TOWED STREAMER **EM**

Reducing drilling risk
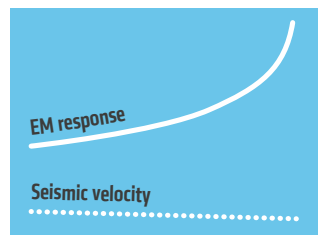
EM response
Seismic velocity
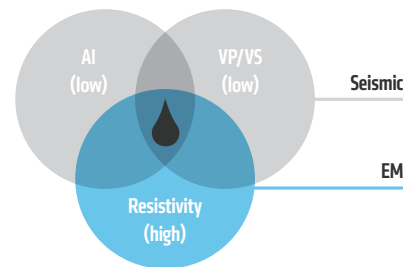**Hydrocarbon saturation**

EM + seismic = reduced risk

Improved hydrocarbon saturation estimates.

Sight & sound

Complementary data add new layers of comprehension: a bit like adding sight to sound. While seismic is the best measure of lithology, EM is more sensitive to changes in fluids.

AI (low) | VP/VS (low) — Seismic
Resistivity (high) — EM
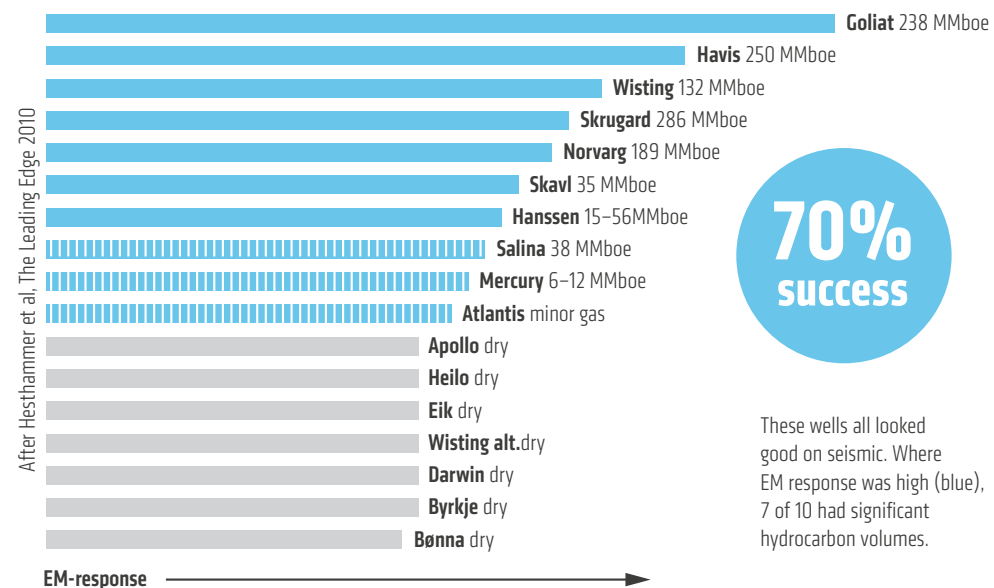
Independent inversions

Seismic data can be inverted for velocity and for acoustic impedance. Inversion of EM data provides resistivity. Correlating all three improves drilling success.
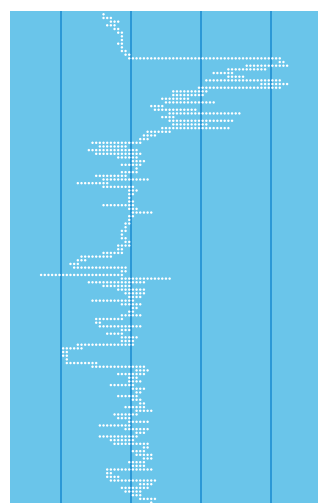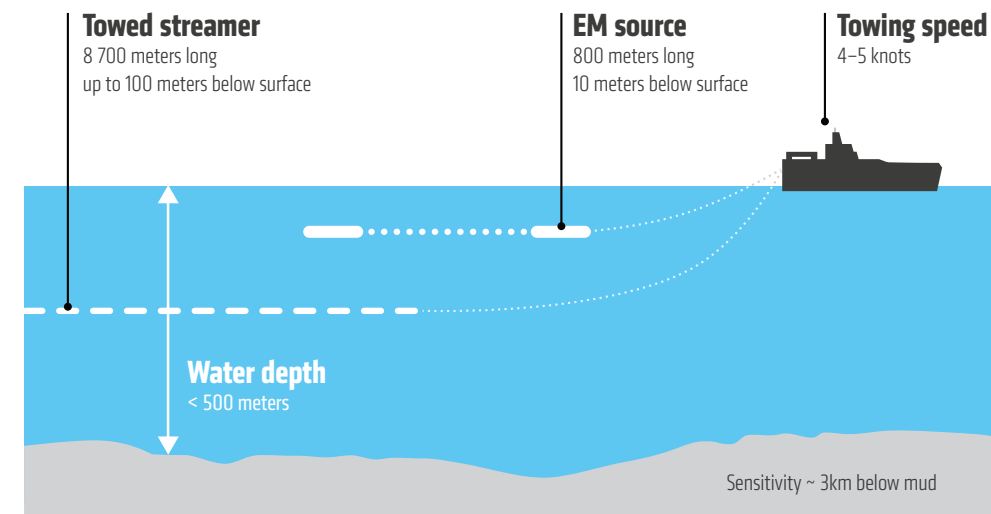

Resistivity

Hydrocarbon saturated rocks are typically highly resistive. Geologists access local resistivty data from well logs.

Drilling success with EM
Barents Sea

After Hesthammer et al, The Leading Edge 2010

- **Goliat** 238 MMboe
- **Havis** 250 MMboe
- **Wisting** 132 MMboe
- **Skrugard** 286 MMboe
- **Norvarg** 189 MMboe
- **Skavl** 35 MMboe
- **Hanssen** 15–56MMboe
- **Salina** 38 MMboe
- **Mercury** 6–12 MMboe
- **Atlantis** minor gas
- **Apollo** dry
- **Heilo** dry
- **Eik** dry
- **Wisting alt.** dry
- **Darwin** dry
- **Byrkje** dry
- **Bønna** dry

EM-response

70% success

These wells all looked good on seismic. Where EM response was high (blue), 7 of 10 had significant hydrocarbon volumes.
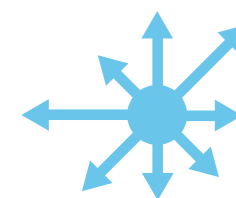
Operational 101

Towed streamer acquisition produces high density 2D or 3D EM data fast.
The operation is very similar to seismic, making it easy to install, operate and even combine.

Towed streamer
8 700 meters long
up to 100 meters below surface

EM source
800 meters long
10 meters below surface

Towing speed
4–5 knots

Water depth
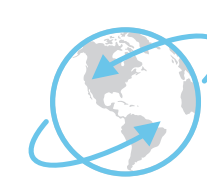< 500 meters

Sensitivity ~ 3km below mud

Fast

Acquisition speed up to 200 sq. or line km EM data / day
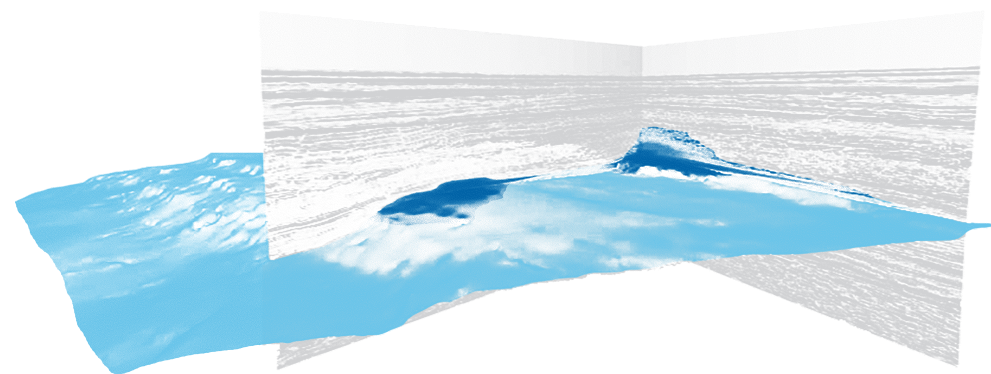
Flexible

Multipurpose EM can de-risk frontier prospects, reveal drilling hazards, or identify missed tail end production.

Global

Northern Europe is the region with greatest EM coverage so far, but feasibility studies around the world show this technology has global potential.

Adding EM to seismic

How and when

Improve ranking of prospects by adding 2D or 3D EM data to existing seismic data. Enhance EM resolution by using the seismic to guide the EM inversion.

Acquire EM and 2D GeoStreamer data efficiently and simultaneously with the same vessel to plan new 3D seismic.

May 2016

HSEQ

Health

PGS' high standards apply.

Safety

Standard PGS towed streamer operations and equipment reduces risk.

EM helps identify shallow gas drilling hazards.

Environment

Low environmental impact.

Fewer vessel days = lower emissions in both standalone and simultaneous acquisition modes.

Quality

Towed streamer EM produces high density data and permits onboard QC and processing.

PGS