

# Understanding innovation at the water-energy-food nexus

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# Summary

- We examine anaerobic digestion as an innovation at the water-energy-food 'nexus'
- An innovation lens is instructive for engaging with issues at the nexus
- Using the nexus as a locus of analysis yields important insights for understanding transitions
- Article in press:  
Hoolohan C, Soutar I, Suckling J, Druckman A, Larkin A, McLachlan C (In Press). Stepping-Up innovations in the water-energy-food nexus: a case study of Anaerobic Digestion in the UK. *The Geographical Journal*

# Background



1. Radical innovations are needed to help address system challenges; Necessary acceleration of such innovations and associated transitions
2. Innovation/transition is typically considered within the context of specific systems...But processes and outcomes also present *beyond* systems of interest
3. Innovation is a key driver of change in systems, so an innovation lens on the nexus is instructive

# Approach

- Case study of anaerobic digestion (AD) as a key innovation
  - Juncture of energy and agri-food systems
  - Focus on subset of solid waste-fed applications (not wastewater or dedicated crops)
  - Interviews and workshops with ‘innovators’ and supporting actors
- Technological Innovation System (TIS) approach used to examine ecosystem of AD innovation
  - Disaggregation into ‘innovation functions’, constraints in which can hinder innovation as a whole

# Findings (1): Health of the UK AD ecosystem highly dependent on how functions are defined / measured

Function (after Hekkert 2007)	Activities within <b>and beyond energy</b>
1. Entrepreneurship	Expansion of commercial projects for energy production, <b>but waste management is key driver</b>
2. Knowledge development	Diverse efforts, inc. energy product optimisation <b>but also novel feedstock treatment, digestate production &amp; analysis of AD impacts</b>
3. Knowledge diffusion	Networking facilitated by range of energy (e.g. REA Biogas) <b>and other interest groups (e.g. ADBA)</b>
4. Guidance of the search	Energy policy instrumental in UK; <b>waste policy becoming key driver in devolved administrations.</b>
5. Market formation	Minor player in biogas / electricity market; <b>other markets remain underdeveloped</b>
6. Resource mobilisation	AD dependent on resources from energy <b>but also agri-food system</b>
7. Creation of legitimacy	Multiple institutional arenas in which legitimacy is fought for, inc. energy <b>but also increasingly waste</b>

## Findings (2): A nexus focus useful for critical reflection of innovation events & impacts

- Innovation systems are not contained within domain boundaries
  - Is AD a special case?
- Actors and actions in one system affect innovation outcomes across systems
  - Focusing on low carbon energy raises potential for unintended consequences to be incentivised
  - Path dependence effect of closing down pathways beyond those addressing non-energy objectives
- Defining the nexus as the locus of analysis ensures system objectives are front and centre.

Findings (3): Innovation lens useful, to a degree, in drawing out dynamics of change at the nexus

- Robust, systematic frameworks are needed for examining complex dynamics at the nexus
- Although analysts and their analytical frames often focus on single domains
- Analysis needs to attend more to role of politics, power and agency of transitions across the nexus (as is the case for innovation within single domains)

# In conclusion...

- Integrative, reflexive forms of transition management are needed
  - Challenges associated with single sector transitions are amplified when considering multiple domains
- Much transition work only narrowly engages with broad notions of sustainability
- Understanding and effecting sustainability transitions requires going beyond *whole-system* approaches to consider dynamics *beyond* system boundaries

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