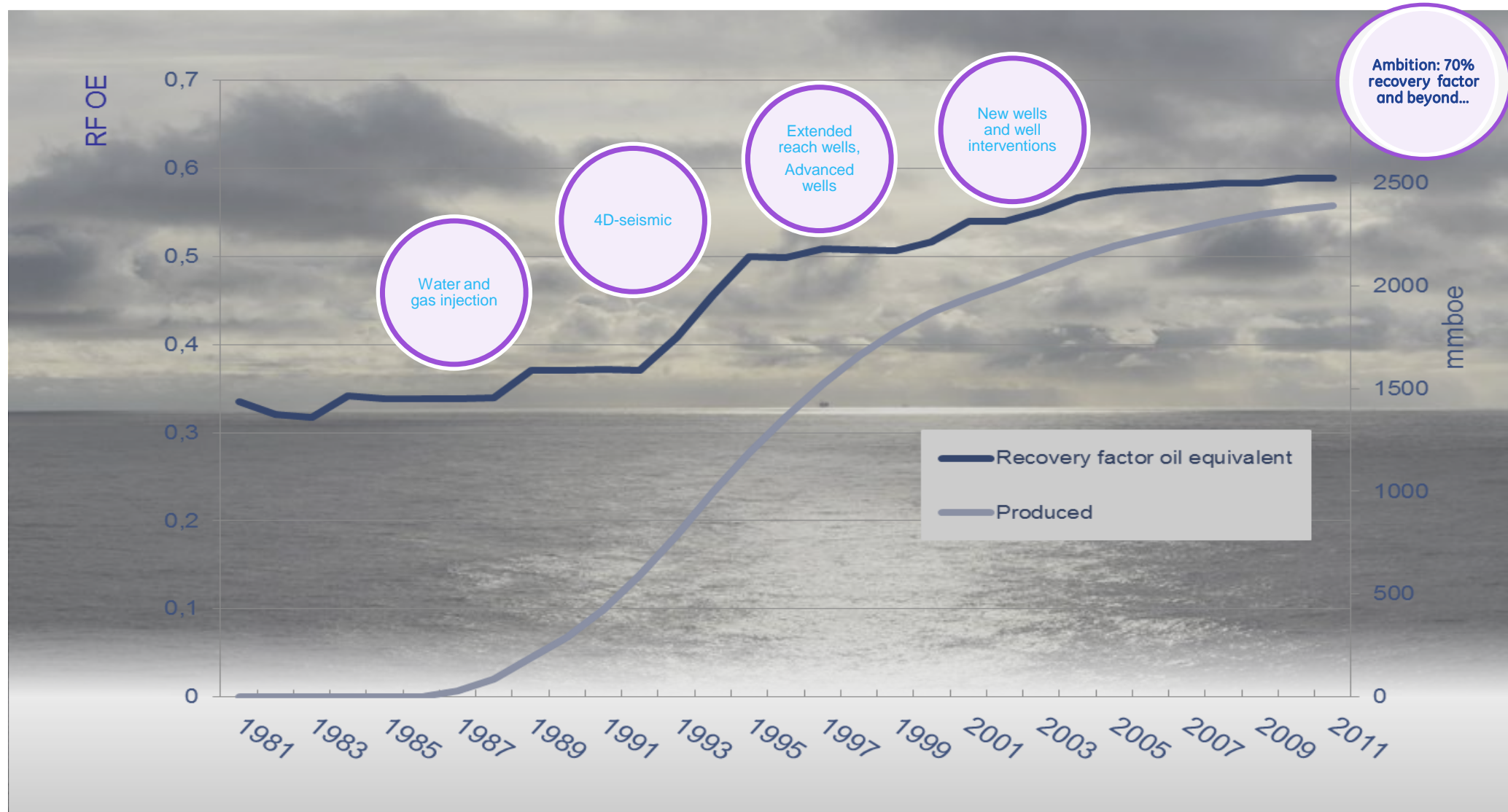


Subsurface & Enhanced Recovery



Field Example Gullfaks

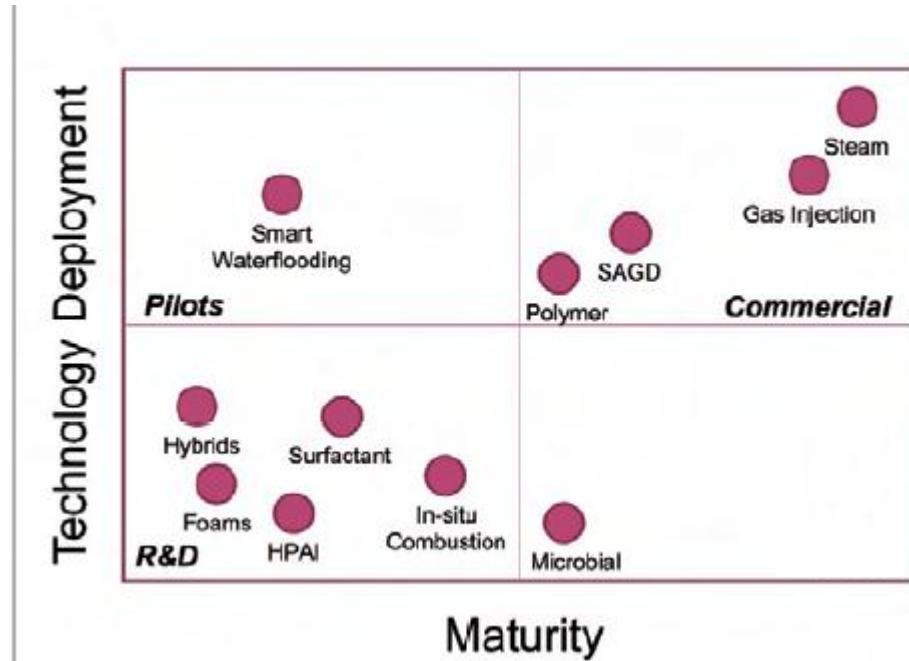
Subsurface & Enhanced Recovery



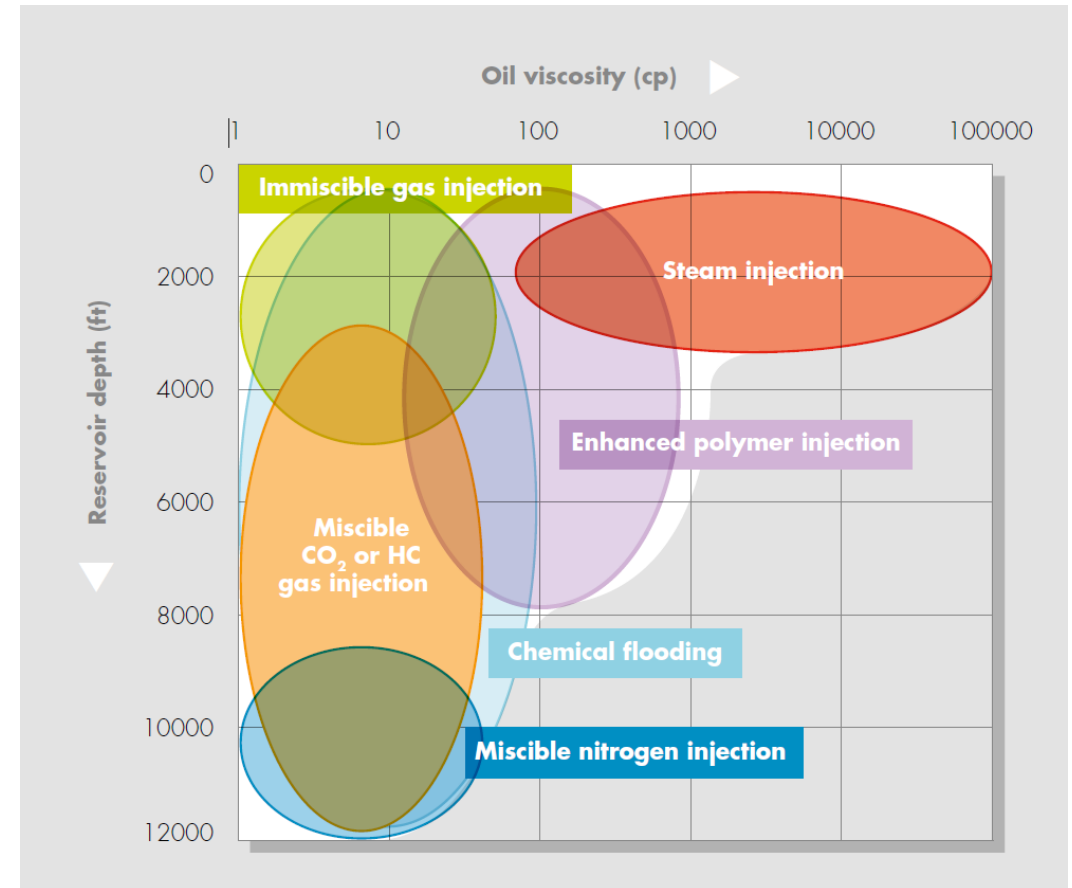
Source : Statoil

Maturity & Operational Window of EOR Methods

Subsurface & Enhanced Recovery



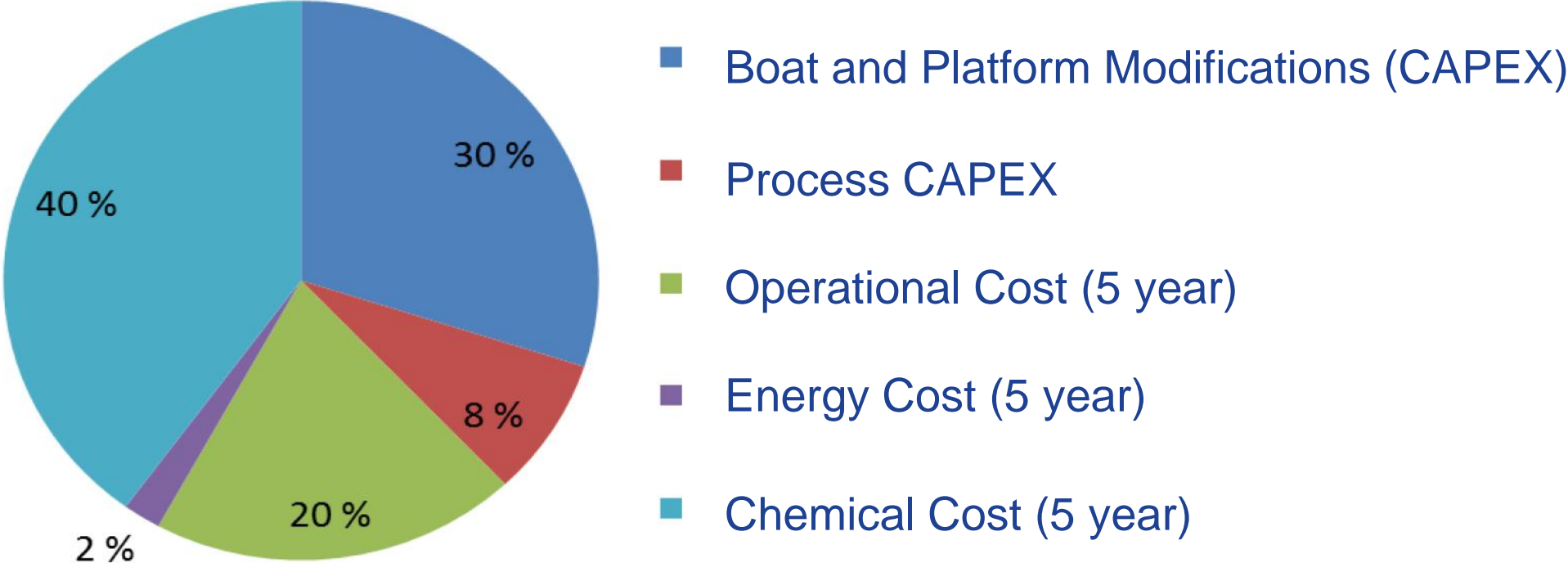
Source : WPC 2010



Source : Shell Enhanced Oil Recovery

EOR Cost (PASF North Sea)

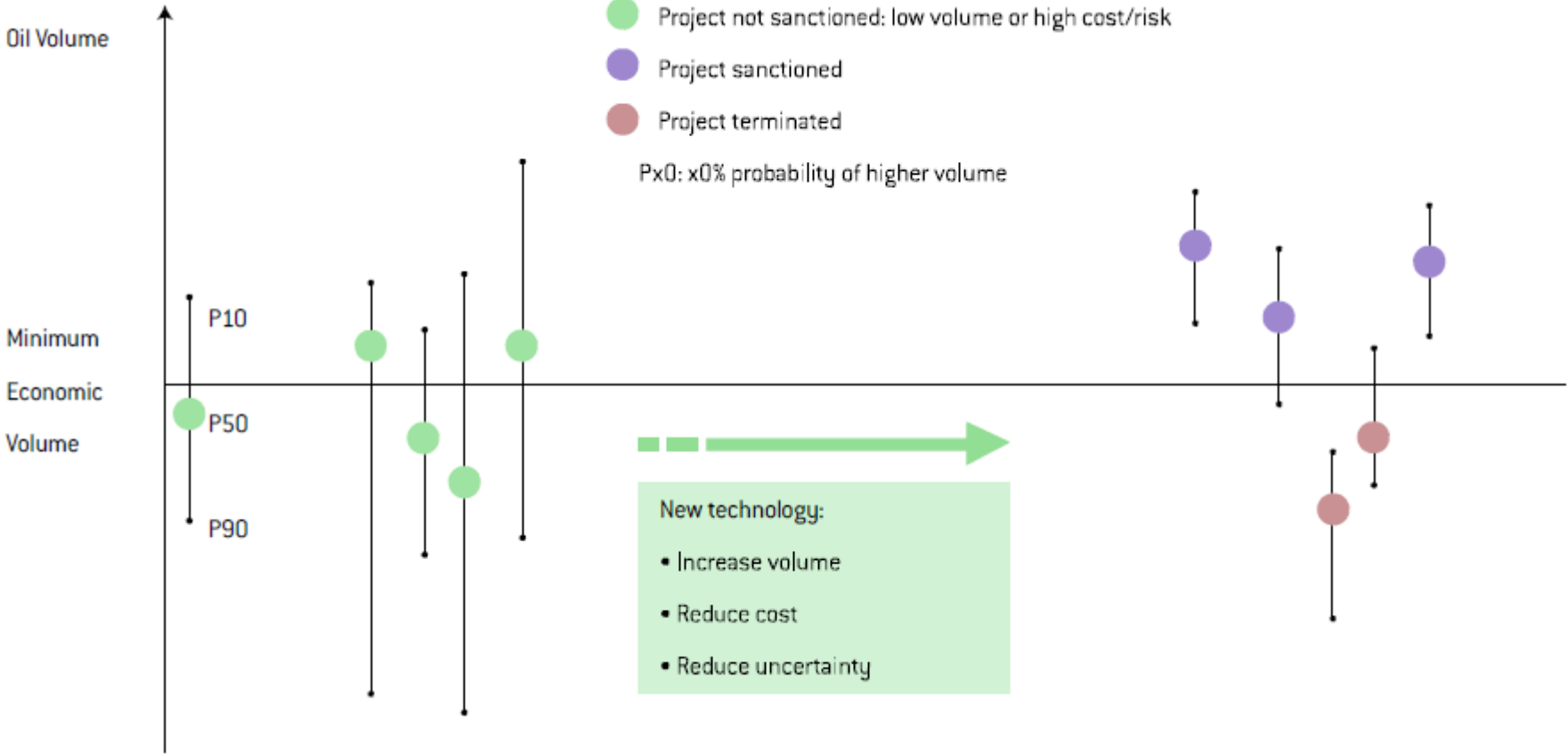
Subsurface & Enhanced Recovery



Source : Konkraft/Statoil

IOR/EOR Technology Barriers

Subsurface & Enhanced Recovery



Source : OG21 TTA2 Technology Strategy

Enormous EOR Potential

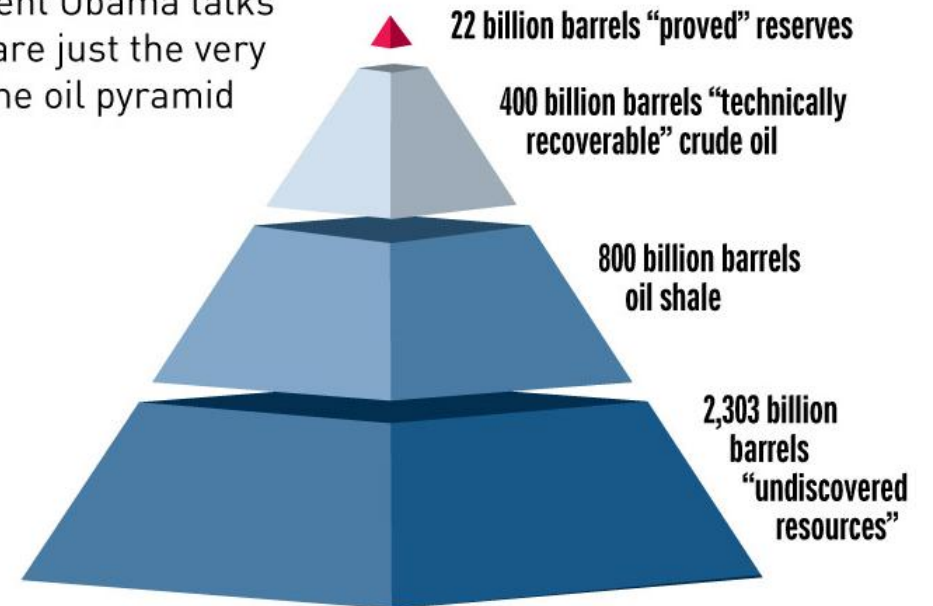
Subsurface & Enhanced Recovery

Realizing the potential

- Basic requirements
- Reservoir management
- HSE requirement
- Profitability

The Oil Scarcity Myth

The U.S. oil “reserves” President Obama talks about are just the very tip of the oil pyramid



Sources: Energy Information Administration, Dept. of Energy, Rand Corporation, Institute for Energy Research

Overview

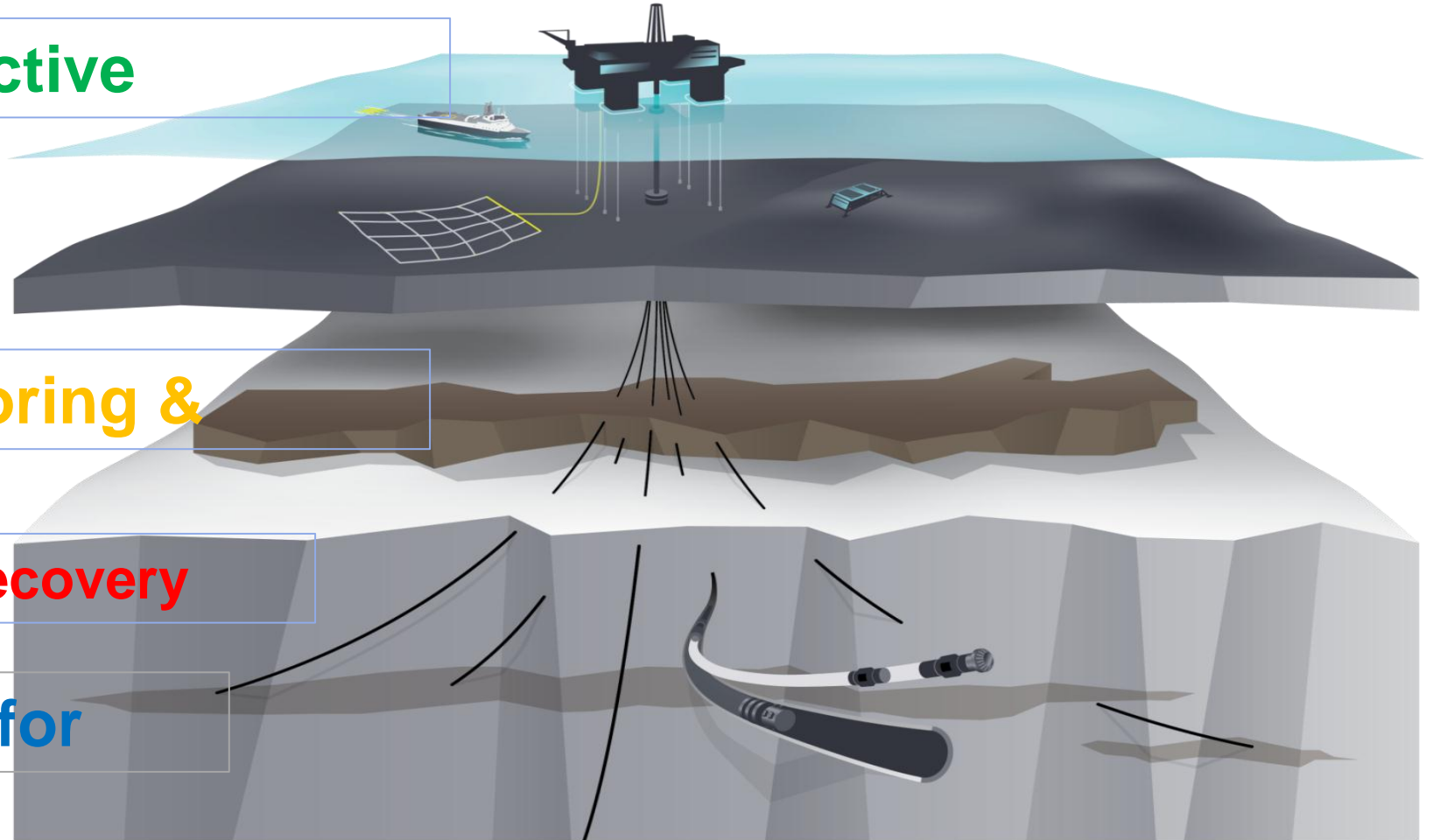
Subsurface & Enhanced Recovery

Safe & cost effective operation

Reservoir monitoring & exploration

IOR/Enhanced oil recovery

Drilling and well for IOR



Mapping of Resource Potential

Subsurface & Enhanced Recovery

FIG 4.2: TOTAL VOLUME OF OIL (Y-AXIS) IN FIELDS DIVIDED ON SOLD (ORANGE), OIL RESERVES (BLUE), AND OIL RESOURCES LEFT AFTER END OF FIELD LIFE (GREEN) OF CURRENTLY APPROVED PLANS.2.

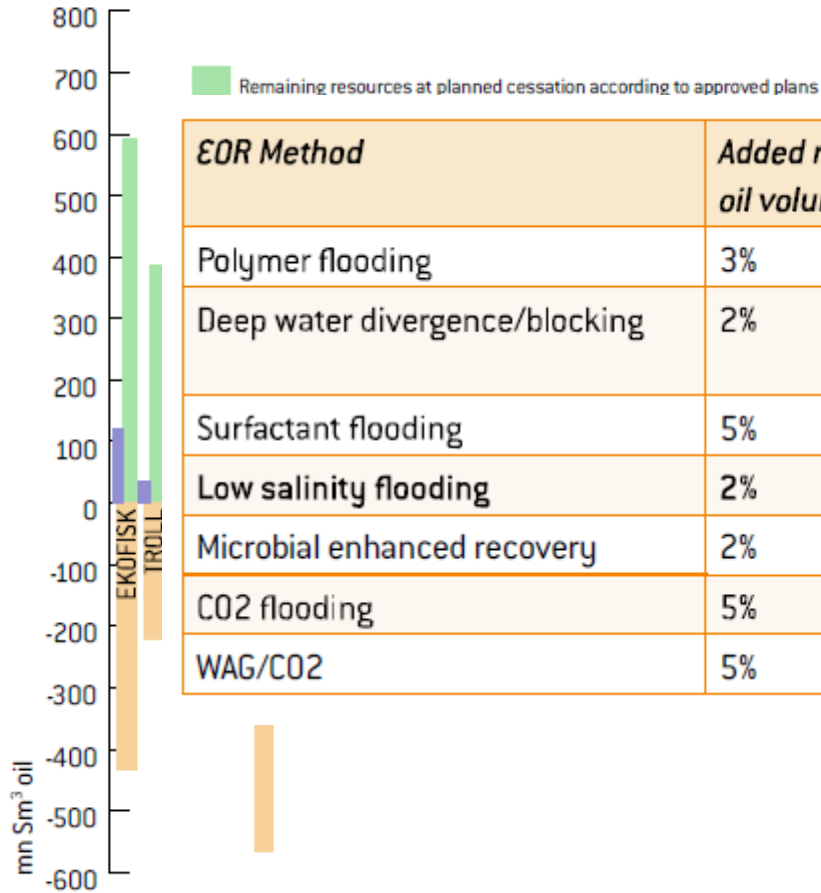


FIG 4.3: FRACTION OF OIL LEFT IN FIELDS IN PRODUCTION CLASSIFIED IN THE TYPES OF IMMOBILE OIL AND MOBILE OIL. THE BOXES SHOW IOR MEASURES THAT CAN BE USED. (BASED ON FIGURE FROM NPD).

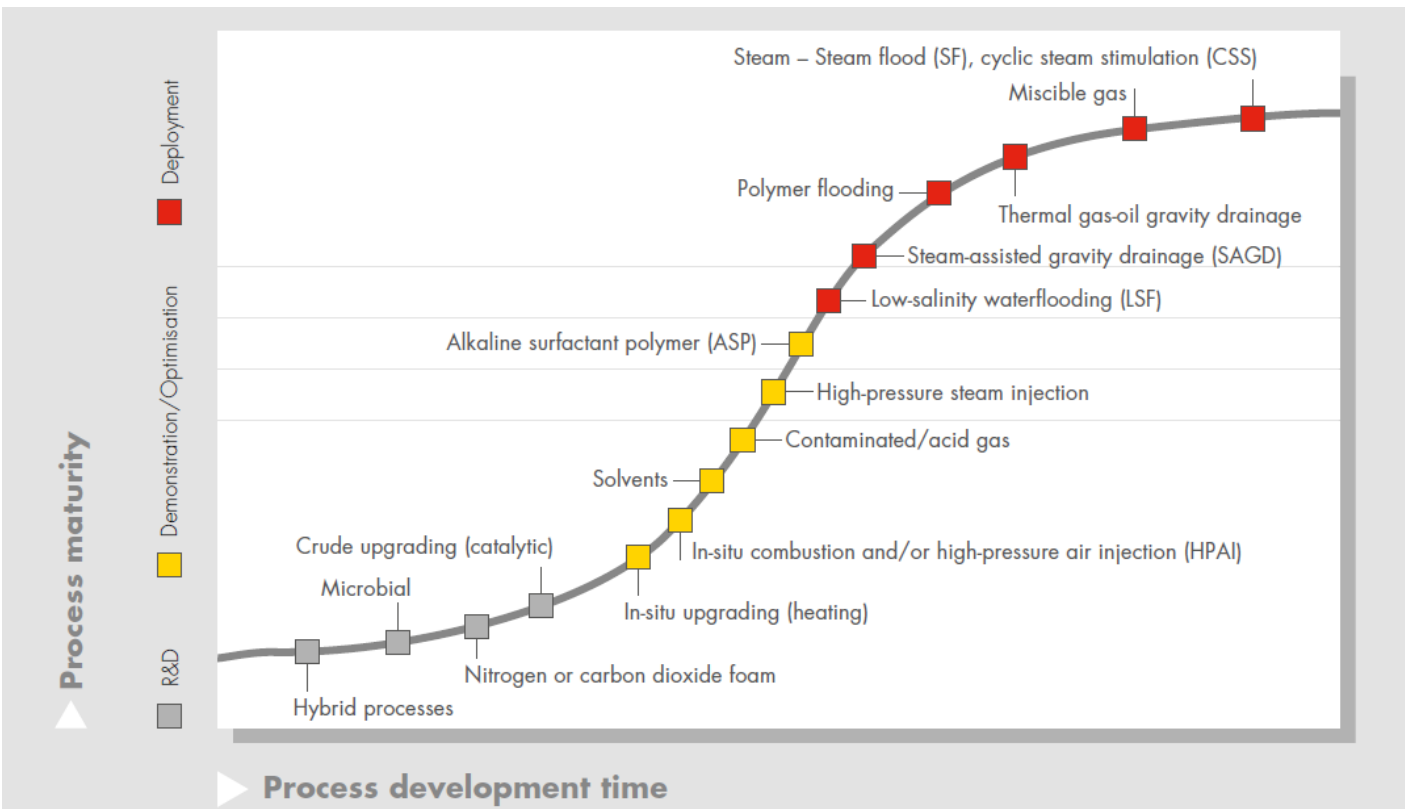
<i>EOR Method</i>	<i>Added reserves in (%) of original in place oil volume (STOOIP)</i>	<i>Type of reservoir complexity or oil</i>
Polymer flooding	3%	Viscous oil, permeability contrast
Deep water divergence/blocking	2%	Permeability contrast, lateral stratigraphic continuity
Surfactant flooding	5%	Immobile oil
Low salinity flooding	2%	Immobile oil
Microbial enhanced recovery	2%	Immobile oil
CO2 flooding	5%	Mobile and immobile oil
WAG/CO2	5%	Vertical distribution of mobile oil

EOR Measures

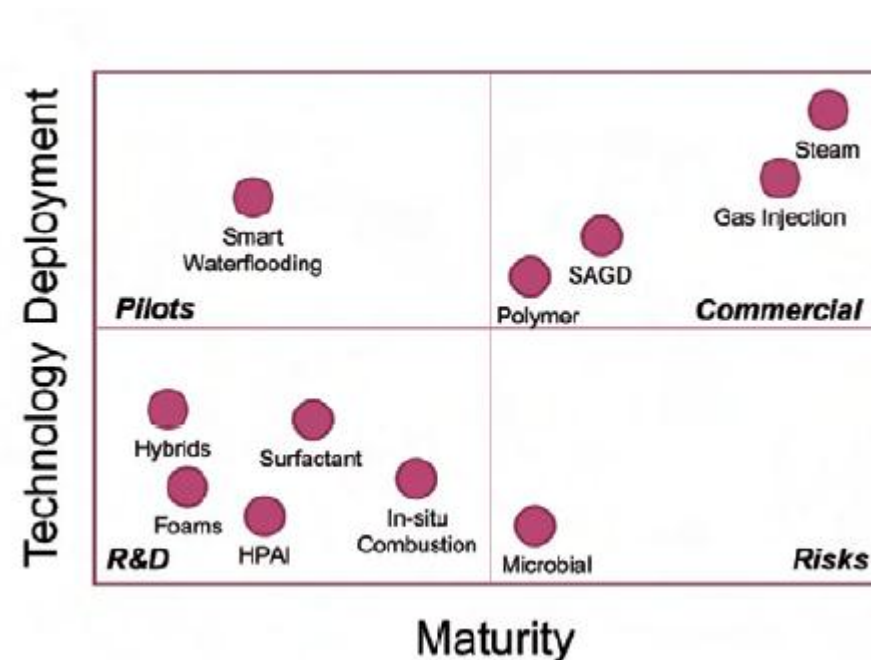
- Polymer flooding
- Low salinity water injection
- Surfactant flooding
- Microbial EOR
- Infill drilling
- Advanced wells
- Zonal shutoff
- Subsea compression

Maturity of EOR Methods

Subsurface & Enhanced Recovery



Source : Shell Enhanced Oil Recovery



Source : WPC 2010