a biogas plant in West Ukraine, and Xi'an ShaanGu Power plans to build a biogas-to-electricity plant on the region of Zhytomyr with an installed capacity of 6,7 MW.

3. OIL AND GAS INDUSTRY

3.1 NATURAL GAS

More than 50% of the gas is used in the domestic sector. Given the low efficiency of heating appliances, this indicates significant potential to reduce the volume of use.

Gas Inflow		Volume, bcm
Production	Ukrgazvydobuvannya	14.6
	Others	2.6
	Ukrnafta	1.3
	Oil and gas production	1.6
Import	Naftogaz	8.2
	Private importers	2.9
Other	Underground Gas Storage: offtake-injection spread	2
Total		**33.2**

Table 9. Gas inflow 2016, bcm
Source: Naftogaz of Ukraine, Ministry of energy and Coal Industry of Ukraine, State Statistics Service of Ukraine, Top Lead

The volume of gas consumption in Ukraine has significantly decreased over the years of independence. Primarily, this is due to a decrease in the volume of industrial production. In 2017, Ukraine's gas consumption decreased by 1.3 bcm compared to 2016, which is equivalent to a decrease of 4%.

Consumer category	2016	2017	+/- %
Households	11.9	11.2	-6%
District heating companies DHCs:	5.7	5.6	
for households	5.7	4.6	-19%
for public and industrial sectors*	0	1.0	
Religious organizations (direct + DHCs)	0.017	0.019	+12%
Regulated segments total**	17.6	16.8	-5%
Public sector	0.5	0.5	0%
DHCs for public and industrial sectors*	1.6	0	
Industrial sector	9.7	9.1	-6%
Operating needs (gas production. transmission and distribution). LPG production	3.8	4.4	+16%
Unregulated segments total**	15.6	14.0	-10%
Balancing volumes***	0.0	1.1	
Total	**33.2**	**31.9**	**-4%**

*The segment was not subject to PSO in 2016.
**According to CMU Resolution #187 of 22.03.2017 "On the approval of the Regulation on public service obligations imposed on the gas market participants in order to ensure public interest in the natural gas market" and pursuant to the Law of Ukraine "On the natural gas market".
***Volumes off-taken by distribution system operators for clients without nominations 2017 data are operational and may be updated

Table 10. Gas consumption in Ukraine, 2016-2017, bcm
Source: Naftogaz of Ukraine, Ministry of energy and Coal Industry of Ukraine, State Statistics Service of Ukraine

Ukraine has successfully become independent from the Russian Federation on gas imports and has the potential to fully meet its own needs with its own resources. Ukraine plans to end imports of gas after 2020.

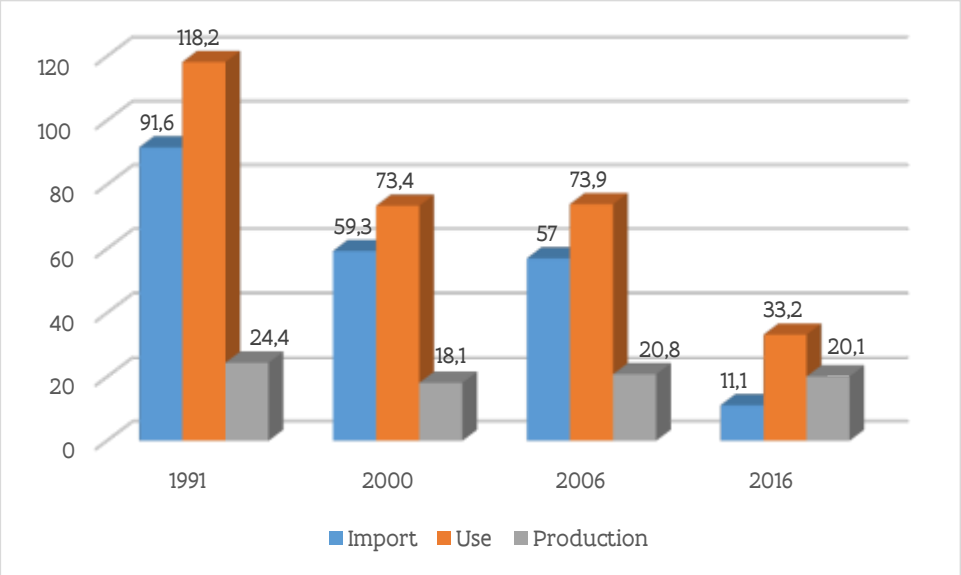


Figure 26. Production, import and use of natural gas, bcm
Source: Naftogaz of Ukraine, State Statistics Service of Ukraine, Top Lead

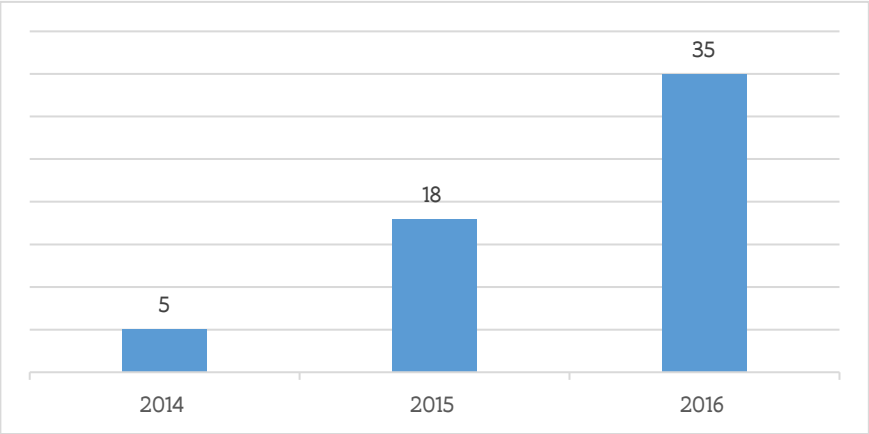


Figure 27. Quantity of private importers (at the end of the relevant year, number)
Source: Naftogaz of Ukraine, State Statistics Service of Ukraine

Gas production

As of 2016, there were 396 oil and gas fields in Ukraine, with the recoverable reserves exceeding 924 bcm. Most of the reserves and extraction volumes are concentrated in the eastern region (Poltava and Kharkiv Oblasts) - 239 fields there account for 80.96% of the balance sheet reserves and 94.49% of the total production. The share of the western region (Lviv, Ivano-Frankivsk Oblasts) in the total production volumes amounts to 5.77%, while the remainder is accounted for by the southern region (Black Sea areas and the shelf).

The leading position in Ukrainian gas production belongs to the state-owned companies. PJSC Ukrgazvydobuvannia (UGV), 100% owned by the state through NJSC Naftogaz of Ukraine, and PJSC Ukrnafta, where the state controls 51% of shares, remaining the key players in the area for gas production. Five major Ukrainian private companies produce 17% of gas.
The remaining 3% of gas is produced by 45 small private gas producers. PrJSC Naftogazvydobuvannia, a member of DTEK holding, and Burisma Holdings, as well as Ukrnaftoburinnia is the leader among private production companies. The private companies' production grew from 1.8 to 4.3 bcm in the period from 2011 to 2016 and is still increasing.

The natural gas production in Ukraine has amounted to 19-20 bcm per annum over the last few years. According to the Energy Strategy by 2035, the main objective of the industry in the medium term is minimizing gas import and developing the own resource base. The Government plans to increase this figure to 27 bcm in 2020 due to an increase in the volumes of prospecting and exploratory drilling in new areas and more intensive production in the existing ones.

In 2017, Ukraine produced 20.5 bcm of gas compared to 20.1 bcm in 2016. Gas production increased by 0.45 bcm (+2%) compared to 2016.

Producer	2016	2017
PJSC Ukrgazvydobuvannya*	14.6	15.3
Private producers	4.2	4.1
PJSC Ukrnafta	1.3	1.1
SJSC Chornomornaftogaz	0.0104	0.0105
Total	**20.1**	**20.5**

* Gross production (incl. private producers where UGV holds a minory stake; incl. operating needs) 2017 data are operational and may be updated

Table 11. Gas production in Ukraine, 2016-2017, bcm
Source: Naftogaz of Ukraine, Ministry of energy and Coal Industry of Ukraine, State Statistics Service of Ukraine

Ukrgazvydobuvannya (UGV)

UGV, a 100% state-owned subsidiary of Naftogaz, which produces 15.3 bcm of gas. This amount includes gas used for the company's operational needs. UGV provides 73% of gas production in Ukraine, although it holds only 45% of all licenses for gas extraction. In order for Ukraine to meet its natural gas needs via domestic gas production, the extraction sector needs further liberalization and additional investment.

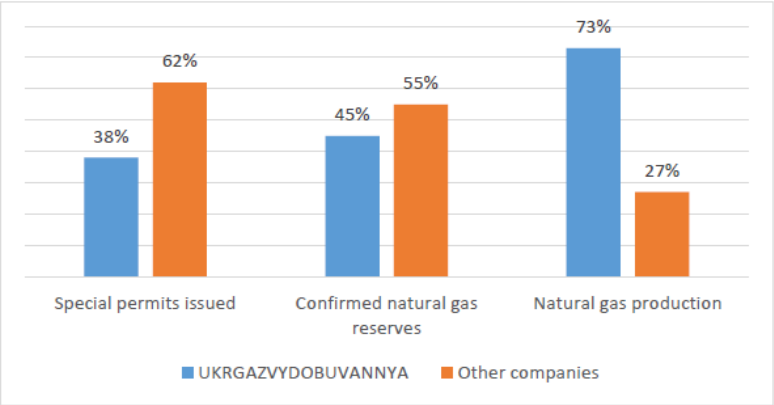


Figure 28. Structure of special permits issued, natural gas reserves and natural gas production
Source: Naftogaz of Ukraine, Ministry of energy and Coal Industry of Ukraine

In 2017, UGV's output grew by 0.64 bcm (4.2%) compared to 2016. Over the past two years the company managed to increase gas production thanks to optimized field development, increased production drilling and production enhancement operations including hydraulic fractures, coil tubing etc. Until recently, UGV has been almost at the margins of profitability; today, it is one of the largest taxpayers. The growth in UGV's production and the uptick among private companies in the market is a strong positive signal to potential foreign investors. Meanwhile, delays in extending and granting licenses by the State Geology and Mineral Resources Service of Ukraine, blocking of licensing processes by regional councils and the overregulated land allocation procedure have all hampered higher growth of gas output.

Additionally, the confirmation of the country's ample gas reserves, the third largest in Europe, is reassured. If this trajectory continues, it is possible to achieve full energy independence; in the long run, Ukraine can become a net energy exporter.

Other producers

Chornomornaftogaz, a 100% subsidiary of Naftogaz, accounted for 10.5 mcm of gas in 2017, which is comparable to 2016 (10.4 mcm). The company has been developing Strilkove field, which supplies Henichesk town in Kherson region. In 2017 Ukrnafta, 51% owned by Naftogaz, decreased its gas production by 17% from 1.3 bcm to 1.1 bcm primarily because the extension of its licenses was blocked for several months by the State Geology and Natural Resources Service of Ukraine.

Private companies produced 4.1 bcm of gas in 2017, which is almost equal to the 2016 output (4.2 bcm).

Gas imports

In 2017, Ukraine covered its gas import requirements with supplies from the European market. Compared to 2016, gas imports increased by 27% from 11.1 bcm to 14.1 bcm. In 2017, 67 companies imported gas to Ukraine (34 companies in 2016). Private traders and gas consumers increased both volume and share of gas imports last year, almost doubling their imports compared to 2016 from 2.9 bcm to 5.4 bcm.

In 2017, Naftogaz imported 8.7 bcm of gas from the European market, which is 0.5 bcm (6%) more than in the previous year. Naftogaz purchased gas from 13 European suppliers in 2017 (15 companies in 2016). None of them accounted for more than 30% of gas imported by Naftogaz.

The liberalization of the wholesale market in Ukraine is taking place following the adoption of the Law "On the natural gas market" (effective since 1 October 2015) and other steps towards the establishment of an open and transparent gas market in Ukraine.

For over two years, Naftogaz has not been buying gas from Gazprom, following the Russian company's refusal to extend "the winter package" in 2016. According to "the winter package", Gazprom was to suspend its "take-or-pay" claims and payment demands for alleged gas supplies to the occupied regions in eastern Ukraine until the anticipated Stockholm arbitration verdict. With this agreement in place, Naftogaz was able to consider Gazprom among potential suppliers. By not signing "the winter package", Gazprom preserved its claims for gas not purchased by Naftogaz thus making its price offer irrelevant.

In December 2017, the Stockholm arbitration tribunal rejected all of Gazprom's claims regarding gas that had not been supplied to Naftogaz. The arbitrators dismissed the "take-or-pay" claims of the Russian company and confirmed that Naftogaz should not pay for alleged supplies to uncontrolled areas of Donetsk and Luhansk regions. The tribunal also obliged the Russian monopoly to sell 5 bcm of gas per year to Naftogaz at the price of a liquid European hub. The price is lower than the current price available to Ukrainian companies at the country's western border. By the same ruling, Naftogaz is obligated to buy 4 bcm per year, which is less than a half of the company's expected gas import needs. The company can cover the rest of its needs by purchasing from suppliers that offer the most competitive terms.

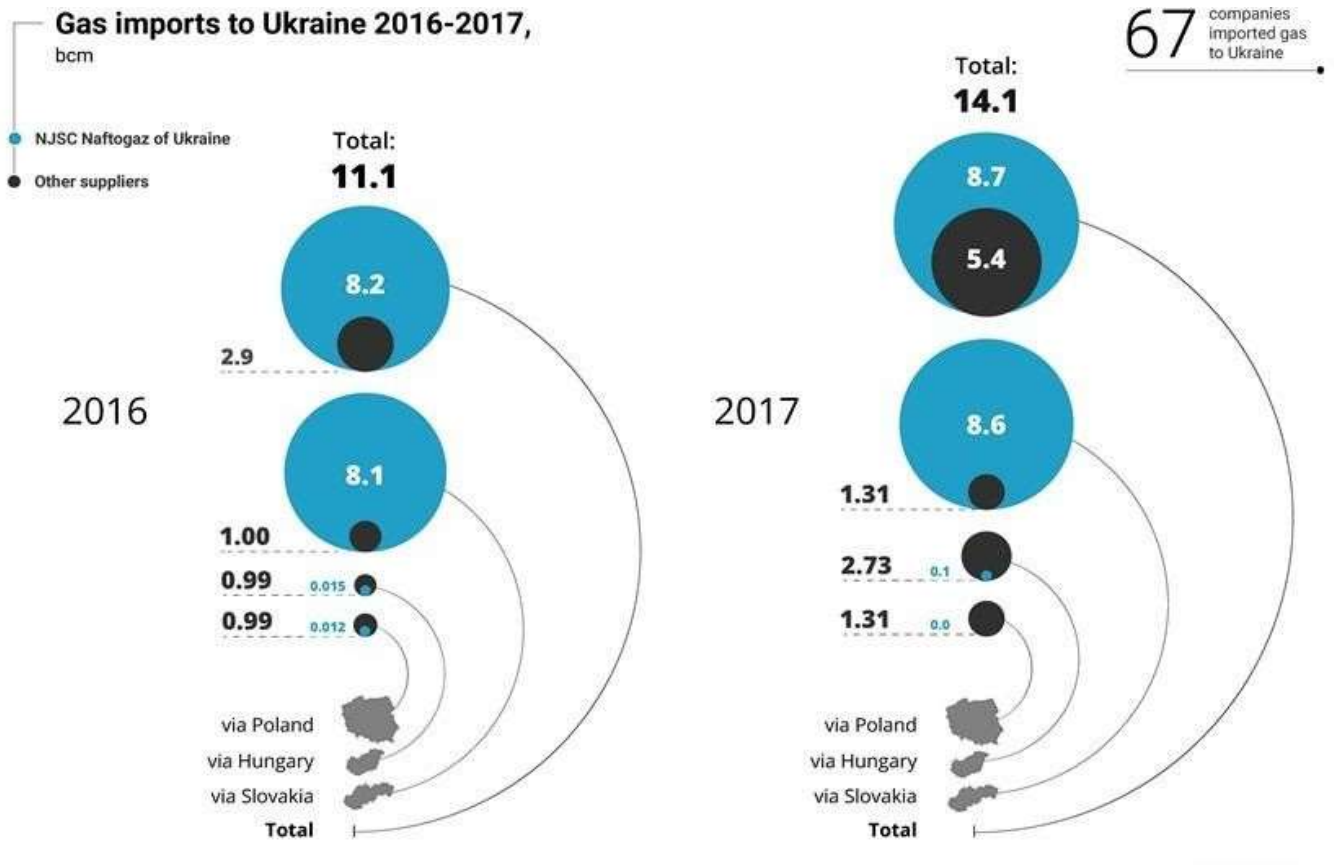


Figure 29. Gas imports to Ukraine
Source: Naftogaz of Ukraine, Ministry of Energy and Coal Industry of Ukraine, State Statistics Service of Ukraine

Transmission/transit

Gas is transported via the gas transportation system of Ukraine (GTS), which main network consists of 38.55 thousand km, 72 compressor stations with a total capacity of 5.448 MW and 1.458 gas distribution stations. The throughput capacity of the GTS reaches 287.7 bcm at the inlet and 178.5 bcm at the outlet (towards European countries - 142.5 bcm). This makes Ukraine one of the most powerful transit countries in Europe.

The GTS is operated by Ukrtransgaz, which is a part of the structure of NJSC Naftogaz of Ukraine. According to law, the GTS operator must be legally and organizationally independent of other types of activities in the market. The unbundling process is underway.

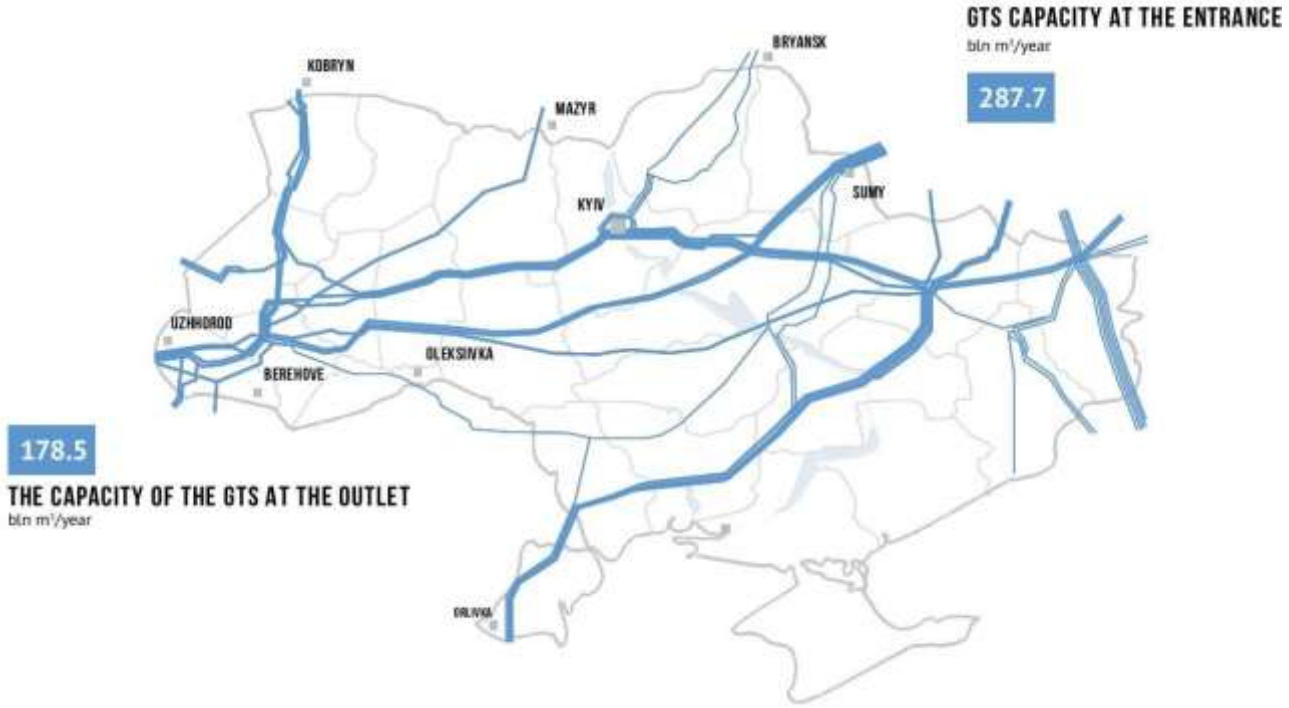


Figure 30. Ukrainian gas transportation system
Source: Naftogaz of Ukraine, Ukrtransgaz, Gazprom, National Energy Security Fund, Ministry of Energy and Coal Industry of Ukraine.
Prepared by the content-marketing agency *Top Lead.*

The planned construction of surplus transit capacities by the Russian Federation will completely exclude the Ukrainian GTS from the transit of Russian gas.

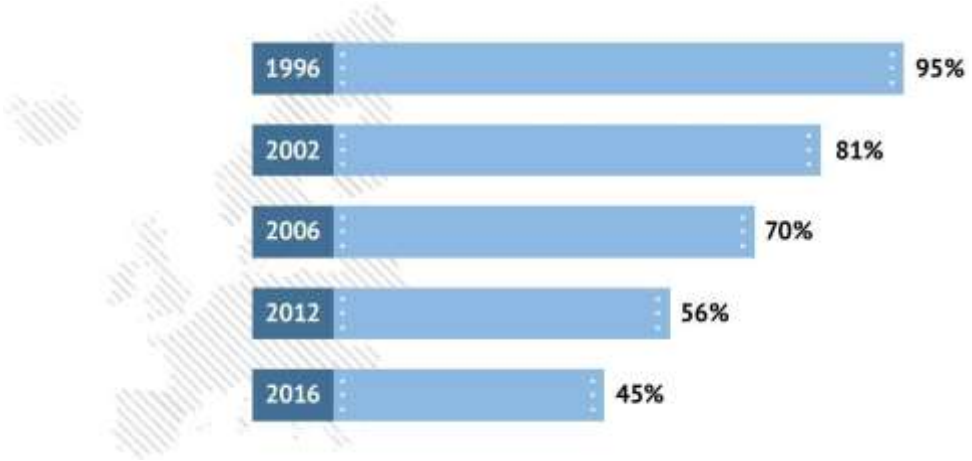


Figure 31. Share of Ukrainian GTS in the transportation of Russian gas to Europe
Source: Naftogaz of Ukraine, Ukrtransgaz, Gazprom, National Energy Security Fund, Ministry of Energy and Coal Industry of Ukraine.
Prepared by the content-marketing agency *Top Lead.*

At 90% of transit capacity in 2016. Ukraine could provide 72% of Russian gas supplies to Europe, but in fact provided only 45%.

3.2 OIL

Volume of oil extraction and processing reached historical minimum

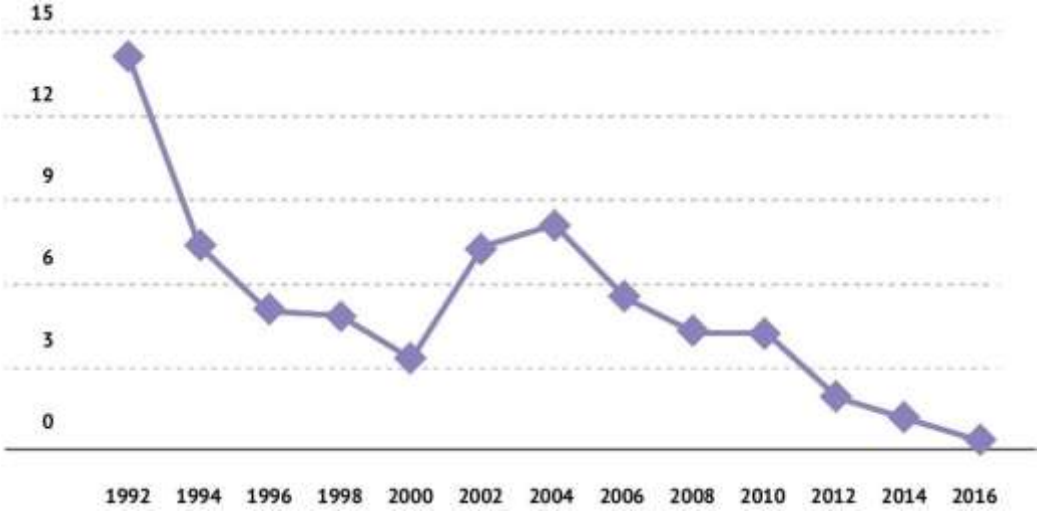


Figure 32. Oil refining by Ukrainian refineries. mln tons
Source: Naftogaz of Ukraine, Ministry of Energy and Coal Industry of Ukraine, SE "Energoatom National Nuclear Energy Generating Company. Prepared by the content-marketing agency *Top Lead.*

The production of oil products over 25 years has decreased by a factor of 12 (Figure 33).

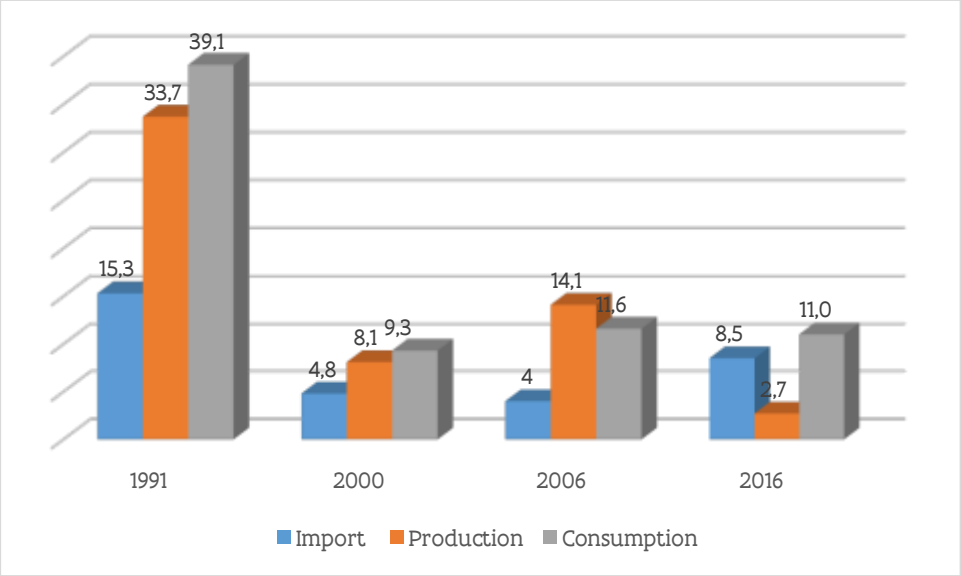


Figure 33. Production, import and consumption of oil products, mln tons
Source: calculations based on information from the State Statistics Service of Ukraine and Eurostat, Aequo

Ukraine produces only 25% of its demand for oil products. In 2001-2006. Ukraine was a net exporter of fuel.

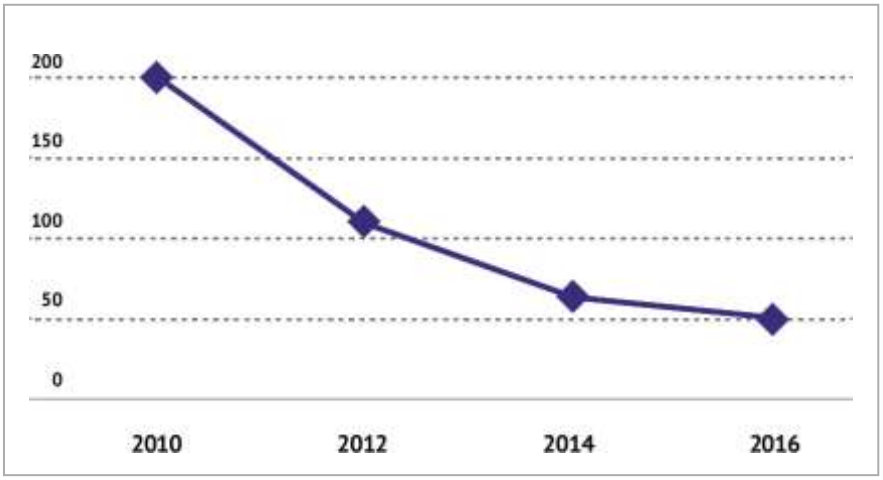


Figure 34. Capital investment in the oil-refining sector, mln USD (in accordance with purchasing power parity)
Source: State Statistics Service of Ukraine. Prepared by the content-marketing agency *Top Lead.*

This investment dynamic excludes the possibility of an increase in the volume of oil refining in Ukraine.

Figure 35. Oil refineries of Ukraine
Source: Naftogaz of Ukraine, Ministry of Energy and Coal Industry of Ukraine, SE "Energoatom National Nuclear Energy Generating Company". Prepared by the content-marketing agency *Top Lead.*

Own oil production in Ukraine is not enough to meet the needs of the refineries for raw materials.

4. ENERGY SECTOR REFORMS & REGULATORY CHANGES

4.1 INTEGRATION WITH THE EU ENERGY SYSTEM

In the energy sector Ukraine has a long history of cooperation with the EU. In 2005 Ukraine and the EU, together with the European Atomic Energy Community (EURATOM), signed the Memorandum of Understanding on a Strategic Energy Partnership. In late 2016, the Memorandum was renewed by the parties. Although the Memorandum itself is declarative and does not impose obligations. It frames the basic directions of cooperation, such as energy safety, gas and oil transit, integration of energy markets, and development of a low-carbon policy. In 2011 Ukraine joined the European Energy Community, which imposed certain obligations on the country in the energy sector.

In 2014 Ukraine signed an Association Agreement with the EU, taking on additional obligations in the energy sector. The obligations include, among others, the following:

- To encourage energy efficiency and energy safety;
- To develop and support renewable energy;
- To create a favorable investment climate;
- To modernize and improve its energy infrastructure;
- To develop a competitive and non-discriminatory energy market;
- To decrease emissions of carbons through energy efficiency and renewable energy projects.

These obligations came into force in November 2014, and Ukraine has been gradually implementing changes in its legislation in this regard. Partially the obligations regarding implementing provisions of the existing EU Directives and Regulations into Ukrainian law. For instance, the following EU Directives are to be implemented in Ukraine:

- Directive 2006/32/EC on energy end-use efficiency and energy services;
- Directive 2010/31/EC on energy performance of buildings;
- Directive 2010/30/EC (Energy Labelling Directive).

In connection with the signing of the Association Agreement, Ukraine has adopted numerous strategic documents and plans outlining further steps, both organizational and technical, in the energy sector. In 2015 Ukraine adopted a Sustainable Development Strategy of Ukraine – 2020, setting the following main goals of the state policy for the energy sector:

- To decrease the GDP energy intensity through shifting to energy-efficient technologies and equipment, and use of alternative energy resources;
- To diversify sources of supply of initial energy resources, and to increase exploration of energy resources from deposits located in Ukraine;
- To establish competitive markets of electrical and thermal energy;
- To synchronize the Integrated Power System of Ukraine (the "IPS") with the European energy system ENTSO-E;
- To implement basic provisions of Directives and Regulations of the EU Second and Third Energy Packages. The latter is aimed at increasing competition in the market, allowing new participants to come to the market and reducing energy prices.

Integration with ENTSO-E

In June 2017, the Ukrainian state-owned operator of the Ukrainian power grid, "Ukrenergo", signed the Agreement on terms of Ukraine's accession to the European Network of Transmission System Operators ("ENTSO-E") (Connection Agreement). Integration with ENTSO-E was also one of the obligations of Ukraine under the Association Agreement.

As of now, only a small part of the Ukrainian IPS operates synchronously with ENTSO-E. It is represented by the Burshtynska CHP (Combined Heat and Power) station. Integration with ENTSO-E would allow Ukraine to synchronize its energy system with that of continental Europe. It is expected that such integration will be achieved by 2025, and that will increase the independence of the Ukrainian energy sector, attract new foreign investors and suppliers to the Ukrainian market, and result in a decrease in electricity prices. In order to benefit from the agreement and from the eventual synchronization with ENTSO-E, Ukraine will bring its energy system in line with EU standards.

The Ukrainian Government has recently approved an Action Plan with regard to implementing the Ukraine-EU Energy Bridge, which would allow Ukraine to export electric energy from the Khmelnytska CHP station to Poland, Hungary and other EU states. It has been reported that European companies, such as Westinghouse Electric Sweden AB, Polenergia International S.àr.l. and EDF Trading Limited, may be willing to participate in this project.

4.2 ELECTRICITY MARKET REFORM

As the electricity market in Ukraine is currently very bureaucratic, it is unattractive for investors. However, recently a new market concept has been adopted by the Ukrainian Parliament through passing the Law of Ukraine, "On Electricity Market". Ukraine is expected to completely shift to new operating rules from 1 July 2019.

The new electricity market model provides a multi-subject diversified market which includes both a contractual form of electricity purchase, and day-ahead, intraday and balancing markets.

Also, the new law provides that entities involved in, e.g., transmission of energy, cannot be affiliated with entities involved in other activities in this market. This measurement is aimed to enhance competition in the energy market.

The law also extends the number of participants in the electricity market, which will include the following:

- manufacturers;
- suppliers;
- the transmission system operator (i.e., a legal entity responsible for managing the energy transfer system, and for interstate powerlines, currently – the State Enterprise "Ukrenergo");
- the energy distribution system operator (i.e., a legal entity responsible for maintenance and technical service of the energy distribution system, currently – the *oblenergo*s);
- traders (new participants who will be reselling energy, thus increasing competition);
- guaranteed buyers (i.e., those obliged to purchase green energy from wind and solar stations, in the current version of the law –the State Enterprise "Ukrenergo");
- consumers (i.e., end users).

Moreover, it establishes liability for participants in the energy market for imbalance of the system (i.e., absence of balance between production and consumption of energy in real-time mode).

Nevertheless, the new law is a framework act with many declarative provisions. In order to make the new electricity market work, the regulatory authorities are required to adopt a large number of secondary legislative acts. The implementation of the law can also prove difficult for a number of other reasons. For instance, Ukrainian authorities and courts would have to consider the law enforcement practice of the Energy Community and the EU. This encompasses numerous documents in a foreign language.

It is expected that as a result of the energy reform, the following improvements will take place:

- It will be possible to abandon the Rotterdam+ methodology (i.e., the methodology that is currently used to calculate wholesale and retail energy prices), given that prices for electricity will depend solely on consumer demand; thus, there will be a shift to the market model of electricity pricing;
- The market will become attractive for investors and participants;
- The artificial monopoly of manufacturers and suppliers will cease to exist;
- A new market of supplementary services (e.g., maintenance of electricity quality and regulation of its periodicity) will emerge;
- Energy supply terms will become more flexible (in particular, the market participants will between themselves define production and consumption schedules);
- The electricity deficit risk will be mitigated;
- Up to 90% of energy will be supplied under direct contracts between manufacturers and suppliers/consumers.

A few preparatory steps will be required before the new electricity market concept can be implemented; this includes the settlement of the existing debts for electricity supply, abandonment of cross-subsidies for population and dotation certificates, and unbundling of the major state-run energy companies.

Privatization of oblenergos

In July 2017 the State Property Fund announced privatization of eight state-owned *oblenergo*s which are currently responsible for energy distribution and are monopolists in this area in Ukraine. As of September 2017, two *oblenergo*s have been purchased by one of the existing energy companies of the Ukrainian businessman Rinat Akhmetov.

This is one of the steps which aims towards increased competition in the future electricity market, which is set to come to exist in 2019.

Introduction of RAB tariffs

As far back as 2016, the Government announced its plans on shifting to the RAB (Regulatory Asset Base) tariffs. The recent draft presented by the National Regulatory Commission for Energy and Utilities was not supported by the Government.

RAB tariffs are expected to attract potential investors, increase energy efficiency, quality of services provided and decrease tariffs in the future. Implementation of RAB tariffs is envisaged by the Association Agreement in part of the implementation of provisions of Directive 2009/72/EC, as well as by the 2035 Energy Strategy.

4.3 OIL AND GAS

Taxation

In 2017, tax rates for rent payments for oil exploration were reduced. Thus, extraction of oil from deposits over 5,000 m is now taxed at a rate of 29% (previously, 45%), and extraction of oil from deposits below 5,000 m is now taxed at a rate of 14% (previously, 21%).

Moreover, a part of the rent payments (namely 5%) for extraction of oil, natural gas and gas condensate will be allocated to the local budgets of respective municipalities where mineral deposits are located. This is expected to have two main positive outcomes:

- Increase the income to local budgets;
- Stimulate local authorities to issue special permits for subsoil use in order to receive additional rent payments.

Another liberalization step made by the Parliament was amending the Tax Code of Ukraine regarding rent payment rates for parties to production-sharing agreements (each, a "PSA"). Earlier parties to a PSA could set the rate in the PSA but such rate could not be lower than the rate established by law. As of today, parties are entitled to envisage a rent payment rate at any level, including lower than that provided by the Tax Code of Ukraine.

Gas sector reform

The gas sector reform process, which is part of the key reforms undertaken by Ukrainian state, started in April 2015, when the Ukrainian parliament passed a law on the gas sector. The law provides, among other things, for unbundling the state-controlled company Naftogaz into companies dealing with gas extraction, transport, distribution and storage. This is to be accompanied by the creation of a competitive gas market in line with the rules of the EU's so-called Third Energy Package. Gas reform is of key importance for Ukraine due to Naftogaz's significance for the condition of public finances (in 2014, the company recorded a deficit of 106.6 billion UAH, which accounted for 6.7% of Ukraine's GDP) and the fact that since the 1990s the trade in gas has been a major source of 'corruption income' for Ukrainian ruling elites. At the same time, this also makes the reform exceedingly difficult to carry out.

Unbundling of Naftogaz

The EU Commission requires Ukraine to unbundle Naftogaz. The proposed unbundling would include separation of functions of Naftogaz in the area of extraction and transportation of energy sources, and in the area of provision of access to gas pipelines and other infrastructure to third parties.

As part of the unbundling, Naftogaz will transfer a part of its assets to a newly established PJSC "Mahistralni Gazoprovody Ukrainy", which would be responsible for transporting gas through the main gas pipelines, and gas storage. Some steps towards the unbundling have been made but this process is largely yet to be completed.

Establishment of a gas hub in Ukraine

Recently eight companies have signed agreements with PJSC "Ukrtransgaz" regarding gas storage in a customs warehouse regime. This will allow gas traders to store natural gas in Ukrainian warehouses for up to three years without paying custom duties. This became possible due to a lack of natural gas in Ukrainian gas storage facilities. The mentioned agreements can be the basis for Ukraine to become one of the largest European gas hubs. Such approach would also benefit traders themselves, as it will allow the stored gas to be used in winter when its price typically increases.

Plans for creating a gas hub in Ukraine were also jointly announced by the Ukrainian and Polish governments in June 2017 in order to increase the energy independence of both states from Russia. The planned hub may be established on the Ukrainian-Polish border, and it is stated that both parties have sufficient infrastructure for this purpose.

4.4 ALTERNATIVE ENERGY

There are a number of laws that govern the use of alternative energy in Ukraine, including:

- The Law of Ukraine "On Alternative Energy Sources";
- The Law of Ukraine "On Alternative Fuels" (which governs production and use of alternative fuels and is aimed at increasing the share of alternative fuels to 20% of the total amount of fuels consumed in Ukraine by 2020);
- The Law of Ukraine "On Combined Production of Heat and Electric Energy (Cogeneration) and Utilization of Waste Power Potential";
- The 2020 National Action Plan on Renewable Energy (wind, solar and hydro energy have been identified as priority areas).

In May 2016 Ukraine applied to the International Renewable Energy Agency (IRENA). As of today, it has the status of the state in the process of becoming a member of IRENA. Joining IRENA would benefit Ukraine through:

- Cooperation with developed countries on renewable energy;
- Use of foreign countries' experience and progressive mechanisms for project financing;
- The option to apply to the Abu-Dhabi Fund for Development (ADFD) for loans for implementation of "green" projects.

Implementation of EU Directives

Ukraine is required to implement the following EU Directives regarding alternative energy:

- EU Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport;
- EU Directive 2001/77/EC on electricity production from renewable energy sources;
- EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

'Warm loans' for the private sector for using energy efficiently and for using alternative energy

The Government has established a program of so-called 'warm loans' for individuals and households. Under this program, state-owned banks subsidize private sector consumers by covering:

- 20% of money borrowed for the acquisition of gas-free/non-electric boilers for individual houses (up to UAH 12,000);
- 35% of money borrowed for the acquisition of energy-efficient equipment/materials for individual houses (up to UAH 14,000);
- 40% of money borrowed for communal energy measures for multi-apartment houses (up to UAH 14,000 per apartment).

Carbon emissions

Ukraine ratified the Paris Climate Agreement in 2016. Based on this, in December 2016 the Government adopted the Concept of implementation of state policy regarding climate change for the period up to 2030. Additionally, Ukraine is obliged to implement provisions of EU Directives 2010/75/EU and 2001/80/EU on emissions. Ukraine has made a commitment under the Association Agreement to implement provisions of the Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading into its national legislation by the end of 2016. However, as of now, the legislation on carbon emissions trading has not yet been developed.

Along with that, Ukraine uses administrative measures for decreasing the level of carbon emissions, which include the environmental tax. In 2018, the National plan for reducing emissions from large burning stations is planned to be implemented.

4.5 RECENT STRATEGIC REGULATORY CHANGES

The Ukrainian Parliament, Government and sectoral authorities have recently adopted a number of strategic documents, including:

- The Energy Strategy till 2035, adopted by the Government in August 2017;
- The Concept for the development of gas producing industry, adopted in December 2016; it contemplates the implementation of measures for increasing energy independence from gas imports;
- The Plan for the development of the power distribution network for 2016–2025, adopted by the Ministry of Energy and Coal Industry in September 2016;
- The Program for the development of major and interstate electrical networks of the IPS of Ukraine for the period until 2023, approved in mid-2016.

Mining

In 2017 the Ministry for Environment and Natural Resources of Ukraine adopted the Rules for the extraction of oil and gas deposits, which came into force on 30 June 2017. The Rules are focused on extraction of deposits of unconventional hydrocarbon systems. The newly adopted Rules replace the rules adopted in the 80s.

Electricity market

In addition to the new Law of Ukraine "On Electricity Market", the new licensing rules for electricity distribution were adopted in July 2017.

Environmental impact assessment

Earlier this year the Parliament adopted the Law of Ukraine "On Environment Impact Assessment". The newly adopted Law requires mandatory assessment of impact (both direct and indirect) on the environment of certain industrial objects and activities, such as, among others:

- Oil and gas processing plants;
- CHP stations;
- Facilities for the production and enrichment of nuclear fuel;
- The extraction of oil and natural gas from the continental shelf;
- Pipelines for transporting oil and gas with a diameter of over 800 mm and having a length of over 40 km;
- Facilities for oil and petrochemicals storage;
- The construction of overhead transmission lines with a voltage of over 220 kV having a length of over 15 km;
- The extraction of mineral resources;
- The storage and processing of hydrocarbon crude;
- Hydro-power plants;
- Wind-power plants with two or more turbines with the height of over 50 m.

The operation of the above objects, and conduct of the above activities, may not be commenced until their impact on the environment has been assessed in accordance with the Law and until a positive decision is received from the relevant authorities. As part of the assessment process, the environmental authorities need to be provided with an assessment of the environmental impact, and such report becomes subject to public discussion. Based on this, environmental authorities provide their opinion on the assessment. A report on the environmental impact assessment, a report for public discussion and an opinion of environmental authorities forms the basis for local authorities to issue a relevant permit.

The Law also provides for the establishment of a single register on the environmental impact assessment. The Law is expected to start being implemented from December 2017.

Alternative energy

Recent developments and amendments in the alternative energy sector include the following:

- Amendments to the Law of Ukraine "On Alternative Fuels" regarding the implementation of regulation of alternative fuels production;
- Amendments to the taxation laws allowing enterprises producing electric energy by a specialized cogeneration plant and/or from renewable energy sources, to opt for a so-called simplified taxation system (which generally offers beneficial tax treatment compared to the general tax treatment);
- The 2017 Law of Ukraine "On Electricity Market" (which provides for a preferential regulatory regime for the renewable energy industry until 2030);
- The Law of Ukraine "On Energy Efficiency of Buildings", adopted in line with the obligations of Ukraine related to cooperation with the Energy Community. The draft law was assessed by the Secretariat of the Energy Community and was recognized as conforming with the provisions of Directive 2010/31/EC. The newly adopted law introduces certification of buildings' energy efficiency and is aimed at decreasing energy consumption in buildings;
- The 2017 amendments to the Law of Ukraine "On Heat Energy", which simplified tariff-setting for producers of alternative heat;
- The 2016 amendments to the Law of Ukraine "On Alternative Energy", cancelling state registration of producers of alternative fuels, with a view to simplifying and encouraging the use of alternative energy.

Also, in 2017 the Law of Ukraine "On Energy Efficiency Fund" was adopted. Once established, the Energy Efficiency Fund will perform the following functions, in particular:

- Partial reimbursement of costs of energy efficiency measures;
- Providing grants to legal entities and individuals;
- Providing financial estimates of energy efficiency projects;
- Implementation of energy efficiency practices;
- Technical evaluation of energy efficiency projects.

5. ENERGY STRATEGY OF UKRAINE UNTIL 2035: SECURITY, EFFICIENCY AND COMPETITIVENESS (NES)

On August 18, 2017 the Cabinet of Ministers at its meeting approved the Energy Strategy of Ukraine until 2035: Security, Energy Efficiency, Competitiveness (NES), which provides for a twofold reduction in the energy intensity of the national economy and increase in the production of both traditional and renewable energy sources. The new energy strategy is a program document that defines the whole complex of large- scale reforms in the energy sector of the state and defines the goals by 2035 and global steps to achieve them.

The published final document mentions the need to "work out the issue of refraining from the formation of pricing and tariff policies on a "cost plus" basis, in particular, through the switch to RAB regulation with the subsequent transition to market mechanisms."

As for the development of the coal sector, the strategy involves the liquidation of the state-owned wholesale coal buyer and the introduction of trade in coal products on exchanges.

The essential task of the energy strategy is to reduce energy consumption of Ukraine's economy by half until 2030 and to boost the Ukrainian production of both traditional and alternative energy sources. According to the document, the target structure of electric power production looks like this: nuclear power in 2035 to produce 50% of the country's electricity, renewable sources - 25%, hydropower - 13%, and the rest will be covered by thermal power plants.

According to the authors of the document, Ukraine needs to transform its gas transportation infrastructure for more active integration with the European one.

The energy strategy also says that Ukraine sets a goal to transfer the point of acceptation and transmission of transit gas volumes from the western to the eastern border. At the same time, the authors of the document doubt that Russian gas transit will continue after 2019.

The NES will be implemented in three stages:

STAGE 1: Energy sector reform through 2020

Complete implementation of the "Third Energy Package" is envisaged during this period, allowing for the creation of full-fledged natural gas and electricity markets in accordance with EU energy legislation. Also to be carried out during this stage is the complete institutional integration of Ukraine into the ENTSO-G network, as well as to meet most of the requirements for integrating Ukraine's unified power system (UPS) into the ENTSO-E grid.

Moreover, this stage involves reforming energy companies in accordance with Ukraine's Energy Community treaty obligations, increasing gas production, reducing GDP-based energy demand, and further developing renewable energy capacity.

Finally, by 2020, Ukraine is expected to achieve radical advances in the field of renewable energies by increasing its share in final consumption by 11 % (8 % of total primary energy supply, or TPES). This will be pursued through stable and predictable policies both to promote the development of renewable energies and to attract investment.

STAGE 2: Optimisation and innovative development of energy infrastructure through 2025

The second stage of NES implementation will be geared towards operating in a new market environment and under Ukraine's actual IPS integration into the European grid, which will significantly affect the rationale in selecting facilities for renovation (or new constructions in the energy sector) and boost energy efficiency as well.
Renewable energy sources, meanwhile, are expected to be the fastest-growing sector in terms of power generation, with an envisioned share increase within the TPES structure to 25 %.

STAGE 3: Sustainable development through 2035

The third stage of the NES anticipates innovative development of the energy sector and the construction of new-generation facilities. It also looks to secure investments in new power generation facilities to replace those, which are to be decommissioned. Selected types of generation will depend on projected fuel prices and the growth rate of each energy generation system, which will in turn raise the level of competition within the sector.

6. ENERGY SECTOR PROJECTS

According to Ukraine's Association of Renewable Energy, only 7.5% of the electricity generated in Ukraine comes from green sources, mainly from hydropower. Growth could have expanded at a much higher rate if lawmakers had provided a more investor-friendly environment. The market needs timely legislative decisions, less bureaucracy, rapid energy reforms and more powers for the industry's regulator. Investors are still cautious and not confident about government commitments to future tariffs.
Notwithstanding the unpredictability, industry players still express optimism and European banks, especially European Bank of Reconstruction and Development, or EBRD, and World Bank are willing to give loans. Many new investors have entered Ukraine's local market to generate electricity from wind, sun, water, and biomass just in the past two years. Here are six market players who are leading the way: Eco Optima Ukraine's renewable power sector started in 2009, when the country introduced differentiated green tariffs on various types of power generation. The green tariffs are pegged to the euro, setting the price per kilowatt-hour in euro cents. The incentive promised fast return on investment.

Eco Optima

Eco Optima was one of the first companies to take advantage of the profitable tariffs and invested into renewable energy sources in western Ukraine. The company is particularly interested in solar, wind and hydro energy. Eco Optima has built and launched three solar and two wind power plants. Its biggest power station generates 46 MW of wind energy. It is currently developing yet another large-scale power plant in Lviv Oblast with a capacity of 36 megawatts of solar energy.

UDP Renewables

Investment and development company UDP Renewables has built the biggest solar power plant in Kyiv Oblast as it occupies 12 hectares of land. It plans to operate the plant at an annual capacity of 50 MW by the end of this year and at 300 MW by 2020. The company belongs to Ukrainian oligarch Vasyl Khmelnytsky who is also planning to build another two plants – one in Odesa and one in Kherson.

TIU Canada

But Khmelnytsky is not the only one with big plans for the country's renewables future. Back in September 2017 Canadian renewable energy company TIU-Canada invested EUR 10 million in building a 10-MW solar power plant in Dnipropetrovsk Oblast. It's the first Canadian investor to invest in Ukraine since the Canada-Ukraine Free Trade Agreement came into force in August 2017. And the company plans to continue investing in Ukraine's renewable energy sector. TIU-Canada decided to come to Ukraine exactly because of its green tariffs. It already started to generate solar power in January 2018.

Rengy Development

Established in 2009, Rengy Development invests and builds renewable energy projects in Ukraine, Armenia and Kazakhstan. The company focuses on solar energy, though it also develops other sources of renewable energy such as wind and biomass. Today Rengy Development has 10 small solar power plants in Ukraine with a total capacity of approximately 68 MW: eight plants in Vinnytsia and two plants in Odesa. Its biggest one generates 9.5 MW. In total, the company has installed 210,000 solar panels stretched throughout 35 kilometers. Its operating plants are estimated to reduce carbon dioxide emissions by more than 60,000 tons a year by replacing the use of fuel. The company has signed several deals with EBRD, the European Investment Bank, and the Clean Technology Fund.

Recom
The second largest solar panel manufacturing company in Europe, German company Recom, came to Ukraine in 2017 to become a part of a Ukrainian government initiative to reduce pollution and fossil fuels consumption. They started in Odesa, but now plan to move their attention to southern Ukraine's Kherson Oblast. The officials there are glad to receive some help as they are ambitiously trying to increase their quota renewable-based electricity. For this purpose, Recom is to invest USD 500 million in a solar power plant that will have the capacity of up to 500 MW. Meanwhile, Recom has already built three power plans in Odesa Oblast that altogether generate 24 MW. Recom has a solid international presence with plants in Israel, Romania, the United Kingdom, the United States, Germany, and Hungary among others. Its Odesa solar plant already became the company's second largest.

Rener
One more renewables champion in Ukraine is Rener, a leader in the renewable industry in western Ukraine, where it has launched eight solar plants with a total capacity of 42 MW: three solar power plants and five mini-hydropower plants. By the end of 2018, the company will have built two more hydropower plants. The Rener group also owns the largest solar power plant in Zakarpattya Oblast, with a capacity of 21 MW.

DTEK and China Machinery Engineering corporation solar plant
One of the largest energy companies in Ukraine DTEK and China Machinery Engineering have signed an agreement of construction of 200 MW solar plant in Dnipro region.

KNESS solar power plants
KNESS is developing three solar power plants in Odesa region totaling 87 MW with EBRD financing involved.

Planetcore solar power plant
Planetcore group from UAE has declared building a 100 MW solar farm in Odesa region.

Scatec solar plant
Norwegian Scatec is building a 25 MW solar plant in Cherkasy region and claims it to be the first project of the company from its 200 MW portfolio in Ukraine which Scatec plants to set until the end of 2019.

Eurocapewind farm
Eurocape is planned to become the largest wind farm in Ukraine and in Eastern Europe totaling 500 MW. The project involves a USD 150 million OPIC loan and USD 320 million OPIC guarantees.

DTEK wind farm Primorska
DTEK is constructing a 200 MW wind park I Zaporizhya region.

Guris wind park
Turkish Guris is building a 80 MW wind farm in Odesa region which should expand wind farms portfolio in Odesa region to 200 MW.

Windcraft Ukraine LLC
Windcraft Ukraine LLC has declared building a 70 MW Ozeryanivska wind farm in Kherson region. Novotroyitska wind farm being built by Windcraft Ukraine LLC in Kherson region should become one of the largest wind mills in Ukraine totaling 44 MW.

Ochakivskiy wind park
Ochakivskiy wind park in Mykolaiv region involves the development of two wind farms totaling 43 MW.

MHP

In 2017 the EBRD provided a senior loan of EUR 25 million to PJSC "Myronivsky Hliboproduct" (MHP), a London Stock Exchange listed Ukrainian producer of poultry meat, grain and fodder. The loan will be used to construct and put into operation a 10 MW biogas plant in the town of Ladyzhyn, Vinnytsia region. The biogas plant will utilize chicken manure and other agricultural residues from MHP's poultry and grain operations. It is expected that once operational the biogas plant will reduce MHP GHG emissions by 90,000 tons of CO_2 equivalent per year.

Kamyanets-Podilskiy TPP

In May 2018 the installation of a thermal power plant with a capacity of almost 45 MW with combined heat and power production by solid fuel and gas boilers was completed in Kamyanets-Podilskiy. Agricultural and forestry waste will be used as biomass: mostly straw, corn and chips. Construction of the complex began in 2015. The cost of the project is USD 9.6 million. The loan was provided by the World Bank at a rate of 0.01% per annum. Kamyanets-Podilskiy TPP is equipped by a unique turbine with the ORC module (Organic Rankine Cycle). It will become the 1st in Ukraine, the 3rd in Europe and the 5th in the world in terms of implementing of this modern method to produce heat.

USAID

The U.S. Agency for International Development (USAID) plans a new five-year project to support reforms in the Ukrainian energy sector with the total cost of up to USD 90 million. The new project would focus on the introduction of competition on energy markets, assistance to municipal authorities, search for new tools of stimulating renewable energy, cyber security of the energy sector, establishment of the energy market regulator, transparency of market information, search for new models to manage the gas transport system (GTS) and Ukraine's integration into the EU markets.

NEFCO (Nordic Environment Finance Corporation)

NEFCO has financed a range of energy-efficiency and renewable energy projects in Ukraine since 2008. The project portfolio currently comprises over 130 projects at various stages.

NEFCO and Finnish Ministry of Foreign Affairs

The Finnish Ministry of Foreign Affairs and the NEFCO signed an agreement on November 29, 2017 to create a trust fund for financing renewable energy in Ukraine in the amount of EUR 6 million. The Finnish- Ukrainian trust fund facilitates the provision of technical assistance and the allocation of grant funds for the implementation of clean energy projects in Ukraine. To date, NEFCO has already funded about 150 projects in the field of renewable energy and energy efficiency in Ukraine.

NEFCO and Yavoriv LLC

NEFCO and the Ukrainian company Energopark Yavoriv LLC have signed an equity agreement for the construction of a 36 MW solar plant in the Lviv region in Western Ukraine. It is NEFCO's first solar project to be implemented in Ukraine, and it will invest EUR 2.5 million in the project. The total investment for the solar project is EUR 34.7 million. Besides NEFCO, the Danish Investment Fund for Developing countries (IFU) and Energopark Yavoriv have injected equity into the project. The European Bank for Reconstruction and Development (EBRD) is co-financing the project with debt. As a possible second phase in the project, the aim is to expand the solar plant to a 72 MW construction once the financing is in place.

7. DATA SOURCES & USEFUL LINKS

Aequo Law firm https://aequo.ua/
American Chamber of Commerce http://www.chamber.ua/
Association of Gas Producers of Ukraine http://agpu.org.ua/en/
Baker&McKinsey https://www.bakermckenzie.com
Bioenergy Association of Ukraine (UABIO) http://uabio.org/en
British Petroleum https://www.bp.com/
Cabinet of Ministers of Ukraine https://www.kmu.gov.ua/en
Carnegie Europe https://carnegieeurope.eu/
DiXi Group http://dixigroup.org
DLF attorneys-at-law http://dlf.ua/en/
DTEK https://dtek.com
EBRD https://www.ebrd.com
Emerging Europe https://emerging-europe.com/
Energy Community https://www.energy-community.org/
European Business Association https://eba.com.ua/en/
Eurostat http://ec.europa.eu
Gazprom http://www.gazprom.com/
Global Legal Insights https://www.globallegalinsights.com
IB Centre https://www.ibcentre.org
IEA Bioenergy http://www.ieabioenergy.com/
Institute for Social and Economic Research http://iser.org.ua
Institute of Renewable Energy (Academy of Sciences of Ukraine) http://www.ive.org.ua/
Interfax Ukraine https://interfax.com.ua/
International Energy Agency https://www.iea.org/
International Finance Corporation http://www.ieabioenergy.com/
International Renewable Energy Agency (IRENA) http://www.irena.org/
Kyiv International Economic Forum http://forumkyiv.org/en/
Kyiv Post https://www.kyivpost.com/
Liga http://www.liga.net/
Ministry of Ecology and Natural Resources of Ukraine https://menr.gov.ua
Ministry of Energy and Coal Industry of Ukraine http://mpe.kmu.gov.ua/
Naftogaz Group http://www.naftogaz.com/
NEURC (National Energy and Utilities Regulatory Commission of Ukraine)
http://www.nerc.gov.ua/
Nordic Environment and Finance Corporation https://www.nefco.org
Novoe Vremya https://nv.ua/
Nuclear Energy Agency https://www.oecd-nea.org/
PJSC "UkrHydroEnergo" http://uhe.gov.ua/

PJSC Ukrtransgas http://utg.ua/en/
Razumkov Centre http://razumkov.org.ua/en/
REN21 http://www.ren21.net/
Scientific Engineering Centre "Biomass" http://biomass.kiev.ua/en/
State Agency on Energy Efficiency and Energy Saving of Ukraine http://saee.gov.ua/en
State Enterpise "Ukrenergo" https://ua.energy/en/
State Enterprise "Energorynok" http://www.er.gov.ua/
State Enterprise "National Nuclear Energy Generating Company "Energoatom"
http://www.energoatom.kiev.ua
State Fiscal Service of Ukraine http://sfs.gov.ua/en/
State Service of Geology and Mineral Resources http://www.geo.gov.ua
State Statistics Service of Ukraine http://www.ukrstat.gov.ua/
State Treasury Service of Ukraine http://www.treasury.gov.ua
The World Bank Group http://www.worldbank.org/
The World Economic Forum https://www.weforum.org/
Ukrainian Association of Renewable Energy http://uare.com.ua/en/
Ukrainian Wind Energy Association http://www.uwea.com.ua/
Unian https://www.unian.info/
World Nuclear Association http://www.world-nuclear.org/