

UKERC Technology and Policy Assessment

Energy pathways and valuing natural capital

Scoping note

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The UK Energy Research Centre

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The Technology and Policy Assessment (TPA) Theme of UKERC

The Technology and Policy Assessment (TPA) was set up to inform decision-making processes and address key controversies in the energy field. It aims to provide authoritative and accessible reports that set very high standards for rigour and transparency. Subjects are chosen after extensive consultation with energy sector stakeholders and upon the recommendation of the TPA Advisory Group, which is comprised of independent experts from government, academia and the private sector.

The primary objective of the TPA is to provide a thorough review of the current state of knowledge. New research, such as modelling or primary data gathering may be carried out when essential. It also aims to explain its findings in a way that is accessible to non-technical readers and is useful to policymakers.

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1. Introduction

The UKERC technology and policy assessment (TPA) team was set up to address key controversies in the energy field and to provide authoritative inputs to decision-making processes through accessible and credible reports that set very high standards for rigour and transparency. The TPA team has been part of UKERC since the centre was established in 2004 and is now in its third phase, which started in 2014. The aim of the TPA is to conduct systematic reviews of literature, as well as some primary research and wider stakeholder engagement.

In Phase III of UKERC the team will be developing a new methodology for rapid evidence reviews and future work from the TPA will have more emphasis than previously on support for and integration with the UKERC research programme. There will be support for and integration with other UKERC research themes, the wider energy research community and external organisations. The methodological lessons that emerge from this project will help inform the TPA team's approach to Rapid Evidence Reviews during Phase III.

2. The subject of this TPA project

Introduction: the subject and its importance

Ecosystems can be thought of as functional units composed of the complex network of interactions between organisms and the environment, and among organisms themselves (Millennium Ecosystem Assessment 2005). These interactions produce and provide energy, cycle nutrients, store and release carbon, and through such processes provide ecosystem services that benefit humanity (Mace, Norris, and Fitter 2012; Millennium Ecosystem Assessment 2005). The term “ecosystem service(s)” is used throughout this scoping note as a general term that encompasses this pathway from ecological processes to the delivery of benefits to human society (Mace, Norris, and Fitter 2012). Ecosystem services are often divided into categories that include provisioning services (e.g. food and fibre), regulating services (e.g. climate regulation, flood prevention), cultural services (e.g. recreational or spiritual value), and supporting services (e.g. nutrient or water cycling) which underpin the delivery of all others (Millennium Ecosystem Assessment 2005; Haines–Young and Potschin 2012).

The idea that ecosystem services are essential for human well-being is increasingly embedded in policy at local, national and global scales (Daily and Matson 2008; Gomez–Baggethun and Ruiz–Perez 2011). Over the last decade a number of major studies have indicated significant declines in the health of many ecosystem services. Globally, the Millennium Ecosystem Assessment (MA) identified that around two thirds of the Earth’s ecosystem services are in decline or threatened due to overexploitation (Millennium Ecosystem Assessment 2005). Similarly, the UK National Ecosystem Assessment (UK NEA 2011). reports a decline in the provision of many ecosystem services over the last few decades. For a few services this trend is reversed, with crops, livestock and timber production all seeing a dramatic increase in production driven by intensive farming and the adoption of modern production techniques (Millennium Ecosystem Assessment 2005; UK NEA 2011).

To better understand provision of ecosystem services in the future, studies such as the UK NEA and the MA have developed a series of scenarios (Haines–Young et al. 2011; Millennium Ecosystem Assessment 2005) that explore drivers of change and implications for the delivery of ecosystem services across a range of possible futures. The aim of such scenarios is not to make predictions, but rather to provide a tool to engage with stakeholders and develop responses to challenges that the scenarios raise (Haines–Young et al. 2011).

Scenarios have also been widely used in the energy domain to explore alternate future pathways of energy system change. During UKERC phase 3, the pathways research theme will develop and analyse a wide range of energy system pathways for the UK, including pathways that do not comply with official energy and climate policy targets

(especially the 80% emissions reduction target for 2050). A major part of this work will be to explore fully the whole systems dimensions of these pathways. The research proposal outlined in this scoping document represents the first stage in this whole systems analysis. It seeks to build a link between energy pathways and ecosystem service scenarios, to understand interactions between the domains, and to provide information that will allow scientists and policy makers to consider the implications of energy systems for ecosystem service provision and vice versa.

3. The Research Question.

The review is structured around one central research question: **To what extent are energy and ecosystem scenarios consistent and comparable?** The approach to answering this overarching question can be broken down into a number of constituent parts.

Firstly, relating to the evidence base that exists;

a) **What ecosystem services scenarios have been published?** Using a systematic approach we will identify studies that have considered scenarios relating to ecosystem services in the future in the peer review and grey literature.

b) **What energy scenarios have been published, and what are their key drivers and features?** This will be informed by the ongoing parallel review being undertaken through the UKERC pathways theme.

Secondly, to examine the relationship between energy and ecosystem service scenarios;

c) **What are the commonalities and differences between scenarios?** For example time horizon, geographic region, use of common data such as energy models, or development of scenarios based on shared assumptions about social, economic, technological and environmental drivers.

d) **To what extent is there consistency between scenarios of energy system and ecosystem services?** Having identified commonalities between scenarios is it possible to cross-link scenarios from the two domains? Where information is available are the scenarios internally consistent in terms of energy pathways and implications for ecosystem services?

e) **If there is inconsistency to what extent does this affect the lessons that can be drawn from the scenarios?**

Having identified and created cross-linkages between scenarios, are any reliant on energy pathways that are not consistent with the described ecosystem service scenario? For example conservation/environmentally focussed ecosystem services scenarios that are reliant on energy generated through carbon intensive pathways.

Finally, to guide the whole systems analysis of UK energy systems;

f) What are the recommendations in the light of the evidence base for integrating ecosystem services in energy pathways? Given the number of groups that have produced energy scenarios in recent years, an outstanding question for the pathways theme of UKERC phase 3 is whether there is a need to produce further energy scenarios or to build on existing work. Based on the review of existing ecosystem service scenarios and the elucidation of links with existing energy scenarios, a major aim of this research will be to consider the best way that ecosystem services can be integrated into UKERC pathways. Specifically; (i) is there a need to produce a set of new ecosystem service scenarios based on emerging energy pathways; (ii) can existing ecosystem service scenarios identified in this review be readily integrated; or (iii) is a combined approach utilising existing ecosystem service scenarios with additional scenario development most appropriate.

g) How will this inform UKERC phase 3 research and beyond? Based on the answer to (f), what are the research needs for the UKERC pathways theme that can then inform the first challenge project and UKERC interaction with other energy system and ecosystem work (e.g. SPLiCE)?

4. Scope of the project

Ecosystem services

The focus of the research will be on identifying those studies that have explicitly developed ecosystem services scenarios. During the initial phase the scope of the search will be designed to capture other environmental scenarios of relevance. For example scenarios of future land use change, biodiversity etc. that represent drivers of change that could influence the provision of ecosystem services. During the initial phase of the review we will assess the number of such studies that exist and make a decision on the feasibility of including them.

To order studies it will be useful to apply a consistent ecosystem services classification to allow easy cross comparison. The Millennium Ecosystem Assessment and UK NEA divide ecosystem services into four broad categories; supporting, regulating, provisioning and cultural services. In the current study we propose to use The Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin 2012) as the framework. This system has been developed to support work on environmental accounting within the European Union and the United Nations Statistical Division (European Commission. et al. 2014; European Commission et al. 2013). A major difference between the MA and CICES classification is that the latter omits supporting services that are taken as intermediate steps in the delivery of final services (Haines-

Young and Potschin 2012). CICES was also used in UKERC Phase 2 for review of ecosystem service impacts of energy production (Papathanasopoulou et al. 2014).

Geographic scope

Initially the scope of the project will be global. However, given that the geographic focus of UKERC is the United Kingdom, the scope will be refined to capture studies that consider this region and other regions that can be considered to be analogous, specifically the EU and USA. Note will be taken of any contextual factors that may affect transferability of evaluation results to the UK context.

5. Proposed Approach

The research will be conducted using a Rapid Evidence Assessment (REA), defined as “a short but systematic assessment on a constrained topic” (GSR 2013). REA’s have been designed to maintain the rigour of a full systematic review, but to deliver results rapidly within constraints imposed by cost and time (Hailey et al. 2000; Khangura et al. 2012).

The proposed approach follows the procedures established in previous TPA assessments, which are directly comparable to established protocols for conducting REAs (Collins et al. 2014). As such the REA will involve the following steps:

- Publication of this scoping note on the UKERC website;
- Convening an Expert Group, representing a variety of opinions and perspectives, to advise the project team; this will be carried out through a streamlined consultation process (i.e. using electronic consultations rather than meetings).
- A systematic search of a clearly defined evidence base using keywords;
- Categorisation, prioritisation and analysis of the evidence, including an appraisal of methodological quality;
- Drafting of a report;
- Expert feedback and peer review of this draft report;
- Publication and dissemination through appropriate mechanisms.

Identifying Evidence

Evidence will be identified through keyword searches of a number of databases (Table 1) using Boolean combinations of relevant terms (Table 2). Given the scope of the study as a rapid evidence assessment, keywords initially the general ecosystem services keywords identified in Table 2 will be used in the search terms. Depending on the number of returned studies this may then be broadened to include individual provisioning, regulating and maintenance and individual cultural service specific keywords.

Returned results will firstly be filtered for relevance based on their title. Following this first stage filtering the full text of retained search results will be retrieved and a second stage of filtering conducted. During this second filtering stage the sole criterion for inclusion will be that the study considers ecosystem service or environmental scenarios.

Following the second stage of filtering of retained search results key descriptive information of each of the results will be captured, namely: (i) the ecosystem service(s) considered; (ii) the time horizon and; (iii) the geographic region. Depending on the number of references retained it may be necessary to constrain the scope of the study to ensure that the work can be completed within the time constraints of the REA. Given that the UK is the primary area of interest, geographic descriptor will be used to constrain the number of studies. Here a tiered approach will filter studies for inclusion such that (i) all studies are retained, (ii) studies focused on the USA and EU are retained, (iii) solely EU (including UK) focussed studies are retained, (iv) solely UK focussed studies are retained. We will conduct an initial exercise to ascertain the time taken to analyse a study and then choose the appropriate geographic filter.

Table 1: Proposed databases to be used in the literature search

Database	URL
Elsevier Science Direct	http://www.sciencedirect.com
Thompson Reuters Web of Knowledge	http://wok.mimas.ac.uk/
Open Grey	www.opengrey.eu

Table 2: Preliminary keywords identified for use in the search terms. Initial literature search will be performed using Ecosystem service keywords under the general heading. Depending on number of reference returned the search may be broadened to include service specific keywords (categories indicated in italics).

Ecosystem service keywords	Scenario keywords
<i>General</i>	Scenario
Ecosystem service	Future
Natural capital	Storyline
Land use	Pathway
Landuse	
Biodiversity	
Provisioning	
Regulating	
Supporting	
Cultural	
Ecosystem	
<i>Individual provisioning</i>	
Livestock; food; fibre; Pasture; Forage; Fisheries; Fish, Aquaculture; Fish; Timber; Forest; Forestry; Fungi; Bees; Honey; Water quantity; Water availability; Flowers; Horticulture	
<i>Regulating and maintenance</i>	
Carbon; Greenhouse gas; Nitrogen; evapotranspiration; albedo; Erosion; Flooding; Pests; Disease; Pollination; Pollinators; Bees; Primary productivity; Soil; soil cycling; Nutrient cycling; Carbon; Noise Particles; Ozone; Ammonia; Nitrogen; Sulphur; Air quality ; Eutrophication; Water quality; Seed dispersal; Soil formation; Dissolved organic carbon; DOC; weathering; Nitrogen cycle: nitrogen; mineralisation; phosphorous; river; water cycle; lake; Groundwater	
<i>Individual cultural</i>	
National parks; protected areas; spiritual; Community; cultural; heritage; Landscape; national parks; protected areas; Human health; health Leisure; tourism; national parks; protected areas; recreation; Education; Sacred; Charismatic	

Data extraction strategy

For the retained search results a recording sheet will be used to capture data under the provisional headings described in Table 3. The aim of this process is to identify commonalities and differences between scenarios. This is a provisional list of core information that will be captured, however it may be necessary to adapt it during the review process.

Table 3: Data to be captured in the study review process

Heading	Description
Metadata	Author, year, title
Purpose	Brief description of the aims of the scenario development
Geographic region	To spatially locate the study and so understand relevance to UKERC. Standardised using International Standard ISO 3166-1
Time horizon	The temporal window of the study.
Method	Method used to construct the scenarios.
Ecosystem services classification used	The nomenclature of ecosystem services considered. This will then be cross walked to the standard classification (see below).
Ecosystem service	The service or services considered in the study. Standardised nomenclature using CICES
Ecosystem service data	Underlying datasets and models used in scenario development
Energy	Whether energy systems are explicitly considered
Energy data	Underlying datasets and models used in scenario development

In addition to the data captured in Table 3, studies will also be scored based on their relevance and robustness. This is an important step in any REA (Collins et al. 2014). Provisionally scores for relevance will be based on the geographic region, the number of ecosystem services considered, and inclusion of energy (Table 4). Provisional scores for robustness will be based on the approach used within the ecosystem service and energy categories used to inform the development of scenarios (Table 5) Both Collins et al. (2014) and the Collaboration for Environmental Evidence (2013) provide guidelines for assessment. As detailed by Collins et al. (2014) scores for these two elements, robustness and relevance, can be combined to provide an overall weighting for each piece of evidence. One approach is to use a matrix to combine the sum of the score for relevance and the sum of the score for robustness. For example in our proposed scoring system (see Table 4 and 5), studies of low quality may score 3 (1 + 1 + 1) for relevance and 3 (1 + 1 + 1) for robustness giving an overall quality score of 9 (3 x 3). High quality studies may score 9 (3 + 3 + 3) for relevance and 9 (3 + 3 + 3) for robustness giving an overall quality score of 81 (9 x 9). As this approach will create a large range in the scores final assessment of the quality of evidence could be based on ranking of the

scores across all studies considered. As data are extracted this scoring procedure will be refined.

Table 4: Provisional scoring criteria for relevance of studies to UKERC Pathways project.

Category	Criteria	Score
Geographic region	World	1
	USA or EU	2
	UK	3
Ecosystem services	1 service	1
	2–5 services	2
	6+ services	3
Energy	Little detail of energy systems	1
	Moderate detail of energy systems	2
	High detail of energy systems	3

Table 5: Provisional scoring criteria of robustness of studies.

Category	Criteria	Score
Ecosystem service and energy	Either little information on methods used for development of scenarios limiting our ability to assess robustness of approach or significant limitations identified in the approach.	1
	Robust approach that is well documented. However, there are identifiable weaknesses in study (e.g. small pool of experts).	2
	Robust and clearly documented method likely to produce rigorous outputs. Study represents best practice.	3

The completed recording sheet will then be used to identify commonalities and differences between ecosystem service scenarios (addressing questions c–e Section 3 above). Data on the energy scenarios or models that underpin the ecosystem services scenarios will enable us to create cross linkages with the other pathways project that is specifically examining energy scenarios. This integration will inform our analysis of questions f and g (Section 3).

6. References

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