Divergent policy agendas for a sustainable European bioeconomy

Les Levidow
Open University

CBMNet, 8 December 2016

KBBE as a policy agenda

- EU has promoted a *Knowledge-Based Bio-Economy* (KBBE) to address societal challenges, linking innovation with sustainability and economic competitiveness.
- Concept has informed EU's research priorities, especially linking the agricultural and energy sectors, alongside support measures to generate new markets for bio-based products.
- KBBE has been taken up in various ways by some member states.

Research Qs & results

- **Questions**
  How do KBBE agendas diagnose the societal problems to be solved, especially the sources of unsustainability?
- How do they raise expectations that technoscientific advance will address societal challenges and so bring progress?
- How do such agendas link research/knowledge with greater economic value? from what source? for whose benefit?
- How do these agendas justify and stimulate institutional change?
- Through such change, what potential futures have been opened up or marginalised?

- **Three case studies of bioeconomy agendas**
  1. EU's research framework programmes
  2. UK bioenergy innovation
  3. UK advanced thermal treatments (ATTs) for waste

Analytical Perspectives

Master narratives of progress

- EU innovation policy has been a master narrative – conflating general societal progress with technoscientific advance.
- Master narratives are the cultural vehicles through which ideas of progress are linked to S&T in particular ways. Not merely stories or fictions, they are taken-for-granted aspects of social order

  Even if S&T is not productive, its promotional policies shape society (Felt et al., *Taking European Knowledge Seriously*, 2007).
- One high-profile master narrative, the Knowledge-Based Economy (KBE), has been promoting 'the commodification of knowledge through its formal transformation from a collective resource (intellectual commons) into intellectual property' (Jessop, 2005).
- Yet this master narrative has flexibility, encompassing diverse visions of the future, e.g. neoliberal, neocorporativist, etc.

Technological expectations

(Borup et al., 2006)

- Technological expectations =
  ‘wishful enactments of a desired future’, through
  ‘real-time representations of future technological situations and capabilities’.
- Rather than simply predict future realities, expectations guide technological-economic activities, provide legitimation and so direct investment towards specific innovation pathways.
- Expectations play a central role in mobilizing resources, e.g.
  ‘in national policy through regulation and research patronage’, i.e. actions towards the desired future.
- Thus expectations are potentially self-fulfilling via support measures.

Agro-food innovation: paradigms

- Agro-food innovation is informed by different paradigms of knowledge and product quality.
- These paradigms have been theorised as binary typologies.
- **Knowledge**:
  Life Sciences modify plants for agronomic traits, greater productivity or new objectives, e.g. nutritional content **(versus)**
  Agroecological methods design agricultural systems that minimise the need for external inputs, instead relying on farmers' knowledge and ecological processes (Vanloqueren & Baret, 2009).
- **Quality**:
  Decomposability: Converging technologies seek to identify, extract and decompose specific qualities, towards their recomposition into economically valuable combinations **(versus)**
  Integral product identity depends on holistic methods and quality characteristics recognisable by consumers, as a basis for their support (e.g. agroecological methods and products).
- Each quality paradigm has a different 'public reference system', i.e. a common knowledge-base (Allaire & Wolf, 2004).

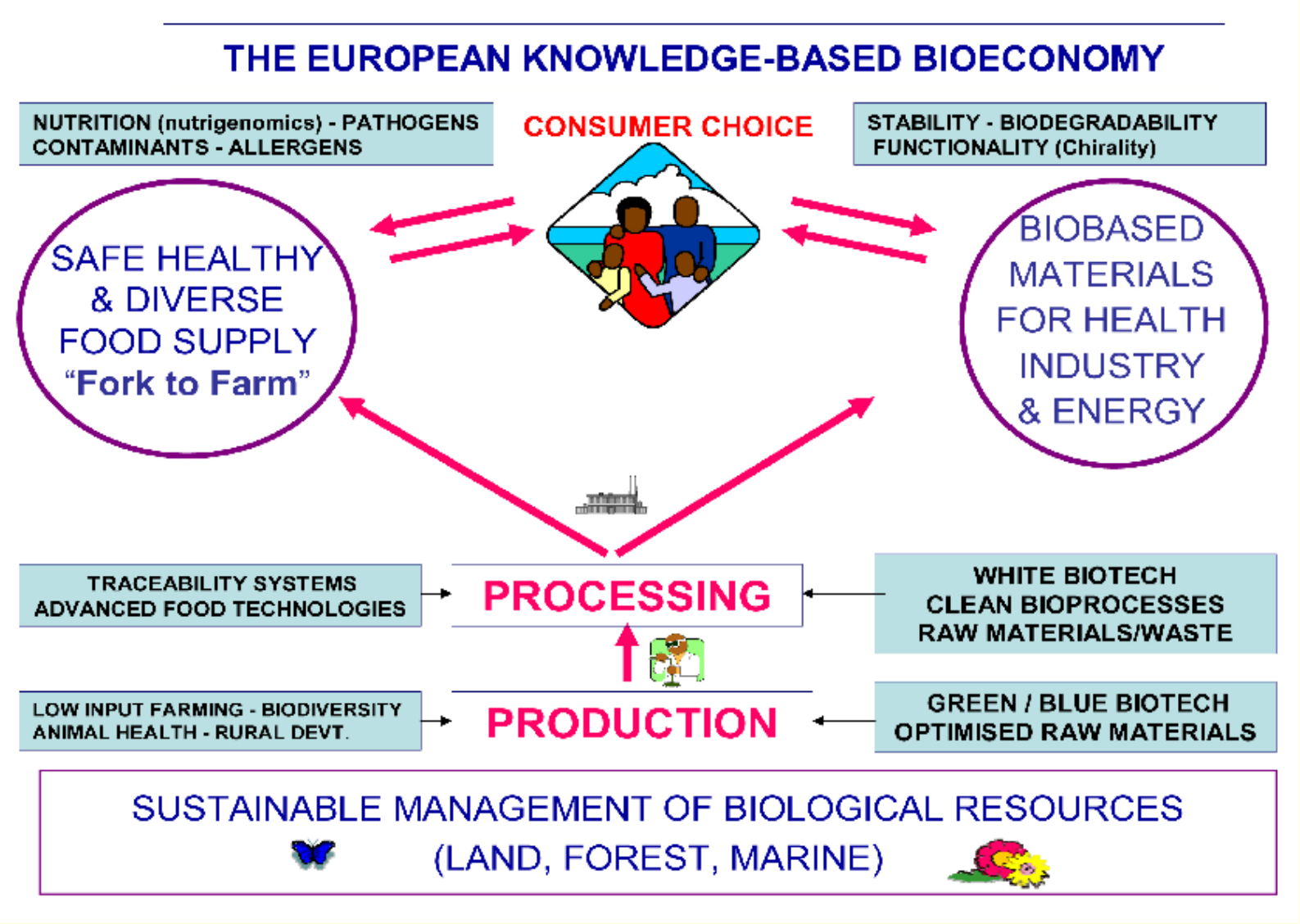
KBBE has divergent paradigms

- **EU's KBBE encompasses divergent paradigms:**
  Dominant: Life Sciences with global value chains
  Marginal: Agroecology with integral product identity

- **Life Sciences** are necessary for Europe to catch up in a global competitive race for accessing and valorising natural resources.
- Problem diagnosis: Inefficient production methods underlie current unsustainability problems, given the rising demand for biomass and future environmental constraints.
- Technological expectations link environmental and economic sustainability:
  More efficient methods will increase renewable raw materials and better process them, thus substituting for fossil fuels and synthetic chemicals.
  Such methods will enhance the EU's economic competitiveness and thus prosperity.

- Informed EU's FP7 Food, Agriculture, Fisheries and Biotechnology (FAFB) and then H2020 WP 'Food Security'.

KBBE as sustainable future

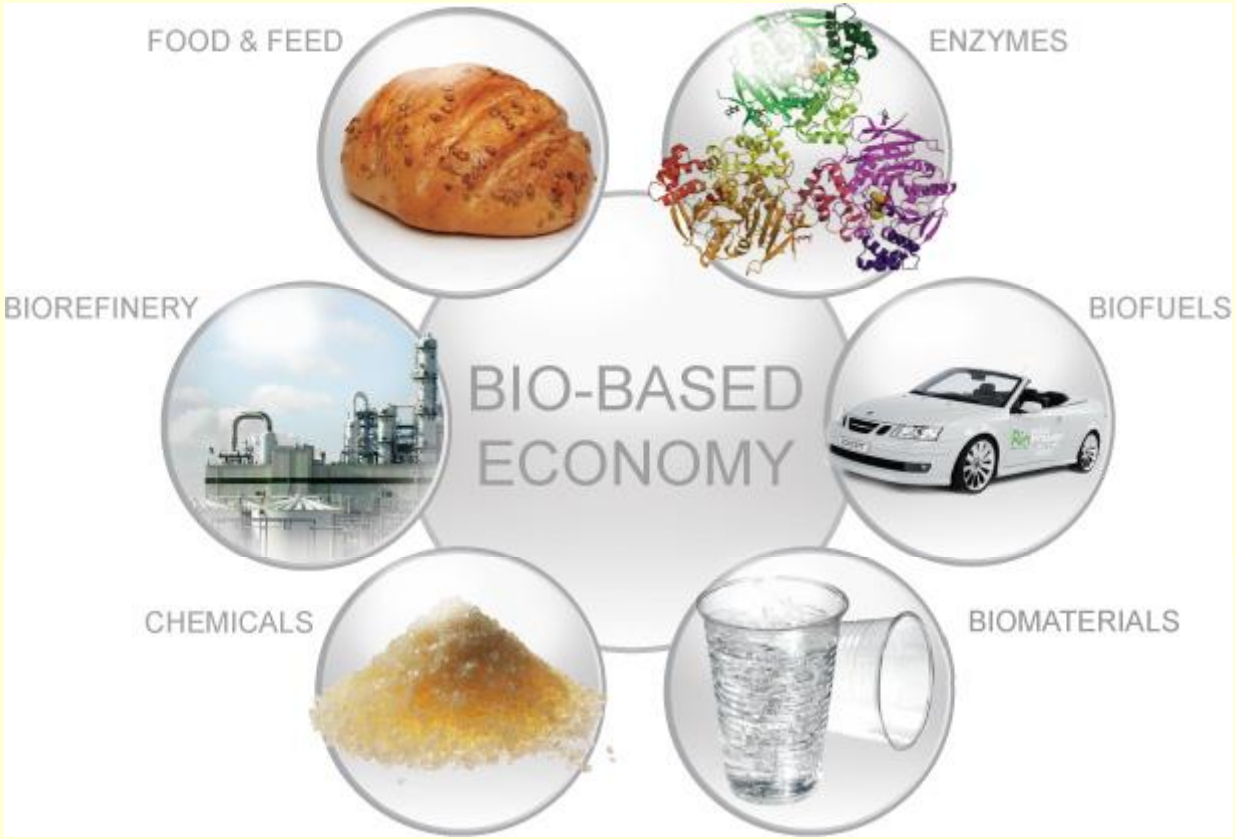


Life Sciences with global value chains

- European Technology Platforms (for plants, biofuels, food) were invited to propose Strategic Research Agendas, which have been widely incorporated into the EC framework programme.
  ETPs link MNCs in agri-supply and food sector with public-sector research institutes.
- Agriculture will be 'oil wells of the 21st century'
  (Biomat Net, 2006). Natural resources are invested with mechanical and informatic metaphors e.g. cells as factories or micro-computers.
- An 'integrated diversified biorefinery' will convert biomass (esp. waste) into various industrial products, substituting for oil.
- Expected impact: 'Market-driven' knowledge, e.g. molecular basis for biomass decomposability, better substituting renewable resources for chemicals and gaining added-value.
  'Knowledge and intellectual property will be critical' (Plants for the Future ETP, 2007), hence a basis of competitiveness, e.g. products or partnerships in global consortia.
- EC research projects: genomics knowledge contribute to public reference systems, as a basis for companies to develop specific applications.

KBBE as Horizontal Integration

(industry network website, www.bio-economy.net



Agroecology: a rival vision of KBBE

- Organics sector sought to influence EC's R&D priorities:
  Sustainable Organic and High Welfare Food and Farming Systems
  'are an important and fast-growing part of the European knowledge-based bio-economy' (2006).
- Promoters gained wide stakeholder support, including commercial actors across the agro-food chain as well as environmental NGOs.
- Technology Platform Organics (2008): diagnosed problems: agriculture depends overly on external inputs, and agroecological methods have a low productivity:

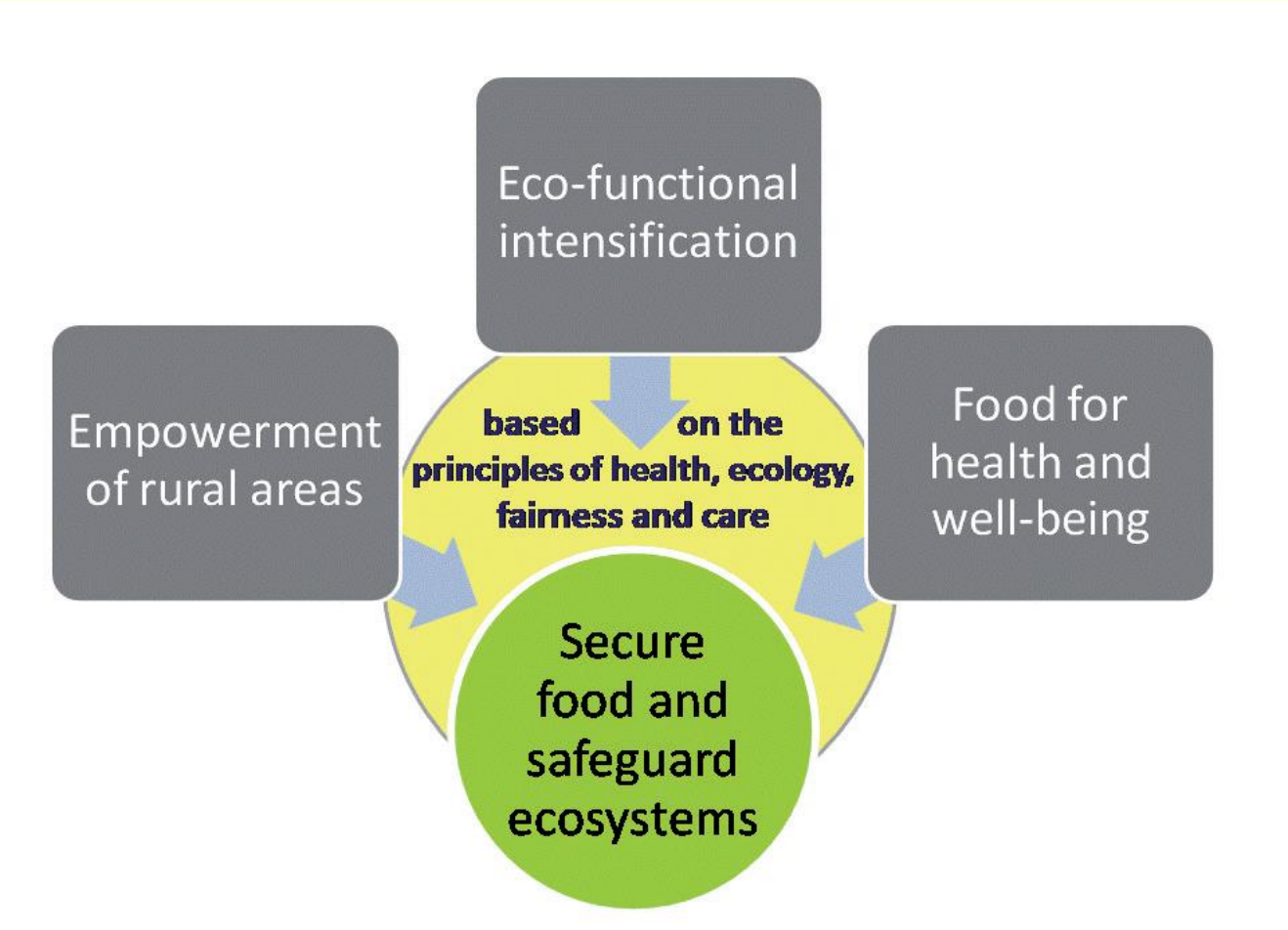
  This could be solved by means of "eco-functional intensification", i.e. more efficient use of natural resources, improved nutrient recycling techniques and agroecological methods for enhancing diversity and the health of soils, crops and livestock…
  Organic farming is a highly knowledge-based form of agriculture involving both high tech and indigenous knowledges…'

  -- *Vision for an Organic Food and Farming Research Agenda to 2025*

  COPA's Organics section supported this as 'a European knowledge sharing and transfer platform for organic and low-external input farming'.

Three themes for organic research

(TP Organics, 2009)



Knowledge-base for agroecology

- FP7 budget increased funds for such research, likewise H2020.
- Expert foresight studies advocated wider knowledge networks for agroecological innovation, e.g. nutrient recycling, *in situ* genetic diversity, farmers' knowledge, etc.

  Approaches that promise building blocks towards low-input high-output systems, integrate historical knowledge and *agroecological principles* that use nature's capacity and models nature's system flows, should receive the highest priority for funding (SCAR FEG, 2011).
- Some EC research topics have generated public reference systems necessary for embedding agroecological methods within farming systems and short supply chains – i.e. an integral product identity recognisable by citizens and consumers.
- Thus rival paradigms for a bioeconomy (Life Sciences versus agroecology) have been institutionalised through stakeholder alliances influencing the EU research system.
- Two UK case studies lie within the Life Sciences paradigm.

2G biofuels: symbol of bioeconomy

- Since 2007 biofuels have provoked a global debate over land-use conflicts between ‘food versus fuel’.
  Biofuel promoters raised expectations that technoscientific advance would better convert non-food biomass to bioenergy and valuable materials, thus avoiding/overcoming any such conflict.
- Early biofuels were renamed ‘first generation’, meant as a step towards 2G or advanced biofuels.
  This prospect has symbolised a wider bioeconomy in policy frameworks.
- Two-stage scenario justified EU requirement (2009 RED) that transport fuel must include 10% RE by 2020 in all member states.
- UK adopted modest initial quotas, yet Parliamentary Committees (2008) warned that these could generate a technological lock-in.

R&D towards 2G biofuels

- Large investments in biofuel R&D were promoted by experts and were made by UK government, citing the imperative for commercial 2G biofuels by the 2020 deadline of RED. **Expectations:**
- "Taking an early lead in developing these technologies would be of strategic benefit to the UK through developing new Intellectual Property and realising cost reductions that come with increased technical understanding to give the UK a competitive position in the international biofuels market place" (NNFCC, 2009).
- Government emphasised "the potential for significant growth … if advanced technologies using wastes and woody feedstocks are commercialised" (DECC, 2012).
- Shift to 'biomass' crops would facilitate cross-sectoral industrial integration (BBSRC).
- Such 'potential' remains prominent in documents justifying biofuel quotas and R&D priorities.
  Yet UK's 2011 report to the EC quietly abandoned expectations for 2G biofuels by 2020. This prospect remains elusive globally.
- Meanwhile 1G biofuels and their infrastructure are locked-in.

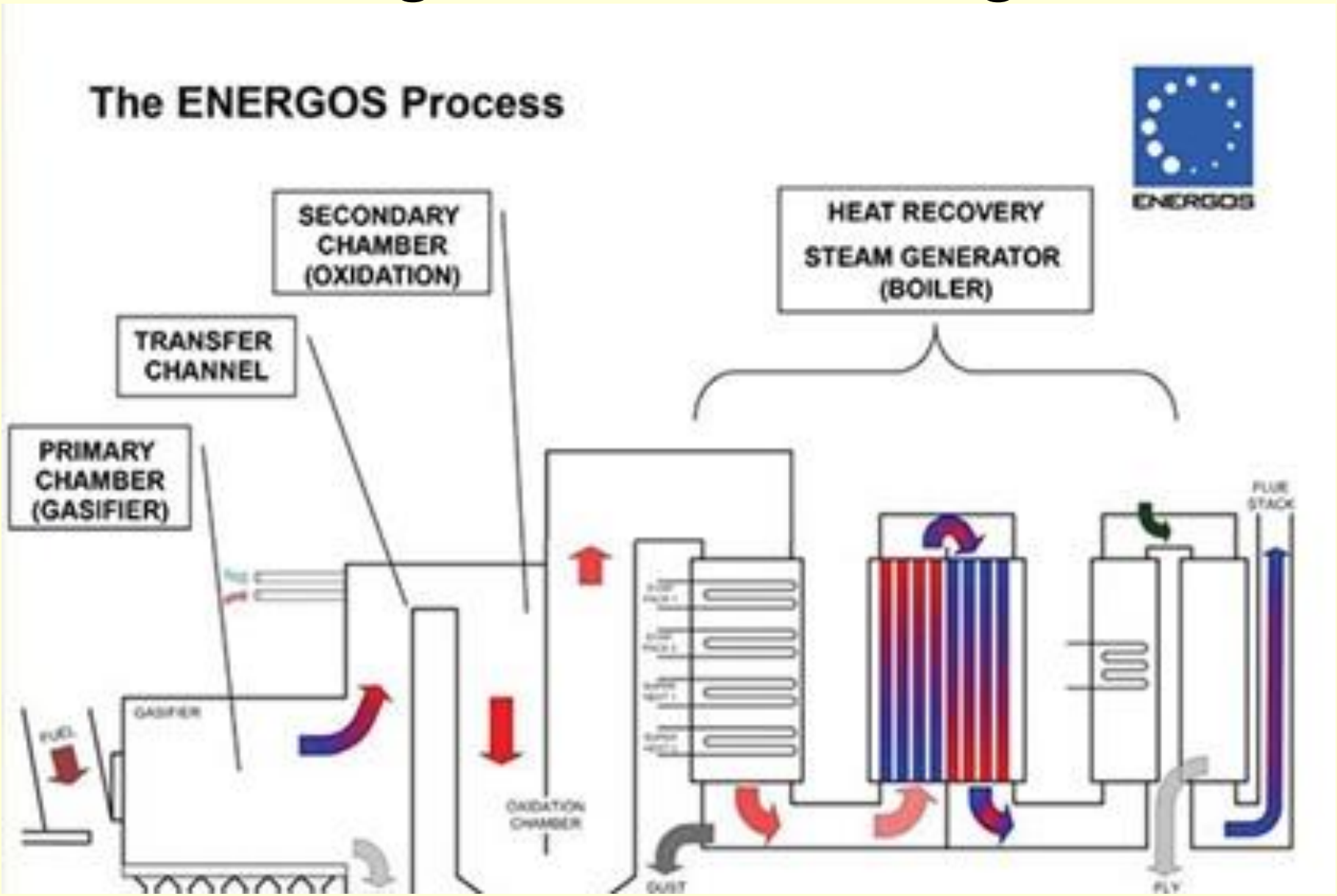
Institutional effects

- **Competitive science?**
  Through bioenergy research, UK science and industry were meant to become more competitive, implying a common national interest in economic growth and prosperity.
  Yet UK research managers have strategically realigned their priorities towards partnerships with foreign counterparts and global energy companies, esp. seeking proprietary knowledge.
  Seeking such deals, researchers have competed against each other, maintaining commercial confidentiality, even within the same research institute.
- **Sustainable fuel?**
- Since at least 2002 the UK government had been promoting hydrogen fuel cells (powered via bioenergy or solar) towards significantly reducing GHG emissions and improving sustainability.
  Yet such R&D had minimal funding in UK bioenergy programmes and little from industry, thus remaining marginal.
  By contrast, biofuel promotion (and quotas) effectively perpetuate and naturalise current infrastructure for liquid fuel.

ATTs for waste-to-energy

- MSW has been an environmental-economic burden but also a potential resource for a bioeconomy.
- Policy pressures to move waste of the hierarchy: reduce, reuse, recycle, recover, dispose waste, the latter mainly landfill.
- Residual MSW is sent to landfill or combusted in mass-burn incinerators, now configured as Energy-from-Waste (EfW) plants.
- Diverse innovation trajectories have been collectively named Advanced Thermal Treatments (ATTs) such as gasification.
- ATTs' promoters have raised expectations for bringing facilities higher up the waste hierarchy through greater energy recovery and eventually a clean syngas that can substitute for fossil fuel (REA, 2010; DEFRA, 2007; DECC. 2012).
- UK has offered many support measures: R&D funds, demo plants, operational subsidy (2.0 ROCs).
- Energos' two-stage combustion gasifier has gained adoption by waste-mgt companies in contracts with several local authorities.

Two-stage combustion gasifier



Moving up the hierarchy?

- *Building a High-Value Bioeconomy* (2015):
  Emphasises 'the economic value of waste as a feedstock for the bioeconomy', esp. via emerging technologies for recovering more energy and eventually high-value products.
  UK's world-class scientific strengths provide the basis for world-leading breakthroughs and for inward investment.
- But govt incentives keep waste conversion at the lower end of the hierarchy, esp. via subsidy for energy recovery (HoL, 2014 rpt).
- Broader reasons: finance has been easier for gasifiers which most resemble incinerators, with energy recovery lower but reliable. Largest-scale plant attempting to produce a clean syngas (Teeside) ended in failure; scale-up was too great, seeking a large RoI.
- After each failure, optimistic expectations are shifted to yet other technological designs which will avoid the previous difficulties.
- Many UK facilities remain dependent on companies and R&D expertise from abroad, benefiting from the state support.
- Focus on 'advanced' tech diverts resources from simpler means to drive waste up the hierarchy.

Conclusions:
divergent paradigms, elusive expectations

- Divergent paradigms: Life Sciences with global value chains, **versus** agroecology with integral product identity.
- Each starts from a different diagnosis of the sustainability problem; each remedy favours different economic interests and knowledges.
- Expectations for future benefits have mobilised greater financial resources and policy commitments for some trajectories.
- Such benefits have remained elusive. Nevertheless support measures have brought institutional changes:
  political-economic alliances shaping R&D agendas,
  UK research managers competing against each other for commercial partnerships,
  1G biofuels and its infrastructure being locked-in, etc.
- 'The bioeconomy' reifies diverse trajectories as a single project, thus obscuring alternative problem-definitions and societal choices which may be marginalised.
- Such processes warrant social science research.

Research projects

- European Commission-funded study, ‘Co-operative Research on Environmental Problems in Europe (CREPE)’, 2008-2010
- ESRC-funded study, ‘Knowledge Production for Sustainable Bio-energy: An analysis of UK decision processes and priorities’, 2011-12
- EPSRC-funded study, ‘Anaerobic digestion and pyrolysis synergies’, 2013-16

References to our research

- Levidow, L., Birch, K., Papaioannou.,T. (2013) Divergent paradigms of European agro-food innovation: The Knowledge-Based Bio-Economy (KBBE) as an R&D agenda, *Science, Technology and Human Values* 38(1): 94-125.
- Levidow, L., Papaioannou, T. and Borda-Rodriguez, A. (2013) Innovation priorities for UK bioenergy: Technological expectations within path dependence, *Science & Technology Studies* 26(3): 14-36.
- Berti, P. and Levidow, L. (2013) Fuelling expectations: a policy-promise lock-in of UK biofuel policy, *Energy Policy* 66: 135-143.
- Levidow, L. and Papaioannou, T. (2014) UK biofuel promotion: Envisaging sustainable biofuels, shaping institutions and futures, *Environment and Planning A* 46(1): 280-298
- Levidow, L., and Upham, P. (2016) Socio-technical change linking expectations and representations: Innovating thermal treatment of municipal solid waste (MSW), *Science and Public Policy*, doi: 10.1093/scipol/scw054