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Retrofit Biomass Heating
&
the Renewable Heating Incentive

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Econergy Ltd: The Company

- UK leader in design & supply of complete biomass heating solutions
  - Founded 1999
  - > 500 projects sold to date
  - > 80 schools, colleges etc.
  - 10KW to 2MW systems
  - 19% owned by British Gas
- Econergy offering
  - Biomass boilers
  - Turnkey solution design & supply
  - District heating
  - Biomass heat supply
- Commercial market sectors
  - Schools, social housing, hospitals, universities, leisure centres, care homes, rural developments, offices, supermarkets, greenhouses etc.
- Domestic boilers
  - Increasingly via installer network

Chessington Community College
Royal Borough of Kingston
Froling 320kW wood pellet boiler

Hadley Learning Centre, Shropshire
Froling 320kW wood chip boiler

Econergy customers include

Government Departments
Forestry Commission (14)
DEFRA
Foreign and Commonwealth Office
MOD

Hospitals & Care Homes
Royal Victoria Hospital, Fife
Royal Cornwall Hospital
Cyon Valley Hospital, Wales
Birtley House Care Home
Oxon Care Home

Local Council Offices
Worcestershire County Hall
Southwark Council, London
Maidstone Council
Bradford City Hall

Leisure
Bowood Golf Club & Spa
Doncaster Leisure Centre
Telford Leisure centre & theatre
Paignton Zoo Crocodile Farm
The Living Rainforest

Social Housing District Heating
Sheffield Homes (4)
Berneslai Homes, Barnsley (6)
Doncaster Homes
South Shropshire Housing Association
Bromford Corinthia Housing Association
Birmingham Council
Stockport Homes
Wolverhampton Homes

Education
Bristol Council Schools (6)
Barnsley Council Schools (8)
University of Cambridge
South Lanarkshire Council schools (3)
Suffolk Council schools (4)
National Star College
Berkshire College of Agriculture
Royal College of Agriculture

Rural Developments
Duchy of Cornwall (4)
Aske Estate (4)
Kevin McCloud

Charities
National Trust (12)
RSPB

Domestic

Commercial
Marks & Spencer
Wessex Water
Skipton Building Society
The Co-operative Group

Contractors
Balfour Beatty
NG Bailey
Crown House
Kier Group
Skanska
John Laing
Lorne Stewart
Mitie
Hayden Young
Crest Nicolson
Sir Robert McAlpine
Briggs & Forrestor
Dodd Group
Warings
T Clarke
Interserve
BAM

Renewable Heat Market…
…a recoiled spring

- 15% of UK's energy to come from renewable sources by 2020
- 12% of heating from renewable sources by 2020 including:
  - 110,000 commercial and public sector installations by 2020
    - 25 % of total heat capacity in these sectors
  - 11,000 industrial installations
  - < 1% of heat today from renewable sources
- Heating accounts for 47% of UK's CO2 emissions
  - 69% gas, 10% oil, 14% electricity
  - 2 million homes on oil
    - a key target segment for renewable heat
- Biomass heating likely to be 50% to 60% of renewable heat

=> Renewable Heat Incentive (RHI) to be introduced in July 2011 to support non-domestic installations

Biomass Energy… is moving into focus

"We see a crucial role for sustainable bio-energy at all scales because of is versatility in producing heat, electricity and transport biofuels. Biomass is potentially <u>the single most important renewable energy resource.....</u> We are currently using only 10% of potential woody biomass and I will keep banging the drum for all the advantages "

Chris Huhne, UK Secretary of State for Energy, Dec 2010

By 2020, the UK could have access to about 1,800 PJ of bioenergy supply; this is equivalent to 20% of current primary energy demand in the UK, and would meet the level of demand estimated in the UK Renewable Energy Strategy (DECC 2009).

UK Bioenergy Report to DECC March 2011

AEA, Biomass Energy Centre, Oxford Economics, Forest Research

"Policies that concentrated more on cheaper renewables such as biomass and less on offshore wind and solar, would make things less expensive"

The Economist, 21st May 2011

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Non-Domestic RHI for Biomass heating

A cash tariff (p/kWh) for useful renewable heat delivered for plant owners….

Tariff name	Eligible Technology	Eligible size kW nominal output thermal	Tariff rate* (pence/kWh)	Tariff duration (years)	Support calculation
Small biomass	Solid biomass (includes: wood chip, wood pellet, wood logs)	Up to 199 kW	Tier 1: 7.6 Tier 2: 1.9	20	Metered Tier 1 applies annually up to tier break, tier 2 above the tier break. The tier break is 1,314hr x installed capacity (kW)
Medium Biomass		200 kW to 999 kW	Tier 1: 4.7 Tier 2: 1.9		
Large Biomass		1000 kW and above	2.6		Metering

- Detailed rules on eligibility, compliance, inspection and enforcement to ensure that only useful heat is rewarded

RHI Phasing for Biomass (wood fuelled) Heating

- Parliamentary approval in July 2011
- Phase 1: July 2011
  - non-domestic RHI launch
  - Renewable Heat Premium payments for domestic trials
    - domestic = single heat source heating single dwelling
    - detail in May 2011
- Phase 2: Oct. 2012
  - domestic RHI
  - launched alongside the Green Deal
    - means certain levels of insulation will be required

- Non-domestic RHI
  - public sector
  - community & not for profit
  - Industrial
  - domestic community heating
- Includes
  - forest residue, waste wood even if contaminated
- RHI paid to owner
- Paid for 20 years
- For eligible installations commissioned after 15/7/2009
- Paid based on metered heat output
- Installations >1MW need to report on sustainability
- Administration by OFGEM

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Example RHI Calculations for biomass heat

RHI Non-Domestic Calculation Examples (based on DECC RHI detail, published 10/3/2011)							
Boiler rating (kW)	**40**	**150**	**150**	**500**	**500**	**750**	**1200**
Tier 1 rate	**7.60**	**7.60**	**7.60**	**4.7**	**4.7**	**4.7**	**2.6**
Tier 2 rate	**1.9**	**1.9**	**1.9**	**1.9**	**1.9**	**1.9**	**N/A**
Load factor actual	**20%**	**15%**	**30%**	**15%**	**35%**	**40%**	**40%**
Actual peak load hours	1752	1314	2628	1314	3066	3504	3504
Total annual kWh of heat	70,080	197,100	394,200	657,000	1,533,000	2,628,000	4,204,800
Tier 1 break (peak load hours)	1314	1314	1314	1314	1314	1314	N/A
Max kWhs at tier 1 rate	52,560	197,100	197,100	657,000	657,000	985,500	N/A
Tier 1 annual RHI cash	£3,995	£14,980	£14,980	£30,879	£30,879	£46,319	N/A
Tier 2 annual RHI cash	£333	£0	£3,745	£0	£16,644	£31,208	N/A
Total annual RHI payment	**£4,327**	**£14,980**	**£18,725**	**£30,879**	**£47,523**	**£77,526**	**£109,325**
Average RHI rate (p/kWh)	**6.18**	**7.60**	**4.75**	**4.70**	**3.10**	**2.95**	**2.60**

Ennerdale, Doncaster Homes
- potential RHI funding scenario

- Retrofit existing gas community heating scheme
  - 132 bungalows, 40 flats
  - 3.9m kWhs fuel@ 2.4p/kWh = 2.7m kWhs heat 3.4p/Kwh
  - 1.2 MW peak load
- Econergy supply: replace central gas boiler with biomass
  - Design
  - Main contractor (inc CDM)
  - M&E supply
  - Froling 500KW chip boiler
  - £340,000 capital
- Biomass Heat
  - 1.5 mKWhs heat @ 2.9p/kWh
    - 510 TPA wood chip (30% mc)
- RHI benefit (chip = gas price)
  - **£47,500 RHI payment pa**
  - **7 yr payback**

Froling 500KW boiler delivery into retofit energy centre

Off gas grid Primary School
An example RHI Calculation

- 100kW packaged pellet boiler & integration
  - £82,000
- Current: old oil boiler
  - 25,700 l /yr at 50 p/l
    - 5.7 p/kWh
  - £12,900 oil cost pa
- Future: pellet boiler
  - 42 tonne/yr at £200/tonne
    - 4.1 p/kWh
  - £8,400 pellet cost
  - £10,800 RHI payment
- Net benefit (fuel + RHI)
  - £15,300
  - 5.5 yr payback

Better return for a secondary school using wood chip v. oil

Retrofit Biomass Heating: Key Design Considerations

- What are the customer's objectives ?
- Feasibility - financial, logistics…
- Heat demand profile, layout of buildings, boiler & buffer sizing
- Wood fuel selection, logistics and sourcing
- Space and access for biomass boiler plant (new build / retrofit)
- Air Quality: boiler installation and flue design
- Other planning considerations and approvals (visual, traffic….)
- Hydraulics and controls philosophy

Biomass Heating Life Time Cost (e.g.)

500KW, 1.5m kWhs pa, 30 yr life

£1.8 million lifetime cost of which:

- boiler & feed system 5%
- total installed cost 15%
- maintenance 10%
- wood fuel cost 70%

Design for minimum cost over lifetime

** Particularly important in urban context*

Which fuel type ?

Wood chip	Wood pellet	Logs
Fuel cost: 2.0 – 3.5 p/KWh 10KW to 10MW ***Low energy density (600KWh/m3)*** Automatic feed for 24x7 hour operation Medium /large scale operation is most economic	**Fuel cost: 3.5 - 5 p/KWh** 10KW to 1000KW ***High energy density (3450KWh/m3)*** Can transport long distances Fuel "flows" Fuel delivered by blower – fuel store generally simpler & cheaper	**Fuel cost: 1.5 - 4 p/KWh** 15 to 70KW Easy to handle Known & existing supply chain Can produce from small scale wood land
<u>Considerations</u> Need local supplier Quality can be variable Fuel reception design is key & can be expensive Fuel does not flow & is difficult to handle	<u>Considerations</u> Pellet quality is critical Cost Need large scale production to keep costs down Unlikely to be local	<u>Considerations</u> Need to load manually at least once per day Only suitable for small scale
		

Wood fuel delivery and storage

Capital cost vs. fuel supply cost

1) Underground bunker (Chip)

2) Blown delivery (Pellet / Chip)

3) Scissor lift trailer (Chip)

4) Hook lift bin (Chip)

Wood fuel sources and sustainability

Are there enough trees ?

- 2020 UK Government Biomass Heat Target: 38TWh
  - **Requires 11 million tonnes per annum of wood fuel: >> £1 billion pa**
- Wood fuel sources (1)
  - Forestry & sawmill residues, arboricultural arisings, under managed woodland, incl. domestic pellets: 3-4 m tpa possible by 2020
  - Wood pellets:
    - >300,000 tonnes of pellet now produced in the UK – c. 90% of this is exported !
    - Very substantial supply, not believed to be a limited if imports included
      - eg. >£6 billion of wood products are currently imported into the UK
  - Energy crops: short rotation forestry, willow, poplar etc: c.700,000 hectares by 2020 possible (>9m tpa)
  - Recycled waste wood: > 4m tpa available now (industrial plant only)
- Low carbon, sustainable sourcing is essential
  - Criteria for legal and sustainable sourcing already defined for central Gov procurement
  - RHI requires sustainability reporting (2011) and compliance criteria (2013)for biomass plant for size of 1MW+

(1) Wood fuel sources: Supply estimated based on information from e4Tech reports to DECC 2009, Biomass Energy Strategy (DEFRA) 2007, Forestry Commission statistics (2009)

International Fuel Supply
- substantial resource

- Current EU biomass supply: 1000 TWh/yr increasing to 2000 TWh/yr by 2020 *(European Climate Fund)*
  - Better forest management, use agricultural residues, energy crops on idle or marginal land, more sawmill residues (eg recycled paper)
- Additional 410 million green tonnes of forestry now available from North Atlantic Basin *(Poyry)*
- 400 million Ha available for energy crops by 2050 yielding approx 10 to 20 bn tonnes/yr

  (Intergovernmental Panel on Climate Change – IPCC)

Secure heat supply to 8 schools

- Planned maintenance and managed heat supply contract
  - 10 million kWhrs biomass / yr
  - > 3,000 tonnes / yr
  - Sold as heat (kWhs) out of the boiler
- “95%” of heat from biomass
  - Defined dedicated wood fuel stock levels and fuel quality assurance
  - Two fuel supply sub-contractors providing mutual back-up
- Maintenance and Support
  - Local operation by FM provider
  - National Econergy service team
  - Tiered call-out priorities
  - Local and national spares
  - Periodic preventative maintenance to maintain optimum performance

Ensuring Air Quality

Current Regulation

- Exempt appliances under the Clean Air Act (CAA) for smoke control zones or air quality management areas
- Part J Building regulations for flues
- Flue design according to CAA

- Local Authorities control emissions
  - *CAA: Flues need to be assessed for all boilers > 45kg/hr (c. 150kW)*
  - May need dispersion modelling
  - Advanced filters starting to be required (eg London, Sheffield)

Emerging Regulation:

- UK Wide
  - New limits proposed in RHI from Oct 2012 onwards
    - 150 mg/MJ NOX (OK)
    - 30 mg/MJ (tight)
      - ie. not all MCS compliant domestic boilers
- Urban areas
  - May include in planning process (eg GLA, London)
  - May require advanced filters in all PM10 AQMAs (eg London)

Biomass low emissions solution
Sheffield Greenland District Heating

- Retrofit base load biomass community heating to 380 flats
- Two Froeling 500kW wood chip boilers (50%mc). Underground bunkers.
- Two ceramic filters; PM10 / PM2.5s << 5 g/GJ
- Part British Gas CERT funded

Retrofit Domestic Tower Blocks - typical benefits

- e.g. 2 x 60 flat blocks
- Current insulation
  - none
- Current heating
  - electric storage
  - Gas/oil/coal communal
  - Gas individual
- Upgrade package
  - Cavity / solid wall insulation + windows
  - Biomass community heating
    - Single plant room with biomass & back-up gas feeding two tower blocks
  - Individual flat metering & controls

Solution & Benefits

200 to 999kW biomass boiler

- Demand reduction per flat from insulation, metering & controls (eg 2 bed flat)…
  - from 12,000 - 20,000kwhs
  - to 6,000 - 8,000 kWh

=> 40 - 60% demand reduction

Fuel cost saving for biomass+RHI

- RHI tier 1: 4.7 p/kWh
  - to repay capital difference
- RHI tier 2: 1.9 p/kWh
  - to compensate fuel price

- Fuel price comparisons
  - gas: 2 - 3 p/kWh
  - wood chip: 2.5 - 3.5 p/kWh
  - wood pellet: 3.5 - 4 p/kWh
  - oil: 5 - 7 p/kWh
  - Electricity 8 to 12 p/kWh
- Example: pellet v. gas
  - gas price = 2.5 p/kWh
  - pellet price less tier 2 RHI
    = 3.75 – 1.90 = 1.75 p/kWh

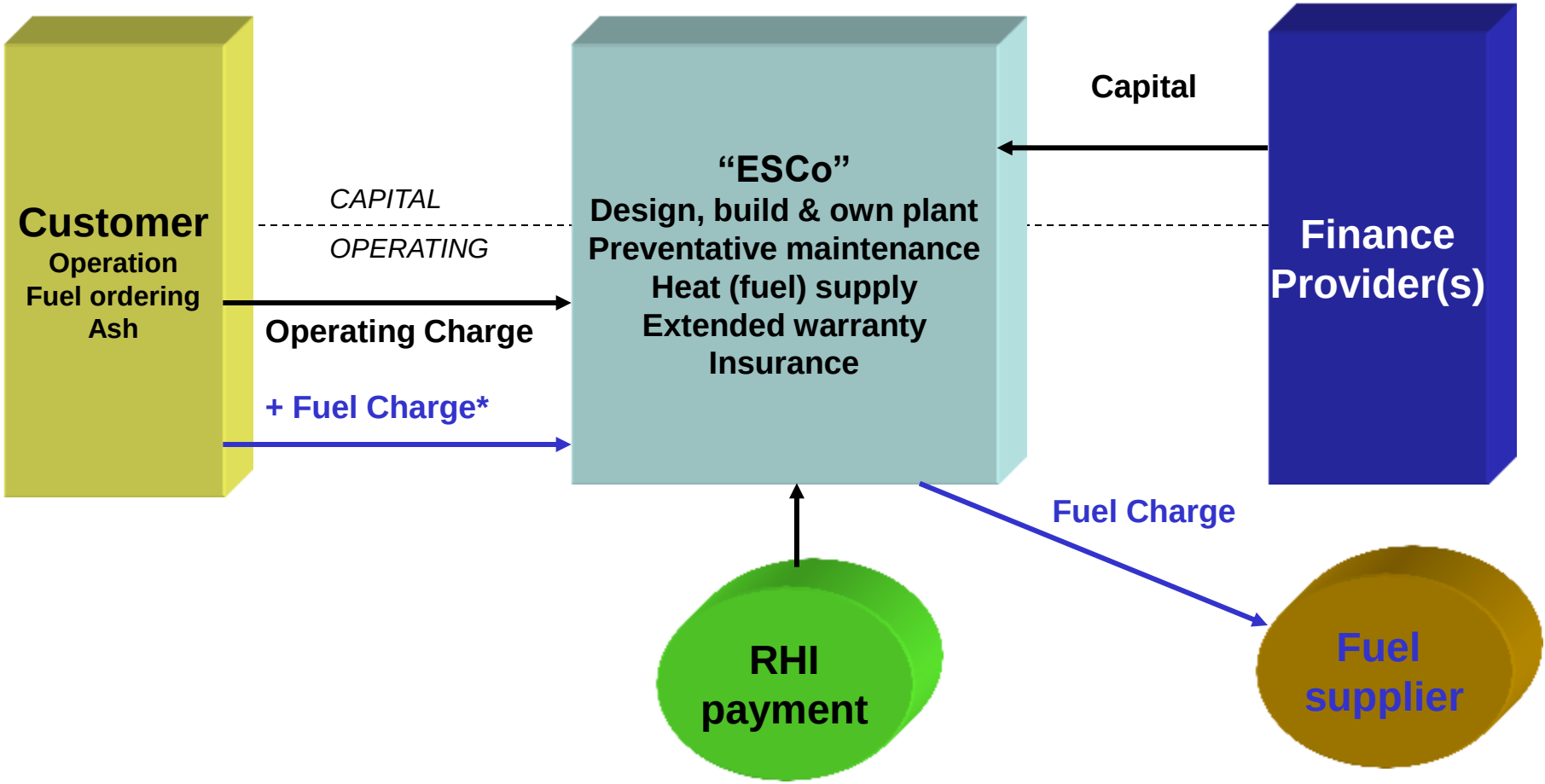
=> Up to 25% fuel saving (v. gas)
or up to 80% saving v. electricity

\+ up to 95% CO2 reduction

Benefits of Biomass District Heating

- To Occupier
  - Easy to use & warm
  - Can control heat & bills
  - Reliability – full back-up
  - No annual boiler maintenance
  - Reduces risks (gas explosion, CO poisoning)
  - No flue
  - No gas mains
  - No fuel storage, manual handling or ash emptying (cf individual biomass boiler)
- To developer/operator
  - Best cost low carbon solution (with insulation)
  - Minimum in property maintenance
  - Consumer acceptance
  - Gas mains safety checks not required
  - Ease of planning: reduced emissions for air quality
  - Reliability: redundant central plant, site spare CIUs
  - Ease of central plant maintenance & remote monitoring

RHI opens the door for various financing structures……



Where to look for biomass heating ?

- Good or excellent financial payback with the RHI
- Typically lowest cost way to reduce CO2 emissions after energy saving
- Space & access is essential
- Ability to fund high capital cost
- Local wood fuel supply (if chip)
- Education or PR
- Security of supply

Initial information required:

- Customer, building type(s) & location
- Economic driver(s)
  - Fuel price, RHI, CRC, Planning, Building regs
  - ROI required (yrs, %)
- Boiler sizing
  - Peak heat demand & profile
  - Current boilers
  - Building(s) floor area
  - Gas / oil usage
- Layout & distances (drawing)
- Space and access
  - Plant room
  - Fuel store
  - Lorry access (tip, blown etc.)

Further information and contacts

- Please call us for design and feasibility assistance
  - Budget costs, proof of concept layouts, technical assistance
- More information
  - Website: Product & design information
  - Commercial: Econergy Biomass Heating Design Toolkit
  - Domestic: Econergy Pellet / Log Boiler UK Installation Guides for Plumbers
  - Environmental Protection UK: Biomass and Air Quality
  - Carbon Trust Biomass Heating Design Guide
- Enquiry form on web-site www.econergy.ltd.uk

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