SMART SITING GUIDE:

Montenegro

Non-Technical Summary

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ECO-TEAM
ENVIRONMENTAL PROTECTION

MEGA
MONTENEGRO
ENERGY
GROWTH AND
ACCELERATION

The Nature Conservancy
Europe

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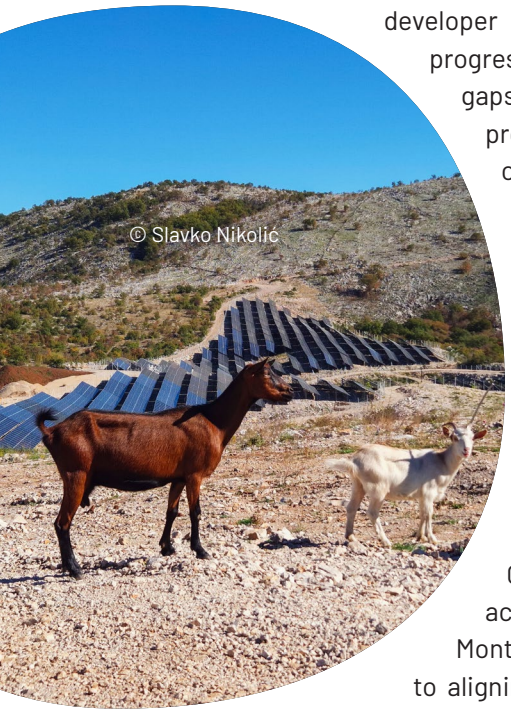
Introducution

The urgency to transition to clean, renewable energy sources has never been greater, as fossil fuel consumption continues to drive greenhouse gas emissions and the world faces worsening climate impacts. At the same time, a global biodiversity crisis is unfolding - species and habitats are vanishing at alarming rates, and this loss undermines the ecosystems humanity relies on for food, water, and resilience to climate shocks. The path forward must address both challenges in tandem.

Solar and wind technologies - mature, low-cost, and scalable - offer a practical route away from fossil fuels. Montenegro currently satisfies about 45.5% of its energy needs from renewables and has set ambitious targets to reach 50% renewables by 2030, leveraging strong solar and wind potential. While developer interest is high, progress faces financing gaps, lengthy permitting processes, and grid capacity constraints. These challenges are magnified when projects intersect with other land uses and values, risking delays or cancellations.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As a Contracting Party to the Energy Community and an EU accession candidate, Montenegro is committed to aligning national law with the EU energy, environmental, and climate acquis. The most recent revision of the EU's Renewable Energy Directive introduced the concept of Renewables Acceleration Areas (RAAs) - designated zones intended to speed up the rollout of renewable energy projects.

Within RAAs, projects are presumed to have limited environmental impact, allowing them to bypass full environmental impact assessments and benefit from simplified and faster permitting processes.

Under the revised RED, artificial and built surfaces should be prioritized for RAAs designation, ensuring that greenfields remain available for other uses to the greatest extent possible.

To support the RAAs implementation process in Montenegro and help the country achieve its renewable energy targets, while preserving its status of an ecological state, The Nature Conservancy (TNC) and Eco-team have launched the Montenegro Energy Growth and Acceleration (MEGA) project in October 2024. Implementing TNC's smart siting approach, MEGA has developed a low-conflict solar and wind siting scenario for the entire country by mapping the highest-priority areas for solar and wind development that minimize environmental and social impacts. This initiative follows a pilot mapping in the Nikšić municipality, which demonstrated substantial low-conflict solar and wind potential and highlighted the value of data-driven planning for reducing the risk of project delays.

By identifying potential for building around 15,630 MW capacity of solar and 650 MW of wind on low-conflict land, the MEGA study shows that Montenegro could fully supply its current electricity needs by developing just one fifth of the identified low-conflict, high development potential areas.

Key national institutions across the energy, spatial planning, environment, and financial sectors have supported the MEGA study through data sharing and participation in the project's Advisory committee.

The produced maps provide a practical planning tool for stakeholders at all levels - from developers and grid operators to financial institutions and decision-makers, and can inform permitting decisions, investment prioritization, and national energy generation and grid planning processes.

PLJEVLJA: DECARBONIZATION PATHWAY

Thermal Power Plant Pljevlja is a keystone of Montenegro's current energy security, supplying roughly 40–50% of the country's electricity and sustaining the livelihoods of thousands in local communities whose daily life depends on its operation. At the same time, the plant faces an inevitable end: a full phase-out by 2041 is planned to meet climate and energy objectives.

MEGA study supports this decommissioning by demonstrating that there is ample solar and wind capacity in low-conflict locations to maintain security of energy supply for Montenegro. While solar and wind alone face challenges to fully replace baseload power, a mix of renewable generation with innovative flexibility solutions and targeted grid upgrades and expansion[1] within RAAs offers a viable pathway forward. Moreover, by directing future solar and wind investments toward brownfields, the study promotes a just transition for workers and communities affected by the shift away from coal and heavy industry, highlighting the potential for job creation within the renewable energy sector.

Our smart siting approach

When huge renewable energy ambition meets limited space, challenges can arise. This is why TNC's approach is to look at space simultaneously through the lenses of conservation and energy development, to find optimal candidate locations for solar and wind power in the very early stages of planning. For this reason, this methodology is also suitable as support for spatial planning and for the designation of RAAs. The approach we took in Montenegro can be broken down into four steps:

1. **Identifying and applying constraints.** In this step, we eliminated areas that preclude utility-scale (>5MW) wind or solar development, either for biophysical reasons such as slope or legal reasons such as residential zones and zones of strict protection in national parks.
2. **Calculating development potential.** We used parameters that affect the feasibility of wind and solar projects such as resource availability, (e.g. average wind speeds and solar irradiance), availability of infrastructure (e.g. proximity and capacity of electrical grids, roads) or proximity to load centers and assigned them weights according to detailed expert input.
3. **Estimating conflict potential.** We compiled an array of datasets related to different conflict categories, such as places important for biodiversity (e.g. Important Bird Areas, other ecologically significant areas), areas of heightened socio-cultural value (e.g. sacral architecture, high landscape value viewsheds) or natural resources (e.g. valuable forests and high-value agricultural land).
4. **Bringing all the data together.** We overlaid steps 1-3 to identify optimal locations, prioritizing places with a low potential for conflicts and high development potential.

While this process is data intensive, the generated datasets have an added value beyond just the outputs of our analysis – with novel datasets having been compiled on grid capacity, brownfield and even rural settlement locations.

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[1] There is a need for substantial enhancements to grid capacity, as renewable energy sources impose markedly higher grid-capacity requirements than thermal energy (approximately 3-5 times)

Breaking out of gridlock

Proximity of a prospective renewable energy project to a high-voltage infrastructure means nothing if it's already carrying as much power as it physically can. Because the connection capacity of the electrical grid was repeatedly identified as one of the main bottlenecks, special attention was given to this criterion. Montenegro's transmission system operator (Crnogorski elektroprenosni sistem-CGES), provided expertise and data to produce a bespoke nation-wide capacity model that was used to refine our development potential calculation.

Shaping development priorities together

When identifying priority areas for development, asking the right people is just as important as having the right methodology. Our project team comprised national experts in energy, geospatial analysis, biodiversity, spatial planning and social values. The methodology and results were verified by an independent peer-review panel, a high-level advisory board with representatives from all relevant institutions.

Two groups of subject matter experts were consulted to calculate weighting factors for Step 2 and 3 using the well-supported Analytic Hierarchy Process, and these weights were used to combine criteria into single development potential and conflict maps.

For three municipalities in Montenegro, Cetinje, Nikšić and Pljevlja, we piloted a new approach - a public participation geographic information system (PPGIS) tool developed to collect direct spatial input from the public. We organized separate workshops for each of the municipalities to obtain spatial and descriptive data for preselected social value groups and used the results to verify our conflict mapping results.

Using brownfields to their full potential

Brownfields, i.e. already converted and underutilized or abandoned areas such as landfills and former industrial sites are widely recognized as a sensible first target for development of renewable energy, firstly because their use for this purpose avoids conversion of more valuable natural or agricultural areas and secondly because they frequently possess the necessary infrastructure for development. For these reasons, brownfields are recognized in the revised RED as priority areas for new RE projects. In this analysis, we paid particular attention to brownfields by calculating their total potential separately from the other areas, but still taking into account the possible conflicts associated with their development.

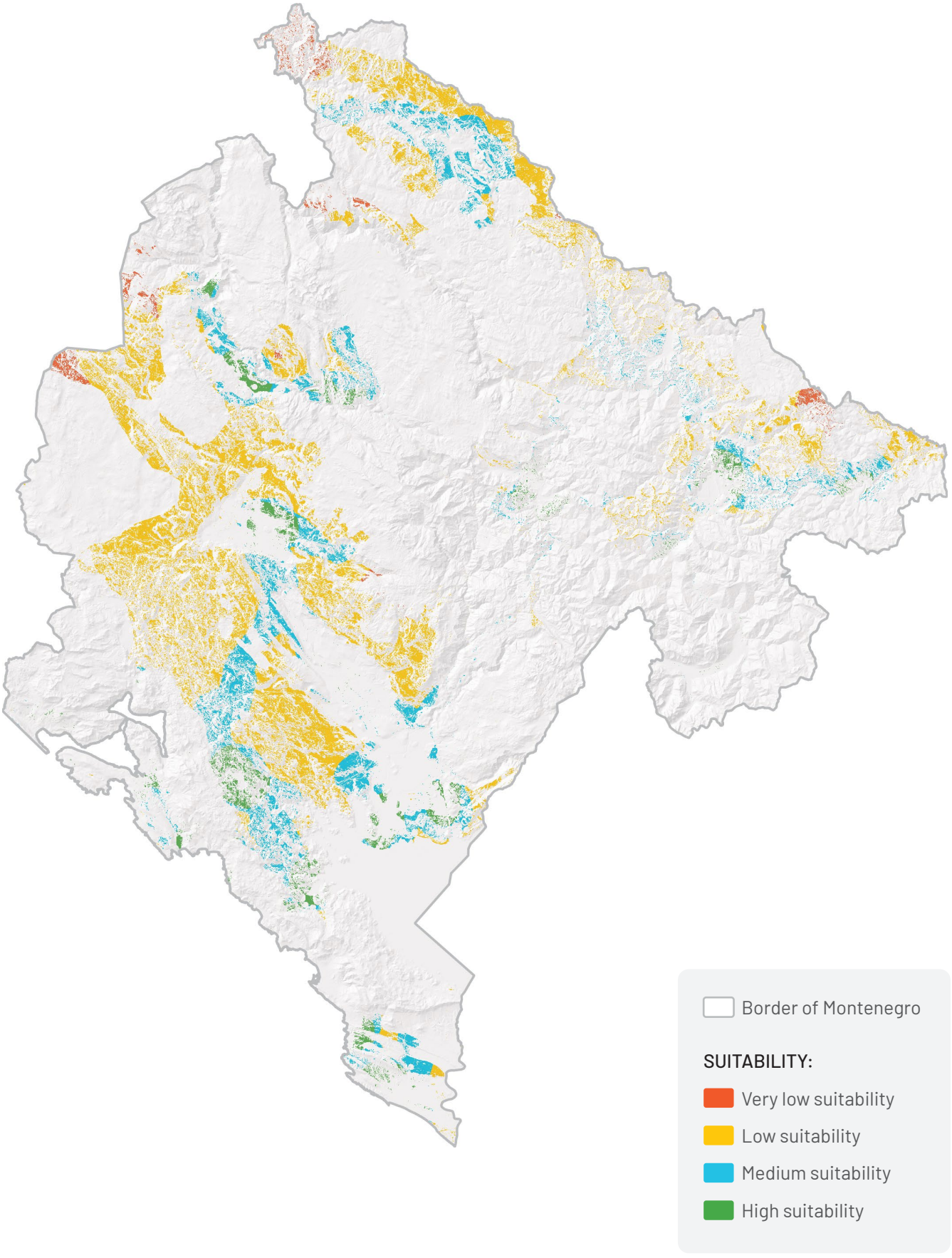
Our findings

The results are encouraging - in locations characterized by minimal conflict and high development potential, a combined capacity of 15,630 MW[2], or nearly 16 GW, for smaller and larger solar power plants has been identified, spanning an area of 156 square kilometers – roughly one and a half times the area of the city of Podgorica. For wind farms, the identified capacity is around 650 MW over approximately 65 square kilometers – an area comparable in size to Petnjica, one of Montenegro's smallest municipalities.

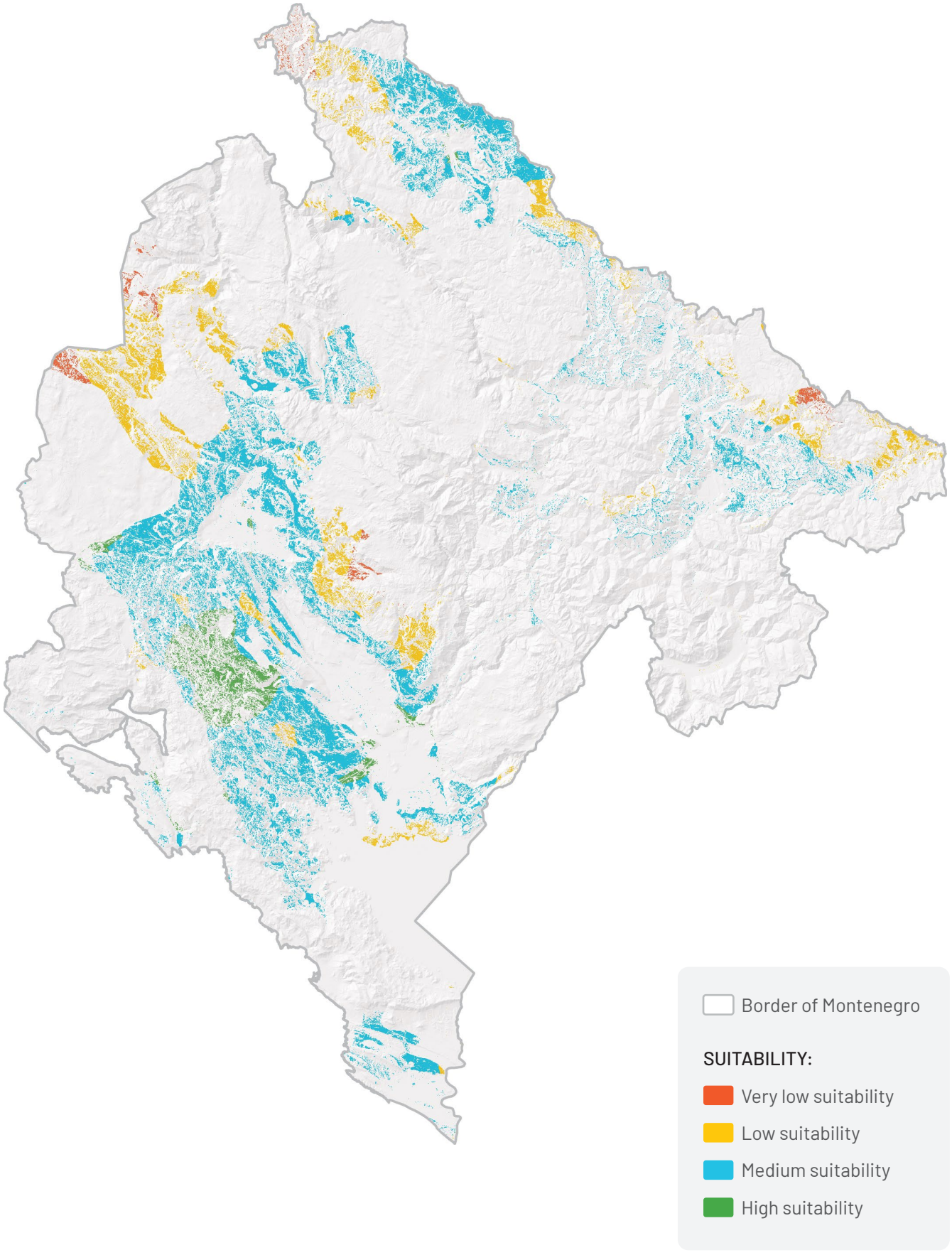
This capacity translates to an annual electricity production of nearly 20 TWh for solar and 1200 GWh for wind, which would surpass Montenegro's current annual electricity production by a factor of five to six. Given Montenegro's current renewable energy share of gross final energy consumption at 45.5% and 850 MW of installed capacity, the potential identified in this study is fit to meet and exceed the country's 2030 renewable energy targets without compromising natural or socio-economic values.

[2] Out of total installed capacity identified for smaller power plants on low-conflict locations with high development potential (8,435 MW), distribution grid can currently accommodate 235 MW.

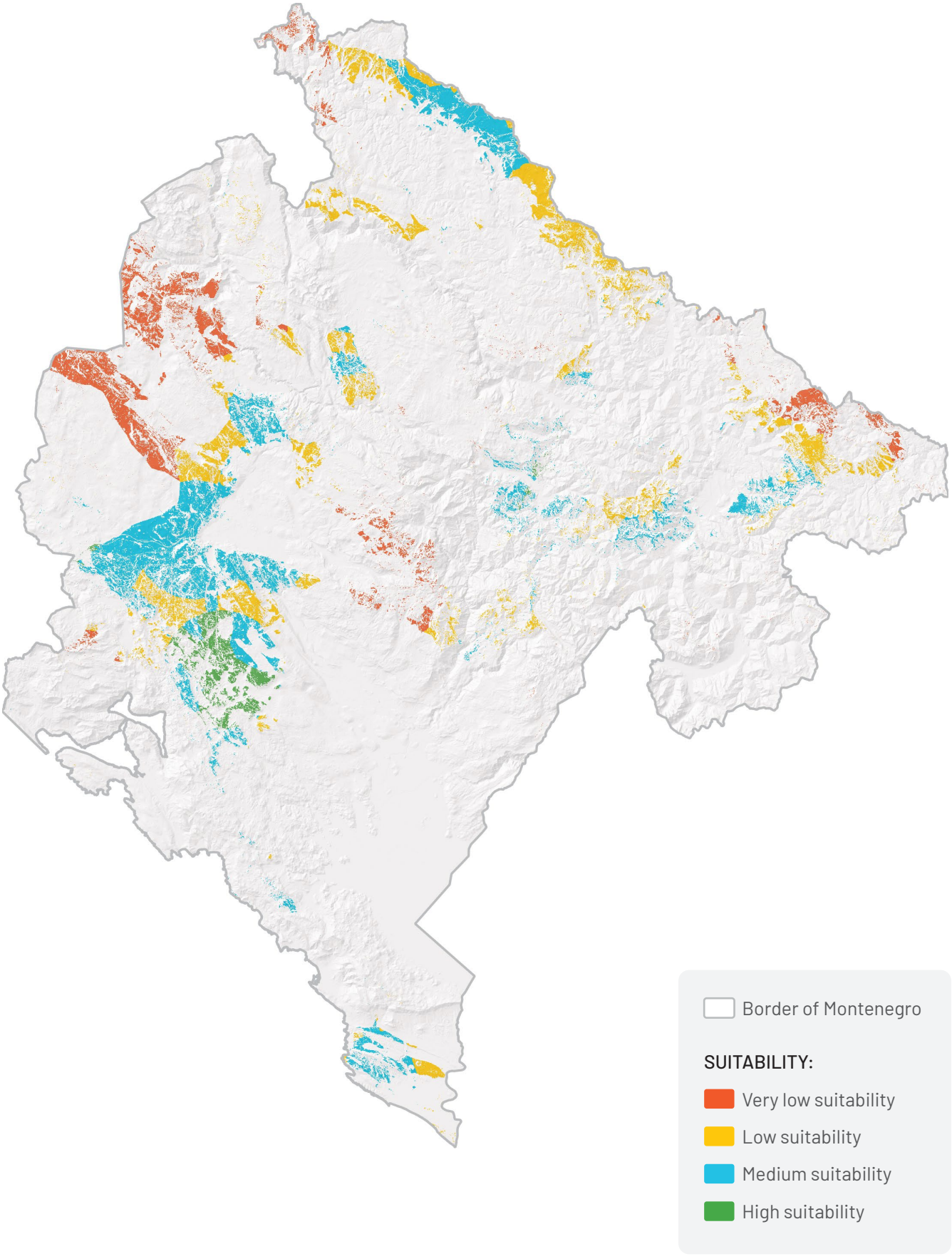
Low-conflict map: **Solar powerplant development for connection to the distribution grid**



Low-conflict map: **Solar powerplant development for connection to the transmission grid**



Low-conflict map: **Wind powerplant development**

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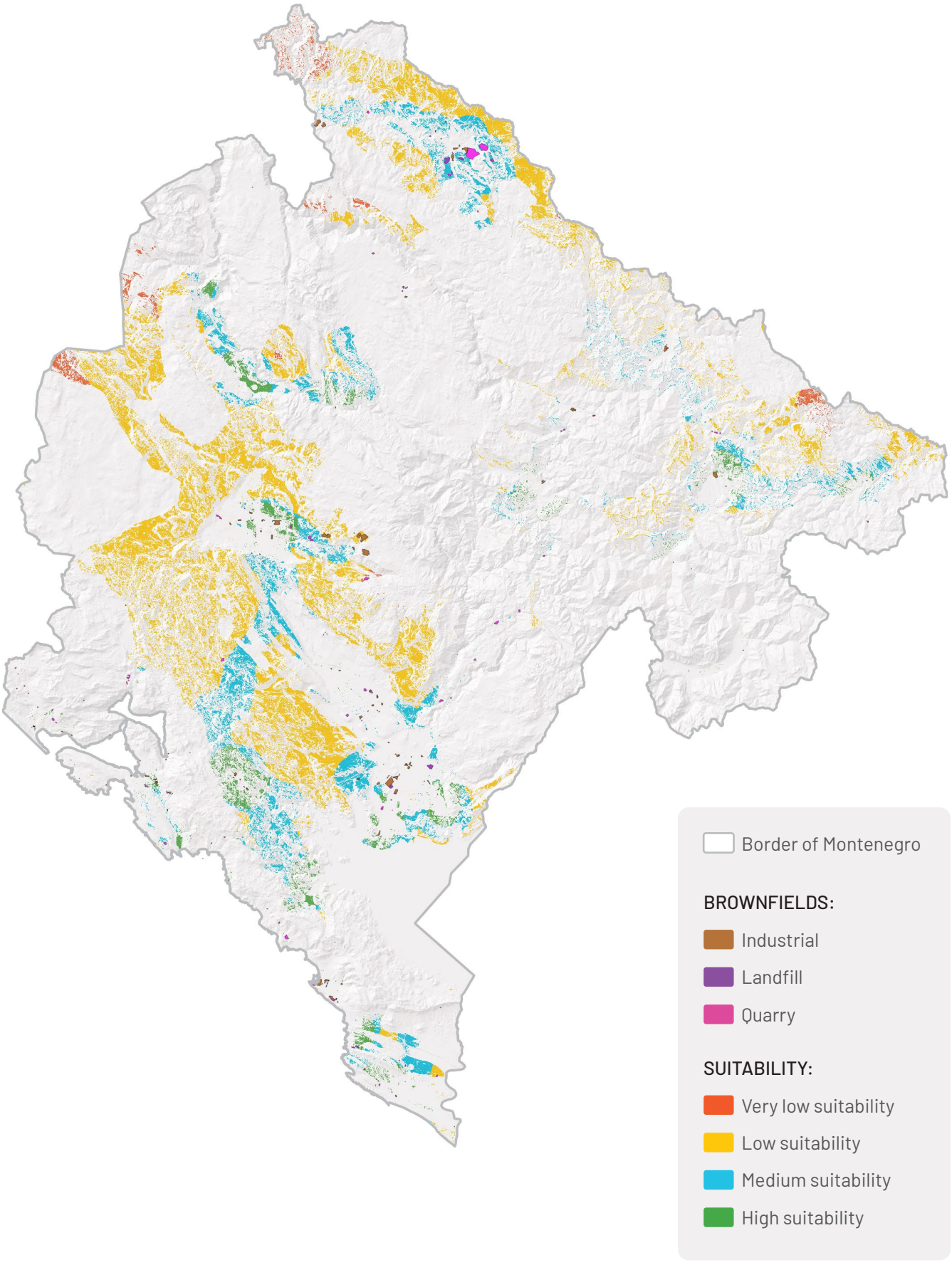
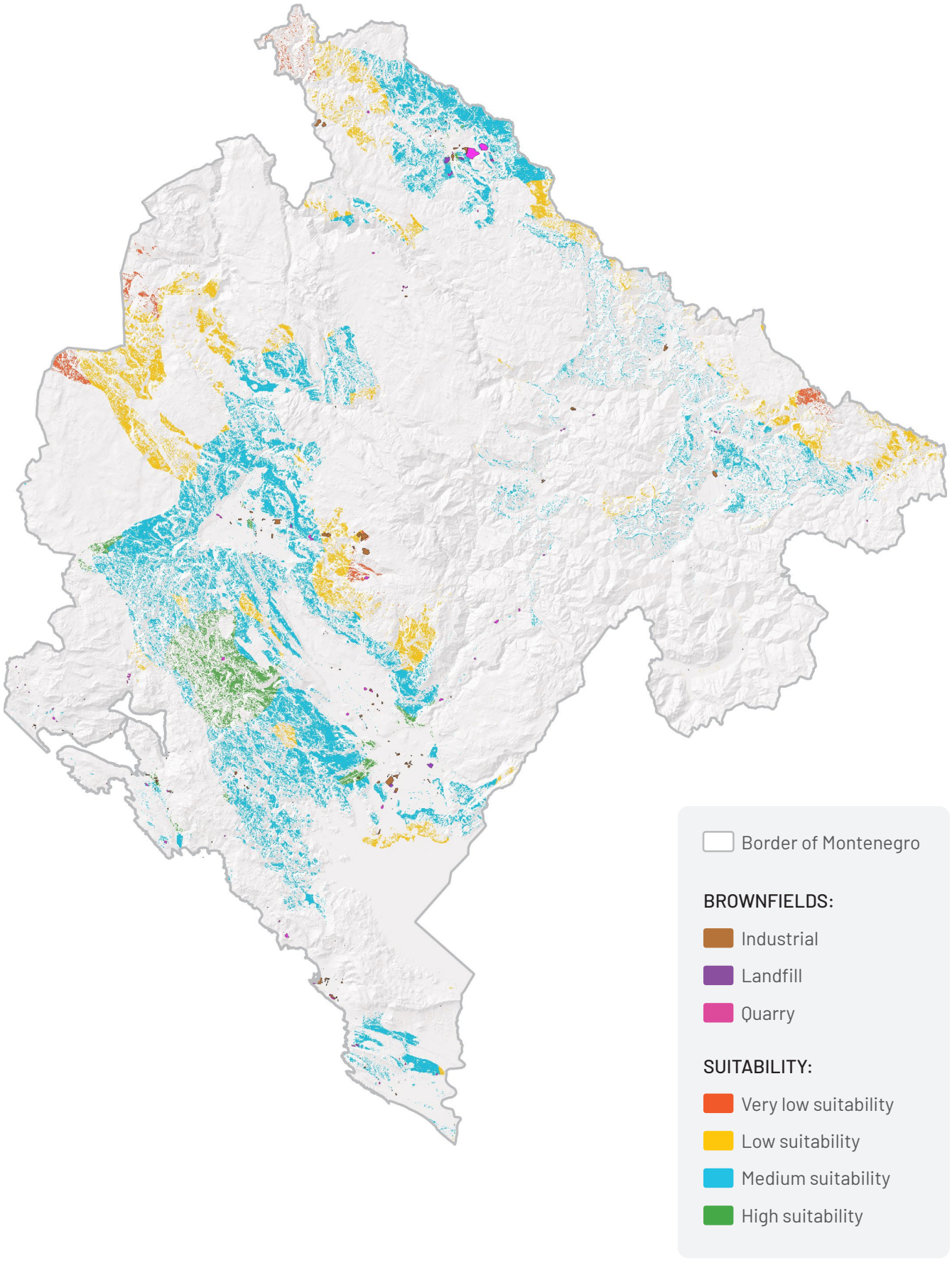
Significant renewable energy potential also exists on brownfield sites (industrial areas, landfills and quarries). Data available to the project team indicate that around 346 MW of combined solar distribution and transmission capacity can be developed on low-conflict areas with medium to high development potential. Energy produced just on these brownfield locations could replace one third of the current generation from Pljevlja coal plant.

Low-conflict map: **Brownfields and solar powerplant development for connection to the distribution grid**



Low-conflict map: **Brownfields and solar powerplant development for connection to the transmission grid**



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17x

capacity increase

Only at low-conflict locations, the study identifies a capacity approximately **17 times larger** than the current installed capacity of all power plants in Montenegro.

1/3

of TE Pljevlja capacity can be replaced

The solar capacity identified **on brownfields** can replace 1/3 of the production from TE Pljevlja.

2030

targets from 1/5 of the locations

Montenegro can meet its **national energy targets** for 2030 through buildout of solar and wind on just a fraction (one fifth) of the identified low-conflict locations.

Use of the study results and replication of the smart siting approach across Southeast Europe

The results indicate that renewable energy development can proceed without compromising land-value preservation. Moreover, the study supports alignment with EU energy, environment and climate acquis positioning Montenegro to emerge as a regional leader in designating RAAs, with a special emphasis on the potential of brownfield locations. The approach used in Montenegro could inspire other countries in the Southeast Europe to adopt a similar strategy that balances decarbonization with biodiversity priorities, contributing to Europe's progress toward a more sustainable energy future.

1. To improve the regulatory and institutional frameworks, we call on:

- the Government of Montenegro to use these results as a basis for designating RAAs in national legislation and to integrate them into decarbonization measures within the national strategic documents;
- spatial planning authorities to take into account these maps when mapping locations for renewable energy development in both national and local spatial plans;
- national grid operators to use the maps to inform grid optimization and development planning;
- the Ministry of Energy and Mining to consider incorporating maps in the design of auctions, either as a tool for selecting locations for site-specific auctions or for assessing the sustainability of projects proposed by developers;
- competent authorities involved in renewable energy permitting to leverage the study maps to prioritize projects with low environmental and social conflicts over those following a business-as-usual approach.

2. To unlock the investment potential, we call on:

- Montenegrin Investment Agency to use the study findings to promote the renewable energy investments towards low-conflict locations;
- investors and commercial banks to consult maps to identify projects that are financially viable, climate neutral and sustainable, leading to reduced risk from public opposition and accelerated permitting;
- financial institutions and donors to use the study results as a decision-making tool for directing financial and technical assistance to initiatives that contribute to the sustainable achievement of the national renewable energy targets.

PARTNERSHIP WITH THE ENERGY COMMUNITY SECRETARIAT

- **Ministerial Council Recommendation on RAAs:** Building on the RAAs framework, the Energy Community Ministerial Council, at its 22nd meeting in December 2024, adopted a Recommendation encouraging Contracting Parties to establish the necessary legal and institutional structures for implementing the RAAs regime, streamlining permitting, and facilitating grid integration.
- **Establishing a Memorandum of Understanding:** To help Contracting Parties in identifying low-conflict areas suitable for solar and wind development, the cooperation between the Nature Conservancy and the Energy Community Secretariat was established in October 2023.
- **Blueprint:** As a result of such cooperation, the Operational Blueprint was published in February 2025 to help decision-makers and experts in the Energy Community region in understanding the concept of RAAs and its practical implementation, using TNC's smart siting approach. The Blueprint outlines the key steps authorities need to take in designating RAAs - from making initial commitments and collecting data to formally designating RAAs.
- **Permitting Protocol:** Additionally, the Partnership aims to publish a document in Q1 2026 to support permit-granting procedures authorities in the Contracting Parties in establishing effective one-stop shops, and thereby helping them meet the requirements of the latest revisions (II and III) of the RED directive for designating contact points.

Detailed descriptions of the methodology, data sources, calculations and results can be found in the MEGA Smart Siting Guide.

References and links:

- National Energy and Climate Plan of Montenegro
- Access to MEGA Smart Siting Guide and ArcGIS maps

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