The Climate Change Committee (CCC) reports – Dr Alex Keen, AMIAgrE

The recommendations for agriculture still appear somewhat limited and unambitious, particularly in the context of the UN FAO report about the loss of biodiversity in nature and agriculture and also within the context of last week's media reports on the establishment of the Centre for Climate Repair (CCR) at Cambridge University under the leadership of Sir David King. Whereas the recommended CCC target is net-zero greenhouse gas emissions by 2050, Sir David King stated on the Today programme that a net-zero emissions target within 10 years would be preferred - it was unlikely to be achieved but should be achieved as rapidly as possible accompanied by action to take CO2 out of the atmosphere with a target of reducing CO2 from 410 ppm to 350 ppm, or less. The aim of the CCR is to look at, develop and evaluate technologies that can reverse the impact of GHG emissions. It may be useful to contact them relative to agricultural engineering.

Both Climate Change Committee reports in pdf format are available to download at: www.theccc.org.uk/publications

The FAO Commission on Genetic Resources for Food and Agriculture, The State of the World's Biodiversity for Food and Agriculture report is at: http://www.fao.org/state-of-biodiversity-for-food-agriculture/en/ (another 600 page report and I haven't had a chance to take-in a lot of the report).

https://www.bbc.co.uk/news/science-environment-48069663 gives a bit of background on the Centre for Climate Repair.

The CCC reports do not analyse the world behaviour of the carbon cycle and therefore do not identify from this areas for greatest potential recovery of atmospheric carbon. Slide 9 is a typical diagrammatic analysis of the world carbon cycle. The largest identifiable area for improved recovery of atmospheric carbon is the difference between the carbon exchange in plant photosynthesis and respiration – around 61 Gt C in slide 9; around a 12% increase in this difference would appear to have a highly significant effect in offsetting burning fossil fuels. [This may entail an increase in soil respiration to offset this benefit? The relationships may require some expertise to model].

I have edited/summarized, to two pages, the CCC reports to what I think are the main outcomes more specifically for agriculture – see attached Word file. I have also copied what look to be the most useful figures and boxes, or part boxes into the attached (edited from the last email) pdf. I have added a brief commentary to the slides in the pdf file.

It still looks to me that it should be possible to build a systems model of the UK land, agriculture, food, energy, and simplified soil behaviour and carbon flows, etc., and the 1975 Kenneth Mellanby analysis "Can Britain Feed Its self?" may provide a useful reference point. I am still looking at summarizing Mellanby's ideas and approach.

As before, although the recommendations include some reforestation, biomass production and carbon capture and storage (CCS), they do not plot a route to zero net carbon emissions from agriculture by 2050. Fig. 1.4 (slide 3 in attached pdf) looks to be significant in the thinking. Agriculture looks to be a relatively small contribution to emissions compared to industry, power, buildings and transport but although reductions in agricultural emissions over the last 25 years are small they are not insignificant. The notion of farmers producing renewable energy as an alternative enterprise and substitute for high emission enterprises such as beef and sheep has not

been properly explored in the report. A second flaw, maybe more important, is similar to the one looked at by Kenneth Mellanby in the early 70s. Then, as now, we import up to 50% of our food, including animal feedstuffs, and in the early 70s there was a concern that the UK population would reach 100m by the year 2000. Would our agriculture be able to cope with the impending demands for food without further large increases in imported food? Mellanby included some of the current issues of concern, including diet, but found that a population of up to 100m could be maintained from UK food production. The CCC recommendations do not appear to include a specific target for agriculture of net zero emission, or net zero food imports, or any clear allowance for projected population change. Changes in diet, land use, cropping methods, soil management, avoidance of agrichemicals, renewable energy farming, population change, etc., need some thorough evaluation. Hence the reference to Mellanby's methodology.

There seem to be a lot of questions relevant to us that have not been fully addressed in the CCC reports – or I haven't yet found enough information to clarify them.

Some CCC reports questions?

• How to reduce ag C emissions to zero through diet, crop production, ag eng and mechanization, and soil management? The zero C emissions is a target without the coherent detailed actions required. There isn't a persuasive holistic quantitative model showing change, cause and effect.
• How can soil C be conserved and what is the sequestration potential?
• The forestry target from the CCC report. What is the potential for forestry amelioration of flood risk? The CCC reports did not deal with sea rise?
• The effect of diet changes on land use and C emissions – what are the main scenarios?
• The potential for renewable energy (wind, solar, biomass, algae) for farmers as alternatives enterprises to food or to enhance their business?
• The effect of changes on biodiversity: should their be clear biodiversity targets as well as a net zero C emissions target?
• What are the benefits of changes in the to the use of spring sown cereal crops, overwinter legume cover crops, strip cropping, inter-row cropping, CTF and other reduced compaction practice, and precision transplanting cereals (as in the SRI in rice)?
• Non-ag recommendations also apply to ag: transport, energy, buildings, etc. It is not clear how these were taken into account for ag.
• What is the potential contribution of precision farming, precision mechanization operations, to reduce the use of high energy chemicals that threaten bio-diversity, particularly to pollinating insects such as bees.
• What proportion of ag land is required to generate renewable energy for net zero C emission farms?
• With reference to Fig 9 (in the attached pdf of slides), what areas of UK farming land can utilise increased photosynthesis in sequestrating C and at what annual level?

Possible IAgrE actions could include:

1. A working group to consider a suitable response

2. Co-ordination with the main engineering institutions linked with the Climate Change Committee or other relevant bodies, for example: ADAS, the UK Net-Zero Advisory Group, the Centre for Climate Repair, EurAgEng, ASABE, (the RAENG?), etc.

3. A Climate Change Meeting/Workshop to review and discuss:

• Methodology to quantify the effect of implementing various scenarios that change UK ag

practice.
• Precision cultivation techniques, CTF, precision weed control.
• The use of winter legume cover crops, strip cultivation methods, inter-row planting, etc.
• The use of electric powered machinery and prime movers (tractors, loaders, harvesters, etc.).
• The potential to increase photosynthesis levels from agricultural cropping and forestry.
• In-situ and on-machinery sensors to monitor and control performance and management decisions. What is the role and potential of automation and robotics?
• Soil management potential for carbon storage and sequestration.
• The significance of soil erosion on the loss of soil C.
• The trends and potential for non-land based foods (including algae and food grown from sewage effluent).
• The protein and energy from land based vegetable meat analogues versus meat from the same area.

The 2011 Foresight Report was mainly a response to the “perfect storm” of climate change, food demand from population increases, food price increases and the environmental needs of sustainable food production. I have attached a copy of the memo I circulated in April 2011 and which formed the basis of the short article in Landwards. I was only involved until the IAgrE report responding to the Foresight report was drafted, but I have heard since that substantial funding was an outcome of the response. Do we have details on how the funding was used to promote sustainable agriculture through agricultural engineering research? Is there a list of outcomes so far?

Information from Dr Alex Keen AMIAgrE

The **Committee on Climate Change** provides independent advice to government on building a low-carbon economy and preparing for climate change

Two reports were published by the Committee on Climate Change on 2nd May 2019.

Net Zero: The UK's contribution to stopping global warming (277 pages). This report responds to a request from the Governments of the UK, Wales and Scotland, asking the Committee to reassess the UK's long-term emissions targets. The Committee on Climate Change recommends a new emissions target for the UK***: net-zero greenhouse gases by 2050.*** In Scotland, it is recommended that the net-zero date is 2045, reflecting Scotland's greater relative capacity to remove emissions compared to the UK as a whole. In Wales, it is recommended that a 95% reduction in greenhouse gases is achieved by 2050. The previous UK target for 2050 was 80% of the CO_2 equivalent emissions in 1990.

Net Zero: Technical report (304 pages). This technical report accompanies the 'Net Zero' advice report which is the Committee's recommendation to the UK Government and Devolved Administrations on the date for a net-zero emissions target in the UK and revised long-term targets in Scotland and Wales.

Both reports in pdf format are available to download at: www.theccc.org.uk/publications

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The main recommendation is a net-zero GHG target for 2050 will deliver on the commitment that the UK made by signing the Paris Agreement. It is achievable with known technologies, alongside improvements in people's lives, and within the expected economic cost that Parliament accepted when it legislated the existing 2050 target for an 80% reduction from 1990. However, this is only possible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay. Current policy is insufficient for even the existing targets.

The second report from the CCC: **Net Zero – Technical report**

This technical report accompanies the 'Net Zero'1 advice report and reviews the evidence considered under the headings: power and hydrogen, buildings, industry, transport, aviation and shipping, agriculture + land use + land use change and forestry, waste, F-gas (fluorinated gas) emissions and greenhouse gas removal.

The most relevant sections from the second, technical, report are P184 to 229 (Chapter 7: Agriculture, land-use, land use change and forestry), and, P268 to 293 (Chapter 10: Greenhouse gas removal).

The attached slides 1 to 8 from the two reports provide some summary focused on the information particularly relevant to agriculture

Slide 1: UK's current GHG emissions target set in 2008

Slide 2: the UK's net-zero GHG scenario recommended in the first CCC report. Quantitative precision is difficult to determine. For example, under agriculture, healthier diets (including less meat and energy intake) appear to be a qualitative aspiration. Quantitative targets and linked cause and effect are left vague.

Slides 3 and 4: These appear more useful in identifying where action is required. Slide 4 shows a small but significant reduction in the agricultural emissions since 1990. The report seems to accept that this relatively low rate of reduction in agriculture will continue and does not propose scenarios to make agriculture a net-zero emissions sector by 2050. The evidence in the second report needs more review through the perspective of agricultural engineers.

Slide 5: as England is the largest land area for farming, its looks as though the dominant influence for the agriculture bar heights maybe cattle – data needs checking.

Slide 6: this slide shows the targets but the sources need checking.

Slide 7 and 8: the slides shows the UK in a relatively good place compared to other industrialised economies (including China) and encourages the notion that the UK could have a major influence and role in supporting developing economies.

Slide 9: this slide is not from the CCC reports but from the internet site on the slide. Numbers of the amount of carbon moving through the paths shown for the global carbon cycle vary from different sources but seem to be of a similar order. The numbers that appear highly relevant to agriculture are the carbon fixed by photosynthesis (120 Pg/yr) and the Carbon lost through respiration from plants and soil (59 and 58 Pg/yr, respectively. Actions that increase photosynthesis and can reduce losses to the atmosphere through respiration could be very important. Unfortunately, this notion is not identified in the reports, but it may be useful for us to consider *(see areas to review under possible actions, in the email)*

Statements relative to agriculture and forestry

- Afforestation targets are 20000 ha/yr increasing to 27000 ha/yr by 2025. 10000 ha/yr have been planted over the last 10 years. Forest cover should be increased from 13% to 17% by 2050. [The recent Land Cover Atlas of the UK (2017) from the University of Sheffield shows that coniferous forest, broad leaved forest, mixed forest and transitional woodland shrub cover 9.8% of UK land – there appears to be some discrepancy with the CCC report in the detail of the data.] (https://www.sheffield.ac.uk/faculty/social-sciences/news/new-uk-land-atlas-reveals-six-percent-uk-built-on-1.744121)
- Measures should take place to reduce CO_2 emissions on farms, including carbon capture and storage (CCS). [These are not prescriptive – what will a net-zero carbon emissions farm look like in 2050?]
- Only electric vehicles will be sold by 2040. Does this include tractors? Will other power sources still be legal?
- One-fifth of agricultural land must shift to alternative uses that support emission reduction: afforestation, biomass production, peatland restoration. [The definition of agricultural land will be problematic, and alternative uses such as wind energy and solar power generation may produce bigger and faster benefits as well a being of greater financial reward to farmers.]
- Less consumption of beef, lamb and dairy products. [Dairy products have been shown to have a much less negative role than cattle grown for meat. A Kenneth Mellanby type exercise needs to be carried out and argued through for the current dietary needs, land use and agricultural knowledge now available.]

- The technical report does refer to robotics and other relevant developments in UK agriculture but this is not in coherent enough presentation and detail to evaluate without further research of the sources and the topics generally.

Alex Keen/20.5.2019