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Identifying and Characterising Microalgal Strains that Overproduce Triacylglycerol as Potential Sources of Biodiesel

Emily Hounslow and Philippa Uttley

dtp09eph@sheffield.ac.uk

dtp09pju@sheffield.ac.uk

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E-Futures

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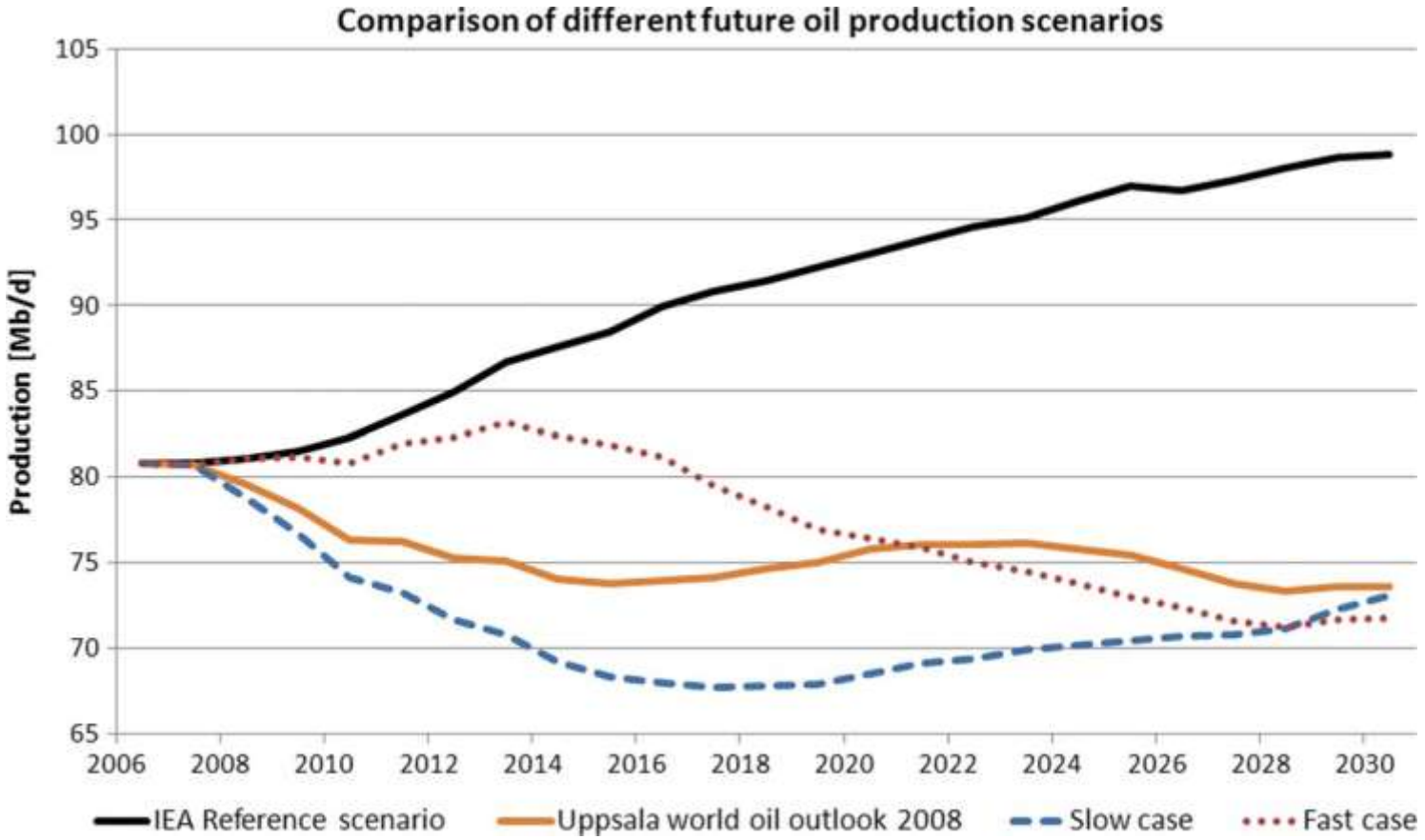
E-Futures

PART A

- Biofuels and Energy Crops
- Carbon Neutral Process
- Triacylglycerol Production and Conversion
- Commercial Installations
- Project Aims
- Part B – Results and Conclusions

Biofuels and Energy Crops

The IEA's World Energy Outlook 2008



Aleklett, K., et al., *The Peak of the Oil Age - Analyzing the word oil production Reference Scenario in World Energy Outlook 2008.* Energy Policy, 2010. **38**(3): p. 1398-1414.

Biofuels and Energy Crops

Comparison of Bioenergy Feedstocks

Five Life Cycle Burdens for Production of One Functional Unit of Energy (317 GJ)

	Land (ha)	Energy (MJ) x 10^4	GHG (kg CO_2 equiv) x 10^4	Water (m^3) x 10^4	Eutrophication (kg PO_4^- equiv)
Algae	0.4 ± 0.05	30 ± 6.6	1.8 ± 0.58	12 ± 2.4	3.3 ± 0.86
Corn	1.3 ± 0.3	3.8 ± 0.35	-2.6 ± 0.09	0.82 ± 0.19	26 ± 5.4
Canola	2.0 ± 0.2	7.0 ± 0.83	-1.6 ± 0.10	1.0 ± 0.14	28 ± 5.8
Switchgrass	1.7 ± 0.4	2.9 ± 0.27	-2.4 ± 0.18	0.57 ± 0.21	6.1 ± 1.7

Clarens, A.F., et al., *Environmental Life Cycle Comparison of Algae to Other Bioenergy Feedstocks.* Environmental Science & Technology, 2010. **44**(5): p. 1813-1819.

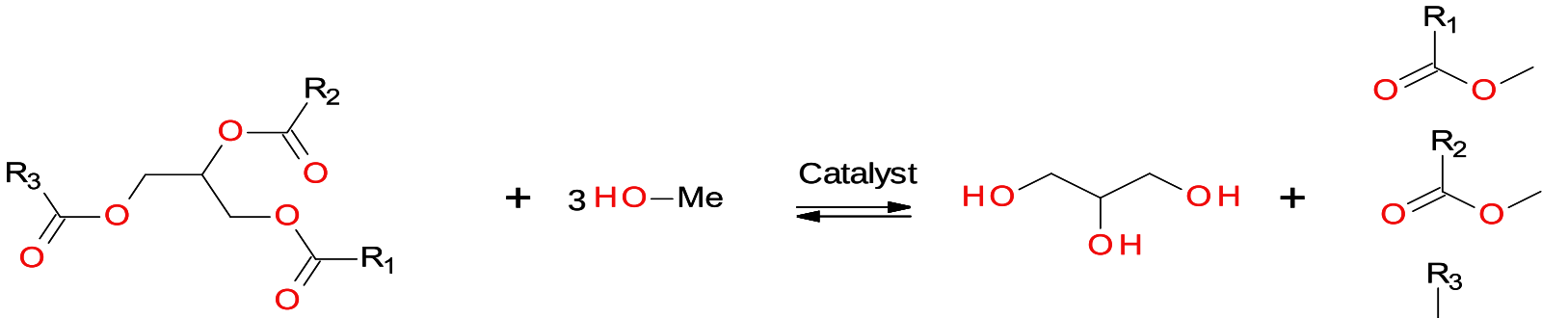
Carbon Neutral Process

Co-location with Anaerobic Digestion	• Production of methane for heat and power • Liquid digestate provides nutrient supply
Co-location with Coal-fired Electricity Generation	• Ready source of CO_2 from flue gases • Co-fire coal with biomass
Choice of Alga and Growth Medium	• Marine alga cultured using seawater • Use of wastewater for phosphate control

Triacylglycerol Production and Conversion

Algae produce a compatible solute in response to stress:

- Nitrogen deprivation
- Increased salinity
- TAG is extracted and converted via transesterification



Chisti, Y., *Biodiesel from microalgae.* Biotechnology Advances, 2007. **25**(3): p. 294-306.

Commercial Installations Photobioreactors

http://www.flickr.com/photos/lowcarboneconomy/2065631607/

Commercial Installations
Raceway Ponds

http://www.rudekinc.com/algae.html

Commercial Installations Harvesting

http://www.rudekinc.com/algae.html

Project Aims

1. **Identify and compare conditions under which two species of algae overproduce lipid**
2. Acquire new laboratory skills

- sub-culturing using aseptic technique
- gravimetric lipid measurement
- determination of chlorophyll content
- cell counting techniques
- Nile Red-staining and fluorescence microscopy

Project Aims
Dunaliella Salina

- Unicellular flagellate
- No cell wall
- Halophile, tolerant of up to 5 M salinity
- Used commercially to produce β-carotene and glycerol
- Does not produce lipid via N deficiency

http://isua.eu/biotechnologie-Dunaliella-Salina.html

Project Aims
Tetraselmis Suecica

- Unicellular prasinophyte
- Cell wall
- Four flagella in apical pocket
- Known to have high Vitamin E content
- Used commercially as feedstock for marine herbivores

http://eol.org/pages/901592

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Is This the Future?

http://www.rudekinc.com/algae.html