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EU Green Deal and Transformation of Energy Sector With Emphasis on Renewable Solar Energy Sources and Their Environmental Impacts

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Abstract: The research refers to Sustainable Development Goals and the transformation of the energy sector in connection with environmental protection aspects and the European goals of the Green Deal Transformation of decarbonization by 2050. Environmental impact assessment (EIA) and it's screening present the important instrument for coordination with economic, social, and environmental aspects of sustainable development. The paper presents the experiences with screenings examples of solar power plants in small-scaled landscapes in Slovenia and criteria for determining environmental impacts and evaluating impacts on the environment, health, cultural heritage, biodiversity, and water. All 26 cases of major solar power plants from 2015 to 2023 that were the subject of "Screening procedures", were analyzed and examined the consideration of criteria for evaluating environmental effects. The research showed that the share of bigger self-standing solar power plants has increased in the last three years. In the case of prior expert location selection, it was possible to determine insignificant environmental impacts for 84% and significant for 16% of the projects. The reasons lie in their locations, sensitive in sensitive mountain, forest, water, natural values, or biodiversity important areas. For such projects the criteria identified significant impacts on the environment, must be examined in more detail in full EIA. The research proves that the speed and efficiency of the EIA screenings changed over the years, increased significantly due to greater competences of the project preparers and the ministries, organizations and public. But some case still refers to an area with environmental burdens or protected and sensitive areas, which lengthens the procedures in time. To achieve the goal of increasing the share of solar energy and make processes more efficient, it makes sense to use the current knowledge, criteria and avoid such areas. It is also recommended to exchange of the knowledge among private and public project investitures, public, ministries and organization to meet renewable targets.

Key words: sustainable development, renewable energy, solar plants, screening, environmental impact assessment

JEL codes: Q

1. Renewable Energy Deployment Targets in the EU

To reach its 2050 decarbonization target, the European Union has set ambitious targets for renewable energy deployment. In doing so, it has identified solar energy as a key source of renewable energy to end the Union's dependence on external fossil fuels and achieve the transition to a climate-neutral economy. It considers that

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photovoltaic solar energy, which is one of the cheapest sources of electricity available, and solar thermal technologies, which enable renewable heating at low cost per unit of heat, can be deployed rapidly and directly benefit citizens and businesses (EU Council Regulation 2022/2577, p.2, point 10).

On 18 May 2022, the European Commission issued a report entitled "EU Solar Energy Strategy" to support the development of a resilient solar industrial value chain in the Union, including through a Photo-Voltaic Industry Alliance to be established at the end of 2022. Accelerating and improving the granting of permits for renewable energy projects will help to expand the Union's capacity to produce clean energy technology. In the current situation, and in particular in the context of highly volatile energy prices, immediate action is needed to ensure significantly faster permitting procedures in order to significantly accelerate the installation of solar energy equipment on man-made structures, which is generally less complex than ground-mounted installations and can quickly contribute to mitigating the effects of the current energy crisis, provided that the stability, reliability and security of the grid are preserved. Therefore, these installations should be subject to shorter permitting procedures than other renewable energy projects.

However, the EU Council Regulation 2022/2577 set a maximum time limit of three months for the permitting procedure for the installation of solar energy equipment and associated energy storage facilities on the same site and grid connection in existing or future man-made structures built for purposes other than solar energy production. These installations should also be granted a specific derogation from the requirement to carry out an environmental impact assessment under Directive 2011/92/EU of the European Parliament and of the Council, as they are unlikely to raise concerns about competing land use or environmental impact.

In Slovenia there were not yet such examples of replacing existing solar plants on existing sites, as it only started to deploy larger projects more intensively in 2015. It's important to see the implementation dynamic, as well as possible environmental challenges for solar in open landscape and outside already urban built areas of industrial cones, parking places, which are considered as non-problematic.

2. European Legal Framework for Environment and Nature

The deployment of solar energy must comply with five EU directives: Directive on the assessment of the effects of certain plans and programmes on the environment (42/2001), Directive 2011/92/EU of the European Parliament and of the Council on the assessment of the effects of certain public and private projects on the environment (EIA Directive) , Habitats Directive 92/43, Water Framework Directive 2009/147/EC. In Slovenia the provisions have been transposed into the Environmental Protection Act-2, the Water Act, and the Nature Conservation Act. Environmental impact assessments and Screening procedures link all environmental directives, as they are horizontal environmental instruments.

However, in December 2022, the EU Council Regulation laying down a framework to accelerate the deployment of renewable energy was adopted, which provides in Article 6: Acceleration of the permit-granting process of renewable energy projects and for related grid infrastructure which is necessary to integrate renewables into the system.

Such provisions cannot be implemented without the empowerment of project developers, the public, the ministry responsible for assessments and the ministries and organizations responsible for providing opinions on likely significant environmental impacts. The innovative Integral Green Slovenia scheme (Piciga D., 2018) should be used in this context, as projects should be balanced in terms of content and size, considering all societal

aspects.

3. National Targets for 2030 and Indicative Milestone for 2040

The Climate Strategy and the NECP have been prepared in a coordinated manner, which means that the GHG emission projections used for both documents are the same. The 2030 targets of the NECP are consistent with the long-term orientation of the Strategy. The Climate Strategy summarises the key orientations and actions of the NECP, which is the action plan of the Climate Strategy. The NECP was adopted by the Government of the Republic of Slovenia on 27 February 2020 and has been subject to a strategic environmental impact assessment. For 2030, the NECP sets a national target for the non-ETS sectors to reduce GHG emissions by at least 20% compared to 2005. The target for the reduction of total GHG emissions by 2030 is up to 36%, in line with the NECP. The country's strategic target or indicative milestone for 2040 is a 55-66% reduction in total GHG emissions compared to 2005. With a 21.14% share of RES in gross final energy consumption in 2018, Slovenia is below the annual target and therefore needs to accelerate the implementation of renewable energy sources.

Renewable energy sources (RES) are an important domestic source of energy. Slovenia's import dependency in 2018 was 48% and domestic energy production was 52%, with RES contributing 16%. The NECP sets a target for 2030 of at least 27% renewable energy sources in gross final energy consumption and an indicative sectoral target: 43% proportion in the electricity sector.

The Climate Strategy sets out the following vision (4.3.2 Vision):

> By 2050, energy use will largely be based on energy supply from renewable energy sources, in addition to other low-carbon sources. RES will be well integrated into the energy system by integrating all types of grids and energy systems, including energy conversion and storage.
> In addition to decarbonisation, the development of RES will also aim to achieve synergies, to improve energy security, provide green jobs and ensure coherent regional development. The multifunctional use of buildings will be promoted.

By 2050, Slovenia aims to increase the proportion of RES in final energy consumption in all sectors, with the overall proportion of RES reaching at least 60% by 2050. The indicative target is at least 80% RES in gross final electricity consumption. The strategic importance of RES will increase with the phase-out of domestic coal. The use of solar energy will be intensified, mainly for electricity generation, but also for the passive use of solar energy. For this purpose, it will modify and adapt the design of neighbourhoods, buildings, and infrastructure to solar energy. It will give priority to the use of solar energy in urbanized, infrastructural and degraded areas (e.g., quarries). It will integrate adaptation and mitigation measures to make them more effective.

4. Implementation of the Targets for Increasing the Proportion of Solar Energy

Solar power plants as renewable energy source have indeed the lowest impact on space and the environment of all renewable energy sources, including hydro and wind power, as they can be sited, e.g., in degraded areas, on the roofs of large shopping centres or car parks. We are currently witnessing a major resurgence of the industry that will make an important contribution to the role of renewable energy sources and also to the country's resilience to climate change. Small-scale, locally adapted solar power systems on grassland and energy infrastructure have already been developed in some places, balancing settlement, cultural heritage, sustainable use of natural resources and respecting landscape features, thus demonstrating environmental acceptability (Kolar-Planinšič, pp. 77-93, 2021). The last three years have seen a significant increase in activity in the

implementation of solar power plant projects in Slovenia, as well as increased commitments at the EU level.

5. Environmental Impact Assessment

The European Regulation therefore provides for an acceleration of implementation in the permitting phase. However, in Slovenia, ZUREP-3 also requires spatial planning of solar power plants and ZVO-2 also requires the carrying out of a substantive environmental assessment of plans and programmes, which are considered as umbrella documents for the preparation of investment frameworks. These ensure that sites and areas are environmentally acceptable, and impacts are eliminated, reduced, or mitigated. Environmental assessments are carried out based on the Environmental Protection Act-2 (hereafter referred to as ZVO-2) and are divided into two parts, depending on the level of planning. The first part is carried out for plans, programmes, and spatial plans at the national and local levels:

a) Strategic Environmental Impact Assessments for the Spatial Development Strategy, Spatial Action Plans for individual renewable resources, National Spatial Plans, according to the ZUREP-3 and Articles 88-100 of the ZVO-2.
b) Comprehensive Environmental Impact Assessment for Municipal Spatial Plans.

Once the spatial planning acts have been adopted and allow for the planning of solar power plants, conceptual plans are drawn up and other more detailed environmental procedures are carried out, which in turn are carried out for environmental interventions or projects and can be divided into a preliminary procedure and an environmental impact assessment, according to the ZVO-2:

a) Screening procedure for a project,
b) EIA for a project.

This study focuses on the screening procedures that are necessary to obtain building permits and connection consents. We examined how the environmental procedures for projects affect the implementation of increased proportion of solar energy and how effective they are in relation to EU goals.

We examined the criteria for identifying likely significant impacts based on which it is possible to deviate from the environmental impact assessment according to the regulation.

Slovenia does not yet have a Spatial Action Plan for Renewable Energy Sources under ZUREP-3 and a strategic environmental assessment under ZVO-2 in place yet. But the Renewable Energy Slovenia project has prepared a technical basis, which has looked for areas with the lowest risk of environmental impacts and the least vulnerability. Areas where plans and projects can be developed without significant risk of compromising other environmental goals, including public health, biodiversity and water, are called priority areas or “go to areas” (V. Nikolič, HUSPO, 2022; RES Slovenia, 2023).

However, for solar power plants on the roofs of existing buildings, the Decree on activities affecting the environment does not foresee an environmental impact assessment or screening, so they can be implemented without further environmental checks.

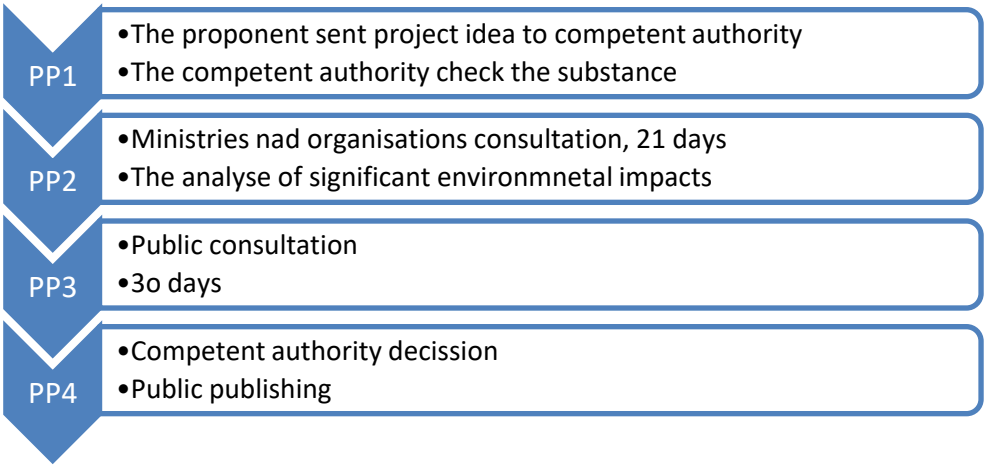
6. Preliminary Procedures or “Screening”

The process involves the ministries and organizations that are asked for their views, as well as the public. It is an open and transparent process, the determination of which takes the form of a decision, which is also made publicly available on the website, and which is also subject to legal protection under the Aarhus Convention.

The preliminary procedure is carried out by the Ministry of Environment, Climate and Energy at the request of the operator of the intervention or investor of the project, requesting the Ministry, by way of an application, to determine whether the intended environmental intervention, prescribed by the regulation referred to in the fourth paragraph of the preceding article, is subject to an environmental impact assessment and to an environmental consent or an integral construction permit in accordance with the law governing construction.

The operator of the proposed environmental intervention shall attach to the application a description of the proposed environmental intervention, the environment or parts of the environment likely to be affected by the proposed environmental impact and a description of the likely significant adverse effects of the proposed environmental impact on the environment or parts of the environment, or a description of the measures envisaged to minimize or avoid significant adverse effects on the environment. In making its determination, the Ministry shall take into account criteria relating to the characteristics of the proposed environmental intervention, its location and the characteristics of the potential environmental effects of the development and, where relevant, the results of any assessments already carried out in accordance with this Act and the regulations governing nature conservation, water protection, the protection of cultural heritage, the protection of forests and radiation safety.

Following the expert determination, the preliminary procedure shall also include a public consultation, which shall be carried out on a public website (LINK) and shall be published for a period of 30 days, during which the public shall be invited to comment. All interventions are publicly announced on the website of the Ministry of Environment, Climate and Energy[1]. For the solar plants analyzed, there were relatively few comments in the public announcements. There have been no appeals or lawsuits against the published decisions, which shows the high social acceptability of the solar power plants.



Scheme 1 For main stages of EU Screening Procedure

7. Criteria for Determining Likely Significant Environmental Impacts for Solar Power Plants

The preliminary procedure is the so-called “screening” procedure. It is classified as a permitting procedure in the EU taxonomy. It is a regulatory procedure where, for projects listed in the Annex of the Directive on the assessment of the effects of certain public and private projects on the environment, the same criteria are used to

[1] Available online at: https://www.gov.si/drzavni-organi/ministrstva/ministrstvo-za-okolje-podnebje-in-energijo/javne-objave.

determine whether or not a project is likely to have significant effects on the environment. The criteria are uniform in all EU Member States and transposed in Slovenia in Annex 2 of the Decree on activities affecting the environment that require an environmental impact assessment. The criteria are therefore used to determine whether an intervention is likely to have significant effects and whether an Environmental Impact Assessment is required for the environmental interventions identified in Annex 1.

Solar power plants fall into the category of: D.III Renewable Energy Sources, D.III.3 Stand-alone devices for the utilization of solar energy with a capacity of at least 250 KW or an area of 0.5 ha (Decree on activities affecting the environment that require an environmental impact assessment, 2022) and are subject to a preliminary procedure for the determination of likely significant environmental effects and to an Environmental Impact Assessment only for those projects for which likely significant effects cannot be excluded.

All solar power plants over 0.5 ha are therefore subject to the preliminary procedure and even a large plant is not automatically classified as a project with the Environmental Impact Assessment, although only if it has significant environmental impacts according to the criteria.

The criteria to be considered in the Screening procedure for the projects are as follows:

1) The characteristics of the environmental impact

a) the size and design of the overall operation;

b) the cumulative effect with other existing or permitted interventions;

c) the use of natural resources, in particular ground, soil, water and biodiversity;

d) the generation of waste;

e) emissions of pollutants and other disturbances to health, well-being or the quality of life (e.g., radiation, vibration, odour, noise, heat, light);

f) the risk of major accidents under the rules governing environmental protection and natural disasters, including those which, according to scientific knowledge, may result from climate change;

g) risk to human health (e.g., from water contamination or air pollution).

2) The location of the environmental impact

The environmental sensitivity of the geographical areas affected by the intervention must be considered, in particular taking into account:

a) the intended and actual use of the land;

b) the relative frequency, availability, quality and regenerative capacity of natural resources (including soil, water and biodiversity) in the area and its subsoil, in particular:

- water protection areas and sources of drinking water,
- protected agricultural land,
- best forest sites,
- mineral resource areas of public interest;

c) the absorption capacity of the natural environment, with particular attention on the following areas: aquatic and coastal land, land in areas protected and threatened under water regulations, in particular wetlands, riparian areas, estuaries, coastal areas and the marine environment, mountain and forest areas, areas protected under nature conservation regulations, areas where excessive environmental burden has already been identified or is predicted, densely populated areas, landscapes and areas of historical, cultural or archaeological interest, in particular areas protected under the rules governing the protection of cultural heritage.

3) Type and characteristics of possible effects

The likely significant effects of the intervention on the environment must be considered in the light of the criteria set out in points 1 and 2 of this Annex and in relation to the environmental effects of the intervention and other areas of the environmental impact assessment1 and taking into account:

a) the magnitude and spatial extent of the impact (e.g., the area of the site and the number of people likely to be affected),

b) the nature or type of the impact,

c) the transboundary nature of the impact,

d) the intensity and multidimensionality of the impact,

The environmental impact assessment shall address: population and human health, impact on biodiversity, in particular protected species and habitats from special protection areas (Natura 2000), – soil, change in actual land use, water, air and climate, material assets, cultural heritage and landscape and the relationships between them.

The following probabilities need to be assessed:

e) the likelihood of the impact occurring,

f) the expected occurrence duration, frequency and reversibility of the effect (direct or indirect, long-range, cumulative, mutually reinforcing, short- or long-term, permanent or temporary),

g) the cumulative impact in addition to other existing or approved interventions,

h) the potential for successful mitigation of the impact.

We have investigated the impact of the preliminary procedures over an 8-year period, from 2015 to 2023, on the realization of the goal of an increased proportion of solar energy in final consumption.

8. Use of Criteria for Determining Likely Significant Environmental Impacts for Solar Power Plants in Screening Procedure From 2015 to 2023

We have found that location, site sensitivity, biodiversity and excessive pollution of the site or environmental stress are the most important factors for determining likely significant effects. For these reasons, a significant impact was identified for 16% of the solar power plants, for example: one solar power plant in the area of a poorly remedied closed landfill site with excessive groundwater contamination, or the seven units on two locations of solar power plants in the area of a nature conservation site, in a sensitive Alpine ecosystem.

In these cases, the decisive criteria for determining that an impact is likely to be significant were the following:

1) The characteristics of the environmental impact,

2) The location of the environmental impact, environmental sensitivity,

3) Absorptive capacity of the natural environment.

The analysis shows that out of a sample of 25 solar plants, only one was located in an area where excessive environmental pollution was identified, specifically a landfill site that has not been properly and finally remedied, and the monitoring indicates excessive pollution. It is therefore subject to an environmental impact assessment, which also identifies measures to mitigate significant impacts.

However, two solar power plants, each with 3 to 4 arrays, are located in protected nature conservation areas, mountain forest areas and fragile Alpine ecosystem, and therefore require a detailed and full environmental impact assessment and consideration of alternatives. For the other sites, for which the operators of the intervention already identified environmentally less sensitive areas at the conceptual design stage, the criteria concluded that there is no likelihood of significant environmental impacts. A non-significant impact was therefore identified in 80%

of the proposals for solar power plants.

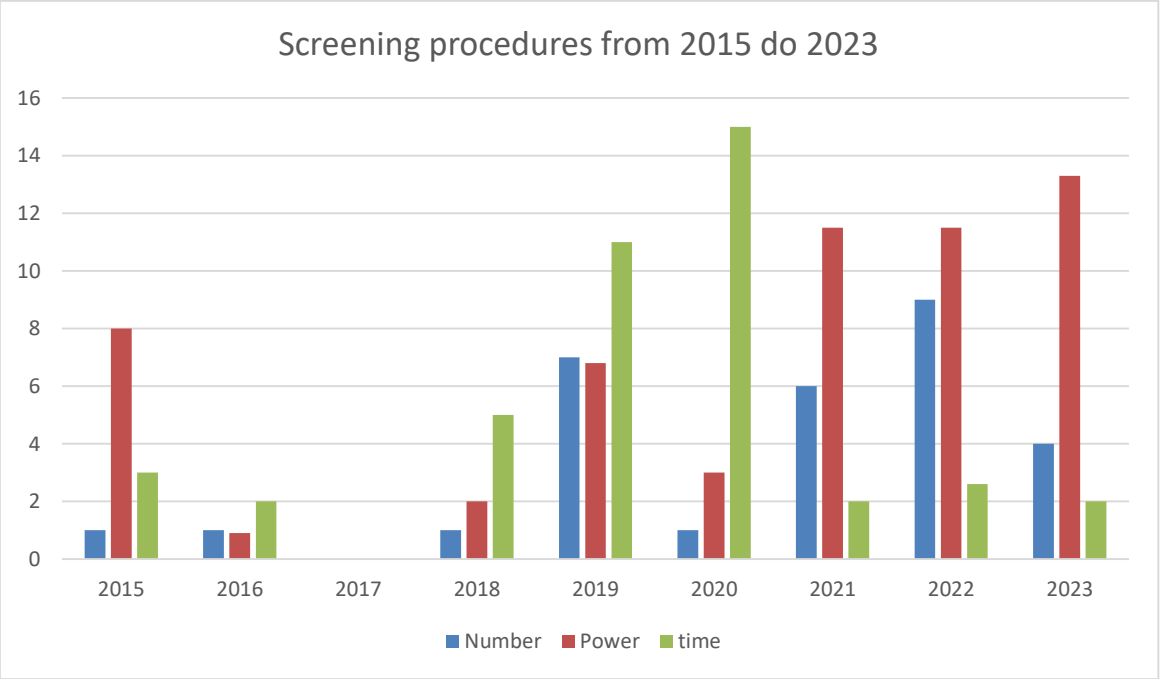


Figure 1 The Screening Procedures in Number, Power and Time Effectiveness'

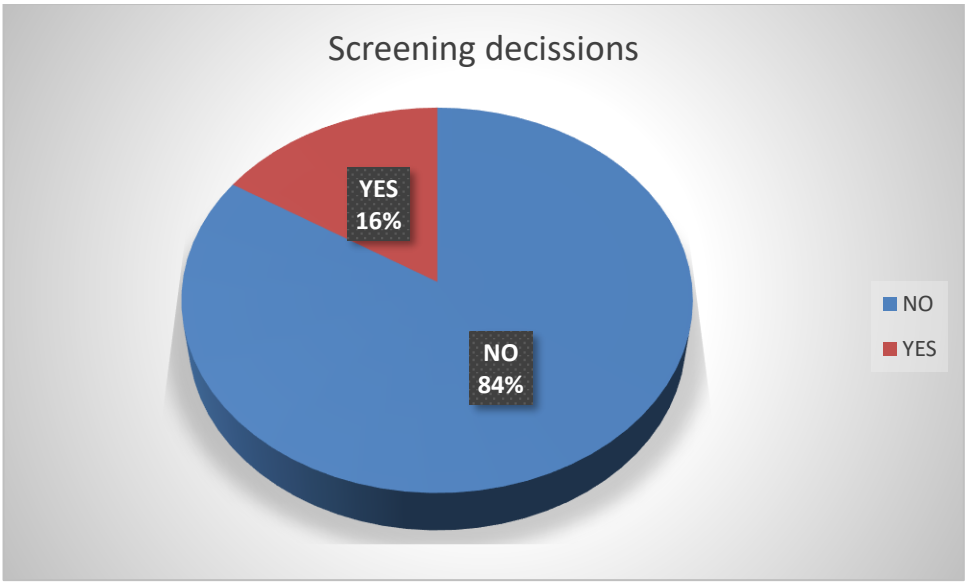


Figure 2 The 84% Share of Solar Power Plant With No Significant Environmental Effects Already in Screening Phase

Therefore, if the solar power plant proposals are located outside nature protected areas or Natura 2000 protected areas, protected cultural heritage sites, landslide, erosion or flood areas, aquatic and coastal land, land in areas protected and threatened under water regulations, in particular wetlands, riparian areas, estuaries, coastal areas and marine environment, mountain and forest areas, areas protected under nature conservation regulations or areas where excessive environmental burden has already been identified or is predicted, landscapes and areas of historical, cultural or archaeological interest, in particular areas protected under the rules governing the protection

of cultural heritage, then they are likely to have a negligible environmental impact, and in the opposite case they can be classified as projects with significant environmental impacts. The risks are therefore defined by criteria and are known in advance, and it is important that all stakeholders in the process have the knowledge needed to avoid the risk. However, up-to-date and correct environmental data that are publicly available (ARSO, Environmental Atlas, 2023) are also important for a good site assessment.

The number of investor initiatives or applications for the preliminary procedure for solar power plants has varied over the years. Thus, we can trace only one initiative from 2015-2016, while 2017 was a year with no initiatives at all. In 2019 and 2022, however, the dynamics increased, with the most, i.e., seven initiatives. The year 2023 is only partially covered by 50%, as the analysis only covers the first half of 2023, between 1 January and 1 June 2023.

The graph shows an upward trend in the total capacity of solar power plants, despite their lower number, demonstrating that there is an increasing number of large-scale solar power plants exceeding 1 MWh. Also, the time taken for preliminary procedures has been decreasing over the last three years, which can be attributed to the empowerment of investors and the public administration. The former have improved their expertise to the extent that 84% of investors have already identified environmentally unproblematic sites and prepared environmentally appropriate projects to be submitted for assessment. The latter have increased their knowledge and experience, and optimized the procedures for faster decision-making, as procedures are entirely dependent on knowledge, mutual learning and research.

80% of the solar power plants could therefore be implemented immediately from an environmental aspect, as the criteria did not identify likely significant impacts on the environment, nature, public health and cultural heritage.

Preliminary procedures have been carried out for a total of 58.5 MW of solar power plants, of which only 16.1 MW are also subject to an environmental impact assessment, which also determines mitigation measures and monitoring.

With the preliminary procedures carried out, it was therefore possible to implement 43.34 MW of solar power plants between 2015 and 2023 without significant environmental impacts. The length of the procedures ranged from 1 month up to a maximum of 15 months for highly complex power plants with several units (3 to 4 units), allowing investment in the same or the following year.

9. Guidance

The impact of the dynamics of the EIA Screening for the implementation of solar power plants is important, as the timing of the preliminary procedures directly influences the dynamics of investment, while ensuring that all the objectives of sustainable development and the green transition are met. The study shows that the average dynamics, i.e., the speed and efficiency of the preliminary procedures, varied by year and increased significantly between 2021 and 2023. At the same time, the average duration of the preliminary procedure, which ranges from 2 to 4 months, including the mandatory statutory 30-day public consultation, has decreased.

If the initiative concerns an area with environmental burdens or sensitive or protected areas, or the power plants with several units on different sites are more complex, more extensive and detailed evidence is involved, which increases the time taken for the procedures to 15 months.

For such cases the study shows that in order to make the preliminary procedures more efficient, it is advisable to take all environmental criteria into account from the conceptual design stage, location alternatives and to design the intervention with the following guidelines in mind:

1) The design of the project should be well considered, the location and mitigation measures should be an integral part of the project.

The size and design of the overall intervention should be proportionate to the spatial, environmental and landscape characteristics.

The project should be designed so that it does not have cumulative negative impacts together with other existing or permitted interventions.

The use of natural resources, in particular ground, soil, water and biodiversity, should be kept to a minimum and insignificant.

Waste generation should be avoided and the recycling of solar panels should be ensured and evidence thereof should be provided.

Resilience to the effects of climate change (extreme weather events: high temperatures, hail, storms, high rainfall, snow, etc.) must be demonstrated.

2) The location of the environmental intervention should be selected and optimized according to expert criteria

The environmental sensitivity of the geographical areas to be affected by the intervention must be taken into account, in particular the intended and actual land use; and the relative frequency, availability, quality and regenerative capacity of the natural resources (including soil, water and biodiversity) in the area and its subsoil, in particular: water protection areas and sources of drinking water, protected agricultural land, best forest sites, mineral resource areas of public interest.

The absorption capacity of the natural environment, with particular attention being paid to the following areas: aquatic and coastal land, land in areas protected and threatened under water regulations, in particular wetlands, riparian areas, estuaries, coastal areas and the marine environment, mountain and forest areas, areas protected under nature conservation regulations, areas where excessive environmental burden has already been identified or is predicted, densely populated areas, landscapes and areas of historical, cultural or archaeological interest, in particular areas protected under the rules governing the protection of cultural heritage, should be taken into account.

3) Type and characteristics of possible effects

The following probabilities need to be assessed: the likelihood of the impact occurring, the expected occurrence, and reversibility of the effect (direct or indirect, long-range, cumulative, mutually reinforcing, short- or long-term, permanent, or temporary), the cumulative impact in addition to other existing or approved interventions and the potential for successful mitigation of the impact.

As waste is one of the criteria, the environmental challenge in this area is reuse, recycling and the circular economy, which will require socially responsible behaviour.

10. Conclusion

The screening criteria from EU EIA Directive can help to achieve the national decarbonization target when they are considering at the very early stage of developing the solar plant projects. The research proves that such an

approach could shorten the EIA screening, minimalized the conflicts between different environmental, health, cultural heritage, water targets, which are also part of EU *acquis* and assure that investments are provided earlier.

To be more effective in achieving the 2050 decarbonization targets and to act responsibly, there is essential to continuously share and develop experiences knowledge across generations and sectors, as well as built capacities and repower competent authority with specific experts on EIA and renewables.

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