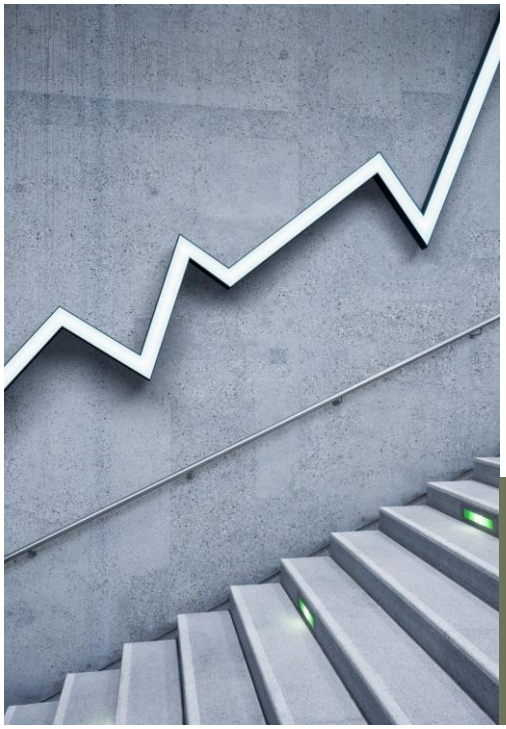

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Geothermal Energy

"ENERGY FOR THE FUTURE, BUT THE FUTURE IS NOW"

Elaine Egan
Rory Dunphy GSI
Koen Verbruggen GSI

Outline of Module:

<u>Lesson 1</u>: Introduction to Geothermal Energy (Case study: Iceland)

<u>(Double or Part1/Part2) Lesson 2</u>: Geothermal Energy Capture Types & Case Study: Ireland

<u>Lesson 3:</u> Student Investigation Question: What type of Geothermal Energy Capture is most suitable for Dublin City & Why?

<u>Lesson 4:</u> Group Presentation of Research Findings/Assessment

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Module Learning Outcomes:

- Students should be able to understand the concept of geothermal energy and its link to rocks
- Gain a deeper understanding into the geological processes involved in geothermal energy
- Learn about the ways in which geothermal energy is captured and its uses
- Learn about a number of case studies; Iceland & Ireland
- Work together to investigate if geothermal energy is/can be a source of sustainable renewable energy for areas in Ireland and identify advantages and/or current limitations.

Lesson 1 outline: Geothermal Energy Introduction & Iceland Case Study

- **Think/ Pair/ Share- Brainstorm on the links that volcanic activity and the rock cycle have on geothermal energy**
- **Advantages/Limitations of Geothermal Energy displayed by students on classroom wall**
- **Video on Geothermal Energy in Iceland**
- **Advantages/ Limitations on wall revisited and added to**
- **General video on Geothermal Energy & exit card activity**
- **LC Case study on Geothermal Energy in Iceland (Read & use Placemat to break down content)**

Geothermal Energy: Volcanic Activity & Rock Cycle

Class Activity 1 (5 mins):

Look at the Fig 1. The Rock Cycle:

- Think about the links that volcanic activity and the rock cycle has with Geothermal Energy
- Pair with your neighbor and discuss (add to your points if possible)
- Share and input into to a brainstorm on the whiteboard

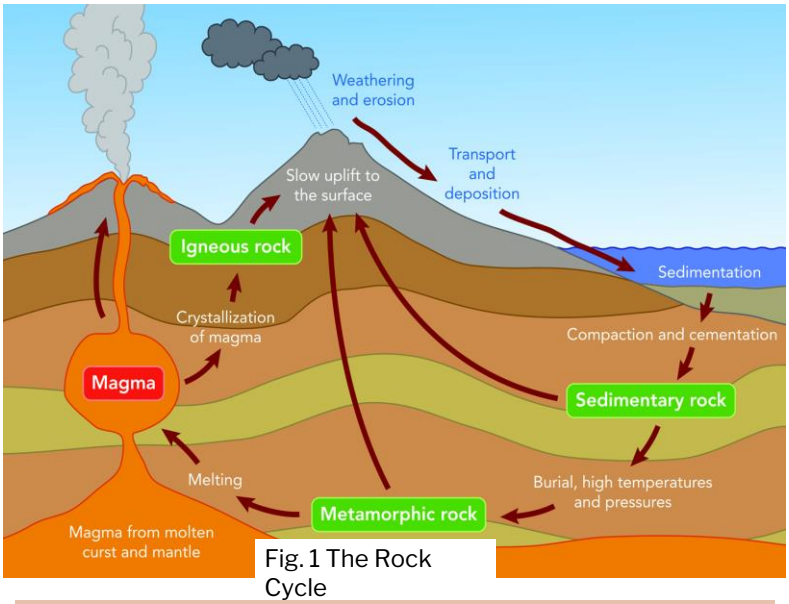


Fig. 1 The Rock Cycle

Class Activity 2: (5 mins)

Take a sticky note and write any advantages/ limitations of geothermal energy you can think of, and stick it to the GEOTHERMAL WALL!!

Geothermal Energy: Iceland

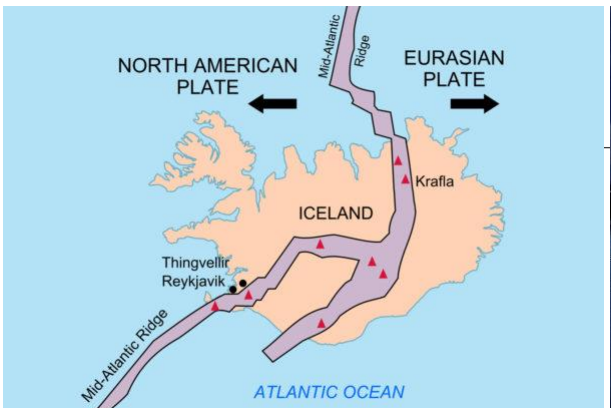


Fig. 2 Located North of Ireland on the boundary of the N. American & Eurasian constructive plates

Fig. 3 Geothermal Power plant and Blue Lagoon

Class Activity 3

While watching the following video, note any further advantages/ limitations that you learn about and place them on a sticky note to add to the wall afterwards

How Geothermal Energy Revolutionised Iceland's Greenhouses | Earth Lab - YouTube (9 mins)

End of Class Activity:

Watch the following: (3mins)
Energy 101: Geothermal Energy – YouTube

3	THINGS YOU FOUND OUT:
2	INTERESTING THINGS
1	QUESTION YOU STILL HAVE

Homework Task:

- Read handout on Geothermal Energy in Iceland
- Using Placemat template break down the case study into bullet point facts using the 4 headings:

1. Iceland and Geothermal Energy
2. How is geothermal energy captured?
3. Uses of Geothermal energy
4. Benefits of Geothermal Energy

Lesson 2 Outline: Part 1: Geothermal Energy Capture Types & Case Study: Ireland

- Handout on Geothermal Energy Explained (Dr. Sarah Blake GSI)
- Various students read out each section and then discuss main points for further clarification.
- Geothermal Energy in Ireland FAQ (students spend time reading this, noting important facts- highlight to them that this is very useful information that they may wish to use when given the main module task)
- Use of the Geothermal Suitability maps for Ireland
- Homework Activity: Identifying areas of suitability for each of the 3 types (vertical closed loop, open loop domestic and open loop commercial)

Ireland:
Shallow Geothermal Energy

- **Activity 1: (10mins)**

- Handout on Geothermal Energy Explained (Dr. Sarah Blake GSI) Various students read out each section and then discuss main points

Individual Device/Handout Activity 2 (10 mins):

Geothermal_energy_FAQ.pdf (gsi.ie) Students read themselves- highlighting important facts

Group Work/Device Activity 3 (10 mins):

-**Explore in groups with a device/tablet the following link: Geoenergy (gsi.ie) completing the following questions:**

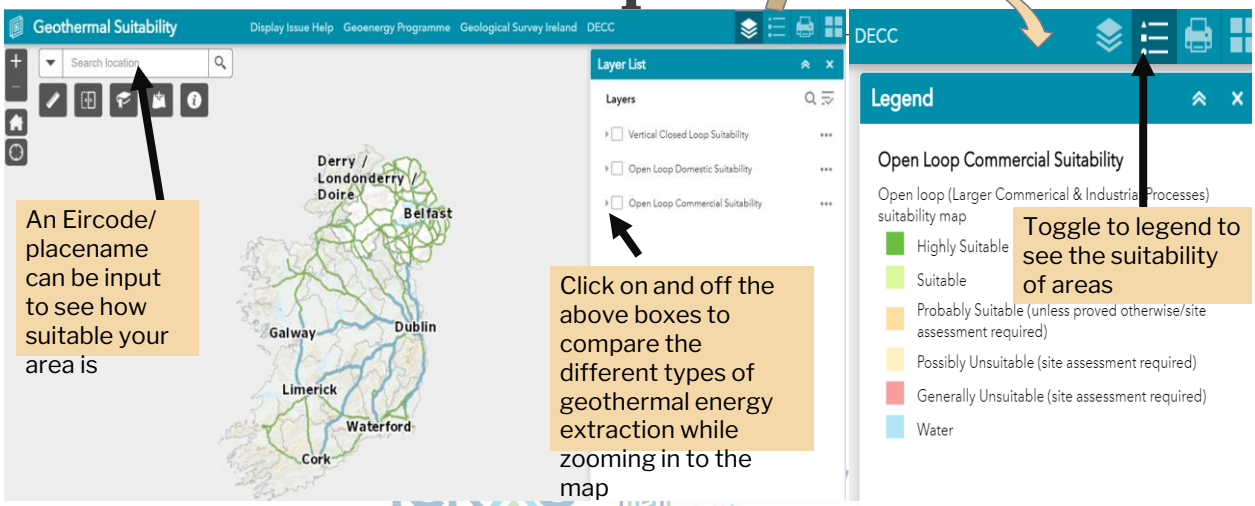
- 1. What is ground source heat energy and how can it be collected?
- 2. What does the Geothermal Suitability Map indicate?
- 3. What are the types of Geothermal Energy capture mentioned?

Type	Source
Data Download	Zip file
Map Viewer	Link to viewer
Web Services	Rest services

Group Work Activity 4 (10 mins

When finished the questions, on the link page: Click "Link to Viewer"

Using the Geothermal Suitability Map



Geothermal Suitability Map

Device Homework Activity: Access the map from the link given on the online platform (using information on this PowerPoint also accessed on the online platform)

Use the map on a device to identify 3 areas for each of the 3 layers (vertical closed loop, open loop domestic and open loop commercial) :

1. High Suitability
2. Probably Suitable
3. Generally Unsuitable

Lesson 2 Outline: Part 2: Geothermal Energy Capture Types & Case Study: Ireland

- **5 min video on use of the Irish District Heat Atlas Map**
- **Students use devices in groups to experience the data available on Irish District Heat Atlas Map**
- **Investigation of the Tallaght District Heating Scheme and Questions to answer**
- **Homework Activity to investigate further information available through links provided**

Using The Irish Heat Atlas Map: Irish District Heating Association

Class Activity 1 (5 mins):

Irish Heat Atlas: Version 1 – YouTube Please watch this 5 min video on how to use the map and gain insight into the potential for district heating uses in different areas of Ireland (in specific please focus on Dublin)

Groupwork/Device Activity 2 (15 mins):

Click the link now and familiarise yourself with the map: Irish Heat Atlas Version 2.1 (arcgis.com) (Look at all areas, but also a focus on Dublin)

District Heating Projects in Ireland: Tallaght

Tallaght District Heating Scheme | Energy Efficiency Agency Dublin | Codema

Group/Device Activity 3 (15 mins): Click on the link and answer the following questions:

- 1. When is the projects Phase 1 due to start?
- 2. How many tonnes of CO2 does the project aim to reduce each year?
- 3. What is district heating?
- 4. Where will the waste heat be obtained from and how much of the energy demand will it cover?
- 5. How much funding was secured for the project and where did it come from?
- 6. List 4 benefits of being connected to a District Heating Scheme

How it works..

- **More Information:** district_heating_brochure.pdf (codema.ie)

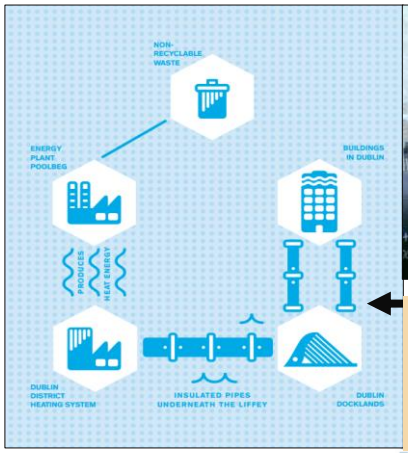


Fig 1. Waste incinerated in Poolbeg produces heat energy that is put through the DHS and piped under the liffey to Dublin docklands and buildings in Dublin

Fig. 2 Insulated pipes (left) and new service tunnel under the Liffey (right)

Further Information Links

Homework Device Activity: Please click on the links below and investigate the further information that is available for your final task

Geothermal Energy (gsi.ie)

Energy 101: Geothermal Heat Pumps – YouTube

Geothermal Energy | A Student's Guide to Global Climate Change | US EPA

Shallow Geothermal Energy (gsi.ie)

district_heating_brochure.pdf (codema.ie)

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Lesson 3 outline: Student Investigation into Geothermal Energy viability in Dublin City

- Arrange students into groups of approx. 4 students each
- Direct students to school platform (or online classroom) where they can access links/resources used in the module and/or additional resources to assist their research.
- Outline research question and break down the body of the research
- Outline methods of producing/submitting findings (video, powerpoint presentation, report)
- Students may be given an extra class to work on this if needed.

Student Investigation into Geothermal Energy viability in Dublin City

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6

Investigating : What type of geothermal energy is suitable for Dublin city and why?

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Breakdown of Research Question:

Research Question: What type of geothermal energy is suitable for Dublin city and why?

In groups do an approx. 5-10min presentation/report/video on what type of geothermal energy capture is most suitable for Dublin city and why.

Think about:

What type is most suitable:

- **Geologically**
- **Economically**
- **Demand**
- **Limitations/ Current Barriers**

- Each person will take on an area to research
- Resources online on student accessed platform (provided)

Further Instructions for this lesson:

Get into your assigned groups

Decide who is doing which role (or pick randomly)

Brainstorm/ break down the question in general as a group

Access the PowerPoint presentation/documents/links available for information to assist your research

Discuss what way/ how you are going to collaborate/ research/ targets

What presentation method will you use/ why

Questions you need to ask teacher

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Lesson 4 outline: Group Presentation of Findings

- Groups will be expected to upload their collaborated findings (to student accessed platform) as part of a finished project to asses the research question
- This format can be video/PowerPoint presentation/report (5-10 mins per group depending on number of groups in the class)
- Students will present their findings as a group and the remaining students should be given an opportunity to ask questions at the end of the groups time.
- For assessment each group should have addressed the research question through the different aspects given (Geologically, Economically, Demand, Limitations/ Current Barriers)
- Any suitable presentation formats should then be printed & displayed on the "Geothermal Wall" established at the start of the module

Example of Assessment

-Can be altered to suit different groups

Percentage	Descriptor	Criteria achieved based on group work and presentation of findings
90-100	Distinction	Excellent group work, work load shared appropriately, evidence of further research, all points covered, findings identified and excellent presentation of findings
75-90	Higher Merit	Very good group work, workload shared, some further research evident, most points covered, findings identified and very good presentation of findings
55-75	Merit	Good group work, medium sharing of workload, little further research evident, points covered in small detail, basic findings identified,
40-55	Achieved	Disjointed group work, poor sharing of workload, no further research evident, points not adequately addressed in a basic way, no findings identified, poor presentation of findings in general
20-40	Partially achieved	Little to no group work, Group not collaborating in a basic manner, 1 or 2 students in group attempted work, very poor findings evident, very poor presentation of findings
0-20	Not Graded	No group work, no roles/work shared, very little progress made, incomplete/no presentation of findings

Acknowledgments

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