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# The Role of Renewables In Sustainable Design

2010

James Toland

# Agenda

Sustainable Development  
Various Forms of Renewables  
Introducing the Heat Pump  
Micro District Heating Soln  
Quality Guarantees  
Design Essentials  
Incentives towards Renewables




European Honey Bee

# Sustainable Development



# What is Sustainable Development

- **Brundtland Commission:**



“.....is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

# Some Areas to Consider

- Modes of Living
- Agricultural Practice
- Lifestyles
- Work Practice
- New Technology



# Renewable Energy



# Renewable Energy?

- Renewable energy is energy generated by natural resources – such as sunlight, wind, rain, tides and geothermal heat – which are naturally replenished
- Examples are
  - Heat Pumps
  - Solar Thermal
  - Solar Photo Voltaics
  - Biomass
  - Wind
  - Hydro
  - Anaerobic Digestion
  - Geothermal



Philippine's Geothermal Power Station

# Introducing the Heat Pump

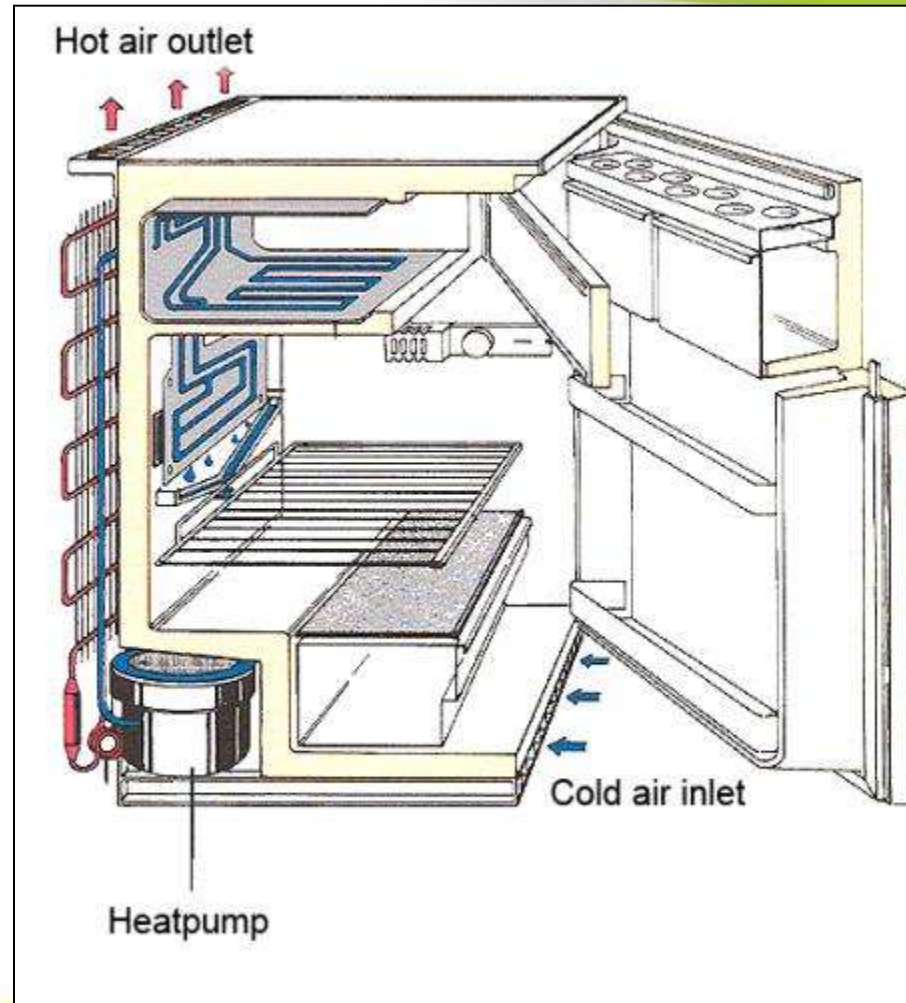


# The Principle of Heat Pump Technology

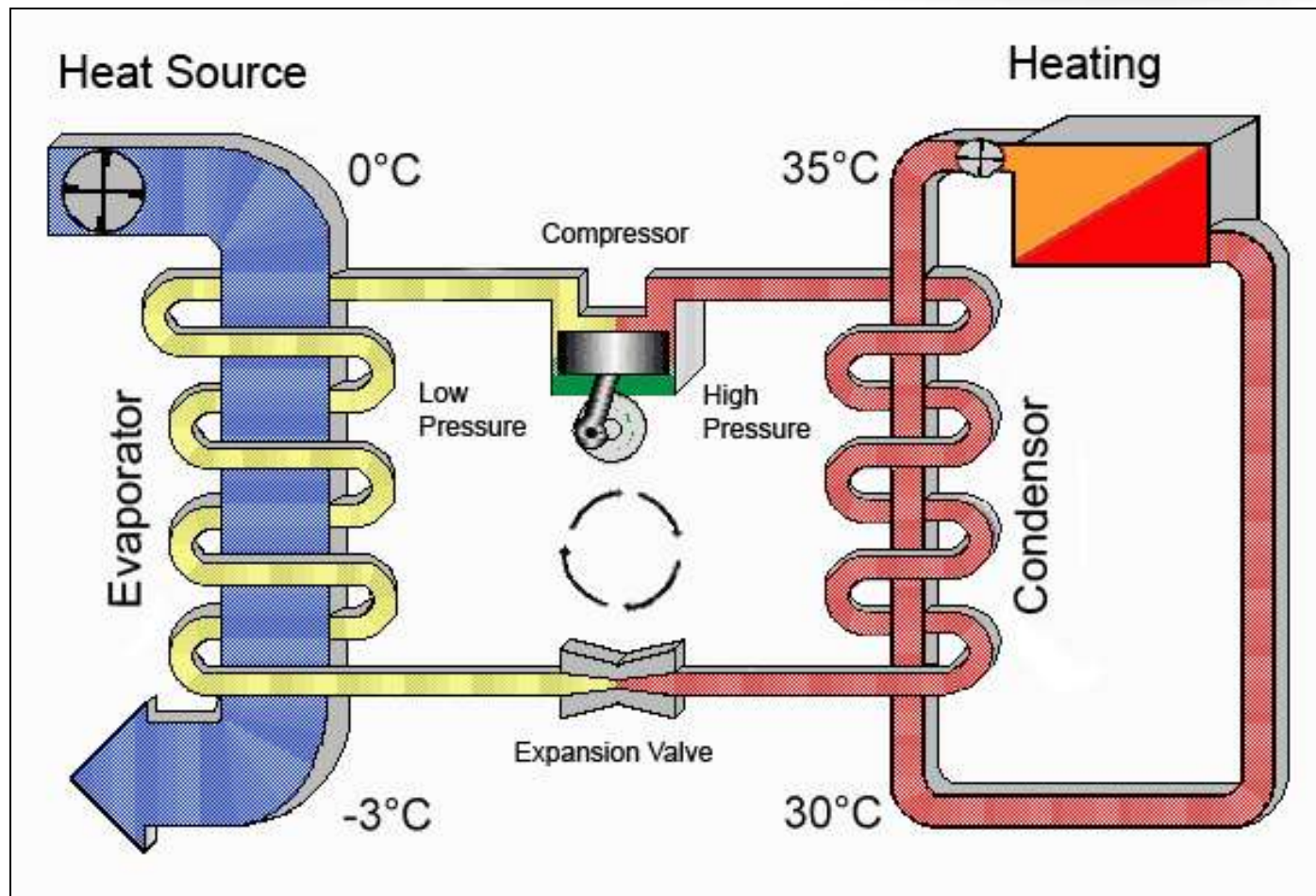


- Takes low grade energy in the ground, water, air
- This is effectively solar energy
- Transmits it to higher grade energy via a compressor
- This heat energy provides heating for the home or office
- It also provides for domestic hot water

# The Technology



# How it works!



# Performance Measurement - COP?

- Coefficient of Performance
- A measurement of the ratio of energy input (electricity) to heat output
- For example:
  - » 2kW electricity to provide 7kW heat = COP of 3.50
- Must however be compared like with like
- Common to compare GSHP's at B0W35 (EN14511)
- Common to compare ASHP's at A2W35 (EN14511)

- EST Monitoring Programme – Installs pre Nov 2008
  - **Professor David MacKay, Chief Scientific Officer, Department of Energy and Climate Change:**  
“Heat pumps will be a crucial component of our low-carbon future, provided they perform well. It’s therefore essential to conduct trials to establish best practice, and perfect this technology for use in building throughout the UK.”
- However, 80% of monitored installs did not meet EU proposed level for classification as renewable energy of 2.6
- Notably - European installs perform better
  - Experience
  - Equipment Quality

# Heat Pump v Natural Gas - Comparison

- Space heating load
  - 100 kWh per week
- Heat pump with COP of 3.5
- Gas Boiler operating at thermal efficiency of 100%
  - HP energy consumption =  $100/3.5 = 30$  kWh
  - Boiler energy consumption =  $100/1 = 100$  Kwh

# Heat Pump v Natural Gas – CO<sub>2</sub>

- At 2009 current UK generator mix emitted CO<sub>2</sub> - 0.43kgCO<sub>2</sub>/kWh of electricity used.
- Corresponding figure for natural gas is 0.194 kgCO<sub>2</sub>/kWh
- Based on previous example
- Heat pump emissions:  $30 \times .43 = 12.9 \text{ kgCO}_2$
- Gas Boiler emissions:  $100 \times .194 = 19.4 \text{ kgCO}_2$
- Therefore Heat Pump emits 33% less CO<sub>2</sub> than Gas Boiler



# Ground Source Heat Pumps

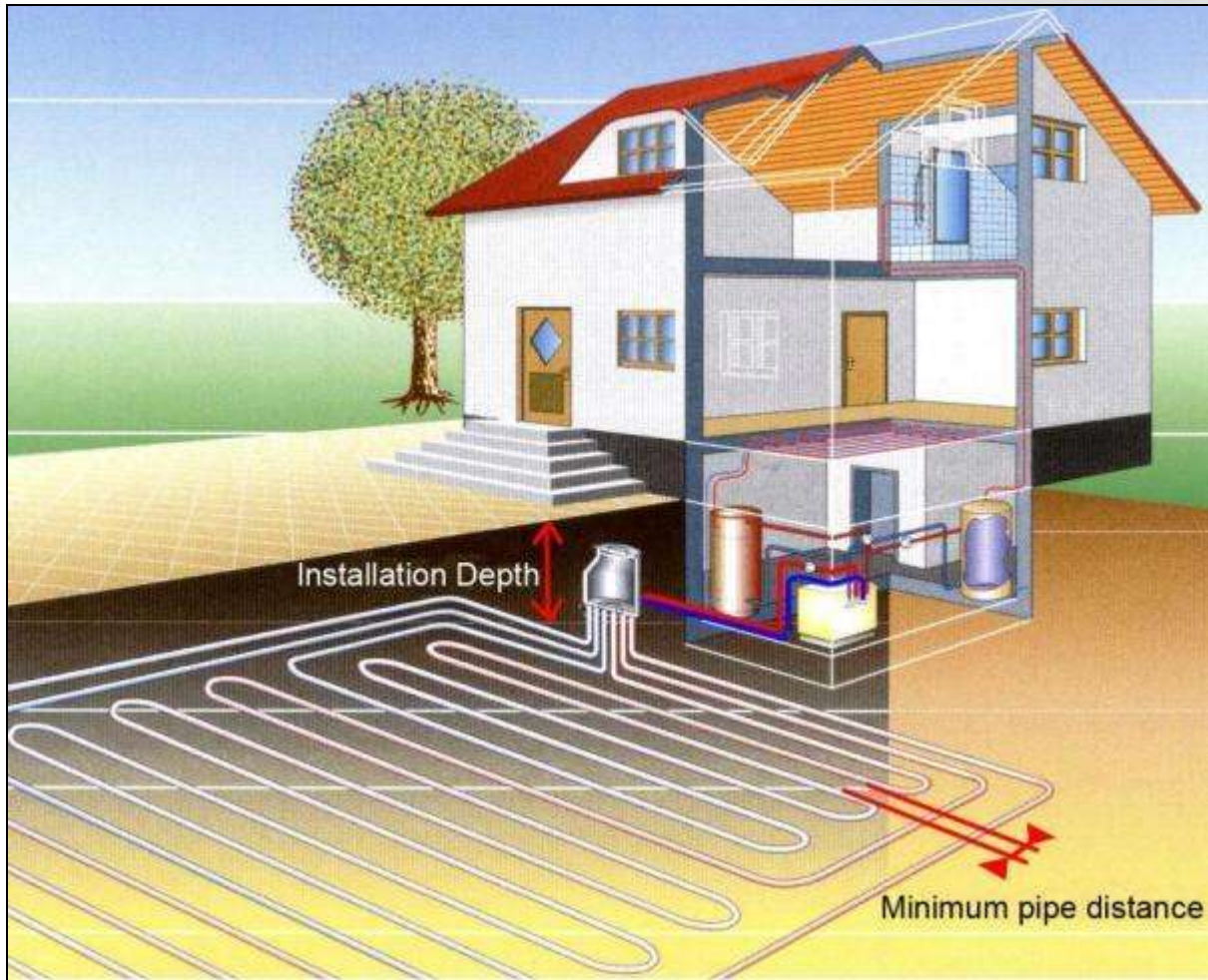


# Advantages of Heat Pumps

- Lower Running Costs
- Low Carbon Footprint
- Long Life Expectancy
- Ease of Maintenance
- Low Temp Solution
- Environmentally Friendly
- No Fuel Storage Issues



# Horizontal Loops



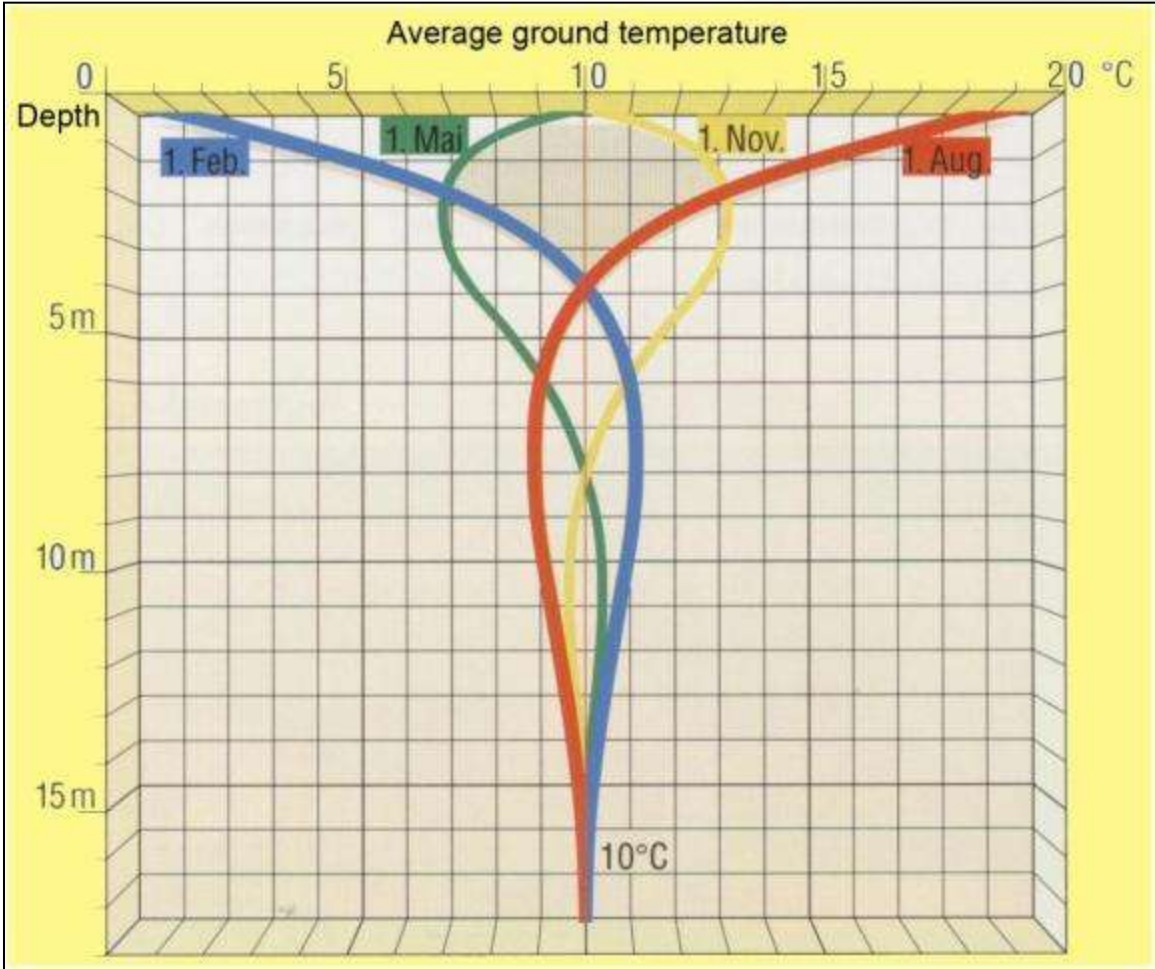
# Closed Loop Boreholes



# Drilling

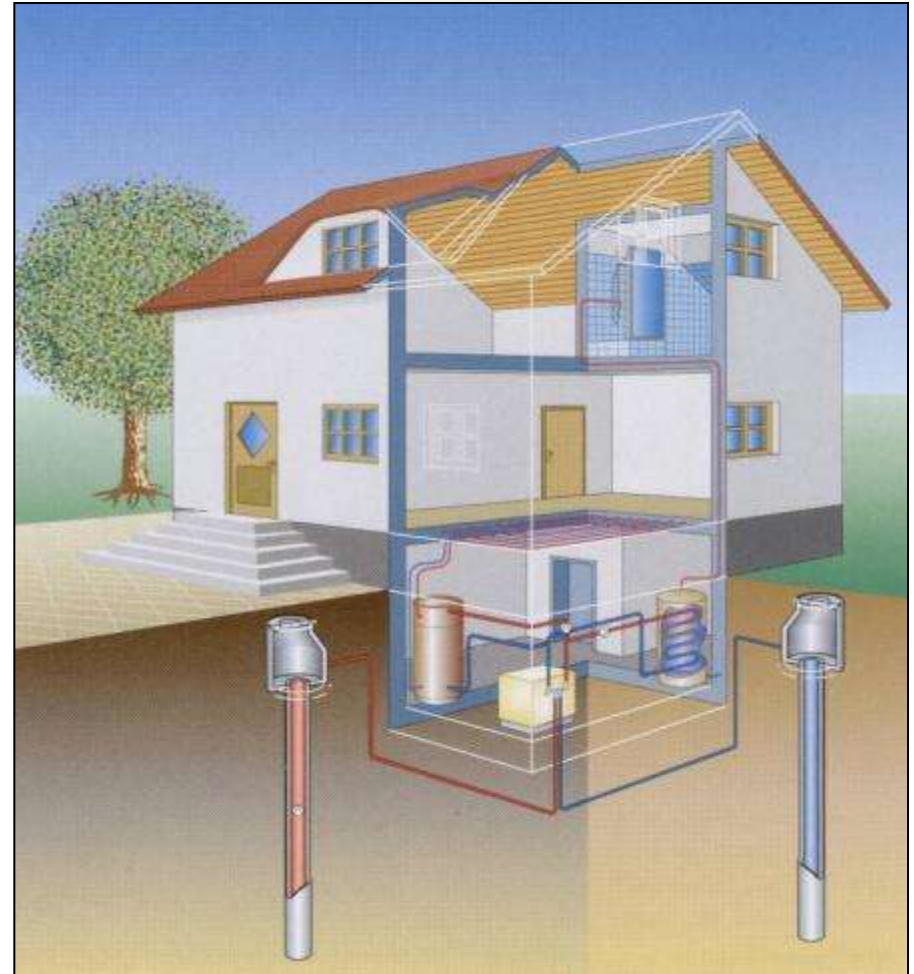


# Borehole Temperatures



# Ground Water Borehole

- Double borehole open loop keeps ground water level constant. Boreholes should be kept a minimum of 15m apart
- Average water temperature below 15m is 10-12°C
- Requires registration with Environmental Agencies
- Water can also be used to supply domestic pressurised water



# River Water Collector



# Air Source Heat Pump



# Air Source Heat Pumps

- Noise – 35 dBa
- Efficiency – COP to 3.8
- Performance to  $-17^{\circ}$
- Defrosting Optimum Efficiency
- Standard versus Exhaust Air
- Micro District Heating Soln
- Single Phase v 3 phase
- Proven Throughout Europe



8kW and 10kW  
153cm (H) x 110cm (W) x 75cm (D)

# External Install



# External Internal Install

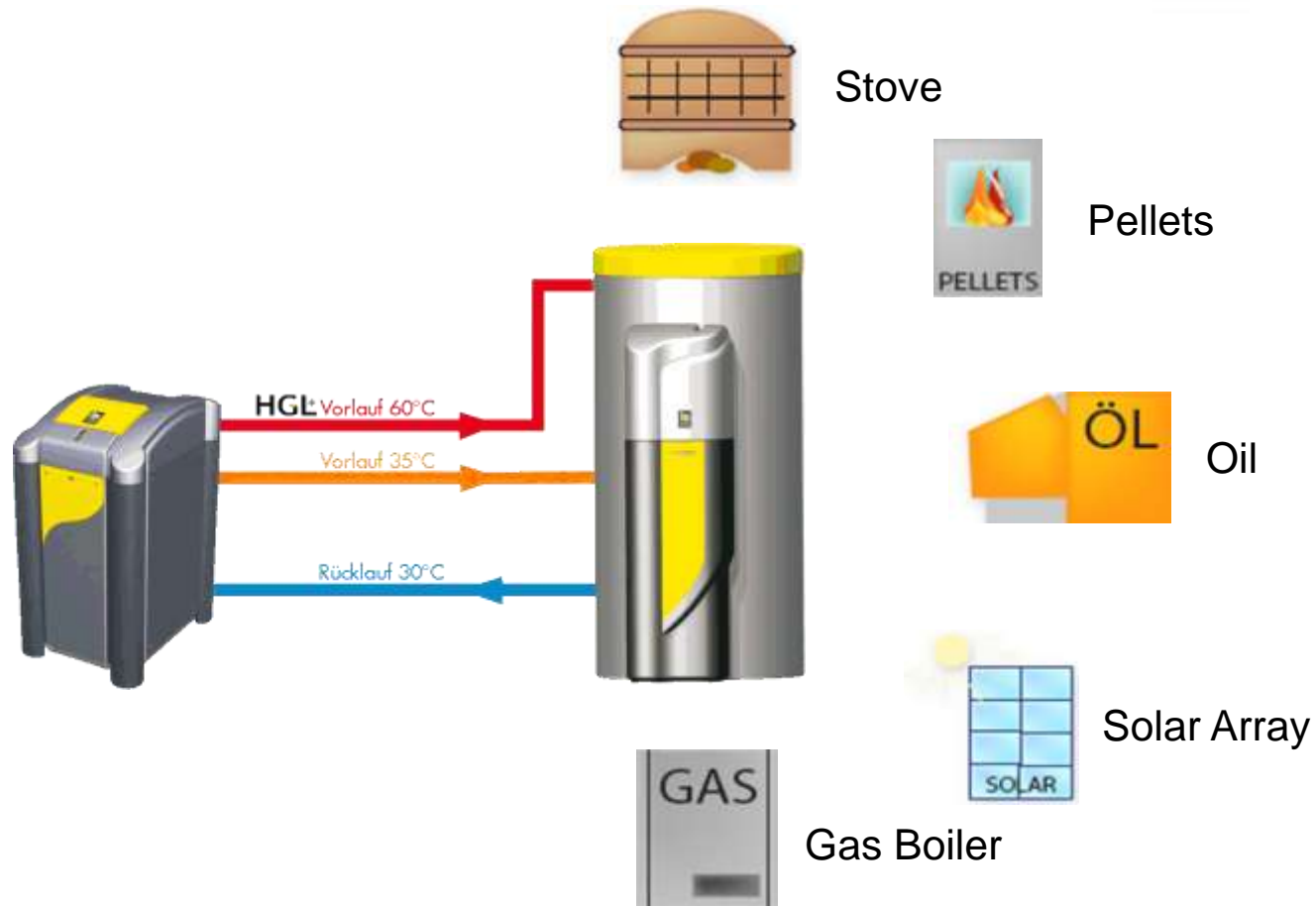


# Control - Navigator<sup>®</sup> 1.0

- Individual control of up to 7 heating & cooling zones
- Allowing for weather prediction
- Accounting for favourable electric tariff
- Optimises HGL efficient hot water production
- Full remote control - all from your office desk!



# Comptability



# Thermal Stores

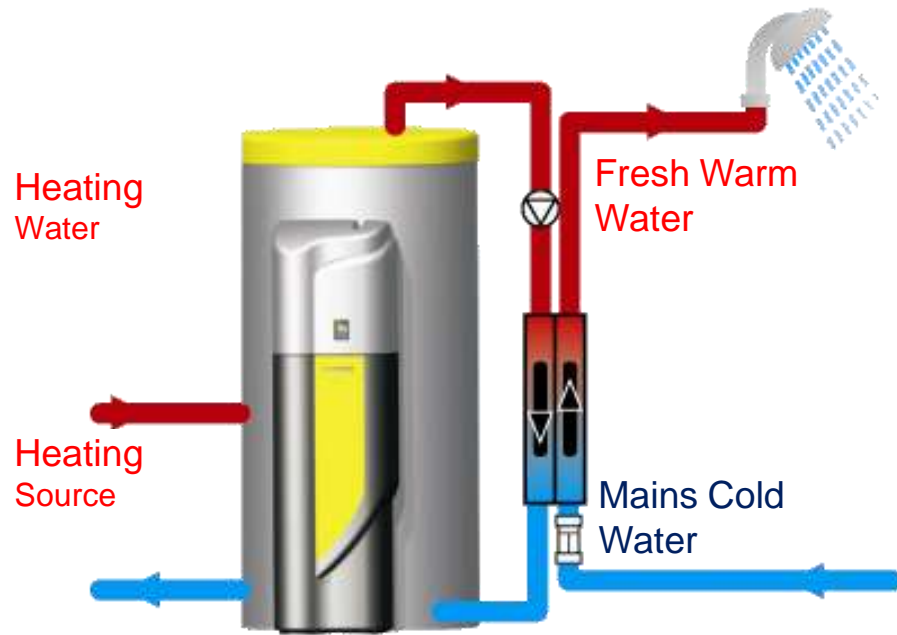


sustainable energy solutions



- Beware of Legionella
- Efficient flow of hot water
- Capacity reflective of DHW requirement
- Thermal buffer for heating system
- Central role in combining all heat sources
- Range of sizes – bigger than older systems

# How it works



# Bringing it all together



# Micro District Heating Solution



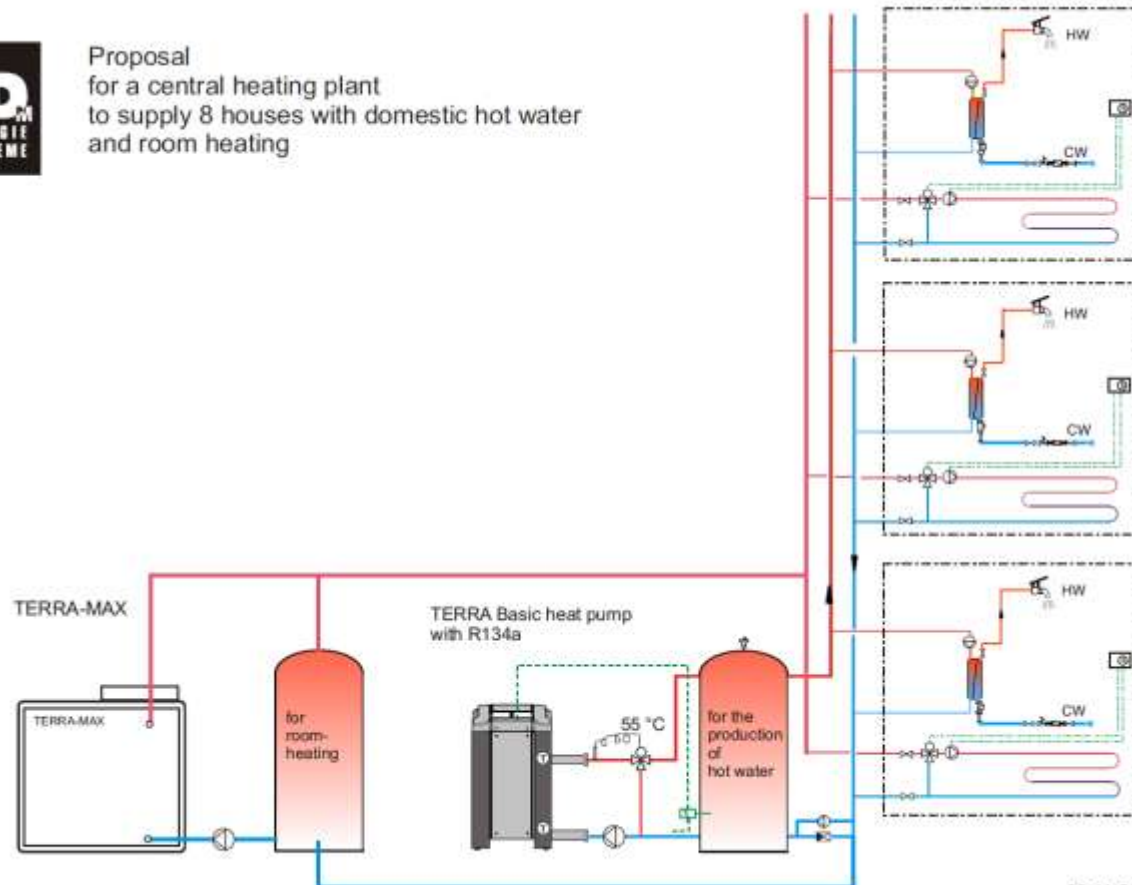
# Energy Considerations

- Fighting Fuel Poverty with Sustainables
- Reducing the Carbon footprint of the Housing Stock
- Reducing maintenance Costs
- Improving Reliability, Less Plant
- Positive Forces
  - Code for Sustainable Homes
  - Renewable Energy Strategy 2009
  - Climate Change Act 2008
  - Grant Aid
  - Numerous New Legislation

# Overview of MDHS



Proposal  
for a central heating plant  
to supply 8 houses with domestic hot water  
and room heating



23.11.2009

# Key Advantages



- All Advantages of a Sustainable Solution
- Heat Metered to Individual Properties
- Cost Benefits
- Meet CO2 Targets
- Remote Housing of Plant – Solar Panel Roofing
- Maintenance Accessibility
- Reduced Discrete Units
- Low Temperature
- Finance Options to meet Capital Costs

# Typical Installations



# Housing – The Duckett

- 10kW Heat Pump
- UFH Throughout
- Unique Project



# Housing – The Old Barns, Cromarty



- 10kW Heat Pump
- UFH Throughout
- Unique Project



# Medical Ctrs - Sacriston

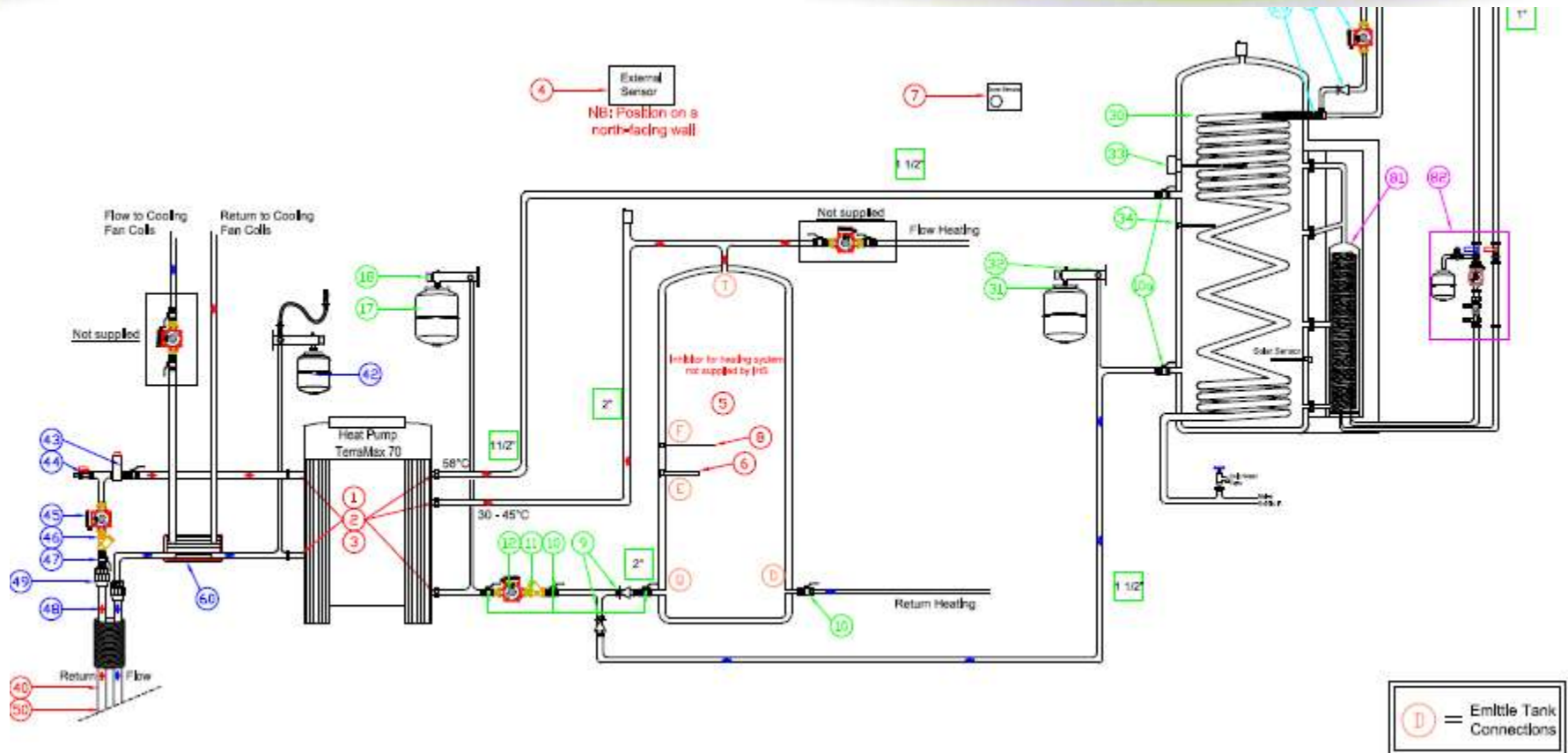


Terra Max 90kW – Incorporating Road Energy  
'Specialist OGI'

# Rail Stn - Parkway



Greenest Station in Britain  
26kW HGL – Heating from Ground Loops



70kW HGL Terra Max with Solar and Bore Holes

# Castles - Mey



## **District Heating**

- 37kW GSHP
- 1000 Ltr Hygenik
- 5 x Boreholes
- The Castle
- The Green House
- The Visitor Centre



# Schools – Bicton Primary



## Heating & Cooling

- 1,600m<sup>2</sup>
- 90 kW HGL
- 5,200m Trenches
- 1,500 Ltr Hygienik
- UFH Throughout
- Savings - £9,300 pa over oil

# IDM, New Hall 2008



## **IDM Energy – Latest Addition**

3 Terra Max 90

27 Boreholes to 150 m

6.000 m<sup>2</sup> Floor Area

Hot water for showers and WCs

Savings per annum over Oil: **€ 23,000**

7 Year Payback



# Quality – Guarantees



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- Microgeneration Certification Scheme Accreditation for small scale solutions up to 45kW
- Energy Technology Product List for Carbon Trust and other grants



COP – 3.8 at A2W35  
Input of 2.1kW electricity  
Output of 8kW of heat  
 $8/2.1 = \text{COP of } 3.8$

# Results



Ms Ediel Walsh  
Invisible Heating Systems  
iHS Design Centre  
Marefield Ind Estate  
Ullapool  
Ross-shire  
IV26 2SR

ETL Product Administration  
Carbon Trust  
The Green Building  
Fleet Avenue  
Newell International Business Centre  
Bilston B15 1QZ  
Tel: +44 (0)121 719 1026  
Email: [ETL@carbontrust.co.uk](mailto:ETL@carbontrust.co.uk)

19 January 2010

Dear Ms Walsh

## THE ENHANCED CAPITAL ALLOWANCE SCHEME NOTIFICATION OF TEST RESULTS

I am writing to you as the Head of ECA to the Government's Enhanced Capital Allowance (ECA) scheme for energy-saving technologies. The Carbon Trust manages the Energy Technology List (ETL) and promotes the ECA scheme on behalf of Government.

You have recently participated in the 2009/2010 Ground Source Brine to Water Heat Pump testing programme and I am writing to inform you of the results of the testing, carried out by BSRIA Ltd. For your information, the test results are documented in the following table.

### Defined Product Features:

Sub-Technology	ETPL Product ID	Product/Model	Serial No	Manufacturer	Declared Capacity	Declared COP
Ground source: brine to water	34565	iDW Terra HGL 15 S	285847	Invisible Heating Systems	14.01	4.19

### ETL Qualifying Criteria:

Heating Mode COP	Cooling mode EER
≥4.00	N/A

The Carbon Trust  
8th Floor, 5 New Street Square, London EC4A 3DF  
T: +44 (0)20 7175 2500 F: +44 (0)20 7173 7000 [www.carbontrust.co.uk](http://www.carbontrust.co.uk)  
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### Test Result:

Minimum Allowable Test Efficiency Allowing for Test Uncertainties %	Measured Capacity (KW)	Measured COP	Test Result
3.796	14.237	4.75	Pass

I am pleased to inform you that the results indicate that the product supplied (Model: iDW Terra HGL 15 S, Serial No: 285847) passed the test and, therefore, meets the ECA pass criteria for inclusion on the Energy Technology List. A copy of the test report is enclosed. The original and official copy is held by the Carbon Trust.

Thank you for your co-operation with the testing programme.

Yours sincerely

**P** Paul Huggins  
Head of ECA

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# Planning Essentials - Terra Opt



- Prompts for relevant data
- Analyses all parameters
  - Weather in the region
  - Ground conditions
  - Heat Losses & Heat Gains
  - Electric price tariffs
  - Solar Input
  - Alternative energy supply
- Provides optimal solutions
- Reports alternative fuel option analyses

# Planning Accurately



# Incentives towards Sustainability



# New FIT Tariffs - PV

- Went live 1<sup>st</sup> April 2010
- Effectively taking from fossil fuels, giving to renewables
- Pay back periods significantly reduced
  - Calculated at 5% to 8% Return
- Payments c. 36 pence per kW for 25 years
- Retrospective to July 09
- Index linked

# FIT Tariffs – PV Payments

	Pence/kwh Year 1	Pence/kwh Year 2	Pence/kwh Year 3	Duration (Years)
≤4 kW (new build)	36.1	36.1	33.0	25
≤4 kW (retrofit)	41.3	41.3	37.8	25
>4-10kW	36.1	36.1	33.0	25
>10 - 100kW	31.4	31.4	28.7	25
>100kW - 5MW	29.3	29.3	26.8	25
Standalone system	29.3	29.3	26.8	25

# Incentivising Heat – Why?

- UK target of 20% reduction in CO2 by 2020
- UK target of 15% of all energy by renewables by 2020
- UK target for heat by renewables of 12% by 2020
- EU Penalties Are Severe
  
- UK currently achieves 1% of heating from Renewables
  
- Various incentives being instigated by government
- Renewable Heat Incentive
- Warm Homes Green Loans

# Renewable Heat Incentive

- RHI in Consultation - due to go live April 2011
- Payment for kWh of energy produced (deemed)
- To bridge gap between cost of renewables v traditional
- Investment rate of return of 12% across all technologies
- With exception of solar thermal being r.o.r. of 6%
- Open to all types of organisations including LA's
- Installations eligible from July 2009 onwards
- Products must be MCS accredited
- Installation by a MCS accredited company
- Greater ROR than FITs to reflect complexity of installations

# Renewable Heat Incentive

Technology	Scale	Pence/kWh	Duration (Years)
Ground source heat pumps	Up to 45kW	7	23
Air source heat pumps	Up to 45kW	7.5	18
Solar thermal	Up to 20kW	18	20
Biomass	Up to 45kW	9	15

# Small Business - Scotland



- Loans for SME's, Private Sector Landlords, NFP's, Charities
- For upgrading to renewables demonstrating operational savings
- From £1,000 to £100,000
- 0% Interest
- Managed by EST for Scottish Government
- All Heat Pumps, Solar Thermal, Solar PV etc.
- Paid back over 8 Years
  
- Carbon Trust offer similar loans UK wide

- Web based info:
  - [www.decc.gov.uk](http://www.decc.gov.uk)
  - <http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx>
  - [http://www.decc.gov.uk/en/content/cms/what\\_we\\_do/uk\\_supply/energy\\_mix/renewable/feedin\\_tariff/feedin\\_tariff.aspx](http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/feedin_tariff/feedin_tariff.aspx)
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# IHS

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Superbly engineered, tailor-designed heating, cooling, hot water and energy systems



Thank You

