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Data Article

Life-cycle inventory data and impacts on electricity production at the United Downs Deep Geothermal Power project in the UK

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A R T I C L E I N F O

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A B S T R A C T

This data article supports the research article “Geothermal energy in the UK: the life-cycle environmental impacts of electricity production from the United Downs Deep Geothermal Power project”. The article reports inventory data, primarily on the construction of the geothermal wells, that is not reported in the main article, and the complete, disaggregated numerical values of the life-cycle environmental impacts reported only in part and in graphical form in the research article. The article also includes data supporting comparative analyses between deep geothermal energy and other energy technologies in the UK, and between the impacts of the construction of wells in a deep and conventional power plant.

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Specifications Table

Subject	Environmental Engineering
Specific subject area	Life Cycle Assessment and geothermal energy
Type of data	Table
How data were acquired	Inventory data was collected at the United Downs Deep Geothermal Project site; LCA results were extracted from Gabi software.
Data format	Raw and processed.
Parameters for data collection	Data collected on-site or extracted from Gabi software
Description of data collection	Inventory data for wells construction was collected on-site and is based on the wells' preliminary design; life-cycle environmental impacts were generated using Gabi software; and data on energy technologies and conventional geothermal wells construction comparison is based on literature.
Data source location	UK for inventory data and life-cycle environmental impacts; Iceland for impacts of conventional geothermal wells construction.
Data accessibility	With the article
Related research article	Paulillo, A., Cotton, L., Law, R., Striolo, A., Lettieri, P., 2019. Geothermal energy in the UK: the life-cycle environmental impacts of electricity production from the United Downs Deep Geothermal Power project. J. Clean. Prod.

Value of the Data

- Inventory data on the construction of geothermal wells at the United Downs Deep Geothermal Power project; and numerical values of the life-cycle environmental impacts from electricity production at UDDGP.
- Data is primarily of interest to Life Cycle Assessment practitioners.
- Data can be used as the basis for further LCA studies on enhanced geothermal systems, as well as for comparative studies with other energy technologies.

1. Data

This data article supports a study of the life-cycle environmental impacts of the first geothermal power project in the UK, namely the United Downs Deep Geothermal Power (UDDGP) project [1,2]. Data includes i) the complete inventory for the construction of the geothermal wells, which is reported only in part in the related research article and ii) the numerical values of the life-cycle environmental impacts that are reported only for selected impact categories and in graphical form in the related article. The data is included in two separate spreadsheets.

The “Inventory” spreadsheet reports the preliminary design of the geothermal boreholes, including length and weight of each casing section, and diameters of the casing and the hole for each section of the wells; the inventory for concrete, drilling mud and spacer for each well; the inventory for chemical and hydraulic stimulations, obtained from Refs. [3–5]; and the technical parameters for the calculations of the allocation factors between electricity and thermal energy used for the heat and power cogeneration scenario.

The “LCA results” spreadsheet reports the normalised impacts per person in Europe, of electricity production from the United Downs Deep Geothermal Power (UDDDGP) project and the complete hot-spot and scenario analyses, including contributions from each activity in the product system. Table 1 reports the results of hot-spot analysis for the base case scenario. The normalised impacts are calculated according to the ILCD (International reference Life Cycle Data system) method [6] for all impact categories but ionising radiations, which is based on [7]. The excel document also reports the numerical values of the comparison between the environmental performance of UDDGP and that of other energy technologies in the UK, which are obtained from the Ecoinvent database [8], v3.4 (the name of each activity is also included). Finally, the spreadsheet reports the results of the comparison between the construction of the wells at UDDGP and those at the Hellisheidi geothermal plant in Iceland, obtained from Refs. [9,10] and based on the life-cycle inventory developed by Karlsdóttir and colleagues [11].

Table 1
HOT-SPOT analysis of the base case scenario.

Impact categories	Collection pipelines	UD1 WELL	UP2 WELL	Power plant	Total
Acidification [mole of H^+ eq.]	1.16E-06	1.96E-04	3.24E-04	2.32E-05	5.44E-04
Climate change [kg CO_2 eq.]	1.89E-04	1.67E-02	2.66E-02	2.95E-03	4.65E-02
Ecotoxicity freshwater [CTUe]	5.53E-03	1.52E-01	2.29E-01	1.11E-01	4.98E-01
Eutrophication freshwater [kg P eq.]	1.25E-07	4.25E-06	6.44E-06	2.16E-06	1.30E-05
Eutrophication marine [kg N eq.]	2.10E-07	8.05E-05	1.34E-04	7.23E-06	2.22E-04
Eutrophication terrestrial [mole of N eq.]	2.35E-06	8.80E-04	1.47E-03	7.07E-05	2.42E-03
Human toxicity, cancer effects [CTUh]	1.36E-10	4.85E-09	7.35E-09	1.66E-09	1.40E-08
Human toxicity, non-cancer effects [CTUh]	2.05E-10	6.53E-09	9.88E-09	3.13E-09	1.97E-08
Land use [kg C deficit eq.]	2.85E-04	3.72E-02	6.11E-02	5.21E-03	1.04E-01
Ozone depletion [kg CFC-11 eq.]	1.06E-11	2.48E-09	5.98E-09	2.15E-09	1.06E-08
Particulate matter/respiratory inorganics [kg PM2.5 eq.]	2.57E-07	3.28E-05	5.40E-05	4.45E-06	9.15E-05
Photochemical ozone formation [kg NMVOC eq.]	8.14E-07	2.37E-04	3.94E-04	2.11E-05	6.53E-04
Resource depletion water [m^3 eq.]	1.06E-06	4.16E-05	6.34E-05	2.38E-05	1.30E-04
Resource depletion, mineral, fossils and renewables [kg sb eq.]	8.15E-09	2.70E-07	4.20E-07	1.66E-07	8.64E-07
Ionising radiations [Bq u235 air-equiv]	3.06E-03	1.07E-01	1.64E-01	3.93E-02	3.14E-01

2. Experimental design, materials, and methods

The inventory data for the wells construction was obtained from preliminary designs collected on at the UDDGP site. The allocation factors for the co-generation case are based on the exergy of electricity (which is equal to 1) and heat, calculated assuming a re-injection temperature of 40 °C and a generic temperature of 10 °C for the surrounding environment. The life-cycle environmental impacts were generated with Gabi sustainability software, version 8, using the Ecoinvent database version 3.4 [8] for all background activities. The ILCD impact method [12] enhanced with the radiological impact category for ionising radiations developed by Paulillo [7] was used to translate the inventory into environmental impacts. Numerical values of impacts generated by the LCA software have been only slightly amended to improve readability and clarity.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2020.105117.

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