



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”

Taly Hunter Williams
Geological Survey Ireland

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

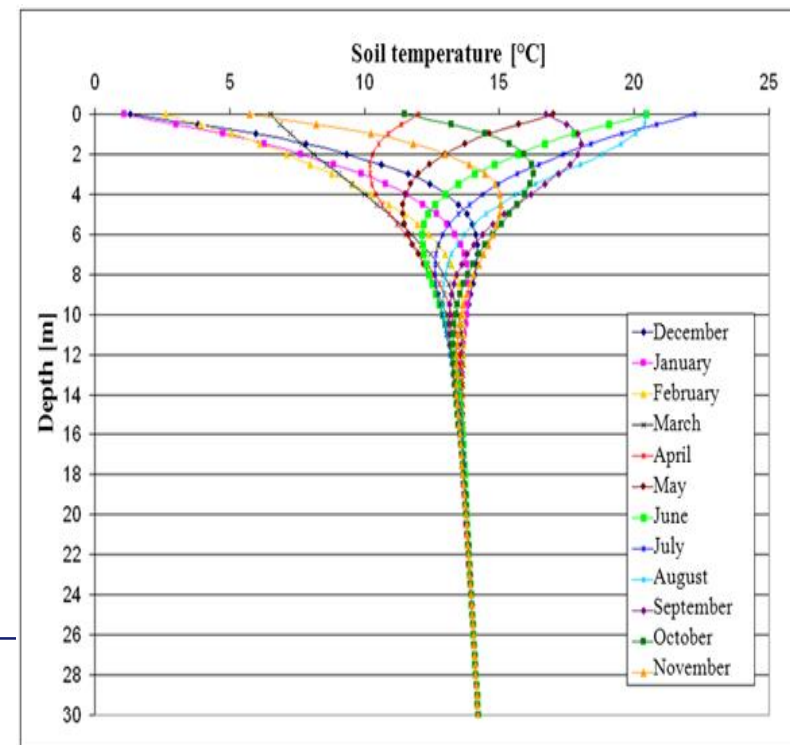
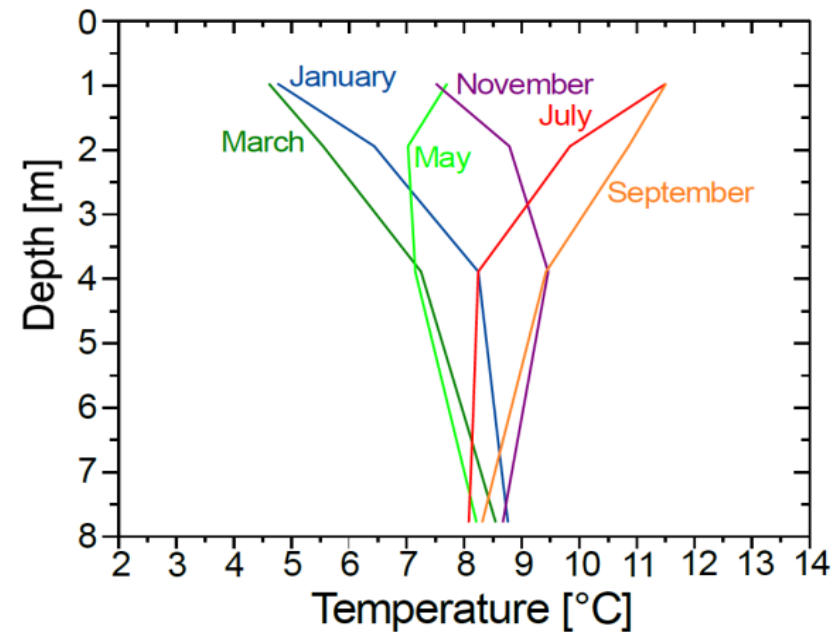
With acknowledgements to:



**Geothermal
Association
of Ireland**

Shallow geothermal energy – heat stored in the ground

- Ground source heat energy available everywhere in Ireland
- Mainly solar heat stored in the ground
- Heat from deep within the earth
- Temperature stable within depths of a few metres
 - unaffected by seasonal variations



Using the heat energy stored in the ground



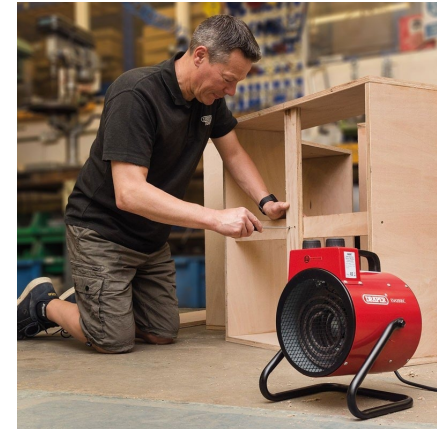
- Direct use of the shallowest geothermal energy is limited
 - Ground temperatures a steady 9-15°C
 - warmest Irish thermal springs have temperatures just over 20°C
- can drill deeper (to 1-2 km)
- or... use some form of temperature amplification to make our shallow geothermal resource useful
- One exists...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



A heat pump....



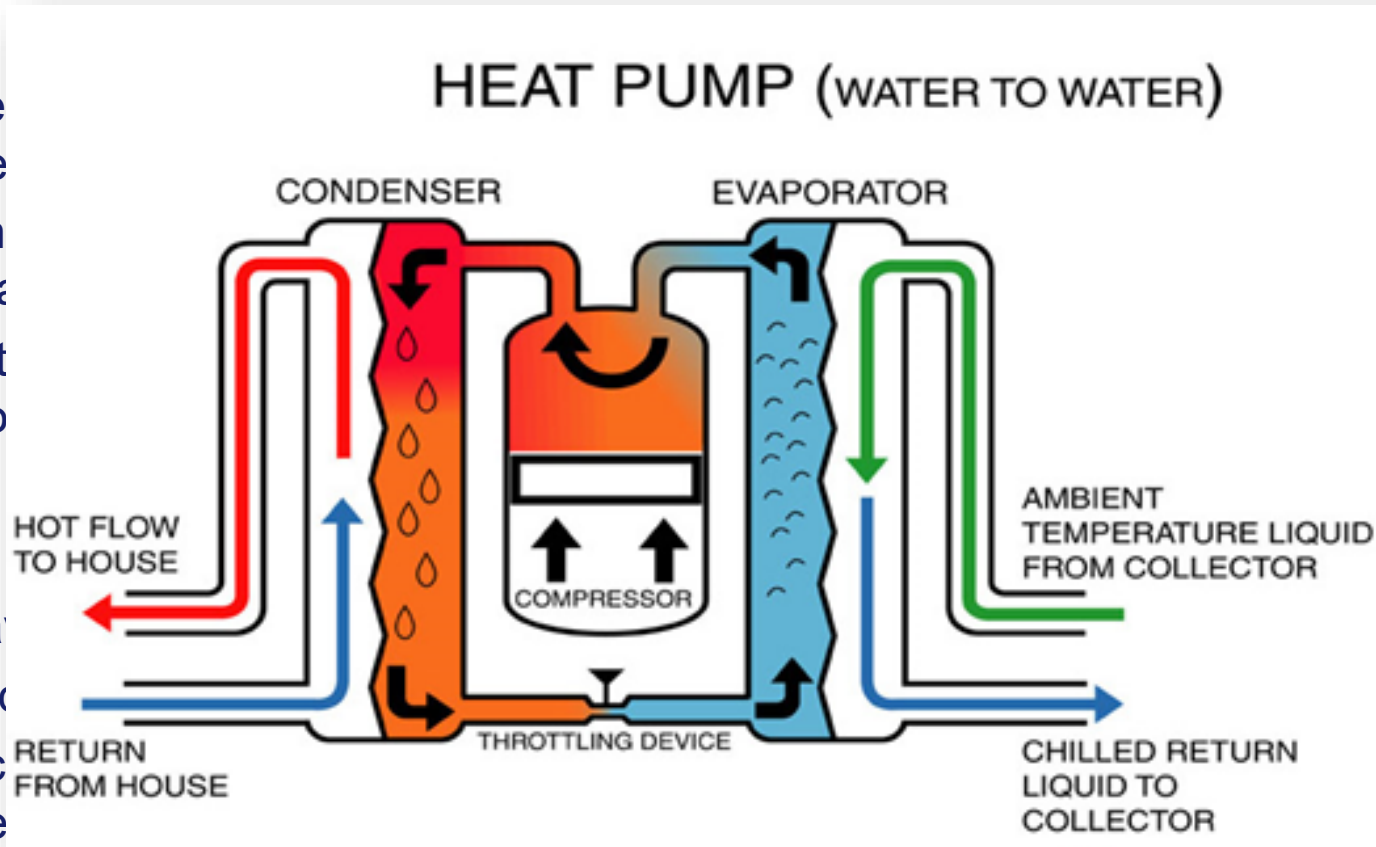
- uses organised energy (mechanical power driven by electricity) to **refine** and **condense** disorganised energy (low temperature heat)
- off the shelf from a good manufacturer can actually produce up to about SIX units of heat from one unit of organised energy (more usually 3 ½ - 4)
 - Known as coefficient 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



A heat pump....



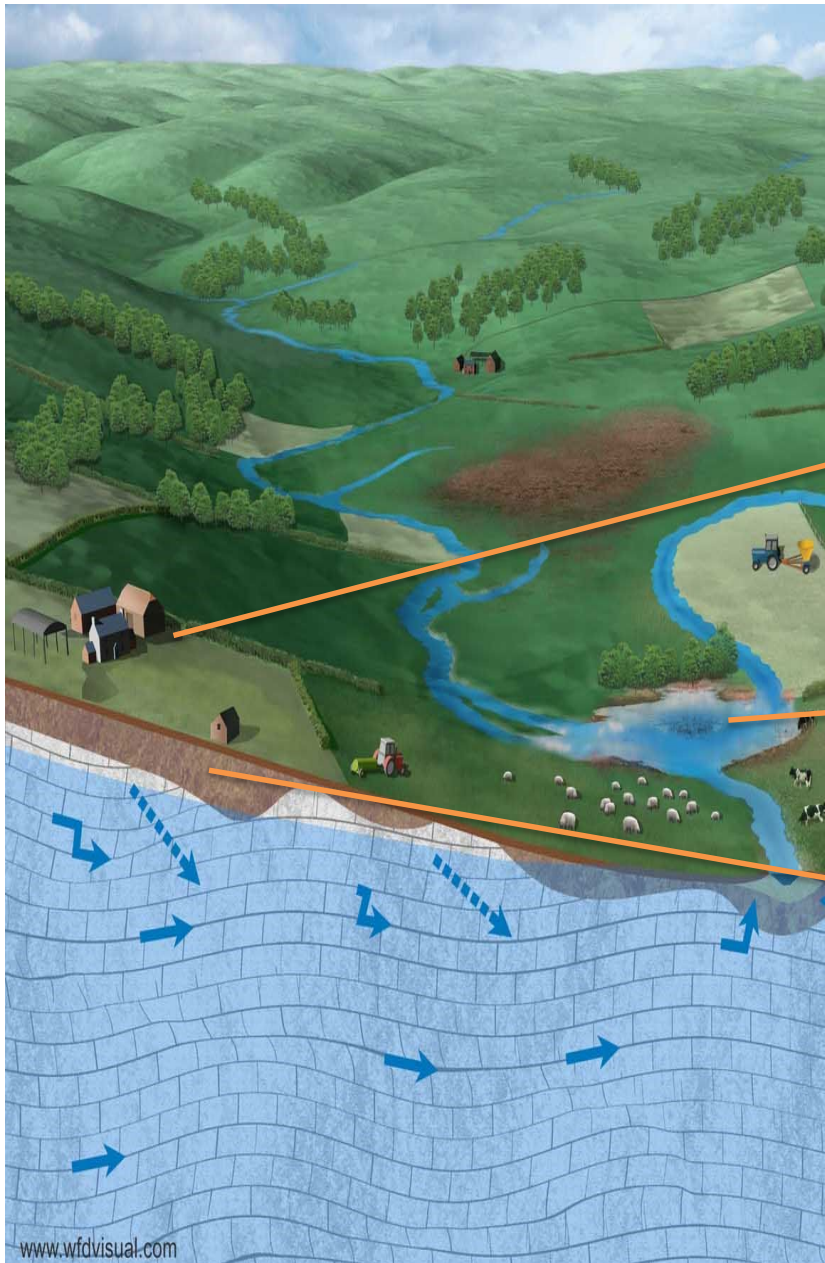
- use
- ene
- can
- an a
- off t
- abo
-
- is a
- proc
- bec
- ene



- operated on renewable electricity, a heat pump is a zero-emissions appliance

- With thanks to Paul Sikora, EcoCute

A heat pump.... can take energy from

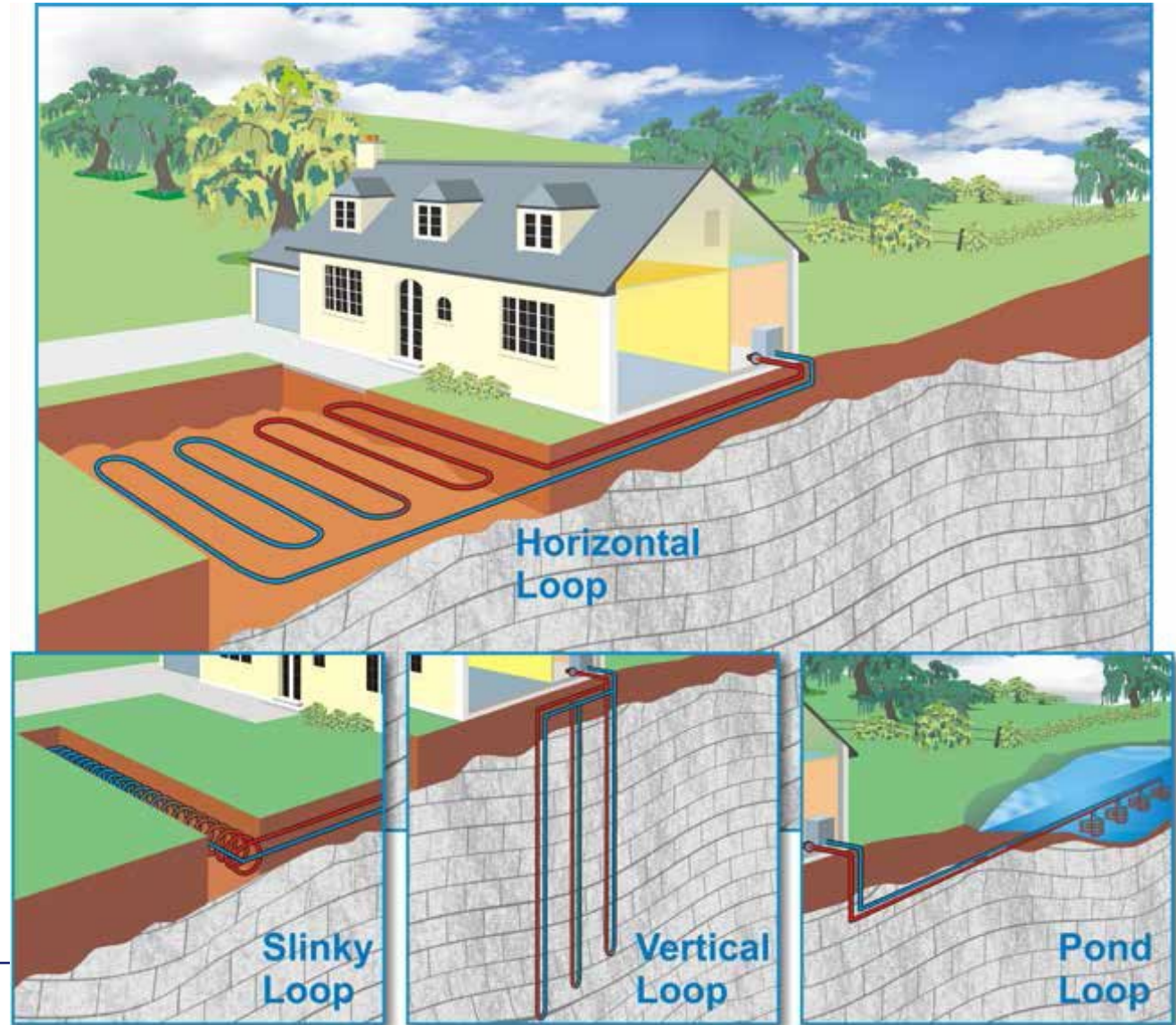


A heat pump.... can take energy from



Ground source heat collector types

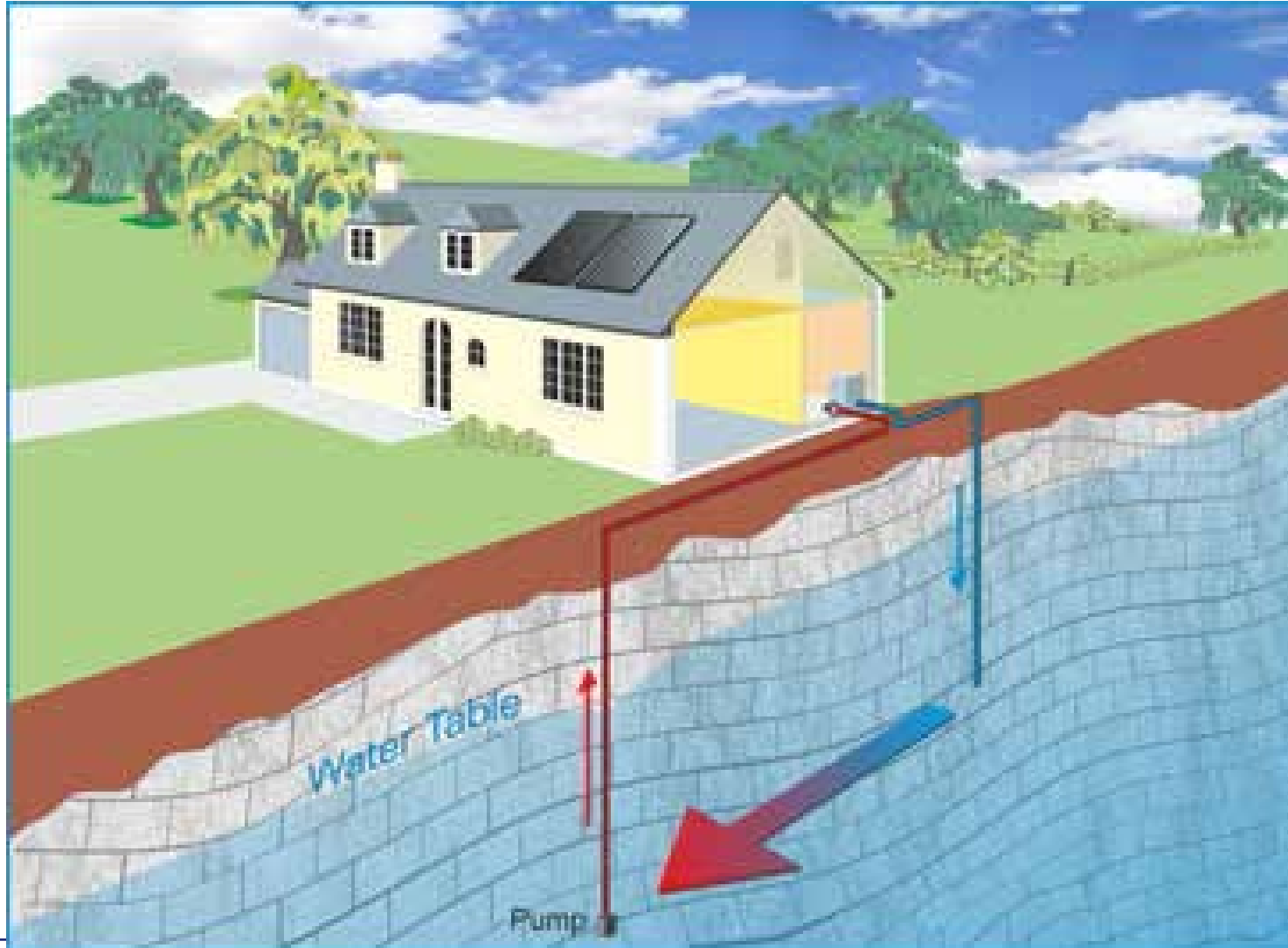
Closed loop



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

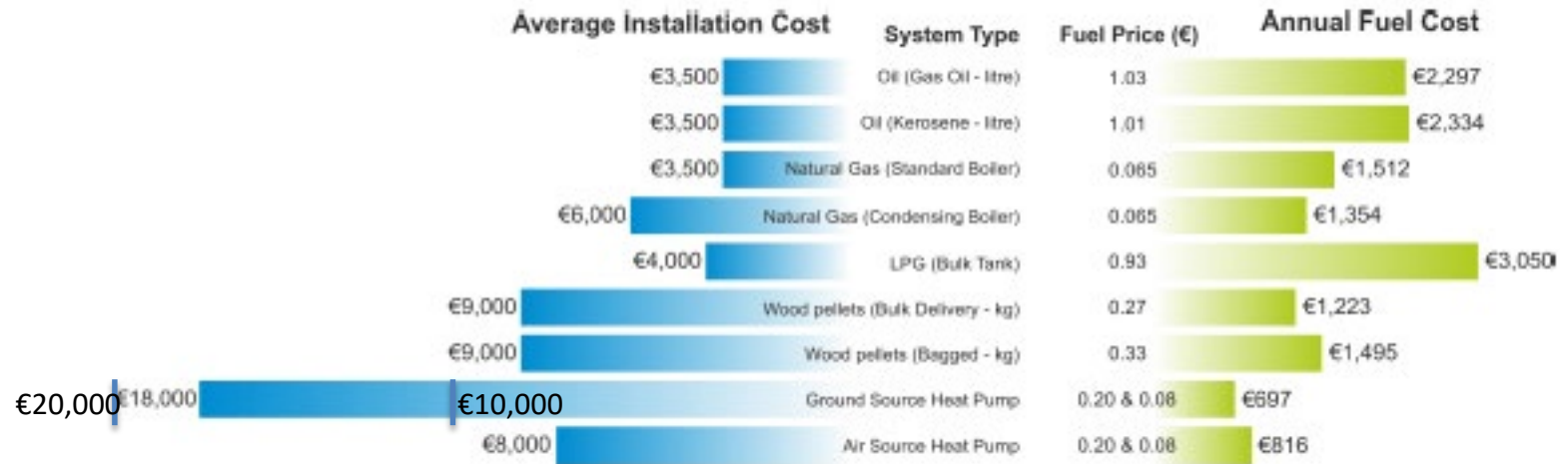
Assumptions:

- 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.

		Cost Range (€)		
Description	Details	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

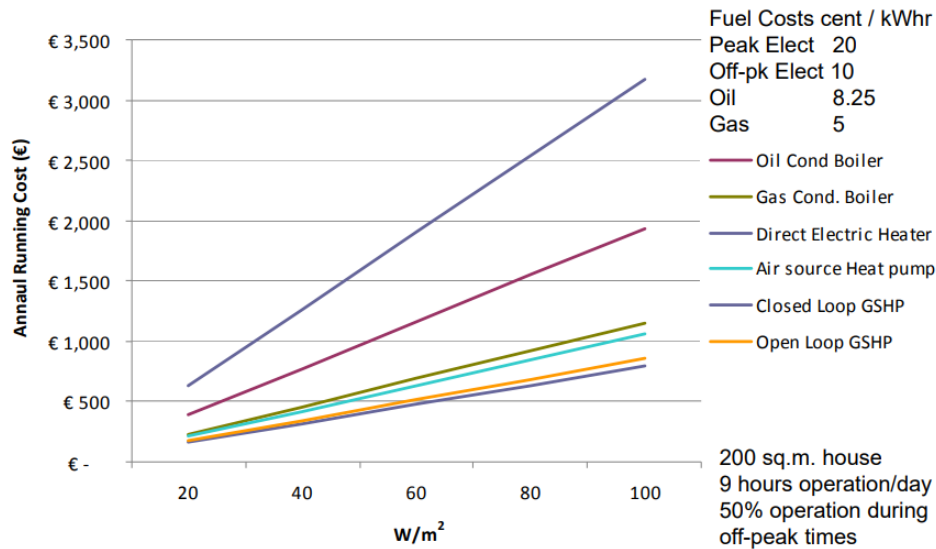
(source: average costs obtained from installer survey – 2012)

Compared to other technologies



SEAI online calculator 2013

Annual Running Cost V's Heat Load



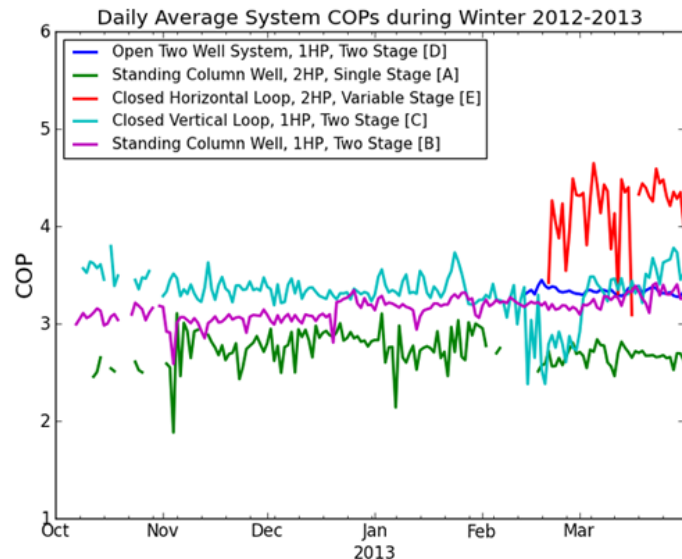
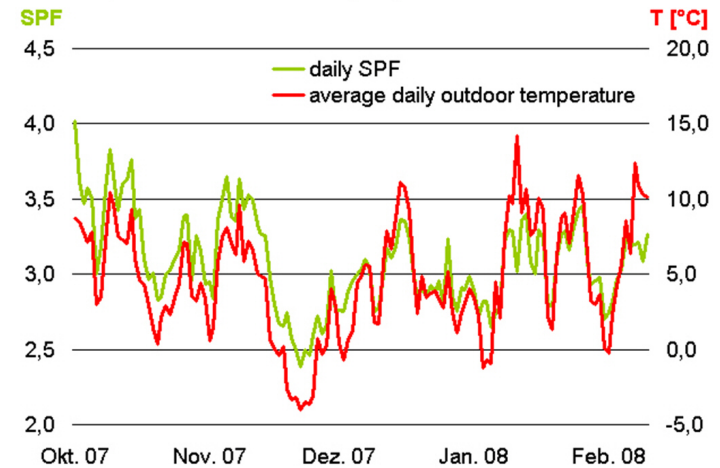
Advantages & disadvantages of GSHPs



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



Advantages & disadvantages of GSHPs



Advantages

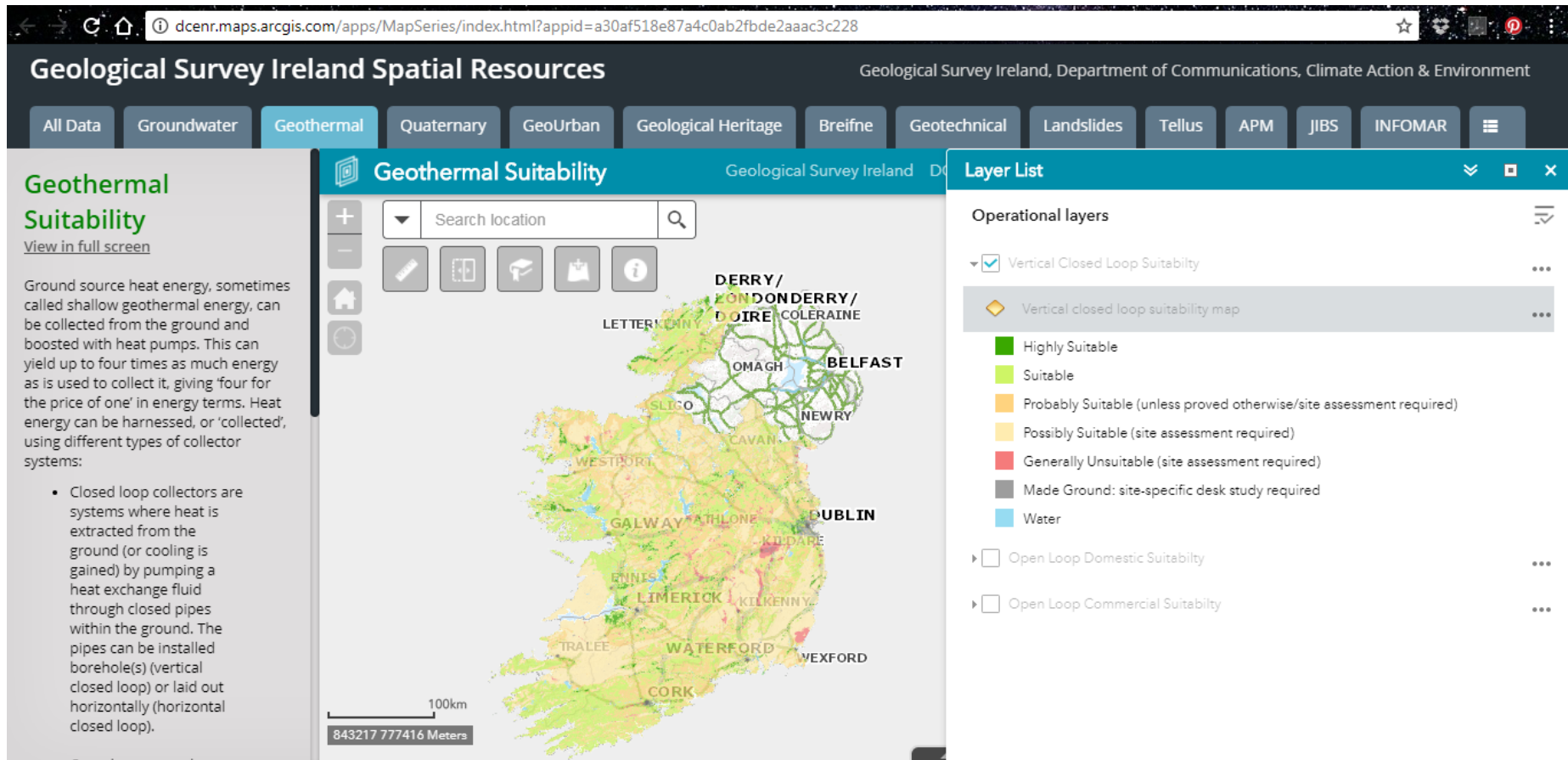
- Can be installed in all ground types
 - All geologies suited to at least one collector type
- More efficient than air source heat pumps, particularly in cold weather
 - Lower running costs
- Very little noise
- No visual impact, no planning objections
- Long-lasting components –
 - Heat pump up to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

Disadvantages

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

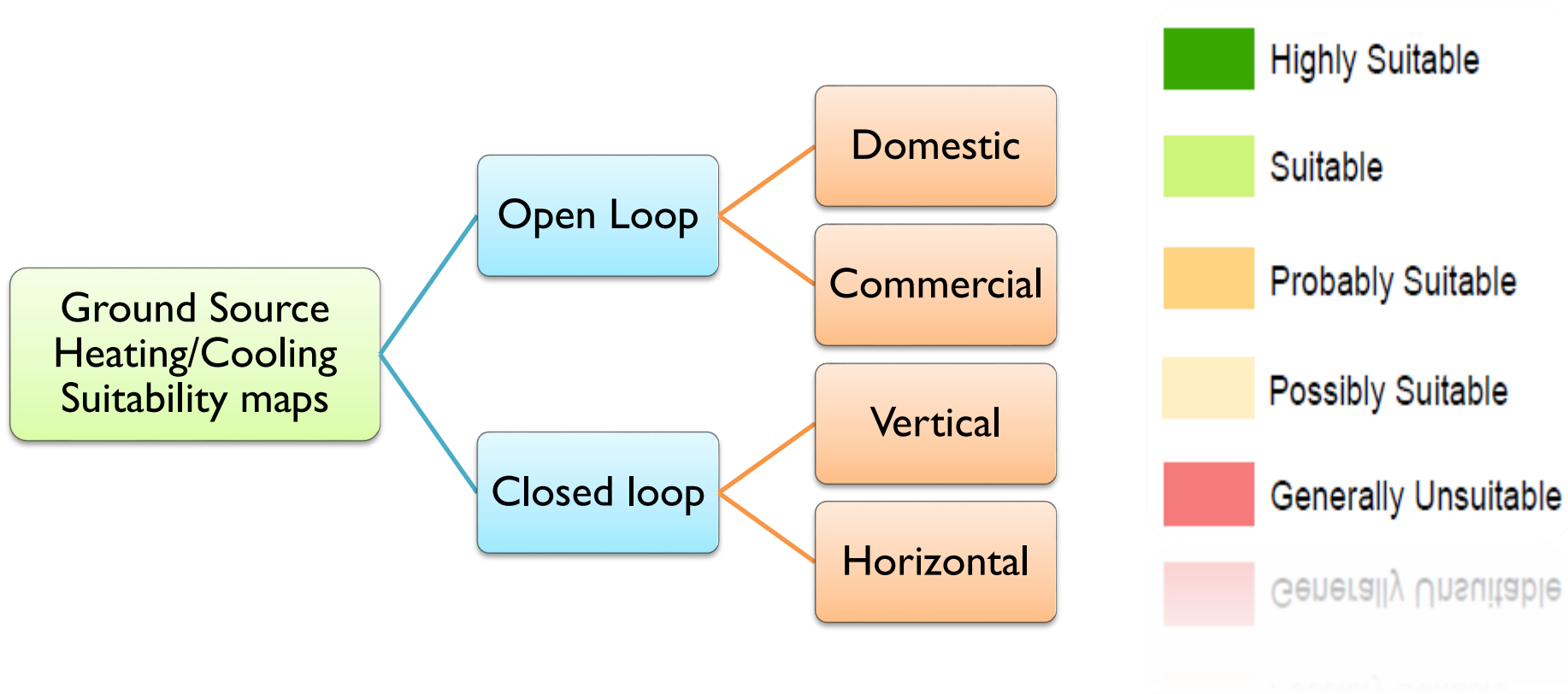
Ground source heating & cooling suitability maps

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



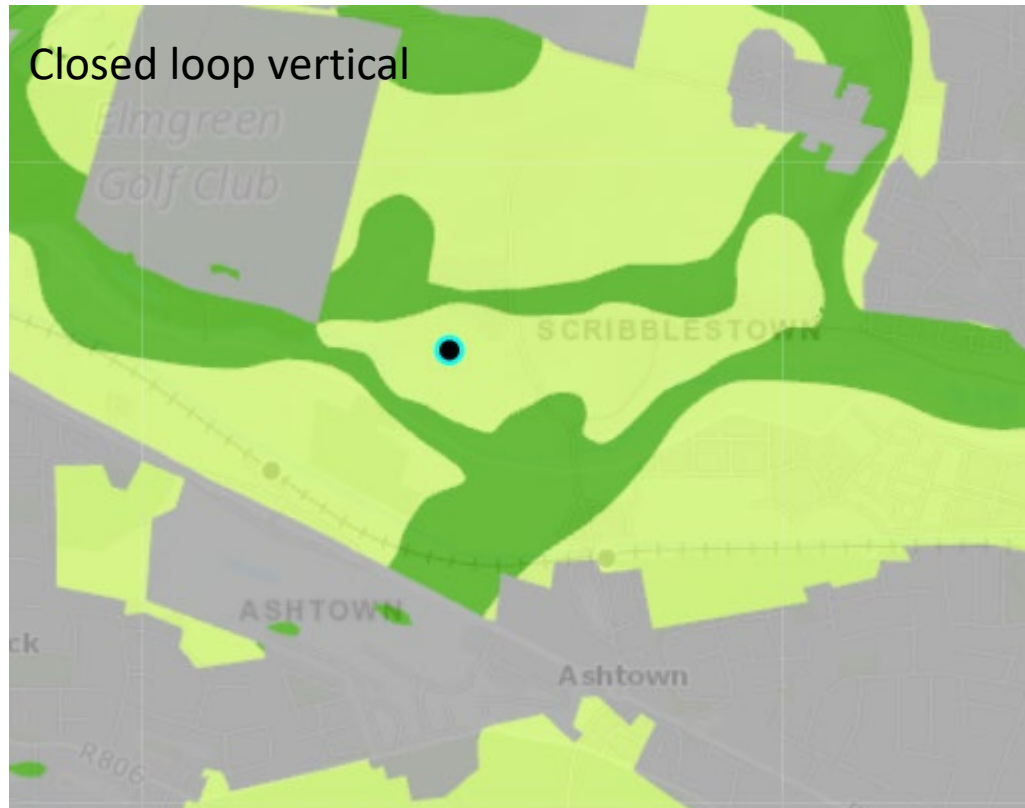
Ground source heating & cooling suitability maps

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



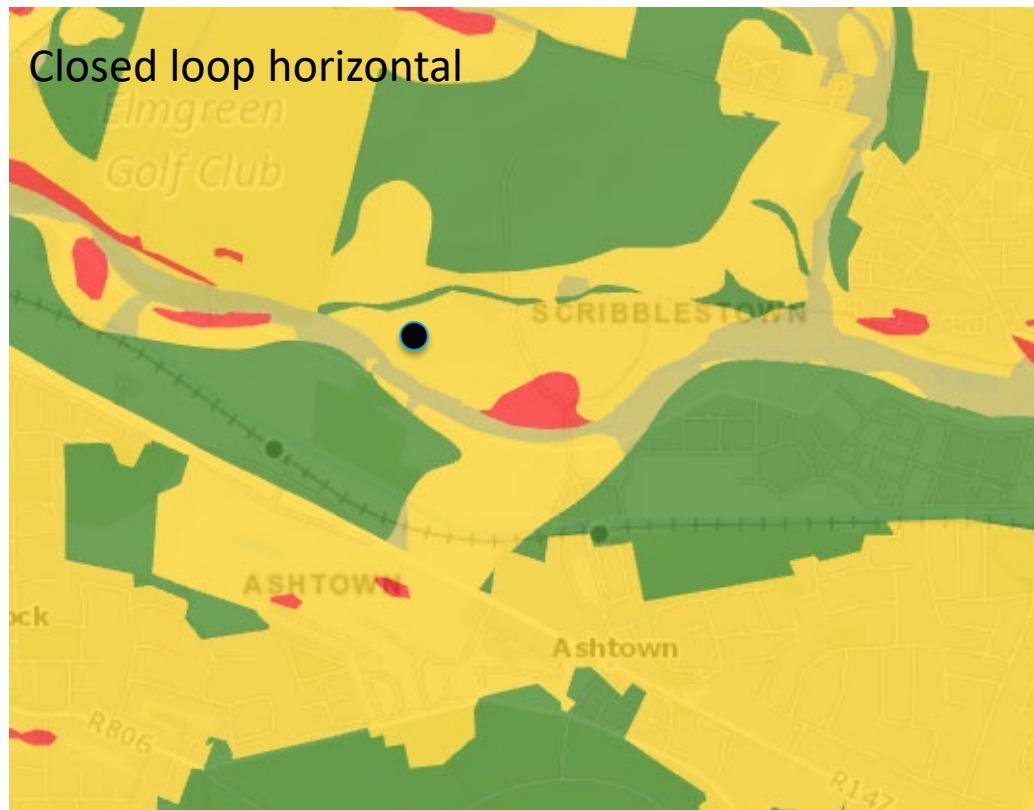
Ground source heating & cooling suitability maps

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



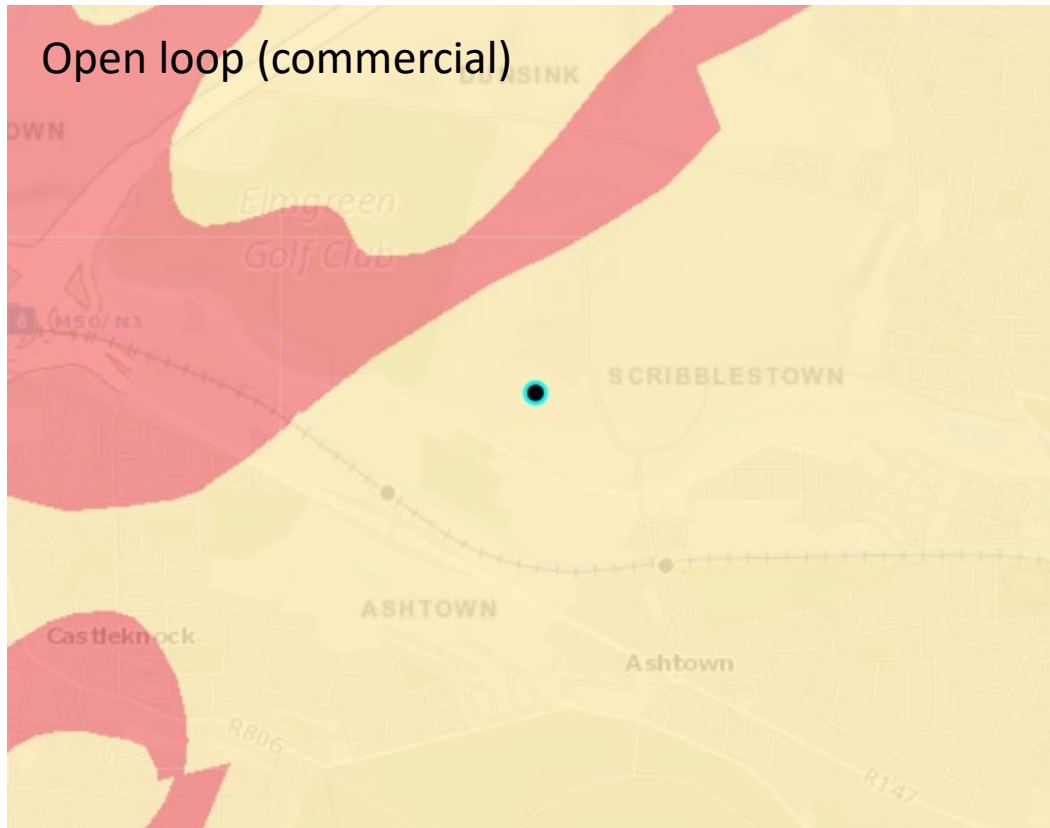
Ground source heating & cooling suitability maps

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



Ground source heating & cooling suitability maps

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



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

