RESEARCH TOPICS

ARISING FROM THE LAND USE SECTION OF ZCB2030

Peter Harper 2011

*The Land Use chapter of Zero-Carbon Britain 2030 set out what is essentially a new paradigm in UK land-use, one that satisfies an extremely wide range of environmental desiderata and provides improved diets and food security. But not ‘what everyone wants’!*

*However it is physically credible, and does pose a coherent challenge. It has never been successfully challenged, except to remark on the formidable institutional barriers.*

*The following is a list of research subjects that were ‘thrown up’ as it were, by the ZCB2030 research.*

DIETS AND FOOD

* The new ‘food pyramids’ with fresh fruit and vegetables at the bottom
  + Do the health arguments really stack up?
  + Are some people metabolically ill-suited to such a dietary change?
* Cell-free meat proteins, substitution of generic meat
* Other protein concentrates from crops
  + Legume seeds
  + Other parts of leguminous plants
  + Grasses
  + ‘surplus vegetables’
* Low-meat meaty cuisine: how to maximise flavours: stocks, flakes, relishes
* Is it more, or less, compatible with ‘slow food’?
* Will food be expensive, and will there be ‘food poverty’?
* How would the scenario interact with large food retailers? Might it be much the same in 2030?
* Would there be more seasonal eating?

FERTILITY

* Will perennial biomass crops deplete the soil in the long run?
* Nitrogen in the scenario – will it gradually run down?
  + Could it be replaced entirely by natural fixation?
  + What are the optimum conditions for the use of mineral nitrogen?
* Does the ZCB scenario offer a solution to Rockstrom’s nitrogen limit?
* Fertility from green manures
  + Is grazing superior to mowing?
  + Does mob grazing stimulate soil carbon accumulation?
* What scope is there to recover nutrients from silage digestates?
* Can phosphorus and other minerals be recovered effectively from sewage and other urban wastes?
* How would the nutrient-loops be closed? Would the fertility of the arable areas slowly decline without subsidy from the grasslands?
  + Does the scenario positively favour mixed farming?
* Are there any technical fixes in prospect to reduce N2O emissions?

PERENNIAL BIOMASS CROPS

* Growing biomass crops in pastureland
  + Is it much harder than the report assumes?
  + With ploughing
  + With herbicides
  + Keyhole or slot planting
  + Long-term monitoring of carbon releases
  + Establishment and growth-rates under various conditions
* Breeding programmes for biomass crops. GM? Willow, miscanthus, silage grasses

LIVESTOCK

* Exploration of Fairlie’s ‘default livestock’ thesis: is there a clear ‘elbow’ in the output-impact curve?
* Particularly interesting avenues for research on new and traditional livestock types in new contexts
* High prices for livestock products would add value and encourage innovative production systems
* Are there implications for animal welfare? Would production of housed livestock be more, or less, intensive?

ADVANCED PRODUCTION SYSTEMS

* “Sustainable Intensification”
* Economics of greenhouse crops under low-carbon energy
  + Use of heat-pumps with thermal mass storage to exploit variable electricity generation in protected cropping situations
  + Hydroponics/Aquaponics? Industrial-scale production?
* What is the role for ‘organic’?
* Peri-urban production. More city farms, more urban livestock? Role of allotments and group-production. CSE?
* The potential of fish-farming without livestock-product inputs
* Agroforesty/silvopastural systems
* Combining functions
  + Livestock and biomass
  + Biodiversity and biomass
  + Entire suite of ‘ecosystem services’
* Biomass-derived feedstocks for industry
  + Chemicals
  + Materials

SEQUESTRATION

* Buildings that maximise, rather than minimise, carbon sequestration: completely different design principles, and mop up the biomass surplus
* What new building products can be produced from the likely biomass crops, e.g. miscanthus, SRF?
* Using biomass for industrial feedstock, especially non-degradable plastics
* Monitoring carbon storage and releases under different conditions
* Biochar production from biomass and other sources
  + Effects of Biochar short, medium long under various conditions
    - ‘charged biochar’, N, mycorrhizas
* Accumulation of below-ground carbon in new stands of miscanthus, SRC etc
* Physico-chemical alternatives to the production of sequestration crops: how quickly are they developing and are they likely to be preferred by 2030? That would substantially slacken the constraints in the scenario
* BECS – biomass energy with carbon storage, or at least ‘carbon recycling’ using hydrogen
* How long is the likely ‘window’ of proposed forestry production to sequester carbon?
  + Can this window be extended?

ENERGY

* Combining hydrogen with biomass feedstocks to produce liquid fuels.
  + The implications: less land for biomass, more aviation….?
  + What are the most likely fuel products?
    - E-methane, methanol, higher alcohols, biodiesel?
* ‘Return of the gas grid’ as a store of energy and a complement to the electricity grid
* Farmers producing their own tractor fuels – spinoff from edible oil production? Farmers as local biomethane producers, using ‘energy silage’
* Should we try to avoid the use of biomass for energy as far as possible?
* Critique of net energy yield from biomass based on fundamental energetics analysis: it cannot possibly work

INTERACTION WITH OTHER SUSTAINABILITY DIMENSIONS

Systematic assessment of relationship to Rockstrom’s 9 planetary boundaries

What is the relation between ZCB approach and the integrity of ecosystem services?

Does decarbonisation automatically tend to ameliorate impacts?

Is it largely agriculture/land use /livestock that contribute most to impacts on biodiversity, water, land use change, nitrogen and phosphorus levcls?

VARIOUS

* What are the effects on the scenario of applying different conventions/assumptions regarding:
  + GWP time horizons
  + Indirect effects of UK food consumption overseas
  + Carbon prices
  + Open-ness of the economy to imports
* Studies of biodiversity across all taxa in biomass plantations
  + Optimising geometry for biodiversity
* New models of ownership and control
* Economic analyses of the return to farmers for various crop types and mixtures under various conditions, carbon prices, subsidies etc
* Role of the EU and CAP in encouraging or hindering low-carbon agriculture
* Potential competition between biomass crops. They become the cornerstone of the economy but will be in high demand for many purposes
* Effect on rural economy of resurgence of land-intensive supply systems and high carbon prices