



Delivering for the ENERGY CHALLENGE Today and Tomorrow



The SCAN Program: Accelerating geothermal exploration in the Netherlands through acquisition of new seismic and well data

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Agenda

- Introduction to EBN B.V. and the SCAN program
- Geological evaluation and seismic survey design
- Seismic acquisition, processing and reprocessing
- SCAN Data well Campaign
 - How do we select locations, define the data acquisition program and design the wells?
 - SCAN well 1: location and aims



Introduction to EBN B.V.

- EBN B.V. (Energie Beheer Nederland), founded 58 years ago, is a 100% state-owned company with some 160 employees, based in Utrecht, the Netherlands
- Our mission: EBN creates economic and societal value from geological energy sources in the Dutch subsurface
- Three strategic pillars:
- Our Dutch North Sea Gas
 Return to Nature
 New Energy

• New Energy:

EBN builds partnerships for the efficient exploitation of geothermal energy and may become financial partner in future geothermal projects





Introduction to SCAN (1)

- SCAN is executed where insufficient subsurface data is available to make a reliable estimate for the potential for geothermal developments
- By law, all subsurface data in the Netherlands is made public five years after acquisition at the latest*. This includes pre-stack (field) seismic data and the (re)processed data. SCAN data is made available directly.

3D seismic and abundant well data available: <u>not</u> a `white spot`, <u>not</u> part of SCAN

No, scarce and/or low quality 2D seismic, no or little well data: `white spot`; SCAN area

SCAN focuses on the `white spots'. On this map they're actually coloured white, grey and light green

* spec-data: 10 years



Introduction to SCAN (2)

- SCAN provides a regional exploration data set. For the development of commercial projects often more seismic and more local studies will be needed
- SCAN is aiming at shallow and deep geothermal projects (500-4000m). However, seismic acquisition will also target Ultra Deep Geothermal depths (UDG > 4000m, often Dinantian carbonates)
- The SCAN programme is funded by the Ministry of Economic Affairs and Climate and executed by EBN and TNO.
 Part of the seismic acquisition is subsidised by the EU Interreg programme DGE-ROLLOUT

SCAN: Seismische Campagne Aardwarmte Nederland



Three projects, common goals

SCAN:

- Conventional and shallow geothermal targets (500 m - 4000 m)
- Generally not the Dinantian
- Focus on the Netherlands, crossborder correlations facilitated
- Fully funded by Dutch government



Interreg DGE-Rollout:

The SCAN geothermal exploration campaign

• Components of the SCAN program:

- 1. Acquisition of new 2D seismic data
- 2. Reprocessing of existing 2D seismic data
- 3. Regional studies: SCAN Dinantian
- 4. Data well campaign
- All data and study results are immediately released to the public domain at completion and published on the websites <u>scanaardwarmte.nl</u> and <u>nlog.nl/scan</u>

Geothermal plays in the SCAN areas



- → Dutch geothermal play type classified as:
 - → Conduction dominated in an intracratonic basin (CD-1; c.f. Moeck 2014)
 - → Hot sedimentary aquifers (HSA)
 - → Low enthalpy (< 125°C)
- → Main geothermal play elements:
 - → Reservoir
 - → Permeability system
 - → Temperature gradient (not much variation in the Netherlands)
- → Permeability systems:
 - → Matrix or primary permeability
 - → Secondary permeability (karst or leaching)
 - → Fracture / fault permeability
 - ➔ Induced permeability (acidization, fracking, mine galleries)



[✓] Primary play • Secondary play

SCAN project phases and activities



Design of seismic survey: based on play evaluation





SCAN seismic acquisition & processing status

- To date > 1680 line km of new 2D seismic data has been acquired with zero LTIs and within budget
- SCAN acquisition is combined with local seismic acquisition programs for UDG and MRA
- Visited > 165 municipalities, distributed > 115.000 letters into the neighbourhoods prior to acquisition
- Currently processed data of 31 lines (1197 line km) are available on the NLOG website
- New 2D data usually available at NLOG within 6 months of data being available for processing

Dedicated EAGE presentation about SCAN seismic acquisition and (re)processing: Tue, Room 15, 8:50-9:10: Rehling et al., The Dutch SCAN Geothermal Seismic Exploration Program – Current Status and Future Plans





SCAN 2D reprocessing

- 2D seismic data, acquired from the early 70s to early 90s, is reprocessed through a broad-band PreSTM sequence
- To date results of 4 reprocessing projects have been released, which amounts to more than 1850 line km (120 lines)
- Reprocessing nearly always resulted in an improved quality of the data



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- Further reprocessing scope in remaining SCAN areas is up to 2450 line km



SCAN Wells

→ Some important reservoir data can only be obtained by drilling wells

- → Data acquisition wells will be drilled a location that provides the best chance to obtain as much relevant data as possible, often combining several potential reservoirs.
- → Wells are P&A-ed at the end of the evaluation program

Information	2D-Seismic data	3D-Seismic data	Well
Economical evaluation: presence and quality of aquifer, temperature			
Presence, continuity, depth and thickness aquifer	Ŧ	++	+++
Porosity	<mark>-</mark>	<mark>+/-</mark>	<mark>+++</mark>
Permeability (transmissivity)			<mark>+++</mark>
Temperature	+	+	<mark>+++</mark>
Safety, well planning and regional geological knowledge			
Regional geological model	++	+++	++
Presence of faults	+	***	+/-
Character of overburden on well trajectory	+	++	+
Risk-assessment of presence of hydrocarbons	+	++	+/-
Water composition	<mark></mark>	<mark></mark>	<mark>++</mark>



Figure only for illustration No actual proposed location

SCAN wells – example sub-plays / search area / location



SCAN Well Delivery Process



Data-acquisition in SCAN wells: generic example





Other presentations at EAGE related to SCAN:

Presentation focusing on geological evaluations within SCAN (Tue 19/10):

 Regional Geological Evaluation for the SCAN Geothermal Exploration Campaign, the Netherlands

Presentation focusing on seismic acquisition and processing (Tue 19/10):

• The Dutch SCAN Geothermal Seismic Exploration Program – Current Status and Future Plans

More information about SCAN can be found on our website:

https://www.scanaardwarmte.nl/

All data is made public, see the Dutch Subsurface Data Portal NLOG: <u>https://nlog.nl/en/scan</u>



Ministerie van Economische Zaken en Klimaat





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<u>www.scanaardwarmte.nl</u> <u>nlog.nl/scan</u>





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North-West Europe DGE-ROLLOUT