

# THE GEOTHERMAL ASSOCIATION OF IRELAND

## Newsletter

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Issue No. 7

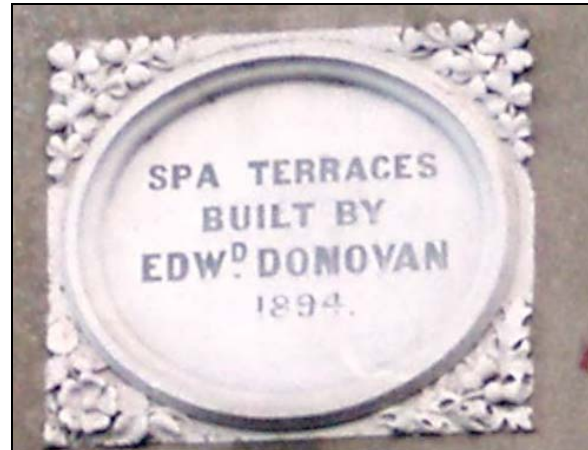
4<sup>th</sup> May 2004

Dear Members,

Welcome to the 7<sup>th</sup> edition of the Geothermal Association of Ireland Newsletter.

We are delighted to carry a major article from Austria on the Arsenal ground source heat pump study.

We hope that you will take part in the GAI events this year. We want to get feed-back and follow-up articles from you. Please email the editor at <conodate@mac.com>



The terrace across the road from Lady's Well. Mallow

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### FUTURE EVENTS

**Field Trip 2: Waterford, Fri 25<sup>th</sup> June:** (with Wexford & Waterford Energy Agencies)

*Visiting:*

Renewable Energy at the Co. Co. offices at Tramore, Co. Waterford.

New Ross, Rape seed oil press for diesel production

Strawbale house, Cheekpoint, geothermally heated

**Lectures** to be announced

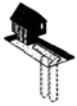
1. A prominent broadcaster on practical and engineering aspects of geothermal energy.
2. Alistair Allen, Chairman of the GAI.

**Seminar**

In September in the SEI office In Glasnevin: A full-day national seminar on the CSA / SEI review of geothermal energy resources in Ireland

The Geothermal Association of Ireland was formed in January 1998.  
To Promote the Development of Geothermal Resources in Ireland.

The Officers are: Chairman Dr. Alistair Allen, Vice Chairman Dr. Paul Sikora, Secretary EurGeol Róisín Goodman, Treasurer Ms. Sally Anne Morrissey, European Officer Dr. Brian Connor, Development Officer Mr. Pat Walsh, Events Officer Mr. Breacan Mooney, Editor EurGeol Gareth Ll. Jones



### The GAI AGM February 2004 Róisín Goodman, CSA Group

Present were Alistair Allen, Paul Sikora, Brian P. Connor, Bill Griffin, Pat Walsh, Willy Moynihan, Gareth Ll. Jones, Róisín Goodman, Sarah O’Connell, Breacan Mooney, Darragh Musgrave. The Minutes were read and approved and the Chairman, Alistair Allen reported on the highlight of the year which was the lecture at GSI in Dublin given by Prof. J. Lund. Tribute was paid to Bob Aldwell who organised a trip to St. Petersburg through the IAH and represented the GAI at that meeting.

The Treasurers Report was presented by given by Bill Griffin in Seamus Hoyne’s absence. The end of 2003 a/c shows €3574 in GAI a/c. membership is currently 8 corporate and 9 individual members. Bill Griffin also reported on the GAI web site which is 95% complete but needs members to suggest improvements at this address: [www.geocities.com/geothermalassoc](http://www.geocities.com/geothermalassoc).

A new flyer and poster to publicise the GAI at the upcoming ‘Ireland Homes Exhibition’ in the Silversprings Hotel, Cork has been drawn up by Bill Griffin. It was suggested that it should be made available for the SEI stand at the Dublin exhibition on St. Patrick’s weekend. Paul Sikora has the names of engineers, architects and mechanical engineers who can be contacted re membership drives.

Contact has been made by Alistair Allen with the International Geothermal Association (IGA) with a view to the GAI joining. GAI is already a member of the European Geothermal Energy Council (EGEC). It was decided that if the cost was €200-300 we would join. Sarah O’Connell noted that the IGA holds an annual conference (Iceland 2003) and a World Geothermal Conference every 5 years (Japan 2000, Turkey 2005).

A review of geothermal energy in the Cork area was presented by Alistair Allen who summarised the progress of the new UCC Art Museum. This new building will use a heat pump to extract heat from the buried gravels in the Lee valley. It will provide 30% of the heat for the building due to be ready by late summer 2004.

Construction has also begun on a new Environmental Research Institute building near the old water works. This building will install a heat pump to extract heat from water in the 120 years old infiltration gallery, which supplied water to Cork city up until 2001. This gallery stretches 500m along the bank of the Lee and consists of a 1m diameter pipe made of porous bricks. A future UCC development will be a new IT building which will be located at the old dog track and will use geothermal energy. Also of interest is that Cork Co. Council encountered temperatures of 23°C in a borehole in the Glanworth area. A temperature of 26°C was also reported from a privately drilled borehole. If confirmed this will be one of the warmest occurrences in Ireland.

Brian Connor reported on his efforts to get Euro-funding for a deep geothermal borehole in Ireland. He has been talking with the President of the European Geothermal Association. Brian suggested that partners in the projects might be Geoteam (Austria), Prof Hans Goldbrunner, Graz University. The project is still developing and the partners are working on it.

A prominent member of the GAI Pat Walsh moved from Spa House to Cork Co. Co in early 2003. He apologised for not having been able to give much time to the GAI and the required membership drive. He was thanked for his important role as a founding member of the GAI

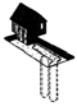
The meeting was followed by presentations from Sarah O’Connell (CIT) on Ground Source Heat Pumps and Gareth Jones (Conodate) on the CSA Group review of Geothermal Energy in Ireland.

**Election of new board Members for 2004:**

Chairman	Alistair Allen
Vice Chair	Paul Sikora
Secretariat	Róisín Goodman, CSA
Treasurer	Sally-Ann Morrissey
European Liasion Officer	Brian Connor
Development Officer	Bill Griffin
Events Officer	Breacan Mooney, WYG



Prof. John Lund (2<sup>nd</sup> left), Director of the Geo-Heat Center at Oregon Institute of Technology, with GAI members at his Dublin talk.



## Geothermal Climate Control at the New UCC Art Museum Building

Paul Sikora Dunstar Ltd., Alistair Allen Geology Dept. UCC

A major new geothermal development in Cork is embodied in the UCC Art Museum / Gallery, currently under construction, it incorporates a 200 kW geothermal combined heating and cooling system. The building is sited on the bank of the R. Lee near the main entrance to UCC at the corner of Western Road and Donovans Road. Built as one of the flagship projects associated with Cork's tenure as European City of Culture 2005, the structure is intended as a showcase for the best thinking in the built environment today, and will house a restaurant and an art gallery to display art collections, which have been donated in trust to UCC.



The wellhead at the UCC Arts Museum Building

The Art Museum design is for a three-storey building 23.5m high, with a basement. The daring structural form and spatial layout will be evident to all visitors, but one of the most innovative aspects of the design will remain out of view, partly in the basement plant room and partly beneath the lawn in front of the building. This is its geothermal combined heating and cooling system, in which a single heat pump unit serves to provide both heating and cooling to the building in whatever proportion required. This feat of thermodynamic magic is managed by a single machine thanks to a controller, which can make the geothermal reservoir serve either as a donor or an acceptor of heat.

The geothermal reservoir itself is groundwater in the gravels which underlie the lawn, and indeed much of the floodplain of the Lee Valley, at depths of only 3m. This deposit infills what is referred to

as the Lee Buried Valley, a geological feature, which formed approximately 18,000 years ago at the height of the Pleistocene glaciation when sea level was considerably lower than at present. It became infilled with highly permeable gravels as temperatures ameliorated, the glaciers receded, and sea level rose rapidly about 12-14,000 years ago. The Art Museum site is close to the southern margin of the Lee Buried Valley, which is about 500 m wide at this point, and at least 50 m deep. The buried valley represents a significant groundwater aquifer in the Cork region, its importance for this project and for others in the Cork City area being that it provides a copious source of water at a relatively stable temperature all year round.

The system at the UCC Art Gallery building will be able to provide up to 200 kilowatts of heating and almost as much cooling. While the heat pump itself can produce heating and cooling only in a fixed proportion, the geothermal reservoir can supplement whichever of the two is in short supply in order to meet the varying demands of the building.



Partly installed heat exchanger and sink

When it goes into service sometime later this year, the system at the UCC Art Gallery building will be one of the largest, if not the largest, single geothermal heat pump system in Ireland. More importantly, however, it will be one of the most innovative geothermal systems anywhere. While the geothermal industry in Ireland is still small in comparison to many other countries, the presence of projects of this stature is a clear indication that the vitality and technical flair of the Irish geothermal industry rank it well above its size.



## Review of the Status of Geothermal Energy in Ireland

G. Ll. Jones, Conodate

The CSA Group is carrying out a review for Sustainable Energy Ireland, under the National Development Plan, of the current status of geothermal energy in Ireland with regard to optimising future utilisation of the country's potential. The partners are Conodate, Geological Survey of Ireland, Cork Institute of Technology.



G. Jones, J. Broderick, K. Broderick, R. Goodman  
Geothermal logging field trial, Rathangan, Co. Kildare

The project covers the following areas.

- A) Review of the current status of knowledge and utilisation of geothermal energy resources in Ireland and evaluation of existing exploitation projects in the context of international best practice.
- B) Identification of potential sources of geothermal energy utilisation in Ireland and geological, structural and hydrodynamic analysis of these areas.
- C) Production of a GIS-linked geothermal database with accompanying maps and a report with recommendations for future use of Ireland's geothermal resources.

The report will present the results of a review and compilation of the data in studies carried out prior to this project in relevant categories of geothermal usage. These areas include borehole temperature testing, warm spring monitoring and current geothermal usage including ground source heat pump usage.



Running the geothermal log, Dunshaughlin, Co. Meath

Also presented are the results of a comprehensive review of the status of all mineral exploration boreholes left open / capped over the past 20 years. Some 80 accessible boreholes have been temperature tested in total. Information so far compiled is currently being validated and incorporated into a new geothermal database.



The thermal spa at Louisa Bridge, Leixlip, Co. Kildare,  
17.5°C, April 2004



Monitoring an artesian well near Kingscourt, in Co. Monaghan, 13.7°C, February 2004



Glanworth Cork Co. Co. borehole at 23°C, April 2004

**Ongoing work includes:**

- A small amount of additional field testing and monitoring is being undertaken.

Final compilation of all borehole data continues with interpretation from a geological and hydro-geological perspective, leading to identification of areas with the best potential for deep geothermal heat.

- Validation of the data from previously monitored warm springs is ongoing.

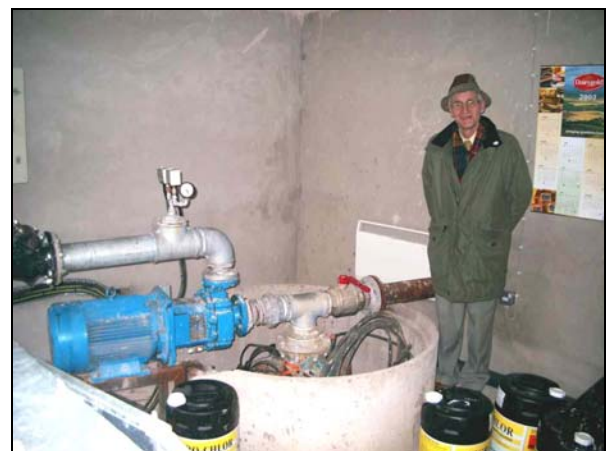
Data collected and compiled on the use and potential use of heat-pumps in the Irish context will be examined in the light of International best practice.

- Data on the urban heat island effect in the Cork area is being interpreted and possible analogues identified in other parts of the country.

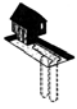
The project is due to be completed in July 2004. the results will be launched in September.

**Results so far indicate that:**

- New information is emerging from borehole testing and compilation which provides a somewhat different picture of Ireland's geothermal gradients than that previously understood, with higher temperatures extrapolated at depth.
- The success of some local development of shallow, high-yield aquifers and urban heat island effect provides a model for the exploitation of similar resources elsewhere in the country.
- Warm springs around the country have been under-developed.
- Although ground source heat pump usage in Ireland is increasing, it is still low by international standards and it is suggested that some form of incentive is required to increase the uptake.



Ned Sheehan, Cork Co. Co. at Box Cross Pumping Station, Co. Cork, 12.8°C, February 2004



## The Geothermal Springs at Bath

Darragh Musgrave, WYG

The phenomenon of geothermal springs must have been something quite extraordinary and alien to our forefathers. In times when the experience of hot water was not the everyday luxury that it is today, many locations of naturally occurring hot springs became important social centres and places of mythical, spiritual and curative importance. None more so than the geothermal springs located in the Avon Valley of southwest England to which the City of Bath owes its origin and name.

With no natural explanation available for such a spring or its waters' curative properties, the location was deemed sacred and in Roman times dedicated to Sulis Minerva, a Roman Deity with healing powers. In the period from the 1<sup>st</sup> to the 4<sup>th</sup> centuries AD, the geothermal spring was established as an important focus of spiritual pilgrimage and therapeutic bathing, around which the town of Aquae Sulis (Bath) developed.

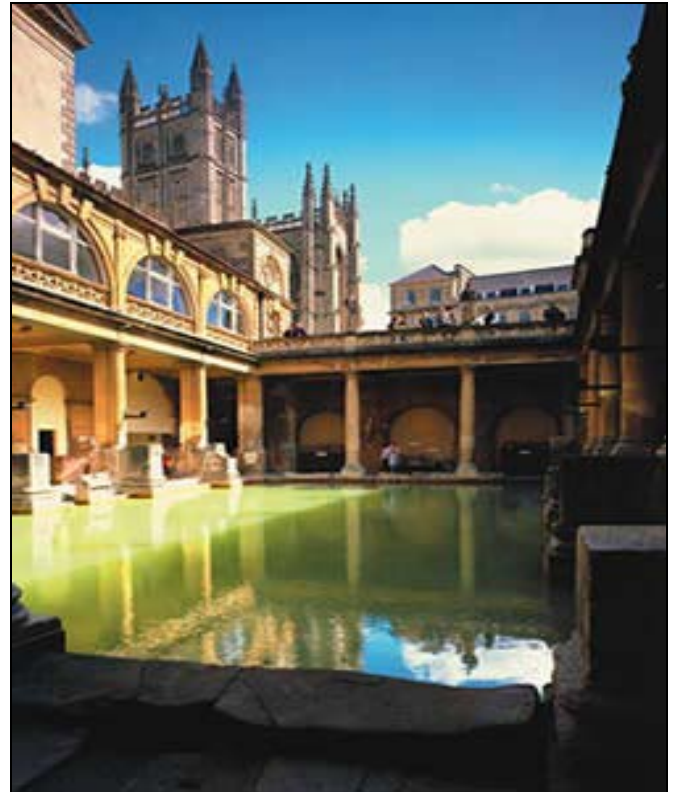
Through the passage of time the Roman structures were built over and the geothermal baths lost. However the uniqueness of the spring remained important and site was kept under the control of the King of England until the 16<sup>th</sup> century.

In Georgian times when spa's and the curative properties of mineral waters were once again fashionable a pump house and well was sunk at the site. The water was available to patrons in the magnificent Grand Pump Room, which became the social heart of Bath for two centuries and is still in use today.

The progression of science has given us some idea of how the hot springs at Bath formed, although their exact origins are still not fully known. It is thought that large geological features associated with the formation of the Avon Valley, such as the Pennyquick Fault, act as conduits enabling heated groundwater to rise from depth through the Carboniferous Lime-stones bedrock creating artesian geothermal springs at ground level. Three such springs are known to occur around Bath while a fourth is located at Bristol. The main artesian spring at Bath produces 1,170,000 litres (~240,000 gallons) of mineralised water at a constant temperature of 46° Celcius per day.

Lost for over 1,500 years, until they were rediscovered, explored and excavated at the end of the 19<sup>th</sup> century, it is the impressive ruins of the Roman site that form the main part of today's tour of

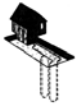
the geothermal springs at Bath. Located in the very heart of the City, opposite the Cathedral Square, you can travel back in time to see how the natural geothermal resources were both spiritually and physically utilised by an earlier civilisation.



The main Roman Baths at Bath.  
(Picture courtesy of official website)

With audio tour guide in hand you are lead through a series of locations and shown how the Romans trapped the sacred spring, built a classical temple (one of only two in Roman Britain), with temple courtyard for worship and sacrifice at the site. Comprehensive archaeo-logical excavations have uncovered the Roman bath house including the original lead lined geothermal pool and associated heated rooms, plunge pool and sauna. The drainage system, which carries the used water to the River Avon 400m away, was found to be still in working order! The tour focuses more on archaeology and history, rather than the origin of the hot springs, and is a testament to the ingenuity, engineering and craftsmanship of the Roman Empire in Britain.

As well as the opening of the site as a tourist attraction, more recent developments include the completion in 1983, of a new groundwater well to supply mineral water to today's patrons of the Grand Pump House. Also in 1993 the installation of a heat



pump system, to extract the geothermal energy from the water for heating the museum and pump house complex during the winter months.

permit ‘travelling pilgrims’ and the citizens of the area to directly experience the phenomenon of the geothermal hot springs of Bath.

Later in 2004 new bathing facilities and therapeutic treatment rooms are to be opened which will once again, 2,000 years after they were first established,

Thanks to the assistance of Stephan Clews the curator of the Roman Baths & Pump House, Bath. See the web site <[www.romanbaths.co.uk](http://www.romanbaths.co.uk)>

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**The GAI on display at MIHE**  
Bill Griffin, Cork County Energy Agency

The Modern and Ideal Homes Exhibition took place at the usual venue in Silversprings hotel on the 20<sup>th</sup>, 21<sup>st</sup> and 22<sup>nd</sup> of February this year. The GAI was represented at the Cork County Council exhibition and GAI brochures and posters were on display. Many people thought the GAI was a company that supplied and installed heat pumps and they were pleasantly surprised that such an association existed at all !!

On a positive note - I spoke with a few people who were impressed with the professional credentials of the members of our small association. This is important because of the simple fact that people are more inclined to trust a not-for-profit group like the GAI to provide them with the realistic benefits of GSHP technology rather than the “hard sell” of a commercial supplier.

For this reason the importance of a GAI presence at future exhibitions is clear. However the costs of such a presence are significant and for this reason we have adopted the plan to contact all the other Energy Agencies and offer them GAI literature to display at future conferences.

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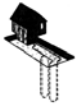
**Geothermal views**



The Gelert Thermal Baths, Budapest, Hungary



At the UCC Arts Museum Wellhead  
Joe Murphy UCC, Alistair Allen UCC, Róisín  
Goodman CSA, Tom Griffin Mercury, February 2004



## Campaign for the take-off of a self sustainable heat pump market in Ireland

Raphaela Boeswarth



Within the programme “Renewable Energy Research - Development and Demonstration” founded by Sustainable Energy Ireland, the Project campaign for take-off for renewable heat pumps in Ireland was elaborated by Arsenal Research; an Austrian research and development institute in the field of renewable energy technologies. Heat pump technology, along with solar thermal technology and photovoltaics, is one of the main sectors of the area of renewable energy technologies. The chief activities in the heat pump section are the heat pump test rig for ground coupled heat pumps, the education and certification system for installers and planners and the monitoring of heat pump systems.

The main target of this project was to prepare a strategy and an appropriate action plan for the development of a self-sustainable heat pump market in Ireland. Before this strategy could be prepared it was essential to survey the current framework for using heat pumps and the current market situation in Ireland. Therefore a questionnaire survey, a survey workshop and personal interviews were carried out.

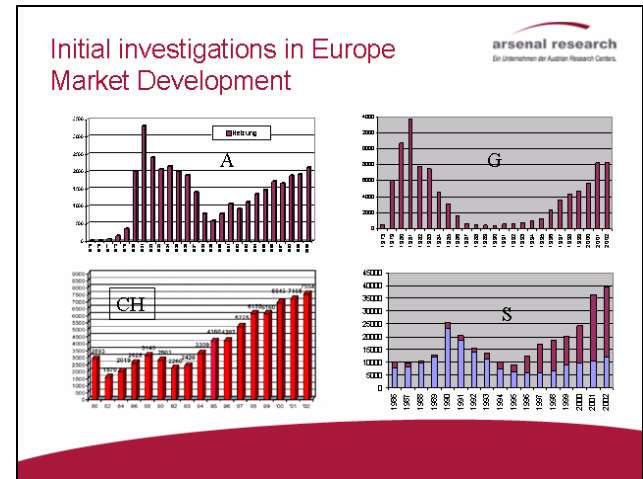
Furthermore a best practice analysis of the most successful heat pump markets in Europe distinguished the driving forces and the best strategies for the development of heat pump markets in Germany, Austria, Sweden and Switzerland. The outcome of the Irish survey activities together with the best practice analysis in Europe provides the basis for the elaboration of a promising development strategy for a lasting heat pump market in Ireland.

### European Experience

The European heat pump market has gone through many ups and downs over the years. The energy crises at the end of the seventies, with the high oil prices, made it easy to market heat pumps. This was the time of an overgrowing heat pump market, when reliable companies were scarce and a large number of fortune seekers offered products, often of poor quality and promising enormous savings, which the installations never could achieve. All this led to a large number of failed installations and the market lost almost all credibility.

At the start of the eighties the European markets reached a peak, but because of poor reputation and decreasing oil prices they collapsed within a few years. Only a very small number of manufacturers survived this period, but 10 years later the sales figures started to grow again. The reasons were

improved building standards which enabled the use of low temperature heating systems, the rising oil prices and the improved quality of the heat pumps and installation.

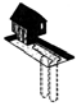


Outcome of the initial investigations in Austria, Germany, Switzerland and Sweden.

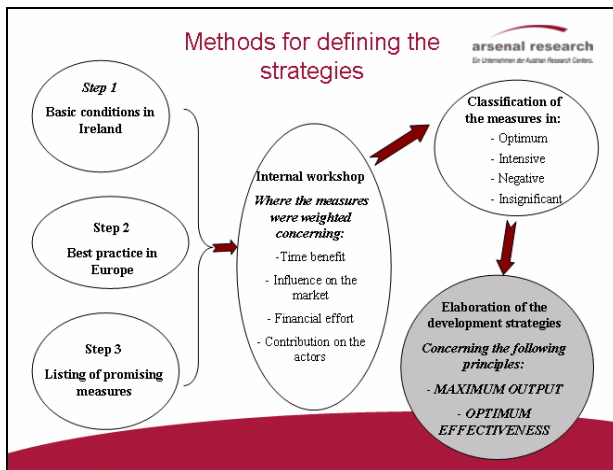
Based on the experiences of these countries the following six main requirements for success could be derived.

- 1. The availability of the heat pump technology.** Educated retailers and installers are able to offer heat pumps as an alternative heating technology to customers looking for a oil boiler.
- 2. Trained installers** are necessary for a functioning market and continuing market growth. This requires training and education of installers, (plumbers, electricians and drillers), retailers, after-sales personnel and service technicians. This needs information on heat pumps and an organized training scheme for all market players to reach a certain standard.
- 3. To obtain and retain a General Acceptance** it is also very important that the heat pumps offered on the market are well tried and reliable in their **Quality** and installed in a proper way. If the heat pumps do not work satisfactorily or are not of adequate / offered quality, the market will suffer major setbacks, and the ongoing market penetration will be diminished.

General Acceptance among the general decision makers, engineers, technicians,



politicians, architects, constructors, housing councils, trustees, landlords, tenants and electric companies is a vital key to promote awareness among end-users. These are the ones designing the buildings, consulting the house builders and owners and informing the public. If these persons have no or the wrong opinion on heat pumps it is important to find out why and to create an understanding since these people are vital when entering a specific market / segment.



Methods for defining different development strategies

**4. Economic incentives** take into consideration whether or not it is economically favourable or even profitable to install heat pumps in comparison to other heating alternatives. Are the energy prices advantageous for heat pumps or not? To have a competitive price, heat pump installations need to have a payback period on the initial investment (including the heat pump and the heat source) of not much longer than 5 to 7 years compared to other heating alternatives, regardless of subsidies.

**5. Awareness amongst end-users** gives an autonomic, self developing and ongoing market where there is a "market pull" from the end users asking for a better heating system. There needs to be large scale information campaigns on heat pumps as a heating alternative and their benefits in comparison to other heating alternatives. Giving the end users, easily obtainable and understandable information, creates awareness among the end-users / customers.

**6. Political decisions** refer to legislative initiatives that require efficient heating systems to benefit over other heating systems, such as oil, coal, gas or direct electric heating. For example standards or regulations controlling the maximum amount of CO<sub>2</sub> emissions allowed from new buildings, affect the development of heat pump installations in a positive manner.

Maximum power (kW), or energy (kWh), spent, standards for sizing the heating system to cover the heat loss of the dwelling and transition to low-temperature heating systems also favour heat pump systems.

### Irish situation

Currently the Irish heat pump market is in an atmosphere of departure. Because of the maritime climate, the great number of new built houses and the relatively low electricity prices the potential for using heat pumps in Ireland is huge. But a few of the requirements mentioned above are currently not fulfilled, therefore the following activities would be necessary to assure a sustainable development of the market and prevent the market defaults of the past.

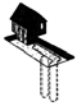
In the field of **market suppliers**, Ireland is in a significantly better situation than Austria, Germany, Switzerland or Sweden were, at the start-up phase of the heat pump market. Because in Ireland there are already a few qualified and experienced manufacturers and importers on the market. In contrast, in the countries mentioned, the lack of quality products was one of the greatest barriers during the start up phase.



R. Goodman CSA (centre) with R. Boesworth and B. Bach Arsenal Research, Dublin April 2004

Currently in Ireland there are a few experienced installers in the field of heat pump technology, but the greater proportion of installers and planners have little or no experience with this technology, and most professionals do not believe in this technology. Therefore a **standardized training programme** for installers and engineers would be imperative to assure a high system quality.

Because of the relatively new heat pump market in Ireland the number of proven systems is currently low, but there are some existing systems. With further growth of the market the number of heat pump systems will rise, which will



have a positive influence on the long term market development, if the quality of the systems is of a high standard. To assume a high and stable quality system it would be necessary to implement a **quality label** for tested heat pumps and a **certification system** for educated professionalism. These quality assumptions would increase the general acceptance of the technology.

In the field of **economy**, heat pump technology is in a difficult situation. In areas without natural gas supply, heat pump technology is competitive among conventional oil boilers, but only with a relatively long pay back period of up to 7 years. This is not outstanding, but a slow growth in the market share could be possible. Because of the high investment costs of heat pumps and the low prices of natural gas, heat pump technology is not competitive with natural gas. Based on these conditions, **financial incentives for reducing the investment costs of heat pump systems have to be recommended.**

Generally in Ireland consumer **awareness** about heat pump technology is too little. Most people have not heard anything about this technology or do not believe in it. Historically the low installation standard in Ireland results in a low awareness of comfort and quality, people appreciate economical aspects more than quality. Therefore public relation at local and national levels would be necessary. The advantages of heat pump systems in running costs and quality have to be promoted and end users should also be informed about the possibilities of the technology.

Currently the **political situation** for heat pumps is symptomatic of a young market. The technology is not positioned in standards or regulations, but in general there is an open minded attitude noticeable. Particularly in the situation of strictly required

reductions of CO<sub>2</sub> emissions. Activities like financial incentives for improving the building standards or replacement for conventional heating systems would certainly influence the heat pump market in a positive way.

Generally Ireland has a **huge potential** for heat pump usage and the currently existing framework is definitely more promising than during the start up phase in Europe. Furthermore Ireland is in the nice position to benefit from the knowledge and experience of the pioneer countries. In the report 'Campaign for Take-off for Renewable Heat Pumps', the most effective activities for developing a heat pump market are described. The kind of realization, and therewith the rate of increase, influences the means available and the contribution of the market actors. However the implementation of the strategy appears, it is essential that Ireland can prevent a market default due to bad working systems. Therefore the main focus of all strategies always has to be the quality of the whole system.

After providing the strategy report as a first discussion tool, the next steps are to be discussed. The fruitful cooperation between Ireland and Austria will be continued in a recently started EU-project where the first Irish pilot heat pump training course will be realized. This will be a promising step to develop a healthy growing and lasting heat pump market.

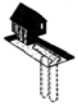
DI (FH) Raphaela Boeswarth

**arsenal research**

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Excursion at the strategy workshop in Vienna



## Ground Source Heat Pump Use And Potential In Ireland

Sarah O'Connell and Stephen F. Cassidy

Mechanical & Manufacturing Engineering Dept, Cork Institute of Technology.

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Ireland has no obvious high temperature resources, therefore exploitation of geothermal energy is mainly through ground source heat pumps (GSHP). There are approximately 1,000 domestic ground source heat pump installations in Ireland, typically in the range between 10 and 14 kW and twenty large-scale or commercial systems have also been installed. Less than 1% of Irish households are heated using a heat pump, which contrasts sharply with Switzerland, one of the world leaders in heat pump technology, in which 67% of homes are equipped with a heat pump.

Our mild climate, combined with high rainfall and high relative humidity give excellent conditions for the use of ground source heat pumps. Average ground temperatures from 8 - 11°C and high soil moisture content ensures good heat transfer and COPs higher than Scandinavian countries such as Sweden where GHSP is used extensively. Horizontal collectors for domestic systems are the preferred option as vertical boreholes are 4 -5 times more expensive to install. Many of the large-scale systems use boreholes because of space restrictions or exploitation of geothermal resources.

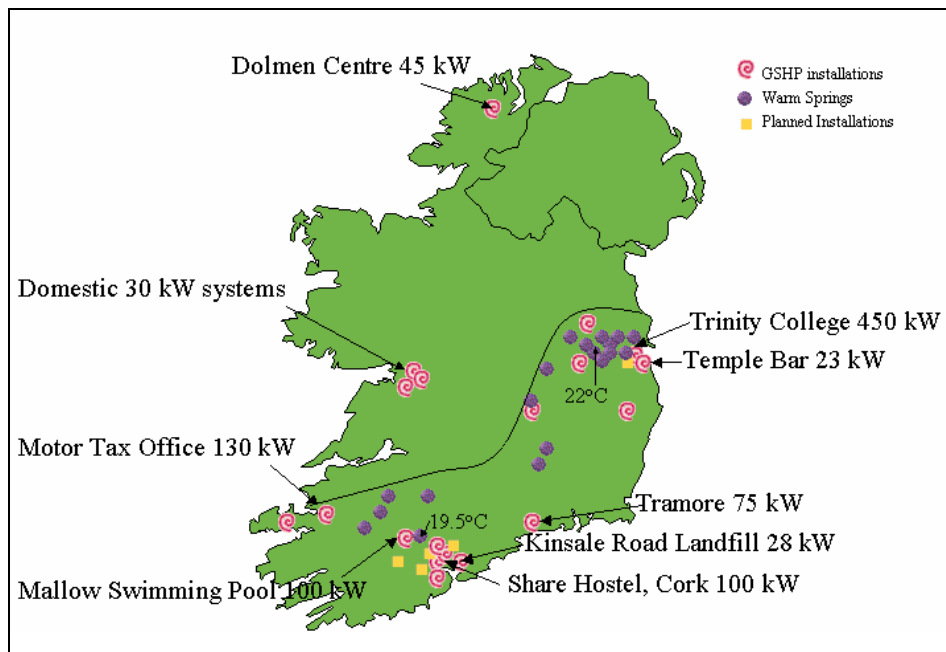
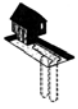


Fig. 1. Large Scale Installations in Ireland.

The European growth rate is 15% and the total European installed capacity is 1,577 MW, of which the estimated installed capacity for Ireland is 12 MW. Geothermal heat pump installations in the US have total capacity of 1,356 MW, comparable to the whole of Europe, and this is expected to increase at a rate of 10% annually. The Irish growth rate is estimated at 45%, this high rate is due to the lack of maturity in the

market. Until the late 1990's there were only two ground source heat pump companies in Ireland, but now there are 8 such companies. In order to prevent the market collapse that occurred in other countries such as Austria and Sweden, an installer training course is being developed. Arsenal Research (Austria), in conjunction with SEI and FÁS, aim to pre-empt the installation of poor quality systems through installer certification.



Exploited geothermal resources for large scale systems in Ireland consist of warm springs, gravel aquifers and low enthalpy shallow ground resources. Figure 1 illustrates the locations and size of these systems. Tralee Motor Tax office is the largest operating installation serving a single building. The borehole collector at Mallow Swimming pool uses the Mallow geothermal aquifer at 19°C as its source. A 150m vertical borehole was chosen for the Green Building in Temple Bar, Dublin due to space restrictions, some seepage from the bedrock also increases the heat pump COP to 4.8. The decomposing waste at the Kinsale Road Landfill site in Cork is used as the heat source for the Administration building. The Share Hostel in Cork uses the Lee Valley aquifer, which, due to the urban heat island effect, has a water temperature of 12–13°C. The Tramore project uses the municipal water supply as the heat source. Where possible, favorable features have been used for the collector, for example, an artesian well in Callan, Co. Kilkenny. In theory this should improve the performance, however, the systems have not been monitored so the reduction in energy consumption has not been quantified.

Payback periods range from 2.5 years for the Green Building in Temple Bar to 11 years for the Mallow swimming pool. Using direct cooling as well reduces the payback period, in the case of the Tralee motor tax office to 4 years.

For the Tralee Motor Tax office, CO<sub>2</sub> emissions were reduced by 52%. For the entire Green Building in Temple Bar, the reduction was 86%. The heat pumps in Trinity reduced CO<sub>2</sub> emissions by 920,000 kgCO<sub>2</sub>/kWh annually. In Churchfield, a natural gas fired boiler is running continuously so there is a negligible reduction in emissions.

Installations in the planning or commissioning stages include a 200 kW system for the UCC art gallery utilising the Lee Valley aquifer, a 75 kW installation at Iniscarra, a 200–300 kW project in Killorglin and five houses in the Ballymun regeneration project.

GSHP are viewed as one of the strategies through which Ireland can reduce greenhouse gas emissions and meet the Kyoto protocol. GSHP could

reduce CO<sub>2</sub> emissions by 617,000 tonnes CO<sub>2</sub>/ year and the primary energy requirement for heating would be cut by 5%. The extra investment required would be 602.6 million euros equivalent to 80,000 units as estimated by Sustainable Energy Ireland.

The barriers preventing this potential from being realised include: higher capital cost of GSHP systems; higher perceived risk; price distortions (external cost of fossil fuels, subsidies for infrastructures); unfavourable market characteristics; lack of installation experience; absence of quality standards and, finally, the level of awareness among the general public and decision makers in government and county councils while growing is starting from a low base. To encourage greater use of GSHP systems a combined strategy of subsidies and restrictions on use of fossil fuels could be employed. High quality of design and installations should be ensured through certification of installers and the development of building codes and standards governing the use of heat pumps. The introduction of a carbon tax seems likely and will encourage GSHP use. Continual research and development of heat pump systems specifically designed for conditions in Ireland will ensure the future of GSHP technology.

#### *Acknowledgements*

Funding received from the HEA under PRTL Cycle II Environmental Research Institute – New Energy Systems in Buildings. The author would also like to thank the Energy Agencies, REIO and Dunstar Ltd for expertise shared.



Horizontal Collector installation. (Courtesy Dunstar Ltd.)

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