Supplying Food for Mankind or Fuel for CHP:

Navigating a global landscape

JIM LYNCH
Chief Scientist, ME Afriqiyah
Distinguished Professor of Life Sciences, University of Surrey

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Context

This analysis was conducted by the OECD countries but it is highly relevant to Africa

BIOENERGY

1. Biomass such as wood
2. Fist generation biofuel. Oil, sugar or starch harvested from ‘useful’ parts of agricultural crops (e.g.. oil, seeds, grain) rather than the stalk or straw. Oils are then converted to biodiesel via transesterification and the starches and sugars converted to bioethanol via fermentation
3. Second generation biofuel. Plant cells from any source (e.g.. straw, wood) are broken down via acid hydrolysis or enzymes to release sugars that are then fermented to produce bioethanol. Alternatively syngas (hydrogen and carbon monoxide) is produced which can then be turned into synthetic diesel via Fisher Tropsch process.

Woodfuel 1

Sawmill Slab

Cheap, dry, plentiful- currently the mainstay of many suppliers

Sawmill chip

Available from softwood mills but is wet and difficult to store

Woodfuel 2

Round timber-

Occarional loads, mainly ‘Clean Up’ loads of misxed species, or otherwise undersirable species

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Woodfuel 3

Material from land clearance:

Example- Heathland Restoration Projects- 150 tonnes taken from Cannock Chase in April 2005

Woodfuel 4

Energy crops

Short Rotation
Coppice

Effect of Moisture Content on the Calorific Value of Wood

Moisture Content (%)	Calorific Value (GJ tonne-1)
0	19.6
10	17.2
30	12.4
50	7.6

BIOMASS Energy Centre

Tel: 01420 526197
Email: Biomass.Centre@forestry.gsi.gov.uk

Typical calorific values of fuels

Fuel	Energy density by mass GJ/tonne	Energy density by mass kWh/kg	Bulk density kg/m^3	Energy density by volume MJ/m^3	Energy density by volume kWh/m^3
Wood chips (Very dependent on MC)	7-15	2-4	175-350	2,000-3,600	600-1,000
Log wood (stacked - air dry: 20% MC)	15	4.2	300-550	4,500-8,300	1,300-2,300
Wood (solid - oven dry)	18-21	5-5.8	450-800	8,100-16,800	2,300-4,600
Wood pellets	18	5	600-700	10,800-12,600	3,000-3,500
Miscanthus (bale)	17	4.7	120-160	2,000-2,700	560-750
Coal (lignite to anthracite)	20-30	5.6-8.3	800-1,100	16,000-33,000	4,500-9,100
Oil	42	11.7	870	36,500	10,200
Natural gas (NTP)	54	15	0.7	39	10.8

Scientific achievements

Bioenergy not a new phenomenon…

Woodfuel
Heat and light generation
Fermentation and distillation
Esterification of vegetable oils

…but significant developments go on

Biofuel quality
Biogas, biomass gasification
Biomass combustion systems
'Second generation' biofuels

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Environmental costs & benefits

Large variation of environmental performance…

…by feedstock

…by conversion process

…by production region

…by type of bioenergy use

…and developments over time

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Bioenergy policies

Numerous policies in several countries

Two main policy areas:

Bridging price/cost gaps

-Tax incentives

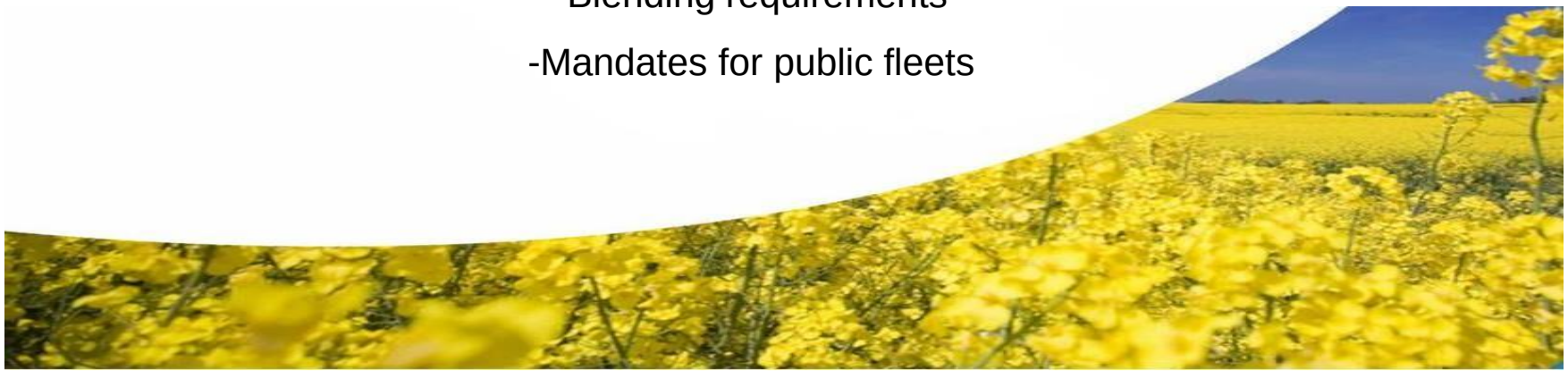
-Guaranteed prices

-Direct support for investment, production etc

Utilisation mandates

-Blending requirements

-Mandates for public fleets



Bioenergy policies

Several links to policies in other sectors

Links to agricultural policies

Direct links through energy crop payments

Bioenergy leads to higher ag prices

Bioenergy support could partially substitutes for agricultural payments

Joint objective of income generation

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Bioenergy policies

Several links to policies in other sectors

Links to environmental policies

Joint objectives (e.g.. air quality)

Higher prices- more intensive farming?

Links to energy policies

Joint objectives (e.g. energy security)

Conflicting objective (fuel prices)

Bioenergy policies

Need for better analyses of policies

1. Objectives
2. Measures
3. Impacts

…on objectives

(in comparison with alternative policies)

…on agricultural markets

(global price support equivalent)

… unintended impacts

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Economics of bioenergy markets

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Continued strong growth in energy use

-Continuation of increasing CO_2 emissions

-Fairly flat oil prices in real terms?

-Increased renewables can play a role in reducing fossil energy use/ GHG emissions

Economics of bioenergy markets

Biofuel industry increasingly dominated by large-scale enterprises…

-Lower production costs

-Relatively few, but large cross-border investments

-Who gets the profits?

… but small-scale power and heat generation under feed-in tariff regimes

-But also some large co-firing

Economics of bioenergy markets

Strong growth in bioenergy production

-High crude oil prices
-Strong public support
High profitability

Regional concentration

Significant impact on agricultural markets

-Higher prices (how much?)
-More volatile prices (how much?)

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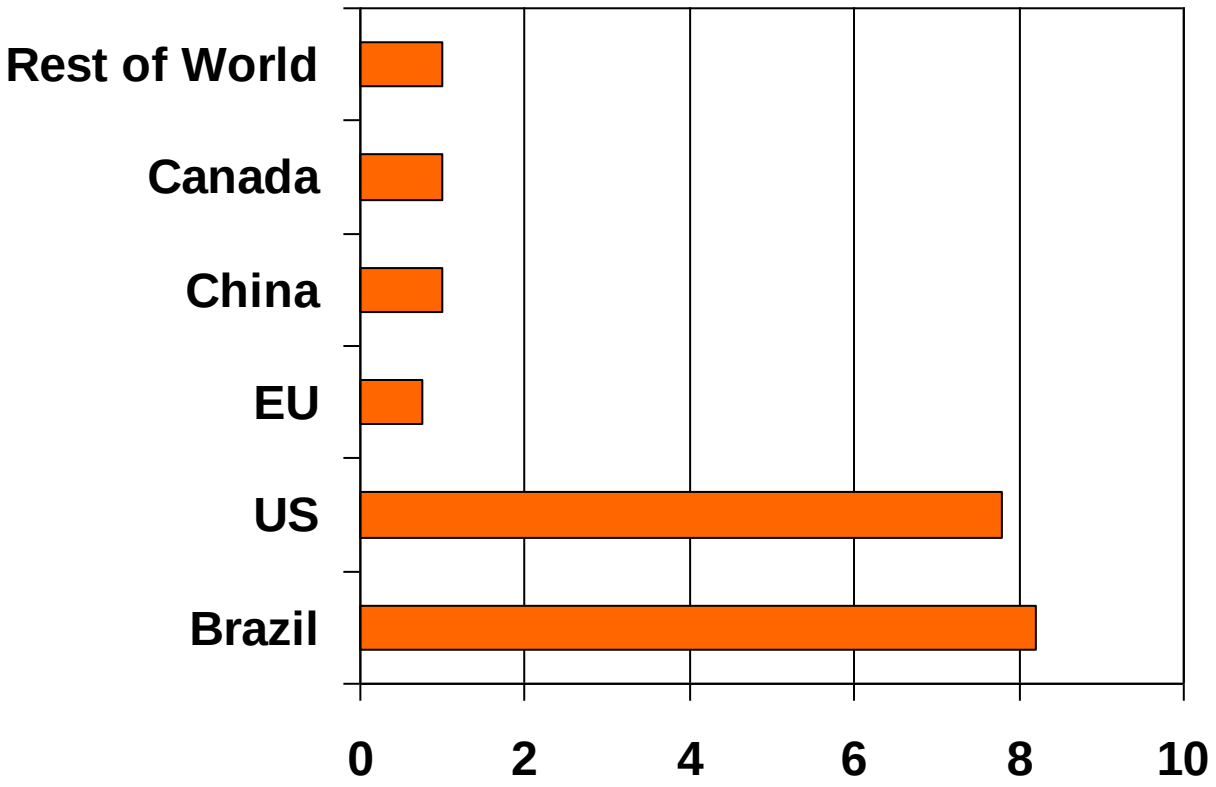
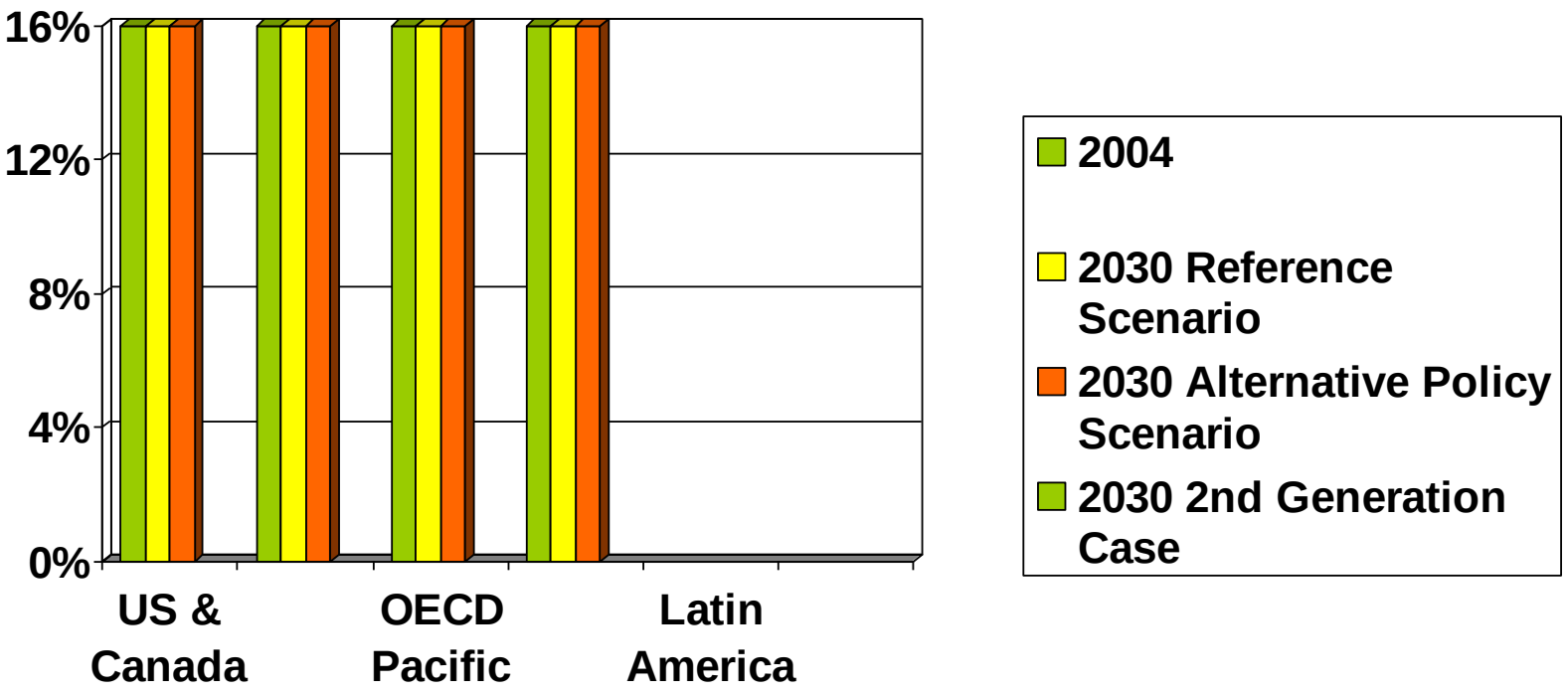
Biofuels production in 2005

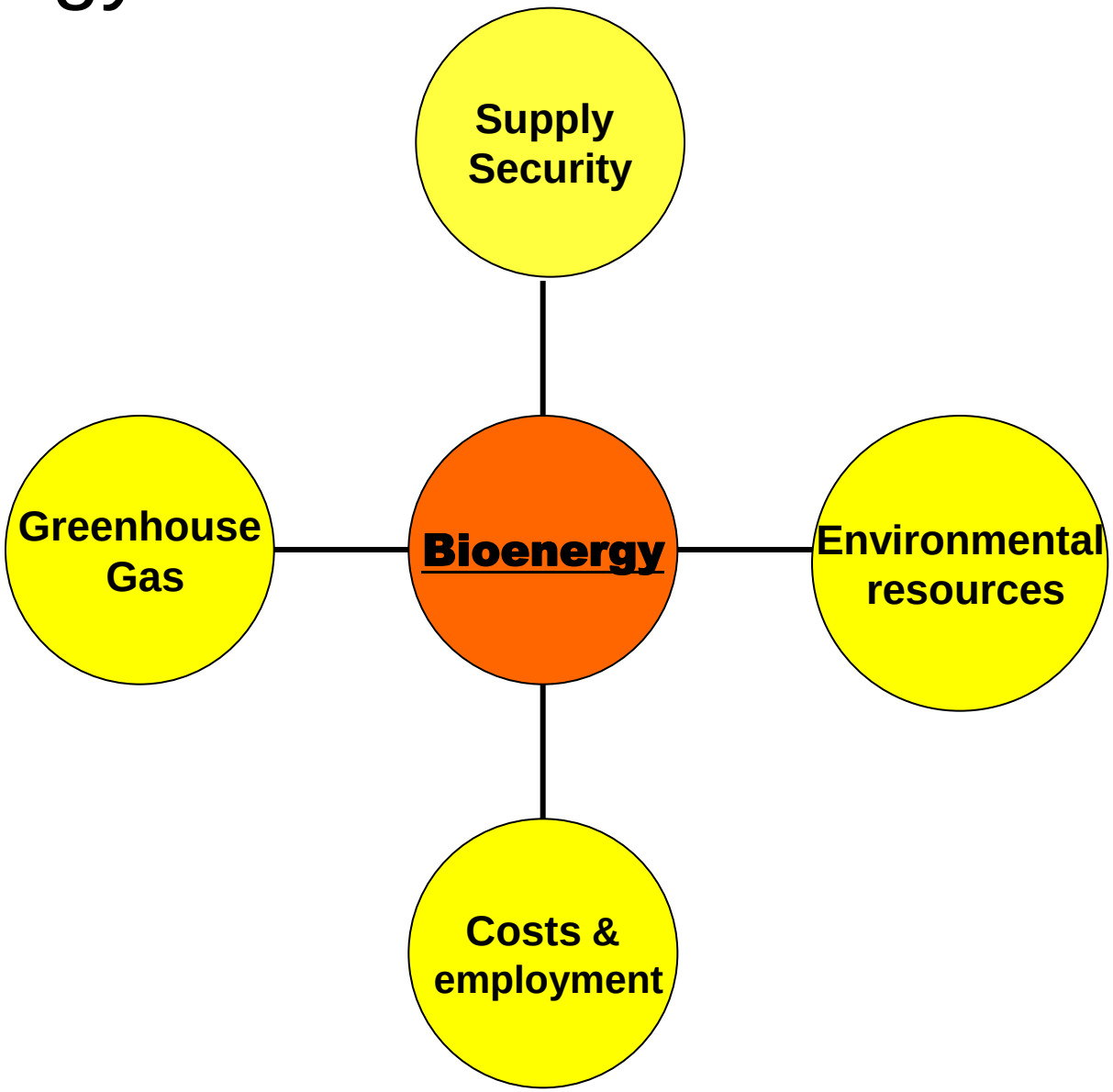


Land Requirements for Biofuels

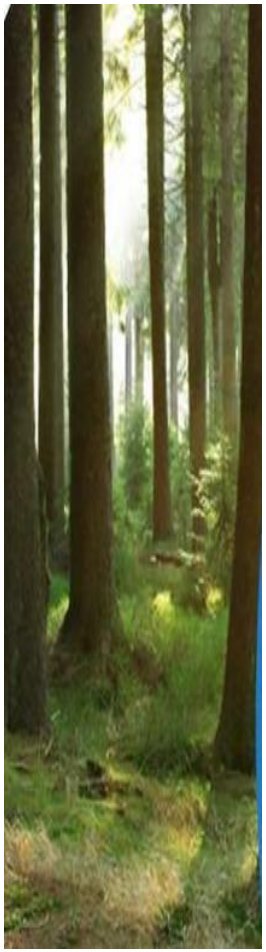


A significant proportion of the world's arable land is turned over to biofuels production- even in the Reference Scenario

Bioenergy- context of assessment



Potential co-benefits between energy use and nature protection



Use of innovative bioenergy cropping systems

-Reduced environmental pressures compared to food cropping (e.g. less nutrient input, enhanced crop diversity, less use of heavy machines, lower structural elements)

-High energy yield

Use of forest residues

-Can support fire prevention measures in otherwise unmanaged forest in Southern Europe

Use of cuttings from grassland

-Necessary for maintain biodiversity-rich grassland and landscape diversity

-Provide (limited) amount of bioenergy

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Bio-energy
-key environmental issues

- **Life cycle greenhouse gas emissions**
- **Life cycle emissions of air pollutants**
- **Impacts of direct and indirect land use change/energy**

-*cropping on:*

-Soil carbon stocks

-Soil conversation

-Water quality and quantity

- Biodiversity and landscapes

Annual Crops

Broad range from low to high pressure risk

	Innovative double cropping	Wheat	Maize	Sugar beet	Poplar **Perennial- for comparison**
Erosion	**A**	**A**	**C**	**C**	**A**
Soil compaction	**A**	**A**	**B**	**C**	**A**
Nutrient inputs into surface and ground water	**A**	**A**	**C**	**B/C**	**A**
Pesticide pollution of soils and water	**A**	**B**	**C**	**C**	**A**
Water abstraction	**A/B**	**B**	**A/B**	**A/C**	**B**
Link to farmland biodiversity	**B**	**B/C**	**B/C**	**B**	**A/B**

Conclusions

1. **Policy support for energy cropping should build on an assessment of environmental impacts**
2. **Bioenergy crops are different from food crops and open new possibilities**
3. **An important bioenergy potential croms from waste and residues and can in many cases be used at low cost**
4. **Life cycle emissions need to be analysed**
5. **Combined Heat and Power (CHP) in biofuel technologies are well suited.**
6. **Bioenergy use in competing end-use sectors transport/heat/electricity depends on policy objectives**
7. **The policy framework needs to provide incentives for environmentally optimal approaches.**

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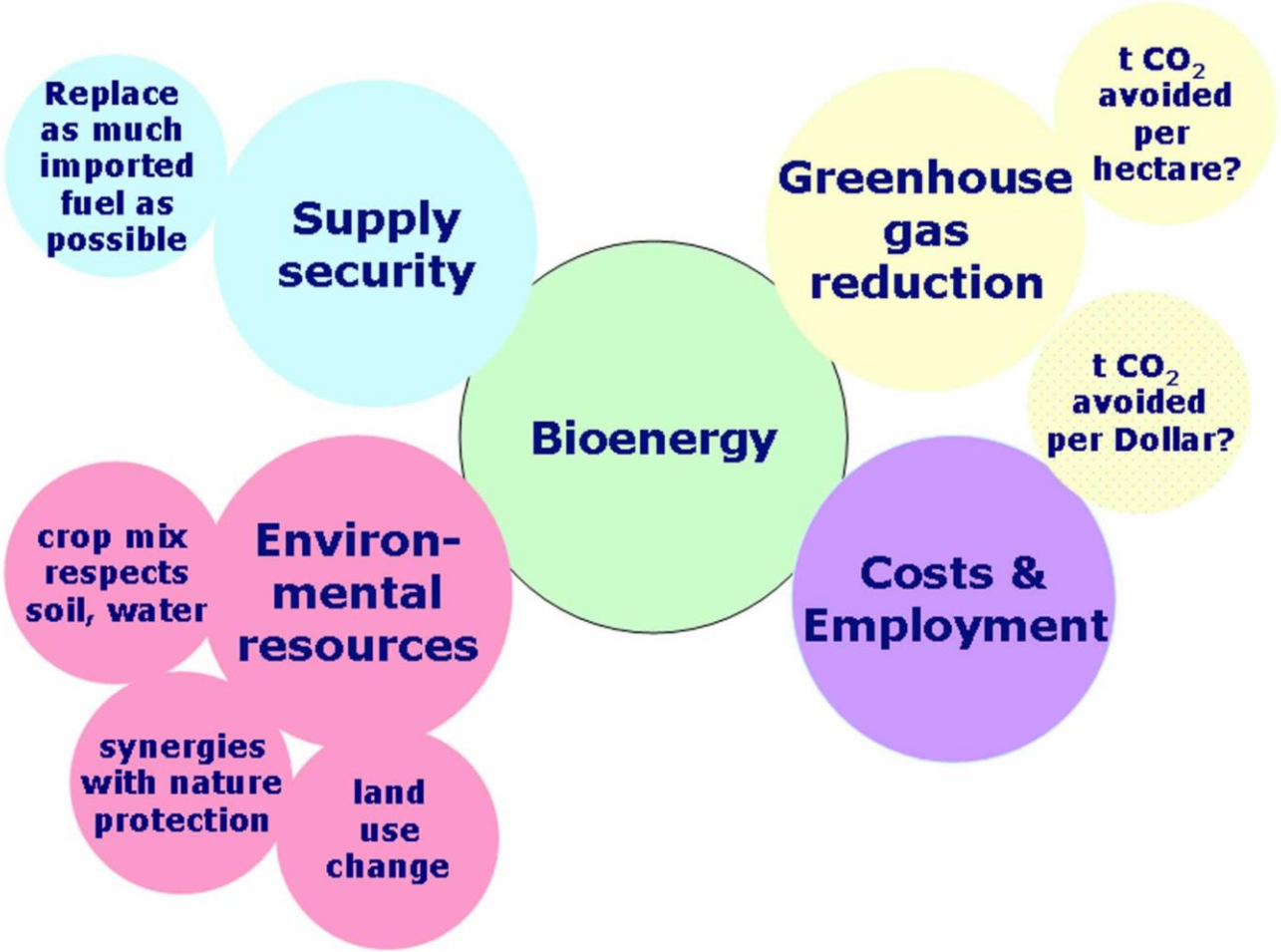
How best to use the potential?



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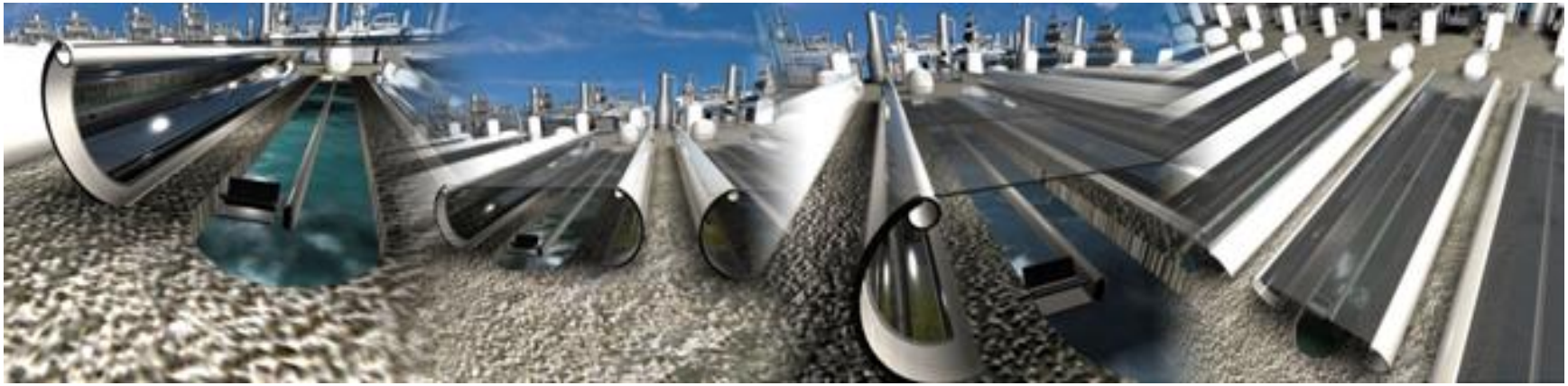
Algae

Freshwater and saltwater algae grown in bioreactors, racetracks or ponds will produce an increasingly important feedstock to the biodiesel industry



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Some final comments

- **We need to develop renewable energy sources & bioenergy is a promising route**
- **At large scale we will get series competition with increasing food demands in the near future**
- **Land use change due to energy cropping has major environmental impacts & negates potential carbon benefits for decades (or longer)**
- **Maximising environm. Benefits from bioenergy requires support via policy and market incentives**

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