Building Success Together

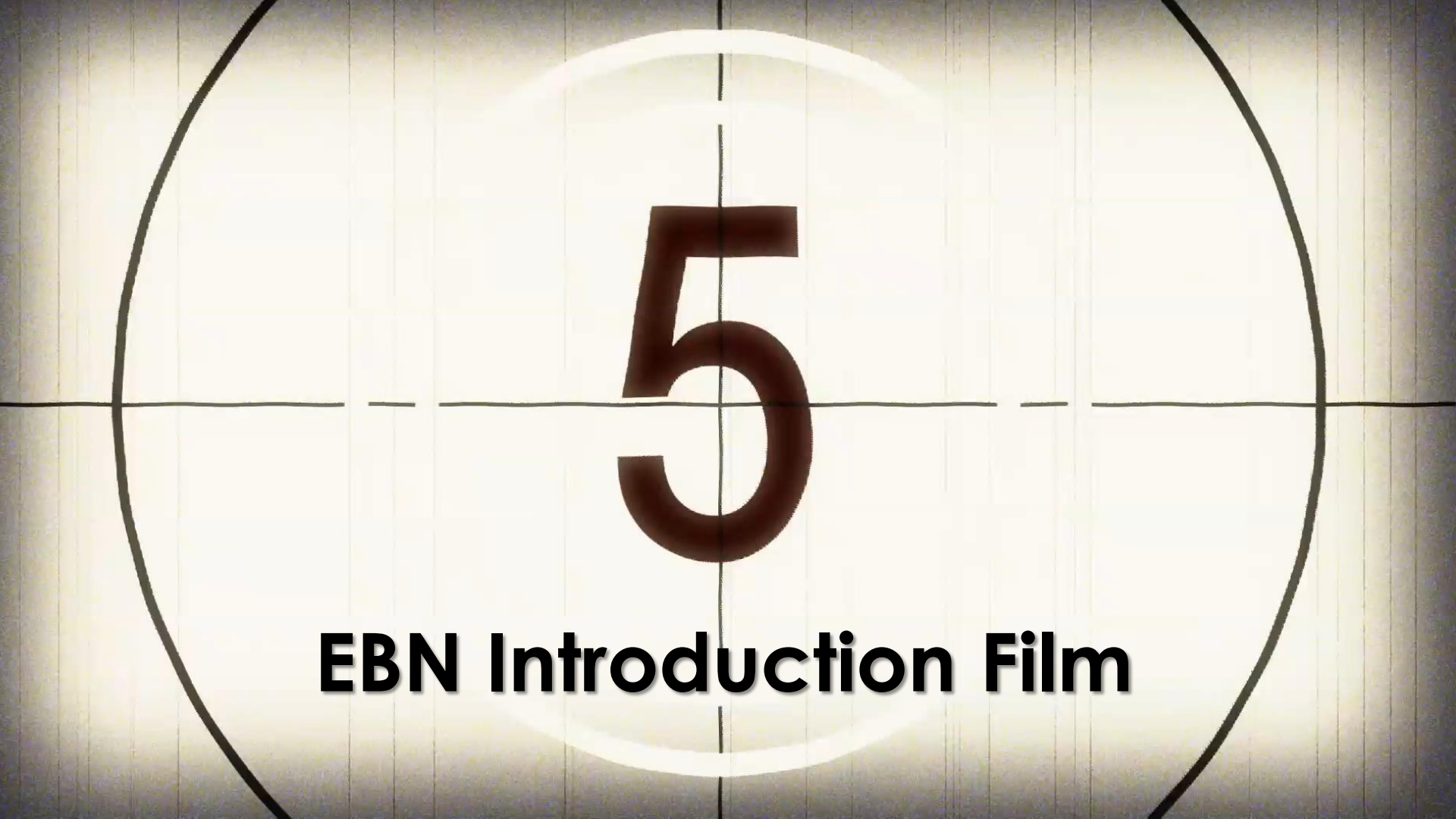
EBN Exploration Team – Martin Ecclestone

EBN Exploration Day

Wednesday 20th November 2019

Agenda

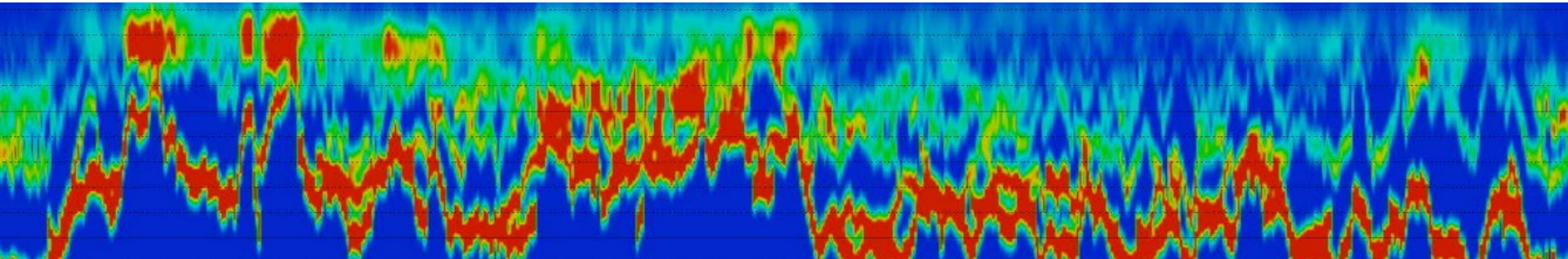
- Introduction
- EBN's Exploration Mission and Ambition
- Building Success Together :
  - Play Based Exploration
  - Basin Modelling
  - Geophysical Developments
  - Prospect Maturation
  - Win Win Win
- Summary



EBN Introduction Film

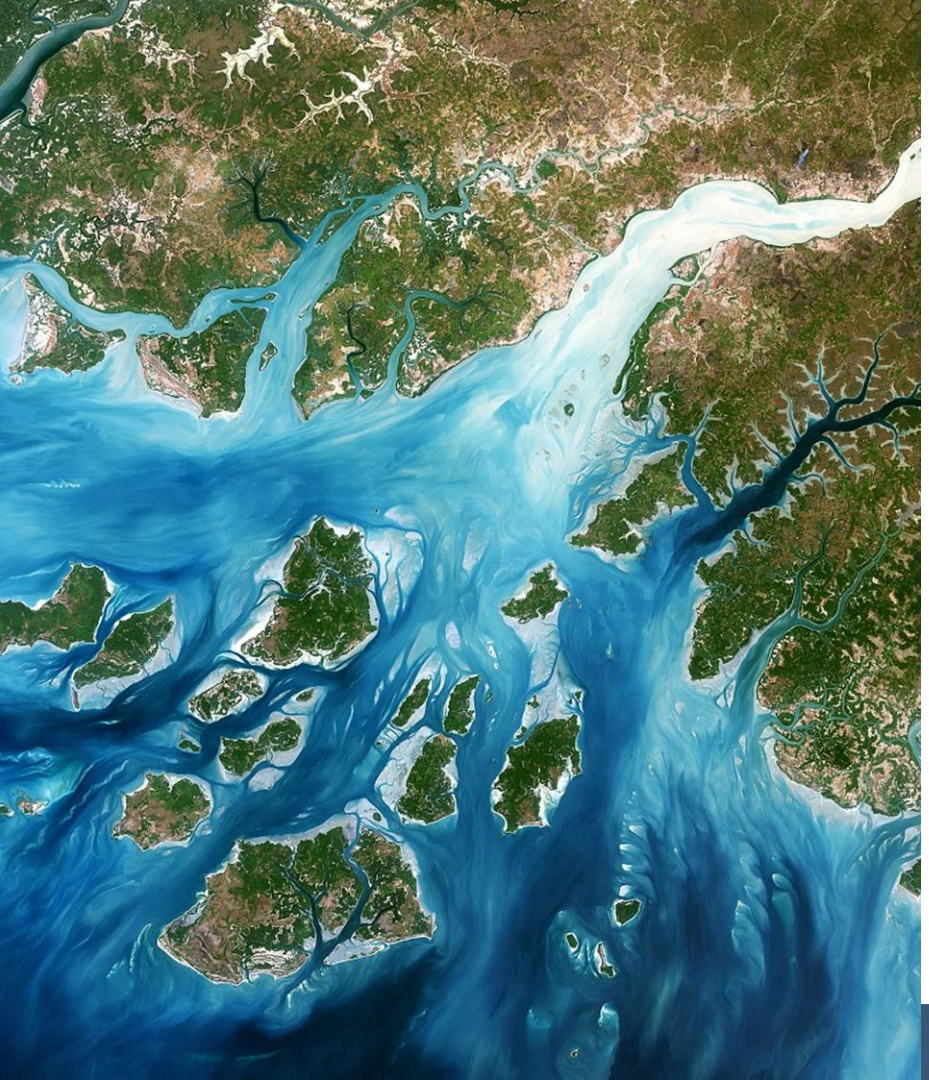
EBN's Exploration Mission & Ambition

- EBN's **exploration Mission** is to stimulate and facilitate economic exploitation of offshore The Netherlands yet-to-find hydrocarbon resources.
- EBN's **exploration Ambition** is to stimulate cooperation and collaboration with and between existing Operators and future investors to support realization of the **Mission** in a manner that creates a **Win-Win-Win**.



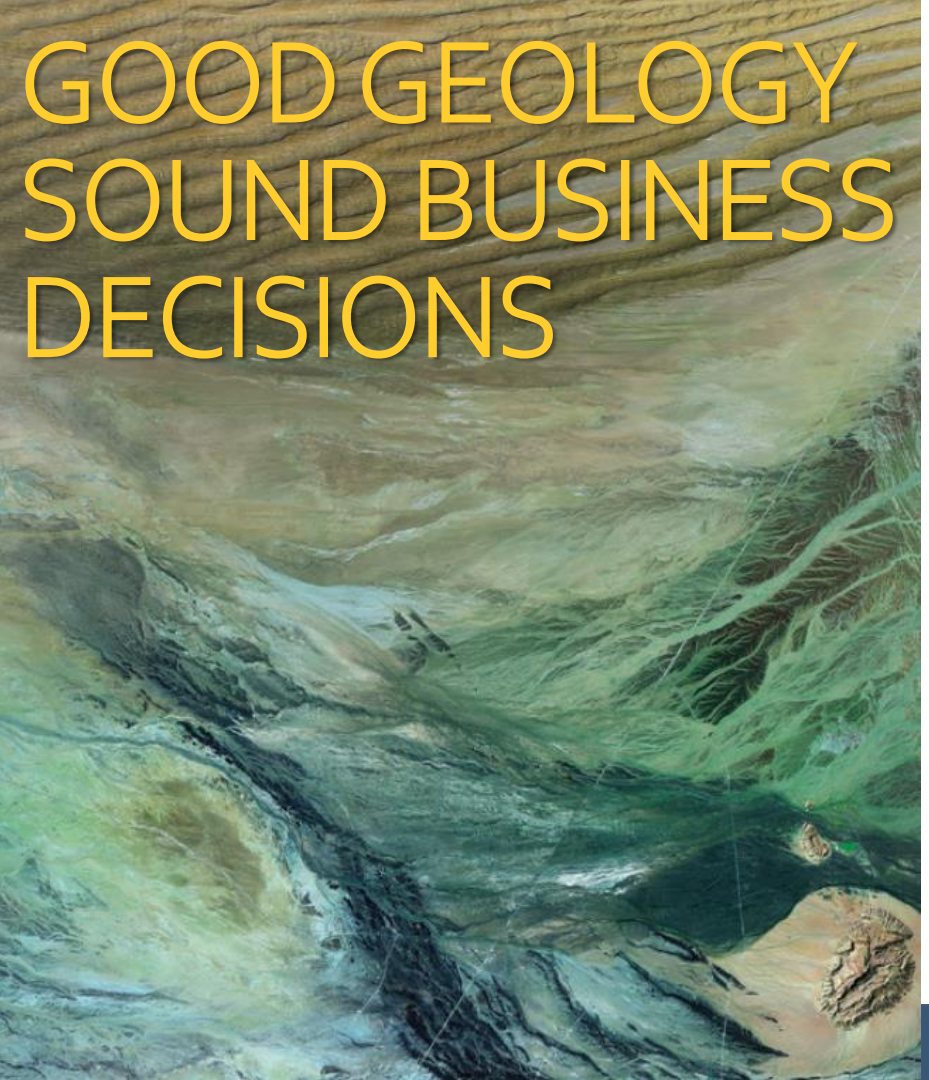
Building Success Together

- Increased cooperation and collaboration within the industry will be necessary to realize remaining exploration potential
- Along with full utilization of data, knowledge, experience and deployment of modern technologies
- Nurturing new ideas, creativity, courage, commitment and optimism
- Thinking outside the box



Building Success Together

- Strengthen geoscience technical workforce and competencies
- Improve ability to safely and efficiently execute operations
- Optimize ways of working to increase efficiency and effectiveness
- Utilize latest technological developments to improve opportunity identification, maturation and exploitation
- Enhance integration across the business and technical functions



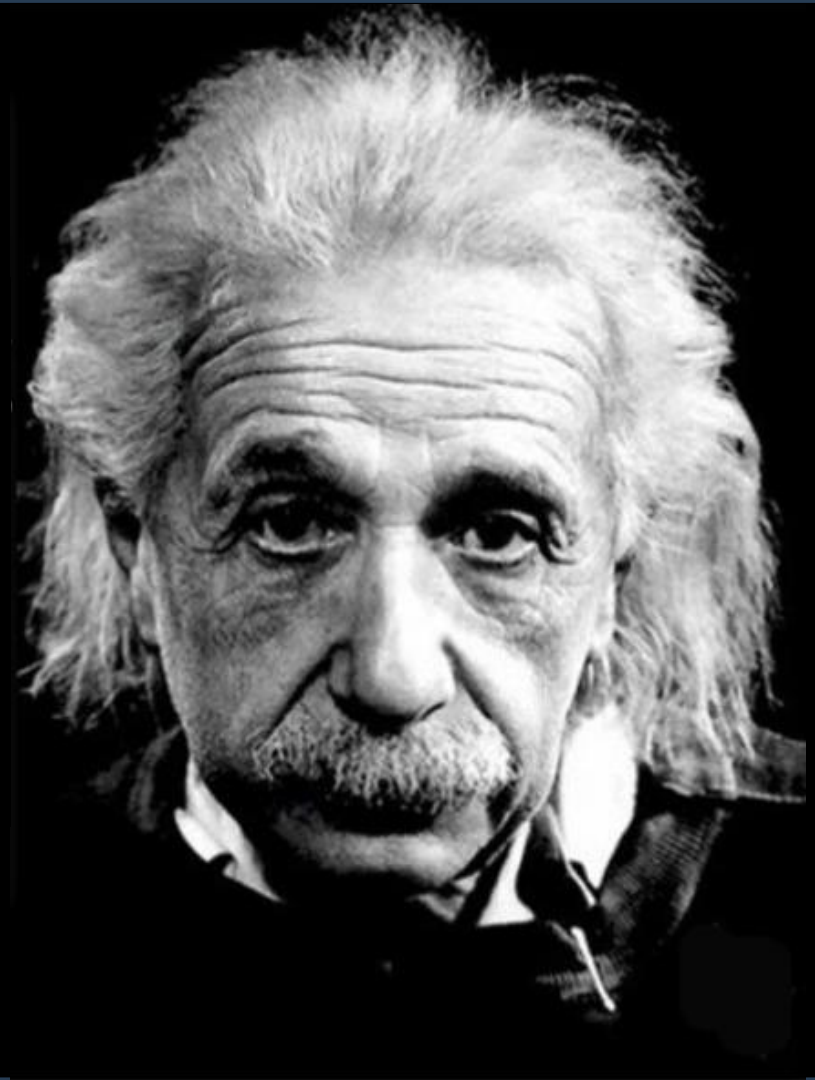
Play Based Exploration

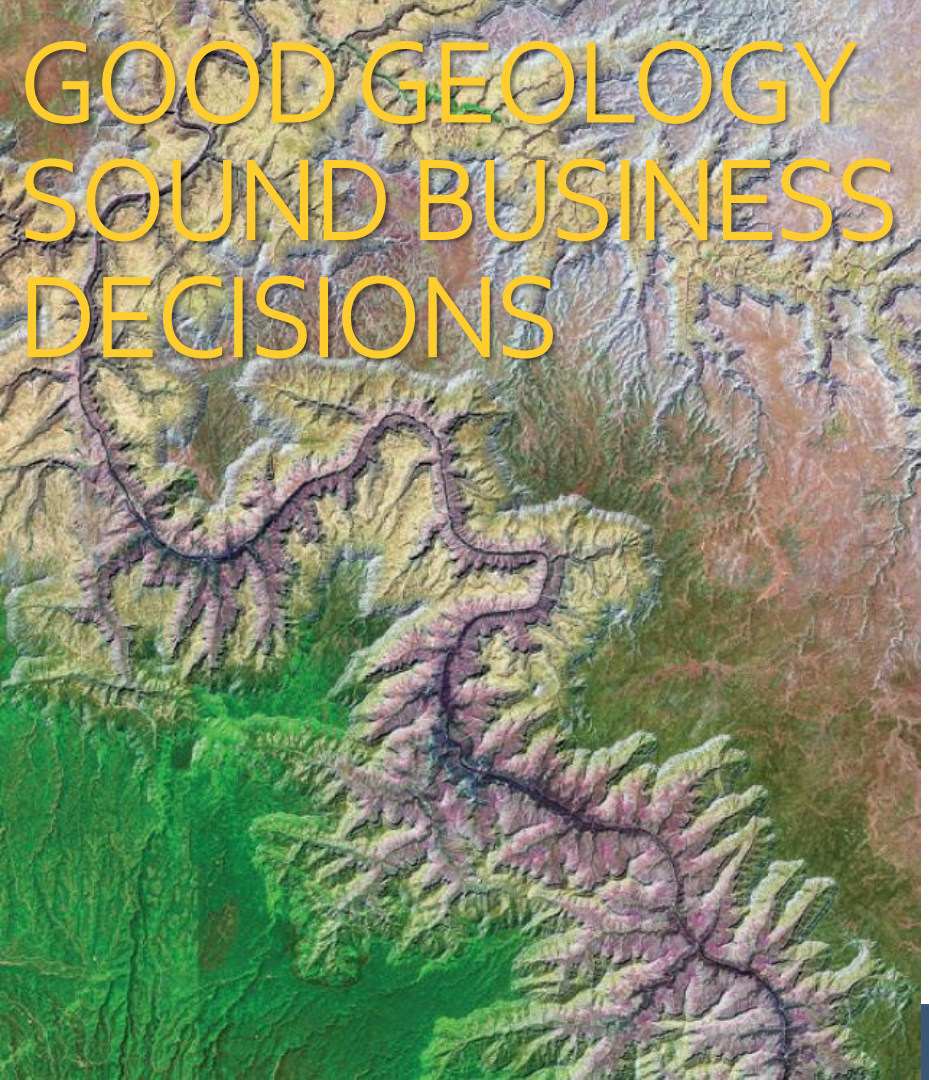
Why bother ?

- Isn't the NL Offshore mature?
- Don't we already understand the offshore petroleum system and plays?
- What's left in the portfolio is too small, too difficult or too risky?
- The evacuation infrastructure is being decommissioned so any new production will be curtailed and thus likely uneconomic?
- We have better opportunities elsewhere in our corporate portfolio?
- We don't have the resources to do this!

In the middle of difficulty lies opportunity.

Albert Einstein





Play Based Exploration

Reasons why we should bother !

- Significant YTF identified in NL offshore prospect portfolio
- Recent discoveries indicate improved understanding of various plays needed
- EBN assesses Northern Dutch offshore area to be under-explored
- EBN willing and able to support operators with creative exploration ideas and investment in new technology deployment
- Dutch gas needed to support energy transition to more sustainable energy resources

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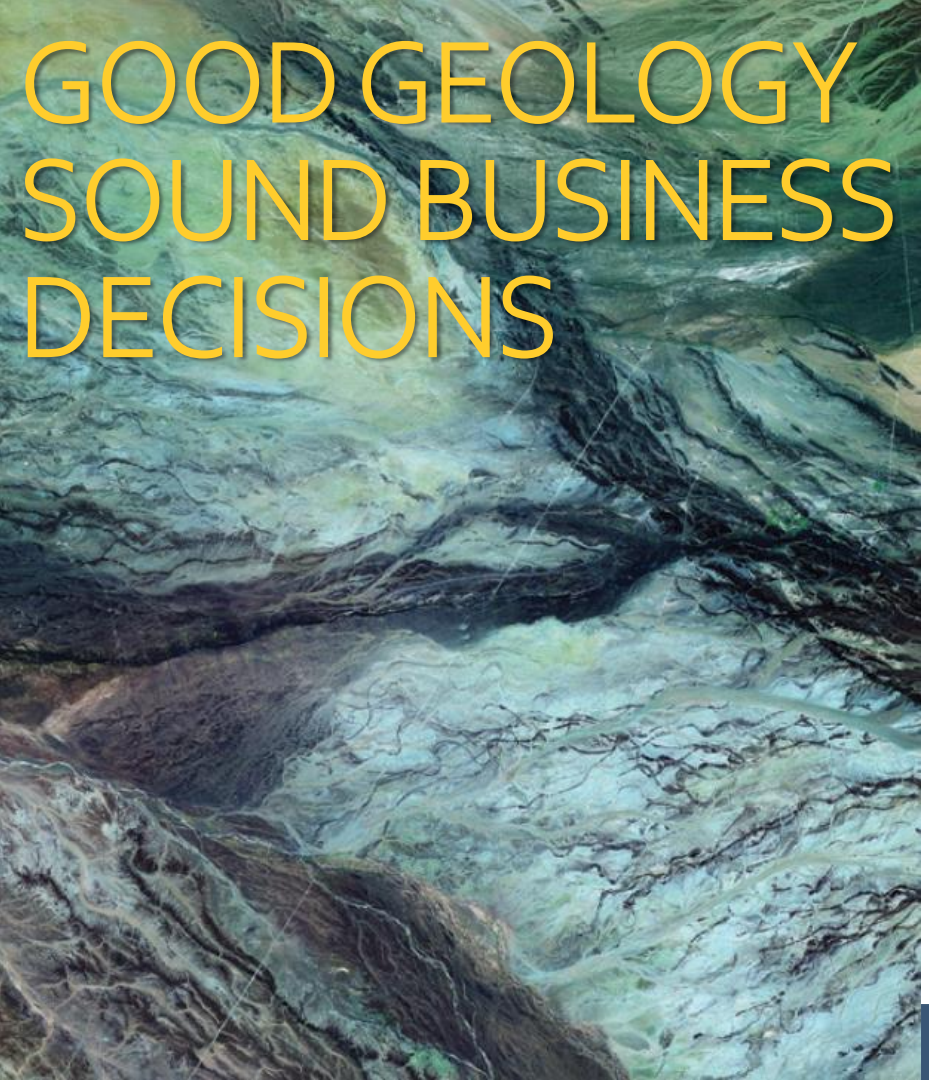
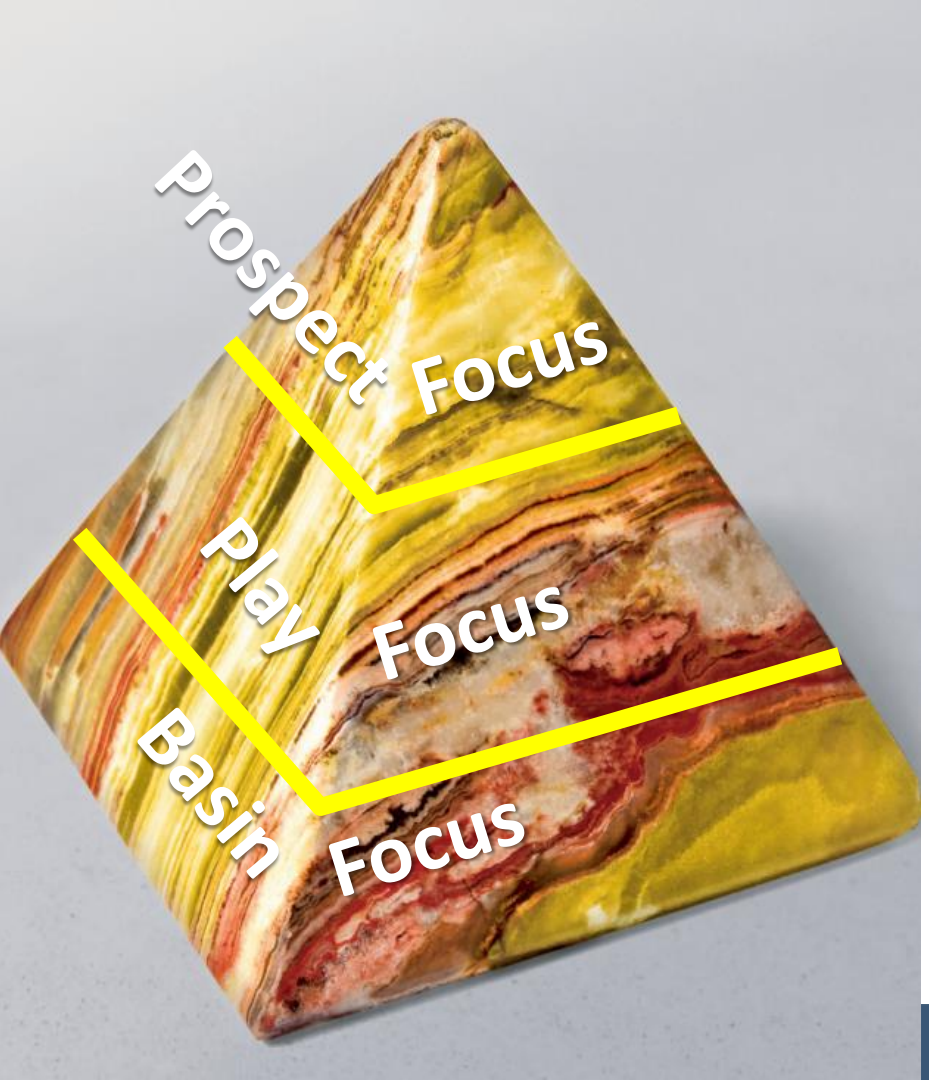


Play Based Exploration

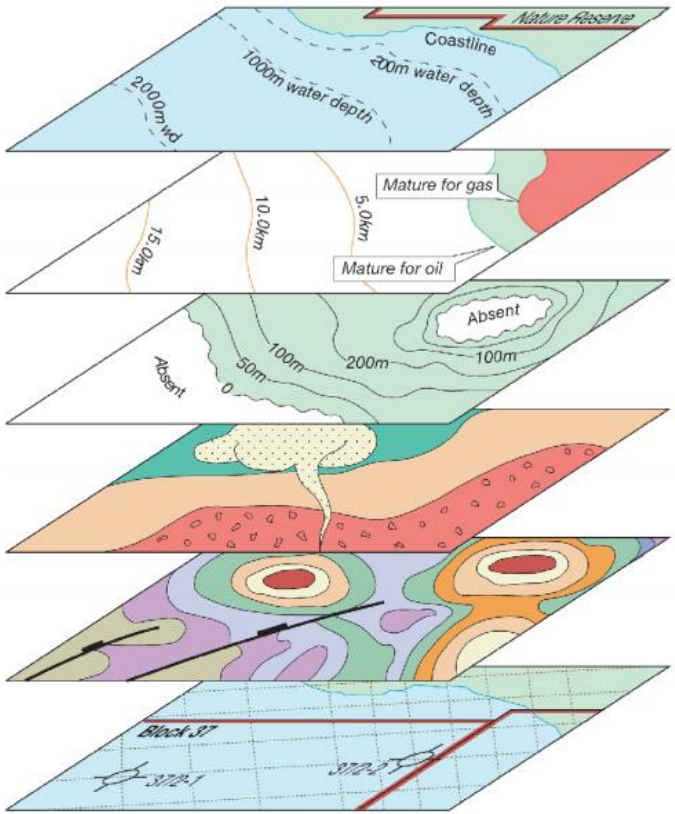
- Compile and consolidate play knowledge in a consistent and easily accessible way.
- Consistently review available data and literature to capture all possible plays, trapping configurations and to present analogues for new plays.
- Maximize value of all wells by undertaking a post-drill well analysis (PDWA)
- To assess risk factors for individual plays in a consistent manner to facilitate risk input into prospect appraisal
- To highlight evaluation tools and techniques as well as pitfalls for individual plays
- To review remaining prospectivity of the NL offshore
- To share results to stimulate exploration activity in the NL offshore.



Play Based Exploration

- The **PBE Pyramid** :
  - **Basin Focus**
    - Plate setting and basin fill
    - Sequence stratigraphy
    - Petroleum systems
    - 4D basin history
  - **Play Focus**
    - Play & CRS maps
    - Prospect & lead portfolio
    - Field size distribution analogues
  - **Prospect Focus**
    - Detailed geoscience evaluation
    - Volumes, risks and uncertainties

Input data example

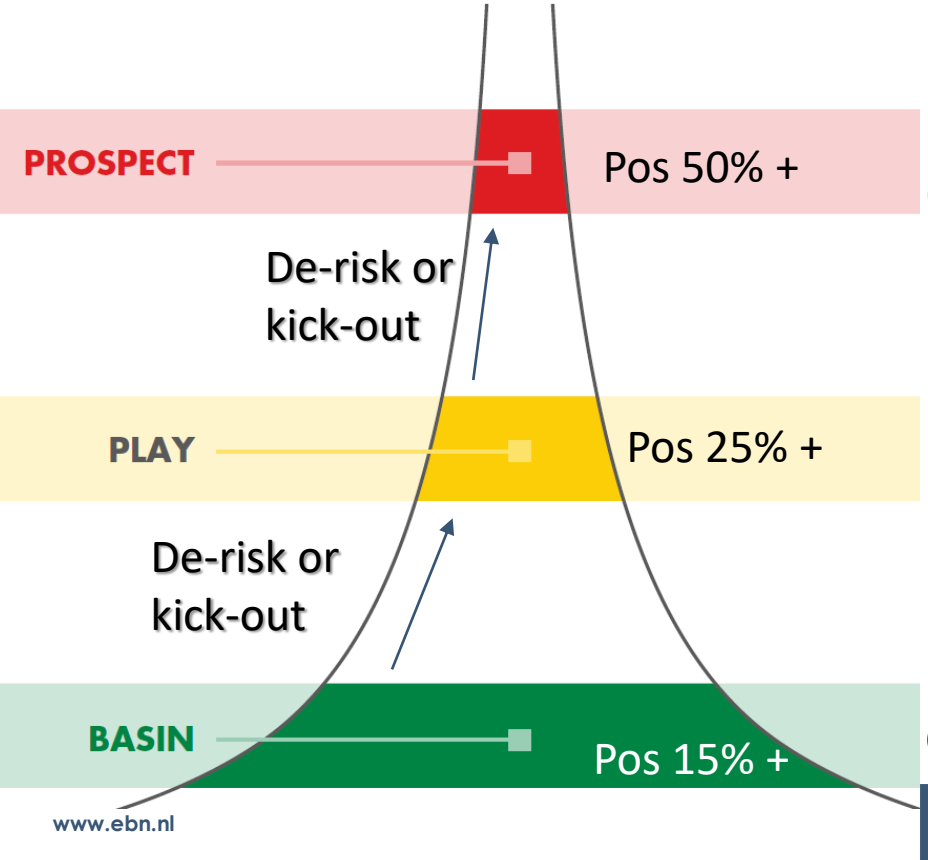


Play Based Exploration

The **Input** for Play-Based Exploration:

- Database Map : Wells, Success / Failure analysis, Risk statistics, Field analogues
- Top Reservoir Structure Map : Tectono-strat timing, Velocity sensitivity, Fault analysis
- Reservoir facies maps : Isopach, Porosity, PermNet, Net to Gross, AVO, Amplitudes, Provenance
- Top Seal Isopach Map: Fault seal risk, Pressure analysis, Timing
- Source and Maturity maps : Source Rock Quality, Flux map, Slicks/seeps, Inversion timing, Temperature, Fetch map
- Focus Map : ARCGis concession and Partnerships

Play Based Exploration



Drilling Commitment

Participant Venture Maturation
(Pre-well, prospect scale, VOI of new seismic)

Kick-on

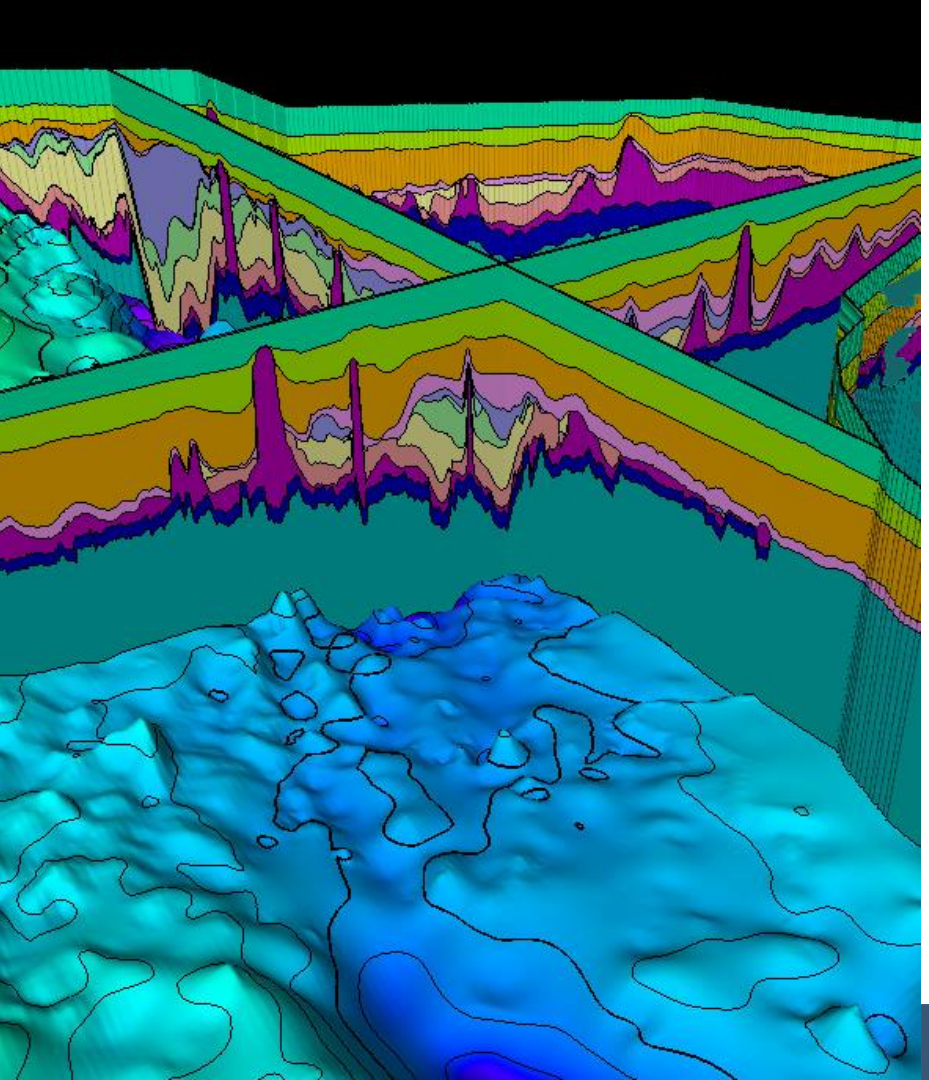
Kick-out

Participant Venture Maturation (play scale)

Kick-in

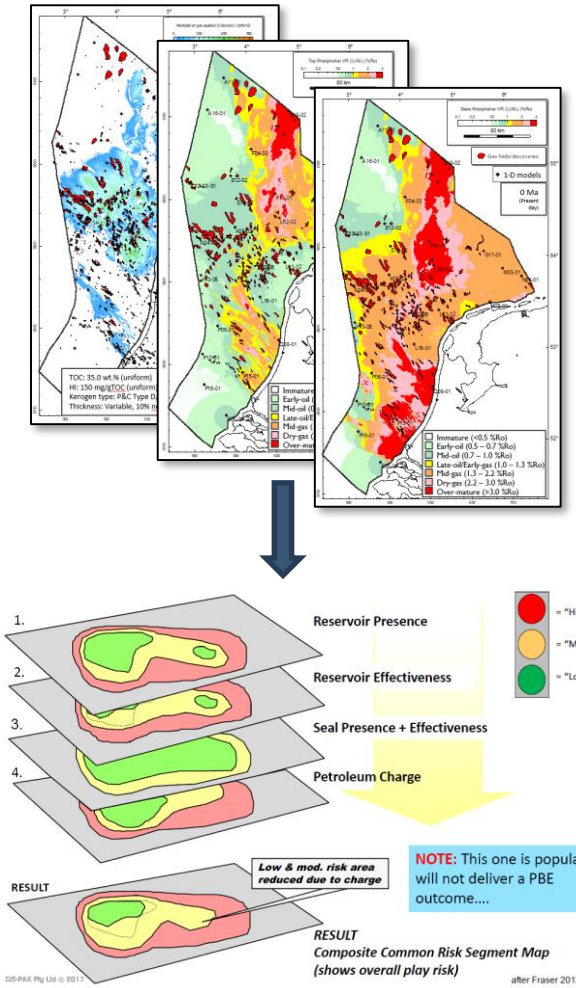
Kick-out

Opportunity Identification (Open Acreage, Basin Scale)



Basin Modelling

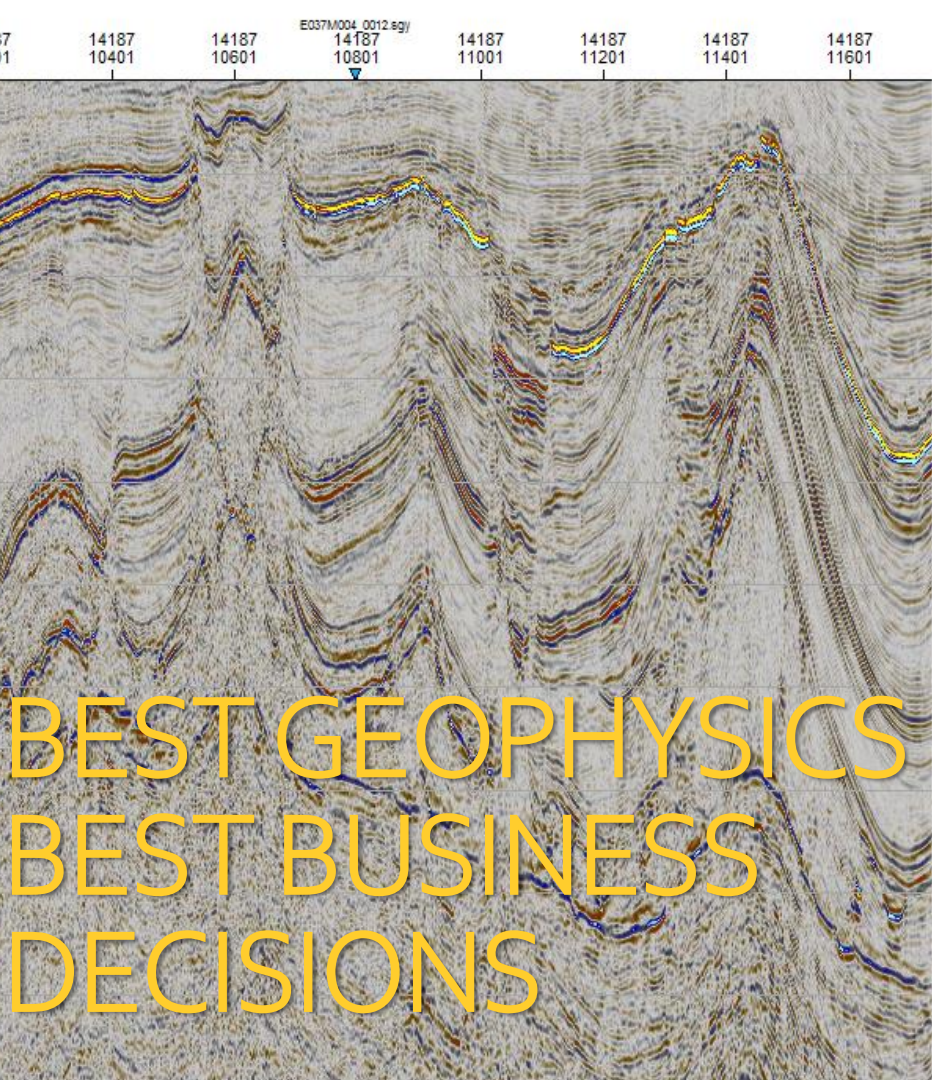
- Large amount of data publicly available (**www.nlog.nl**) to map presence & efficiency distribution for key Play Elements
  - Reservoir, Seal and Source Rock. Overview of Charge & Migration is patchy
- **Petroleum System Analysis project** has been completed by **IGI Ltd.** to provide high level overview of the :
  - Distribution, quality and maturity of source rock intervals and their hydrocarbon generation capacity through time and space



Basin Modelling

- Public data used for input
- Maturity and expulsion maps (60+) available for:
  - Posidonia Formation
  - Westphalian
- Results will be **input** for furthering **Play Based Exploration** work
- Maps will be integrated in Player software (GIS-PAX) as CRS maps
- Results (Q1 2020 onwards) will be made available for **FREE** via **www.ebn.nl**

From: Player Manual (GIS-PAX)



Geophysical Developments

- **2D & 3D broadband reprocessing**
- **Ghost-free marine acquisition** for deeper targets and improved resolution and interpretability using broadband seismic
- **Wide/Full Azimuth Illumination** using OBN
- **Higher resolution**, geologically consistent, Velocity Models using Full Waveform Inversion or well based starting models
- **Imaging of complex structures** using algorithms that can handle rapid velocity variations, steep dips, overhangs and multiple ray-paths using Reverse Time Migration
- **Improved processing and (4D) matching** of incompletely or differently acquired seismic surveys using Least Squares Migration
- **Better & faster interpretations** using advanced seismic facies, waveform analysis, DHI search, 3D visualization and AI techniques

Geophysical Developments

- **OBN acquisition** provides field data compatible with modern velocity model derivation and imaging algorithms allowing for improved imaging and depth conversion below complex overburdens
- **Many areas** offshore Netherlands suffer from poor imaging at Rotliegend and Carboniferous play intervals
- **Many (un)identified prospects** cannot be effectively matured due to structural closure and column height uncertainties.
- **OBN deployment** considered potential **Gamechanger** in SNS

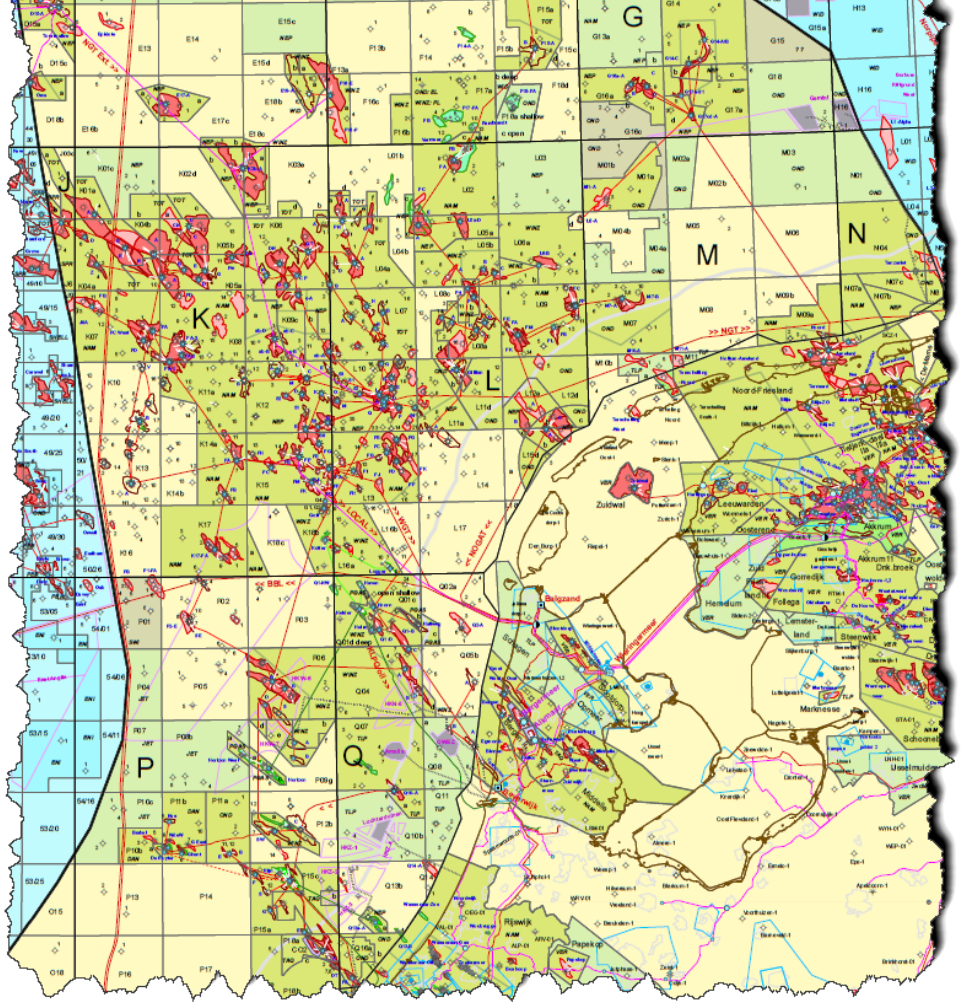
Your Business Objectives Are Our Business Objectives

- **How can EBN help you achieve:**
  - Accelerated identification and maturation of leads and prospects through your opportunity maturation funnel (Kick-In, Kick-On, Kick-Out)
- **How can EBN best support you?**
  - Resources?
  - New technology deployment?
  - Technical collaboration sessions?
  - Opportunity Framing Facilitation?
  - Portfolio review?

Think Outside

Win Win Win

- **Win for Operators**
  - Accelerated high grading of prospects
  - Knowledge and skill sharing
  - More successful discovery wells
- **Win for EBN and Dutch state**
  - Focussed and accelerated maturation of economic offshore prospects
  - Economic Dutch gas production with lower GHG footprint than imported gas
- **Win for all**
  - Ensure offshore gas resources are safely and economically exploited to support the Energy Transition



Summary

- EBN believes that the NL SNS remains a *"Sea of Opportunity"*
- Close collaboration and cooperation with and amongst Operators is required to realize remaining exploration potential
- Results of EBN subsurface studies will be made available free of charge
- **Contact EBN – your business objectives are our business objectives**

Introduction to Geoscience Input into Well Planning and Design

Workshop 6:	Sunday, 7 June
Conveners:	Martin Ecclestone (EBN) Douwe van Leverink (EBN)

Workshop Description

Wells are vital to our business in accessing hydrocarbon and geothermal resources and in the deployment of CCS. Drilling wells generates significant risk exposure for safety, capital and reputation. It is therefore important that work undertaken during the well planning phase supports quality well design and effective preparation for well operations. If the planning phase is successful, this will result in delivery of wells that have a high likelihood of achieving the pre-drill stated well objectives, on time, on budget and without harm to people and environment. Key to quality well planning is the integration of multi-disciplinary input (Fig. 1).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