[redacted]

Geothermal Consultation
Geoscience Policy Division
Department of the Environment, Climate and Communications
29-31 Adelaide Road
Dublin, D02 X285
Ireland

Friday, 25 February 2022

Re: Consultation Response on the Draft Policy Statement on Geothermal Energy for a Circular Economy

Dear GSDP,

Please find attached a response to the Draft Policy Statement on Geothermal Energy for a Circular Economy from Terra GeoServ Ltd (GeoServ).

GeoServ welcomes the development of the draft policy to this point and we hope that our input can further help inform the process and help develop a thriving and stainable geothermal sector in Ireland.

As part of this submission, GeoServ believes that the establishment of a Geothermal Energy Advisory Group to support the final policy drafting process and regulatory framework envisaged, is critical. This would ensure that the sector is provided with a platform for growth and development in the short term, as well as allowing geothermal to facilitate the achievement of Ireland energy and climate change commitments.

We look forward to having the opportunity to participate in the future phases of the consultation and being part of the GAC when formed.

Yours sincerely,

[redacted]

[redacted]

[redacted]

Geoserv

PUBLIC CONSULTATION RESPONSE

‘Draft Policy Statement on Geothermal Energy for a Circular Economy’

Department of the Environment, Climate and Communications

FEBRUARY 2022

DOCUMENT ISSUE SHEET

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Date	25 February 2022		

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Terra GeoServ Ltd (T/A GeoServ Solutions) is registered Ireland under Company Number 561043 with its Registered Office at: Unit 6 – Block B, Southern Cross Business Park, Boghall Road, Bray, Co. Wicklow A98 HR94, IRELAND.

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1 EXECUTIVE SUMMARY:

GeoServ welcomes the Department of the Environment, Climate & Communications (DECC) Draft policy statement on 'Geothermal Energy for a Circular Economy'. Based on the initial review of the Draft policy statement content, the following key point are being highlighted:

- The policy statement and associated AA, SEA and NIA need to consider all applications of geothermal energy solutions including large scale cooling, energy storage and other technologies such as geostructures;

- The proposed licensing process needs to support and promote the current growth of commercial building fabric heating and cooling which comprises the lion's share of the geothermal market in Ireland. This market is already under considerable pressure from competing heat pump technologies;

- The licensing system and associated regulatory framework should be based on energy usage (kWh or MWh) or energy exchanged with the ground and not based on installed capacity thresholds;

- In order to facilitate the development of a sustainable sector, all geothermal systems (from residential to industrial) should be registered with varying degree of complexity based on energy usage;

- The use of monitoring and system operational data should underpin the future planning and roll out of geothermal energy especially in urban areas by providing operators and system owners the security of the long term successful operation of geothermal systems;

- The engagement of stakeholders as part of the geothermal policy and regulatory framework development process must be focused not only on the geoscientific community, but must also take into consideration:
    - Local community groups;
    - building control, mechanical and electrical engineering professionals;
    - industry representatives;
    - heating and cooling plant designers;
    - government agencies responsible for renewables & supports (SEAI);
    - government agencies responsible for environmental protection (EPA).

  Such stakeholders should be included in a Geothermal Energy Advisory Working Group that could facilitate the development of the final policy and further strengthen the likelihood of success of sector.

- Incentives to support the growth of the sector need to be focussed on potential CO2 emission reductions achieved and on reducing the operational costs of geothermal heating and cooling solutions for operators. Incentives for operators of larger scale projects should also be focussed on offsetting the initial investment required in developing such schemes in Ireland;

This document summarises in the sections below, some of the key points elaborated with respect to the proposed licensing and regulatory system outlined in the draft policy statement. The response also considers other critical aspects relating to public acceptance and potential for job creation in the context of the future development of the geothermal sector in Ireland.

2 BACKGROUND TO GEOSERV

GeoServ was established in 2003 and has been working on geoscientific and geothermal projects since. GeoServ's key skills are focussed on the provision of holistic turnkey services to the shallow geothermal market by implementing early research and design strategies for collector systems as well as the provision of drilling, installation and commissioning of GSHP collectors in both residential but mostly in the commercial sector.

GeoServ senior experts have extensive experience in both design and delivery of complex projects as well as experience in the analysis and development of recommendations and supporting measured (regulatory and legislative) for the shallow geothermal sectors in Europe. GeoServ experts have worked on European Commission funded projects including the Geothermal Regulations for Heat (GTR-H) project as well as the development of a common regulatory framework for GSHP system in Europe as part of the REGEOCITIES project and more recently in the CHEAP-GSHPs (www.cheap-gshps.eu) and GEO4CIVHIC (www.geo4civhic.eu) project on Environmental Impacts, Standards and Regulations. Our staff has also actively participated in the development of best practice guidance and standards for the design and installation of GSHPs in Ireland (NSAI) and Europe (CEN).

Our service offering also covers the deep geothermal sector with our technical experts having been involved in the exploration, planning and development of deep geothermal heat and power plants in Ireland, Northern Ireland and the UK since 2006. Our services include project management support for developing projects including early feasibility, exploration programme design and implementation as well as project permitting and planning. GeoServ has also undertaken several international feasibility studies for the development of deep geothermal applications for power generation, cooling and desalination.

3 POLICY STATEMENT OBJECTIVES

The draft geothermal statement provides an overview of the proposed objectives of the future geothermal policy in Ireland and how this aims to align, amongst others, with:

- Government Circular Economy Strategy
- National Energy and Climate Plan 2021-2030
- Climate Action and Low Carbon Development (Amendment) Act objectives (net-zero by 2050 and 51% CO_2 reduction by the end of the decade).

It is therefore critical that the final policy statement on geothermal energy, sets out clear targets and objectives for the development of geothermal resources in Ireland in the context of main government policy objectives. Such targets could for example outline:

- Deployments of GSHPs in building heating and cooling to 2030 – the National Energy and Climate Plan references the deployment of 600,000 heat pumps in Ireland by 2030.
- The expected energy produced from larger geothermal projects in term of delivered heat energy by 2030
- The expected electricity produced from geothermal power projects by 2050
- Annual expected growth rates for the above similar to those published in other EU Member States and regions
    - Netherlands https://geothermie.nl/images/bestanden/Masterplan_Aardwarmte_in_Nederland_ENG.pdf
    - Bavaria - Expansion of geothermal energy for heat generation in Bavaria (July 2021)

Such targets would generate considerable private sector interest in developing the sector, but also allow the effectiveness of the policy and the regulatory framework to be benchmarked against the net uptake of the technology.

In addition to targets, the final statement may wish to also consider other policy drivers that may increase the uptake of geothermal energy. Such drivers could include:

- Planning guidelines for commercial and public sector buildings to consider geothermal resources as part of any redevelopment or new build
- Targeting specific industrial sectors, such as those identified in the GSI Briefing Note 2 – Geothermal Energy (July, 2021)

4 LICENSING STRUCTURE

4.1 GEOSERV Energy Usage Licensing Proposal

Energy usage should be the main determining factor in terms of system types (or archetypes proposed) **rather than installed capacity and form the basis for a licensing and regulatory system.**

Energy usage is more critical at implementing a fair licensing system and sustainable growth of the industry. The subsurface impacts of geothermal systems is dependent, not on the installed plant capacity but rather the amount of hours that such a plant is operating.

For example, the operational profiles of geothermal systems for building fabric heating and cooling are generally very predictable and governed by the current building regulations (and implementation of the European Performance of Buildings Directive) as well as the climatic conditions characteristic to Ireland. The latter determine the average heating and cooling periods. Conversely, systems that are deployed for industrial, agricultural and energy storage purposes, have a tendency to maximise the system running hours to offset higher capital investment and improve operational costs.

As examples for the above, three scenarios from real case studies from the Geothermal Association of Ireland Installation of the Year competition are provided (appendix A) to illustrate the importance of energy usage based licensing. The table below summarises the main characteristics of the 3 examples.

No.	Name	Total Annual Energy Demand (kWh)	Heating (kWh)	Cooling (kWh)	Estimated Plant Operational Hours (Peak Capacity)	Net Energy from the Ground (kWh)
1	Residential - Part L	4914	4914		up to 614	3510 extracted
2	Commercial Building Heating and Cooling – IKEA Ballymun	1,040,050	841,800	198,250	693	643,250 extracted
3	Cooling – Industrial Application. Vistakon, Castletroy, Co. Limerick	7,796,400	-	7,796,400	8760	7,796,400 rejected

A licensing system structure focused on the energy usage is outlined in this section and:

- Promotes a simplified registration and compilation of renewable heating, cooling and CO_2 emission saving data from residential GSHPs
- Promotes the current market growth of GSHPs deployed for fabric heating and cooling in commercial buildings allowing site specific permits to be automatically issued once the energy loads are compliant with Part L regulations and a design verification process has been undertaken (site surface area could also be considered in this case);
- Provides greater certainty to the operator in the case of larger scale projects allowing a **total** 6 year period for the development of a project implemented through a staged licensing approach.

The energy usage model coupled with a regulatory framework to suit closed loop and open loop systems, would allow the following to be more easily implemented:

- Regulator (and other statutory stakeholders) to better understand the likely environmental impacts of a proposed project from the outset (low energy usage for space heating and cooling vs industrial scale plants);
- Operator to have a better understanding of neighbouring systems and potential performance of planned or built system with respect to security and long term operation.
- Energy usage data gathered as part of the permitting and licensing process to directly measure the CO_2 emission savings and renewable energy deployment targets set out in government policy;
- Allow mapping of operational systems and their impacts to further inform future licensing decisions especially in dense urban areas (examples of these are provided in the Netherlands and Sweden with Aquifer and Borehole thermal energy storage systems in the former and residential GSHPs in the latter).
- Allow Local Authorities to have informed strategies for energy masterplanning and the deployment of geothermal

	Residential	Fabric Heat (ie direct building or facility space heating and cooling)	Industrial Heat (ie all other non direct building/space heating & cooling - non-exhaustive list)
ENERGY USAGE BACKGROUND	1 Heating 2000 Max Running Hours p/a 2 Cooling 400 Max Running Hours p/a 3 Part - Conservation of Fuel and Energy – Dwellings Exemption for higher running hours for historical buildings not covered by Part L & EPBD	1 Heating 2800 Max Running Hours p/a 2 Cooling 800 Max Running Hours p/a 3 Part L - Conservation of Fuel and Energy - Buildings other than Dwellings	1 Agri 4 Energy Storage 2 Industrial of any kind 5 Tourism/Leisure/Balneology 3 DHN 6 PowerGen (if ever)
THRESHOLD PROPOSAL	*Installed capacity n ax of* 25 kW Depth 200 m Energy usage verified against Part-L compliance at planning stage for all retrofit and new builds (Preliminary BER Assessment *Dwelling Report'* provides monthly energy demand and peak requirements)	*Energy Usage* Balanced Heat & Cool. favoured 200 MWh Net p/a Annual Enery Use up to 1100 MWh Net p/a or Max Plant Operating < 3600 Hours p/a (see examples below) *Design Verification Submission* Energy Load Profiles Borehole Design Specification CL - test borehole - thermal properties CL - collector thermal & hydraulic model, testing methodology OL - test borehole pumping/injection test, water quality	*Energy Usage* Annual Enery Use > 1200 MWh Net p/a or Temperature > 45 oC or Max Plant Operating > 3600 Hours p/a
	Online Registration Only BER assessment Heat Pump & Installer Borehole Location & Driller/Installer	*Automatic Permit site Specific* for OL existing - water abstraction route for CL license for energy use threshold above Min term 30 years - with renewal option	*GEEL* *Staged Licensing Submission* *Year 1 to 3*: Borehole Design Specification; Exploration Programme of work; CL - test borehole - thermal model; CL - borehole thermal & hydraulic desing; OL - test borehole, pumping/injection test, water quality *Year 4 to 5*: Energy & End User Analysis (the Business Case); Planning & EIA; Long term operational Model; Decomissioning Strategy etc *GECL License* *project specific* *license awarded at YEAR 6*: Min term 30 years - with renewal option; for OL for Impacted hydraulic area (based on test resutls); for CL Thermal Influence Area based on design model
MONITORING & DATA	* Web Enable Heat Pump Controls - Compulsory * Data access though manufacturer/installer (* this may be diffcult to implement and regulate but operational data of HPs is standard with all units)	Quaterly data submission CL - source temperature data CI - flow rates OL - GW temperature OL - GW flow rate OL - chemistry (optional if identified as requirement at design verfication)	Quaterly data sumission CL - source temperature data CI - flow rates CL - thermal plume (annual) OL - Temperature, chemistry & Flow OL - Seimismic Monitoring OL - air quality Any other monitoring as per EIA/Planning conditions imposed
REGULATORY BODIES	LA Building Control	GSRO & EPA LA Building Control	GSRO, EPA Statutory Agencies

OL – open loop; CL – closed loop

4.2 DECC Threshold Proposal:

The draft policy statement proposed the use of a licensing system based on 8 No. system archetypes:

Project Archetype	Output	Technology	Typical Application
Closed Loop			
1	< 70 kW	Closed Loop Domestic	Small-scale heating
2	> 70 kW	Closed Loop Commercial/ Industrial	Heating/cooling
3	> 70 kW	Advanced Geothermal System (AGS)	District heating/cooling, industrial heating
Open Loop			
4	< 70 kW	Open Loop Domestic	Small-scale heating
5	> 70 kW	Open Loop Commercial/ Industrial	Heating/ cooling
6	> 70 kW	Hydrothermal	District heating/cooling, industrial heating, horticulture
7	> 70 kW	Enhanced Geothermal System (EGS)	Electricity production, combined heat and power
8	Variable	Mine waters	District heating/cooling, industrial heating

4.3 DECC Licensing Proposal

The above thresholds are proposed in the context of a regulatory framework that comprises:

- *Any producing less than 25 kW of energy will not be regulated beyond the current regime for product standards for heat pumps (in effect excluding domestic geothermal heat pumps from the regulatory framework)*

- *Those between 25kW and 70 kW will require registration with, and possibly authorisation by, the GSRO; and*

- *Only those over 70 kW will require an exploration licence and lease from the GSRO.*

The licensing structure comprises a Geothermal Energy Exploration Licence (GEEL) for a period of 6 years to be awarded over a km^2 area. Viable projects would then be awarded a Geothermal Energy Capture Lease (GECL) for a period of 30 years.

The threshold and licensing proposal in the policy statement needs to consider the following:

- **Registration** will only be applicable based on the current proposal to those systems between 25kW and 70kW. The policy document needs to consider that reporting on CO_2 emissions reduction and share of renewable energy technologies is a mandatory requirement under the Recast Renewable Energy Directive (EU 2018/2001 – 2021 proposed revision) and that as part of this Member States should improve reporting of such data. The geothermal market in Ireland still remains dominated by residential GSHPs for which, to date, little or no installation and performance data is available due to a lack of reporting.

It would therefore be critical that **ALL geothermal installation are registered** (including domestic ones) with residential systems simply required to complete this as an online process base don land registry folio.

- The **GEEL licensing structure** will **not be practical for implementation at urban scale**, where fabric building heating and cooling projects will be in close proximity of each other and the proposed licensing structure at km^2 scale is likely to preclude project development with only 'first come first served' projects for a period of 6 year. This period would effectively preclude other potential neighbouring projects from considering geothermal for heating and cooling.

  The GEEL approach may be more appropriate for larger geothermal plants and systems only. In this case the GEEL should be implemented based on a staged approach, where initial exploratory work and subsequent detailed business can be completed and submitted to GSRO for review through different 'license gate' periods rather than proposed 6 year period for a GEEL only. The last of such 'license gate periods' should be the issue of a GECL (in the 6^{th} year). This would considerably shorten the permitting process, provide greater operator security in the potential for securing a final license as well as promoting a more rapid development of geothermal energy in Ireland.

- The **Heat Volume Guarantee** outlined in the policy statement appears to be an interesting concept. However, an operator would seek a guarantee for the energy exchange, based on an operational profile and running hours of the plant on which the business case for a project may be developed. Therefore, the kW threshold here could not be used to provide such guarantee. In addition, the policy statement does not elaborate what the guarantee would actually provide the operator and what would be the outcome should the planned system not have access the expected/guaranteed heat volume.

- **Consent Requirements** –the proposed permitting structure highlights a non-exhaustive set of consent activity requirements under both the GEEL and GECL. The consent requirements outlined suggest that operators would/may have to apply twice for certain permissions such as planning and EIA/AA. This is likely to considerable burden the permitting process, unduly extend project development times, both of which would not be favoured by project developers and will not facilitate a more rapid deployment of geothermal resources in Ireland. If the GEEL and GECL is used, operators should be exempt from certain permitting requirements for exploration activities permitted under the GEEL whilst requiring planning and EIA/AAs as the final project development or 'license gate' stages.

5 INCENTIVES

The draft policy statement makes reference to the need for an improved understanding of economics of geothermal energy projects and how the costs of geothermal energy (particularly heat) would compare across all renewable energy source.

The final policy statement should ensure that incentives to support the growth of the sector are put in place so that:

- An initial period of time is set to rapidly increase market uptake of geothermal technologies with the objective of increasing market demand, increase supply chains and ultimately reduce technology costs;

- Support measures are aligned with government policy objectives of reducing CO_2 emissions and that geothermal can compete based on higher CO_2 savings delivered and benchmarked with other technologies especially in building heating and cooling applications.

- Incentivise electricity tariffs where heat pumps are used (eg. dedicated heat pump tariff) in order to reduce the gap with gas price. The fuel costs (SEAI, 2022) in Ireland are such that the many mid-tier commercial sized heating systems (eg. 100 to 300kW) are not incentivised to switch to heat pumps due to increased operational costs.

- The initial costs of exploration and investment for large scale projects is mitigated through either upfront financial supports (tax breaks, green loans etc) or through a set tariff support payments for energy produced that would secure the business case for early investors and developers in the developing Irish market.

- Financial supports for building heating and cooling applications should not be focussed on upfront grants, but should provide incentives to the system owner/operator when geothermal energy technologies are selected.

6 PUBLIC ACCEPTANCE

The current knowledge of geothermal energy and its potential for delivering low carbon energy solutions remains relatively low. The ambition of the final policy statement should include the setting of targets for the potential deployment of geothermal projects (irrespective of scale) that is aligned with current government policy targets on the retrofitting of buildings, uptake of heat pumps and development of geothermal energy schemes.

Such targets therefore need to consider that these will be noticed by the general public and as such broad support for disseminating the benefits of various geothermal technology solutions and projects needs to be considered in the final policy statement.

To this effect, it is critical that geothermal is highlighted to the public as:

- a quantifiable, indigenous and low carbon source of energy with the ability to address heating and cooling energy requirements at various scales;
- is a valued energy source recognised by the wider public, energy sector professional and government departments that will form an integral part of Ireland's energy system;
- it provides very low carbon heat and cooling compared to other heating and cooling technologies available on the market (the table below provides a summary of heating technology comparison for Ireland)
- that the development of geothermal is undertaken in a safe and sustainable manner following accepted guidance and standards
- larger scale projects require clear, open and transparent dialogue with local communities, member of the industry, operators and end users to demonstrate its benefits (indigenous energy supply, job creation, reduction of CO2 emissions, improved air quality).

	Noise	Environmental Impact	Fuel Delivery/Storage	Efficiency	Sustainablility	Energy Storage	Cooling capability	Maintenance	Operational Challenges
Geothermal Heat Pump	None	Extremely Low	None	350% all year round. Unaffected by ambient conditions. When heating and cooing are required simultaneously this can be greater than 700%.	High	Buffer Vessels and DHW storage normal, but GT systems can store heat energy in the ground to balance seasonal cycles and avail of renewable electricity to balance grid and reduce operational costs	GSHP systems can cool and heat simultaneously	Low	
Air Source Heat Pump	Fans are external and produce considerable noise. This increases as the load increases.	Medium - ASHPs are mounted in the open - high visual impact	None	300% above ambient air temperature of 8ºC, averaging 200% during heating system. Will require some other form of heating when operating low ambient conditions.	Medium	Buffer Vessels and DHW storage normal	ASHP systems can cool OR heat, but not simultaneously	Medium	Fans and heat pumps exposed to he elements will have a shorter life cycle than GSHP equivalents resulting in higher maintenance costs and higher embodied carbon.
Biomass Boiler	Fans and feeding equipment can produce significant noise.	High - Large above ground footprint. Emit flue gases to the local environment	Large fuel storage and constant removal of combustion by-products required.	>80%	Medium	Buffer Vessels and DHW storage normal	No cooling available	High	Storage and disposal of fuel and ash
Wind Energy	Continuous noise during high load	Medium - Large towers and have a high visual impact.	None	>100%	Medium		No cooling available	Medium	Availability unpredictable
Photovoltaic	None	Low	None	>100%	Medium	Battery storage bulky, expensive. Aspects have negative environmental impact	No cooling available	Medium	Availability does not synchronise with load for heating.
Solar Thermal	None	Low	None	Up to 1,000%	High	Using buffer vessels or in combination with a GSHP Installation	No cooling available	Low	Availability does not synchronise with load for heating.

7 TRAINING, CERIFICATION & STANDARDS

The sustainable deployment of geothermal energy systems in Ireland requires that standards and international best practice is observed at design, installation and operational stages of any system.

In the context of the types of systems to be licensed in this submission, it's important to note that best practice guidance documentation for the installation of GSHP systems in Ireland is already available through the following key documents:

- NSAI Standard Recommendation (S.R.) 50-4:2021 - Building Services – Part 4: Heat pump systems for dwellings;
- prEN 17522 Design and construction of borehole heat exchangers;
- GAI - Guidance Document Completion, Installation & Testing Of Closed & Open Loop Heat Exchangers. April, 2020 Rev B
- CIBSE - CP3 Open-loop groundwater source heat pumps: Code of Practice for the UK (2019)
- (EPA) Drinking water advice note - Advice Note No. 14
- Institute of Geologists of Ireland – Water Well Drilling Guidelines
- ASHRAE - Best Practices for Designing Geothermal Systems

The implementation of such standards and best practice is however not currently supported by a holistic training and certification approach that allows skilled professionals from different disciplines to work in uniform approach. The Geothermal Association of Ireland is a member of Geotrainet network (www.geotrainet.eu) that has developed a European network of certification for GSHP professionals that is recognised across Europe. Such professional gain European recognition for any certificates received. GAI has developed a manuals and training material for GSHP drillers and installers that would require recognition from professional organisations. Such certification should promote the dissemination of standards in the developing GSHP sector in Ireland.

Additional standards and best practice guidance should be drawn from the experiences of the minerals sector in Ireland to develop similar documents for larger scale geothermal projects where exploration works and licenses are considered. Such documents need to be tailored to the scope works that is likely to be implemented as part of a larger scale project and based on the applications and energy uses.

8 SKILLS AND JOB CREATION

Geothermal energy projects require that highly skilled professionals are required to deliver these from early design and inception stages right through to installation, operation and maintenance. A non-exhaustive list of the skill sets required for these projects is shown below and aims to consider both smaller scale installations as well as complex large scale geothermal plants.

(adapted from ARUP , 2021)

Type	Description	Role
Geoscientist	*Specialist roles involved design and delivery of GHSP projects as well as exploration and development phases or larger scale projects.*	*Geologists, hydrogeologists, geophysicists, geochemists, GIS specialists, drilling and reservoir engineers*
Education & Communication	*Professional skills required at communicating the technology opportunities, training skilled professionals and engaging with local communities involved in geothermal projects.*	*Academics, teachers, PR & Communication professionals, community relations.*
Designers	*Skilled workforce required throughout the planning, design, installation and operational stages of any geothermal project*	*Civil, mechanical, chemical, electrical designers, HSE specialists*
Engineers		*Civil, mechanical, electrical engineers, plumbers, operations & maintenance technicians*
Construction	*Mix of skilled professionals and labour, including many roles transferrable from existing workforce*	*Construction services and labourers, skilled machinery operators, drivers*
Drilling	*Various skilled professionals in all aspects of delivery of drilling services. Transferrable existing workforce in Ireland but in need to upskilling and expansion*	*Drilling & related service crews, drilling support services*
Legal & Financial	*Other roles needed to deliver mostly larger geothermal projects.*	*Lawyers, economists, administrative, marketing and sales professionals.*

Geothermal projects create both direct and indirect jobs throughout all stages of the supply chain. Many of the skilled workers required to deliver geothermal energy projects in Ireland are already part of the workforce, however an increase in future market share in ground source heat pumps will require training of a new workforce. With respect to larger scale geothermal projects, there are some skilled professionals in the Irish workforce (especially in the upstream, plant infrastructure delivery), however investment in upskilling the existing workforce would be required.

European figures on the development of the geothermal sector show that the number of jobs created is proportional to the number and size of the project.

In countries with developing/ mature geothermal markets (for example Germany) a geothermal heating project can create up to 30 direct jobs and an electricity project can create 100 jobs, many of which are highly skilled. In the geothermal industry in Germany, a total of 24,500 jobs were reported in combined ground source heat pump and deep geothermal sectors in 2019 (source BWI).

Job growth projections for the development of the Dutch geothermal market show that in 2018, 240 direct and indirect jobs in the deep geothermal sector are projected to increase to a total of 2400 jobs with an expected growth rate of deep projects of between 10 and 20 per annum by 2030 (SPG, 2018).

The opportunity for job creation in Ireland as part of the development of the geothermal sector need also to be clearly outlined as part of any policy developed by DECC and identify support mechanisms to deliver training in collaboration with professionals organisations (Engineers Ireland, Geothermal Association of Ireland, IGI, ASHRAE) to allow for the upskilling and development of a workforce to sustain the growth of the sector. The benefits to of this are briefly summarised below.

- The trouble-free path for redeployment or up-skilling of the workforce and creation of sustainable employment and businesses;
- Existing drilling industry will get a boost with new opportunities for this well-established industry;
- Mechanical and electrical services contractors will re-train from services focussed on fossil fuel fired technologies and chillers to installing and maintaining geothermal installations.
- Project management skills to deliver complex systems and projects already exists in the major mechanical and electrical engineering companies, who would have to interact with specialist geothermal service providers;
- Support service and facilities management teams can easily adapt to the new geothermal energy project developments.

APPENDIX A

GEOTHERMAL ENERGY UTILISATION

IRELAND CASE STUDIES

EXAMPLE 1 - RESIDENTIAL – as part of building retrofit and new building construction, a building needs to demonstrate it will comply with Part - Conservation of Fuel and Energy – Dwellings. A number of examples of the preliminary BER assessment that need to consider the building materials, reduction in heat losses and gains is shown in a series of examples of how the energy demand is derived using a standard DEAP software assessment methodology (https://www.gov.ie/en/publication/d82ea-technical-guidance-document-l-conservation-of-fuel-and-energy-dwellings/) .

Example D of the technical guidance considers a refurbished semi-detached house of 126m^2 with an energy demand of 39 kWh/m^2/year using a heat pump.

In this case:

- the total energy demand of the house will be 4,914 kWh with no cooling requirement
- Assuming a system efficiency of 350%, the likely energy extracted from a ground source heat pump per annum is 3510 kWh
- Depending on the modelled peak requirements, this demand could be met by an 8kW or 10kW running for a different number of hours to achieve the same energy extraction:
    - 8kW – 614 running hours to achieve the 4,914 kWh demand
    - 10 kW – 491 running hours to achieve the same energy demand

- The system will be dominated by 3510kWh of net energy extraction from the ground

The data relating to the compliance with Part L and the operational profile of residential systems can be easily determined and any data relating to system installation used to sustainably register residential GSHP system at the planning stage.

EXAMPLE 2 – Commercial Building Heating and Cooling – this example draws from the knowledge and previous technical data gathered from the IKEA geothermal system (Finnegan, 2011[1]).

The design specific data of the system and the implemented geothermal collector are summarise below:

- System installed capacity of 1.5 MW$_{th}$ (through 7 No. 200 kW heat pumps)
- Floor space Heating and Cooling of 30,500m^2 of shop floor and 10,100m^2 of loading bay
- From the building fabric thermal modelling the following annual energy demand is applicable:
    - 841,800 kWh of heating per annum
    - 198,250 kWh of cooling per annum

- In this case, the system installed capacity is designed to 1.5MWth to satisfy the occasional peak demand of the building (ie the coldest and warmest moths of the year). With the 200kW modular system ramping up and down based on the building demand at different times of the year
- If the maximum peak capacity of the system is considered:
    - 1500 kW – 561 running hours for heating
    - 1500 kW – 132 running hours for cooling
    - Total annual running hours - 693
- The system is characterised by 643,250 kWh of net energy extracted per annum

[1] Finnegan, M. 2011. Case study – large scale borehole field, IKEA, Ballymun, Dublin. *Proceedings of the Geothermal Association of Ireland conference - Geothermal Energy– Progress and Developments*. Kilkenny, 2011.

The IKEA system therefore offsets the energy extracted in the heating season with energy rejected during cooling with very low running hours throughout the year. The impact of such system on the subsurface can be easily assessed against the energy demand, the size of the site and nearby receptors.

EXAMPLE 3 – Cooling Dominated industrial applications – this example draws from the knowledge and previous technical data gathered from the VISTAKON geothermal system (GAI, 2013[2]).

The design specific data of the system and the implemented geothermal collector are summarise below:

- System installed capacity of 890 kW_{th}
- Groundwater free cooling (without a heat pump) using 2 No. open loop boreholes delivering c. 15 l/s each)
- Plant room inlet temperature 11°C and rejection temperature 19°C to surface water (IPCC license)
- Industrial plant operation and cooling requirement 24/7, 365 days per year
- The following annual cooling energy demand is applicable:
    - 7,796,400 kWh of cooling per annum

- The system is characterised by net energy rejected per annum only

The use of geothermal resources in this case is maximised in a commercial setting with extended plant operating hours. Thus an industrial system of this kind is likely to have a different environmental footprint that those geothermal system used for building heating and cooling.

[2] Vistakon, 2013. Vistakon Ireland - Category – Open Loop > 100kW thermal capacity. *Installation of the Year Entry data. GAI Annual Conference. Dublin, 2013.*