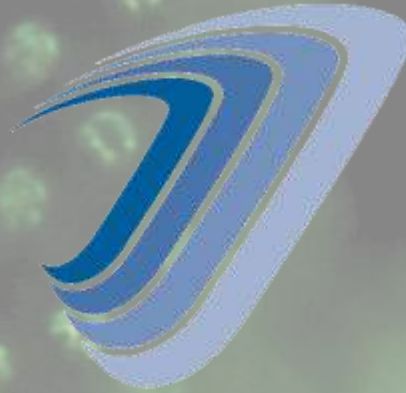


narec
distributed energy



The InteSusAI project LCA

Tom Bradley – Senior Project Engineer
tom.bradley@narecde.co.uk

Introduction

1. Description of the InteSusAI project
2. LCA harmonisation between Algae Cluster projects
3. Initial results

Description of InteSusAI

Integrated Sustainable Algae

Integrated Sustainable Algae

InteSusAI

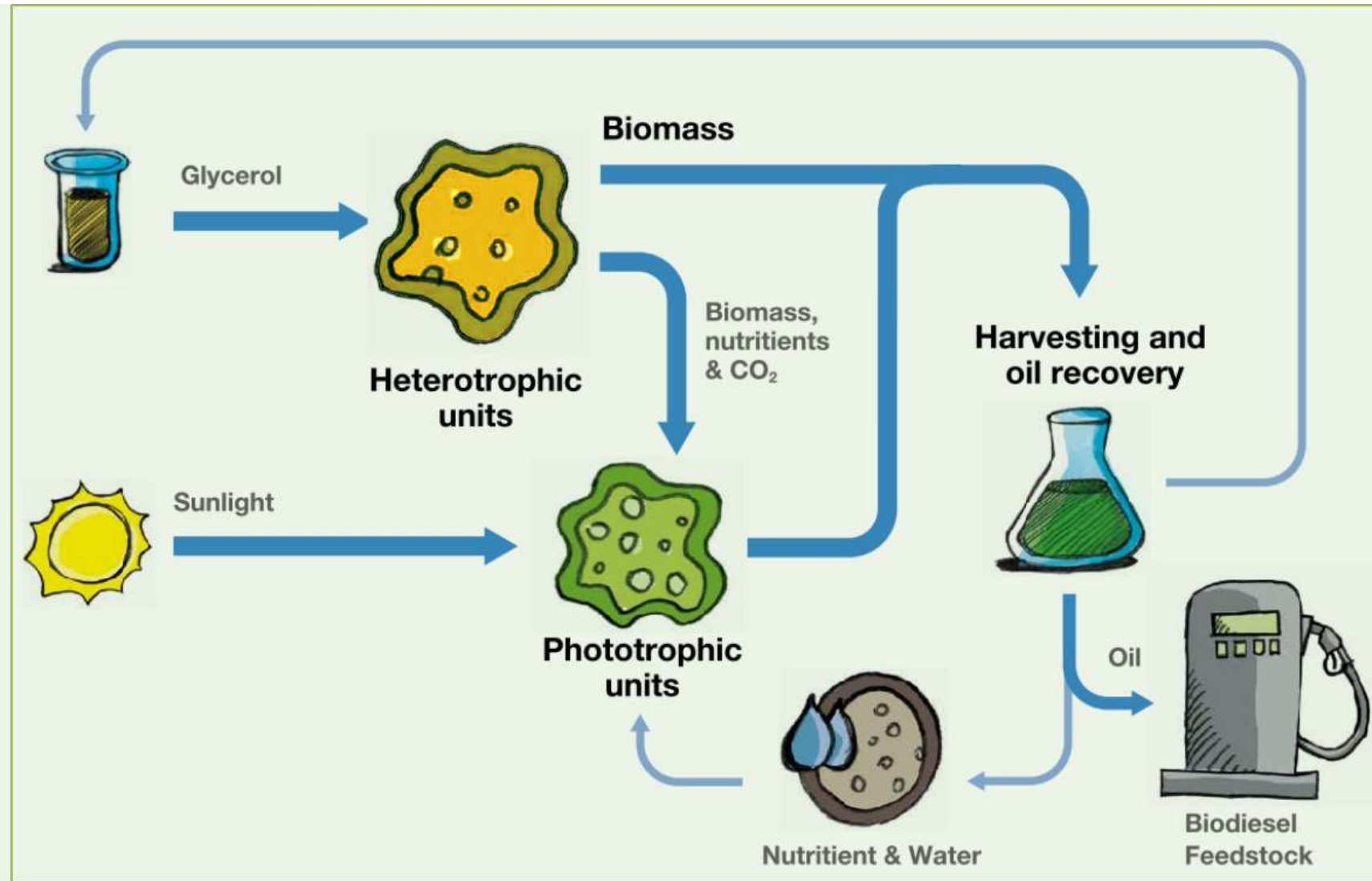
Project full title:	“Demonstration of integrated and sustainable enclosed raceway and photobioreactor microalgae cultivation with biodiesel production and validation”
Project Number:	268164
Cell Identifier:	FP7-ENERGY.2010.3.4-1
Funding Scheme:	Collaborative Project

Description of InteSusAI: Consortium

	Partners	Country
CPI		UK
NIOZ		The Netherlands
DLO-FBR		The Netherlands
Necton		Portugal
NAREC		UK
EUREC		Belgium

Description of InteSusAI: The Concept

- Two independent algae systems
- The first producing algae with carbon as an energy source, the second using sunlight
- The second uses captured carbon from the first, essentially an algae based CCU system to produce fuel from waste CO₂ from a heterotrophic algae system

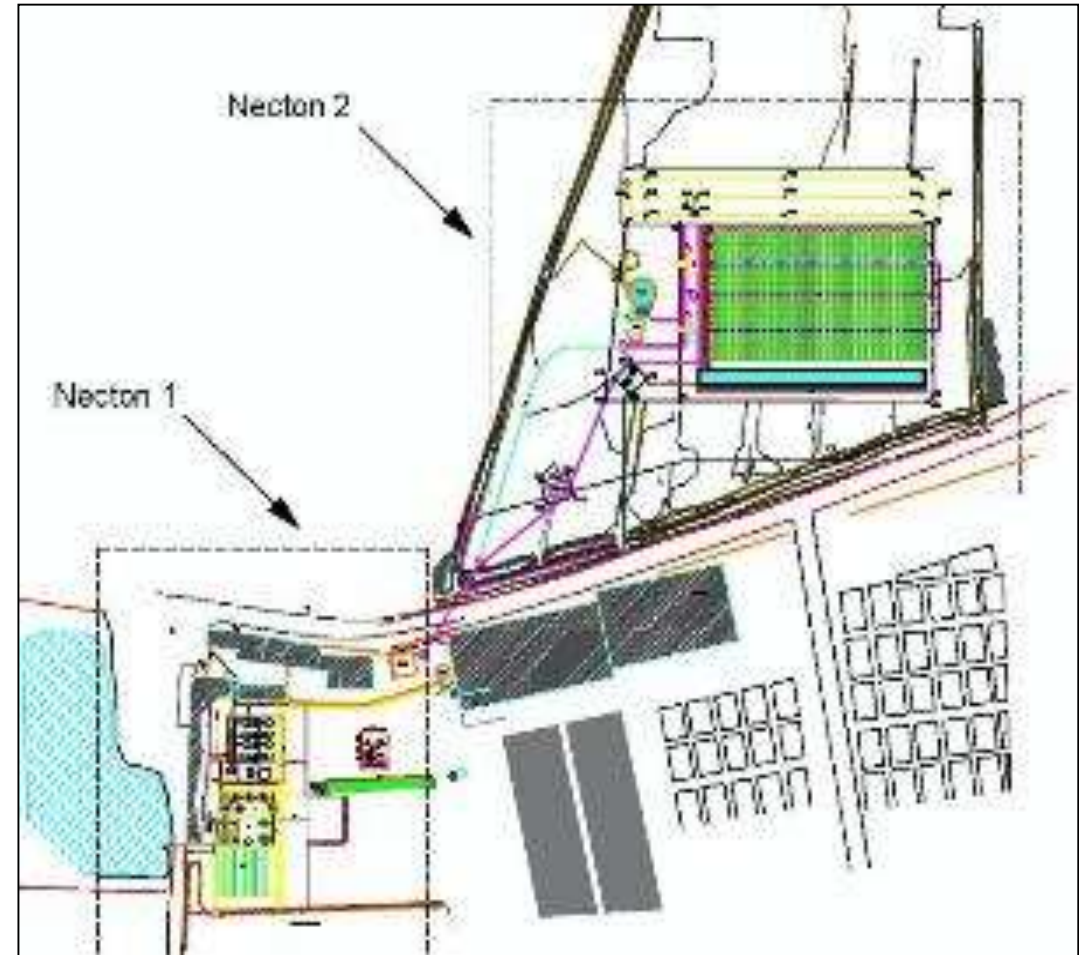


Description of InteSusAI: The Reality



Description of InteSusAI: The Reality

- Necton 1 - Heterotrophic
 - Fermentation
 - 4 x 1,000 L stainless steel
 - Harvesting equipment
 - Water production
- Necton 2 – Autotrophic
 - Raceway
 - 1 x 200,000 L open pond
 - TPBR
 - 4 x 15,000 L serpentine tubular phototrophic bioreactors









LCA Harmonisation

- LCA studies of algae biofuels generally vary significantly in their results
- This is due to differences within methodologies, systems studies and assumptions

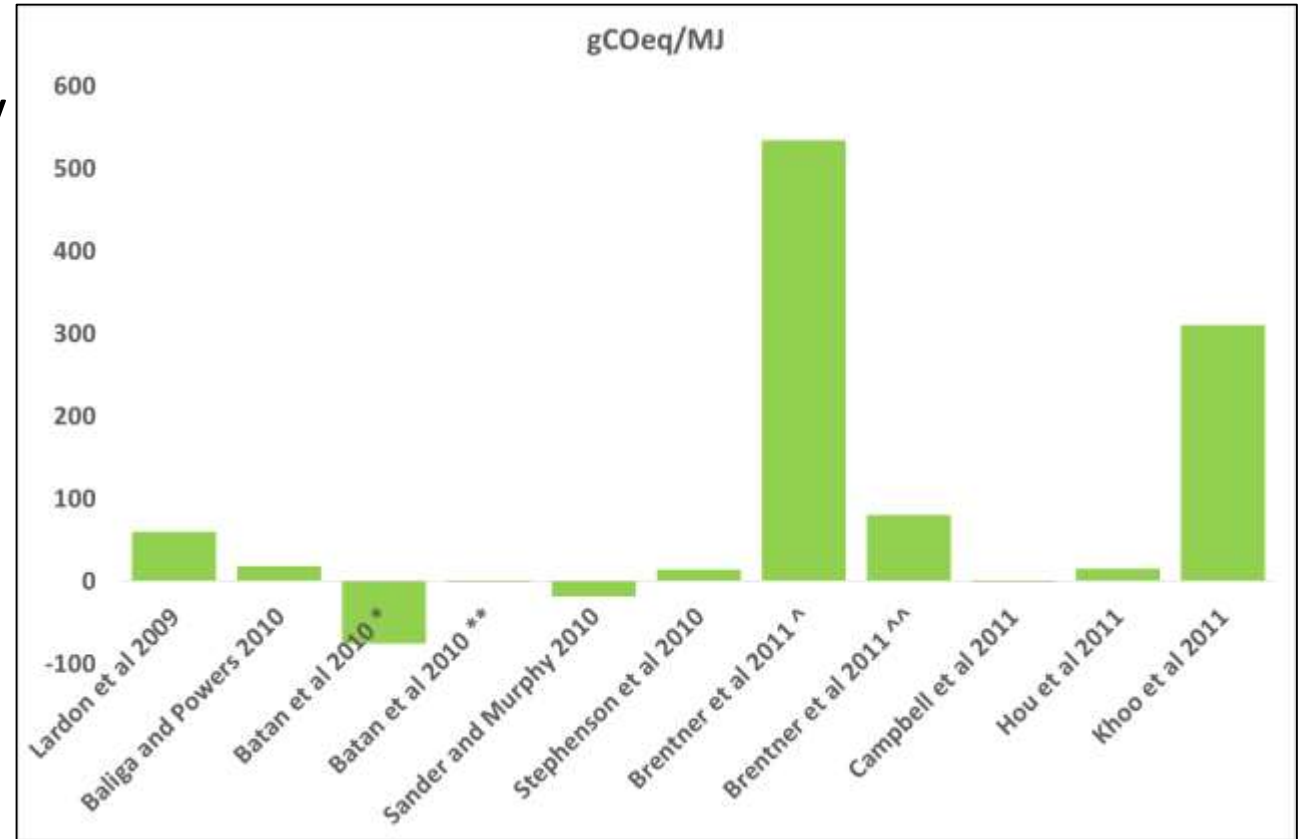
* Combustion not taken into account

** Combustion taken into accounts

^ Base configuration

^^ Best case

Taken from page 306 of Biofuels from Algae



LCA Harmonisation: Assumptions with other studies

- Functional Unit (eg, 1MJ, 3171GJ, or 1 ton of fuel, or of total biomass)
- Energy density of fuel (varied from 42MJ/kg to 24MJ/kg)
- Use of Lower Heating Value or Higher Heating Value
- Boundary Conditions (well to gate, well to pump, well to wheel...)
- Co-products Impact Categories (which used? Confusing similar methods?)
- Energy sources
- Geographical locations
- Sources:
 - Data from other literature
 - Upscaled laboratory data
 - Real world data
- Technologies
 - Using either photobioreactors (vertical, horizontal etc...)
 - Raceways
 - Fermenters

LCA Harmonisation: Development of Methodology

- Face to face meetings organised by Commission
- European Workshop on LCA for Algal Biofuels and Biomaterials (Brussels)
- Face to face meetings when possible
- Online (Skype) and regular email contact
- Presentation of combined methodology at conferences, consortia meetings and workshops
- Adaption of methodology to fit with constructive criticism at conferences/workshops
- Formalisation of methodology as a technical note with Applied Energy, in order for peer review, and to share with other researchers
- Visits to other projects by LCA practitioners to formalise approaches

LCA Harmonisation: Development of Methodology

- Common method between the whole Algae Cluster (InteSusAI, All-Gas, BIOFAT)
- Must align with ISO 14040/ISO 14044.
- Impact categories align with latest science (for example, using latest data from Intergovernmental Panel on Climate Change Fifth Assessment).
- Allow comparison with LCA carried out using the Renewable Energy Directive.
- Replicable by all three practitioners.
- Suitably transparent, whilst respecting intellectual property protection by partners.

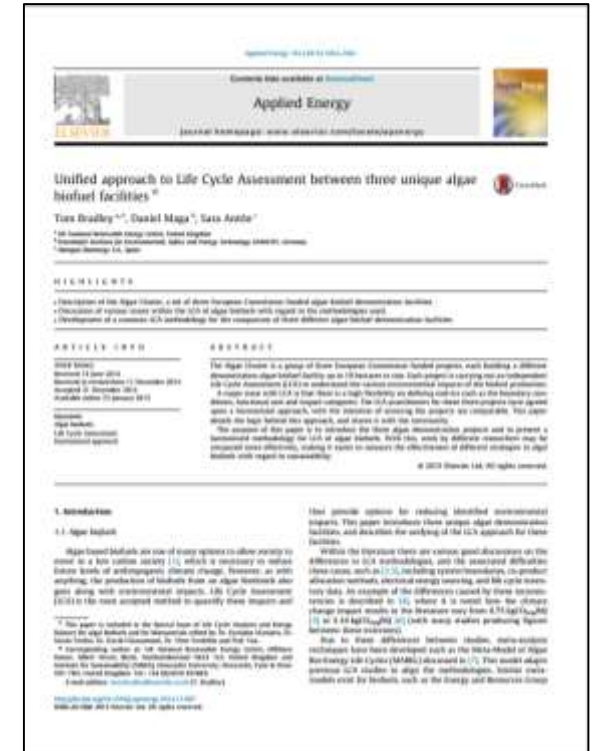
LCA Harmonisation: Issues

- Not all practitioners use same software or methods
- Confidentiality and IP
- Different products and co-products
- Projects did not all run to the same timelines
- Differences in what was expected from each practitioner in their own projects
- Redundancies within firms

But, thanks to hard work, pragmatism, and all project partners (not just LCA) taking an interest, a combined approach worked.

LCA Harmonisation: Goal and Scope

- “Combustion of 1 MJ (Lower Heating Value) of algal biofuel in a car engine”
- Well to wheel
- Facility construction included
- EcolInvent database 3.1
- Recycling: Allocation cut-off by classification
- Thinkstep GaBi software
- AR5 GWP 20/100 impacts (developed database for GaBi)*
- ReCiPe Categories
- System Expansion
- Ensure individual GHG emitted are listed to ensure others can use future GWP/GTP etc. methods (future proofed)
- Average EU-28 grid mix used, and future mix for 2020



<https://doi.org/10.1016/j.apenergy.2014.12.087>

Initial Results

- Climate change impacts of InteSusAI system are approx. 10% lower than fossil diesel, based on real world data over a 100 year period
- 20 year time horizon emissions are very similar to fossil diesel
- Ozone depletion also decreases
- Impacts Expected to significantly decrease if the system is scaled up
- Currently refining LCA models to prepare for publication

Questions?

