Science in the City

Building Participatory Urban Learning Community Hubs through Research and Activation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824466

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THE LIGHTING UP OF OUR PLANET IN

THE MIDDLE OF THE UNIVERSE AT NIGHT

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- **Zero Carbon technology**

"A *zero carbon technology / development* is one that achieves zero net carbon emissions from energy use on site, on an annual basis"

- **Carbon neutral technology**

"*Carbon Neutral* is defined as a technology that emits the amount of carbon at the point of use as it takes in during its lifetime"

- **Low Carbon technology**

"A *low carbon technology / development* is one that achieves a reduction in carbon emissions of 50% or more from energy use on site, on an annual basis."

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- Zero Carbon Technologies → 1. Solar – Thermal & PV; 2. Wind; 3. GSHP; 4. Hydro
- Neutral Carbon Technology → 5. Biomass
- Low Carbon Technologies → 6. CHP; 7. Biofuels
- Emerging technologies → 8. Hydrogen; 9. ASHP

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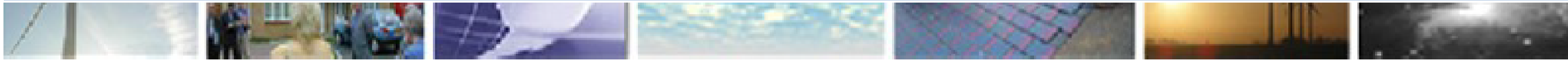
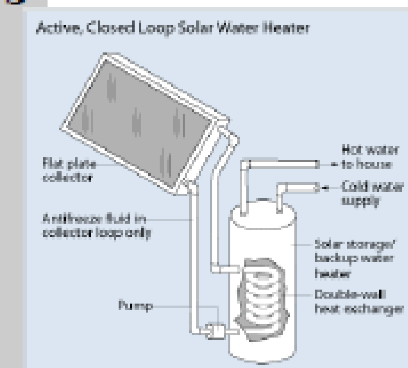


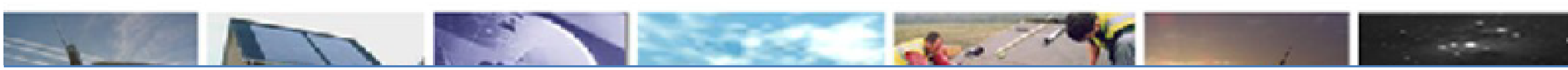
1. Solar technology:

- 1.1- Solar thermal hot water

The figures used are approximate and may vary depending on which source you view.

Installation main components	Installation considerations	Costs
•Solar panels /collectors - Flat plates(30% efficiency, cheaper) - Evacuated tubes (40% efficiency, more expensive) •Heat transfer system •Hot water cylinder	•Roof area (unshade, 2 -4 m²) •Orientation (south facing) •Panels inclined 30º-45º from horizontal •Existing water heating system •Budget •Periods of freezing temperatures •Tank Size	•Installation - Flat plate collectors £2000 - £3000 -Evacuated tube systems £3500-£5000 •Maintenance - Very little maintenance costs (to be checked by a professional installer every 3-5 years)





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- 1. Solar technology:
  - 1.1- Solar thermal hot water

The figures used are approximate and may vary depending on which source you view.

Output	Lifetime & Payback	Environmental benefits: CO_2 reductions	Available Grants
50-70% of the water for a home, which spreads out to approximately 90% in summer, 50% in spring and 20% in winter.	20 – 30 years lifetime Payback: 7 - 9 years	400 - 750 kg per year (average installation), about 10% of average household emissions	-LCBP -Possible Local Council Grants available - Possible EEC grants

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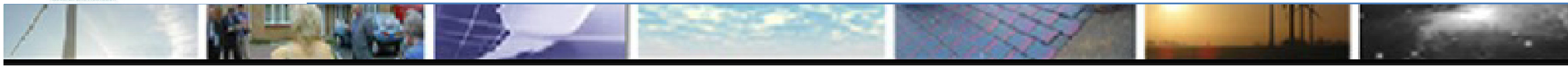

- **1.2- Solar PV**

Installation main components	Installation considerations	Costs
PV Array Balance of system equipment (BOS) Inverter DC-AC Metering	• Roof area (at least 10 m^2 unshaded) • Roof inclined 30°-45° or less. • Orientation (south facing)	Installation Between £10k and £14k Small annual maintenance costs

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- 1.2- Solar PV

Output	Lifetime & Payback	Environmental benefits: CO2 reductions	Available Grants
1 kWp (smallest system available) produces 750 KWh of electricity = 20- 25% of average household consumption per year	25 years lifetime Payback: as energy cost increases, payback decreases	325 kg per year (based on a 1KWp installation)	LCBP = max £3000 per KWp installed (up to a maximum of £15000 subject to an overall 50% limit of the install cost.

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- 2. Wind Energy

Installation main components	Installation considerations	Costs	Output
•Turbine •Mast •Inverter •Battery storage (if off-grid system)	•Average wind speed of 5 – 7.5 m/s is needed. •Planning issues, visual impact, noise and conservation areas. • Possible building survey due to increase pressure on fabric of the building.	•1 KW = £1595 (B&Q) •Larger systems exponential ly rise.	•1 KW turbine = 1000KWh per year (depending on site conditions)

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- 2. Wind Energy

Lifetime & Payback	Environmental benefits: CO_2 reductions	Available Grants
Lifetime: 20 years lifetime Payback: unlikely to provide full costs payback during lifetime, but likely to improve as energy costs rise	0.5 t/house x year	LCBP (max £1000/kw installed up to max of £5000 or 30% of installation costs)

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▪ 3. Ground Source Heat Pumps

The figures used are approximate and may vary depending on which source you view.

Installation main components	Installation considerations	Costs
• Ground loop • Deep bore drill •Heat pump contains: -Evaporator -Compressor -Condenser •Heat distribution system (under floor or standard radiators)	•Correct sizing of the heat pumps and the ground loop or bore is crucial •Space available: vertical drill or horizontal loop	**The installed cost, for a professional installation, ranges from about £800-£1,400 per kW of peak heat output, excluding the cost of the distribution system.**

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- 3. Ground Source Heat Pumps

Output	Lifetime & Payback	Environmental benefits: CO2 reductions	Available Grants
Full house heating: - Under floor heating more efficient than radiators	Lifetime: 25 years Payback: 9-10 years in comparison with a gas central heating system	600- 750 kg CO_2 PA, saving 63% emissions when compared to gas heating system	LCBP Maximum £1200 regard subject to an overall 30% limit

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- 4. Small Hydro

The figures used are approximate and may vary depending on which source you view.

Installation main components	Installation considerations	Costs
Old Technology Usually developed by Head of Water Strength of flow	Rainfall to support turbine in UK mainly Scotland Ecological effects may be adverse	£700 - £3k per installed KW. Average cost around £1400 per KW

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- 4. Small Hydro

Output	Lifetime & Payback	Environmental benefits: CO2 reductions	Available Grants
Average worldwide is 100KW machines	Costs around 4p per unit generated	No CO2 emissions at all Ecological benefits to some areas	LCBG not defined as yet.

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Installation main components	Installation considerations	Costs
Replaces existing gas boiler in system	Machinery can be larger than standard gas boilers	•£3,000 for dwelling size unit
Has a combustion engine to run power plant from number of fuels	Too much output for smaller homes	
On grid or off grid connection possible	Connection agreement required from energy supplier	

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6. Low Carbon technology: CHP 2

Output	Lifetime & Payback	Environmental benefits: CO2 reductions	Available Grants
Electrical: 1000W AC at 220-240V. Thermal: Heat output from 7.5-13kW Maybe unstable at small scale	Lifetime: 15 years Saving £150 - £200 per year 4 -7 year payback period	0.5 tonnes per annum when compared with condensing gas boiler	LCBP: Not defined yet, but will be available in the future.

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Air Source Heat Pumps (ASHP) 1/3

What is it?

Heat pumps extract thermal energy from a variety of renewable sources, including the air, earth or water, and upgrade it to a higher, more useful temperature. If the heat source for the system is the air then it is known as an **Air Source Heat Pump** (ASHP).

Main components

An ASHP system consists of:

1 A compressor and a carefully matched 2 evaporator coil and heat 3 exchanger, and a 4 refrigerant liquid which circulates within the system.

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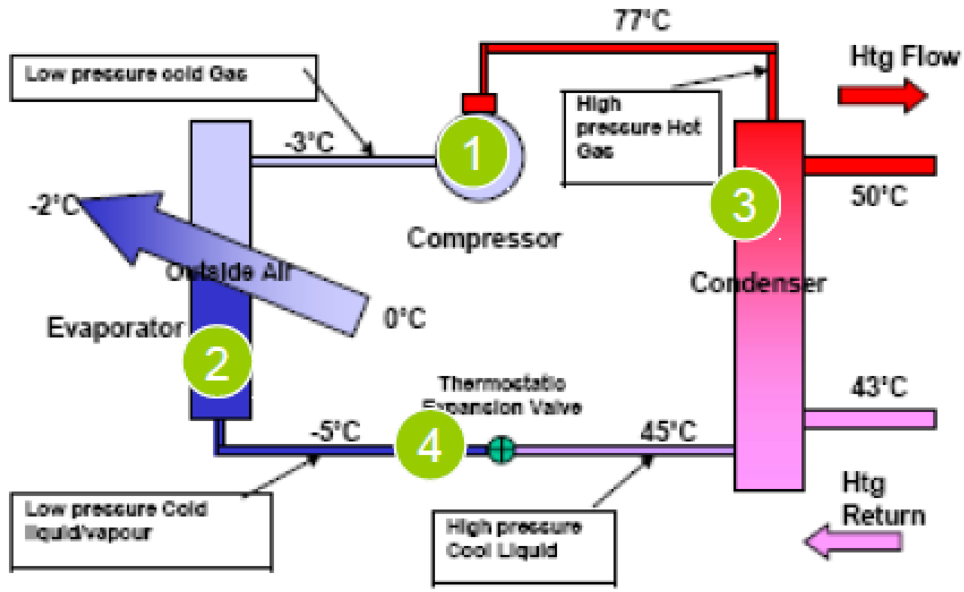
Air Source Heat Pumps (ASHP) 2/3

How does it work?

1 By extracting heat from the surrounding air, the heat energy released can be up to 4 times the energy required to power the equipment.



2 The resulting refrigerant gas is then compressed adding more heat energy and raising its temperature to around 75°C.

3 This heat is then passed via the heat exchanger into water and used to provide space heating through radiators as for conventional heating systems, or via underfloor heating systems.

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Air Source Heat Pumps (ASHP) 3/3

BENEFITS

- The amount of energy consumed to operate the pump is much less than would be required to heat the house by conventional means.
- Heat pumps are inherently efficient as they use low temperature heat created from renewable energy sources, and release relatively low carbon emissions.

BARRIERS

- Technology quite new
- South facing roof required
- No over shadow from surrounding buildings
- Lack of robust information from installations already completed
- Cost -payback

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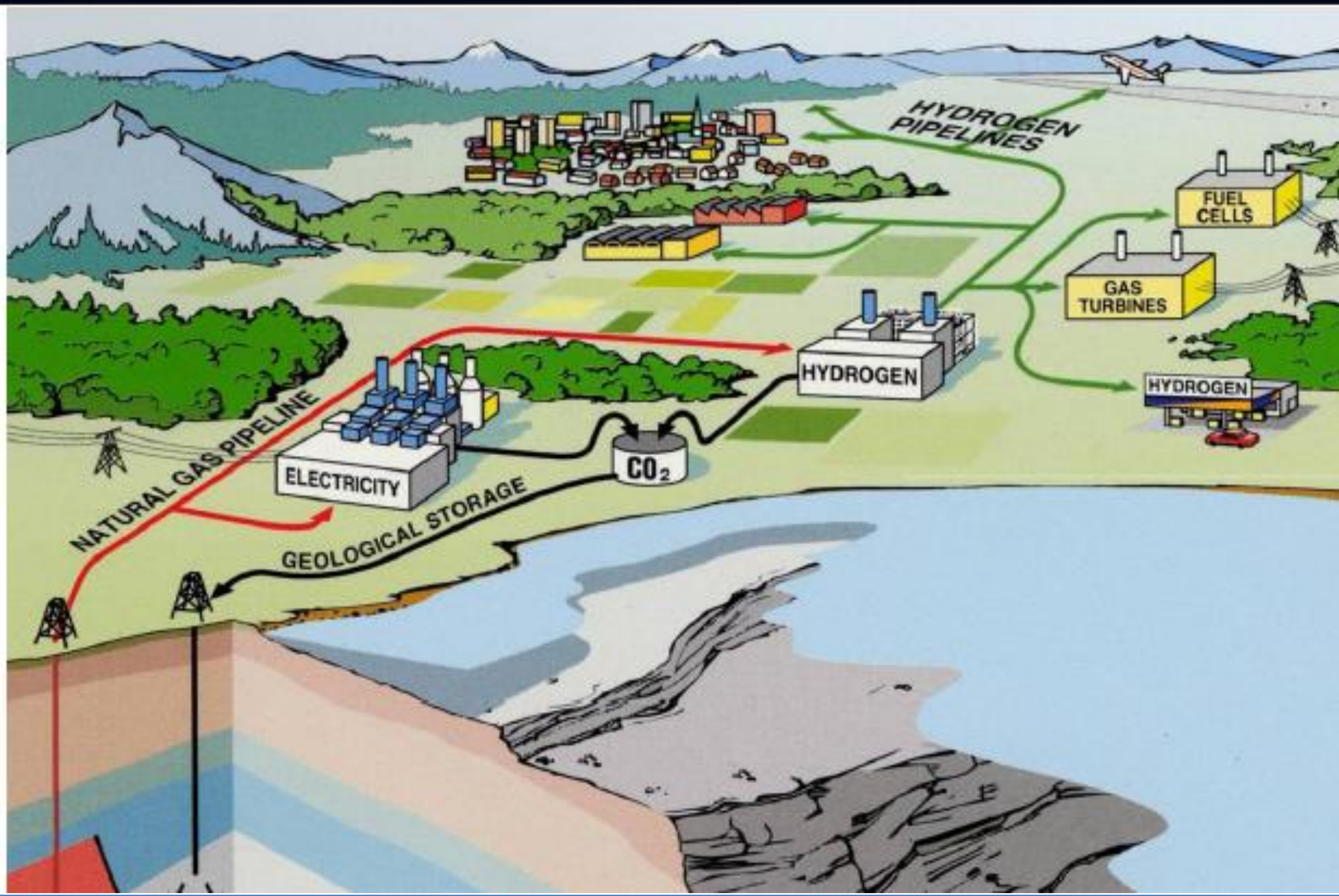
The Hydrogen Economy



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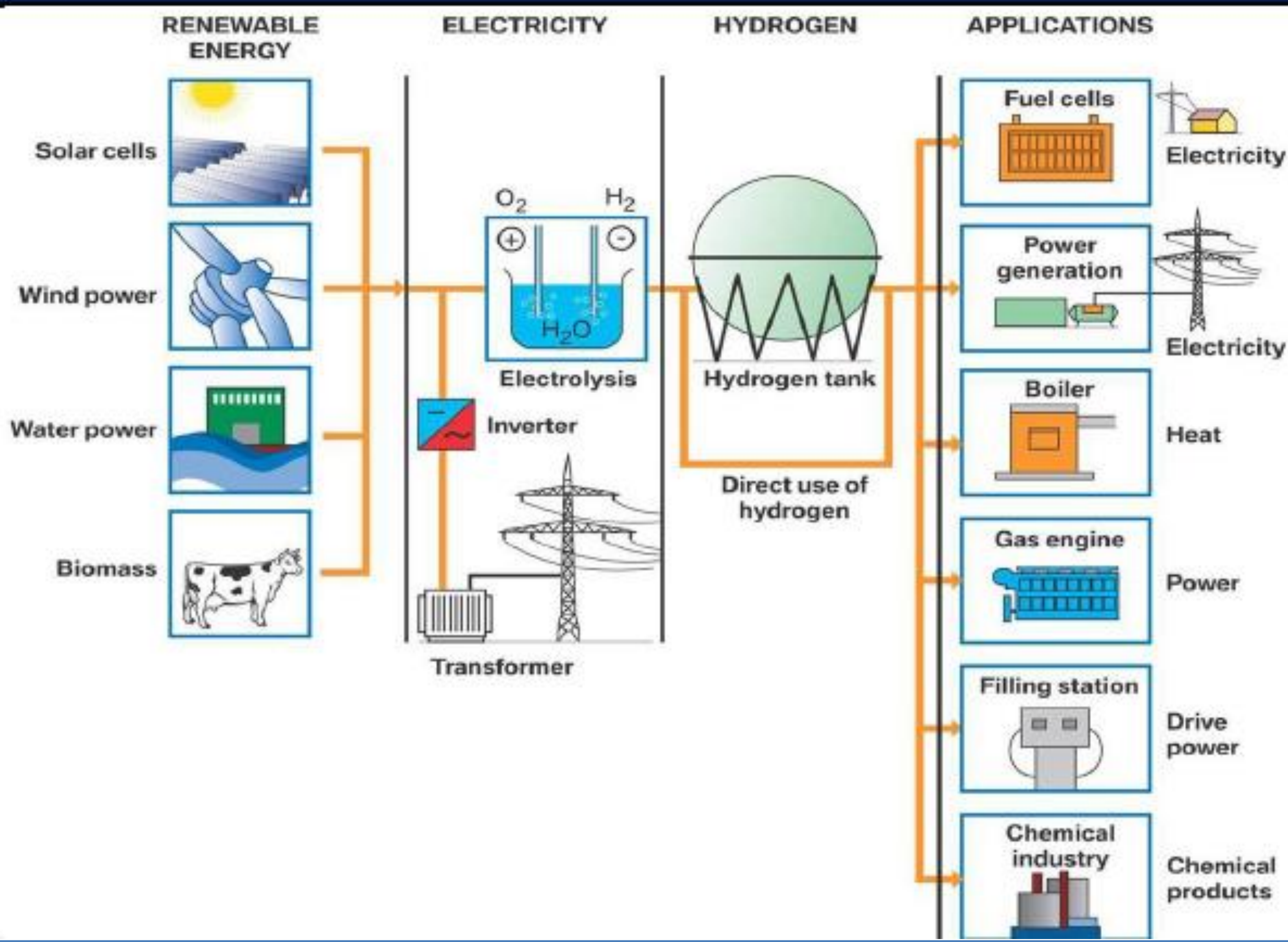
Hydrogen from Renewables



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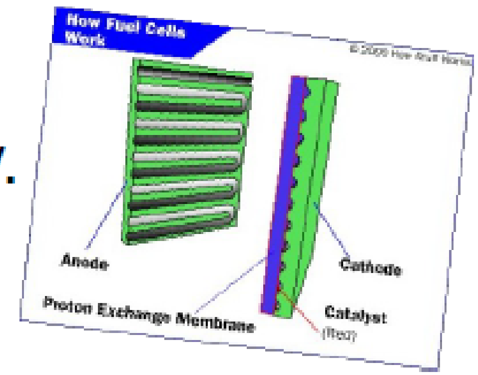
Fuel cell technology

How does a fuel cell work?



- Very simply, a fuel cell is like a battery.
- It has two electrodes, an anode and a cathode, separated by a membrane.
- The electrons flow out of the cell to be used as electrical energy.
- Unlike batteries, fuel cells never run out.

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Hydrogen Technology: Benefits and barriers

BENEFITS:

- Totally clean fuel: when it is burned it leaves behind only air and water (sub product).

BARRIERS

- Firstly, there is the question of cleanly generating enough hydrogen.
- Then there is the problem of finding a way to store the gas (explosion)
- Other issues such as reliability and the cost of production still remain to be solved.

Is it finally possible on a larger scale?

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CONCLUSION

Thus from the slides we can conclude that we can save lot of non-renewable sources of energy and prevent carbon from entering our atmosphere, thus making earth a better place to live in.

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REFRENCES:-

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[3]THE RENWEABLE HANDBOOK,WILLIMAN KEMP

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