Towards sustainable renewable energy investment and deployment

Trade-offs and opportunities with water resources and the environment

The required increase in renewable energy is closely related to broader questions of natural resource management and therefore interlinked to the sectors of water, agro-forestry and ecosystems - the "nexus". The potential impacts of renewable energy expansion on other sectors can be positive (synergies based on complementarity of interests, to multiply beneÿts) or negative (trade-o° s, based on poor planning, generating undesired e° ects). At the level of transboundary basins, both types of impacts can spread across borders, thus necessitating a regional dialogue over renewable energy development.

The purpose of this publication is to support renewable energy policy-makers in identifying and addressing synergies and trade-o° s by guiding them through the three parallel "tracks" of the renewable energy development process: strategic planning (long term); policy design and adoption (medium term); and project development (immediate, short term). This approach aims to help policy-makers in: broadening cooperation across sectors; exploring ÿnancing and partnership opportunities; maximizing the beneÿts of renewables and reducing their negative impact on the environment.

This publication builds on the results of two types of multi-stakeholder dialogues that have been carried out with the support of the United Nations Economic Commission for Europe (UNECE): the Renewable Energy Hard Talks aimed at identifying barriers and policy response to renewable energy deployment; and the Water-Food-Energy-Ecosystem Nexus Assessments (carried out under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, also known as Water Convention) aimed at supporting cross-sectoral and transboundary cooperation.

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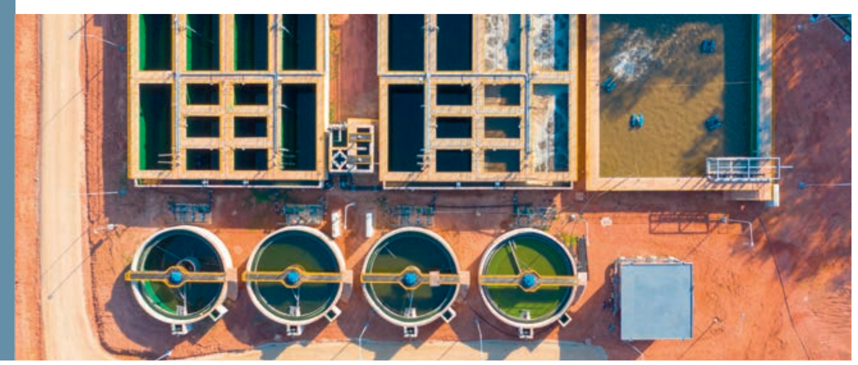

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FOREWORD

As renewable energy becomes mainstream and widespread, the need to integrate sustainability objectives and multi-sectoral priorities into the renewable energy decision-making process becomes imperative. For energy policy-makers, “integration” involves action throughout the whole renewable energy development process, from strategic planning and policy design to project development, to ensure that the objectives and constraints of all sectors are properly considered. Moreover, there are various synergies, in particular with water management and agro-forestry, which should be explored.

This report proposes a pragmatic approach to tackling integration. It builds on existing methods and tools and on the extensive experience of the United Nations Economic Commission for Europe’s (UNECE’s) networks of experts to support policy-makers across the spectrum of relevant sectors: renewable energy development, sustainable management of land and water resources, environmental protection, meeting needs in agriculture and municipalities, and enhancing regional and transboundary cooperation.

This publication is the result of a wide-ranging collaboration across UNECE’s divisions. It calls for policy-makers to leverage the broad and diverse expertise of the variety of sectors and stakeholders engaged in renewable energy to optimize the socio-economic and environmental benefits from renewables deployment and proposes solutions that minimize the trade-offs.

I hope this publication will inspire countries to pursue such green economy opportunities and support them in the implementation of the 2030 Agenda for Sustainable Development and the Paris agreement on climate change.

Olga Algayerova

Executive Secretary

United Nations Economic Commission for Europe

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This publication draws on the Renewable Energy "Hard Talks" carried out in Bosnia and Herzegovina (2018) and in Serbia (2019), as well as from the Water-Food-Energy-Ecosystem "Nexus Assessments" carried out in the Western Balkans (2016-19) under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The active participation in these multi-stakeholder dialogues of policy-makers, experts and civil society from the energy, water, environment, agriculture and forestry sectors was instrumental in the conceptualization of the toolkit proposed in this report.

Vassilis Triantafyllos and Lucia de Strasser are the main authors of this study. Gianluca Sambucini and Annukka Lipponen coordinated and contributed to this publication. The authors wish to thank Ella Behlyarova, Iva Brkic, Francesca Martella-Kehl, Antonin Menegaux, Valentina Paderi, Florian Steierer, and Maryna Yanush for their input and review. The valuable comments by Mark Lambrides, Amy Newsock, and Jeff Opperman are also gratefully acknowledged.

The Italian Ministry of Environment, Land and Sea supported the development of the assessment tool presented in the publication through the Follow-Up Project to the Assessment of the Water-Food-Energy-Ecosystem in the Drina River Basin, assisting policy-makers and investors in identifying and addressing synergies and trade-offs with environment protection and water management in the early stages of planning.

Contents

List of figures

List of tables

Executive Summary

Renewable energy will increasingly drive the transformation of the energy sector. Global energy demand is foreseen to almost double until 2050. Over the next 30 years, the energy sector will undergo major, structural transformations, including decarbonization, electrification and decentralization of production. Electrical power produced from renewable energy has a crucial role to play in this transition, as the declining cost of technologies – notably, solar photovoltaic and wind – are making renewable projects more viable and often competitive with conventional alternatives. Despite variations across countries and fluctuations over time, renewable energy markets are expanding, and policy-makers are being called to facilitate investments through appropriate instruments and regulations. At the same time, they face the complex challenge of maximizing the impact of renewable energy as a catalyst for development while ensuring that its deployment is sustainable.

Renewable energy can drive sustainable development in the agricultural and water sectors, provided that synergies and trade-offs in the water-food-energy-ecosystem nexus are appropriately addressed. The 17 Sustainable Development Goals (SDGs) adopted in 2015 by the United Nations Member States span the economic, social and environmental dimensions of sustainability. Progress towards each of the goals is intertwined with progress towards the others. Together, they form a complex network connected by linkages that are both positive (synergies, reinforcing each other's progress) and negative (trade-offs, hampering each other's progress). Renewable energy technologies can be used to improve access to water and to increase food production, but their deployment can also compete with other needs, bringing unintended cross-sectoral impacts, including on biodiversity and ecosystems. These considerations underline the importance of considering intersectoral impacts and sustainability priorities as early as possible in the renewable energy planning process, and ensuring that they are addressed consistently through well-integrated, sustainable renewable energy projects.

This approach requires the effective implementation of multi-stakeholder, cross-sectoral dialogue along three parallel "tracks": strategic planning, policy design and project development. This report offers a non-comprehensive "toolkit" to enable policy-makers to identify, evaluate and act upon the synergies and trade-offs introduced by the deployment of renewable energy. The aim is to upscale renewable energy while simultaneously facilitating (or at least safeguarding) progress in the other sectors, with a special focus on water, agriculture and environment. Crucially, this must occur at all levels of decision-making: – strategic planning, policy development and project development. The toolkit includes step-by-step guidance to operationalize the identification of key cross-sectoral linkages and sustainability issues at these three levels, and proposes tools and methods to address them in practice. It is thus designed to support a multi-stakeholder, cross-sectoral dialogue process that aims to help policy-makers uncover common context-specific synergies and trade-offs.

Transboundary cooperation and coordination are necessary to exploit regional synergies and to ensure the sustainability of renewable energy deployment. There are significant advantages to cooperating on renewable energy across national borders, notably the opportunity to exploit resource complementarities and pursue common objectives and interests. As renewable energy projects can have transboundary impacts, effective cooperation is also crucial to prevent tensions and ensure appropriate coordination at the basin planning level. Regional cooperation platforms such as international river basin organizations can play a major role in facilitating such dialogue.

Multi-stakeholder dialogue should involve policy-makers from relevant sectors as well as key actors from civil society, industry and investment groups. While energy policy-makers can be regarded as the primary owners of the sustainable renewable energy planning process, the approach proposed in this publication emphasizes the importance of coherent planning across sectors, and calls for all concerned policy-makers to act in concert. The main areas where policy needs to be coherent with renewable energy are water, agro-forestry and the environment, as well as cross-sectoral areas such as climate change, health, employment, tourism and rural development. Multi-stakeholder dialogue must also involve civil society organizations, renewable energy industry representatives, and bankers and financiers. The aim of this heterogeneous approach is to afford the many aspects of renewable energy due consideration. These range from public interest, ownership and awareness, to technical feasibility, bankability, and eligibility for developmental or impact financing.

Strategic planning should not be limited to assessment of the potential of different renewable energy technologies; it must also consider other sectors' priorities. The sustainability of renewable energy deployment begins with resource assessment, spatial planning and target setting. These activities should incorporate geographic, technological and cross-sectoral aspects as well as "nexus priorities" into the strategic planning process. To this end, the report suggests mapping three types of scenarios resulting from intersectoral linkages: "win-win" situations – where the renewable energy potential and synergies with other sectors are high, "lose-lose" – where the renewable energy potential is low and the negative impacts are high, and mixed situations – where there are intersectoral trade-offs that need to be well-understood and addressed.

Renewable energy policies can be vetted to effectively tackle intersectoral synergies and trade-offs, as proposed through the Sustainability Assessment Matrix. To ensure sustainability, policy-makers need to make sure that intersectoral linkages are adequately reflected in renewable energy policy, as well as water, agriculture and environment-related policies. Synergies should be supported and encouraged, and trade-offs should be systematically assessed, transparently discussed, mitigated and, as appropriate, compensated. The report proposes a step-by-step process to map cross-sectoral policy interlinkages, identify potential gaps and barriers, and clarify what needs to be done to address them. This process can be used for evaluating existing renewable energy policies as well as for designing new ones.

Policy-makers should actively engage with private actors and ensure that they are committed to developing sustainable projects. The priorities of all private actors involved in project development should be aligned with those of policy-makers. Such actors will likely include project owners, developers, equipment manufacturers, and engineering, procurement and construction (EPC) contractors, as well as bankers and financiers. To help achieve this alignment, policy-makers should create an enabling environment that facilitates compliance with the relevant standards, including through incentives. They should also ensure that the energy projects have value beyond energy generation and that they are in line with the government's social, economic and environmental priorities, and the state's rules and regulations.

1. Introduction: Integrating sustainability into renewable energy investment and deployment through a "nexus" approach

1.1 The Sustainable Development Goals and the water-food-energy-ecosystem nexus

In 2015, the United Nations Member States adopted the document "Transforming Our World: The 2030 Agenda for Sustainable Development". The Agenda aims to achieve economic, social and environmental sustainability and to improve quality of life. It proposes 17 Sustainable Development Goals (SDGs) as stimulants for action in areas of critical importance. The SDGs cover a broad spectrum of human activities and establish clear objectives necessary to achieve a sustainable future for the world's population.

It is widely acknowledged that the SDGs, specifically those that refer to food security (SDG 2), water and sanitation (SDG 6), and clean energy (SDG 7), are closely interlinked. They all rely to a significant extent on the exploitation of common, finite and increasingly degraded water and land resources. Policies and measures put in place to meet the targets established under each goal may therefore compromise the achievement of the targets under the other two. The inseparable links between these three SDGs form a "nexus" between energy, water and food.[1] Other SDGs are also deeply affected by the increasing exploitation of natural resources, including those calling for climate action (SDG 13) and the protection of life on land (SDG 15). Furthermore, due to humanity's dependence on ecosystem services for resource provisioning, the well-being of ecosystems is a fundamental prerequisite for true sustainable development of the "nexus sectors".[2]

SDG 7 focuses on ensuring access to affordable, reliable, sustainable and modern energy for all. Energy demand is expected to increase by 80% up to 2050 due to expanding global population as well as social, economic and technological developments.[3] Over the same period, the global population will reach 10 billion and food demand will grow by some 50% (compared to 2013, according to a modest economic growth scenario).[4] Global water demand will rise by 55%, reaching 5 500 km^3 (from about 3 500 km^3 in 2000) with manufacturing (+400%), electricity production (+140%) and domestic use (+130%) increasingly in competition with the largest water consumer: irrigation.[5]

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[1] Fader et al. (2018) "Toward an understanding of synergies and trade-offs between water, energy, and food SDG targets", *Frontiers in Environmental Science*, Vol. 6, Art. 112.

[2] In this report "nexus sectors" refers to those sectors that play a role in the management of energy, water, agriculture and forestry resources, as well as environmental protection.

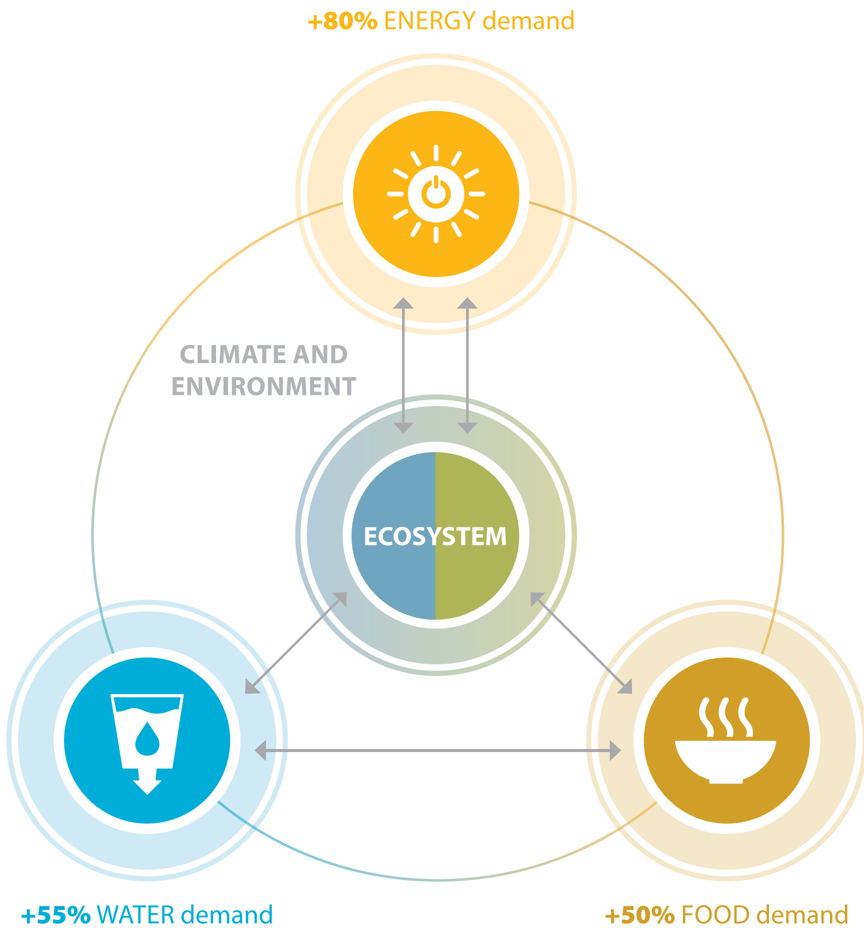
[3] International Renewable Energy Agency (IRENA) (2015) *Renewable Energy in the Water, Energy & Food Nexus.* Abu Dhabi (www.irena.org/publications/2015/Jan/Renewable-Energy-in-the-Water-Energy--Food-Nexus).

[4] Food and Agriculture Organization (FAO) (2017) *The Future of Food and Agriculture: Trends and Challenges.* Rome (www.fao.org/publications/fofa/en).

[5] Organisation of Economic Co-operation and Development (OECD) (2012) *Environmental Outlook to 2050: The Consequences of Inaction*. Paris (www.oecd.org/g20/topics/energy-environment-green-growth/oecdenvironmentaloutlookto2050theconsequencesofinaction.htm).

As these demands drive the nexus sectors to higher levels of production, intersectoral competition for available resources (see Figure 1) will increase due to the constraints of natural resources availability and the degradation of common resources. This competitive approach could result in unmet demands, and increasing struggle to achieve clean energy, safe water and sanitation and food security for all, with serious consequences for health and justice. As there is no set hierarchy or primacy between SDGs, achieving any one of the three goals at the expense of the others simply results in a net social loss.

Figure 1: Increasing demand of resources by 2050 projected in some major global studies (section 1.1) and the water-energy-food-ecosystem nexus



1.2 Renewable energy and the nexus

The energy sector is undergoing a profound transformation. Decarbonization has become a primary concern for governments, who are increasingly being called upon to address the effects of climate change across society and the economy. The electrification of sectors traditionally dominated by fossil fuel-based energy (e.g. transport) is expected to dramatically increase demand for clean electricity. Decentralization is also affecting the historical patterns of energy production and consumption, especially regarding electricity, with a discernible trend towards smaller power generation units located closer to demand and self-generation for residential and industrial usage. This trend is expected to induce significant and structural changes in the energy and nexus sectors.[6]

[6] International Energy Agency (IEA) (2019) *Renewables 2019, Analysis and forecast to 2024: Executive Summary*, p. 4. (www.iea.org/renewables2019).

Furthermore, beyond the well-established benefits from decarbonization, electrification and decentralization, the constantly decreasing cost of technology makes renewable energy[7] investments economically viable and increasingly competitive with fossil fuel options.[8] As a consequence, renewable energy will play an increasingly central role in the energy systems of the future, as a key practical solution to tackling climate change.

Over the last five years, new investments in power generation capacity from renewable energy have consistently surpassed those in fossil fuel-based generation. However, current investments are still below the level required to limit global temperature increases. A significant reallocation of investment capital towards renewable energy is needed to meet the SDGs as a whole.[9][10][11] This is confirmed by the projections of the International Energy Agency (IEA). To reach the sustainability goals (Sustainable Development Scenario), power generation globally from wind and solar photovoltaic sources must jump from 1.5 thousand TWh in 2017, to reach over 14 TWh by 2040.[12] The growth of solar and wind is even more important, as new investments in hydropower have slowed due to the rising costs of investment (often the "best" sites have already been exploited) and the associated costs of addressing environmental and social impacts.[13]

Due to the interlinkages between the three nexus sectors, the required increase in renewable energy investment could potentially have a positive impact on the other nexus sectors. However, as of today, most renewable energy policies and projects are not explicitly designed to exploit synergies. Furthermore, as with conventional energy technologies, renewables also make use of natural resources, and theirs demand in terms of land and water, in particular, can be significant (examples include large dam and the associated reservoir, or the extensive cultivation of crops for biofuel production). As result, they may end up competing with and affecting the development of other nexus sectors.[14] Renewable energy deployment can therefore be associated with painful cross-sectoral trade-offs, particularly with agricultural production and water supply.

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[7] This report defines renewable energy broadly as a type of energy that comes from "natural sources that are replenished at a faster rate than they are consumed" (Renewable Energy Policy Network for the 21st Century (REN21) (2019) *Global Status Report 2019*). The most common sources are hydro, biomass, geothermal heat, solar and wind.

[8] IRENA (2019) *Renewable Power Generation Costs in 2018*. Abu Dhabi (www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/May/IRENA_Renewable-Power-Generations-Costs-in-2018.pdf); IRENA (2016) *The Power to Change: Solar and Wind Cost Reduction Potential to* 2025 (www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Power_to_Change_2016.pdf).

[9] Renewable Energy Policy Network for the 21st Century (REN21) (2019) *Global Status Report 2019*, Chapter 1, Figure 3. (www.ren21.net/gsr-2019).

[10] For 2019, net new generating capacity by renewable energy sources is estimated to increase by 12% compared to the previous year, representing the largest growth comparable with 2015, the previous record-setting year.

[11] International Energy Agency (IEA) (2019) *World Energy Investment 2019*. Paris (https://webstore.iea.org/world-energy-investment-2019).

[12] IEA (2018) *World Energy Outlook 2018*. Paris (www.iea.org/weo2018).

[13] IEA (2019) *Renewables 2019: Market Analysis and Forecast from 2019 to 2024*. Paris (www.iea.org/fuels-and-technologies/hydropower).

[14] This report focuses only on water and land resources and does not discuss the broader impact of renewable energy deployment on global resources and the life cycle of equipment (e.g. mining, manufacturing, decommissioning, etc.).

Increasing environmental, social and economic sustainability thus requires the systematic exploitation of synergies and a reduction in trade-offs across the deeply interconnected nexus sectors. The processes involved in planning and deploying renewable energy should be designed to account for all these cross-sectoral impacts, and should aim to multiply the benefits of renewable energy across sectors, as well avoid unnecessary competition for resources that could slow development in each sector. For instance, the use of degraded land and water could be prioritized over the conversion of highly productive land and biodiversity-rich water bodies. As nexus sectors depend on the same natural resources and ecosystems, prioritizing the sustainable utilization of resources to preserve them more effectively becomes a common interest of investors and policy-makers across all sectors.

It is worth underlining the economic argument behind the idea of "doing more with less" that is intrinsic to Agenda 2030 and the nexus approach. Energy demand growth will require new energy investments. Renewable energy sources will continuously become more widespread because they represent the most preferable way to meet that demand while also achieving the goal of limiting global warming to below 1.5°C relative to pre-industrial levels. Financing is commonly also sectoral, therefore investors in all sectors need to cooperate more closely to contribute to the simultaneous achievement of multiple goals. The case of renewable energy deployment is particularly evident, given the massive effort that will be required to finance new investments.

1.3 Integrating sustainability across sectors and countries

The sustainability of renewable energy must be appropriately integrated throughout the planning and deployment processes to ensure that proliferation of renewables does not impede progress in neighbouring sectors and countries. The resulting renewable energy strategies, policies and projects should be sustainable and compatible with other sectoral plans, and should multiply the social, environmental as well as economic benefits of renewable energy deployment (Box 1).

Box 1: The "European Green Deal": A cross-sectoral approach to sustainability

At the strategic planning level, an example of a regional approach to sustainability is the recently announced "European Green Deal". In December 2019, the President of the European Commission outlined a package of measures for the European Union which aim to improve the well-being of people by making Europe climate-neutral (net-zero greenhouse gas emissions by 2050) and protecting natural habitats.[15] The key steps to achieving those objectives include decarbonization of the energy sector through greater deployment of renewables, measures for increased energy efficiency in buildings, a focus on a circular economy, protection of ecosystems and biodiversity, adoption of a green and healthier agriculture system and increasing uptake of electric vehicles, among others.[16] This cohesive and systemic cross-sectoral approach to sustainability across Member States of the European Union focuses on renewables within the greater context of environmental protection and sustainable development.

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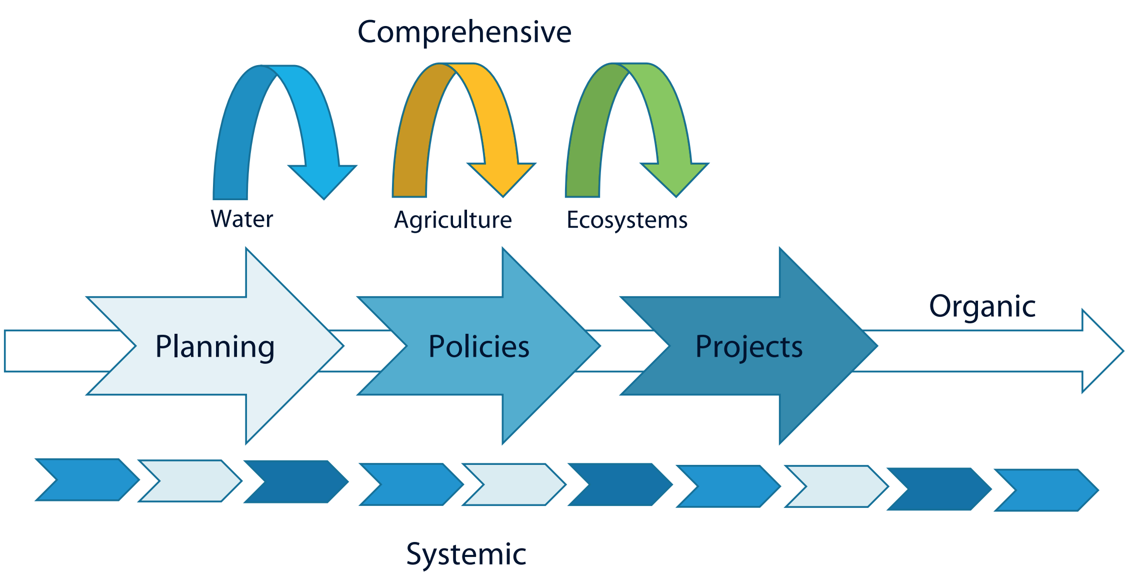
[15] For more information see the European Commission Website (https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en).

[16] Climate Change News Website, "The EU releases its Green Deal. Here are the key points", 12 December 2019 (www.climatechangenews.com/2019/12/12/eu-releases-green-deal-key-points).

Several processes and methods from international best practices have attempted to introduce sustainability concerns into the decision-making processes, either directly or indirectly. For example, the need to assess the environmental and social impacts of new renewable projects is well understood, and many countries have introduced such requirements for project developers. Similarly, consultation of multiple stakeholders (including from other sectors) prior to the adoption of new policy measures – or the associated laws – has become an accepted principle of good governance and transparent decision-making related to renewable energy projects.

However, in practice the introduction of sustainability variables throughout the process is not sufficiently integrated to guarantee systematic consideration of sustainability and cross-sectoral concerns. In the case of renewable energy, projects are most commonly identified and proposed by private developers or utilities, and not as a result of systematic renewable energy planning. The need for a more comprehensive approach is evident. The renewable energy decision-making process should integrate the assessment of nexus considerations at every relevant step. Moreover, this integration needs to be both organic (decision-makers need to internalize such assessment of cross-sectoral and environmental concerns and not view it as something foreign, irrelevant or hostile to the progress of their sector), and systemic (it should form a system of continuous planning, monitoring and evaluation of impacts, permeating all decision-making processes) (Figure 2).

Figure 2: Addressing the sustainability of renewable energy in a comprehensive, organic and systemic manner



Since competition over land and water resources can lead to tensions (both within and across national borders), such a holistic assessment of impacts is crucial for conflict prevention. The impacts of renewable energy can propagate directly or indirectly, most commonly through water resources (water flow, sediment flow, conditions of river habitats, etc.). As 60% of global water resources are internationally shared, managing transboundary impacts is a necessity for many countries and settings. Large hydropower development and reservoir operations are among the most common causes of transboundary tensions, as they directly affect water availability and flow management. However, large hydropower plants aside, other and unexpected issues will start to arise as renewable energy investment proliferates. For example, small hydropower can have a significant cumulative impact on the environment, biomass consumption can drive forest degradation and increase flood risk,[17] the cultivation of thirsty bioenergy crops can add to water demand, and even the deployment of large solar and wind farms can bring significant changes to land use.

The exploitation of shared resources for renewable energy deployment can create regional tensions in many ways, underlining the importance of dedicated regional and transboundary dialogues. In fact, increased collaboration among countries would not only help to mitigate trade-offs, but also help to better exploit transboundary synergies and complementarities on the basis of shared interests and broaden regional cooperation.

[17] This can have an impact on water through the "forest-water nexus", as described in FAO (2019) *Advancing the Forest and Water Nexus* (www.fao.org/3/ca6483en/CA6483EN.pdf).

2. A toolkit to manage cross-sectoral and transboundary impacts

2.1 The need for a practical toolkit for policy-makers

The need to consider nexus sectors in renewable energy planning was first highlighted in a 2015 report by the International Renewable Energy Agency (IRENA) entitled *Renewable Energy in the Water, Energy and Food Nexus*.[18] The report explored various synergies and trade-offs between renewable energy, water and food production, calling for the development of a practical assessment tool to identify, quantify and assess the impact of energy policy choices in the energy-water-food-ecosystems nexus, and conceptualizing the incorporation of sustainability concerns into renewable energy deployment. In the same year, the United Nations Economic Commission for Europe (UNECE) published a methodology for assessing nexus issues in transboundary basins,[19] the first applications of which highlighted the important role of renewable energy.

In 2017, UNECE published a report[20] exploring good practices and policies for intersectoral synergies and sustainability in renewable energy deployment. The publication provides examples of synergies between renewable energy and the energy-water-food-ecosystems nexus, and proposes tools to identify, explore and exploit them. The aim was to maximize the value of renewable energy and amplify positive impacts to the interlinked nexus sectors. Going beyond a strictly national approach, the report also examines the potential synergies between renewables and the nexus sectors from a transboundary perspective. By advocating collaboration and coordination between riparian countries in renewable energy planning and deployment, it showcases a variety of possible benefits in regional cross-sectoral coordination and cooperation on renewable energy development, and calls for the development of an "energy-specific nexus assessment tool" to assess renewable energy initiatives from a nexus perspective (Figure 3).

The global environment community also issued a similar call for stronger cooperation on sustainable renewable energy at the policy level. In 2019, the World Wildlife Fund and the Nature Conservancy published the report *Connected and Flowing*,[21] which illustrates how the adoption of a truly sustainable mix of renewable energy can protect vital river ecosystems and the well-being of local communities. The central idea is to reduce the bias towards hydropower as the most convenient renewable energy technology and encourage planning for renewables at the level of power systems (considering all technologies) and regional cooperation (valuing the complementarity of resources). The report summarizes the challenges that policy-makers face in developing a power system that is low-carbon, low-cost and low-impact (in terms of negative social and environmental costs).

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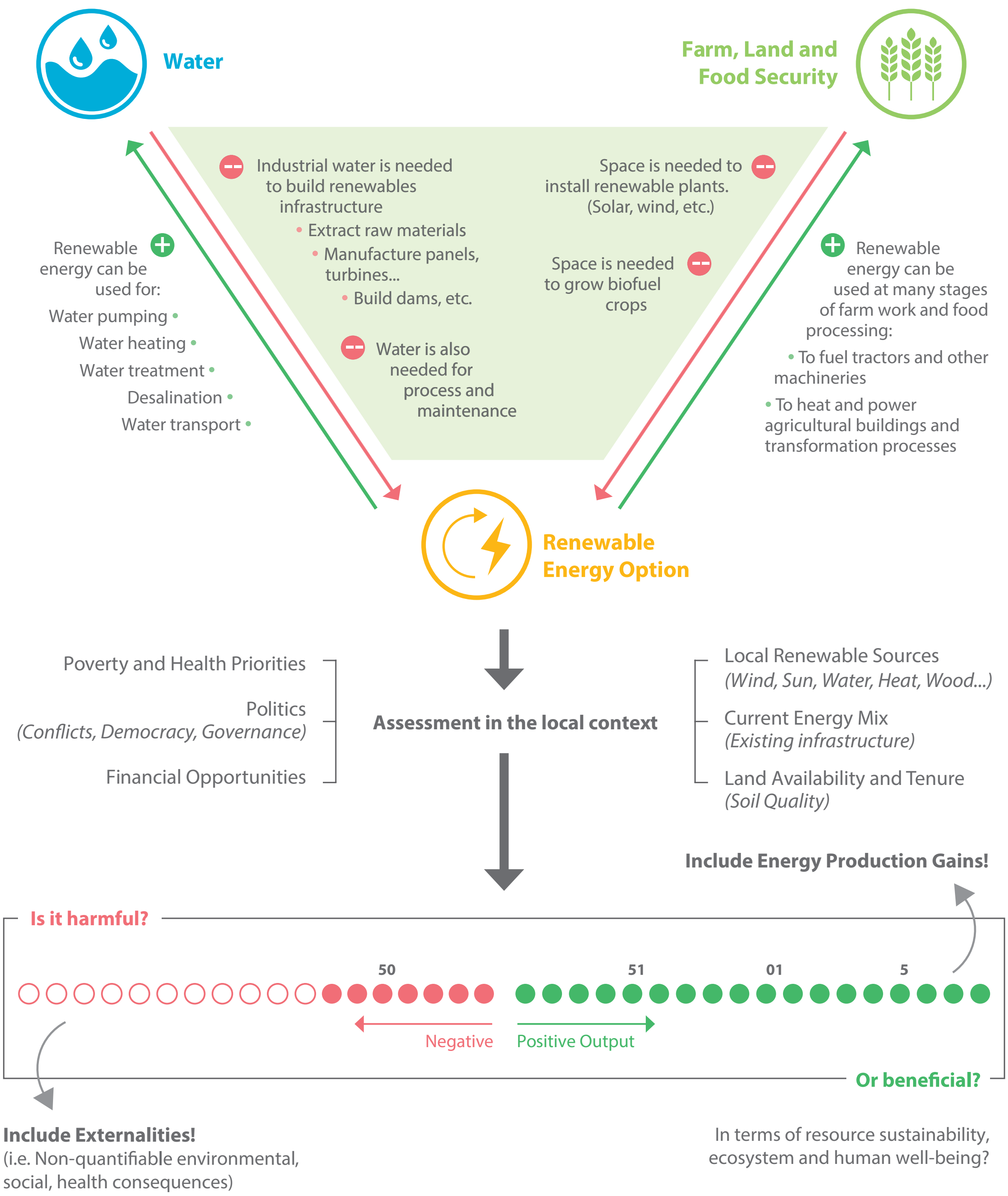
[18] IRENA (2015) *Renewable Energy in the Water, Energy & Food Nexus*. Abu Dhabi (www.irena.org/publications/2015/Jan/Renewable-Energy-in-the-Water-Energy--Food-Nexus).

[19] UNECE (2015) "Reconciling resource uses in transboundary basins: Assessment of the water-food-energy-ecosystems nexus". Geneva.

[20] UNECE (2017) "Deployment of renewable energy: The water-energy-food-ecosystems nexus approach to support the Sustainable Development Goals". Geneva.

[21] Opperman, J. et al. (2019) *Connected and Flowing: A Renewable Future for Rivers, Climate and People*. Washington, DC: WWF/The Nature Conservancy (nature.org/content/dam/tnc/nature/en/documents/TNC_ConnectedFlowing_Report_WebSpreads.pdf).

Figure 3: Proposed framework to develop an "energy-specific nexus assessment tool" for renewable energy development[22]



The next step is to operationalize a toolkit for policy-makers to assist them in producing strategic plans and sustainable policies and projects, through:

- systematic identification of cross-sectoral synergies and trade-offs

[22] UNECE (2017) "Deployment of renewable energy: The water-energy-food-ecosystems nexus approach to support the Sustainable Development Goals".

- definition of appropriate policy responses to maximize and minimize them, respectively
- enhancement of transboundary coordination and cooperation.

Accordingly, the toolkit proposed in this report targets mainly policy-makers, and places a strong emphasis on the various opportunities – not to be missed – to maximize the positive impact of renewable energy development, across both sectors and countries. The toolkit also helps to navigate the various trade-offs.

2.2 Synergies and trade-offs between renewable energy and nexus sectors

Synergies exist where the most beneficial option for one sector also provides benefits in at least one other nexus sector. This creates a "win-win" scenario for the nexus sectors involved. In the case of renewable energy policy choices, the identification and exploitation of cross-sectoral synergies between renewable energy and the agricultural production or water sectors, compound and distribute the net social benefit of renewable energy across other sectors, making what is an already attractive proposition (i.e. renewables as a clean energy source) an even higher policy priority.

Trade-offs exist where positive outcomes in one sector bring about negative outcomes in another. In many cases, the impact of renewable energy is preferable to a non-renewable alternative. In fact, assuming that a specific increase in energy demand must be met by increasing energy generation (although this may not always be the case; see Box 2), renewable energy will often present an advantage, since its environmental footprint is typically lower than that of conventional options, such as coal-fired plants. However, in some cases trade-offs call for careful consideration of alternatives. For instance, as pointed out in the IRENA 2015 Report,[23] some renewable energy technologies (e.g. Wind and Solar PV) are much less water intensive than fossil fuel-based technologies (e.g. coal-fired electricity plants), but others (e.g. Concentrated Solar Power (CSP) or Bioenergy) have a substantial water footprint that is particularly important to consider in situations where water is scarce. Trade-offs correspond to "win-lose" scenarios.

Box 2: The "energy efficiency first" principle

From a systems perspective, the addition of new renewable energy capacity should be compared with the impact of energy efficiency measures. The "energy efficiency first" (EE1st) is a key principle of energy security and sustainability, and has been adopted and actively promoted, among others, mainly by the European Union.

On 30 November 2016, the European Commission presented the Clean Energy for all Europeans package of proposals, known as the Clean Energy Package (CEP).[24] The proposals aim to bring EU energy legislation into line with the new 2030 climate and energy targets, and contribute to the

[23] UNECE (2017) op. cit. fn. 2, p. 13, fig. 4.
[24] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, Clean Energy For All Europeans, COM/2016/0860 final.

2015 Energy Union goals.[25] The CEP and subsequent amendments evolved into a set of Regulations and Directives which constitute the strategic approach of the European Union on Energy – namely, to lead the clean energy transition by adopting three main goals: putting energy efficiency first, achieving global leadership in renewable energies and providing a fair deal for consumers. The "energy efficiency first" principle encapsulates the main goal of the EU transition to clean energy, and is intended to ensure secure, sustainable, competitive and affordable energy supply in the European Union.

"Energy efficiency first" applies to all policy-making and investment decisions, and ensures that energy-saving solutions are not overlooked or undervalued; that benefits from energy efficiency are valued accurately and over the long term; and that policies that prioritize investment in energy efficiency are actively pursued. Any assessment of policies that aim to increase investment in new renewable energy should compare such policies against a scenario where investment in energy efficiency could bring about the same energy sector policy goals.

The "energy efficiency first" principle can also be considered from a nexus approach, where multiple benefits and/or cross-sectoral synergies arise from investments in energy efficiency. This could be the case, for example, for municipal water utilities, whose role in providing clean water will become increasingly crucial, and where a joint "water-energy efficiency" approach will be needed to tackle water losses, while simultaneously reducing the cost of operations (energy typically represents the highest expenditure for water utilities) and wastewater treatment (see Box 3).[26]

Policy-makers should be able to navigate the impacts of their possible choices across different sectors, in order to systematically identify "win-win" and "win-lose" scenarios, and to decide how to act in both cases. Once trade-offs are identified, the quantification of all effects, positive and negative, across the different nexus sectors can provide policy-makers with clear indications of the overall cross-sectoral value of a given choice, and set the basis for an informed discussion on trade-offs using the "avoid, mitigate, compensate" approach.

The first step in capitalizing on synergies and addressing or mitigating trade-offs is to identify and understand them. Appropriate methodologies must be applied to assess the benefits across sectors, and to look beyond evident synergies for possible hidden trade-offs in less obvious areas. In promoting cross-sectoral nexus synergies,[27] research has shown[28] that, although positive interactions can be identified between almost all secondary targets under SDGs 2, 6 and 7, no pair of targets under any of the three nexus SDGs displays synergies without also presenting trade-offs. It is therefore crucial to examine and assess interlinkages thoroughly before planning the deployment of renewable energy, in order to understand how it will affect the nexus sectors as a system.

[25] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, COM/20150080 final.
[26] See IEA on Energy and Water: www.iea.org/weo/water.
[27] A review and quantitative analysis of 37 projects related to the energy-water-food nexus can be found in: Endo et al. (2015) "A review of the current state of research on the water, energy, and food nexus", *Journal of Hydrology: Regional Studies*, Vol. 11(2017), pp. 20-30.
[28] Fader et al. (2018) op. cit. fn 1, p. 6.

It is important to stress that the synergies and trade-offs between renewable energy and other nexus sector needs are often context-specific. A thorough analysis of the particularities of each renewable energy policy initiative and its possible interactions with other nexus sectors must precede any conclusion regarding the determination of synergies and trade-offs. Once synergies and trade-offs have been identified, policy-makers can take more informed decisions about the specific measures and incentives to be adopted to encourage the promotion of identified synergies or the mitigation of possible trade-offs. They can examine planned policies and adjust those already in place with a clearer understanding of the overall net social value the measures aim to create.

Furthermore, the multiple benefits provided by renewable energy and the reduction in the negative impact on the environment and local communities, can make a significant difference in terms of reducing the political risks of investments. The ability of policy-makers to systematically exploit synergies, and identify and mitigate trade-offs related to renewable energy, can increase social acceptance among the public and boost interest from investors.

2.2.1 Renewables and water

The relationship between water and energy is well understood. In most energy production processes, water is a key input. Most thermal power plants require water for cooling, and water produces energy via small and large hydropower plants; water is also an important factor in the extraction of fossil fuels. Only wind and solar PV exert almost insignificant pressures on water demand (with the exception of solar-powered irrigation which can indirectly increase water withdrawals).[29] Conversely, energy is necessary to sustain and improve water services. It makes water more easily availably (pumping, conveying and distributing) and cleaner (treating wastewater and desalinizing brackish water).[30]

An important aspect of the linkages between water and renewable energy is the possibility to increase access to both energy and water by adopting a synergistic approach. Renewable energy-based desalination, pumping or water treatment technologies can provide low-energy intensity solutions for increased access to water covering a variety of uses. The ability to deploy these renewable-based solutions in a distributed, stand-alone and small-scale manner can also make them ideal for areas where access to energy (as well as water) is limited (e.g. islands or remote farming locations). Other synergies may be found in the maximization of benefits from existing infrastructure. For example, "floating solar" PV on hydropower reservoirs increases the energy output of existing infrastructure without exerting additional pressure on water or land, although it may result in increased variability locally.

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[29] World Bank (2013) *Thirsty Energy: Securing Energy in a Water-Constrained World*, p. 3 (http://documents.worldbank.org/curated/en/835051468168842442/Thirsty-energy).
[30] WWAP (United Nations World Water Assessment Programme) (2014) *The United Nations World Water Development Report 2014: Water and Energy*. Paris: UNESCO.

Box 3: Municipal wastewater and renewable energy

Municipal wastewater treatment is energy intensive and therefore an expensive business. After personnel, energy in most cases represents the main cost for water utilities. Together with desalination and large-scale water transfers, wastewater treatment will contribute to doubling the global energy demand of the water sector by 2040.[31] Utilities and governments are therefore urged to innovate and improve the financial viability of the sector.

A water-energy integrated approach to this challenge would aim to make the sector energy neutral and even, potentially, generate more energy, which can then be sold. This can be done in three steps: firstly, by decreasing the demand for energy in the wastewater treatment process (aeration control alone can decrease demand by 50%); secondly, by recovering energy from wastewater; and thirdly, by generating the extra energy from other sources, on site.[32] While the first step is a matter of energy efficiency (see Box 2), the second and third involve renewable energy production.

Energy recovery is most commonly associated with bio-chemical processes aimed at exploiting the calorific value of wastewater (i.e. producing bioenergy, normally biogas, from anaerobic digestion, sludge treatment, etc.). However, there is also potential for thermal and mechanical energy recovery from effluents (via heat exchangers and hydropower, respectively). Then there are two main possibilities for producing extra renewable energy on site: boosting bioenergy production with additional input (e.g. organic waste or by-products from other sources) and producing electrical power from renewables (e.g. solar panels or hydro from other streams).[33]

One example from the Western Balkans region is the wastewater treatment plant in the city of Subotica, Serbia, where energy recovery (biogas from sludge treatment) has played a central role in the modernization aimed at upgrading wastewater treatment to EU standards.[34]

Possibilities for renewable energy in wastewater vary greatly depending on the available technology, capacity, costs and applicability. From a circular economy perspective, waste from agriculture and forestry could also be used in combination with wastewater to produce biogas, thereby generating co-benefits in these sectors. Overall, efforts to enhance the modernization of the wastewater sector would bring significant environmental and social benefits, notably a reduction in the pollution of water sources, a key objective of tourism development.

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[31] International Renewable Energy Agency (2017) *Water-Energy Nexus: World Energy Outlook Special Report*. Paris: IEA (www.iea.org/reports/water-energy-nexus).

[32] Maktabifard et al. (2018) "Achieving energy neutrality in wastewater treatment plants through energy savings and enhancing renewable energy production". *Reviews in Environmental Science and Bio/Technology*, Vol. 17, p. 655.

[33] Ibid.

[34] Municipal Infrastructure Support Programme of Serbia, Project Factsheet Subotica (www.misp-serbia.rs/wp-content/uploads/2010/05/FS-subotica-2012-EN.pdf).

2.2.2 Renewables and agriculture (food), forestry and rural development

Energy and food are intrinsically linked, as energy is required to grow, transport, process and store food. At the same time, agricultural products can be used as fuel for energy production. One of the key cross-sections between energy and agricultural production (food, feed and fibre) is land use. Intersectoral competition for land availability revolves mainly around land for biomass (energy crops) versus land for food production; however, potential conflicts with solar PV siting and wind power also exist. Although land use is traditionally considered as a trade-off between the two sectors, some approaches treat it as a synergy (as in the case of "agrovoltaics" or "solar sharing"; see Box 5, section 2.2.3).[35]

Overall, distributed and integrated renewable energy generation can make the agricultural sector "climate smart" by increasing access and energy availability for a variety of uses, improving resilience to extreme weather events and reducing local pollution. In the case of rural development, renewable energy can be a driver for increasing the social welfare of remote and rural communities and creating new jobs in the new, low-carbon economy.[36]

Renewable energy from waste can also be mentioned in this category because of the very high potential – most often unexploited – of producing bioenergy from agricultural waste[37] as well as food waste generated by restaurants, supermarkets and households. One of the main barriers to the development of this type of renewable energy is the absence of established value chains. This is, therefore, one area where cross-sectoral cooperation could result in multiple benefits (e.g. waste reduction, renewable energy production and job creation).

A similar consideration can be made for wood energy, which is commonly used for heating and cooking in many countries, and forest biomass in general (which includes by-products from the wood industry). Forests play an important role in producing and regulating freshwater flows, and forested watersheds are essential for sustaining freshwater supply. The SDGs related to water (SDG 6) and land (SDG 15) explicitly acknowledge the linkages between forests and water.[38] Forests are also an important source of energy. In many developing countries, wood energy provides the majority of total energy supply, while in several developed countries wood energy accounts for nearly 25% of total energy supply.[39] The provision of energy from forests can be a key factor in forest degradation, but can also be the key to sustainable forest management if the appropriate value chains are set up and sustainability principles are taken into account.[40] (Box 4) Overall, waste valorization has a major role to play in

[35] Jossi, F. (2018) "Putting the 'farm' back in solar farms: study to test ag potential at PV sites", *EnergyNews*, (https://energynews.us/2018/01/22/midwest/putting-the-farm-back-in-solar-farms-study-to-test-crop-potential-at-pv-sites).

[36] IRENA (2019) "Renewable Energy and Jobs – Annual Review 2019" (www.irena.org/publications/2019/Jun/Renewable-Energy-and-Jobs-Annual-Review-2019).

[37] See, for instance, www.fao.org/3/a-i8150e.pdf.

[38] UNECE (2018) *Forests and Water – Valuation and Payments for Forest Ecosystem Services* (www.unece.org/fileadmin/DAM/timber/publications/sp-44-forests-water-web.pdf).

[39] UNECE (2017) *Wood Energy in the ECE Region – Data, Trends and Outlook in Europe, the Commonwealth of Independent States and North America* (www.unece.org/fileadmin/DAM/timber/publications/SP-42-Interactive.pdf).

[40] See, for instance, WWF (2012) *Living Forests Report*, Chapter 4. Forests and wood products (http://d2ouvy59p0dg6k.cloudfront.net/downloads/living_forests_report_ch4_forest_products.pdf).

increasing the sustainability of bioenergy production and contributing to rural development (valuing waste can generate an important secondary income stream for farmers and wood producers).

Box 4: Wood energy: Linking forestry and rural development

One-third of the surface of the UNECE region is covered by forest. This significant share of land cover implies that the management of forests has direct and indirect impacts on other land use in general and water management in particular.

In countries in economic transition, wood is a major source of fuel for heating and is often harvested and traded in informal ways. Green wood is often preferred due to its lower burning temperature (especially in inefficient burning equipment), which leads to severe degradation of indoor and outdoor air quality. Such inefficient use results in higher wood consumption, while uncoordinated removal of wood increases pressure on easily accessible areas of forests close to road infrastructure. The resulting degradation of local forest results heightens water runoff and soil erosion, which in turn increase the sediment charges of rivers and dams.

Wood energy, even if derived from unrecorded removals and traded informally, represents an important source of livelihood in rural areas. The overall contribution of wood energy to national economies is an often neglected and widely underestimated economic factor in countries in transition. An FAO study[41] in Serbia analysed in detail the contribution of wood fuel to climate change mitigation and the economy of Serbia, and found that the current use of wood energy substitutes for imports of light heating oil to the value of EUR 1.3 billion, or EUR 650 million for natural gas (total Serbian GDP in 2010 was EUR 60 billion). Use of wood fuel also averted CO_2 emissions of about 7 million tonnes from fossil fuels.

Countries in economic transition may consider assessing in detail the social, economic and environmental role of wood energy, and consider embracing wood energy as a solution towards achieving SDG 7. Wood energy projects at national level can contribute to: (i) improving air quality; (ii) increasing income generation in rural areas; (iii) developing new industrial sectors (e.g. stove manufacture); (iv) reducing pressure on national forest resources; and (v) reducing erosion and runoff from slopes, decreasing sediment charge in rivers and improving filtration of drinking water.

The biggest comparative advantage of wood fuel is its local application for generating heat. Countries might consider switching fuels to wood chips for larger public buildings such as hospitals, schools and administrative buildings in areas with abundant resources. Wood chips are the fuel of choice for such medium and large-scale heat applications. Moreover, forests are not the only source, with wood chips available as by-products of infrastructure maintenance, such as roadside greening, electric power line vegetation control, and park and garden management.

[41] FAO (2015) *WISDOM Serbia – Spatial Wood Fuels Production and Consumption Analysis* (www.fao.org/3/a-i4394e.pdf).

2.2.3 Renewables and the environment (ecosystems)

While non-renewable energy sources generally have a detrimental effect on ecosystems and the environment, the effect of renewable energy is overall less environmentally harmful, even when the varying ecological footprints of different technologies are taken into consideration. Notably, large-scale hydropower development produces major impacts and the cumulative effects of small-scale hydropower can also be significant. The positive environmental impact of distributed and integrated renewable energy in the context of housing (both in urban and rural contexts) is well documented. Renewable technologies for water heating and electricity self-generation can help reduce indoor pollution and decrease significantly the carbon footprint of households. Overall, these "green" residential solutions can attract ecologically sensible tourism to remote areas of high environmental value.

The deployment of large-scale renewable generation brings environmental benefits in terms of greenhouse gas (GHG) emission reduction, where it substitutes or reduces the need for production from more polluting and more carbon-emitting alternatives (thereby contributing crucially to addressing the global environmental and climate crisis). Nevertheless, as with any other infrastructure development, such large-scale deployment may have a non-negligible environmental impact (e.g. the impact on marine and land ecosystems of off-shore and on-shore wind power generation, respectively). This is not just restricted to construction and operation; decommissioning (end-of-life equipment) can also produce environmental impacts.[42]

It is important to emphasize that renewable energy is not intrinsically biodiversity-friendly, and may create disturbance when deployed in areas that impact wildlife and natural habitats. It is of utmost importance, then, to support research into solutions that effectively integrate biodiversity into the design of renewable energy. Box 5 provides a good example of how such research can lead to multi-benefit solutions (to agriculture and energy) and support biodiversity conservation.

Box 5: Pollinator-friendly solar: From science to policy

The interrelationship between solar photovoltaic power and agriculture is traditionally understood as one of competition for a mutually needed resource: land use. The ability to site solar photovoltaic installations on agricultural land which could otherwise be used for farming or raising of livestock is one of the main arguments against this otherwise generally non-intrusive renewable technology.

A number of initiatives turned this trade-off into a synergy, by converting solar power plants into pollinator habitats and bee boxes to assist declining bee populations in the United States and elsewhere.

[42] Potential unintended environmental consequences of renewable energy development are evaluated in J. Kiesecker et al. (2019) "Hitting the target but missing the mark: Unintended environmental consequences of the Paris Climate Agreement", *Frontiers in Environmental Science*, 9 October (www.frontiersin.org/articles/10.3389/fenvs.2019.00151/full).

A team of researchers from the Environmental Science division of the Argonne National Laboratory (United States)[43] has been examining the potential benefits of establishing pollinator habitats at utility-scale solar energy (USSE) facilities, with the aim of conserving biodiversity and restoring ecosystems. The area around solar photovoltaic installations generally remains uncultivated. However, research has shown that these locations are perfect for planting native species – key habitats for pollinators such as honeybees and monarch butterflies – in the hope of encouraging steady population growth among pollinator species.

The research focused on three common crops (soybeans, almonds and cranberries) that are dependent on insect pollinators for their annual crop yields, and quantitatively assesses the financial benefits from making solar farms near these crop types pollinator-friendly.

On the basis of this research, the State of Illinois adopted a "Pollinator-Friendly Solar Energy Bill" in 2018[44] which, along with the states of Maryland and Minnesota, encourages solar developers to create habitats for bees, monarch butterflies and other pollinators within their solar sites. This represents a good example of policy-making using scientific research and industry practices to encourage and further enhance nexus-compatible initiatives, leading to concrete policy actions.

2.3 Transboundary coordination and cooperation

The need for coordination and cooperation is evident in the case of transboundary basins, where the ability to work together on the management of water resources – even at a technical level through effective exchange of information – can be crucial to averting disasters related to extreme weather events or water contamination. Planning jointly, coordinating policies and actions, and exchanging data and information across national borders can add significantly to the effectiveness of water management in shared basins. Overall, effective transboundary cooperation can bring significant benefits to riparian countries compared to non-cooperation. These benefits can be economic (e.g. increased opportunities for market integration), but may also be of other types (e.g. increased political stability, environmental sustainability, etc.).[45]

As discussed, renewable energy deployment can bring negative transboundary impacts and, simultaneously, complementarities and common interests that motivate cross-border cooperation (Box 6). Platforms and channels established for transboundary cooperation could play a key role in discussion about renewable energy planning at basin level (accounting for the specific hydrogeology of the basin and the potential for joint projects), hydropower being the most obvious example. For other technologies, benefits might relate to scale, coordination in obtaining technology, and

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[43] Walston et al. (2018) "Examining the potential for agricultural benefits from pollinator habitat at solar facilities in the United States", *Environmental Science & Technol*ogy, Vol. 52, pp. 7566–7576, 1 (https://pubs.acs.org/doi/10.1021/acs.est.8b00020).

[44] Environmental Law and Policy Center, Press Release: "Illinois pollinator-friendly solar energy bill passes, adds momentum to solar energy development", 30 May 2018 (http://elpc.org/issues/clean-energy/solar/press-release-illinois-pollinator-friendly-solar-energy-bill-passes-adds-momentum-solar-energy-development).

[45] UNECE (2015) *Policy Guidance Note on the Benefits of Transboundary Water Cooperation: Identification, Assessment and Communication*. Geneva; UNECE. 2018. *Identifying, assessing and communicating the benefits of transboundary water cooperation*. Geneva.

optimizing the use of cross-border infrastructure, particularly for flow regulation and storage to address variability concerns.

Box 6: The Water Convention's nexus approach to transboundary cooperation

The Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Water Convention) have established a Task Force on the Water-Food-Energy-Ecosystems Nexus to oversee nexus assessments of natural resource management in shared water basins. Using a Transboundary Basin Nexus Assessment (TBNA) methodology developed specifically for this purpose, a series of transboundary assessments have been carried out exploring intersectoral challenges as well as opportunities arising from closer cooperation on natural resource management across sectors and countries. To date, the methodology has been applied to six transboundary river basins and one shared groundwater aquifer.[46] The experience acquired has been documented in a comprehensive synthesis report[47] that illustrates the methodology and the lessons learned, providing a solid foundation for further analytical work on the subject.

The value of transboundary coordination on renewable energy was demonstrated in all nexus assessments, particularly in the Drina River Basin.[48] One key result of the Drina assessment – supported by an integrated analysis of the energy system and water resources – was that riparian countries could optimize their energy production by adopting a more coordinated approach to hydropower operation in the basin. Moreover, cooperation could be critical for flood management, climate resilience and environmental sustainability. This result is informing dialogue between environmental authorities, water administrations and energy policy-makers on future investments, including in renewable energy.

While a variety of mechanisms and platforms to exchange information and coordinate the management of international waters exist in international practice, the majority of transboundary basins still lack cooperation frameworks. However, the prospect of sustainable renewable energy development at regional level (often already discussed in parallel) should renew the interest of policy-makers in transboundary cooperation.

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[46] The findings of the first three assessments (Alazani/Ganykh (Azerbaijan and Georgia), the Sava (Bosnia and Herzegovina, Croatia, Montenegro, Serbia and Slovenia) and the Syr Darya (Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan)) can be found in the UNECE (2015) publication *Reconciling Resource Uses in Transboundary Basins: Assessment of the Water-Food-Energy-Ecosystems Nexus*. The findings of the nexus assessment on the Drina River Basin (Bosnia and Herzegovina, Montenegro and Serbia) can be found in the UNECE (2017) publication *Assessment of the Water-Food-Energy-Ecosystems Nexus and Benefits of Transboundary Cooperation in the Drina River Basin*. The assessments of the Drin River Basin (Albania, Kosovo, Montenegro and North Macedonia) and the North-West Sahara Aquifer System (Algeria, Libya and Tunisia) are ongoing.

[47] UNECE (2018) *Methodology for Assessing the Water-Food-Energy-Ecosystems Nexus in Transboundary Basins and Experiences from its Application: synthesis* (www.unece.org/fileadmin/DAM/env/water/publications/WAT_55_NexusSynthesis/ECE-MP-WAT-55_NexusSynthesis_Final-for-Web.pdf).

[48] UNECE (2017) op. cit. fn. 29.

2.4 Stakeholders, strategies, policy and projects

In order to promote understanding of the interlinkages between sectors, all relevant actors – private and public – should be given the opportunity to offer their input, assist in the identification of interrelationships, and participate in an accurate, transparent and impartial assessment. Each group of stakeholders has its own perspective on renewable energy and may overestimate or underestimate the effects of a proposed initiative, sometimes due to lack of information or to the presence of barriers to their involvement in the decision-making process.

Stakeholder involvement needs to start early on in the decision-making process and continue throughout its various steps and phases. Such involvement will ensure that the participation of stakeholders and the specificities of the nexus sectors are taken into consideration from the high-level, strategic phase of renewable energy planning, to the intermediate phase of adopting concrete policies and measures to achieve the strategic goals and, finally, to the final phase of implementing those policies to create sustainable renewable energy projects.

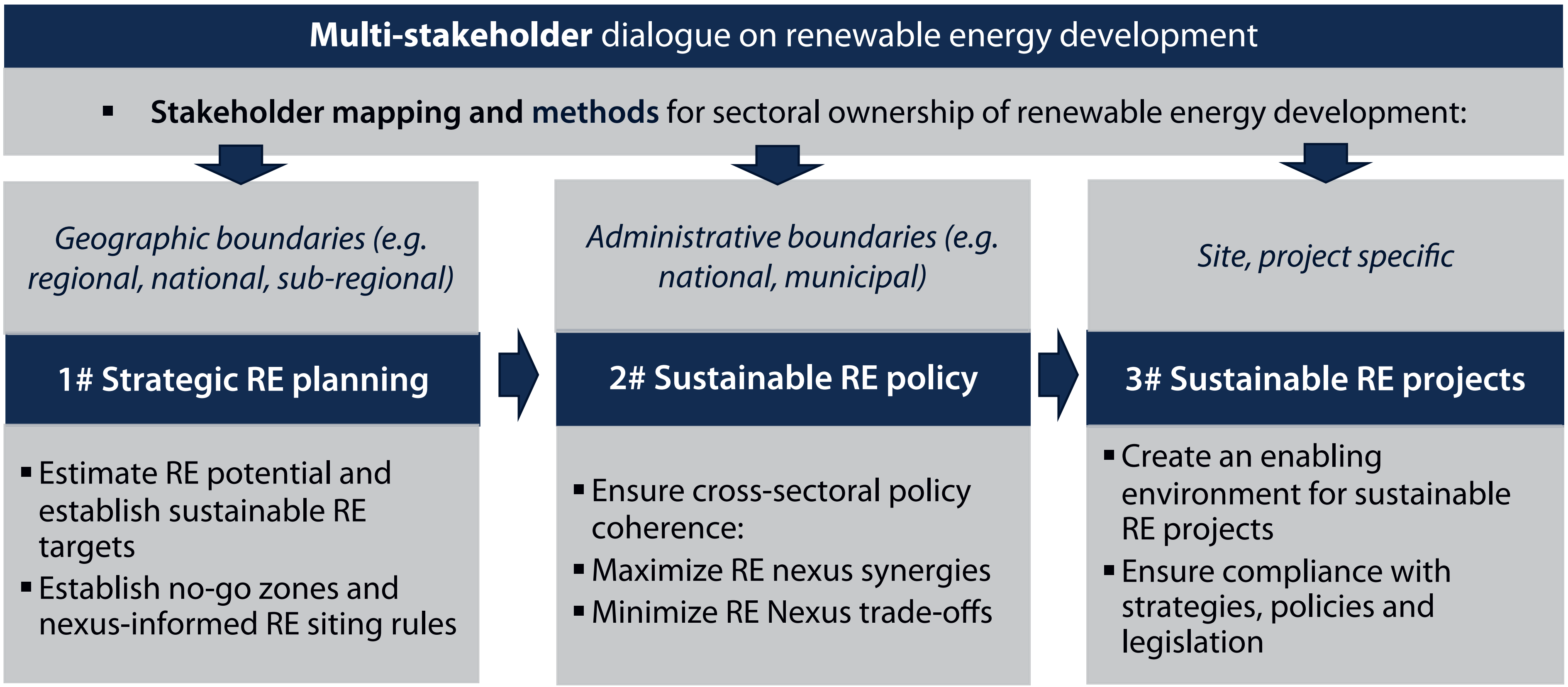
Conceptually, the three phases or steps of the decision-making process may at first appear to reflect a linear progression – starting with strategies, then moving on to implementation policies and, finally, to specific projects deployed according to the previously established strategies and policies. In practice, however, the strategies are designed in parallel with the policies, and projects are developed according to existing rules already in place. It seems more appropriate, therefore, to talk about three parallel "tracks".

The following chapters guide energy policy-makers through a step-by-step process for developing *strategic renewable energy (RE) planning*, *sustainable RE policy* and *sustainable RE projects*. These three tracks are supported by multi-stakeholder dialogue, which brings the different aspects together and allows for the consideration of cross-sectoral and sustainability issues at three levels (Figure 4). This process should help policy-makers identify and appropriately address these synergies and trade-offs, notably by involving more effectively multiple stakeholders in decision-making.

In suggesting a step-by-step process and indicating good practices and instruments available, this report proposes a "toolkit" to integrate linkages between renewable energy and the nexus sectors at all relevant levels of decision-making. However, it should be noted that this toolkit has been developed on empirical grounds and includes an extensive, but by no means exhaustive, review of the literature. Therefore, it should not be regarded as a comprehensive, stand-alone instrument. It is, rather, a sort of "path-finder" for policy-makers who want to better understand and start acting upon the many cross-sectoral trade-offs and synergies related to renewable energy deployment.

The structure is designed to gather the input of a variety of stakeholders whose area of interest, power or mandate, can be very different. Moreover, depending on the type of decision to be taken, the roles and responsibility of each stakeholder may vary. Hence, it is important that energy policy-makers design the process of stakeholder engagement ad-hoc, bearing in mind the type of process (e.g. the development of a strategic plan for sustainable development in a region; the revision of a National Action Plan for renewable energy, the evaluation of a proposed project, etc.) and the related geographical scale of reference.

Figure 4: Multi-stakeholder dialogue and the three tracks of sustainable renewable energy development: Planning, policy and project



3. Setting up multi-stakeholder dialogue and public participation

To appreciate the importance of multi-sectoral and multi-stakeholder dialogue and public participation in the context of sustainable renewable energy deployment, it can be useful to recall the many interlinkages between SDG 7 and the other 16 goals. These relationships have been thoroughly mapped in research, and draw attention to the impressive number of sustainable development targets that rely on energy and the transformation of the energy sector. This is because productive sectors will require more energy, but also because many changes will be possible only with the widespread adoption of clean, smart and integrated energy technologies.[49]

Identification of common priorities and goals across sectors, stakeholder groups and members of the public necessitate a "nexus dialogue" around renewable energy. Such a dialogue should be based on the specific objectives and priorities of each stakeholder group, and use the SDGs as a common frame of reference for social, environmental and economic benefits arising from the coordinated use of finite resources such as water, land and energy.

A multitude of actors are concerned by renewable energy development and could, at least theoretically, contribute to or impede its deployment. While energy policy-makers are responsible for developing sustainable renewable energy systems – introducing policies and measures to achieve this goal and overseeing the implementation of renewable energy projects that put policies into action – several other stakeholders both inside and outside the energy sector are also naturally involved, interested or affected.

The toolkit presented in this report primarily targets energy policy-makers and recommends that they convene all other stakeholders to discuss the development of strategic planning, policy and projects. It is important to emphasise that it is in the interest of energy policy-makers to engage in such dialogue. As already mentioned, a clear benefit from generating a common vision for renewable energy development, across sectors and society, is a reduction in risks and barriers related to renewable energy investments. Furthermore, such a vision creates the conditions for other stakeholders and policy-makers in different sectors to become owners of the renewable energy transition process, resulting in higher overall ambition, awareness and capacity for integration.

Once the stakeholders are well defined and mapped, energy policy-makers can draw on different methods to increase their input in the participatory process. The nature of the policy under development will dictate to a large extent who needs to be involved. This chapter provides a basic description of key stakeholder groups, then describes three methods for enhancing stakeholder input: public participation and transparency, cross-sectoral analysis and integrated modelling, and regional and transboundary coordination.

Interactive forms of public participation such as multi-stakeholder dialogues may be used as a part of the public participation procedure, but only in addition to and not instead of public hearings or

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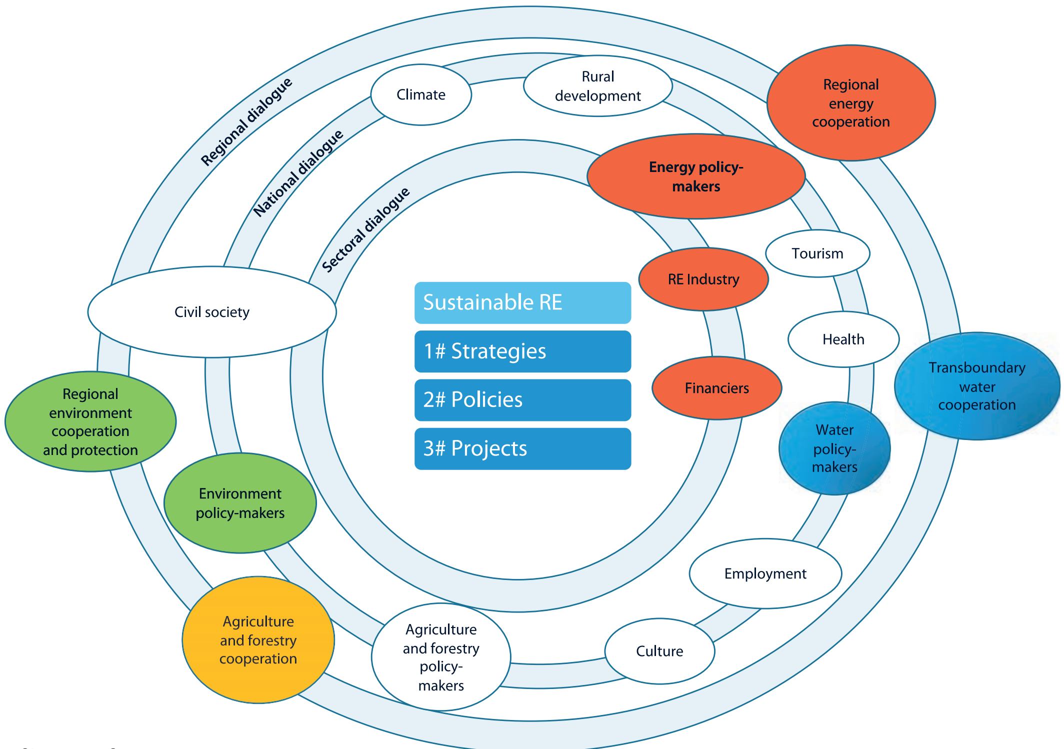
[49] Nerini et al. (2018) "Mapping synergies and trade-offs between energy and the Sustainable Development Goals", *Nature Energy*, Vol. 3, January, p. 12, Figure 2 (https://doi.org/10.1038/s41560-017-0036-5).

inquiries.[50] A physical public hearing may also be supplemented by technologies such as audio or video conferences to enable stakeholders who cannot physically attend the hearing to participate.[51] It is critical to ensure responsive, inclusive, participatory and representative decision-making at all levels by engaging effectively with the public (Target 16.7).

3.1 Mapping stakeholders

Energy policy-makers should map stakeholders based on the role they play, or could play, in the decision-making process. Stakeholders within the energy sector as well as in the water, food and environment sectors must be clearly identified, in order to effectively target and appropriately incentivize them to take an active part in the process (see Figure 5). The following paragraphs provide broad descriptions of five main groups of stakeholders. The configuration of key sectors and actors may vary, depending on the national, regional and even municipal context.

Figure 5: Stakeholders who should be involved in regional, national and sectoral dialogues to develop sustainable renewable energy strategies, policies and projects



Energy policy-makers

Energy policy-makers are the recipients of input from other stakeholders, both from within the energy sector and from other sectors. Stakeholder consultations should not be a matter of form but substance; therefore, energy policy-makers, as key owners of the renewable policy-making process, have an obligation to actively seek relevant and informed input from the other stakeholders and to take it into consideration during the development and implementation of policies. Energy policy is

[50]UNECE (2015) "Maastricht Recommendations on Promoting Effective Public Participation in Decision-making in Environmental Matters" (the "Maastricht Recommendations"), para. 123 (www.unece.org/fileadmin/DAM/env/pp/Publications/2015/1514364_E_web.pdf).

[51] Para. 120 of the Maastricht Recommendations.

thus the focal point where cross-sectoral input is concentrated, evaluated and internalized within the decision-making process.

Policy-makers from other nexus sectors

Improving cross-sectoral dialogue and coordination is key to understanding and taking into consideration the cross-sectoral interrelations of renewable energy deployment. The primary role of stakeholders from other nexus sectors is to offer new perspectives on renewable energy development and to spell out the requirements and possibilities for cooperation. This is crucial information that may otherwise be overlooked.[52] The input of nexus sectors to plans, policies and projects is indispensable to ensure their sustainability, and therefore merits commitment on the part of policy-makers from different sectors to establishing institutional dialogue.

This report focuses mainly on engagement of policy-makers from the water, agriculture and forestry, and environment protection sectors. However, it should be noted that the categorization of policy-makers on the basis of their mandate and areas of competence depends on the specific institutional setting in place. Additional sectors might also influence or rely on natural resource management in various ways, and energy policy-makers may seek their involvement in the process due to their strategic importance (e.g. tourism, housing and navigation). Furthermore, it is important to pay attention to relevant crosscutting policy areas (e.g. climate change, sustainable development, etc.), and/or sectors whose participation in the process may be considered beneficial or tactical (e.g. health, rural development, finance and culture). Inclusion of these policy-makers, especially where input is most relevant, is encouraged.

The public

"The public" is an inclusive concept commonly accepted by the 46 ECE Member States and the European Union, all of which are parties to the Aarhus Convention (see Box 7, section 3.2.2). It means one or more natural or legal persons, their associations, organizations or groups,[53] ranging from highly influential non-governmental organizations (NGOs) with deep sectoral know-how and wide global or regional outreach, to small associations and groups that defend the interest of local communities and to local inhabitants. The role of the public is of crucial importance. At the level of strategic planning, the public guarantees that the interests of society and the environment are appropriately considered when mapping and assessing the potential of renewable energy across the territory. Through active involvement, civil society organizations are able to develop a common "vocabulary" with policy-makers, helping to make their concerns and suggestions better understood.

In terms of policies and measures that have an impact on energy consumers or vulnerable groups, the public can guarantee that their interests are protected. For each specific renewable energy project that is constructed, civil society holds the key to maximizing social impact (which involves, crucially,

[52] For a comprehensive analysis of stakeholder involvement in nexus-cognizant policy-making, see Mohtar et al. (2016) "Water-Energy-Food Nexus Framework for facilitating multi-stakeholder dialogue", *Water International*, Vol. 41, No. 5, pp. 655-661 (doi:10.1080/02508060.201 6.1149759).
[53] See Article 2(4) of the Aarhus Convention. The full text of the Convention is available at the UNECE website: www.unece.org/env/pp/treatytext.html.

the identification of synergies to respond to the real needs of populations and the local economy) and ensuring social acceptance. Last, but not least, with the transformation of the energy sector towards more decentralized production, citizens are becoming "prosumers" (producers and consumers). This is broadening the scope of public participation to include an informed discussion across interested parties regarding financial support mechanisms and market regulations.

Renewable energy industry

In its broadest sense, the "renewable energy industry" includes industry associations as well as project owners, project developers, engineering, procurement and construction (EPC) contractors, equipment manufacturers and everyone else involved in the renewable energy value chain. Combined these groups represent the interests of the private sector. They rely on their knowledge and experience to identify, design and implement renewable energy projects with cross-sectoral synergies and minimal trade-offs, based on the best technology available.

For the renewable energy industry, sustainability concerns may still be perceived as an additional set of hurdles and obstacles to overcome in the long process to bring a project to completion. It is therefore necessary for industry actors to become co-owners of processes to increase the sustainability of renewables (see Chapter 6).

Financiers and investors

The role of financiers and investors is to present considerations regarding the financial feasibility of planned projects, which is the ultimate requirement for their realization. Sustainability is sometimes associated with increased costs and a reduced return on investment rates (particularly in the case of substantial trade-offs that need to be mitigated or compensated). However, this reality does not consider the potential of renewable energy projects to generate multiple benefits and the many interests at stake that could lead to co-finance and de-risking of investments.

"Impact investing" refers to the action of investing with the intention to generate positive, measurable social and environmental impact alongside a financial return.[54] Although traditionally undertaken by institutional bodies with public sector mandates, such as development banks and international financial institutions (IFIs), private impact investment is set to increase aggressively, with recent demand by investors for environmentally friendly investments driving growth in green financing worldwide.[55]

Overall, several innovative financing facilities exist, such as blending instruments that aim to achieve policy objectives by combining grants with loans or equity from public and private financiers.[56] These can allow for the effective introduction of sustainability concerns in the investment decision and for leveraging finances explicitly in line with policy objectives. Also, at the level of international donors

[54] For more information, see the Global Impact Investing (GIIN) website: https://thegiin.org/impact-investing.
[55] Desai, V. (2019) "Green financing set for aggressive growth globally in 2019", 4 February, Indvstrvs website: https://indvstrvs.com/green-financing-set-for-agressive-growth-globally-in-2019.
[56] European Commission Website, Innovative Financial Instruments (blending), available at: https://ec.europa.eu/europeaid/policies/innovative-financial-instruments-blending_en.

providing financial assistance to developing countries, the perspective of financing initiatives that advance multiple SDGs at the same time could raise interest, as it provides for a much more efficient utilization of financial resources and as such is coherent with the core principles of the Agenda 2030.

3.2 Methods to increase input from the public and other stakeholders

Closer involvement in the decision-making process, on the part of the public and concerned stakeholders, builds the ownership necessary to drive changes in relevant sectors necessary to sustainably deploy renewable energy. It is crucial that all stakeholders feel confident that their opinions will be heard and considered when making decisions. This spirit of open and constructive dialogue is crucial when there are trade-offs at stake. Failing to engage in constructive dialogue can lead to friction among the parties involved.

Multi-stakeholder, multi-sectoral cooperation is needed to ensure that the compatibility of renewable energy deployment is well integrated with the nexus sectors throughout the decision-making process. The greater the extent to which this dialogue influences sectoral plans, policies and projects, the more meaningful the process from a nexus perspective. (Examples include the creation of a water-energy partnership for utilities on energy recovery from wastewater treatment, or the identification of key areas where renewable energy can support the development of green tourism.) Crucially, the value of this multi-stakeholder process must be recognized by institutions at the highest level, and appropriately supported. In this way, the process will not remain an isolated exercise, instead becoming a natural reference point for the renewable energy decision-making process, and potentially a reference for similar cross-sectoral policy efforts.

3.2.1 Effective public notification and access to information

Lack of effective public notification or access to relevant information within decision-making procedures leads to public and stakeholder concerns, disinformation and breaks in possible dialogue. Decision-makers can overcome this challenge through the design of effective public notification methods and access to all relevant information from the very start. Competent authorities must ensure that the notification and accompanying information is available to the public throughout the entire public participation procedure and for the duration of the time period for any administrative or judicial review procedures regarding the final decision.[57] In some cases, additional notification is needed, for example when: (i) there is doubt that all of the stakeholders concerned have been notified, (ii) the proposed activity will entail more than one decision, (iii) new information comes to light, (iv) additional information which could not be provided with the original notification becomes available, and (v) the public participation procedure is changed in any material way.[58]

During the decision-making cycle, information should at minimum be accessible for examination: (i) at the seat of the competent public authority, (ii) electronically (if feasible), (iii) at a suitable easily accessible location if the seat of the competent authority is located far from the place of the activity, and (iv) during usual working hours.[59] Practical measures to facilitate effective access, assistance and

[57] Para. 60 of the Maastricht Recommendations.
[58] Para. 62 of the Maastricht Recommendations.
[59] Para. 92 of the Maastricht Recommendations.

impartial guidance should be put in place to assist the public.[60] Additional information should be made public as soon as it becomes available to the public authority. The presence of additional information should be clearly signalled in all places where information is accessible to the public.[61] If large amounts of new information become available, the public authority should ensure that the remaining time frame enables the public to prepare and participate effectively.[62]

3.2.2 Public participation and transparency

The importance of public participation in renewable energy deployment is becoming more pronounced as renewable energy becomes increasingly mainstream and visible. Effective public participation is necessary to establish channels of communication with society – the ultimate beneficiary of the transition to clean energy. The Aarhus Convention provides a legal framework for policy-makers on the specific subject of public participation in environmental matters (Box 7). Multilateral development banks are increasingly integrating public participation into their procedures, due to its importance as a means to increase transparency and acceptance of decisions, anticipate risks and avoid costs related to remedying wrong decisions at a later stage, and improve the overall quality of final decisions (Box 8).

Box 7: The Aarhus Convention on public participation in environmental matters

The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (the Aarhus Convention) was adopted in 1998 and entered into force on 30 October 2001. The Convention is open for accession by any UN Member State, and has been ratified by 46 states and the European Union. The Aarhus Convention provides a solid framework for public participation in decision-making on environmental matters at local and domestic levels and across borders.[63]

The Aarhus Convention empowers people with the rights to access information, participate in decision-making on environmental matters and seek justice on environmental matters. Public authorities of the Parties to the Convention must *inter alia* ensure:

(a) *Access to environmental information*. Information on the state of the environment, policies or measures taken, or the state of human health and safety should be accessible by all. Public authorities should actively disseminate environmental information in their possession.

(b) *Public participation in decision-making related to environmental matters*. The public, including NGOs promoting environmental protection, should be able to participate in decision-making process from the outset, when all options are open, including by taking part in hearings and commenting on projects, plans and programmes relating to the environment. Their inputs should be taken into account in decision-making, and

[60] Paras. 97-98 of the Maastricht Recommendations.
[61] Para. 105 of the Maastricht Recommendations.
[62] Para. 105 of the Maastricht Recommendations.
[63] For more information see: www.unece.org/env/pp/introduction.html.

final decisions should be made publicly available along with the reasoning and considerations on which the decision is based.

(c) *Access to justice*. Members of the public should have the right to judicial or administrative review procedures to challenge a refusal or an inadequate response to a request for environmental information; the legality of a decision, act or omission to permit a specific activity; and acts or omissions by private persons or public authorities that contravene national environmental law.

Figure 6 below presents the Aarhus Convention step-by-step model for effective public participation procedure in environment-related decision-making.

Figure 6: Key elements of effective public participation in decision-making

The issue of public participation is not only important when discussing the deployment of renewable energy projects on large scales, to prevent frictions or compensate negative impacts. It is also crucial when it comes to small-scale distributed renewable energy, like solar PV or small hydropower, to design policies and programmes that facilitate their sustainable uptake among citizens and effectively responds to the needs of local communities.

Box 8: The role of multilateral development banks in increasing transparency and public participation

Bilateral and multilateral donors as well as International Financial Institutions (IFIs) can play a prominent role in providing mandate-driven financing to advance policy objectives, among which the transition to clean energy sources is a key global priority. They can also help increase transparency and public participation at the project development stage by introducing processes and safeguards for projects that apply or secure funding. Many financing institutions with a social or environmental mandate have established platforms that allow public concerns to be voiced against the financing of specific projects.

For example, the European Bank for Reconstruction and Development (EBRD) has established the Project Complaint Mechanism (PCM), an accountability mechanism to review complaints about EBRD-financed projects. It provides individuals and civil society organizations that may be directly or adversely affected by an EBRD project with a means to raise complaints. The PCM allows for transparency and visibility of complaints and fosters public participation and access to information on projects that are either considered for financing or have secured EBRD support. Public participation and access to information requirements should be prioritized for projects with a significant impact (e.g. utility scale wind or solar), and for projects with substantial transboundary effects (e.g. hydropower projects that affect water flows between countries). In such cases, notification and consultation procedures for planned projects (as well as the operation of existing projects) should be established.

Experience has shown that transparent, open and clear dialogue on a proposed initiative, early in the planning stage, can help to address public concerns that can otherwise delay or even derail projects. The introduction of public participation and consultations can allow for constructive discussions that extend beyond "not in my back yard" concerns associated with renewable energy technologies, especially where such concerns are unfounded and relate to lack of information. Conversely, in cases where there is genuine cause for concern, public participation can help identify issues and bring them to the fore, so that they can be adequately addressed in a timely manner. Finally, it is important to support awareness-raising initiatives for broader and more integrated renewable energy, to enable civil society itself to more effectively act as a vehicle of sustainable renewable energy uptake.

3.2.3 Cross-sectoral analysis and modelling

In order to properly reflect all sectoral priorities, modelling tools of varying complexity can be utilized to identify the potential implications of a particular policy. This approach helps to identify the "optimal" policy approach across all sectors, and to prioritize actions and take decisions accordingly[64] (see section 4.2 on tools for sustainable renewable energy planning). Cross-sectoral analysis and modelling has assumed increasing importance due to the interrelationships linking the nexus sectors, as well as the need for more drastic policy interventions, for example, to limit global warming to below 2°C relative to pre-industrial levels (even more so in the case of 1.5°C).[65] Such interventions inevitably require action across the whole spectrum of the economy. Cross-sectoral analysis and modelling tap into the knowledge and experience of professionals from different sectors and synthesizes their aggregated expertise into models that incorporate multi-disciplinary variables and perspectives (see Box 9).

[64] For example, in N. Bieber et al. (2018) "Sustainable planning of the energy-water-food nexus using decision making tools", *Energy Policy*, Vol. 113, pp. 584–607, the authors developed and applied a detailed modelling framework of Ghana's Greater Accra Metropolitan Area which took into consideration all three components of the energy-water-food nexus as a guide for policy-makers planning interventions in the energy sector.
[65] For the importance of analytics in policy-making with nexus considerations in mind and a review of available analytical tools for policy-makers and other stakeholders, see Mohtar et al. (2016) op. cit.fn.33.

Box 9: Quantifying cross-sectoral impacts for nexus-informed policy-making: The World Bank's Thirsty Energy Initiative

The World Bank, under the "Thirst Energy Initiative", has partnered with the Energy Research Centre of the University of Cape Town, South Africa, to incorporate water constraints into the country's energy-planning model and to foster a more sustainable system.[66]

The project revolves around the concept of creating a "water-smart energy model". The main conclusions of the Thirst Energy Initiative are documented in the report *Modeling the Water–Energy Nexus: How Do Water Constraints Affect Energy Planning in South Africa?*[67]

The key message of the project is that efforts to account for the regional variability of water supply and the associated costs of water supply infrastructure can positively impact energy planning, especially in a water-scarce country such as South Africa. The report presents two different scenarios – one where true water supply and infrastructure costs (including regional variations of availability and costs within the country) are incorporated into a model, which allows a choice between dry or water-cooling; and one where such costs are not accurately reflected. The report demonstrates that when the cost of water is not taken into account, the model selects the more water-intensive option to increase energy resources. Once water costs are incorporated into the model, technologies that are less water intensive but more costly (and which were ignored for this reason) become more competitive.

The report's outcome is important because it proves that the adoption of a systemic nexus perspective can result in different energy choices than would otherwise be reached by opting for energy resource development alone.

This case study thus represents a good example of how cross-sectoral analysis and modelling can help energy sector planners incorporate nexus factors, such as water constraints, into their decision-making processes.

This approach is particularly valuable for the adoption and implementation of environmental policies. The concept of "integrative governance" advocates for cross-sectoral coordination and collaboration in governance in order 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).[68] This integrated governance approach applies both at the planning stage (with the identification of relevant stakeholders) and the implementation stage (through the use of various methods to mobilize public and private sector stakeholders), and is fully

[66] World Bank website, "Thirsty energy: Water-smart energy planning in South Africa", (www.worldbank.org/en/news/feature/2017/06/15/thirsty-energy-water-smart-energy-planning-in-south-africa).
[67] World Bank Group (2017) *Modeling the Water-Energy Nexus: How Do Water Constraints Affect Energy Planning in South Africa?* (https://openknowledge.worldbank.org/handle/10986/26255).
[68] Weitz et al. (2017) "Closing the governance gaps in the water-energy-food nexus: Insights from integrative governance", *Global Environmental Change*, Vol. 45 (2017), pp, 165-173, 168.

aligned with the multi-track process for integrating sustainability concerns into renewable energy decision-making proposed in the following chapters.

3.2.4 Regional and transboundary coordination

The existence of regional coordination and cooperation platforms, or at least initiatives, is a prerequisite for the coordinated planning of renewable energy deployment. The prospect of energy trade can also be a booster for investments, while regional market requirements can drive the implementation of regulations based on best international standards. In fact, greater synergies and options for win-win outcomes are available at larger scales. Basin-level, transboundary cooperation mechanisms or initiatives play a similar role when it comes to water issues. They are necessary to implement coordinated planning, and can drive different countries' national policies and regulation on water management towards common higher standards.

A good example of how a regional platform can influence the sustainability of renewable energy deployment comes from the Energy Community (EnC). The EnC Secretariat often issues statements that reflect the commitment of countries to tackle a certain issue. One of these statements (2018) focused on the impact of small hydropower development:[69] "*Hydropower development projects are subject to a so-called screening obligation. If significant negative effects on the environment are established at this stage, a full environmental impact assessment on various factors (such as human beings, fauna and flora, soil, water, air, climate, landscape, material assets, cultural heritage and the interaction between those) must be carried out. The project can only go forward if measures to avoid, reduce and, if possible, offset its major adverse effects are established. When carrying out the screening procedure, the cumulative impacts of different projects in the same geographical area have to be taken into account*".

In terms of renewable energy and water, transboundary cooperation is needed to discuss a multitude of issues that require coordination, or even joint management. These range from flow regulation to water quality control (including sedimentation), and may even include aquifer management and protection (in the case of shared groundwater resources). The Water Convention provides a global legal framework of reference for cooperation (Box 10), but the existence of transboundary cooperation initiatives on the ground allows countries to act together. The International Sava River Basin Commission (ISRBC) provides an example of a well-established transboundary cooperation platform used to discuss the impact of multi-sectoral developments (including renewable energy) on the basin water and land resources. The Commission was an attempt to broaden the scope of cooperation in support of the implementation of the Framework Agreement on the Sava River Basin (FASRB).[70]

[69] Issued in November 2018. Available at: www.energy-community.org/news/Energy-Community-News/2018/011/13.html.
[70] www.unece.org/environmental-policy/conventions/water/envwaterpublicationspub/envwaterpublicationspub74/2017/reconciling-resource-uses-in-transboundary-basins-assessment-of-the-water-food-energy-ecosystems-nexus-in-the-sava-river-basin/doc.html.

Box 10: The Water Convention: Supporting transboundary cooperation

The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Water Convention)[71] is a UNECE multilateral environmental agreement that aims to ensure the sustainable use of transboundary water resources by riparian states through the promotion of transboundary cooperation. The Water Convention was adopted in Helsinki in 1992 and entered into force on 6 October 1996, and has been ratified by 42 states and the European Union. Although it was initially negotiated as a regional instrument, it has been amended and as of March 2016 is available to all UN Member States.

The Water Convention strengthens transboundary water cooperation and measures for the ecologically sound management and protection of transboundary surface waters and groundwater. The Convention promotes and encourages the implementation of integrated water resources management, in particular the basin approach.[72]

The Water Convention has three central obligations for States-Parties (or principal pillars):[73]

(a) *To prevent, control and reduce transboundary impacts*: Parties are required to take measures to prevent, control and reduce any transboundary impact on the environment, human health and safety and socioeconomic conditions, as well as to use water resources sustainably, taking into account the ecosystem approach and to set water-quality objectives and criteria, draw up contingency plans and minimize the risk of accidental water pollution.

(b) *To ensure reasonable and equitable use*: Parties should consider the basin particularities to ensure the equitable use of waterways and should take into account the needs of future generations.

(c) *To promote cooperation through agreements and joint bodies*: Parties are required to conclude transboundary agreements and set up joint bodies (river or lake commissions) at the basin level to cooperate on the management and protection of their transboundary waters. As a framework agreement, the Convention does not replace bilateral and multilateral agreements for specific basins or aquifers; instead, it fosters their establishment and implementation, as well as further development.

The Convention promotes cooperation over the use of hydropower resources with a view to reducing associated transboundary impacts. Such cooperation can also help create platforms for coordinated action by riparian states on broader issues, such as joint deployment of (non-hydro) renewables at the basin level, or coordinated planning of energy-agriculture synergies (irrigation and renewables) and other such basin-wide initiatives. Joint bodies created to implement the

[71] More information at the UNECE Website: www.unece.org/env/water.html.
[72] More information at the UNECE Website: www.unece.org/env/water/text/text.html.
[73] UNECE (2017) *The Water Convention: Responding to Global Water Challenges*. (www.unece.org/fileadmin/DAM/env/water/publications/brochure/Brochures_Leaflets/A4_trifold_en_web_2018.pdf).

Convention’s obligations could evolve into water cooperation platforms for the discussion of related issues, notably impacts from sectoral development on water resources. Such possibilities are subject to the mandates defined by states for joint bodies.

It is also worth recalling that regional cooperation for agriculture and forestry, as well as the environment, can also facilitate discussions on sustainable renewable energy. This is because of the respective roles these sectors play in catalysing renewable energy investments with a high social impact and aligning investments towards the protection of nature and biodiversity for the common good.

4. Track 1: Strategic renewable energy planning

4.1 A step-by-step process for strategic renewable energy planning

Renewable energy potential is a resource that needs to be exploited to promote social well-being. In spite of the fact that, by definition, renewable resources are naturally replenished, sub-optimal exploitation of these resources not only implies failure to capitalize on the benefits, but also additional costs (e.g. opportunity costs associated with not utilizing a resource, not utilizing it to its maximum potential or not utilizing it at the most appropriate time). In other words, decision-making regarding the exploitation of this potential is limited by the sectoral costs and benefits.

It is important to remember that the main goal in accelerating renewable energy is to address climate change. In order to succeed, the transition to renewable energy needs to occur without provoking societal conflicts. Impacts from unplanned development might not only harm people and nature, but also result in delays and higher project costs that slow deployment.[74]

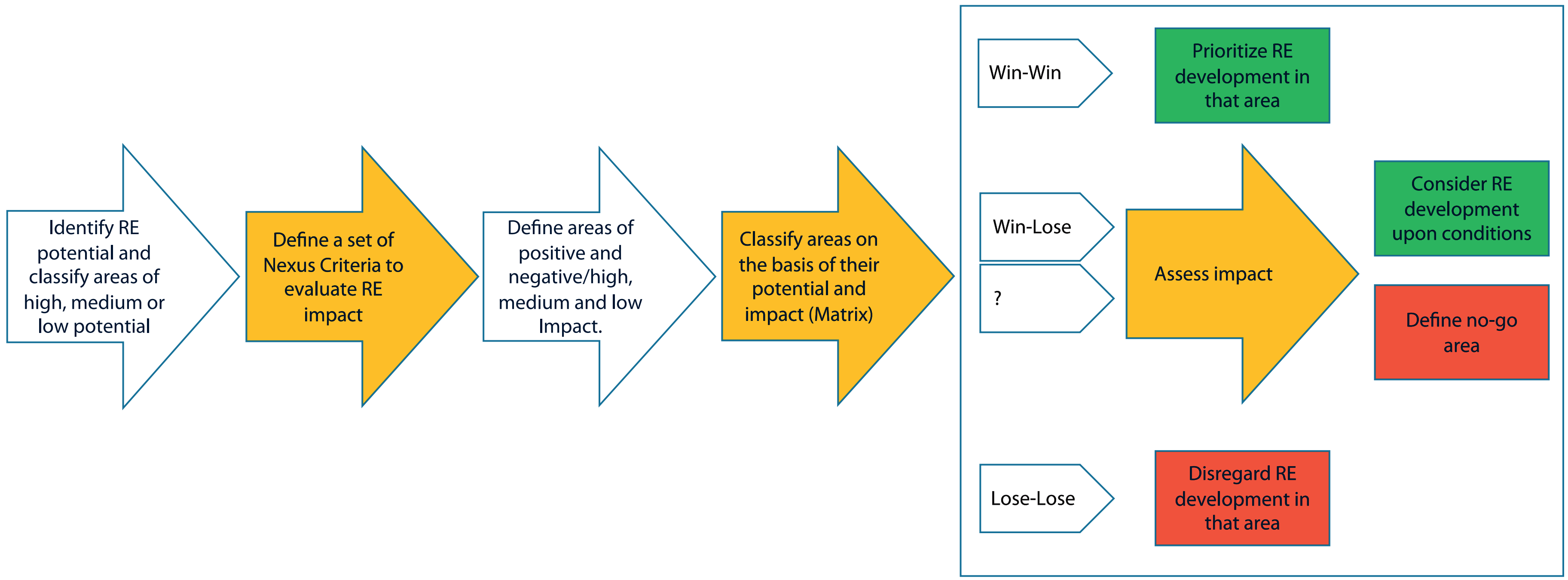
Strategic planning for renewable energy deployment means improving sectoral cooperation over the same resources and developing a common vision for renewable energy development, natural resource management and climate action. Essentially, this is a matter of risk reduction. Governments and project developers should be able to evaluate how energy systems and projects respond to different scenarios (notably, climate scenarios) and quantify the associated risks early on in the planning process, in order to develop less risky (and less costly) projects. The common vision should influence policy developments in various sectors and ensure cross-sectoral coherence in terms of action. The resulting strategic planning for sustainable and nexus-compatible renewable energy deployment should include agreement on no-go zones,[75] high potential zones and areas where development is possible but trade-offs should be addressed. The process proposed in Figure 7 is designed to achieve this agreement (Figure 7).

Depending on the case, strategic planning can be carried out with different geographical boundaries or "landscapes", in mind. These can be the hydrographical boundaries of a river basin, the administrative limits of national borders or a municipality, or even those of an economic macro-region. However, due to the multi-sectoral nature of the exercise, which must consider the inter-dependency of systems with different geographical boundaries,[76] the process will naturally include the consideration of elements across scales.

[74] Kiesecker et al. (2019) "Hitting the target but missing the mark: Unintended environmental consequences of the Paris Climate Agreement", *Frontiers in Environmental Sciences*, Vol. 7, p. 151.
[75] The identification of no-go zones needs to include careful consideration of the ecology of the system, as well as the stakeholders and how they use the landscape. On conservation planning see, for instance, Groves and Game (2016) *Conservation Planning Informed Decisions for a Healthier Planet* (www.nhbs.com/conservation-planning-book).
[76] Liu et al. (2017) "Challenges in operationalizing the water–energy–food nexus", *Hydrological Sciences Journal*, Vol. 61, No. 11.

Figure 7: Step-by-step process for strategic renewable energy planning.

Note: The steps that require strong involvement on the part of cross-sectoral stakeholders are indicated in yellow.



The first step is to assess which stakeholders need to be participate in strategic renewable energy planning, and to involve them (Chapter 3). The following table provides a generic example of such an assessment and the roles each party will play (Table 1):

Table 1: Stakeholders involved in strategic renewable energy planning

Stakeholder group	Level of involvement	Role
Energy policy-makers	High	Leading the sustainable renewable energy planning process
Other nexus policy-makers	High	Ensuring coherence with other nexus sectoral plans
The public	High	Ensuring public participation and consultation
Renewable energy industry	Medium	Observer – consulting on technology and innovation and economic viability
Financiers and investors	Low	Observers – consulting on financing possibilities

The key steps of the process described in Figure 7 are as follows:

- Identify the spatial distribution of renewable potential and specify (according to energy sector-specific criteria) the areas where this potential is technically and economically exploitable. Classify areas by high, medium or low potential (HP, HP and LP, respectively). This assessment should be conducted for each technology. The use of Geospatial information System (GIS) mapping for renewable energy resource assessment (see section 4.2) would allow the use of these maps as a basis or support for more in-depth analyses, such as GIS-based energy system planning and modelling (e.g. planning of the electrical grid),[77] hydrological modelling for basin management[78] and other uses.
- Define, through a process of intersectoral consultation with authorities, public consultation and cross-sectoral analysis, a commonly accepted set of Nexus Criteria, in order to evaluate the impact of renewable energy development on the different sectors. A set of Nexus Criteria could consist of:
    - The preservation of natural protection, biodiversity reserves (e.g. Natura 2000), land with a high conservation value and unprotected but intact landscapes.
    - The preservation of agricultural land and/or the valorization of agricultural activities.
    - The optimization of flow regulation for multiple purposes and protection from hydrogeological risk.
- Apply the Nexus Criteria to identify geographical areas with high, medium or low impacts from the perspective of the nexus sectors, with reference to both positive (synergies) and negative

[77] *GIS-Based Planning and Modeling for Renewable Energy: Challenges and Future Research Avenues* (www.mdpi.com/2220-9964/3/2/662).
[78] Van Der Knijff, J.M., Younis, J. and De Roo, A.P.J. (2010) "LISFLOOD: A GIS-based distributed model for river basin scale water balance and flood simulation", *International Journal of Geographical Information Science*, Vol. 24, No. 2, pp. 189-212.

(trade-offs) aspects. This will produce six categories of areas: Low Positive Impact (LPI), Medium Positive Impact (MPI), High Positive Impact (HPI), Low Negative Impact (LNI), Medium Negative Impact (MNI) and High Negative Impact (HNI) (see Table 2). As with the assessment of renewable energy potential, this assessment should be carried for each technology. For example:

  - *Biomass*. High-productivity agricultural land (where agricultural by-products are available in high amounts) can be considered positive impact areas. Forest land experiencing degradation can be classified as negative impact areas. Synergy can be found in lands already converted for human uses which use spare natural lands providing water and food security.
  - *Solar*. Synergies lie in the possibility of providing off-grid solutions (where the grid does not reach consumers) or desalination where freshwater is scarce, or the renewable energy transition of entire communities through mini-grid solutions.

- Classify areas based on their renewable energy potential (high, medium or low) and their impact on nexus sectors (high, medium, low; positive or negative). Possible classifications (to be established based on consultation among stakeholders) could include the following:
  - → Areas of medium and high exploitable renewable energy potential (HP and MP) that coincide with zones that have any degree of positive impact (LPI, MPI and HPI) can be classified as "win/win".
  - → Areas of low potential (LP) and any degree of negative impact (LNI, MNI and HNI) can be considered "lose/lose".
  - → Areas of medium and high potential (MP and HP) that have any degree of negative impact are "win/lose".
  - → Areas of low potential (LP) and any degree of positive impact (HPI) are uncertain.

The Potential/Impact Matrix summarizes this classification (Table 2).

Table 2: Potential/Impact Matrix

	Low **P**ositive **I**mpact	**M**edium **P**ositive **I**mpact	**H**igh **P**ositive **I**mpact		**L**ow **N**egative **I**mpact	**M**edium **N**egative **I**mpact	**H**igh **N**egative **I**mpact
Low **P**otential	Uncertain	Uncertain	Uncertain		Lose/Lose	Lose/Lose	Lose/Lose
Medium **P**otential	Win/Win	Win/Win	Win /Win		Win /Lose	Win /Lose	Win /Lose
High **P**otential	Win/Win	Win/Win	Win/Win		Win /Lose	Win /Lose	Win/Lose

- Prioritize renewable development in win/win areas. Given the shared interest, consider the possibility of developing renewable projects in close coordination across sectors.
- Disregard renewable development in lose/lose areas.
- Assess the impact of renewable energy deployment in areas that are "win/lose" and the potential in uncertain areas. The assessment should be based on rigorous analyses (see the tools available

in section 4.2). This step essentially consists of negotiation across sectors. Therefore, it is crucial that the principles of transparency and public consultation are respected (see Chapter 3). Potential outcomes of this dialogue include:

- agreement on no-go zones for renewable energy deployment
- agreement on areas where renewable energy deployment is conditional on mitigation or compensation measures
- the identification of areas where renewable energy deployment can be considered despite low resource potential, because of its added value in other nexus sectors.

This process directly informs three policy issues of critical importance:

1. The definition (or redefinition) of renewable energy targets. This can be done for each technology based on the above cross-sectoral discussion. This would mean, essentially, disregarding the potential in high negative impact areas and considering the potential in other areas, as agreed, based on negotiation.
2. The identification of key areas where new strategies, policies and action plans are needed, or existing ones should be revised to encourage, forbid and facilitate renewable energy deployment, both in the energy sector and in the other nexus sectors (see Chapter 5).
3. The elaboration of context-specific nexus-informed siting rules for renewable energy deployment (see section 4.3.6).

4.2 Methods and tools available

The increasing availability of spatial data has become a real game changer for renewable energy planning. Spatial data can now be used to address many of the key questions for development planning, including potential environmental impacts. Geographic Information System (GIS) software modelling tools allow for predictive modelling, for example, supporting the estimation of future distribution patterns of resources, and the extrapolation of predictions in areas where data have yet to be collected. New tools also allow for the rapid assessment of habitat quality and connectivity, and the optimal configurations of habitats to achieve conservation goals. With growing recognition of the importance of ecosystem services and climate change adaptation, new tools and approaches (including Artificial Intelligence) will become increasingly useful, for example, to estimate the impact of land-use changes, or to identify the most climate resilient areas.

The following paragraphs describe methods and tools available to policy-makers and practitioners for the renewable energy planning phase, which can be used to support the process described in section 4.1. These methods and tools are not mutually exclusive and can therefore be combined. They have been identified based on empirical experience[79] rather than a systematic review of the literature; as such it is worth recalling that innovation in this field is rapid with mapping products and analyses for technical potential constantly updating.

[79] Notably, through the Nexus Assessments and other nexus-related activities carried out under the Water Convention.

4.2.1 Spatial mapping of renewable energy potential

The mapping of renewable energy potential, whether in the form of wind, solar, hydropower or biomass, is essential in order to establish the role that renewables can play in the energy mix of a country. For example, the RE-Map platform provided by IRENA offers a repository of renewable energy potential from various sources, by country and region;[80] and the Global Atlas[81] provides information on exploitable renewable energy potentials in (GIS) format. This information (which draws on key geographical, demographic and techno-economical parameters) can be used for renewable energy planning both at utility scale and for off-grid applications.

It is worth emphasising the importance of remote sensing for renewable energy potential mapping. Remotely sensed data[82] are relatively cheap (and sometimes free), provide up-to-date information over large geographical areas, and in some cases may be the most practical way to construct base maps for inaccessible regions, at least during the initial phase. More detailed information relating to higher geographic resolutions and/or technology-specific questions may be available from academia, industry and civil society, which may include surveys, specific standards of environmental protection, or results from integrated modelling and complex optimization. This highlights once again the crucial importance of stakeholder engagement in the process of strategic renewable energy planning.

4.2.2 Energy system planning and modelling involving Nexus considerations

Incorporating cross-sectoral considerations into energy modelling is essential, in order to take informed decisions when it comes to new investments. The impact of climate change on water resource availability is a clear example of a critical interlinkage, raising questions such as whether there will be enough water – including variability and projected change over the long term – to justify an investment in hydropower. Land and water use competition can be crucial constraints when planning for biofuel production.[83] In general, choices related to energy production can have indirect effects on other sectors (even beyond direct resource competition) that can only be accounted for through integrated modelling.[84] A number of tools are available to carry out nexus-informed energy system modelling exercises. A list (updated in 2018) can be found in the paper "Energy modelling and the Nexus concept".[85] It is worth emphasising that dramatic advancements in remote sensing, GIS and

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[80] Visit the portal at: www.irena.org/remap.

[81] The Global Atlas for Renewable Energy is a web platform that allows its users to access maps of renewable energy resources for locations across the world. More information is available at www.irena.org/globalatlas.

[82] See, for example, Landsat by NASA, which is greatly enhancing understanding of the dynamics of vegetation and terrestrial ecosystems: http://landsat.gsfc.nasa.gov.

[83] Munoz Castillo et al. (2019) "The land-water nexus of biofuel production in Brazil: Analysis of synergies and trade-offs using a multiregional input-output model", *Journal of Cleaner Production*, Vol. 214, pp. 52-61. DOI:10.1016/j.jclepro.2018.12.264 (http://pure.iiasa.ac.at/id/eprint/15653).

[84] Bazilian et al. (2011) "Considering the energy, water and food nexus: Towards an integrated modelling approach", *Energy Policy*, Vol. 39, pp. 7896-7906.

[85] Brouwer et al. (2018) "Energy modelling and the Nexus concept", *Energy Strategy Reviews*, Vol. 19, January (www.sciencedirect.com/science/article/pii/S2211467X17300652).

spatial modelling capabilities offer new opportunities to policy-makers and practitioners, including knowledge integration (e.g. cross-sectoral) and complex decision support.[86]

4.2.3 GIS-based optimization of new investments in renewable power generation

Basing renewable energy planning on GIS information is useful because the potential of different sources is highly distributed, and siting generation plants will need to be done accordingly. Yet, as discussed, even where resource potential is high, there can be significant constraints or limitations on project deployment. These range from the presence of settlements and long distances from the power grid, to the presence of natural and biodiversity areas that need to be protected. GIS planning allows for a detailed account of all such factors, and should, therefore, from a nexus perspective become a common good practice.[87]

Spatially explicit energy system optimization can be undertaken using different tools (see the list above), but the most critical aspect of this analysis is the definition of criteria. The process suggested in section 4.1 is greatly supported by this type of analysis, as the criteria for optimization are essentially a GIS representation of Nexus Criteria.

The following is a basic sequence of activities to support a process for GIS-based least-cost optimization of renewable energy investments (e.g. towards a specific renewable energy generation target):

1. Develop the model of the energy system
2. Map points of generation and consumption, and distribution lines
3. Map the spatial distribution of renewable energy sources potential (4.2.1)
4. Apply geographic constraints to locate no-go zones:
    i. Natural constraints (elevation, slope)
    ii. Nexus-related (e.g. Nexus Criteria)
5. Exclude from the map no-go zones
6. Define the minimum desired production potential
7. Define the optimal mix of investments in renewable generation based on:
    i. Costs of technology
    ii. Distances (cost of building new transmission)
    iii. Potential costs of mitigation measures.

Other criteria for optimization aside from the least-cost principle can also be applied. It is also possible to consider different criteria simultaneously (see section 4.2.4). GIS tools can support optimization wherever the spatial element is relevant.

[86] See, for instance, InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) by Stanford University: https://naturalcapitalproject.stanford.edu/software/invest.

[87] Camargo, L.R. and Stoeglehner, G. (2018) “Spatiotemporal modelling for integrated spatial and energy planning”, *Energy, Sustainability and Society* , Vol. 8, p. 32 (https://link.springer.com/article/10.1186/s13705-018-0174-z).

4.2.4 Spatial multi-criteria decision analysis (SMCDA)

As anticipated, geospatial optimization decisions can be further informed by introducing cross-sectoral variables. Spatial optimization tools exist that combine a variety of factors and criteria to reach decisions on renewable energy siting. Using a combination of GIS, engineering tools, and social, environmental and economic variables, geospatial planning can assist decision-makers in choosing between alternatives, and enables them to substantiate their decisions in a transparent and scientific manner.[88] When introducing such a decision-making process, the criteria chosen should also include environmental and social factors that may affect the final choice. These might not be related to sector-specific priorities and could include distance from cultural or natural heritage sites, or proximity to wildlife breeding or feeding grounds (for wind), or forest or agricultural residue availability (for biomass),[89] among others. Selection of the appropriate criteria for this type of analysis allows for the integration of nexus priorities into the decision-making process. Moreover, these approaches define "optimal" siting as that which creates the highest level of consensus, advocating for a high level of stakeholder involvement throughout the entire decision-making process to ensure that the final decision constitutes the best possible compromise.

Renewable energy siting is one of the key factors affecting the type and intensity of impacts in other sectors. Several complementarities exist between the deployment of renewables and the management of nexus-linked resources, such as water and land, that promote nexus synergies. Those complementarities should be considered at the planning stage by including relevant criteria in the SMCDA process in order to identify zones where they apply. It is possible to carry out multi-objective or multi-criteria optimization to produce a range of comparable scenarios to support dialogue on trade-offs among stakeholders with different interests. This can be a useful addition to the process of siting multipurpose dams, for example.

4.2.5 Nexus-informed siting rules for renewable energy technologies

Solar sharing

One of the main issues affecting solar PV siting is competition for land that could be utilized for growing food. The concept of mixed, multipurpose land use through co-production of food and energy, known as "solar sharing",[90] is well established in certain countries (notably Japan, where "floating solar" technology is highly advanced). By elevating and arranging PV panels accordingly, photosynthesis can still take place and farming machinery can be used. Recent research[91] has also shown that this approach may represent a synergy rather than a trade-off in some situations, since certain shade-tolerant crops perform better under the partial shade offered by the panels. Research has also shown

[88] Hanssen et al. (2018) "Spatial multi-criteria decision analysis tool suite for consensus-based siting of renewable energy structures", *Journal of Environmental Assessment Policy and Management*, Vol. 20, No. 3 (doi:10.1142/S1464333218400033).
[89] Woo et al. (2018) "Optimizing the location of biomass energy facilities by integrating multi-criteria analysis (MCA) and geographical information systems (GIS)", *Forests*, Vol. 9, p. 585 (doi:10.3390/f9100585).
[90] IRENA (2015) op. cit. fn. 3, p. 83, Box 2.14.
[91] Barron-Gafford et al. (2019) "Agrivoltaics provide mutual benefits across the food–energy–water nexus in drylands", *Nature Sustainability* (doi:10.1038/s41893-019-0364-5).

that even shade-intolerant crops can be grown under solar PV installations.[92] From a long-term planning perspective, incentivizing this approach in predominantly farming communities could also allow for an increase in rural development and more secure income streams for agricultural populations. Possible decline in farming output could also be controlled by closely monitoring produce output and mandating the dismantling of solar arrays in the event that output drops below a certain percentage. This is the case in Japan where panels are installed in light-weight bases and can be removed if farming produce output drops below 80%.[93]

Multi-purpose dams

The potential for hydropower dams to contribute to flood prevention has been documented and understood for many years.[94] In the same vein, multi-purpose dams can allow for a variety of synergies (beyond flood control) between all three nexus sectors, such as irrigation for agriculture, water storage and supply management, and electricity storage. Moreover, their role in climate change adaptation (through water storage) is becoming more prominent. Introducing these factors as criteria in a multi-criteria analysis on hydropower siting can influence the final decision on whether and where to establish a new large hydropower plant. The design and eventual operation of the plant will also influence the potential for multiple uses. It is therefore necessary to take other, intermittent, renewable energy potential into account and consider the river basin and the hydraulic systems as a whole. This approach can also help navigate the various complexities associated with the management of a multi-purpose dam, since some of the purposes lead to conflicting operational approaches. This analysis, incorporating nexus-relevant criteria for the planning and operation of large hydropower projects, should also be performed on a regional scale between riparian states.

The Transboundary Basin Nexus Assessment (TBNA) methodology, synthesized in a 2018 publication by UNECE,[95] can be a useful tool to accompany the planning of new multi-purpose dams on a regional scale, and to agree on rules to operate them for maximum disbursement of social benefit between riparian countries. New hydropower is commonly subject to strict environmental and socio-economic impact assessments. These assessments are also often a prerequisite for funding – in accordance with the policies of most financial institutions – and are routinely used to substantiate the evaluation and addressing of trade-offs.

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[92] Sekiyama et al. (2019) "Solar sharing for both food and clean energy production: Performance of agrivoltaic systems for Corn, A Typical Shade-Intolerant Crop", *Environments*, Vol. 6, p. 65 (doi:10.3390/environments6060065).
[93] IRENA (2015) op. cit. fn.3; Movellan, J. (2013) "Japan: Next-generation farmers cultivate crops and solar energy", 10 October, Renewable Energy World website (www.renewableenergyworld.com/2013/10/10/japan-next-generation-farmers-cultivate-agriculture-and-solar-energy).
[94] Pircher, W. (1990) "The contribution of hydropower reservoirs to flood control in the Austrian Alps, Hydrology in Mountainous Regions. II – Artificial Reservoirs; Water and Slopes" (Proceedings of two Lausanne Symposia, August 1990). IAHS Publ. No. 194.
[95] UNECE (2018) op. cit. fn. 30.

Rural development

Renewable energy can play a crucial role in the advancement of the rural economy in remote communities. Deployment of renewable energy can provide hosting communities with significant benefits, including new revenue sources, new job and business opportunities, capacity building and community empowerment, affordable energy, and innovations in products, practices and policies in rural areas.[96] To tap into those benefits, a synergistic approach must be promoted that integrates the non-energy-related benefits of renewable energy into rural development strategies. For instance, France has developed a strategic plan for anaerobic digestion dedicated to rural areas, known as the EMAA (plan Énergie Méthanisation Autonomie Azote). The strategic goal of the plan is to have 1 000 anaerobic digesters on farms in France by 2020. The EMAA has a dual purpose – to develop a model to maximize the positive externalities of anaerobic digestion (e.g. reduction of greenhouse gas emissions and recovery of organic waste), and to provide an additional source of income for farmers.[97] The effects of renewable energy deployment in rural communities should also be considered when determining the siting rules for renewable energy. As noted by the IEA, "*long term national strategies for energy decarbonization should identify not just geographical opportunities for renewables installation, but also the potential synergies with the economic needs of such disadvantaged areas and remote communities*".[98]

Another example of rural development through renewables comes from Serbia's Rural Development Policy, a cross-sectoral initiative that recognizes renewables as a tool for sustainable rural development. The policy provides subsidies for farmers to install solar PV with a view to attaining multiple benefits. In fact, PV can provide additional income for farmers through diversification of economic activities, making rural households more financially independent but also more self-sufficient from an energy perspective. More broadly, PV deployment in rural contexts can support the creation of new jobs (both for on-farming and off-farming activities).[99] An interesting aspect is that this synergy was identified and put into operation by the Ministry of Agriculture, not the Ministry of Energy. However, it should be noted that further discussion may still be needed to eliminate the risk of PV speculation on agricultural land.

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[96] OECD (2012) *Linking Renewable Energy to Rural Development: Executive Summary Brief for Policy Makers*. Paris. (http://dx.doi.org/10.1787/9789264180444-en).

[97] European Court of Auditors (2018) *Special Report No. 05: Renewable energy for sustainable rural development: significant potential synergies, but mostly unrealised* (www.eca.europa.eu/en/Pages/DocItem.aspx?did=44963).

[98] IEA-RETD (2016) *REvLOCAL - Revitalisation of local economy by development of renewable energy* (http://iea-retd.org/archives/publications/revlocal).

[99] The policy was discussed during the Renewable Energy Hard Talks, held in Serbia on 21 and 22 March 2019. More information is available at the UNECE website: www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-hard-talks.html.

Biofuels and indirect land use change (ILUC)

When biofuels are produced on existing agricultural land,[100] they compete directly with the production of food, feed and fibre crops. This competition may result in a shift in food and feed crop cultivation on newly reclaimed land (e.g. forests, wetlands and peatlands). This land use change is associated with an increase in carbon dioxide (CO_2) emissions released into the atmosphere, which can be attributed directly to the production of biofuels. This offsets the emission savings from the use of biofuels as a substitute for fossil fuels. In order to properly assess biofuel potential, CO_2 emissions caused by indirect land use change (ILUC) should therefore be factored into policy decisions and considered when setting up incentives for their production. The need to make biofuels more sustainable in order to help further reduce Greenhouse Gas (GHG) emissions, provide a sustainable energy source (particularly for developing countries and remote populations) and encourage greater market penetration of advanced biofuels is undeniable. Modelling ILUC emissions is thus a complex challenge, as was evident in the attempt by the European Commission to adopt a comprehensive policy on this issue between 2010 and 2012.[101]

4.2.6 Strategic environmental assessment

Strategic environmental assessment (SEA) is a systematic decision support process, which aims to ensure that environmental and possibly other sustainability aspects are considered effectively in the development of policies, plans and programmes.[102] SEA is an internationally established instrument, used to assess the environmental and social consequences of new policies, plans or programmes prior to decision-making, and is legally required in an increasing number of countries (presently 106).

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 which are likely to have a significant adverse environmental impact across boundaries, are enshrined in most national legislations, as well as in the Espoo Convention and the Protocol on Strategic Environmental Assessment (SEA) (Box 11).

Box 11: The Espoo Convention and the Protocol on Strategic Environmental Assessment SEA

The Convention on Environmental Impact Assessment (EIA) in a Transboundary Context (Espoo Convention) is a UNECE convention signed in Espoo, Finland in 1991 and ratified by 44 states and the European Union. The Convention reinforces transboundary harmonization in legal and regulatory issues, notably EIAs. It obliges states to notify neighbours about plans for projects that

[100] Conventional (first generation) biofuels are biofuels produced from food crops (e.g. sugar, starch and vegetable oils) grown on land using feedstock which can also be used for food and feed. Advanced (second and third generation) biofuels are produced from feedstock that does not compete directly with food and feed crops, such as wastes and agricultural residues (i.e. wheat straw, municipal waste), non-food crops (i.e. miscanthus and short rotation coppice) and algae. European Commission Memo on Indirect Land Use Change (2012): https://ec.europa.eu/commission/presscorner/detail/en/MEMO_12_787.
[101] For more information see the European Commission website: https://europa.eu/rapid/press-release_MEMO-12-787_en.htm.
[102] Fischer, T.B. (2007) *Theory and Practice of Strategic Environmental Assessment*, Earthscan, London.

are projected to affect their environment, and to carry out public participation and consultation processes between the involved states. In 2003, the Parties to the Espoo Convention adopted the Kyiv Protocol, which states that a Strategic Environmental Assessments (SEA) should be undertaken much earlier in the decision-making process than the EIA.

The EU SEA Directive (on the assessment of the effects of certain plans and programmes on the environment)[103] states that SEAs are required for all plans and programmes (e.g. on land use, transport, energy, waste, agriculture, etc.) that involve projects likely to have significant environmental effects and which would require an obligatory EIA.

At the international level, SEAs are also supported by international financing institutions, including the World Bank and the Asian Development Bank, as well as other expert and advisory bodies.

The application of SEAs to the development of the renewable energy sector at various planning stages can provide the following benefits:

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

(b) At the strategic/policy level, a SEA can facilitate discussion on scenarios for renewable energy development. It can thus contribute to the selection of the most appropriate energy mix, taking into consideration environmental and health risks as well as the benefits of all reasonable alternatives, thereby enabling objective comparison.

(c) A SEA applied at the strategic/policy level can support proper consideration of renewable energy development in other, including parallel, 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 further explored.

(d) A SEA can streamline the development of specific projects and relevant project-level assessments (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 an EIA, can be carried out without major issues. Proper application of SEA – in line with the provisions of the UNECE Protocol on Strategic Environmental Assessment – can help to maximize the environmental and social benefits resulting from renewable energy development, while avoiding or minimizing potential adverse effects.

Important EU regional instruments of a legal order are Directive 2014/52/EU, which amends Directive 2011/92/EU, on assessment of the effects of certain public and private projects on the environment, and Directive 2001/42/EC on assessment of the effects of certain plans and programmes on the environment. These Directives also form part of the EU acquis, which must be transposed by Energy Community (EnC) Member States, and are therefore of importance for many countries of the ECE Region. Another important legislative instrument of particular relevance to the water sector is EU

[103] Directive 2001/42/EC https://ec.europa.eu/environment/eia/sea-legalcontext.htm.

Directive 2000/60/EC (the Water Framework Directive, WFD), which aims to ensure the good status of Europe's waters by managing water at a river basin scale. The WFD requires assessment of the ecological status of water bodies, including their biological, physico-chemical and hydromorphological quality. For example, regarding permit applications for hydropower projects, the Directive states that "*a Member State shall ensure that the application does not permanently exclude or compromise the achievement of the objectives of this Directive in other bodies of water within the same river basin district and is consistent with the implementation of other Community environmental legislation*". This holistic approach to water management is in accordance with the need for a strategic evaluation of synergies and trade-offs around hydropower deployment, which have significant cross-sectoral impacts.

Adherence to this criterion for proposed energy projects should be examined in both national and transboundary contexts. Moreover, the evaluation should not be limited to the existence or lack of an EIA or SEA requirement but, more importantly, to qualitative aspects (e.g. quality control, public participation, governmental capacity to create and evaluate EIAs/SEAs, monitoring, etc.) regarding enforcement of this requirement in practice.

4.3 Climate strategies to drive coherence of action across sectors and within regions

Due to the crosscutting nature of climate mitigation and the global dimensions of the fight against climate change, the development of climate strategies offers a unique opportunity for intersectoral and regional dialogue. Renewable energy deployment is one of the key actions to be taken in the energy sector and, as such, is crucial for climate strategies.

An example of how strategic renewable planning can be integrated into broader climate policy is the EU (and Energy Community) requirement for Member States to develop National Energy and Climate Plans (NECPs) covering the five dimensions of the Energy Union (one of which is decarbonization of the economy) for the period 2021-30. This approach of joint planning for energy and the climate at the national strategic level is a good example of cross-sectoral, long-term planning that addresses the nexus sectors in a holistic manner. Member States are also strongly encouraged to identify areas suitable for joint or coordinated planning within a region, and to consult other governments as early on as possible in the NECP preparation process.

The 2018 EnC Publication, *Policy Guidelines by the Energy Community Secretariat on the development of National Energy and Climate Plans under Recommendation*,[104] extends application of this requirement beyond the European Union to EnC Contracting Parties, and provides that "*The various national plans in a region should complement and where possible reinforce each other, using national strengths to address the region's challenges in the most secure and cost-effective way. Particular attention should be paid to ensuring a coordinated approach concerning the development of new energy resources and infrastructures*".

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[104] 2018/01/MC-EnC. More information at the Energy Community Website: www.energy-community.org/news/Energy-Community-News/2018/06/19.html.

This initiative can be considered a good practice for establishing an integrated planning approach that, in addition to climate change (SDG 13), incorporates priorities relating to water-energy-food-ecosystem nexus interlinkages (SDGs 2, 6, 7 and 14) and other interlinked sectors.[105] Within such an integrated approach, the positive and negative impacts of strategic decisions in the energy sector would be identified at the regional level, and the decision to proceed or not for the benefit of society would be better informed by comparison with a broader variety of options arising from regional cooperation.

[105] For example, poverty elimination (SDG 1), good health and well-being (SDG 3), decent work and economic growth (SDG 8), reduced inequalities (SDG 10), sustainable cities and communities (SDG 11), and responsible consumption and production (SDG 12).

5. Track 2: Sustainable renewable energy policy

The process proposed in this chapter aims to analyse renewable energy policies from the perspective of cross-sectoral trade-offs and synergies, with the aim of enhancing renewable energy sustainability. Both existing and new policies can be analysed through this process, using the Sustainability Assessment Matrix proposed for this purpose. This process aims to identify, assess and classify synergies and trade-offs between the renewable energy policy being examined and the policies of other nexus sectors. Crucially, it identifies gaps and barriers that exist both in the renewable energy policy under analysis and the policies of involved nexus sectors. With adjustments, the proposed method could be replicated in other contexts (e.g. water supply) to gather opinions from involved public and private stakeholders, during either the consultation process for a new policy measure or the amendment of an existing policy measure.

5.1 A step-by-step process for sustainable renewable energy policy development

As with Track 2, the first step is to set up a multi-stakeholder dialogue (Chapter 3) based on stakeholder mapping and recognition of the potential contribution of each group to the development of sustainable energy policies (see Table 3).

Table 3: Stakeholders involved in sustainable renewable energy policy

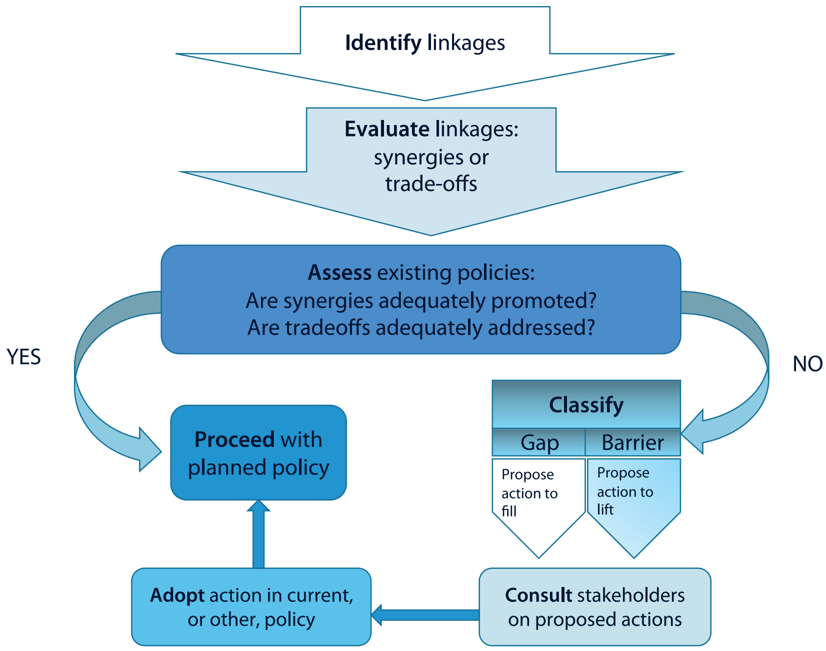
Stakeholder group	Level of involvement	Role
Energy policy-makers	High	Reviewing or developing own policy and associated measures
Other nexus policy-makers	High	Reviewing or developing own policy and associated measures
The public	High	Counterpart for discussing measures for consumers and prosumers
Renewable energy industry	Low	Observer – consulting on technology and innovation
Financiers and investors	Low	Observers – consulting on financing possibilities

The key steps of the process (see Figure 8) are as follows:

- Identify cross-sectoral linkages between energy and the food-water-ecosystems nexus. The identification process should also allow for the identification of transboundary dimensions.
- Evaluate the linkages and classify them as positive or negative.
- Assess whether the results of those linkages are adequately addressed in existing or planned policy measures (i.e. whether the identified synergies are promoted, and the identified trade-offs are addressed or mitigated).
- For linkages that are not appropriately addressed, determine whether this is due to a lack of policy measures (gap) or the presence of conflicting policy measures (barrier), stopping synergies from occurring and generating trade-offs.

- Propose actions that address the linkages (i.e. that promote positive or mitigate negative impacts).
- Consult stakeholders on proposed actions and their suitability and adjust as needed.
- Adopt proposed actions and proceed with the planned policy.

Figure 8: Step-by-step process for sustainable renewable energy policy development



5.2 Sustainability Assessment Matrix (SAM)

The use of a Sustainability Assessment Matrix (SAM) like the one proposed in Table 4 can help implement the various steps of the process.

The process identifies cross-sectoral linkages between a proposed (or existing) renewable energy policy and nexus-relevant areas (water, food, ecosystems), and allows for the examination of potential transboundary dimensions. For clarity, each cross-sectoral section is then further deconstructed into subsections, in order to better specify where the linkage with energy lies. For example, the "water" section is broken down into three different sub-categories: "water access", "water management" and "water infrastructure". The sub-categories can be increased or broken down further to a third level of categories, making the Matrix as flexible, detailed and analytical as needed.

Table 4: The Sustainability Assessment Matrix

Nexus sectors		Synergies			Trade-offs	
		Identification	Assessment		Identification	Assessment
Water						
Water supply/services						
Water management						
Water infrastructure						
Agriculture and Forestry						
Land availability						
Land quality						
Rural development						
Agroforestry						
Ecosystems						
Natural environment						
Wildlife/habitats						
Indirect environmental impact of renewable energy						
Cultural impact						
Transboundary aspect						
Transboundary impact on water						
Transboundary impact on food/agriculture						
Transboundary impact on ecosystems						

Users should classify the linkages under the respective column ("synergies" or "trade-offs") by marking "IDENTIFIED", and providing a brief description of the linkage (see the example in Table 5). This is done to assess whether linkages are adequately addressed in the existing or planned policy and through related measures. It should be noted that "addressing" a linkage in this context is a neutral term related to the desired outcome. "Addressing" a synergy means actively promoting or allowing for it; "addressing" a trade-off means taking measures to minimize or mitigate its effects. Where an identified synergy is addressed (i.e. encouraged), the measure used to encourage it should be mentioned. Likewise, where an identified trade-off is mitigated, the mitigation measure should be noted. Users should mark "ADDRESSED" under the "Assessment" column of the Matrix if the linkage is addressed, and briefly note the measure used to address it.

Where linkages are not ADDRESSED, policy-makers can note whether this is due to lack of relevant policy measures or the existence of conflicting policy measures. This enables users to establish whether there is a GAP or BARRIER in existing policies related to a specific linkage. A GAP is a situation where the identified synergy is not facilitated or promoted, or where the identified trade-off is not offset, minimized or mitigated. Similarly, users can establish whether there is a BARRIER in existing policies. A BARRIER is a situation where an existing policy (which can be related to energy or to other sectoral policies) either blocks a synergy or makes an identified trade-off more difficult to mitigate. Users can mark in the “Assessment” column the existence of a GAP or a BARRIER for non-addressed linkages. In the case of a GAP, the lack of a proper measure is noted, while in the case of a BARRIER, the specific measure is identified.

Once the GAPS or BARRIERS are identified and described, the policy-makers concerned should discuss how to best fill or lift them, respectively. At this stage, a public consultation to gather input from all stakeholders is extremely important. Having built consensus on how to better deal with identified and non-addressed linkages, the proposed actions are adopted, and the planned policy can be implemented with sustainability and nexus priorities effectively integrated.

The proposed analytical process for using the SAM to evaluate cross-sectoral linkages in policies can be useful to energy policy-makers and other relevant stakeholders for a variety of reasons:

- It allows for a detailed mapping of linkages across nexus sectors, which can be useful to all policy-makers, even beyond matters strictly related to renewable energy.
- It shows areas where there are no impacts, allowing energy policy-makers to focus on the existing issues and opportunities and engage in concrete discussions with specific stakeholders.
- It identifies areas were impacts have been addressed and no further intervention is required – an important means of monitoring the effectiveness of actions that have already been taken.
- It showcases where the policy framework as a whole is lacking, and as such stimulates the action of policy-makers from other sectors. In fact, the most effective way to fill a GAP or to lift a BARRIER could fall under the responsibility of a policy-maker from another sector, or even another country.
- It explicitly invites input from nexus policy-makers and makes them co-owners of the process. They can introduce their priorities and concerns, and receive clear direction on how to contribute concretely to sustainable renewable energy deployment.
- It allows investors with green mandates to create a “checklist” for the compatibility of projects with policy requirements (as well as, potentially, with eligibility requirements for funding from “green financing” streams).

The following table presents an example of the use of the SAM for the Agriculture sector (Table 5). It includes a (hypothetical) policy measure to support the deployment of solar PV in rural areas through financial incentives.

Table 5: Example of implementation of the Sustainability Assessment Matrix

Nexus sectors		Synergies			Trade-offs	
		Identification	Assessment		Identification	Assessment
Agriculture						
Land availability		**IDENTIFIED**: Solar PV technologies exist that allow for elevated panels for farming, and also display synergies with increasing bee populations.	**GAP**: The policy can incentivize usage of elevated PV technologies for maximizing benefit from land usage. **BARRIER**: Land zoning rules that prevent Solar PV on farmland should include an exception for PV plants that use elevated technology.		**IDENTIFIED**: New PV installations will use land that could be exploited for farming, etc.	**ADDRESSED**: Zoning rules allow the installation of PV on lands already available for industrial usage or for integrated farming solutions.
Land quality		**NOT IDENTIFIED**	–		**IDENTIFIED**: PV plant parts and, particularly, storage equipment can adversely affect soil if improperly disposed after decommissioning	**GAP**: Obligation to recycle at decommissioning /after a fixed amount of years.
Rural development		**IDENTIFIED**: Small solar PV can provide alternative revenue sources and increased financial security to farmers.	**GAP**: A clause should be included in the proposed policy that makes permitting simpler for farmers that install small (<100 KW) PV plants. **BARRIER**: A tax law provision exists that does not allow farmers to enjoy certain tax exemptions if they have alternative revenue from non-farming activities.		**IDENTIFIED**: Easier income due to solar subsidies can disincentivize local agricultural populations from becoming involved in more physically demanding and financially unstable agricultural professions. **IDENTIFIED**: Local communities often react to large-scale RE installations.	**GAP**: Increase the living standards of agricultural workers, and promote the modernization of farming activities through incentives for modern equipment and supply chain processes. **GAP**: Include a requirement for all projects above a certain size to pay contributions to local communities/ municipalities

5.3 Linking sustainable renewable energy policy to strategic renewable energy plans

A crucial factor in increasing the sustainability of renewable deployment is the existence of long-term, strategic planning at the national and/or regional level, including consideration of the part that renewable energy is envisaged to play (Track 1). In other words, sustainable strategies facilitate the development of sustainable policies. However, even though the benefits of integrated strategic planning are receiving more attention, sector-specific approaches remain the norm when developing national energy strategies. As such, the role of renewable energy within a country's long-term energy vision is often not planned strategically.

Even where they exist, national Action Plans and Roadmaps for renewable energy do not take into consideration broader sustainability and cross-sectoral concerns. Neither do they examine different deployment scenarios in order to identify those with more positive outcomes across interlinked sectors. The EU Energy *acquis* can be regarded as a benchmark when it comes to sustainability, at least in regard to climate and environment (see section 4.3). However, even EU policies for renewables are not necessarily developed based on integrated planning or a rigorous evaluation of cross-sectoral considerations. The National Renewable Energy Action Plans (NREAPs) developed by EU Member States according to the Renewable Energy Directive,[106] aim to set clear, actionable targets for renewable energy, but do not prescribe evaluations of the broad benefits of renewable energy or verification of their compatibility with sustainability principles.

To make these elements explicit, strategies should embrace a broader thematic scope and examine cross-sectoral as well as regional linkages, while Action Plans should include both cross-sectoral and transboundary impacts of the planned actions. To this effect, coordination between neighbouring countries on the development of Renewable Energy Action Plans would represent progress towards higher resource use efficiency and increased regional cooperation.

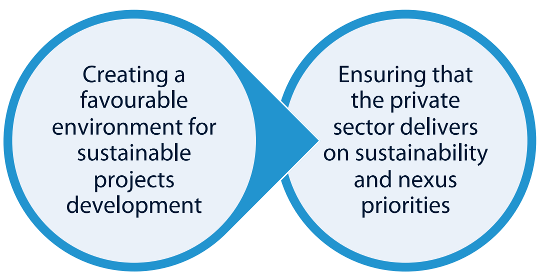
[106] 2009/28/EC. The Directive is also an obligation of Energy Community Member States.

6. Track 3: Sustainable renewable energy projects

Strategic policy choices will not deliver on sustainable energy deployment without the active engagement of those actors who deal directly with project development on the ground. Such individuals, in practical terms, hold the key to realizing projects that are sustainable socially, environmentally "nexus-proofed" and highly beneficial for local communities. Their task is to translate all these qualities into project plans that are technically feasible and financially sustainable. While this task is undeniably complex, it is important to recognize that sustainability issues (particularly those related to the environment) are of increasing concern across the entire spectrum of society. Accordingly, there is greater momentum towards investments, projects and partnerships that explicitly seek to promote sustainability, improve efficiency or resource use, and increase innovation. In the case of renewable energy, this trend can generate projects the benefits of which go far beyond the production of low-carbon electricity, and that can easily qualify for impact financing. At the same time, sustainable renewable energy planning (linking to the previous tracks) enables the identification of projects that avoid environmental, social and economic conflicts. These are projects are less risky and, consequently, less costly.

In this context, policy-makers are called upon to create a favourable environment for private actors to channel this potential. This involves assembling project developers, financiers, investors and the wider community of citizens (and potential prosumers), to discuss the potential impacts/risks and benefits of sustainable renewable energy solutions, and to find innovative ways of deploying them. At the same time, they are responsible for ensuring that private actors comply with strategic priorities, policy and legislation. Essentially, policy-makers can think of Track 3 as a two-step process of incentivization and facilitating compliance (Figure 9).

Figure 9: Two-step process for sustainable renewable energy project development (policy-maker perspective)



Stakeholder engagement and consultation during the project development phase is particularly important because it enables the benefits and impact on the environment and the hosting community (direct and indirect) to be clearly defined. Once identified, these will be the subject of "negotiation" among stakeholders. This is confirmed both in literature and practice, notably through the experience of large projects that involve the relocation of human settlements, or trigger disputes over land use. This report does not treat this subject in detail since a systemic approach would be difficult to propose in light of the context-dependent nature of specific approaches. Instead, Table 6 simply highlights the importance of effectively involving *all* groups (with reference to the broad groups of stakeholders described in Chapter 3).

Table 6: Stakeholders involved in sustainable renewable energy projects

Stakeholder group	Level of involvement	Role
Energy policy-makers	High	Checking sustainability incentives and compliance with strategies, policies, regulation and legislation. Establishing partnerships (depending on the project)
Other nexus policy-makers	High/Low	Playing a similar role to energy policy-makers (depending on the project)
The public	High	Counterpart in local communities
Renewable energy industry	High	Ensuring the best available technology for project
Financiers and investors	High	Financing and ensuring the bankability of the project

Policy-makers from nexus sectors should be more or less involved in project development depending on the project's characteristics and the specific synergies and/or trade-offs at stake. For instance, a project may be strongly supported by agricultural policy-makers because of its strategic impact on rural development. In such a case, agriculture policy-makers would play a role similar to that of energy policy-makers, ensuring that the project responds to strategies, policies and legislation. This confirms the crucial importance of developing integrated strategies (Track 1) and coherent policies (Track 2) that place renewable energy within the larger picture of sustainable development.

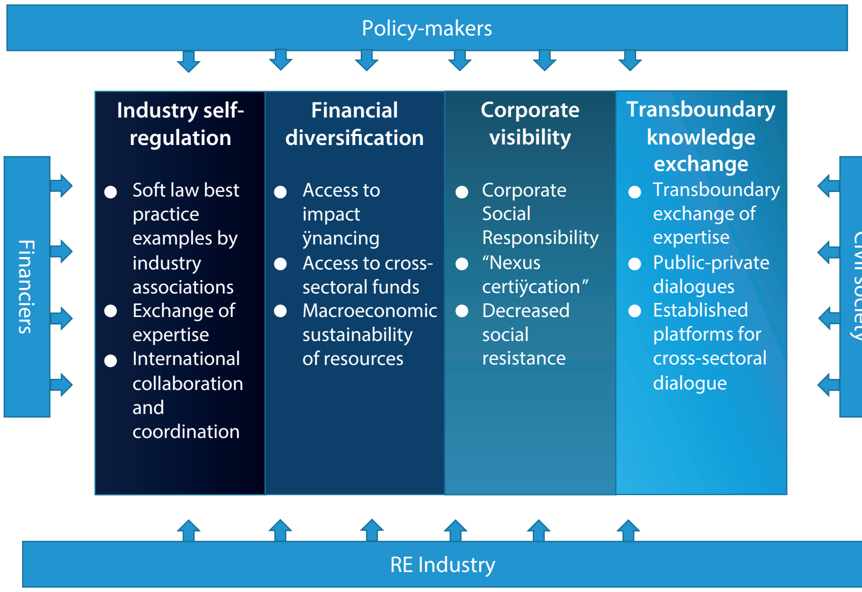
6.1 Creating a favourable environment for sustainable renewable energy project development

The development of a renewable energy project is driven by actors who do not necessarily operate on the basis of the same priorities as policy-makers. Project owners, sponsors, contractors and (commercial) investors are primarily interested in concluding the commissioning of projects within the shortest timeframe and at the lowest cost, in order to maximize the return on their investment. Nevertheless, it is important that they are also committed to developing sustainable projects, in line with the government's social, economic and environmental priorities. In order to achieve this, they need to become co-owners of the overall goal of increasing sustainability in the renewable energy sector. Sustainable projects offer better financial returns because they are associated with lower financial risks[107] (negative environment and social impacts can bring costly delays).

In order for policy-makers to achieve the active engagement of project developers and other private actors, a system of incentives must be in place. In this respect, it is possible to identify at least four groups of incentives that can encourage private actors to value sustainability and nexus-compatibility in renewable energy project development and design (Figure 10).

[107] For a detailed discussion on the issue, see Opperman et al. (2017) *The Power of Rivers: A Business Case.* Washington, DC: The Nature Conservancy.

Figure 10: Checklist of incentives for private actors to become co-owners of the sustainable renewable energy development process



Industry self-regulation

A key incentive for private actors to engage in sustainability is encouragement and the explicit recognition (especially by policy-makers) of sustainability guidelines and best practices. Actors such as international industry organizations can play an important role in producing and disseminating sustainability guidelines, as well as encouraging the uptake of best practices by project development actors and industry members. This is because they represent the interests of those actors and are in a position to disseminate knowledge. These practices constitute a sort of self-regulation within the industry. An example of industrial best practice dissemination through "soft law" is the International Hydropower Association's "Hydropower Sustainability Guidelines on Good International Industry Practice",[108] a code of conduct addressed primarily to industry actors with good practices for the sustainable development of hydropower (Box 12).

Box 12: The International Hydropower Association's guidelines for sustainable hydropower

Hydropower is one of the main areas where the interlinkages between energy, water and agriculture are evident and significant trade-offs can be identified between the usage of water for energy and its availability and suitability for consumption and irrigation.

Moreover, since many rivers are internationally shared, 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 harmonization of rules on sustainable deployment and usage at various stages of a project's lifetime.

[108] IHA, op. cit. fn. 34.

The International Hydropower Association (IHA) has adopted a comprehensive set of guidelines[109] and specific tools[110] to assess the sustainability of a hydropower project, to identify gaps and to promote continuous improvement. The most important of these is the Hydropower Sustainability Assessment Protocol (HSAP), a tool for assessing hydropower projects across a range of social, environmental, technical and economic criteria. The HSAP provides an international common language to explain how these criteria can be addressed at all stages of a project's lifecycle – planning, preparation, implementation and operation.

The conformity of a hydropower project with the IHA guidelines and the utilization of 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. Tools such as the HSAP can be used to screen issues for projects consistent with a broader strategic plan.

Non-industrial players such as inter and non-governmental organizations can also play a key role in spreading best practices throughout the industry. In the field of bioenergy, for instance, the Food and Agriculture Organization of the United Nations (FAO) has developed a Bioenergy and Food Security (BEFS) Approach to guide and support countries through the main stages of the bioenergy policy development and implementation process.[111] The BEFS Approach provides tools for evidence-based policy formulation, risk assessment and the de-risking process, as well as a monitoring and evaluation framework that includes 24 "sustainability indicators" commonly agreed between FAO and the Global Bioenergy Partnership (GBEP)[112] – a joint initiative of policy-makers, industry and civil society. One of the most important parameters of the BEFS Approach is its emphasis on the sustainable development of biomass. The processes involved should not compromise food security and should instead exploit synergies with rural development and climate action.

Another available tool whose use could be encouraged is IRENA's Project Navigator,[113] an online platform that provides guidance and resources for renewable energy project development. Although not specifically focused on sustainability, it provides basic information on the role and format of EIAs in the project development process. An interesting feature of the navigator is that it helps users plan the process of decommissioning in a sustainable way, by recycling the majority of parts and ensuring proper disposal of the rest. This crucial dimension of a project is often overlooked in the planning phase, but will become of crucial relevance in the future when the first generation of technology reaches the end of its lifecycle.

[109] IHA (2018) *Hydropower Sustainability Guidelines on Good International Industry Practice*. Ann Arbor, MI (www.hydropower.org/publications/hydropower-sustainability-guidelines).
[110] More information is available at the IHA website: www.hydropower.org/topics/featured/hydropower-sustainability-assessment-protocol.
[111] More information is available at the FAO website: www.fao.org/energy/bioenergy/bioenergy-and-food-security/en.
[112] More information is available at the GBEP website: www.globalbioenergy.org.
[113] More information is available at the IRENA Project Navigator website: https://navigator.irena.org/index.html.

Corporate visibility and recognition

The growth in environmentally conscious agendas among global industry leaders in corporate branding strategies, presents an opportunity for renewable energy companies to also build their brands around sustainability and nexus-alignment. Corporate social responsibility (CSR) and sustainable practices in project development could increase the social as well as the financial value of energy companies, particularly publicly traded ones.[114] Recent examples of oil and gas companies becoming active in renewable energy development, automotive companies focusing on electric vehicles, or information technology companies sourcing only renewable energy for their energy needs, highlight the fact that sustainability has become a key element in brand recognition.

A simple policy measure to stimulate this momentum could be the establishment of awards for projects that have cross-sectoral synergies or that successfully mitigate trade-offs. This could provide recognition and visibility to sustainably minded industry actors, while showcasing successful industry practices that can be replicated. It would also provide a (non-financial) incentive for industry actors to spend additional efforts in research and innovation towards sustainability.

Financial diversification

Financial diversification of revenues could also provide a strong incentive for aligning projects with nexus objectives. Once electricity production from renewables reaches "grid parity" (i.e. is comparable with the cost of purchasing electricity from the grid), government subsidies and other forms of support for renewables will soon come to an end; however, project developers could seek additional support by exploring cross-sectoral synergies. For instance, a modern plant for combined heat and power (CHP) production from biomass might be obliged to sell electricity to the grid at market price (non-subsidized), but could still receive subsidies for providing heat to local district heating systems, under the condition that it secures a large percentage of its fuel from local agricultural residues. In a similar vein, developers could stimulate solar PV installation in remote regions with restricted water access, by using a grant to cover part of the capital expenditure (CAPEX), on condition that the project establishes, powers and operates a water pump, desalination facility or water purification facility. These two practical examples show how financial diversification can stimulate cross-sectoral synergies (and tap into a broader resources of financial support).

Using the idea of achieving more with less to promote synergies and generate positive impact across sectors, is not only a key pillar of the sustainability concept (and the Agenda 2030), it also exemplifies a profound economic rationale. It reflects the principle of economic efficiency in the utilization of available resources, which allows natural resources to generate more value for a longer period of time. This principle is deeply rooted in sustainability theory, but does not yet guide mainstream energy investments, mainly because the economic benefits of introducing sustainability into resource management and service provision are sometimes hard to realize. They are also difficult to model, measure and evaluate, since they can take a long time to appear and may involve numerous parameters that cannot be easily quantified. In fact, a leading private investor on the subject of

[114] Corporations may also have procurement and sustainability commitments that incorporate a commitment to renewable energy and nature conservation into corporate buyers' principles, procurement guidance and evaluation criteria for project proposals.

"impact investment" opined that, until the economic impact of environmentally and socially conscious investments can be measured, it will remain difficult to persuade investors that it is worth investing in a socially responsible manner.[115] In this area, the role of financiers may be crucial. The finance industry is very well equipped to quantify and assess the economic benefits of sustainability and to develop tools and processes that can demonstrate the economic impact of sustainable investments. The role of policy-makers, here, is once again to convene much-needed multi-stakeholder dialogue around the topic of sustainable renewable energy development.

Regional and transboundary exchange of knowledge

Renewable developers, project owners and financiers can cooperate and exchange experiences and best practices on increasing sustainability and nexus-compatibility at the regional level. Technologies are evolving, costs are dropping and new, more sustainable ways to model and manage the linkages between energy, water, food and ecosystems are developing at a rapid pace. Despite that, it is not always easy to follow all technological developments or to remain aware of all new concepts or ideas. This is even more the case in countries with underdeveloped renewable energy markets or low institutional capacity. Focusing on the exchange of ideas and technical expertise, promoting "good" renewable projects, showcasing innovation, prioritizing research and development, and promoting overall sustainable practices in renewable project development could help to build an industry culture that understands and utilizes innovative technical solutions to achieve nexus objectives.

The role of policy-makers in this context is crucial. Multi-stakeholder, cross-sectoral policy dialogues enable good policies to be shared, good practices to be made public, good projects to gain visibility and sustainability-oriented developers to expand their business, transfer their expertise and build valuable partnerships. This can also have very positive spillover effects on other sectors. In the context of transboundary river basin management, sharing knowledge and discussing best practices, in general, is a practical way of advancing cooperation.

The Nexus-Focused Renewable Energy Hard Talks (see Box 13) represent a strong example of public and private sector stakeholders exchanging opinions on policies and projects at the regional level, with sustainability at the center of discussion.

Box 13: Cross-sectoral, transboundary policy dialogues: The nexus-focused Renewable Energy Hard Talks in the Western Balkans

The Renewable Energy Hard Talks are events organized by the UNECE Group of Experts on Renewable Energy (GERE), in cooperation with host countries and other institutional partners.[116] The events take the form of country-focused, multi-stakeholder policy dialogues that aim to identify

[115] James Coulter, co-CEO of TPG Capital, interviewed by Nancy Hungerford for a CNBC exclusive, opined that "until we can measure impact well in a way that gives people confidence, it's going to be hard to be definitive that you're delivering. And if you can't measure it, how do you know you've really achieved it…we need metrics to prove impact". A transcript is available at the CNBC website: www.cnbc.com/2019/09/23/cnbc-transcript-james-coulter-co-ceo-of-tpg-capital.html.

[116] Including the European Commission, USAID, the Renewable Energy Policy Network for the 21st Century (REN21), DENA (the German Energy Agency) and others. For more information on the Renewable Energy Hard Talks see: www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-hard-talks.html.

risks and barriers to renewable energy investments specific to the host countries, and to recommend policy options from international practice to address them, with the ultimate purpose of de-risking investment.[117] In Bosnia and Herzegovina[118] (2018) and Serbia[119] (2019), the GERE and the Task Force on the Water-Food-Energy-Ecosystems Nexus of the Water Convention (see Box 10) combined their experience during the Hard Talks to carry out nexus-focused dialogues, including considerations of transboundary coordination, where applicable.

The Renewable Energy Hard Talks called upon participants (including public sector stakeholders, private sector developers, civil society representatives and financiers) to share their views on the sustainability and nexus aspects of renewable energy. To this end, a specific session during each event focused on exploring synergies between renewables and the nexus, with dedicated workgroups each focusing on a different type of renewable technology. Going forward, participants in the Hard Talks agreed on the need to integrate sustainability into renewable energy planning, policy-making and investment. Furthermore, a number of concrete policy recommendations were adopted, in line with participants' input, to increase renewable investment in the host countries – some of which had a sustainability dimension.[120]

6.2 Ensuring that the private sector delivers on sustainability and nexus priorities

When engaging with project developers and private actors, policy-makers should bear in mind that it is key that the outcomes of engagement are sustainable and in line with the government's social, economic and environmental priorities. Projects must be designed, implemented and operated in compliance with the relevant national laws and in coherence with the international commitments of the government (e.g. the 2030 Agenda). Because of the key role that public-private partnerships (PPPs) can play in the deployment of renewable energy, UNECE has developed a Standard on PPPs in Renewable Energy.[121] In the context of the SDGs, the UNECE Standard recognizes the importance of measuring the impact of projects beyond simply energy generation. In order to achieve this, it provides guidance to policy-makers on designing and implementing PPPs that have a "People First" approach.[122] A People First PPP is defined as an approach that obtains a set of socially, economically and

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[117] To achieve this objective, the first four Hard Talks applied a version of the United Nations Development Programme (UNDP) "Derisking Renewable Energy Investments" methodology to analyse 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, de-blocking) renewable energy investment.
[118] The Sarajevo Hard Talk was held on 4-5 December 2018. More information is available at: www.unece.org/index.php?id=50834.
[119] The Belgrade Hard Talk was held on 21-22 March 2019. More information is available at: www.unece.org/index.php?id=51516.
[120] The recommendations from the Hard Talks in Bosnia and Herzegovina and Serbia are available at: www.unece.org/index.php?id=52576.
[121] The UNECE Standard on PPPs in Renewable Energy is available at: www.unece.org/fileadmin/DAM/ceci/ppp/Standards/ECE_CECI_WP_PPP_2018_07-en.pdf.
The document is available at: www.unece.org/cicppp/public-private-partnerships-ppp/icoeppp/ppp-standards.html.
[122] For more information, see the UNECE Guiding Principles on People-first PPPS in support of the SDGS: www.unece.org/fileadmin/DAM/ceci/ppp/Standards/ECE_CECI_2019_05-en.pdf.

environmentally desirable outcomes by ensuring alignment with the SDGs, making people the main beneficiaries of projects, increasing access to water, energy, transport and education, especially for vulnerable members of society, promoting social cohesion, improving quality of life for communities, and contributing to ending hunger and promoting the empowerment of women.[123]

By way of illustration, "People First" renewable energy projects must demonstrate environmental and social sensitivity, and be in "*full compliance with domestic environmental and social protection laws, and international best practice standards*". Governments are thus advised to adopt the following set of measures:

- Identify and assess the environmental and social impacts of partnerships (and projects).
- Implement policies that guide engagement with respect to such impacts (Track 2).
- Develop a management programme, including mitigation measures, that addresses the impacts throughout the life of the project.
- Communicate with stakeholders affected by the project, through transparency and disclosure.[124]
- Institute grievance mechanisms to resolve issues.
- Mandate Environmental and Social Impact Assessments to ensure the environmental and social compatibility of a project.

Ultimately, policy-makers should develop a framework which ensures that the economic and social gains from a project exceed the cost to end-users, offtakers and government, and accounts for costs to the environment and related mitigation activities. Assessment of projects should be based on a "value for people" (VfP) approach. In other words, projects should address critical challenges facing humanity such as fighting hunger, poverty, promoting well-being through increased access to essential services, promoting social cohesion and so on. The VfP approach recommends evaluating project performance in terms of outcomes and impacts, which should bring the greatest benefit to the people measured with respect to the SDGs.

While economic regulation is necessary, it should not be considered in isolation from other regulatory functions, such as environmental, health and safety rules/regulations, and the use of natural resources. The risks associated with climate change are often underestimated when host governments and project sponsors analyse a project's viability. It is important therefore to analyse and address diligently such risks in the early stages of a project, agree on a fair share of subsequent revenue risks and eventually consider available insurance instruments.

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[123] See ibid, p. 5.

[124] The "People First" approach to PPPs can be related to a human-right based approach in the development and implementation of projects. For projects affecting Indigenous Peoples or their territories, the Free, Prior and Informed Consent (FPIC) Manual for Project Practitioners is a useful tool to protect Indigenous Peoples' rights where their consent is being sought, in line with the UN Declaration on the Rights of Indigenous Peoples. For more information see: www.fao.org/3/a-i6190e.pdf.

7. Conclusions

This publication focuses on aspects of sustainability and the intersectorality of renewable energy deployment (synergies and trade-offs), with the aim of providing policy-makers with a conceptual framework to navigate them. More effective consideration of these aspects in policy-making can help maximize the benefits to society and the environment of the wide deployment renewable energy, and at the same time reduce any associated negative impacts. In the context of the 2030 Agenda for Sustainable Development, this approach can help achieve multiple SDGs simultaneously, while reducing multi-sectoral competition for natural resources which are increasingly under pressure due to increasing demands, climate change and widespread environmental degradation.

The report proposes a non-comprehensive “toolkit” for renewable energy policy-makers and guides them through the processes of strategic planning, and sustainable policy and project development, in the form of multi-stakeholder, multi-sectoral consultations. The toolkit includes step-by-step guidance as well as methods and tools to comprehensively, organically and systemically integrate nexus priorities and sustainability concerns into renewable energy development. Crucially, it also integrates consideration of transboundary impacts and regional cooperation opportunities into the decision-making process.

Application of this toolkit will strengthen cross-sectoral ties among stakeholders. Importantly, it will also help energy policy-makers identify the actors responsible for further action in the various sectors, and engage with them (this report suggests at minimum engaging with the water, agriculture/forestry and environment sectors). All stakeholders are called upon to identify common priorities, set sustainable goals and targets (notably relating to renewable energy), discuss opportunities for partnerships and define mechanisms to eliminate negative impacts. The report also acknowledges the potential of establishing coordination frameworks for climate change action or sustainable development and, where applicable, transboundary cooperation frameworks to facilitate such exchanges.

The benefits of regional cooperation in maximizing synergies across borders and addressing transboundary trade-offs in a coordinated, cooperative manner cannot be overstated. The most evident benefit is economic, as the adoption of a coordinated approach in the planning and deployment of renewables on a large scale helps to exploit the complementarity of available resources and capacities, which naturally have varying potentials throughout the territory. Crucially, the use of a diversified mix of resources can also increase the capacity to absorb larger amounts of variable renewable energy, such as wind and solar, ultimately optimizing the potential of the available resources.

The key to successfully exploiting synergies and effectively addressing trade-offs is the capacity of energy policy-makers to engage with other sectors and to convene multi-stakeholder dialogues, thereby generating cross-sectoral ownership of renewable energy developments and beneficial partnerships. Policy-makers are called upon to identify and address existing gaps and barriers to the exploitation of synergies and the resolution of trade-offs through the application of a Sustainability Assessment Matrix. However, it is evident even from a preliminary application of the Matrix that filling gaps and addressing barriers extends beyond the competences of policy-makers, underlining the need to work with other actors outside the energy sector.

The toolkit proposed in this report is non-comprehensive. Experts and practitioners are invited to contribute to its improvement with appropriate tools and methods. Furthermore, policy-makers are invited to test its application in their strategies, policies and projects, to validate its applicability and provide feedback. UNECE stands ready to support their efforts according to its mandate and available resources.