Bioenergy, greenhouse gas abatement and policy integration in the UK… Are we asking too much?

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The context

- A role for biomass in a sustainable energy future?
- Why is biomass not flourishing?
- What are the implications of different biomass fuel chains?
- Why and how should policies be directed at promoting biomass energy?

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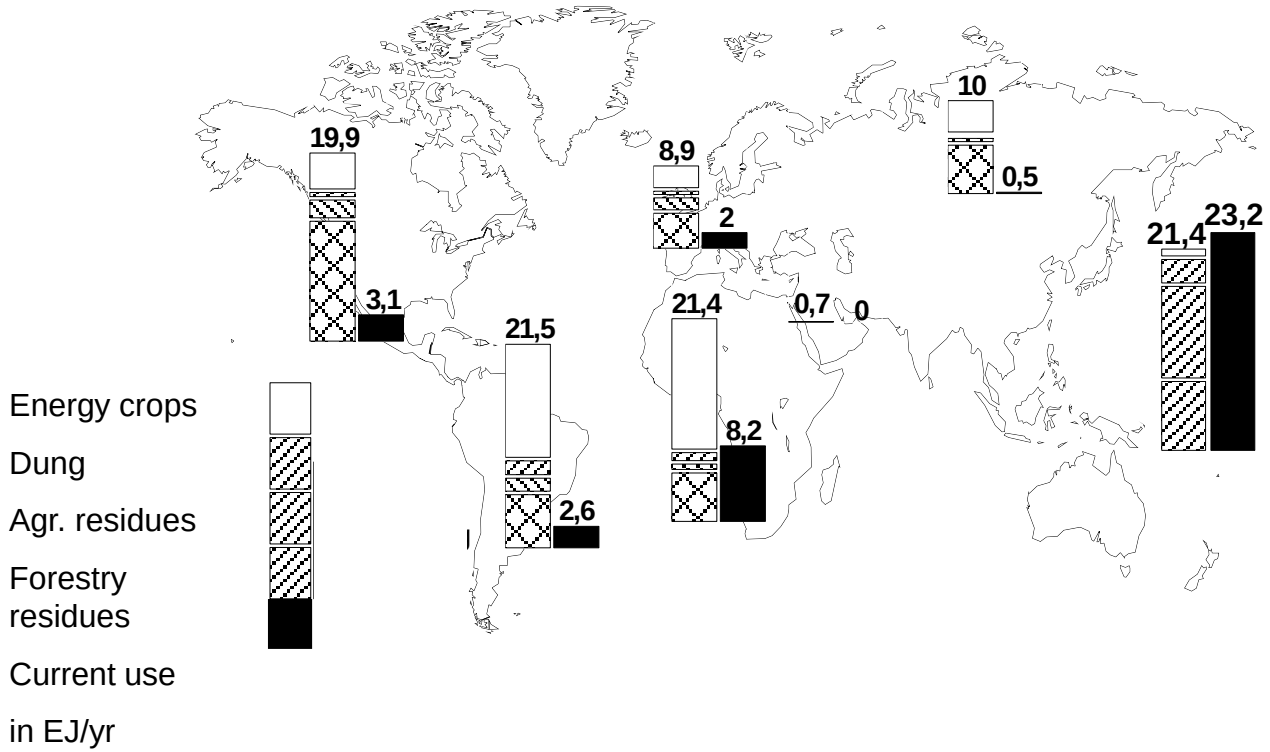
There is a need…

- Drivers behind renewable energy:
  - Decrease dependence on non-renewable resources
  - Improve energy security/independence
  - Reduce environmental impacts of energy use
- Why use biomass?
  - Widespread and diverse
  - Renewable source for a variety of energy vectors
  - Large potential for CO2 neutral fuel and reducing other pollutants
  - Diversification in agriculture & forestry
  - Rural regeneration/development

…there are resources worldwide…

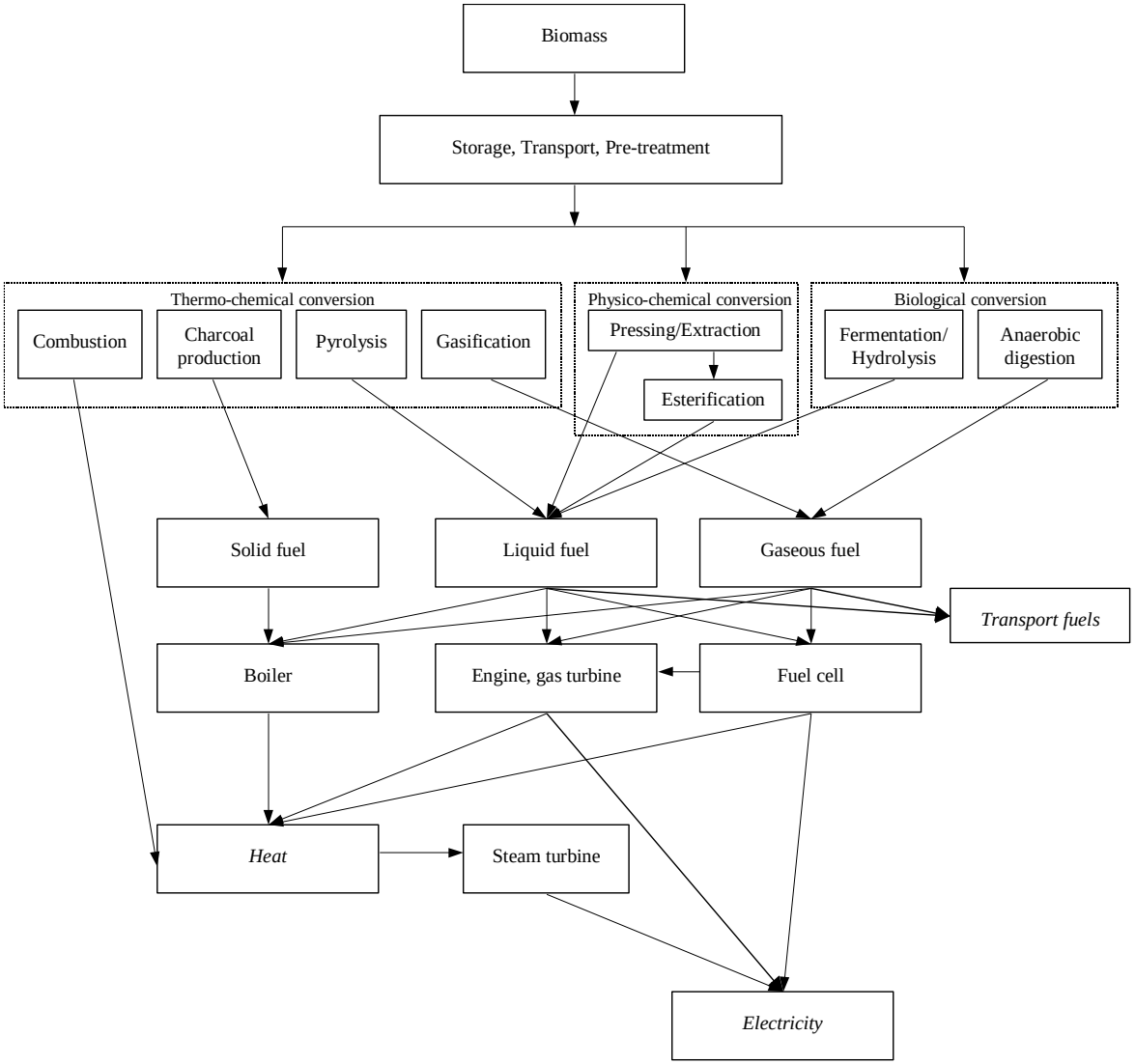
Current biomass use: 33 - 55 EJ (World primary energy: 400 EJ)
Future scenario estimates: 2025: 60 - 145 EJ
2050: 100 - 280 EJ



…and in the UK…

Biomass energy	
Current use	
1.8 Mtoe → 0.6% of primary energy	
Potential	
Forestry residues	**2 Modt = 36 PJ = 0.86 Mtoe**
Straw	**10 Modt = 180 PJ = 4.3 Mtoe**
Energy crops **(Agr. land: 18.5 Mha** **Arable land: 4 Mha)**	**<u>SRC</u>** **1Mha = 10 Modt = 180 PJ = 4.3 Mtoe** **<u>Oilseed rape</u>** **0.5 Mha = 830 kt bio-oil + 1.5 Modt = 37 + 27 PJ = 0.88 + 0.65 Mtoe = 1.5 Mtoe**

…and there are many routes to modern energy vectors



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Blessed and damned by its own variety

- Issues in modern biomass use:
  - Expensive fuel/energy
  - Questionable energy balance/environmental benefits
  - Land-use
  - Inconvenient fuel/fuel cycle
  - Multitude of stakeholders and sectors involved
  - Not perceived as a source for modern energy services
  - Unclear set of policies directed at biomass fuel chains
- Key questions:
  - Better understanding of fuel chain implications
  - Strategic fit with evolving energy and transport sector to supplying modern energy services
  - Pathways and integrated policies

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Understanding fuel chain impacts

- **Electricity from SRC**
- **Biodiesel from oilseed rape**

Fuel chain activities for electricity from SRC

	Production	Transport (Road)	Conversion	Waste disposal
Electricity from SRC	Herbicide treatment Subsoiling Ploughing Harrowing Planting Cutting back Fertiliser and pesticide application Harvesting (bundle) Chipping (bundle) Rotovating	Truck ($60m^3$) Distance: 100 km	Combustion / Integrated gasification combined cycle Efficiency: 40%	Recycling / Landfill.

GHG emissions breakdown for electricity from SRC fuel chain

Fuel cycle stage	CO_2 equivalent emissions g/kWh_e
Production	46.8
Transport	13.9
Conversion	0.59
Clean-up	0.17
Total	**61.5**

Electricity from coal: 1054 g/kWh
Electricity from CCGT: 411 g/kWh

Fuel chain activities for biodiesel from oilseed rape

	Production	Transport (Road)	Conversion	Waste disposal
RME from oilseed rape	Ploughing Stubble cultivation Sowing Fertiliser and pesticide application Harvesting Storage	Transport to oil mill Final transport to refuelling station	Oil extraction Refining Esterification Use in car	n.a.

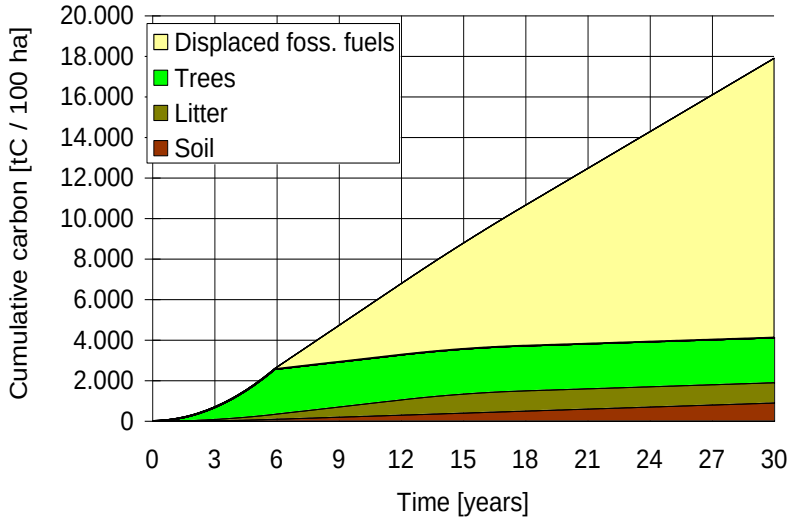
GHG emissions breakdown for biodiesel fuel chain

Fuel cycle stage	CO2 equivalent emissions kg/(ha yr)
Plant production & oil extraction	887
Oil processing	535
Transport to refuelling station	13
Use in car	215
Total	**1,650**

Biodiesel: 32 kgCO2/GJ

Diesel: 72 kgCO2/GJ

Biomass energy and… associated carbon sinks



- Acceptability of C sinks?
- Ensure broader environmental and social viability of bioenergy schemes?
- Stimulation of sustainable modern bioenergy schemes?
- Sustainable energy and sustainable sinks?

Bioenergy C substitution… and associated C sinks

	Substitution tC/(ha yr)	Sink* tC/ha
SRC electricity		7.5
Coal electricity	5.4	
CCGT electricity	1.9	
Biodiesel		-
Diesel	0.28	

In C accounting terms under the KP, bioenergy associated sinks could be very significant

Other fuel chain issues

- Range of impacts to consider:
  - air quality
  - soil quality
  - water use and quality
  - biodiversity
  - rural amenity
- No major insurmountable environmental concerns
  - SRC:
    - main concerns being associated with water use and quality
    - impacts of sewage sludge
      - nitrogen leaching, heavy metals, energy and emissions from transport?
- Amenity issues should not be neglected however trivial or difficult to value they appear, as they may be a major cause of public opposition
  - visual impacts, traffic, noise, odours,…

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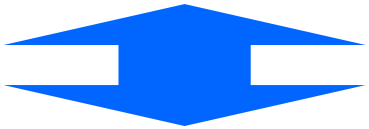
The role of policy

Markets are imperfect



Policy instruments are used to bring about objectives of social or economic interest, by overcoming some of these imperfections

intrinsically linked to agriculture, forestry and the environment (greenhouse gases)

EU Policies

- Energy and Transport
  - Renewables Directive
    - 12% renewable contribution to primary energy by 2010
  - CHP Directive
    - 18% of electricity from CHP by 2010
  - Biofuels Directive
    - 2% biofuels contribution to transport fuels by 2005; 5% by 2010
- Environment
  - Kyoto Protocol GHG reduction commitment of 8 by 2008-2012
    - Emissions Trading Scheme beginning in 2005
  - Air quality e.g. Large Combustion Plant Directive
- Agriculture
  - Common Agricultural Policy and Agenda 2000
  - GHG reductions (ECCP WG Agriculture)
    - raw materials and sinks

UK Policies

- Energy and Transport
  - Renewables Obligation
    - towards 10% renewable electricity by 2010
  - Green Fuels Challenge
    - 20p/l tax rebate for biodiesel
  - Direct support for renewables £230 mill. over next 3 years
- Environment
  - 20% GHG reduction target by 2010
    - Climate Change Levy / Carbon Trust
    - Emissions Trading Scheme beginning in 2002
- Agriculture
  - Set-aside payments for non-food crop production
  - DEFRA and Forestry Commission incentives to SRC

Conclusions

- Significant biomass potential for the production of a variety of energy vectors
- Many options present benefits in terms of:
  - saving non-renewable energy sources, reducing GHG emissions and providing income diversification for farmers
- But, biomass will be an important sustainable energy source only if able to supply the energy vectors demanded by modern energy services based on economically and environmentally sound fuel chains

Conclusions

- Greater understanding of the implications of biomass fuel chains
- Biomass is intrinsically linked to energy, environmental and agricultural policies and these will shape the biomass energy markets
- Coherent signals need to be sent to stakeholders through integrated policies that take into account and are directed to the entire biomass fuel chain