

Generating an Income from Green Energy

5th May 2011

Halliwel Jones Stadium

The Agenda

- **Introduction**
 - Rachel Waggett, Warrington Local Authority
- **Welcome from Warrington Wolves: An overview of the Ground Source Heat Pump**
 - Andy Gatcliffe, CEO
- **Renewable Heating Technology: Solar Thermal and Heat Pumps**
 - Mark Group Ltd, John Major
- **Renewable Heating Technology: Biomass**
 - Imperative Energy, Chris Hughes
- **Renewable Electricity Technology: Solar PV, Wind and Hydro**
 - Eco Environments, David Hunt
- **Small Scale Anaerobic Digestion Case Study**
 - Reaseheath College, Daniel Galloway
- **Networking and Exhibition**

Solar Thermal



- Technology has been available for 40+ years
- Significant following in mainland Europe
- Has been applied to swimming pools, commercial buildings and the domestic markets
- Can be used to provide DHW and heating support

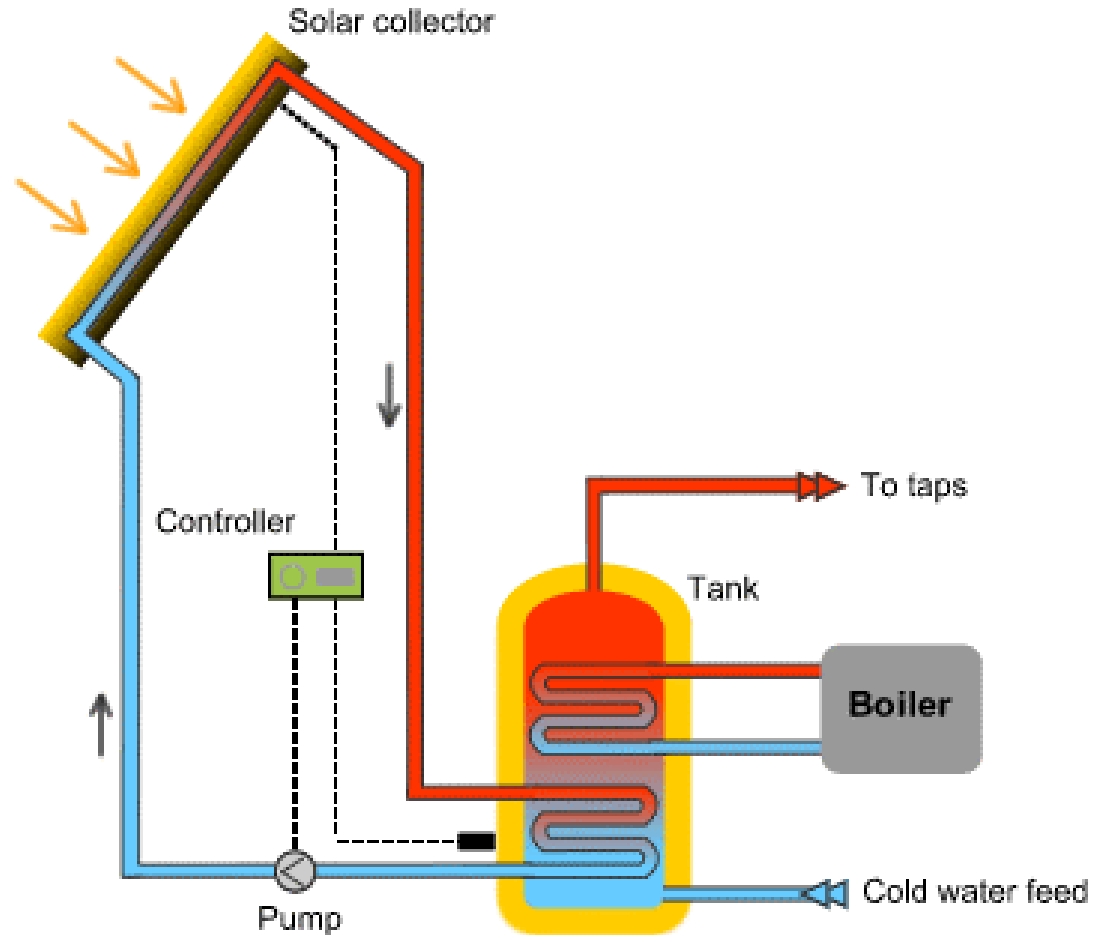
Collectors – Flat plate / Evacuated tube



Typical System



If you want
to save energy ask
MARK

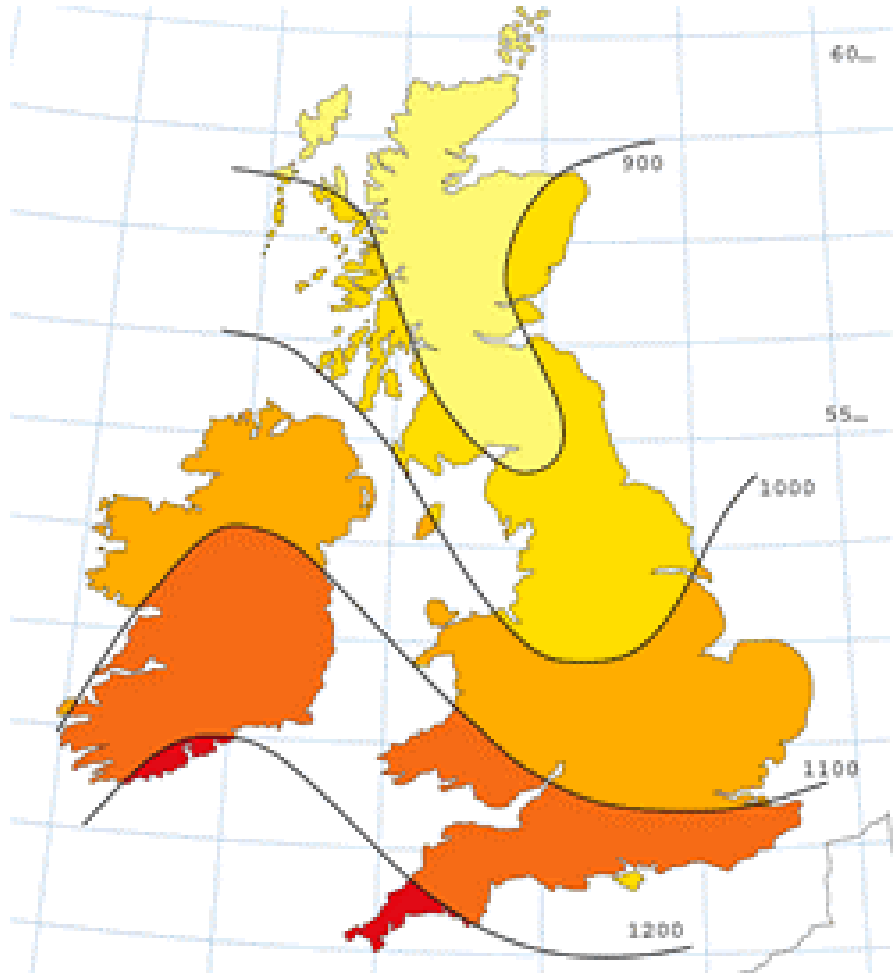


Location



If you want
to save energy ask

MARK



- Solar Thermal works throughout the UK
- Suitable for South (ideally) SW/SE and West orientations
- Yield is dependent on orientation and pitch

Case Study



- 10 Nursing Homes
- Energy Security & rising costs an issue
- Solar Provides hot water and heating support
- Reduction on energy bills of circa 35% per annum

Case Study



- 500 acre dairy farm
- Rising fuel costs an issue
- Uses 500 litres of hot water (90C) daily
- Reduction on energy bills of circa 35% per annum
- 18 Sq Metres Of Tubes Fitted
- 70% of hot water now provided free
- Bills reduced by £1500 per annum

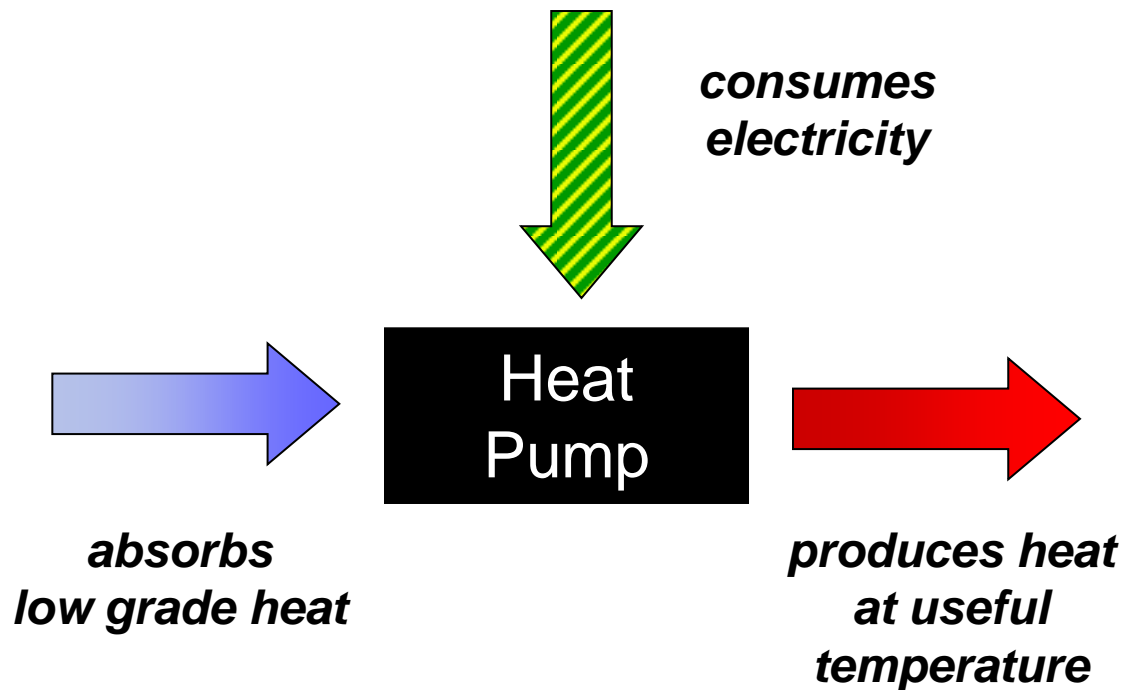
Heat Pumps



If you want
to save energy ask

MARK

What is a Heat Pump?



Heat Pump - Decisions



Source

Ground

Air



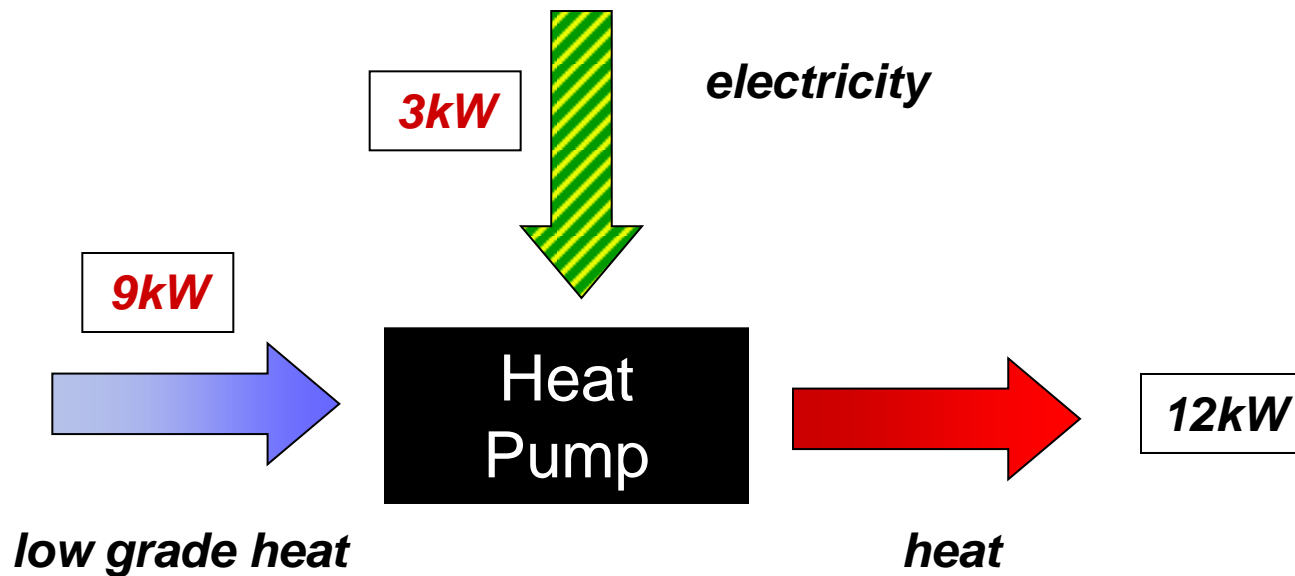
Efficiency



If you want
to save energy ask

MARK

Example 2



$$\text{Coefficient of Performance} = 12 / 3 = 4$$

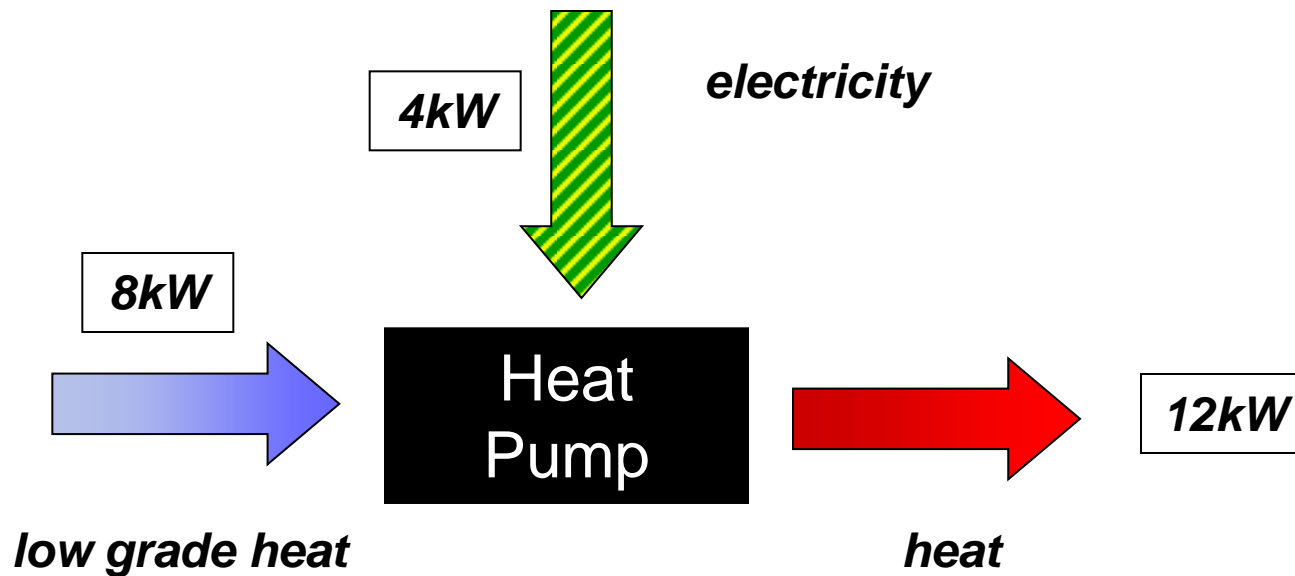
Efficiency



If you want
to save energy ask

MARK

Example 1



$$\text{Coefficient of Performance} = 12 / 4 = 3$$

Case Study -ASHP



- Social Housing Project – Mixed Property Types
- Energy Security & rising costs an issue
- ASHP provides all DHW and heating
- Reduction on energy bills of circa 30% per annum
- Loved by the end users
- Cost effective replacement

RHI Payments



Phase 1 – This will be introduced from July 2011 and apply to the Commercial Sector only. The technologies covered under this scheme will be 1.Biomass 2.Ground Source Heat Pumps 3.Solar Thermal 4.Biomethane. It should be noted that ASHPs are not included in this phase but may be, particularly Air/Water, in phase 2 from October 2012

Phase 2 - Will cover the Domestic sector and will be introduced with the Green Deal in October 2012. Technologies covered by the scheme will be 1.Biomass 2.Heat pumps (both Ground and air source) 3. Solar Thermal.

Commercial Payments



Solar thermal	Solar thermal	Less than 200 kWth	8.5	20	Metering
Small ground source	Ground-source heat pumps; Water-source heat pumps; deep geothermal	Less than 100 kWth	4.3	20	Metering
Large ground source		100 kWth and above	3		

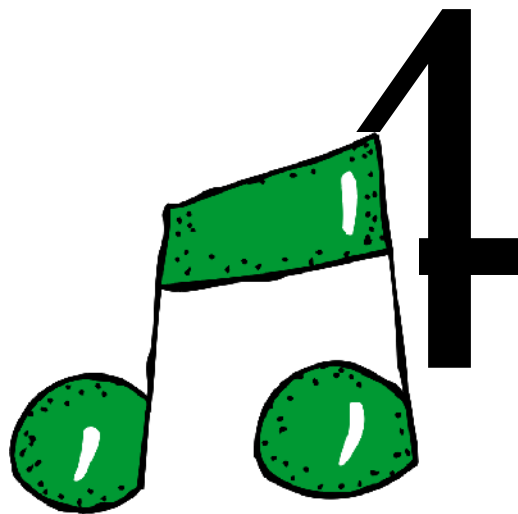
The return on investment stated in the RHI is between 6 -12%



Any Questions ?

Biomass Boiler Technologies for commercial and industrial installations

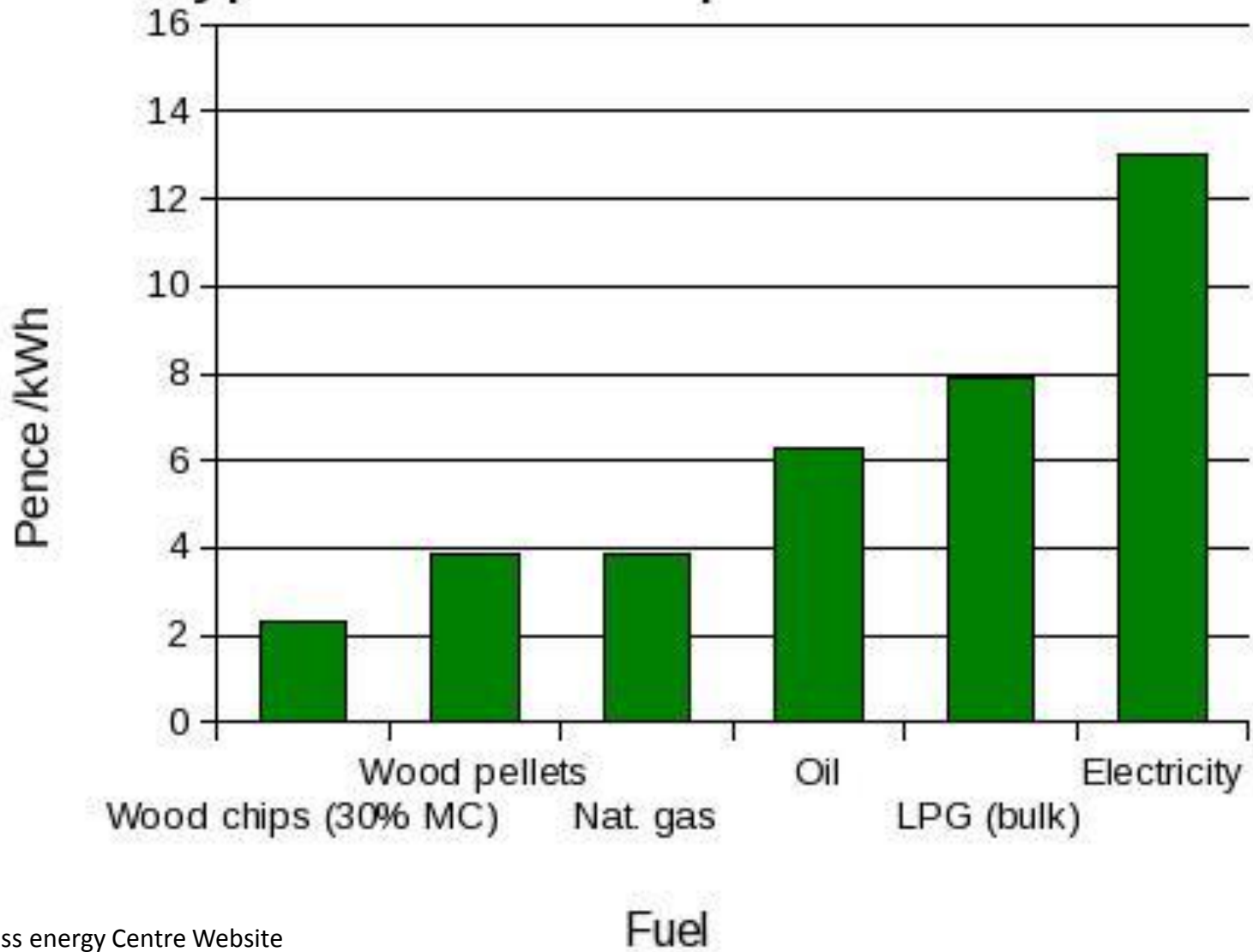
Presented by
Chris Hughes







Typical domestic prices for fuels



Source – Biomass energy Centre Website

Data valid for Dec 2010

www.biomassenergycentre.org

Renewable Heat Incentive

up to 200kW – 7.6p/kWh*

200-1,000kW – 4.7p/kWh*

>1,000kW – 2.6p/kWh

*2 tier system with anything above an equivalent
1314 full load hours at 1.9p/kWh

See www.decc.gov.uk

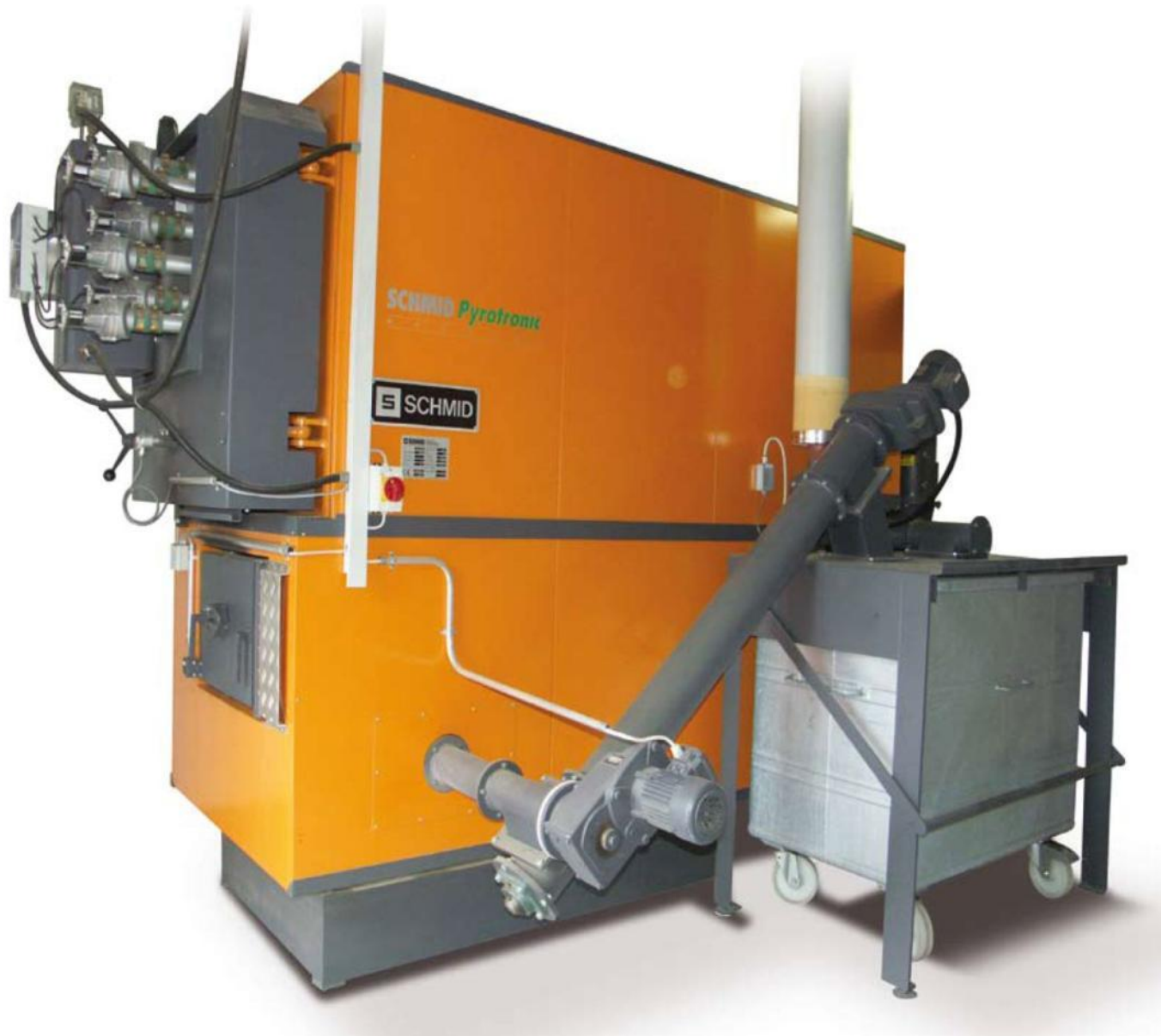




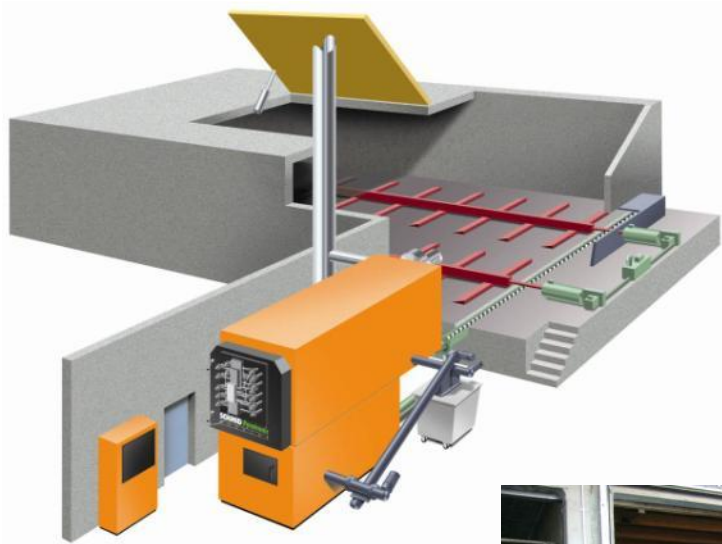


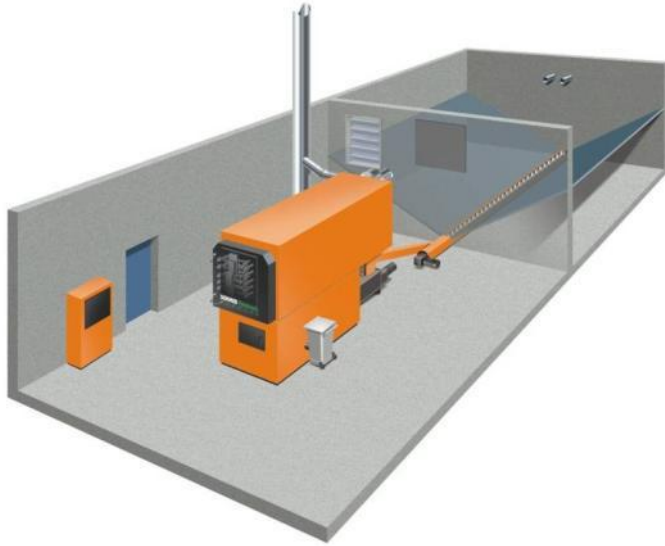
S **SCHMID**
WOOD FIRING SYSTEMS












ESCO



A close-up photograph of a pine cone with vibrant yellow-green needles. A white line graphic starts from the left, goes up, then right, then down, then right again, ending in a rounded shape on the right side of the slide.

Imperative Energy Limited
Dragons Wharf
Dragons Lane
Sandbach
Cheshire
CW11 3PA

Presented by
Chris Hughes

www.imperativeenergy.com



David Hunt



Eco Environments

05 May 2011

Business Briefing:

‘Generating an Income from Green Energy’



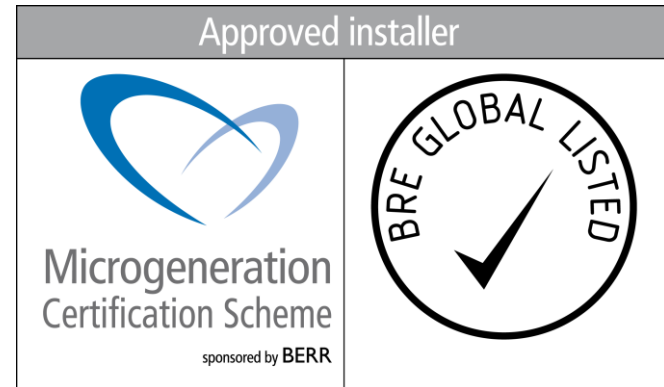
Who are We?

- **A UK award-winning 4x Microgeneration Certified Scheme (MCS) accredited company**
- **We design, install and commission renewable energy and energy conservation solutions. Our clients range from house builders, social landlords, architects and property developers, to businesses, both PLC's and SME's to a broad and happy range of domestic customers**

What Do We Do?

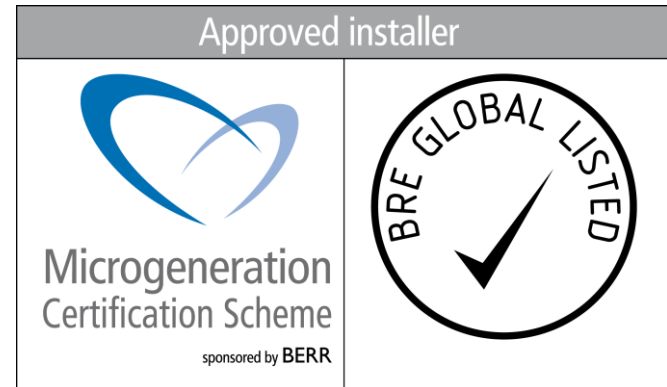
- **We design, install and commission renewable energy systems, from feasibility and planning, to operation and maintenance.**
- **Solar Photovoltaic (PV), Solar Thermal, Air-source heating and Wind turbines are our speciality**

What is MCS?



‘The Microgeneration Certification Scheme (MCS) is owned by the department for Business, Enterprise and Regulatory Reform (BERR formerly DTI) and is designed to evaluate products and installers against robust criteria for microgeneration technologies, providing greater protection for consumers and ensuring that the Government’s (i.e. taxpayers) grant money is spent in an effective manner’ - BERR

Why is MCS important?



- To ensure a quality installation and service.
- You WILL NOT be eligible for any feed in tariffs if you don't use an MCS approved product, and an MCS approved installer.

Clean Energy Cashback Scheme

From 1st April 2010 Feed in Tariffs (FIT's) became the main mechanism for encouraging renewable energy installation for electricity generating technologies. April 2011 sees the introduction of the Renewable Heat Incentive (RHI), for heat generating technologies.

Feed in tariffs are geared to provide an 8-10% annual return on investment for solar PV, and greater still for wind.

This is a scheme where you will be paid for every Kilowatt hour (kwh) of electricity you generate, whether you use it or not. You will also save the equivalent amount by not having to buy the amount of electricity you have generated. You will also be paid for any electricity you export. These tariffs are dependent on you using MCS approved products and installers.

Why and How?

The new Feed-in Tariff (FIT) scheme, sometimes referred to as ‘Clean Energy Cashback’, is available through licensed electricity suppliers. The scheme is intended to encourage the uptake of small-scale low carbon technologies up to 5MW, through tariff payments made on both generation and export of produced renewable energy.

The Energy Act 2008 contained enabling powers for the introduction of a Feed-in Tariff for small-scale low-carbon electricity generation in Great Britain, up to a maximum limit of 5 megawatts (MW) capacity, The Secretary of State for Energy and Climate Change has used those enabling powers to introduce the FIT scheme through changes to electricity supply licences. The Feed-in Tariffs (Specified Maximum Capacity and Functions) Order 2010 (“the FITs Order”) came into effect on 1 April 2010

Eligibility – Basic Overview

The maximum declared net capacity for the renewable installations under the scheme is 5 megawatts (MW), and supports the following technologies:

- **Photovoltaic (PV)**
- **Wind**
- **Hydro**
- **Anaerobic digestion**
- **MicroCHP (pilot programme with a 2kW limit)**

Installations applying for the scheme which have a capacity of 50kW or less are required to use Microgeneration Certification Scheme (MCS) eligible products installed by an MCS accredited installer. This requirement does not apply to anaerobic digestion installations or larger installations up to the scheme limit of 5MW.

Table of generation tariffs to 2020

Technology	Scale	Technology	Scale	Tariff
	Scheme Year			
		PV	≤4 kW (new build**)	36.1
		PV	≤4 kW (retrofit**)	41.3
		PV	>4-10 kW	36.1
Anaerobic digestion	≤500kW	PV	>10-100 kW	31.4
Anaerobic digestion	>500kW	PV	>100kW-5MW	29.3
Hydro	≤15 kW	PV	Stand alone system**	29.3
Hydro	>15-100 kW	PV	≤1.5kW	34.5
Hydro	>100 kW-2 MW	PV	>4-10 kW	26.7
Hydro	>2 MW – 5 MW	PV	>10-100 kW	24.1
MicroCHP pilot*	≤2 kW*	Wind	>15-100kW	18.8
PV	≤4 kW (new build**)	Wind	>500kW-1.5MW	9.4
PV	≤4 kW (retrofit**)	Wind	>1.5MW-5MW	4.5
PV	>4-10 kW	Wind		
PV	>10-100 kW	Wind		
PV	>100kW-5MW	Wind		
PV	Stand alone system*	Wind		
Wind	≤1.5kW	Wind		
Wind	>1.5-15kW	Wind		
Wind	>15-100kW	Wind		
Wind	>100-500kW	Wind		
Wind	>500kW-1.5MW	Wind		
Wind	>1.5MW-5MW	Wind		
Existing microgenerators transferred from the RO				
9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 to 2027				

* Note the microCHP pilot will support up to 30,000 installations with a review to start when the 12,000th installation has occurred

** "Retrofit" means installed on a building which is already occupied ;"New Build" means where installed on a new building before first occupation ; "Stand-alone" means not attached to a building and not wired to provide electricity to an occupied building

After index linked increase of 4.8% from 1st April 2011

Solar Photovoltaic with total installed capacity of 4kW or less, where installed on a new building before first occupation	36.1 pence per kilowatt hour	37.8 pence per kilowatt hour	37.8 pence per kilowatt hour
Solar Photovoltaic with total installed capacity of 4kW or less, where installed on a building which is already occupied	41.3 pence per kilowatt hour	43.3 pence per kilowatt hour	43.3 pence per kilowatt hour
Solar Photovoltaic with total installed capacity greater than 4kW but not exceeding 10kW	36.1 pence per kilowatt hour	37.8 pence per kilowatt hour	37.8 pence per kilowatt hour
Solar Photovoltaic with total installed capacity greater than 10kW but not exceeding 100kW	31.4 pence per kilowatt hour	32.9 pence per kilowatt hour	32.9 pence per kilowatt hour
Solar Photovoltaic with total installed capacity greater than 100kW	29.3 pence per kilowatt hour	30.7 pence per kilowatt hour	30.7 pence per kilowatt hour
Stand-alone (autonomous) solar photovoltaic (not attached to a building and not wired to provide electricity to an occupied building)	29.3 pence per kilowatt hour	30.7 pence per kilowatt hour	30.7 pence per kilowatt hour
Wind with total installed capacity of 1.5kW or less	34.5 pence per kilowatt hour	36.2 pence per kilowatt hour	36.2 pence per kilowatt hour
Wind with total installed capacity greater than 1.5kW but not exceeding 15kW	26.7 pence per kilowatt hour	28 pence per kilowatt hour	28 pence per kilowatt hour
Wind with total installed capacity greater than 15kW but not exceeding 100kW	24.1 pence per kilowatt hour	25.3 pence per kilowatt hour	25.3 pence per kilowatt hour

Hydro Systems

Hydro Turbines

The power in water is used to turn a turbine which can produce electricity.

Hydro turbines generate DC electricity which goes through an inverter to become AC before connecting directly to the property supply.

The electricity generated can be used straight away, or fed into the grid.



Size	2011-2012 Rate (p / kWh)	Lifetime
≤15kW	20.9	20
>15-100kW	18.7	20
>100kW-2MW	11.5	20
>2MW - 5MW	4.7	20

Wind

“The UK is the windiest country in Europe representing 40% of EU’s total wind potential.

If we could harness this natural resource efficiently, we could power the whole country several times over”

Wind Turbines

Probably not so suitable for urban areas, but ideal for properties in more rural or spacious areas.

A 6kw turbine produces on average 16,000 kwh per annum, a 15kw turbine generates over 25,000kwh, creating revenue as well as powering the property.



A local 'Eco Environments' install (08/03 M57 junc2)





Solar

“The earth receives more energy from the sun in just one hour than the world uses in a whole year ”

Solar Photovoltaics?

SOLAR PV- Solar is a far more predictable source of electricity, as such it is easier to look at numbers. PV could provide nationally

Every roof space- 460Twh, 116% of UK consumption!

A typical domestic installation will cover about 2/3 to 3/4 of household needs, commercially it depends on your roof size and energy use.

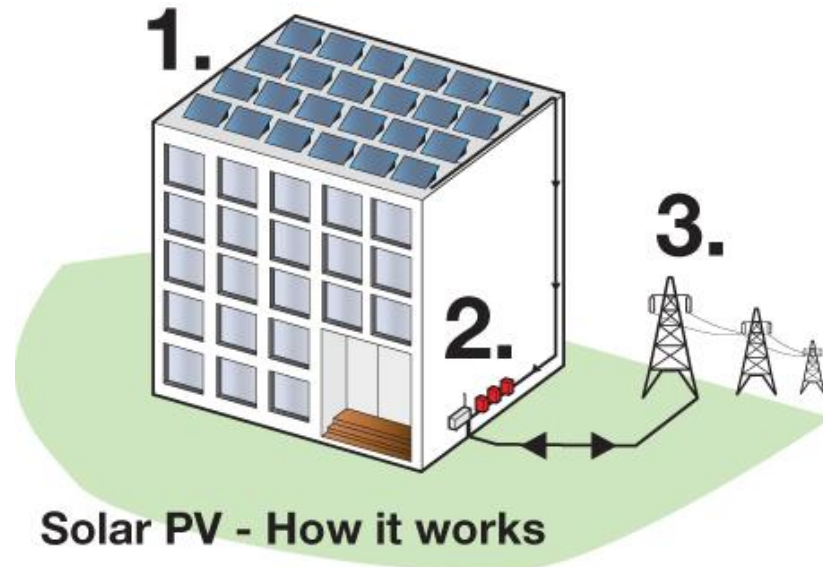
Solar Photovoltaics (PV)

Solar panels work on daylight, rather than sunlight, though do perform better, the more sun there is.

Solar PV is very simple to integrate into the household electricity supply.

You must notify the DNO when connecting to the grid, beforehand if your system is of a reasonable size.

Grid systems export surplus electricity to the grid, for which you are paid.



Solar PV - How it works

1. Photovoltaic modules can be mounted on the roof of buildings in many different ways. The cells in the modules convert daylight into DC electricity. This process is silent and has no moving parts.
2. The DC electricity is wired to a set of inverters, usually installed in the plant room. The inverters convert the DC electricity to AC. The AC electricity is then sent through the main distribution board for use in the building.
3. When more electricity is generated than is being used in the building, the excess can be exported to the grid. At night, or when the demand is higher than the PV system can supply, electricity is imported from the grid.

Solar Photovoltaics (PV)

Solar panels

Come in a range of power outputs and can be put into different sized arrays depending on the output required.

Solar panels generate DC electricity which is goes through an inverter to become AC before connecting directly to the property supply.

Solar panels need to be on a south facing, or predominantly south facing roof to have real value.





Solar Photovoltaics (PV)



Solar PV

As an example of commercial solar PV system (£25,748 install cost)

As an example, if you were to install a 9.81kwp system, generating 8,339 kwh's a year

Your income from generation would be $8,339 \times 37.8p = £3,151.95$

Your saving would be $6,671 \times 10p = £667.08$ (80% of generation, 10p typical cost per kwh)

Your income from export would be $1,668 \times 3.1p = £51.70$

A total income/saving of £3,870.73 per year, and £96,768.29 over 25 years.

This equates to a 375% return on investment, or 15.3% annually. (This will increase as energy prices go up) + Save 4.5 Tonnes of CO² PA

Solar PV

As an example of a larger commercial solar PV system (£128,373.34 cost)

As an example, if you were to install a 50kwp system, generating 42,080 kwh's a year

Your income from generation would be $33,664 \times 32.9\text{p} = \text{£}13,844.32$

Your saving would be $26,931.2 \times 10\text{p} = \text{£}3,366.40$ (80% of generation, 10p typical cost per kwh)

Your income from export would be $6,733 \times 3.1\text{p} = \text{£}260.90$

A total income/saving of £17,471.62 per year, and £436,790.40 over 25 years.

This equates to a 340% return on investment, or 13.61% annually. (This will increase as energy prices go up) + CO² Saving of 23 Tonnes PA

Solar PV Payback Calculation - Commercial

Average Cost per kW Installed (£)	2,579
Estimated Installed Cost (£)	126,373
Size of the Array (kWp)	49
Load Factor	0.8
Solar Radiation Factor	1027
Overshading Factor	1
10-100 KW	32.9
100.1-500 KW	30.7

Enter your own figures in ORANGE boxes
PAYBACK reached in year where cells turn GREEN in Accumulative Total

Notes:
 > Calculations ignore the time value of money
 > Assumes inverter lasts 25 years

Estimated Output (kWh/annum)	40258	Assumed Annual Rate of Inflation	4%	% of Energy Used on Site	80%	Annual Increase in Energy Cost	6%	Annual Maintenance Cost (£)	500	1000
------------------------------	--------------	----------------------------------	-----------	--------------------------	------------	--------------------------------	-----------	-----------------------------	------------	------

Year	Estimated Output Taking Degradation at 1% loss/year into Account (kWh/annum)	Efficiency of Cells	inflation compound factor	FIT including inflation (p/kWh)	Total Generation annual income (£)	Energy Used on Site (kWh)	Energy Cost (p)	Savings from Energy Used (£)	Total Income & Saving per year (£)	Accumulative Total (£)	Year
1	40258	100%	1	32.9	13,245	32207	10.00	3221	15,966	15,966	1
2	40258	100%	1.04	34.2	13,775	32207	11	3414	16,689	32,654	2
3	40258	100%	1.08	35.6	14,326	32207	11	3619	17,445	50,099	3
4	39856	99%	1.12	37.0	14,750	31885	12	3798	18,047	68,146	4
5	39457	98%	1.17	38.5	15,186	31566	13	3985	18,672	86,818	5
6	39063	97%	1.22	40.0	15,636	31250	13	4182	19,318	106,136	6
7	38672	96%	1.27	41.6	16,099	30938	14	4389	19,987	126,123	7
8	38285	95%	1.32	43.3	16,575	30628	15	4605	20,681	146,804	8
9	37902	94%	1.37	45.0	17,066	30322	16	4833	21,399	168,203	9
10	37523	93%	1.42	46.8	17,571	30019	17	5072	22,143	190,345	10
11	37148	92%	1.48	48.7	18,091	29719	18	5322	22,913	213,259	11
12	36777	91%	1.54	50.6	18,627	29421	19	5585	23,712	236,970	12
13	36409	90%	1.60	52.7	19,178	29127	20	5861	24,539	261,509	13
14	36045	90%	1.67	54.8	19,746	28836	21	6150	25,396	286,906	14
15	35684	89%	1.73	57.0	20,330	28548	23	6454	26,285	313,190	15
16	35328	88%	1.80	59.3	20,932	28262	24	6773	27,205	340,395	16
17	34974	87%	1.87	61.6	21,552	27979	25	7108	28,159	368,555	17
18	34625	86%	1.95	64.1	22,189	27700	27	7459	29,148	397,703	18
19	34278	85%	2.03	66.6	22,846	27423	29	7827	30,174	427,877	19
20	33936	84%	2.11	69.3	23,523	27148	30	8214	31,237	459,113	20
21	33596	83%	2.19	72.1	24,219	26877	32	8620	32,339	491,452	21
22	33260	83%	2.28	75.0	24,936	26608	34	9046	33,481	524,933	22
23	32928	82%	2.37	78.0	25,674	26342	36	9492	34,666	559,599	23
24	32598	81%	2.46	81.1	26,434	26079	38	9961	35,895	595,495	24
25	32272	80%	2.56	84.3	27,216	25818	40	10453	37,170	632,664	25

This show 500% ROI or 20% annually

Wind – 12.1kw

12.1kw wind turbine installation (£50,000 fully installed)

If you were to install a 12.1kw machine, generating 36,008 kwh's a year (6.46 m/s wind speed)

Your income from generation would be $36,008 \times 28p = £10,082.24$

Your saving would be $25,205 \times 10p = £2,520.56$ (70% of generation, 10p typical cost per kwh)

Your income from export would be $10,803 \times 3.1p = £334.87$

A total income/saving of £12,937.67 per year, and £258,753.49 over 20 years.

This equates to a 517% return on investment, 24.67% annually. (This will increase as energy prices go up)

Wind

Additional costs include

- **Planning Permission**
- **Independent Risk Assessment**
- **EIA (Environmental Impact Assessment) for more than 2 machines**
- **Ecological Surveys?**
- **Legal agreements if land is leased/rented**

0845 6868 111

www.eco-environments.co.uk



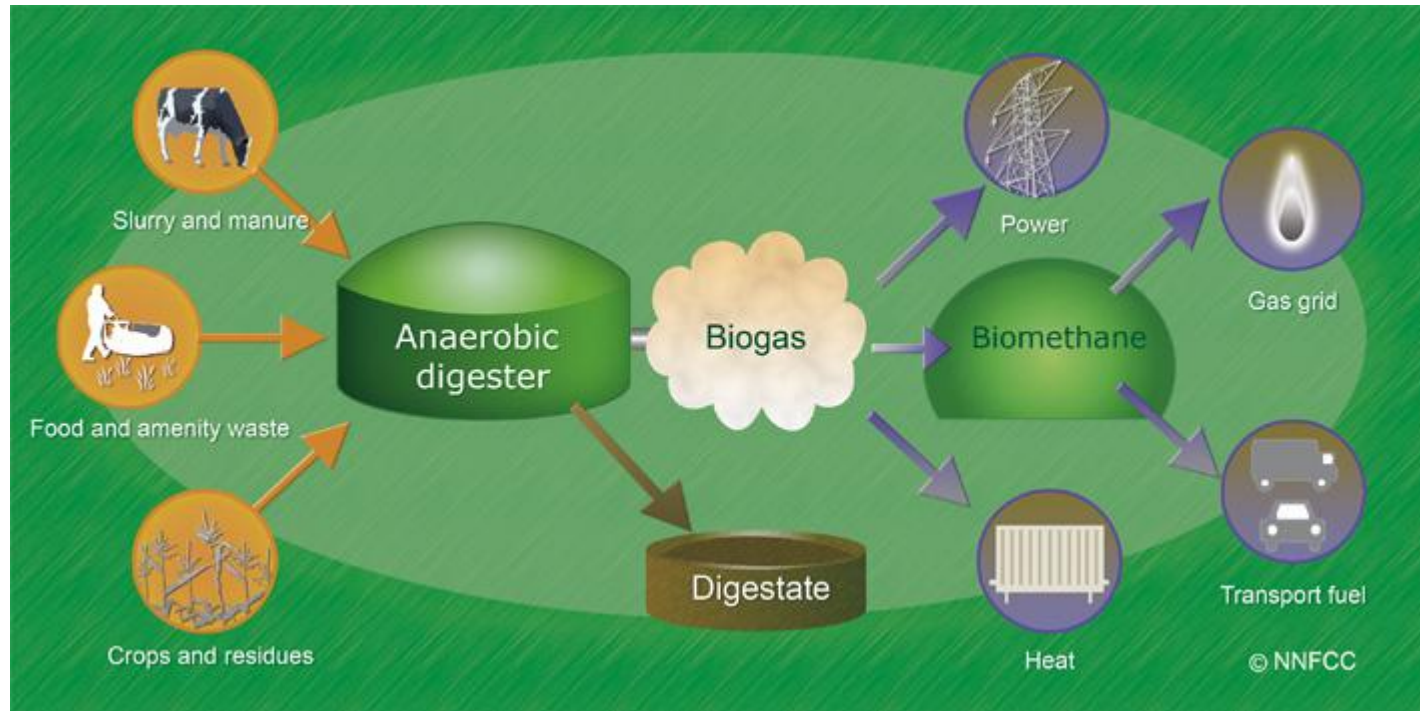
Thankyou



Anaerobic Digestion

An outline of Reaseheath College projects and activities

Introduction to AD



Source: <http://www.biogas-info.co.uk>





Feedstocks

What goes into a digester determines what comes out, so careful choice of feedstocks is essential. Securing a reliable feedstock supply is fundamental to profitable AD and if feedstocks are to be bought from an third party securing long-term contract on acceptable terms is critical.

Typical feedstocks include:

Feedstock	DM %	Biogas Yield m3/tonne	Value of Biogas £/tonnes
Cattle Slurry	10%	15-25	4.70-7.90
Pig Slurry	8%	15-25	4.70-7.90
Poultry manure	20%	30-100	9.50-31.70
Maize silage	33%	180-220	57.40-70.00
Grass silage	28%	160-200	50.50-63.40
Maize grain	80%	500	160
Whole crop wheat	33%	185	58

The AD process

The Anaerobic Digestion process involves three key phases.

- Hydrolysis – the phase that breaks down the long chain carbohydrates and other feedstock's into soluble organic compounds.
- Acid Fermentation/Acetogenesis -Acetogenesis - Bacterial breakdown of the organic material. Hydrogen and carbon dioxide are produced as part of this process.
- Methanogenesis – hydrogen is then bound to the carbon to produce methane

Biogas

Biogas is a mixture of 60% methane, 40% carbon dioxide and traces of other contaminant gases. Biogas can be combusted to provide heat, electricity or both. Alternatively, the biogas can be cleaned up and the pure methane injected into the mains gas grid or used as a road fuel.

The energy in biogas can be used in several ways:

- Heat production
- Electricity production
- Combined heat and power
- Transport fuel
- Injection in to the main electricity or gas grid

Digestate

Digestate consists of left over indigestible material and dead micro-organisms - the volume of digestate will be around 90-95% of what was fed into the digester.

All the nitrogen, phosphorous and potassium present in the feedstock will remain in the digestate as none is present in the biogas. Typical values for nutrients are:

- Nitrogen: 2.3 - 4.2 kg/tonne
- Phosphorous: 0.2 - 1.5 kg/tonne
- Potassium: 1.3 - 5.2 kg/tonne

Nutrients are considerably more bioavailable than in raw slurry.

Digestate can be used straight from the digester, in which case it is called whole digestate. Alternatively it can be separated in to liquor and fibre.

Financial Incentives

- **FIT/RHI** pay a set fee per kWh of energy produced dependant on technology and scale.
- **FIT** – Rate currently under review by government.
 - 11.5 p/kWh < 500 kW_e
 - 9 p/kWh > 500 kW_e
- **RHI** – All scales of biomethane injection and biogas combustion (CHP) < 200 kW_{th}
 - 6.5 p/kWh
 - Claim RHI + FIT at small scale

Planning/Permitting

Two separate processes

- **Planning** – Local Government

- Typical considerations; traffic, visual impact, noise, air quality.
- EIA required over 50,000 tonnes input per annum.

- **Permitting** – Environment Agency

- Evaluates environmental risk of site.
 - Exemptions, Standard Permits, Bespoke Permits.
- Dependant on input feedstocks, plant capacity and local geography.

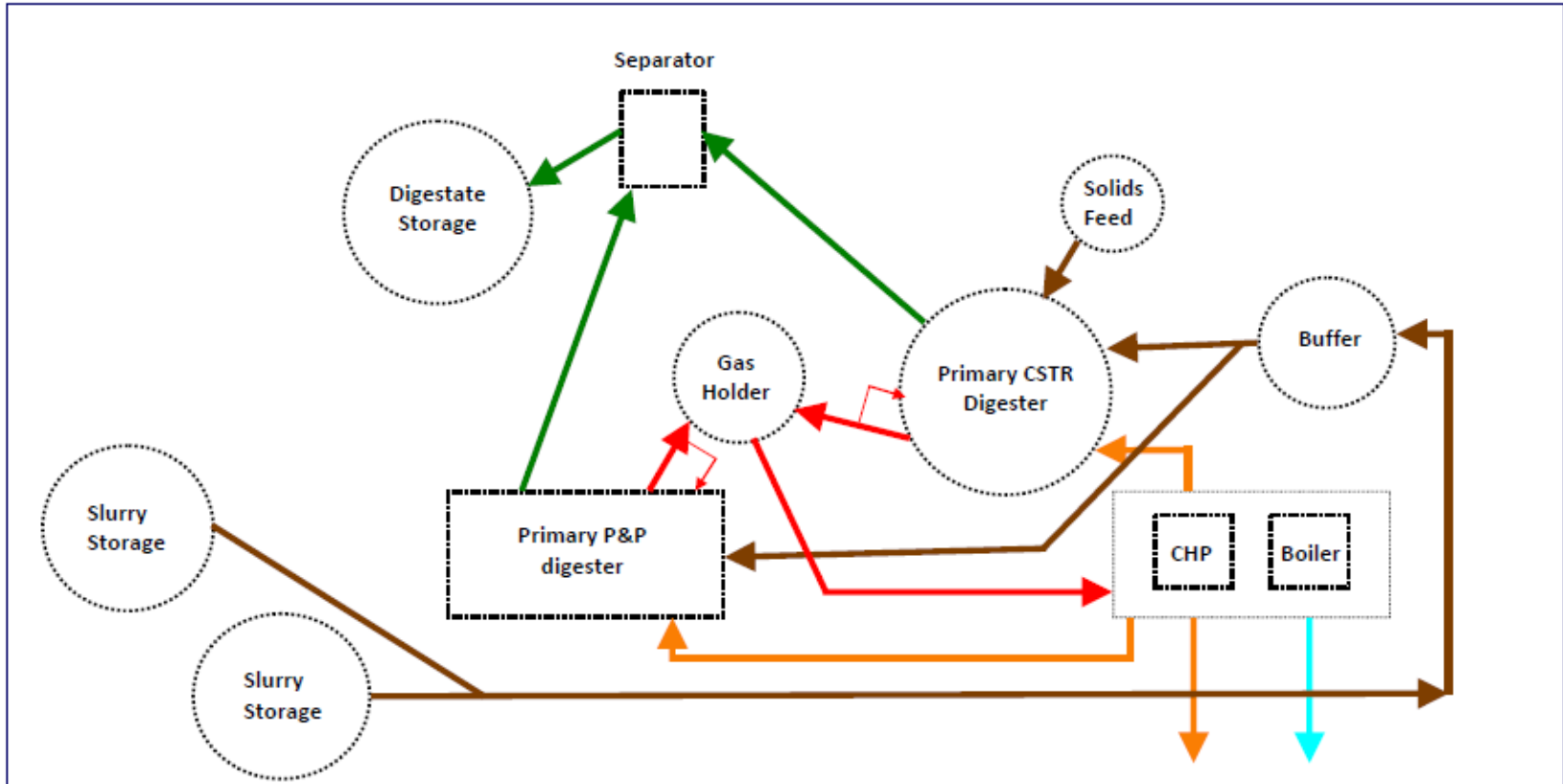
Three main anaerobic digestion projects at Reaseheath:






- AD Demonstration Plant
- On-farm AD feasibility for Cheshire and Merseyside
- Support for farmers interested in AD

AD demonstration plant

- Agricultural feedstocks
- 50 kW_e CHP Engine
- Two AD units- CSTR and ‘Plug and Play’
- Further opportunities to add value?

The Reaseheath AD Demonstration Plant



Key:	
Input	
Digestate output	
Gas Output	
Heat Output (CHP + boiler)	
Electricity Output (CHP)	

Note:
 Primary P&P digester = Plug and Play
 Primary CSTR digester = sealed vertical, cylindrical digester

On-farm AD feasibility for Cheshire and Merseyside

Innovative research supported by RDPE/ NWDA,

Partners: Rural Futures, SKM Enviros, CNG Services, Reaseheath College

- Farm size and location across Cheshire
- Location and capacity of gas grid
- Utilisation of gas and/or electricity from AD systems
- Capital requirements
- Barriers to uptake

AD Feasibility- Key findings

- Common farm size of 150/300 cattle.
- Only selling electricity to the grid makes a positive rate of return at present
- 3.4 % achievable, 150 x 3 centralised unit with 30 % energy crop.
 - Reduction in cost from £615 k to £338 k to make 12% return.
- 3.2 % achievable, 300 cow + 30 % energy crop.
 - Reduction in cost from £600 k to £321 k to make 12% return.
- Currently require 200 m³/hr of biogas production to supply to gas grid
 - 400 cow herd + 30 % energy crop

AD projects at Reaseheath

- Additional work being undertaken:
 - Member of trade association (ADBA)
 - Member of working groups for Agriculture and Digestate
 - Participation in development of DEFRA AD strategy- Knowledge and Understanding Working Group
 - Research activity

Support for businesses interested in AD

Reaseheath Enterprise Hub can provide:

- Access to detailed reports
- Links with industry suppliers and potential funding
- An individual outline feasibility study based on your available feedstocks as well as a financial assessment and business plan.

Support for businesses

If you are still interested in AD and the opportunities it may provide your business, please get in touch.

hub@reaseheath.ac.uk

Thank You
Any Questions?

And Enjoy the Networking Opportunity