

Economic examination of low-to-medium enthalpy geothermal energy utilisation in Hungary through a case study on the Nagyszénás 3 well

Andrea Reischl

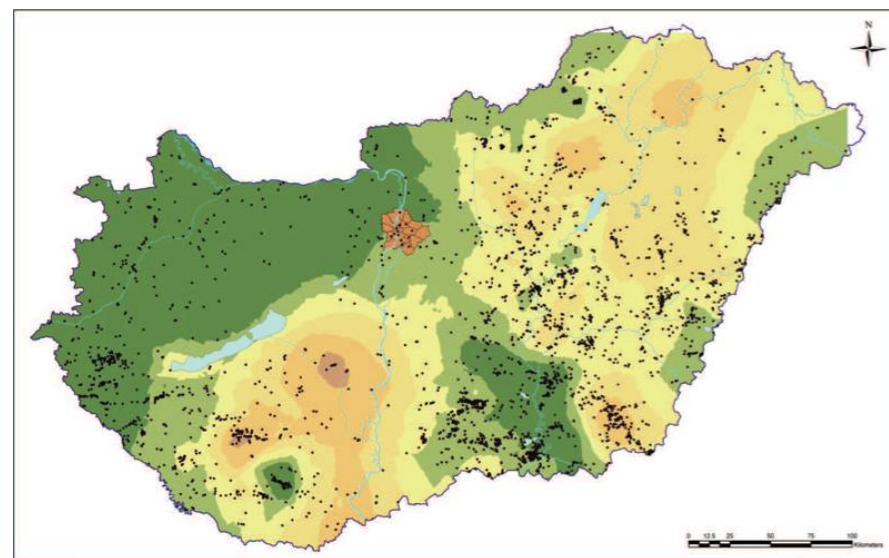
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Motivation

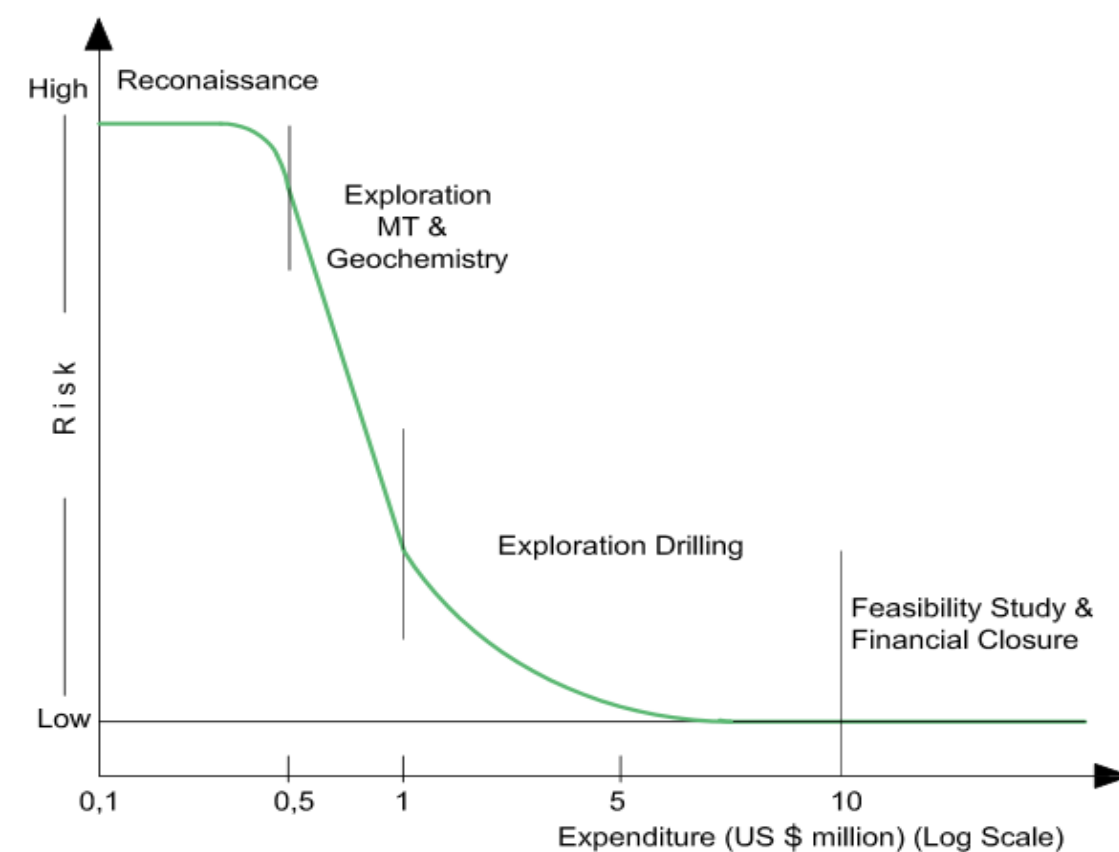
Hungary has an enormous geothermal potential with an average heat gradient of twice that of the world average:
 → 5°C per 100m compared to a world average 2.5°C/100m
 and a vast amount of hydrocarbon exploration wells (black dots):



many of which are abandoned and have:
 → well temperatures above 100°C and pressures up to 60MPa.

Question: Is it economically viable to use the NSZ-3 abandoned hydrocarbon well for geothermal electricity production in Hungary?

A particular feature of abandoned wells is, that a big part of initial capital costs is already incurred, which significantly reduces upfront cost, moves cash flows forward and thus increases NPVs.



A cascade use of the produced fluid allows for multiple consecutive stages of value creation, through various uses such as an ORC, a greenhouse and rotary separators with a total capacity depending on the flow rate of up to 3.9MW_e.

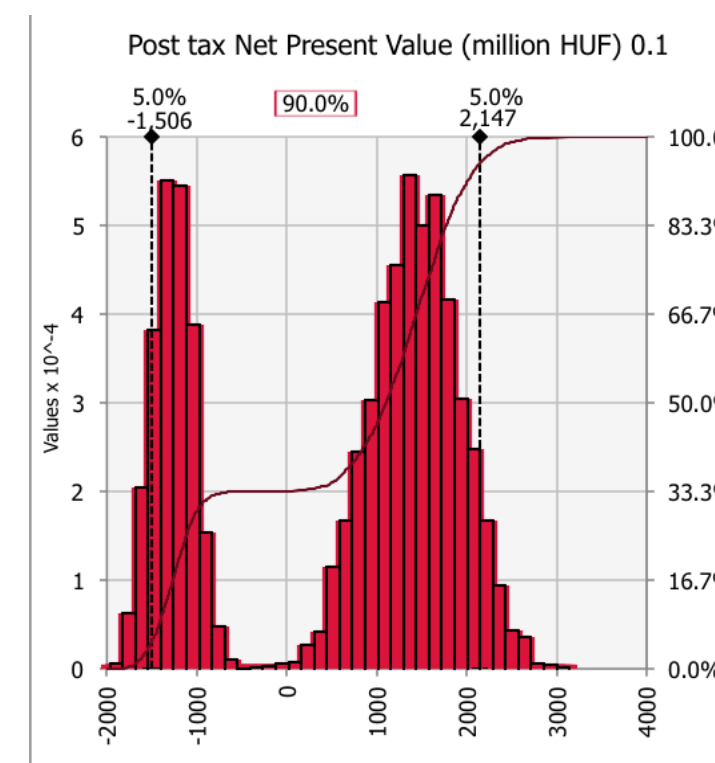
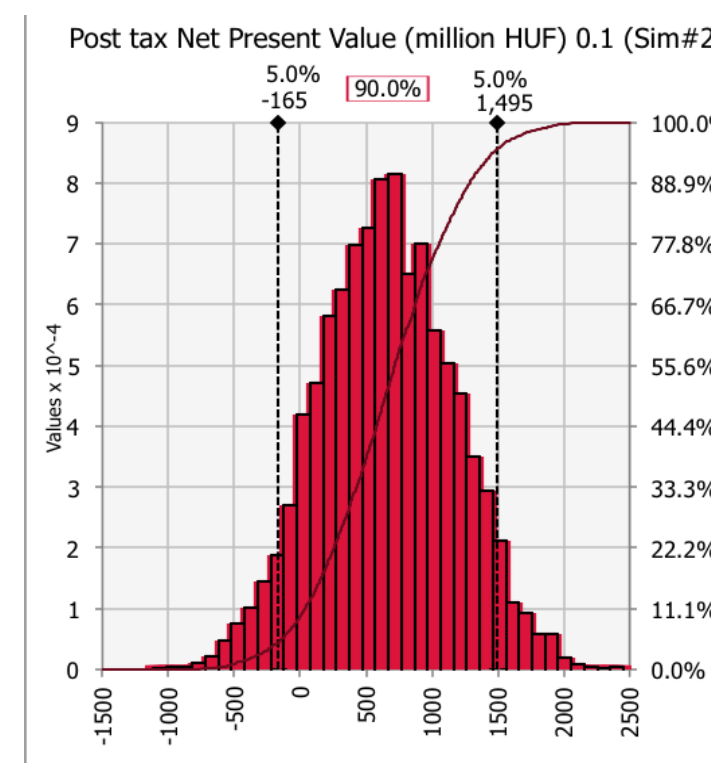
Method

Data was modelled in excel through a cost benefit analysis. Monte Carlo analysis allowed for repeated random sampling for running many iterations of the model. By setting the number of iterations sufficiently high, uncertainty in the data was accounted for.

The two considered models were a long-term test based development and a blind project, in which costs for the long-term test were avoided. The long-term test costs are relatively high but serve to confirm estimated well data (flow rates, pressure, etc.) and enable informed decision making. The blind project embraces uncertainty and ideally serves as a cash-positive pilot project.

Results

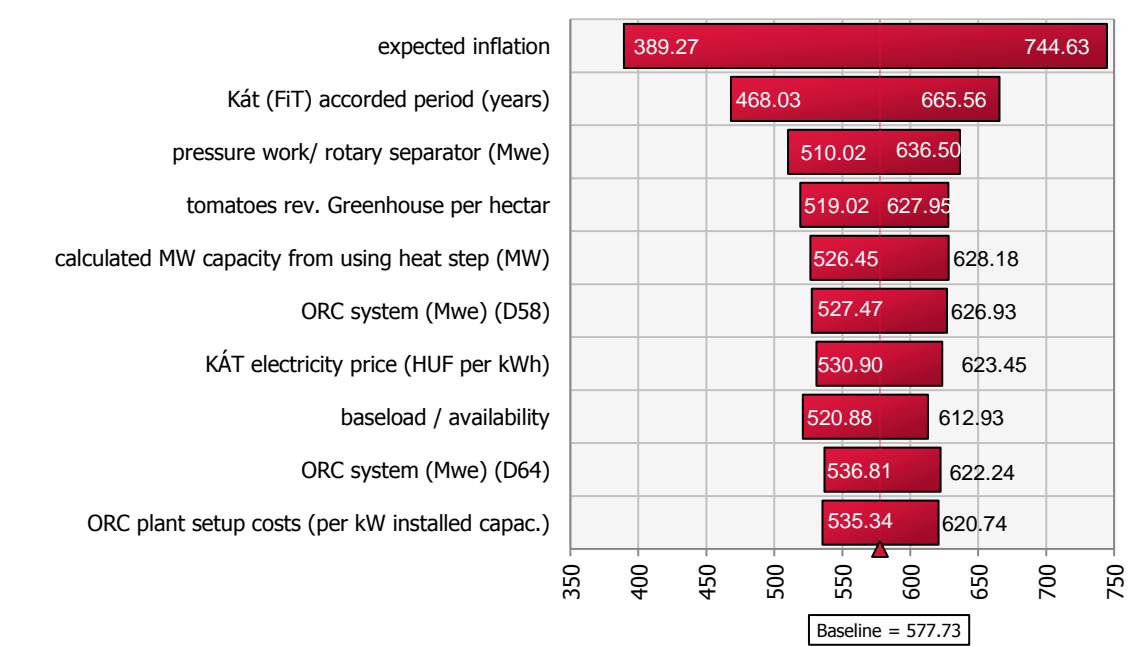
It is desirable to start a geothermal pilot project for the economic evaluation of geothermal electricity production as part of a cascade system in Hungary. The economic indicators, such as the post tax NPV, the profit to investment ratio and payback in years are all acceptable and in some cases very favourable. Both the blind case scenario (right) and the long-term test scenario (left) will lead to positive post tax NPVs on average:



For a 30 litres/sec capacity blind project, the average for the profit to investment ratio (PI) is 0.55, for payback it is 7.3 years, and for the post tax NPV it is 880 million HUF.
 Under the long-term test scenario, the average for the PI ratio is 0.35, for payback 7.75 years, and for the post tax NPV 1.1bln HUF

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Graph 13: Tornado for blind project 10litres/sec capacity Inputs Ranked By Effect on Output Mean



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When building a blind project, the factors most affecting the post tax NPV are, the volume works of each cascade use; the rotary separators, the ORC, the gas turbine and the greenhouse, which determine how appropriate the built plant size ultimately is.

Discussion and recommendation

There are many uncertainties and assumptions, such as linear cost curves, due to which the results need to be taken with some care. The conclusion nevertheless is certain: initiating a pilot project, whether blind or with a long-term test is highly recommended and economically feasible. If the results from the pilot project confirm the estimations of this study, then launching other geothermal cascade projects based on 115, already identified abandoned wells with suitable conditions, can serve as a great contribution to renewable energy and energy efficiency targets of Hungary and boost the local and national economy. To accelerate development in this area, a more favourable investment environment with incentives such as better taxation terms or long feed-in-tariff-supported periods is needed.