

6.182 MWp Solar PV Plant in Dnipropetrovsk Region, Ukraine

Capstone Project

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MBA 20

Date 26 April 2020

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1. Executive Summary

Role of RES power plants in the energy system of Ukraine. Power plants using RES have demonstrated the most dynamic development of all electricity producers in Ukraine and their share in the energy system is rising. Installed capacity of the RES power plants accounted for some 3.6% of the nationwide installed capacity of power plants as of the beginning of 2019, 1.9% of electricity generation and 8.7% of electricity sales cost in 2018. Installed capacity of RES power plants grew from 685 MW in 2013 to 3,634 MW as of the end of June 2019. Solar power plants accounted for 75% of the total installed capacity of all RES power plants.

State support system for RES power plants. Key element of the state support system for RES power plants is fixed electricity feed-in ("green") tariff rates determined by the law for electricity output of RES power plants commissioned until the end of 2019 or even later but under condition of signing of pre-PPA with the Guaranteed Buyer (off taker of electricity sold by RES power plants). Mentioned tariff rates will be effective until 31 December 2029. 20-year PPA will be guaranteed for RES power plants which will take part in the "green" auctions from 2020 and beyond on the basis of the "green" tariff rates to be determined on a competitive basis at the auctions. Other important elements of the support scheme include mandatory off-take of electricity produced by RES power plants, full payments for electricity exclusively in cash form, bonus to the "green" tariff for the use of local equipment and tax incentives.

New electricity market model. From 1 July 2019 the new electricity market model has become operational in Ukraine which provides for different options of electricity sale, prices formation, settlements and other aspects of market relations by market participants. Under the new electricity market model all elements of state support of RES power plants have been retained. Purchase and sale of electricity at the "green" tariff will be performed based on a bilateral PPA between the RES power producer and the Guaranteed Buyer. The Guaranteed Buyer will sell "green" electricity in the day-ahead market and the intraday market, and respective non-balances in the balancing market which are all segments of new electricity market model at the prices of respective market segments. The difference between value of electricity purchased by the Guaranteed Buyer at the "green" tariff/auction prices and the value of this electricity sold at the new electricity market segments will be reimbursed by the TSO through the TSO's tariff for electricity transmission. The RES power plants commissioned in 2017-2023 will be financially responsible for the imbalance between planned and actual electricity output with gradual increase of the compensated share of imbalances cost from 10% in 2021 to 100% in 2030. For RES power plants commissioned in 2024 and beyond the compensated share of imbalances cost will be 100%.

Project company. SPP LLC is a special purpose company (SPC) to be established under the laws of Ukraine for implementation of the Project.

Project Shareholder and rationale for it. Project will be implemented by the Shareholder. Its strategic business development target is growth of consolidated turnover at the expense of new business activity development in the RES sector – construction of own ground located solar PV power plant of small capacity and entering electricity market of Ukraine in capacity of electricity seller, the company's business diversification under growing competition in the energy equipment supply market.

Following conditions facilitate achievement of this strategic goal by Shareholder:

- Advantageous investment and legal environment for RES power plants construction in Ukraine.
- Availability of high feed-in tariff for solar PV power plants effective till 2030.
- Reduction of cost of equipment for solar PV plants which contribute to higher projects

economic efficiency.

- RES development has been determined as a strategic goal in the energy sector development strategic documents e.g. Energy Strategy of Ukraine until 2035, RES National Development Action Plan until 2020, Low Carbon Strategy of Ukraine until 2050, international commitments of Ukraine as the member state of the Energy Community Treaty and in the framework of the Association Agreement between Ukraine and EU.
- Considerable unused potential of RES development in Ukraine as a tool for reduction of national dependence upon imported fossil fuels e.g. for electricity generation.

Project scope. Construction and operation of a solar PV power plant with an installed capacity of 6.182 MWp (4.920 MW_{AC}).

Project site location. Within the boundaries of Zhd village council, Dnipropetrovsk region of Ukraine.

Plant's connection point in existing grids. 150/35/10 kV substation "Zhd". The distance between the Plant and the substation is some 1.5 km.

Plant's technical concept. The Plant will be installed on fixed tilt, ground mounted support structures, use 60-cell, monocrystalline modules manufactured by Jinko Solar and 82 string inverters from Huawei with a capacity of 60 kW each. Five transformers 1.0 MVA each will collect the power from the inverters. Main technical data of the Plant are summarized in the Figure below.

Item	Parameter
Installed capacity	6.182 MWp
Module	Jinko Solar Cheetah 60M JKM320M-60, monocrystalline 60-cell modules 320 Wp each
Number of PV modules	19,320
Inverter type	Huawei SUN 2000-60KTLM0
Number of inverters	82
Nominal AC output power	60 kW _{AC} , in total 4.920 kW _{AC}
Nominal power ratio	6.182/4.920= 1.26
Transformer stations	1.0 MVA, 0.4/10 kV (PTS-1000-10/0.4 kV)
Number of transformers	5
Type of installation	Fixed tilt structures (29° south-tilted)
Grid connection point	150/35/10 kV substation "Zhd"

Project cost. The total capital expenditures for implementation of the Project has been estimated at EUR 4.305 million, hence the specific cost is 0.70 EUR/Wp, which is in the range of prices recently seen in PVP projects in Ukraine using similar contractual arrangements.

Operating expenses. In the absence of a signed O&M contract, the OPEX budget of the Project was estimated on the basis of a benchmark project at 20 EUR/kWp/year (VAT exclusive) which is in the highest range of OPEX for benchmark projects and considers the lack of the effect of economy of scale which larger power plants have.

Project implementation arrangement. The Project will be implemented according to the set of contracts signed between the SPC and suppliers of main equipment as well with Shareholder which will be a general contractor (responsible for civil construction and equipment installation works) for the SPC. Shareholder will perform preparatory works on the site of the Plant and general coordination and control of activities of all contractors engaged for implementation of the Project. LLC "MVK" will be responsible for all engineering, procurement, mounting and commissioning of the Plant (as a subcontractor of Shareholder) and its grid connection facilities. Therefore, by the scope of works LLC "MVK" will perform EPC

contractor's functions.

Project planned financing structure. Of the total Project CAPEX budget of EUR 4.3 million, 40% will be provided through equity or quasi-equity contribution of Shareholder. Loan will be raised equal to 60% of the Project cost.

Project implementation milestones. Key planned milestones of the Project implementation schedule are the following:

- Plant's start of construction: August 2020
- Plant's completion of construction: September 2020
- Plant's connection to grid: September 2020
- Plant's commissioning: October 2020
- Plant's start of commercial operation: December 2020.

Project Development Stages

- Approval of the town planning document for location of the Plant
- Allocation of the land plot for location of the Plant
- Allocation of land plots for location of the grid line
- Allocation of land plots for access to the Plant's site
- Preparation of design documents for construction of the Plant according to Ukrainian standards
- Passing of all-inclusive construction expertise of the design document for the Plant
- Signing of the grid connection agreement
- Preparation of design documents for external grids for the grid connection of the Plant according to Ukrainian standards, its approval by the grid company
- Passing of all-inclusive construction expertise of the design document for the external grids for the grid connection of the Plant
- Finalisation of signing of contracts with suppliers and contractors for construction of the Plant
- Obtaining of a permission document for construction of the Plant
- Start of construction of the Plant
- Construction completion of the Plant
- Commissioning and grid connection of the Plant
- Start of commercial electricity sale at the green tariff by the Plant (licence, green tariff, PPA)

On the Plant site preparatory works for territory cleaning and planning shall be launched to prepare the site for the launch of construction.

Project environmental and social impacts. The key environmental impacts of the Project will originate from the siting and construction of the Plant facilities and equipment, construction of the 10kV cable transmission line. There are no environmentally protected areas and known archaeological sites onsite or in the project impact area. Therefore, all potential projects impacts are manageable and mitigatable.

The project is expected to generally have positive social impacts, such as:

- Financial contributions to the local community in the form of land tax payments.
- Some new jobs created for project construction and operation, including local labour (3-5 persons total staff at operation stage).
- Improvement of security of energy supply in the region with safe renewable solar energy.
- Ad-hoc support to the local community in response to the village needs.

Financial projections. Based on the calculations performed, the Project shows moderate performance in the base case, and low performance in the sensitivity assessment.

2. Project Implementation Environment

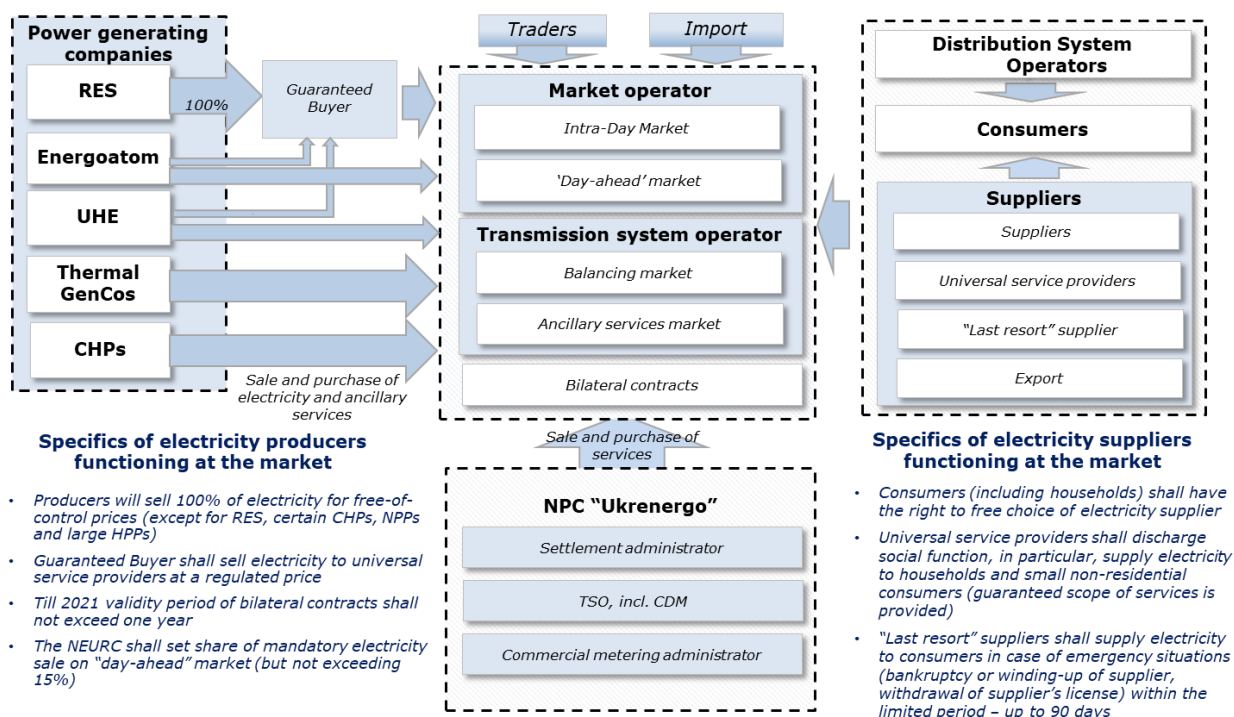
2.1. Electricity Market

From 1 July 2019 the new electricity market model has become operational according to the Law of Ukraine "On the Electricity Market" (Electricity Market Law).

The new electricity market model stipulates liberalization of the market relations including tariff formation for electricity and related services, and introduction of the following market segments (see Figure below):

- bilateral contract market;
- day-ahead market;
- intraday market;
- balancing market;
- ancillary services market;
- retail market (which has become operational from 1 January 2019).

New Electricity Market Segments



The new electricity market provides for different options of electricity sale, prices formation, settlements and other aspects of market relations by market participants. In particular, the SE "Guaranteed Buyer" is obliged to purchase all electricity produced by RES, specifically by solar power plant, at the feed-in tariff specified in the preliminary power purchase agreement and power purchase agreement set for the next 10 years. See Annex 2 for more details about the market.

2.2. Ukraine Power Sector

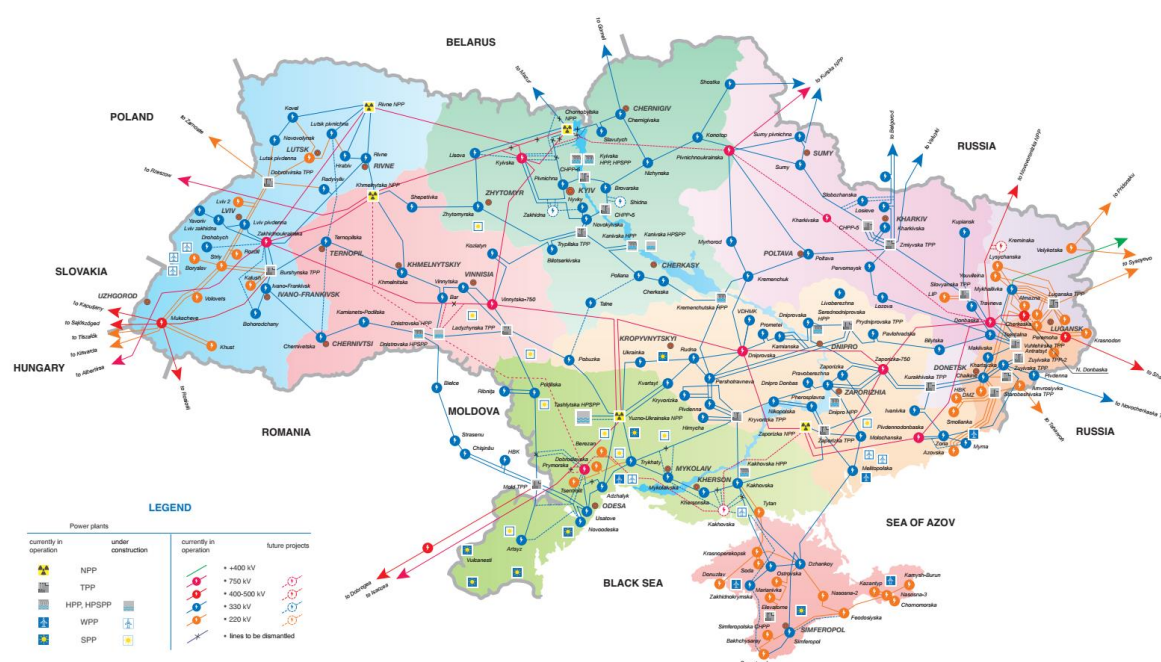
The United Energy System (UES) of Ukraine is one of the largest energy systems in Europe, the total installed capacity of power plants is about 49.7 GW (in the beginning of 2019), the maximum load is 24.6 GW (in December 2018). The western part of the UES, the so-called "Burshtyn TPP island" is separated from the main part of the UES and operates synchronously with the ENTSO-E (covers about 4% of the nationwide load); it allows the export/import of electricity to/from Hungary, Romania and Slovakia in technically limited volumes. Electricity export is also carried out using a radial connection between Dobrotvir TPP and the energy

system of Poland. At the same time, Ukraine officially declared, as one of its priority energy policy goals, full-scale integration of the UES with the ENTSO-E and implements measures for preparation of the UES to meet technical standards and requirements of the ENTSO-E (with estimated completion horizon 5-9 years).

The UES of Ukraine includes NPPs, thermal (TPPs and CHPs) and large hydraulic power plants, well-developed main electricity grids, as well as distribution grids designed to transport large volumes of electricity within the territory of the country and for export (see Figure below).

Electricity transmission (through 21.8 thousand km of main and interstate electricity networks 220-750 kV and 137 substations 110-750 kV) is unbundled from electricity generation, distribution and supply. The national TSO, state enterprise (SE) National Power Company (NPC) Ukrenergo manages the transmission grid and is also responsible for centralized dispatch management (CDM) of the UES. Electricity distribution networks (826.7 thousand km, 0.4-110 kV, 204.6 thousand substations 6-150 kV) are owned and operated by regional power distribution companies (known as Oblenergos) holding the energy sector regulator's (National Energy and Utilities Regulatory Commission, NEURC) licenses for electricity distribution. Power suppliers are NEURC's licensees on electricity supply and must enter into contracts with Oblenergos for the use of their networks for electricity distribution and pay them for services on electricity distribution.

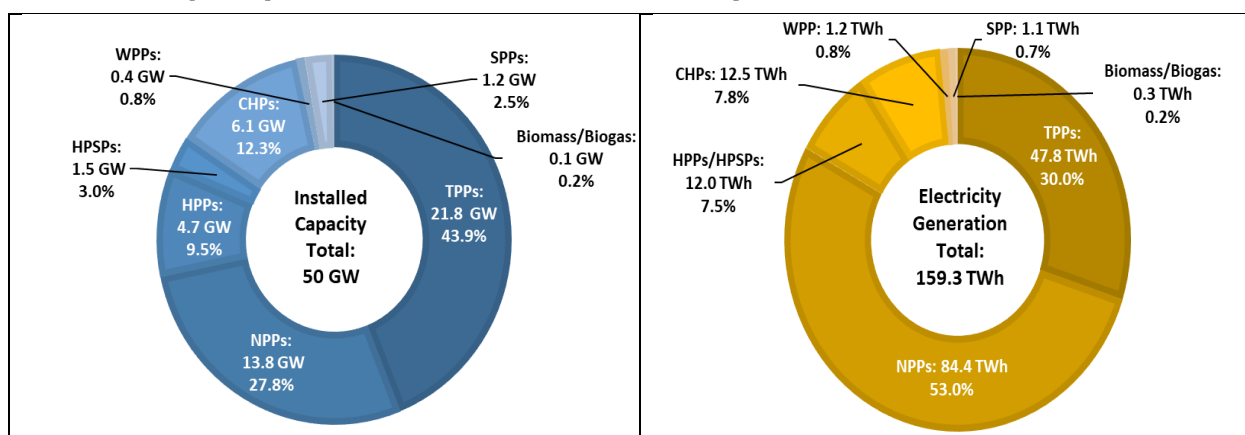
UES of Ukraine, as of January 2019



Source: SE NPC Ukrenergo

The dominant position in the power generating sector is held by TPPs and NPPs with their share in the balance of power about 72% of the total nationwide installed capacity and in electricity generation - 83% of the total electricity production (see Figure below).

Installed Capacity of Power Plants and Electricity Generation, 2018



Note: Installed capacity is on 01.01.2019, in January – April 2019 green tariff rates were approved for 1.1 GW of RES power plants. Electricity generation is for 2018. Both charts exclude power plants located in Crimea and on the territories of Donetsk and Lugansk regions which are temporarily not under control of Ukraine

Source: SE NPC Ukrenergo, NEURC

National nuclear energy generating company “Energoatom”, operator of all domestic NPPs, is the largest producer of electricity in Ukraine, providing more than 50% of total domestic electricity production using only a quarter of the total installed capacity. NPPs are in considerably better technical condition than TPPs and CHPs because more funds were traditionally allocated to ensure their reliable and safe operation. However, in the future, NPPs will require attraction of considerable financial resources for decommissioning, life extension and new construction to replace outdated units.

TPPs provide about 30% of annual electricity generation and are the second largest electricity producer in Ukraine. The power units of Ukrainian TPPs, in general, were put into operation in 1960 - 1975. TPPs equipment is characterized by low reliability and efficiency as well as high level of pollutant emissions. Over the past twenty years, no new TPPs were commissioned. Since 2007, the gradual reconstruction and modernization of power units of certain TPPs has been carried out resulting in improvement of their technical and economic performance and increase (in most cases) of installed capacity by 15 - 35 MW. In 2017, the total lifetime of 77 units of thermal power plants (19.4 GW or 80.1% of the installed capacity of all Ukrainian TPPs) exceeded the limit for operation of such equipment.

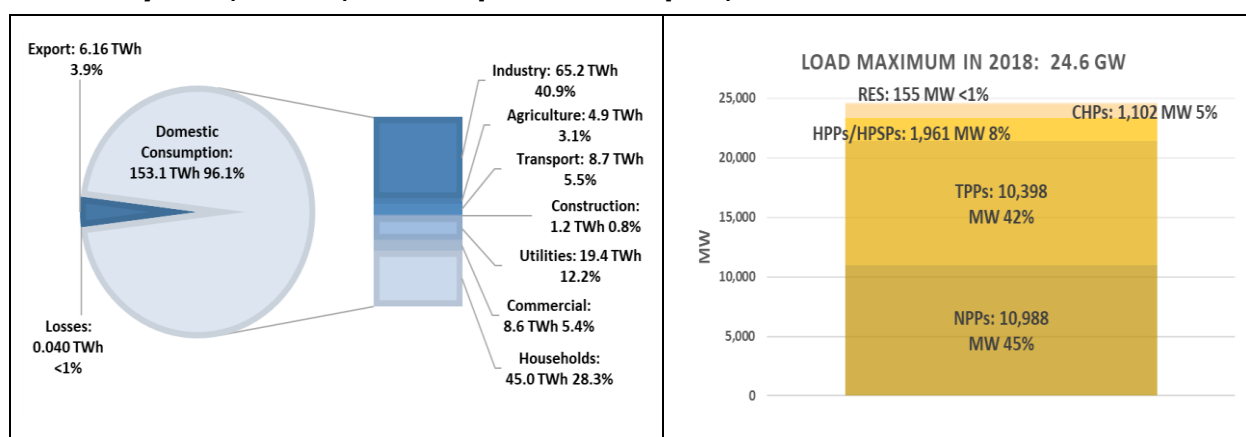
Under condition of the deficit of regulating capacities in the UES of Ukraine (those are mostly represented by HPPs, slightly by HPSPs), in addition to providing the base load, TPPs play an important role in regulating load fluctuations. Consequently, due to a shortage of manoeuvrable capacities, TPPs are used intensively to regulate daily fluctuations of load. Such operating modes of TPPs result in additional use of service life resource of their power units' equipment, increased accident rate and fuel overrun. It should be noted that after the intensification of the military conflict with the Russian Federation from 2014, Ukraine has lost control over the coal reserves in Donbass. Because of location of the part of the TPPs on the non-controlled territories and due to the limited import supply, Ukrainian TPPs, for which coal of anthracite group (anthracite fines + T) is the main fuel, suffer from a shortage of basic fuel, especially in winter when the load grows. Producers operating TPPs are re-equipping power units using anthracite coal for combustion of coal of a gas group to reduce dependence on imported coal. However, the transfer of power units to the coal (gas group) in the context of the limited availability of gas coal reserves in Ukraine is not the final solution of TPP fuel supply shortage issue. Due to the lack of funding sources, there is also unresolved issue of

environmental modernization of TPPs by power generating companies operating the TPPs as it is necessary for implementation of the National Emissions Reduction Plan for Large Combustion Plants and meeting obligations of Ukraine as the member state of the Energy Community Treaty.

Large HPPs are concentrated in the Dnipro HPP cascade and one large HPP in the basin of the Dniester River. Dnipro cascade is one of the largest hydraulic constructions in the world and takes a key place in the regulation of frequency and capacity in the UES of Ukraine. Construction of large HPPs in Ukraine was carried out in 1930-1970s. Operator of all large HPPs and two HPSPs is the state-owned company Ukrhydroenergo (UHE). Despite the fact that units of large HPPs are generally outdated, implementation of the project for HPP reconstruction at the financial support of IBRD, EBRD and EIB allowed both to improve their technical condition and get additional capacity of the HPPs and electricity production.

Almost half of electricity output of the power plants is consumed by industrial customers, but substantial portion, 1/3 of electricity, is consumed by households (see Figure below). In 2018, 6.2 TWh of electricity produced by Ukrainian electricity plants were exported (58% to Hungary, 23% to Poland, 15% to Moldova, 3% to Slovakia, 1% to Romania). No electricity was imported. Commercial electricity import was first launched in 2019. NPPs, TPPs/CHPs and large HPPs covered >99% of the maximum daily load in 2018 (see Figure below).

Electricity load, losses, consumption and export, 2018



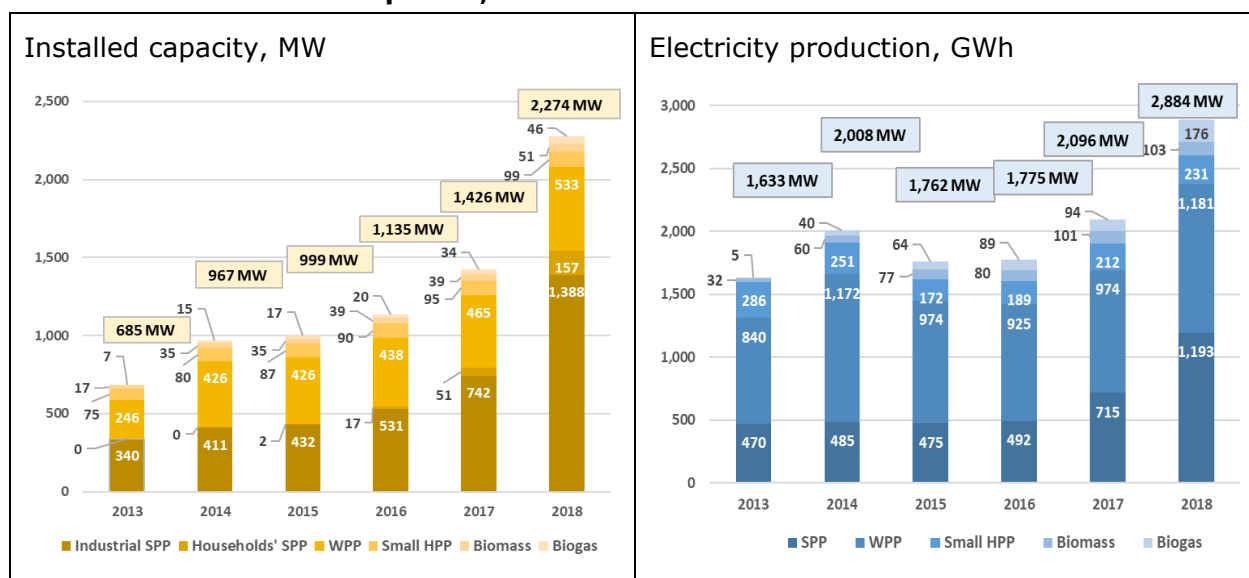
Source: SE NPC Ukrenergo

2.3. RES Power Sector Development Status

In the last years, power plants using RES (RES power plants) have demonstrated the most dynamic development of all electricity producers in Ukraine. It is explained by respective state policy providing support for RES power plants development. In 2015-2018, 1,307 GW of RES power plants were commissioned with accelerated yearly capacity commissioning increment (32 MW were commissioned in 2015, 848 MW in 2018).

The RES power plants contributed some 3.6% into nationwide installed capacity of power plants as of the beginning of 2019, 1.9% into electricity generation and 8.7% into electricity sales cost in 2018 (see Figure below for development trend of RES power plants in 2013-2018).

RES Power Plants Development, 2013 – 2018

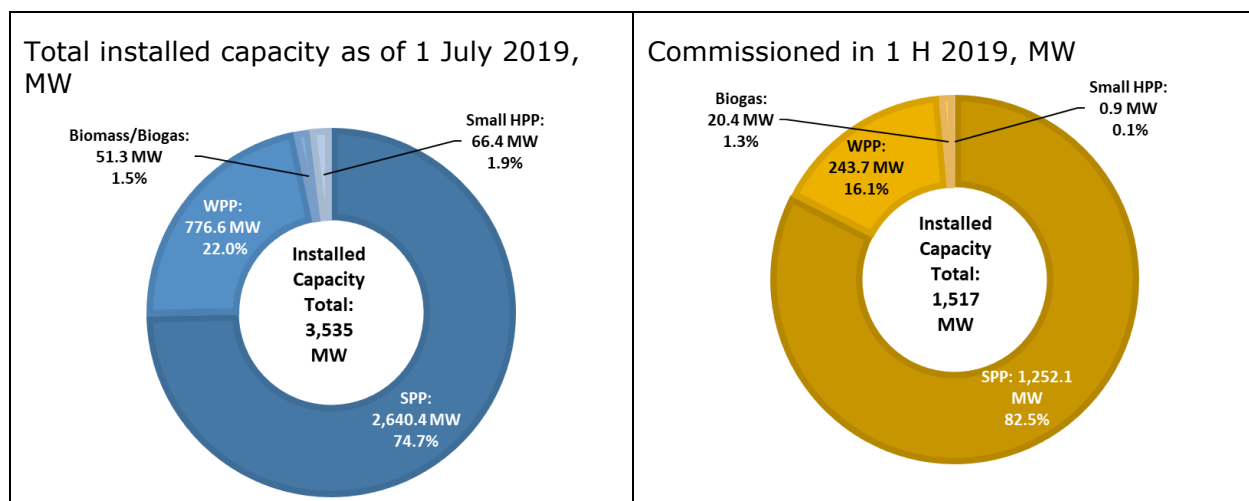


Note: Excluding RES power plants located on temporarily occupied territories

Source: NAER

According to NEURC, as of 1 July 2019, the total installed capacity of RES power plants reached 3,634.4 MW, 94% of which are SPPs and WPPs (see more details in Figure below). During the 1st H of 2019 installed capacity of RES power plants increased by 1,517.1 MW which is the historical highest, 99.6% of which are SPPs and WPPs.

Capacity Breakdown of Operational RES Power Plants by Technology, as of 1 July 2019

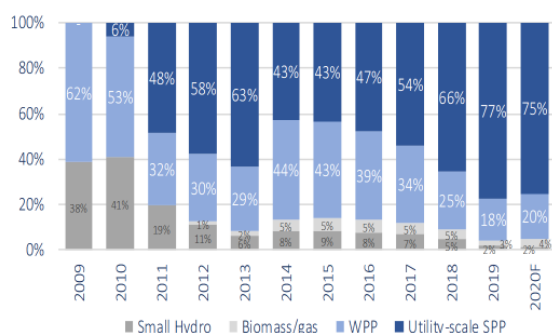


Note: Excluding RES power plants located on temporarily occupied territories

Source: NEURC

RES installed capacity structure 2009 – 2020F

RES Installed Capacity Structure (excluding household SPPs), %



The National Action Plan on Renewables for the period till 2020¹ calls for achievement of the installed capacity of SPPs of 2.3 GW with respective electricity generation of 2.42 GWh. WPP capacity is planned to reach 2,280 MW with respective electricity generation of 5.9 GWh.

2.3.1. RES market players

In 2018 – 2019, there is a peak of RES power plants development in Ukraine, in particular, solar and wind projects. Some international investors (Scatec Solar, Vindkraft, LongWing, NBT, Total Eren, Ekotechnik Group, TIU Canada, Guris, Acciona, etc.) launched/continued their RES power plants projects in Ukraine. There is also a huge number of RES power projects implementing by experienced Ukrainian developers (Rengy Development, DTEK Renewables, KNESS Group, UDP Renewables, Eco Optima, Volterra Energy Group, TKS Group, Aquanova, Clean Energy Group, etc.) or in co-operation between international and Ukrainian developers.

RES market players

Owner	Country	Installed capacity in operation, MW (1)				Total	Share, %
		WPP	SPP	Small Hydro	Biomass/gas		
DTEK	Ukraine	368.4	580.0	7.5	-	955.8	20.8%
CNBM	China	-	301.2	-	-	301.2	6.6%
VR Capital	USA	-	234.0	-	-	234.0	5.1%
Maxim Yefimov/Wind Parks of Ukraine	Ukraine	225.3	-	-	-	225.3	4.9%
Vindkraft Group	Sweden	171.8	-	-	-	171.8	3.7%
Serhiy Khripkov	Ukraine	-	161.8	-	-	161.8	3.5%
UDP Renewables	Ukraine	-	136.6	-	-	136.6	3.0%
Andriy Gordienko	Ukraine	-	125.1	-	5.0	130.1	2.8%
Eco-Optima	Ukraine	33.9	59.6	-	-	93.5	2.0%
Ruslan Bozhko, Olexandr Repkin	Ukraine	-	73.0	-	-	73.0	1.6%
Anton Didenko and partners	Ukraine	-	63.9	-	2.1	66.0	1.4%
Aquanova Group	Ukraine	-	26.5	36.6	-	63.1	1.4%
KNESS Group	Ukraine	-	62.5	-	-	62.5	1.4%
Novosvit Group	Ukraine	-	38.5	22.1	-	60.6	1.3%
TKS Group	Ukraine	-	60.6	-	-	60.6	1.3%
Acciona Energia	Spain	-	57.6	-	-	57.6	1.3%
Scatec Solar	Norway	-	47.0	-	-	47.0	1.0%
TIU Canada/Refraction Asset Management	Canada	-	44.4	-	-	44.4	1.0%
Guris	Turkey	32.7	-	-	-	32.7	0.7%
EMSOLT	Turkey	-	11.0	-	-	11.0	0.2%
Other		99.8	1 338.3	45.5	119.1	1 602.7	34.9%
Total		931.8	3 421.5	111.7	126.2	4 591.2	100.0%

Source: NEURC, Censor.net

Data is presented as of September 2019

¹ Approved by the CMU Resolution No. 902 dated 01 October 2014.

There are 454 RES electricity producers in the register of the GB as of September 2019, majority of them are owned by Ukrainian small and medium size investors. Reputable foreign investors (Acciona, Akuo Energy, GS Engineering & Construction, LongWing, NBT, Refraction, Saffelberg, Scatec Solar, United Green, etc.) account for 1000+ of MW of installed RES capacity and projects under construction.

The EBRD has played the key role in RES power sector development in Ukraine. In 2009, the EBRD launched the Ukraine Sustainable Energy Lending Facility (USELF I and II) to support and finance the first non-large RES energy projects in Ukraine. Since inception, the facility invested more than EUR 100 million to finance over 150 MW for all renewable energy technologies. In 2018, the EBRD launched a new lending facility (USELF-III) to replace the original USELF. As a result of the development of the renewable energy sector, there is growing interest from major international developers to implement larger RES projects. Therefore, to continue supporting the Ukrainian renewable energy sector, the EBRD, intends to commit an envelope of EUR 250 million from its own resources to finance new private RES projects in Ukraine.

2.3.2. Qualified Local EPC and O&M Service Providers

In the last past years SPP sector has been developing very fast. One of the main drivers for fast sector development is presence in the sector of a large number of companies providing turnkey services for SPPs construction.

Major SPP EPC Contractors in Ukraine

Company Name	Constructed SPPs	Capacity, MW	SPPs at the stage of construction	Capacity, MW
PODILSKIY ENERGOCONSULTING LLC (KNESS) https://kness.energy/en/ /presented data as of February 2019/	49	463	18	243
BLOCKMASTER UKRAINE LLC https://blockmaster.com.ua/en/ /presented data as of August 2019/	14	147.6	6	63.5
RODINA ENERGY GROUP https://rodinaeg.com/en/home/ /presented data as of July 2019/	17	149.9	6	150.3
EDS ENGINEERING https://eds-ltd.com.ua/en/ /presented data as of July 2019/	12	130.4	11	75.6
HELIOS STRATEGIA LLC https://heliosstrategia.com/en/ /presented data as of August 2019/	30	124	27	214
SOLAR SERVICE UKRAINE https://solarservice.pro/ /presented data as of August 2019/	11	177	13	175
AVENSTON https://avenston.com/en/ /presented data as of July 2019/	25	85.7	4	29.24
VOLTAGE GROUP	14	71.6	5	29

Company Name	Constructed SPPs	Capacity, MW	SPPs at the stage of construction	Capacity, MW
https://www.voltageg.com/?lang=en /presented data as of August 2019/				

2.4. State Support of RES Power Plants

The key legislative act, which determines the RES support scheme in Ukraine, is the Law of Ukraine "On Alternative Energy Sources" No. 555-IV dated 20 February 2003 (the Alternative Energy Sources Law).

The main features of the RES support scheme envisaged by this law are as follows:

- *For RES power plants eligible for fixed rates determined by the law (Group 1 RES power plants), those:*
 - commissioned until 31 December 2019 regardless RES technology type and installed capacity,
 - having pre-PPA signed before 31 December 2019 regardless RES technology type and installed capacity, and
 - PVPs commissioned after 31 December 2019 and not having pre-PPA signed before 31 December 2019 having installed capacity up to 1 MW - "small PVPs", and
 - wind farms commissioned after 31 December 2019 and not having pre-PPA signed before 31 December 2019 having installed capacity up to 5 MW - "small wind farms group 1";
 - wind farms commissioned after 31 December 2019 and not having pre-PPA signed before 31 December 2019 consisting of three turbines regardless their installed capacity - "small wind farms group 2":
 - special fixed feed-in ("green") tariff rates for electricity produced from RES such as wind, solar, biomass, biogas, geothermal as well as by small HPPs (with the installed capacity up to 10 MW), are introduced until 31 December 2029;
 - the feed-in tariff rates are set per each particular type of RES power plants by applying different "green" coefficients to the base tariff rate which is the retail electricity tariff for the 2nd voltage class consumers as set by the NEURC in January 2009 (at the time of introduction of the "green" tariffs);
 - feed-in tariff rates are adjusted on a quarterly basis to follow changes in UAH/EUR currency exchange rate; herewith, the "green" tariffs cannot be less than the minimum amount of the "green" tariffs fixed in Euro pursuant to the National Bank of Ukraine UAH/EUR exchange rate on 01 January 2009;
 - gradual decrease in feed-in tariff coefficients is envisaged for all types of RES power plants up to 2030, depending on the date of their commissioning;
- *For RES power plants which participate in "green" auctions on a mandatory basis according to the law (Group 2 RES power plants).* RES power plants mentioned above (Group 1 RES power plants) can participate in the auctions on a voluntary basis:

- PVPs commissioned after 31 December 2019 without pre-PPA signed before 31 December 2019 with installed capacity > 1 MW;
- wind farms commissioned after 31 December 2019 without pre-PPA signed before 31 December 2019 with installed capacity > 5 MW (excluding wind farms with three wind turbines irrespective of the installed capacity);
 - “green” tariff rates shall be set on a competitive basis through the auction procedure but the rates shall not exceed the fixed feed-in tariff rates set for the Group 1 RES power plants (see more details on the auctions below);
- *For all RES power plants (Groups 1 and 2 RES power plants):*
 - mandatory off-take requirement is determined for the GB to purchase electricity produced from RES, except for the volumes of electricity used for own needs of RES power plants;
 - RES producers receive full payment for electricity produced;
 - the concept of special surcharge (bonus) as a reward for the use of equipment of the Ukrainian origin is introduced (5% surcharge for 30% local equipment component and 10% for 50%). Specific percentage distributions related to specific elements of the equipment are provided by the Alternative Energy Sources Law per RES technology type to calculate the level of the use of equipment of the Ukrainian origin. The concept of surcharge will be only applicable to the power plants and their start-up facilities commissioned within the period from 01 July 2015 until 31 December 2024.
 - VAT exemption was determined in the Tax Code until 31 December 2022 for imported equipment used for PVP plants (modules, inverters) and wind farms (wind turbines).

“Green” tariff rates for Group 1 RES power plants. The Figure below shows the guaranteed fixed “green” tariff rates for entities operating Group 1 RES power plants.

Electricity generated from RES can be sold to the GB and other electricity market participants (e.g. to local power distribution and supply companies and to electricity customers (except households). At the same time, other electricity market participants have the right, but not the obligation, to buy electricity produced by RES power plants. But at the current level of the feed-in tariffs other market participants have no economic incentives to buy electricity produced by RES power plants.

Feed-in Tariff Rates for Entities Operating Group 1 RES Power Plants

EUR/MWh

Technology / Commiss. Year	01.01.20 17- 31.12.20 19	01.01.20 20- 31.12.20 20	01.01.20 21- 31.12.20 21	01.01.20 22- 31.12.20 22	01.01.20 23- 31.12.20 24	01.01.20 25- 31.12.20 29
Biomass	123.86	123.86	123.86	123.86	123.86	123.86
Biogas	123.86	123.86	123.86	123.86	123.86	123.86
Geothermal	150.25	135.17	135.17	135.17	135.17	120.09
Mini hydro (0.2-1 MW)	139.48	125.48	125.48	125.48	125.48	111.48
Small hydro (1-10 MW)	104.47	94.24	94.24	94.24	94.24	83.47
Solar (ground based)	150.25	112.55	108.78	105.01	101.24	97.47

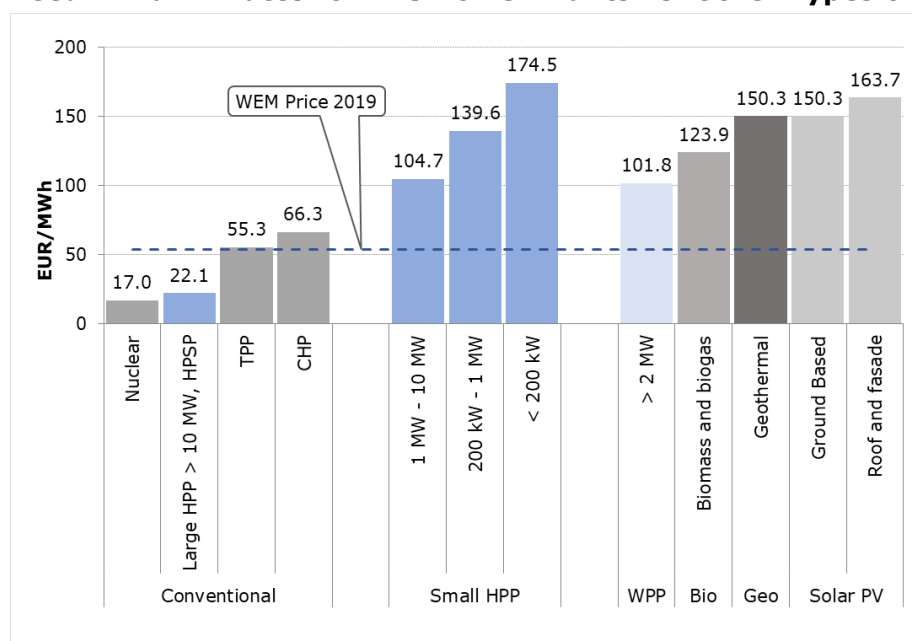
Solar (roof/facade based)	163.71	122.79	118.48	114.71	110.4	106.63
Wind (>2 MW turbines)	101.78	90.47	90.47	90.47	90.47	79.16

Note: Rate of the green tariff depends on the power plant's commissioning date and is fixed until 31.12.2029

Information on RES power plants with small installed capacity is not included.

Comparison of prices for RES power plants with prices/tariffs for conventional power plants is presented in Figure below. It shall be noted that any comparison of the “green” tariff rates with the tariffs of other producers shall take into account the fact that all other major power plants in Ukraine (NPPs, TPPs/CHPs, and large HPPs) have been in operation for many decades, thus, basically their tariffs represent mainly operational expenses, including fuel cost, without any capital investments (except for a limited number of rehabilitation projects that were supported by the NEURC via special tariff surcharges). Therefore, in order to assess to what extent RES tariffs are expensive vs. the tariffs of conventional power plants, one need to forecast levelized cost of electricity (LCOE) for different types of new power plants. This is especially relevant in the situation when Ukraine’s conventional power plants are obsolete and many old power plants will need to be decommissioned in the nearest 10-20 years.

Feed-in Tariff Rates for RES Power Plants vs. Other Types of Power Plants



The Alternative Energy Sources Law guarantees that in the case of future legislative changes RES power plants will be provided with the “green” tariffs under this Law unless they decide to shift to another regulation mode at their own discretion. Therefore, the law provides good security for retaining of the regulatory regime effective at the time of the RES power plant commissioning.

Off-take system for RES power plants. According to the Electricity Market Law, purchase and sale of electricity at the “green” tariff, including surcharge to it (for the use of equipment of the Ukrainian origin), will be performed based on a bilateral PPA between the RES power producer and the GB after commissioning of the RES power plant and obtaining of the NEURC’s license for electricity production. The template form of such a PPA was approved by the NEURC. Current scheme of settlements with RES electricity producers in the electricity market is presented in Figure below.

Upon request of potential RES power producer, the GB is obliged to conclude PPA at any time prior to construction and/or commissioning of the relevant RES power plant upon submission by such a producer of the documents envisaged by the Electricity Market Law. Pre-PPA can be signed if all conditions precedent listed in the law are met:

- the right for land ownership/use is confirmed;
- the grid connection agreement for the RES power plant is concluded;
- the construction permit for the plant is obtained.

Terms and conditions to obtain the “green” tariff rate under the pre-PPA provide for commissioning of the PVP facility during 2 years from the date of pre-PPA signing and of all other RES facilities during 3 years from the date of pre-PPA signing. Pre-PPA will be null and void after this.

The “green” tariff rate is conditional upon the RES power plant commissioning date.

Respective bilateral contracts between the GB and RES power producers shall be concluded:

- for the whole term of the “green” tariff support scheme until 01 January 2030 for Group 1 RES power plants;
- for 20 years for Group 2 RES power plants.

The GB shall include an arbitration clause in PPAs signed with Groups 1 and 2 RES power producers (upon request of the investor). The condition for an arbitration clause is as follows: RES producers shall make contributions to the account of the GB for the latter to establish a special (target) fund to cover its arbitration costs. The amount of contributions is determined by the NEURC as part of the net income of the payer of contributions from its electricity generation activity but not more than 1% of net income.

The GB will sell “green” electricity in the DAM, the IDM, and respective non-balances in the BM at the prices of respective market segments. In order to ensure reimbursement of economically justified costs of the GB for purchase of electricity under the “green” tariff/auction prices the GB shall provide the services “on ensuring increase of the share of renewable energy production” to the TSO until 01 January 2030 (for “green” tariff) and during 20 years (for auctions) according to the standard agreement approved by the NEURC. The value of such services is approved by the NEURC and is defined as the difference between value of electricity purchased by the GB at the “green” tariff/auction prices and the value of this electricity sold at the DAM and the IDM, cost of imbalances and estimated operational costs of the GB.

The price difference between the “green” tariffs/auction prices and the market prices as well as the GB’s operational expenses, the GB’s expenses related to settling electricity imbalances of RES power producers, will be reimbursed by the TSO through special payments for the mentioned public service obligations.

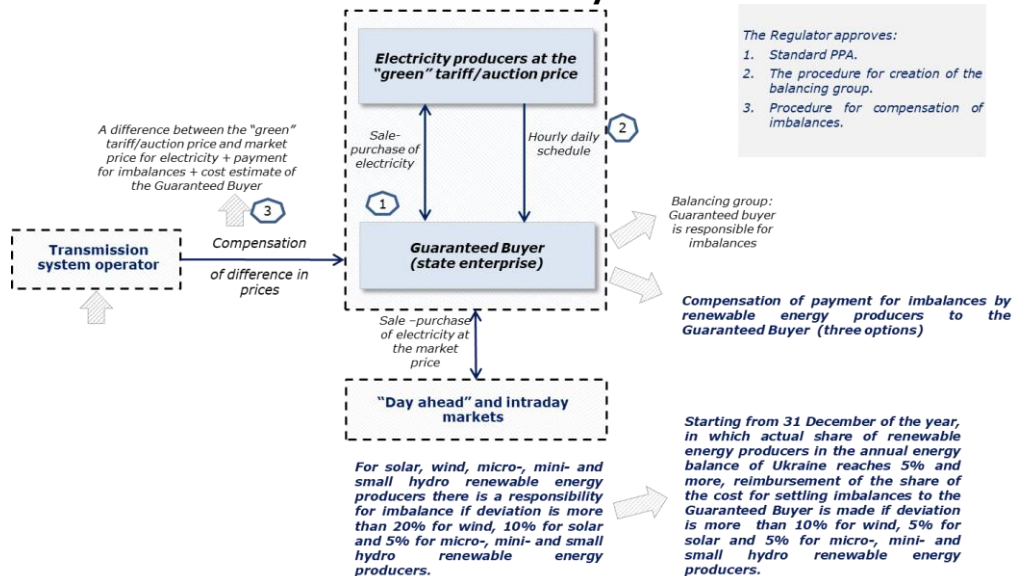
The GB shall pay for purchased electricity at the “green” tariff rates/action prices according to commercial metering data received from the CMA.

According to the law, full and timely payments for “green” electricity are expected to be properly ensured through applying of the system of special accounts with the authorized bank², fund allocation algorithm approved by the NEURC, and financing guarantees specified in the Market Rules.

Electricity producers at “green” tariff/ auction prices under the new electricity market model are shown in Figure below.

² Special accounts of certain market participants do not entitle their owners with the right to withdraw funds. The withdrawal is made automatically according to the procedure set by the NEURC

RES Power Plants under New Electricity Market Model



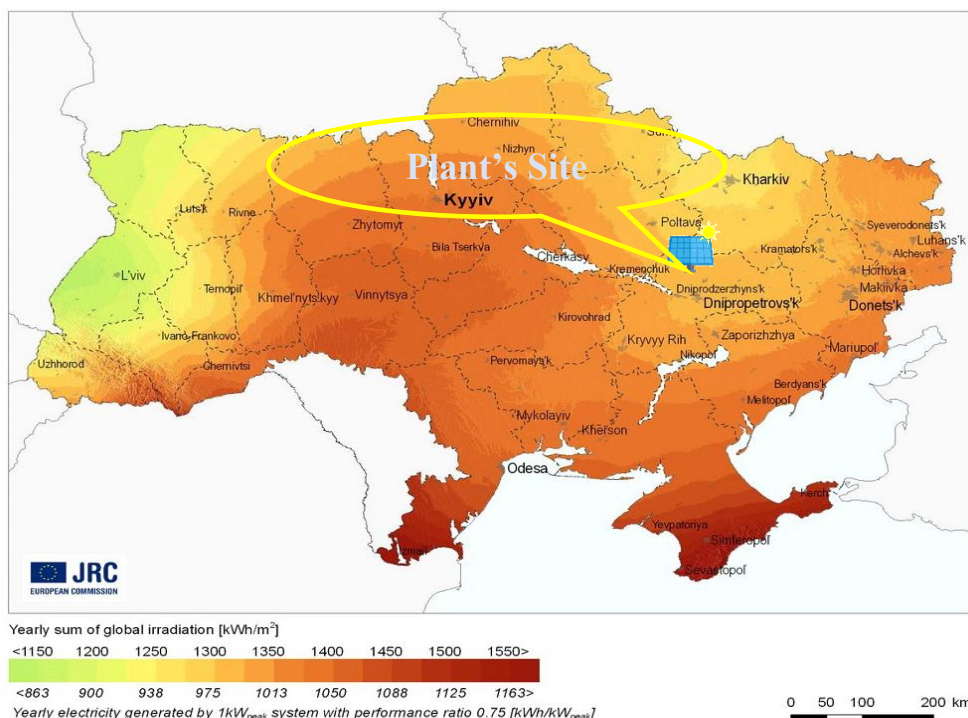
The deviation of actual hourly volumes of electricity supplied by RES power plants from hourly schedules of electricity delivery for the next day/intraday shall be considered as imbalances. RES power plants shall join the balancing group of the producers working under the "green" tariff support scheme. See Annex 3 for more details about RES development in Ukraine. See Annex 4, 5, 6 for more details about auction, balancing and curtailment respectively.

3. Project Data

3.1. General Overview

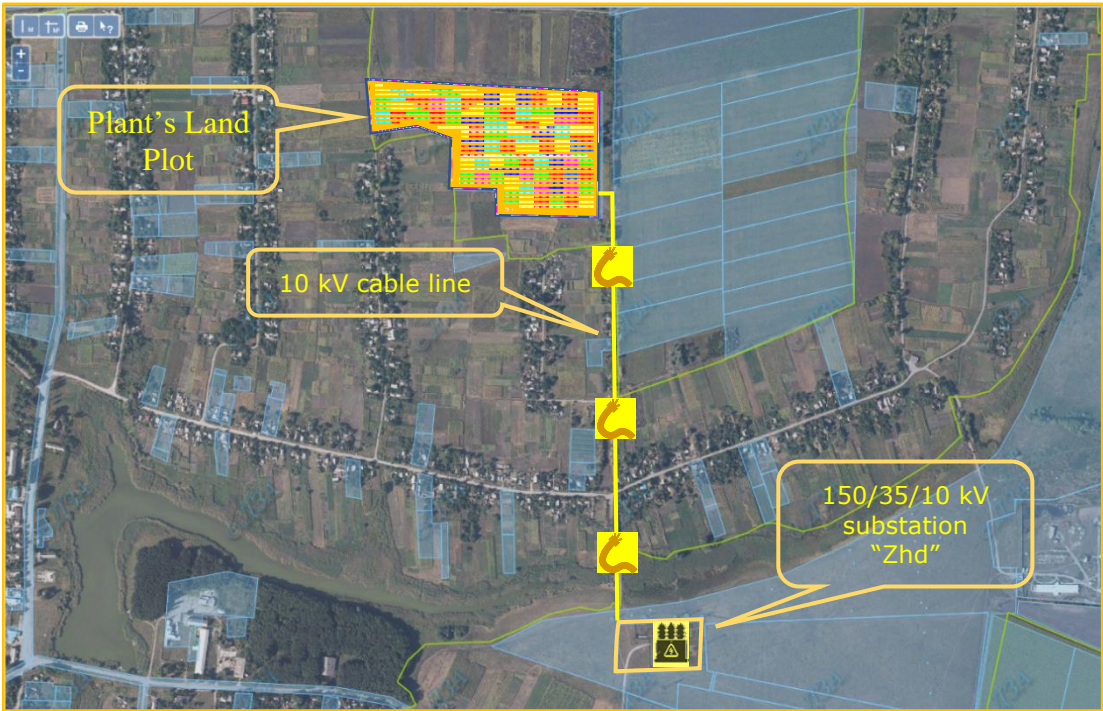
The proposed project concerns the construction and operation of a solar PV power plant with an installed capacity of 6.182 MWp (4.920 MW_{AC}) in Dnipropetrovsk region of Ukraine (the "Plant"). The Plant will be located within the boundaries of Zhd village council, Dnipropetrovsk region (see Figure below).

Location of the Plant's Site



The Plant will be connected to the 150/35/10 kV substation “Zhd”. The distance between the Plant and the substation along the route of the cable line required for the grid connection of the Plant is some 1.5 km (see Figure below).

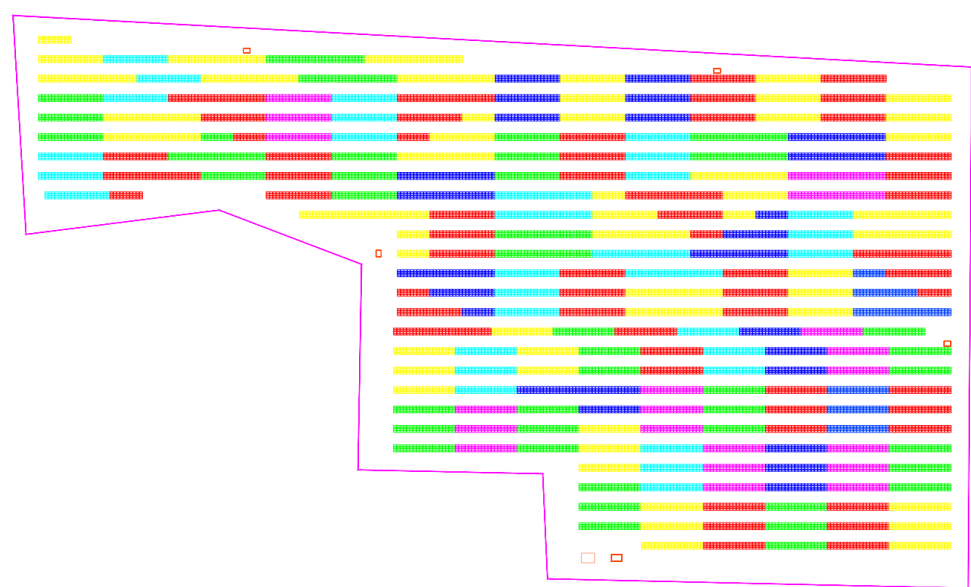
Location and Grid Connection of the Plant



The Plant will be installed on fixed tilt, ground mounted support structures, use 60-cell, monocrystalline modules manufactured by Jinko Solar and 82 string inverters from Huawei with a capacity of 60 kW each. Five transformers 1.0 MVA each will collect the power from the inverters. The transformers are easily accessible by an internal road.

Preliminary layout of the Plant is presented in Figure below.

Preliminary Layout of the Plant



Main technical data of the Plant are summarized in Figure below.

Main Technical Data of the Plant

Item	Parameter
Installed capacity	6.182 MWp
Module	Jinko Solar Cheetah 60M JKM320M-60, monocrystalline 60-cell modules 320 Wp each
Number of PV modules	19,320
Inverter type	Huawei SUN 2000-60KTLM0
Number of inverters	82
Nominal AC output power	60 kW _{AC} , in total 4.920 kW _{AC}
Nominal power ratio	6.182/4.920= 1.26
Modules per string	624 strings with 20 modules/string 360 strings with 19 modules/string
Number of strings	984
Transformer stations	1.0 MVA, 0.4/10 kV (PTS-1000-10/0.4 kV)
Number of transformers	5
Type of installation	Fixed tilt structures (29° south-tilted)
Grid connection point	150/35/10 kV substation "Zhd"

3.2. Technical Concept

3.2.1. PV Modules

PV modules for the Plant will be supplied by Jinko Solar, a world-renowned solar modules manufacturer based in China. Jinko Solar has an annual capacity of 9.7 GW for silicon wafers, 7.0 GW for solar cells, and 10.8 GW for solar modules, as of 31 December 2018. The PV solar cells and modules are manufactured in China. Jinko Solar is among the top 16 companies in Bloomberg's Tier 1 list of PV modules manufacturers.

Technical Specifications of the PV Modules

General characteristics	Jinko Solar JKM320M-60
Nominal (MPP) power	320 Wp
Tolerance (Power)	- 0 / + 3%
Efficiency (STC)	19.18%
Type of cell	Mono crystalline
Number of cells	60 (6 x 10)
Dimensions	1,665 x 1002 x 35 mm
Weight	19 kg
Output terminal	MC4 or equivalent
Frame	Aluminium silver anodized alloy
Module composition	Glass / EVA / Backsheet (white)
Maximum operating voltage	1000 V
MPP Voltage (STC)	33.0 V
MPP Current (STC)	9.59 A
Open Circuit Voltage (STC)	40.9 V
Short Circuit Current (STC)	10.15 A
Power Output Temp. Coefficient	-0.40 %/K
NOCT	45 °C (+/-2K)
Series fuse rating	20 A

Jinko Solar modules offer product warranty of 12 years and linear power warranty as follows:

3.2.2. Inverters

Planned inverter is the string inverter model SUN 2000-60KTL-M0 manufactured by Huawei. Huawei is a Chinese global ICT solutions provider founded in 1987. Huawei shipped over 4 GW of inverters in 2017 worldwide. Its track record can be considered acceptable with respect to solar solutions. In 2018, Huawei accounted for 22 percent of all inverters shipped worldwide and 60 percent of the global share of three-phase string inverters.

Technical Specifications of the Inverter

Technical Features Inverter	SUN2000-60KTL-M0
INPUT DATA	
Peak power input	79.4 kWp
Max. input current	22 A
Max. input voltage	1,100 V
MPPT voltage range	200 V – 1000 V
OUTPUT DATA	
AC nominal output	60 kVA
Max. output $\cos \varphi=1$	66 kVA
Max. output current (400 V)	95.3 A
Max. efficiency	98.9 %
Euro. efficiency	98.7 %
Grid connection	220V - 230V, 3W+N+PE/ 380V - 400V, 3W+N+PE
Frequency	50 - 60 Hz
Nominal power factor	0.8 – 0.8 (ind. / cap.)
Stand-by Consumption	< 1 W
GENERAL DATA	
Dimensions (height x width x depth)	1075 x 555 x 300 mm
Weight	74 kg
Degree of protection	IP 65
Display	Led indicators
Operating temperature range	-25 - +60 °C
Protection devices	
DC /AC overvoltage protection	yes
Earth fault monitoring	yes

The European efficiency of 98.7% is within the normal market standard range for string inverters.

3.2.3. Mounting Structures

Mounting structures of SMS-402 type for PV modules will be supplied by the multi-specialty construction company "SAVA" LLC (Ukraine).

The mounting structures correspond to requirements of national standards and construction norms regarding soils, snow and wind loads.

3.2.4. Other Systems

The *surveillance system* provides for:

- 24-hour security involving 3 professional security guide persons employed by a specialized security company.
- Video surveillance system which will be installed on the site consisting of 3 automatic video cameras transferring video signal to the central guide console.
- Motion sensors all-round the site (6 sensors of OPTEX type).
- Zone switching on of lighting depending on motion sensor response to perimeter breach.

- Fence.

The *system for solar activity monitoring and dispatching* provides for installation of meteorological stations which will collect the following information:

- solar irradiation level;
- wind speed;
- outdoor temperature;
- solar panels temperature.

Communication with a packaged transformer substation (PTS) will be arranged via optical fiber communication cable. All collected data will be transferred to Supervisory Control and Data Acquisition (SCADA) system.

The *monitoring system* provides for the following:

- Due to Smart Logger 2000 (Huawei) operating according to PLC technology there will be possibility of collection and analysis of data for each connected inverter (inverter status; output capacity; voltage and current of each string connected to the inverter; voltage and current of each live wire of the PTS at its 0.4 kV side).
- In each PTS at 0.4 kV side there will be additionally installed DIRIS A 40 network analyzer (or of some similar type) for collection, processing and analysis of network's parameters. In addition, from each transformer installed at PTS there will be collected data regarding transformer oil's and outdoor temperature (for the purpose of control of PTS's equipment operation).
- Due to VSN 800-14 meteorological station (ABB) information regarding solar irradiation level, wind speed, outdoor and PV panels' temperature will be collected.

See Annex 8 for more details.

3.2.5. Forecasted Energy Production

A PVsyst simulation (PVSYST V6.82) was performed by Photomate s.r.o., inverters supplier for the Plant.

PVsyst's built-in database Meteonorm 7.2 was used as a source for the irradiation and temperature figures. It is based on long-term (10 years or longer) measurements by national weather services.

Meteonorm 7.2 gives the following yearly sums of GHI at the Plant location (see Figure below).

Annual Global Horizontal Irradiation at the Plant Location

Location	Global Horizontal Irradiation [kWh/m ²]
Zhd	1,245.1

Source: PVsyst

The corresponding measurement uncertainty is estimated as 5.6%.

Meteonorm 7.2 gives the following annual mean air temperatures at the Plant location (see Figure below).

Annual Mean Air Temperature at the Plant Location

Location	Mean air temperature [°C]
Zhd	9.38

The PVsyst calculations were performed for the Plant which configuration is presented in Figure below.

Plant Configuration

Parameter	Set value
PV modules	Jinko Solar JKM 320M-60

Parameter	Set value
String length	19 modules per string for 360 strings 20 modules per string for 624 strings
Inverter	Huawei SUN2000-60KTL-M0
Structures' orientation	Tilt 29° azimuth 0°
Electrical design	984 strings 6.182 MWp 82 inverters 4.920 kV _{AC}

Figure below presents the energy yield forecast result for the PV modules for the first year of operation already including all the loss factors.

P75 Case Results in the First Operational Year

Parameter	Value
	P75
Specific yield [kWh/kWp]	1,193
Energy production [MWh]	7,375

See Annex 9 for more details.

3.2.6. Grid Connection

The point of power output (the point in existing grids of the grid company from which the new grids to the grid connection point of the Plant should be constructed) and the grid connection point (the point of ownership split between the grid company and the SPC, where the commercial electricity metering point is commonly installed) of the Plant is determined by Technical Requirements for the connection of the Plant to the grids of Joint Stock Company (JSC) "DTEK Dniprovski Elektromerezh".

The Plant will be connected to the 150/35/10 kV substation "Zhdanivska" (alternative name "Urozhaina"). The distance between the Plant and the substation along the preliminary route of the electricity line is roughly 1.5 km.

According to the agreement signed by the SPC with JSC "DTEK Dniprovski Elektromerezh" for the grid connection of the Plant, the following steps should be undertaken for connection of the Plant to the 150/35/10 kV substation "Zhdanivska" owned by JSC "DTEK Dniprovski Elektromerezh":

- installation of additional 10 kV cell at the substation for connection of 10 kV cable transmission line;
- construction of 10 kV cable transmission line for connection of 0.4/10 kV transformer substations of the Plant to the 150/35/10 kV substation "Zhdanivska" and, some 1.5 km long;
- arrangement of relay protection and automatics at the substation "Zhdanivska";
- arrangement of telemechanic supervisory control and communication;
- construction of 0.4/10 kV transformer substations of the Plant;
- arrangement of commercial electricity metering at the substation of the Plant.

The exact scope and cost of works for external grids construction will be determined by the working design document for external grids.

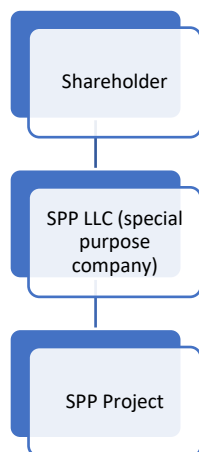
Five transformer 0.4/10 kV substations – packaged transformer substations (PTS) will be constructed at the Plant's site which will be configured as follows:

- PTS-1000-10/0.4 kV No.1: 17 inverters * 19 modules * 12 strings = 3,876 modules
- PTS-1000-10/0.4 kV No.2: 13 inverters * 19 modules * 12 strings + 4 inverters * 20 modules * 12 strings = 3,924 modules
- PTS-1000-10/0.4 kV No. 3,4,5: 3 PTS * 16 inverters * 20 modules * 12 strings = 11,520 modules.

3.3. Shareholder

SPP LLC ("SPC") is a special purpose company for the Project. The SPC possesses all available permits for the Project, it will be the client for the Plant's construction and operate the Plant after its commissioning. The SPC shall be established specially for implementation of the Project without any substantial business activities up to date.

Project Structure



3.4. Contractual Arrangement and Participants

The Project will be implemented according to the set of contracts signed between the SPC and suppliers of main equipment as well with Shareholder which will be a general contractor (responsible for civil construction and equipment installation works) for the SPC.

Shareholder will be at the same time the main contractor for the Plant. De facto, Shareholder will perform preparatory works on the site of the Plant and general coordination and supervision of all contractors engaged in the implementation of the Project. See Annex 10 for more details.

3.5. Planned Financing Structure

Of the total Project CAPEX budget of EUR 4.3 million, 40% will be provided through equity or quasi-equity contribution of Shareholder. 60% loan supporting the Shareholder as well as for the Project cost refinancing for this sum can be potentially provided by Ukrainian or European bank.

3.6. Implementation Schedule

Key planned milestones of the Project implementation schedule are the following:

- Plant's start of construction: August 2020
- Plant's completion of construction: September 2020
- Plant's connection to grid: September 2020
- Plant's commissioning: October 2020
- Plant's start of commercial operation: December 2020.

3.7. Implementation

3.7.1. Town Planning Documents

The detailed development plan (DTP) for the land plot for location of the Plant shall be approved by the Head of District State Administration of Dnipropetrovsk Region.

The town planning conditions and limitations shall be issued for the SPC on the basis of the approved DTP for the Project site as initial data for preparation of the working design document for the Plant.

According to the approved town planning document the Project site can be used for construction of the Plant with up to 90% of the plant area that can be used for construction.

3.7.2. Land Plot and Land Rights

The SPC is the owner of the land plot for construction and location of the Plant as confirmed by the abstract from the State Register of Property Rights for Real Estate Property. Main information on the land plot is summarized in Figure below.

Information on the land plot for location of the Plant

Main Parameters	Land Plot
Land plot's location	Territory of Zhd village Council (beyond the territory of the village), Dnipropetrovsk Region
Land plot's state cadastre number	1111111111:02:002:1012
Land plot's area	10 ha
Landowner	SPP LLC
Type of land rights	Ownership
Land plot's designated purpose	For location, construction, operation and maintenance of buildings and erections of power generating companies, institutions and establishments (land classification number 14.01)
Role of the land plot in the project	For construction, operation and maintenance of the Plant
Limitations on land use	Absent
Site construction feasibility	According to engineering conditions the site can be used for all types of construction
Availability of natural reserves on the territory and in the vicinity of the site	Absent
Availability of cultural heritage and archaeological objects on the territory and in the vicinity of the site	Absent
Approval of the land plot's borders with neighbouring land holders	Approved
Approvals of state agencies	Available

3.7.3. Grid Connection

According to the technical requirements for the Plant's grid connection, 10 kV distribution points of the Plant shall be connected to 150/35/10 kV Zhd substation via 10 kV cable electricity transmission line. The length of the line will be some 1.5 km.

The grid connection scope will be split by three parts:

- Construction of internal 0.4 – 10 kV grids of the Plant (internal grids).
- Construction of 10 kV cable line (external grids – Part 1).
- Reconstruction of the Zhd substation (external grids – Part 2).

Main provisions of the agreement to be signed for the grid connection of the Plant

Main Parameters	Land Plot
Party 1	The SPC
Party 2	The Grid Company
Agreement signing date	03/08/2020
Agreement maturity date	31/12/2021
Agreement maximal tenor	350 calendar days after the date of the first payment plus 5/10 day for powering of the Plant
Plant power delivery point	150/35/10 kV Zhd
Plant grid connection point	Terminating point 10 kV line connection substation Zhd and 0.4/10 kV transformer substations of the Plant at the 0.4/10 kV transformer substations
Agreement scope	Turnkey construction of the grids between the power delivery and grid connection points (external grids)
Plant capacity for connection	4 MW _{ac} in two stages: 2 MW _{ac} + 2.9 MW _{ac}
Connection voltage at the grid connection point	10 kV
Deadline for commissioning of the Plant by the SPC	31/12/2021

3.7.4. Design Documents and Construction Permits

The project will be implemented as a combination of two construction projects:

- Construction of the Plant including internal grids (within the Plant's site).
- Construction of external grids for the grid connection of the Plant (beyond the Plant's site).

SPC shall submit to DABI the notification on the launch of preparatory works and start preparatory works for the territory of the Plant's site cleaning and planning to prepare it for the start of the construction.

3.7.5. Contracts

Following contracts for the Project implementation shall be signed:

- The agreement for non-standard grid connection of the Plant between the SPC and JSC «Elektromerezhi» (Grid Connection Agreement).
- The agreement for topographic and geodesic works in the Plant site between the SPC and an individual certified geodesic engineer (at the time if writing has been completed).
- The agreement for preparation of the working design documents for preparatory works in the Plant site between the SPC and Shareholder.
- The agreements for preparation of the working design document for the Plant between the SPC and Shareholder (in capacity of a general designer of the Plant) and between Shareholder and LLC "MVK" as a subcontractor of Shareholder.
- The general contractor agreement for the Plant between the SPC and Shareholder (in capacity of a general contractor of the Plant).
- The contract for supply of PV solar modules for the Plant between Shareholder and JINKO Solar Co. Ltd.
- The contacts for PV solar modules customs clearance and delivery to the Project site between the SPC and MEE A/S, MAERSK Ukraine Ltd.
- The contract with Photomate s.r.o (official representative of Chinese Huawei Technologies in Central and Eastern Europe) for supply of the inverters.

3.7.6. Preparation for Commercial Electricity Sales

Among available options for the sale of electricity produced by the Plant, the most viable option is conclusion of the power sale agreement (PPA) with the State Enterprise "Guaranteed Buyer" (off-taker for all RES power plants) and sale of electricity at the feed-in ("green") tariff. Guaranteed "green" tariff rate for ground-mounted PV solar power plants commissioned in 2020 is 112.55 EUR/MWh and is guaranteed until the end of 2029.

Two other options would be electricity sale under direct contracts to power distribution companies and sale to industrial customers. However, both options are economically unattractive, since the prices in these markets are significantly below the "green" tariff.

The main risk for the Plant in case if it is not commissioned timely is 25% reduction in "green" tariff rate compared to its current level. At the same time considering the Plant's current development status, this risk is manageable. The impact of this risk for the Project's financial viability has been assessed in Section 3.10 "Financial Projections".

3.8. Social and Environmental Impacts

The project site is located in the north – east part of the Zhd village, and takes up a land plot of 10 hectares.

Population of Zhd village is 1,123 people.

According to the current Ukrainian national legislation, construction of a PV plant is not subject to an EIA (ОБД). However, the project design documentation still requires a separate chapter on the environmental impacts, which was prepared for this project in line with respective construction norm (ДБН).

Main environmental impacts of the Project would include:

- Land take for siting the PV panels, access road and other project installations and facilities, and consequent land use change.
- Impacts of construction of the main site, and associated facilities (including access roads and cable transmission line) such as generation of dust, noise and air emissions from vehicles involved, increased road traffic.
- Impacts of generation, storage and disposal of solid waste during construction and operation, including broken or disused PV modules and other electric equipment, which is likely to be classified as hazardous waste.
- Wastewater generation (stormwater, sanitary wastewater, and wastewater from panel washing, if applicable); and
- Subsequent decommissioning and disposal of the installations after the Plant operation closure.

The key environmental impacts of the Project will originate from the siting and construction of the Plant facilities and equipment, construction of the 10kV cable transmission line (some 1.5 km distance).

During the land preparation for structures and modules placement, most of the vegetation present onsite will have to be cleared.

There are no environmentally protected areas onsite, or in the project impact area. The nearest national environmental reserve is located some 17 km north from the project site. The project site does not include territories reserved for establishment of future ecological network reserves in Dnipropetrovsk region.

Due to the significant distances from these protected areas to the project site, no impacts on them are expected.

There are no mass migratory routes of swimming birds identified in the vicinity of the Plant's site.

There are no known archaeological sites in the project site vicinity. The nearest cultural heritage objects, kurgans, are located some 3.5 km north from the project site. In case any archaeological objects are found during land excavation or other construction activities, the SPC will follow the national procedure for chance find.

The nearest residential properties of Zhd village are located at approximately 100m south of the site boundary. The establishment of a sanitary protection zone (SPZ) for this type of the project is not required by the current Ukrainian regulations, as during the operation it will not have the impacts (air emissions, noise, significant EMFs, etc.) that the SPZ is meant to mitigate. But to prevent adverse impact of the Plant the PV modules layout is prepared to account for 50m SPZ around the Plant.

The project will generate solid wastes during construction, operation and decommissioning. The main waste streams will include construction waste (non-hazardous), broken or disused PV modules and other electric equipment (likely to be classified as hazardous waste), and communal/office waste (non-hazardous). The impact of waste generation by this project is considered to be low, if managed in line with the regulations (e.g. waste minimization, recycling, safe handling, and disposal at licensed facility).

Wastewater generated on-site will include sanitary wastewater (insignificant volumes), stormwater, and possibly wastewater from panel washing. On the basis of similar projects implemented in the past, the impacts of the wastewater generated by this project on the soil and ground waters are considered to be insignificant.

The Project will use monocrystalline 60-cell 320 Wp modules made by Jinko Solar, which is among the top PV producers in the world. Reportedly, these PV modules are environmentally safe, and conform to the applicable current international standards. Jinko Solar in the letter sent to the SPC has provided the guarantees regarding the recycling of PV modules upon their service life expiration.

The project is expected to generally have positive social impacts, such as:

- Financial contributions to the local community in the form of land tax.
- Some new jobs created for project construction and operation, including local labor (3-5 persons total staff at operation stage).
- Improvement of security of energy supply in the region with safe renewable solar energy.
- Ad-hoc support to the local community in response to the village needs.

The land designation title for this project has been changed from non-farming agricultural lands to the energy generation use. Consequently, there is no adverse impact for available pasture lands to sustain animal stock at the village.

Detailed Territory Plan (DTP) shall be approved by the District State Administration for siting of the Plant. No critical remarks for the draft shall be submitted by the public during public hearings.

See Annex 7 for detail description of the implementation process.

3.9. Risks Assessment

Project risks assessment is summarized in Figure below.

Project Risks Assessment

Issue/Risk	Level
Country risk	High as of 26.04.2020
Regulatory risks	High as of 26.04.2020
Reduction of electricity consumption	Medium as of 26.04.2020
Shareholder's financial capacity and integrity	Low
Procurement	Low
Completion / construction risk	Low

Issue/Risk	Level
Grid access risk	Low
Performance risk	Low
Permits and project development	Low
Environmental risk	Low
Currency risk	Low
Interest rate risk	Low

See Annex 11 for detail description.

4. Financial Data

4.1. Summary

The financial model considers a total senior debt amounting to EUR 2.583 million (60% of CAPEX). Shareholder equity contribution amounts to EUR 1.722 million (40% of CAPEX). Main indicators have been calculated for various scenarios with regard to main parameters (CAPEX, OPEX, Tariff Rates, Electricity Output, etc.).

In the financial calculations a contingency including VAT (2% of the CAPEX) was used.

With regard to OPEX, the amount based on the results of a benchmark project was used in the calculations. The OPEX cost in the financial model is indexed with the Euro inflation, 0.5%/year.

Solar irradiation is highly influenced by seasonality (winter versus summer time), hence respective seasonal electricity pattern for P75 was used in the financial calculations. PV modules degradation factor was assumed at 0.5%/year.

According to the Plant planned commissioning time (October 2020) the green tariff rate was taken at 112.55 EUR/MWh.

For the loan the following parameters were considered in the financial model calculations:

- Tenor: 7 years.
- Grace period: 6 months (applicable for loan principal amount only)
- Interest: 7% fixed.
- Repayment dates: half annual.
- Upfront fee: 1%.

Detailed per-year financial indicators of the Project are presented in Excel file.

4.2. Cost Estimates

4.2.1. CAPEX

The Project total capital expenditures (including VAT, IDC & DSRA) amounts to EUR 4.305 million, hence the specific cost is 0.70 EUR/Wp, which is in the range of prices recently seen in PV projects in Ukraine for similar contractual arrangements. The summary CAPEX breakdown of the Project is presented in Figure below.

Project CAPEX Breakdown

No.	Type of expenses	EUR	EUR/Wp	Share
1	Project surveys incl. obtainment of necessary approvals (VAT inclusive)	65,000	0.01	1.5
2	Plant site territory planning (VAT inclusive)	104,846	0.02	2.4
3	Fencing and access road - materials (VAT inclusive)	61,800	0.01	1.4
4	Access road arrangement (VAT inclusive)	37,000	0.01	0.9
5	Fencing arrangement (VAT inclusive)	10,000	0.002	0.2
6	Materials for administrative building and storage facilities (VAT inclusive)	67,121	0.01	1.5
7	Administrative building construction (VAT inclusive)	10,000	0.002	0.2
8	Video surveillance and perimeter control, exterior lighting - materials (VAT inclusive)	41,600	0.01	1.0
9	Exterior lighting installation (VAT inclusive)	10,000	0.002	0.2
10	Video surveillance and perimeter control installation (VAT inclusive)	15,000	0.002	0.3
11	Fixation systems (stationary mounting structures) (VAT inclusive)	521,000	0.08	12.0
12	Piling for mounting structures installation (VAT inclusive)	90,000	0.01	2.1

No.	Type of expenses	EUR	EUR/Wp	Share
13	Mounting structures installation (VAT inclusive)	80,000	0.01	1.8
14	PV panels (VAT exempted, delivery and customs clearance excluded)	1,823,808	0.30	42.1
15	PV panels delivery and customs clearance (not subject to VAT)	17,462	0.003	0.4
16	PV panels installation (VAT inclusive)	40,000	0.01	0.9
17	Inverters (VAT exempted)	241,160	0.04	6.2
18	Cables and wires (VAT inclusive)	85,000	0.01	2.0
19	Packaged Transformer Substation - 0.48 / 10 kV (VAT inclusive)	170,000	0.03	3.9
20	0.4 - 10 kV cable networks construction (VAT inclusive)	28,400	0.005	0.7
21	Packaged Transformer Substation - 0.48 / 10 kV and inverters installation (VAT inclusive)	30,000	0.005	0.7
22	ASCMPC (Automatic system for commercial measurement of power consumption), telemechanics and electricity metering (VAT inclusive)	16,000	0.003	0.4
23	Materials for external grids (VAT inclusive)	106,000	0.02	2.4
24	External grid connection services bill (VAT inclusive)	173,077	0.03	4.0
25	Powering of the Plant (VAT inclusive)	18,000	0.003	0.4
26	Start-up and commissioning works (VAT inclusive)	6,000	0.001	0.1
27	Concrete (VAT inclusive)	56,300	0.01	1.3
28	Other materials (VAT inclusive)	46,500	0.01	1.1
29	Other works (VAT inclusive)	30,000	0.005	0.7
30	Unforeseen expenses (2% CAPEX) (VAT inclusive)	86,621	0.01	2.0
31	IDC & DSRA (5% CAPEX) (not subject to VAT)	216,888	0.04	5.0
	TOTAL	4,304,583	0.696	100.0

4.2.2. OPEX

In the absence of a signed O&M contract the OPEX budget of the Plant was estimated on the basis of a benchmark project at 20 EUR/kWp/year (VAT exclusive). The summary OPEX breakdown of the Plant is presented in Figure below.

Plant OPEX Breakdown

No.	Operation and maintenance expenses	Euro/year	Euro/kWp	Share
1	Maintenance and consumables (VAT exclusive)	65,452	10.6	52.2
1.1	Labour costs for production staff (VAT exclusive)	25,119	4.1	20.0
1.2	Accrual and deduction of payroll for production staff (VAT exclusive)	5,525	0.9	4.4
1.3	Equipment rental for cleaning and landscaping (grass cutting, snow removal, roads maintenance) (VAT exclusive)	14,193	2.3	11.3
1.4	Labour costs for administrative staff (VAT exclusive)	6,765	1.1	5.4
1.5	Accrual and deduction of payroll for administrative staff (VAT exclusive)	1,488	0.2	1.2
1.6	Expenses for business trips, transport, communications (VAT exclusive)	2,656	0.4	2.1
1.7	Consumables, tools, inventory, fuel, services (VAT exclusive)	1,743	0.3	1.4

No.	Operation and maintenance expenses	Euro/year	Euro/kWp	Share
1.8	Expenses for labour protection, fire safety (VAT exclusive)	2,526	0.4	2.0
1.9	Rental (VAT exclusive)	1,465	0.2	1.2
1.1	SCS, bank commission (VAT exclusive)	42	0.0	0.0
1.11	O&M Contractor's Profit (VAT exclusive)	3,930	0.6	3.1
2	Administrative expenses (VAT exclusive)	28,438	4.6	22.7
2.1	Director of LLC (part time)	7,955	1.3	6.3
2.2	Chief accountant of LLC (part time)	7,159	1.2	5.7
2.3	Lawyer of LLC (part time)	7,159	1.2	5.7
2.4	Labour protection engineer (part time)	6,165	1.0	4.9
3	Management services for the automatic system for commercial accounting of power consumption, dispatching of the Plant operation, reporting (VAT exclusive)	5,966	1.0	4.8
4	Land tax (VAT exclusive)	8,984.02	1.5	7.2
5	Security service (VAT exclusive)	14,902.22	2.4	11.9
6	Social obligations (VAT exclusive)	1,541.27	0.2	1.2
	TOTAL (per year)	125,283.60	20.3	100.0

The estimated OPEX for servicing of the Plant is taken for a servicing company (O&M contractor) without a diversified portfolio of clients which would bring the OPEX very close to the benchmark value of 20 EUR/kWp which is in the highest range of OPEX for benchmark projects and considers the lack of the effect of economy of scale which larger power plants have.

4.3. Financial projections

4.3.1. Annual Financial Projections (2020 - 2031) – Scenario 1 - FiT 112.55 MWh

	UoM	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Electricity Output	mln kWh	0,113	7,293	7,257	7,220	7,184	7,147	7,111	7,074	7,038	7,001	6,964	6,928
Load Factor	%	0,2	13,5	13,4	13,3	13,3	13,2	13,1	13,1	13,0	12,9	12,9	12,8
Full Load Hours	hours	18	1 180	1 174	1 168	1 162	1 156	1 150	1 144	1 138	1 132	1 127	1 121
Feed-in Tariff / Market Price	EUR/MWh	112,55	112,55	112,55	112,55	112,55	112,55	112,55	112,55	112,55	112,55	45,00	45,00
Revenue	000 EUR	13	821	817	813	809	804	800	796	792	788	313	312
EBITDA	000 EUR	2	693	686	679	672	666	659	652	645	638	160	155
EBITDA Margin	%	15,7%	84,4%	84,0%	83,6%	83,2%	82,7%	82,3%	81,8%	81,4%	80,9%	51,1%	49,8%
Net Income	000 EUR	(41)	251	263	283	302	320	337	354	366	360	(47)	(51)
Loan Balance	000 EUR	2 583	2 384	1 987	1 589	1 192	795	397	0	0	-	-	-
Equity Balance	000 EUR	1 707	1 958	2 228	2 511	2 813	3 133	3 471	3 825	4 191	4 551	4 505	4 454
Total Assets	000 EUR	4 290	4 342	4 215	4 100	4 005	3 928	3 868	3 825	4 191	4 551	4 505	4 454
Debt Service Reserve Account	000 EUR	-	282	268	254	240	226	213	-	-	-	-	-
Loan Debt Service	000 EUR	-	662	543	516	488	460	432	206	-	-	-	-
Total Cash Flow	000 EUR	5	132	249	102	117	135	152	368	564	559	152	148
Cash Balance	000 EUR	5	137	386	488	605	741	893	1 261	1 826	2 384	2 536	2 684
FCFE	000 EUR	(1 717)	132	242	102	117	135	152	368	564	559	152	148
FCFF	000 EUR	(4 297)	768	761	597	587	581	576	570	564	559	167	163
DSCR	x	x	1,66x	1,12x	1,16x	1,21x	1,26x	1,31x	1,37x	-	-	-	-

4.3.2. Annual Financial Projections (2020 - 2031) – Scenario 2 - 15% reduction (according to intention of the Ministry for SPP of <10MW capacity)

	UoM	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Electricity Output	mIn kWh	0,096	7,277	7,240	7,204	7,167	7,131	7,094	7,058	7,021	6,985	6,948	6,912
Load Factor	%	0,2	13,4	13,4	13,3	13,2	13,2	13,1	13,0	13,0	12,9	12,8	12,8
Full Load Hours	hours	15	1 177	1 171	1 165	1 159	1 153	1 148	1 142	1 136	1 130	1 124	1 118
Feed-in Tariff / Market Price	EUR/MWh	95,67	95,67	95,67	95,67	95,67	95,67	95,67	95,67	95,67	95,67	45,00	45,00
Revenue	000 EUR	9	696	693	689	686	682	679	675	672	668	313	311
EBITDA	000 EUR	(2)	568	562	556	549	543	537	531	524	518	159	155
EBITDA Margin	%	-16,7%	81,6%	81,1%	80,6%	80,1%	79,6%	79,1%	78,6%	78,1%	77,5%	51,0%	49,7%
Net Income	000 EUR	(44)	145	158	178	198	218	238	255	267	261	(47)	(52)
Loan Balance	000 EUR	2 583	2 384	1 987	1 589	1 192	795	397	0	0	-	-	-
Equity Balance	000 EUR	1 704	1 918	2 173	2 351	2 549	2 766	3 004	3 259	3 526	3 787	3 740	3 688
Total Assets	000 EUR	4 286	4 302	4 160	3 940	3 741	3 561	3 401	3 259	3 526	3 787	3 740	3 688
Debt Service Reserve Account	000 EUR	-	282	268	254	240	226	213	-	-	-	-	-
Loan Debt Service	000 EUR	-	662	543	516	488	460	432	206	-	-	-	-
Total Cash Flow	000 EUR	0	71	209	48	13	33	53	269	465	460	151	147
Cash Balance	000 EUR	0	71	280	328	341	374	426	695	1 160	1 620	1 771	1 918
FCFE	000 EUR	(1 722)	1	111	48	13	33	53	269	465	460	151	147
FCFF	000 EUR	(4 301)	641	635	546	486	481	476	471	466	460	166	163
DSCR	x	x	1,38x	0,93x	0,96x	1,00x	1,04x	1,09x	1,13x	-	-	-	-

4.3.3. Annual Financial Projections (2020 - 2031) – Scenario 3 – lowest acceptable rate

	UoM	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Electricity Output	mIn kWh	0,076	7,257	7,221	7,184	7,148	7,111	7,075	7,039	7,002	6,966	6,930	6,893
Load Factor	%	0,1	13,4	13,3	13,3	13,2	13,1	13,1	13,0	12,9	12,9	12,8	12,7
Full Load Hours	hours	12	1 174	1 168	1 162	1 156	1 150	1 144	1 139	1 133	1 127	1 121	1 115
Feed-in Tariff / Market Price	EUR/MWh	76,00	76,00	76,00	76,00	76,00	76,00	76,00	76,00	76,00	76,00	45,00	45,00
Revenue	000 EUR	6	552	549	546	543	540	538	535	532	529	312	310
EBITDA	000 EUR	(5)	423	418	412	407	402	396	390	385	379	158	154
EBITDA Margin	%	-84,8%	76,7%	76,1%	75,5%	74,9%	74,3%	73,7%	73,0%	72,3%	71,6%	50,8%	49,6%
Net Income	000 EUR	(47)	19	33	53	74	94	115	135	149	144	(48)	(52)
Loan Balance	000 EUR	2 583	2 384	1 987	1 589	1 192	795	397	0	0	-	-	-
Equity Balance	000 EUR	1 704	1 925	2 106	2 189	2 287	2 480	2 672	2 865	3 013	3 157	3 109	3 057
Total Assets	000 EUR	4 287	4 309	4 093	3 778	3 479	3 274	3 069	2 865	3 013	3 157	3 109	3 057
Debt Service Reserve Account	000 EUR	-	282	268	254	240	226	213	-	-	-	-	-
Loan Debt Service	000 EUR	-	662	543	516	488	460	432	206	-	-	-	-
Total Cash Flow	000 EUR	-	49	106	7	(83)	8	8	206	347	343	150	146
Cash Balance	000 EUR	-	49	155	162	79	87	94	301	648	990	1 141	1 287
FCFE	000 EUR	(1 726)	(153)	(42)	(22)	(107)	(91)	(70)	149	347	343	150	146
FCFF	000 EUR	(4 304)	493	488	483	373	365	360	356	351	347	166	162
DSCR	x	x	1,05x	0,70x	0,73x	0,75x	0,78x	0,81x	0,85x	-	-	-	-

