Generating an Income from Green Energy

22nd March 2011

Chester Race Course

The Agenda

- **Renewable Heating Technology: Solar Thermal and Heat Pumps**
  - Advantage Projects, Alan Draper
- **Heat Pump & Solar Thermal Case Study**
  - Elm Cottage Caravan Park, Chris Buss
- **Renewable Heating Technology: Biomass**
  - Eco Energy Depot, Simon Sherriff
- **Renewable Electricity Technology: Solar PV, Wind and Hydro**
  - Eco Environments, David Hunt
- **Small Scale Anaerobic Digestion Case Study**
  - Reaseheath College, Daniel Galloway, Lucy Shenton
- **Networking and Exhibition**

Advantage Projects Ltd - services

- ADvantage Projects Ltd are;
  - Specialists in renewable energy
  - Independent engineering consultants
  - Project managers
- Scope ~ currently available technologies
  - Energy efficiency
  - Solar systems and heat pumps
- Business benefits
  - Renewable Heat Incentive ~ RHI

Solar Positioning

		Vert.	80	70	60	50	40	30	20	10	Horiz.
	WEST	56	63	69	74	78	82	86	87	89	90
255		60	68	74	79	84	86	89	90	91	90
240		64	72	78	84	88	90	93	93	92	90
	SW	67	75	82	87	92	95	96	96	94	90
210		69	77	85	90	95	97	98	97	95	90
195		71	79	86	91	96	99	99	98	95	90
	SOUTH	71	80	87	93	97	100	100	98	96	90
165		71	80	87	93	97	99	100	98	95	90
150		71	79	86	92	96	98	98	97	95	90
	SE	69	77	84	89	93	96	96	96	94	90
120		65	74	80	86	89	92	94	94	93	90
105		62	69	76	81	85	88	90	91	91	90
	EAST	58	65	70	76	80	84	86	88	90	90

22nd March 2011

Solar Thermal

- Could provide most of hot water during the summer months and up to 50% year round
- A 6m² system can reduce CO_2 emissions by around 2000kg per year (compared with electricity)
- Can be used for larger applications, e.g. swimming pools, laundry processes.
- Panels are heavy (25kgs/m²) – check roof structure
- About £700 per sq m for an installed system
- Needs new hot water cylinder or "thermal store"
- Payback around 10 years

Heat Pumps

- **Ground source heat pumps**
  - Takes heat from the ground / water source
  - Concentrates heat to use inside buildings
  - COP = 4 - measure of efficiency
  - 1kW of electricity delivers 4kW of heat
  - Space heating or hot water provision
  - Can also be used for cooling
  - Vertical or horizontal ground collectors

- Capital costs per kW ~ £1000 - £1200
- Groundworks costs vary considerably
- CO2 saving 60% versus oil
- Payback around 10 years
- Renewable heat incentive ~ RHI

Air source energy

Air source heat pumps

- Takes heat from the air (fan assisted heat exchanger), increases the temperature and transfers the heat to a building.
- Distributes heat into the building either as air heating or water heating.
- Most effective when combined with under floor heating
- COP = 2.8 to 3.6
- Can be used for cooling as well

- Capital **c**ost is about £800 per kW installed
- CO2 saving 40% vs oil
- Payback in 20 ⟶ 11 years
- Renewable heat incentive ~ RHI

EU-CERT.HP
European Certified
Heat Pump Installer

Renewable Heat Incentive

- Applicable to all renewable heat installations
  - Category 1- commercial, industry, public sector
  - Category 2 - domestic
- 2 Phases – July 2011 / autumn 2012,
  - For Category 1, start July 2011
  - For Category 2, autumn 2012 with RHI premium payment from July 2011 - details in May

Renewable Heat Incentive

- All installations since 15 July 2009 eligible
- Off gas grid installations
- Metering versus deemed
- Autumn 2012
  - Green deal
  - Domestic tariff launched
  - Eligible technologies extended

Levels of support					
Tariff name	**Eligible technology**	**Eligible sizes**	**Tariff rate (pence/ kWh)**	**Tariff duration (Years)**	**Support calculation**
Small biomass	Solid biomass; Municipal Solid Waste (incl. CHP)	Less than 200 kWth	Tier 1: **7.6**	20	Metering Tier 1 applies annually up to the Tier Break, Tier 2 above the Tier Break. The Tier Break is: installed capacity x 1,314 peak load hours, i.e.: **kWth x 1,314**
			Tier 2: **1.9**		
Medium biomass		200 kWth and above; less than 1,000 kWth	Tier 1: **4.7**		
			Tier 2: **1.9**		
Large biomass		1,000 kWth and above	**2.6**		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**		
Solar thermal	Solar thermal	Less than 200 kWth	**8.5**	20	Metering
Biomethane	Biomethane injection and biogas combustion, except from landfill gas	Biomethane all scales, biogas combustion less than 200 kWth	**6.5**	20	Metering

Thank you for Listening

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Elm Cottage Case Study

Chris Buss
Caravan Park Owner

Elm Cottage Caravan Park

Renewable Heat - Biomass

Simon Sherriff - Director
EcoEnergyDepot….

Company History

- Chester based.
- Formed in 2006 as a specialist renewable energy solution provider.
- Expertise in small scale Biomass applications up to 200kW and Solar Power
- Achieved MCS accreditation in 2010 with our installation partners Harness Energy.
- UK Main distributors and importers for Biotech of Austria, Extraflame, and Ecoteck of Italy.
- Clients include private individuals, private business, schools, and local government.

Biomass Technological Overview

- Biomass heating often associated with large scale heavy engineering
- Massive power plants and MW of power output. Our boilers are larger than Oil or Gas, but still can installed in compact spaces.
- 90% of UK properties have a heating load of less the 200kW.
- Most properties are old, poorly insulated, and already have some form of heating system (oil, gas).
- Massive potential for CO2 savings by implementing biomass on smaller properties

Log Boilers?

- Cheapest capital outlay
- Always require a buffer store
- Manually loaded at least once a day
- Fuel plentiful
- Ash removal every day
- Only suitable for hands on customers with a caretaker
- Some automatic systems available
- Fuel cheap

Wood Chip Boilers?

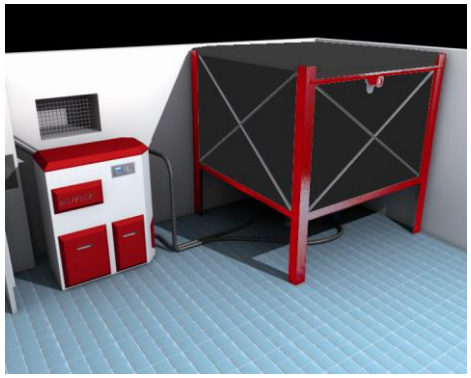
- Not suitable for heating applications less the 35kW
- Larger boilers, with large scale industrial feeding systems.
- Fuel bulky usually monthly refill
- Mainly 3 phase electrics
- Fully automatic, some boilers do not require a buffer store.
- Suitable for large scale applications.
- Requires a decent fuel supply but can be very cheap to run

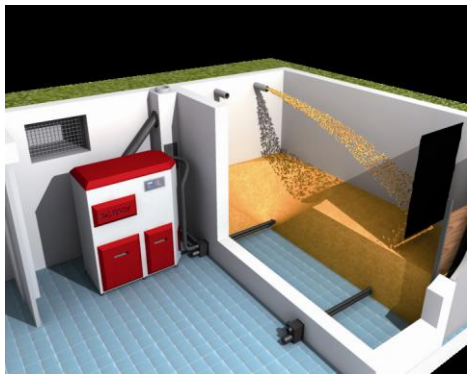
Wood Chip Storage

Wood Pellet Boilers?

- Scalable boilers starting from 9kW upwards.
- Fully automatic heating systems with yearly servicing.
- Can be fitted to sealed or open vented heating systems
- Can be connected to virtually any heating system including UFH.
- Pellets not as cheap as chip or logs but still cheaper than oil or lpg
- Bulk fill possible

Pellet Storage





Financial Incentives

Three main incentives for Biomass installations

- Carbon trust grants (up to 28th March)
- Enhanced Capital Allowances Scheme
- RHI – The Renewable Heat Incentive

CARBON TRUST

Renewable Heat Incentive

- Ground breaking policy introduced by the previous Labour government but with cross-party support
- Designed to encourage the uptake of renewable technologies by providing a return on investment
- Will start in July 2011 for commercial users only
- Second phase will start in October 2012 for domestic heat installations.

What is a commercial application?

- Any property not used for domestic purposes.
- Tearoom, Warehouse, Pool, School, Government Buildings, and Industrial Units
- If a property can be shown to have been converted for mostly commercial use it may be eligible.
- All district heating schemes. Common boiler heating multiple units will be eligible.

How is the Incentive Measured.

- All boilers produce heat
- One unit of heat is expressed in KwH.
- A 200kW boiler is capable of producing 200KwH an hour or 200 units.
- Heat can be measured using a heat Meter.
- To qualify for the Renewable Heat Incentive all boiler must be metered.

What are the tariffs?

- Biomass is split into three catagories:
  - Small scale Biomass <200kW
  - Medium Scale 200kW-1MW (1000kW)
  - Large Scale >1MW
- Benefit paid for 20 years. Grandfathering possible.
- Each category is split into two tariff levels to prevent energy wastage:
  - Small 7.6p Reduced Rate 1.9p
  - Medium 4.7p Reduced Rate 1.9p
  - Large 2.6p

- Larger installations benefit from their size hence reduced overall benefits.

What will I get back?

- Returns are dependent on energy use
- Using a standard rule of thumb formula you would get the following returns:

Boiler Size KW	Energy Usage	Tariff Limit	Tariff 1	Tariff 2	Total Annual	Total Lifetime
50	80000	65700	4,993	272	**£5,265**	**£105,298**
100	160000	131400	9,986	543	**£10,530**	**£210,596**
150	240000	197100	14,980	815	**£15,795**	**£315,894**
200	320000	262800	19,973	1,087	**£21,060**	**£421,192**

Case Study - RBS Knott End

RBS Knott End - Lancashire

- Small old 1900's property located in an off gas area in Lancashire.
- Existing radiator system with an old 20kW inefficient oil boiler reaching the end of its life.
- Oil tank located at the rear of the property.
- Small utility room for plant and equipment.

Initial consultation services.

- Detailed initial site survey.
- Recommendations to improve energy efficiency using standard methods (loft insulation, double glazing).
- Detailed heat load calculation – vital for Biomass applications.
- Product recommendations.
- On-site technical assistance with heating design.

The Options Available?

- Heat Load was calculated at 15kW.
- Other renewable heating alternatives rejected due to the age of the property.
- The main priority of the customer was to reduce CO2 footprint so small scale biomass application was recommended.
- Log boiler was not suitable as the system needed to be fully automatic
- Wood Chip was rejected as heating system was too small
- A small compact fully automatic wood pellet system matched the customer requirements and was recommended for the site.

Our recommendations

- A small 23kW Janfire Pellet Boiler from Sweden.
- Based on a burner principle so capable of Oil option
- Provides hot water and heating
- Ash removal bi-monthly
- Fully automatic ignition
- Modulating boiler from6-23kW
- Pellet Store to be located Externally in a outhouse shed

Site Photographs

- Plant room was modified to have wider doors

Financials

- Total investment in this application was very high at a total installation cost of 30k. Typically today this would be more like 15-20k.
- ECA scheme would allow 100% tax relief against this investment providing a 22.4p boost for every pound invested.
- The Renewable Heat Incentive will pay £1,579 a year (estimated) and a total of £31,589 over the lifetime of the project.
- Even with the high cost of this project. The combined benefits of ECA and RHI pay for the installation of the boiler over the lifetime of the project.

More Site Photgraphs

- Hopper Shed in Garden

Site Conclusions

- Client successfully demonstrated that small scale biomass was feasible on buildings of all sizes.
- CO2 reduction of over 70% achieved on site through energy efficiency and biomass boiler.
- Project cost easily covered by the Renewable Heat Incentive .
- We would expect a payback today typically of 10 years.
- At project inception pellet availability was critical. In 2007, fuel delivery was patchy. Today, Bio-fuels are widely available and often cheaper than oil or gas.

That’s it!

Thanks for listening!

Any questions?

Simon Sherriff
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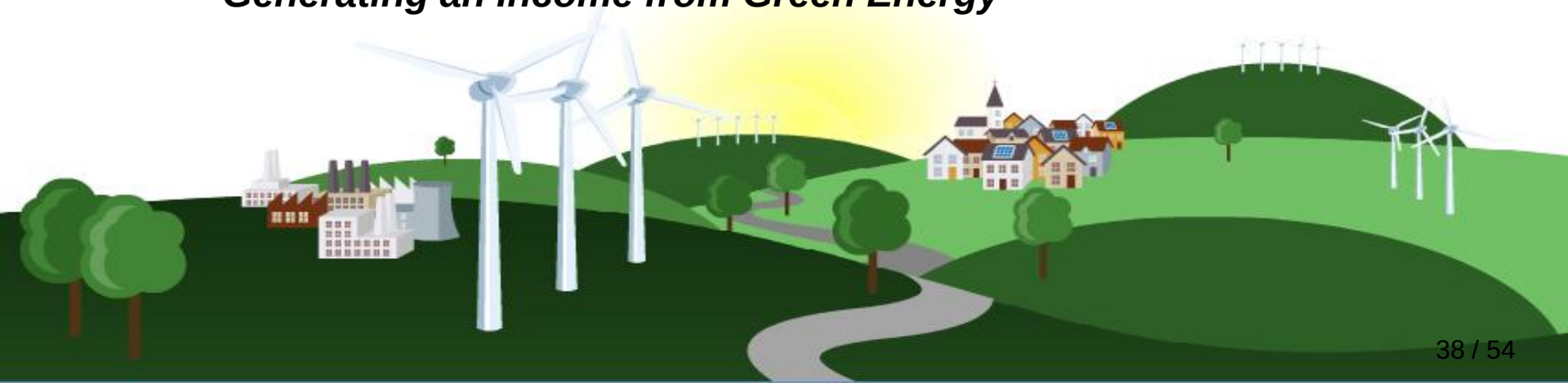
David Hunt
Mark Buchanan

Eco Environments

22 March 2011

Business Briefing:

'Generating an Income from Green Energy'



Who are We?

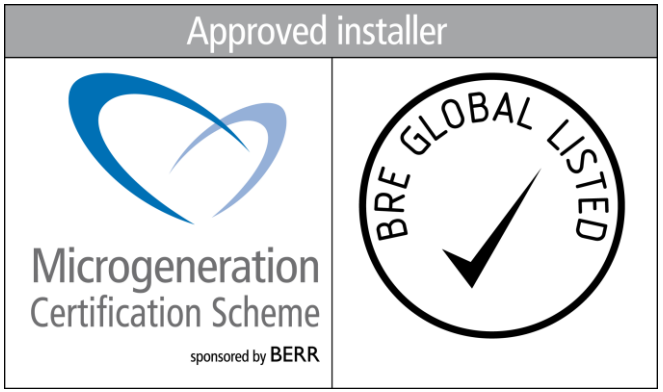
- **A UK award-winning 4x Microgeneration Certified Scheme (MCS) accredited company**
- **We design, install and commission renewable energy and energy conservation solutions. Our clients range from house builders, social landlords, architects and property developers, to businesses, both PLC's and SME's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

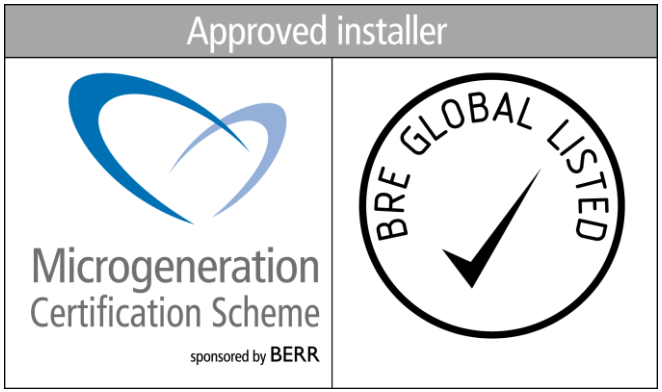
- **Solar Photovoltaic (PV), Solar Thermal, Air-source heating and Wind turbines are our speciality**

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.

Feed in Tariffs

Table of generation tariffs to 2

Technology	Scale / Scheme Year											
Anaerobic digestion	≤500kW											
Anaerobic digestion	>500kW											
Hydro	≤15 kW											
Hydro	>15-100 kW											
Hydro	>100 kW-2 MW											
Hydro	>2 MW – 5 MW											
MicroCHP pilot*	≤2 kW*											
PV	≤4 kW (new build**)											
PV	≤4 kW (retrofit**)											
PV	>4-10 kW											
PV	>10-100 kW											
PV	>100kW-5MW											
PV	Stand alone system*											
Wind	≤1.5kW											
Wind	>1.5-15kW											
Wind	>15-100kW											
Wind	>100-500kW											
Wind	>500kW-1.5MW											
Wind	>1.5MW-5MW	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	20
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	to 2027

PV	≤4 kW (new build**)	36.1
PV	≤4 kW (retrofit**)	41.3
PV	>4-10 kW	36.1
PV	>10-100 kW	31.4
PV	>100kW-5MW	29.3
PV	Stand alone system**	29.3
Wind	≤1.5kW	34.5
Wind	>1.5-15kW	26.7
Wind	>15-100kW	24.1
Wind	>100-500kW	18.8
Wind	>500kW-1.5MW	9.4
Wind	>1.5MW-5MW	4.5

* 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

Feed in Tariffs

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

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)*

Wind Turbines

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 ¾ of household needs, commercially it depends on your roof size and energy use.

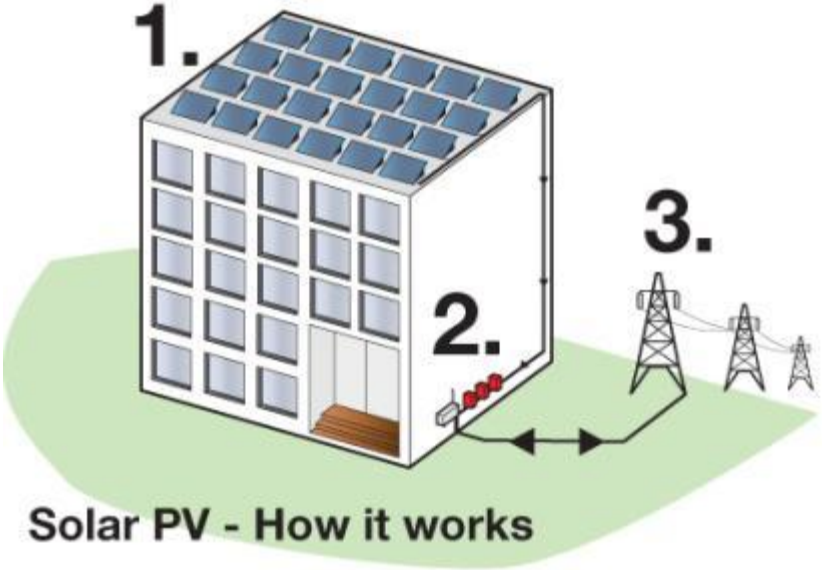
Solar Photovoltaics (PV)

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)

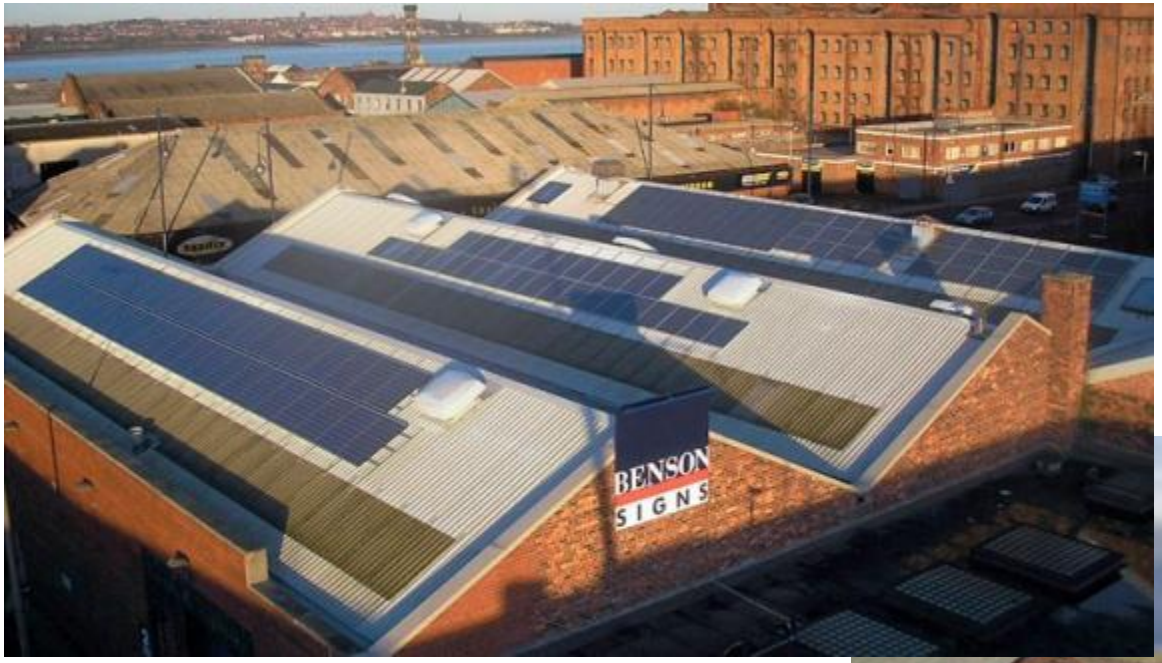
Solar panels

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 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 Photovoltaics (PV)

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.

Continuous power generation.

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

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 x 37.8p = £3,151.95

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

Your income from export would be 1,668x 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 CO^2 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 x 32.9p = £13,844.32

Your saving would be 26,931.2 x 10p = £3,366.40 (80% of generation, 10p typical cost per kwh)

Your income from export would be 6,733 x 3.1p = £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) + $C0^2$ Saving of 23 Tonnes PA

Feed in Tariffs

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
Estimated Output (kWh/annum)	40258

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

Assumed Annual Rate of Inflation	% of Energy Used on Site	2 Annual Increase in Energy Cost	Annual Maintenance Cost (£)	
4%	80%	6%	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/wKh)	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 a12.1kwp machine, generating 36,008 kwh's a year (6.46 m/s wind speed)

Your income from generation would be 36,008 x 28p = £10,082.24

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

Your income from export would be 10,803 x 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 Assesment) for more than 2 machines**
- **Ecological Surveys?**
- **Legal agreements if land is leased/rented**

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Anaerobic Digestion

An outline of Reaseheath College projects and activities

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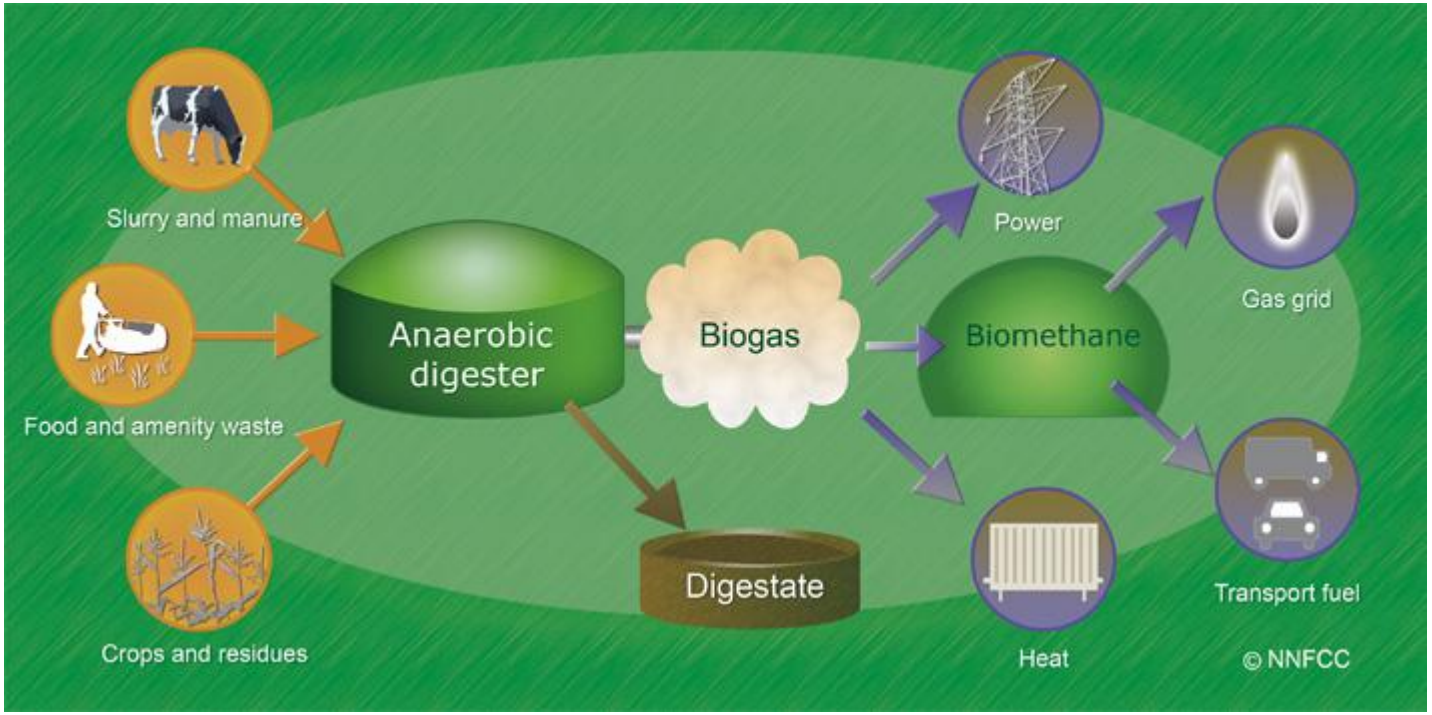
Introduction to AD



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

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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

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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

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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.

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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

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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.

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Three main anaerobic digestion projects at Reaseheath:

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

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AD demonstration plant

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

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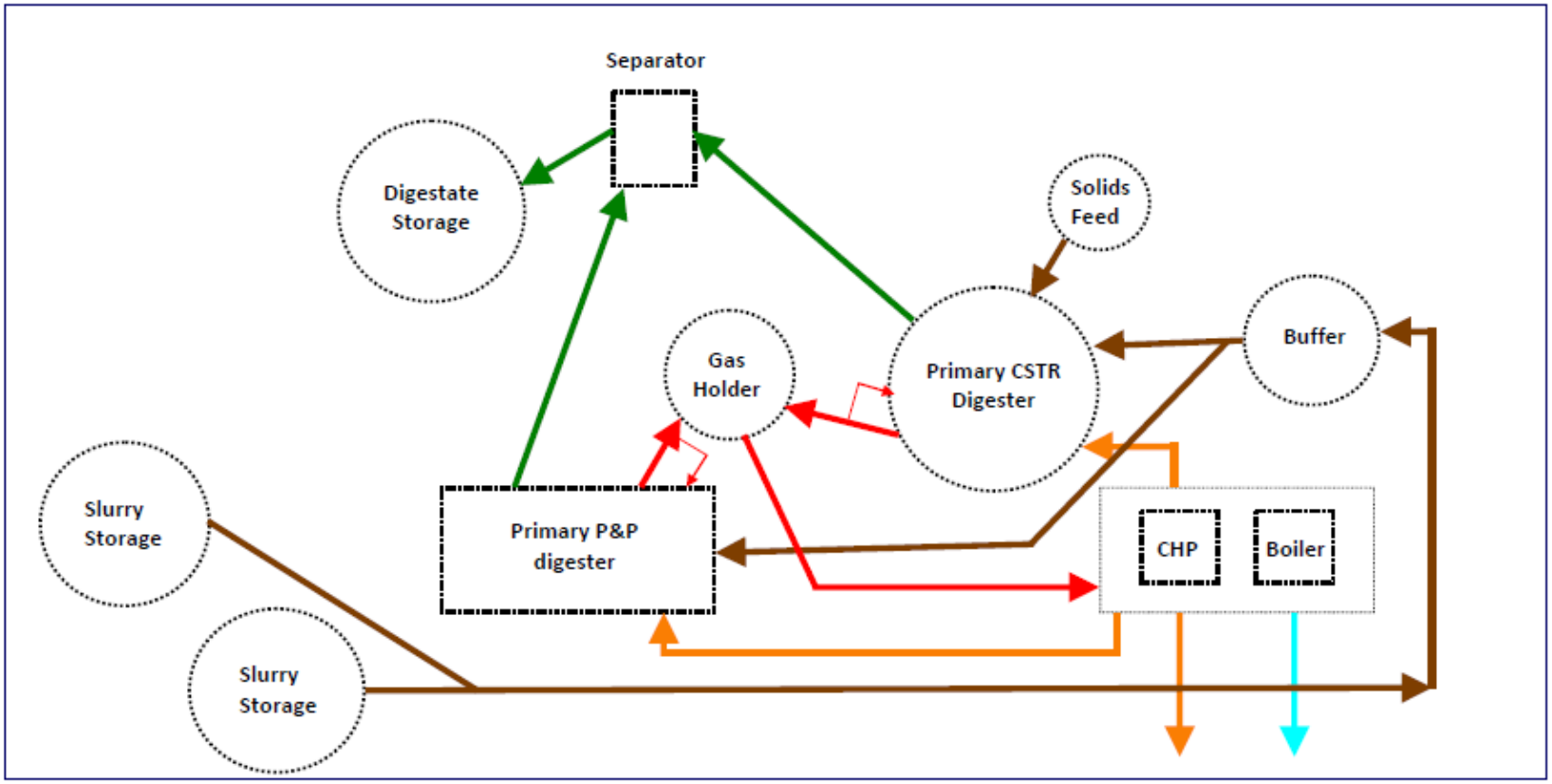
The Reaseheath AD Demonstration Plant



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

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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

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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 m^3/hr of biogas production to supply to gas grid
  - 400 cow herd + 30 % energy crop

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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

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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.

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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

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Thank You

Any Questions?

And Enjoy the Networking Opportunity