

Education and community outreach at the United Downs Deep Geothermal Power Project, Cornwall, UK

Lucy Cotton, Jane Charman, Suzie Doe and Peter Ledingham

Geothermal Engineering Ltd, Falmouth Business Park, Bickland Water Road, Falmouth, Cornwall, UK

cotton@geothermalengineering.co.uk

Keywords: deep geothermal, Cornwall, community outreach, education, social licence

ABSTRACT

The United Downs Deep Geothermal Power (UDDGP) project is the first geothermal power project in the United Kingdom. It aims to develop the geothermal resources in the heat-producing granites that lie beneath Cornwall in SW England. Financial support has come from the European Regional Development Fund and the local authority (Cornwall Council) who, together, have provided £13m of the £18m project budget. Between November 2018 and June 2019 two deep wells were drilled; the production well to a depth of 5,275m and the injection well to 2,393m. If well testing proves successful a 1-3MWe (net) power plant will be built.

In parallel with the technical programme, Geothermal Engineering Ltd (GEL) has given a high priority to the implementation of a diverse and inclusive programme of education and public outreach in the local and wider community. Dedicated educational materials on deep geothermal and wider environmental issues have been developed to suit a range of student ages from 5 years to degree level. The use of interactive games, animation videos, lectures and site visits has ensured that learning is accessible to all age groups. The education programme has so far reached approximately 3,000 students.

The community outreach programme has built and strengthened GEL's relationship with the community and aims to provide reliable and objective information about geothermal energy in general, and the United Downs project in particular. A community liaison group was established before the start of drilling and meets at regular intervals to discuss the progress of the project and any concerns local residents may have. Public open days are held at regular intervals to encourage people to come and view the site, ask questions and learn about geothermal energy. GEL has also attended numerous community events, public meetings and county-wide shows, spreading the message to thousands of members of the public.

The potential exists to develop geothermal resources throughout Cornwall but it is only with support from local communities that it will be able to gain momentum. Not only does GEL wish to create a sustainable geothermal industry for the county, it strives to inspire the younger generation to do the same. Public response to the education and outreach programmes implemented at UDDGP has increased the acceptance of deep drilling and geothermal exploration in the county and will help pave the way for these future projects.

1. INTRODUCTION

The United Downs Deep Geothermal Power (UDDGP) project is the first commercial geothermal power development in the UK. It has been known for decades that the heat-producing granites of SW England represent a potential geothermal resource, with heat flow roughly double the national average. West Cornwall previously hosted a Hot Dry Rock geothermal research programme carried out from the late 1970s until the early 1990s. There are many references to this work, for example Parker (1989), Richards et al (1994) and Parker (1999).

Geothermal Engineering Ltd (GEL) developed a concept for further exploration in 2009 and secured a site, together with the necessary permits, in 2010. In 2017, £10.6 million was secured from the European Regional Development Fund and £2.4 million from Cornwall Council. This, together with £5 million raised from private sources, allowed GEL to drill two deep wells from its site near Redruth into a target geological structure; the Porthtowan Fault Zone. Drilling began in November 2018 and was completed at the end of June 2019. The production well reached a depth of 5,275m (MD) and the injection well 2,393m (MD). If testing proves successful, a 1-3MW(net) power plant will be commissioned at the site, supplying power to the national grid. Further details of the project can be found in Ledingham and Cotton (2020).

Geothermal and deep drilling technology is generally unfamiliar to UK residents and unfamiliarity often leads to concern. UDDGP is a pilot project and, if successful, other projects will be developed in future locations throughout Cornwall. This will require a "social licence" to operate. In addition, specific concerns about noise and the potential for induced seismicity have to be addressed. GEL recognised the importance of good communications and therefore, in addition to the technical aspects of the project, has undertaken extensive education and community outreach programmes in both the local and wider communities. Commitments were made relating to information exchange, transparency, accessibility, protection of the environment, minimizing nuisance, addressing concerns and promoting cooperation.

The overriding philosophy was to make the maximum amount of information possible easily available to members of the public and to encourage direct communications with project staff.

2. EDUCATION PROGRAMME CONCEPT & THEORY

Dissemination through education has become an integral part of the UDDGP project. The programme aims to inform a younger audience about the possibilities of geothermal energy in Cornwall and around the world. Currently the school curriculum in the UK only touches on geothermal energy briefly, as part of the renewables energy syllabus. As a team with knowledge and recent experience, GEL has sought to change this to allow for a more detailed unit to be included that uses UDDGP as a case study.

UDDGP is being developed as a proof of concept with a view to developing further projects in the county upon its success. In order for the industry to grow, awareness and interest needs to start at the grass roots of the community and, with climate change becoming an increasing global concern, the teaching of renewable energy sources is growing more popular across the syllabuses. The education programme designed by GEL focuses on two particular aspects; growing a new industry and filling a gap in taught subjects.

2.1. Growing a new industry through education

Cornwall is not new to exploring the subsurface for natural resources; it has a long mining history and was once one of the world's largest tin and copper producers. The last active mine (South Crofty) was closed in 1998, well within living memory of the middle to older generations, including many grandparents of the students for whom the UDDGP education programme is intended. The legacy left from the county's mining heritage has helped to introduce the concept of drilling for a 21st century resource in an historic mining region; the term 'mining for heat' has often been used in relation to geothermal energy.

The education programme has been designed for students between the ages of 7 and 21; from primary school to university level. Each of the sessions delivered is tailored to suit the needs and interests of the different age groups and subject areas for those aged 16 and over, who have made subject choices. The broad target audience has led to a variety of outreach lessons being developed; from furthering a natural curiosity and inquisitiveness about the surrounding environment, to delving into technical aspects of the project such as geophysics and microseismicity with the older age groups.

A key part of the education outreach is to show that with the potential development of a new geothermal industry in Cornwall there will be opportunities for technical and non-technical jobs in both the core activities and supply chain. Cornwall has long suffered from high levels of unemployment and a lack of well-paid skilled jobs and new graduates are often encouraged, or even forced, to move away for work. This programme aims to give hope and opportunity to the next working generation, offering them the prospect of rewarding jobs in a new sustainable industry at home. Moreover, thanks to its history, Cornwall is home to one of the most renowned mining schools in the world; Camborne School of Mines (CSM). The graduates from CSM have the skill sets needed to be able to work around the world in modern day exploration industries, including geothermal.

This means that Cornwall has a readily available knowledge base and skill set that can be engaged for the development of a geothermal energy sector. GEL has delivered a lot of careers-based talks and presentations and hopes that the UDDGP education programme will allow students to understand and see the potential of the industry, helping to drive it forward.

2.2. Motivation for designing a new geothermal education programme

Renewable energy is included the curriculum at several different age levels. With growing concern and awareness of climate change it will continue to be an important topic in schools. GEL studied the available resources online and found that, while there were many available for other renewable energies such as wind and solar, there was very little detailed information about geothermal energy; only enough to explain the basics of conventional geothermal or EGS. Understandably, since it is novel, there was nothing to explain the concept being tested at United Downs.

With the increase in sensitivity around 'fracking' in the UK it was also critical that the objective to circulate water within a naturally occurring fracture system was conveyed in a way that was easy to understand and visually clear for all ages. Therefore GEL decided to create new resources which were fit for its purpose.

2.3 Science Communication

Being able to break down the technical information to convey it in a way that makes it accessible for all ages (especially ages 7-11) is crucial and the UDDGP education programme has been split into specific age groups according to the English education system. Science communication is key to the understanding and acceptance of new projects and is now a routine part of most scientists' day-to-day work. Scientists and companies are using online platforms such as websites, YouTube and social media feeds to help reach their audience, whether it is people with previous knowledge or those being curious and wanting to learn more. These free platforms provide an excellent way to engage people in subject areas outside of their comfort zones.

As well as providing science communication digitally there is an increase in physical outreach, where individuals and companies like GEL provide talks or sessions through educational initiatives such as STEAM (Science, Technology, Engineering, Arts and Maths). These sessions help to improve the link between industry and academia, providing students with a connection to real projects and helping to put taught subjects into context.

The members of staff from GEL who designed the education programme were from both technical and non-technical backgrounds. This proved to be a great advantage as the concept had to be deconstructed and communicated effectively to non-technical members of staff, who could then use their skill set to help communicate it in a visually appealing and technically accurate way.

In order to teach primary and secondary school students about geothermal energy in general, and the United Downs concept in particular, in a session delivered either at school or on the site, lesson plans incorporating different learning styles were created. Four main learning styles were adopted; Visual, Audio, Read/Write and Kinaesthetic (VARK), Marcy (2001). Table 1 below outlines how these styles were applied for Key Stage 2 and Key Stage 3 students.

Key Stage	Visual	Audio	Read/Write	Kinaesthetic
KS2 (age 7 - 11)	<p><u>Animation</u></p> <p>The KS2 animation includes the use of a character ‘Miss Molecule’ (a water Molecule) to explain the stages of the geothermal system. Other aspects of the session build on her introduction.</p> <p><u>Site Tour</u></p>	<p><u>Presentation</u></p> <p>PowerPoint presentation including careers, geothermal in general and introduction to session</p> <p><u>Questions & Answer session</u></p>	<p><u>Worksheet</u></p> <p>A worksheet is given at the end of the session to gauge understanding and learning.</p>	<p><u>At school</u></p> <p>Miss Molecule’s Mission (a physical style circuit game)</p> <p><u>At site</u></p> <p>Memory-match game</p>
KS3 (age 11 – 14)	<p><u>Animation</u></p> <p>The KS3 animation gives more technical detail of the project and explores higher knowledge areas.</p> <p><u>Site tour</u></p>	<p><u>PowerPoint</u></p> <p>Individual group presentations and learning hub presentations</p> <p><u>Questions & Answer session</u></p>	<p><u>Worksheet</u></p> <p>Adapted version of KS2 worksheet aimed at a higher level of understanding</p>	<p><u>At School</u></p> <p>Attending ‘STEM’ Discovery days</p> <p><u>At site</u></p> <p>Higher difficulty memory-match card game</p>

Table 1: Learning styles applied for the UDDGP education programme at Key Stage 2 and 3

GEL commissioned the production of two animation videos; one for ages 7-11, the other for ages 11 +. The team worked closely with a local animation studio to tell the story of geothermal energy and how it relates to current global issues such as climate change. The mechanics of how a geothermal energy system works were explained in both animations, with the video for younger children featuring a character called “Miss Molecule” who transports the heat energy from the reservoir to the power plant to produce electricity.



Figure 1: ‘Miss Molecule’ – The main character from the KS2 animation that helped GEL to teach the concept of water flow at United Downs

2.4 Key Stage 4 and the Raspberry Shake programme

At age 14, secondary school children select subjects to study during years 10 and 11 before taking GCSE (General Certificate of Secondary Education) exams. This is referred to as Key Stage 4. The GEL programme for this age group was aimed at those who had chosen geography as a subject. The standard geography curriculum includes very little on geothermal energy but does include the study of tectonics, earthquakes and volcanos. The GEL programme therefore used the concept of a 'dynamic earth' to introduce the subject of geothermal resources and explain the UDDGP concept.

As part of the programme GEL provided nine local secondary schools with Raspberry Shake seismographs; essentially raspberry pi computers with geophones to measure ground vibration. They are sensitive enough to detect both local and global-scale seismic events. Once installed, these systems become part of a global network of 'Shakes' as well as contributing to a Cornish schools microseismic monitoring network. The installations create a link between industry and education, giving students the opportunity to be involved in a real project and analyse live data associated with a local engineering development. The data also highlights the level of naturally occurring background seismicity, which helps to 'normalise' discussions around induced events.

As well as being a good educational tool, the installation of the Raspberry Shake network densifies the company's own microseismic monitoring system and provides another data source, adding a further level of confidence to recorded results.

The Raspberry Shake Programme was launched at the end of November 2018. Three 'Hub Sessions' were held at secondary schools closest to the project site, reaching approximately 550 Year 10 geography students. Each Hub Session comprised a presentation from UDDGP staff, a viewing of the KS3 animation and a Q&A session.



Figure 2: Raspberry Shake Seismic Hub at Richard Lander School, Cornwall.

The events seemed to spark a genuine interest in many of the students and provoke a positive response not only about UDDGP itself but the role of microseismicity within the project. The often negative public perception of seismicity is something that GEL is very aware of and the Cornish Raspberry Shake Programme is one approach that can be taken to openly and objectively discuss the subject.

Although the sessions were aimed specifically at Year 10 geography students, the resource can be used by teachers across a range of subjects and ages. Therefore a follow up session was held specifically for teachers, comprising a day-long workshop running through the uses and applications of the Raspberry Shake tool, with demonstrations of software available for school use to interpret the data.

2.5 Careers-focussed education

The Further and Higher Education elements of the programme are largely run on site and aimed at small groups of students from specific subject areas such as geology, geography, renewable energy and environmental science. The students are given a presentation tailored to the needs of their course with further time for questions and answers. After the session in the classroom the students are taken to the viewing platform overlooking the site to have the current site activities explained to them.

Universities from all around the UK have attended site visits, with Camborne School of Mines (CSM) having a particularly close relationship with UDDGP. Staff from GEL have also given lectures as guest speakers at universities across the country. Informing the next wave of graduates about the work at UDDGP has been a priority for the outreach team.

GEL staff have also been invited as Key Note Speakers to a variety of career-focused events encouraging young people into engineering and geoscience, and also to events aimed at promoting the industry specifically to young women.

Internships were awarded in 2018 and 2019 covering different aspects of the project including engineering, geophysics and geology.

Parallel to the education programme, GEL has run an extensive community outreach programme (see Section 4). This has instilled a renewed enthusiasm amongst the older generation who remember the mining era in the county first-hand, and aligns well with the new interest sparked in the younger generation, particularly those local to the site. By connecting with the contrasting age groups, the information provided by GEL has filtered through to a large proportion of the local population.

School-age children and students are far more aware of the effect that climate change is having on the world and are supportive of a new technology in the UK that will reduce carbon emissions within the energy industry. At the end of site visits, young students are asked to write one thing that they have learned or like about geothermal energy or the UDDGP project. These are a good indicator of how the intended messages from the education programme are received.



Figure 3: Notes left by younger students visiting the site.

3. EDUCATION RESULTS

The real benefits of the education programme will only become apparent in the long term, when students that have been exposed to it make choices about their further education and careers and form lasting opinions about renewable energy and the environment.

However, it is clear that the great majority of students have enjoyed their exposure to the project and gained something from it. There has been very positive feedback from teachers, especially from primary schools, expressing their support for the programme. The outreach has not only made resources available for schools but has also enabled teachers to use United Downs as a case study in both geography and science as part of the teachings of renewable energies.

In purely numerical terms, the programme has reached 46 educational institutions and approximately 3000 students. Figure 3 shows that the programme has extended over a wide geographical area.



Figure 4: Locations of schools and institutions that have interacted with UDDGP.

4. COMMUNITY OUTREACH PROGRAMME

It was recognised from the beginning of the project that effective community engagement was as important as the technical aspects of the programme. The outreach programme was designed to ensure that accurate and easily understandable information was readily available to the communities closest to the site and also to the wider population of Cornwall. A multi-faceted approach was adopted from the outset but with a significant focus on the drilling phase, which was the most likely cause of concern because of potential environmental and disturbance concerns.

Dissemination of information began as soon as the funding agreements were signed in June 2017, nine months before any activity took place at the site itself and more than a year before drilling began. It was important to ensure that the project team came to be recognised as the most up to date and reliable source of information and to prevent speculation becoming “fact”. The programme was developed, refined and expanded as the project progressed:

A year in advance:

- Public information events held in community centres
- Hand delivery of information flyers to homes and businesses
- Formation of a Community Liaison Group
- Attendance at local Parish Council meetings to present project plans
- Creation of a dedicated project website and social media feeds

Six months prior to drilling:

- Appointment of a Community Relations Manager
- Introductions to local community groups
- Regular updates on the website and social media feeds
- Regular updates to village and parish magazines and newsletters
- Attendance at summer fairs and other community events

During drilling:

- Public drop-in sessions (open days) at the drilling site
- Presentations to interested groups, both on-site and at other locations
- Drilling updates to the project website and social media feeds
- Visiting local community groups on a regular basis
- Repetitive attendance at local summer fairs and shows to reach a wider geographical audience
- Contributions to the local economy (including a community grant fund)

4.1 Breaking down barriers and proactive engagement

In order to help address any concerns that the local population may have felt towards UDDGP, it was important to earn the community’s trust, through a local and qualified team. A Community Relations Manager was employed in the early stages of the project to work in and with local communities. This direct personal contact was an important element in gaining trust, since information alone can’t be held accountable and questioned, but an individual can. GEL appointed a Community Relations Manager who already had relationships with some of the residents, which helped new relationships to be formed more quickly.

Members of the public who have concerns may, nevertheless, be reluctant to express them, or know how to go about it. Therefore a very proactive approach was taken to interactions with the community. In addition to the larger events attended by the project team, the Community Relations Manager regularly attended smaller events, such as coffee mornings, and

asked those present for feedback, opinions and questions in order to open an effective dialogue. Transparency is also crucial to building trust in both the project and the project team. Information was widely shared and problems were discussed openly. The public was given easy and direct access to the project team at all levels and encouraged to engage with it.

4.2 Community Liaison Group

As a further, more formal, means of maintaining a dialogue with the community, a Community Liaison Group was established in 2017. Members of the project team, local residents and businesses, parish and county councillors and other stakeholders met regularly, beginning almost a year before drilling began. The meetings served as a vehicle for direct two-way communication, allowing the project team to provide reliable and up to date information on progress and plans, and the community representatives to raise any issues that were of concern and make suggestions regarding communications and information sharing.

The meetings were very productive and helped forge good relationships which have served the interests of all parties. They have been valuable in giving the project team an insight into the issues affecting the communities closest to the site.

4.3 Responsiveness

An important principle of the community liaison policy is that the UDDGP team will be very responsive to enquiries and complaints from members of the public. Concern had been expressed in the planning stages that communications through the local authority were likely to be slow and, generally, unsatisfactory in terms of addressing issues.

To combat such concerns, the Community Relations Manager remained contactable at all times and the public were given several options for contacting the project team, with an undertaking that they would receive a direct and prompt response:

- Strategic members of the team have 24/7 access to emails.
- A “Contact Us” form on the website which was monitored by two members of staff any urgent messages would be dealt with in or out of normal working hours.
- A 24/7 response phone line.
- A downloadable noise monitoring fact sheet and options for different methods of contact with the complainant

This initiative has proved to be extremely successful; people who have contacted the project team all received a timely response.

4.4 Giving back to the community

A community grant fund of £20,000 per well was made available for community projects within the local parishes. Applicants were encouraged to apply for funds ranging from £250 to £2500 and funding priority was given to those projects that incorporated a sustainability or carbon reduction aspect within their application. Many funding applications were received and grants were awarded to two public children’s parks, a play scheme for a travellers’ community, a community hall access ramp and a defibrillator for the outside of a village hall. The second round of funding applications will close early in August 2019.

GEL also made a conscious effort to purchase services and supplies as locally as possible, and encouraged its major contractors to do the same. It is estimated that the project has contributed £1.5m to the Cornish economy, with two thirds of that amount being spent within 10 miles of the project site.

5. COMMUNICATION PLATFORMS AND METHODS

A variety of platforms and methods have been used to disseminate information. Flexibility and adaptability were required to meet a range of online and physical circumstances and locations. These can be summarised as follows:

- Public visits to the site
- Presentations at other locations
- Exhibitions and information booths at other locations
- Online resources
- Written updates

5.1 Public visits to the site

Two kinds of visits have taken place; organised group visits and public ‘drop-in’ sessions. Organised group visits take the form of a presentation, usually by a technical member of the UDDGP team, followed by a questions and answers session and some time spent on the visitors’ viewing platform. The presentation material varied according to the member of staff involved and any particular special interest of the group, but generally included an introduction to geothermal energy, followed by details of the UDDGP project history, objectives and progress. In most cases the KS3 animation was also shown. At the time of writing (July 2019), 48 groups had visited the site; a total of 824 members of the public.

Monthly public drop-in sessions were held, starting in November 2018. A dedicated visitors' room allowed members of the public to interact with the project team, view information panels, see the drilling operation from the viewing platform and watch project films. Each session lasted approximately 2 hours and attracted, on average, 150 people. To date 1030 people have attended these sessions. About 25% were from the four parishes closest to the site but more than half were from other parts of Cornwall (Figure 5), which is encouraging for the planned future geothermal development in the county.

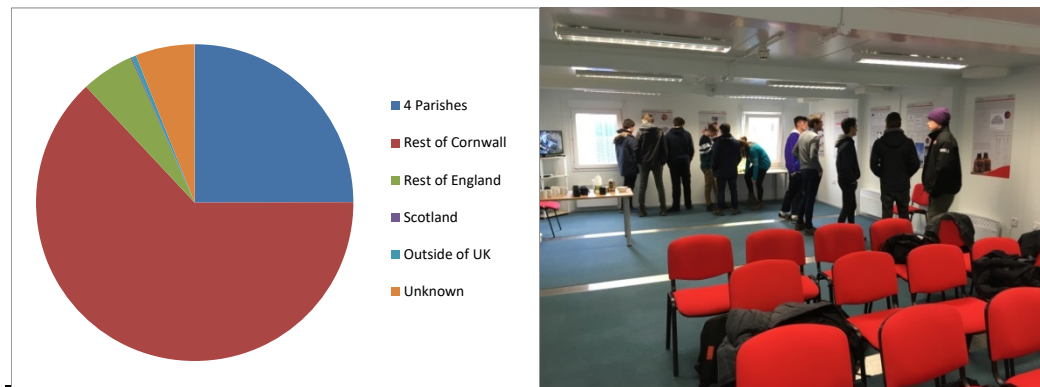


Figure 5: Geographical spread of visitors to the drop-in sessions and examples of information panels in the visitors' room

GEL worked hard to create a friendly and user-focussed experience for visitors. Information panels were designed to present a clear and comprehensive explanation of the project, from geothermal basics to the more complex subjects of drilling, geology and seismicity. An important element in the design of these panels was to present information in a way that would be comprehensible to all levels of understanding. This principle also applied to the exhibition material and online resources (see below). The images used could have been very alien to those not within the industry so it was important not to use scary or dramatic imagery to explain the engineering and science aspects of the project

5.2 Presentations at other locations

GEL staff made presentations to a variety of groups from widespread geographical locations and backgrounds, from non-technical to specialist (such as local mining and geology groups). There were a number of specific interest groups that booked talks with specific members of the UDDGP team. As well as more technical talks, GEL hosted a number of talks to local interest groups such as Women's Institutes and church groups, all of whom have built strong relationships with their respective communities.

Presentation material was generally the same as used for the group visits to the site.

A small number of presentations were made to specifically targeted audiences. These included representatives of the Local Authority and Local Enterprise Partnership, and a group of 'environmental ambassadors'; organisations with particular environmental concerns (such as Friends of the Earth and Greenpeace) lobbying groups and companies with sustainable credentials. The purpose of these presentations was to inform and build relationships with individuals and groups who shape the economic growth of the county and who are guardians of its environment.

5.3 Exhibitions and information booths at other locations

At project-specific exhibitions, public meetings, community events and shows it is not practical to make presentations of the kind described above. For those events GEL prepared large and small exhibition panels (Figure 6). The large panels were generally used for indoor events in large venues while the small panels, together with a TV screen for displaying project films, were used as an information booth in small venues and outside. The content and design principles adopted for these panels were the same as for the information panels at the site.

To date, the panels have been used at around 30 public events reaching approximately 1000 people



Figure 6: Exhibition panels used for public events away from the site

5.4 Online resources

Project website and social media feeds have been crucial in providing a dependable and constant source of information online. The website was designed and managed by GEL and includes content on geothermal energy in general and the project specific specifically. The drilling progress page was updated on a near daily basis and information was also provided about the future programme. The updates provided on the website proved to be very popular as the page constantly generated the highest number of user sessions, especially during the drilling phase of the project.

It was very important from the start of the UDDGP project to create a strong online presence to a local and worldwide audience and to provide feeds where users knew the information was from a reliable source. The website worked in parallel with the project's social media feeds, particularly Facebook and Twitter. By having both platforms GEL was able to create relationships with people online and help build the trust in the project by providing a platform for reciprocal communication.

As well as the animations that were made for the education programme, GEL commissioned a series of short films lasting only a few minutes showing strategic moments within the project. They have been used extensively at public and educational events, and in presentations, and also available online.

5.5 Written updates and media

There has been considerable media interest in the project, both locally and nationally. Media events at the start of drilling in November 2018 resulted in publicity locally and also broadcast pieces on national TV, radio and in national newspapers. The project is able to supply broadcast quality material from its own resources and provide updates as appropriate. In general the timing of these updates is controlled by the project team.

Various magazines and journals have published pieces about the project.

On a local scale, the project team provides regular updates to local parish and village newsletters, which are widely circulated in the area.

6. COMMUNITY RESPONSE

Experience from the UDDGP project clearly demonstrates that a carefully thought out, properly planned and well implemented community outreach programme is not only the right thing to do, but also provides a tangible benefit.

The response within the local community, the wider population of Cornwall, among visitors to the site and from audiences at presentations has been overwhelmingly positive. This has been reflected both in verbal comments and online communications. The project team has built and maintained good relationships with the public and other stakeholders and the project itself enjoys considerable public support. There is growing enthusiasm for the development of a geothermal industry in Cornwall and this will go a long way towards paving the way for future projects in new communities.

It is particularly satisfying to record that the local residents have been very supportive. In the planning stage of the project it was these residents who were most concerned about the potential disruption and disturbance that would result from the site preparation and 24 hour drilling operations. But well managed site operations, coupled with good communications and a continuous flow of trustworthy information, has resulted in their fears being unfounded.

Also, despite initial concerns, and perceived similarities between UDDGP and so-called 'fracking' projects, there have been no public protests and work has not been impeded.

Since the creation of the website and social media feeds in 2017, the online audience has grown and the project now has a strong local and global presence, with a range of industry and non-industry followers. The project's social media feeds have received overall positive engagement, and project posts, especially those that celebrate milestones in the drilling process, have had a lot of supportive comments and shares. Through social media, the project has even gained 'unofficial local ambassadors' who defend it, correct misinformation and direct those expressing concern to the UDDGP website.

7. CONCLUSIONS

The education and outreach programmes implemented at the United Downs Deep Geothermal Power have been very successful in developing relationships with local communities, schools, businesses, academia and members of the public from primary school to retirement age.

Geothermal Engineering Ltd set out to provide a reliable source of information and establish smooth and direct lines of communication to and from the community, built on principles of transparency and trustworthiness. The tangible and measurable response has shown that it has achieved these objectives.

The programme has reached thousands of schoolchildren, students and members of the general public in a short period of time and generated significant, and growing, enthusiasm and support.

The in-house development of bespoke educational materials has allowed the project team to address the specific needs of its various target audiences and effectively communicate to specialists and non-specialists alike over a wide range of age groups, using a mix of physical media, presentations and online resources.

The positive experience from UDDGP and the earned acceptance of the local community will help to pave the way for future geothermal developments in the county.

REFERENCES

- Marcy, V., 2001. Adult learning styles: How the VARK Learning Styles Inventory can be used to improve student learning. *Perspectives on Physician Assistant Education*, 12(2), pp.117-120.
- Ledingham, P. and Cotton, L.: The United Downs Deep Geothermal Power project. *Proceedings, World Geothermal Congress 2020, Reykjavik, Iceland (2020)*.
- Parker, R.: *Hot Dry Rock Geothermal Energy, Phase 2B Final Report of the Camborne School of Mines Project*, 1-2, (1989), Pergamon Press, Oxford, UK.
- Parker, R.: The Rosemanowes HDR project 1983-1991. *Geothermics*, 28, 4/5, (1999), 603-615.
- Richards, H., Parker, R., Green, A., Jones, R., Nicholls, J., Nicol, D., Randall, M., Richards S., Stewart, R., Willis-Richards, J.: The performance and characteristics of the experimental hot dry rock geothermal reservoir at Rosemanowes, Cornwall (1985-1988), *Geothermics*, 23, 2, (1994), 73-109.