Generating an Income from Green Energy

26th May 2011

Macclesfield Town Hall

The Agenda

- **Welcome and Introduction**
  - Cheshire East Council, Rob Elliott
- **Update on Cheshire East Renewables Master Plan**
  - LDA Design, Rob Shaw
- **Renewable Heating Technology: Solar Thermal and Heat Pumps**
  - Macclesfield Renewables, Clive Wilkinson
- **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**

Cheshire East Climate Change and Energy Planning Research

A Low Carbon Energy Resource for the Borough

Rob Shaw

26th May 2011

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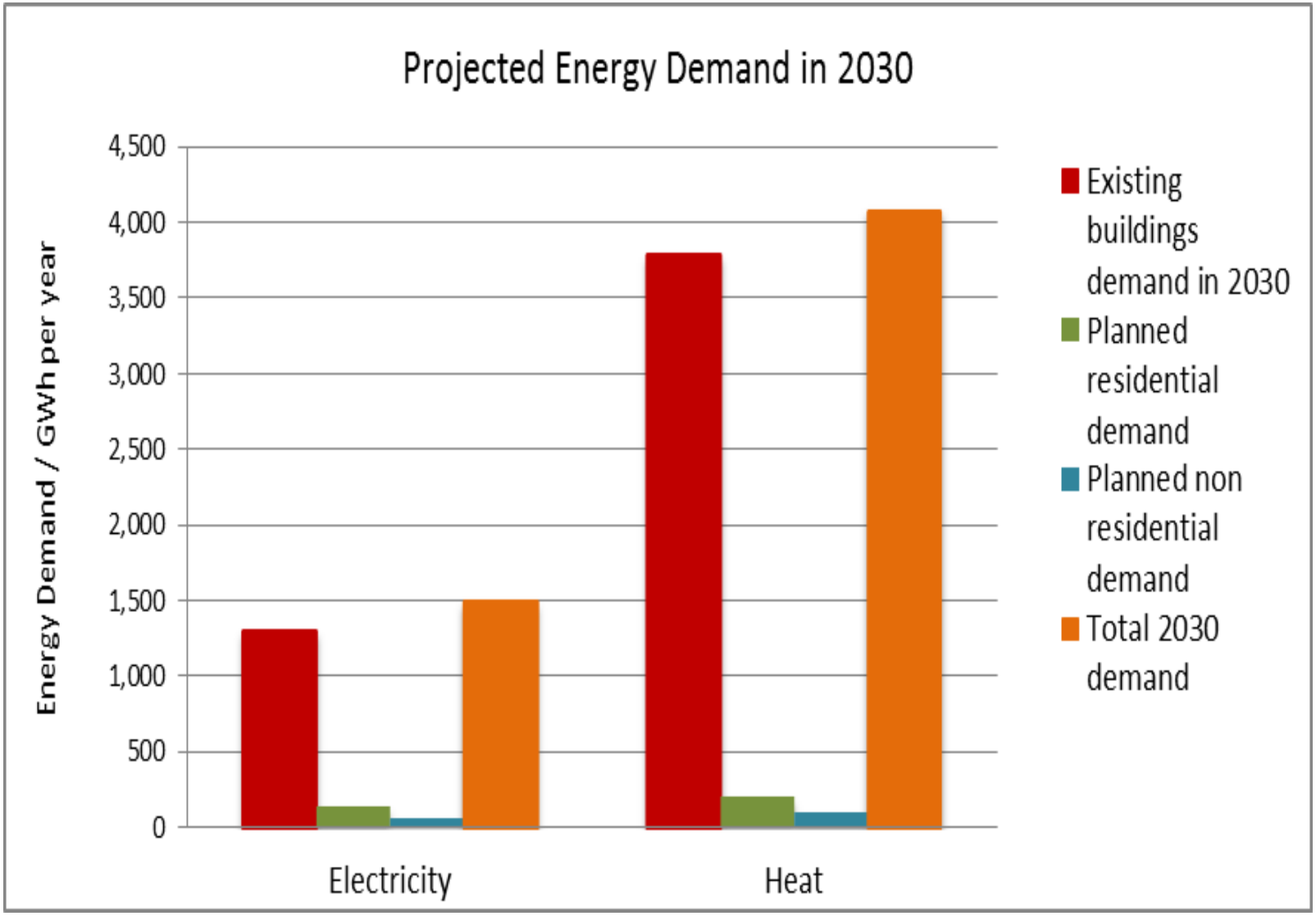
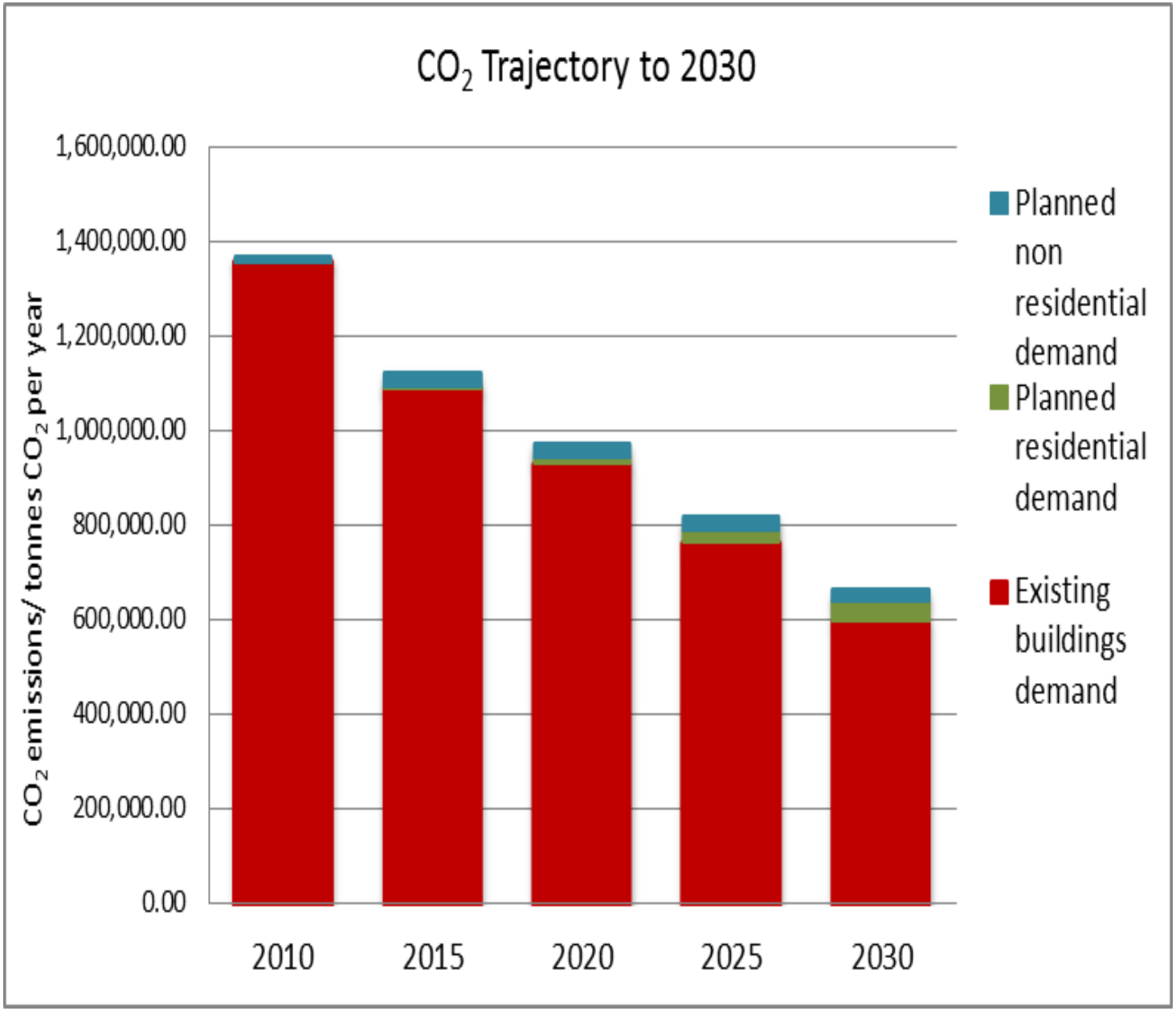
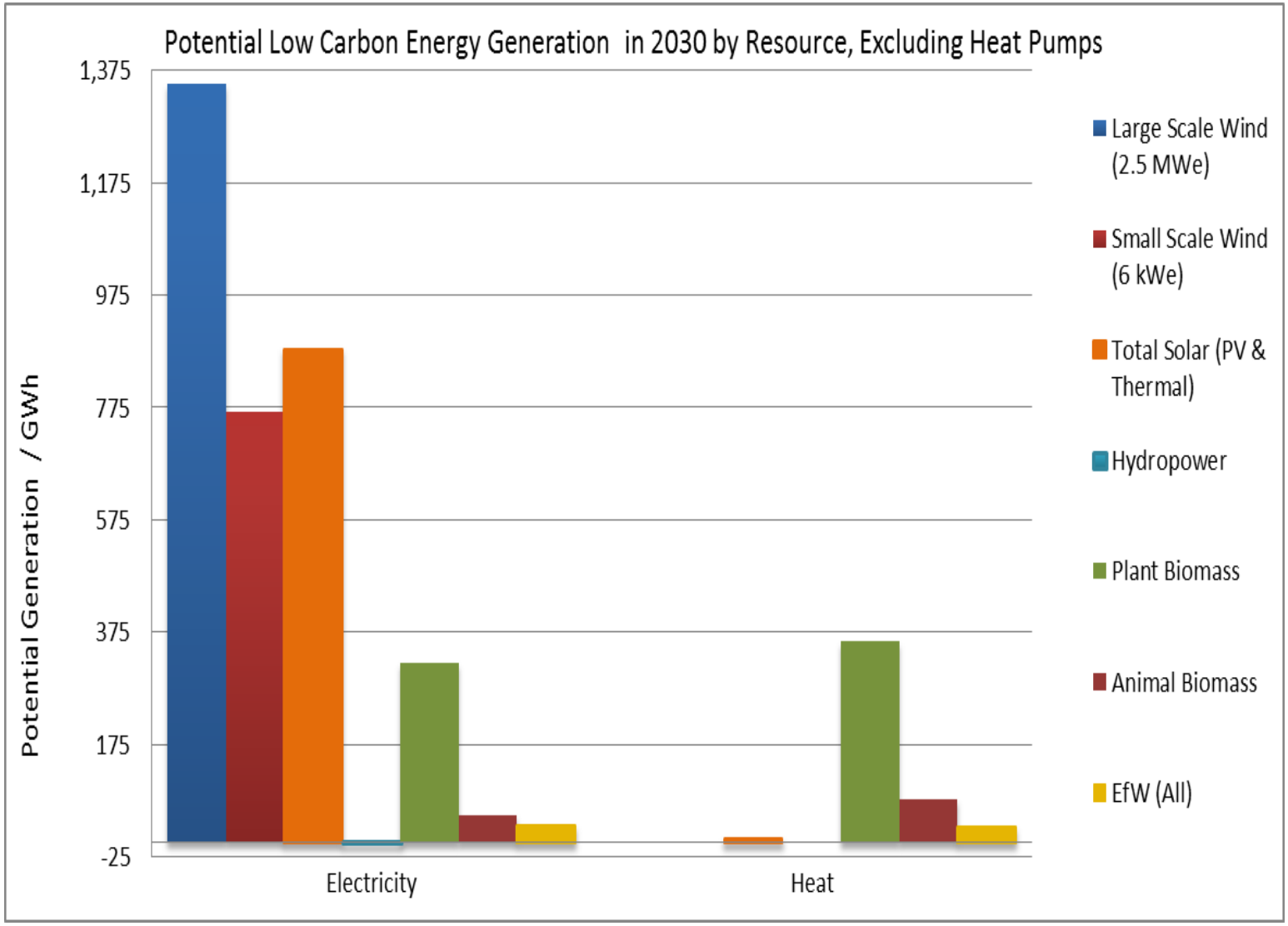
The Study

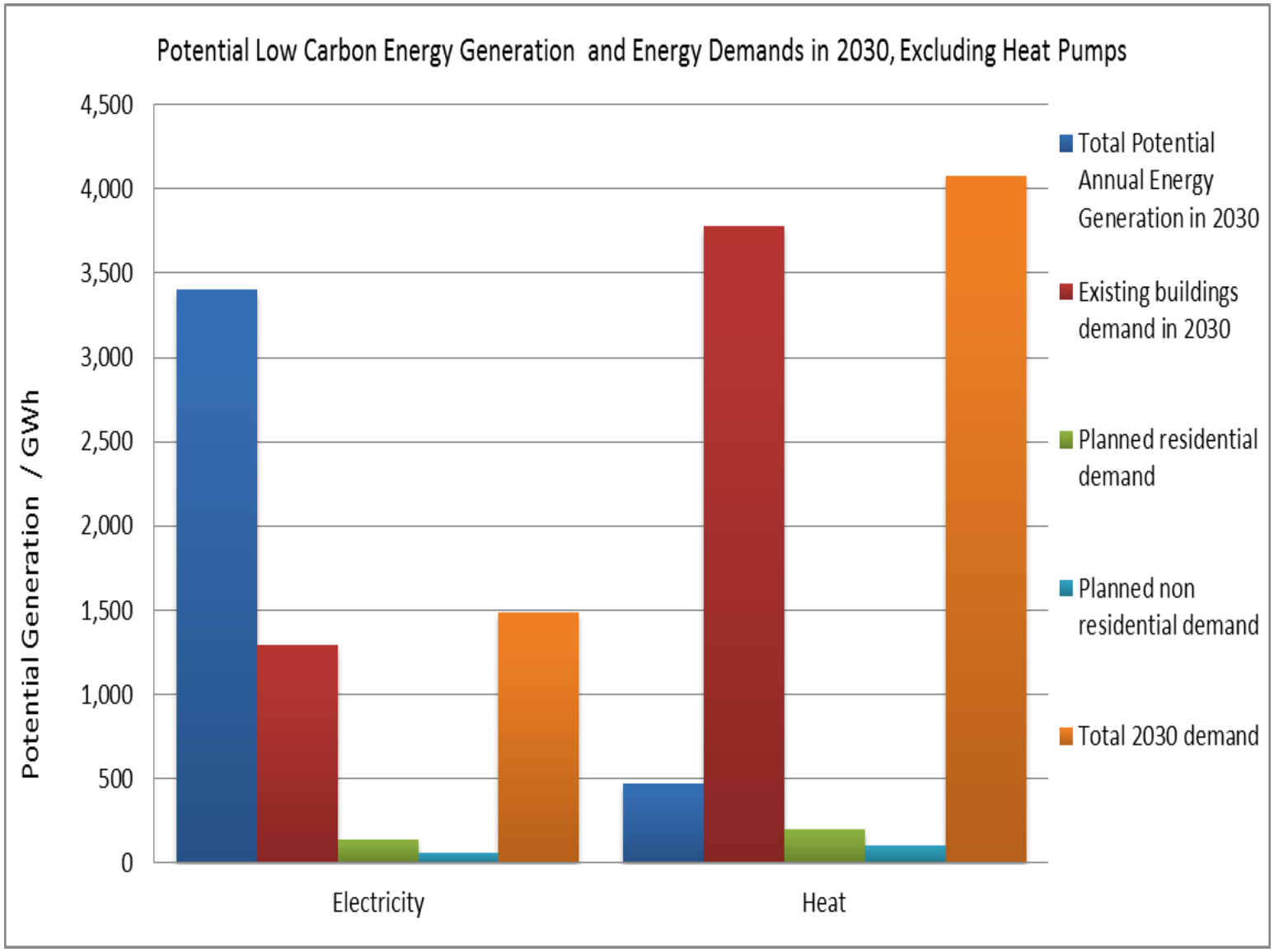

Energy Demand


Projected Energy Demand in 2030
Energy Demand / GWh per year
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Electricity
Heat
Existing buildings demand in 2030
Planned residential demand
Planned non residential demand
Total 2030 demand

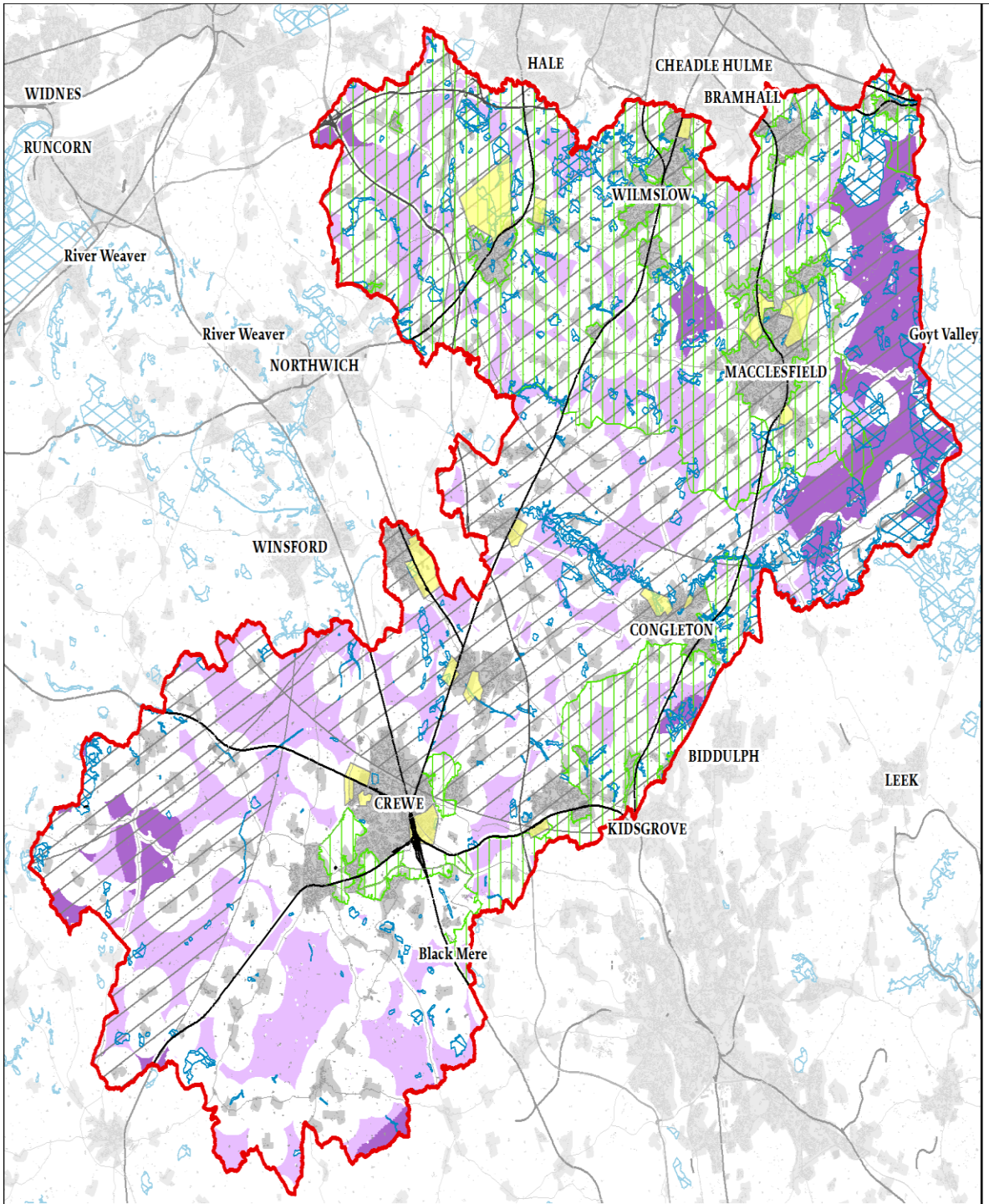

CO_2 Trajectory to 2030
1,600,000.00
1,400,000.00
1,200,000.00
1,000,000.00
800,000.00
600,000.00
400,000.00
200,000.00
0.00
CO_2 emissions/ tonnes CO_2 per year
2010
2015
2020
2025
2030
Planned non residential demand
Planned residential demand
Existing buildings demand


Energy Capacity


Potential Low Carbon Energy Generation in 2030 by Resource, Excluding Heat Pumps
Potential Generation / GWh
1,375
1,175
975
775
575
375
175
-25
Electricity
Heat
Large Scale Wind (2.5 MWe)
Small Scale Wind (6 kWe)
Total Solar (PV & Thermal)
Hydropower
Plant Biomass
Animal Biomass
EfW (All)


Potential Low Carbon Energy Generation and Energy Demands in 2030, Excluding Heat Pumps
Potential Generation / GWh
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Electricity
Heat
Total Potential Annual Energy Generation in 2030
Existing buildings demand in 2030
Planned residential demand
Planned non residential demand
Total 2030 demand

Wind



LEGEND

Cheshire East
Local Authority boundary

Windspeed (metres per second)
at 40 m Altitude Over Datum

5 m/s to 6.5 m/s

6.5 m/s and over

Potential urban wind opportunities

RAMSAR
National Nature Reserve
Site of Special Scientific Interest
Special Area of Conservation
Special Protection Area
Sites of Biological Importance

Green Belt
Green Gap

Civic Aviation Authority

Exclusion areas have been taken as:
* Ancient woods
* Registered Parks and Gardens
* Scheduled Monuments
* 800m Urban buffer
* 150m Major Road buffer
* 150m Rail buffer
* National Parks

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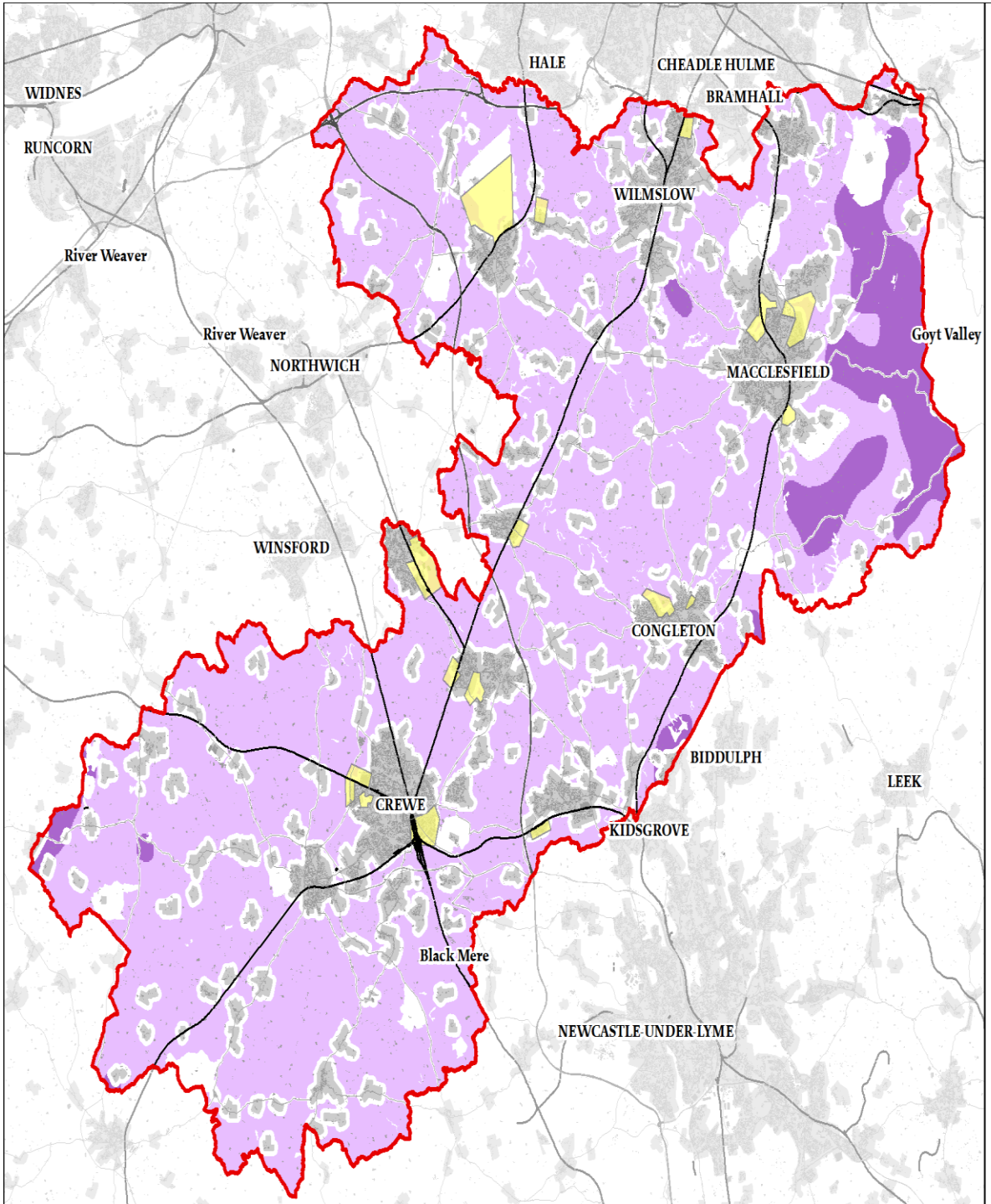

LEGEND

Cheshire East
Local Authority boundary

Windspeed (metres per second)
at 25 m Altitude Over Datum:

5 m/s to 6.5 m/s

6.5 m/s and over

Proposed urban wind
opportunities

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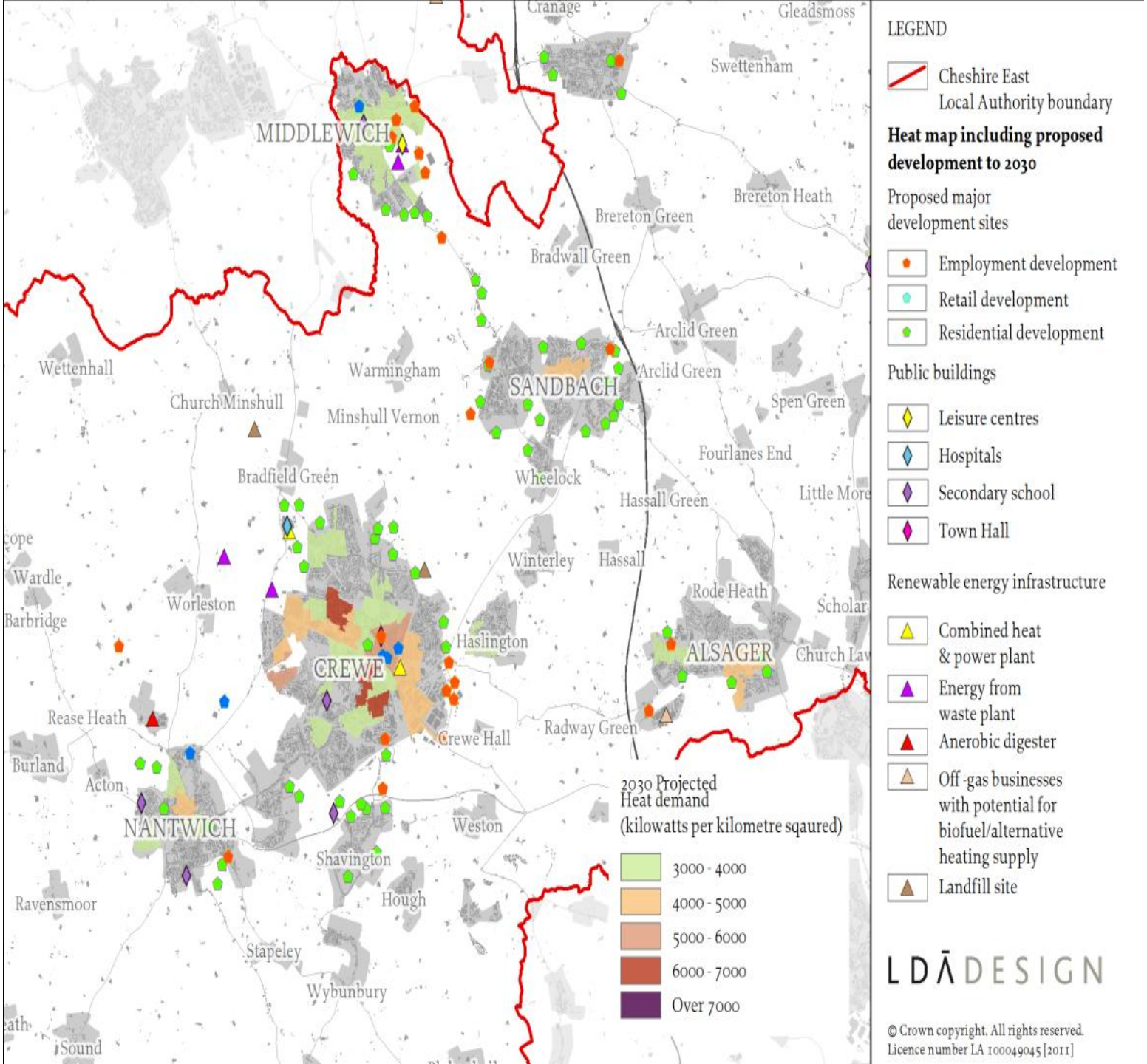
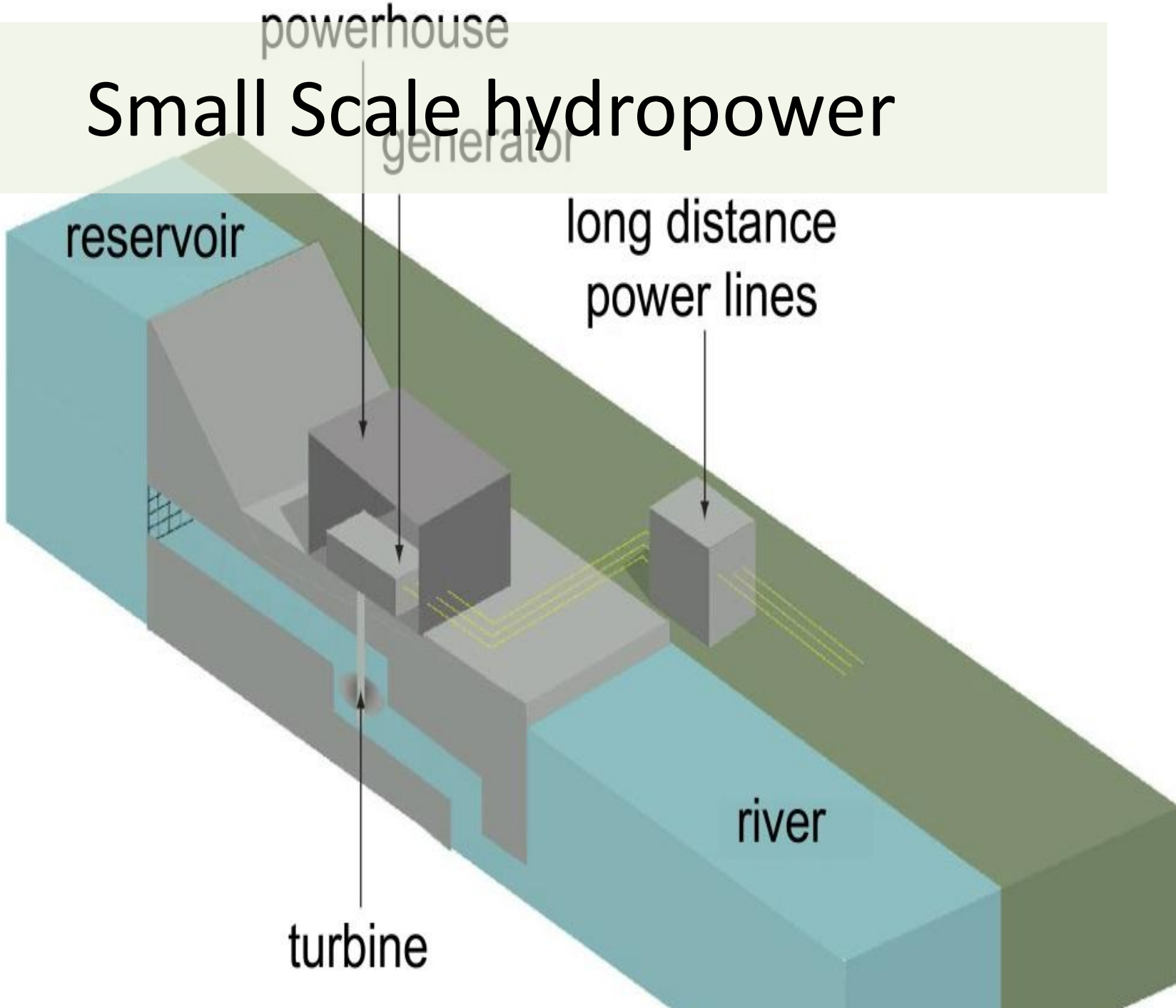
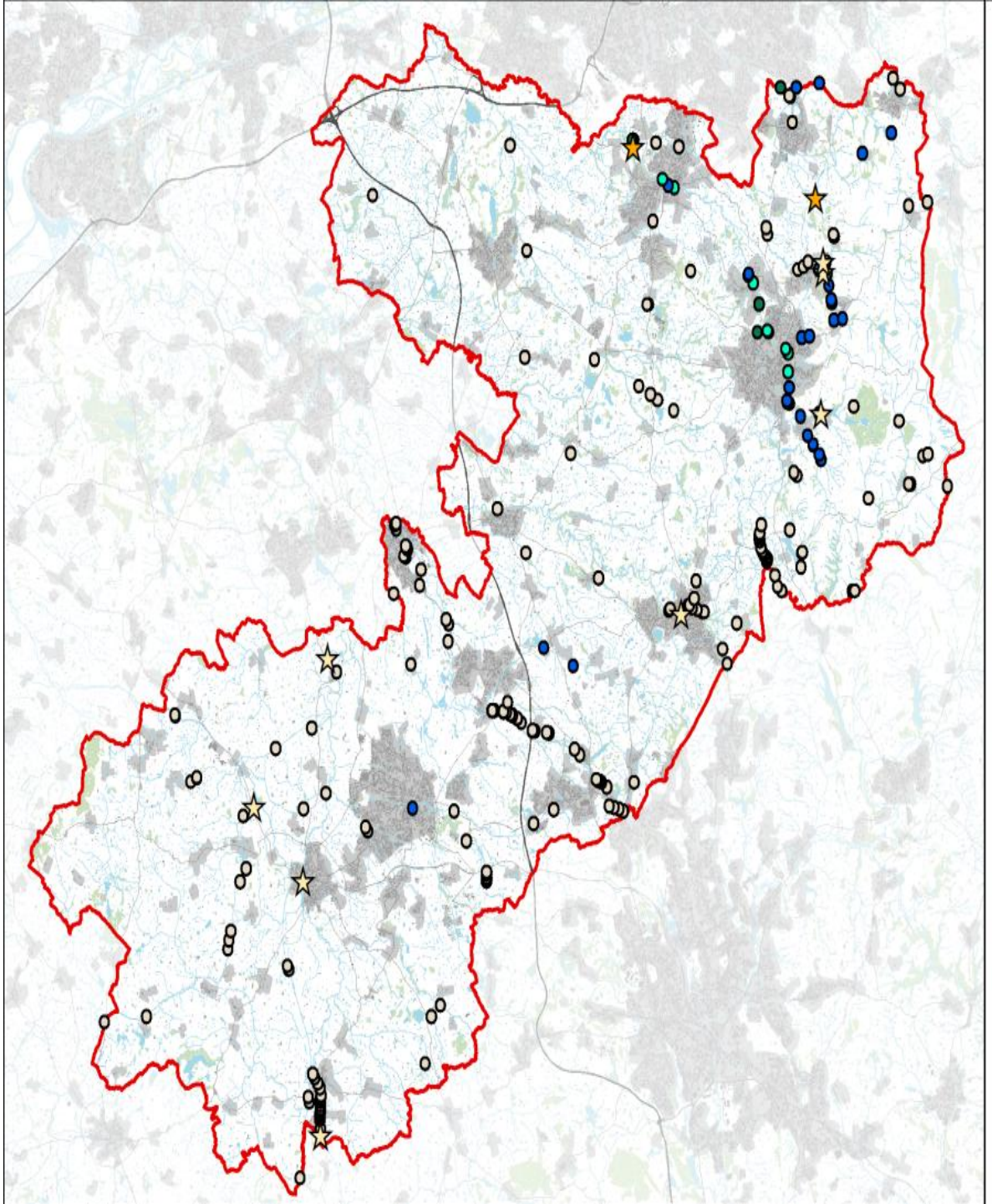
CHP & District Heating



Small Scale hydropower





LEGEND

Cheshire East
Local Authority boundary

Current hydropower projects within Cheshire East

Existing hydropower schemes

Proposed hydropower schemes

Hydropower opportunites

0 - 10 kW

10 - 20 kW

20 - 50 kW

50 - 100 kW

Other barriers

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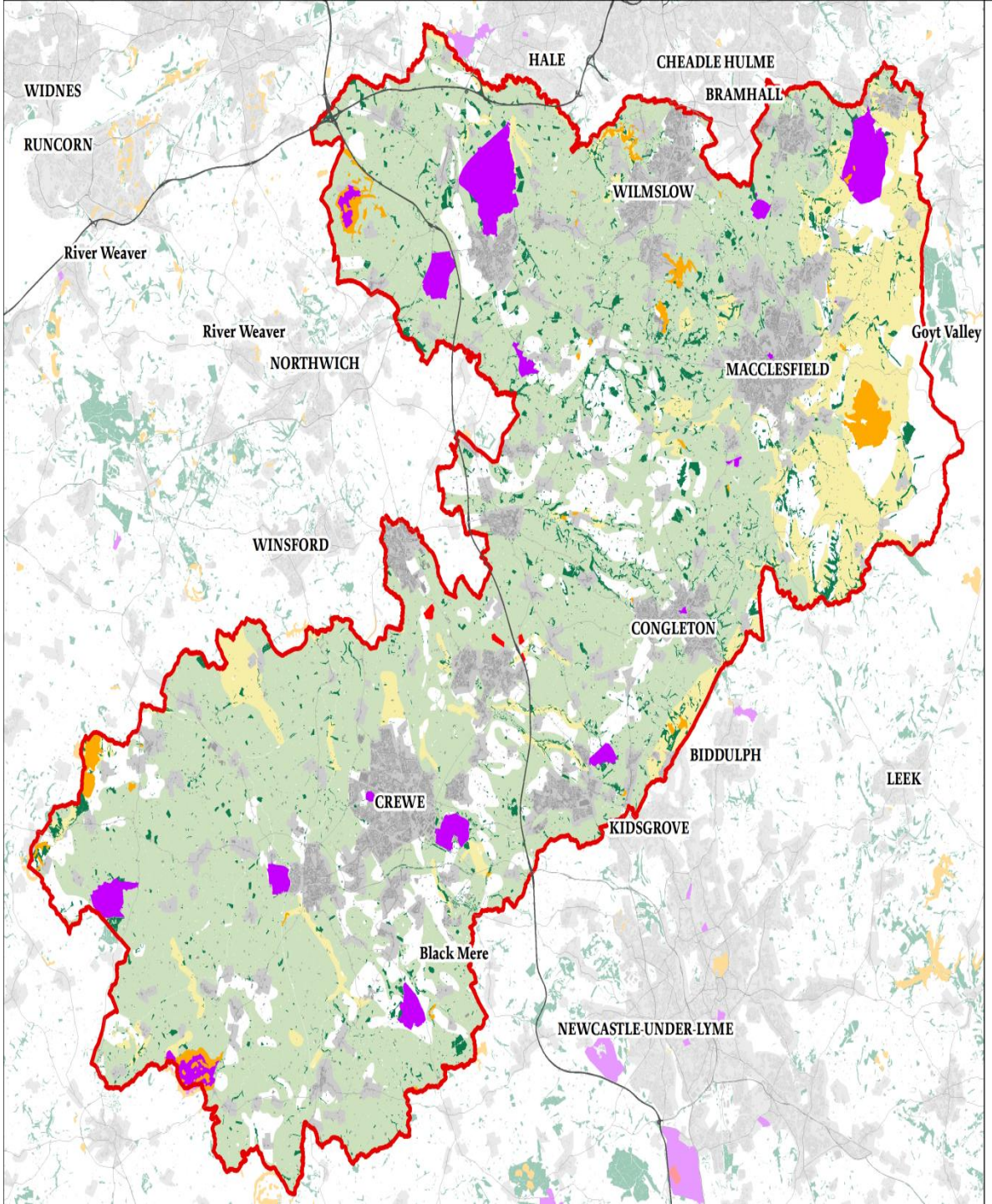
Biomass & Anaerobic Digestion



LEGEND

Cheshire East
Local Authority Boundary

Potential biomass resource

- Registered Park & Garden
- Energy Crop Scheme
- Woodland Grant Scheme
- Existing Woodland

Agricultural Land Classification

- Grade 3
- Grade 4

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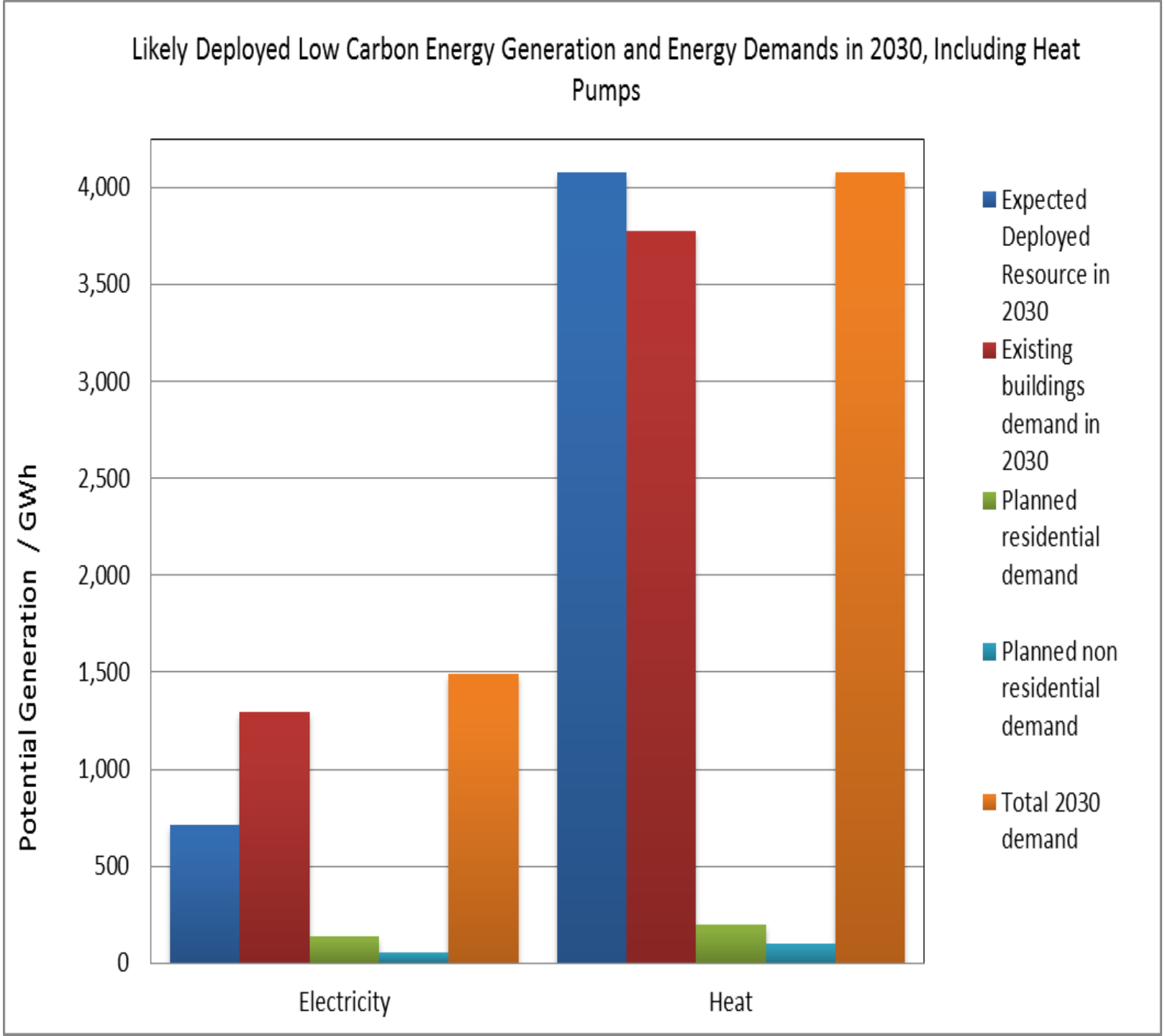
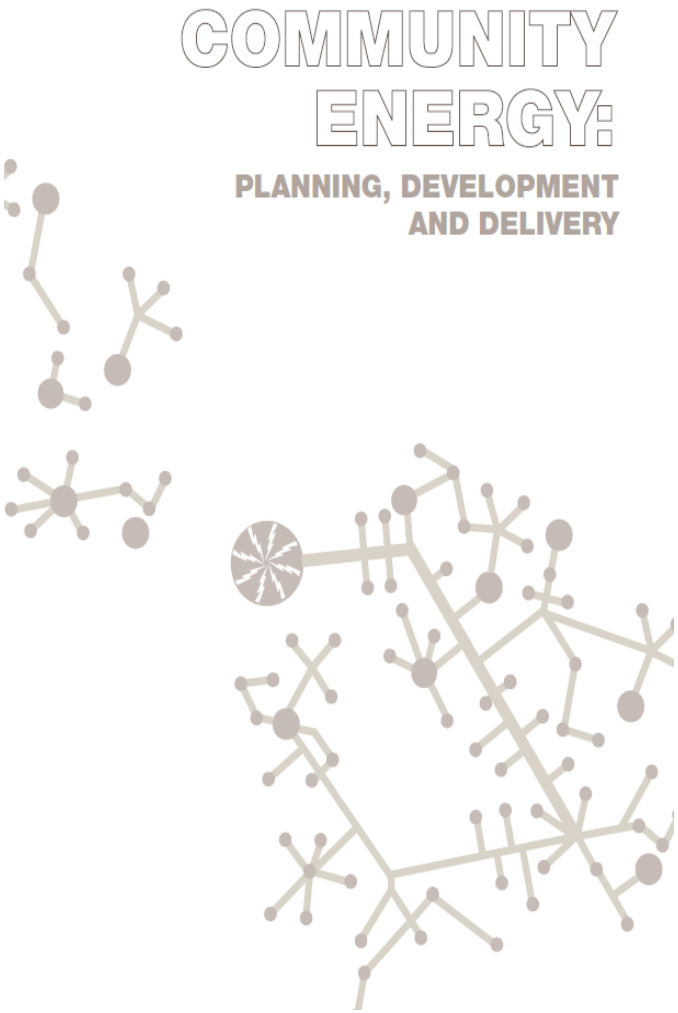

Likely Deployed Low Carbon Energy Generation and Energy Demands in 2030, Including Heat Pumps
Potential Generation / GWh
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Electricity
Heat
Expected Deployed Resource in 2030
Existing buildings demand in 2030
Planned residential demand
Planned non residential demand
Total 2030 demand

A straightforward step-by-step approach to identifying energy projects and creating successful and efficient energy schemes

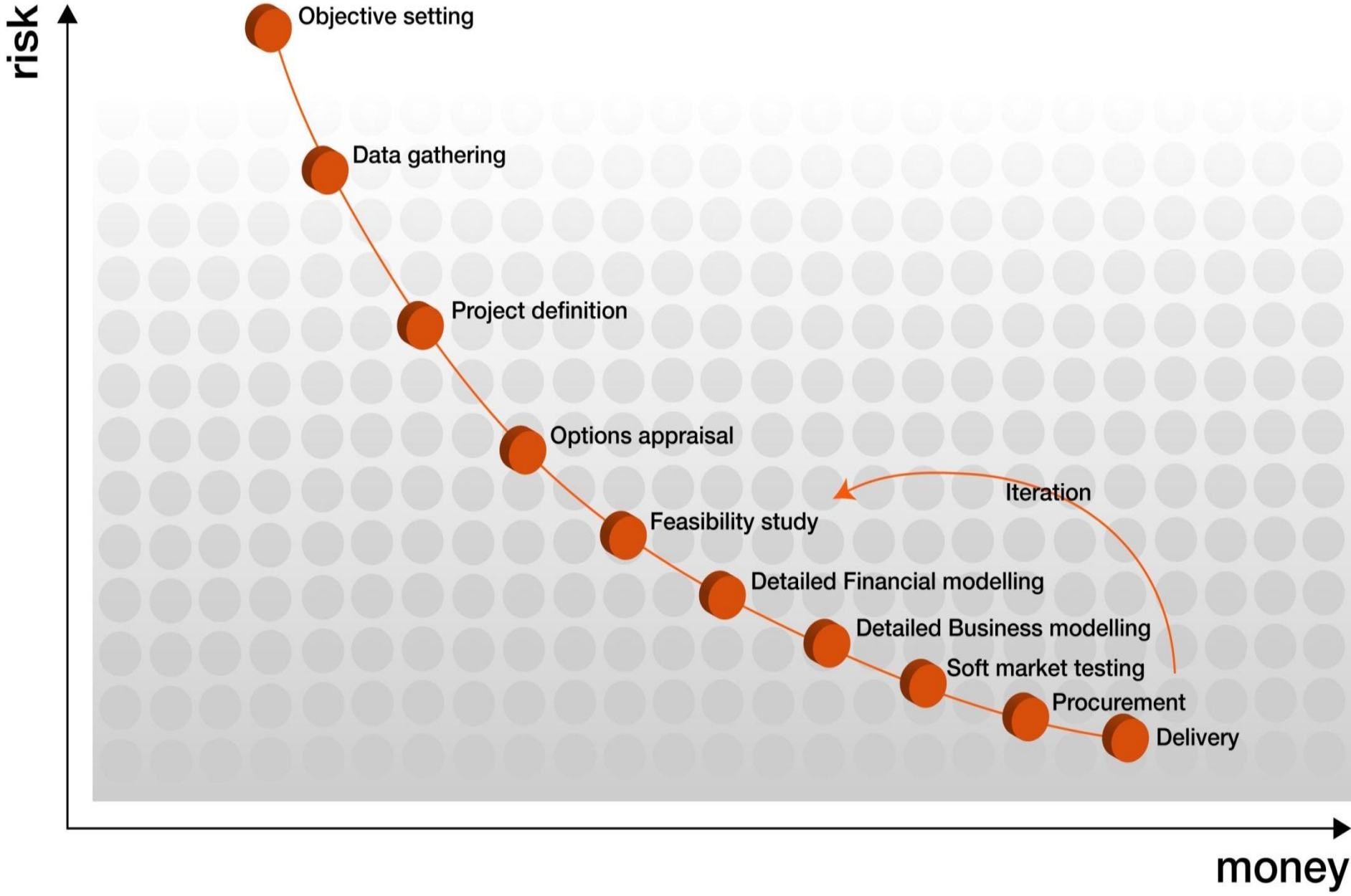


chpa
Bringing Energy Together

tcpa

LDĀDESIGN

Area-wide energy mapping by local authorities



To finish

- Borough has good energy opportunities
- Some more constrained than others
- Great potential for project developers

www.lda-design.co.uk/downloads/Comm_Energy_PlanDevDel.pdf

Rob Shaw
Director of Sustainability and Climate Change

LDA Design

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Introduction to solar thermal systems and heat pumps

Macclesfield Town Hall, Thursday 26th May

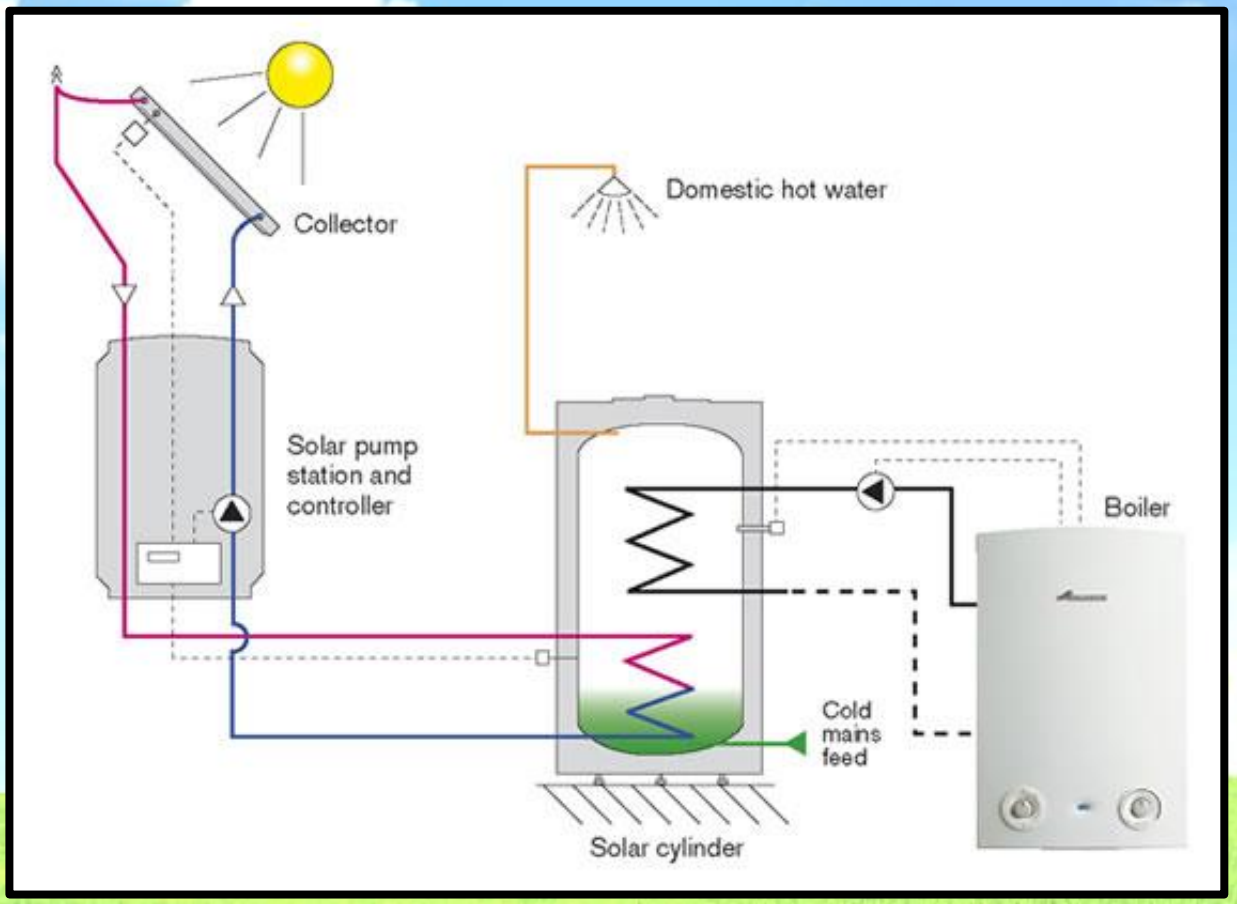
Presented by Clive Wilkinson, Macclesfield Renewables

Solar thermal – the basics

How it works:

Solar thermal systems are designed to collect radiation from the sun and heat a transfer fluid to be used in the generation of domestic hot water or to supplement a wet central heating system.

Simple schematic:



Solar thermal – the basics

Types of solar thermal collectors:

Flat panels – This type of panel can be either mounted on the roof or in-roof (which is shown on the picture)

Evacuated tubes – This type of panel is most suited to our northern climate but they are more expensive.

Solar thermal – the basics

Points to consider:

-Orientation – the nearer to south the better!

-Roof angle

- Shading – not as crucial as it is with solar PV

-Accessibility

-Hot water usage

-Compatibility with existing heating system

- Costs – typically around £5000 to £7000 for household installation

Air source heat pumps – the basics

Main points:

-Electrical driven heat generator that will produce more heat output than the electrical input. For every 1kW used, between 2.5 kW and 4kW will be produced by the heat pump.

Two type of ASHPs:

Air to air - takes energy from the cooler outside atmosphere, upgrades the temperature and produces warm air to be used inside the building. Ideal for offices.

Air to water - Similar to A2A - take energy from cool outside air upgrades temperature to produce warm water for heating & hot Water. Ideal for under floor heating systems

Air source heat pumps – the basics

Points to consider:

- ASHPs are designed to work at low flow temperatures, so the size of radiators and hot water tank must considered.

- Potential noise pollution and the unit must be well ventilated.

-Sizing the unit according to heat loss calculations is very important.

-Existing energy supply – if you are using gas then air source probably isn't an option, but other energy sources are much more comparable.

- Costs can range from between £5,000 and £12,000 depending on the size of the unit and the necessary alterations to your heating arrangement.

Air source heat pumps – the basics

Case study:

We have been monitoring a system installed by ourselves in October 2010 , where we installed an air to water heat pump and solar thermal panels to replace a conventional heating system.

The previous winter quarter fuel bill was around £1300. With the heat pump and solar thermal installed, the fuel bill for this winter was £500.

Ground source heat pumps – the basics

Main points:

-Works in a similar way to air source, it is an electrical driven unit that produces more heat output than the electric used. Typically with a GSHP you can expect a COP of 3.2.

- Ground source systems use solar and geothermal energy stored in the ground to provide the low temperature basis for the heat pump to harvest.

- GSHPs are normally used for much larger heating projects that require large outputs and are a lot more expensive than air source heat pumps.

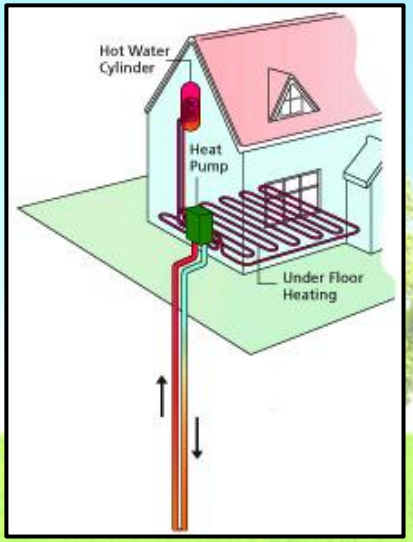
Ground source heat pumps – the basics

Two types of GSHPs:

The method for collecting the energy from the ground comes in two forms:

Matrix method: Used when large areas of land are available. An in ground piping matrix is buried about 1 metre below the surface and extending horizontally over a large area.

Borehole method: This system is used when land area is restricted. One or more deep holes are drilled in the ground to a depth of up to a 100meters, collector pipe work is passed down the bore holes.



Ground source heat pumps – the basics

Points to consider:

- Site for ground source unit

- Ground suitability – geological study required

-The amount of area needed for ground loop is substantial

-Other local services available

-Sizing of the unit is important like ASHP.

- Existing fuel source used – oil and solid fuel make ground source most attractive

- Installation costs can cost from between £20,000-£35,000 depending on method of ground loop.

The financial benefits of renewable heat systems

The Renewable Heat Incentive

Main points:

- RHI based on annual payments of over 20 years for renewable heat installation

- 2 phases for introduction – July this year for non-domestic installations, October 2012 for domestic installation

- For domestic installations, the RHI Premium Payments are available from this year – one off payment aimed at households off the gas grid

- Each technology has individual tariffs based on the installation and running costs.

Benefits of a solar thermal system

Main points:

- Estimated annual saving of 50-60% on your hot water bill (should be 100% in summer months

- RHI tariff for solar thermal is 8.5p.

- Annual output of a typical solar thermal system is around 2,000 kilowatts. (Based on a household installation.)

-Equates to around £160 in annual RHI payments

-The RHI Premium payment available to householders is around £300

Estimated payback period – around 10-12 years

Benefits of an air source heat pump

Potential savings on your energy bills:

Displaced fuel	Estimated annual savings
Gas	-£130
Electric	£330
Oil	£250
Solid	£170

Source: Energy Saving Trust

Savings above based a system sized for a 3 bed semi detached house with a heat pump working at 220%. Systems sized for commercial applications could achieve a larger saving.

-Industry watchdog Redpoint have predicted up to a 10-15% increase in energy bills this winter, which would make heat pumps more competitive.

Benefits of an air source heat pump

Potential revenue from the Renewable Heat Incentive:

- Air source heat pumps are not included in the initial RHI tariffs. The government are planning to introduce ASHP tariffs by 2012.

-Premium payments for air source heat pumps are available of up to £850 for both domestic and non-domestic market. The eligibility criteria for the Premium Payments is yet to be set but it will concentrate on existing properties with no gas supply.

Estimated payback period – around 10 years

Benefits of a ground source heat pump

Potential savings on your energy bills:

Displaced fuel	Estimated annual savings
Gas	£70
Electric	£530
Oil	£500
Solid	£370

Source: Energy Saving Trust

Savings above based a system sized for a 3 bed semi detached house with a heat pump working at 300%. Systems sized for commercial applications could achieve a larger saving.

Benefits of a ground source heat pump

Potential revenue from the Renewable Heat Incentive:

-The price per kW for a GSHP is 4p – guaranteed for 20 years

- Extremely difficult to predict the potential payments, completely depends on usage and output of unit.

-At a very rough estimate, you could potentially receive up to £1000 a year from the RHI (based on unit with a 17kW output.)

- Householders eligible for up to £1250 in Premium Payments for installing a ground source system.

Estimated payback period – around 15 years

End of the presentation

Thank you for your time!

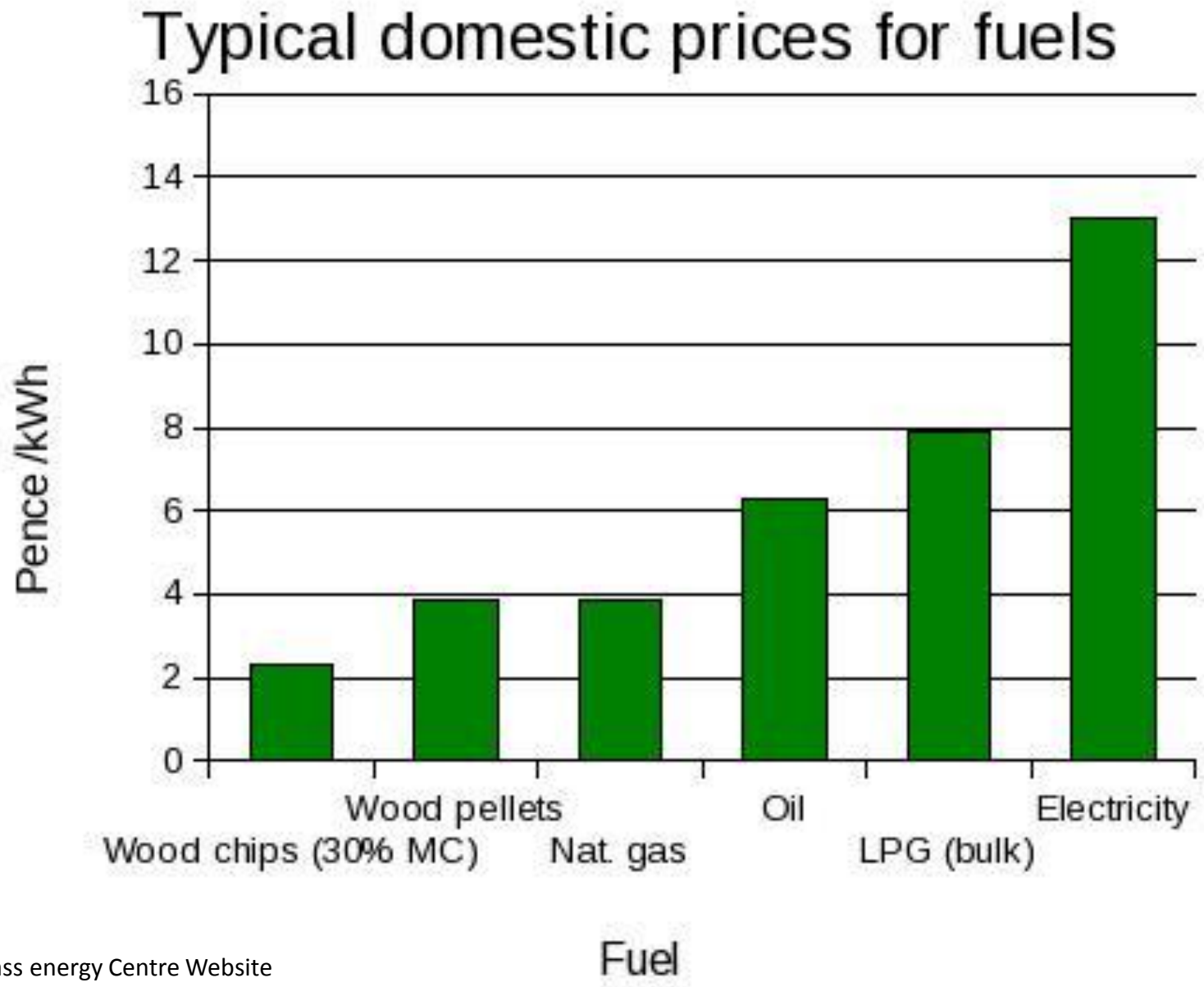
Biomass Boiler Technologies for commercial and industrial installations

Presented by

Chris Hughes

Imperative Energy

42%



Source – Biomass energy Centre Website
Data valid for Dec 2010
www.biomass energycentre.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

SCHMID

WOOD FIRING SYSTEMS


SCHMID
UTSL

Case Study
Boutique Hotel – 80kW Pellet Boiler

- 52 week heating season

- Main load boiler
- 24 hours per day x 52 weeks = 8736 hours
- Seasonal load factor – 50%

- 4,368hrs x 80kW = 349,440kWh

- 1314 x 80 = 105,120kWh

- Tier 1 = 105,120kWh x 7.6p = £ 7,989
- Tier 2 = 244,320kWh x 1.9p = £ 4,642

- Total predicted RHI revenue = £ **12,631**
- 20 year total = £ 252,620 (not allowing for RPI)

Imperative Energy


SCHMID Pyrotronic
SCHMID

Case Study
Ellesmere Port College – 550kW Pellet Boiler

- Opening hours 8am-6pm, 5 days
- 30 week heating season

- Base load boiler
- 10 hours per day x 30 weeks = 1500 hours

- 1,500hrs x 550kW = 825,000kWh

- 1314 x 240 = 722,700kWh

- Tier 1 = 722,700kWh x 4.7p = £ 33,244

- Tier 2 = 102,300kWh x 1.9p = £ 1,943

- Total predicted RHI revenue = £ **35,187**
- 20 year total = £ 703,740 (not allowing for RPI)

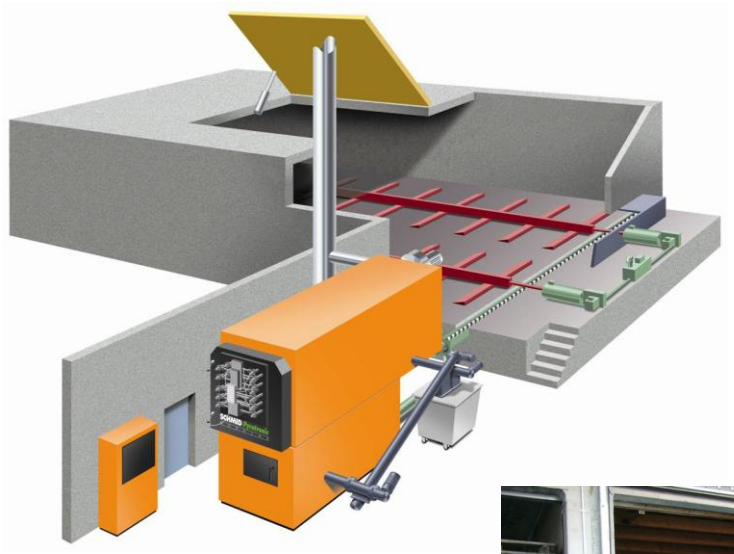
Imperative Energy

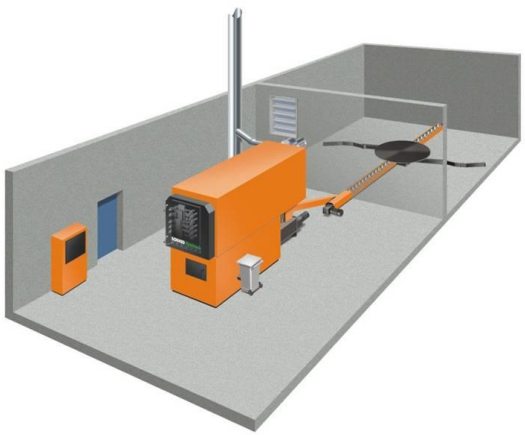

SCHMID Pyrotronic
SCHMID Pyrotronic
Kessel 2

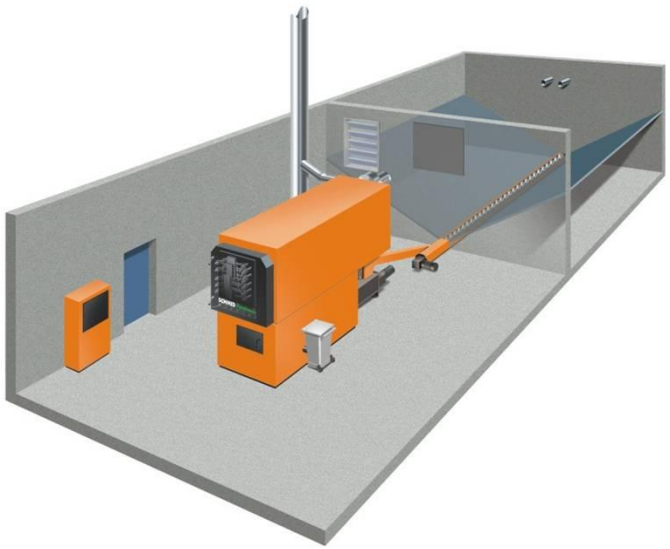
Case Study
Large Scale - 320kW Boiler

- Process Steam (95% availability)
- Operating hours 24/7/365 = 8760
- 8300hrs x 3000kW = 25 million kWh
- 25mkWh x 2.6p = £ 650,000
- Total predicted RHI revenue = £ **650,000**
- 20 year total = £ 13,000,000 (not allowing for RPI)

Imperative Energy








Holzpellet-Silo
Holzpellets

ESCO

Imperative Energy

Imperative Energy Limited

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Cheshire

CW11 3PA

Presented by

Chris Hughes

www.imperativeenergy.com

Imperative Energy

David Hunt

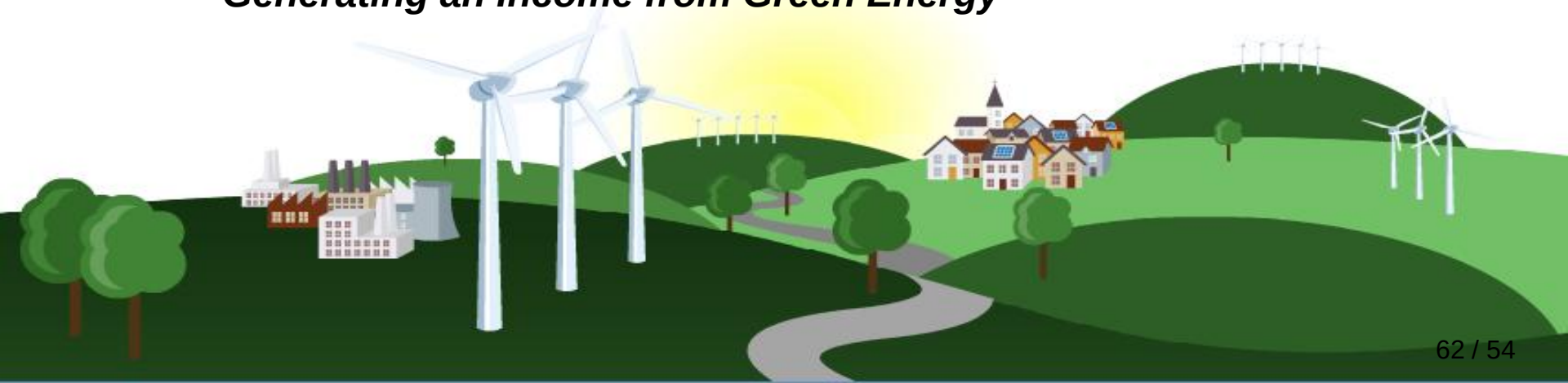
ECO ENVIRONMENTS LTD
Energy & Efficiency. Delivered.

Eco Environments

26 May 2011

Business Briefing:

'Generating an Income from Green Energy'



Who are We?

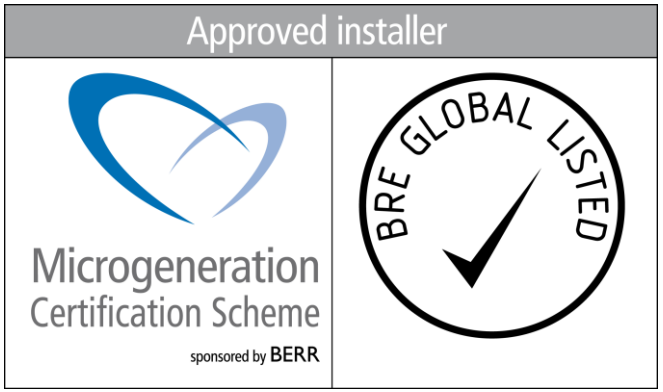
- **A UK award-winning 4x Microgeneration Certified Scheme (MCS) accredited company**
- **We design, install and commission renewable energy and energy conservation solutions. Our clients range from house builders, social landlords, architects and property developers, to businesses, both PLC's and SME's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

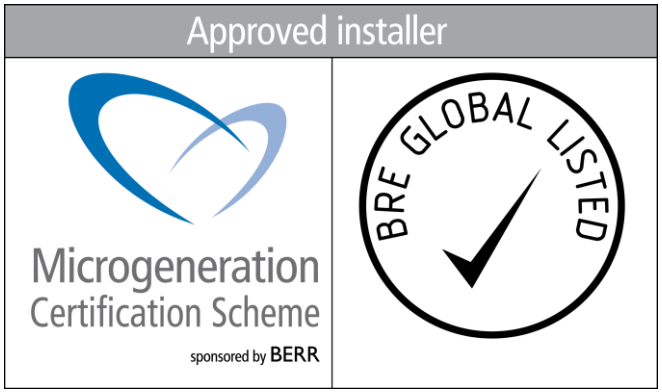
- **Solar Photovoltaic (PV), Solar Thermal, Air-source heating and Wind turbines are our speciality**

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.

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

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)*

Wind Turbines

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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.

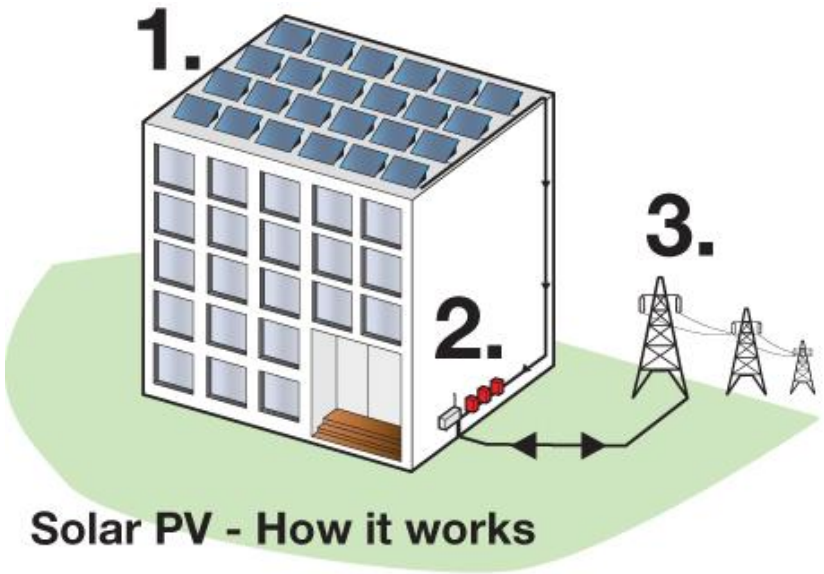
Solar Photovoltaics (PV)

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)

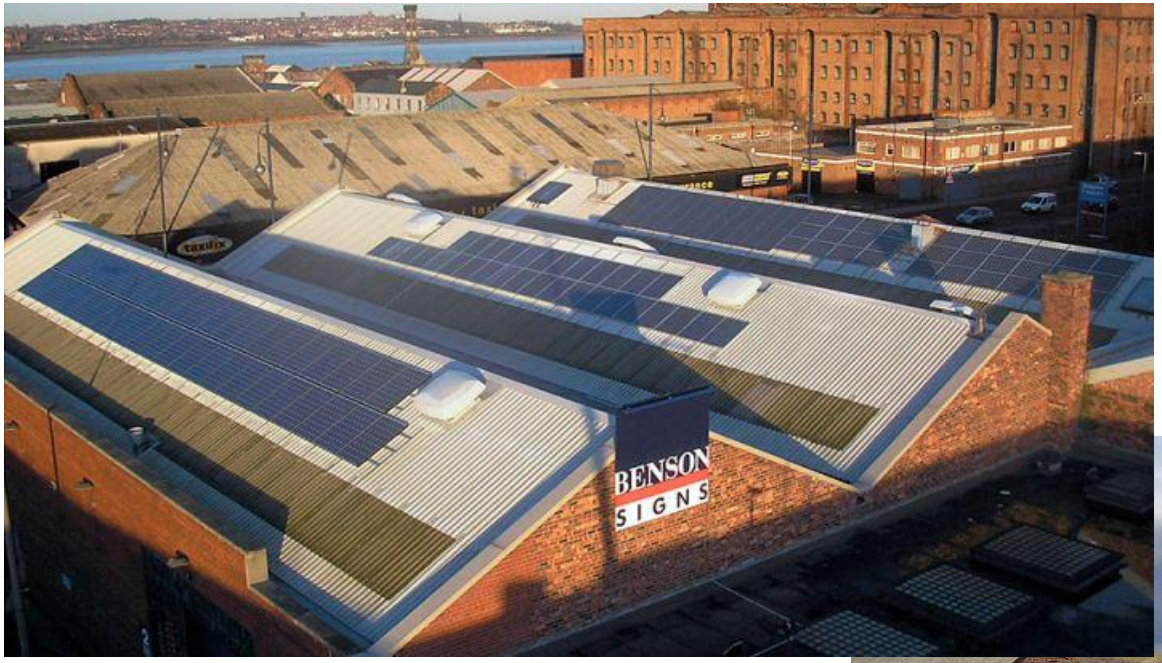
Solar panels

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 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 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 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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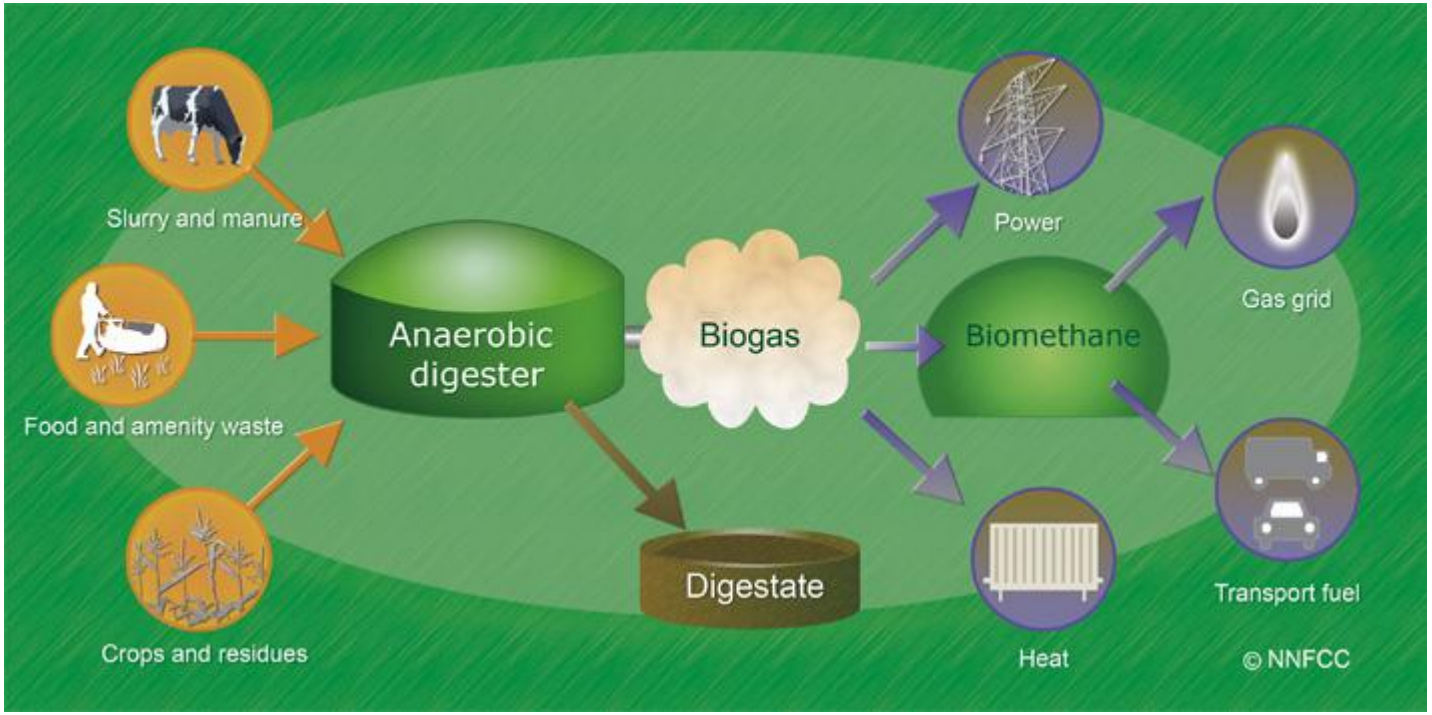
Introduction to AD



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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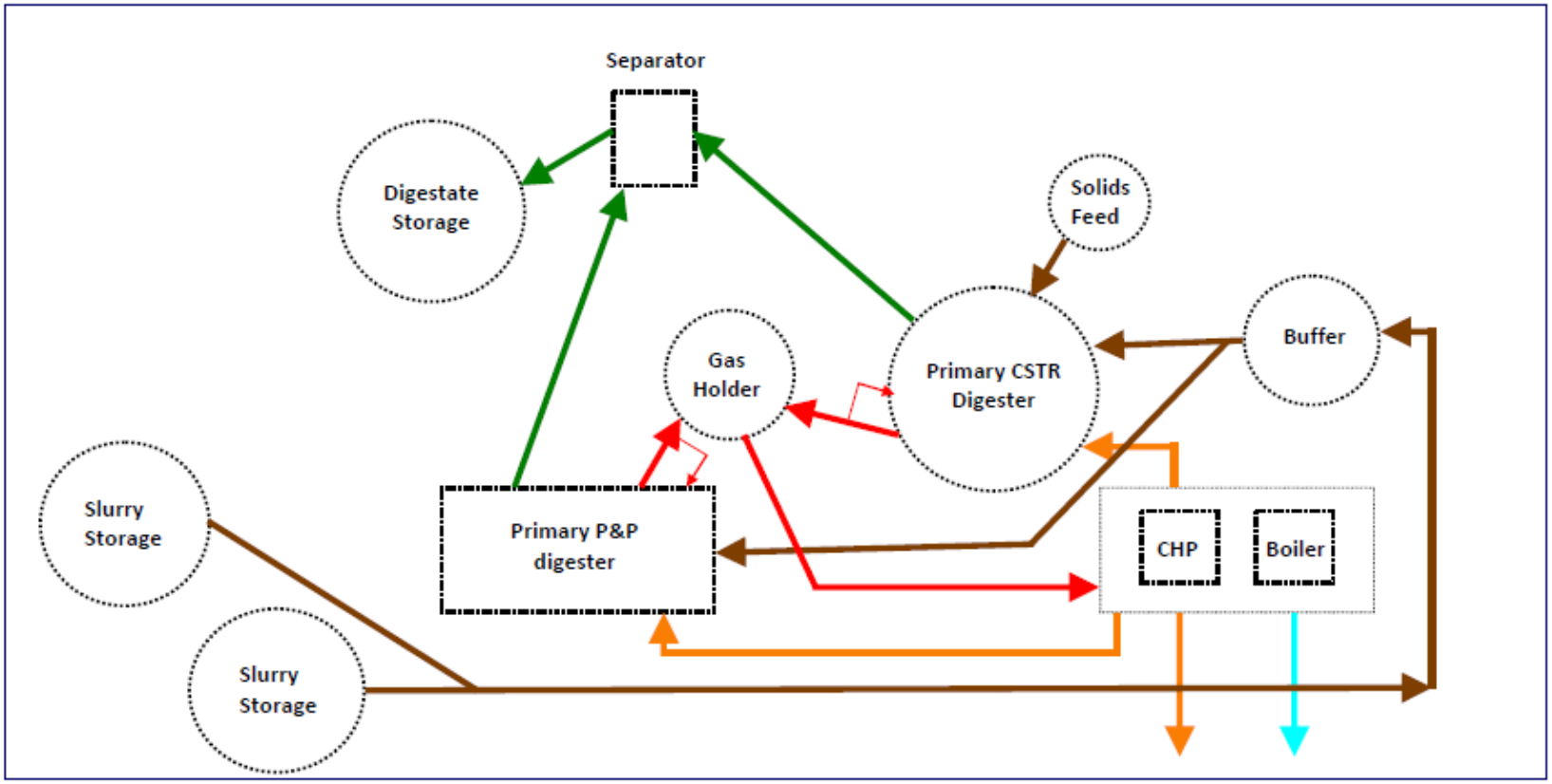
The Reaseheath AD Demonstration Plant



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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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.

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Thank You

Any Questions?

And Enjoy the Networking Opportunity