EKLIPSE

Knowledge & Learning Mechanism on Biodiversity & Ecosystem Services

Developing a mechanism for supporting better decisions on our environment based on the best available knowledge.

EKLIPSE Draft Document of Work: Energy request

Content:

GENERAL INFORMATION

Topic of the request:

How are European energy policies affecting biodiversity and ecosystem services in countries globally?

The scientists mandated to draft the Global Sustainable Development Report 2019 (GSDR) seek a better understanding of the telecoupling effects of the EU's low carbon energy policy on biodiversity and ecosystem services in countries globally, from an SDG perspective through two questions:

1- What are the SDG targets that the EU energy policy tries to pursue (also indirectly) and what are the systemic trade-offs and co-benefits that are created beyond the territorial boundaries, where, at what scale, and who are the affected winners and losers?
2- What policies and governance mechanisms could remedy these impacts; or in hindsight, how could one have chosen pathways to more sustainable development?

This information will be used to feed the science-policy interface of the GSDR to inform policy.

Requester:

Centre for Development and Environment University of Bern - Peter Messerli, Henri Rueff

Date request received:

27 September 2017

Date of first meeting with requesters and EKLIPSE KCB and methods experts:

20 December 2017

Expected deadline for deliverables:

Initially 31 August 2018, extended to December 2018

EKLIPSE KCB Focal Point for the request:

Rania Spyropoulou, with support from Flore Jeanmart

EKLIPSE Secretariat contact point for the request:

Marianne Darbi

CONTEXT AND SPECIFICATION OF THE REQUEST

Background and context of the request

While a renewable energy transition is an unavoidable pathway for decarbonisation, some studies documented its effects on marine ecosystems, avian biodiversity, competing land use for food production, habitat loss and deforestation (i.e biofuels), with potential spill overs beyond the EU territorial boundaries. Other trade-offs may occur such as manufacturing hazards due to a growing demand of extractive resources needed in the fabrication of batteries and solar panels. In addition, important controversies currently animate the political debates centred on the role of nuclear energy and hydropower to support a fossil fuel free future, yet putting pressure on landscapes, biodiversity and ecosystems in Europe and beyond. The full cost and benefits of opting for renewable energy when compared to the opportunity costs of renouncing conventional ones needs to be synthesized through collating existing knowledge and case studies. It is certainly understood that conventional energy sources likewise have impacts on biodiversity and ecosystem services globally.

The request builds on the global SGD report. The Global Sustainable Development Board addresses various perspectives of the Sustainable Development Goals, analyzing a way in which the SDG report can help policy members in achieving their agendas, and how we can acquire higher policy coherence.

What is the spatial scale of the request?

The spatial focus is on the EU (EU 2030 Energy Strategy). However, the impact of EU's energy policy may affect several countries globally.

What is the policy context of the request?

EU 2030 Energy Strategy (What are co-benefits, challenges and synergies between the EU Energy transition and biodiversity?)

What are the objectives of the request?

1. To produce synthetized knowledge on the effect of a low-carbon energy policy on biodiversity and ecosystem services beyond the EU boundaries
2. To better understand the mechanisms by which energy policy interconnects with biodiversity and ecosystems services in an unforeseen way
3. To inform policy makers, scientists, UN state members on the above issues and provide policy-oriented solutions to anticipate and mitigate these issues

Which questions shall be addressed?

In light of the above mentioned objectives, two major questions shall be addressed:

1. What are the SDG targets that the EU energy policy tries to pursue (also indirectly) and what are the systemic trade-offs and co-benefits that are created beyond the territorial boundaries, where, at what scale, and who are the affected winners and losers?
2. What policies and governance mechanisms could remedy these impacts; or in hindsight, how could one have chosen pathways to more sustainable development?

These two questions can be further specified through the following range of exploratory questions:

- What analyses exist that explore the EU energy policy strategy and related telecoupling effects on biodiversity and ecosystem services?
- What are the SDG targets and interlinkages that the EU energy policy tries to pursue (also indirectly) and what are the systemic trade-offs and co-benefits that are created beyond the territorial boundaries, where, at what scale, and who are the affected winners and losers?
- What policies and governance mechanisms could remedy these impacts on biodiversity and ecosystem services; or in hindsight, how could one have chosen pathways to more sustainable development?
- What are the recurrent patterns of interactions (nexus), cascading effects, etc.?
- What can be identified as leverage points and potentials for policy impact?
- What are the positive and negative feedback loops that may point to decarbonisation pathways?
- Are there any time issues, irreversibility?
- What is the relevance of context (place, scale, time)?
- What are the governance and transformation interventions that can potentially be applied? Lessons learnt?
- What are the main knowledge gaps?

What is the level of controversy?

Low carbon energy policy supporting renewable energy raises questions on tradeoffs impacts such as:

- Biofuels vs. land use for biodiversity, food
- Windmills vs. land use, birds
- Biomass fuel vs. Deforestation
- Solar energy vs. manufacturing hazards, land use and habitat loss, concentration of thermal solar plants

While these tradeoffs are widely acknowledged, the weight of their impact and consequences on decision making remains poorly understood.

Over what time horizon does the question recur?

- Global SDG report will be released end of 2019
    - 8 months before it should be ready and in production.
    - August 2018- Data collected must be available to feed into the report as the writing team for the report starts in July/August.
    - This doesn't mean that the exercise should stop. It can be targeted to other audiences.

What sources of knowledge should be included?

- Scientific knowledge
- Indigenous and local knowledge
- Opinions and values

What types of knowledge synthesis and information are useful or acceptable?

- Horizon scanning
- Seeking understanding of changes in time and space
- Seeking measures of anthropogenic impact
- Seeking measures of effectiveness of interventions
- Seeking appropriate methodologies
- Seeking optimal management
- Understanding public opinions and/or perceptions
- Seeking people's understanding of an issue

What methods or approach could be envisaged?

Expert judgements, opinions and short accounts supported by scientific publications. We need a scientific validation of the knowledge that will be processed.

Expected outputs (quantitative, qualitative… means, ratios…) – What format would be most useful?

- Expert judgements, opinions and accounts supported as much as possible by scientific publications
- When possible, taking an SDG interaction perspective based on the ICSU guide to interactions https://www.icsu.org/publications/a-guide-to-sdg-interactions-from-science-to-implementation, identifying SDG targets directionality, scale, type of countries (OECD, transitioning, developing, LDCs)
- Providing a transformative pathway for policy, when solutions exist

Which sectors and societal groups will be affected by or will benefit from therequest and how?

EU policy makers, societies and local communities in the countries affected, scientific communities needing synthesised knowledge on EU energy policy impacts on biodiversity and ecosystems services

Time frame of the request – by when would results be needed?

Overall very narrow timeline: foresee a straightforward procedure

An open call may be published first, out reaching to scientific and policy communities. Their contributions could be received and treated until the end of August 2018. However, to absorb as many contributions for the GSDR, we would appreciate a dialogue with the research teams on any intermediate results as soon as possible.

Results would be expected by 31 August 2018 (but intermediary results that could be provided as soon as possible would be welcome)

REFERENCES

Moser, S., Lannen, A., Kleinhückelkotten, S., Neitzke, HP, Bilharz, M. 2016. Good Intentions, Big Footprints: Facing Household Energy Use in Rich Countires. CDE Policy Brief, No. 9, Bern, Switzerland: CDE.

Gabrielle, B., Bamiere, L., Caldes, N., De Cara, S., Decocq, G., Ferchaud, F., Loyce, C., Pelzer, E., Perez, Y., Wohlfahrt, J., Richard, G., 2014. Paving the way for sustainable bioenergy in Europe: Technological options and research avenues for large-scale biomass feedstock supply. Renew. Sustain. Energy Rev. 33, 11–25. doi:10.1016/j.rser.2014.01.050

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SCOPING OF THE REQUEST

1st Meeting with the requester

On Dezember, 20, 2017 a virtual meeting took place between the requester, members of the EKLIPSE Secretariat and the EKLIPSE Knowledge Coordination Body. The aim of this meeting was to go through the request and to clarify thepurpose of the request and the expectations of the requester and to discuss how EKLIPSE can help to their purposes.

It was discussed that although the request builds on the global SGD report, this report breaks into smaller scales. Therefore, seen that the energy transition's interests and repercussions are so high, the request should focus on the EU (including the impact of EU's energy policy on other countries globally). Particular aspects of the EU policy to look at include:

- Overall policy of reducing emissions, strategic move of the EU on global markets, not able to point to specifics
- Investors are relevant to the approach they would like to take.
- Areas targeted in the request: tradeoffs, opportunities and solutions between renewable energy vs. biodiversity: e.g. Windmills offshore detrimental for biodiversity; Hydropower and nuclear power as decarburization measures
- Important to consider that the alternatives to renewals are worse.
- Understanding the SDGs and the EU policy in the SDG context: how does the EU's energy policy relate to SDG 7, three universal targets under SDG 7, could serve as a potential filter to choose on which aspects of the EU energy policy to focus
- Indicators to measure progress are not related to the concepts of biodiversity.
- Progress shouldn't be measured at the country level, but at the EU level or globally.

Methodological considerations:

- Suggestion to try an outline to study what are the tradeoffs and the benefits, where are problems or synergies to be expected, and mapping where the biggest conflicts are to be expected.
- To see how the SDGs direct to biodiversity and ecosystem services would suppose a semantics exercise.

Furthermore, the timeline and steps of the request have been discussed. The overall timeline is very narrow. The data collected must be available to feed into the report as the writing team for the report starts its work in July/August. Nonetheless, the request could continue beyond this deadline, i.e. targeted to other audiences.

Call for knowledge

To explore the range of existing knowledge EKLIPSE launched a Call for Knowledge asking for any reference to material, including grey literature and as yet unpublished results to the topic.

This Call for Knowledge (see ANNEX 2: Call for Knowledge) was open from 23rd January to 20th February 2018. It was announced and distributed through the following channels:

- It was published on the open calls section of the EKLIPSE website.
- It was promoted through the KNOCK discussion forum.
- It was widely distributed via email through the network of EKLIPSE and its partners.
- It was shared through social media, notably via twitter.

Unfortunately, these efforts yielded very little feedback. Therefore, a short adhoc literature screening has been conducted.

Literature screening

In response to the lack of feedback received to the call for knowledge the EKLIPSE Secretariat consulted with the EKLIPSE KCB. It was considered worthwhile to continue the scoping of the request. For this purpose a short adhoc literature screening has been conducted by the EKLIPSE secretariat which yielded another three dozen of sources that are relevant to the request. These are displayed in ANNEX 3: Literature Screening.

In addition, experts and institutions have been identified (listed in the table below), that could be further reached out to in carrying out the request.

Name	**Institution**	**Location**	**Contact/link**	**Source/comment**
Ana Luisa Fernando	New University of Lisbon| NOVA. Department of Science and Technology of biomass	Lisbon, Portugal		Tranquada Boleo, S. M. 2011. Environmental impact assessment of energy crops cultivation in the Mediterranean Europe
CENSE	New University of Lisbon| NOVA. Department of Science and Technology of biomass	Lisbon, Portugal		Tranquada Boleo, S. M. 2011. Environmental impact assessment of energy crops cultivation in the Mediterranean Europe
	Biodiversity Research Insitute	Portlande, USA	http://www.briloon.org/renewable	
	Impacts of Renewable Energy on Global Biodiversity Univeristy of Cambridge	Cambridge, UK	https://www.4cmr.group.cam.ac.uk/research/projects/retrofit-research-centre	
	BARE University of Exeter	Exeter, UK	http://biosciences.exeter.ac.uk/exeter/research/bare/	
Martha J. Groom	University of Washington, USA		groom@u.washington.edu	
Peter Verburg	Vrei Universiteit Amsterdam	Amsterdam, The Nether-	peter.verburg@vu.nl	Hellmann, F. and Verburg, P.H. 2010. Impact assessment of the European biofuel

		lands		directive and land use biodiversity. Journal of environmental Managemetn 91: 1389-1396
Fritz Hell-manns	PBL Netherlands Environmental As-sessment Agency	Tha Hague, Netherlands		Hellmann, F. and Verburg, P.H. 2010. Im-pact assessment of the European biofuel directive and land use biodiversity. Journal of environmental Managemetn 91: 1389-1396
	Carkson&Woods	Somerset, UK	hel-lo@clarksonwoods.co.uk	Montag, et al. 2016.The Effects of solar farms on local biodiversity: A comparative study. Clarkson and Woods and Wychwood Biodiversity
	Wychwood biodiver-sity	UK	guy@wychwoodbiodiversity.co.uk	Montag, et al. 2016.The Effects of solar farms on local biodiversity: A comparative study. Clarkson and Woods and Wychwood Biodiversity
Eric Lambin	Université catholique de Louvain	Belgium		Suggested by Flore Jeanmart
Patrick Mey-froidt	Université catholique de Louvain	Belgium		Suggested by Flore Jeanmart

Policy relevance of the request

Suggested way forward from the scoping

The request is characterized by the following conditions:

- very narrow timeline : contributions could be received and treated until the end of August 2018 in order to feed into the Global Sustainable Development Report 2019, but the work could still continue beyond that date
- little feedback received during the call for knowledge, but still quite good literature base identified as a starting point through an adhoc literature screening

Seen these conditions the following is suggested:

- The request and he associated Document of Work (this document)shall be reviewed by the EKLIPSE KCB for their upcoming meeting on 25th May 2018
- Ideally, a decision shall be made by the KCB during this meeting whether to pursue the re-quest to the next stage and how.
- Seen the narrow timeline, it is impossible that a full knowledge synthesis following the EKLIPSE process (see The process: how EKLIPSE answers requests below) can be done by 31st August. Therefore, as an alternative to launching a call for experts to form an expert working group, a steering group could be put in place. The experts identified in the table above could be a first starting point to this.

CARRYING OUT THE REQUEST

2nd Meeting with the requester

On July, 4, 2018 a virtual meeting took place between the requester, members of the EKLIPSE Secretariat, the EKLIPSE Knowledge Coordination Body and the EKLIPSE methods group (see ANNEX 4: Minutes of the 2nd meeting with the requester). In the meeting the following was discussed/agreed:

- Miriam Grace presented the draft methodological protocol suggested by the EKLIPSE methods expert working group (see ANNEX 5: EKLIPSE energy request: draft methodological protocol v2-04.07.2018): The methods EWG recommends an expert consultation approach with aspects of Fuzzy Cognitive Mapping and Del-phi process to address the request. The outputs will consist of a diagrammatic conceptual model of the interlinkages between EU energy policy efforts and sectors, focussing on trade-offs and synergies with the SDGs. Adjacency matrices will be used, as a result the strongest links and interrelations between concepts and terms will be identified. There was consensus by all participants to move on as suggested.
- It has been discussed under which format experts will contribute to the request, options considered were: 1) an Expert working group (with light version of a call for experts), 2) a steering group, 3) only as workshop participants (with some input requested prior to the workshop). Seen the narrow timeline, the EKLIPSE team decided that instead of an expert working group, a consultant/research assistant shall be hired to carry out necessary analyses which will then be discussed at a workshop with experts.
- The envisaged framing for the work of the research analyst will set the focus on the four main routes of the EU Energy Roadmap (energy efficiency, renewable energy, nuclear energy, and carbon capture and storage) and the creation of a list of terms out of this.
- When analyzing the relation to the SDGs it would be good to focus on the target level (data entry at target level) of the SDGS (there are 169 targets under 17 SDGs). This, however, would generate a quite large matrix of interactions, but most likely complexity can be reduced by focusing on some key SDGs (2, 7, 13, 15, …). It would be great to show benefits through the interactions (and use this as a communication tool to policy makers. Building on the suggestion by Henri Rueff, there was consensus that the 7-point scale developed by ICSU (A Guide to SDG interactions: From Science to implementation, https://council.science/publications/a-guide-to-sdg-interactions-from-science-to-implementation) should be used to qualify/quantify the nature of the interaction. This would also ensure to make the link to the current/upcoming scientific literature.

Regarding the timeline, in late 2018/early 2019 the final draft needs to be ready (and go into production in early Spring 2019). Therefore, between now and December 2018 input into the zero draft can be made. Thus ideally, the final output from the EKLIPSE energy request would be expected/needed end of October/beginning of November so that it can be fed into the GSDR.

The envisaged output from the EKLIPSE energy request shall feed directly into the GSDR. This could include the following contents:

- Framing the overarching policy relevance of the request, including the political framing that all countries have to consider their spillover effects (the focus here is on the EU), as starting point to the discussion (text)
- Presentation of the model/matrix/diagram (developed with the EWG)
- Examples for specific interactions, e.g. illustrating tradeoffs (short texts)

Hiring a research assistant and preparation of a workshop

In September, a research assistant has been hired to do conceptual work on the request (on the basis of the methodological protocol as outlined in ANNEX 5: EKLIPSE energy request: draft methodological protocol v2-04.07.2018) and to prepare a workshop with experts. The workshop is envisaged for the first half of November.

The Terms of Reference for the work of the research assistant are outlined in ANNEX 6: Terms of Reference/service description for the research assistant. In summary, this includes three tasks:

1) Analyzing the EU energy policy with a focus on the four main routes of the EU Energy Roadmap (energy efficiency, renewable energy, nuclear energy, and carbon capture and storage)
    - Collating and analyzing relevant documents
    - Coding policy interactions using the SDG targets
    - Identifying the essential concepts and processes and creating a list of terms

   Contribute to constructing a draft model of the impacts of EU energy policy on biodiversity and SDG targets in the form of a conceptual map

2) Contribute to organising the consultation exercise with experts (participants)
    - Preparation: identification of and communication with the participants (approx. 25), development of agenda, organising logistics of meeting;
    - Execution: organisation of the consultation exercise (workshop in October), note taking

   Follow-up: write-up of the consultation exercise

3) Contribute to analysing the findings : Integrating the participants' resulting individual models into the final model, guidance will be provided; preparing the results for publication

ANNEX 1: Minutes of the 1st meeting with the requester

EKLIPSE energy request: Minutes of the 1st (virtual) meeting with the requester

Date: 20 December 2017

Participants: Peter Messerli (requester), Henri Rueff (requester), Rania Spyropoulou (KCB focal point for the energy request), Heidi Wittmer (KCB chair), Marianne Darbi (EKLIPSE secretariat contact point for the energy request), Juliette Young (EKLIPSE secretariat), Inès Martìn del Real (EKLIPSE secretariat)

Meeting chair: Rania Spyropoulou

Minutes: Marianne Darbi, Inès Martìn del Real, Juliette Young

Agenda:

1. Goal of the meeting
2. Context introduction by Henri and Peter
3. What are the expectations from EKLIPSE's work
4. Timeline
5. Next Steps/ToDos

1) Goal of the meeting:

- go through the request. To know what do they want, why do they want it, and how can EKLIPSE help to their purposes.

Other questions:

- How do they understand the EU policy for energy?
- What do they understand by globally?

2) Context introduction by Henri and Peter :

- The request builds on the global SGD report
- The Global Sustainable Development Board addresses various perspectives of the Sustainable Development Goals, analyzing a way in which the SDG report can help policy members in achieving their agendas, and how we can acquire higher policy coherence.

- Telecoupling effect: Sustainable development within OCD countries shows that are performing really bad in spill-over effects. Examples: Ecological footprint, land-use, policies in Europe which have an impact elsewhere.
- EKLIPSE is missing some global perspective and should not only be narrowed down to the EU.
- Co-benefits, challenges and synergies in the EU Energy transition and biodiversity?

Aspects of the EU policy to look at:

- Overall policy of reducing emissions, strategic move of the EU on global markets, not able to point to specifics
- Investors are relevant to the approach they would like to take.
- Areas targeted in the request: tradeoffs, opportunities and solutions between renewable energy vs. biodiversity: e.g. Windmills offshore detrimental for biodiversity; Hydropower and nuclear power as decarburization measures
- (Heidi)--> Important to consider that the alternatives to renewals are worse.
- try an outline to study what are the tradeoffs and the benefits, where are problems or synergies to be expected, and mapping where the biggest conflicts are to be expected.
- Understanding the SDGs and the EU policy in the SDG context: how does the EU's energy policy relate to SDG 7, three universal targets under SDG 7, could serve as a potential filter to choose on which aspects of the EU energy policy to focus
- Indicators to measure progress are not related to the concepts of biodiversity.
- Progress shouldn't be measured at the country level, but at the EU level or globally.
- To see how the SDGs direct to biodiversity and ecosystem services would suppose a semantics exercise.

3) What are the expectations from EKLIPSE's work:

- A panel of experts to reflect on the knowledge they have from their personal work.
- A background paper in specific interests linking the EU Energy transition and its impact on Biodiversity and Ecosystem services.
- Need to broaden the audience.
- (Heidi) --> there are some similarities to the first request/report by EKLIPSE (on nature based solutions)
- Three possible levels of expertise:
  1- Focus on Biodiversity and Ecosystem services issues.
  2- Understanding of these policies and the dynamic environment they are in. Policy and economics have cascading effects in investment and other policies.
  3- EU policy mechanisms itself--> Need of a frame base.
- Although the SDG report is a global report it breaks into smaller scales. Why not focus on the EU, if the energy transition's interests and repercussions are so high?
- Looking for expert opinion of certain topics.
- Not only environmental oriented, but also people oriented.

4) Timeline

- Global SDG report will be released end of 2019
  - 8 months before it should be ready and in production.

    - August 2018- Data collected must be available to feed into the report as the writing team for the report starts in July/August.
    - This doesn't mean that the exercise should stop. It can be targeted to other audiences.
- Overall very narrow timeline: foresee a straightforward procedure

5) Next steps and ToDos

- Seen the narrow timeline, next steps have to be implemented asap
- Prepare the Call for knowledge:
    - Marianne to send an example/template before Christmas
    - Peter/Henri to write a short background note on the request and send back to EKLIPSE early January
- Evaluation of the policy relevance of the request:
    - Heidi and Rania to reach out to EU Commission/Karl Falkenberg for best policy entry

ANNEX 2: Call for Knowledge

Dissemination of the call for Knowledge via KNOCK Forum

Call for knowledge: How are European energy policies affecting biodiversity and ecosystem services in countries globally?

While a renewable energy transition is an unavoidable pathway for decarbonisation, some studies documented its effects on marine ecosystems, avian biodiversity, competing land use for food production, habitat loss and deforestation (i.e biofuels), with potential spillovers beyond the EU territorial boundaries. Other trade-offs may occur such as manufacturing hazards due to a growing demand of extractive resources needed in the fabrication of batteries and solar panels. In addition, important controversies currently animate the political debates centred on the role of nuclear energy and hydropower to support a fossil fuel free future, yet putting pressure on landscapes, biodiversity and ecosystems in Europe and beyond.

The full cost and benefits of opting for renewable energy when compared to the opportunity costs of renouncing conventional ones needs to be synthesized through collating existing knowledge and case studies. It is certainly understood that conventional energy sources likewise have impacts on biodiversity and ecosystem services globally. We are therefore interested in any reference to material, including grey literature and as yet unpublished results that refer to the following questions:

- What analyses exist that explore the EU energy policy strategy and related telecoupling effects on biodiversity and ecosystem services?
- What are the SDG targets and interlinkages that the EU energy policy tries to pursue (also indirectly) and what are the systemic trade-offs and co-benefits that are created beyond the territorial boundaries, where, at what scale, and who are the affected winners and losers?
- What policies and governance mechanisms could remedy these impacts on biodiversity and ecosystem services; or in hindsight, how could one have chosen pathways to more sustainable development?
- What are the recurrent patterns of interactions (nexus), cascading effects, etc.?
- What can be identified as leverage points and potentials for policy impact?
- What are the positive and negative feedback loops that may point to decarbonisation pathways?
- Are there any time issues, irreversibility?
- What is the relevance of context (place, scale, time)?
- What are the governance and transformation interventions that can potentially be applied? Lessons learnt?
- What are the main knowledge gaps?

We encourage contributions of knowledge by 20th February 2018. To read more about this call and the request process, please refer to the Call for Knowledge (CfK 3/2018) on our Open Calls page or check the attached pdf document.

Documents:

- Call_for_knowledge_European_energy_policies_final_230118.pdf

Keywords: Biodiversity (incl. observation), Bioenergy/biofuel, Ecosystem services
Last edited: 24.01.2018 08:33 (GMT) - by Eszter Kelemen

Text of the Call for Knowledge

EKLIPSE

Knowledge & Learning Mechanism on Biodiversity & Ecosystem Services

Developing a mechanism for supporting better decisions on our environment based on the best available knowledge.

EKLIPSE is developing a European Mechanism to answer requests from policy makers and other societal actors on biodiversity related issues

More information on the processes and the EKLIPSE project funded by the EU in H2020 is available at ***www.eklipse-mechanism.eu***

CALL FOR KNOWLEDGE FOR INITIAL SCOPING – CfK 03/2018, EKLIPSE – JANUARY 2018

Responses most useful before: February 20th 2018

TOPIC:

How are European energy policies affecting biodiversity and ecosystem services in countries globally?

Invitation to share knowledge for informed decision-making

This request was submitted by the Centre for Development and Environment, University of Bern.

Context: This call for knowledge emanates from the independent group of scientists working on the 2019 Global Sustainable Development Report mandated by the United Nations Member States[i]. This also relates to the EU 2030 Energy Strategy for reduced emissions, increased use of renewable energy, and energy efficiency improvement, which may have a range of positive and negative effects on biodiversity, ecosystem services, and the people benefiting from these services in Europe and globally. The telecoupling effects of the EU 2030 Energy Strategy needs an improved understanding to adjust measures accompanying its implementation towards policy coherence.

While a renewable energy transition is an unavoidable pathway for decarbonisation, some studies documented its effects on marine ecosystems, avian biodiversity, competing land use for food production, habitat loss and deforestation (i.e biofuels), with potential spillovers beyond the EU territorial boundaries. Other trade-offs may occur such as manufacturing hazards due to a growing demand of extractive resources needed in the fabrication of batteries and solar panels. In addition, important controversies currently animate the political debates centred on the role of nuclear energy and hydropower to support a fossil fuel free future, yet putting pressure on landscapes, biodiversity and ecosystems in Europe and beyond. The full cost and benefits of opting for renewable energy when compared to the opportunity costs of renouncing conventional ones needs to be synthesized through collating existing knowledge and case studies. It is certainly understood that conventional energy sources likewise have impacts on biodiversity and ecosystem services globally.

EKLIPSE is inviting scientists, policy makers, practitioners and other societal actors to share their knowledge on this specific selected request to explore available resources and evaluate if the request requires a structured knowledge gap analysis and consultation on research priorities.

To scope current knowledge on how European energy policies affect biodiversity and ecosystem services in countries globally, we are interested in any reference to material, including grey literature and as yet unpublished results that refer to the following questions:

- What analyses exist that explore the EU energy policy strategy and related telecoupling effects on biodiversity and ecosystem services?
- What are the SDG targets and interlinkages that the EU energy policy tries to pursue (also indirectly) and what are the systemic trade-offs and co-benefits that are created beyond the territorial boundaries, where, at what scale, and who are the affected winners and losers?
- What policies and governance mechanisms could remedy these impacts on biodiversity and ecosystem services; or in hindsight, how could one have chosen pathways to more sustainable development?
- What are the recurrent patterns of interactions (nexus), cascading effects, etc.?
- What can be identified as leverage points and potentials for policy impact?
- What are the positive and negative feedback loops that may point to decarbonisation pathways?
- Are there any time issues, irreversibility?
- What is the relevance of context (place, scale, time)?
- What are the governance and transformation interventions that can potentially be applied? Lessons learnt?
- What are the main knowledge gaps?

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4. Vaissiere, A.-C., Levrel, H., Pioch, S., Carlier, A., 2014. Biodiversity offsets for offshore wind farm projects: The current situation in Europe. Mar. Policy 48, 172–183. doi:10.1016/j.marpol.2014.03.023
5. Zaman, K., Awan, U., Islam, T., Paidi, R., Hassan, A., bin Abdullah, A., 2016. Econometric applications for measuring the environmental impacts of biofuel production in the panel of worlds' largest region. Int. J. Hydrog. Energy 41, 4305–4325. doi:10.1016/j.ijhydene.2016.01.053

The final framing of the request is being developed through an interactive dialogue between the EKLIPSE scientists and the requester (University of Bern), and will be further discussed with stakeholders to ensure relevance for policy making regarding biodiversity and ecosystem services.

We want to explore the amount of knowledge that exists in this area, who the main knowledge holders are and, if after scoping we decide to answer this request, we want to identify the most suitable methodology for answering it.

Please contribute your comments and knowledge/references in the online KNOCK forum.

How to contribute to the Call for Knowledge

All knowledge collected through this call for knowledge will be collected and discussed on the KNOCK Forum. To upload documents and participate in the discussion, please register at our quick and easy 'Keep me Posted' page. Then, please click on the relevant thread to upload your information. Each thread already contains documents that are potentially relevant to the request. We invite you to add any information that you think is relevant for this request, and justify its inclusion (e.g. additional information from countries, scales or disciplinary perspectives not covered sufficiently etc…). Relevant information should be grouped under the following headings: **1) literature reviews, 2) empirical studies/practical experiences, 3) modelling studies and 4) conceptual papers** and can include:

- Links to open access papers.
- Links to published and unpublished grey literature or case studies.
- Description of on-going research projects, or knowledge compilations, expected to deliver results within the next year.
- Your on-the-ground experiences in this field.

Objective of the call and request to be addressed by this call

EKLIPSE coordinates innovative and transparent approaches for science, policy and societal actors to jointly provide the best available evidence leading to better informed decision-making and to identify current and future research priorities. A request on whether missing knowledge is hampering the effectiveness of approaches that aim to restore biodiversity and ecosystem function and services was proposed by Centre for Development and Environment, University of Bern to the EKLIPSE Call for Requests (CfR.2/2017). The objective of this call for knowledge is to launch an initial scoping process on the request meant to identify available assessments, existing studies and other resources.

Background on EKLIPSE

EKLIPSE is an EU-funded project that started in February 2016. With support from the European Commission and a high level Strategic Advisory Board (SAB), the project aims to establish a robust and flexible long-term mechanism for policy support on biodiversity and ecosystem services, communicating and engaging a wide set of knowledge holders and ensuring tailor-made outreach of results to knowledge requesters and society more broadly.

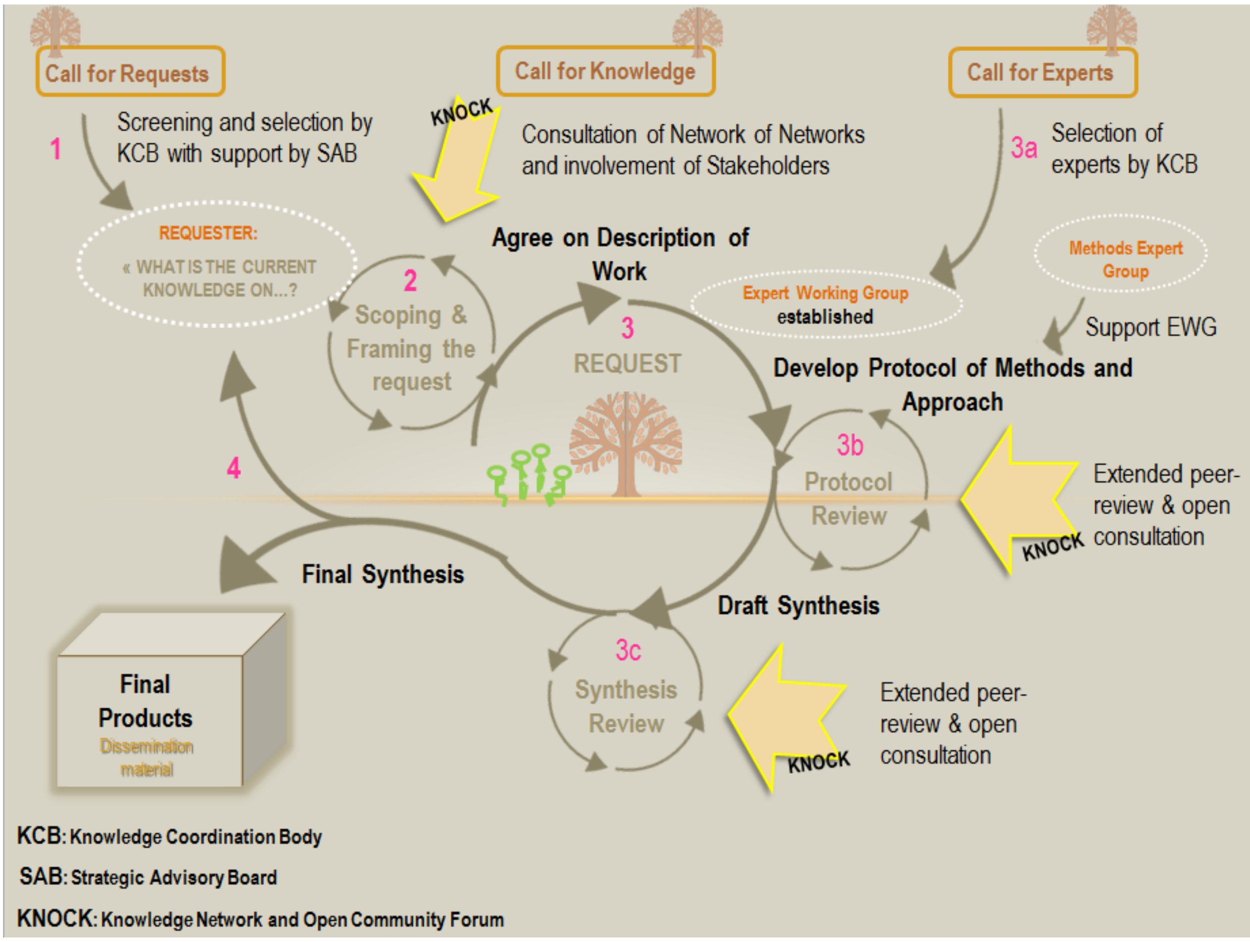
The success of EKLIPSE and its resulting mechanism is in everyone's hands:

- the 'requesters' from policy and society who need to know what knowledge is out there to answer their policy or societal needs;
- the knowledge holders (be they scientists or other citizens) who want their knowledge to mean something; and
- the extensive networks working on biodiversity and ecosystem services who have the enthusiasm and knowledge to make the mechanism work in the long term.

The process: how EKLIPSE answers requests

The EKLIPSE process consists of several steps (see figure below): After the Call for request (step 1), the second step is the Call for Knowledge that supports further Scoping and Framing the request (step2). Based on the findings of the Call for Knowledge, EKLIPSE and the requester discuss how to proceed with the request (step 3). If already sufficient knowledge on the request is available or other reasons exist for not continuing with the request, the request will not be taken further, and the outcome is the collection of knowledge identified in second step. If EKLIPSE and the requester agree on continuing, the request will be framed and finalised jointly with relevant science, policy and societal actors. EKLIPSE then organizes a Call for Experts inviting experts to form an expert working group on the request (step 3a).

The selected expert group will, together with the Knowledge Coordination Body (KCB) and the requester, agree on the methodological approach to be taken for the knowledge synthesis. This will be compiled in a protocol, made publicly available and peer reviewed (step 3b). During the process of gathering, integrating and synthesizing the best available evidence, communication between all relevant actors will be key. Finally, the results of the co-generated evidence will be peer reviewed before being communicated in targeted ways to the requester (e.g., as a report or brief or other output to be discussed with the requester), as well as relevant decision-makers, the knowledge community and the general public (steps 3 c and step 4).



Next steps: How EKLIPSE will continue with this request

If EKLIPSE decides to carry out a new knowledge synthesis based on the responses to this call for knowledge, it will invite experts on the topic to express their interest in joining the Expert Working Group. The expert working group will cover diverse and complementary skills (including multidisciplinary skills and a broad geographical coverage) and will interact with relevant stakeholders to ensure appropriate methodological choices and uptake of outputs.

The Call for Experts will be widely publicized on the EKLIPSE website, on the Forum and other dissemination channels to ensure a broad coverage of disciplines and geography. The selected group will be supported financially by the EKLIPSE project for travel expenses and in certain cases through honorary contracts.

ANNEX 3: Literature Screening

Approach

Results

Type of Information[1]	Citation	Information source	Spatial Scale	Abstract
1) Literature review	Gasparatos, A. Et al. 2017. Renewable energy and biodiversity: Implications for transitioning to a Green Economy. Renewable and Sustainable Energy Reviews 70: 161-184	10.1016/j.rser.2016.08.030		This literature review identifies the impacts of different renewable energy pathways on ecosystems and biodiversity, and the implications of these impacts for transitioning to a Green Economy. While the higher penetration of renewable energy is currently the backbone of Green Economy efforts, an emerging body of literature demonstrates that the renewable energy sector can affect ecosystems and biodiversity. The current review synthesizes the existing knowledge at the interface of renewable energy and biodiversity accross the five drivers of ecosystem change and biodiversity loss of the Millennium Ecosystem Assessment (MA) framework (i.e. habitat loss/change, pollution, overexploitation, climate change and introduction of invasive species). It identifies the main impact mechanisms for different renewable energy pathways, including solar, wind, hydro, ocean, geothermal and bioenergy. Our review demonstrates that while all reviewed renewable energy pathways are associated (directly or indirectly) with each of the five MA drivers of ecosystem change and biodiversity loss, the actual impact mechanisms depend significantly between the different pathways, specific technologies and the environmental contexts within which they operate. With this review we do not question the fundamental logic of renewable energy expansion as it has been shown to have high environmental and socio-economic benefits. However, we want to make the point that some negative impacts on biodiversity do exist, and need to be considered when developing renewable energy policies. We put these findings into perspective by illustrating the major knowledge/practices gaps and policy implications at the interface of renewable energy, biodiversity conservation and the Green Economy.
2) Empirical study	Jackson, A. L. R. 2011. Renewable energy vs. Biodiversity: Policy conflicts and the future of nature conservation. Global Environmental Change 21: 1195-1208	https://doi.org/10.1016/j.gloenvcha.2011.07.001	EU	The European Union's (EU) network of nature conservation areas – Natura 2000 – covers almost 18% of EU territory, and is subject to strict legal protection, which is enforced by the European Commission, a supranational authority. Given the Natura 2000 network's size, conflicts between Natura 2000 and renewable energy projects are inevitable, particularly as countries push to meet their 2020 energy and emissions reduction targets by pursuing more – and larger – renewable energy projects. Focusing on two cases in the renewable energy sector – a hydroelectric dam in Portugal's Sabor valley, and a large tidal barrage in the UK's Severn estuary – this article shows that the EU's strict biodiversity protection regime could necessitate the rejection of many large renewable energy projects. That is, it may not be possible *as a matter of EU law* for national authorities to grant permission for such projects. The potential for such difficulties will be shown to be highly visible to policymakers, and could, this article argues, trigger negative impacts in terms of the rule of law, and negative feedbacks on nature conservation policies in the EU and, by way of precedent, globally. The legal issues presented here should not, this article argues, be regarded as insurmountable problems, nor as a trigger for reforms aimed at weakening biodiversity protections. Ra-

[1] 1) literature reviews, 2) empirical studies/practical experiences, 3) modelling studies and 4) conceptual papers)

				ther, these issues are better regarded as an opportunity for an open, informed, global debate regarding the relationship between biodiversity and climate change policies, and the hierarchy, if any, between them.
1) Literature review	Hastik, R. et al. 2015. Renewable energies and ecosystem service impacts. Renewable and Sustainable energy Revies 48: 608-623	doi.org/10.1016/j.rser.2015.04.004		Expansion of renewable energies (=RE) is a key measure in climate change mitigation. For this expansion mountainous areas are regarded as specifically suitable because of their high-energy potential. However, mountains also are biodiversity hot-spots and provide scenic landscapes and therefore offer high natural and cultural value. Preserving this natural and cultural value whilst intensifying RE, is expected to increase land use conflicts. This is of great concern in particular for vulnerable areas such as the Alps. Reconciling RE expansion with the preservation of natural and cultural values and thus minimizing environmental impacts represents one of the most important challenges now. For this a systematic assessment of the wide range of impacts is needed. This literature review scrutinizes RE resources which are relevant in the Alpine region and their effects on the environment by applying the Ecosystem Service approach. Thereby, we identified possible environmental constraints when exploiting Alpine RE potentials and generated recommendations for future strategies on expanding RE. The outcomes highlight the strong need for interdisciplinary research on RE and environmental conflicts. Interdisciplinary approaches such as the concept of Ecosystem Services can help to cover the wide range of aspects associated with these particular human–environment interrelations.
2) Empirical study	Fang, B. er al. 2016. Energy sustainability under the framework of telecoupling. Energy. 106: 253-259	https://doi.org/10.1016/j.energy.2016.03.055		Energy systems, which include energy production, conversion, transportation, distribution and utilization, are key infrastructures in modern society. Interactions among energy systems are generally studied under the framework of energy trade. Although such studies have generated important insights, there are limitations. Many distant interactions (e.g. those due to the Fukushima nuclear crisis) are not in the form of trade, but affect energy sustainability. Even when distant interactions are related to energy trade, they are not systematically analyzed. Environmental impacts of trade are often not integrated with economic analysis of trade. In this paper, to identify and fill important knowledge gaps, we apply an integrated framework of telecoupling (socioeconomic and environmental interactions over distances). The framework of telecoupling, which is more comprehensive and cross-disciplinary than the energy trade framework, is a useful theoretical and methodological tool for analyzing distant interactions among coupled human and natural systems (including energy systems). Telecouplings widely exist in energy systems with various forms and link energy sustainability of different countries closely, so we proposed some methods for energy sustainability analysis under the framework of telecoupling. From the aspect of causes, a method is proposed to judge whether the telecoupling driven by economic factors is conducive to energy sustainability. From the aspect of effects, a method is proposed to assess whether an event is conducive to energy sustainability. The telecoupling framework presents opportunities for more profound and comprehensive understanding of energy sustainability.
2) Empirical study	Pin Koh, L., and J. Gahzoul. 2008. Biofuels, biodiversity, and people: Understanding he conflicts and finding opportunities. Biological Conservation 141: 2450-2460	https://doi.org/10.1016/j.biocon.2008.08.005		The finitude of fossil fuels, concerns for energy security and the need to respond to climate change have led to growing worldwide interests in biofuels. Biofuels are viewed by many policy makers as a key to reducing reliance on foreign oil, lowering emissions of greenhouse gases and meeting rural development goals. However, political and public support for biofuels has recently been undermined due to environmental and food security concerns, and by reports questioning the rationale that biofuels substantially reduce carbon emissions. We discuss the promise of biofuels as a renewable energy source; critically evaluate the environmental and societal costs of biofuel use; and highlight on-going developments in biofuel feedstock selection and production technologies. We highlight net positive greenhouse gases

				emissions, threats to forests and biodiversity, food price increases, and competition for water resources as the key negative impacts of biofuel use. We also show that some of these environmental and societal costs may be ameliorated or reversed with the development and use of next generation biofuel feedstocks (e.g., waste biomass) and production technologies (e.g., pyrolysis). We conclude that certain types of biofuels do represent potential sources of alternative energy, but their use needs to be tempered with a comprehensive assessment of their environmental impacts. Together with increased energy conservation, efficiencies and technologies such as solar-power and wind turbines, biofuels should be included in a diverse portfolio of renewable energy sources to reduce our dependence on the planet's finite supply of fossil fuels and to insure a sustainable future.
3) Modelling study	Britz. W., and Hertel, T.W. 2011. Impacts of EU biofuels directives on global markets and EU environmental quality: An intefrated PE, global CGE analysis.Agriculture, Ecosystems and Environment 142: 102-109	https://doi.org/10.1016/j.agee.2009.11.003	EU	As policy makers become increasingly aware of the impact of their decisions on the global economy, as well as the impact of developments in the global economy on regional and national resource use, the demand for cross-scale analysis of economic and environmental policies has become a high priority. This paper contributes to this literature by developing a new methodology to link two widely used policy models in order to provide an integrated assessment of the environmental impacts of EU biofuels mandates. By combining the CAPRI model of EU agricultural production and resource use with the GTAP model of global trade and land use, we are able to estimate both the global impacts of EU biofuels policies as well as the detailed, regional changes in land use and nutrient surplus. The applicability of this combined modeling approach extends well beyond biofuels. It could offer important insights into the global impacts of EU agricultural policy reforms, as well as analysis of the EU-regional impacts of global agreements on trade policy or climate change mitigation. In short, the methodology developed in this paper holds great promise for future, cross-scale analysis of global issues bearing on agriculture, land use and the environment.
3) Modelling study	Hellmann, F. and Verburg, P.H. 2010. Impact assessment of the European biofuel directive and land use biodiversity. Journal of environmental Managemetn 91: 1389-1396	https://doi.org/10.1016/j.jenvman.2010.02.022	EU	This paper presents an assessment of the potential impact of the EUs biofuel directive on European land use and biodiversity. In a spatially explicit analysis, it is determined which ecologically valuable land use types are likely to be directly replaced by biofuel crops. In addition, it is determined which land use types may be indirectly replaced by biofuel crops through competition over land between biofuel and food crops. Four scenarios of land use change are analyzed for the period 2000–2030 while for each scenario two policy variants are analyzed respectively with and without implementation of the biofuel directive. The results indicate that the area of semi natural vegetation, forest and High Nature Value farmland directly replaced by biofuel crops is small in all scenarios and differs little between policy variants. The direct effects of the directive on European land use and biodiversity therefore are relatively minor. The indirect effects of the directive on European land use and biodiversity are much larger than its direct effects. The area semi natural vegetation is found to be 3–8% smaller in policy variants with the directive as compared to policy variants without the directive. In contrast, little difference is found between the policy variants with respect to the forest area. The results of this study show that the expected indirect effects of the directive on biodiversity are much greater than its direct effects. This suggests that indirect effects need to be taken explicitly into account in assessing the environmental effects of biofuel crop cultivation and designing sustainable pathways for implementing biofuel policies
3) Modelling study	Hellmann, F. and Verburg, P.H. 2011. Spatially explicit modelling of biofuel crops in Europe. Biomass and Bioenergy 35: 2411-2424	https://doi.org/10.1016/j.biombioe.2008.09.003	EU	This paper describes a methodology to explore the (future) spatial distribution of biofuel crops in Europe. Two main types of biofuel crops are distinguished: biofuel crops used for the production of biodiesel or bioethanol, and second-generation biofuel crops. A multi-scale, multi-model approach is used in which biofuel crops are allocated over the period 2000–2030. The area of biofuel crops at the national level is determined by a macro-economic model. A spatially

				explicit land use model is used to allocate the biofuel crops within the countries. Four scenarios have been prepared based on storylines influencing the extent and spatial distribution of biofuel crop cultivation. The allocation algorithm consists of two steps. In the first step, processing plants are allocated based on location factors that are dependent on the type of biofuel crop processed and scenario conditions. In the second step, biofuel crops are allocated accounting for the transportation costs to the processing plants. Both types of biofuel crops are allocated separately based on different location factors. Despite differences between the scenarios, mostly the same areas are showing growth in biofuel crop cultivation in all scenarios. These areas stand out because they have a combination of well-developed infrastructural and industrial facilities and large areas of suitable arable land. The spatially explicit results allow an assessment of the potential consequences of large-scale biofuel crop cultivation for ecology and environment.
3) Modelling study	Fischer, G. et al. 2010. Biofuel production potentials in Europe: Sustainable use of culticated land and pastures, Part II: Land use scenarios. Biomass and Bioenergy 34: 173 - 187	https://doi.org/10.1016/j.biombioe.2009.07.009	EU	Europe's agricultural land (including Ukraine) comprise of 164 million hectares of cultivated land and 76 million hectares of permanent pasture. A "food first" paradigm was applied in the estimations of land potentially available for the production of biofuel feedstocks, without putting at risk food supply or nature conservation.Three land conversion scenarios were formulated: (i) A base scenario, that reflects developments under current policy settings and respects current trends in nature conservation and organic farming practices, by assuming moderate overall yield increases; (ii) an environment oriented scenario with higher emphasis on sustainable farming practices and maintenance of biodiversity; and (iii) an energy oriented scenario considering more substantial land use conversions including the use of pasture land.By 2030 some 44–53 million hectares of cultivated land could be used for bioenergy feedstock production. The energy oriented scenario includes an extra 19 million hectares pasture land for feedstocks for second-generation biofuel production chains. Available land is foremost to be found in Eastern Europe, where substantial cultivated areas can be freed up through sustainable gains in yield in the food and feed sector.Agricultural residues of food and feed crops may provide an additional source for biofuel production. When assuming that up to 50% of crop residues can be used without risks for agricultural sustainability, we estimate that up to 246 Mt agricultural residues could be available for biofuel production, comparable to feedstock plantations of some 15–20 million hectares.
2) Empirical study	Fletcher, RJ. Jr. Biodiversity conservation in the era of biofuels: risk and opportunities. Front Ecol Environ 9 no:3:161-168	https://doi.org/10.1890/090091	USA	Growing demand for alternative energy sources has contributed to increased biofuel production, but the effects on biodiversity of land-use change to biofuel crops remain unclear. Using a meta-analysis for crops being used or considered in the US, we find that vertebrate diversity and abundance are generally lower in biofuel crop habitats relative to the non-crop habitats that these crops may replace. Diversity effects are greater for corn than for pine and poplar, and birds of conservation concern experience greater negative effects from corn than species of less concern. Yet conversion of row-crop fields to grasslands dedicated to biofuels could increase local diversity and abundance of birds. To minimize impacts of biofuel crops on biodiversity, we recommend management practices that reduce chemical inputs, increase heterogeneity within fields, and delay harvests until bird breeding has ceased. We encourage research that will move us toward a sustainable biofuels economy, including the use of native plants, development of robust environmental criteria for evaluating biofuel crops, and integrated cost–benefit analysis of potential land-use change.
4) Conceptual paper	Groom, M.J., E.M. Gray and P.A. Townsend. 2007. Biofuels and Biodiversity: Principles for Creating Better	10.1111/j.1523-1739.2007.00879.x	USA	Biofuels are a new priority in efforts to reduce dependence on fossil fuels; nevertheless, the rapid increase in production of biofuel feedstock may threaten biodiversity. There are general principles that should be used in developing guidelines for certifying biodiversity-friendly biofuels. First, biofuel feedstocks should be grown with envi-

	Policies for Biofuel Production.			ronmentally safe and biodiversity-friendly agricultural practices. The sustainability of any biofuel feedstock depends on good growing practices and sound environmental practices throughout the fuel-production life cycle. Second, the ecological footprint of a biofuel, in terms of the land area needed to grow sufficient quantities of the feedstock, should be minimized. The best alternatives appear to be fuels of the future, especially fuels derived from microalgae. Third, biofuels that can sequester carbon or that have a negative or zero carbon balance when viewed over the entire production life cycle should be given high priority. Corn-based ethanol is the worst among the alternatives that are available at present, although this is the biofuel that is most advanced for commercial production in the United States. We urge aggressive pursuit of alternatives to corn as a biofuel feedstock. Conservation biologists can significantly broaden and deepen efforts to develop sustainable fuels by playing active roles in pursuing research on biodiversity-friendly biofuel production practices and by helping define biodiversity-friendly biofuel certification standards.
2) Empirical study	Haughton, A.J. et al. 2009. A novel, integrated approach to assessing social, economic and environmental implications of changing rural land-use: a case study of perennial biomass crops. Journal of Applied Ecology 46: 315 - 322	https://doi.org/10.1111/j.1365-2664.2009.01623.x	UK	Concern about climate change and energy security is stimulating land-use change, which in turn precipitates social, economic and environmental responses. It is predicted that within 20 years in the UK, bio-energy crops could occupy significant areas of rural land. Among these, dedicated biomass crops, such as Miscanthus (*Miscanthus* spp.) grass and short rotation willow (*Salix* spp.) coppice, differ significantly from arable crops in their growth characteristics and management. It is important that the potential impacts of these differences are assessed before large-scale, long-term planting occurs. We used a Sustainability Appraisal Framework (SAF) approach to landscape planning in the UK to identify stakeholder aspirations (objectives) and associated criteria (indicators) for the planting of dedicated biomass crops. The use of environmental and physical constraints mapping allowed the SAF to focus only on environmentally-acceptable locations, thereby avoiding unsustainable trade-offs. The mapping identified 3·1 million ha of land in England as suitable for planting, suggesting the UK government target of 1·1 million ha by 2020 is feasible. Evaluation of the SAF identified that while biodiversity was of concern to stakeholders, some current indicators of biodiversity are not appropriate. Butterfly abundance proved the most appropriate indicator, and it was found that total abundance was greater in field margins of both willow and Miscanthus biomass crops than in arable field margins.Synthesis and applications. The potential conflicts of assuring food security, water availability, energy security and biodiversity conservation are recognized as a key challenge by governments worldwide. Methods with which decision-makers can compare the performance of different land-use scenarios against sustainability objectives will be crucial for achieving optimized and sustainable use of land-based resources to meet all four challenges. Using biomass crops planting as an example, this work illustrates the potential of a Sustainability Appraisal Framework, subject to identification and agreement of appropriate indicators, in securing a holistic understanding of the wide-ranging implications of large-scale, long-term changes to rural land-use in the wider context of sustainable land-use planning per se.
4) Conceptual paper	Gomiero, T. 2017. Large-scale biofuels production: A possible threat to soil conservation and environmental services. Applied Soil Ecology	10.1016/j.apsoil.2017.09.028		Biofuels have been promoted as a sustainable energy carrier, able to supply fuels while reducing Greenhouse Gas emissions (GHGs) within the energy sector. It is also believed that biofuels will offer new income opportunities to farmers and create new jobs in rural areas. I argue that this may be a far too optimistic picture. Biofuels have poor energy performance (in actual fact, their use requires a high volume of subsidies), are potentially in conflict with food production and have high environmental impacts, especially on soil, forests and natural resources. Large scale biofuels production may cause detrimental effects on those key ecosystem services that we should strive to pre-

				serve, in particular when considering soil health. Assessing the sustainability of energy carriers requires a comprehensive assessment able to address multiple issues at the same time. It is necessary to rethink biofuels policy in view of preserving soil heath and key ecosystem services. Agricultural policies would better focus on supporting farmers in the adoption of more sustainable farming practices. Policies aiming at preserving forests are also necessary. Subsidies could be used to explore different renewable energy sources, with a lower impact on our support systems, and more sustainable agricultural practices. Eventually, rethinking our development patterns may become necessary in order to cope with the Earth's limited resources and reduce the alarming trends associated with the environmental impact of human global societal metabolism.
1) Literature reviewand 2) Empirical study	Robinson, G.M. and Carson, D.A. eds., 2015. *Handbook on the Globalisation of Agriculture*. Edward Elgar Publishing.	https://www.e-elgar.com/shop/handbook-on-the-globalisation-of-agriculture		This Handbook provides insights to the ways in which globalisation is affecting the whole agri-food system from farms to the consumer. It covers themes including the physical basis of agriculture, the influence of trade policies, the nature of globalised agriculture, and resistance to globalisation in the form of attempts to foster greater sustainability and multifunctional agricultural systems. Drawing upon studies from around the world, the Handbook will appeal to a broad and varied readership, across academics, students, and policy-makers interested in economics, trade, geography, sociology and political science.
4) Conceptual paper	Gomiero T. Special Issue" Critical issues on Agri-food System Management: Addressing Complexity in Present and Future Challenges.	http://www.mdpi.com/journal/sustainability/special_issues/agrifood_system		
2) Empirical study	Gomiero, T. 2015. Are biofuels an effective and viable energy strategy for industrialized societies? A reasoned overview of potentials and limits. Sustainability7, no 7: 8497-8521	10.3390/su7078491		In this paper, I analyze the constraints that limit biomass from becoming an alternative, sustainable and efficient energy source, at least in relation to the current metabolism of developed countries. In order to be termed sustainable, the use of an energy source should be technically feasible, economically affordable and environmentally and socially viable, considering society as a whole. Above all, it should meet society's "metabolic needs," a fundamental issue that is overlooked in the mainstream biofuels narrative. The EROI (Energy Return on Investment) of biofuels reaches a few units, while the EROI of fossil fuels is 20–30 or higher and has a power density (W/m^2) thousands of times higher than the best biofuels, such as sugarcane in Brazil. When metabolic approaches are used it becomes clear that biomass cannot represent an energy carrier able to meet the metabolism of industrialized societies. For our industrial society to rely on "sustainable biofuels" for an important fraction of its energy, most of the agricultural and non-agricultural land would need to be used for crops, and at the same time a radical cut to our pattern of energy consumption would need to be implemented, whilst also achieving a significant population reduction.
2) Empirical study	Söderberg, C and K. Eckerberg. 2013. Rising policy conflicts in Europe over bioenergy and forestry. Forest Policy and Ecomics 33: 112-119	10.1016/j.forpol.2012.09.015	EU	rowing concerns over emissions of green-house gases causing climate change as well as energy security concerns have spurred the interest in bioenergy production pushed by EU targets to fulfil the goal of 20 per cent renewable energy in 2020, as well as the goal of 10 per cent renewable fuels in transport by 2020. Increased bioenergy production is also seen to have political and economic benefits for rural areas and farming regions in Europe and in the developing world. There are, however, conflicting views on the potential benefits of large scale bioenergy production, and recent debates have also drawn attention

				to a range of environmental and socio-economic issues that may arise in this respect. One of these challenges will be that of accommodating forest uses – including wood for energy, and resulting intensification of forest management – with biodiversity protection in order to meet EU policy goals. We note that the use of biomass and biofuels spans over several economic sector policy areas, which calls for assessing and integrating environmental concerns across forest, agriculture, energy and transport sectors.In this paper, we employ frame analysis to identify the arguments for promoting bioenergy and assess the potential policy conflicts in the relevant sectors, through the analytical lens of environmental policy integration. We conclude that while there is considerable leverage of environmental arguments in favour of bioenergy in the studied economic sectors, and potential synergies with other policy goals, environmental interest groups remain sceptical to just how bioenergy is currently being promoted. There is a highly polarised debate particularly relating to biofuel production. Based on our analysis, we discuss the potential for how those issues could be reconciled drawing on the frame conflict theory, distinguishing between policy disagreements and policy controversies.
1) Literature review	Gomiero, T. 2015. Effects of agricultural activities on biodiversity and ecosystemas: Organic versus conventional farming. Handbook on the Globalisation of Agriculture.	10.4337/9780857939838.00009		In this chapter, I review the effects of farming practices on biodiversity, focusing in particular on the potential role of organic agriculture in preserving biodiversity. From the literature review, it emerges that organic farming, when properly managed, can provide greater potential for biodiversity than its conventional counterpart, as a result of greater habitat variability and more wildlife-friendly management practices, along with the exclusion of agri-chemical pesticides. Organic agriculture also has positive effects on soil biophysical and ecological characteristics – long-term soil fertility. Indeed, an increasing body of evidence indicates that landscape heterogeneity is a key factor in promoting biodiversity in the agricultural landscape. Benefits may be also achieved by conventional agriculture when reducing the inputs of agri-chemicals and better integrating crop production with soil protection and landscape ecological structures. I highlight that farming and environmental conservation have to be understood within the whole structure of the food system, and that analysis should be made and actions towards agricultural sustainability and biodiversity conservation should be taken accordingly. That means working in parallel on the social, economic and political dimensions of our society. Individual farmers cannot take that challenge alone, or bear the whole cost of the effort. Long-term experiments and multicriteria analysis of the range of feasibility and viability of organic and low-input agriculture should also be carried out in a number of different scenarios
2) Empirical study	Tranquada Boleo, S. M. 2011. Environmental impact assessment of energy crops cultivation in the Mediterranean Europe	https://www.researchgate.net/profile/Sara_Boleo/publication/277188890_Environmental_impact_assessment_of_energy_crops_cultivation_in_the_Mediterranean_Europe/links/55ae1c4008aed9b7dcdb3082/E		Energy crops offer ecological advantages over fossil fuels by contributing to the reduction of greenhouse gases and acidifying emissions. However, there could be ecological shortcomings related to the intensity of agricultural production. There is a risk of polluting water and air, losing soil quality, enhancing erosion and reducing biodiversity. In the scope of the project Future Crops for Food, Feed, Fiber and Fuel (4F Crops), supported by the European Union, an environmental impact assessment study was developed and applied to the cultivation of potential energy crops in the Mediterranean Europe. The categories selected were: use of water and mineral resources, soil quality and erosion,emission of minerals and pesticides to soil and water, waste generation and utilization, landscape and biodiversity. Results suggest that annual cropping systems have a more negative impact on the environment than lignocellulosic and woody species, namely regarding erodibility and biodiversity. Annual systems and woody crops are also more damaging to soil quality than herbaceous perennials. However, differences among crop types are not as evident in the remaining indicators. Impact reduction strategies are limited to crop management options, but, site specific factors should be accurately assessed to evaluate the adequacy between crop and location.

		nvironmental-impact-assessment-of-energy-crops-cultivation-in-the-Mediterranean-Europe.pdf		
1) Literature review	Hernandez, R.R et al. 2014. Environmental impacts of utility-scale solar energy. Renewable and Sustainable energy Reviews 29: 766-779	https://doi.org/10.1016/j.rser.2013.08.041		Renewable energy is a promising alternative to fossil fuel-based energy, but its development can require a complex set of environmental tradeoffs. A recent increase in solar energy systems, especially large, centralized installations, underscores the urgency of understanding their environmental interactions. Synthesizing literature across numerous disciplines, we review direct and indirect environmental impacts – both beneficial and adverse – of utility-scale solar energy (USSE) development, including impacts on biodiversity, land-use and land-cover change, soils, water resources, and human health. Additionally, we review feedbacks between USSE infrastructure and land-atmosphere interactions and the potential for USSE systems to mitigate climate change. Several characteristics and development strategies of USSE systems have low environmental impacts relative to other energy systems, including other renewables. We show opportunities to increase USSE environmental co-benefits, the permitting and regulatory constraints and opportunities of USSE, and highlight future research directions to better understand the nexus between USSE and the environment. Increasing the environmental compatibility of USSE systems will maximize the efficacy of this key renewable energy source in mitigating climatic and global environmental change.
2) Empirical study	Montag, et al. 2016.The Effects of solar farms on local biodiversity: A comparative study. Clarkson and Woods and Wychwood Biodiversity	http://www.clarksonwoods.co.uk/download/Solar_Farms_Biodiversity_Study.pdf	UK	
2) Empirical study	Turney, D. and V. Fthenakis. 2011. Environmental impacts from the installation and operation of large-scale power plants. Renewable and Sustainable energy Reviews 15, no. 6: 3261-3270	doi.org/10.1016/j.rser.2011.04.023	USA	Large-scale solar power plants are being developed at a rapid rate, and are setting up to use thousands or millions of acres of land globally. The environmental issues related to the installation and operation phases of such facilities have not, so far, been addressed comprehensively in the literature. Here we identify and appraise 32 impacts from these phases, under the themes of land use intensity, human health and well-being, plant and animal life, geohydrological resources, and climate change. Our appraisals assume that electricity generated by new solar power facilities will displace electricity from traditional U.S. generation technologies. Altogether we find 22 of the considered 32 impacts to be beneficial. Of the remaining 10 impacts, 4 are neutral, and 6 require further research before they can be appraised. None of the impacts are negative relative to traditional power generation. We rank the impacts in terms of priority, and find all the high-priority impacts to be beneficial. In quantitative terms, large-scale solar power plants occupy the same or less land per kW h than coal power plant life cycles. Removal of forests to make space for solar power causes CO_2 emissions as high as 36 g CO_2 kW h^{-1}, which is a significant contribution to the life cycle CO_2 emissions of solar power, but is still low compared to CO_2 emissions from coal-based electricity that are about 1100 g CO_2 kW h^{-1}.
2) Empirical	Cameron, D.R. et al. 2012. An approach to enhance the conserva-	doi.org/10.1371/journal.po-	USA	The rapid pace of climate change poses a major threat to biodiversity. Utility-scale renewable energy development (>1 MW capacity) is a key strategy to reduce greenhouse gas emissions, but development of

study	tion-compatibility of solar energy development. PLoS ONE 7, no.6	ne.0038437		those facilities also can have adverse effects on biodiversity. Here, we examine the synergy between renewable energy generation goals and those for biodiversity conservation in the 13 M ha Mojave Desert of the southwestern USA. We integrated spatial data on biodiversity conservation value, solar energy potential, and land surface slope angle (a key determinant of development feasibility) and found there to be sufficient area to meet renewable energy goals without developing on lands of relatively high conservation value. Indeed, we found nearly 200,000 ha of lower conservation value land below the most restrictive slope angle (<1%); that area could meet the state of California's current 33% renewable energy goal 1.8 times over. We found over 740,000 ha below the highest slope angle (<5%) – an area that can meet California's renewable energy goal seven times over. Our analysis also suggests that the supply of high quality habitat on private land may be insufficient to mitigate impacts from future solar projects, so enhancing public land management may need to be considered among the options to offset such impacts. Using the approach presented here, planners could reduce development impacts on areas of higher conservation value, and so reduce trade-offs between converting to a green energy economy and conserving biodiversity.
2) Empirical study	Tsoutsos, T., N. Frantzeskaki and V. Gekas. 2005. Environmental impacts from the solar energy technologies. Energy Policy 33 no3: 289-296	https://doi.org/10.1016/S0301-4215(03)00241-6		Solar energy systems (photovoltaics, solar thermal, solar power) provide significant environmental benefits in comparison to the conventional energy sources, thus contributing, to the sustainable development of human activities. Sometimes however, their wide scale deployment has to face potential negative environmental implications. These potential problems seem to be a strong barrier for a further dissemination of these systems in some consumers.To cope with these problems this paper presents an overview of an Environmental Impact Assessment. We assess the potential environmental intrusions in order to ameliorate them with new technological innovations and good practices in the future power systems. The analysis provides the potential burdens to the environment, which include—during the construction, the installation and the demolition phases, as well as especially in the case of the central solar technologies—noise and visual intrusion, greenhouse gas emissions, water and soil pollution, energy consumption, labour accidents, impact on archaeological sites or on sensitive ecosystems, negative and positive socio-economic effects.
2) Empirical study	Dennis, Y.C., Leung, Tuang Yang. 2012. Wind energy development and ist envionmental impact: A review	https://doi.org/10.1016/j.rser.2011.09.024		Wind energy, commonly recognized to be a clean and environmentally friendly renewable energy resource that can reduce our dependency on fossil fuels, has developed rapidly in recent years. Its mature technology and comparatively low cost make it promising as an important primary energy source in the future. However, there are potential environmental impacts due to the installation and operation of the wind turbines that cannot be ignored. This paper aims to provide an overview of world wind energy scenarios, the current status of wind turbine development, development trends of offshore wind farms, and the environmental and climatic impact of wind farms. The wake effect of wind turbines and modeling studies regarding this effect are also reviewed.
1) Literature review	Tabassum-Abbasi et al. 2014. Wind energy:Increasing deployment, rising environmental concerns. Renewable and Sustainable energy Reviews: 270-288	doi.org/10.1016/j.rser.2013.11.019		Of all the renewable energy sources (RESs)—except direct solar heat and light—wind energy is believed to have the least adverse environmental impacts. It is also one of the RES which has become economically affordable much before several other RESs have. As a result, next to biomass (and excluding large hydro), wind energy is the RES being most extensively tapped by the world at present. Despite carrying the drawback of intermittency, wind energy has found favor due to its perceived twin virtues of relatively lesser production cost and environment-friendliness. But with increasing use of turbines for harnessing wind energy, the adverse environmental impacts of this RES are increasingly coming to light. The present paper summarizes the current understanding of these impacts and assesses the challenges they are posing. One among the major hurdles has been the NYMBI (not in

				my backyard) syndrome due to which there is increasing emphasis on installing windfarms several kilometers offshore. But such moves have serious implications for marine life which is already under great stress due to impacts of overfishing, marine pollution, global warming, ozone hole and ocean acidification. Evidence is also emerging that the adverse impacts of wind power plants on wildlife, especially birds and bats, are likely to be much greater than is reflected in the hitherto reported figures of individuals killed per turbine. Likewise recent findings on the impact of noise and flicker generated by the wind turbines indicate that these can have traumatic impacts on individuals who have certain predispositions. But the greatest of emerging concerns is the likely impact of large wind farms on the weather, and possibly the climate. The prospects of wind energy are discussed in the backdrop of these and other rising environmental concerns.
1) Literature review	Saidur, R. et al. 2011. Environmental impact of wind energy. Renewable and Sustainable energy Reviews 15, no. 5: 2423-2430	https://doi.org/10.1016/j.rser.2011.02.024		Since the beginning of industrialization, energy consumption has increased far more rapidly than the number of people on the planet. It is known that the consumption of energy is amazingly high and the fossil based resources may not be able to provide energy for the whole world as these resources will be used up in the near future. Hence, renewable energy expected to play an important role in handling the demand of the energy required along with environmental pollution prevention. The impacts of the wind energy on the environment are important to be studied before any wind firm construction or a decision is made. Although many countries showing great interest towards renewable or green energy generation, negative perception of wind energy is increasingly evident that may prevent the installation of the wind energy in some countries. This paper compiled latest literatures in terms of thesis (MS and PhD), journal articles, conference proceedings, reports, books, and web materials about the environmental impacts of wind energy. This paper also includes the comparative study of wind energy, problems, solutions and suggestion as a result of the implementation of wind turbine. Positive and negative impacts of wind energy have been broadly explained as well. It has been found that this source of energy will reduce environmental pollution and water consumption. However, it has noise pollution, visual interference and negative impacts on wildlife.
2) Empirical study	Hötker, H., K.M. Thomsen and H. Jeromin. 2006. Impacts on biodiversity of expoitation of renewable energy sources: the example of birds and bats-facts gaps in konwledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Insttut im NABU, Bergenhusen.	http://www.proj6.turbo.pl/upload/file/389.pdf	Germany	
1) Literature review	Wang, S. and S. Wang. 2015. Impacts of energy on environment: A review	https://doi.org/10.1016/j.rser.2015.04.137		Wind power is increasingly being used worldwide as an important contribution to renewable energy. The development of wind power may lead to unexpected environmental impacts. This paper systematically reviews the available evidence on the impacts of wind energy on environments in terms of noise pollution, bird and bat fatalities, greenhouse gas emissions, and land surface impacts. We conclude that wind energy has an important role to play in future energy generation, but more effort should be devoted to studying the overall environmental impacts of wind power, so that society can make informed decisions when weighing the advantages and disadvantages of particular wind power development.

2) Empiri-cal study	Kaldellis, J.K. et al. 2016. Environmental and social footprint of offshore wind energy. Comparison with ons-hore counterpart. Renewable Energy 92: 543-556	https://doi.org/10.1016/j.renene.2016.02.018		Offshore wind power comprises a relatively new challenge for the international wind industry with a demonstration history of around twenty years and a ten-year commercial history for large, utility-scale projects. By comparison to other forms of electric power generation, offshore wind energy is generally considered to have relatively benign effects on the marine environment. However, offshore projects in-clude platforms, turbines, cables, substations, grids, interconnection and shipping, dredging and associated construction activity. The Op-eration & Maintenance (O&M) activities include the transport of employees by vessel or helicopter and occasional hardware retrofits. Therefore, various impacts are incurred in the construction, operation and decommissioning phases; mainly the underwater noise and the impacts on the fauna. Based on the fact that in many of the aforemen-tioned issues there are still serious environmental uncertainties, con-tradictive views and emerging research, the present work intents to provide a thorough literature review on the environmental and social impacts of offshore wind energy projects in comparison with the onshore counterparts.
1) Litera-ture review	Gill, A.B. 2005. Offshore renewable energy: ecological implications of generating electricity in the coastal zone. Journal of Applied Ecology 42, no. 4:605-615	https://doi.org/10.1111/j.1365-2664.2005.01060.x		Global-scale environmental degradation and its links with non-renewable fossil fuels have led to an increasing interest in generating electricity from renewable energy resources. Much of this interest centres on offshore renewable energy developments (ORED). The large scale of proposed ORED will add to the existing human pressures on coastal ecosystems, therefore any ecological costs and benefits must be determined. The current pressures on coastal ecology set the context within which the potential impacts (both positive and nega-tive) of offshore renewable energy generation are discussed. The number of published peer-review articles relating to renewable ener-gy has increased dramatically since 1991. Significantly, only a small proportion of these articles relate to environmental impacts and none considers coastal ecology. Actual or potential environmental impact can occur during construction, operation and/or decommissioning of ORED. Construction and decommissioning are likely to cause signifi-cant physical disturbance to the local environment. There are both short- and long-term implications for the local biological communities. The significance of any effects is likely to depend on the natural dis-turbance regime and the stability and resilience of the communities. During day-to-day operation, underwater noise, emission of electro-magnetic fields and collision or avoidance with the energy structures represent further potential impacts on coastal species, particularly large predators. The wider ecological implications of any direct and indirect effects are discussed. Synthesis and applications. This review demonstrates that offshore renewable energy developments will have direct and, potentially, indirect consequences for coastal ecology, with these effects occurring at different scales. Ecologists should be in-volved throughout all the phases of an ORED to ensure that appropri-ate assessments of the interaction of single and multiple develop-ments with the coastal environment are undertaken.
1) Litera-ture review	Bonar, P.A.J. et al. 2015. Social and ecological impacts of marine energy development. Renewable and Sustainable Energy Reviews 47: 486-495	doi.org/10.1016/j.rser.2015.03.068		For marine energy to be truly sustainable, its social and ecological impacts must be identified and measures by which to mitigate adverse effects established before devices are deployed in large arrays. To inform future research and encourage environmentally-sensitive developments, this review aims to identify the most significant social and ecological issues associated with wave and tidal current energy generation. Modifications to wave climates, flow patterns, and marine habitats, particularly through increased underwater noise and collision risk, are identified as key ecological issues. Social acceptance of re-newable energy is found to be closely linked to the level of stakehold-er involvement and the public perception of renewable energy. The review concludes with a call for a more strategic and collaborative research effort between developers, academia, and the public sector to improve environmental monitoring standards and best practices for device and array design.

2) Empirical study	Inger R. et al. 2009. Marine renewable energy: potential benefits to biodiversity? An urgent call for research. Journal of Aplied Ecology 46, no.6: 1145-1153	https://doi.org/10.1111/j.1365-2664.2009.01697.x		The evidence for anthropogenically induced climate change is overwhelming with the production of greenhouse gases from burning fossil fuels being a key driver. In response, many governments have initiated programmes of energy production from renewable sources. The marine environment presents a relatively untapped energy source and offshore installations are likely to produce a significant proportion of future energy production. Wind power is the most advanced, with development of wave and tidal energy conversion devices expected to increase worldwide in the near future. Concerns over the potential impacts on biodiversity of marine renewable energy installations (MREI) include: habitat loss, collision risks, noise and electromagnetic fields. These factors have been posited as having potentially important negative environmental impacts. Conversely, we suggest that if appropriately managed and designed, MREI may increase local biodiversity and potentially benefit the wider marine environment. Installations have the capacity to act as both artificial reefs and fish aggregation devices, which have been used previously to facilitate restoration of damaged ecosystems, and de facto marine-protected areas, which have proven successful in enhancing both biodiversity and fisheries. The deployment of MREI has the potential to cause conflict among interest groups including energy companies, the fishing sector and environmental groups. Conflicts should be minimized by integrating key stakeholders into the design, siting, construction and operational phases of the installations, and by providing clear evidence of their potential environmental benefits. Synthesis and applications. MREI have the potential to be both detrimental and beneficial to the environment but the evidence base remains limited. To allow for full biodiversity impacts to be assessed, there exists an urgent need for additional multi and inter-disciplinary research in this area ranging from engineering to policy. Whilst there are a number of factors to be considered, one of the key decisions facing current policy makers is where installations should be sited, and, dependent upon site, whether they should be designed to either minimize negative environmental impacts or as facilitators of ecosystem restoration.
1) Literature review	Frid, C. et al. 2012. The environmental interactions of tidal and wave energy generation devices. Environmental Impact Assessment Review 32, no. 1: 133-139			
1) Literature review	Boehlert, G.W. and A.B. Gill. 2010. Environmental and Ecological effects of ocean renewable energy development: A current Synthesis. Oceanography Society 23 no.2: 68-81			Marine renewable energy promises to assist in the effort to reduce carbon emissions worldwide. As with any large-scale development in the marine environment, however, it comes with uncertainty about potential environmental impacts, most of which have not been adequately evaluated—in part because many of the devices have yet to be deployed and tested. We review the nature of environmental and, more specifically, ecological effects of the development of diverse types of marine renewable energy—covering marine wind, wave, tidal, ocean current, and thermal gradient—and discuss the current state of knowledge or uncertainty on how these effects may be manifested. Many of the projected effects are common with other types of development in the marine environment; for example, additional structures lead to concerns for entanglement, habitat change, and community change. Other effects are relatively unique to marine energy conversion, and specific to the type of energy being harnessed, the individual device type, or the reduction in energy in marine systems. While many potential impacts are unavoidable but measurable, we would argue it is possible (and necessary) to minimize others through careful device development and site selection; the scale of development, however, will lead to cumulative effects that we must understand to avoid environmental impacts. Renewable energy de-

				velopers, regulators, scientists, engineers, and ocean stakeholders must work together to achieve the common dual objectives of clean renewable energy and a healthy marine environment.
2) Empirical study	Pinho, P. et al. 2007. The quality of Portuguese Environmental Impact Studies: The case of small hydropower projects. Environmental Impact assessment Review 27, no. 3: 189-205	https://doi.org/10.1016/j.eiar.2006.10.005		In most Environmental Impact Assessment (EIA) systems environmental authorities can stop an EIA process by refusing the respective EIA Report, on the grounds of technical or methodological insufficiencies identified in the review procedure. However, often times, it cannot be taken for granted that, once an EIA Report is formally accepted, as part of an EIA process, its quality standard is, consistently, of a satisfactory level. This paper summarises the results of a one-year research project aimed at assessing the quality of EIA studies carried out for small hydropower plants in Portugal. An extensive survey was carried out to analyse all EIA Reports that were the basis of successful EIA processes involving this kind of small scale projects, under the old and the new national EIA legislation, that is, over the last two decades. Often times unnoticeable to the general public and the media, located in isolated areas upstream secondary rivers, these projects are likely to generate some significant environmental impacts, in particular on the aesthetics value and character of local landscapes and on pristine ecological habitats. And yet, they are usually regarded as environmental friendly projects designed to produce emission free energy. The design of the evaluation criteria benefited from the literature review on similar research projects carried out in other EU countries. The evaluation exercise revealed a number of technical and methodological weaknesses in a significant percentage of cases. A set of simple and clear cut recommendations is proposed twofold: to improve the current standard of EIA practice and to strengthen the role of the so called EIA Commissions, at the crucial review stage of the EIA process.
1) Literature review	Shortall, R. et al. Geothermal energy for sustainable development: A review of sustainability and assessment frameworks	https://doi.org/10.1016/j.rser.2014.12.020		Sustainable development calls for the use of sustainable energy systems. However, the way in which a geothermal resource is utilized will ultimately determine whether or not the utilization is sustainable. Energy usage is set to increase worldwide, and geothermal energy usage for both electricity generation and heating will also increase significantly. The world's geothermal resources will need to be used in a sustainable manner. The sustainable utilization of geothermal energy means that it is produced and used in a way that is compatible with the well-being of future generations and the environment. This paper provides a literature review of the linkages between geothermal energy developments for electricity generation and sustainable development, as well as a review of currently available sustainability assessment frameworks. Significant impacts occur as a result of geothermal energy projects for electricity generation and these impacts may be positive or negative. The need for correct management of such impacts through a customized sustainability assessment framework is identified and the foundation for sustainability assessment framework for geothermal energy development is built in this paper.
2) Empirical study	Kristmannsdottir, H. and H. Armannsson. 2003. Environmental aspects of geothermal energy utilization. Geothermics 32, no. 4-6: 451-461	https://doi.org/10.1016/S0375-6505(03)00052-X		Geothermal energy is a clean and sustainable energy source, but its development still has some impact on the environment. The positive and negative aspects of this environmental impact have to be considered prior to any decision to develop a geothermal field, as well as possible mitigation measures. The main environmental effects of geothermal development are related to surface disturbances, the physical effects of fluid withdrawal, heat effects and discharge of chemicals. All these factors will affect the biological environment as well. As with all industrial activities, there are also some social and economic effects. In Iceland an enforcement program was launched in the early 1990s to study the environmental impact of developing geothermal resources. Work began on tackling the environmental issues relative to the high-temperature geothermal fields under development in Iceland. Research was conducted on microearthquake activity in geothermal areas and a methodology developed for mapping steam caps. The foundations were laid of networks for monitoring land elevation and gravity changes. Baseline values were defined

				for the concentrations of mercury and sulfur gases. Groundwater monitoring studies were enforced. Atmospheric dispersion and reaction of geothermally-emitted sulfur gases and mercury were studied. Aerial thermographic survey methods were refined and tested and their capacity to detect and map changes in surface manifestations with time was demonstrated. To further the use of geothermal energy worldwide the International Energy Association set up a Geothermal Implement Agreement (GIA) in 1997; its environmental Annex has been actively implemented, with several projects still under way.

ANNEX 4: Minutes of the 2nd meeting with the requester

EKLIPSE

Knowledge & Learning Mechanism on Biodiversity & Ecosystem Services

EKLIPSE energy request: Minutes of the 2nd (virtual) meeting with the requester

Date: 4 July 2018

Participants: Henri Rueff (requester), Myriam Truffert (requester), Marianne Darbi (EKLIPSE secretariat contact point for the energy request), Juliette Young (EKLIPSE secretariat), Lynn Dicks (EKLIPSE methods expert group), Miriam Grace (EKLIPSE methods expert group)

Meeting chair: Marianne Darbi

Minutes: Marianne Darbi

Agenda:

6. Presentation and discussion of the draft methodological protocol
7. Discussion of the timeline
8. Envisaged output
9. Next Steps/ToDos

1) Presentation and discussion of the draft methodological protocol:

Miriam presented the draft methodological protocol suggested by the EKLIPSE methods expert working group: adjacency matrices will be used, as a result the strongest links and interrelations between concepts and terms will be identified.

Henri confirmed that the requester are happy with the approach suggested, but highlighted that when identifying and considering different terms it would be quite crucial to always bear in mind that the focus is on the outcomes of the energy policy of the EU and its likely transboundary (spillover) effects → Marianne mentioned that with the envisaged framing for the work of the research analyst with a focus on the four main routes of the EU Energy Roadmap (energy efficiency, renewable energy, nuclear energy, and carbon capture and storage) and the creation of list of terms out of this, this issue would be addressed.

Henri further mentioned that when analyzing the relation to the SDGs it would be good to focus on the target level (data entry at target level) of the SDGS (there are 169 targets under 17 SDGs). This, however, would generate a quite large matrix of interactions, but most likely complexity can be reduced by focusing on some key SDGs (2, 7, 13, 15, …). It would be great to show benefits through the interactions (and use this as a communication tool to policy makers.

Building on the suggestion by Henri, there was consensus that the 7-point scale developed by ICSU (A Guide to SDG interactions: From Science to implementation, https://council.science/publications/a-guide-to-sdg-interactions-from-science-to-implementation) should be used to qualify/quantify the nature of the interaction. This would also ensure to make the link to the current/upcoming scientific literature.

Juliette mentioned that it is important to focus on the policy relevance of the request, in particular by identifying key people form the policy realm and doing a short and swift review of the policy relevance.

It has been discussed under which format experts will contribute to the request, options considered are: 1) an Expert working group (with light version of a call for experts), 2) a steering group, 3) only as workshop participants (with some input requested prior to the workshop). All of these could theoretically fit to the envisaged tasks, therefore, the EKLIPSE teams will check and decide what is most appropriate/reasonable in terms of administrative capacity and timeline.

2) Discussion of the timeline:

Henri mentioned that there will be a meeting of all authors drafting the Global Sustainable Development Report (GSDR) next week in New Yok to discuss the "Zero draft". In late 2018/early 2019 the final draft needs to be ready (and go into production in early Spring 2019). Therefore, between now and December 2018 input into the zero draft can be made. Thus, the final output from the EKLIPSE energy request would be expected/needed end of October/beginning of November so that it can be fed into the GSDR.

The tentative timeline has been updated accordingly (see annex).

3) Envisaged output:

The output from the EKLIPSE energy request shall feed directly into the GSDR. This could include the following contents:

- Framing the overarching policy relevance of the request, including the political message that the developed countries have to consider their spillover effects, as starting point to the discussion (text)
- Presentation of the model/matrix/diagram (developed with the EWG)
- Examples for specific interactions, e.g. illustrating tradeoffs (short texts)

4) Next steps and ToDos

- All to check the minutes by 10th July
- All to add to the list of potential experts for an EWG (Marianne to send the list) by end of July (the sooner the better)
- Marianne will create and share a link to an EKLIPSE owncloud folder for the request where all documents can be stored
- Marianne/EKLIPSE to check for budget and administrative procedure for hiring a research assistant
- Miriam to draft a few short paragraphs on the research assistant reference terms of reference/task description and requirements of potential candidates by 10th July (by end of this week would be even better) on the basis of the methods protocol discussed and send this to

Marianne. Marianne will put this into the format and circulate to all for quick comments (by end of next week).

- All to think about potential candidates and send name, affiliation and contact to Marianne (by end of next week, the sooner the better).
- Marianne will send out the advertisement: UFZ will contact the potential candidates asking them for an offer (ideally end of next week)
- EKLIPSE Secretariat (Marianne, Juliette) and KCB (Heidi, Rania, Flore)to check for administrative procedure for EWG (prepare Call for Experts or put in place a steering group)

ANNEX: EKLIPSE energy request – tentative procedure and timeline (updated 4th July)

What?	(by) when?	Who?
explanation of the task → Miriam and Lynn to update the draft methodolocial protocol as agreed (organise along the illustration)	by Wednesday (4th July) morning	Miriam and Lynn
discussion of tentative timeline and procedure with the requester, virtual meeting (meeting link: https://global.gotomeeting.com/join/920616933)	virtual meeting on Wednesday 2-3pm CET	KCB energy, Miriam, Lynn, requester
Hire a research assistant to analyse the EU energy policies, create a list of terms and to prepare the work of the EWG and help with the workshop, will work over summer → Rania will check with some potential candidates → all to think about potential candidates → EKLIPSE to think about appropriate procedure (keeping in mind transparency and ethical standards), therefore create Terms of Reference and openly advertise (share via email, put on EKLIPSE website, but also send to potential candidates that have been identified)	Job advertisement out in July, research assistant starting asap (August)	KCB energy, EKLIPSE secretariat
Put in pace an "EWG" with limited tasks/duration (e.g. a couple of work hours remote prior to and after the workshop + workshop participation) → no call for experts, but identification of individual workshop participants by the scoping team and the research assistant	Identification of and contact to experts starting late summer (August/ September), workshop preparation	EKLIPSE Secretariat, KCB Energy, Research assistant
Workshop: Group discussion with EWG → prior to this the research assistant sends the list of terms to the participants for individual (remote) feedback → during the WS group discussion of models	October/November	Research assistant, KCB Energy and EKLIPSE Secretariat to prepare the WS, EWG as WS-participants
Feedback to the requester on interim results (that will be further elaborated) that can be fed into the Global SDG Report → EWG to create summary of outcomes from the WS → EKLIPSE Secretariat to provide summary as feedback to the requester	November (after the WS)	EWG, KCB Energy, EKLIPSE Secretariat

→ virtual meeting with the requester to discuss the results and the further process (outputs)		
Elaboration of the results to feed into the Global SDG Report, including: → some framing on the policy relevance (text) → model/matrix developed in the workshop → some examples for specific interactions/trade-offs (short texts)	September – late November/early December	Research assistant

ANNEX 5: EKLIPSE energy request: draft methodological protocol v2-04.07.2018

Prepared by Miriam Grace, with input from Lynn Dicks, Marianne Darbi, Rania Spyropolou and Heidi Wittmer

Summary

We recommend an expert consultation approach with aspects of Fuzzy Cognitive Mapping and Delphi process to address the request. The outputs will consist of a diagrammatic conceptual model of the interlinkages between EU energy policy efforts and sectors, focussing on trade-offs and synergies with the SDGs.

Workflow

Twelve individuals/institutions were identified in the Document of Work as likely possessing relevant expertise to address the request. We would suggest aiming to contact 30 people, due to likely attrition. We anticipate that it would be challenging to identify a larger number of participants, as well as to condense and integrate the resulting models. A snowballing method may be used to increase the number of participants, i.e. asking for further recommendations from contacted individuals. It would also be useful to circulate a call for recommendations within the entire EKLIPSE consortium.

We propose the use of a fuzzy cognitive mapping procedure including elements of a Delphi approach, in which individual experts prepare influence diagrams which are then dicscussed, revised and combined. This will be implemented either through a workshop, or remotely. The steps involved in the workflow are summarised in Figure 1.

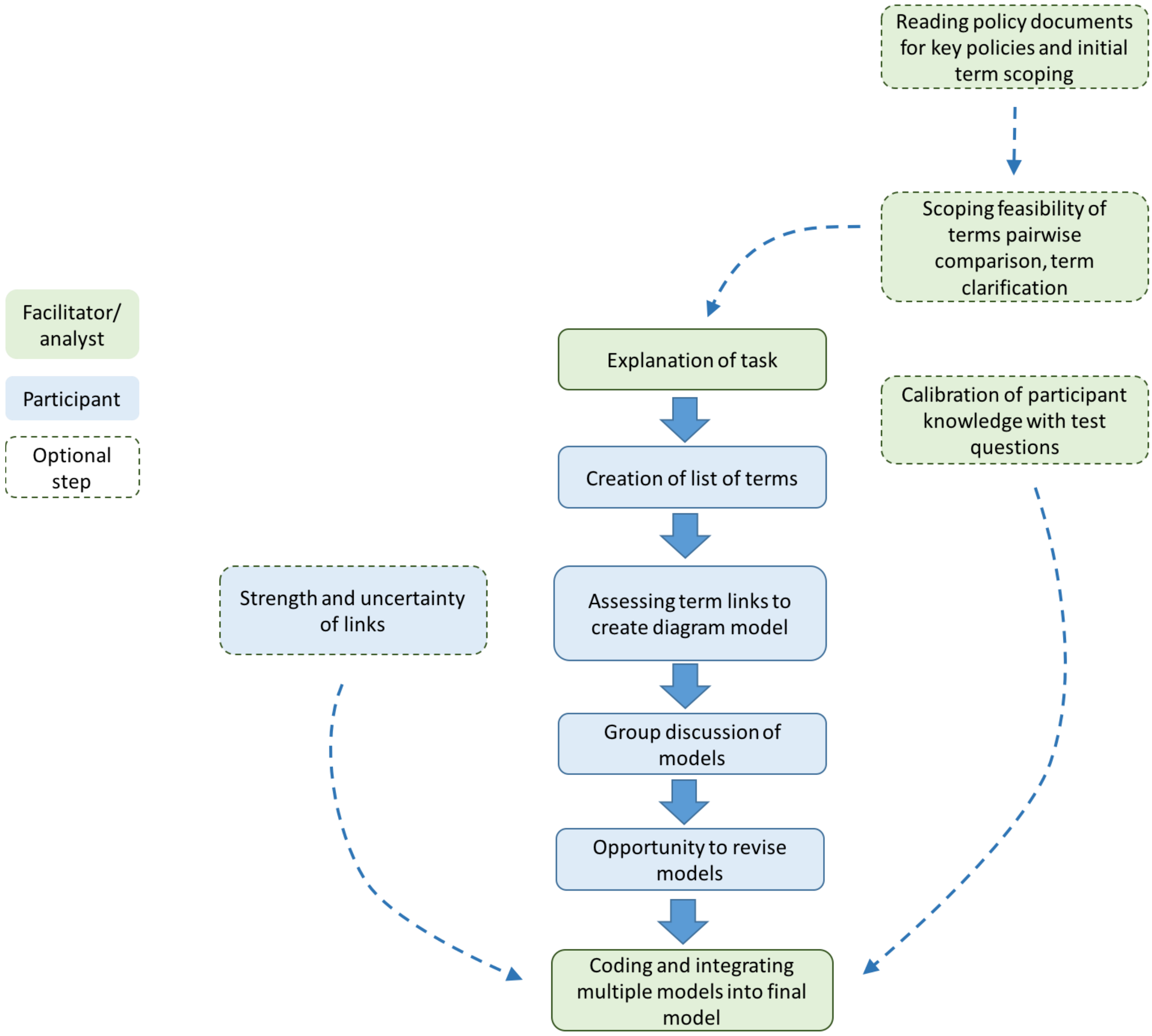


Figure 1: The proposed method is an iterative expert-based consultation to produce a conceptual model diagram of the interactions of EU energy policies on SDG targets and overseas biodiversity.

In the first step, the analyst will identify key EU energy policies from relevant policy documents, as well as the DoW. This is considered important to ensure that the knowledge of these policies, considered highly specialised, is adequately represented in the final diagram. Further, this step will facilitate the preparation of a list of terms as part of the feasibility scoping step. These terms will capture concepts from, broadly speaking, the policies concerned, the techologies involved, the biodiversity impacts, and the SDGs affected. To reduce the challenges likely to arise from integrating multiple models in later steps, the analyst will perform a process of clarifying the types of term which will be elicited from the experts. The goal will be to ensure that elicited terms fall into well-defined categories, e.g. separating processes from outcomes. This could be done by producing a first draft of the conceptual model, with the components discussed within the working group. We suggest the hiring of a research associate on a short-term contract, to carry out this step and contribute to further facilitation and analysis.

The construction of the conceptual model can be done either through first producing a list of key interacting terms, and then systematically assessing the links between each of these, or through freehand drawing of links between terms. It has been shown that pairwise comparison of terms yields more complex and exhaustive maps than freehand drawing of links (Hodgkinson et al 2014). However, with a large number of terms, pairwise comparison becomes complex and time-consuming, leading to likely participant fatigue (e.g. 10 terms have $10^2 = 100$ possible interactions which must be scored). Therefore, we suggest a feasibility scoping step in which the analyst identifies a preliminary list of terms. If the resulting number is reasonably small, a pairwise comparison approach will be used. Otherwise, a freehand drawing approach will be used. We also suggest exploring the applicability of the programs available to facilitate FCM, such as Mental Modeler (http://www.mentalmodeler.org/) (Gray et al 2013, Gray et al 2015).

In the next step, the facilitator will prepare a short introduction to the task, including its conceptual scope and practical details. This will be provided to the participants, together with a list of the exploratory questions identified in the DoW to prompt consideration. These questions must be carefully assessed to avoid the influence of ambiguity in phrasing, which could affect results. Any terms which remain ambiguous must be defined.

The facilitator will then ask the individual participants to identify key terms, possibly followed by the linkages between each of them (depending on whether the method chosen is pairwise comparison or freehand/software drawing), and to use this information to construct a conceptual model diagram. This could be done either remotely, in person for all participants in parallel, or in small groups. The parallel in-person approach would require a large number of facilitators. The group approach increases the likelihood that group dynamics will affect the outcome.

The linkages will be coded using a scoring system based on Fuzzy Cognitive Mapping, assigning each linkage a score between -1 and 1. This allows an assessment of the type of effect (positive or negative) and its strength. After the completion of the diagrams, the facilitators will identify the key similarities and differences across them. They will highlight these to the participants in a discussion session, where the participants have the opportunity to engage with each other and build on each others' work. This aspect would be most suited to a workshop structure; this would be easier to facilitate, could reduce attrition, and provide an incentive for participation. However, this step could also be carried out remotely by circulating all the diagrams to the participants. This would allow anonymity of the participants, which is one of the essential components of the Delphi process. The discussion will be followed by another individual session in which the participants can choose to revise their diagrams, allowing for a degree of consensus-building and knowledge-sharing.

Differences in participant knowledge and levels of uncertainty about terms or linkages could be corrected for in a number of ways. One of these is Cooke's method, in which expert outputs are weighted through calibration with relevant test questions to which the answers are known. These questions would be prepared ahead of the workshop and carefully assessed to reflect appropriate domain knowledge. Another approach would be the addition of a confidence value to each of the linkages, estimated by the participant.

The Fuzzy Cognitive Mapping methodology offers techniques that allow for transparent and systematic integration of maps produced by multiple participants (see e.g. Jetter & Kok 2014). For each map, the variables and their relationships can be represented in an adjacency matrix. Integrating maps presents challenges including variations in concepts. One approach to tackle this would be asking participants to suggest synonyms for the terms they include, allowing for easier comparison across participants (Smithin 1980). We also hope to minimise this issue through the preliminary term clarification step. In addition, the final integrated map can then be simplified to focus on the most generally agreed components. This will be undertaken by the analyst. A term's importance in the system can be assessed via the strength of its relationship to other terms, through network centrality measurements; other graph theoretical approaches could provide additional insights (Özesmi & Özesmi 2004).

The final diagram will provide a consensus overview of participants' knowledge of the expected interactions of EU renewable energy policies with SDG targets and, in particular, biodiversity and ecosystem services overseas.

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ANNEX 6: Terms of Reference/service description for the research assistant

Service description

As part of the project " EKLIPSE - Establishing a European Knowledge and Learning Mechanism to Improve the Policy-Science-Society Interface on Biodiversity and Ecosystem Services" (Call: H2020-SC5-2014-2015, Topic: SC5-10c2015A), the Helmholtz-Centre for Environmental Research GmbH – UFZ plans to award a contract to support the elaboration of a request facilitated by EKLIPSE entitled "How are European energy policies affecting biodiversity and ecosystem services in countries globally?" in developing a model of the impacts of EU energy policy on biodiversity and Sustainable Development Goals targets, with a focus on overseas effects.

1. Background

While a renewable energy transition is essential for decarbonisation, it has documented effects on marine ecosystems, avian biodiversity, competing land use for food production, habitat loss and deforestation (i.e biofuels), with potential spill-overs beyond EU territorial boundaries. Other trade-offs may occur such as manufacturing hazards due to growing demand for extractive resources needed to produce batteries and solar panels. Both conventional and renewable energy sources have impacts on biodiversity and ecosystem services globally. This is a controversial topic, featured in many political debates; a key example is whether an increased role for nuclear energy and hydropower is justified by the likely pressure on landscapes, biodiversity and ecosystems in Europe and beyond. The costs and benefits of opting for renewable energy, in comparison to the opportunity and other costs of renouncing conventional sources, need to be better understood through synthesizing existing knowledge and case studies.

The request builds on the Global Sustainable Development Report currently being drafted (GSDR 2019). The GSDR 2019 will address various perspectives of the Sustainable Development Goals, analyzing a way in which the GSDR 2019 can help policy members in achieving their agendas, and how to acquire higher policy coherence.

The scientists mandated to draft the GSDR 2019 seek a better understanding of the telecoupling effects of the EU's low carbon energy policy on biodiversity and ecosystem services in countries globally, from an SDG perspective through two questions:

1- What are the SDG targets that the EU energy policy tries to pursue (also indirectly) and what are the systemic trade-offs and co-benefits that are created beyond the territorial boundaries, where, at what scale, and who are potential affected winners and losers?

2- What policies and governance mechanisms could remedy these impacts; or in hindsight, how could one have chosen pathways to more sustainable development?

This information will be used to feed into the science-policy interface of the GSDR to inform policy.

2. Goal of the contract

We are looking for a short-term research assistant (consultant) for an honorary contract. The ideal candidate must have proven research and collaboration skills, and an interest in EU environmental policy and sustainable development. The successful candidate will contribute to the elaboration of a request facilitated by EKLIPSE entitled "How are European energy policies affecting biodiversity and ecosystem services in countries globally?” in developing a conceptual model[2] of the impacts of EU energy policy on biodiversity and Sustainable Development Goals targets, with a focus on overseas effects.

The successful candidate will be a key member of a team developing a conceptual model of the impacts of EU energy policy on biodiversity and Sustainable Development Goals targets, with a focus on overseas effects. The role will combine policy analysis, organising a consultation exercise in the form of a workshop, and analysing the results for publication. The candidate will work closely with project partners at the University of East Anglia and UFZ, who will provide supervision.

The key task will be to construct a draft graphical model of these interactions, which will be used and refined in the subsequent expert/decision-maker consultation approach (at a workshop) to obtain the final model. The initial step will be to collate and analyse policy documents relating to the EU 2030 and 2050 Energy Strategies[3,4]. A list of key policies, essential concepts and processes will be identified from these, and their interactions assessed in terms of strength and direction. These will be represented in the draft model in the form of a conceptual map. This will inform the protocol for the consultation exercise, and the candidate will then contribute to organising this task. The expert participants will be guided to create individual models which will be integrated into the final model. The candidate will contribute to analysing the findings, and preparing the results for publication as an EKLIPSE report, and potentially other outputs.

3. Tasks and timeline

tasks	duration	Work capacity (in %)	description
1	09/2018	40%	4) Analyzing the EU energy policy with a focus on the four main routes of the EU Energy Roadmap (energy efficiency, renewable energy, nuclear energy, and carbon capture and storage) ○ Collating and analyzing relevant documents ○ Coding policy interactions using the SDG targets ○ Identifying the essential concepts and processes and creating a list of terms 5) Contribute to constructing a draft model of the impacts of EU energy policy on biodiversity and SDG targets in the form of a conceptual map
2	09-10/2018	40%	6) Contribute to organising the consultation exercise with experts (participants) ○ Preparation: identification of and communication with the participants (approx. 25), development of agenda, organising logistics of meeting; ○ Execution: organisation of the consultation exercise (workshop in October), note taking ○ Follow-up: write-up of the consultation exercise

[2] After, e.g. Özesmi and Özesmi (2004) https://www.sciencedirect.com/science/article/pii/S030438000300543X
[3] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2050-energy-strategy
[4] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy

3	10-11/2018	20%	7) Contribute to analysing the findings 8) Integrating the participants' resulting individual models into the final model, guidance will be provided 9) preparing the results for publication

4. Deadline for execution

The above services are expected to be provided between 01 September 2018 (latest starting date) and 30 November 2018.

5. Form of delivery of the contract for work and services

The following are to be supplied:

10) draft model in the form of a conceptual map (in appropriate digital format)
11) organization of the consultation exercise
12) preparation of results in text form (in digital format)

6. Requirements for the contractor

Essential

- Knowledge of the EU environmental context, including familiarity with EU institutions.
- Ability to contribute to high-quality scientific outputs, e.g. academic articles or technical reports
- Experience of working with technical scientific or policy documents
- Experience of collaborative project work
- Fluency in English
- Experience of working in international teams
- Experience of organising or facilitating workshops

Desirable

- Experience of working with EU environmental policy, ideally in energy or biodiversity
- Postgraduate qualification in a relevant field, e.g. sustainable development, ecology or conservation, international relations, environmental law, data science, etc, or equivalent experience
- Experience of preparing material for scientific publications
- Experience of network analysis and/or knowledge synthesis approaches
- Experience of public engagement and/or interacting with decision-makers
- Experience of working with the UN Sustainable Development Goals
- Coding skills in R or Python, or similar
- Experience of project management
- Experience of statistical data analysis

Potential candidates should send their offer to secretariat@eklipse-mechanism.eu including a brief CV focusing on the experience needed for the contract as well as a brief description of motivation (max 1/2 page) targeting why they think they could fulfill the tasks at hands for this contract.

[i] Further information on the Global Sustainable Development Report 2019 is available at https://sustainabledevelopment.un.org/globalsdreport/2019