

## **WORKSHOP 4:** Metrics for a holistic assessment of natural capital in energy pathways

Summary report on the fourth in a series of four project workshops. Held at Careys Manor, Lyndhurst Road, Brockenhurst, Hampshire, SO42 7RH  
28<sup>th</sup> - 29th September 2016.

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## The ADVENT Project

ADVENT (Addressing Valuation of Energy and Nature Together) is a 5 year research project funded by NERC as part of the RCUK Energy Programme. It involves a consortium of seven partner institutions and aims to develop conceptual frameworks and modelling tools to integrate the analysis of prospective UK energy pathways with considerations relating to the value of natural capital. This will include quantifying the implications of differing future UK low-carbon energy pathways for stocks of natural capital (e.g. groundwater and natural habitats) and for the provision of ecosystem services (e.g. irrigation, visual amenity, recreation). In addition, the project will compare the outcomes of different methodologies to value changes in ecosystem services and provide guidelines regarding the application of such approaches. Ultimately, the project seeks to provide both public and private sector decision makers with tools that allow them to take a whole-systems perspective on energy futures in a way that better integrates energy and environmental considerations.

## ADVENT Workshop Programme – Background and Aims

This workshop is the fourth in a series of four that take place as part of Work Package 1 (WP1) of the ADVENT research programme. These workshops will establish the baseline of existing knowledge on which the programme needs to build, extending and combining existing conceptual frameworks and making key decisions regarding the energy pathways and appraisal mechanisms to be investigated further.

These reviews and discussions will build upon the experience of the partners in previous and ongoing projects (e.g. UKERC, VNN/VNP, NEA/NEAFO and SPLICE). The objective is to build upon recent reports that cover future energy pathways being developed elsewhere, for example, options discussed in the Committee on Climate Change (CCC, 2015) 5th Carbon Budget Review, annual National Grid reports (e.g. National Grid, 2015), the UKERC study on the future role on natural gas in the UK (McGlade *et al.*, 2016) and those currently being developed in the pathways theme of UKERC Phase 3. The selection of pathways will also be important in terms of identifying the generation technologies and other changes that need to be evaluated in subsequent phases of the research. This, in turn, will have implications for the modelling tools required, the issues associated with integrating them and the types of outputs generated.

The workshops in WP1 will examine the following topics:

- i) conceptualising the role of energy in ES and natural capital frameworks and developing these as necessary,
- ii) approaches to modelling and option appraisal in the energy and valuing nature communities,
- iii) the 'state of the art' regarding UK energy pathways through to 2030/2050, and
- iv) metrics for a holistic assessment of natural capital in energy pathways.

## **Workshop 4: Metrics for a holistic assessment of natural capital in energy pathways**

### **Workshop Aim**

The ADVENT project will produce a wide and varied range of outputs, from national level quantitative model outputs to transcripts of discussions with local stakeholders. These outputs all have a role in informing how to tackle the challenge of Addressing the Valuation of Energy and Nature Together (ADVENT). This workshop aims to explore how to incorporate all types of information to provide valuable policy advice, including exploring how to make meaningful comparisons between different pathways when energy and environmental implications are measured in different units and at different temporal and spatial scales.

### **Key questions**

1. What will the ADVENT research outputs be in terms of indicators, units and metrics: for example, what sort of metrics are used to assess generation capacity, profile of supply, cost of supply? (e.g. GHG emissions / MWh, CCC reports); what metrics are available from the ecosystem services research? (e.g. DEFRA state-of-the-environment measures).
2. What sort of resolution can metrics be generated at (spatial/temporal)?
3. Are some metrics more important than others? Can we prioritise? Which metrics will the users require?
4. Can we adapt the outputs of the qualitative research to fit into the quantitative models?
5. How is uncertainty addressed in the different outputs?

### **Workshop outputs**

A range of outputs is expected from the ADVENT research, including the research undertaken in WP5, the modelled outputs of WP6 and 7, and the PhD student outputs. To enable our discussion an integrated matrix of results will be produced including –aims, methods, indicators, outputs (metrics / units), and potential users, from all the ADVENT research. A key output from this workshop will be the completion of a matrix of this information to enable clarity in our discussions of how to then integrate these outputs.

To support the workshop discussion the following essential reading list was circulated to participants in advance of the meeting.

Economics for the Environment Consultancy Ltd, RSPB, PwC (2015) Developing Corporate Natural Capital Accounts. Final Report For the Natural Capital Committee January 2015

<https://www.cbd.int/financial/values/uk-corporatenatural.pdf>

DEFRA (2015) England Natural Environment Indicators, 23 July 2015 (DEFRA)

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/447576/England\\_Natural\\_Environment\\_Indicators\\_2015.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447576/England_Natural_Environment_Indicators_2015.pdf)

Matt Walpole Ecosystem Service Indicators: Lessons from Global and National Initiatives

[http://jncc.defra.gov.uk/pdf/ukindicators\\_bif5\\_PT\\_EcosystemServices-MW.pdf](http://jncc.defra.gov.uk/pdf/ukindicators_bif5_PT_EcosystemServices-MW.pdf)

CCC (2015) Committee on Climate Change – Adaptation Indicators

The Adaptation Sub-Committee is currently seeking views on a draft set of indicators that it intends to use to prepare its statutory report on the National Adaptation Programme in 2015.

<https://www.theccc.org.uk/charts-data/adaptation-indicators/>

World Bank (2011) *The Changing Wealth of Nations*. This book outlines WB methods for National capital Accounting including the calculations for valuing flows and estimating wealth stocks.

Mace et al. (2015) Towards a risk register for natural capital. *Journal of Applied Ecology* 52: 641-653.

López et al. 2014 Trade-offs across value-domains in ecosystem services assessment *Ecological Indicators* 37 (2014) 220– 228

## Workshop Participants

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## **SUMMARY OF KEY DISCUSSIONS**

### **Introduction**

This report provides an overview of the structure of workshop 4, the development of the matrix, and the associated discussions. The matrix is intended as a working draft document which will be developed throughout the project.

### **Presentations**

Four introductory presentations were given, as detailed in the agenda in Appendix 1:

- Introduction: The use of metric in the valuation of energy and nature together (Nicola Beaumont)
- Insights on handling non-commensurable data (Tara Hooper and Caroline Hattam)
- Knowledge Assessment Platform for the valuation of Energy and Nature together (KAPtEN) – (David Cutting)
- Implications for the TIM, output strategy (Brett Day)

To enable the completion of the matrix each WP and sub-WP lead prepared a 5 minute summary presentation of their outputs, specifically presenting on each of the following topics: Aim, method, indicators, outputs (including metrics/units), potential users, date of completion, scale/location, assumptions. The presentations are available online on the ADVENT dropbox, and are as follows:

WP5.1 – Lovett

WP5.2 – Taylor

WP5.3 – Hastings / Smith

WP5.4 – Ziv

WP5.5 - Pearson

WP5.6 – Hattam / Hooper

WP5.6 - Papathanasopoulou

WP6 – Day/ Agnolucci / Ekins

WP7 – Eigenbrod

### **Matrix Development**

The primary aim of the workshop was to complete the comparison matrix, including: Aim, method, indicators, outputs (including metrics/units), potential users, date of completion, scale/location, assumptions (see Appendix 2). This is a working draft document and will continue to be developed as the project continues.

Metric types included: wellbeing and market costs; Ecological diversity; GHG; Public acceptability; Water quality/quantity

### **Additional discussions**

The discussion relating to the development of the matrix provided a starting point for WP8 as we can begin to understand the complexity and variability of ADVENT outputs and consider how best to integrate these. It was also a helpful exercise to move us from our “deep-thinking” year into our more applied 3 year “bulge” period of primary research activity. The various discussion topics are grouped and listed below.

#### **i. Discussion of TIM**

The population and application of TIM was discussed in depth, particularly regarding non-commensurable metrics. An overview of the key points is provided below.

TIM enables the maximisation of economic value above a baseline of constraints. If data is quantified and spatial it can go into TIM, but it has to be the same units (e.g. welfare metrics) to be optimised. Optimisation is dependent on using the same units. Additional factors/indices (of different units) can be put in TIM and included as constraints. Constraints can include: GHG, water, visual dis-amenity, productivity, minimum biodiversity loss.

There was some hesitance about the need to put all non-commensurable data into one metric in order to populate TIM, with the key question being “should welfare maximisation be the driving metric?” This was accompanied by some caution about how to take into account qualitative information (such as interview transcripts). The need to provide policy makers with optimised outputs was questioned, as opposed to more broadly illuminating the trade-offs and letting the policy makers work out non-commensurable metrics. An alternative approach was suggested by Paul: use spatial models to map physical impacts under scenarios and then put in economic value where relevant and bring it together through, for example, normalisation and weighting (MCA). This approach of getting the cost optimal spatial location and then determining the environmental impacts doesn’t need TIM.

The crux of the discussion was to what extent we use TIM, with two options available:

- i. use TIM in a limited way and do not try and put all data into TIM
- ii. use TIM “properly” and make all commensurate

It was agreed that we should wait until later to make this decision – in part based on the outputs of the fast track analysis and it was agreed that we would need Lovetts input to the discussion, who was missing during day 1.

Additional discussion points relating to TIM included:

- i. Water quantities – not in TIM at the moment, could/should these be added?
- ii. Air pollution – also missing from TIM – Paolo raised that there is no air diffusion model, so very difficult to include
- iii. Constraints in TIM and how these will be chosen. All agreed on the need for hard constraints, but how we choose and handle softer constraints is problematic, GIS

overlay/expert knowledge? TIM would move softer constraints into the same metric to enable our understanding of the trade-offs. Three options for constraints: Productivity, minimum biodiversity loss, another (food production?). How radical the constraints should be was also discussed, for example could we explore building on National Parks? It is expected that the extent of this will depend on the pathways. It was agreed that we would risk plausibility if scenarios allow total loss of existing controls. Additional constraints could include: transmission infrastructure and costs. National Grid can provide quotes. Grid saturation constraints (e.g. SW (distribution network) and pinch points in Scotland (transmission network).

## ii. Discussion of spatial coverage

Pearson needs change data at 1km spatial resolution for WP5.5 biodiversity impacts to show up, related to NEA nine land-use categories. It was raised this may be difficult as bioenergy has gone in at field scale and patchily. It is recognised that there are smaller scale biodiversity changes which are important (farm scale), but there are no resources for considering in further depth for case studies. Felix suggested adding heterogeneity/scrubby stuff to landscape, finding data on how the proportion of scrub affects biodiversity and have sub-1km data in land cover data set maps – 20% scrub to 40%scrub – and look how these affect biodiversity. These sort of factors can be modelled to give a first approximation, but will need further thought (UCL/Southampton). Only makes sense at national scale, as too crude for very spatially explicit interpretation. Also analogies for Miscanthus. Note we are not attempting local scale and need something defensible at national scale. This issue of scale also applies to TIM (which uses 2km grid due to agricultural census constraints).

**Action: FE to write up proposed methodology**

It was queried what is meant by National coverage, is this GB? We can map energy resources for NI, but data (for e.g. constraint mapping) is not great. Andrew may be able to access EU datasets. The general opinion was to restrict to GB to save time in seeking (and potentially not finding) UK level. Although economic data is UK as a whole. However, NI could be useful internal resource for e.g. bioenergy.

**ACTION: AL to clarify at next teleconference**

Three WP will have case study sites, WP5.3 based in NE Scotland, WP5.6 based in North Devon, and WP5.4 to be decided in near future in communication with broader ADVENT group, especially WP5.6. In the case of the WP5.6 coastal typologies it may be possible to assume case studies are representative of the coastal typologies, transfer to national scale and put into TIM as sensitivity testing.

**ACTION: Pip and Guy to select case study sites in collaboration with PML and Aberdeen**

It was raised that it may be helpful to highlight case studies on website and/or glossy leaflet?

The spatial scales covered by ADVENT will thus be local (case studies), 1km, 2km, GB or National, and Global

### iii. Discussion of temporal coverage

There was a brief discussion of what time scale people are intending to use, both in terms of overall time scale and time slices. The WP have different temporal scales, from months to 2050. The UKTM models will provide 5 year time slices and there was general agreement that this should be adequate. The 2030 timeline for fast track analysis seems appropriate for the project more generally, although some discussion of 2050 may need to be revisited. There was some discussion of when the predicted energy systems will come on stream, e.g. when CCS would start and how quickly you can build it, and it was proposed that we investigate the National Grid scenario timescales to address this.

### iv. Other issues / AOB

- Delivery dates - The delivery dates in the proposal were designated independently of the PhD students. It is recommended to revisit the delivery dates in the proposal and confirm these, as some have been moved to be consistent with the PhD student timeline (e.g. some delivery dates were 2019, but are now 2020). The global analysis will be finished by 2017 but some resource (Kate/PhD students) should continue to be available after the fast track to ask questions on the global scale from the scenarios
- Bioenergy focus – it was raised that the project may be too heavily based on bioenergy. How do wider energy technologies fit within TIM with its heavy agriculture/land-use focus?
- Clarity on how people will use pathways would be helpful
- Pearson – could move timing of post-doc to fit overall project timescales. The integration of biodiversity and TIM was also discussed with two options available, firstly that WP5.5 simply uses the TIM outputs, or secondly that we aim for the integration of simplified biodiversity models into TIM (i.e. improving the tool). The latter was preferred.
- General enthusiasm for shared and open resources
- Query how we feed into Paolo- what data input does he need – water consumption (quantity), land diverted from crops
- There was a request for clarity on which environmental/natural capital impacts are being considered, in relation to which technologies/energy type and which part of their lifecycle (should transmission and decommissioning be included?).
- It was raised that we may be focussing too heavily on the negatives, and that we need to make sure positives of new energies are included. Need to characterise the counterfactuals

in some detail, and carefully construct reference scenario. No Reference scenario in the fast track. Carbon budget (legally binding) would be usual reference. It was suggested that we could include nuclear option / disaster to show potential environmental negatives, but agreed this would be too much and would swamp the research but recognition of this should at least be noted, for example by citing key statistics from Chernobyl, Fukushima.

### **Summary of Key Discussions**

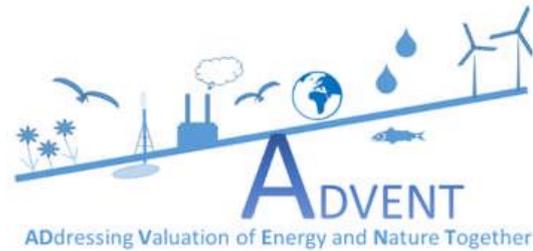
The development of an initial draft matrix was the key output for this workshop, but this process also led to valuable structured discussions of three keys aspects of the ADVENT Project: Use of TIM; spatial coverage; and temporal coverage.

### **Next Steps**

This document will be circulated to the group and the development of the matrix will continue throughout the project. This matrix development is anticipated to provide a key mechanism is maintaining the integration of the ADVENT project components.



## Appendix 1: Workshop 4 Agenda



### ADVENT Worksho 4 Agenda

#### Metrics for a holistic assessment of natural capital in energy pathways / indicators

Careys Manor, Lyndhurst Road, Brockenhurst, Hampshire, SO42 7RH

28<sup>th</sup> and 29<sup>th</sup> September 2016

**Dates:** 27<sup>th</sup> September (early arrivals) – 29<sup>th</sup> September 2016.

**Location:** Meeting to be held at Careys Manor, Lyndhurst Road, Brockenhurst, Hampshire, SO42 7RH. <http://www.careysmanor.com/> About a 10 minute walk from Brockenhurst Railway Station.

**Introduction:** This workshop examines two interrelated questions that will guide the development of research within the ADVENT (ADDrESSing Valuation of Energy and Nature Together) consortium. Firstly, what future energy pathways should the ADVENT consortium consider in order to explore the implications of energy choices for provision of environmental services? Secondly, how can meaningful comparisons be made for environmental services that are measured in different units and at different temporal and spatial scales? The resolution of these questions is central to producing outputs that are policy relevant and allow stakeholders to explore the environmental implications of different energy futures.

#### Workshop Agenda

<b>27<sup>th</sup> September</b>	Arrivals – after 4pm	
20.00 – 22.00	<i>Evening meal and chance for informal discussions</i>	Zen Garden
<b>DAY 1 – 28<sup>th</sup> September</b>	<b>Workshop 3: The ‘state of the art’ regarding UK energy pathways through to 2030/2050</b>	
9.00	<i>Tea/coffee arrivals</i>	Beech Room
9.30	How consistent and comparable are ecosystem services and energy system scenarios? Rob Holland	
09.45	Discussion of research questions (see briefing note)	
10.30	<i>Tea/coffee</i>	

11.00	Scenarios for energy post-2016	
11.45	Discussion	
13.00	<i>Lunch</i>	Cambium Restaurant
14.00	Discussion continues...	Beech Room
15.00	<i>Tea/coffee</i>	
	<b>Workshop 4: Metrics for a holistic assessment of natural capital in energy pathways</b>	
15.30	Introduction. The use of metric in the valuation of energy and nature together –Nicola Beaumont Insights on handling non-commensurable data – Tara Hooper and Caroline Hattam	
16.30	Knowledge Assessment Platform for the valuation of Energy and Nature together (KAPtEN) – David Cutting	
17.00	Free time for informal discussion and walks/bar. Why not try <a href="https://www.theguardian.com/travel/2009/jun/12/walk-guide-brockenhurst-hampshire">https://www.theguardian.com/travel/2009/jun/12/walk-guide-brockenhurst-hampshire</a>	
20.00 - 2200	<i>Evening meal</i>	Cambium Restaurant
<b>DAY 2 – 29<sup>th</sup> September</b>	<b>Workshop 4: Metrics for a holistic assessment of natural capital in energy pathways continued.</b>	
9.00	<i>Tea/coffee arrivals</i>	Beech Room
9.15	<i>Introduction to the day – Aim is to produce an integrated matrix of research results, including indicators, outputs (including metrics/units), users.</i>	
9.30	Presentations from each of the individual work packages on: Aim, method, indicators, outputs (including metrics/units), users.	
1100	<i>Tea/coffee</i>	
11.30	Completion and discussion of integrated matrix of results	
12.00	Implications for the TIM, output strategy Brett Day	
13.00	<i>Lunch</i>	Cambium Restaurant
14.00	Discussion of integration of ADVENT outputs	
15.00	<i>Afternoon Tea</i>	
15.30	AOB	
16.00	End	

## Appendix 2: Working draft Matrix 3<sup>rd</sup> Oct 2016

WP	Aim	Method	Indicator	Likely outputs Metrics / Units	Potential users	Date of completion	Scale/location	Assumptions
5.1	Identify location for energy structures for each pathway, given assumptions	GIS analysis	Site locations, generation capacity	GIS data layers for different pathways/siting assumption combinations	WP5 and WP6	May 2017	National and Point	The most important factors influencing location decisions are mapped
5.2	Deployment strategies for bioenergy with CCS query coverage of CCS	Integration of PROCESS BASED models for bioenergy and ?MODEL? nat cap which models??	GHG emissions, food production land take? Food production lost?	Kg CO2 eq, Tons food outputs from CCS? Or focus just on bioenergy?	Government business	Dec 2018 Yield maps by 2016, rest later by Casper 2020	UK, possibly global 1Kkm resolution	
5.3	Impacts of changes in energy efficiency and consumption patterns.: land use cost; generation cost; transport electrification;	Spatial models		MJ/ha - £, displaced Land Use	Other WP	As proposal – 2020 – PhD students. SEPA planning application for wind farms, industry (shell)	NE Scotland – to generate metrics to apply to UK	
5.4	Visual impacts – impacts of energy production systems and energy transmission (pylons) on public welfare	Hedonic valuation – viewshed tool, land registry, renewable energy planning database	Aggregated decrease in house price £ Aggregated loss of council tax income	Model Paper	Include in recreation model	July 2018	UK / GB  Recreation – England  Study sites - tbc	Usual hedonic related assumptions

<b>Lead</b>	<b>Aim</b>	<b>Method</b>	<b>Indicator</b>	<b>Likely outputs</b>	<b>Potential users</b>	<b>Date of completion</b>	<b>Scale/location</b>	<b>Assumptions</b>
5.5	Biodiversity metrics for measuring impacts of energy scenarios	<p>Sps distribution models coupled with demographic models – driven by climate and land use change</p> <p>Either take TIM outputs and run models, OR put simplified model integrated into TIM</p>	UK biodiversity indicators (Defra); Status of UK priority species (C4) and status of pollinating insects	<p>Distribution and abundances of priority sps</p> <p>Estimated change in relative abundance</p>		1 year of post doc in year 3	2050 UK 1km resolution	
5.6	Impacts and tradeoffs of MRE implementation	Building on NEA CES conceptual framework Photo elicitation Postal survey	Of CES Behaviour e.g. recreational use of sites Socio-economic indicators Tradeoff between MRE and CES	Images, narratives, quantified assessments, units of text	Marine planners, MRE companies, community energy groups	2018	Bristol channel – 3 case study sites on N Devon coast – some transferable. England MMO coastal typology	Photo elicitation and narratives non-generalizable Survey

5.6		Local I-O	Income, employment, output	£, FTE	Marine planners, MRE companies, community energy groups Local enterprise partnerships	2018	2050 3 case study sites in N Devon	Structural change will differ between case study areas
<b>Lead</b>	<b>Aim</b>	<b>Method</b>	<b>Indicator</b>	<b>Likely outputs</b>	<b>Potential users</b>	<b>Date of completion</b>	<b>Scale/location</b>	<b>Assumptions</b>
WP6	Decision support	Econometric model – three parts – agriculture, forest, recreation, agricultural carbon (cool farm), tree carbon, biodiversity, water quality		Agricultural output. Profit, £, timber output, visits, economic welfare £, GHG emissions, cost, bird diversity index, N and P concentrations	National / regional decision makers	finished	2km grid GB for agriculture and forest, for recreation – greenspace sites, 2km river stretch.	Profit maximisation Utility maximisation
WP6 – Production of indicators	Effect of biofuel mandates / uptake on food price	Demand and supply model	Impact of biocrop on food prices				National – crop by crop	
	How constraints on water availability impact GAV from industrial activity	Production function at industrial sub-sectoral level	Impact of water shortage on industrial GVA				National ; industrial sub sectors	
WP7	Overseas foot print of energy choices	Environmentally extended MRIO STATIC	Biodiversity, food, water resources ,GHG	Number of species, threats, tons or £ of food, km2 water, kg CO2e	Government , business, NGO	MID 2017	Global	Those implicit in trade model