



Low Carbon Vehicle Event Millbrook

Operating Trucks with Used Cooking Oil

10th Sept 2014





Presentation Outline

- Brief overview of consortium activity
- UCO technology
- Results so far (summary of real world and emission testing)
- Euro VI plans
- Where next?





Consortium Partners

Consortium

- United Biscuits – Consortium Lead
- Convert2Green Ltd – Ultra Biofuel supplier
- University of Leeds – Academic partner; verification and analysis of results





United Biscuits

- Largest Biscuits and Snacks food manufacturer in UK
- United Biscuits Logistics is an in-house function distributing on behalf of UB and Intersnacks throughout the UK and Ireland.
 - 350 articulated loads a day
- Well developed corporate sustainability programme with targets in all areas
- 'Fewer and Friendlier Miles' transport campaign reducing carbon emissions by 40% since 2006 through a range of initiatives.
 - re-use of waste oils from manufacturing as a potential diesel alternative
- Trials commenced using waste oils blended with diesel however results were mixed.
- Breakthrough with Biomotive fuels now part of Convert2Green who had developed an engine conversion enabling conventional vehicles to run on a much higher blend of Ultra Biofuel



Overview

Convert2Green

- C2G founded in 2006
- National used cooking oil collection service
- Leading independent UK biofuel manufacturer
- National delivery of bio diesel, C2G Ultra Biofuel™ and other biofuels
- Large research and development programme
- Supplies over 2,000 vehicles in UK
- Close government advisor on biofuel policy
- Blue Chip customer base



University of Leeds

- Energy Institute
- Life Cycle carbon footprint analysis
- Fuel properties and lube oil studies
- Emissions and fuel efficiency studies





Scope of trial

- 12 vehicles on trial running on “C2G Ultra Biofuel”
- 10 x Euro 5 Mercedes Axor 2543LS, 2011
- 2 x Euro 6 Mercedes Actros 2545LS, 2014
- 2 identical Euro 5 vehicles as diesel comparators



- Single refuelling station supplies 100% Ultra biofuel with remote fuel management





Trial headlines

- 10 trucks operating for 19 months
- 2,000,000 kms travelled to date using c 575,000 litres UCO
- **1,813 tonnes CO₂ saved**
- No related mechanical issues or Repair & Maintenance (R&M) spend
- Good driver feedback
- Fuel consumption performance in line with calorific value vs std diesel
- No cold weather issues (all year round performance)
- **Fuel substitution average rate 87% ultra biofuel to date**



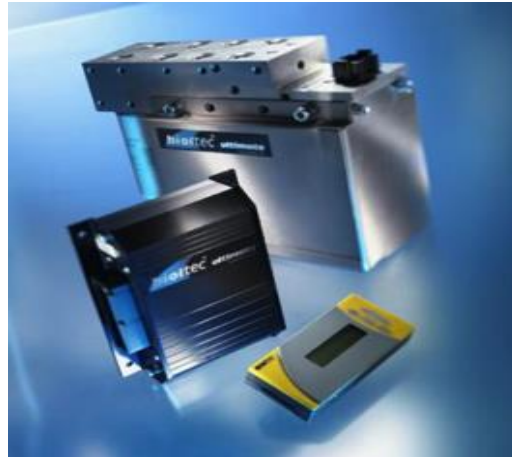
UCO Technology – Fuel

- C2G Ultra Biofuel **IS NOT** conventional biodiesel. It is not Fatty Acid Methyl Ester (FAME)
- C2G Ultra Biofuel **IS** a vegetable oil made from Used Cooking Oil
- Manufacturing plant at C2G in Middlewich using bespoke refining and purification technology
- Low impact refining process: e.g.
 - **Carbon saving over derv 97%** (3,150 Kg **CO₂e** /1,000 litres fuel using DfT calculator)
 - Process removes metals eg P, Mg, Ca, K (<1ppm)
 - Moisture (<150 ppm)
- Conforms to German Quality DIN 51 623 specification and ISO 4406 standard for fuel cleanliness



UCO Technology – Truck

- Dual fuel truck conversion technology supplied by German partners Bioltec GmbH
- Fitted by United Biscuits VMU based in Ashby de la Zouch
- Vehicle Telemetry supplied by Modern Drive, Germany





UCO Technology – Truck

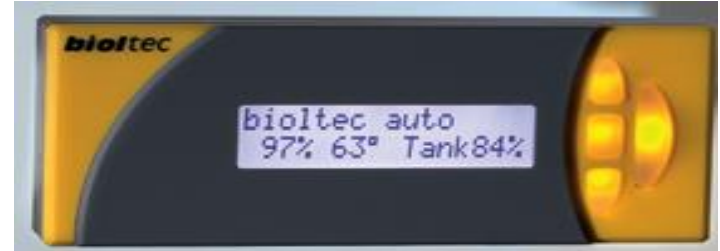
- Dual fuel system which runs the truck on a mix of white derv and Ultra Biofuel
- Split/dual fuel tank fitted which feed through to 'intelligent mixing system'
- Fuel Management System blends Ultra Biofuel as the engine load and operating temperature increase and vice versa





UCO Technology – Key Features

- Driver starts engine normally, system supplies standard diesel
- 4 minutes in system automatically introduces Ultra Biofuel
- System continually monitors for optimum fuel usage based on engine **load** and **temperature**
- 1-2 mins from end journey driver initiates flush of standard diesel
- Comprehensive 'expert' menu for diagnostics for maintenance
- On board Telemetry providing remote data access for trial

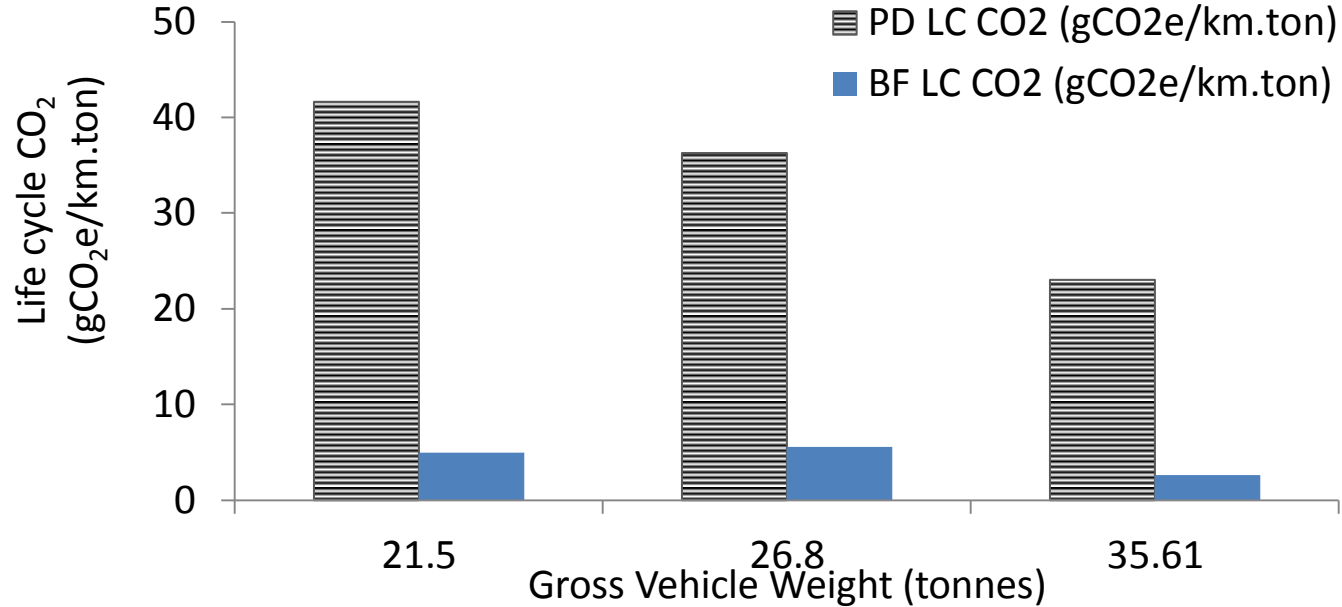




University of Leeds – Scope of Study

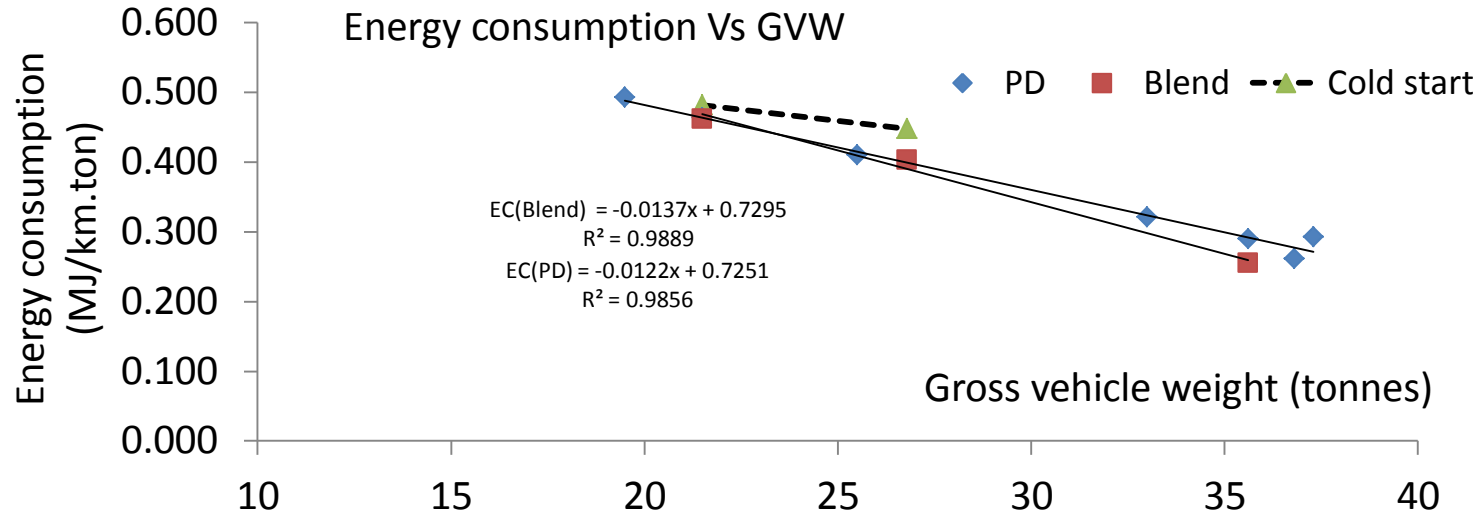
- Life Cycle CO₂ emissions
- Real world Biofuel consumption
- Real world Biofuel Substitution Ratio
- Real world tail pipe emissions
- Injector Study
- SAE papers being published to cover all of the above

Truck Life Cycle CO₂



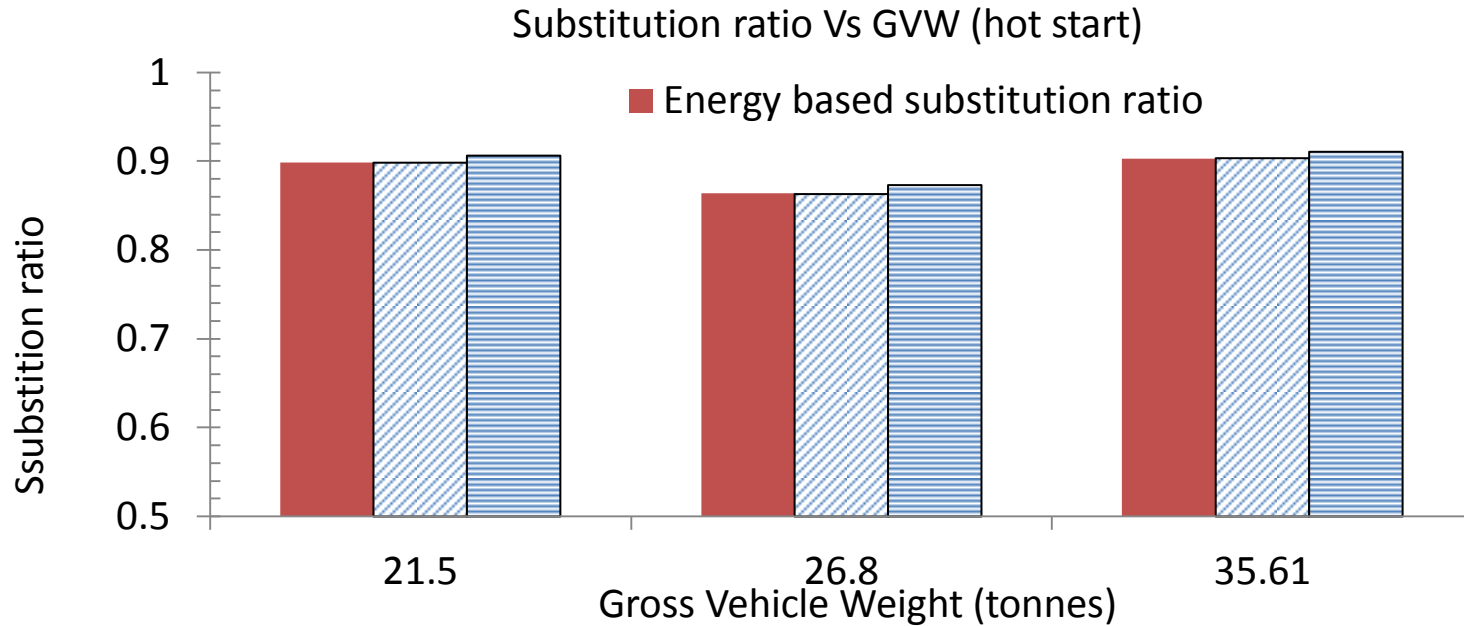
- The chart shows CO₂ emissions of std diesel vs ultra bio per tonne km

Real World Fuel Consumption



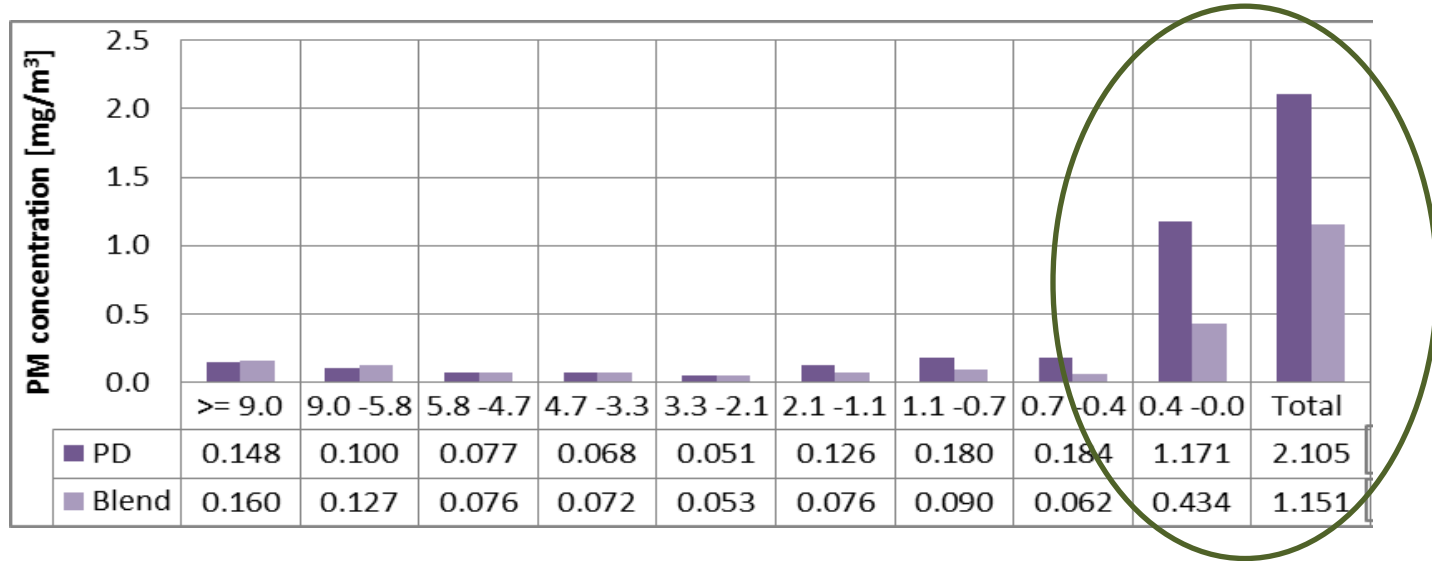
- The chart shows very consistent energy consumption diesel vs ultra bio

Real World Biofuel Substitution



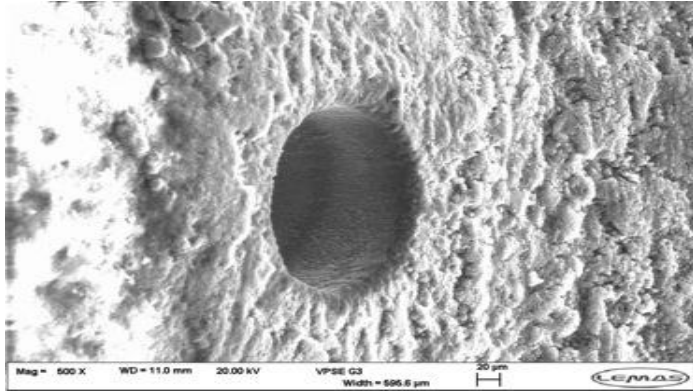
- Analysis demonstrating 87% ave substitution rate

Real World Tailpipe Emission – Particulate Matter (loaded trailer)



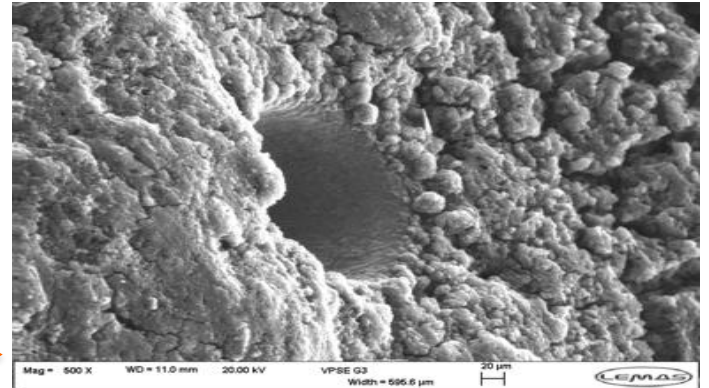
- Data showing tailpipe emission by concentration of particulate matter
- Ultra UCO reduced particulate matter by ~50% for smallest (most harmful) particles

Scanning Electron Microscope (SEM) fuel injector nozzle images:



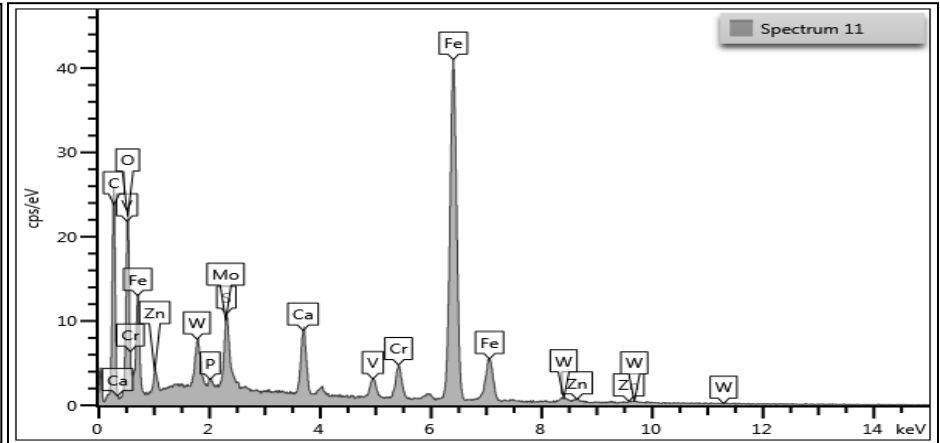
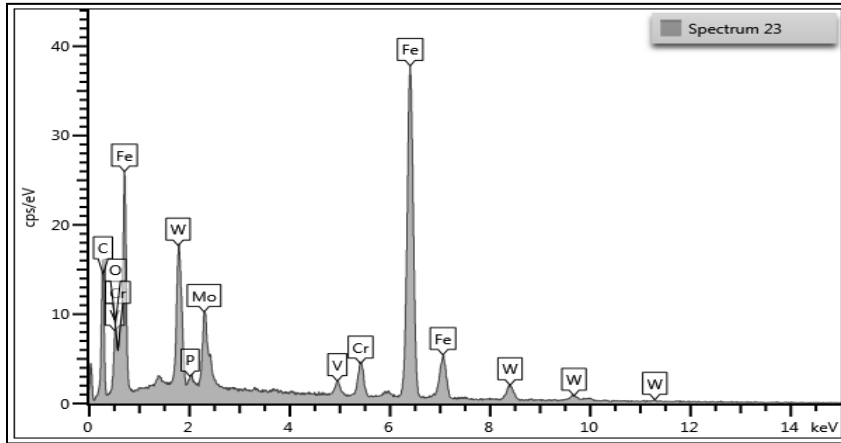
Fuel injector from **Ultra Bio** truck after ~300,000 Km (2 ½ years)

Fuel injector from diesel comparator truck
~360,000 Km on **Diesel**



- Numerous images taken of both nozzles and injector needles showing if anything less deposits from operating Ultra Bio vs Diesel.

EDX (Energy Dispersive X-ray) fuel injector needles:



Fuel injector from **Biofuel** truck

Fuel injector from **Diesel comparator**

- Analysis measuring composition of deposits shows no adverse effects



Trial Next Steps

- Positive results from Euro 5 trial
- Need to future proof as fleet replacement is now Euro 6
- Fleet now extended with 2 UB Mercedes Actros Euro 6
 - truck in HDV Arena
- Euro 6 development self-funded
 - seeking financial support to measure/understand benefits
 - goodwill provision of data to DfT



What is the future for Ultra Bio fuel?

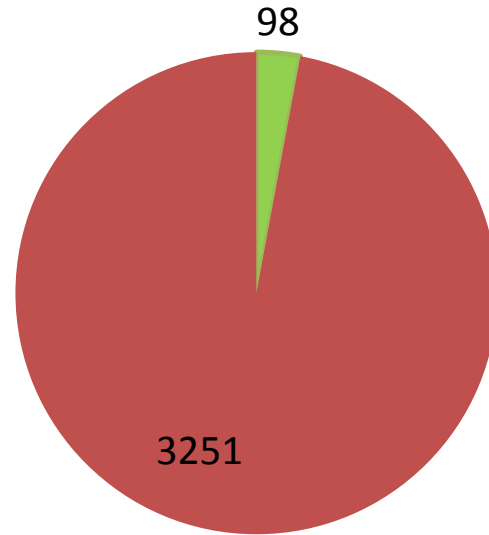
- C2G Ultra biofuel is the most sustainable fuel available for LGV's **as demonstrated by UB over 3 years**
- The fuel can be manufactured from waste cooking oil, greases or waste animal fats
- Estimated 250,000,000 litres UCO generated in the UK (1bn EU)
 - only half used for Renewable Transport Fuels Obligation (RTFO)
 - are we making the best use of this precious resource ?
- This technology can also be used with animal fats
 - Another untapped waste resource



Where do we go from here?

- Seeking support to encourage other fleets to adopt the technology
- C2G Ultra Biofuel is the highest possible carbon saving fuel
 - made in the UK from UK waste
 - capable of supplying several hundred million litres to LGV's, trains and marine
 - **The Market is LARGE**
- Ultra Biofuel is proven, scalable, available immediately.
- How are the DFT, OLEV able to support the development of what could be the most effective low carbon fuel available?

GHG (gCO₂e per litre)



The lifecycle carbon saving using the DFT calculator is 97% compared with mineral derv.

■ Ultra ■ Diesel EN590

- Graphical illustration of greenhouse gas saving of Ultra Biofuel vs std diesel