Static and Dynamic Estimates of CO2 Storage Capacity in Two Saline Formations in the UK North Sea

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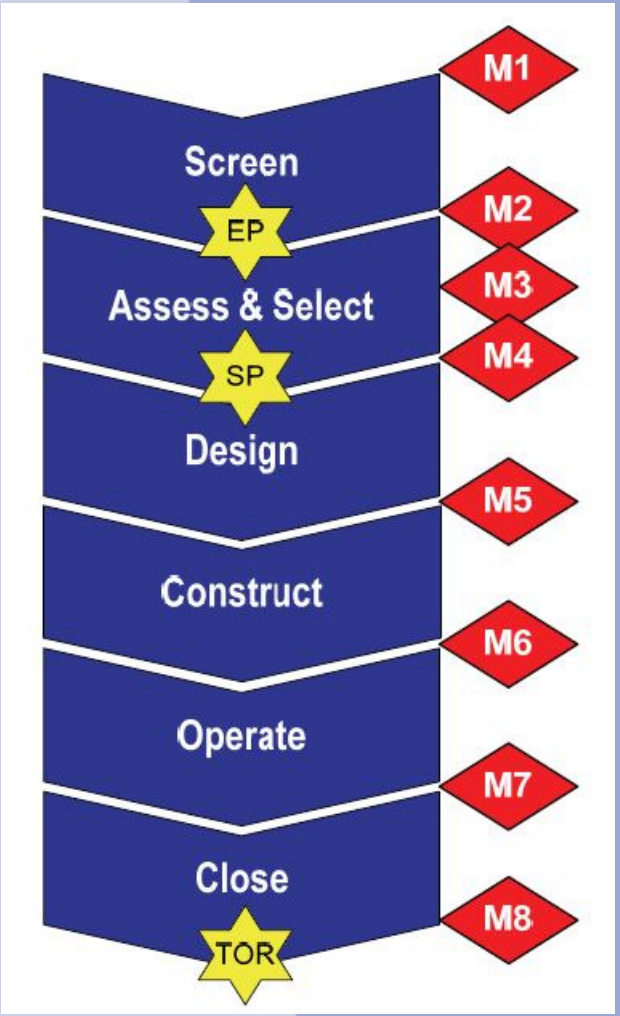
CO_2 Storage Resource/Capacity Estimates

- Different techniques will be employed for making estimates at different stages

- Primary calculation is what mass of CO_2 can be stored without it escaping from defined storage volume

(DNV CO2QUALSTORE Report, Figure 1)



Introduction

- **Storage capacity depends on**
  - bulk volume of saline formation
  - porosity (connected pore volume)
  - pressure limit = 1.5 x initial pressure; 0.75 x lithostatic pressure, etc?
  - distribution of CO_2 within aquifer
    - buoyant rise of CO_2
    - capillary trapping
    - dissolution
    - geological heterogeneity
- **Storage efficiency**
  - volume of CO_2 stored/total pore volume

Methods of Storage Assessment

- **Material balance**
  - closed aquifer
  - semi-closed aquifer
  - open aquifer
- **CO_2 Migration Pathway Analysis**
- **Reservoir Simulation**

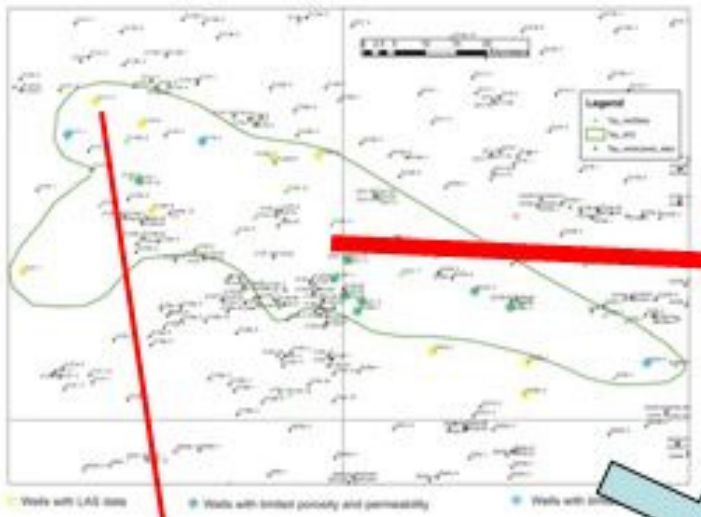
Material Balance

- **Used in oil industry to estimate oil in place**
- **Closed saline formation**
  - volume of CO_2 limited by maximum pressure increase

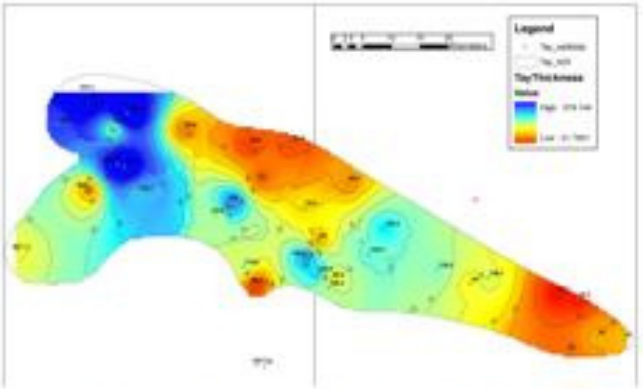
$$c_t = c_w + c_r = -\frac{1}{V}\frac{\Delta V}{\Delta P}$$

- **Semi closed**
  - allow brine to leak through top and bottom seal
  - assume CO_2 trapped by capillary forces
  - more CO_2 may be stored

Reservoir Simulation Approach



90 wells well-top data from DTI web

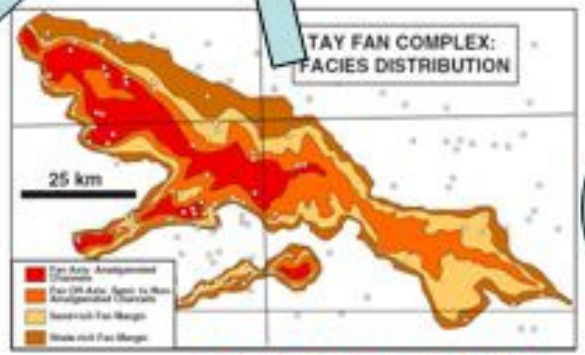


3 surfaces from BGS

PETREL static model

ECLIPSE dynamic model

9 wells WELL-LOG from BGS

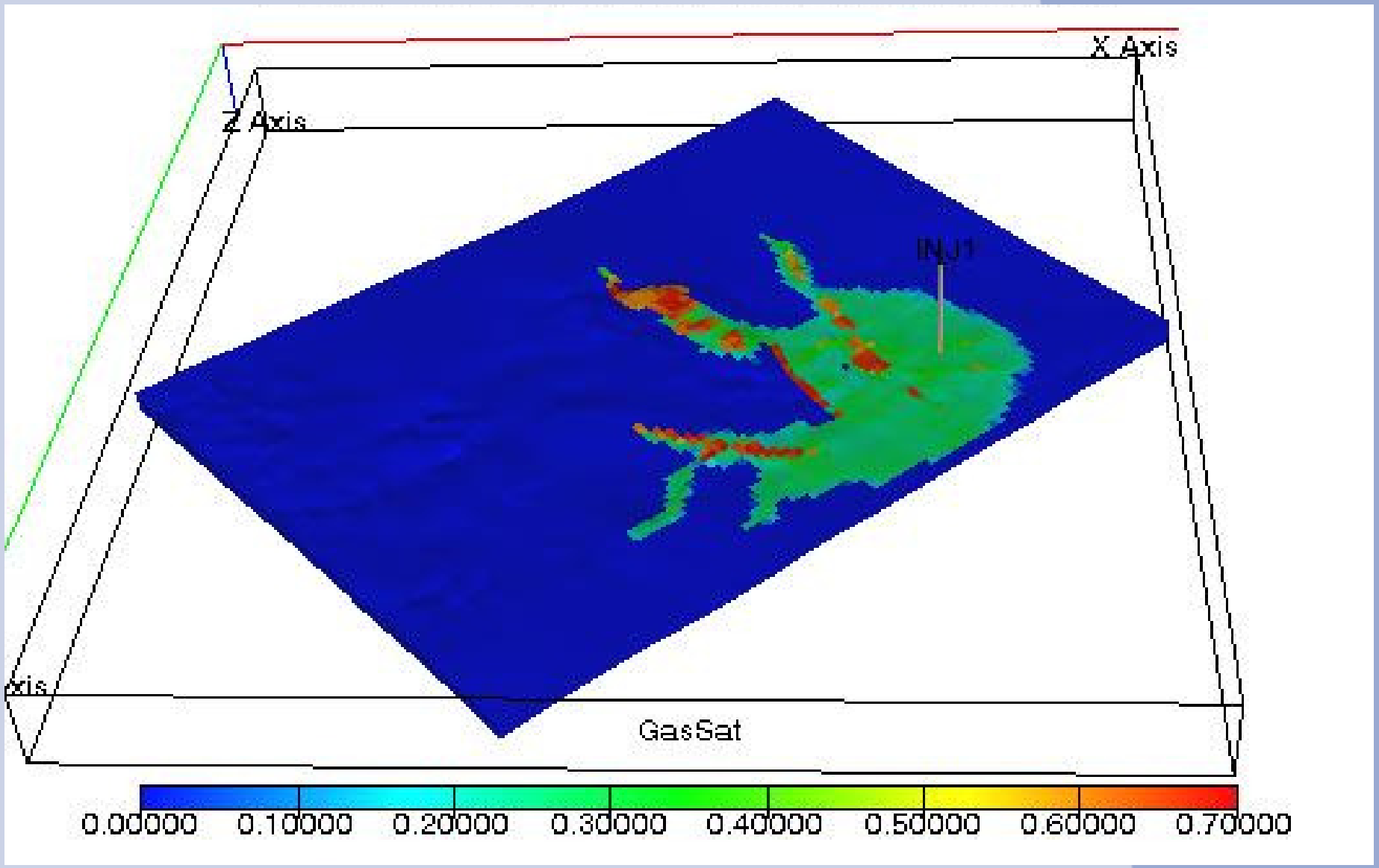


Published data

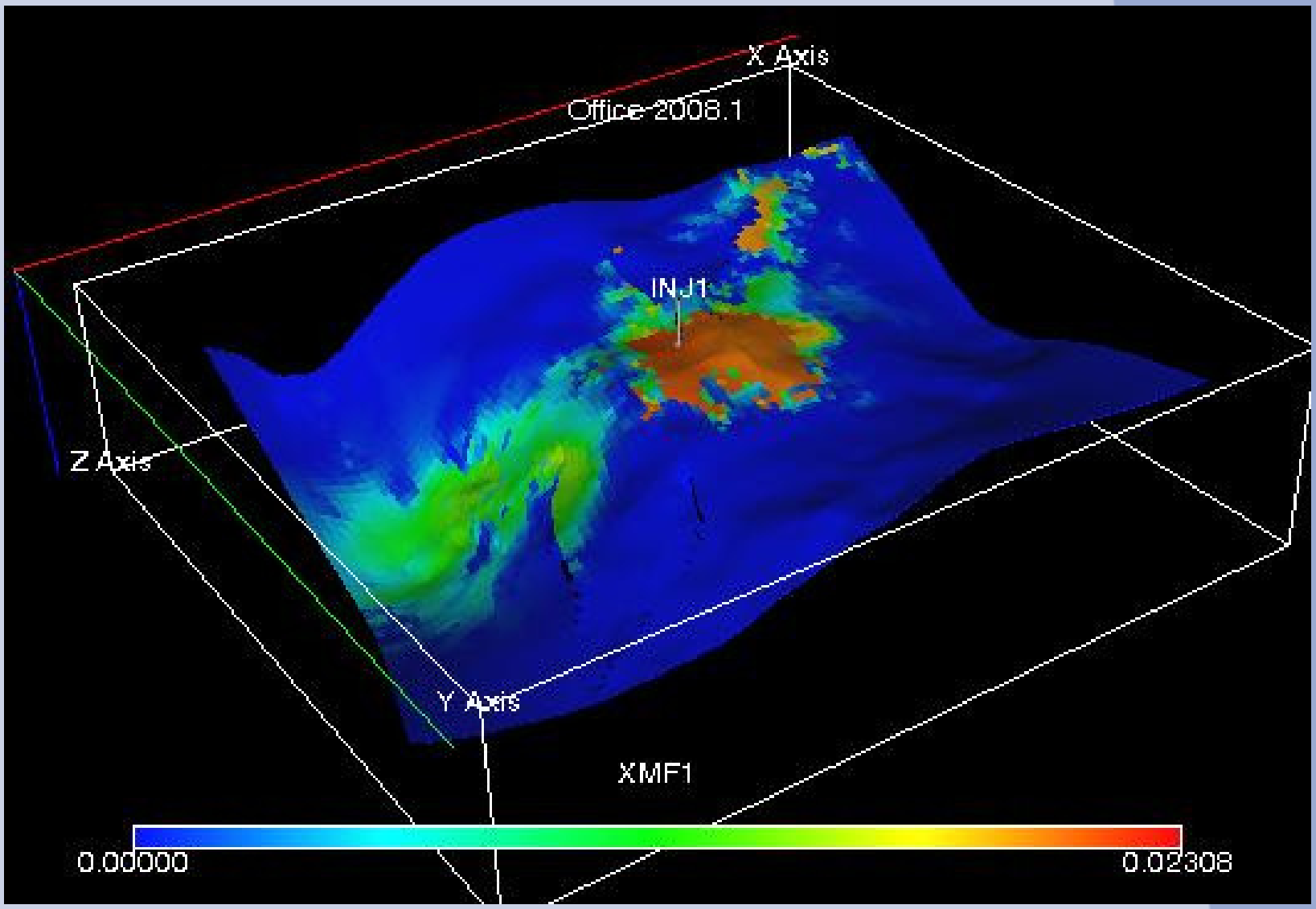
PROSPER Wellbore simulation

PVTi CO2-brine properties

Site 1


X Axis
Z Axis
INJ1
GasSat
0.00000
0.10000
0.20000
0.30000
0.40000
0.50000
0.60000
0.70000

Site 2



Results

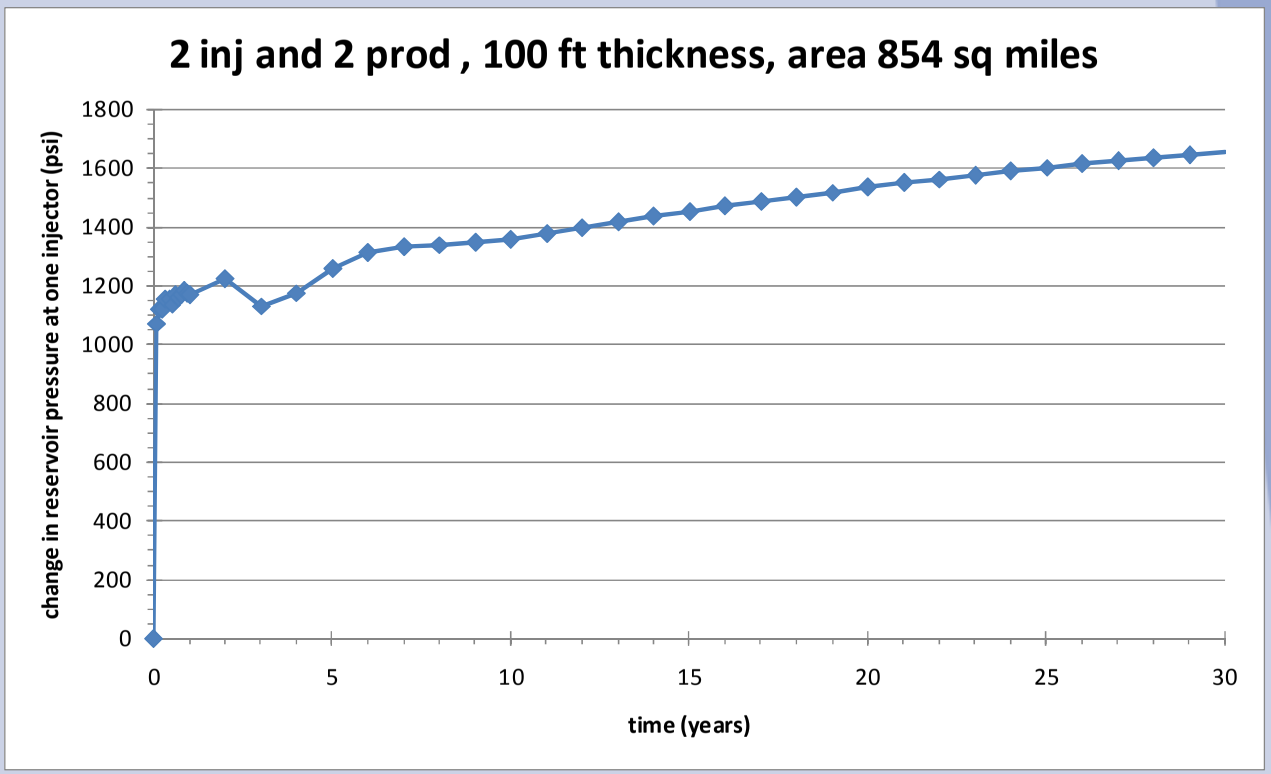
Model	Site 1			Site 2		
	E (%)	Mass (Mt)	Time (yrs)	E (%)	Mass (Mt)	Time (yrs)
MB closed	0.46	394	27	1.40	1,445	99
MB semi closed	1.04	934	64	2.59	2,263	155
Res Sim – 15y	0.27	219	15	0.25	219	15
Res Sim - limit	1.00	774	53	2.75	2,263	155

Dummy Calculation

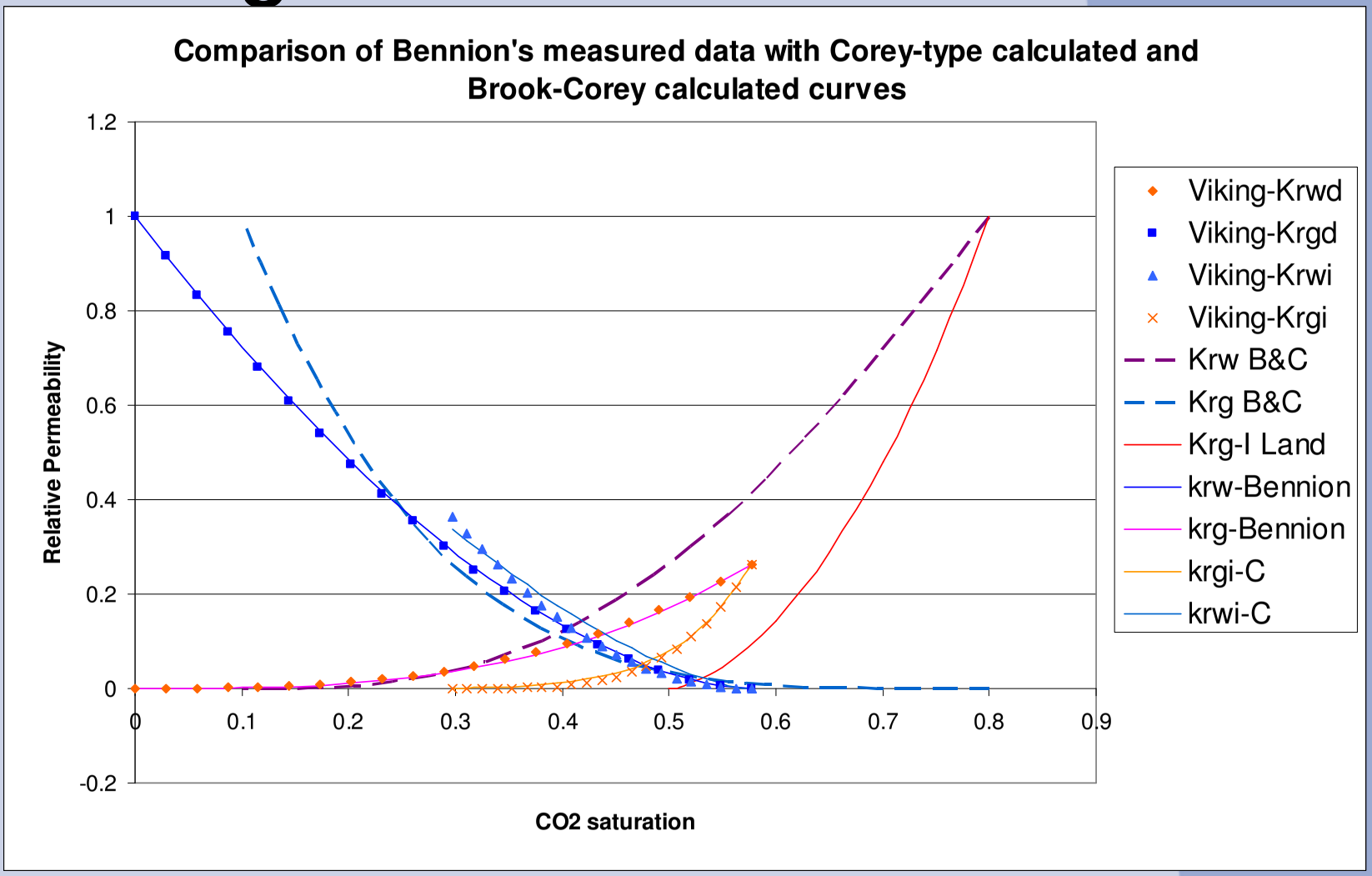
Injection rate	3 MT/yr for 30 years
Area	853 square miles
Thickness	100 ft
Porosity	20%
Permeability	100 mD
Depth	6000 ft
Temperature	150 F
Initial Pressure	2598 psi
Acceptable pressure increase	1600 psi
Irreducible water saturation	0.558
Endpoint CO_2 relative permeability	0.32

Well stock required?

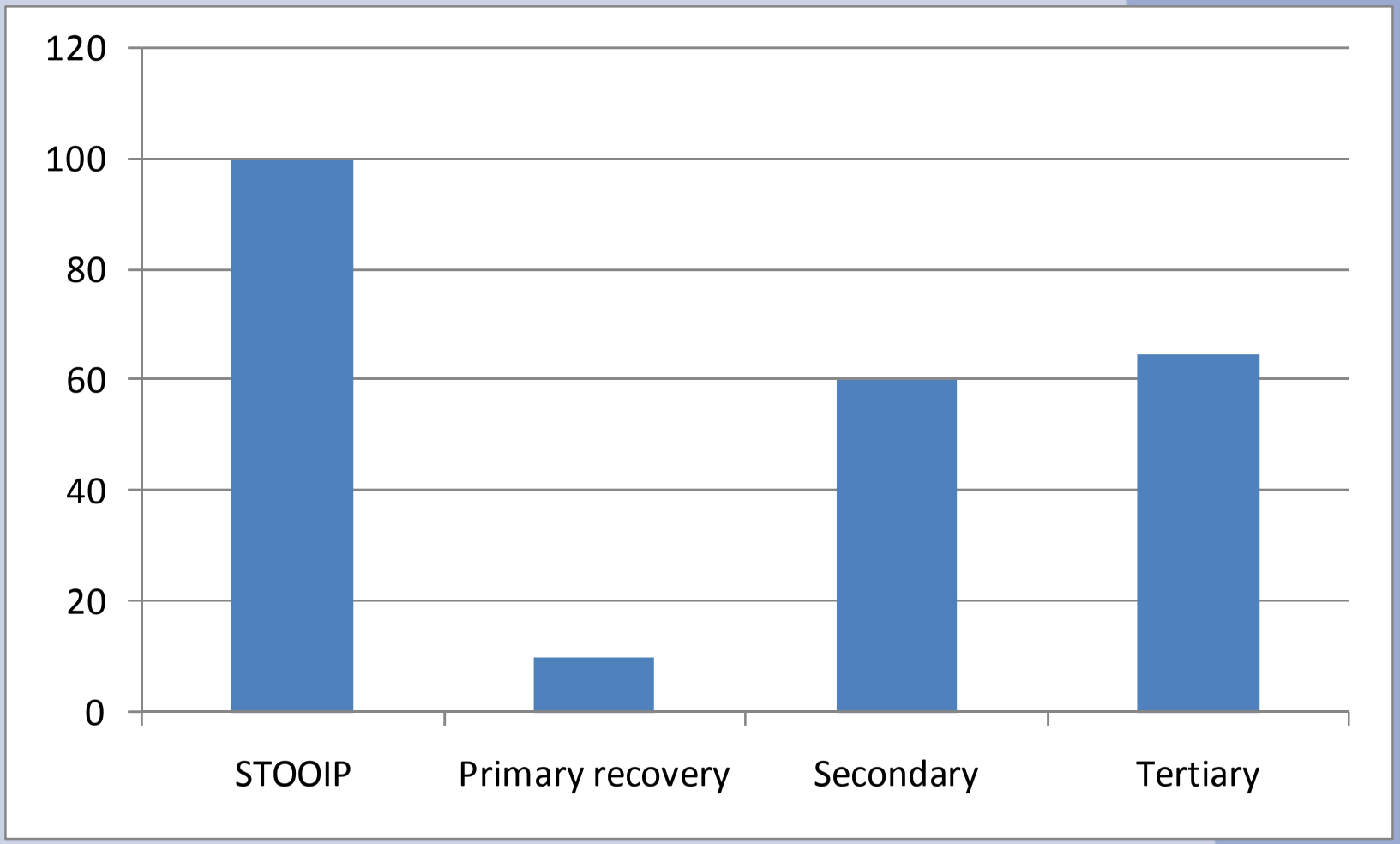
- Economides = 1155 injection wells
- Use enhanced voidage wells = 4 (2 injectors and 2 voidage wells)



Uncertainties: eg Relative Permeabilities



Estimating Oil Recovery



Estimating CO2 Resource