

## Article

# Linking Environmental Policy Integration and the Water-Energy-Land-(Food-)Nexus: A Review of the European Union's Energy, Water, and Agricultural Policies

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**Abstract:** Against the backdrop of climate and environmental pressures, as well as limited resource availability and trade conflicts, devising policies for energy and the use of natural resources in general becomes exceedingly complex. Moreover, policies are required to account for interrelations between individual resources and between different sectors and policy fields, but implementation often lacks. To evaluate the current state of integrated policy design in the EU, a review of European energy, water, and agricultural policies was conducted. Using a qualitative comparative research approach, the objective was to identify and explain the differing degrees and variations in policy integration among them. To this aim, the concepts “Environmental Policy Integration” and “Water-Energy-Land Nexus” were jointly applied as analytical frameworks. The analysis revealed that currently, different authorities are endowed with largely sectoral mandates. Accordingly, the respective sectoral policy sets are historically grown based on differing sets of formal and informal rules and processes, thus making policy integration among the sectors, let alone within the nexus, a highly challenging task.

**Keywords:** water-energy-land nexus; environmental policy integration; policy analysis; European Union

## 1. Introduction

A multitude of environmental, economic, political, and social challenges demonstrate that current practices of natural resource management are unsustainable. In this context, current research shows that sectoral interdependencies among resources are increasingly important [1–6] and they influence each other through complex feedback [7]. With Agenda 2030, the international community has confirmed its commitment to adopting measures supporting sustainable development. Reflecting on sectoral interdependencies, the 17 Sustainable Development Goals (SDGs) are interrelated, and associated actions and policies require integrated and holistic approaches. Already since the 1990s, integrative policy concepts such as Environmental Policy Integration (EPI) and, more recently, the nexus around the conflicting interdependencies among water, energy, and land (WEL Nexus) have entered public and political agendas. The UN Global Sustainability Panel in its 2012 report highlighted the importance of the water, energy, and food nexus [8], and reinforced this focus in the 2014 UN Global Sustainability Development Report by attributing a special section to ‘the climate-land-energy-water-development nexus’ [8]. In 2011, the World Economic Forum in its ‘Global Risks Report’ identified the water-energy-food (WEF) nexus as one of its three cross-cutting global risks [9], and the World Business Council for Sustainable Development (WBCSD) under its ‘Vision 2050’ has centered several activities around the water-energy-land-food nexus [10]. The ‘World Energy

Outlook 2012' explicitly addresses the nexus among water and energy [11], and the U.S. National Intelligence Council (US NIC) in its report 'Global Trends 2030' identified the nexus among water, energy, and food as one of four global megatrends [12]. With a focus on developing countries, the European Commission in 2012 published a report entitled 'Confronting Scarcity: Managing Water, Energy and Land for Inclusive and Sustainable Growth' [13]. On a global scale, providing all people sufficient access to clean water, adequate nutrition and a clean, reliable source of energy has been the primary objective. Within Europe, however, sufficient access to these resources has long been achieved and the focus instead has shifted to their effective and sustainable management:

"The effective management of water, energy and land can and should contribute to economic growth. We draw on water, energy and land for a broad range of productive activities, from the production of food and fiber to the generation of power that moves our society. Water, energy and land are key inputs to the economic system, and thus play a crucial role in creating wealth [13]."

Effective management first and foremost builds on political processes and governance structures. This holds especially true for the EU with its large territory and population, and its complex multi-level governance system. However, to this date, only limited research addresses integrated natural resources governance on the EU level. With regard to EPI, there is considerable literature on EU governance, but the concept is almost exclusively applied to individual sectors and policy fields such as agriculture [14] or climate and energy policies [15]. Also, according to the literature, the concept lacks implementation, since EU efforts on including environmental concerns have been limited primarily to a strategic, discursive level [14]. In turn, with regard to the WEF Nexus concept, existing literature reveals that in the EU, the concept is often used to address links between only two sectors, or to analyze impacts of one sector on another. Examples include the nexus between energy consumption and economic growth [16,17], the electricity-fuel nexus [18], or the climate-energy security nexus [19,20]. More closely in line with the nexus approach as it was internationally promoted, Karabulut et al. [21] and Ziv, Watson, Young, Howard, Larcom, and Tanentzap [3] apply the water-energy-food nexus approach to case studies in the Danube river basin and the UK, whereas Siciliano et al. [22] analyze the relations between European large-scale farmland investments and the nexus. However, such comprehensive applications of the WEF Nexus concept seldom include governance aspects, e.g., [23]. This brief overview of studies demonstrates that, so far, little research has been conducted on the degree of integration of natural resource governance in the EU. This research gap needs to be addressed in order to overcome the prevailing silo-thinking, especially on higher governance levels such as the EU.

The aim of this paper is thus to review, in how far the European Union and its policy strategies are currently designed to pursue the objective of an integrated perspective on natural resources governance. It further investigates the challenges and barriers to a more coherent policy design. Therefore, current EU policies of high relevance for the water, energy, and land sectors are identified. The analysis of these policies' degree of integration is based on the literature on EPI differentiating between vertical and horizontal policy integration and the WEL Nexus literature on integrated governance. The paper provides a review of the current state of policy integration, which is assessed against the background of the two conceptual frameworks, EPI and WEL Nexus. The remainder of this paper is structured as follows. In Section 2, we further introduce the conceptual frameworks. In Section 3, the results of the qualitative in-depth analysis of implemented policy integration in current, nexus-relevant EU policies are presented. Section 4 includes a discussion of research outcomes and offers respective policy implications. The paper then concludes with a section on research implications, limitations, as well as further research needs (Section 5).

## 2. Conceptual Framework and Methodology

This paper offers a review of EU policies relevant to energy, water, and land with regard to their degree of integration. Already in form of the EU's predecessor, the European Coal and Steel Community, governing natural resources has been a crucial field of common action. However, how individual resources are regulated and managed differs widely. Despite its historical role in European integration,

energy policy has long been a strictly national prerogative. Article 194 of the Treaty on the Functioning of the European Union affirms the ‘Member State’s right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply’ [24]. However, with the Energy Union in 2015, the EU has moved towards a more communitized energy policy, especially with regard to supply security, the internal energy market, and decarbonization efforts. Similarly, the provision of water is a national task, but against the background of environmental pressures, the EU has enforced several regulatory frameworks on water quality and the treatment of wastewater as part of its environmental policy and strives for integrating water concerns into related policy fields. Issues of land management are primarily regulated by either EU environmental policies or agricultural policies. The Common Agricultural Policy (CAP) is a core concern of the EU, managing regulations and support for farmers and rural areas since 1962. It is among the most contested and financially significant EU policy fields. In sum, EU management of natural resources, specifically energy, water, and land is very complex, and providing more integrated policies constitutes a significant governance challenge.

As mentioned in the introduction, there are primarily two concepts of relevance for integrating natural resources policies in the EU: EPI and the WEL Nexus. As analytical frameworks they provide the foil against which to reflect EU policies in order to identify and explain variations in integration. In this section, these concepts and the review approach will be introduced.

The review primarily draws on policy documents that can directly contribute to or are of relevance for achieving policy integration among the energy, water, and land policy sectors in Europe. For this purpose, the major political frameworks from the energy, water, environmental, and agricultural policy fields, as well as overarching policy documents dealing with sectoral interdependencies and general sustainability issues, were considered and qualitatively analyzed. For the identification of the relevant documents, keywords were deductively derived based on the available scientific literature [25,26] and searched for on the homepage of the European Union [27]. A list of the identified policy documents (N = 41) is provided as Supplementary Materials Table S1.

The policy documents were supplemented by relevant secondary literature. To this aim, a general web search was conducted for all specific policy measures of relevance (e.g., the Water Framework Directive (WFD) & CAP). This search produced both non-governmental and scientific reviews of different policies. The identified documents thus included original policy documents as well as policy reviews, totaling over 100 documents of relevance. These documents were then reviewed with regard to the assumptions and requirements about policy integration provided by the concepts EPI and WEL Nexus.

Before introducing the concepts, the terminology of policy integration is specified. The term policy integration, both in policy documents as well as in much of the scientific literature, is often used interchangeably with policy coherence. To carefully frame our research approach, in the remainder of this paper, we will differentiate between the two concepts based on Nilsson et al.’s [28] definition, according to which policy coherence refers to policy outputs whereas policy integration refers to policy processes and the institutional setting. Analytically, policy coherence thus results from an integrated policy framing. In actual policy-making, however, they can hardly be considered separately.

### 2.1. EPI Concept

Both the EPI and the WEL Nexus concepts originate in the sustainable development discourse. The concept of EPI emerged in the 1990s, following the 1987 Brundtland Report, as a means to harmonize economic, social, and environmental policies [29]. The primary objective of EPI is to integrate environmental concerns into non-environmental sectors. EPI has been politically backed internationally, but especially by the EU [29]. However, this principle has seen little implementation since, and thus, research has turned towards investigating how governance structures are formed [29].

With respect to governance structures, EPI is often divided into a horizontal dimension (defined as the ‘extent to which a central authority has developed a comprehensive cross-sectoral strategy’)

and a vertical dimension (defined as the ‘degree to which sectoral governance structures have been “greened”’) [30]. The vertical perspective primarily addresses procedures and interactions that have been established to promote environmental objectives within policy domains, such as sector-specific environmental targets [31]. Research, however, has shown that such sectoral strategies most likely will not automatically converge in order to best meet the overall objectives set in a comprehensive strategy [30]. Instead, successful EPI will require an even balance between both dimensions as well as the political will to achieve them [31–33]. Thus, the EPI concept accounts for environmental objectives within sectoral policies and a cross-sectoral strategy.

EPI has a long history in European policy design. The first legal basis was implemented as part of the Single European Act in 1986, demanding the integration of environmental objectives into other sector policies. This objective was further reinforced by the Maastricht and Lisbon treaties [34]. Although these treaties lay out a legal basis for the formal consideration of environmental objectives, their relevance has remained far inferior to sectoral objectives. Merely providing environmental concerns a legal basis, hence, does not guarantee an effective implementation [32]. Nonetheless, increasing consideration of environmental objectives becomes apparent, e.g., when looking at the development of the EU’s Environment Action Programs [34].

A significant stream of EPI research on energy, water, and land policies has focused on its implementation in the CAP, e.g., [14,35]. In the literature, the food and agricultural policy is described as ‘an extreme case of the ensuing compartmentalized and “exceptionalist” policy-making, where sector-specific policy ideas and institutions provide privileged access for sectoral interest groups and generate policies that benefit their members’ [35]. Correlate finding of the research is that, despite a noticeable increase in the environmental discourse or rhetoric, the comparatively low priority of environmental policy and the ‘closed agricultural policy network’ make it difficult to ‘move from political commitment to genuine EPI’ [14]. Instead, environmental concerns seem to fulfill mainly a strategic role in legitimizing existing practices [36]. Concluding this research, Alons [14] thus recently stated: ‘Environmental objectives have become a variable in the agricultural policy-making equation, but its coefficient remains small.’ The example of EPI in agricultural policy is of direct relevance to the WEL Nexus approach, since environmental concerns in the agricultural sector very often directly relate to water concerns. Generally, however, EPI is actively promoted by actors in the broader environmental sector, whereas its implementation in other relevant policy sectors so far has had only limited impact [29]. So, while there is considerable literature on EPI, the concept has not been translated into the integration of natural resources governance in the EU.

## 2.2. WEL Nexus Concept

The WEL Nexus is a comparatively recent concept, which was formulated in the context of the Bonn 2011 Nexus Conference as a means to optimize the management of the interdependent resources with the twin objectives of achieving a sustainable, fair resource allocation and economic growth [2,37]. As such, it was introduced into EU thinking on sustainable development with the 2012 report “Confronting Scarcity: Managing water, energy and land for inclusive and sustainable growth” [13]. Although ‘the nexus’ has been extensively discussed on many levels during the past years, a consistent definition, or even terminology of the concept, does not exist. Most publications refer to the ‘water, energy, food’ (or ‘food, energy, water’)-security nexus (WEF/FEW Nexus) [2,5,10,38–43]. Others instead refer to the nexus among ‘water, energy and land’ (WEL Nexus) [13,44,45], or a combination of the two [46,47]. Also, some publications specifically investigate certain relations or sectors, such as the nexus between seafood and hydropower [48]. Others again explicitly include a fourth sector—namely climate—to the nexus [11,45,49,50]. Depending on specific perspectives, several publications address merely bilateral relationships among any two of the nexus sectors—most notably, the water-energy relationship, e.g., [1,11,51–64]. In this paper, the WEL Nexus perspective was chosen, since it reflects a holistic approach, including all three sectors and a focus on natural resources instead of exclusively human

needs (i.e., food), while subsuming overarching climate aspects under the three sectors, respectively (e.g., emissions originating from agricultural practices or power generation).

Despite these variations in nexus terminologies and perspectives, their common ground is the realization that the sectoral fragmentation among water, energy, and land resources constitutes a crucial challenge in achieving sustainable development: ‘silo-thinking’ in managing these sectors leads to unintended side-effects and conflicts [65]. The aim is therefore to identify potential trade-offs as well as synergies, enabling the design of optimized, cross-sectoral resource management strategies [2,39]. In contrast to different approaches of integrated resource management (such as, e.g., integrated water resources management or the integrated landscape approach), the idea of the nexus approach is to not prioritize an individual resource, but regard the water, energy, and land dimensions of the nexus at once, in their complex interrelations [39].

‘The nexus’ has been addressed by a number of different methods and disciplines in the past years. While current research suggests that quantifying the WEL Nexus could offer possibilities for an enhanced understanding of interconnections, related approaches and applications face several methodological obstacles [66,67]. Even though research on socio-economic issues increases the nexus, academic literature, so far, has been dominated by techno-economic approaches [68–71]. However, especially in industrialized countries, problems or inefficiencies in the use of natural resources are often caused by fragmented management and governance of these resources. Common barriers are a high level of bureaucracy, historically grown sector policies and institutions, and differentiated responsibilities [33]. Thus, in this paper, the WEL Nexus approach is specifically applied to governance issues.

In this paper, we define the WEL Nexus as an analytical approach for optimized solutions of natural resources management based on a holistic assessment of challenges and opportunities [13,39,72]. Applying the EPI terminology, we understand the nexus as a concept aiming at both vertical and horizontal policy integration across related policy fields, such as energy, water, or agricultural policy. Given these objectives, a nexus-enabled integrated policy-design for managing those resources should systematically account for the cross-sectoral effects of sectoral policies. Such an approach may ‘support a transition to sustainability, by reducing trade-offs and generating additional benefits that outweigh the transaction costs associated with stronger integration across sectors’ [2]. However, it will also likely alter the costs and benefits of existing policies and actions [13]. So although a nexus-enabled policy approach is expected to lead to better solutions, it may confront initial resistance in the different sectoral domains. Research has further shown that currently societies are only vaguely organized as to effectively implement and enact integrated (i.e., coherent) planning and action [1,38], and that even within the sectors, different policy packages often conflict with each other [73]. This holds true especially in the case of the EU, where sectoral fragmentation is strongly prominent [15]. Thus, the WEL Nexus offers a new, alternative approach for EU policy integration to advance.

With respect to managing the WEL Nexus, the EU is confronted with diverse conflicts of interests and unintended interrelations. Two prominent examples are the nitrogen pollution of ground water by agriculture [74] and the link between energy and water infrastructures in industry [75]. The EU emphasizes that internal policies affecting sustainable consumption and production patterns in the EU are important to help prevent resource scarcities [13]. Although a significant stream of research on the WEL Nexus has developed, its vast application and inconsistent definitions impose challenges on operationalizing the nexus for EU policies [76]. Attempts to achieve better coherence in the governance of the nexus resources inevitably lead to questions about the most adequate level of integration among the resource sectors. By emphasizing the need for considering interlinkages among the sectors, the nexus concept frames a new objective of policy integration among the related resource sectors. The nexus concept, in contrast to the main purpose of EPI, does not aim at implementing general environmental objectives into other policy sectors, but instead sets focus on the interlinkages between the water, energy, and land sectors [2]. Given this difference, existing, but often single-sector findings from the EPI literature can provide valuable insight, but will not be sufficient. Accordingly,



a multi-sector analysis of the specific cross-sectoral interdependencies among the nexus sector policies shall provide the fundament for assessing the current state of policy integration in the European Union.

Reviewing EU policy integration based on the WEL Nexus concept faces methodological challenges. While the EPI concept provides specific analytical categories, the WEL Nexus concept has been heavily criticized for its lack of operationalization [76]. The EPI concept also entails differing interpretations and implementation options, but to a comparatively smaller degree [29]. As the above discussion shows, there is considerable overlap in the challenges for policy integration between EPI and the WEL Nexus concepts, given that water, energy, and land as natural resources are inevitably also part of the environmental sector. Though nexus aspects might fall under the concept of EPI, the WEL Nexus concept offers a more systemic perspective than the EPI concept. While the WEL Nexus approach looks at the overall integration of different policy sectors, the EPI approach entails the integration of specific sectoral policy goals. Thus, both concepts complement each other well for reviewing the state of integration in EU policy. Based on the WEL Nexus' systemic perspective and EPI's analytical categories, in the subsequent review we will investigate EU policy integration with regard to cross-sectoral and nexus-informed strategies and policies, and the mutual consideration of related objectives within sectoral policies.

### 3. Review

#### 3.1. Cross-Sectoral Considerations in EU Policy Documents by Policy Sector

As point of departure for the in-depth qualitative analysis of policy integration, we examined policy documents for considerations of policy coherence. In a first step, explicit references to policy coherence were considered by policy sector. Policy coherence, in this context, was defined in line with its understanding in the Sustainable Development Goals as 'synergies and trade-offs among [ ... ] targets, between different sectoral policies, and between diverse actions at the local, regional, national, and international levels' [77]. This definition served as the basis for analysis, where the specific focus was set on the cross-effects among the sectors. The analysis revealed that, within the policy sectors of direct relevance to water, energy and land, considerations of policy coherence are most prominent in the sector of general environmental policy. Of the directly resource-relevant sectors—water, energy, and agriculture—policy coherence is most strongly considered in water policy documents (cf. Table S1: WFD, WFD\_DecMak, WatScarcImpact, WFD\_IntegrWat, NitrDir\_Backgr, SoilWaterStudy, ResEcEffWatDistr, WFD\_Leaflet). Given that environmental considerations and sustainability objectives are of direct and spanning relevance for all resource sectors, this result is not unexpected. Furthermore, as discussed (Section 2.1), the EPI focus of integrating environmental concerns into other sectors has long been part of EU policies, which accordingly is reflected in the documents.

In a second step, the documents were reviewed with regard to implicit considerations of policy coherence for sector-specific policy considerations. The results indicate that of the relevant policy sectors, in the energy sector, cross-sectoral considerations are least integrated into policy design. In the considered energy policy documents, no reference to water policy was found. Agricultural policy was singularly referred to with regard to the combined emission of CO<sub>2</sub> in the case of energy crop production for bioenergy (cf. Table S1: En2030Strt). The same trend shows in the analysis of the agricultural and water policy sectors with none or only few energy policy considerations (cf. Table S1: WatScarcImpact, SoilWaterStudy, ResEcEffWatDistr). According to the results, it can further be assumed that policy coherence, at least to some degree, has been achieved among agricultural and water policies with frequent cross-sectoral considerations, respectively.

To further differentiate these first, general results, a more detailed analysis of policy coherence was conducted. For this purpose, the documents were analyzed for reflections of cross-sectoral considerations. Specifically, the implementation of policy coherence as a policy objective was searched for and found primarily in general environmental policy with few instances in water and agricultural policy (cf. Table S1: IndicIntegrEnvCAP, ReviewEIA, CAP\_2013RefOverv, WatScarcImpact,

ResEcEffWatDistr). These observations again confirm that the implementation of cross-sectoral policy considerations is least advanced in the energy policy sector.

Furthermore, references to the respective other resources were searched for. One central result was that the agricultural policy sector seems to play a crucial role when analyzing the integrated policy perspective, since the respective cross-sectoral considerations with energy and water resources were repeatedly and specifically addressed (cf. Table S1 CAP\_Markets, CAP\_RuralDev, CAP\_Tow2020, CAP\_2003CrossComp, CAP\_Payments, IndicIntegrEnvCAP). Also, these considerations were found in different documents and address a broad number of different objectives. The analysis of energy policy documents, in contrast, revealed references to both agriculture and water policies; however, all originate from the same document, namely the Renewable Energy Directive (2009/28/EC) (cf. Table S1: RenEnDir). Within this document, general sustainability considerations play an important role, so that merely the very general objective of ‘measures taken for soil, water and air protection, the restoration of degraded land, the avoidance of excessive water consumption in areas where water is scarce’ is referred to [78]. The review of policy coherence finds that the agricultural sector plays a central role for integrated resources governance. In order to look beyond these indicative results, they serve as the starting point for the subsequent comparative analysis of policy integration among the sectors.

### 3.2. In-Depth Analysis of Vertical and Horizontal Policy Integration in Nexus-Relevant European Policies

To consolidate the above analysis, this section provides an in-depth qualitative comparative analysis and discussion of those EU energy, water, and agricultural policies that were identified to show a significant degree of implemented vertical and horizontal policy integration. Firstly, we evaluated the vertical dimension. This allows us to investigate to what extent EU sector policies are nexus-informed.

#### 3.2.1. Vertically Integrated EU Water and Agricultural Policies

In case of water and agricultural policies, a high degree of vertical policy integration can be found. In Europe, the management of water resources is primarily regulated via three binding directives: (a) the Water Framework Directive (Directive 2000/60/EC), (b) the Bathing Water Directive (Directive 2006/7/EC), and (c) the Marine Strategy Framework Directive (Directive 2008/56/EC). The WFD, as the EU’s main instrument for water protection, requires its member states to achieve ‘good status for surface and groundwater’ by 2015 (Article 4 WFD). It was adopted in 2000 and in this early version highlights the need to integrate water protection and sustainable management into other policy areas such as ‘energy, transport, agriculture, fisheries, regional policy and tourism’ [79].

One integral part of the WFD is the Nitrates Directive, which came into effect in 1991, and specifically addresses the prevention of ground and surface water pollution from agriculture by promoting the use of good farming practice [80]. Within the WFD, several measures have been defined with a direct link to agriculture, including, e.g., the management of water demand, fertilizer emissions, as well as efficiency and reuse measures [81]. It thus shows that the negative side-effects of intensive agriculture production were considered in water management. To date, however, specific analyses to determine the actual effects of such policy frameworks on other resource sectors are rare [2]. However, the link between water and agriculture policies is bilateral, as the above results indicate.

The CAP is currently the most important EU policy framework to mandate the formal consideration of externalities among the nexus resources, especially low water quality resulting from agriculture. With a total spending of over 58 billion Euro, the CAP accounts for almost 40% of the EU budget [81] and pursues three main long-term objectives: (a) viable food production, (b) sustainable management of natural resources, and (c) climate action and balanced territorial development [82]. In March 2013, the cornerstones of the post-2013 CAP were defined. ‘Cross-compliance’ was reinforced, directing payments for farmers to comply with rules on farming practices that account for the environment, food safety, animal and plant health, and animal welfare while maintaining ‘agricultural land in good agricultural and environmental condition’ [81]. The post-2013 reform of the CAP was motivated by

three main challenges within the agricultural sector, which—although not explicitly referring to the WEL Nexus—very closely correlate to the nexus challenges (Table 1):

**Table 1.** Challenges in the agricultural sector [82].

Economic challenges	<ul style="list-style-type: none"> <li>• food security and globalization</li> <li>• a declining rate of productivity growth</li> <li>• price volatility</li> <li>• pressures on production costs due to high input prices and the deteriorating position of farmers in the food supply chain</li> </ul>
Environmental challenges	<ul style="list-style-type: none"> <li>• resource efficiency</li> <li>• soil and water quality</li> <li>• threats to habitats and biodiversity</li> </ul>
Territorial challenges	<ul style="list-style-type: none"> <li>• rural development</li> <li>• demographic, economic and social developments including depopulation and relocation of businesses</li> </ul>

In order to address these challenges, a new policy instrument has been added to the new CAP: the ‘Green Direct Payment’ [82]. It rewards farmers for complying with three agricultural practices: (a) maintenance of permanent grassland, (b) ecological focus areas, and (c) crop diversification [82]. Furthermore, as part of the second pillar, rural development, at least ‘30% of the budget of each rural development program must be reserved for voluntary measures that are beneficial for the environment and climate change’ and will be implemented as part of the national (or regional) rural development programs [82]. Given the financial endowments of almost 100 billion Euro for the period from 2007 to 2013, rural development could thus contribute substantially to funding the protection of water resources [81].

The main challenge to do so consists in that EU water policy objectives are anchored in different policy areas sub-ordinate to different authorities with partially contradictory interests [81]. In order to overcome these challenges, the re-established mechanisms of cross-compliance and the European Agricultural Fund for Rural Development provide the means to more strongly encourage good farming practice in compliance with environmental legislations [82].

Integrating policies across the water protection and agriculture policy realms in the EU constitutes a valuable contribution towards an integrated policy framework, which comprehensively considers both direct and secondary policy effects on each of the nexus resources. Notwithstanding the progress made, the European Court of Auditors’ analysis pointed out that the integration of EU water policy goals as part of the CAP cannot be regarded as completed yet, and that several major challenges remain, often related, e.g., to weaknesses in the definition of standards or inconsistencies among member states [81].

### 3.2.2. Approaches for Horizontal Policy Integration in Nexus-Relevant European Policies

Next, horizontal policy integration was investigated, i.e., the degree to which the EU has developed cross-sectoral strategies. Specifically, this analysis evaluates to what extent the EU pursues an overall integrative approach. In addition to the sectoral approaches of policy integration, further instruments of horizontal EPI exist in the EU in the form of political initiatives, overarching strategies, plans and assessment tools that are of great relevance for achieving a nexus-enabled policy approach. Prominent examples of such merely horizontal approaches are EU roadmaps. As part of the Energy Roadmap 2050, the EU reaffirmed its objective to reduce greenhouse gas emission to 80–95% below 1990 levels by 2050 [83]. Furthermore, the share of renewable energies in final energy consumption is to increase to at least 20% by 2020. More specifically, in terms of the energy sector, the ‘Roadmap



for Moving to a Competitive Low-Carbon Economy in 2050' broadly refers to potential negative side-effects of renewable energies, e.g., biofuels, concluding that 'any negative impacts on other resources (e.g., water, soil and biodiversity) will need careful management' [84].

Thus, for the energy sector, horizontal policy approaches exist within these roadmaps, formulating overarching objectives that are to be reached by vertical processes. Similar approaches exist for water management. The 'Roadmap to a Resource Efficient Europe' defines a number of non-binding water management objectives including, for example, to keep water abstraction below 20% of available renewable water resources, while minimizing the impacts of droughts and floods through adapted crops, increased water retention in soils, and efficient irrigation mechanisms [85]. In accordance with the nexus understanding, the roadmap further calls for a comprehensive and integrative management approach to achieve these objectives [85]. Such overarching strategies and plans—despite their reference to the main nexus idea—currently lack an operational implementation in day-to-day policy making [48].

In addition to those long-term strategies, which propose concrete and, in some cases, binding quantitative targets, other horizontal approaches also have a long-term background. One such approach to putting environmental objectives onto a stronger legal basis was the Cardiff-Process in the early 2000s. It moved forward the integration of environmental and sustainability considerations into the different policy sectors and stipulated learning that has translated into further nexus-relevant policy measures. It followed upon the addition of Article 6 to the EC Treaty (COM (1998) 333) in 1998, according to which 'environmental protection requirements must be integrated into the definition and implementation of the Community policies [...] in particular with a view to promoting sustainable development'. Accordingly, it requested a number of Councils to develop strategies for the integration of environmental and sustainability considerations into their respective policy fields for the European Council meeting in Goeteborg in 2001. Post-Goeteborg analyses, however, revealed huge differences in the quality, scope, and ambition of objectives among the submitted documents [86]. Unfried [87] identified the 'lack of support from political leaders together with—maybe also as a result—the lack of commitment among the councils of ministers [ ... ] as reasons the Cardiff process had not achieved the intended level of integration', so that the Cardiff process was eventually 'singled out for its unrealistic potential to lead to policy learning for EPI' [15]. Nonetheless, the Cardiff process has instigated some important progress in the policy integration of environmental considerations. It was an innovative policy measure that stipulated, e.g., cross-sectoral councils and working groups as well as significant progress in sectoral environmental integration indicators [88]. It further revealed important challenges inherent in cross-sectoral policy integration that, in a similar form, must be overcome in order to implement an effective nexus policy framework. These challenges include (a) promoting the implementation of the policy measures in the member states, (b) the development of national processes for integration, (c) establishing harmonized reporting mechanism for information exchange, and (d) promoting a process of trans-national policy learning and the development of networks of experts [86].

Other measures implemented to environmentally assess operational public policies include, for example, Environmental Impact Assessment (EIA) (Directive 2011/92/EU) and Strategic Environmental Assessment (SEA) (Directive 2001/42/EC) [89] as procedures to ensure that 'the environmental implications of decisions are taken into account before the decisions are made' [90]. Within the EIA, the direct and indirect effects of a project on (a) human beings, fauna and flora, (b) soil, water, air, climate and landscape, (c) material assets and cultural heritage, and (d) interaction between the above listed are to be identified [91]. In contrast to the EIA, SEA applies to public plans and programs—not, however, policies [90]. In addition to identified implementation gaps, the absence of obligatory environmental standards was identified as a major drawback [92]. This gives rise also to challenges related to the fact that many projects are under the jurisdiction of different member states, which in turn inheres the risk of duplications, inconsistencies, burdens (e.g., administrative) and thus potential conflicts [92]. Such inefficiencies often result from differences in the national EIA procedures, e.g., with respect to different stages of the project proposal process or differing timeframes, but could

likely be reduced, if more formal consultation on transboundary impacts among neighboring countries was implemented, e.g., in the form of specified timeframes for consultation with neighboring countries or joint procedures for international projects [92].

The effect of these European environmental assessment approaches on actual policy making, however, has been limited [89]. According to Jordan and Lenschow [29], this hints at a weak impact of environmental policy in general, but can partly also be explained by the lack of clarity as to what these measures are to achieve: Is it to ‘strengthen environmental policies, integrate the environment into other sectors, promote public participation or deliver sustainable development’ [29]. Furthermore, the attempt to regulate and better inform decision makers by using these assessment tools is often diminished by their improper application or even abuse [28].

#### 4. Discussion and Policy Implications

Given the EU objective to develop a more integrated policy framework that explicitly accounts for the dynamic interplay between different natural resources, the above analysis of current, relevant policy measures can serve as a first foundation. The analysis showed that including the objectives of the WFD into the CAP is currently the most prominent attempt of especially vertical policy integration on a sectoral level. With regard to the energy sector, vertical integration does not seem to play a role at all. Despite the fact that numerous studies have affirmed the direct links between energy production and both water resources e.g., [51,53,55,56,93,94] as well as land resources and food production [47,95], the explicit consideration of these cross-resource effects is not yet formally integrated into current energy directives or action plans. Thus, overall, the degree of vertical integration among energy and water, as well as energy and land sectors, has been identified as rather weak.

One reason can be seen in the fact that, currently, authority is spread across different actors with mandates for specific sectors, such as energy, agriculture, or water. Within the EU Commission, water policy falls within the responsibilities of the Directorate General (DG) Environment, which officially aims at ‘greening’ other policy areas. The energy and agriculture sectors instead form their own DGs. Such different sub-units usually act based on historically grown—and thus different—sets of formal and informal rules and processes, which can be inconsistent or conflicting, thus making policy integration hard to reach [96]. This fragmented responsibility is in line with our finding that these two sectors show a relatively weak level of policy coherence. Additionally, their uneven legal ‘weight’ impedes the development of a common and integrated ‘nexus-enabled’ policy understanding [32]. Whereas the CAP is completely communitized, the energy sector is a policy field of shared responsibilities between the EU and its member states. The EU is thus limited to setting overarching policy objectives in the form of directives, which leave the actual implementation in the responsibility of the member states. The CAP, however, is based on regulations that are transferred directly into national law [97]. The different legal character, therefore, makes it hard to achieve a common level of integration among the nexus sectors. Furthermore, not only the different legal character but also differing, partly contesting, underlying values and objectives impede a more integrated policy design. For example, a CAP that aims at economically efficient and intensive production, which inevitably comes with a high demand of fertilizers as well as a high quantity of manure, undermines or outright contradicts environmental objectives such as low nitrate levels [14].

However, with certain challenges remaining, selected aspects of water management have already been successfully integrated into the CAP by binding payments to farmers to conformance with the standards of cross-compliance, which now include standards explicitly related to water management. Given the often trans-national character of externalities related to the provision of water, energy or food, the WFD can serve as a reference for a policy measure that explicitly recognizes the relevance of geographical—rather than national—system boundaries (e.g., river basins) and is thus conceptualized as to provide a mandatory policy framework that leaves the development of specific, trans-national implementation strategies to local authorities. Nevertheless, as the example of Germany shows, the success of these instruments highly depends on the national implementation. In 2018, the European

Court of Justice found Germany guilty of failing to reach required maximum levels of nitrate pollution of groundwater [98].

In terms of horizontal policy integration, the impact of existing European roadmaps, as well as impact assessment tools, is strongly limited by lacking enforcement measures. Nevertheless, the cross-cutting procedures of environmental impact assessment, for example, may serve as the conceptual foundation for mandating the explicit analysis of cross-sectoral effects among the nexus resources when proposing plans or programs within the EU. The existing variety of approaches—if systematically brought together—can provide a solid foundation for developing a coherent European nexus policy framework.

In order to address the identified remaining challenges of such a policy framework, a combined top-down and bottom-up policy approach is needed that can stipulate cross-sectoral cooperation and the consolidation of political system boundaries with natural-geographic, often trans-national requirements. Important assessment tools in this regard are cross-compliance mechanisms and support for regional development, in line with the approach taken by CAP. Additionally, however, the policy framework must carefully address the challenges of determining a reasonable degree of regulation, which—while framing the path towards its policy objectives—leaves sufficient room for competition-based market structures or locally adapted implementation strategies. Providing universal access to the limited natural resources essential for human life is of indispensable importance. Furthermore, our analysis highlighted that tools and measures are only useful if integrated and used in day-to-day policy making. Specifically, implementation could be improved by streamlining standards and procedures, and formulating clear and specific policy goals. Therefore, a revised and updated EU sustainable development strategy seems to be urgently necessary in order to coordinate policy objectives towards more sustainable pathways. This demand is backed by e.g., the German Federal Government since the last EU strategy was published in 2006 [99]. In this case, the role of member states also needs to be considered. For example, national implementation of EU regulations as well as existing national sustainable development strategies play an essential role in achieving integrated policy making [32]. A central aspect of this is also the promotion of policy learning, e.g., by cross-sectoral working groups as introduced by the Cardiff-Process, to increase the political will to follow through on integration efforts.

These policy implications are especially relevant for EU energy policy. The analysis revealed that the energy sector lags behind most in terms of integration. Though horizontal integration approaches exist in the form of overarching strategies, vertical approaches are almost non-existent. Cross-sectoral considerations are lacking beyond very general sustainability considerations. Here, EU energy policy has to clearly and specifically include concerns of and consequences for other sectors as well in order to enable a generally more integrated natural resources policy. Energy policy could especially profit from policy learning, since EU agricultural and water policy have considerable experience in comparison.

With regard to the applied analytical frameworks, each has its limits, but there is also notable overlap. Analysis along the frames of EPI and WEL Nexus revealed that including environmental aspects into other sector policies often remains on a rhetorical level, and that instead, changes to the governance structures are required that transcend the historically grown sectoral boundaries. Here, the Nexus concept enables a broad, comprehensive approach to integrating natural resource policies, while the EPI concept is capable of identifying and evaluating specific governance challenges, although in a sectorally defined context. However, both the EPI and the WEL Nexus concept are considered to allow for various interpretations and implementation options [29,76]. This conceptual ambiguity is difficult to translate into jurisdiction since it does not define the degree of integration required [29], and thus, is mirrored in the incomplete realization of more integrated EU natural resource policies. Here, synthesizing policy integration and nexus research can offer valuable insights, such as considering cognitive factors in the analysis of nexus governance [65]. In this paper, synthesizing both integration concepts provided valuable insight into the different dimensions of integrating natural resource

policies. The paper thus offers a new method for analyzing integrated natural resources governance and contributes to the ongoing discussion on finding ‘the right level’ of policy integration in the European Union.

## 5. Conclusions

At present, policy design for natural resources, especially in the energy sector, only rudimentarily accounts for cross-sectoral effects among the different resources, despite the clearly visible interdependencies among the resource systems. Given the discussed sustainability objectives, adequate policy design, however, must encompass and account for the full spectrum of social, ecological, and economic preconditions. Traditionally, policy design has been framed and analyzed per sector. Only more recently, cross-sectoral effects among the nexus resources have been accounted for, and mostly rudimentarily. Against the background of the advanced EPI literature, the approach used in this paper allowed the assessment of the state of policy integration across the sectors energy, water, and land. The review of EU resource governance indicates that the adaptation or consolidation of singular measures under the paradigm of EPI does not suffice to meet the needs of cross-sectoral and transnational challenges, such as the integrated management of natural resources. Instead, it will require the institutionalization of a comprehensive system perspective as conceptualized by the WEL Nexus in order to overcome the current particular interests. Thus, further research is required on the implementation of a nexus policy perspective in the EU, specifically, whether fundamentally new institutional settings are required, or integrating a coherent, cross-sectoral perspective into the existing structures provides a more efficient approach to policy coherence. Specifically, the question of what role the member states play needs to always be taken into account.

Furthermore, comprehensive scientific research is needed to systematically analyze the systemic interrelations between natural resources (i.e., the true feedbacks and interactions among the resources and their drivers) for deriving scenarios that can serve as a foundation for the development of effective nexus governance options.

In order to analyze progress towards the objective of more integrated policy making, research into the operationalization of relevant concepts is necessary. As this review has demonstrated, synthesizing EPI and WEL Nexus provides a useful analytical framework for estimating the state of policy integration. At the same time, the already existing policy approaches should be further refined as to successively obviate the currently remaining policy inefficiencies. As the above analysis shows, a policy framework in line with a comprehensive WEL Nexus approach will likely confront a number of challenges very similar to those encountered in previous measures of policy integration, so that the handling of these challenges may provide significant insights for the effective implementation of a WEL Nexus approach. Answering these questions will require careful analysis, given the current debates around the ‘right’ degree of EU integration and the balance between fully integrated and intergovernmental politics.

**Supplementary Materials:** The following are available online at <http://www.mdpi.com/1996-1073/12/23/4446/s1>, Table S1: List of policy documents investigated, according to document type and year of publication.

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