Low carbon solutions for Birmingham
Bio-hydrogen

Prof. Dr. Andreas Hornung
EBRI - Aston University
Integration of technology as solution for sustainable and economic green energy systems

BioenNW – Delivering Local Bioenergy to North West Europe
Bio-thermal valorisation of biomass - BtVB Process 0.5 t of CO₂ saving for each tonne of feed

BioenerNW – Delivering Local Bioenergy to North West Europe
Lab Scale Pyroformer set-up at Aston University

- Feeder
- Hot Gas Filtration
- Control unit
- Sluice
- Condensation followed by ESP
- Reactor unit
Pyrolysis tests at Harper Adams
Installation of a 100 kg/h pyrolysis demo plant for CHP generation
Where to find us in Birmingham
October 2012
The new pyrolysis gasification at EBRI
BioenNW – Delivering Local Bioenergy to NorthWest Europe

- Dry cooling
- Research lab
- Biomass storage
- Pyrolyse/gasification
- Gas buffer
- CHPs
Hydrogen production costs
Hydrogen production costs on basis of electrolysis processes or via synthesis gases from different fossil and renewable sources

Electrolysis processes require between 50 to 79 kWh to produce 1 kg hydrogen (40 kWh/kg)

The lowest production costs can be realised based on natural gas for 2.5 ct/kWh.
• Production costs of bio hydrogen from BtVB

• A 5 MW$_{el}$ unit (30,000 t/a) sewage sludge as fuel (30 % via Pyrolyse) and (70 % via gasification from wood) realises about 5000 t “Biochar”

• Given 50 % Inerts and 50 % carbon are therefore 1250 t of carbon

• 105 M Mol carbon or 210 t hydrogen (half stociometric conversion of carbon with pyrolysis water) or 2,352,000 m$^3$ hydrogen. CO is used to fire the engines

• 21 Cent per m$^3$ H$_2$ or approx. 2,4 €/kg (6 ct/kWh, pure biochar would result in less than 3 ct/kWh), this fuels a fuel cell car for 250 km.
The new hydrogen Bio-economy
The new Hydrogen Bio-Economy

- 20% mix of hydrogen to natural gas grid
- Use for fuel cell cars
- Estates decentral. fuel cell heaters
- Hydrogen Grid

- Residue wood
- Food waste
- Intermediate pyrolysis
- Gasification
- Winkler generator
- Perowskite Membrane Separation
- Town gas grid
- CHP

BioenNW – Delivering Local Bioenergy to North West Europe
Biogas production
Biomass production
Thermal lines

Hydrogen
Fuel Cell
E-power

E - power

Greenfinch Ltd (Ludlow) 6,000 tpa Demonstrator
Rennie & sons (Bedford) 12,000 tpa

Severn Trent Water

Picture of the stations around Birmingham
Contact details:

Prof. Dr. Andreas Hornung
Director of the European Bioenergy Research Institute - EBRI
a.hornung@aston.ac.uk