Methane to Markets

The Kindersley Centre, Berkshire

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AD and Environment: a Win-Win

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Methane and climate change

- 100yr Global warming potentials
- The importance of methane as a greenhouse gas

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Why is Methane so Important?

- The view of the IPCC (2001)
- Slightly revised by (Derwent & Collins, 2002)

IPCC (2001) - GHG factors	100 yr GWP
Methane	23
Nitrous Oxide	296
CO_2	1.0
CO	2.1
NO_x (Derwent *et al* 2002)	3.9
HC - not clear from IPCC TAR	6.6

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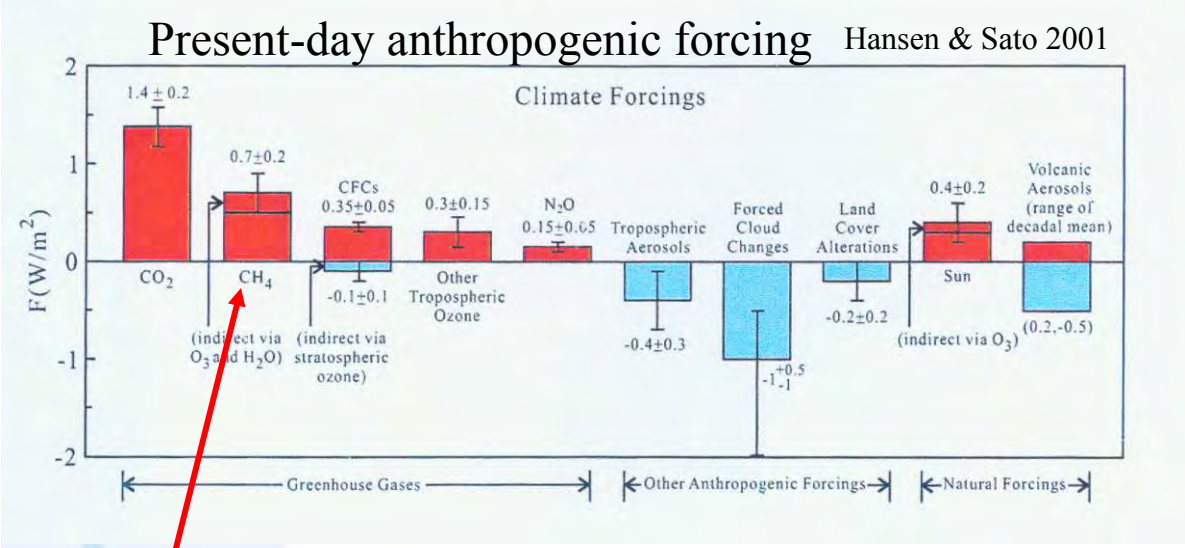
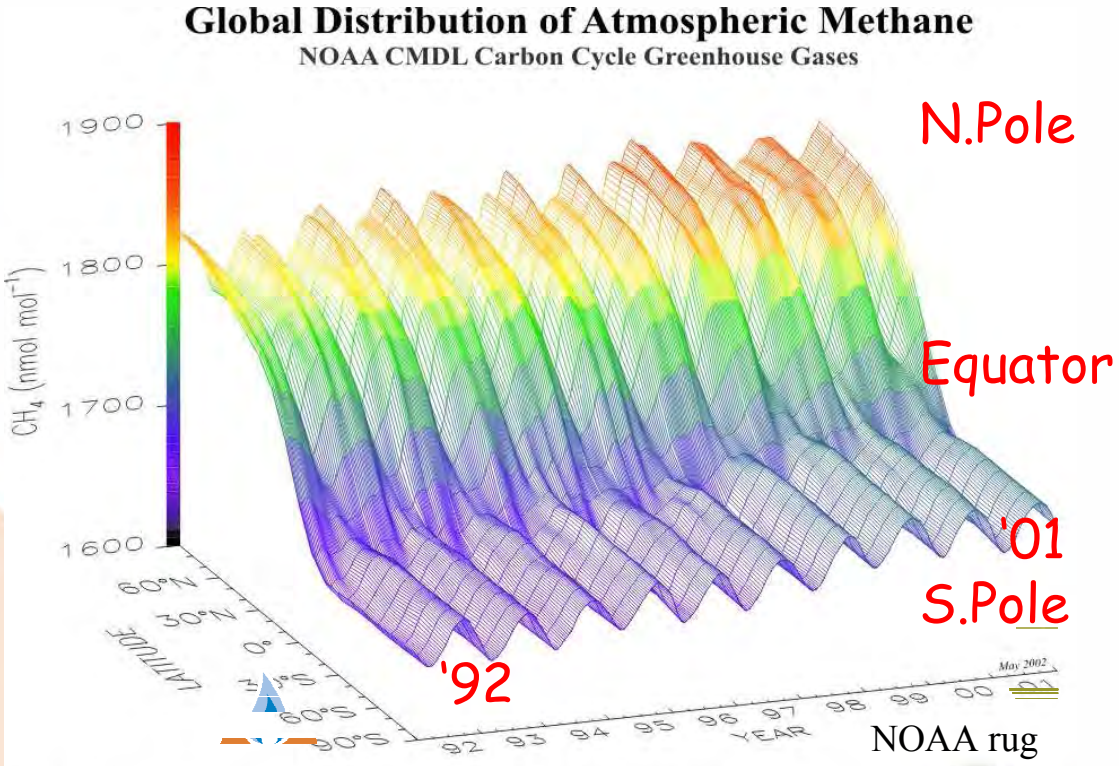


Taken from Nisbet (2004)

Methane is an excellent lever to move a planet - over 20yr, 1 gram has about 60x the warming impact of 1gm CO_2

Monitoring is mostly by US. Some EU, Aus, NZ, Canadian effort.
UK will not help with CO_2 but does measure methane in Ireland.



Three dimensional representation of the latitudinal distribution of atmospheric methane in the marine boundary layer. Data from the NOAA CMDL cooperative air sampling network were used. The surface represents data smoothed in time and latitude. Principal investigator: Dr. Ed Dlugokencky, NOAA CMDL Carbon Cycle Greenhouse Gases, Boulder, Colorado, (303) 497-6228 (edlugokencky@cmdl.noaa.gov, http://www.cmdl.noaa.gov/ccgg).

What role for biomass energy?

- Role in global carbon cycle
- Bioenergy potentials
  - What is the scale of the resource?
  - What forms of biomass feedstock are most important?

From:
Smeets & Faiij; (2004)

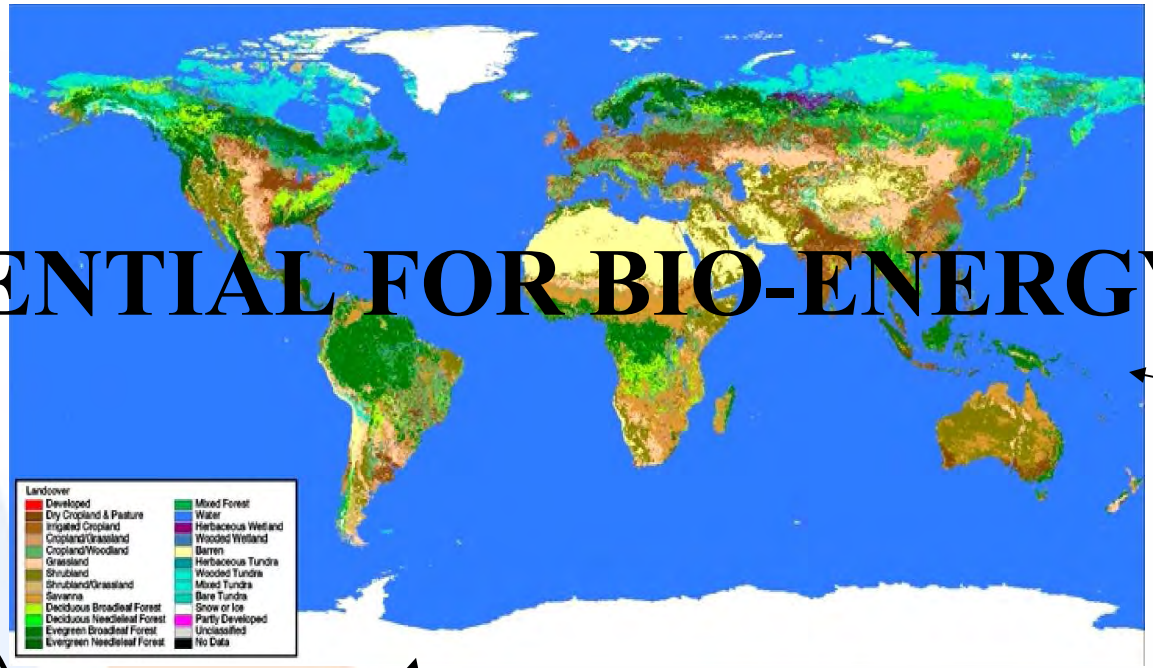
population

energy consumption

trade

future land use patterns

biotechnology



POTENTIAL FOR BIO-ENERGY?

GDP

agricultural system irrigation, breeding, mechanization, chemicals

Competition from food and fibre sectors

land productivity

agricultural policy

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Land Availability – a view from Developing Countries

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Global estimates of the bioenergy resource (Moriera, 2006)

Source[a]	Types of Residue[b]	BIOMASS RESIDUE POTENTIALLY AVAILABLE (EJ/yr)			
		YEAR			
		1990	2020-2030	2050	2100
1	FR, CR, AR		31		
2[c]	FR, CR, AR, MSW		30	38	46
3	FR, MSW		90		
4					272
5	FR, CR, AR, MSW			217 – 245	
6		88			
7[c]	FC, CR, AR, MSW		62	78	
8	FR, CR, AR		87		
A1[d]	Energy crops			660	1118
A2[d]	Energy crops			310	396
B1[d]	Energy crops			449	703
B2[d]	Energy crops			324	485

Between 30 and 1118 EJ/yr

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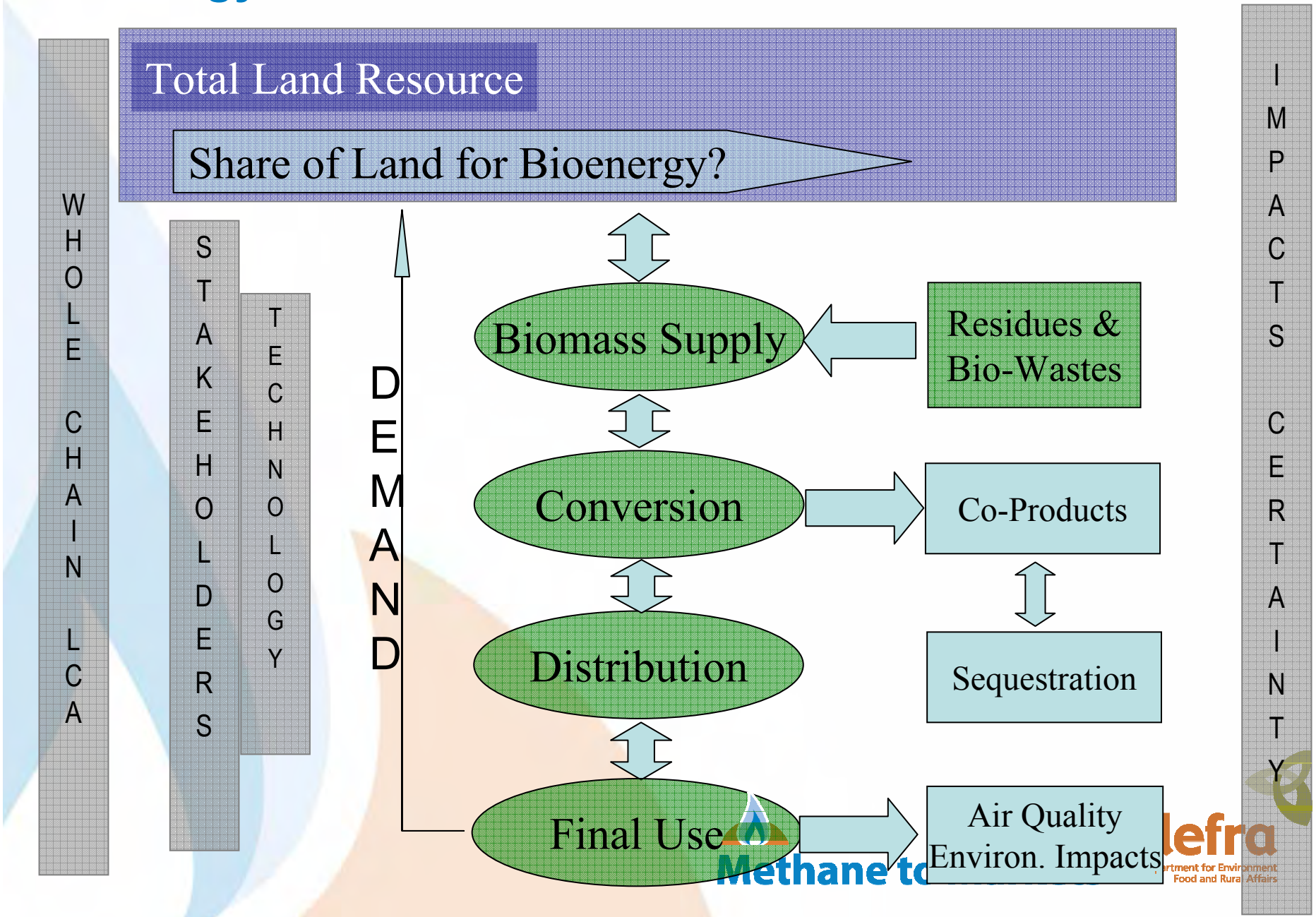
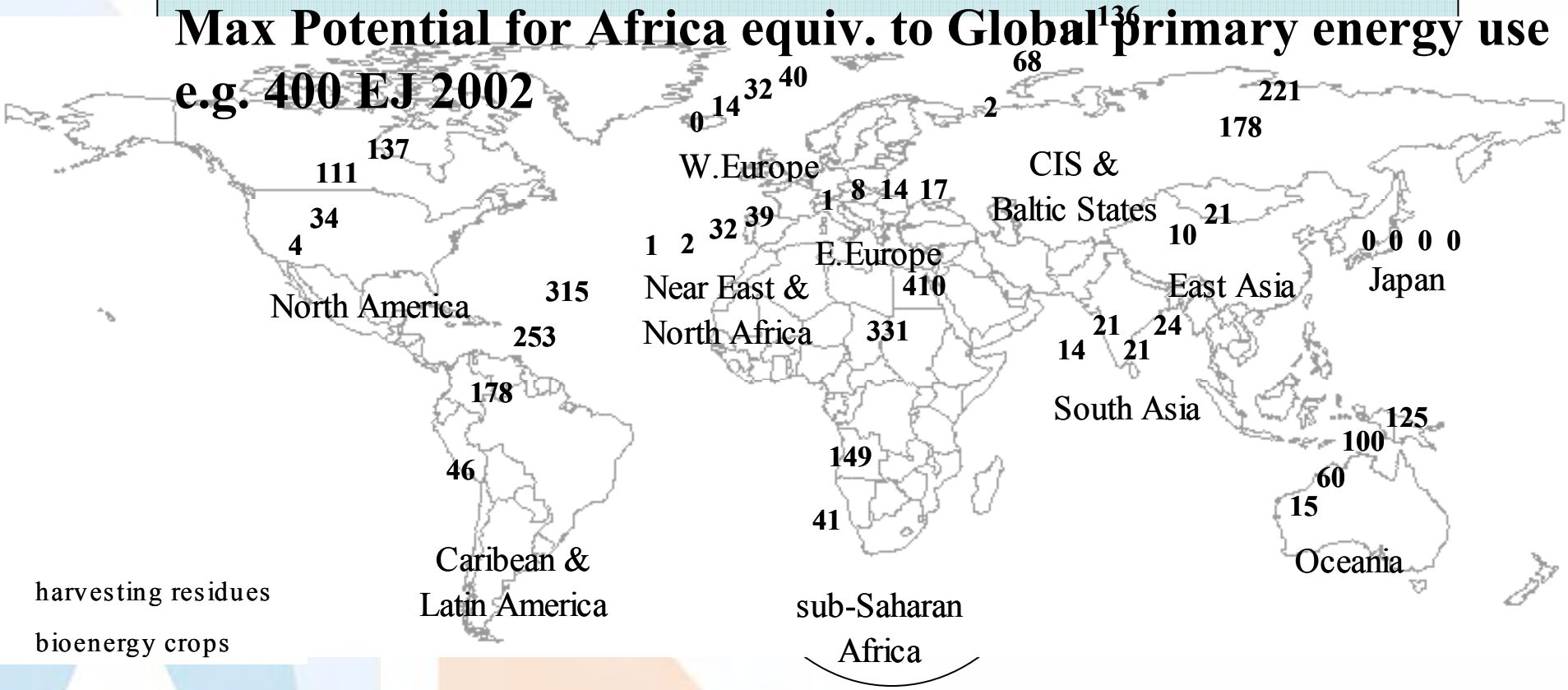
Bioenergy chain overview



Bioenergy production potential (EJ) in 2050 different scenario's



Source: Smeets & Faaij 2004

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The alternative fates of carbon fixed through photosynthesis matter

- Un-used methane arising from the decomposition of biomass (particularly from waste streams), must be controlled
- AD systems can play a win-win role in this
  - Enhancing nitrogen management in agriculture is a major bonus
- Combustion can too e.g. through co-firing

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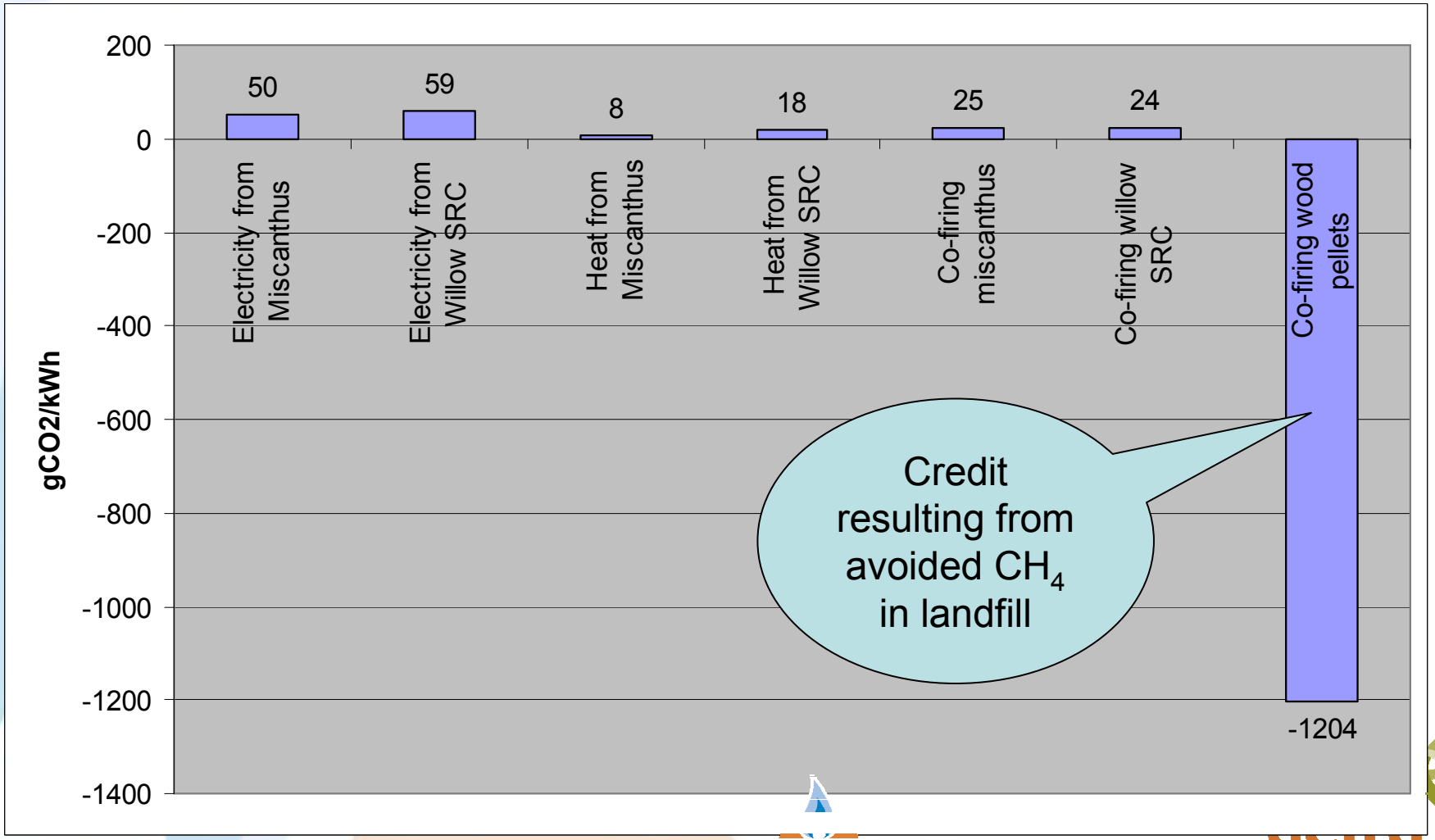
GHG emissions from biomass co-firing, dedicated electricity or dedicated heat supply



Woods *et al*, 2006

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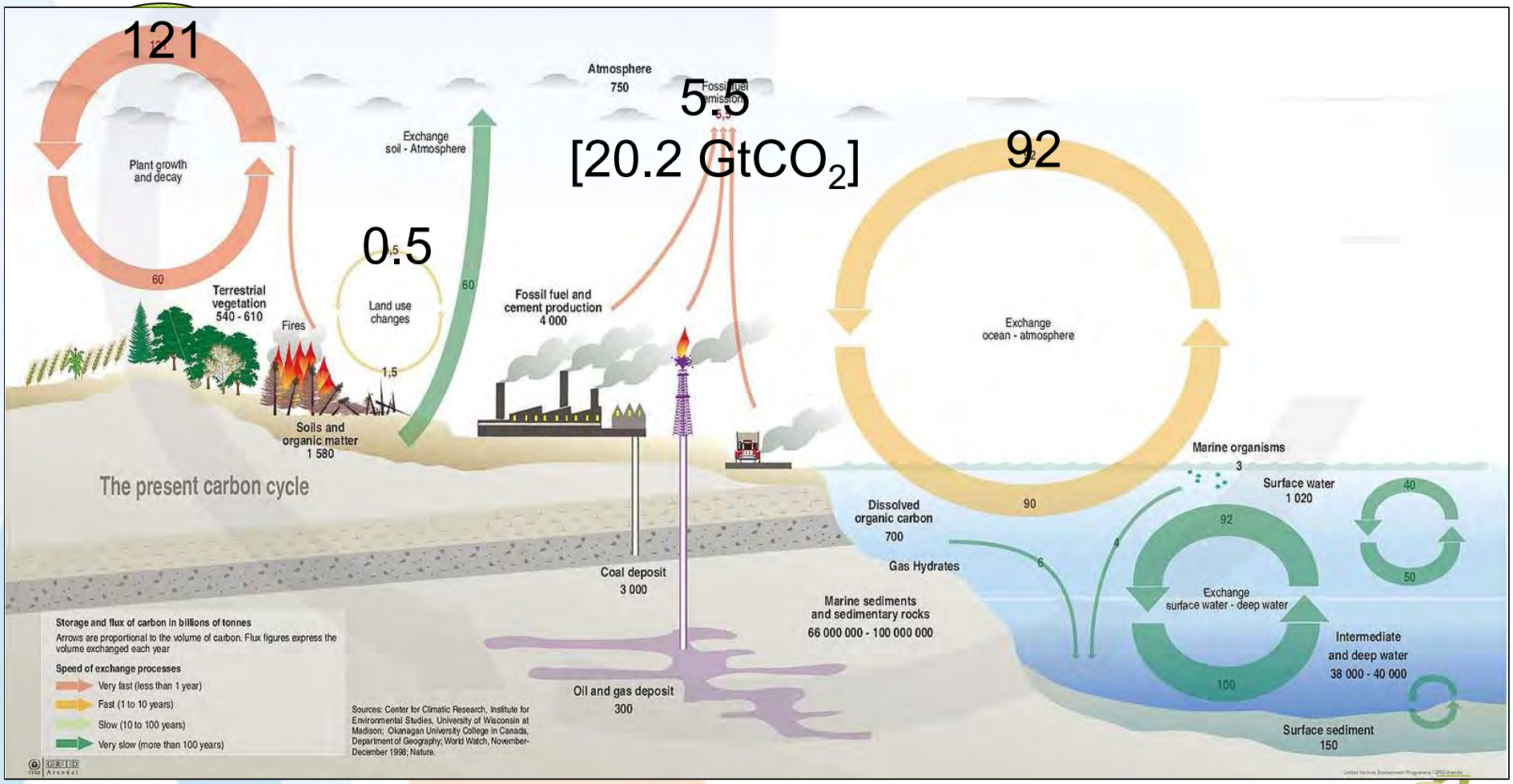
The Carbon Cycle (GtC) – a role for bioenergy?



Source: http://www.vitalgraphics.net/graphic.cfm?filename=climate2/large/11.jpg

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Dealing with Uncertainty

- Land-use change:
  - Changes in Biomass Stock (deforestation)
  - Changes in soil carbon (e.g. grassland)
  - Water requirements and hydrological balances
  - Water quality
- N_2O emissions from agriculture
  - Mineral N-fert and organic matter management
- CH_4 emissions from agriculture
  - Complex chain-dependent inter-linkages now and in the future
- Transport logistics
  - Air quality and GHG benefits from biogas

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Land-use change: UK agriculture

'… According to DETR (1997), soils in England, Wales and Scotland contain some 21.78 billion tonnes of carbon, of which 16.4 GtC is in Scottish peat uplands[1], leaving 5.4BtC (*19.8 Gt* CO_2) in the soil of the remaining UK land where agriculture is the primary land use. Most of this is contained in grasslands.

Arable soils in the UK contain 592 MtC (*2.17GtCO*$_2$; Smith *et al)*.'

According to Edwards,R. (JRC, 2004):

'Grassland has 49 to 54 tonnes/ha higher soil C content than a wheat-field with straw ploughed back.'

[1] Soil Assoc. (2005) quoting: Indicators of Sustainable Development in the UK, DETR, 1997.

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Bioenergy as C-Sequestration Option

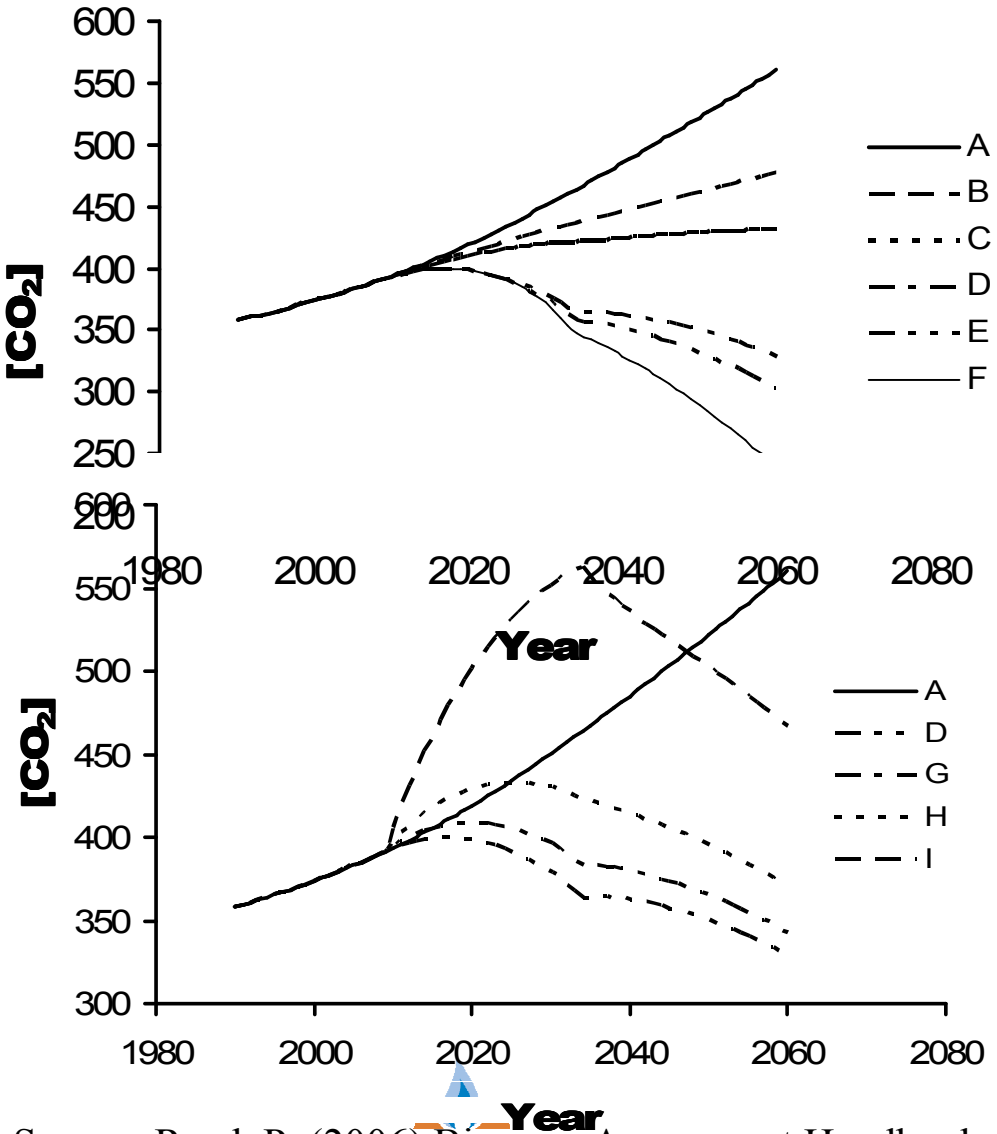
Line A high material growth, consumption-oriented, SRES A2 scenario.

Line B (A plus) sugar cane

Line C sugar cane and switch-grass - no CO2 storage.

Line D forestry activity also added

G, H and I the effect on line D of land use changes resulting in the release of 30, 90 and 300 tons of C/ha through loss of soil carbon and burn-off to clear existing vegetation



Source: Read, P. (2006) Biomass Assessment Handbook. JXJ publ.

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Conclusions

- Managing & exploiting methane will play a critical role in climate change mitigation and adaptation
- We are not resource limited but technology, know-how and policy will play critical role in driving complex bioenergy systems
- Existing work
  - EU – BiogasMax network
  - India – Centre for Sustainable Technology (formerly ASTRA), IISc, Bangalore

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