



An Roinn Comhshaoil,
Aeráide agus Cumarsáide
Department of the Environment,
Climate and Communications



Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

Shallow geothermal energy “the heat beneath our feet”

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Geological Survey Ireland

AgroFossilFree (AFF) Heat Pumps in Agriculture – Workshop
Teagasc Ashtown Food Research Centre
22nd February 2022

With acknowledgements to:



**Geothermal
Association
of Ireland**

Using the heat energy stored in the ground



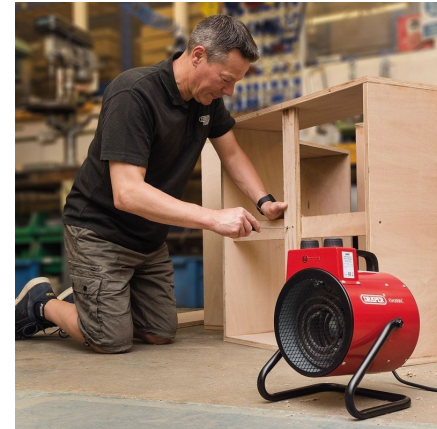
- Direct use of the shallowest geothermal energy is limited
 - Ground temperatures a steady 9-15°C
 - warmest Irish thermal springs have temperatures just over 20°C
- can drill deeper (to 1-2 km)
- or... use some form of temperature amplification to make our shallow geothermal resource useful
- One exists... and it is called the heat pump



A heat pump....



- uses organised energy (mechanical power driven by electricity) to **refine** and **condense** disorganised energy (low temperature heat)
- off the shelf from a good manufacturer can actually produce up to about SIX units of heat from one unit of organised energy (more usually 3 ½ - 4)
 - Known as coefficient of performance (COP)
 - a gas or oil powered boiler can never yield more than ONE unit of heat from ONE unit of organised energy
- is available with outputs from 2 kW to about 2,000 kW
- produces cooling at the same time as it makes heat
- becomes a greener appliance each time more renewable energy is added to the electricity grid
 - operated on renewable electricity, a heat pump is a zero-emissions appliance

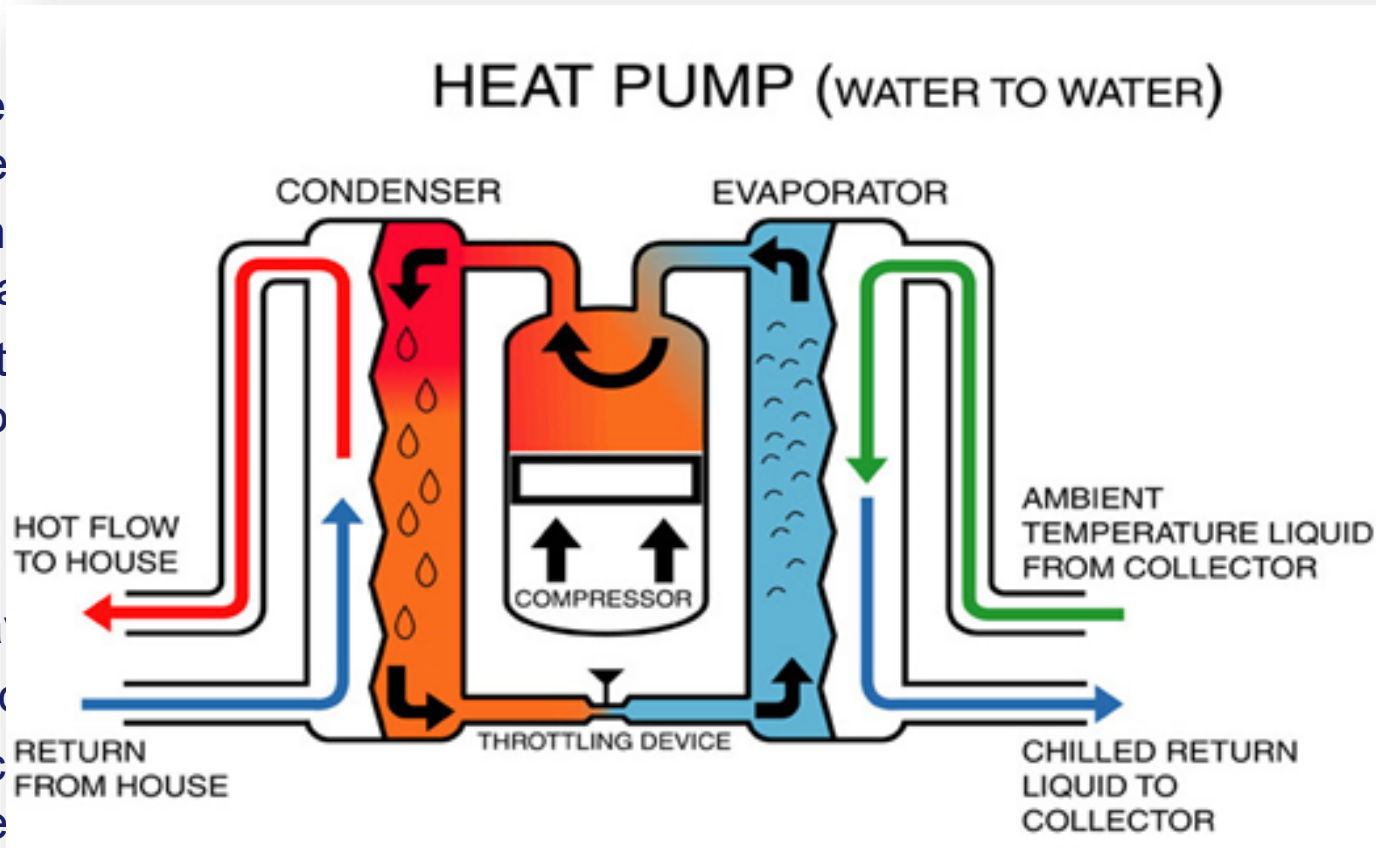


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- With thanks to Paul Sikora, EcoCute

A heat pump....



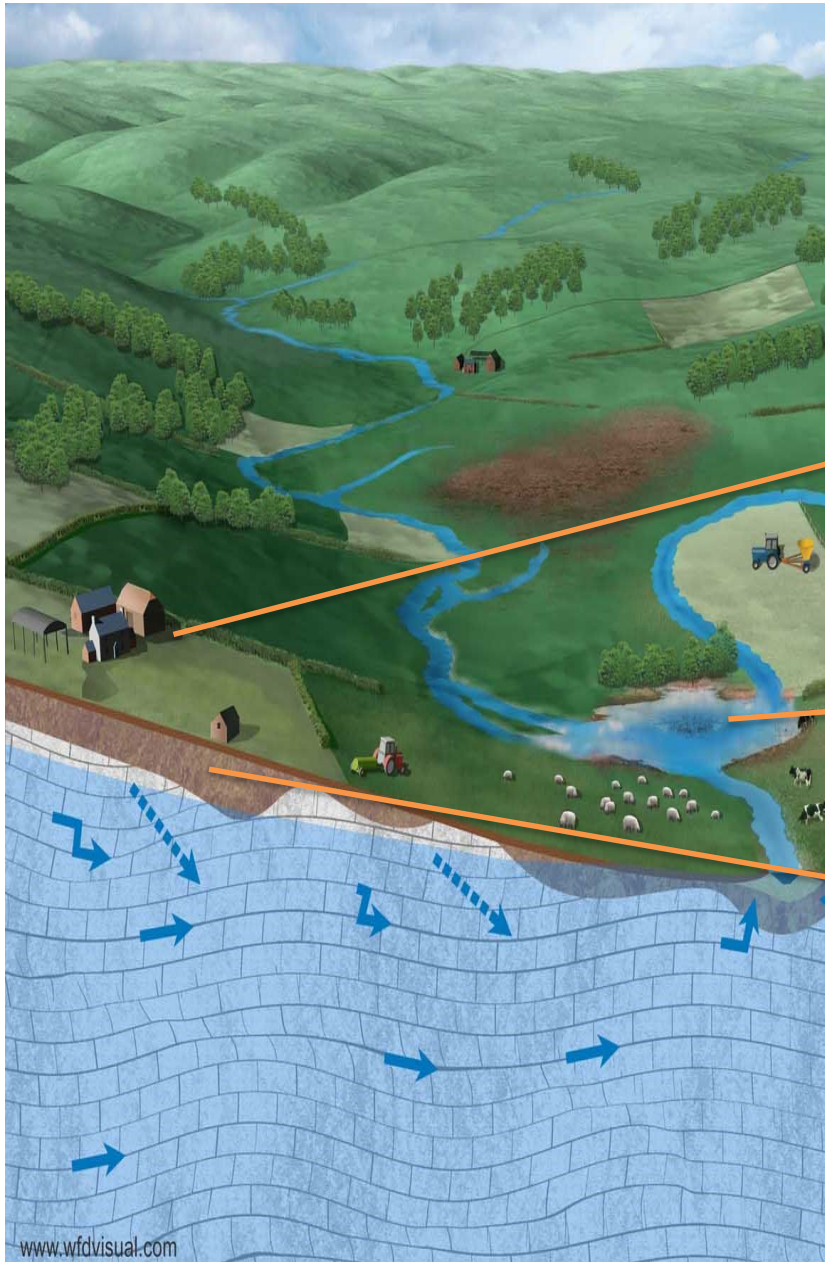
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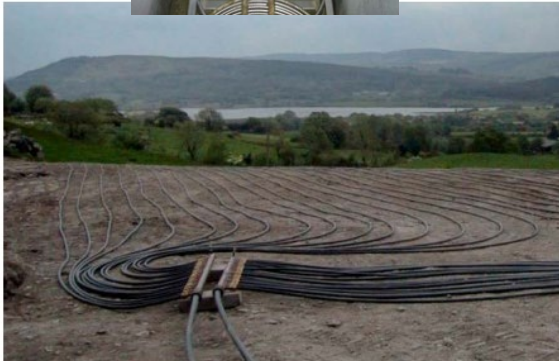
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A heat pump.... can take energy from



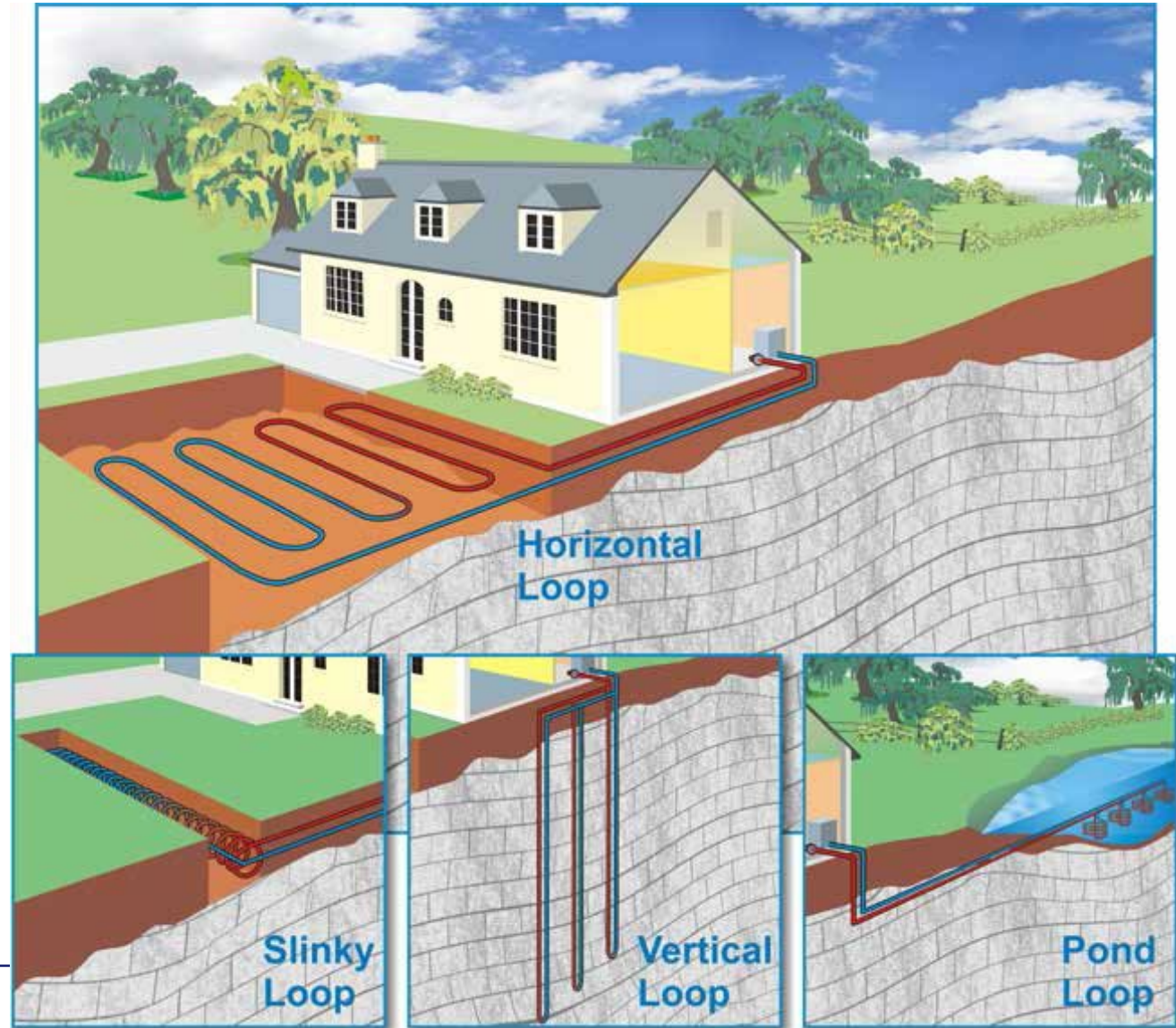
A heat pump.... can take energy from



Ground source heat collector types



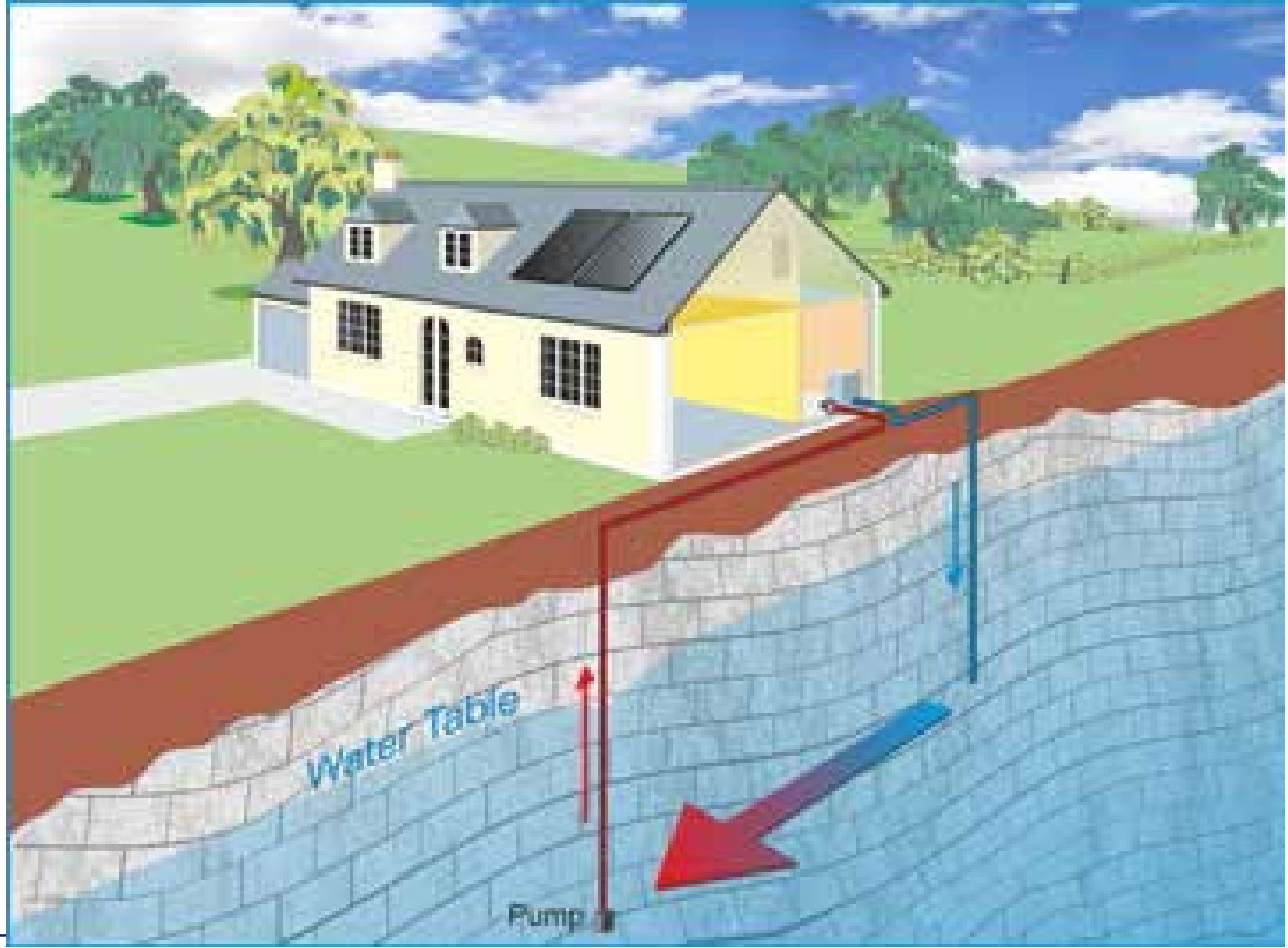
Closed loop



Ground source heat collector types



Open loop







Ground source

Air source



Large Horizontal Collectors



- Closed Loop Heating and Cooling
- Horizontal array area – 2,500m²
- 39 circuits at 150 m each
- Size of heat pump – 1 * 160kW
- Hours of operation – 3,640 hours/year
- Energy Savings **€20-30K**
- CO₂ Savings – 30.8 tonnes / year
- Improved level of comfort for visitors and staff
- Waste heat from cooling provides heat to other spaces in the building.

Open Loop Collector

- Use existing aquifers to pump water
- Typically best used in heating & cooling applications
- Most suited for larger systems
- Library Floor area – 2,300m²
- Heating and cooling mode with use of grey water
- Cost per annum vs boiler & chiller - €20-30K
- Reduction in tonnes of CO₂ per annum: 256



Closed Loop Vertical Collectors

- Suitable in all locations in Ireland
- Use of a borehole and closed loop pipe with bring or water
- Design of the ground loop is extremely important
- IKEA Ballymun Dublin
- 1.5 MW capacity for both heating & cooling
- 150 bores 120m deep – A total of 18,000 metres of drilling
- 65% annual reduction in carbon emissions
- borehole drilling cost per metre: €65-€70



Typical system costs



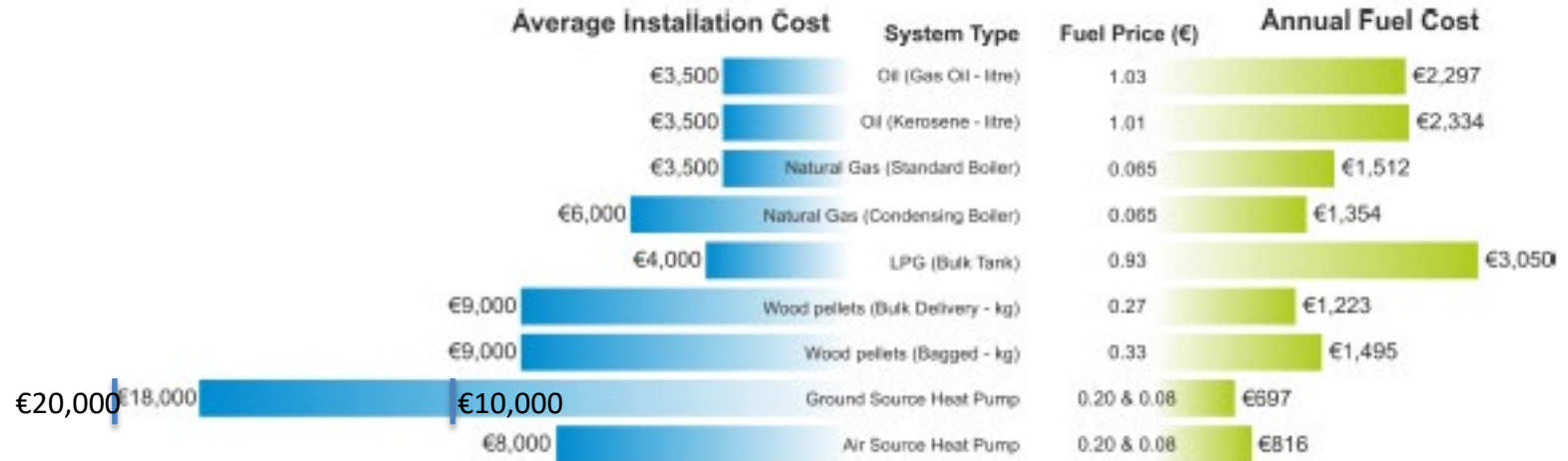
Assumptions:

- 4 bedroom detached house with 200 m² under floor heating
 - *Drilling 1 No. 100m borehole at €35 p/m rate, airlifting, supply and install of casing and down hole pump.
 - **Based on estimate of drilling 2 No. 100m borehole €25 p/m, supply and inject thermally enhanced grout €15 p/m, installation and pressure testing of collector pipe. Cost includes €2,500 for geothermal collector pipe and materials.

Description	Details	Cost Range (€)		
		Open loop	Closed loop: vertical	Closed loop: horizontal
Heat Pump	8kW to 12kW	8,000 - 11,000	8,000 - 11,000	8,000 - 11,000
	Borehole drilling & completion, Materials & Installation	6,500*	10,500**	
	Closed Loop - Horizontal (incl. Materials & Installation: Excavation)			3,500
System Maintenance	Annual Maintenance Cost	250	150	150
	Estimated Total (ex VAT)	€12,500 - €14,500	€18,950 - €21,950	€10,650 - €14,650

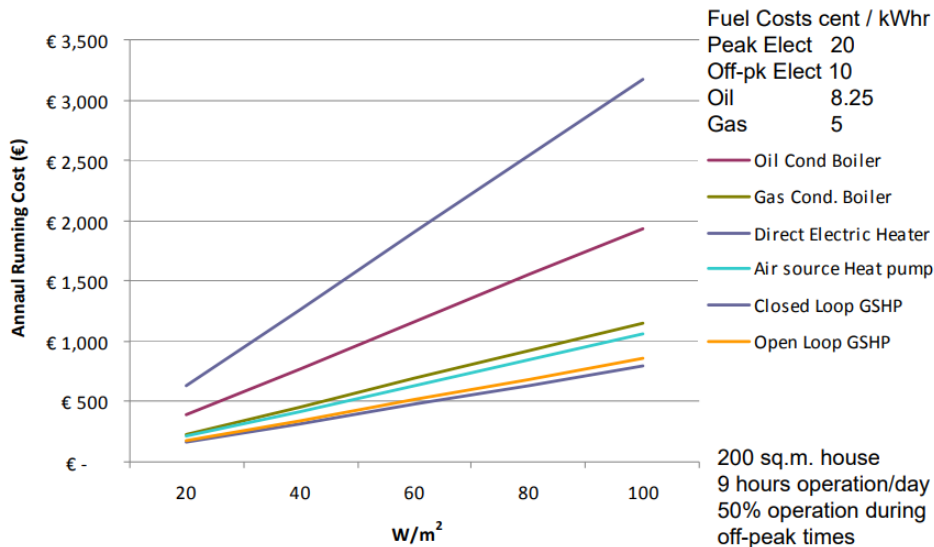
(source: average costs obtained from installer survey – 2012)

Compared to other technologies



SEAI online calculator 2013

Annual Running Cost V's Heat Load

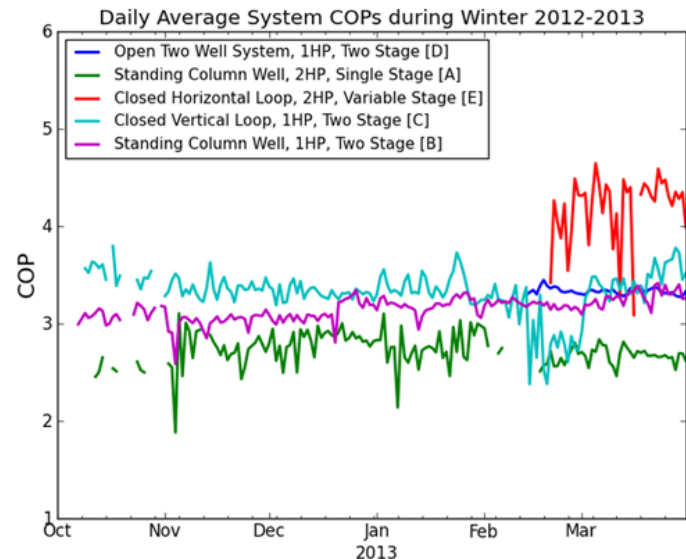
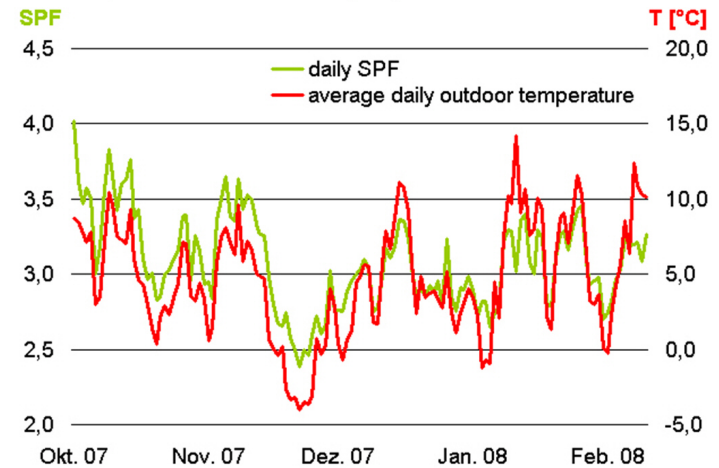


Advantages & disadvantages of GSHPs

Advantages

- Can be installed in all ground types
 - All geologies suited to at least one collector type
- More efficient than air source heat pumps, particularly in cold weather
 - Lower running costs
- Very little noise
- No visual impact, no planning objections
- Long-lasting components –
 - Heat pump up to 25 years
 - Collector up to 100 years

SPF in conjunction with outdoor temperature (daily)
An example of air-to-water heat pump



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Disadvantages

- Higher set-up costs than air source
- Installation of the collector can be disruptive

Ground source heating & cooling suitability maps

<https://www.gsi.ie/en-ie/data-and-maps/Pages/Geoenergy.aspx>



Geological Survey Ireland Spatial Resources

Geological Survey Ireland, Department of Communications, Climate Action & Environment

All Data Groundwater **Geothermal** Quaternary GeoUrban Geological Heritage Breifne Geotechnical Landslides Tellus APM JIBS INFOMAR

Geothermal Suitability

View in full screen

Ground source heat energy, sometimes called shallow geothermal energy, can be collected from the ground and boosted with heat pumps. This can yield up to four times as much energy as is used to collect it, giving 'four for the price of one' in energy terms. Heat energy can be harnessed, or 'collected', using different types of collector systems:

- Closed loop collectors are systems where heat is extracted from the ground (or cooling is gained) by pumping a heat exchange fluid through closed pipes within the ground. The pipes can be installed borehole(s) (vertical closed loop) or laid out horizontally (horizontal closed loop).

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Layer List

Operational layers

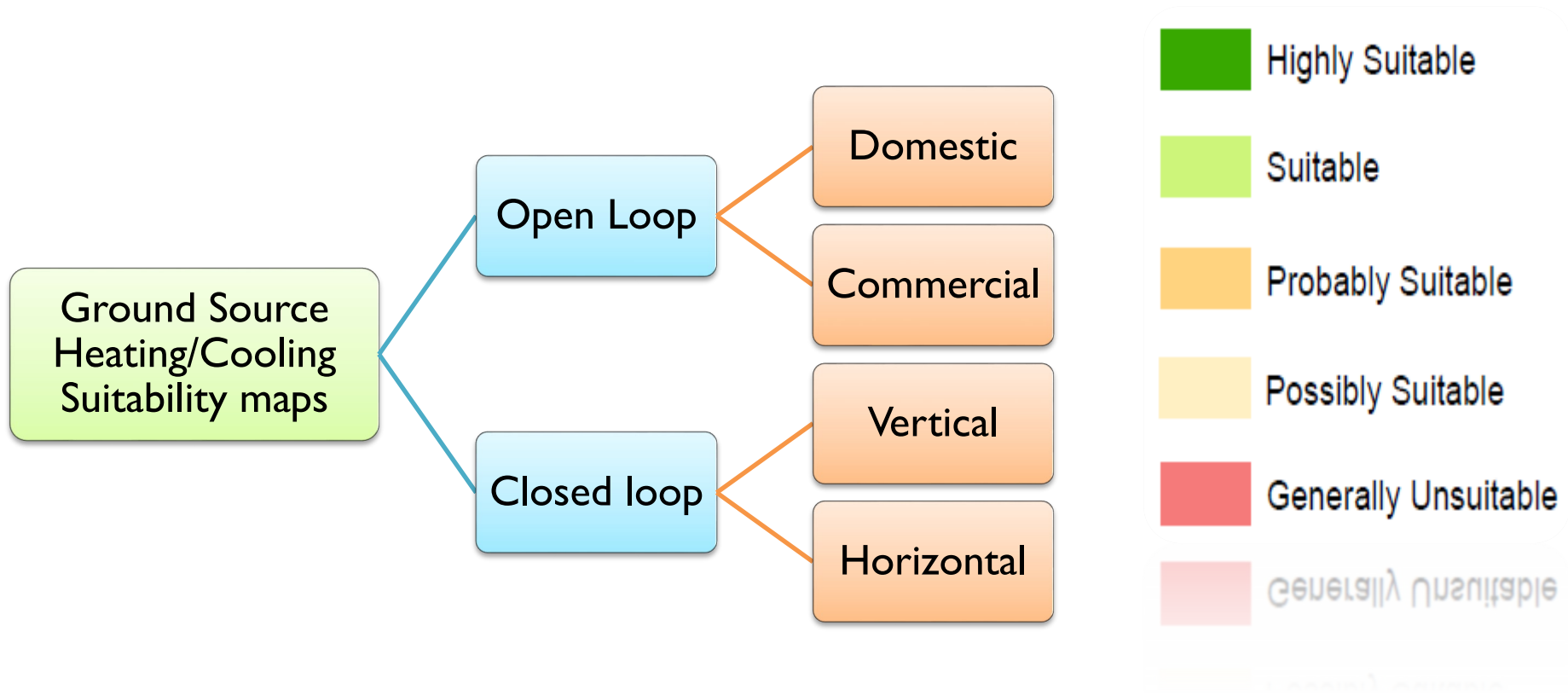
- Vertical Closed Loop Suitability
- Vertical closed loop suitability map
- Open Loop Domestic Suitability
- Open Loop Commercial Suitability

Legend:

- Highly Suitable
- Suitable
- Probably Suitable (unless proved otherwise/site assessment required)
- Possibly Suitable (site assessment required)
- Generally Unsuitable (site assessment required)
- Made Ground: site-specific desk study required
- Water

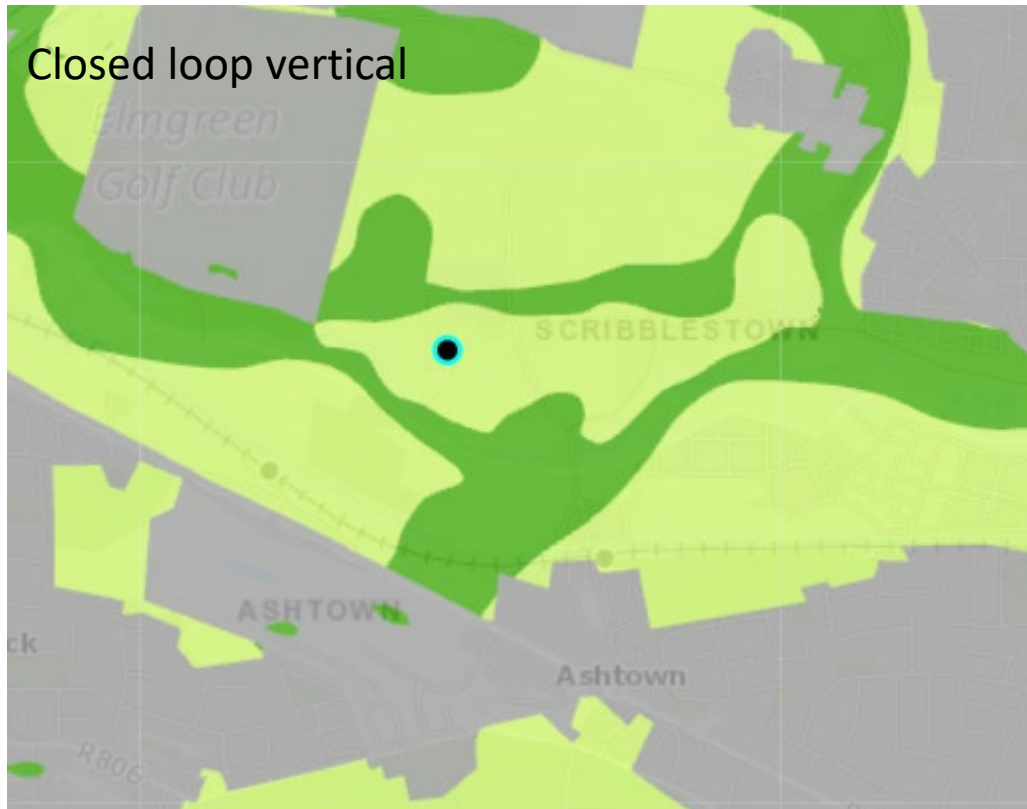
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Ground source heating & cooling suitability maps

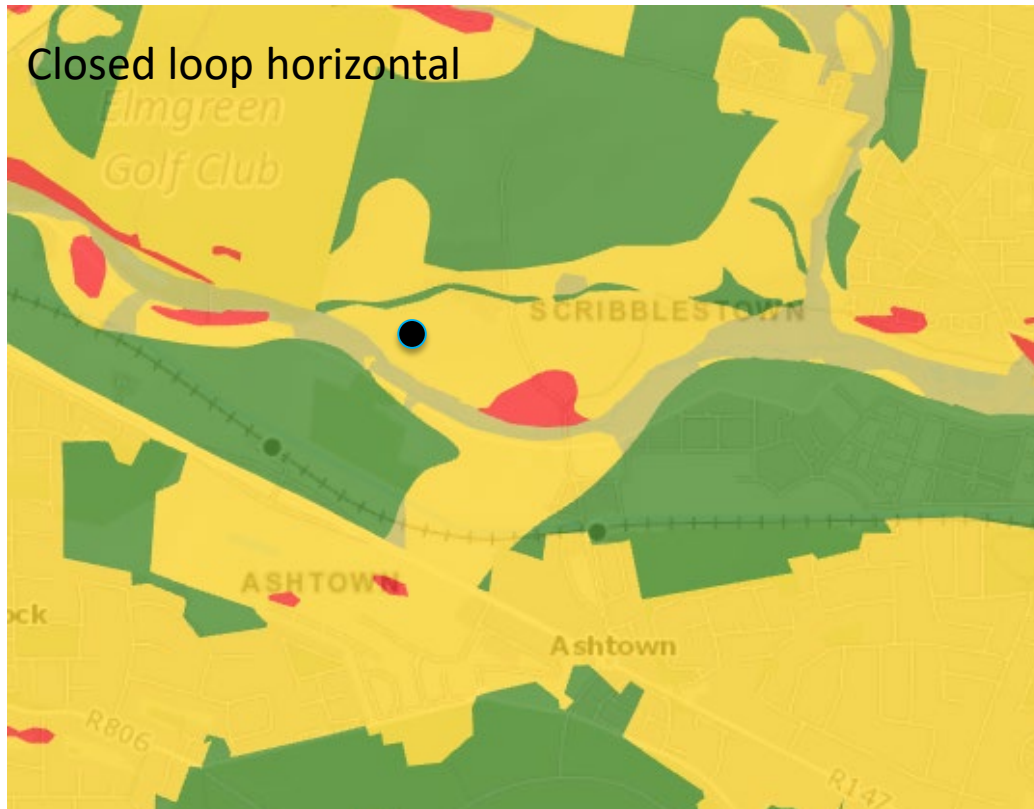
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Ground source heating & cooling suitability maps



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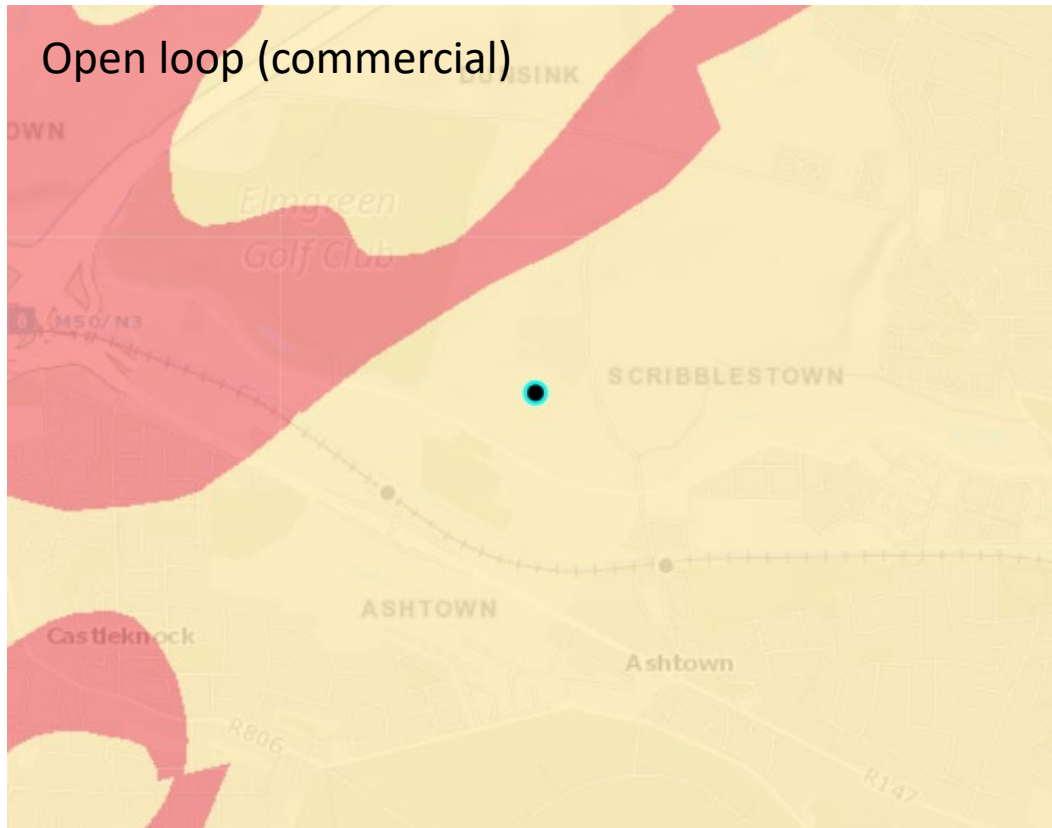


Source: GSI Geoenergy

Ground source heating & cooling suitability maps



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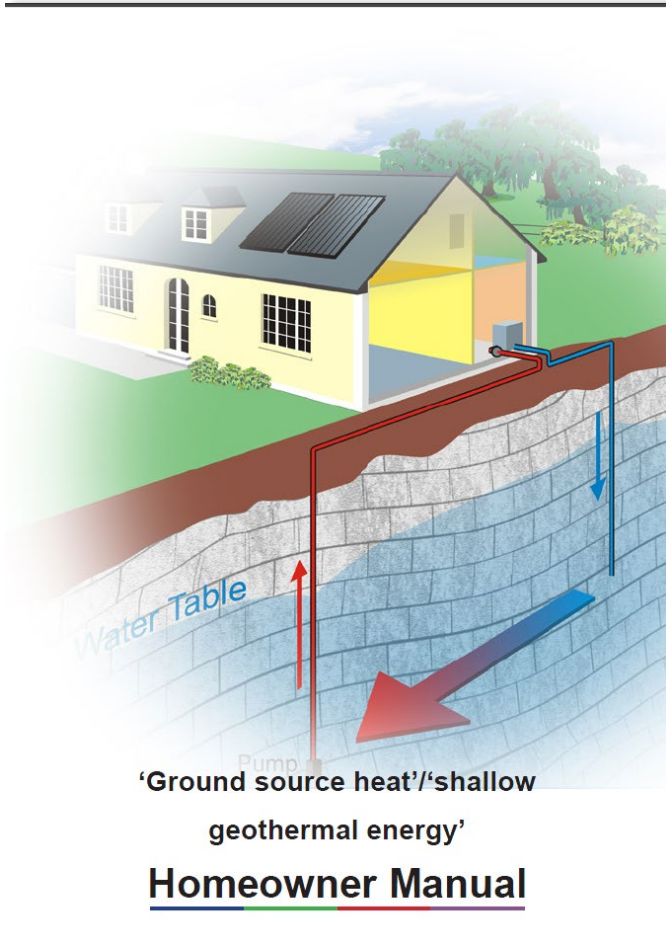
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Summary



- There is a ground source heating or cooling solution for nearly every location in Ireland
 - Deciding whether to use air-source or ground-source heat pumps will depend on a number of factors, such as:
 - Initial cost vs efficiency savings
 - Site considerations – size, noise & visuals & planning
 - Heating demand – scaling
 - Location within the country – coastal vs inland, other renewables, natural gas
 - preference
 - There is information to help make a decision on ground source, air source or alternative renewables
 - If electricity powering HP is from wind, then zero emissions heating
-

Where to find out more



- Basic considerations of site & cost
- Guidance on best system
- Illustrates principles of GSHPs
- Shows installations

www.gsi.ie

www.seai.ie

www.geothermalassociation.ie

www.hpa.ie

