



ATLAS TO EXPLORE HYDROCARBON OPPORTUNITIES  
IN THE DUTCH OFFSHORE

Explore in a mature basin

# GEODE in a nutshell

TNO

ebn

- Joint project of EBN B.V. and TNO to create an atlas to explore hydrocarbon opportunities in the Dutch offshore.
- Easily accessible web-based GIS environment where play-based exploration data including risk maps and post drill well analysis data is presented for the main hydrocarbons (sub)plays of the Dutch offshore.
- Results of this project are immediately made available in the public domain for free.
- Work in progress

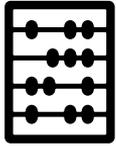


GEODE



[www.geodeatlas.nl](http://www.geodeatlas.nl)

# Facts & Figures



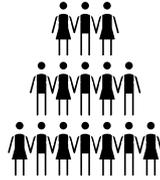
8 main plays (and many subplays) in Dutch Offshore



4 main source rocks



> 60 quality review sessions



>30 people involved in multidisciplinary teams



Thriving Geoscience ecosystem between TNO and EBN and also inside EBN



132 datasets and number growing



Learnings:

- Fit for Purpose
- Lump where you can, split where you must
- Festina Lente



dynamic platform



New GIS platform set up and released by EBN as per planning

# GEODE general status

- GEODE up and running.
- General improvements
  - Re-arranging source rock dashboards
  - Detailed update/version register
  - Detailed download instructions (also for QGIS)
  - Clear instructions how to cite GEODE
- **Very positive and supportive feedback from E&P industry incl operators and service companies**

## GEODE Play Maps

- A collection of Play Maps prepared for the GEODE Atlas project (EBN/TNO)
- All maps are part of a multi-layered pdf-file with more information on additional layers
- Prepared by the various project teams, drafted by Stefan Feeters
- Chalk, Lower Cretaceous and Carboniferous will follow this year

Logos: GEODE, TNO, ebn, Geodeatlas.nl

Example of layers available in pdf-file: Zechstein

- Select using this button in left column



# Agenda



1 Personal Introduction

4 GEODE

Purpose and contents

2 EBN

Energising the Transition

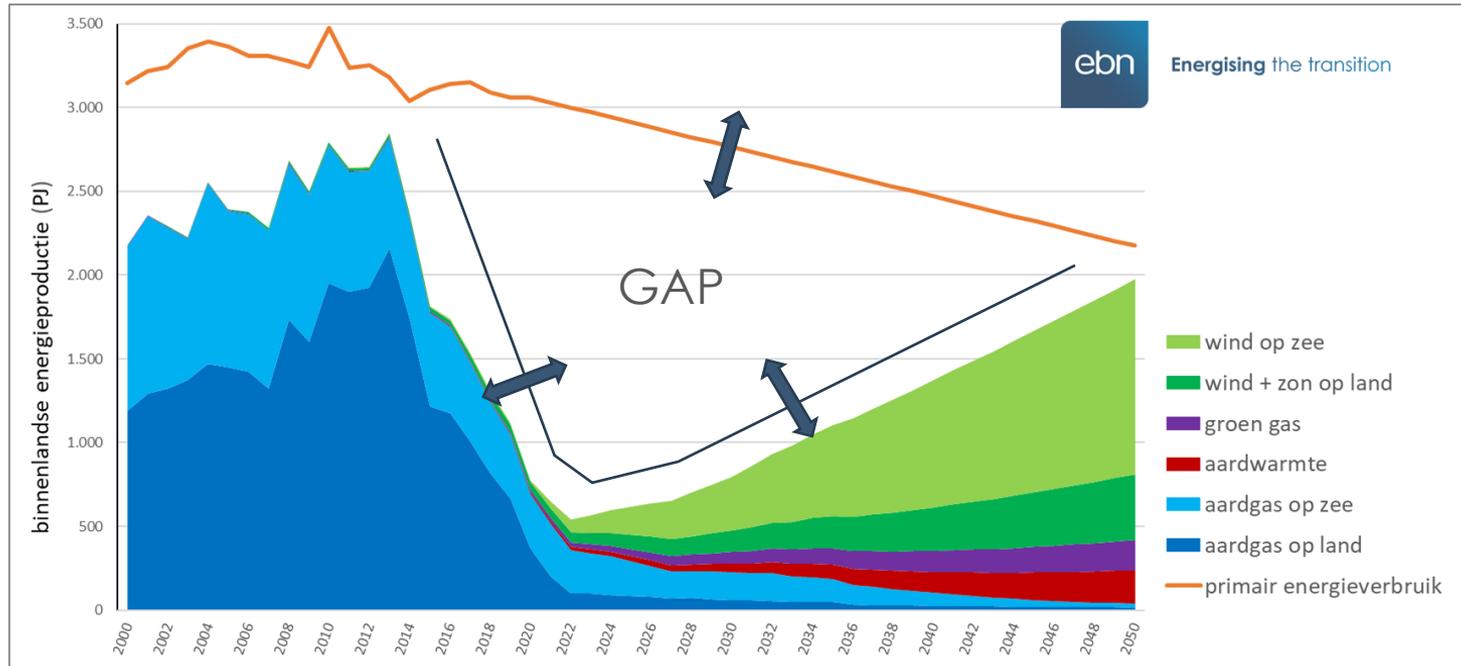
5 Demo

3 Play Based Exploration

Q&A

# Energy transition in a VUCA world

(volatile, uncertain, complex and ambiguous)



Klimaatbeleid zoals vast gelegd in Regeerakkoord: Om uiterlijk in 2050 klimaatneutraal te zijn, scherp en we het doel voor 2030 in de Klimaatwet aan tot tenminste 60% CO2 reductie.

# About EBN

The logo for EBN (Energie Beheer Nederland) consists of the lowercase letters 'ebn' in a white, sans-serif font, centered within a dark blue square.

- Energie Beheer Nederland (EBN) is owned 100 per cent by the Dutch state; our shares are administered by the Ministry of Economic Affairs and Climate
- Responsible for implementing parts of the Dutch energy and climate policy
- Since 1963 involved in oil and gas production in the Netherlands (40% stake)
- Since 2016 active in renewables by implementing geothermal energy, CCS, biomethane and hydrogen and storage -> making the gas value chain more sustainable

# Why?



# How?

## Vision

Sustainable energy must be accessible for everyone in the Netherlands (available and affordable)

## Mission

EBN provides the linking force in the energy transition in the Netherlands

# Strategy

ebn



**Our Dutch Gas**



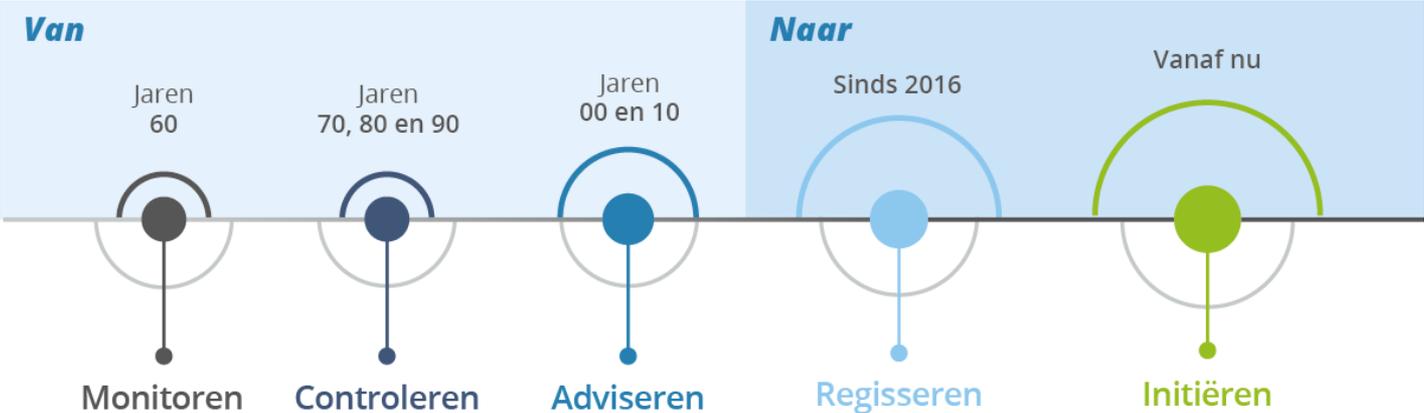
**Return to Nature**



**New Energy**

# Changing role of EBN

With the changing energy landscape, the **role of EBN is also changing**, becoming a *partner and/or shareholder* in other sectors, such as geothermal energy, CCUS, green gas, hydrogen, with the goal of making the energy value chain more sustainable and future-proof



# Activities

## Examples



**Our Dutch Gas**

EBN works on solutions to produce the hydrocarbon assets efficiently, sustainable and safe



**Return to Nature**

EBN takes a leading position in decommissioning and re-use of the current infrastructure

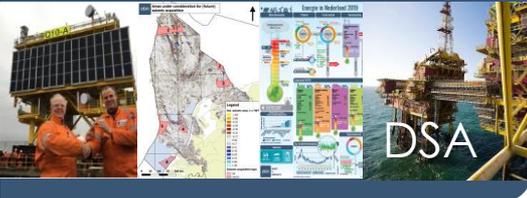


**New Energy**

EBN develops partnerships to develop geothermal energy, Hydrogen energy/co2 storage



**1. Optimize core activities**



**2. Develop new activities**

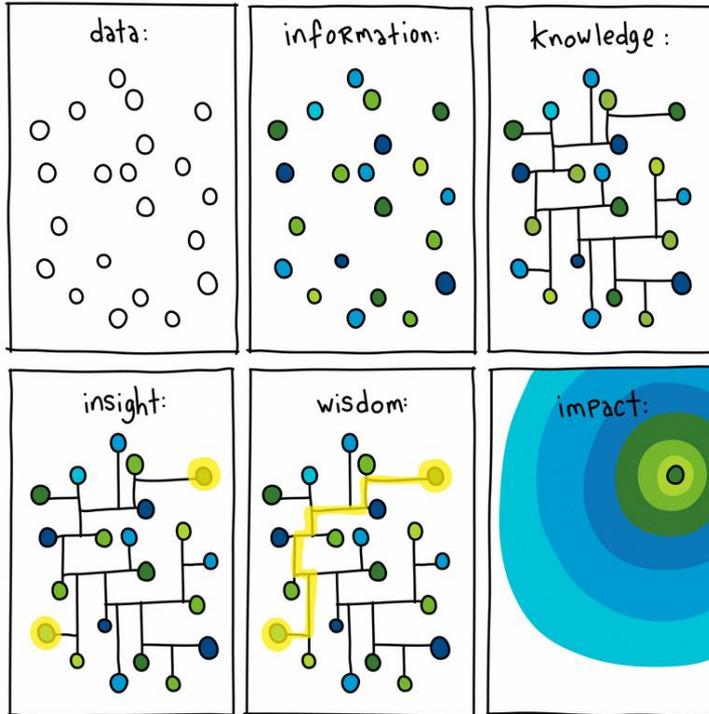


**3. Explore new opportunities**



# Basic data pattern for knowledge workers EBN

ebn



gapingvoid  
Culture Design Group

@gapingvoid

GEODE

TNO ebn

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5 Demo

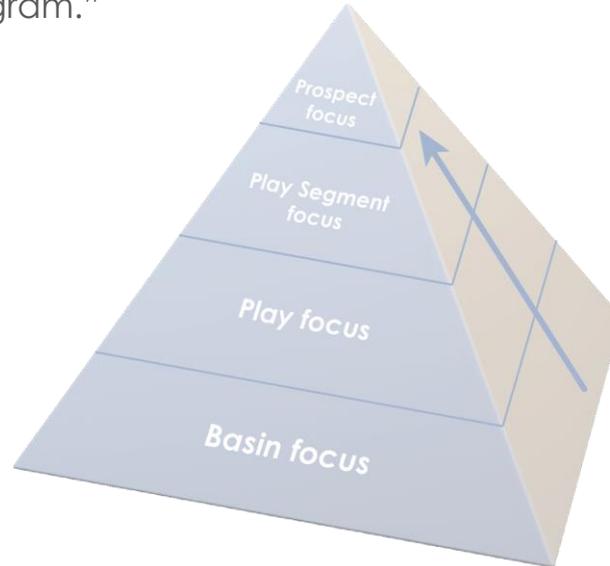
3 Play Based Exploration

Q&A

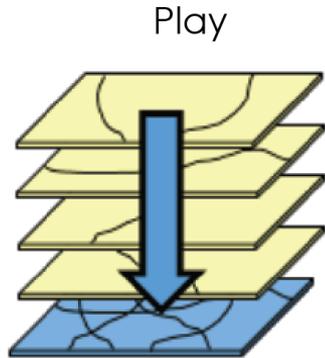
# An introduction to play based exploration (PBE)

“Play based exploration (PBE) is a well-known and widespread industry best-practice to document and evaluate knowledge of the subsurface and systematically determine the economic value of remaining reserves. This approach allows efficient screening of potential opportunities or pitfalls and provides steer towards an appropriate and focused work program.”

The PBE process consists of multiple pre-determined steps and deliverables and develops from a regional basin analysis (i.e. understanding of geology and basin fill in a regional tectonic context), towards a play and eventually lead/prospect focus **and back**

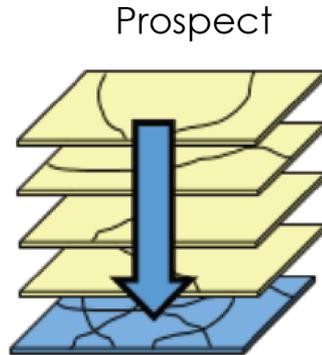


# Common risk segment (CRS) mapping



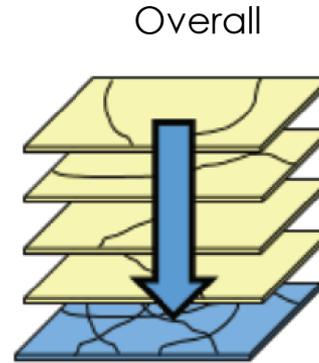
Stack defines where the play is proven = the fairways

X



Stack defines the inherent variability of the prospect level risks

=



Stack is an estimate of what a typical prospect POS might be

- Reservoir
- Seal/Trap effectiveness
- Trap presence
- Charge/Migration
- Play CRS map**

**Split-risking approach**

# Exploration activities NL

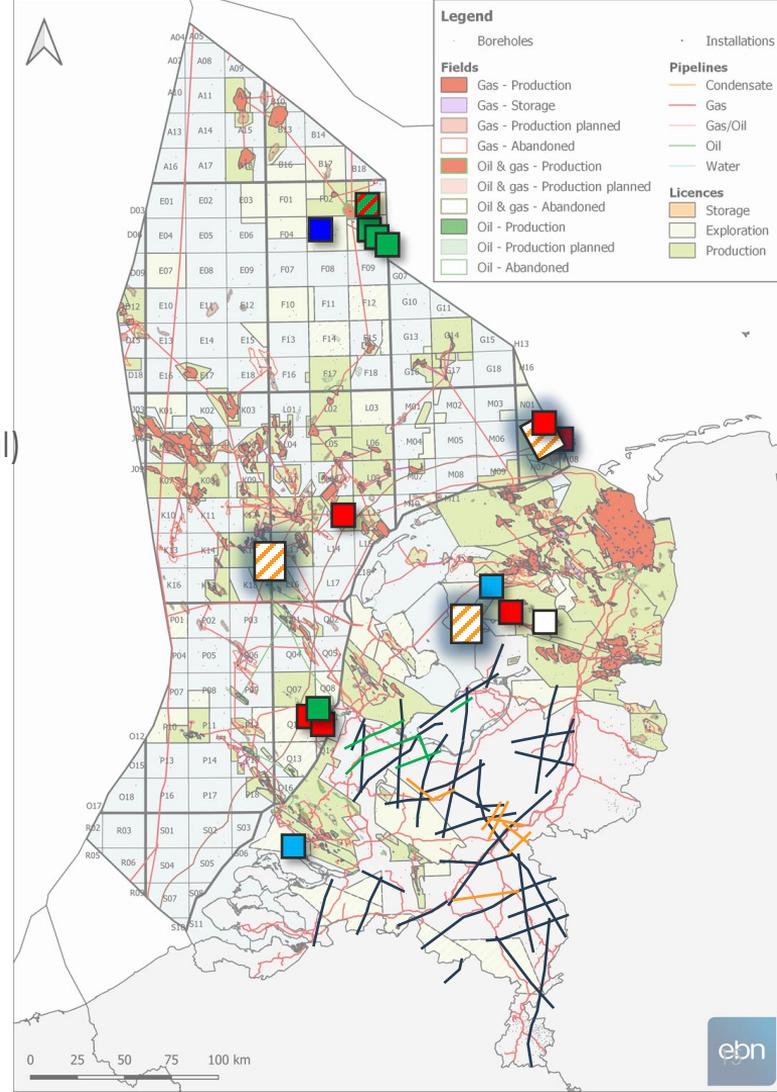
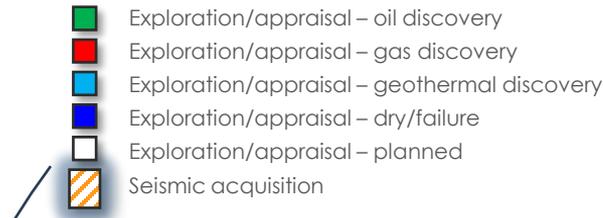
## 2021:

- 6 exploration & appraisal wells spudded (1 geothermal)
- Onshore seismic acquisition completed (Zuid Friesland)

## 2022:

- 8 exploration & appraisal wells (to be) spudded (1 geothermal)
- Offshore OBN seismic acquisition campaign
- Offshore 3D seismic acquisition campaign test phase
- SCAN/MRA/UDG seismic lines completed

## 2023 and beyond....



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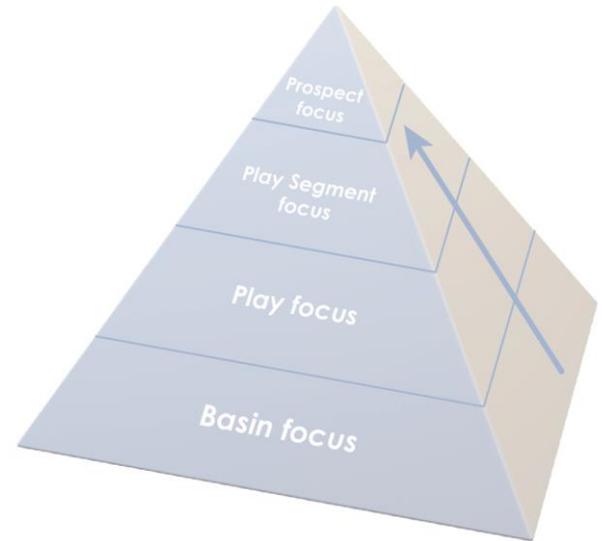
5 Demo

Q&A

# GEODE Project goals



- ❑ GEODE aims to help to better understand and frame exploration opportunities against the backdrop of regional common risk segment maps with the objective to stimulate exploration activities within the Dutch Offshore.
- ❑ A Play Based Exploration (PBE) approach is used to create these common risk segment maps.
- ❑ The aim is to mature all relevant plays to a 'Play focus' level in the PBE pyramid in order to:
  - Consolidate subsurface knowledge,
  - Support the identification of the most prospective areas,
  - Make the best possible use of the limited remaining time window for exploration activities.

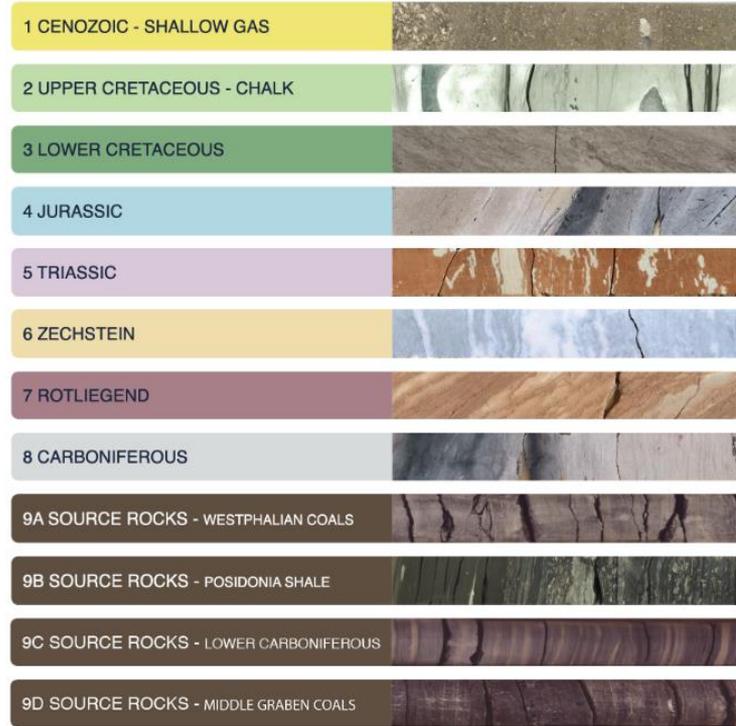


# Selected plays for the Dutch offshore

TNO

ebn

- Dashboards for 8 plays and 4 source rock intervals



Core photos used on this platform are derived from North Sea Core CIC and NLOG.

# Project deliverables per (sub)play\*\*



- Data quality maps
- Pools in play & subplays
- Well status and analysis (penetration, hydrocarbons, technical status, etc)
- Top and base play depth maps
- Reservoir & seal (gross) thickness maps\*
- Average porosity maps and porosity classes\*
- Gross Depositional Environment maps
- Aggregated supercrop maps
- Post-drill well analysis (PDWA)
- Common Risk Segment maps (CRS)
- Critical Risk (Weakest Element) maps
- Composite Common Risk Segment maps (CCRS)
- Annotated play map

\* (sub)play dependent

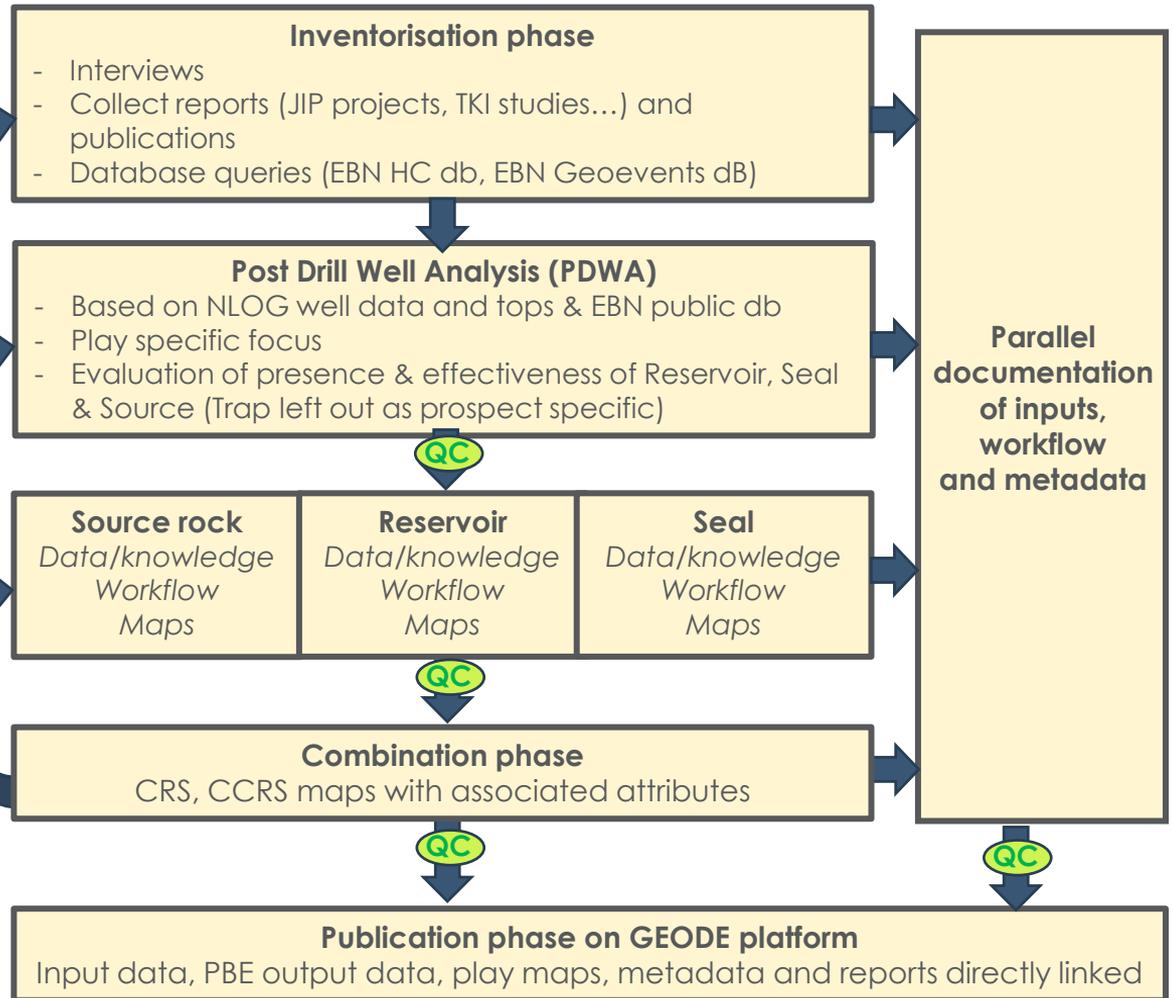
\*\* Public data

# Workflow ("Logistics")



Quality control step done with the QA/QC team of the play. These QC teams are formed by external Subject Matter Experts

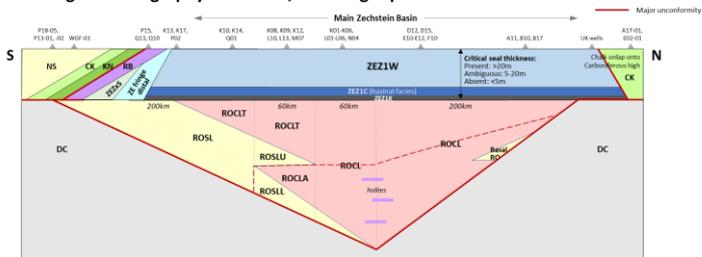
Update where necessary



# Workflow (“Geological”)

## 1. Play and sub-play definition (Reservoir and Seal pairs)

Rotliegend stratigraphy schematic, including top seals



**Rotliegend sandstone reservoirs**  
 ROSL Slochteren Fm unspecified  
 ROSLU Upper Slochteren Mb  
 ROSLL Lower Slochteren Mb

**Intra-Rotliegend shale seals**  
 ROCLT Ten Boer Claystone  
 ROCLA Ameland Claystone  
 ROCL Silverpit Claystone  
NB ROCLB (ROSL shale equivalent) occurs in 3 wells only: SZ-1, TEN-1, TEN-2

**Top seals above Rotliegend**

**1. Main Zechstein Basin**  
 ZEZ1K Kupferschiefer thin shale (<2m)  
 ZEZ1C Zechstein Carbonate thin, basinal facies => usually sealing  
 ZEZ1W Werra Anhydrite Excellent top seal (no fractures)

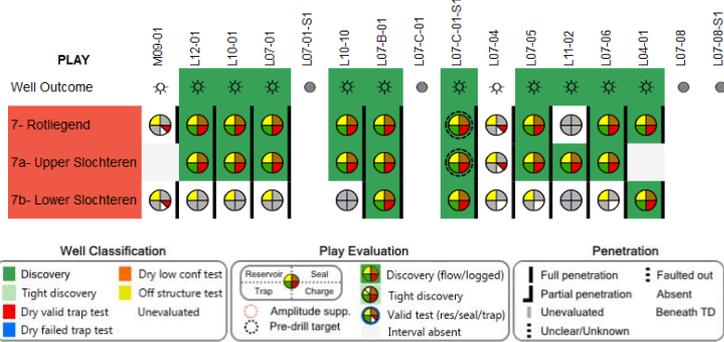
**2. \*Fringe Zechstein**

ZEZ1E, ZEZ1G, ZEZ1F, ZEZ1M, ZEZ1S  
 - Floor seals, often thin  
 - Ultimate seal in younger Zechstein formations (eg Q10)

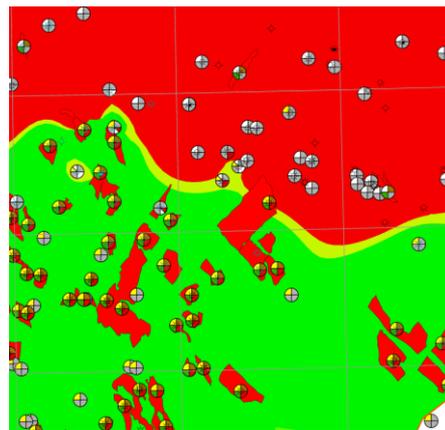
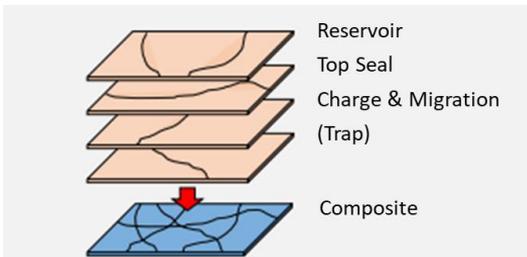
**Younger formations overlying Rotliegend**

- very rare in NE Offshore.  
 - Usually no Zechstein => no Rotliegend.  
 - Triassic (RB), Rijland (KN), Chalk (CX) or North Sea Groups may directly overlie DC (Carboniferous)

## 2. Exploration history and Post-Drill Well Analysis: play penetrations, well failure analysis, trap types in relation to predrill target definition

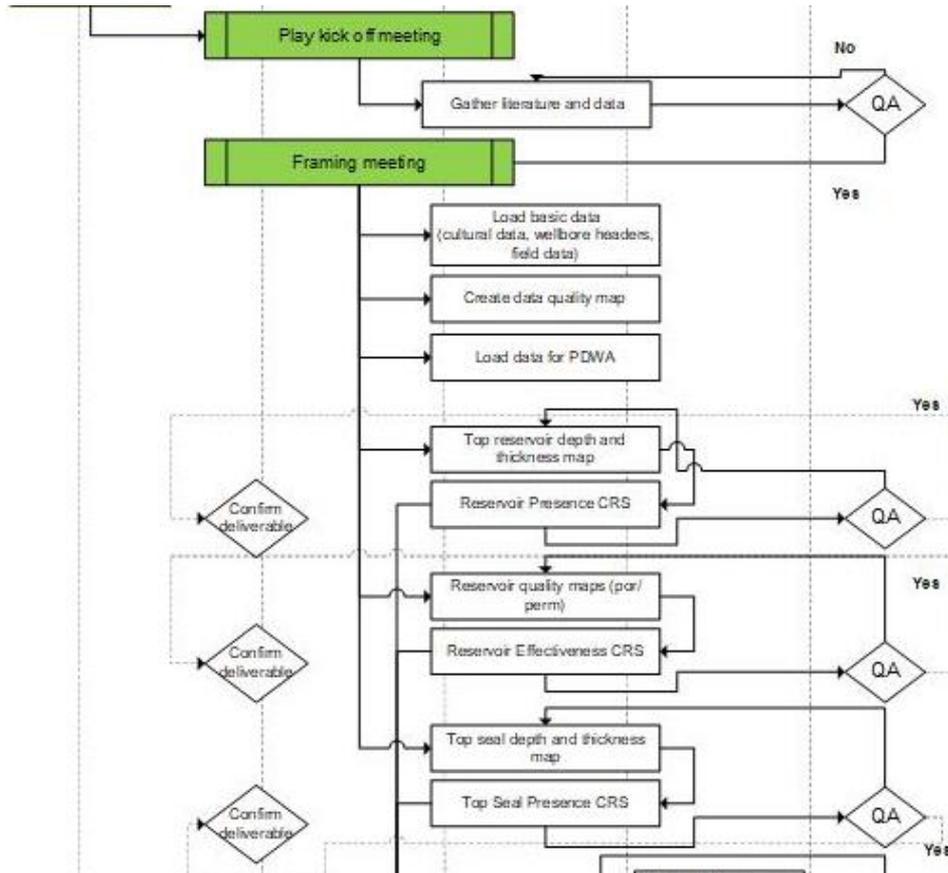


## 3. Composite Risk Segment maps for play elements of selected (sub)plays using geological proxy maps and incorporating exploration history data; based on split risk: average prospect risk maps where each segment carries an estimate of the shared (play) vs local (repeatability) risk



## 4. Composite Common Risk Segment maps and quantification of the shared (play) and local (repeatability) risk (Split risk approach)

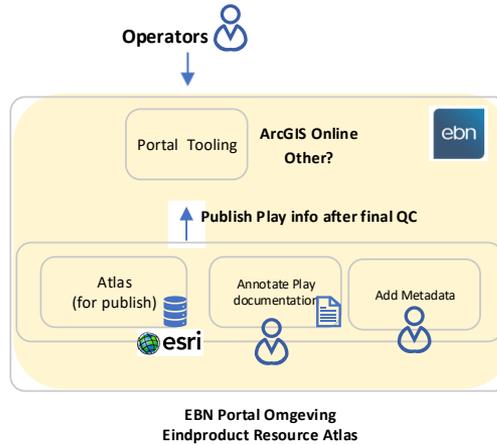
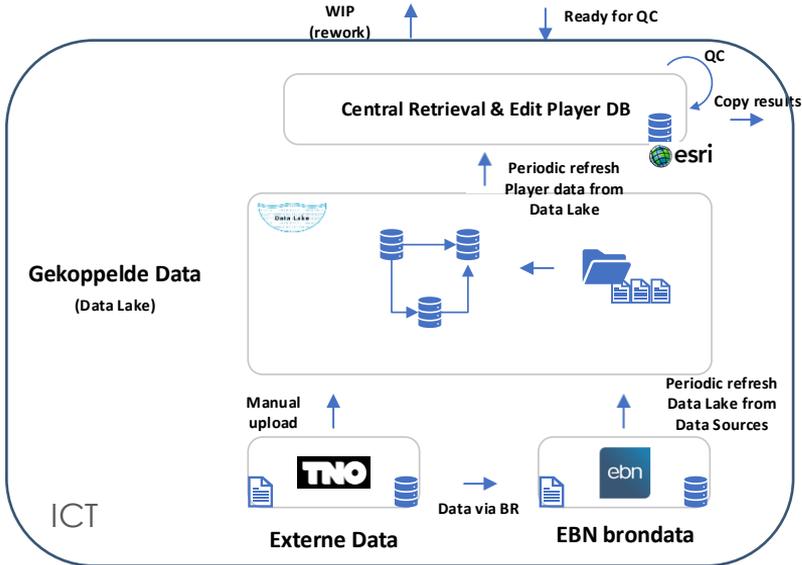
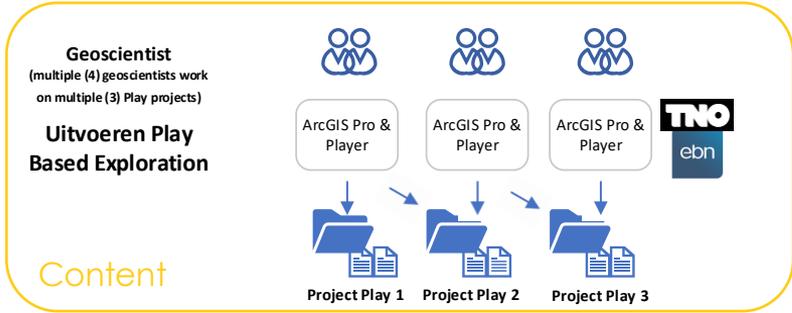
# Documented work process incl quality control



Detailed description of the working process, including required qa/qc milestones and gates.

External subject matter experts carry out qa/qc.

# ICT omgeving

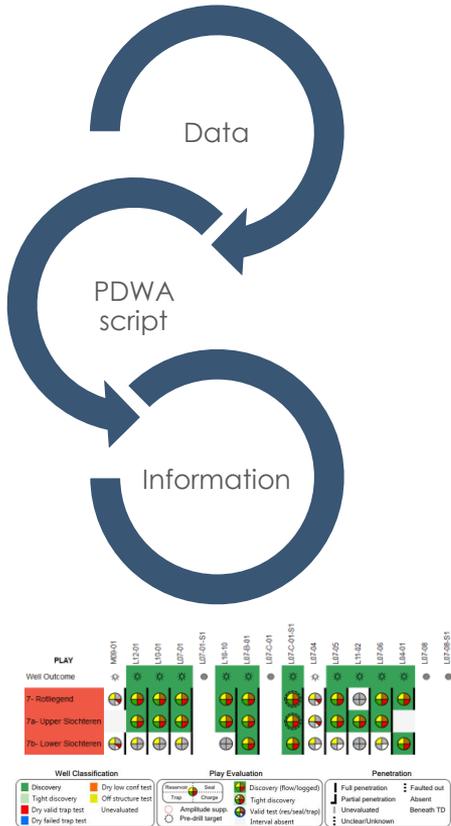


# Process improvements: from Data to Information



## Fully automated Post Drill Well Analysis (PDWA)

- Based on (public) data available through EBN Datalake
- Hardcoded extraction by Feature Manipulation Engine into the Player ArcSDE database in ArcGIS Pro



Play7a\_PDWA Top Seal Presence

- Present
- Ambiguous
- Not Present
- Unevaluated

PDWA Reservoir Presence

- Present
- Ambiguous
- Not present
- Unevaluated

**NLOG Well Tops**

PDWA Reservoir Effectiveness

- Effective
- Ambiguous
- Not effective
- Unknown

**Petrophysical evaluations**

- NLOG
- Missed Pay Analysis (Panterra)

PDWA Gas Shows

**EvalGasShows**

- Gas shows
- Interpreted gas
- Proven gas

**HC Shows db (EBN), Well status (NLOG)**

# GeoNetwork for meta-data



□ **GeoNetwork** open-source platform for publishing the metadata associated with the various maps and data.

□ Each dataset (at Play level) in portal is linked to its corresponding metadata fileset in GeoNetwork.



7a\_ROSLU\_Thickness\_Map

Gross thickness map (in m) for ROSLU as a proxy for reservoir presence

Completed

Download and links

Stratigraphy per well  
Excel list of well tops for all public wells  
[https://www.nlog.nl/sites/default/files/thematische\\_data/nlog\\_strat/elsei.xlsx](https://www.nlog.nl/sites/default/files/thematische_data/nlog_strat/elsei.xlsx) Open link

About this resource

Categories: Datasets

Continents, countries, sea regions of the world: Netherlands

Other keywords: RO, ROSLU, Reservoir presence, Map

Contact for the resource: EBN, Author: Audrey Roustiau

Status: Completed

Technical information

Lineage: TNO NLOG marker file (well tops) exported on 24/02/2021 edited to be fit for purpose for the project (see process step below)

Is source dataset of

7a\_ROSLU/ROSLU\_CRIS\_Reservoir\_Presence  
Common Risk Segment map (CRS) for reservoir presence for the Rotliegend Undefined/ Upper Slochteren subplay more... Associated record

Overview

# Wat hebben we geleerd?



## **“Fit for purpose”**

Framing sessies van groot belang om gezamenlijk met elkaar in team vast te leggen *wat* er gedaan moet worden, en door *wie*, en *wanneer*.

## **“Lump where you can, split where you must”**

Continue afweging van mate van detail die aan evaluatie en integratie gegeven moet worden.

## **“Festina Lente”**

Haast je langzaam: snelheid versus zorgvuldigheid.

## **“Effectieve, efficiënte en resultaat gerichte samenwerking TNO-EBN staf”**

Hoe houden we dit “Ecosysteem” in stand?

Contractuele ‘terms & conditions’ niet goed doorgesproken bij start van project leidend tot onduidelijkheid over ‘in-kind contributions’

# What's next?



EBN & TNO currently exploring scope options for 2023 to

- Extend hydrocarbon-CRS maps to onshore (and incorporate recently acquired SCAN data)
- Incorporate CRS maps for other resources (CO<sub>2</sub> or H<sub>2</sub> storage, heat extraction)
  
- This would be a global-first to provide wall-to-wall CRS maps for various resources

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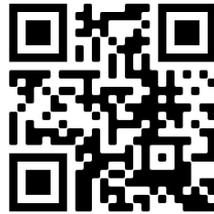
A large, blue-tinted photograph of an offshore oil rig in the middle of a calm sea under a clear sky. The rig is silhouetted against the horizon. The text is overlaid on the lower half of the image.

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GEODE is a joint initiative of EBN BV and TNO

Thanks for your attention. Any questions?



[www.geodeatlas.nl](http://www.geodeatlas.nl)

Contact us at [exploration@ebn.nl](mailto:exploration@ebn.nl)

**TNO**

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