ENGINEERING SOLUTIONS FOR SUSTAINABILITY:
MATERIALS AND RESOURCES 3

Toward a Circular Economy

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Session 9: Future Visions for the Circular Economy

The Food-Energy-Water Nexus and A Circular Economy

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What is the Food-Energy-Water Nexus?

The interdependence of systems that provide food, energy and water to meet human needs.

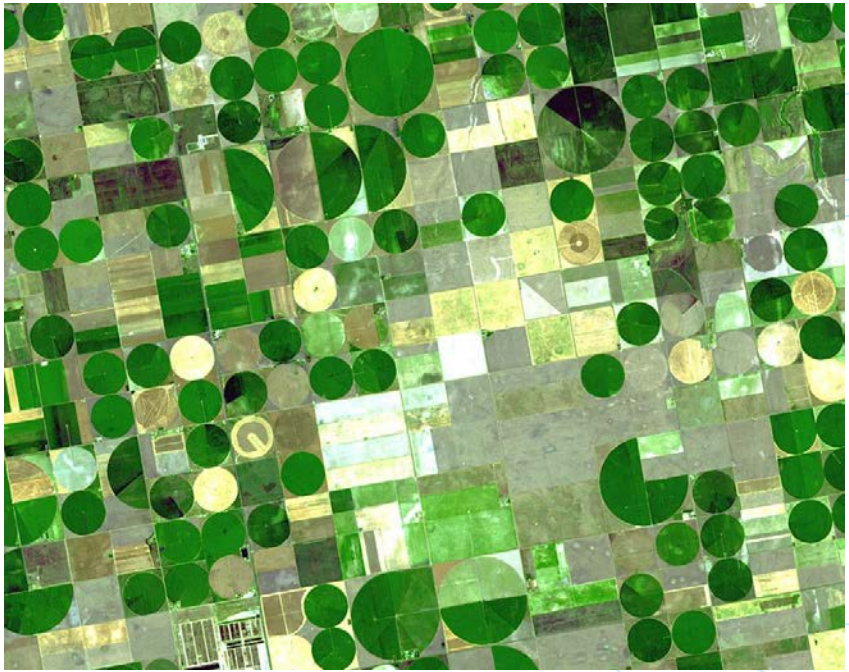


Illustration of an interconnected food-energy-water system; Center-pivot irrigation circles Finney County Kansas; water source – Ogallala aquifer; Figure Source: NASA

The Problem

- Food-Energy-Water: Interconnected
  - Not the first time this has been recognized
  - Difference is the magnitude of resource use and rate of change
- Sectoral, policy, and disciplinary silos
- Perspective
  - Frequent view: emerging economy challenge
  - However, FEW challenges exist at multiple scales: temporal, communities, organizations
- How to frame the question
  - Broad set of goals
  - Multiple alternatives, scenarios
  - Uncertain outcomes

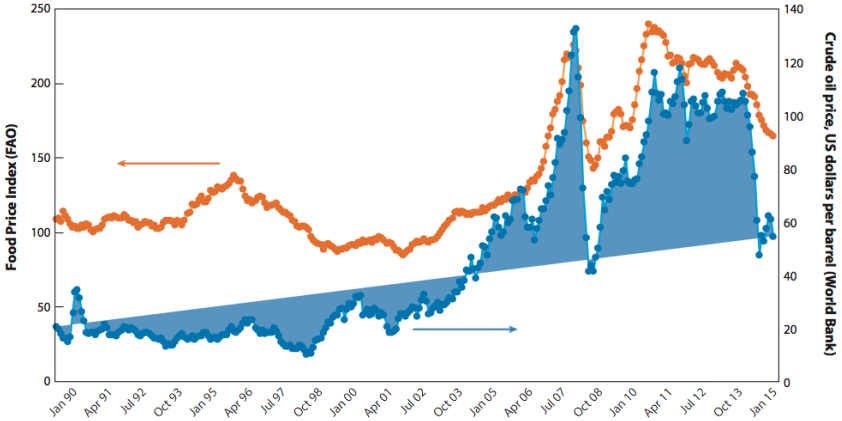
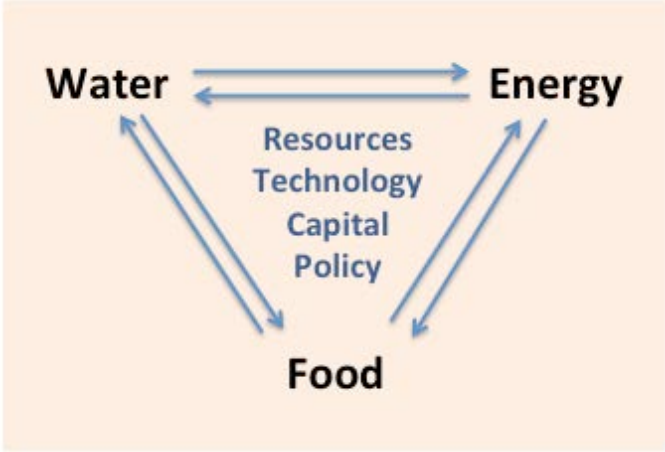


Figure: Illustration of interdependency; ; food and oil prices 1990 – 2015. Data from FAO and EIA; source: The Energy-Water-Food Nexus, DL Keairns, RC Darton and A Irabien Annu. Rev. Chem. Biomol. Eng. 2016. 7:9.1–9.24

Nexus Thinking

- How is the Nexus framed?
  - ‘Security’
  - Availability and accessibility (sustainable, affordable, reliable)
  - ‘Footprinting’ - tends to focus on particular issues
  - Life cycle and supply chain
  - Some include soil/land, ecology, climate



- Nexus studies focus
  - Reviews and Nexus issues discussion
  - Sustainability objectives – e.g. human well-being, ecosystem health
  - Product and service delivery
  - Modeling and assessment methods

What drives the Nexus challenge?

- Population growth
- People moving to cities
  (urban population growth)
- Economic development
  (leading to increased consumption and pressure on resources)
- Climate

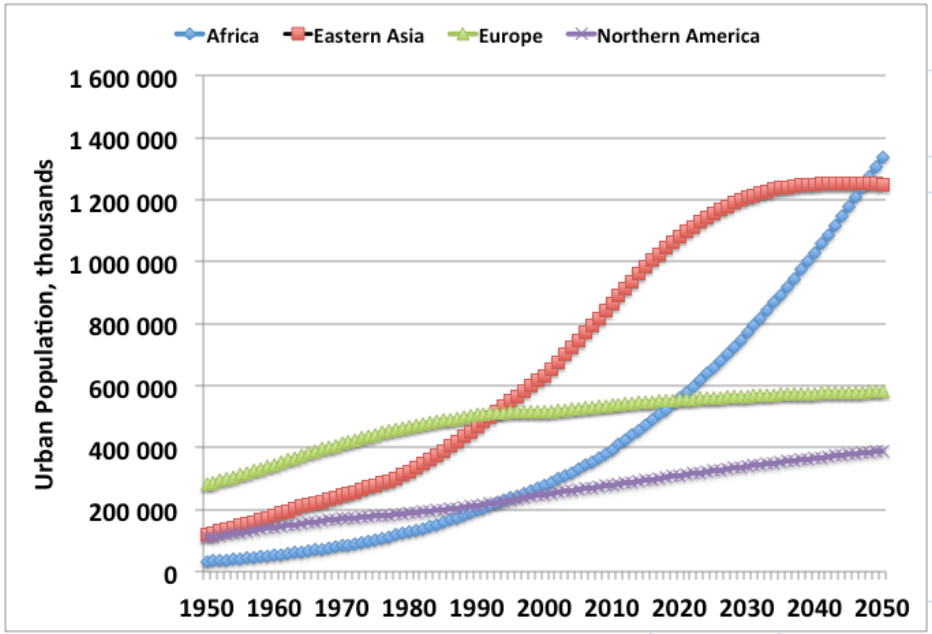
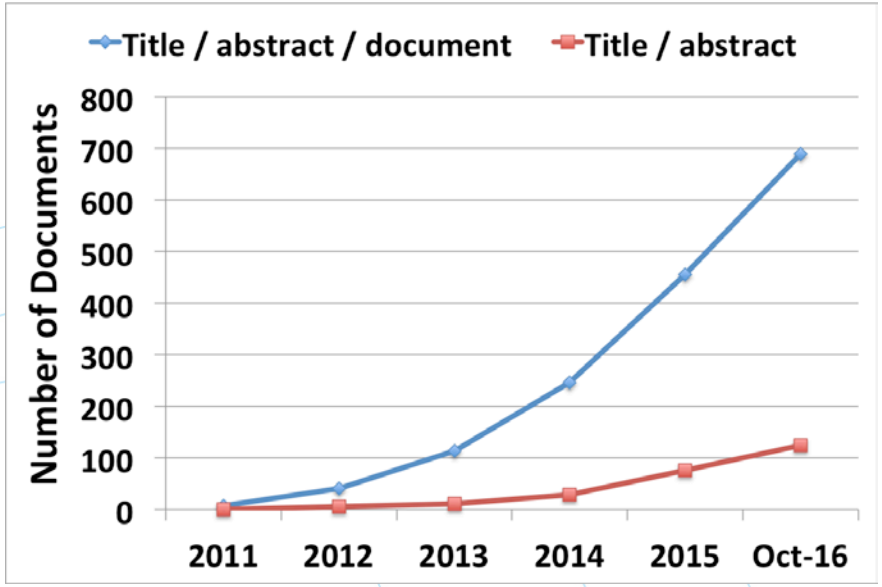


Figure Data Source: UN Population Division

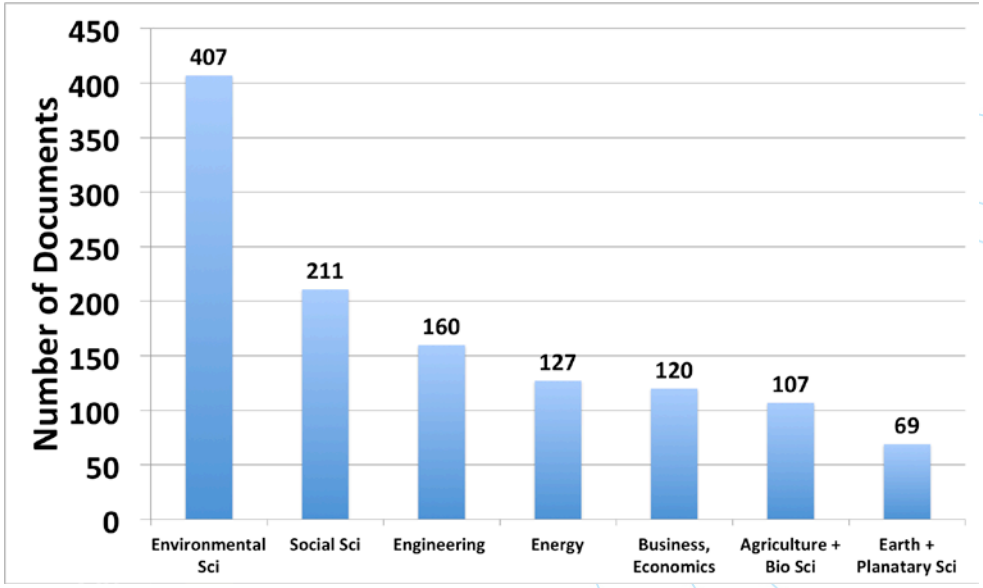
Policy Challenges

- Legislation generally targeted for specific problem
- Dominated by responding to ‘crises’
- Policies frequently framed as regulation
- Need for holistic, evidence-based policy making

Who is Working on the Nexus?



Search on food+energy+water+nexus



Diverse backgrounds

Nexus and the Circular Economy

- Food-energy-water Nexus describes supply/demand interactions
- Circular economy is method to reduce resource demand
- However, FEW Nexus and Circular Economy have been separate conversations
- Circular Economy thinking is needed in Nexus studies
  - Flows across system boundary
  - Design out ‘waste’ throughout the system
  - Important implications for process and system design, operation or use
  - Important implications for governance

Opportunities / Needs

- Engineering community and professional society actions* that have an impact on addressing the Nexus challenges in the context of a circular economy
  - How do we think differently about complex interconnected system challenges
  - Opportunities for professional society collaboration and collaboration with industry, local communities, NGOs and agencies
  - Opportunities to prepare position papers, hold congressional briefings to engage with public policy
- Metrics that inform and guide decisions
  - Project, business, regulations, policy
- Case studies with stakeholder involvement
- New methodologies of analysis
- Availability and improved access to Nexus data
- Funding support for multidisciplinary and multinational studies

* Actions beyond continuing the publication of scientific and technology findings

Acknowledgement

- The Nexus review perspective is based on The Energy-Water-Food Nexus by DL Keairns, RC Darton and A Irabien, Annu. Rev. Chem. Biomol. Eng.2016. 7:9.1–9.24 and our continuing work on the Nexus.
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