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Water-food-energy-ecosystems nexus in transboundary basins

Sustainable renewable energy investments and development: accounting for water resources and the environment with a nexus approach

Note by the secretariat

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Summary

The need to increase renewable energy uptake as a pathway to limit global warming well below 2°C above pre-industrial levels and pursuing effort to limit it to 1.5 °C is well documented. However, most countries are not on track to meet climate targets and more efforts are needed to speed up the necessary changes and boost renewable energy investments, also central to achieve the Sustainable Development Goals (SDGs).

The required increase in renewable energy is closely related to broader questions of natural resource management and as such it is interlinked to the sectors of water, agro-forestry, and ecosystems - the "nexus". The potential impact of renewable energy expansion on other sectors can be positive (synergies based on complementarity of interests, to multiply benefits) or negative (trade-offs, based on poor planning, generating undesired effects). At the level of transboundary basins both can spread across borders, motivating a regional dialogue over renewable energy development.

The present document builds on the work already done by the United Nations Economic Commission for Europe (ECE) towards sustainably increasing renewable energy investments and improving cross-sectoral planning in the decision-making processes. The Renewable Energy Hard Talk events held in Bosnia and Herzegovina (2018) and Serbia (2019) included a Nexus component for this purpose. Substantively, the approach used drew from the nexus assessment work under the ECE Water Convention and evolved into a list of criteria for sustainable renewable energy policies and investment initiatives that bring multiple benefits across sectors and countries while minimizing trade-offs, including with other water uses and environment protection.

The purpose of this document is to support policy-makers and investors in identifying and addressing synergies and trade-offs at the early stage of the planning phase by proposing a practical assessment tool. This would help find broader cooperation, financing and partnership opportunities across sectors, better sharing of benefits and reduction of costs or negative impacts which may deter renewable energy development.

The Group of Experts on Renewable Energy and the Working Group on Integrated Water Resources Management are invited to review the present document, make comments and entrust the secretariat to further develop the material into a publication: "Towards sustainable renewable energy investment and deployment: Trade-offs and opportunities with water resources and the environment".

I. Introduction

1. In order to achieve economic, social and environmental sustainability and to improve quality of life, countries of the world adopted in 2015 the 2030 Agenda for Sustainable Development, which includes 17 SDGs and drives action in areas of critical importance. Three of the SDGs that refer specifically to food (SDG2), water (SDG6) and energy (SDG7) are intrinsically linked, as are the resource management, infrastructure development and political measures needed to reach them. The inseparable links between those three Goals form a "nexus" between energy, water, and food, in the sense that actions in one sector commonly have impacts on the others. The achievement of these SDGs should be supported by ensuring responsive, inclusive, participatory and representative decision-making at all levels (SDG16).

2. Although investments in new renewable energy installed capacity consistently surpassed investments in fossil fuels in the past five years, current investments in renewable energy remain significantly lower than those required to limit global warming as envisaged in the Paris Agreement. A significant reallocation of investment capital towards renewable energy is therefore needed.

3. The required increase in renewable energy investment will have an impact on the interlinked sectors. This impact can have a multiplier effect on the benefit that derives from

a strictly sectoral evaluation of renewables. There are synergies that can be exploited to enhance the social benefit from renewable energy investment while also satisfying water, food and ecosystems priorities. Conversely, a strictly sectoral planning of renewable energy expansion may have undesired effect that compromise or slow down progress in the other sectors.

4. The need to assess both costs and benefits across sectors is required to estimate the net impact of renewable energy investments from a cross-sectoral perspective. This calls for a more holistic approach to planning and implementation, including for regional strategies and projects that transcend national boundaries. This is particularly evident, for example, in the development of hydropower projects and their effects (sectoral and cross-sectoral) in riparian countries, where systematically identifying and assessing cross-sectoral and transboundary impacts is crucial for informed decision-making.

5. The present document summarises the work already done by ECE both on the subject of renewable energy investments and on the nexus approach, particularly in a transboundary context, and presents a list of criteria that could serve as the basis for the development of a tool to identify, assess and navigate the cross-sectoral impacts of renewable energy deployment in nexus-related sectors.

II. ECE initiatives on renewable energy investment uptake and the energy-water-food-ecosystems nexus

6. In line with the requirement for increased renewable energy investments in order to reach climate mitigation goals, the ECE has undertaken significant initiatives to promote renewable energy investment across its member countries. The ECE Group of Experts on Renewable Energy[1], in cooperation with host countries and a number of other institutional partners has organised a series of Renewable Energy Hard Talks[2]. These country-focused multi-stakeholder policy dialogues aim to identify risks and barriers to renewable energy investments in the host countries and to recommend options from the international best practices toolset to address them, with the ultimate purpose to de-risk and boost renewable energy investment. To achieve this objective, the first four Hard Talks applied a version of the Derisking Renewable Energy Investment (DREI) Methodology of the United Nations Development Programme (UNDP) to analyze each host country's energy and renewables sectors, to identify barriers and risks to investment and to provide policy recommendations, based on international best practices as well as on country-specific particularities, towards de-risking - and, therefore, unlocking - renewable energy investment.

7. In parallel, acknowledging the importance of the nexus dimension as well as the fact that nexus considerations often transcend national frontiers and have a transboundary impact, the ECE has mobilized, under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Water Convention), a Task Force on the Water-Food-Energy-Ecosystems Nexus[3]. A series of transboundary assessments in shared basins have been performed under its guidance, exploring inter-sectoral challenges but also opportunities arising from a closer cooperation and an integrated approach to the management of water, energy, agriculture and ecosystems. The findings of the river basin assessments have been extensively documented[4]. The ECE experience in applying the Transboundary Basin Nexus Assessment (TBNA) Methodology has been reported in a

[1] The Group of Experts was created in 2014 with a mandate to carry out action-oriented, practical activities to substantially increase the uptake of renewable energy. More info at: https://www.unece.org/energy/re.html.

[2] More details on the ECE Renewable Energy Hard Talks, including concrete outcome recommendations are available at: https://www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-hard-talks.html.

[3] The Task Force was created by the Meeting of the Parties to the Water Convention during its sixth session (Rome, 2012).

[4] All published nexus assessments of transboundary basins are available from: https://www.unece.org/env/water/publications/pub.html.

synthesis publication[5] that consolidates the methodological approach and systemises the desired outcomes, providing a solid foundation for further analytical work on the subject.

8. Through the growing experience from several initiatives in renewable energy uptake and transboundary nexus assessments, the need for a more coordinated approach to renewable energy deployment was identified. In 2017, ECE published a seminal Report[6] to explore good practices and policies for inter-sectoral synergies and sustainability of renewable energy deployment. The Report provides examples of synergies between renewable energy and the energy-water-food-ecosystems nexus and proposes tools to identify, explore and exploit those synergies, maximizing the value of renewable energy and dispersing positive impacts to the interlinked nexus sectors.

9. The ECE's approach of combining experience on renewable energy investment and the nexus for an integrated approach in renewable energy deployment, including considerations of transboundary coordination when applicable, culminated in the last two Hard Talks, held in Bosnia and Herzegovina and Serbia. Building on the main theme of the Hard Talks up to that point, which focused mainly on unlocking renewable energy investment, the last two Hard Talks also introduced an energy-water-food-ecosystems nexus component in the events. More specifically, expanding on the previous work on the Drina River basin nexus assessment, the Hard Talks in those two Drina riparian countries introduced into the renewable energy investment discussion the following parameters:

(a) the examination of synergies and trade-offs between renewable energy deployment and the energy-water-food-ecosystems nexus. A specific session of each event was dedicated to exploring those synergies by dedicated workgroups, each focusing on a different renewable technology type. A matrix of proposed "nexus criteria" for assessing and navigating trade-offs was distributed to participants beforehand and stimulated the discussion; and

(b) the need for transboundary coordination and cooperation in renewable energy planning, mandated by the key findings of the nexus assessments and the realization that, in the Drina Basin in particular, the two Hard Talk host countries could maximize the impact of new investments and optimize current production by adopting a more coordinated and cooperative approach to renewable energy development (including, but not limited to, hydropower).

III. Maximising synergies: identification of cross-sectoral benefits through renewable energy investment

A. Overview

10. Considering energy-water-food-ecosystems linkages provides an opportunity to go beyond trade-offs between the different sectors and to look for synergies. Instead of balancing the positive outcomes in one sector versus negative outcomes in another, closer scrutiny of the interrelations across the nexus components provides many examples where the correct option constitutes a "win-win" scenario for all affected nexus sectors. Once those synergies are identified and exploited, the net social benefit of renewable energy is compounded and distributed across other sectors, making an already attractive proposition an even higher policy priority.

[5] ECE publication (2018) "Methodology for assessing the water-food-energy-ecosystems nexus in transboundary basins and experiences from its application: synthesis".

[6] ECE publication (2017) "Deployment of renewable energy: The water-energy-food-ecosystems nexus approach to support the Sustainable Development Goals", op. cit.

11. In order to capitalize (also financially) on those synergies, the first step is to identify and understand them. Subsequently, appropriate methodologies must be applied to assess the benefit across the sectors and, even in *prima facie* beneficial cases, to look beyond the evident synergies for possible hidden trade-offs in less obvious areas. Then, trade-offs also need to be better understood: research has shown that, although positive interactions can be identified between almost all secondary targets under the respective SDGs of the nexus (SDGs 2, 6 and 7), no pair of targets under any of the three SDGs shows only synergies without also showing some trade-offs as well.

12. During the Sarajevo and Belgrade Hard Talks, dedicated working groups were formed amongst participants to propose synergies between increasing renewable energy investment and the food, water and ecosystems sectors. The main areas where synergies between renewable energy and other nexus components were identified in the two Hard Talk host countries are described in the following sections.

B. Energy and Water

13. One of the most important synergies between water and renewable energy is the possibility to increase access to both energy and water by a synergistic approach. For example, desalination plants, well pumps and wastewater treatment facilities powered by renewable energy can provide low energy intensity solutions for increased access to water (particularly in off grid locations) whereas utilization of low impact hydropower technologies (microturbines) in existing infrastructure can improve access to energy in isolated areas with low impact to the environment. Another type of synergy could be found in the maximization of the value of already committed resources: e.g. floating solar PV on hydropower reservoirs increases the energy output with minimal effect on water and food; hydropower provides grid flexibility and/or storage for higher shares of variable renewables (e.g. solar and wind). Overall, important synergies exist also at the level of resource efficiency both at supply and demand side.

C. Energy and Agriculture, Forestry and Rural Development

14. The key cross-section between energy and agriculture is biomass. While the notion of biofuels produced on agricultural land is deeply controversial, the usage of agricultural and forestry waste for “second” and “third generation” biofuel production is a synergy that brings benefits as it provides an important secondary income stream for farmers without conflicting with food production. Beyond biofuels, renewable energy can increase access and optimize energy usage of agricultural irrigation and pumping by introducing renewable energy sources very close to actual demand through distributed generation solutions. New installations will require careful planning, but best practices are already accumulating. For instance, there are possibility to optimize usage of agricultural land by integrating solar PV in a way that still allows for growing crops among PV installations.

D. Energy and Environmental & Social Impact

15. Substantial synergies can be found between renewable energy uptake and social impact: decentralized renewables and integrated “green” residential solutions can attract an ecologically sensible tourism to remote areas of high environmental value. Beyond this, the overall technological shift associated with the transition to renewable energy creates new employment and business opportunities. The positive environmental impact of renewables is also well documented: distributed renewable technologies can help reduce indoor pollution due to utilization of clean technologies for heating and electricity, and overall large-scale renewable investments combined with widespread electrification would result in a more environmentally friendly energy mix.

E. Transboundary Synergies

16. The transboundary dimension is made easily evident in the case of shared river basins, where the coordinated management of a common resource (based on cooperation, exchange of information, integrative planning and good governance) can provide added value and maximize the benefits of infrastructural investments, including when it comes to renewable energy. A basin-scale approach to renewable energy development is justified by the opportunity of co-optimizing hydropower production and building on regional complementarities (e.g. different wind, solar, and hydro potentials). A permanent forum for discussions and cooperation could prove instrumental in exploring, identifying and utilizing possible synergies and complementarities across countries (the International Sava River Basin Commission can serve as an example of such a forum).

F. Identifying and Maximizing Synergies through a Nexus Compatibility Matrix

17. Identifying synergies between renewable energy and other nexus sectors can be particularly case-specific since an analysis of each country's or region's potentials and needs must precede any conclusion on where synergies can be found. Moreover, identifying synergies is only the first step: specific measures and incentives must be adopted to encourage the promotion of those synergies.

18. In order to identify, assess and actively encourage such synergies, both from a policy perspective (by adopting policies that facilitate and incentivize those synergies) and an investment perspective (by actively prioritizing projects with synergistic impact for financing and development), an assessment tool to systematically analyze synergies is needed. A matrix, reflecting the main areas where synergies are found and showcasing the choices (both at the policy and at the project development level) could become a valuable tool for assessment and promotion for sustainable development of renewable energy. A preliminary approach of what such an assessment tool could contain is included in Annex 1 of the present document.

IV. Navigating trade-offs: criteria for identifying and assessing inter-sectoral impacts

A. Overview

19. The findings of IRENA's "Renewable Energy in the Water, Energy and Food Nexus" Report from 2015 established the need for development of an assessment tool to identify, quantify and assess the impact of energy policy choices in interlinked sectors, particularly the energy-water-food-ecosystems nexus. The conceptual principles of assessment proposed by IRENA provided a solid foundation for the further development of such an assessment tool, which could be utilized to introduce sustainability concerns early in the planning stage of renewable energy investment. The ECE work described in the present document supports and provides various elements for the development of a practical instrument which could be leveraged for sustainable deployment of renewable energy.

20. A number of criteria were prepared for the Sarajevo and Belgrade Hard Talks as a draft tool to identify, assess and navigate trade-offs early in the renewable energy planning process. Those criteria were s included in a Discussion Paper that was distributed to all participants prior to the events (in line with the standard Hard Talk format) and were utilized as a tool to focus and guide the discussions on the issue of sustainable development of renewables and nexus concerns. The discussions in both Hard Talks validated the need to maximise the positive synergies that exist across sectors and countries, both to open up new technical solutions and financial opportunities and to minimize environmental problems and risks to human health. The Hard Talk list of criteria were taken into consideration when developing the Nexus Compatibility Matrix included in the Annex of the present document.

B. Environmental assessment

21. The need to assess the environmental impact of energy activities at an early stage of planning, as well as the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries, are enshrined both in most national legislations but also in the Espoo Convention and the Protocol on Strategic Environmental Assessment (SEA).

22. A proper application of SEA – in line with the provisions of the UNECE Protocol on Strategic Environmental Assessment – can help to maximize environmental and social benefits resulting from renewable energy development, while avoiding or minimizing potential adverse effects. The application of SEA to development of the renewable energy sector at the various planning stages can provide the following benefits:

(a) SEA can ensure that renewable energy development is in line with environmental and health objectives and commitments a given country has adopted;

(b) At the strategic/policy level, SEA can facilitate the discussion on scenarios for renewable energy development. Thus, it can contribute to selection of the most appropriate energy mix, which considers environmental and health risks as well as benefits of all reasonable alternatives, and thus enables objective comparison.

(c) SEA applied at the strategic/policy level can support proper consideration of renewable energy development in sub-sequent planning schemes (e.g. spatial or land-use planning) by providing recommendations on priority renewable energy resources to be further developed and/or locations to be primarily further explored.

(d) SEA can streamline development of specific projects and relevant project-level assessment (EIA), for instance by identifying locations where major environmental or health risks can be excluded or mitigated. Therefore, development and approval of specific projects including EIA can be carried out without main problems.

23. Other important regional instruments are Directive 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment and Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment. These Directives are also part of the EU *acquis* that must be transposed by Energy Community (EnC) Member States and is therefore important for many of the countries of the ECE Region.

24. Adherence to this criterion for proposed energy projects should be examined both in a domestic and a transboundary context. Moreover, the evaluation should not be limited to the existence or lack of and Environmental Impact Assessment (EIA) or Strategic Environmental Assessment (SEA) requirement but, more importantly, to qualitative aspects (quality control, public participation, governmental capacity to create and evaluate EIAs/SEAs, monitoring, etc) of how this requirement is actually enforced in practice.

C. Strategic assessment and planning

25. The need for a strategic and integrated approach to planning is becoming readily evident. Still, in many cases, sector-specific planning remains the norm. A step towards the right direction on strategic planning is the EU and EnC requirement for Member States to create integrated National Energy and Climate Plans (NECPs) that cover the five dimensions of the energy union for the period 2021 to 2030 (one of which is decarbonisation of the economy) and, in particular, the strong encouragement to identify areas suitable for joint or coordinated planning within a region and to consult other governments early on in the preparation process. This initiative could be the example for establishing requirements for a more integrated planning approach that, beyond climate change (SDG 13), also incorporates priorities on energy-water-food nexus interlinkages (SDGs 6,7 and 2) and also other interlinked sectors Within such an integrated context that accounts for impacts in most sectors of human endeavor, positive and negative impacts of a planned intervention (be it a new policy measure or the project proposal for new infrastructure) would be made clear and the decision to proceed or not would be fully informed.

D. Public participation and transparency

26. The crucial issue of public participation in renewable energy deployment is becoming more pronounced as renewable energy becomes more mainstream and the impact of individual projects more tangible. Without public acceptance and buy-in, renewable energy investments can be blocked. The Aarhus Convention[7] provides for a solid framework for governments to engage public effectively decision-making in energy sector that may have impact on the environment. Effective and inclusive public participation and access to information should be ensured by relevant public authorities during the preparation of legislation, plans, programmes, policies and projects. Such projects can include: large-scale projects with significant effects due to their size (e.g. utility scale wind/solar), smaller projects with cumulative cross-sectoral impact (e.g. small hydro) and also projects with substantial transboundary effects (e.g. hydropower projects that affect flows between countries).

27. Experience has shown that a transparent, open and clear dialogue on a proposed project early in the planning stage can help address many public concerns that, if not addressed early on, can substantially delay or even completely derail a planned project. Awareness-raising initiatives and educational programmes for broader and more far-reaching interventions should also take place, making the civil society a part of planned change in the sector.

E. Sustainable hydropower deployment and usage guidelines

28. Hydropower is one of the main areas where the interlinkages between energy, water and agriculture are made evident. Moreover, and due to the fact that many rivers cross the boundaries of more than one country, hydropower is a prime example of the need of transboundary coordination and cooperation in the management of a common resource. The impact of hydropower projects mandates the harmonisation of rules on sustainable deployment and usage at various stages of a project's lifetime.

29. The International Hydropower Association provides a comprehensive set of guidelines and specific tools to assess the sustainability of a hydropower project, to identify gaps and to promote continuous improvement. The conformity of a hydropower project with the IHA guidelines and the utilization of the available tools to plan and implement new projects (but also manage existing ones) in a sustainable and nexus-aligned way should be a necessary criterion for the greenlighting of candidate projects. Moreover, on a regional and transboundary perspective, the International Commission for the Protection of the Danube River has developed the Guiding Principles on Sustainable Hydropower. For small hydro, the annex for Reconstruction and Development has issued an Environmental and Social Good Practice Note for Small Hydropower Projects (sHPPs), providing detailed guidance on the management of related environmental and social risks.

30. Broader utilization of international sustainability guidelines and tools would have a dual benefit on hydropower project development: firstly, the projects themselves would better align with international standards for social and environmental sustainability; secondly, demonstrable conformity with an international set of standards would also help with public acceptance of planned hydropower projects. For example, during the Sarajevo and Belgrade Hard Talks, issues of lack of sustainability and public opposition to sHPPs were often the focus of discussions. In such cases, international best practice compliance could have addressed many of the reasonable concerns on sustainability of planned projects and most, if not all, of the perceived ones.

F. Sustainable renewable energy deployment guidelines

31. The development of renewable energy is often not planned adequately and, even when a plan exists, it rarely takes into account the interrelations with other sectors. At the planning

[7] http://www.unece.org/env/pp/welcome.html

stage, a more comprehensive and coordinated strategy is required in order to safeguard the optimal utilization of resources, both at the national and the regional level. To that effect, the National Renewable Energy Action Plans (NREAPs) that many countries prepare according to similar guidelines should also take into consideration broader concerns, incorporating nexus considerations in deployment planning and could examine different deployment scenarios in order to identify the one with more positive outcomes across all interlinked sectors. Moreover, the NREAPs should focus more on the transboundary impacts of the planned actions and, possibly, the option of joint NREAPs (or even regionally coordinated ones) between neighbouring states should be promoted.

G. Regional sector-specific dialogue & coordination

32. To better identify and address transboundary impacts of renewable energy deployment, regional coordination and cooperation platforms and *fora* can be crucial. A good example is the Energy Community's (EnC) Energy and Climate Committee, which is used to strengthen regional cooperation across policy areas and sub-sectors. This regional dialogue often results in coordinated and harmonized approaches between different countries, as in the example of the EnC Secretariat Statement of November 2018 on small hydropower development, which defines common principles for new hydropower development for all member States of the EnC.

33. Regional sector-specific dialogue should also be promoted in the water and food (or, more specifically, agriculture) policy areas. On water, a number of international instruments exist for supporting basin level management of water, both at the global level (e.g. the Water Convention) and for the single river basins (e.g. the International Sava River Basin Commission - ISRBC). Regarding the food and agriculture aspect, the Food and Agriculture Organisation is a valuable global forum for exchange, and some regions can also rely on regional organizations dialogue (as in the example of the Standing Working Group for Rural Development in the Western Balkans).

H. Inter-sectoral dialogue & coordination

34. Beyond the strictly sectoral exchanges, an increase in inter-sectoral dialogue and coordination is required to understand and take into consideration the interrelations of the various nexus components but also, notably, to effectively tackle climate change. An important element to promote this dialogue is the correct identification of stakeholders involved, with stakeholders from other sectors often offering unique, and sometimes invaluable, perspectives that are otherwise overlooked.

35. Once dialogue and coordination pipelines are established across nexus sectors, the next step is introducing all relevant priorities across the spectrum into the decision-making process. To properly reflect all variables, complex modeling tools can be utilized to identify the optimal policy approach across all sectors and, consequently, to prioritize projects and investments on that basis. This approach would not preclude "bottom-up" efforts by policy makers and investors to maximize benefits across sectors and minimize negative impact, as described in this document.

I. Environmental coordination

36. Coordinating nexus priorities in the adoption and implementation of environmental policies is foreseen under the concept of *integrative environmental governance*, which advocates for a "cross-sector coordination and collaboration" in environmental governance that aims to reduce redundancies (duplications and overlaps in policy functions), cover gaps (areas where proper policy arrangements are absent) and avoid incoherence (contradictions in policy and implementation measures). This integrated governance approach includes both the planning stage, with the identification of competent stakeholders, and the implementation stage, with various methods to mobilize public and private sector stakeholders. Moreover, the integrative approach is closely interlinked with many of the nexus-aligned criteria

proposed above, such as strategic assessment and planning, public participation and transparency, sustainable renewable energy deployment guidelines, inter-sectoral dialogue and coordination, and others.

J. Identifying and addressing trade-offs through a "Nexus Compatibility Matrix"

37. A tool for identifying, assessing and mitigating tradeoffs would again prove valuable in promoting renewable energy sustainably, both from the perspective of policy makers as well as from that of project owners and developers. A Matrix that reflects the tension areas across sectors (and also boundaries), identifies "friction points" and provides a toolset from international best practices to address and mitigate them would prove valuable for prioritizing the policy measures and projects that maximize benefits while at the same time minimizing negative impact. A conceptual approach of what such a Matrix on the policy side could look like is included as Annex I to the present document. In a similar way, a tool for project developers could be also developed. This resource document would assist project developers in designing sustainable and bankable RE projects, or nexus-proofing/upgrading them (i.e. maximising their benefits).

V. Conclusions and next steps

38. Energy, water and food are basic human needs that are highly intertwined. This close interrelation poses a danger: attempts to better satisfy one of those needs may have adverse effects in enjoyment of the others. On the other hand, it also creates opportunities: due to the close interlinkages between them, many situations exist where pursuing one of those needs positively reflects on the ability to reach the others. The deployment of renewable energy is therefore a unique occasion to internalize this "nexus thinking" thereby maximizing the economic, social, and environmental benefits that these investments will bring.

39. The foreseen global increase of renewable energy must be planned and implemented on solid analytical foundations. Renewable energy has reached its maturity and the solutions it brings to the energy sectors must actively balance trade-offs associated with other sectors and the environment and result in net benefits. The need for integrated planning to avoid negative impacts, or to offset them by increasing positive impacts, will be fundamental in the success of the transition to clean energy. Notably, the possible transboundary impact of renewable energy projects (beyond hydropower) should always be reduced, and the benefits of complementary solutions maximized: this not only increases trust but also accelerates regional-scale renewable energy deployment.

40. In order to ensure the sustainability of renewable energy, it is crucial to formulate a tool for identification, analysis and evaluation of the cross-sectoral synergies and trade-offs between renewable energy and the water, food and ecosystems nexus sectors. The work already done by ECE in proposing draft "nexus criteria" that help navigate trade-offs and promote synergies, could be expanded upon to formulate such an assessment tool, in the form of a "Nexus Compatibility Matrix" that could be used by policy makers, investors, financiers, civil society organizations and other stakeholders to evaluate the alignment of a proposed renewable energy initiative with nexus considerations.

Annex

I. Draft Nexus Compatibility Matrix

A. Draft Tool for Policy Makers

1. This resource document is meant to help policy makers planning strategically for RE deployment (taking advantage of synergies and minimizing trade-offs including with the environment). This should lead to the identification of most appropriate technologies to apply and where, following the following steps:

(a) Strategic and spatial planning based on potentials and constraints and considering the value of ecosystems;

(b) Definition of most appropriate technologies and locations;

Identification of financing opportunities, including climate finance, green bonds, blended-finance and co-finance of synergic solutions;

(c) Implementation of measures and incentives to stimulate private sector investments;

(d) Implementation of measures and incentives to stimulate private sector investments.

2. The table below is a resource document that helps policy makers considering all aspects of intersectoral synergies (assessment and promotion) and trade-offs (assessment and mitigation) in this process, including at the regional and transboundary level.

Synergies		*Trade-offs*	
Assessment	**Promotion**	**Assessment**	**Mitigation**
Water management and supply		*Water resource availability and quality*	
Improvement of water access (e.g. off-grid pumping, desalination in islands)	Financing through water access grants	Reduced availability and impact on water quality	Strategic Impact Assessment
Maximization of benefits from existing water infrastructure (e.g. floating solar)	Facilitation of permitting process, incentives for existing infrastructure owners/operators	Impact on water flow, sedimentation, floods, etc.	Guidance(s) for sustainable hydropower; Hydropower Sustainability Assessment Protocol (IHA)
Agro-forestry and rural development		*Land resource availability and quality*	
Decreased reliance on grid access for remote regions, standalone or hybrid solutions for irrigation	Partial subsidization of standalone solutions for remote regions	Excessive land use and reduction of natural land	Land considerations in power expansion models; site-specific RE solutions (solar on rooftop, site selection for wind etc.); including environmental and agricultural data in RE potential atlas
Utilisation of biomass from by-products of agro-forestry (wood waste from sawmills, vineyards, sugarcane prod, etc.);	Long term contracts for by-product collection and distribution.	Impact on agricultural land and/or food production	Bans for first generation biofuels; incentives for second and third generation biofuels; PV siting that also allows for agriculture
RE schemes for eco-tourism (remote production or eco-certification)	Incentives to rehabilitate/modernize and increase energy efficiency in remote villages	Impact on soil quality	
Environment conservation/restoration		*Environment degradation*	
Climate mitigation: replacement of existing fuel capacity	Climate financing for RE development	Indirect environmental impact of RE (production of equipment, rare materials for batteries, etc.)	Life Cycle Analysis of RE, prioritization of newer, most efficient technologies
Siting close to consumption centres – minimization of grid losses	Pre-selected sites with easier permitting/land use processes	Impact on local and indigenous population	Public consultation, better communication of regional benefits

Environmental management of RE sites	Planting of trees, waste management rules, compensatory agreements with municipal authorities	Impact on biodiversity	Compliance with international and regional legislation (e.g. Habitats Directive)
Regional complementarities		*Transboundary impact*	
Regional coordination in RE deployment	Encouragement of cross-border capacity planning, more focus on interconnections	Transboundary impact on RE infrastructure. Espoo convention and Protocol on Strategic Impact Assessment; Aarhus Convention and EU Water Framework Directive; Water Convention and Protocol on Water and Health	
Sustainable development		*Indirect impact of RE promotion*	
Accelerating sustainable development	Mapping benefits of RE against SDG targets	Loss of jobs in fossil fuel industry	Re-education of fossil fuel workers in new competences in demand with the RE industry

B. Draft Tool for RE Project Developers

3. This resource document is meant to identify and prioritize sustainable RE projects throughout the project development process. It is addressed to project owners/sponsors, private investors, green funds, banks (commercial and developmental) and developmental organisations and it aims to provide a tool for selection and facilitation of projects, from a "greenfield" state to full commissioning, that exhibit the most positive cross-sectoral synergies while at the same time exhibiting the fewer, and most directly mitigated, cross-sectoral trade-offs.

4. The table below is a resource document that helps stakeholders design and invest in sustainable and bankable RE projects, or nexus-proof and upgrade (i.e. maximise benefits) them:

(a) Chose a technology and a region (this can be based on the outcomes of the work of policy makers (1. Tools for policy makers);

(b) Design a bankable and sustainable project that minimizes environmental and transboundary impact;

(c) Find financing opportunities.

Synergies		*Trade-offs*	
Assessment	**Promotion**	**Assessment**	**Mitigation**
Water management and supply		*Water resource availability and quality*	
Improvement of water access (e.g. off-grid pumping, desalination in islands)	Financing through water access grants	Reduced availability and impact on water quality	Strategic Impact Assessment
Maximization of benefits from existing water infrastructure (e.g. floating solar)	Facilitation of permitting process, incentives for existing infrastructure owners/operators	Impact on water flow, sedimentation, floods, etc.	Guidance(s) for sustainable hydropower; Hydropower Sustainability Assessment Protocol (IHA)
Agro-forestry and rural development		*Land resource availability and quality*	
Decreased reliance on grid access for remote regions, standalone or hybrid solutions for irrigation	Partial subsidization of standalone solutions for remote regions	Excessive land use and reduction of natural land	Land considerations in power expansion models; site-specific RE solutions (solar on rooftop, site selection for wind etc.); including environmental and agricultural data in RE potential atlas
Utilisation of biomass from by-products of agro-forestry (wood waste from sawmills, vineyards, sugarcane prod, etc.);	Long term contracts for by-product collection and distribution.	Impact on agricultural land and/or food production	Bans for first generation biofuels; incentives for second and third generation biofuels; PV siting that also allows for agriculture
RE schemes for eco-tourism (remote production or eco-certification)	Incentives to rehabilitate/modernize and increase energy efficiency in remote villages	Impact on soil quality	
Environment conservation/restoration		*Environment degradation*	
Climate mitigation: replacement of existing fuel capacity	Climate financing for RE development	Indirect environmental impact of RE (production of equipment, rare materials for batteries, etc.)	Life Cycle Analysis of RE, prioritization of newer, most efficient technologies
Siting close to consumption centres – minimization of grid losses	Pre-selected sites with easier permitting/land use processes	Impact on local and indigenous population	Public consultation, better communication of regional benefits

Environmental management of RE sites	Planting of trees, waste management rules, compensatory agreements with municipal authorities	Impact on biodiversity	Compliance with international and regional legislation (e.g. Habitats Directive)
Regional complementarities		*Transboundary impact*	
Regional coordination in RE deployment	Encouragement of cross-border capacity planning, more focus on interconnections	Transboundary impact on RE infrastructure. Espoo convention and Protocol on Strategic Impact Assessment; Aarhus Convention and EU Water Framework Directive; Water Convention and Protocol on Water and Health	
Sustainable development		*Indirect impact of RE promotion*	
Accelerating sustainable development	Mapping benefits of RE against SDG targets	Loss of jobs in fossil fuel industry	Re-education of fossil fuel workers in new competences in demand with the RE industry