PROJECT: Cross-Border Sustainable Renewable Energy Acceleration in Ukraine - Mapping Synergy Renewable Energy Acceleration Areas between Ukraine, EU Member States, and Moldova

IMPLEMENTED BY: Energy Community Secretariat
PROJECT MANAGER: Aleksandra Bujaroska, Senior Expert in Environmental Governance, Permitting and Planning
aleksandra.bujaroska@energy-community.org

CRITERIA: Environmental Criteria and Constrains, Renewable Energy Criteria and Infrastructure Readiness

HIGH-LEVEL DRAFT V.1

Prepared by:
Anastasiia Oleshchenko, Environmental Specialist,
Viktor V. Putrenko, Environmental Specialist,
Valentyn Didyk, Renewable Specialist

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ACRONYMS

BESS	Battery energy storage system
DSO	Distribution System Operators
ENTSO-E	European Network of Transmission System Operators for Electricity
ECS	Energy Community Secretariat
EU	European Union
IPS	Integrated Power System
kW	Kilowatt
MS	Member States
MW	Megawatt
OSA	Oblast State (Military) Administration
PCS	Power Conversion System
PV	Photovoltaic
RE	Renewable Energy
RED II	Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast)
Revised RED	Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652
RAAs	Renewables Acceleration Areas
RES	Renewable Energy Sources
TSO	Transmission System Operator

INTRODUCTION

At the XXII Ministerial Council meeting of the Energy Community in December 2024, the Ministerial Council adopted Recommendation 2014/1/MC-EnC on accelerating the deployment of renewable energy projects and implementing the energy efficiency principle first. This Recommendation calls on the Contracting Parties of the Energy Community to establish the necessary legal and institutional preconditions for the implementation of provisions related to Renewable Acceleration Areas and the streamlining of permitting procedures for renewable energy projects under Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652 (Revised RED). Furthermore, the Recommendation mandates the Secretariat to assist Contracting Parties in these efforts and to report annually on the progress achieved.

In support of this mandate, the Energy Community Secretariat, with assistance from the European Climate Foundation (ECF) under its Ukraine Programme, is implementing a project aimed at establishing Cross-Border Renewable Energy Acceleration Areas (RAAs) in Ukraine.

This initiative targets five critical regions – Lvivska, Zakarpatska, Ivano-Frankivska, Chernivetska and Vinnytska Oblasts, chosen for their strategic positioning along Ukraine's borders with the EU and Moldova and their environmental significance. These oblasts encompass protected natural areas and substantial renewable energy potential, serving as a focal point for advancing Ukraine's green recovery, energy transition, and integration into the EU energy market.

This Report presents the consolidated results of the work carried out by the Environmental and Spatial Planning Specialists, together with the Renewable Energy Specialist, under the coordination of the Energy Community Secretariat. Their task was to draft, review, and finalise tailored RAA criteria designed to serve as a practical policy document that guides future efforts and supports renewable energy-related planning processes, including spatial planning, in Ukraine. These criteria are specifically adapted to the Ukrainian context and lay the foundation for future planning and designation activities, while carefully considering the requirements and provisions set forth by the Revised RED, which formally establishes the RAA concept for the Member States of the European Union.

The report is structured in two chapters: Chapter I outlines the Environmental Criteria and Constraints, organized into thematic clusters. It details relevant data sources, potential data collection challenges, mitigation measures, and the GIS-based methodology used to map and assess constraints. Chapter II presents the Renewable Energy Criteria and Infrastructure Readiness, grouped

into ten land-type clusters. It assesses technical suitability, legal constraints, and land-use compatibility, and provides guidance on data requirements, critical data gaps, and GIS integration.

In line with the Revised RED, Natura 2000 sites, nationally protected areas, major migratory routes, and other biodiversity-sensitive zones are excluded, except for artificial surfaces such as rooftops and transport infrastructure. Accordingly, the environmental criteria establish the foundational layer, which is then assessed against renewable energy potential and infrastructure readiness criteria to identify priority areas suitable for establishing RAAs. Furthermore, the report integrates guidance from the Operational Blueprint: Designation of Renewables Acceleration Areas.[1]

To support an inclusive and transparent process, the Energy Community Secretariat published the draft Criteria for comment and invited feedback from a broad range of stakeholders. Additionally, three online consultation sessions were held, during which the draft criteria were presented by the consultants and discussed with participants. The feedback received during this process is summarised in the annex to this Report and has been incorporated into the final version of the criteria.

[1] https://www.energy-community.org/news/Energy-Community-News/2025/02/11.html

CHAPTER I ENVIRONMENTAL CRITERIA AND CONSTRAINS

SECTION I.1. THE RAAS ENVIRONMENTAL CRITERIA SET

The whole set of environmental constraints in the designating RAAs can be grouped into three main groups by their specificity:

1. ***Wildlife protection constraints***, which identify certain areas as priority areas for biodiversity protection limiting to varying degrees the other types of using such territories. These constraints include:

    1.1. Areas protected under international legislation.

    1.2. Areas designated under national protection schemes for nature and biodiversity conservation.

    1.3. Major bird migratory routes.

    1.4. Other sensitive areas identified through sensitivity maps and relevant tools.

2. ***Natural conditions***, which limit development of renewable energy sites regardless of human activity, including elevation, steep slopes and spread of natural hazards.

3. ***Land use regulations***, which combine the natural resources (forest, water, agricultural and recreational resources) both usage and protection demands.

Areas, meeting criteria of these three groups *may overlap*, which does not entail any special consideration.

The fourth group of criteria has to be defined to implement the requirement on exception for artificial and built surfaces located in protected areas, major bird migratory routes and other sensitive areas identified through sensitivity maps and relevant tools:

4. ***Reverse inclusion criterion*** based on artificial and built surfaces.

The ***cross border connections*** of environmental criteria have to be taken into account while designating RAAs, such as Natura 2000 sites at opposite border side to Emerald sites in Ukraine, as well as continuation of migration routes to neighbouring to Ukraine European countries, etc. And at the same time the state border strip has to be excluded from the further steps of analysis as any activity in such strip is carried out only with the permission of the State Border Guard Service. It will be included into analysis as a criterion in a fifth group:

5. ***Planning constraints***, which limit development of the territory.

Clarification on the application of buffer zones to wildlife protection constraints.

Energy facilities, including those using renewable sources, have varying degrees of negative electromagnetic, acoustic, etc. impact on the environment. In this regard, Ukrainian building requirements provide for the establishment of sanitary protection zones around such facilities. The size of such zones is determined by the parameters of the impact on humans of different types of such facilities. However, in the absence of special standards for wildlife protection, it is proposed to take into account the maximum possible size of such sanitary protection zones when considering the criteria of wildlife protection constraints. According to the acting building regulations the largest size of such sanitary protection zones is determined as 700 m for a wind power plants with a capacity of over 20 MW[1]. At the same time, according to the results of research conducted by specialists of the O.M. Marzeev Institute of Public Health of the National Academy of Medical Sciences of Ukraine[1], the current standards are outdated and justifications for the size of such sanitary protection zones up to 1700 m have already been prepared.

Taking into account the highest levels of sensitivity of wildlife comparing to human it is proposed to consider 1700 m sanitary protected zones to ensure excluding environmental impact of renewable energy facilities to wildlife in protected areas while assessing the areas protected under international legislation.

CRITERIA GROUP 1. Wildlife Protection Constraints

Criterion 1.1: Areas protected under international legislation.

Indicator 1.1.1: Areas of Emerald Network Sites with 1700 m buffer zones[2].

The Revised RED requires the exclusion of Natura 2000 sites while designating RAAs, which are created in EU countries to meet the requirements of the Birds[3] and Habitats[4] Directives. These two directives provide a legislative framework for all EU Member States to ensure implementation of the requirements of the Convention on the Conservation of European Wildlife and Natural Habitats (1979), Bern Convention[5]. Non-EU countries which are Parties to the Bern Convention by analogy with the Natura 2000 Network in EU countries set-up the Emerald Network of Areas of Special Conservation Interest. The Emerald Network sites are established to protect the species, as well as their habitats, listed in the Appendices of the Bern Convention providing the lists of wild species that are protected by the Convention.

Ukraine is a Party to the Bern Convention since 1996 and accordingly assumed obligations under it. Under the Bern Convention, Ukraine is obliged to take measures to implement a national policy for the conservation of wild flora, wild fauna and natural habitats, paying particular attention to species in danger of extinction and vulnerable

[2] The necessity of buffer zone and its size are explained below in the last paragraph of the description of the Criterion 1.1.1.

[3] The Directive on the conservation of wild birds, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0147

[4] The Directive on the conservation of natural habitats and of wild fauna and flora, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701

[5] Convention on the Conservation of European Wildlife and Natural Habitats, available at https://rm.coe.int/1680078aff

species, especially endemic species, and habitats in danger of extinction, as well as undertakes to take into account in its policy for the planning and development of territories and in its measures aimed at combating pollution, the need to protect wild flora and fauna, and promote education and the dissemination of general information on the need to protect species of wild flora and fauna and their habitats.

The series of biogeographical evaluation seminars aimed to assess the adequacy of the relevant country site lists have been conducted for all habitats and species, including birds, for Ukraine in November 2015, May and September 2016, May 2018, and June 2019. Finally, in 2019, at a meeting of the Standing Committee of the Bern Convention, a modern scheme of the Emerald Network of Ukraine was approved. Currently the List of Emerald sites in Ukraine includes 377 sites[6].

Indicator 1.1.2: Areas of Ramsar Sites with 1700 m buffer zones.

Ramsar sites are wetlands of international importance, designated under the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat. The Convention contains regulations on the conservation and sustainable use of wetland ecosystems, which are valuable for preserving biological diversity and ensuring human existence.

Ukraine become party to the Ramsar Convention in 1996. Under the Ramsar Convention Ukraine took obligations on defining wetlands of international importance, elaborating regulations, and creating protected areas for protecting such wetlands, increasing the number of waterfowl in suitable wetlands, as well as supporting research and the exchange of data and publications relating to wetlands and their flora and fauna. In Ukraine, most Ramsar sites are protected under the national protection scheme. Currently the List of Wetlands of International Importance (the Ramsar List) includes 50 sites at the territory of Ukraine[7].

Indicator 1.1.3: Areas of UNESCO Biosphere Reserves with 1700 m buffer zones.

Biosphere Reserves are protected areas under the UNESCO the Man and the Biosphere Programme[8]. The National Committee of Ukraine for the UNESCO Program "Man and the Biosphere" has been created in 1973. Ukraine, as a member of UNESCO, actively participates in the work of the MAB Program.

In Ukraine there are 8 sites included into Biosphere Reserves MAB network. All of them have protection status also according to the national legislation as two of categories of Nature Reserve Fund – Biosphere Reserves or National Nature Parks. Within the 5 regions in Ukraine of interest to the Project, there are 3 sites included into Biosphere Reserves MAB network, two of which are parts of cross border sites.

[6] A complete list of Emerald Network Areas in Ukraine is posted with the indicated numbering on the convention website: https://rm.coe.int/updated-list-of-officially-adopted-emerald-sites-december-2019-/168098ef51

[7] The List of Wetlands of International Importance is available at https://www.ramsar.org/document/list-wetlands-international-importance-ramsar-list

[8] The official web-site of the UNESCO the Man and the Biosphere Programme - https://www.unesco.org/en/mab

<u>Criterion 1.2:</u> Areas designated under national protection schemes for nature and biodiversity conservation.

Indicator 1.2: Nature Reserve Fund of Ukraine areas with 1700 m buffer zones.

According to the Law of Ukraine "On Nature Environment Protection" land and water areas, natural complexes and objects that have special ecological, scientific, aesthetic and economic value and are intended to preserve natural diversity, the gene pool of animal and plant species, maintain the general ecological balance and background monitoring of the environment, are withdrawn from economic use in whole or in part and are declared a territory or object of the Nature Reserve Fund of Ukraine.

The Law of Ukraine "On the Nature Reserve Fund of Ukraine" (adopted in 1992) establishes 11 categories of protected areas of varying degrees of strictness of the protected regime. In general, the Law defines its own specific national scheme of categories of protected areas, although for most national categories of protected areas a similar correspondence can be determined among the IUCN categories in accordance with the established regime. Such categories as Nature Reserves and Reserved Sites exclude any economic activity while National Nature Parks or Regional Landscape Parks have zoning of the territory with differentiated usage regime and cover areas of different activities including urban settlements. Also, the objects areas of different categories can vary significantly from several dozen square meters (such as Nature Monuments) to thousands square kilometres (such as National Nature Parks).

Some protected areas of the Nature Reserve Fund can be at the same time areas protected under international legislation, but such duplications will not create excessive work during criteria assessment as they are all known.

<u>Criterion 1.3:</u> Major bird migratory routes.

Indicator 1.3.1: Migratory routes with 1700 m buffer zones.

Ukraine is a party to the Bonn Convention on Migratory Species of Wild Animals[9] (1979) since 1999 as well as of the African-Eurasion Waterbird Agreement[10] (AEWA) since 2002. The Parties have undertaken to conserve and, where necessary and feasible, restore habitats important for ensuring the favourable conservation status of migratory species. The key national tool for ensuring the protection of birds on their migration routes is the creation of protected areas of different types along migratory routes. But such protected areas mostly designated on migratory birds stops locations and doesn't cover totally the migratory routes.

Indicator 1.3.2: Important Bird and Biodiversity Areas with 1700 m buffer zones.

Important Bird and Biodiversity Areas (IBAs) are sites identified as being internationally significant for the conservation of birds and other biodiversity, based on a set of standardised, data-driven criteria. Since the launch of the IBA concept by BirdLife in 1979, IBAs have been identified in over 200 countries and territories worldwide, in both terrestrial and marine realms, and thousands of protected areas

[9] Convention on the Conservation of Migratory Species of Wild Animals (1979), available at: https://www.cms.int/en/convention-text

[10] African-Eurasion Waterbird Agreement (1995), available at: https://www.unep-aewa.org/en/documents/agreement-text

have been designated as a direct consequence. In Ukraine they cover area 26.561 sq. km representing habitats of 317 bird species, including 21 globally threatened bird species.

<u>Criterion 1.4:</u> Other sensitive areas identified through sensitivity maps and relevant tools.

The Revised RED provides for the consideration, in addition to protected under international and national legislation areas, and migratory routes, of other vulnerable areas that can be identified by applying various cartographic and analytical tools.

Such additional sensitive areas might be areas for protection of which there are some general international or national obligations, but no areas with specific regime are designed for this purpose. The data might be unofficial on such areas, but it has to be obtained through clear and standardised procedures. The data sources might be data bases of international environment organisations, national scientific institutions or non-governmental organisations focused on environmental studies, as well as data of remote sensing.

Taking into account the nature conservation legislation and the data collected by different institutions/NGOs for the territory of Ukraine on wild life vulnerability it is proposed to supplement the first three wildlife protection constraints with two more indicators under the criterion “Other sensitive areas identified through sensitivity maps and relevant tools”.

Indicator 1.4.1: Areas with high level density of observations of endangered species including 1700 m buffer zones.

According to the Law of Ukraine "On Nature Environment Protection" rare and endangered species of fauna and flora that permanently or temporarily reside (grow) in natural conditions within the territory of Ukraine, its continental shelf and exclusive (marine) economic zone are subject to special protection and are listed in the Red Book of Ukraine. The endangered species of fauna and flora of international and European importance are also marked in the IUCN Red List and lists of endangered species attached to international agreements, conventions and EU Directives. Protection of such species not always ensured by established protected areas and might require considering on the base of scientific observation.

While there is still no state system of biodiversity monitoring in Ukraine, the corresponding task is being implemented, within the limits of its capabilities, but still very effectively, by a team of enthusiastic biologists, who have united in the non-profit non-governmental organization "Ukrainian Nature Conservation Group". Members of this organization work in different regions of Ukraine, mainly in scientific and educational institutions and, on their own initiative, fill the database on the location of rare species of flora and fauna in the territory of Ukraine, which can be used to consider the endangered species locations while designating RAAs.

Indicator 1.4.2: Peatlands with 1700 m buffer zones.

Peatlands with a peat depth of more than one meter and drained peatlands are defined by the Land Code of Ukraine as being of particular value. In addition, peatlands as part of wetlands of international importance are also of particular value. Natural peatlands

play an important role in regulating the hydrological regime of rivers and are one of the most effective natural reservoirs of greenhouse gases. Unfortunately, there is no state data on peatlands areas and borders and their location can be taken into account for analysis purposes only through GIS analysis instruments based on satellite data.

CRITERIA GROUP 2. Natural Conditions

***Criterion 2.1:* Elevation.**

Indicator 2.1: Areas with elevation higher than 2 000 m.

This indicator is established at the international level within the methodology elaborated by the International Renewable Energy Agency (IRENA, 2016) and is a rather arbitrary criterion for the territory of Ukraine as there are only six peaks in the Ukrainian Carpathians whose height exceeds 2,000 meters.

***Criterion 2.2:* Steep slopes.**

Indicator 2.2: Areas with slopes more than 15%.

Areas with slopes more than 15% are defined as areas with difficult engineering and geological conditions for development needs according to national building regulations[11].

***Criterion 2.3:* Areas prone to flooding.**

Indicator 2.3: Areas with a probability of flooding of 1%.

Areas with a probability of flooding of 1% are defined as areas with difficult engineering and geological conditions for development needs according to national building regulations. [5]

The areas of spread of other natural hazards unfavourable to RAAs (like landslides, avalanches, mudflows) will be mostly excluded by applying the criteria of steep slopes and areas prone to flooding.

CRITERIA GROUP 3. Land Use Regulations

***Criterion 3.1:* Areas of forest fund.**

Indicator 3.1: Forest areas with 100 m buffer zones.

The Forest Code of Ukraine defines forests as national wealth and, by their purpose and location, they perform mainly water protection, protective, sanitary and hygienic, health, recreational, aesthetic, educational, and other functions and are a source for meeting society's needs in forest resources. Their protection is regulated by the Code as well as by other laws of Ukraine.

The national building regulations provide fire protection indent to the built-up areas with a maximum size of 100 m[5]. Thus the 100 m buffer zones have to be considered while assessing the forest fund criterion.

[11] State Building Standards B.2.2-12:2019 "Planning and Development of Territories", available at: https://e-construction.gov.ua/laws_detail/3260441209981634046?doc_type=2

***Criterion 3.2:* Areas of water fund.**

Indicator 3.2: Waterbodies with normative waterside protection zones.

The Water Code of Ukraine defines the demands on protection of water resources, in particular it provides for the establishment of waterside protection zones along/around all water bodies, which together with water bodies belong to the lands of the water fund. According to the Water Code the waterside protection zones are established 25-100 m depending on the type and size of water body.

***Criterion 3.3:* Agricultural lands.**

Indicator 3.3: Areas categorised as agriculture land.

The Land Code of Ukraine establishes the priority of using suitable land for agricultural needs, providing for the use of such lands for agriculture, forestry or nature protection.

***Criterion 3.4:* Recreational lands.**

Indicator 3.4: Recreational lands with 1700 m buffer zones.

According to the Land Code of Ukraine the recreational lands are a separate category of lands, strictly limiting the conditions for their transfer to other categories of land and the rules for their use, while special attention is paid to preserving the natural state of such lands.

According to the national building regulations the recreational lands can't be covered by the sanitary protection zones[13]. As it is explained in details in the subsection on clarification on the application of buffer zones to wildlife protection constraints above, considering potential sanitary protection zones from renewable energy facilities, provides for the inclusion in the analysis also of 1700 m buffers from the recreational lands.

CRITERIA GROUP 4. Reverse Inclusion Criterion

Criterion 4.1: Artificial and built surfaces.

Indicator 4.1: Areas of high concentration of artificial and built surfaces.

Taking into account the requirements of the Revised RED the areas of concentration of artificial and built surfaces such as industrial sites, transport hubs, and settlements, will be excluded from areas that will be identified as meeting the criteria of the second and third groups of criteria, namely of natural conditions and land use regulations described above.

Placement of alternative energy facilities on artificial surfaces within international and national protected areas, as well as migratory routes and sensitive areas requires a targeted analysis in each specific case as it might also have a negative impact on biodiversity. Thus, it isn't relevant to consider them in evaluating the criteria of the first group (Wildlife protection constraints).

CRITERIA GROUP 5. Planning Constraints

Ukrainian legislation and departmental regulations impose a number of restrictions that must be taken into account when developing a territory, including the placement of renewable energy facilities. In particular, these are historical and cultural restrictions, sanitary, aviation and security restrictions, development regulations. Data on such restrictions are not systematized and structured. Therefore, collecting data on them and taking such restrictions into account is possible only with detailed planning at the local level. Although the security restriction on areas of state border regime has legislative established size and can be taken into account while conducting planning on high level.

Criterion 5.1: State border regime areas.

Indicator 5.1: Border strip.

In accordance with the requirements of the Law of Ukraine "On the State Border of Ukraine", the Cabinet of Ministers of Ukraine has established along the state border of Ukraine on its land sections and along the banks of border rivers, lakes and other water bodies a border strip 5 kilometres wide from the state border line, where a border regime has been introduced[12]. Any activity, including construction, in the border strip is carried out only with the permission of the State Border Guard Service. Thus, it is impossible to meet requirements of the Revised RED to RAAs at such areas.

The areas that will be identified as meeting the environmental criteria described above are completely excluded from further analysis for the purposes of RAAs designation.

[12] The Resolution of the Cabinet of Ministers of Ukraine On the Border Regime of July 27, 1998 No. 1147, available at: https://zakon.rada.gov.ua/laws/show/1147-98-%D0%BF#n232

SECTION I.2. DATA SOURCES AND REQUIREMENTS.

Indicator 1.1.1: Areas of Emerald Network Sites with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Emerald Network Adopted Sites	Areas of Emerald Network Sites	https://emerald.eea.europa.eu	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Emerald Network Proposed Sites	Areas of Emerald Network Sites	https://emerald.eea.europa.eu	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the Emerald Network Sites	Buffer zone for Areas of Emerald Network Sites	Calculation on the base of data on Emerald Network Adopted and Proposed Sites	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 1.1.2: Areas of Ramsar Sites with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Ramsar Sites	Areas of Ramsar Sites	https://www.ramsar.org Ministry of Environmental Protection and Natural Resources of Ukraine	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the Ramsar Sites	Buffer zone for Areas of Ramsar Sites	Calculation on the base of data on Ramsar Sites	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 1.1.3: Areas of UNESCO Biosphere Reserves with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
UNESCO Biosphere Reserves	Areas of UNESCO Biosphere Reserves	https://www.unesco.org/en/mab	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the UNESCO Biosphere Reserves	Buffer zone for UNESCO Biosphere Reserves	Calculation on the base of data on areas of UNESCO Biosphere Reserves	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 1.2: Nature Reserve Fund of Ukraine areas with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Nature Reserve Fund	Areas of Nature Reserve Fund	Ministry of Environmental Protection and Natural Resources of Ukraine	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the areas of the Nature Reserve Fund	Buffer zone for Nature Reserve Fund	Calculation on the base of data on areas of Nature Reserve Fund	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 1.3.1: Migratory routes with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Migratory routes	Areas of major bird migratory routes	Ministry of Environmental Protection and Natural Resources of Ukraine https://migrationatlas.org/ and other open sources	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Migratory routes	Path of major bird migratory routes	https://migrationatlas.org	Vector line data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the migratory routes	Buffer zone for major bird migratory routes	Calculation on the base of data on areas and path of major bird migratory routes	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 1.3.2: Important Bird and Biodiversity Areas with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Important Bird and Biodiversity Areas	Sites identified under the concept of BirdLife	Ukrainian Society for the Protection of Birds (BirdLife Partner in Ukraine)	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the Important Bird and	Buffer zone for Important Bird and	Calculation on the base of data on Important Bird and Biodiversity Areas	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Biodiversity Areas	Biodiversity Areas					

Indicator 1.4.1: Areas with high level density of observations of endangered species including 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Sites of endangered species	Points of observations of endangered species	Ministry of Environmental Protection and Natural Resources of Ukraine https://www.gbif.org https://uncg.org.ua/biodiversity-viewer	Vector point data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Areas of endangered species	Areas with high level density of observations of endangered species	Density calculation on the base of data on points of observations of endangered species	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the areas or sites of endangered species	Buffer zone for Major bird migratory routes	Calculation on the base of data on areas and sites of endangered species	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 1.4.2: Peatlands with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Areas of peatlands	Areas of Peatlands with a peat depth of more than one meter	https://planetarycomputer.microsoft.com/dataset/group/io-land-cover	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the areas of peatlands	Buffer zone for areas of peatlands	Calculation on the base of data on areas of peatlands	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 2.1: Areas with elevation higher than 2 000 m.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Elevation	Elevation model	https://dwtkns.com/srtm30m/	Raster	1:50000	Gepodatabese, GeoPackage	2020 - 2025
Selected territory	Selected territory with elevation higher than 2 000 m	Extraction from the elevation model	Raster	1:50000	Gepodatabese, GeoPackage	2025

Indicator 2.2: Areas with slopes more than 15%.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Slopes	Slopes model	https://dwtkns.com/srtm30m Modelling	Raster	1:50000	Gepodatabese, GeoPackage	2020 - 2025
Selected slopes territory	Selected territory with slopes more than 15%	Extraction from the slopes model	Raster	1:50000	Gepodatabese, GeoPackage	2025

Indicator 2.3: Areas with a probability of flooding of 1%.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Flooding	Flooding model	http://data.europa.eu/89h/8e49997c-ba99-4ed1-9aec-059bb440001b	Raster	1:50000	Gepodatabese, GeoPackage	2020 - 2025
Selected flooding territory	Selected flooding territory	Extraction from the flooding model	Raster	1:50000	Gepodatabese, GeoPackage	2025
Selected vector flooding territory	Selected vector flooding territory	Extraction from the flooding model	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 3.1: Forest areas with 100 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Forest areas	Forest areas according to the Forest Code of Ukraine	https://planetarycomputer.microsoft.com/dataset/group/io-land-cover https://forestry.org.ua State Land Cadastre	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 100 m from the forest areas	Buffer zone for forest areas	Calculation on the base of data on forest areas	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 3.2: Waterbodies with normative waterside protection zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Waterbodies polygon	Waterbodies area	https://planetarycomputer.microsoft.com/dataset/group/io-land-cover OSM data on water bodies	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Waterbodies line	Waterbodies line	https://planetarycomputer.microsoft.com/dataset/group/io-land-cover OSM data on water bodies	Vector line data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Protection zones	Normative waterside protection zones	Calculation on the base of data on waterbodies and Water Code of Ukraine norms	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 3.3: Areas used for agriculture.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Agriculture areas	Areas used for agriculture	https://planetarycomputer.microsoft.com/dataset/group/io-land-cover State Land Cadastre	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025

Indicator 3.4: Recreational lands with 1700 m buffer zones.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Recreational lands	Areas of recreational lands	https://planetarycomputer.microsoft.com/dataset/group/io-land-cover State Land Cadastre	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Buffer 1.7 km from the recreational lands	Buffer zone for recreational lands	Calculation on the base of data on recreational lands	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

Indicator 4.1: Areas of high concentration of artificial and built surfaces.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Built-up areas	Areas covered artificial and built surfaces	https://planetarycomputer.microsoft.com/dataset/group/io-land-cover OSM data on built-up areas	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025

Indicator 5.1: Border strip.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
State border of Ukraine	The polyline of a State Border of Ukraine	Ministry for Development of Communities and Territories of Ukraine State Service of Ukraine for Geodesy, Cartography and Cadastre	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2024 - 2025
Border strip	Buffer 5 km from the state border of Ukraine	Calculation on the base of data on the state border of Ukraine	Vector polygonal data	1:50000	Gepodatabese, GeoPackage	2025

SECTION I.3. RISK MANAGEMENT CONSIDERATIONS

Name of Risk	Type of Risk	Priority	Proposals
Personal threat to life.	Military	High	Work in a team of interchangeable experts, the possibility of changing the location to a safer one.
Restricting access to data important for ensuring security in wartime.	Military	Medium	Using open source data and expert assessment results to test the methodology, so that when more reliable official data is obtained, it would be possible to apply them to obtain more accurate results.
Lack of access to official data.	Organisational	Medium	Formation of official requests to government bodies at various levels, use of open data.
Expert disagreement in the choice of quantitative characteristics of criteria.	Organisational	Medium	Conducting a negotiation procedure, agreeing on unified quantitative evaluation indicators, involving external knowledge bases.
Preparing and using data in different formats or coordinate systems.	Technical	Low	Transformation of all data into one format and coordinate system.
Obtaining data with different levels of detail or multiple datasets with different composition.	Technical	Low	Selecting the most reliable and detailed datasets from those available.

SECTION I.4. GIS APPROACH

In order to process geospatial data and unify them, it is necessary to use geographic information systems or software products based on them. The most common GIS in Ukraine are ArcGIS and QGIS.

The main tasks performed in the GIS environment:

- data collection, transformation and unification;
- analysis based on existing data;
- data visualization in the form of printed and web maps and services.

Data collection, transformation and unification involves obtaining data from various sources and standardizing them. Data sources can be repositories and services on verified international web resources, data published on official Ukrainian resources or obtained upon relevant requests, data collected on a volunteer basis. Data transformation and unification involves their evaluation and processing in order to use a single coordinate system, data compliance in terms of accuracy, detail and relevance.

Data analysis involves their joint processing in order to obtain new or additional results. In particular, the assessment of the territory from the point of view of environmental and regulatory restrictions for the placement of alternative energy facilities. The main means of analysis include the formation of attributive and spatial queries to data, the analysis of proximity or buffer zones, and the compatible overlay of layers.

The results are presented in the form of sets and series of thematic maps, which can be published in paper or digital form. The main requirements for paper maps are the use of common layouts and high resolution of illustrations. The main requirements for digital maps are interactive publication on server facilities (web hosting, separate GIS servers, cloud platforms) in the form of geospatial services with appropriate access rights.

Preferred geospatial format:

- *Vector:* Geodatabase, GeoPackage (.gpkg), GeoJSON.
- *Raster:* GeoTIFF (.tif), with clearly defined NoData values.

Projection/CRS:

- *For international needs:* EPSG:4326 (WGS84) or local UTM zone.
- *For Ukrainian needs:* EPSG: 5561 (UCS2000) or local UCS.

Minimum Data Requirements:

- *Spatial Resolution for raster:* ≤30 meters for DEM.
- *Attribute Fields for vector data:* Include relevant metadata such as land cover classification, roads classification, electricity greed voltage, etc.
- *Time Period:* latest available version (better last 3 years).

- *Coverage Area:* Lvivska, Zakarpatska, Ivano-Frankivska, Chernivetska and Vinnytska Oblasts.
- *Metadata for each dataset:* source and acquisition method, date of creation and updates, licensing terms or usage restrictions, authors.

CHAPTER II. CRITERIA ON RENEWABLE ENERGY POTENTIAL AND INFRASTRUCTURE READINESS

The criteria on renewable energy potential, infrastructure readiness are developed for following clusters (or zones): artificial and built surfaces, such as rooftops and facades of buildings; transport infrastructure and their direct surroundings; parking areas; farms; waste sites (landfill for solid waste); industrial sites; mines; artificial inland water bodies, lakes or reservoirs; urban waste water treatment sites; degraded land not usable for agriculture.

The criteria related to renewable energy potential and infrastructure readiness are applied with due consideration of the environmental criteria that must be applied beforehand as indicated in Chapter I.

SECTION II.1. CRITERIA BASED ON RENEWABLE ENERGY POTENTIAL AND INFRASTRUCTURE READINESS

CRITERIA GROUP 1: Rooftops and Facades of Buildings

State-owned, municipal, and other public buildings, such as schools, hospitals, administrative offices and institutions and privately owned structures like factories, warehouses, commercial centres, and residential complexes, suitable for the installation of solar PV panels on both rooftops and facades. A roof is the upper protective structure of a building that simultaneously performs load-bearing and enclosing functions; a facade of a building or structure is the outer part of a building or structure with all elements from the roof to the pavement.

1.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels sized from 250W to 650W considering[13]: roof area needed for solar PV panels depending on a type of roof: flat roof: by 12.0m2 per 1.0 kW; pitched roof: by 7.0m2 per 1.0 kW with regard to technological deviations; facade vertical area needed for solar a panel sized from 250W to 650W: by 16.0m2 per 1.0 kW.
d. Availability to install BESS/PCS at 15-30 kWh.
e. The roof must withstand the load from solar panels up to 20 kg/m².
f. Orientation (azimuth) – south, south-east and south-west.

1.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.
b. Availability of ownership rights regarding space of roofs.
c. Exclusion of sites from consideration: cultural heritage - the territory of a World Heritage Site, the historical area of a settlement, a historical and cultural

[13] Solar panel dimension is usually between 1.6m2 to 2m2.

reserve, a historical and cultural protected areas[14];

1.3. Land Use Compatibility criteria:

a. Avoiding co-located buildings and constructions shading.
b. Availability of local architectural permitting for solar installation on facade and roof zones.
c. Availability of urban planning conditions and restrictions, technical specifications from the electricity supply company.

CRITERIA GROUP 2: Transport Infrastructure Corridor

There are two elements of transport infrastructure suitable for use in solar PV panel installation if there are no local technical and legal reservations:

- right-of-way territories outside the location of cities, towns and villages – for installation of horizontal solar PV panels;
- noise barriers or canopies inside the location of cities, towns and villages - for installation of vertical PV solar panels.

The potential transport infrastructure includes:

a) Land within the right-of-way (excluding the roadway that is directly dedicated to vehicular traffic and shoulders);
b) Land outside the right-of-way, if they contain structures that ensure the functioning of highways (parking and recreation areas) in relation to highways of state importance (international, national, regional

The transport infrastructure along which the solar PV panels can be installed will be classified: roads of state importance (international, national, regional).

2.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels (right-of-way territories outside the location of cities, towns and villages: for panels on stationary structures at an optimal angle, an area of about by 17.0m2 will be required to accommodate 1 kW; noise barriers or canopies inside the location of cities, towns and villages: for panels on stationary structures at 90 degree angle, an area of about by 20.0m2 will be required to accommodate 1.0 kW).
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations) - according to DSOs' network development plans.

[14] https://zakon.rada.gov.ua/laws/show/1805-14#Text

f. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. There must be a 20-meter-wide space along the road on the right and/or left side (outside the roadway) suitable for installing solar panels.
h. Terrain slopes that are greater than 15° and absolute altitudes greater than 1900 m should be excluded.

2.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

2.3. Land Use Compatibility criteria:

a. Belonging to the land of transport[15].
b. Availability of road owners' or road management authorities' permissions to place objects within:
   - right-of-way territories outside the location of cities, towns and villages;
   - noise barriers or canopies inside the location of cities, towns and villages.

CRITERIA GROUP 3: Parking Areas

Potential REAA objects are road service facilities (specially equipped places for stopping route vehicles, parking lots).

3.1. Technical Suitability criteria:

a. Location /geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. To place 1 kW, an area of about 17.0 m2 is required.
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution: a) availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV at a distance of no more than 5 km b) availability of substations and their characteristics at a distance of no more than 5 km. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

3.2. Land Use Compatibility criteria:

a. Cadastral limitations regarding the designated purpose of land.
b. Limitation of the location/facility by the land user, the land resources authority, environmental and sanitary-epidemiological authorities, architecture and cultural heritage protection authorities.

CRITERIA GROUP 4: Farms

Separate farms - land plots with a residential building, household buildings, surface

[15] https://zakon.rada.gov.ua/laws/show/2480-17

and underground communications, perennial plantations located on them, which is located outside the settlement[16].

4.1. Technical Suitability criteria

4.1.1. Criteria for solar technology:

a. Location /geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels sized from 250W to 650W considering:
    - roof area needed for solar PV panels depending on a type of roof: flat roof: by 12.0m2 per 1.0 kW; pitched roof: by 7.0m2 per 1.0 kW with regard to technological deviations;
    - facade vertical area needed for solar a panel sized from 250W to 650W: by 16.0m2 per 1.0 kW.
d. Ability to withstand snow loads of up to 5400 Pa[17] and wind loads of up to 2400 Pa.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations).
f. Availability to install ESS/PCS at 15-1000 kWh. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

4.1.2. Criteria for wind technology:

a. Average annual wind speed at a height of 100 m, m/s, should be not less than 5.0 m/s.
b. Orographic constraints: a) terrain slopes greater than 15 ° should be excluded.
c. Total area suitable for wind installation and infrastructure : overall average direct area is: 0.3 ± 0.1 hectares/MW for permanent impact; 0.7 ± 0.6 hectares/MW for temporary impact. Total direct surface area should be of about 1.0 ± 0.7 hectares/MW.
d. Availability and location of state importance roads (international, national, regional roads) and local roads (territorial, regional and district roads) on a distance at no more than 5 km with direct access to the site via unclassified roads.
e. Availability of a grid connection point for potential wind zones:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km;

[16] https://zakon.rada.gov.ua/laws/show/973-15#Text
[17] 1 pascal (Pa) is equal to 1 newton per square meter (N/m²)

- possibility of laying cables or overhead power lines from a site to nearest substations.

f. Availability to install BESS/PCS at industrial-scale (400kWh to 10MWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

The additional detailed criteria that could be applied for selection of potential wind zones include topographic, geodesic and orographic data; geology (geomorphology and hydrogeology, soil conditions); seismic risk, groundwater, soil resistivity, and load-bearing capacity.

4.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

4.3. Land Use Compatibility criteria:

a. Belonging to the agricultural land[18].

CRITERIA GROUP 5: Waste sites

This group includes solid waste landfills , which are engineered specialized facilities designed for the disposal of municipal solid waste and conditionally inert waste.

5.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels.
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations).
f. Availability to install BESS/PCS at small/medium-scale (60-100kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

5.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

5.3. Land Use Compatibility criteria:

a. Location on non-agricultural lands unsuitable for agriculture, of deteriorated quality, on lands not occupied by forests and other green spaces.
b. Availability of complex plans for the urban spatial development of territorial

[18] The Land Code allows changing the designated purpose of agricultural land: https://zakon.rada.gov.ua/laws/show/2480-17#Text

communities (urban planning documentation at the local level and land use documentation).

CRITERIA GROUP 6: Industrial Sites

This group includes:

- Industrial land, which includes land provided for the placement and operation of main, auxiliary and auxiliary buildings and structures of industrial, mining, transport and other enterprises, their access roads, utility networks, administrative buildings, other structures, including land in industrial parks.
- Industrial land that is abandoned or underused, in part or completely.
- Industrial land part of just transition programmes or other rehabilitation, redevelopment or repurpose plans.

6.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels.
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points:
    - availability, location and characteristics of cable and overhead existing and planned power lines : Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of existing and planned substations and their characteristics at a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations).
f. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

6.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

6.3. Land Use Compatibility criteria:

a. Belonging to the land of industry.

CRITERIA GROUP 7: Mines

The group includes:

a. Inactive, phaseout, partially active mines, mine waste heaps, which are a collection of rocks from mining operations and coal fractions stored in a designated area.
b. Inactive, phase out, partially active quarries (a set of open pits intended for the development of a mineral deposit).
c. Quarries and/or mines part of just transition programmes or other rehabilitation, redevelopment or repurpose plans.

7.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels.
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV; at a distance of no more than 5 km;
    - availability and location of connection points at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km; possibility of laying cables or overhead power lines from a site to nearest substations).
f. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

7.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

7.3. Land Use Compatibility criteria:

a. Belonging to the land of industry.

CRITERIA GROUP 8: Artificial Inland Water Bodies

This group includes artificial reservoirs (reservoirs, ponds) and canals, except for canals on irrigation and drainage systems[19].

8.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels.
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations).
f. Availability to install BESS/PCS at small/medium-scale (60-100kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

[19] https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text

8.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

CRITERIA GROUP 9: Urban Wastewater Treatment Sites

This group includes:

a. Treatment facilities of settlements[20].
b. Local treatment facilities - Facilities and devices designed to treat wastewater of an enterprise before it is discharged into the household, industrial or storm sewerage system or used in closed water management schemes of the enterprise[21].

9.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels.
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations).
f. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Availability and location of roads (regional and district) with direct access to the site via unclassified roads.

9.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

9.3. Land Use Compatibility criteria:

a. Belonging to the land of industry.

CRITERIA GROUP 10: Degraded Land Not Usable for Agriculture

This criteria group includes land, which is unsuitable for agricultural but suitable for solar and wind technologies under this group[22], is:

- Degraded land (land plots whose surface has been disturbed as a result of

[20] https://zakon.rada.gov.ua/laws/show/2887-20#Text
[21] https://e-construction.gov.ua/files/new_doc/3019282773518059294/2023-01-19/b10c343f-4a22-4a54-aa2d-47b910f8715b.pdf
[22] https://zakon.rada.gov.ua/laws/show/2768-14#Text

earthquakes, landslides, karst formation, floods, mining, etc.; land plots with eroded, waterlogged, acidic or saline soils, soils contaminated with chemicals, etc.);
- Low-productive lands (lands whose soils are characterized by negative natural properties, low fertility, and their economic use for the intended purpose is economically inefficient).

10.1. Technical Suitability criteria

10.1.1. Technical Suitability criteria for solar technology:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiance (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels.
d. Orientation (azimuth) – south, south-east and south-west.
e. Availability of grid connection points in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;
    - availability of substations and their characteristics at a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations).
f. Availability to install BESSPCS at small/medium-scale (60-1000kWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.

10.1.2. Technical Suitability criteria for wind technology:

a. Average annual wind speed at a height of 100 m, m/s, should be not less than 5.0 m/s.
b. Orographic constraints[23]: a) terrain slopes greater than 15° should be excluded.
c. Total area suitable for wind installation and infrastructure[24]: overall average direct area is: 0.3 ± 0.1 hectares/MW for permanent impact; 0.7 ± 0.6 hectares/MW for temporary impact. Total direct surface area should be of about 1.0 ± 0.7 hectares/MW.
d. Availability and location of state importance roads (international, national, regional roads) and local roads (territorial, regional and district roads) on a distance at no more than 5 km with direct access to the site via unclassified roads.
e. Availability of a grid connection point for potential wind zones in accordance with distribution system development plans and investment programmes for electricity distribution:
    - availability, location and characteristics of cable and overhead power lines: Medium voltage - 35 kV; High voltage - 110 kV at a distance of no more than 5 km;

[23] METHODOLOGY FOR ASSESSING OF THE WIND ENERGY POTENTIAL OF THE UKRAINE TERRITORY USING GEOGRAPHIC INFORMATION SYSTEMS. УДК 621.311.24. https://doi.org/10.36296/1819-8058.2024.4(79)68-81. 489-Article Text-832-2-10-20250131
[24] https://www.nrel.gov/docs/fy09osti/45834.pdf

- availability of substations and their characteristics at a distance of no more than 5 km;
- possibility of laying cables or overhead power lines from a site to nearest substations.

f. Availability to install BESS/PCS at industrial-scale (400kWh to 10MWh). The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Availability and location of roads (state importance roads (international, national, regional roads) and local roads (territorial, regional and district roads) on a distance at no more than 5 km with direct access to the site via unclassified roads.

The additional detailed criteria that could be applied for selection of potential wind zones include[25]: topographic, geodesic and orographic data; geology (geomorphology and hydrogeology, soil conditions); seismic risk, groundwater, soil resistivity, and load-bearing capacity.

Additional criteria related to wind:

- Roads - at a distance of less than 60 m;
- Railways - at a distance of less than 500 m;
- Power lines - at a distance of less than 250 m.

10.2. Legal Constraints criteria:

a. National environmental restrictions in addition to the environmental criteria.

10.3. Land Use Compatibility criteria:

a. Belonging to the agriculture land (for low-productive land).

[25] DSTU 8340:2015 WIND ENERGY SITES FOR WIND POWER PLANTS Selection requirements; DSTU 8292:2015 Wind energy. Wind power plants. Connection to the electricity system

SECTION II.2. DATA REQUIREMENTS AND SOURCES

CRITERIA FOR ROOFTOPS AND FACADES OF BUILDINGS

Technical Suitability

Criteria	Location	GHI	Orientation (azimuth)
Type of data	vector polygonal data	raster (gridded) data	DEM (raster data)
Desired resolution/scale	vectorized at scale 1:50000	30m (1 arc-sec); 270 m (9 arc-sec)	10m (1/3 arc-sec 30m (1 arc-sec)
Preferred sources	GIS OSA data https://www.openstreetmap.org/	https://globalsolaratlas.info/map	https://srtm.csi.cgiar.org
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	GeoTIFF
Frequency of updates (if applicable)	2025	2025	2025

Legal Constraints

Criteria	Cultural heritage	Nature conservation areas
Type of data	vector polygonal data	vector polygonal data
Desired resolution/scale	vectorized at scale 1:25000	vectorized at scale 1:50000
Preferred sources	State land cadaster	https://www.protectedplanet.net/country/UKR
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2025	2025

Land Use Compatibility

Criteria	Land ownership
Type of data	vector polygonal data
Desired resolution/scale	vectorized at scale 1:50000
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	

CRITERIA FOR TRANSPORT INFRASTRUCTURE CORRIDORS

Technical Suitability

Criteria	Location	GHI	Total area	Orientation	Grid connection
Type of data	vector lines data of roads	raster (gridded) data	vector polygons data of cities, towns, villages		vector lines; points data of electricity powerlines; substations
Desired resolution/scale		270 m (9 arc-sec)			
Preferred sources	GIS OSA data; Open StreetMap	Global Solar Atlas	GIS OSA data; Open StreetMap		Обленерго
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)		2025	2025	2025	2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data
Desired resolution/scale	1:25000	1:25000	1:25000
Preferred sources	GIS OSA data; OpenStreetMap	State land cadastre	OpenStreetMap
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2025	2025	2025

Land Use Compatibility

Criteria	Land use zoning	Land use conflict
Type of data	Vector polygonal data	Vector lines data
Desired resolution/scale		
Preferred sources	State land cadastre	https://wd.clarity-project.info/package/7576fcf4-d79f-49af-ab1e-be0671116a56
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025

CRITERIA FOR PARKING AREAS

Technical Suitability criteria

Criteria	Location	GHI	Orientation (azimuth)	Grid connection points
Type of data	Vector polygonal data	raster (gridded) data	DEM	vector lines and points data of powerlines; substations
Desired resolution/scale	1:10000	270 m (9 arc-sec)		
Preferred sources	GIS OSA data	Global Solar Atlas		GIS OSA data, GIS DSOs data
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Legal Constraints

	Sanitary hygienic zone	Cultural heritage	Nature conservation areas
Type of data	Vector polygonal data	vector polygonal data	Vector polygonal data
Desired resolution/scale	1:25000	1:50000	1:25000
Preferred sources	GIS OSA data; OpenStreetMap	State land cadastre	State land cadaster; https://www.protectedplanet net/country/UKR
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025

Land Use Compatibility

Criteria	Land plot category
Type of data	vector polygonal data with attributive data about category
Desired resolution/scale	1:25000
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2025

CRITERIA FOR FARMS

Technical Suitability

Criteria	Location	GHI
Type of data	Vector data for farms	raster (gridded) data
Desired resolution/scale	Depends on level it could be polygons or points	270 m (9 arc-sec)
Preferred sources	State land cadastre	Global Solar Atlas
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF
Frequency of updates (if applicable)	2024-2025	2024-2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data
Desired resolution/scale	1:25000	1:25000	1:25000
Preferred sources	OSA data; OpenStreetMap	State land cadastre;	https://davr.gov.ua/fls18/RTR_f.pdf
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

CRITERIA FOR WASTE SITES

Technical Suitability

Criteria	Location	GHI	Orientation	Grid connection points
Type of data	Vector polygonal data	raster (gridded) data	DEM (raster data)	vector lines and points data of powerlines and substations
Desired resolution/scale	1:25000	270 m (9 arc-sec) is available from web sources	10m (1/3 arc-sec); 30m (1 arc-sec)	10m (1/3 arc-sec); 30m (1 arc-sec)
Preferred sources	GIS OSA data, State land cadastre	Global Solar Atlas	https://srtm.csi.cgiar.org	GIS OSA data, GIS DSOs
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips	Buffer zones of natural areas
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data	vector lines and polygonal data
Desired resolution/scale	1:25000	1:25000	1:25000	-
Preferred sources	GIS OSA data; OpenStreetMap	State land cadastre	https://davr.gov.ua/fls18/RTR_f.pdf; OpenStreetMap	OpenStreetMap
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

CRITERIA FOR INDUSTRIAL SITES

Technical Suitability

Criteria	Location	GHI	Orientation	Grid connection points
Type of data	Vector polygonal data	raster (gridded) data	DEM (raster data)	vector lines and points data of powerlines; substations
Desired resolution/scale	1:25000	270 m (9 arc-sec)	10m (1/3 arc-sec); 30m (1 arc-sec)	
Preferred sources	GIS OSA data, State land cadastre	Global Solar Atlas	https://srtm.csi.cgiar.org	GIS OSA data, GIS DSOs
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips	Buffer zones of natural areas
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data	vector lines and polygonal data
Desired resolution/scale	1:25000	1:25000	1:25000	-
Preferred sources	GIS OSA data; OpenStreetMap	State land cadastre	https://davr.gov.ua/fls18/RTR_f.pdf	OpenStreetMap
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

CRITERIA FOR MINES AND QUARRIES

Technical Suitability

Criteria	Location	GHI	Orientation	Grid connection points
Type of data	Vector polygonal data	raster (gridded) data	DEM (raster data)	vector lines and points data of powerlines; substations
Desired resolution/scale	1:25000	270 m (9 arc-sec)	10m (1/3 arc-sec) is preferable; 30m (1 arc-sec)	
Preferred sources	GIS OSA data; State land cadastre	Global Solar Atlas	https://srtm.csi.cgiar.org	GIS OSA data, GIS DSOs
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips	Buffer zones of natural areas
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data	vector lines and polygonal data
Desired resolution/scale	1:25000	1:25000	1:25000	-
Preferred sources	GIS OSA data; OpenStreetMap	State land cadastre	https://davr.gov.ua/fls18/RTR_f.pdf	OpenStreetMap
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

CRITERIA FOR ARTIFICIAL INLAND WATER BODIES, LAKES OR RESERVOIRS

Technical Suitability

Criteria	Location	GHI	Orientation	Grid connection points
Type of data	Vector polygonal data	raster (gridded) data	DEM (raster data)	vector lines and points data of powerlines; substations
Desired resolution/scale	1:50000	270 m (9 arc-sec) is available from web sources	10m (1/3 arc-sec) is preferable; 30m (1 arc-sec)	
Preferred sources	GIS OSA data, State land cadastre	Global Solar Atlas	https://srtm.csi.cgiar.org	GIS OSA data, GIS DSOs; State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas
Type of data	Vector polygonal data	Vector polygonal data
Desired resolution/scale	1:25000	1:25000
Preferred sources	GIS OSA data; OpenStreetMap	State land cadastre;
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

CRITERIA FOR URBAN WASTE WATER TREATMENT SITES

Technical Suitability

Criteria	Location	GHI	Orientation	Grid connection points
Type of data	Vector polygonal data	raster (gridded) data	DEM (raster data)	vector lines and points data of powerlines; substations
Desired resolution/scale	1:25000	270 m (9 arc-sec)	10m (1/3 arc-sec) is preferable; 30m (1 arc-sec)	
Preferred sources	GIS OSA data, State land cadastre	Global Solar Atlas	https://srtm.csi.cgiar.org	GIS OSA data, GIS DSOs data
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips	Buffer zones of natural areas
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data	vector lines and polygonal data
Desired resolution/scale	1:25000	1:25000	1:25000	-
Preferred sources	GIS OSA data; OpenStreetMap	State land cadastre	https://davr.gov.ua/fls18/RTR_f.pdf	OpenStreetMap
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre;
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

CRITERIA FOR DEGRADED LAND NOT USABLE FOR AGRICULTURE

10.1. Solar Technology

Technical Suitability

Criteria	Location	GHI	Orientation	Grid connection points	Availability and location of roads
Type of data	Vector polygonal data	raster (gridded) data	DEM (raster data)	vector lines and points data of powerlines; substations	vector lines data
Desired resolution/scale	1:50000	270 m (9 arc-sec)	10m (1/3 arc-sec); 3 0m (1 arc-sec)		
Preferred sources	GIS OSA data, State land cadastre	Global Solar Atlas	https://srtm.csi. cgiar.org	GIS OSA data, GIS DSOs data; State Land Cadastre	OpenStreetMap
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	GeoTIFF	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025	2024-2025	2024-2025	2024-2025	2024-2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data
Desired resolution/scale	1:25000	1:25000	1:25000
Preferred sources	GIS OSA data, OpenStreetMap	State land cadastre; https://kadastr.live/	https://davr.gov.ua/ fls18/RTR_f.pdf
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)			

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

10.2. Wind Technology

Technical Suitability

Criteria	Average annual wind speed at 100 m	Terrain slope	Absolute altitude	Grid connection points	Availability and location of roads
Type of data	Vector data	DEM (raster data)	DEM (raster data)	vector lines and points data of powerlines; substations	vector lines data
Desired resolution/scale		10m (1/3 arc-sec) is preferable; 30m (1 arc-sec)	10m (1/3 arc-sec); 30m (1 arc-sec)		
Preferred sources	https://globalwindatlas.info/en/	https://srtm.csi.cgiar.org	https://srtm.csi.cgiar.org	GIS OSA data, GIS TSO data, DSOs, State land cadastre	OpenStreetMap
Format (e.g. raster, shapefile)	GeoJSON	GeoTIFF	GeoTIFF	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates	2025	2025	2025	2025	2025

Legal Constraints

Criteria	Sanitary hygienic zone	Nature conservation areas	Riparian protection strips	Buffer zones of natural areas	Other criteria
Type of data	Vector polygonal data	Vector polygonal data	Vector polygonal data	vector lines and polygonal data	Vector data
Desired resolution/scale	1:25000	1:25000	1:25000	-	-
Preferred sources	GIS OSA data, OpenStreetMap	State land cadastre	https://davr.gov.ua/fls18/RTR_f.pdf	OpenStreetMap State land cadastre	OpenStreetMap; State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2025	2025	2025	2025	2025

Land Use Compatibility

Criteria	Land use zoning
Type of data	Vector polygonal data
Desired resolution/scale	-
Preferred sources	State land cadastre
Format (e.g. raster, shapefile)	Shapefile (or GeoJSON, GeoPackage)
Frequency of updates (if applicable)	2024-2025

SECTION II.3. DATA GAPS AND RISK MANAGEMENT

Location / geographical coordinates of all clusters:

- artificial and built surfaces, such as rooftops and facades of buildings;
- transport infrastructure and their direct surroundings;
- parking areas;
- farms; waste sites (landfill for solid waste);
- industrial sites; mines;
- artificial inland water bodies, lakes or reservoirs;
- urban waste water treatment sites;
- degraded land not usable for agriculture), -

in GIS format are to be provided by the State land cadaster. As an alternative, it should be provided by OSAs of Lviv, Zakarpattia, IvanoFrankivsk, Chernivtsi, and Vinnytsia.

Grids and substations data in GIS format (ultra-high voltage - 220 kV, 330 kV) should be provided by TSO. As an alternative, the TSO should provide the relevant data of 2021.
Grids and substations data in GIS format (medium voltage: 6 kV, 10 kV and 35 kV; high voltage: 110 kV) should be provided by DSOs. As an alternative, the DSOs should provide the relevant data of 2021.

Questionnaires for data collection will be tailored to stakeholder groups focusing on renewable energy planning and addressing key issues such as policy priorities, feasibility, and barriers.

Methods of data collection:

- Sending of questionnaires to regional state administrations, local state, municipal and private owners.
- Holding explanatory workshops if needed.
- Working meetings with representatives of stakeholders.
- Interviews if needed.
- Gathering feedback from regional state administrations, local state, municipal and private owners.

The identification of critical data, optional data, expected consequences of missing data, and possible mitigation strategies are provided below.

Criteria	Critical data	Optional data	Consequences of missing data	Possible mitigation strategies
Location / geographical coordinates of buildings suitable for solar PV panels	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location / geographical coordinates of transport infrastructure	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location /geographical coordinates of parking	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location /geographical coordinates of farms	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location / geographical coordinates of solid waste landfills	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location / geographical coordinates of industrial sites,	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location / geographical coordinates of mines	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location / geographical coordinates of urban waste water treatment sites	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Location / geographical coordinates of Degraded agricultural land	State land cadastre data	GIS OSA data	Mapping failure	OSA data and expert judgments
Availability of grid connection points (Ultra-high voltage - 220 kV, 330 kV)	GIS TSO data 2025	Vector format TSO data, 2021	Mapping failure	TSO data and expert judgments
Availability of substations and their characteristics	TSO data 2025	TSO data, 2021	Mapping failure	TSO data and expert judgments
Availability of grid connection points (Medium voltage - 6 kV, 10 kV, 35 kV; High voltage - 110 kV)	GIS DSOs data 2025	Vector format DSOs data, 2021	Mapping failure	DSO data and expert judgments
Availability of substations and their characteristics	DSOs data 2025	DSOs data, 2021	Mapping failure	DSO data and expert judgments
Legal Constraints Criteria	State land cadastre data	https://www.protectedplanet.net/country/UKR	Mapping failure	OSA data and expert judgments
Land Use Compatibility Criteria	State land cadastre data	https://www.protectedplanet.net/country/UKR	Mapping failure	OSA data and expert judgments

SECTION II.4. GIS INTEGRATION NOTES

QGIS (Quantum GIS) is an open-source geographic information system used for creating, analyzing, and visualizing spatial data. It supports both raster and vector formats, making it ideal for energy-related planning tasks. With its tools and plugin support, QGIS enables detailed spatial modeling, including renewable energy site suitability analysis.

To ensure accurate and compatible integration into GIS workflows, spatial data with the specifications are required. Datasets must be georeferenced and formatted appropriately.

Raster data is used for continuous variables like solar radiation (GHI), wind speed, digital elevation models (DEM), slope, and aspect. These datasets are grid-based, ideal for modelling spatial variation.

Vector data is used for discrete features such as roads, power lines, substations, land parcels, administrative boundaries, protected areas, river networks, buildings, land use classifications, etc. These datasets contain attributes and geometries (points, lines, polygons) critical for exclusions, infrastructure mapping, and proximity analysis in site selection.

Preferred Format:

- **Vector**: Shapefile (.shp), GeoPackage (.gpkg), GeoJSON
- **Raster**: GeoTIFF (.tif), with clearly defined NoData values

Projection/CRS:

- EPSG:4326 (WGS84) or local UTM zone

Minimum Requirements:

- **Spatial Resolution for raster**: ≤30 meters for DEM, ≤270meters for solar radiation or wind speed
- **Attribute Fields for vector data**: Include relevant metadata such as land cover classification, roads classification, electricity greed voltage, etc.
- **Time Period**: latest available version (better last 3 years)
- **Coverage Area**: west region
- **Metadata** with each dataset, detailing: source and acquisition method, date of creation and updates, licensing terms or usage restrictions

ANNEX I – CONSULTATION REPORT

After competition of consultation