

Transparent Framework for Stakeholder-Aware Geothermal Site Suitability Screening in the Netherlands

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In the Netherlands, geothermal energy is expected to play a substantial role in the heat transition, yet deployment remains ~7.5 PJ in 2024, far below the 80 PJ ambition for 2050. A national exploratory study commissioned under the Bodem en Ondergrond covenant shows that barriers already emerge before feasibility studies, when municipalities, provinces and other actors must judge whether development is plausible. Early-stage screening is therefore a multi-actor, multi-dimensional challenge that must align subsurface potential with surface realities. Although subsurface potential is publicly available (e.g., ThermoGIS), screening in practice is still largely technical: socio-economic, regulatory, environmental, built-environment and infrastructure constraints are often addressed late, frequently only downstream in processes that precede or inform programmes such as EBN's SCAN programme. This limits early spatial prioritisation, realistic expectation-setting and stakeholder communication.

To address this gap, we develop and evaluate a transparent, stakeholder-aware spatial screening framework for deep geothermal suitability in the Netherlands that integrates technical, regulatory, environmental and socio-economic considerations in an interpretable GIS-based Multi-Criteria Decision Analysis (MCDA) structure [Malczewski 2006, Raos et al 2022], while making differences between stakeholder perspectives explicit. Using a Design Science Research (DSR) approach with TNO and EBN, criteria are translated into spatial indicators and combined through governed rules; a medallion architecture links source data to harmonised layers and model-ready indicators, and an invariant core stabilises screening semantics so stakeholder perspectives can be explored through bounded configurations without changing the model [Hevner et al 2024]. Evaluation is embedded through expert walkthroughs, sensitivity analysis and policy case studies in Zuid-Holland (mature context) and Noord-Brabant (exploratory), using interpretability, credibility, robustness, decision relevance and traceability as explicit quality dimensions.

The framework shifts screening beyond a single technical suitability surface by distinguishing exclusion, limitation and relative opportunity, clarifying where favourable subsurface conditions are unlikely to translate into plausible development contexts. It makes stakeholder prioritisation logics comparable within one shared structure and produces policy-facing outputs that identify where geothermal development may be promising, and which surface-level bottlenecks dominate at the pre-feasibility stage. Overall, the work underlines that the Dutch geothermal challenge is not only to identify technically promising subsurface conditions, but to make them interpretable considering governance, spatial and socio-economic realities. By formalising these interactions within one GIS–MCDA screening structure, the approach improves early-stage decision-making and communication by reinterpreting geothermal resource information as resource opportunity, dominant limitations and stakeholder-dependent outcomes.

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