



# DESIGNATE

## Decision Support under Uncertainty for Geothermal Applications

**DURATION**  
15/12/2019 - 15/03/2024

**BUDGET**  
1 000 217 €

### PROJECT DESCRIPTION

The DESIGNATE project (Decision Support under Uncertainty for Geothermal Applications) investigates geothermal applications for direct heat use or cogeneration of heat and electricity from deep geological reservoirs and abandoned mines. The goal of this project is to make forecasts about the role of these geothermal applications in the Belgian energy portfolio and provide support for strategic planning of subsurface activities by:

- Explicitly considering uncertainties in modelling non-standard geothermal resources;
- Creating tools for integrated forecasts under uncertainty;
- Setting up a methodological framework for territorial LCAs considering surface and subsurface impacts;
- Analysing interferences and their consequences for geothermal energy deployment in Belgium.

In order to meet climate goals and provide energy security, geothermal energy can play an important part in Belgium's energy production portfolio. The current implementation of geothermal energy in Belgium is very limited, making accurate forecasts about the economic potential difficult. In the DESIGNATE project, tools and workflows are developed to investigate the potential of deep geothermal energy and geothermal applications in abandoned mines in Belgium, considering uncertainties at reservoir, technology and economic level.

The classical approach of using numerical reservoir simulations as input for economic models often falls short in the area of uncertainties, investment risks and regional energy and environmental simulations. Analytical models can provide fast and continuous results with an accurate representation of uncertainty in techno-economic and environmental models. The DESIGNATE project will develop analytical models for different geological settings and technological applications. The challenge arises when stepping away from simple well designs and homogeneous reservoirs, and when uncertainty is introduced. Analytical solutions will be developed to predict the evolution of temperature and pressure in geothermal doublets and single well geothermal systems in fractured reservoirs, as well as to determine the geothermal potential of abandoned mines.

These analytical models will provide direct input for a geological techno-economic assessment (G-TEA) and a territorial life cycle assessment (LCA). The G-TEA will include decision tree analysis and Real Options analysis for allowing flexible adjustment to uncertainty, and will be based on the developments of the Belspo ALPI project. The territorial LCA approach will include determining impacts on the surface and subsurface, with a time and spatial aspect. Both G-TEA and LCA results will be coupled to provide a full overview of impacts of geothermal projects. Introducing flexibility in the decision-making process is an innovative and more realistic way of dealing with uncertainties.

In parallel, the current version of the Policy Support System (PSS) for geological CO<sub>2</sub> storage will be converted to make integrated forecasts under uncertainty on the deployment of geothermal projects in a regional context. PSS Geothermal will simulate making investment decisions on geothermal projects by using optionality and nested Monte Carlo calculations for limited foresight. Project development is simulated considering the analytical reservoir models as resource, the technical and economic aspects of project development, heat transport, energy demand, energy market and the policy framework. A multi-disciplinary approach is necessary to successfully complete this integration.



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The developed tools and workflows will be applied to 5 or 6 real and theoretical case studies. The results will be published in several scientific publications and reports, and a report with recommendations to investors and policy makers. In addition, the project results will be presented at a final event as well as at scientific conferences.

Similar to various elements from the Belspo projects PSS-CCS and ALPI forming a basis for the approach in the DESIGNATE project, the developed tools and results of this project can also be used further in both applied (new cases) and more fundamental (methodology development) future research. In addition, the project results will be relevant for investors, regulators and various policy areas such as environment, energy and deep subsurface. In the long term, an increased use of geothermal energy is expected to have an impact in terms of energy (security), the environment, climate and planning of subsurface activities.

## CONTACT INFORMATION

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