Scottish Environment LINK

Climate Change and Land Use Seminar
Perth 26 March 2007.
Presentations (or resumes) with note of discussion points.

Taking part were:
Chair: Simon Pepper, LINK Honorary Fellow.
Members: Mike Donaghy (Freshwater TF, WWFS), Adam Harrison (WWFS), Mandy Gloyer (Agriculture TF, RSPB), Deborah Long (Biodiversity TF, Plantlife), Carey Coombs (SA Scot), Su Cooper (PL), Paul Gallagher (Planning TF, SWT), Helen McDade (Landscape TF, JMT), Clifton Bain (Climate TF, RSPB) Nikki Sinclair (NTS), Drennan Watson (CC, LINK HF), Beryl Leatherland (MCofS), Denis Dick (SWT), Katrina Marsden (RSPB), Christine Byrne (SWT), Paul Kirkland (BC), Ian McCall (Access Network, RAS).
Speakers and guests: Geeta Wonnacott (SE CC Team), Emma Jordan (SNH), Grant Moir (LL&TNPA), Hugh Clayden (FCS).
Staff: Jen Anderson, Jane Herbstritt, Adean Lutton, Hugh Green, Alice Walsh

Context: The climate change agenda is moving swiftly ahead, with the main emphasis on carbon cuts. There is a clear danger that the rest of the environmental agenda will be relegated according to its effect or otherwise on carbon cuts. LINK needed to be prepared to deal with emerging agendas by:

- Demonstrating how our agenda helps in mitigation and adaptation.
- Pulling together our expertise on sensible approaches to mitigation / adaptation.
- Countering unsustainable approaches to reducing carbon.
- Reappraise our current conservation approaches – are they are fit for purpose?

LINK Climate Change task force has 3 active members (RSPB, FoES, WWFS). Its focus will be on the forthcoming Climate Change bill. Other LINK TFs need to ensure that the work they are already doing is appropriately framed in the climate change context.

Action: TFs to identify up to 3 actions for their TF to take forward.

ADAPTING TO CLIMATE CHANGE – NATURAL ENVIRONMENT

PRESENTATION Adapting to climate change: the outlook for biodiversity, Deborah Long

1. Detecting & understanding change
2. Restoring & creating habitats
3. Flexibility in conservation programmes
4. Building resilience
5. Tackling fragmented landscapes

Predicting change: use of models

- Impacts on microhabitats
- Identifying future vulnerable species
- Identifying future invasive species
- Impacts through food chains & ecosystems.

Field monitoring of change

Identifying refugia
2. Restoring & creating habitats
Secure current species & habitats
Identify & conserve keystone species irrespective of current threat status
Protect sites

3. Embedding flexibility into conservation programmes
Important Plant Areas: maps showing an example of a spatial planning tool for biodiversity conservation, butterfly colonization example.

4. Building resilience
Conserving genetic variation at population level
Using adaptive management strategies
Integrate local knowledge with science to maintain or adapt local ecosystems
Provide incentives to conserve semi natural vegetation & ecosystems & ensure all new plantings are ecologically suitable
Tackling fragmented landscapes
Building an effective policy framework: integration into wider policy using EPI
Educating policy makers
Develop mechanism to value biodiversity: economically, culturally & socially
Using current policy to maximum advantage, eg biodiversity duty, WFD

What's still to be done?
1. Detecting & understanding change
Refine models of change
Conduct long term field monitoring of change
Identify refugia
Increase public support with effective examples & increased participation

2. Restoring & creating habitats
Continue to conserve species
Protect sites as part of functioning ecosystems
Manage sites for change

3. Embed flexibility
Plan for biodiversity & future change
Ensure all land management schemes are biodiversity positive

4. Build resilience
Conserve genetic diversity at population level
Implement adaptive management strategies
Incorporate local knowledge with science to manage local ecosystems
Provide incentives to conserve semi natural habitats as carbon stores & ensure new plantings are ecologically suitable

5. Tackle fragmentation
Implement EPI in Scotland
Provide mechanisms to value biodiversity
Use current policy mechanisms to the full

Biodiversity has an economic value – demonstrate this though don't let it overshadow its other values.
We need to get cleverer. Biodiversity is a low consideration for efforts on climate change.
LINK can show the way from member's projects on the ground and identify the policy mechanisms for the longer term.

PRESENTATION: Adapting to Climate Chang e- Flood Risk Management - Mike Donaghy.

Flooding is going to get worse
A major consequence of CC, from a flood risk perspective, is the increasing difficulty for forecasters to predict storms and therefore to warn people reliably of the likelihood of flooding.

The UK government's **Foresight Report for Scotland** predicts that:
These storms will produce bigger floods.
They will become more localised.
They are also likely to become more violent.
They will also come more often.
Foresight by SE LINK
SE LINK argued successfully in the Scottish Parliament that it should include **sustainable flood management** and wetlands in the transposition of the Water Framework Directive to the Water Environment Water Services (Scotland) Act 2003.
Within the context of Climate Change adaptation this has proved invaluable in developing a response to the management of increased flood risk.
The Government accepts that building concrete schemes is not the way forward.

Government's response to managing increased flood risk
Formation of National Technical Advisory Group on Flooding. **SE LINK**
Increase in grant aid to LAs to 80%.
Increase in aid budget to £89 million.
Flood Issues Advisory Committee was assembled: awareness, avoidance, alleviation and assistance themes. **SE LINK**
SPP7 was produced to control development on flood plains.
SNIFFER flood risk management steering group contracts government research. **SE LINK**
(Association of British Insurers ended the agreement for universal coverage in Scotland. They altered their policy on resilience too.)

SE LINK's response to managing increased flood risk
Freshwater Task Force: main activists are RSPB and WWF
WWF leads on flood risk management
Realisation that there were no existing sites demonstrating the role of natural flood management in the achievement of sustainable flood management.
WWF already had a previous record of working well with Clackmannanshire Council and the hydrologists Mountain Environments. The River Devon exhibited most of the features and issues common to rivers in Scotland and elsewhere. Meetings were held with land users. A flood process map was produced and sites were selected. The River Devon Natural Flood Management Demonstration Site was created.

The River Devon Natural Flood Management Demonstration Site
Main Principles:
Deal with the causes of flooding not just the effects

Catchment Approach
Upland to Lowland
Use Natural Processes to Slow the Flow
Soft Engineering

Catchment approach

- The whole catchment is examined and the flood processes identified
- Natural Flood Management uses a range of techniques all on different scales e.g. upland wetlands and native woodlands, large and small
- NFM aims to combine the integrated effects of many different sites multiplied through an entire catchment to reduce peak flows in the rivers

Upland to lowland
NFM also works from the uplands to the lowlands using the knowledge that storms are more intense in the uplands and there is a strong link between the uplands and lowlands. If the runoff can be attenuated in the uplands then flood peaks in the lowlands will be reduced

NFM techniques

- Restoration of upland wetlands
- Upland reforestation
- Plantation forest management
- Restoration of gully woodlands
- Alternative reservoir management
- River restoration
- Restoration of floodplain wetlands
- Restoration of riparian woodlands
- Management of urban watercourses

Many **upland wetlands** were drained in the past to improve grazing – restoration can increase their potential to store large volumes of storm water
At Glen Day, Devon catchment Large straw bale positioned to block drain. Anchored and planted with willows. Increased capacity of wetland by 50%.
Trees planted to create a ‘leaky barrier’ on the wetland
Uplands throughout the UK have been cleared of native woodlands which act as a storm water buffer between intense rain and surface watercourses

Forest management
Plantation forests designed before F&WG are being clearfelled, exposing old artificial drains. Exposed hillslopes need to be re-habilitated towards natural drainage

Gully woodlands
Upland gully woodlands have a strong influence on runoff rates in headwater areas – the woodlands potentially buffer watercourses from rapid overland flow. Large woody debris can cause 34% more water to be stored and reduce water speed by 13%

Reservoir management
Reservoirs store water and potentially can be drawn down before storms to create large in-line attenuators of flood water

River restoration
River restoration is part of NFM where natural channels have been canalised, erosion rates are excessive, habitats and vegetation have been lost – restored rivers transmit floods in a controlled way. Willow Spiling(pic) in position to reduce erosion, particularly of fine sediments

Floodplain wetlands
Wetlands in the floodplain are off-line stores of water – many have been drained to improve agriculture but this results in the loss of potential storage and rapid drainage after partial flooding

Riparian woodlands

Woodlands on the floodplain can add to the off-line floodwater storage – riparian woods can be designed to allow water behind the wood which act as a 'leaky barrier'

Urban watercourses

Urbanisation usually includes major modifications to watercourses. Most of which increase rates of runoff – techniques such as roof water storage and sediment management need to be used

Flood monitoring

A network of river gauging, flood level and rainfall stations was established in 2002 and are used to quantify the effectiveness of the work

Wildlife monitoring

NFM also results in environmental gain – habitats and wildlife are monitored during the project

Local people

Benefits to the local people were monitored through public workshops and consultations

Practicalities

- NFM has the capacity to deal with much of the uncertainty created by Climate Change
- NFM depends on land users, who need to get economic benefits from implementation
- NFM is a long term solution and may need an interim solution such as temporary flood defences
- NFM techniques need to be better developed
- There are several additional benefits created by taking the NFM approach
- SFM requires changes to planning policy and should be linked to River Basin Management Plans
- **Flood Policy requires to be updated to allow for the SFM duty to be realised**

DISCUSSION

Water Framework Directive gives great opportunity for participation and joined up thinking and planning. Natural flood management approaches are good for biodiversity, have a big role in making communities safer, and are far cheaper than the alternative engineering approaches, which also have their place. 1961 Flooding Act is likely to be replaced next year.

There are opportunities to divert flooding funds to eg agriculture budgets for land management options. Payment for environmental services features large in the EU Forest Action Plan. Explore further with FC.

Framing the debate is crucial and we need to get smarter in our communications. Climate change is one of 3 global crises including water, loss of biodiversity. We need to spell out how they interact. Complexity and the role of science is not well understood. Complex systems need to be properly investigated when key indicators show problems.
A 'risk management' step by step approach to climate change would be useful – a new approach for conservation organisations.
Landscape Management is the bigger picture. There is an EU expert group on Land Use Planning, not done in Scotland. Leadership required. ?LINK.
Defra promoting 'ecosystem services' - be prepared to explain cash or carbon savings. This links to the economic value of the natural heritage that LINK is starting to work on.
Blockages: Problems with lateral –type approaches include old boys network, or companies managed from overseas. Civil servants find NFM approach (once value understood) difficult to work with – used to linear approach and dealing with short term budgets. Solution to give money to the body in charge to distribute rather than SE depts.

EMERGING INDUSTRIES – THREATS AND OPPORTUNITIES

PRESENTATION: Biomass Energy & the Natural Heritage - Emma Jordan, Scottish Natural Heritage

Outline

SNH Renewables Policy
Overall Position on Biomass
Natural Heritage Issues
Recommendations for a sustainable industry

SNH Policy on Renewable Energy - Support development of renewable energy subject to due care for the natural heritage:
A strategic approach: guide towards locations and technologies most easily accommodated within Scotland's landscapes and habitats
Safeguard nationally and internationally important areas

Overall SNH Position on Biomass

SNH **supports** biomass energy which delivers overall **GHG savings** in the electricity, heat and transport sectors
Most natural heritage impacts can be addressed through **good land management practices**

Support the use of **standards** and **guidelines** to ensure a sustainable biomass industry
GHG Savings
Life cycle analysis is essential
GHG emissions from

- Transport
- Land use type & management
- Fuel processing

Good Land Management Practices

Overall, natural heritage effects depends on the material used & the land use it is replacing

Effects on Biodiversity

Woody Biomass Benefits

- Better woodland and forest management
- Increased thinning
- New planting of broadleaved woodland
- Better management of farm woodland and hedges

Threats*:*

- Exploitation of woodlands of high biodiversity value
- Total removal of scrub and deadwood
- Extension of planting onto natural/ semi-natural land

Energy Crops Benefits (if replacing arable)*:*

- Cyclical harvesting
- Multi species coppicing
- Limited use of pesticides
- Retain overwinter stubble
- Retention of tree belt/ edge

Threats:

- Planting on high quality set-aside
- Use of non-native strains
- Uncontrolled planting of GM varieties

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Effects on Soil & Water Quality

Woody Biomass Benefits:
- Better woodland and forest management
- Increased thinning
- Better management of farm woodland and hedges
- Ash recycling

Threats:
- Total removal of scrub and deadwood
- Whole Tree Harvesting (WTH)
- Harvesting & re-planting on peaty soils
- Use of heavy extraction equipment
- New access tracks
- Ash recycling

Energy Crops Benefits:
- Cyclical harvesting
- Multi species coppicing
- Bioremediation of brownfield sites
- Lower fertiliser requirements

Threats:
- Use of monocultures
- Water demands of willow coppice
- Planting on high quality set aside land
- Total removal of residues
- Use of heavy extraction equipment
- Build up of biotoxicity

Effects on Landscape

Benefits:
- Landscape diversity from farm woodland and hedges
- Increased planting of native woodlands
- Cyclical harvesting
- Multi-species coppicing

Threats:
- Clear felling
- Use of monocultures
- Overexploitation of natural woodlands

Effects on Recreation & Access
Benefits:
- Improved habitat diversity
- Incorporation of access corridors through SRC plantations

Threats:
- Loss of access in rural arable areas

Recommendations for a Sustainable Industry
+ Compliance with existing good practice guidance- FC, GEAC
+ Compliance with existing environmental standards/ accreditation schemes- UK Woodland Assurance Standard
+ Use of life cycle assessments
+ More research into the effects of energy crops on the natural heritage
+ Need for ongoing review of land use changes to ensure a sustainable balance between competing demands

PRESENTATION: Biofuels in Scotland: opportunities and threats - Adam Harrison WWFS

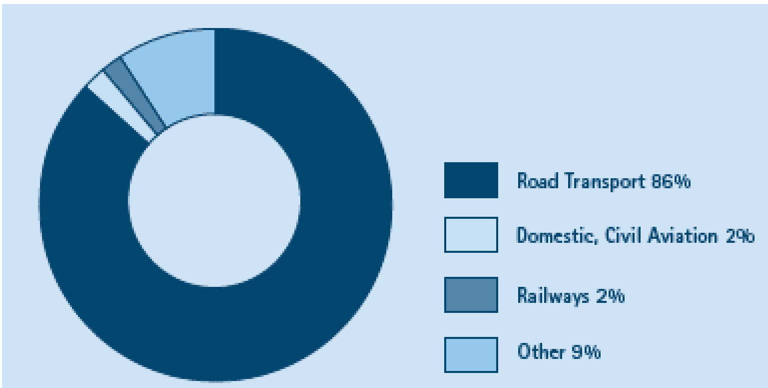
1. Definitions:
Bioenergy – the production of energy from biological matter – usually grown but also wastes.
Biofuels – liquid fuels derived from biological materials – usually thought of as transport fuels – but can also be used as heating fuels and for electricity generation.

- Bioethanol can be made from starch and sugar crops – (conventional arable crops like wheat, barley, sugar beet and sugar cane). Globally bioethanol makes up 90% of transport biofuels – mainly produced in Brazil and US. Production doubled between 2000 and 2005.
- Biodiesel from vegetable oils (such as OSR or imported oil crops like palm oil and soya) and animal fats. Globally only c. 10% of transport fuels – most produced in Germany. Quadrupled between 2000 and 2005.
- Biogas can also be produced from slurry, solid waste and sewage by both gasification and fermentation. It has the potential to be very efficient.
- In the future, it will be possible to derive biofuels from grasses and woody feedstocks that could come from dedicated energy crops such as SRC and miscanthus as well as from forestry and pasture products. Future biofuels such as these are known as *second generation* biofuels. They are likely to have much better GHG balances and lower environmental burdens because of the types of crops and by-products that can be used and the efficiency of conversion – however it will be 10 years at least before they are commercially viable.

2. Challenges:
Transport fuels are where the greatest interest in bioenergy has been generated.

Transport accounts for 22% of Scotland's emissions – 3.2 Million tonnes of C equivalent in 2004.

Greenhouse Gas Emissions by the Transport Sector in Scotland, 2004 (National Transport Strategy):



Net emissions of greenhouse gases (including Land Use, Land Use Change and Forestry category) in Scotland in 2004 were 14.6 million tonnes of carbon equivalent (MtC). The transport sector was the second largest contributing sector behind energy supply, contributing 22% of emissions.

Between 1990 and 2004, emissions from the transport sector increased from 3.0 to 3.2 MtC, an increase of 7%. This contrasts with a decline in emissions from every other sector in Scotland except the residential sector. Transport emissions are expected to grow by 27% by 2021.

The Executive states that "Delivering carbon savings is a central feature of Scotland's National Transport Strategy."

3. Opportunities:

Emissions savings

Existing measures to cut transport emissions as outlined in Scotland's National Transport Strategy (Dec 2006) are expected to generate **annual savings of 500 kilo tonnes of carbon by 2010** (see figure 8) and greater reductions thereafter. These measures are not, however, expected to reduce the overall level of emissions from transport but rather to offset the growth in transport emissions that is expected to occur between 2004 and 2010. In reality they account for only about 15% of 2004 transport emissions.

Savings from the use of **transport biofuels** is expected to amount to only 130 KtC - about 4% of 2004 emissions by 2010.

Figure 8: Reserved and Devolved Existing Transport Policies - Scotland Carbon Impacts

Policy	Reserved or	Annual carbon

	Devolved?	savings (KtC) in 2010
In UKCCP 2000		
Voluntary Agreement Package (company car, vehicle excise duty, voluntary agreements)	Reserved	190
Fuel Duty Escalator (1993-1999)	Reserved	150
Wider Transport Measures (including sustainable distribution)	Devolved	70
New in UKCCP/ SCCP 2006		
Renewable Transport Fuel Obligation Scheme (RTFO)	Reserved	130
Future EU level voluntary agreement with car manufacturers to reduce CO2 emissions from new cars	Reserved	8
Total		**548**

But developing biofuels offers other opportunities of interest to the Executive:

Security of supply – biofuels offer a greater diversity of fuel supply countries including the possibility of some supply being domestic. This is the major political driver of biofuels in the US – not GHG savings.

Estimates vary but some think the EU could supply c. 25% of its demand. US upto 75%.

Sugarcane alone could displace 10% of global transport fuel.

Higher agricultural commodity prices and new products and markets – offer income and rural development opportunities for Scottish farming and rural businesses. There are already signs that world commodity prices are rising because of biofuel demand. This may be a mixed blessing since Scottish livestock production relies on cheap grain for feed. However it could mean more availability of oil crop by-products – soya feed as a by-product of soya oil production – a reverse of the current situation;

In Mexico there have already been riots over the rising cost of maize flour – a staple of the Mexican poor and the American SUV.

Who will benefit? International agribusiness unless development can be shaped to benefit others. Some of the developments in Scotland are by farmers producing fuel for their own use but the majority is large industrial producers, relying on cheap imports of international commodities like palm oil and soya.

Flexible – able to store and transport to point and time of use – unlike wind

4. Will biofuels make any difference?

Biomass for heat makes more sense than transport biofuels:

Half of the UK's energy demand is for generating heat – domestic and commercial;
The most carbon efficient conversion technologies for bioenergy are to produce heat or CHP. Typically 85% of the energy content of biomass can be utilised through burning of woody biomass.
Gasification of biomass to produce electricity is more efficient than conversion to transport fuels.

Emission savings are limited:

Savings from the use of **transport biofuels** is expected to amount to only 130 KtC - about 4% of 2004 emissions by 2010. One of the reasons for the relatively small contribution of biofuels to reducing transport emissions (beyond the fact that they are projected to rise so quickly) are **blend limits** – technically any biofuel can be used up to 100% - but engines will need modification. Until new vehicles replace existing then it is likely that the majority of biofuels will be used at c 5% blend – therefore limits capacity to cut emissions.

Biofuels will only be part of the solution to transport emissions:

Limits on both the likely emissions savings and those imposed by environmental limits to production outlined below will restrict the likely contribution of biofuels to reducing the expanding emissions from transport.

Other strategies based on carbon pricing and trading, vehicle efficiency improvements and demand management through investments in alternatives (planning, public transport, remote working, etc) are needed to tackle the problem.

5. Threats:

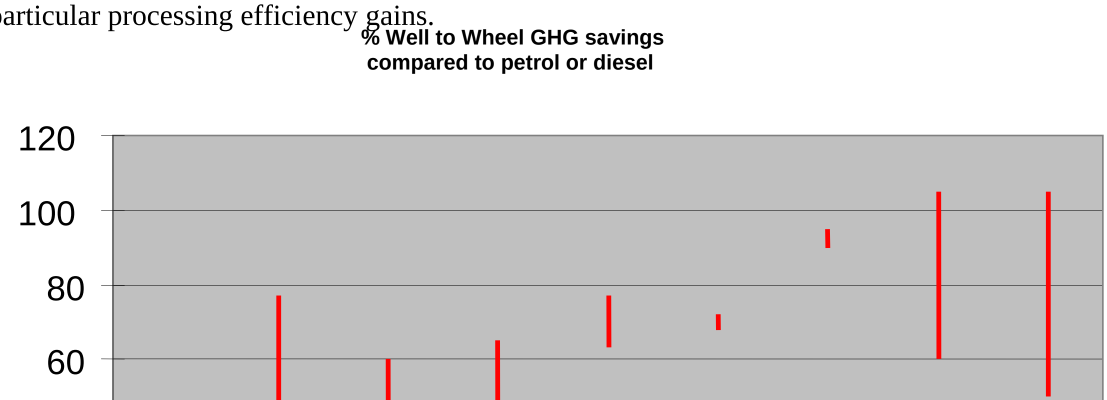
GHG balance:

Biofuels are often referred to as carbon-neutral because the carbon released when they are burnt has been absorbed in their production.

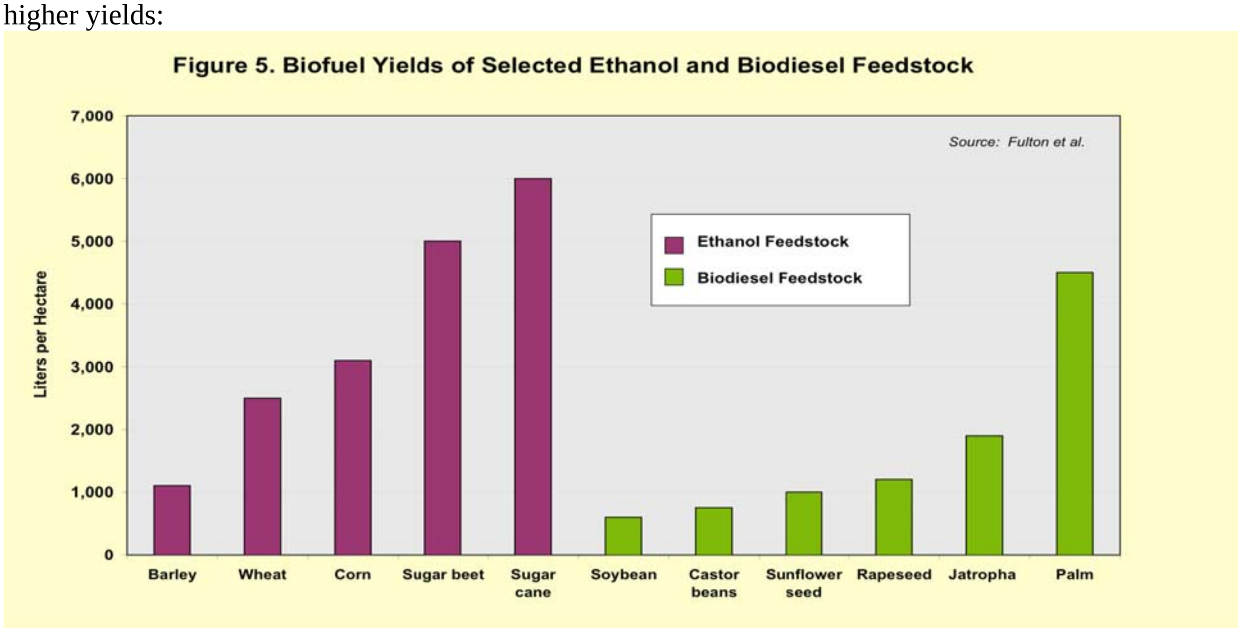
In reality all bioenergies use energy in their production ranging from the manufacture of inputs like fertilisers; and the use of fuel for cultivation, harvesting, transport and processing into useable fuels. In some cases this energy use (usually in the form of fossil fuels) can produce as much or more carbon than can be saved from replacing fossil fuels in transport.
For example there has recently been a shift in the US from using natural gas to using coal to generate the energy used to process corn into ethanol – seriously compromising the total GHG balance of US corn bioethanol (see chart below).

Biofuels also have other associated emissions – NOxs released as a result of using fertilisers. Also poorly used burning biofuels can have NOx emissions themselves;

At each stage in the life-cycle choices are available that can improve or worsen the GHG balance of the final product – making individual fuels more or less climate friendly. UK and European yields of conventional arable crops are already high and unlikely to improve without GM. There might well be savings to be made on energy balances from maximising input efficiencies and in particular processing efficiency gains.



In general tropical feedstocks are likely to have a better balance than temperate – because of higher yields:



Land use:

Calculations based on current average yields suggest that if targets for biofuel use were to be met in the UK from domestically produced oilseed rape and wheat for biodiesel and bioethanol respectively, approximately 1.9 million hectares would be required. This is equivalent to 32% of the UK's arable land. (RSPB) whilst the NFU estimate 900 000 ha – and believe that this can be accommodated from set-aside and within current wheat production that is in excess of UK demand.

Biodiversity, water, pollution, landscape, access, heritage:

Currently known arable crops – OSR, wheat, barley etc will have known biodiversity, landscape, pollution impacts – but on a larger scale if demand increase substantially. In particular there is a threat to expansion of production into land currently used for biodiversity benefits such as set-aside and possibly permanent grasslands.

New second generation perennial crops – miscanthus – on a much bigger scale may have new impacts – landscape? Otherwise there has been little research done on likely biodiversity impacts. Once established at least they have lower water, fertiliser and pesticide demands than conventional arable crops so are likely to have fewer environmental impacts.

Second generation woody biomass production (SRC and forestry) – if they expand could have significant landscape and biodiversity impacts – either positive or negative depending on how it is planned and how diverse a structure is created. An issue of concern could be the water demands from establishing woody crops – particularly of exotic species.

OSR is widely touted as the best bet biofuel for Scotland. Scotland has some of the highest OSR yields in Europe – and currently a surplus of supply. In 2005 Scotland planted 35 000 hectares of OSR (9000 of which was non-food on set-aside or as energy crop) and produced 124 000 tonnes. However even here it is recognised that costs are too high and potential too low for it to be a major part of the biofuel mix. Planned capacity in 'Scotland' is already at 750 000 tonnes ie: imports will be needed for Rosyth and Grangemouth plant capacity;

Real threat comes from threatened expansion of production in high conservation value areas in south east Asia and Latin America.

Tropical countries such as Indonesia (palm oil) and Brazil (sugar cane and soya), will play an important role alongside domestically produced crops.

The FAO expect that demand for palm oil will double between 2001 and 2030 to 54.2 Mio. t (25,6 Mio. t 2001), from both fuel and conventional uses (FAO 2006 FAO: World Agriculture: towards 2030/2050. Rome). By 2050 such uses (biofuels) may account for some 42 percent of total use compared with 24 percent at present and only 16 percent 30 years ago.

Developments are happening already:

http://www.dailyexpress.com.my/news.cfm?NewsID=38985
Sabah, the biggest palm oil producing state in Malaysia, is set to become the world's premier bio-diesel producing area with a 300,000 tonnes-per-year plant to be set up at the state's palm oil industrial cluster in Lahad Datu. *(The government of Malaysia has plans for 7 such industrial clusters)*. It is envisaged that the plant will have an initial capacity of 150,000 tonnes when it goes into production in September 2007. Full capacity is expected to be achieved in December 2008. Most of the production is also expected to be exported to Korea.

http://www.pbs.org/nbr/site/research/educators/060605_29b/
Malaysia, which produces 47% of the world's palm oil has announced plans to construct three palm oil plants that would produce more than 120,000 tons of biodiesel in 2006, with their output rising to 500,000 tons in 2007.

During the last two decades of the twentieth century, more than 300 million hectares - an area larger than the size of India - of tropical forests have been cleared for plantations (including palm oil and soy), agriculture, pasture, mining, or urban development.

Over the next 25 years, a further 250-300 million hectares of tropical forest are likely to be lost in this way.

Oil palm is the fastest expanding crop in the tropics.

- Worldwide, oil palm area increased by 43 per cent to 10.7 million ha during the period 1990 to 2002
- Global palm oil production is expected to nearly double by 2020.

- In Argentina, soy now occupies more land than all other crops added together.
- In Mato Grosso, Brazil's single biggest producer state, soy cultivated area increased 89 per cent between 1995 and 2004
- Future expansion of soy cultivation is expected to be accommodated in South American producer countries (Argentina, Bolivia, Brazil and Paraguay), as China and the USA have little arable land reserves.

Land use change emissions – the biggest threat:
Emissions associated with land use change – because of carbon released from pet soils, tropical rainforest, wetlands - could be far greater than any savings made from replacing fossil fuels;

It has been estimated using IPPC guidelines that it would take 250-500 years to break even if produce biodiesel from soya on cleared rainforest in Brazil;

Already 18% of global GHG emissions are caused by deforestation and 80% of Brazilian emissions are due to deforestation

6. What biofuels are being developed in Scotland?

Argent Energy - 2004 – Lanarkshire – used vegetable oils and tallow for biodiesel – c. 50 000 tonnes p.a. – 50 million litres – £1.2 million of SE support;

Terra Eco Systems – sewage waste to be used as fertiliser in Lothians to produce barley and wheat for processing into bioethanol in Europe and OSR for biodiesel in Europe;

Ineos Enterprises – 2006 - Grangemouth biofuels refinery biggest in Europe - £9 million of SE support – expecting to open in 2008 – and supply 35% of UK's biodiesel – 500 000 tonnes p.a. projected OSR or more likely imports – Palm oil and soya?

DMF Biodiesel – 2006 - Rosyth – demand for 250 000 tonnes of OSR p.a.

Oran – Kintore, Aberdeenshire - tallow for electricity generation not biofuels.

Only 25 petrol stations supplying biodiesel in Scotland – RIX Petroleum

An unknown number of small UVO processors and farmers producing their own fuels.

7. Policy drivers:
Farming Policy:
CAP reform has tended to reduce the influence of policy over cropping choices at the farm level – although the energy crop payment Euro 45 per hectare does support biomass crops.

There is also a range of rural development schemes under development but to date these have focussed on establishing supply chains of woody biomass for heat.

Set-aside policy – is it going to be dropped?

Biomass Action Plan:
Places some emphasis on the role of public procurement in stimulating markets – the FC have 120 vehicles running on biofuels.

It is also using Regional Selective Assistance funds to invest in processing capacity.

The Renewable Transport Fuel Obligation – the main policy driver

Background:
To date UK government support for biofuels has been through fuel duty incentives. Biodiesel and bioethanol are taxed at 27.1p per litre (20p per litre less than fossil petrol and diesel). This support is guaranteed until March 2009. The biodiesel incentive has been in place since July 2002. The bioethanol one has been in place since January 2005.

EU Directive 2003/30/EC of 8 May 2003 requires Member States to set indicative targets for their use of biofuels in road transport for 2005 and 2010. The Directive includes 'reference values' of 2% biofuel sales (as a proportion of all road fuel sales) for 2005, and 5.75% for 2010. Member States can set their own targets, but deviations from the reference values must be justified. Last week the EU updated its targets for transport biofuels to 10% by 2010 if they are produced sustainably.

The UK response to the directive is the RTFO modelled on the existing Renewables Obligation in the UK electricity supply industry and was announced by Alistair Darling on 10 November 2005. Through this initiative the RTFO expects to reduce the carbon emissions from road transport in 2010 by about 1 million tonnes, equivalent to taking 1 million cars off the road (130 KtC in Scotland). However at this stage GHG savings targets are NOT being set – simply renewables fuel use targets and obligations.

The RTFO will (from April 2008) obligate transport fuel companies in the UK to replace 2.5% of their total transport fuel with biofuels by 2008/09, 3.75% by 2009/10 and 5% by 2010/11. Certificates will be issued when renewable fuels are supplied. At the end of the obligation period (April to April), these certificates must be produced to the Administrator[1] to demonstrate compliance. Certificates can be traded.

If companies do not have enough certificates at the end of an obligation period, they will have to 'buy-out' the balance of their obligation by a payment to the Administrator.

The Government acknowledges that different biofuels can have very different environmental benefits in terms of greenhouse gas savings depending on a number of factors including production, processing and transportation of feedstock. The promotion of biofuels could also lead to unintended, negative environmental and social impacts. Accordingly, under the RTFO, Obligated Companies will be required to submit reports on both the net greenhouse gas saving

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[1] The RTFO Administrator will be an NDPB and will formally come into existence once the RTFO Regulations are approved by Parliament in late 2007.

and sustainability of the biofuels they supply – using methodologies currently being developed in consultation with some stakeholders.

Environmental issues of concern:

Growing biofuels may release more GHG than it saves:

Although the RTFO is on paper a CC policy it has not in fact set GHG savings targets – only targets for how much renewable transport fuels to be used. The danger is that without being able to distinguish between renewables that are less GHG saving than others the RTFO will not have an overall impact on CC.

A GHG accounting methodology is being developed by consultants to allow in the first place GHG savings to be measured and reported (monthly and at the end of each obligation period - April) but with the proviso that in the future it might be used to set the level of support being offered to renewables – the greater the GHG saving the higher the level of support.

GHG measuring has to be full life-cycle – the methodology being developed seems good (covering the life-cycle from farming to fuel tank) but currently major omissions include the emissions from converting land from for instance forests, peatlands and wetlands in the tropics to biofuel feedstock production. This is not such an issue in the EU where feedstocks will probably be produced on existing arable land. However there might be cases of permanent grassland being ploughed up.

Emissions associated with land use change will be reported under the sustainability reporting (not the GHG reporting). Unfortunately the sustainability reporting requirements allow companies to give 'don't know' reports – ie: do not have to present the information, which means a supplier does not need to provide the information.

Where no land-use change information is available or provided for a particular batch of fuel default values will not be set for GHG emissions – because it is thought that it would be too difficult to set the levels accurately and it would discriminate against feedstocks from regions where forest loss is known even if the particular feedstock has not caused loss.

It would seem that there will be no incentive for companies to even attempt to report on land-use change – there is no compunction to, no penalty if they don't and that will happen if they do is that they will have even lower GHG savings associated with their product.

Growing biofuels may have severe habitat and biodiversity impacts – particularly overseas:

Although on paper the biofuel industry will be able to source UK feedstocks production is never likely to be sufficient and all the major UK biofuel processing plants are being developed in close proximity to ports and much of our biofuel requirement will be imported and based on soy (from Latin America) and palm oil (from SE Asia) for biodiesel and sugar cane (from Brazil and possibly southern Africa) for bioethanol.

Estimates are not consistent but indicate that feedstock demand for palm oil for instance is likely to be at least as great as current food and cosmetics use. This means that biofuels are likely to be a major contribution to further forest loss and other environmental impacts.

The RTFO has no requirement for batches of biofuels to have been produced to certified standards. It will expect companies to report what standards are being met but will allow any standard to be included. On the positive side it is using a range of existing and developing assurance schemes such as LEAF for UK arable feedstocks as well as international schemes for palm oil and soya.

The UK government argues that strict standards will not be WTO compliant:
DfT are claiming that requiring reporting (either GHG balance or sustainability) and even more so requiring minimum standards for either will act as an illegal barrier to trade under WTO rules. However this has never been tested in the WTO and many parties assume that since the policy is designed to address CC which is an internationally accepted problem using IPCC guidelines which are also internationally accepted it is unlikely that a dispute would be upheld.

Other issues:
Influence on the EU:
Along with a scheme in the Netherlands the UK's RTFO is the only such scheme in the EU. The EC is interested in combining the Dutch and UK schemes and designing a pan-European scheme to push Member States into implanting the Biofuels Directive more quickly and more sustainably.

Summary:

- The RTFO is supposed to be about encouraging low carbon transport fuels and therefore tackling climate change.

It's likely to fail in this because:

  - It will have no mandatory standards for either the carbon intensity or the sustainability of the fuels it will allow to be counted towards the obligation companies will be under from 2008 – there is no way to distinguish 'good' from 'bad' fuels;
  - The methodology being developed to report on carbon intensity will not measure the full life-cycle carbon balance of a fuel – in particular it does not include the emissions associated with converting forest/wetlands/peatlands to biofuel plantations. These emissions could easily outstrip any savings made compared with using fossil fuels;
  - The reporting requirement for sustainability will allow a 'don't know' response;
  - *There is no firm commitment to mandatory standards in the next RTFO.*

- **The Risks:**

The RTFO as designed will push or at least allow the rapidly emerging, expanding and developing biofuels industry down the road of unsustainability because it gives confused messages and targets for obligated companies about what they have to achieve:

  - There is no reward for reporting on real carbon-intensity - higher-carbon fuels will be able to count against the obligation to the same degree as lower-carbon fuels;
  - There is no requirement to reach sustainability standards – in fact there are three levels of standards none of which is mandatory.
  - *It will undermine emerging industry standards like the RSPO and the RTRS – what is the point of biofuel companies joining them if there is no reward?*

- **Environmental implications:**
  - High carbon fuels will not lead to climate change emission savings – either directly because there is no way of distinguishing and favouring low-carbon fuels, or indirectly because the RTFO will not be able to account for the full life-cycle carbon balance of the fuel.

- Lack of mandatory standards will not allow the UK to stop the use of biofuels that have caused HCV habitat loss – in fact the demand for biofuels "at any cost" will drive forest, wetland and peatland loss;
- It will fuel the market for unsustainable palm, soya and sugar cane – with multiple social and environmental impacts.

- **Solutions:**

Minimum standards for GHG now and sustainability as soon as possible.

RTFO is developing a broadly accepted methodology for measuring or estimating the life-cycle GHG balance of a range of feedstocks. This could work now and there are signs of business agreeing.

Similarly standards will ultimately be needed for wider social and environmental impacts. Processes like LEAF for UK arable crops, Roundtable on Sustainable Palm Oil, Roundtable on Responsible Soya, etc are working up standards and auditing protocols which when ready will have to become part of a mandatory standard.

Resources List:
WWF Position Paper on Biofuels in the EU – September 2006 -
http://assets.panda.org/downloads/wwf_position_eu_biofuels.pdf
SPICE Briefing on Biofuels – December 2006 -
http://www.scottish.parliament.uk/business/research/briefings-06/SB06-108.pdf
SAC Economic Evaluation of Biodiesel Production from Oilseed Rape grown in North and East Scotland – October 2005 -
http://www.hie.co.uk/HIE-economic-reports-2005/sac-biodiesel-executive-summary.pdf
Biofuels for Transportation: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century – 2006 -
http://www.worldwatch.org/taxonomy/term/445
Department for Transport – Renewable Transport Fuel Obligation – webpages -
http://www.dft.gov.uk/pgr/roads/environment/rtfo/
Scotland's National Transport Strategy – December 2006 -
http://www.scotland.gov.uk/Resource/Doc/157751/0042649.pdf
Low Carbon Vehicle Partnership - http://www.lowcvp.org.uk/

DISCUSSION
It is important for LINK to keep eye on the main ball of greenhouse gas savings over time – lessons here for LINK from wind power expansion.
How gains/losses are measured over lifetime. Communications issue in keeping perspective, and required sophistication at decision-making level in Scotland.
SE is currently pump-priming the wrong type of demand.
Co-Firing consultation on now.
Tropical forest cover crucial if we are to remain below 2 degrees above pre-industrial levels.
On demand side – we need to encourage much broader look at traffic reduction.
Forestry lessons have resulted in useful tool-kit which could be applicable for biomass/agriculture.
?LEAF standards for arable as standard for feedstocks.
Safeguards will depend on scale of demand – unknown. FC anticipates 1000 h/a new SRC.
Set Aside will be needed – anticipate abolition after 2008 CAP health check, huge biodiversity implications.

Carbon argument against utilising low carbon soils for biomass as also prime food growing areas – increase need for imports.
WCL literature review on biomass imminent. Defra also reviewing land use across UK.

SOILS – RETAINING OR RELEASING GREENHOUSE GASES

Peat and carbon – Clifton Bain

Greenhouse gas emissions
- 35% from energy supply (power stations, heat and electricity)
- 20% C02 emissions from land use change
- Largely drainage of organic (peaty) soils for agriculture and forestry

Conservation Tool Kit
- Nature Conservation (Scotland) Act 2004
  - Aim to deliver conservation objectives
  - Landowners supported
  - Community understanding
  - Activity beyond site boundary
  - Connection to planning system
  - Biodiversity duty on Public Bodies and Govt Depts

- EU Wild BirdsDirective, EU Habitats and Species Directive
  - Rigorous examination of potentially damaging activity
  - Favourable conservation status throughout species and habitat range

- BAPs – Species and Habitat Action Plans
  - Clear priorities and objectives
  - Actions recognise economic context
  - Reduce market distortions and align incentives to promote biodiversity
  - Engages across sectors of Govt

While peat bogs are a phenomenal store of carbon, a healthy bog will contribute to global warming via methane emissions. Not a sequestration solution. Short term carbon savings can be made by bog damaging planting – massive losses long term.
Below 2 degrees warming, outlook for blanket bog is not bad. Stressed bogs will get worse – negative feedback loops.

PRESENTATION: ECOSSE – A Funders perspective – Geeta Wonnacott SE Climate change and Air Division.

Development Of A Model To Simulate Carbon And Nitrogen Dynamics In Organic Soils And Predict The Response Of These Soils To Land Use And Climate Change became ECOSSE.

SE & WAG had a very basic set of questions and the contractors turned this into a novel and scientifically sound piece of work! – land use was a significant source of GHGs and both Scotland and Wales had a lot of soils which could contribute to emissions….

- Scotland & Wales have a lot of soils with a surface organic horizon (peats and organo-mineral soils) and soils where the surface layer is not present but they still contain a large amount of carbon
- Land use change affects many of these soils in both countries e.g. CAP reform, expansion of biomass/biofuels
- The impacts of land use and climate change on these soils is uncertain
- C stock values for soils are uncertain – it is hard to predict the **magnitude** and **direction** of GHG source and sink effects
- Need to know if changes in land use will result in GHG emissions or sinks
- Need to know if climate change scenarios will result in loss of soil carbon stocks as GHGs, DOC and POC
- Need to have a better understanding of these soils as they support many important aquatic and terrestrial habitats
- Sustainable soil use policy development needs a better understanding of the national resource – for Scotland & Wales peats and organo-mineral soils are important

What can we take from this work?

- We do not have sufficiently accurate estimates of the C held in our soils and we need to address this gap
- We have a model (ECOSSE) which describes organo-mineral and organic soils and can be used to predict impacts of climate change and land use change on GHG emissions
- We need accurate data of soil C stocks and the ability to measure trends
- DOC and soil acidity are intimately linked **-** this has implications for policies designed to aid recovery of soils from acidification

- In order to support land use decisions designed to mitigate GHG emissions we need to have data to verify our assumptions
- ECOSSE will be a valuable tool in helping us predict how carbon-rich soils will react to climate and land use change – as with any model it will improve as more data becomes available with which to validate it!

What next?

- modify our methodology for calculating the GHG flux from LUC sector
- Re-visit land use policy given more guidance on the likely impacts for soil C loss
- Improve our understanding of our national soil C stocks

Many thanks to the scientific expertise and dedication of the research consortium led by Professor Pete Smith

Soils and Farming – Carey Coombs

Carey represents LINK on the Climate Change and Agriculture Stakeholder Group

- Report March 2008
- Remit. Actions for Farmers and Policy Makers
- Short term.
- Representation
- LINK position
- What is agriculture?

The Way Forward.

- Soil management. biodiversity, functionality and fertility.

- Energy management.
- Systems research. Agro-forestry, agro-ecology, integration.
- Food sovereignty.
- Economic re-localisation.
- Less livestock.
- Efficiency- redefined.

Agriculture

Officially, agriculture accounts for 14% of the Scotland's greenhouse gases. However, this only includes farm level emissions and emissions associated with the energy used at farm level, but excludes the following major sources of GHG emissions which are far more important: *how much?*

- the substantial CO_2 and nitrous oxide emissions from the production of N fertiliser
- the transport of farm inputs
- the large losses of soil carbon
- the reduced soil methane oxidation rates due to the use of fertilisers

Indirect use of energy accounts for the majority of agriculture's total use of energy (72%), far more than on-farm energy use. A 25-year soil survey by the National Soil Resources Institute found that the UK's soil is losing carbon "on an enormous scale", an estimated 13 MtC each year (Bellamy P et al, 1995). *Scottish soils data*

Overall Scottish agriculture emissions fell by 14% between 1990 and 2004. CH_4 down 8%, N_2O down 20%

Agriculture 63% of Scottish CH_4; 83% of N_2O

LUC conversion to cropland emitted 12% of Scotland's total net emissions.

Agriculture

Enteric fermentation – CH_4

Manure Management - CH_4 and some N_2O

Agricultural soils – N_2O

Fuel consumption – CO_2

Burning of/field burning of agric. residues/other (2003 inventory)

Landuse change and forestry (2003 inventory)

Changes in forest and other woody biomass – C sink

Forest and grassland conversion –CO_2

Abandonment of managed lands (2003 inventory)

CO_2 emissions and removals from soils CO_2

Energy and CO_2

10k calories of exosomatic energy are spent in modern food systems to deliver 1 kcal delivered to consumer.

Nitrogen fertiliser production

Manufacture - N-fertiliser is energy intensive to make, with calculations suggesting that each kilogram of fertiliser is responsible for 6.7kg CO_2 equivalent emissions. It is the single main source of energy use and GHG emissions in agriculture. For example, N fertiliser accounts for 60% of the energy inputs in non-organic oilseed rape production As for total greenhouse gas emissions, if the N20 emissions from soil are included, N fertiliser accounts for virtually all in oilseed rape production - 90%.

The reason for N fertiliser being the main agricultural contributor to climate change is because of its manufacturing process. N fertiliser is produced from natural gas (which cannot then be used as an energy source) - this accounts for 22% of the GHG emissions from N fertiliser production and transport.

Human Impact Land-use change related carbon dioxide emissions,i.e. man's conversion of soils from natural to agricultural use, has led to substantial losses in the soil carbon sink. Greater soil disturbance, such as that caused by ploughing, can cause rapid respiration and loss of large amounts of soil carbon which would otherwise decompose more slowly.

Potential for control Sensitive land-use practice is key to better balancing the soil carbon sink, and perhaps reversing recent trends of loss of carbon from soils. Farming practices such as 'no-till', whereby agricultural land is used without the soil disturbance and carbon loss which comes with ploughing, are becoming more widespread and land-use remains a key area of research in studies of man-made greenhouse gas emissions and strategies to reduce them.

Nitrous oxide

Global man-made nitrous oxide emissions total about 8 million tonnes each year. Agricultural soils dominate man-made nitrous oxide emissions, with agriculture as a whole accounting for the vast majority of emissions. The primary sources of atmospheric ammonia are man-made with the largest increases in emissions in recent decades being due to increased global livestock farming.

Human Impact Livestock are the largest source of atmospheric ammonia emission, with areas of extensive animal rearing giving 'hot spots' of ammonia production. Fertilizer application and agricultural chemical use are also significant sources of atmospheric ammonia, as is fossil fuel powered transport.

Potential for control The ever increasing demand for cheap meat on a global scale has led to a rapid increase in large scale intensive livestock rearing. Such facilities give rise to large amounts of ammonia, some of which then contributes to the atmospheric nitrous oxide burden. Better livestock rearing and land use practices may substantially reduce such emissions and, in the long term, more extensive farming and higher meat prices are likely to be required.

Soils

Human Impact Increased use of nitrogen based fertilizers in recent decades has given rise to much increased nitrous oxide emissions from temperate soils. Additionally, increased atmospheric nitrogen deposition due to man-made nitrogen emissions, such as intensive livestock rearing, can induce elevated rates of nitrous oxide emission over large areas of otherwise natural temperate soil. As with tropical soils, rates of nitrous oxide from natural temperate soils are also likely to change in response to human-induced variations in temperature and rainfall.

Potential for control More efficient use of nitrogen based fertilizers and better overall land-use practice are required if nitrous oxide emissions from temperate soils are not to grow further. Ensuring that nitrogen based fertilizer additions do not end up on natural soils, whether directly or indirectly, makes sense both environmentally and economically.

Changes in land-use can have large effects on the balance of nitrification and denitrification in non-agricultural temperate soils, a fully informed land-use change strategy can therefore help to reduce emissions. Strict control of man-made atmospheric nitrogen emissions could also help to reduce future nitrous oxide emissions from this source.

Nitrous oxide Sources - Agricultural soils

Agricultural soils represent a very large, and growing, global source of nitrous oxide. Current estimates for annual emissions from this source range from 2 to about 4 million tonnes of nitrous oxide-N globally. With a rapid increase in population growth, and the consequent need for more food production, both the area of agricultural soils and the intensity of their use is likely to continue to rise rapidly in coming decades.

Direct Sources

A major direct source of nitrous oxide from agricultural soils is that of synthetic fertilizer use. Widespread increase in the use of such nitrogen based fertilizers has been driven by the need for greater crop yields, and by more intensive farming practices. Where large applications of fertilizer are combined with soil conditions favorable to denitrification, large amounts of nitrous oxide can be produced and emitted to the atmosphere. Similarly, the widespread and often poorly controlled use of animal waste as fertilizer can lead to substantial emissions of nitrous oxide from agricultural soils. Some additional nitrous oxide is thought to arise in agricultural soils through the process of nitrogen fixation, though the true importance of this source remains poorly defined.

Human Impact Man's need for more food, as a result of an expanding global population, has inevitably led to an increase in the use of both synthetic fertilizer and the wider application of animal waste on agricultural soils. However, the application of such nitrogen based fertilizers in many areas has been excessive, with large proportions of the added fertilizer providing no benefit to crop yield, but inducing elevated nitrous oxide emissions.

Potential for control The better targeting of fertilizer applications, both in space and time, can significantly reduce nitrous oxide emissions from agricultural soils. Land-management strategies which accurately take account of the optimum amounts of fertilizer addition necessary for maximum crop yield and minimum waste are crucial both environmentally and economically. Similarly, the exact form of nitrogen based fertilizer and the best time of year at which to use them is key information on which to base fertilization campaigns.

Indirect Sources

Human Impact As with direct nitrous oxide emission from agricultural soils, man takes full responsibility for indirect emission. Not only do large quantities of leached nitrogen based fertilizer have a significant impact on indirect nitrous oxide emissions, they have also led to dangerously high nitrate concentrations in drinking water and to eutrophication in rivers and estuaries around the world. Increased food consumption and consequent increases in municipal sewage treatment have also inevitably led to increased indirect nitrous oxide emissions from this source.

Potential for control Again, it is through properly informed land-management practice and fertilization campaigns that nitrous oxide emissions can primarily be reduced. Much of the impetus for control of nitrogen based fertilizers has come from concern over high nitrate levels in drinking water supplies and the threat of eutrophication in estuaries and coastal waters. Individual governments have enacted changes in policy to bring about reductions in such nitrogen leaching, with the creation of 'Nitrate Sensitive Zones' (NSZs) requiring particular attention in the UK.

Nitrous oxide Sources - Livestock and Feed

Livestock themselves produce only relatively minor amounts of nitrous oxide directly. Where livestock do have a large impact on nitrous oxide emissions is through initial production of their feed, and through subsequent management of their waste. Livestock feed production, like human food production, often involves large applications of nitrogen based fertilizer to agricultural soils.

Human Impact As humans are directly responsible for livestock rearing, we are also responsible for livestock related nitrous oxide production. Increased global demand for meat and diary products has led to increases in animal wastes. Additionally, the more intensive livestock rearing practices now common throughout the world have necessitated more intensive livestock feed cultivation, with the inevitable increase in N fertilizer use and nitrous oxide emissions.

Potential for control The demand for livestock feed with a high nitrogen content makes the potential for reductions in livestock related emissions through feed cultivation practices limited. As with agriculture as a whole, better targeted fertilizer application and properly informed land-use practice may go some way to reducing nitrous oxide emissions from this source.

The various livestock waste management strategies provide further ways in which emissions can be reduced. The use of subsurface injection of liquid waste for instance can result in a much lower emission of nitrous oxide than that from its surface application to open pasture.

Nitrous oxide Sinks

The Stratosphere The majority of atmospheric nitrous oxide is destroyed in the stratosphere by reaction with light and excited oxygen atoms resulting in an average atmospheric lifetime of around 120 years. It is this long lifetime which helps to make nitrous oxide such a powerful greenhouse gas.

Soils The uptake of nitrous oxide by soils is generally regarded to be small on a global scale.

Methane

Natural methane sources Wetland methane emissions dominate the natural sources of methane. Global emissions from natural sources total around 250 million tonnes each year. Natural emissions of methane can be greatly affected by climate change and the stability of methane hydrates, with increasing global temperatures, is a cause of much concern for some climate scientists.

Man-made methane sources Energy related and ruminant methane dominate man-made methane sources.

Methane sinks Officially, around 17% of the UK's methane emissions (69% of Scotland's) come from agriculture. Approximately 80% of these methane emissions are from ruminants, and 20% are from animal waste (Defra). However, this official figure excludes an important agricultural source of atmospheric methane levels – the effect of fertilisers.

Some have suggested that less intensive livestock systems, such as organic farming, could increase total agricultural emissions of methane - not necessarily true if all impacts of farming on atmospheric methane are considered.

It is believed that the introduction of the Single Farm Payment will result in a reduction in methane emissions from livestock, through a fall in their numbers and a reduction in animal waste.[2] In Scottish, methane emissions fell 28% between 1990 and 2002. Cattle are responsible for 49% of Scotland's methane emissions. Scotland's agricultural emissions fell 9% between 1990 and 2002 because of a decline in cattle and sheep numbers.

Methane emissions from animal waste Slurry is a major source of methane, producing far more methane than solid manure: approximately 10% of slurry is converted to methane while only 1% of solid manure on pasture is converted to methane (Gibbs & Woodbury, 1993). Slurry also produces considerable water pollution risks as well as serious odour problems. This means that

[2] Review of the UK climate change review programme - consultation document

outdoor (genuine free-range) systems and the use of straw-based housing are far better in terms of manure emissions than intensive indoor systems and housing based on concrete or slatted floors.

Methane Sources – Ruminants The loss of methane from ruminant livestock is a problem not only in the respect of greenhouse gas emissions, but also to farmers in that food converted into and released as methane is food not being converted into meat and/or milk.

Human Impact methane emission arising from ruminant livestock is, by definition, entirely due to man. With a continuing expansion of meat and dairy product consumption around the world, the demand for ruminant livestock and so the size of this methane sink has grown rapidly.

Intensive rearing methods, developed to provide large amounts of meat and dairy products at low prices and to a wide consumer base, has led to very high densities of ruminant livestock and strong local methane sources. An additional source of methane due to ruminant livestock is that of animal waste .

Potential for control The best studied and applied methane reduction strategy has been that of altering the feed composition, either to reduce the percentage which is converted into methane or to improve the meat and milk yield. Improvements in the overall quality of animal feed may allow meat and dairy production to be maintained at the same level with fewer animals and so less total methane emission.

Relatively recent ruminant methane reduction strategies have included the introduction of methane inhibitors, both biological and chemical, with the animal feed, to kill off or at least reduce the activity of the methanogenic bacteria and protozoa in the gut.

The trapping of methane from strong sources of livestock manure methane, such as slurry tanks, has already proved a very successful way of reducing methane emissions to the atmosphere from this source. The recovered methane, often called 'biogas', can be simply flared off as carbon dioxide or can potentially be used as a fuel. Other options include a move away from such intensive rearing methods, with an increase in grazing time for animals and so a greater dispersal of their manure.

Potential for control Our potential for control of the soil methane sink lies primarily in our ability to change land-use practices. The better targeting of fertilizer application and land conversion could help to avoid the destruction of large soil methane sinks unnecessarily. Likewise, reductions in the large amounts of atmospheric nitrogen pollution we produce could also help to maintain levels of methane oxidation in existing soil methane sinks.

The ecology of climate change. Closing loops.

Agro-ecology The one big message is that we are not dealing with a series of independent environmental and production issues. All are interlinked and inter-dependent.
Scotland’s agricultural land must reach stable ecological status. Farming as an industry must reach stable ecological status, and that includes input and output processes and thereby reduces or eliminates the overall negative impact of agricultural practice on the climate.

Farming practice.
Cropping/rotations
Mixed farming. I.e use of grass clover/
Manure use and storage. Slurry
Composting and humus building
Energy use direct and indirect
Diversity of indigenous and bred fauna and flora and relationships thereof. Stability.
Nutrient useage , sourcing and wasting.

Farm policy
Consumer/producer distance
Urban and peri -urban food policy

Water.
Identified mitigation measure
1. reducing losses from grassland soils
- reducing nitrogen inputs as mineral fertiliser and manure
- changes in forage and grassland mix
- management of manure application
2. reducing losses from animals
   - diet composition and supplement
   - reducing numbers
   - increasing animal productivity or system change
3. reducing manure loss
   - increased frequency
   - changing manure systems
   - biogas from manure
4. reducing losses form soils
   - reducing nitro input
   - use of winter crop
   - change in crop mix
   - irrigation

growing energy

Soil management practice.
In 2003, the European Climate Change Program working group on carbon stores related to agricultural soils concluded, "there is evidence that under current agricultural practices, many European soils are losing organic carbon and thus constitute sources of atmospheric CO2 rather than sinks". This sudden near-redundancy in the role of soil humus and biology due to the modern introduction of inorganic fertiliser must have been a major historic cause of soil carbon level falls and thus the current low levels of arable soils, and probably remains a significant cause of the on-going losses. Therefore ploughing is only a problem in farming systems which do not include practices that build up soil carbon.

The basis of farming practice must be.
- <u>soil carbon as the basis of the system</u>: farmers must have a very strong interest in improving soil carbon levels. Inorganic fertilisers should be prohibited or their use drastically reduced and the success of farming must become dependent on high soil organic matter levels.
- <u>additions of organic matter</u>: organic matter can be added in various forms and at several points in the system: the 1-4 year grass/clover leys build up soil organic matter through the root systems and leaves (which are ploughed-in); the addition of animal manure (through the rotation of a livestock component in the mixed system plus/or brought-in manure); the addition of composted plant and animal residues; and the use of winter cover crops and green manures. (Although animal wastes can just be considered as recycled plant carbon, and not necessarily increasing the carbon input, we believe the different chemistry and biology of the material helps improve the ability of soil to build up carbon)
- <u>high percentage of grassland</u> – use of mixed arable and livestock systems and greater use of grass for animal feed, farming rotations should include about 50-60% of grassland on the

farm at any one time, or about 25-30% on arable farms, including higher average levels of permanent grassland.

- larger crop root systems – farming must aim to produce crops with large and deeper systems, sequestering more carbon and more in the deeper layers where less decomposition takes place[i] and below the ploughing depth, building-up the soil carbon store more efficiently.
- higher soil microbial levels: populations of soil organisms encouraged where farming depends on adequate levels of soil organic matter and there are limits on suppression by agrochemicals. The microbial biomass contains carbon and promotes the aggregation of soil particles that prevent erosion. Although mineralisation rates will be increased, organic matter inputs cannot be converted into soil organic carbon without the action of microbes and we believe higher soil microbial populations should also increase the capacity of soils to convert a proportion of the organic matter inputs into the more stable humus fractions (the details and net effect needs further consideration and confirmation).

Several practices of farming also reduce the potential for mineralisation of soil carbon:

- no-till stages and areas – the grass/clover ley stage means that the land is not cultivated for many years in each rotation. The higher grassland percentage and field margins (used to support natural predators) also increases the no-till area.
- less autumn sowing - the use of crop rotations, more spring crops and the greater diversity of crops grown results in less autumn sowing in organic farming.
- winter cover crops – these protect the soil from erosion and mineralisation
- lower grazing intensity – the lower livestock grazing intensity required under organic standards reduces or avoids any negative effects of high stocking levels on soil carbon levels
- composting – composting is used far more widely than among non-organic farmers. Composting causes a lower level of carbon input (c. 20% is lost in the process), but the C is more stabilised and results in greater soil C accumulation.[ii]
- wind breaks – the greater presence of hedgerows and trees reduces soil erosion

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ASSESS CONCLUSIONS AND FURTHER ACTION - DISCUSSION

ECOSSE model needs real data input to provide answers.
We need to be very clear about the proportions of GHG's emitted when making our justifications for land uses.
Agriculture TF agenda should coordinate LINK response to above issues.
It will be very bad for progressive agriculture is carbon is demonised without differentiating between other goods and bads.
Economics is the driver for farmers – make it win-win. Ecosystem services.
Farmers average age is about 55. We are in danger of losing traditional knowledge and skills within the next 10 years.
Meat eating is inefficient by factor of 10.
Good Agriculture and Environment Condition (GAEC) regulations should look longer terms to provide basic standards for sustainable planetary land use.
Rural Development Regulation – blunt tool. Losing livestock from areas that benefit conservation and social. Market favours lowland reared livestock. Pressure from consumers becoming greater than tax system for farmers.
Nitrate Vulnerable Zones can be worked at catchment level. Leads to bigger questions on what farming is for – require a Rural Policy.
National Planning Framework 2 will have a future vision for Scotland. Important that LINK advocates position to it. Opportunity as SE want to involve LINK.

Taxation on nitrogen? Not on agenda though ‘carbon farmers’ might be. Level playing field question would arise.
Forestry experience shows that a soils-up approach is needed to avoid disaster.

Biodiversity tf issues:
Landscape management and ecological perspective / illiteracy.
Case studies from member bodies.
Ecosystem Services. Cost them and be clear on our bottom line.
Risk management. Build in biodiversity values.
Funding currently pathetic. Maintain our wider picture perspective and bring it to the fore in all our discussions. The environment is the context.

Agriculture: Lots relate to what the TF is doing. Land Management Contracts need to be smarter at building in more general climate change asks, getting them prioritised and funded. Getting money from other budgets is a possibility. NVZ doesn’t mention climate change. Connect our asks.

Freshwater. Big model is WFD which enshrines ecological value of water. Flooding issue can help people reconnect to the land. Downriver people see upriver actions as aiding them so will pay. Need longer term plans and cohesion between them.

Getting the message out there:
Communication to wider audiences needed.
Stop Climate Chaos gearing up for UK election, local communications sought to help bottom up to politicians. Need to make the message more than cut carbon.
General support for the idea of developing key principles of sustainable landscape management that LINK (and the agencies) can support. Illustrate them with examples and make them intelligible.
Climate Change TF is focusing advocacy on key issues of demand reduction, energy efficiency as commonly understood.
Consultation on Renwable transport fuel obligation out now. Popular with public Strong position to say its not credible.
More effort to communicate these issues across depts needed. SEPA thinking on it.
More joined up thinking is happening in the SEERAD family now.
Industry wants to be sustainable. Opportunity to find common ground now.

Note: Alice Walsh
May 07

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[i] Oral communication, Dr Paul Hepperly, New Farm Training and Research Manager, The Rodale Institute, Pennsylvania, 9.1.2005 (at Soil Association conference in Newcastle)
[ii] Oral communication, Andreas Fliessbach, FiBL, 9.1.2005 (at Soil Association conference in Newcastle)