Integrating marine ecosystem services into macroeconomic modelling

Supervisors

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Project description

Background: In support of the UK's climate change policy to reduce carbon dioxide emissions, a target for renewable energy to supply 15% of total energy by 2020 has been set, with offshore wind contributing 25% of this amount. These changes will have consequences for both the economy and the environment. Changes in the structure of the economy to support offshore wind and reduce fossil fuel supply will impact levels of output and employment across associated sectors. Environmental impacts of offshore renewables will also affect ecosystem services which support other non-energy sectors, such as fisheries and tourism[1]. Current estimations of economic and environmental impacts are made using environmentally extended input-output (EEIO) models (Figure 1) but these do not dynamically integrate the feedback effects of impacts on ecosystems and their services and thus fall short in comprehensively assessing the economic and environmental consequences of policy initiatives.

Aim: This PhD will develop a method to interlink ecosystems and their services with the economy in a novel dynamic framework which can be used to provide a more holistic and ecosystem-based assessment of policy decisions.

Methods: Development of the integrated dynamic framework and model (Figure 1) will be guided by the following research questions:

1. How can ecosystems and their services replace the restricted resource matrix of the current EEIO system?

2. How can the input-output tables be modified to ensure that they are dynamic and include the necessary economy-ecosystem feedback loops?

3. How can this system be used to estimate the full economic cost/benefit of policies across the whole of the economy?

The student will (1) further develop the cross-tabulation matrix that links the Common International Classification for Ecosystem Services (CICES) to economic sectors through the standard industrial classification (SIC) codes ensuring single ecosystem services are linked with multiple economic sectors[2]; (2) extend the dynamic Leontief input-output model to bring ecosystem services into the capital accounts; (3) test the model using the UK renewable offshore wind target as a case study to quantify full economic impacts associated with changes in the integrated energy and environmental system, including quantification of changes in ecosystem services and associated impacts on interlinked economic sectors.

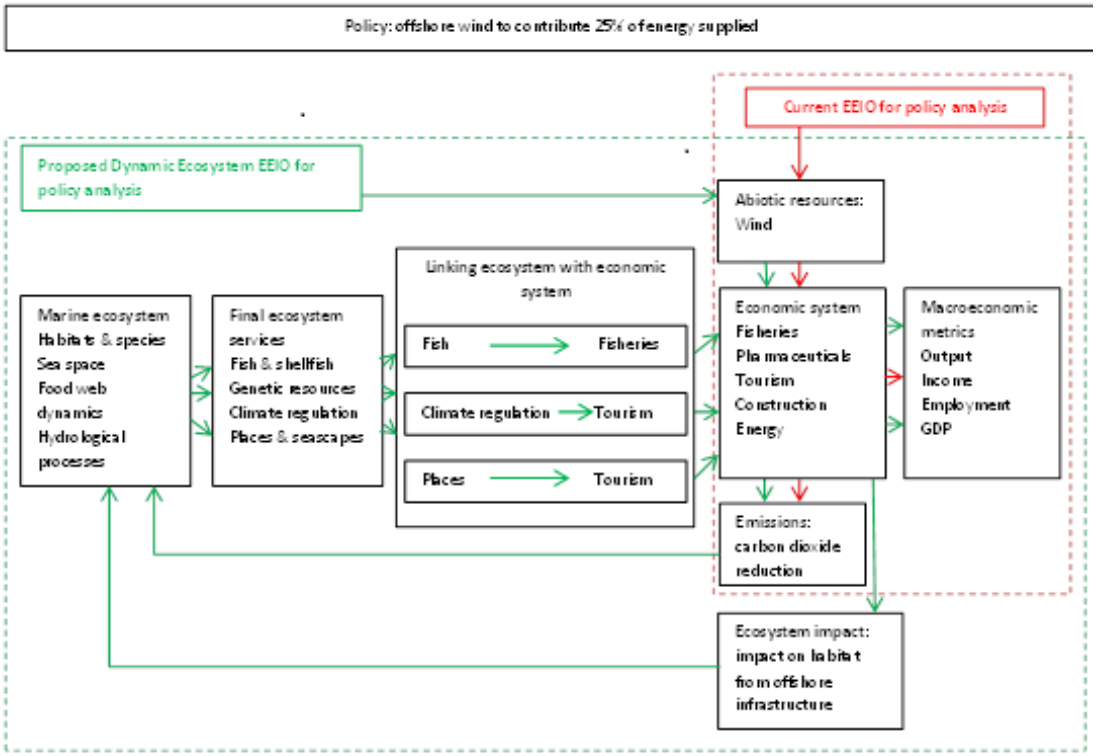
Training: The successful PhD candidate will develop an understanding of the theoretical and practical issues in combining economic-ecological systems; develop their macroeconomic skills; gain new knowledge of the ecosystem service framework and its value in informing economic systems; and become versed in the terminology and priorities of different disciplines (economy, ecology) to ensure effective communication and relevance of their research.

Further reading:

[1] Papathanasopoulou, E., Beaumont, N., Hooper, T., Nunes, J. & A.M. Queiros (2015). Energy systems and their impacts on marine ecosystem services. Renewable and Sustainable Energy Reviews, pp. 917-926 DOI information: 10.1016/j.rser.2015.07.150

[2] Haines-Young, R.& M. Potschin (2010).Proposal for a Common International Classification of Ecosystem Goods and Services (CICES) for Integrated Environmental and Economic Accounting (V1). Accessed 09/09/15. Available from http://www.nottingham.ac.uk/cem/pdf/UNCEEA-5-7-Bk1.pdf

Figure 1: Linking ecosystem and economic systems using environmentally extended input-output (EEIO) models with offshore wind as an example (current EEIO method in red; proposed dynamic framework in green).


Policy: offshore wind to contribute 25% of energy supplied
Current EEIO for policy analysis
Proposed Dynamic Ecosystem EEIO for policy analysis
Abiotic resources: Wind
Linking ecosystem with economic system
Fish → Fisheries
Climate regulation → Tourism
Places → Tourism
Marine ecosystem
Habitats & species
Sea space
Food web dynamics
Hydrological processes
Final ecosystem services
Fish & shellfish
Genetic resources
Climate regulation
Places & seascapes
Economic system
Fisheries
Pharmaceuticals
Tourism
Construction
Energy
Macroeconomic metrics
Output
Income
Employment
GDP
Emissions: carbon dioxide reduction
Ecosystem impact: impact on habitat from offshore infrastructure