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

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CRITERIA:

Environmental Criteria and Constrains, Renewable Energy Criteria and Infrastructure Readiness

TECHNOLOGY: Onshore Wind and Solar

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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.

The Energy Community Secretariat, with the assistance of the European Climate Foundation (ECF) under its Ukraine Programme, is implementing a project to provide preparatory inputs for Ukraine's Cross-Border Renewables Energy Acceleration Areas (RAAs) focused on onshore wind and solar, which could inform future implementation and decision - making once the relevant legal and regulatory framework is in place.

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[2]. Taking into account the highest levels of sensitivity of wildlife comparing to human it is proposed to consider 700 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 and national 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 700 m buffer zones.

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 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

[2] State Standard of Ukraine 8339:2015 "Wind energy. Wind power plants. Assessment of the impact of a wind power plant on the environment".
[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

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]. According to the Bern Convention if an area has candidate status for inclusion in the Emerald Network list, it also a subject to the protection regime under the Convention and should be excluded when designating RAAs.

Indicator 1.1.2: Areas of Ramsar Sites with 700 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 700 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 700 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>Recommendation:</u> Since The Law of Ukraine "On the Ecological Network of Ukraine" lays down the regulatory and legal foundations for the formation of a holistic network of territories that are of special value for environmental protection and, in accordance with the laws and international obligations of Ukraine, are subject to special protection, it is recommended to consider ecological network schemes as an additional source of data on the territories that are of special value for environmental protection in case such schemes been elaborated for the relevant area.

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

Indicator 1.3.1: Migratory routes with 700 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

[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

routes. But such protected areas mostly designated on migratory birds stops locations and doesn't cover totally the migratory routes.

At the same time a migratory corridor is a conditional path along which birds travel during seasonal flights, the width of it is not fixed, as it depends on many factors, such as: the species of bird, geographical conditions, the presence of water bodies or mountains, as well as natural obstacles that can narrow or widen the migration path. Some corridors can be very narrow, while others can be much wider, depending on the birds' need for certain resources to pass, such as water or food. According to recent studies, the width of the flight front is approximately equal to the width of the nesting area. The boundaries of such corridors are not clearly defined on the territory, which makes it impossible to take them into account in spatial analysis for the purposes of planning the development of the territory.

Considering this criteria demands conducting additional research to determine exact areas necessary for supporting birds' migration to be included to the spatial analysis for the purposes of RAAs designation.

Indicator 1.3.2: Important Bird and Biodiversity Areas with 700 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 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.

Recommendation: At the next steps of elaboration of RAAs designation methodology other species migratory routes (bats, insects etc.) might be also consider in case of availability of relevant and reliable data.

Criterion 1.4: 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 700 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 700 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 800 m.

This indicator is established at the international level within the methodology elaborated by the International Renewable Energy Agency (IRENA, 2016). But according to IRENA methodology it is set to a value of 2000 m, which has 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.

Setting a value of this indicator for the territory of Ukraine it should be taken into account that areas in the Ukrainian Carpathians above ca. 1000 m belong to the alpine and subalpine zones, within which most biotopes are subject to protection according to the Resolution No.4 of the Convention on the Conservation of European Wildlife and Natural Habitats (1979)[11]. In addition, we already have the first precedent of recognizing the special requirements on protection of mountain

[11] The National Habitat Catalogue of Ukraine, available at: https://www.researchgate.net/publication/331935396_NATIONAL_HABITAT_CATALOGUE_OF_UKRAINE

landscapes in general above the defined elevation at the legislative level, since the Law of Ukraine of August 21, 2025 No. 4577-IX[12] defines that the management of the territories of energy facilities intended for military and defence purposes, located in the mountainous areas of the Carpathians at an altitude of 800 meters and above, requires the mandatory presence of a plan of environmental protection measures for the maximum possible preservation of wild flora and fauna and their natural habitats. Thus, taking into account at least the legislative demands, the areas at an altitude of 800 meters and above have to be excluded from the further analysis for RAAs designation.

***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[13].

***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[13].

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.

[12] The Law of Ukraine of August 21, 2025 No. 4577-IX "On Amendments to the Tax Code of Ukraine and Other Laws of Ukraine Regarding Support for Enterprises of the Defense Industrial Complex", available at: https://zakon.rada.gov.ua/laws/show/4577-20#Text

[13] 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

The national building regulations provide fire protection indent to the built-up areas with a maximum size of 100 m[13]. Thus the 100 m buffer zones have to be considered while assessing the forest fund criterion.

***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.

Recommendation: While the Project area doesn't cover the regions with sea, coasts the possibility of designation of RAAs along sea coasts and on shelf areas has to be analysed additionally and special criteria regarding waterside protection zones has to be elaborated for such areas.

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

Indicator 3.3: Areas categorised as agriculture land.

The Land Code of Ukraine (Article 23) establishes the priority of using suitable land for agricultural needs, providing for the use of such lands for agriculture, forestry or nature protection.

Recommendation: Since according to numerous investigation there are extensive areas of degraded lands among the lands categorised for agricultural needs, it is recommended to consider the official data on degraded lands for the placement of RAAs.

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

Indicator 3.4: Recreational lands with 700 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 700 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[14]. 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.

Recommendation: At the next steps of elaboration of RAAs designation methodology and going down to a lower level of analysis of the territory the development regulations, as well as sanitary, aviation, security, historical and cultural restrictions has to be considered. Also an assessment of the loss of ecosystem services might be conducted in cases it is possible to be done, as well as a socio-ecological approach, analysing alternatives for the use of the territory, might be applied to assessment.

[14] 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 700 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	Geodatabase, GeoPackage	2024 - 2025
Emerald Network Proposed Sites	Areas of Emerald Network Sites	https://emerald.eea.europa.eu	Vector polygonal data	1:50000	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m 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	Geodatabase, GeoPackage	2025

Indicator 1.1.2: Areas of Ramsar Sites with 700 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	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m 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	Geodatabase, GeoPackage	2025

Indicator 1.1.3: Areas of UNESCO Biosphere Reserves with 700 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	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m 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	Geodatabase, GeoPackage	2025

Indicator 1.2: Nature Reserve Fund of Ukraine areas with 700 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	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m 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	Geodatabase, GeoPackage	2025

Indicator 1.3.1: Migratory routes with 700 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	Geodatabase, GeoPackage	2024 - 2025
Migratory routes	Path of major bird migratory routes	https://migrationatlas.org	Vector line data	1:50000	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m 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	Geodatabase, GeoPackage	2025

Indicator 1.3.2: Important Bird and Biodiversity Areas with 700 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	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m 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	Geodatabase, 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 700 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	Geodatabase, 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	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m from the areas or sites of endangered species	Buffer zone for areas or sites of endangered species	Calculation on the base of data on areas and sites of endangered species	Vector polygonal data	1:50000	Geodatabase, GeoPackage	2025

Indicator 1.4.2: Peatlands with 700 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	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m 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	Geodatabase, GeoPackage	2025

Indicator 2.1: Areas with elevation higher than 800 m.

Name	Description	Data Sources	Type of data	Desired resolution/ detailing	Format	Relevance
Elevation	Elevation model	https://dwtkns.com/srtm30m/	Raster	1:50000	Geodatabase, GeoPackage	2020 - 2025
Selected territory	Selected territory with elevation higher than 800 m	Extraction from the elevation model	Raster	1:50000	Geodatabase, 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	Geodatabase, GeoPackage	2020 - 2025
Selected slopes territory	Selected territory with slopes more than 15%	Extraction from the slopes model	Raster	1:50000	Geodatabase, 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	Geodatabase, GeoPackage	2020 - 2025
Selected flooding territory	Selected flooding territory	Extraction from the flooding model	Raster	1:50000	Geodatabase, GeoPackage	2025
Selected vector flooding territory	Selected vector flooding territory	Extraction from the flooding model	Vector polygonal data	1:50000	Geodatabase, 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	Geodatabase, 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	Geodatabase, 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	Geodatabase, 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	Geodatabase, 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	Geodatabase, 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	Geodatabase, GeoPackage	2024 - 2025

Indicator 3.4: Recreational lands with 700 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	Geodatabase, GeoPackage	2024 - 2025
Buffer 700 m from the recreational lands	Buffer zone for recreational lands	Calculation on the base of data on recreational lands	Vector polygonal data	1:50000	Geodatabase, 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	Geodatabase, 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	Geodatabase, 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	Geodatabase, 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 irradiation (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels sized from 250W to 650W considering[15]: 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 of grid connection at 6 kV and 10 kV points on a distance of no more than 5 km.
e. Availability to install BESS/PCS at 15-30 kWh, the capacity is 1-3 kWh per 1 kW of power.
f. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.
g. The roof must withstand the load from solar panels up to 20 kg/m².
Orientation (azimuth) – south, south-east and south-west.

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

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 reserve, a historical and cultural protected areas[16];

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 irradiation (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

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

more than 30 km and of not less than 20 meters;availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on 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.
f. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.
h. 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.
i. 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[17].
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 irradiation (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 30 km and of not less than 20 meters; b) availability of substations and their characteristics at a distance of no more than 30 km.
f. Availability of grid connection at 6 kV and 10 kV points on a distance of no

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

more than 5 km.

g. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
h. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

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 and underground communications, perennial plantations located on them, which is located outside the settlement[18].

4.1. Technical Suitability criteria

4.1.1. Criteria for solar technology:

a. Location /geographical coordinates: latitude and longitude.
b. Global horizontal irradiation (GHI) - not less than 1100 kWh/m2, kWp.
c. Total area suitable for installation of solar PV panels sized from 250W to 650W and installed on roofs and facades 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[19] 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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion

[18] https://zakon.rada.gov.ua/laws/show/973-15#Text
[19] 1 pascal (Pa) is equal to 1 newton per square meter (N/m²)

battery storage is approximately 93 m2.

g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

The 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.
Additional criteria related to wind:

- Roads - at a distance of less than 60 m;
- Railways - at a distance of less than 500 m;
- Airports - at a distance of less than 10 km.

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[20].

[20] The Land Code allows changing the designated purpose of agricultural land:

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 irradiation (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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

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 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.

https://zakon.rada.gov.ua/laws/show/2480-17#Text

7.1. Technical Suitability criteria:

7.1.1. Criteria for solar technology:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiation (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 30 km and of not less than 20 meters; availability of existing and planned substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

7.1.2. Criteria for wind technology:

h. Average annual wind speed at a height of 100 m, m/s, should be not less than 5.0 m/s.
i. Orographic constraints: a) terrain slopes greater than 15 ° should be excluded.
j. 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.
k. 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.
l. 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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations.
m. Availability to install BESS/PCS at industrial-scale (400kWh to 10MWh). The capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1

megawatt-hour of lithium-ion battery storage is approximately 93 m2.

n. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

The 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.

Additional criteria related to wind:

- Roads - at a distance of less than 60 m;
- Railways - at a distance of less than 500 m;
- Airports - at a distance of less than 10 km.

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 and quarries

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 irradiation (GHI) - not less than 1100 kWh/m2, kWp.
c. Orientation (azimuth) – south, south-east and south-west.
d. 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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on a distance of no more than 5 km;
    - possibility of laying cables or overhead power lines from a site to nearest substations).
e. Availability to install BESS/PCS at small/medium-scale (60-1000kWh). The capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
f. Additional recommended criterion: ensure that the installed capacity matches

the consumption volume and profile, as well as the existing and potential load of the nodes.

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[21].

9.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiation (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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

9.2. 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[22].
b. Local treatment facilities - Facilities and devices designed to treat wastewater of

[21] https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
[22] https://zakon.rada.gov.ua/laws/show/2887-20#Text

an enterprise before it is discharged into the household, industrial or storm sewerage system or used in closed water management schemes of the enterprise[23].

9.1. Technical Suitability criteria:

a. Location / geographical coordinates: latitude and longitude.
b. Global horizontal irradiation (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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30 km;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.
h. 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[24], is:

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

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

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 irradiation (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 30 km; availability of substations and their characteristics at a distance of no more than 30 km and of not less than 20 meters;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.

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[25]: a) terrain slopes greater than 15° should be excluded.
c. Total area suitable for wind installation and infrastructure[26]: 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 30 km and of not less than 20 meters; availability of substations and their characteristics at a distance of no more than 30

[25] 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
[26] https://www.nrel.gov/docs/fy09osti/45834.pdf

km;
    - availability of grid connection at 6 kV and 10 kV points on 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 capacity is 1-3 kWh per 1 kW of power. The amount of land needed per 1 megawatt-hour of lithium-ion battery storage is approximately 93 m2.
g. Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes.
h. 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 detailed criteria that could be applied for selection of potential wind zones include[27]: 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 technology:

- Roads - at a distance of less than 60 m;
- Railways - at a distance of less than 500 m;
- Airports - at a distance of less than 10 km.

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).

[27] 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	1:25000	270 m (9 arc-sec)			
Preferred sources	GIS OSA data; Open StreetMap	Global Solar Atlas	GIS OSA data; Open StreetMap		DSOs
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	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	1:25000	
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. Solar

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

Technical Suitability. Wind

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

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. Solar

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

Technical Suitability. Wind

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

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

Technical Suitability. Solar

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

Technical Suitability. Wind

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

A. Environmental Criteria and Constrains

Summary of Comments

The feedback on environmental criteria for potential REAAs designation gathered through consultations with key stakeholders relates both to methodological content of the defined criteria and to the technical errors along the criteria report. The recommendations and comments were collected during a series of stakeholder consultation sessions, as well as have been accepted also in a written form.

Written submissions.

During the stakeholder consultations period the feedback in writing has been received from NGO “Greenpeace Ukraine”, NGO “Ecoclub”, and from CWP Europe. Written feedback pointed to several technical errors along the criteria report, as well as raised such methodological questions as the reasonableness of the size of buffer zones proposed to be applied to wildlife protection constraints and to forest lands, the importance of the ecological network of Ukraine, defining the clear boundaries of the bird migration corridors, and the applied GIS technologies. Also it was proposed to consider Emerald Network sites wider including those with candidate status, and bats migratory routes.

Stakeholder engagement.

During the feedback sessions the representatives of the Ministry of Economy, Environment and Agriculture of Ukraine and the Ministry of Energy of Ukraine, as well as of environmental and energetic NGOs, and other experts have expressed their comments and proposals, namely concerning the additional regulations and environmental impact assessment aspects to be considered, such as the Law of Ukraine "On the Ecological Network of Ukraine", the World Natural Heritage Sites, other European directives, migration routes of other species, preservation of the landscape structure, assessment of the loss of ecosystem services, and applying a socio-ecological approach. The high attention has been payed to the bird migration routes criterion as the most difficult in determination on the ground for planning purposes. Also the high priority of degraded lands for the placement of RAAs has been discussed.

How Feedback Was Addressed

Considering the comments and proposals received by the results of the stakeholder consultations the Environmental Criteria and Constrains has been supplemented with remarks on consideration of the official data on degraded lands for the placement of RAAs, other species (including bats) migratory routes in case of data availability, assessment of the loss of ecosystem services in cases it is possible to be done, applying a socio-ecological approach in cases it is possible to be done, and consideration of the ecological network schemes as an additional source of data on the territories that are of special value for environmental protection in case such schemes been elaborated for the relevant area.

The description of the Indicator 1.3.1. “Migratory routes with 700 m buffer zones” has been supplemented with reasoning that considering this criteria demands conducting additional research to determine exact areas necessary for supporting birds’ migration to be included to the spatial analysis for the purposes of RAAs designation as the boundaries of such corridors are not clearly defined on the territory.

The Indicator 2.1 on Elevation criterion has been lowered from 2 000 m to “Areas with elevation higher than 800 m” while within the feedback session has been discussed that areas in the Ukrainian Carpathians above ca. 1000 m belong to the alpine and subalpine zones, within which most biotopes are subject to protection according to the Resolution No.4 of the Convention on the Conservation of European Wildlife and Natural Habitats (1979). And further analysis revealed that the Law of Ukraine of August 21, 2025 No. 4577-IX defines that the management of the territories of energy facilities intended for military and defence purposes, located in the mountainous areas of the Carpathians at an altitude of 800 meters and above, requires the mandatory presence of a plan of environmental protection measures for the maximum possible preservation of wild flora and fauna and their natural habitats.

The size of buffer zones proposed to be applied to wildlife protection constraints has been reduced to 700 m according to the acting building regulations. The description of the Indicator 1.1.1: “Areas of Emerald Network Sites with 1700 m buffer zones” has been widened by including sites with candidate status.

The description of the Criterion 3.2. “Areas of water fund” has been supplemented with the comment that while the Project area doesn’t cover the regions with sea coasts the possibility of designation of RAAs along sea coasts and on shelf areas has to be analysed additionally and special criteria regarding waterside protection zones has to be elaborated for such areas.

Also the pointed out technical errors have been fixed.

	Proposal	Explanation on consideration or not
	By Ms. Olesia Petrovych, expert at the Reform Support Team at the Ministry of Environment	
1.	In addition to the specified criteria, it is advisable to take into account the provisions of the Law of Ukraine "On the Ecological Network of Ukraine" as a fundamental network for ensuring a sustainable environment.	The Law of Ukraine "On the Ecological Network of Ukraine" doesn’t introduce additional types of nature reserves or any separate regimes of territory use, but lays down the regulatory and legal foundations for the formation of a holistic network of territories that are of special value for environmental protection and, in accordance with the laws and international obligations of Ukraine, are subject to special protection.

	Proposal	Explanation on consideration or not
		At the same time the final draft will be supplemented with recommendation to consider ecological network schemes as an additional source of data on the territories that are of special value for environmental protection in case such schemes been elaborated for the relevant area.
2.	It is advisable to consider natural heritage sites, protected under the Convention Concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention).	The only natural heritage site in the Project region as well as on the territory of Ukraine at all is "Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe" which are included into the protected areas designated under national protection schemes.
3.	It is worth considering the possibility of using exclusively degraded lands for the placement of RAAs, which are practically unsuitable for any other proper use. It is recommended to request data on degraded lands from the Soils Protection Institute of Ukraine.	The final draft will be supplemented with recommendation to consider the official data on degraded lands for the placement of RAAs.
4.	Speaking of bird migration routes, the proposed buffer of 1700 m seems insufficient, since migratory birds are guided by the general landscape that they see from a bird's eye view from horizon to horizon, which covers significantly greater distances. The task is to preserve the visual perception of landscapes along migration routes. In particular, the preservation of the landscape structure of the Carpathians could be justified by Ukraine's obligations within the framework of the Framework Convention on the Protection and Sustainable Development of the Carpathians (the Carpathian Convention).	Limiting the possibility of development and construction of the territory to the width of the visible horizon from a bird's eye view along the migratory routes looks too unrealistic, since it covers a strip 200-300 km wide.
	By the expert Ms. Hanna Yakymenko:	
5.	The criteria should be supplemented with an assessment of the loss of ecosystem services.	Such analysis might be conducted only for the specific site, but not for the assessment at the regional level. The final draft will be supplemented with recommendation to consider the loss of ecosystem services in cases it is possible to be done.
6.	In addition to bird migration routes, migration routes of other species, such as bats or insects, should be taken into account. Relevant data can be requested from the I.I. Schmalhausen Institute of Zoology of National Academy of	This task can't be accomplished within the framework of a study at the regional level.

	Proposal	Explanation on consideration or not
	Sciences of Ukraine or taken from the natural annals of national natural parks in the relevant territories.	
7.	When analysing the structure of land use, it is recommended also take into account cultural heritage land and energy land, which are already occupied by energy facilities.	The recommendations to consider data on cultural heritage land and energy land (as also other planning restrictions) are given in the report (see the Criteria group 5).
8.	It is recommended to apply a socio-ecological approach to assessment, analysing alternatives for the use of the territory.	Such analysis might be conducted only for the specific site, but not for the assessment at the regional level. The final draft will be supplemented with recommendation to apply a socio-ecological approach in cases it is possible to be done.
9.	At the same time, it is advisable to consider the possibilities of dual use of the territory, where energy facilities can complement existing uses.	Appropriate recommendations are elaborated in the Chapter 2 of the Report.
	By Maryna Shymkus from the Ministry of Economy, Environment and Agriculture of Ukraine	
10.	The advisability of taking into account European directives that Ukraine must implement in the near future.	The Report is based on current international obligations officially taken by Ukraine and national regulations, while the criteria may be supplemented as appropriate during the national procedure.
11.	The contradiction of the possibility of taking into account migration routes, the protection of which has not yet been fully implemented in Ukraine.	Taking into account migration routes is provided by the provisions of the Revised RED.
12.	The need to preserve the landscape structure, primarily the highlands, although in Ukraine there are still no direct regulations on the preservation of landscape structure.	The criteria of elevation might somehow provide the highlands preserving.
	By Mr. Oleksandr Martyniuk, from the National Power Company "Ukrenergo"	
13.	Clarify the criterion "Areas of water fund" for sea coasts, as its current formulation based on normative waterside protection zones eliminates the possibility of placing energy facilities on shelf areas.	The final draft will be supplemented with the appropriate note under the criterion 3.2. "Areas of water fund" regarding the sea coasts.
14.	To somewhat limit the criterion "Agricultural lands", in particular to exclude degraded lands as those on which energy facilities could be located without harming the environment.	The final draft will be supplemented with recommendation to consider the official data on degraded lands for the placement of RAAs.
	By Mr. Mykola Kobets from Bankwatch	

	Proposal	Explanation on consideration or not
15.	Recommended to request data on degraded lands from the Bioenergy Association of Ukraine (UABIO)	The final draft will be supplemented with recommendation to consider the official data on degraded lands for the placement of RAAs.
	By Mr. Andrii Tupikov from NGO "Ukrainian Nature Conservation Group"	
16.	Numerous studies show that landscapes above 1000 m are almost without exception filled with particularly valuable species and natural complexes, which should be taken into account when determining territories for RAAs.	The Indicator 2.1 will be changed in the final draft in to "Areas with elevation higher than 800 m".
17.	There are doubts about the appropriateness of including artificial objects of the Nature Reserved Fund in the RAAs criteria.	Artificial objects of the Nature Reserve Fund of Ukraine still have special value from the point of view of preserving biodiversity, and therefore it seems inexpedient to allocate their territories for the placement of alternative energy facilities using a simplified procedure.
18.	Given the proposal to apply buffers of 1700 m for areas defined under the Wildlife Protection Constraints criteria, it is considered insufficient to apply the standard sizes of waterside protection zones for water bodies, which may also be no less vulnerable than some of the nature conservation areas.	In case water bodies are of particular importance from the point of view of biodiversity conservation, they have been given a certain status of a protected area and then they will be taken into account in the analysis accordingly. Regarding the protection of the remaining water bodies within the framework of the Project, it was decided to take into account the current regulatory requirements.
	By the NGO "Greenpeace Ukraine"	
19.	Use *Emerald Network sites* wider including those with candidate status.	The description of the Indicator 1.1.1 is supplemented appropriately.
20.	Add the description of the *Indicator 1.1.1*: "Areas of Emerald Network Sites with 1700 m buffer zones" with following sentence: "If an area has candidate status for inclusion in the Emerald Network list or will be included in the Emerald Network list in the future, it should be excluded when designating RAAs."	The description of the Indicator 1.1.1 is supplemented appropriately.
21.	Split the *criterion "Major bird migratory routes"* into two: 1.3.1 all endangered birds species (national/international level) migratory routes. 1.3.2 bats migratory routes.	The final draft will be supplemented with recommendation to consider bats migratory routes in case of data availability.

	Proposal	Explanation on consideration or not
22.	Add *Criterion 1.3*: Major bird migratory routes. With following indicators: Indicator 1.3.1: Migratory bat routes with 1700 m buffer zones. Ukraine is a Party to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979) since 1999 and acceded to the Agreement on the Conservation of Populations of European Bats (EUROBATS, 1991) in 1999, with entry into force in 2000. Under the provisions of EUROBATS, Parties undertake to protect migratory bat species and their habitats, including key roosting sites, foraging areas, and migration corridors. Conservation measures include maintaining ecological connectivity and ensuring that anthropogenic barriers (e.g., wind turbines, transport infrastructure) do not critically affect migration routes. In Ukraine, national implementation is carried out through integration of bat protection into environmental legislation, monitoring programmes, and inclusion of important roosting and migratory habitats within the Emerald Network and the national protected areas system. However, existing protected areas often safeguard key hibernation or breeding sites, while large-scale migration corridors remain only partially covered. Indicator 1.3.2: Important Bat Sites with 1700 m buffer zones. Within the framework of EUROBATS, the identification of Important Bat Areas (IBAsites for bats) is promoted as a tool for safeguarding critical habitats and migration routes of bat populations. Such areas are determined according to standardized ecological and scientific criteria, including the presence of threatened species, large aggregations, and sites essential for migration. In Ukraine, several important underground hibernation sites and forest massifs have been recognized as critical for bat conservation. Nevertheless, systematic mapping of migratory routes is still at an early stage, and further integration of identified sites into the national protected areas system is required.	The final draft will be supplemented with recommendation to consider bats migratory routes in case of data availability.
23.	Add the sentence "*The Revised RED requires the exclusion of Natura 2000 sites while designating RAAs*" with words "as much as Emerald Network sites and those" to get following statement: "The Revised RED requires the exclusion of Natura	The Revised RED doesn't contain any mention of Emerald Network sites as it is an EU document.

	Proposal	Explanation on consideration or not
	2000 sites as much as Emerald Network sites and those while designating RAAs".	
24.	Also Mr. Serhii Khara drew attention to the error made at the end of the clarification on the application of buffer zones to wildlife protection constraints – it is written that it is proposed to consider 1700 m buffer while assessing the areas protected under *international* legislation, but the areas protected under national legislation have to be mentioned also.	The error will be corrected in the final draft.
	By the NGO "Ecoclub"	
25.	Comment 1: According to Criteria 1.4, namely *Indicator 1.4.1*, which provides for the creation of a 1,700-meter buffer zone from areas with dense growth of rare and endangered species of flora and fauna, using materials from volunteer biologists is possible only after verification of this information. Its representativeness of this territory and the created protected areas with a map of the location of the protected area, including in vector form, for the conservation of objects of the Red Book of Ukraine in accordance with the Resolution of the Cabinet of Ministers of Ukraine of May 12, 2023 No. 499 "On Approval of the Procedure for the Creation of Protected Areas for the Conservation of Biodiversity in Forests and the Procedure for the Creation of Protected Areas for the Conservation of Objects of the Red Book of Ukraine," which clearly defines the procedure for their creation. This will allow the exact location of the protected object or objects to be determined. In addition, this criterion leaves unclear what is considered an "area with a high density of observations of endangered species," how many species should be present per unit area in this case, whether it is the same for representatives of flora and fauna, what time period the data in these databases can be considered relevant, given the rapid dynamics of changes in the species composition of flora and fauna, and the period during which the area was studied (the vegetation period of plants can vary significantly, and the life cycles of fauna can also vary significantly). Will such areas be taken into account only in terms of species density, or will the population density of the species requiring protection also be considered?	The proposed within the framework of the Project criteria and elaborated maps have only recommendation nature and might be detailed and revised during the national procedure using the official national data.
26.	Comment 2: Article 12 of the document contains *Criterion 3.3*, which concerns agricultural land. This criterion is unclear as to what restrictions	The Land Code of Ukraine (Article 23) establishes the priority of using suitable land for agricultural needs,

	Proposal	Explanation on consideration or not
	such land imposes on the designation of Renewable Energy Acceleration Areas (RAAs).	providing for the use of such lands for agriculture, forestry or nature protection.
27.	Proposal 1: A ***buffer zone measuring 1700 meters*** for solar technology is completely unjustified, as it will significantly reduce the potential area for locating this type of renewable energy facility. In view of the absence of an established sanitary protection zone in the current regulatory framework, it would be more appropriate to use 400 meters, which is ten times larger than the possible approved protection zone for 750 kV power grids in accordance with Resolution No. 1455 of the Cabinet of Ministers of Ukraine dated December 27, 2022, "On Approval of the Rules for the Protection of Power Grids." At this distance, the potential negative impact should be minimized and be at the lowest possible level from the solar technology.	There are no differentiation in RAAs for wind and solar technologies, thus the criteria have to consider the most strict demands.
28.	Proposal 3: In accordance with ***Criterion 3.1*** of Group 3 of Article 11 of the document, it is envisaged to take into account a buffer zone of 100 m in accordance with State Building Standards B.2.2-12:2019, however, it is more expedient for the preservation of high species diversity of flora and fauna at the boundary of different biocenoses (ecotone effect or boundary effect), it is more expedient to increase the buffer zone and establish it for the wind technology to a minimum of 700 m (in accordance with State standards of Ukraine 8339:2015) and 400 m for (in accordance with proposal No. 1).	If the forest have some recognised nature protection significance it will be covered by at least one of criteria of the group 1 (Wildlife Protection Constraints) and appropriate buffer will be applied to it.
	By the CWP Europe	
29.	Regarding the ***paragraph following point 4 at the page 6***: The justification is incomplete. Why is the importance of the ecological network of Ukraine, the basis of which is the Law of Ukraine "On the Ecological Network", downplayed? In my opinion, this element of the document is underdeveloped. Both the Emerald Network and the Ecological Network are the results of the practical implementation of the principles and provisions of the Bern Convention. And the elements of the ecological network of Ukraine are no less important than those that are currently elements of the Emerald Network. I propose to refine this issue.	The Law of Ukraine "On the Ecological Network of Ukraine" doesn't introduce additional types of nature reserves or any separate regimes of territory use, but lays down the regulatory and legal foundations for the formation of a holistic network of territories that are of special value for environmental protection and, in accordance with the laws and international obligations of Ukraine, are subject to special protection. At the same time the final draft will be supplemented with recommendation to consider ecological network schemes as an

	Proposal	Explanation on consideration or not
		additional source of data on the territories that are of special value for environmental protection in case such schemes been elaborated for the relevant area.
30.	Regarding the ***Clarification on the application of buffer zones to wildlife protection constraints*** (page 7): It is a pity that the authors did not provide a link to the document under index "1", because it is this that determines the viability of the Criteria in development issues. The authors also did not understand well the figures that they justify as standards. A distance of 700 m is used in practice to justify a sanitary zone based on the noise factor. Already at the limit of 400 m, the noise from most modern wind power generators does not exceed the noise standards for the night period. Therefore, to say that this is an old standard is not correct. It is still used in the context of normalizing the noise impact of wind farms. And this is exactly what the Marzeev Institute does (an analysis of the EIA reports would confirm this). As for 1700 m, it is not at all clear where this indicator came from (especially since there is no reference to the original source). In addition, referring to only one source to substantiate such an important criterion is insufficient, in my opinion. Again from practice: the value of 1700 m is very similar to the standard for limiting the impact of light pollution (shadow flicker) in wind power. But given the peculiarities of shadows falling from wind turbine blades during the day (shadow profile), it is absolutely irrational to take the zone of 1700 m so roughly that there is nothing around. A wind power plant can be placed 700 m from residential buildings and there will never be flicker there. In the context of the above, another question: for solar power plants or energy storage systems (BESS), do you also need to retreat 1700 m from everything? What is the pragmatism of such rough standards, if in Europe, for example, on the contrary, they are being softened? What is the expediency of such comprehensive, non-alternative restrictions, if these criteria should contribute to the green recovery of Ukraine, and not restrain it? Why does the document not consider the possibility of developing criteria by direction: for example, criteria for territories under wind power plants, the second for solar	The size of the buffer applied to wildlife protection constraints will be reduced in the final draft to 700 m according to the acting building regulations.

	Proposal	Explanation on consideration or not
	power plants, the third for biomass, etc.? I think it needs to be refined.	
31.	Regarding the *Criterion 1.1*: If the project proposes to retreat 1700 m from any "protected area", then why write about it on two pages of text. Then it is more expedient to define only one indicator for criterion 1.1: Indicator 1 – protected areas – 1700 m buffer zone. At the same time, I am against this approach: a biosphere reserve cannot be compared with any element of the Emerald Network. Their environmental value and functional purpose are very different.	The differentiation of the Wildlife Protection Constraints is provided by the Revised RED.
32.	Regarding the *Indicator 1.1.1*: The buffer zone of 1700 m, according to reference "2", is not substantiated in any way further in the text. The issue of the ecological network of Ukraine is completely ignored. I suggest linking the link in the text to the page where the sources are mentioned.	The references will be corrected in the final draft. The Law of Ukraine "On the Ecological Network of Ukraine" doesn't introduce additional types of nature reserves or any separate regimes of territory use, but lays down the regulatory and legal foundations for the formation of a holistic network of territories that are of special value for environmental protection and, in accordance with the laws and international obligations of Ukraine, are subject to special protection. At the same time the final draft will be supplemented with recommendation to consider ecological network schemes as an additional source of data on the territories that are of special value for environmental protection in case such schemes been elaborated for the relevant area.
33.	Regarding the *Indicator 1.3.1*: First, I suggest that the developers of the Criteria think about how, in practice, ecologists should define the clear boundaries of the bird migration corridor in order to measure the necessary 1700 m on both sides. The most widely used and effective method today is monitoring. Secondly, in Ukraine there are marked, with a reference to the area, international migration corridors. The point needs to be detailed.	Taking into account migration routes is provided by the provisions of the Revised RED. At the same time it seems that considering this criteria demands conducting additional research to determine exact areas to be included to the spatial analysis for the purposes of RAAs designation.
34.	Regarding the *Indicator 2.3*: Again, there are inaccuracies with the reference to the source of information.	The references will be corrected in the final draft.
35.	Regarding the *Indicator 3.1*: Firstly, there is no practical justification for a buffer zone of 100 m	If the forest have some recognised nature protection significance it will

	Proposal	Explanation on consideration or not
	from forests, except for a reference to Ukrainian legislation. The view should probably be broader, given the project's application to become an interstate document. Will a 100 m zone cover the needs of biodiversity in nutrition, reproduction, and migration? The answer from practice is no. Why 100 m, and not 1700 m? Secondly, if a forest is included in the territory of an ecological network, what standard should be applied to it? Apparently, it is stricter. But this is not stated in the document.	be covered by at least one of criteria of the group 1 (Wildlife Protection Constraints) and appropriate buffer will be applied to it.
36.	Regarding the *Criterion 3.4*: Document "13" referred to by the authors is missing. The size of the buffer zone of 1700 m around recreation areas is again unfounded. Why not 1800 m, 1500 m or any other value? A wind turbine is perfectly visible from a distance of two kilometres: does it mean that the visual change of the landscape is less important in terms of recreation? In my opinion, this is a debatable issue that needs to be further developed. Why can't a regional landscape park in a zone of regulated economic activity or in a camping area install a solar power plant to meet the needs of tourists and abandon diesel generators?	The references will be corrected in the final draft. The visual change of the landscape can be evaluated only in case of specific site analysis and can't be a subject for analysis at the regional level. The size of the buffer applied to wildlife protection constraints will be reduced in the final draft to 700 m according to the acting building regulations.
37.	Regarding the *Indicator 5.1*: The indicator should be given a numerical characteristic - 5 km.	The description of the Indicator 5.1 contains a numerical characteristic of 5 km.
38.	Regarding the *last paragraph of the Section I.1* («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."): The difference between renewable energy facilities and classic thermal and nuclear power plants is their lower capacity and spatial dispersion. In Europe, there is currently a trend towards easing environmental restrictions due to the need to find new areas for new RES capacities. Therefore, it is unlikely that such a 1700 m criterion will lead to a surge in RES development in key areas. Let's imagine the situation. According to this criterion - 1700 m from the total - a potentially suitable area for RES has been identified. It should obviously be transferred to the simplified development category. However, the assessment was carried out purely based on physical factors. And if endemic plants grow in this accelerated RES territory or rare animals are	The criteria are developed for designation of RAAs which are provided with simplified permit procedure by the Revised RED. It doesn't mean that on other areas it will be forbidden to place RES, but that will demand full permit procedure.

	Proposal	Explanation on consideration or not
	noticed? Who should do what? What are the Criteria in this case?	
39.	Regarding the *Section I.4 GIS Approach*: The authors, along with ArcGIS and QGIS, for some reason avoid mentioning Digitals, Google Earth, AutoCAD. Although these programs are quite effective and informative at the macro-sighting stage. And in general, in my opinion, one should not name a software product in such a document. The main thing is that the applied GIS technologies give high-quality analysis results. Other questions also arose: who should do GIS analysis? Who are these recommendations for?	The Report is designed to describe the methodology for performing the analysis within the framework of the Project, taking into account the scope and conditions of the study. During the national procedure, the relevant methodology may be deepened and improved as appropriate.

B. Renewable Energy Criteria and Infrastructure Readiness

Comments reflected in the revised text	
Comment provided	Summary of comment
Written comments provided by the NPC "Ukrenergo" on 27 August, 2025	As for potentially requested information: the proposal was accepted. It will be arranged a working meeting for determining the minimum level of data details with developing a secure protocol for data transmission and processing with limited access. At the same time, the requirement of signing the secure protocol for data transmission and processing is not acceptable as provided data should be used for mapping with an open access. As for all REAAs: the proposal on the capacity of energy storage with coefficient of 1-3 kWh of capacity per 1 kW of power was accepted. The storage capacity coefficient at 1-3 kWh of capacity per 1 kW of power was installed at all REAA criteria. As for Rooftops and Facades of Buildings: the proposal to include technical criteria for the possibility of connecting to the existing grid for rooftop/facade solar power plants was acceptable. The criterion on possibility of connecting to the existing grid for rooftop/facade solar power plants was installed in the related rooftop/façade criteria. As for the proposal to include in the criteria information on the volumes and profile of consumption in the region: added in all sets of criteria "Additional recommended criterion: ensure that the installed capacity matches the consumption volume and profile, as well as the existing and potential load of the nodes." As for availability of low voltage grid connection points: The criterion regarding availability of grid connection at 6 kV and 10 kV points on a distance of no more than 5 km was added. The distance from a REAA to the 35 kV and 110 kV lines was increased to 30 kilometers. As for Industrial Sites: the proposal to add the possibility of building wind farms at industrial enterprises and in the territories of industrial zones was acceptable. The set of criteria for possibility to place wind farms at industrial zones were installed.

	As for Degraded Land Not Usable for Agriculture: the proposal to add airspace restrictions around airports to additional criteria that can be used to select potential areas for wind farm construction, as wind turbines may pose a threat to air traffic was accepted. The distance at 10 kilometers was installed.
Proposal from the NEC "Ukrenergo during the online feedback session on August 8, 2025	As for the proposal to add in the criteria for all REAAs information on a minimum distance from a REAA to grids and substations was accepted. Criteria on minimum distances from a REAA to overhead lines at 20 meters were applied.

Comments considered in the revised text		
Comment provided by	Summary of comment	Reasoning
Written comments provided by the NPC "Ukrenergo" on 27 August, 2025	As for proposal the to include the Odesa region to REAA mapping.	The proposal is outside of the REAA project scope. REAA mapping targets at only five critical regions - oblasts (Lviv, Zakarpattia, Ivano-Frankivsk, Chernivtsi, and Vinnytsia), chosen for their strategic positioning along Ukraine's borders with the EU and Moldova.
	As for Rooftops and Facades of Buildings and Transport Infrastructure Corridor: the proposal to unify compliance criteria for different surface areas the exact parameters of the square required.	The proposal was not acceptable: - to unify surface needed is not reasonable as a surface area depends on the concrete project; - these project details should be clarified by developers on a relevant project stage.
	As for Rooftops and Facades of Buildings: the proposal to add into the list criteria the presence of a permit for the installation of a rooftop solar power plant from the State Architectural and Construction Inspectorate (SACI) or a local government body responsible for issuing construction permits.	It is outside of the REAA project scope. These permits will be needed/obtained on practical phases of an individual project development.
	As for Transport Infrastructure Corridor: the proposal to add additional laws to the criteria for land belonging to transport lands, refers only to the Law of Ukraine "On Energy Lands and the Legal Regime of Special Zones of	The comment is exclusively/only related to the reference regarding "Belonging to the land of transport (https://zakon.rada.gov.ua/laws/show/2480-17) in the Footer on page 28 of the Criteria (the file "RAAs CRITERIA Ukraine_high level draft -v1.1"). As for the criterion as such: this is the criterion for the land of transport. Any other lands for: industry, electronic

	Energy Facilities No. 2480-17".	communications, energy, defense, etc.) are not related to this REAA.
	As for Farms: the specified threshold of 5 m/s at a height of 100 meters seems too low and requires additional justification, as well as development and approval with investors in wind farms or specialised associations.	The 3 MW wind turbine typically starts operating at a cut-in wind speed of around 2.5 to 4 m/s, reaches its rated power at wind speeds of 9 to 14.3 m/s, and shuts down at a cut-out wind speed of 18 to 25 m/s. The applied already criterion is the minimum average annual wind speed. The criterion of a higher wind speed of more than 5 m/s is obligatory for wind installations inside REAAs.
	As for additional requirements for RES facilities (installed capacity, type of RES equipment, voltage class, expected utilisation factor of installed capacity).	It is outside of the REAA project scope. These requirements should be applied on practical phases of individual project development.
	As for Waste sites: It is advisable to provide for a location of solar panels that would not create obstacles during the mandatory post-landfill reclamation of the land plot, which includes the construction of leachate and gas barriers, laying a cover (e.g., with a layer of clay and soil), landscaping and soil stabilisation measures. Where the landfill is not yet closed, there may be opportunities to develop a solar power plant project as an integrated component of the overall landfill closure project.	It is outside of the REAA project scope. These requirements should be applied on practical phases of individual project development.
	As for Urban Wastewater Treatment Sites: to add criteria specific to floating solar power plants to the technical criteria: depth of the reservoir, chemical composition of the water, presence of currents, wind conditions, etc.	It is outside of the REAA project scope. The parameters such as depth of the reservoir, chemical composition of the water, presence of currents, wind conditions, etc. should be revised and applied on practical phases of individual project development.

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