

Finding Petroleum Conference

EOR Economics What Works and What Doesn't

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See Disclosure Appendix of this report for important Disclosures and Analyst Certifications

Introduction

- Most of the easy oil & gas has already been tapped
- From the first trillion barrels of oil produced to date, more remains unrecovered
- EOR prize is therefore material
- Some estimates suggest a 5% increase in recovery could give 300-600Bn bbls

Today's global EOR projects centre on CO₂ and steam injection

<u>Process</u>	CO ₂		STEAM	POL	IC	SAP	N ₂		HW	GAS HC		BAC
	M	I					M	I		M	I	
Planning	12	4	7	6	1	2						
USA	101	5	45		12	2	1	3	3	1	12	
CANADA	7		14	1	3			1		1	22	
Others	1	10	82	21	1			1			3	1
Total	121	19	148	28	17	4	1	5	3	2	37	1

POL: Polymer injection

SAP: Surfactant-Alkaline-Polymer injection (eg Daqing)

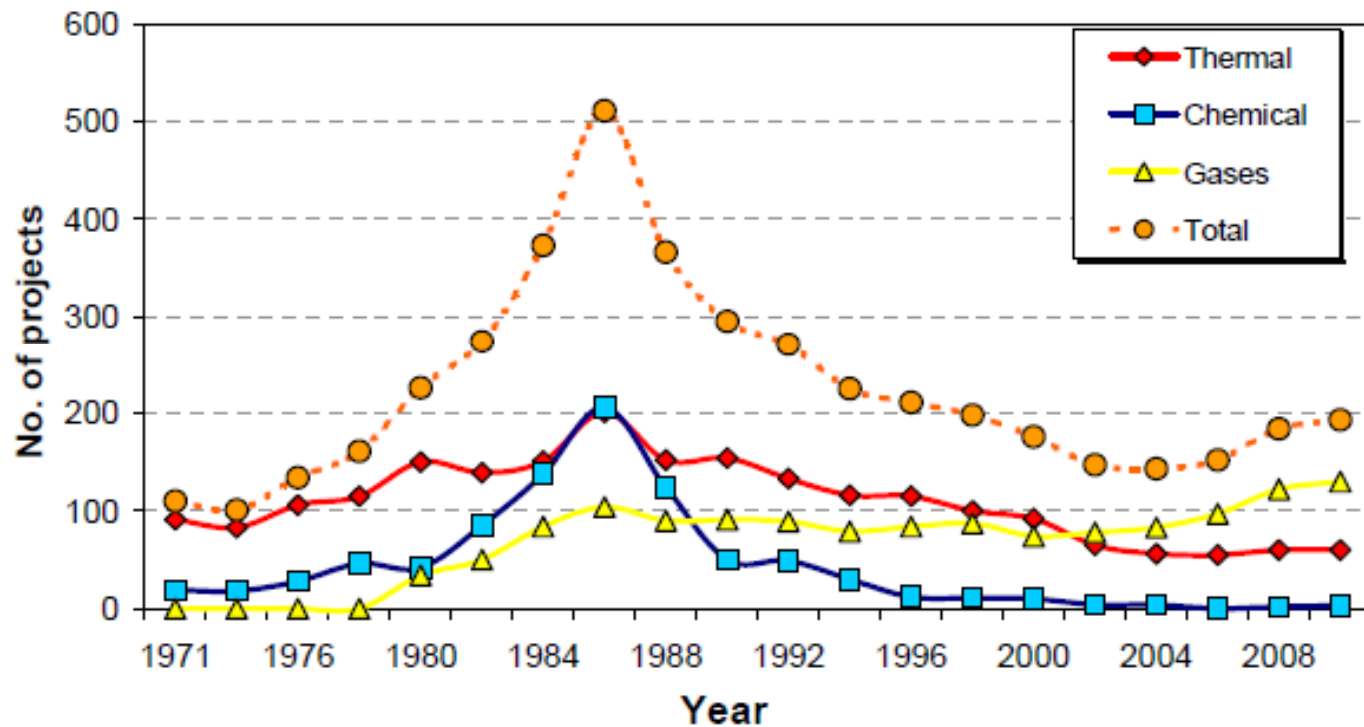
HW: Hot Water

IC: In-Situ Combustion

BAC: Microbial

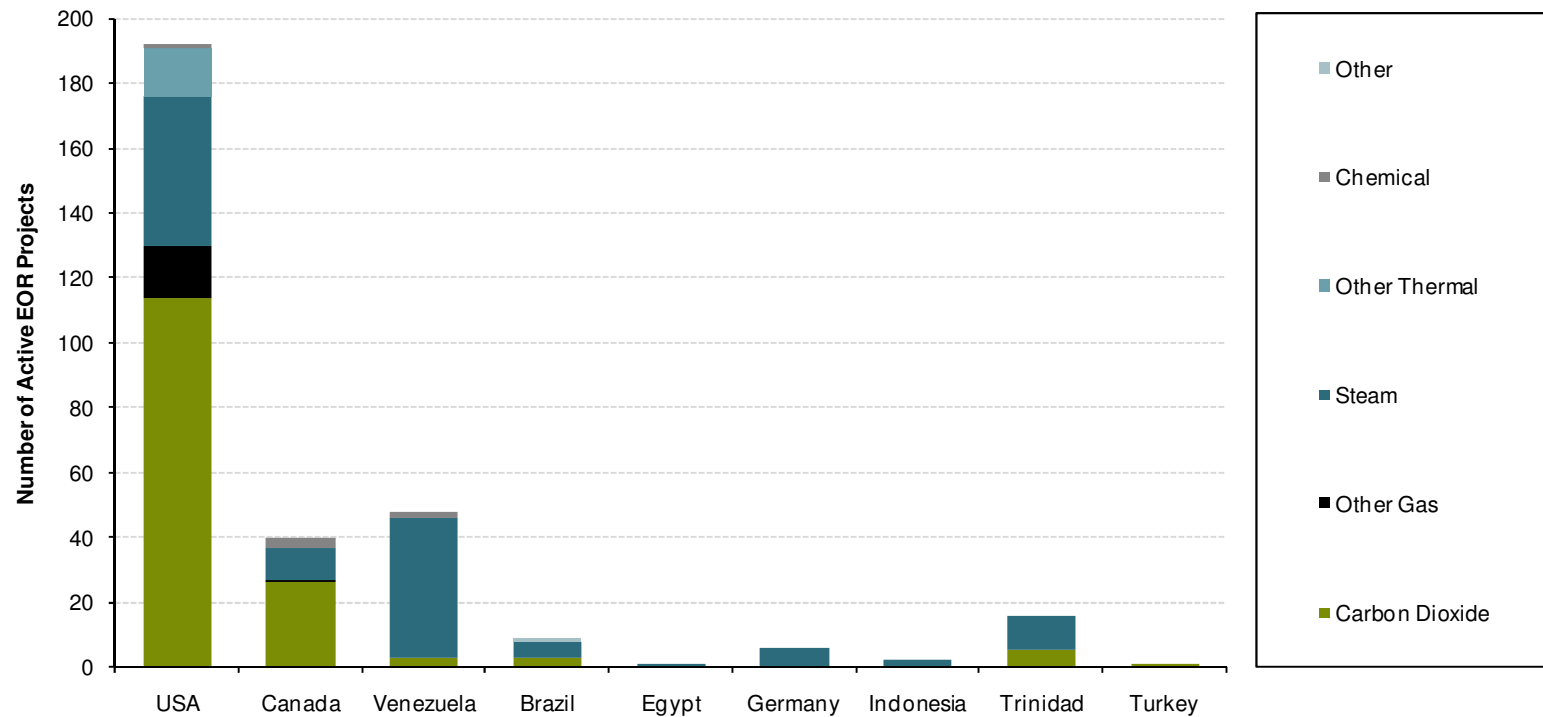
Source: Oil & Gas Journal

Over time though the number of EOR projects has declined



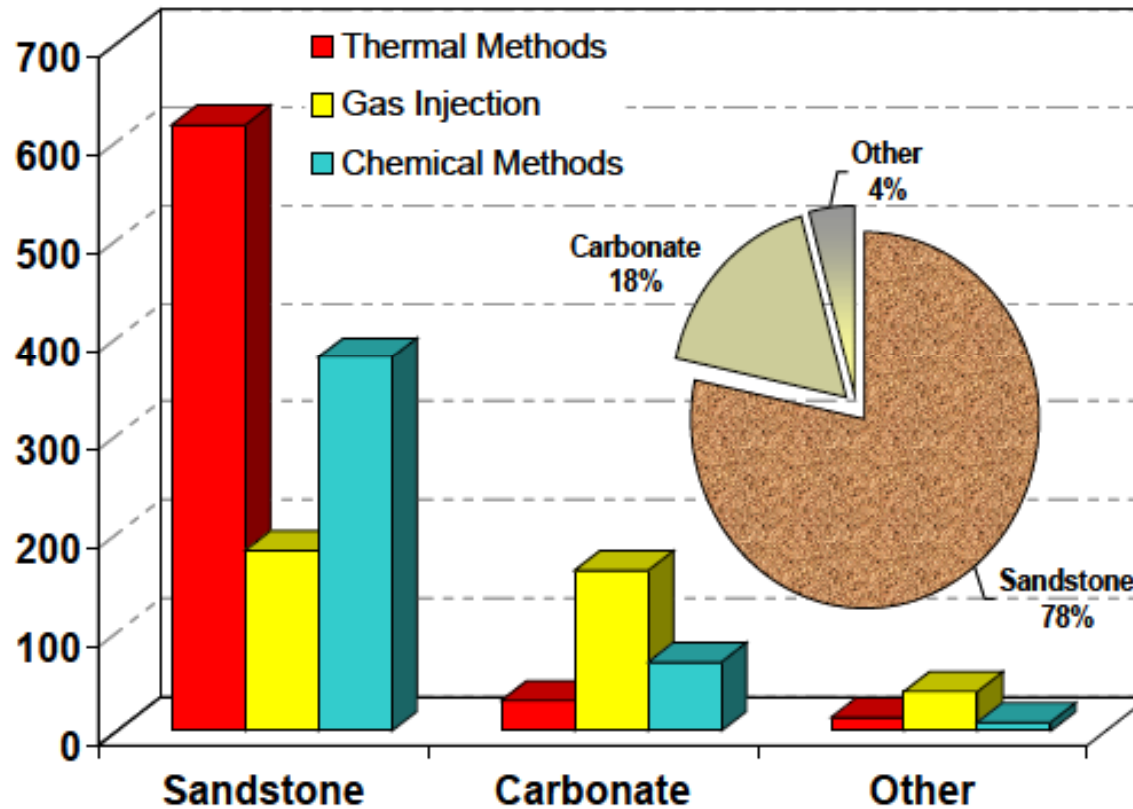
Source: Oil & Gas Journal, Alvarado & Manrique, Energis, 2010

Today's active EOR projects centre within the US, Canada and Venezuela



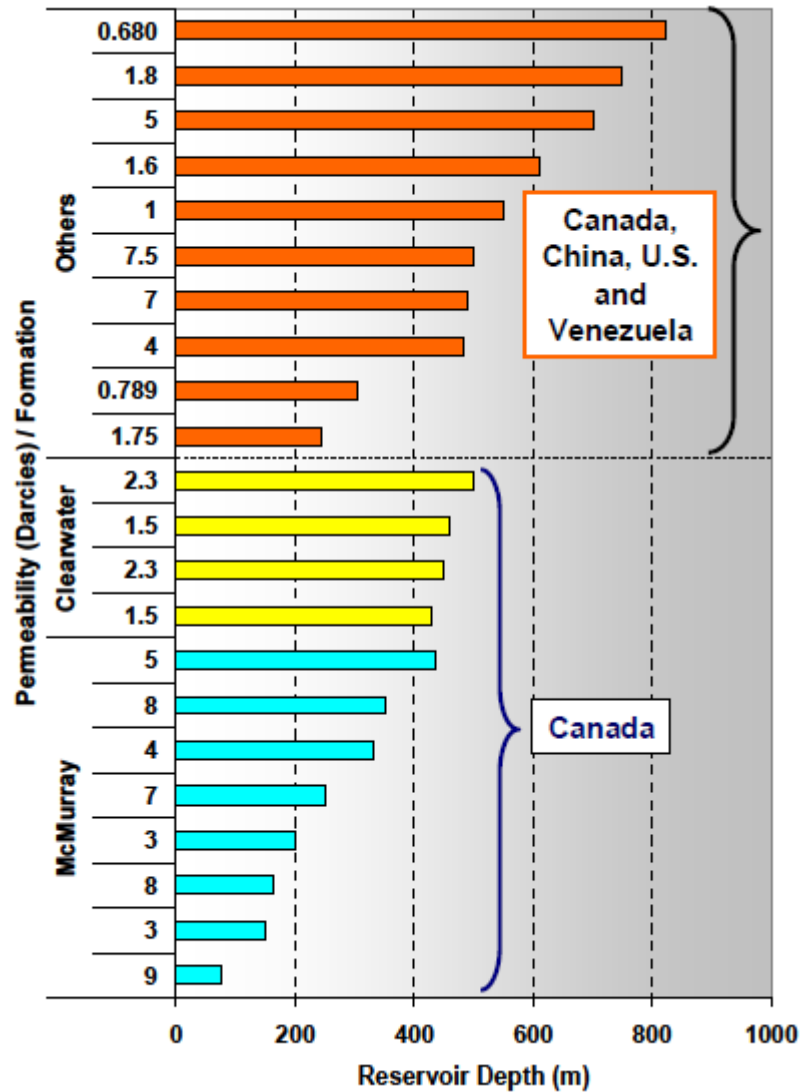
Source: Oil & Gas Journal

Globally, sandstone reservoirs appear to be the preferred reservoir for EOR



Source: Oil & Gas Journal, Alvarado & Manrique, Energis, 2010

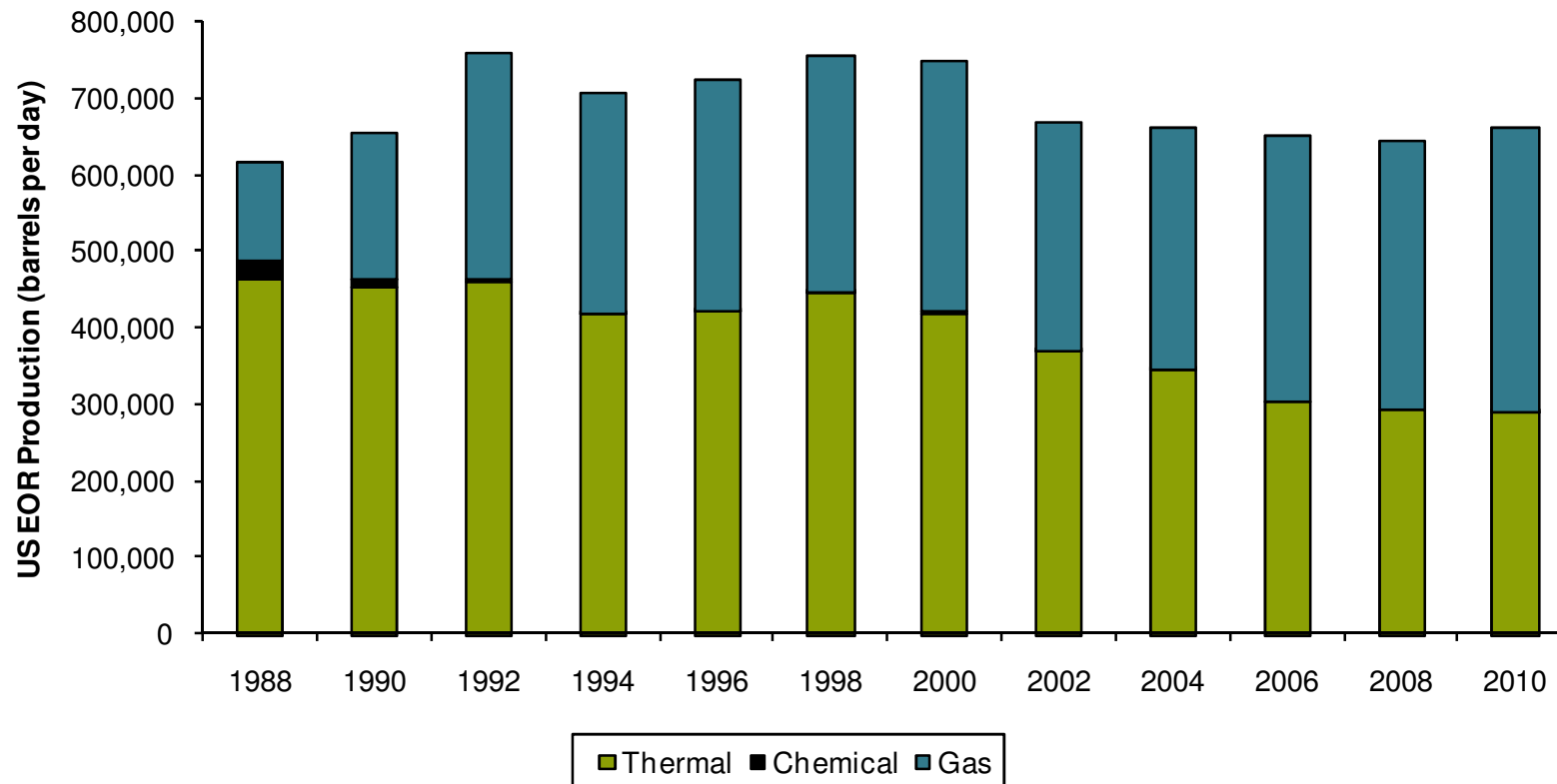
Depth and Permeability dictate commercial viability of SAGD EOR



Source: Oil & Gas Journal, Alvarado & Manrique, Energis, 2010

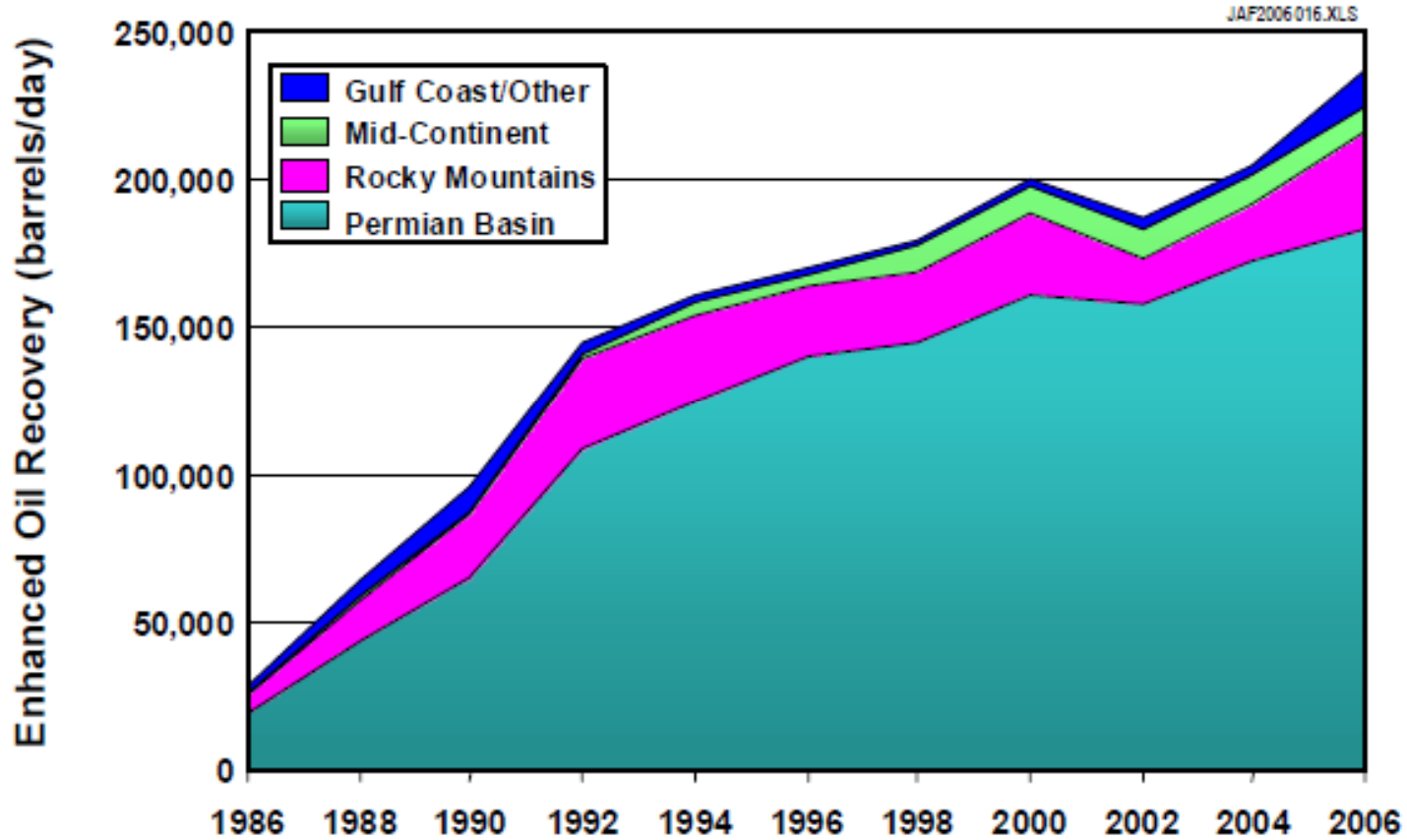
Production from active EOR projects in the US is increasingly coming from Gas or CO₂

■ Roughly 10-12% of total US oil production is coming from EOR efforts



Source: Oil & Gas Journal

CO₂ led EOR production has been successful in the US



Source: Oil & Gas Journal

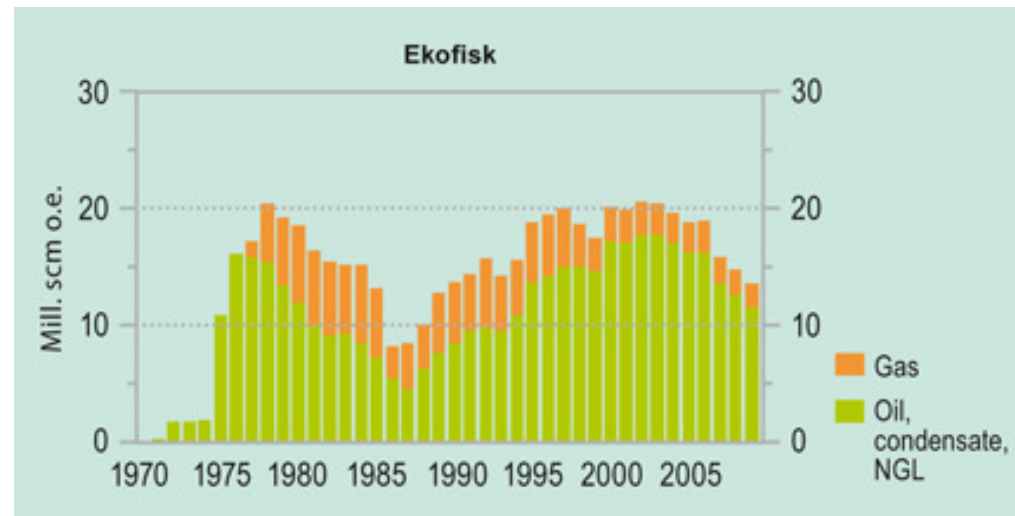
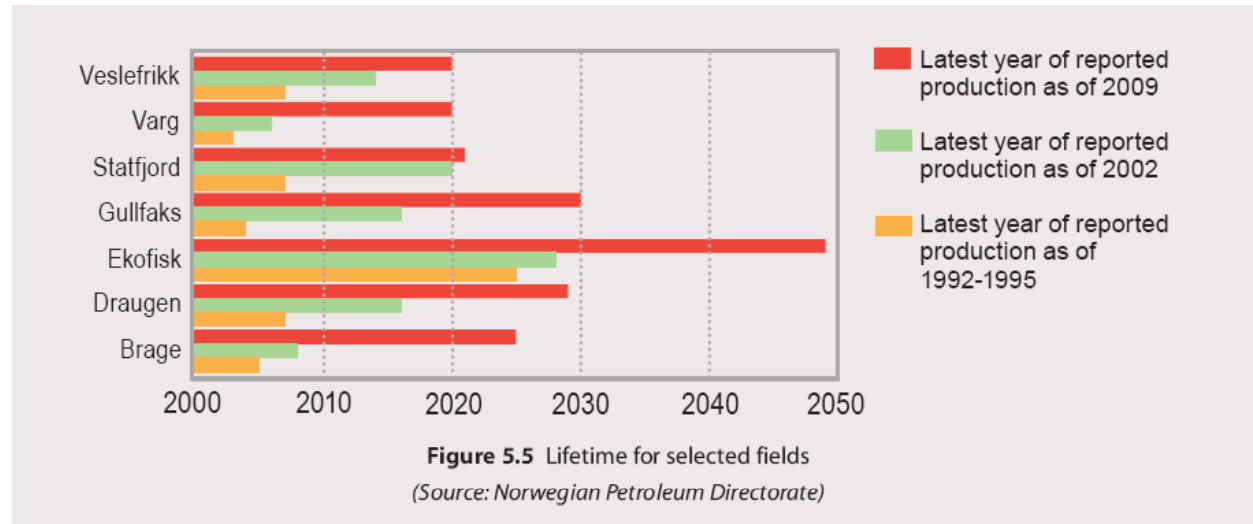
Major CO₂ Pipelines in the United States is the limiting factor to increased CO₂ usage



Source: U.S. Dept. of Transportation, National Pipeline Mapping System

Norway is a good example of successful EOR even with 78% taxes

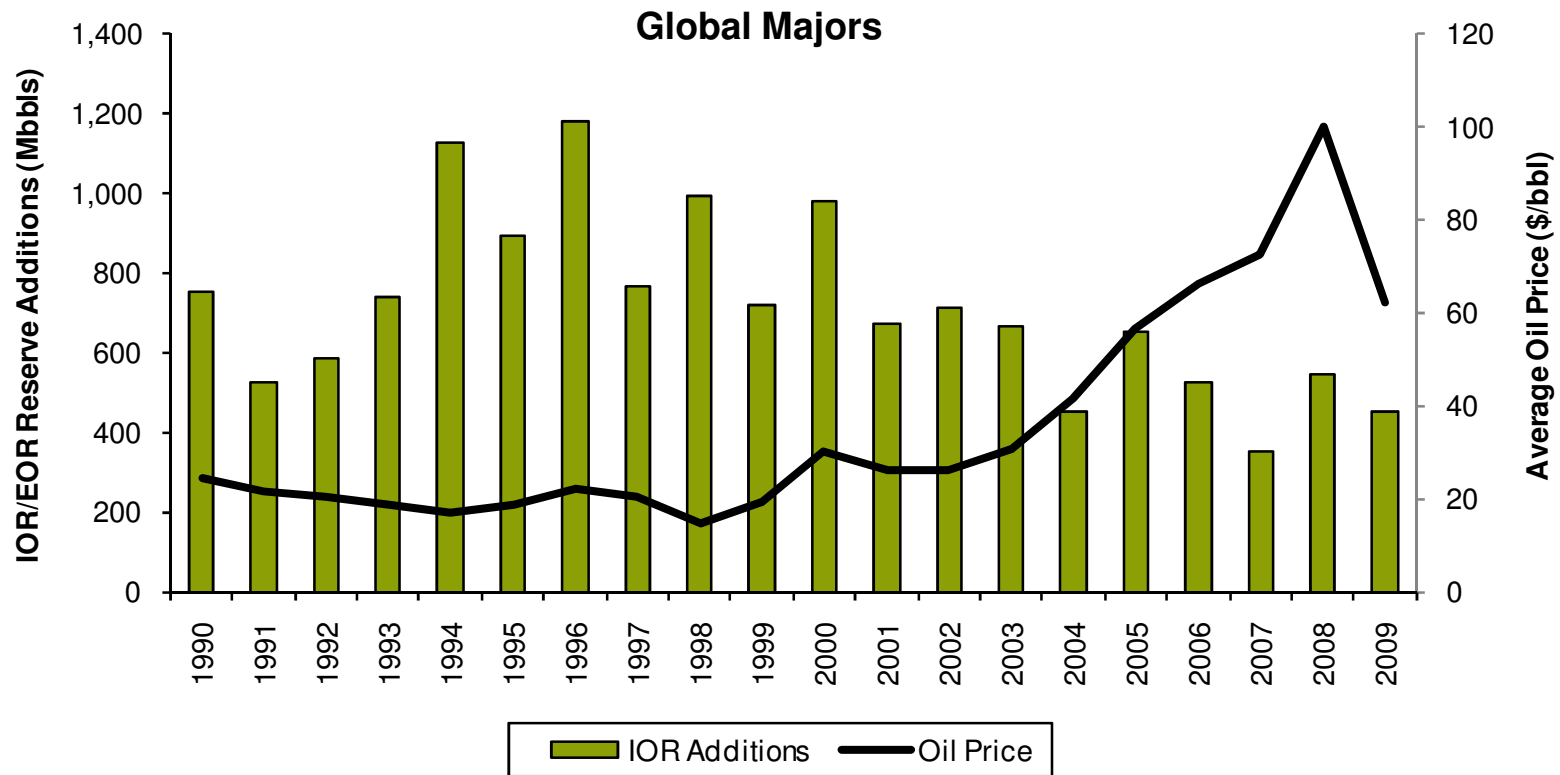
- In 1995 the average recovery from Norwegian fields was 40%, but has increased to 46% by 2010
- At the same time, the expected lifetime of fields has been significantly expanded
- The Ekofisk field is a prime example. A water injection plan was approved in 1983 and increased expected recovery from 17% to 50%



Source: Norwegian Petroleum Directorate

Reserves additions due to Enhanced Oil Recovery

- Summing the oil reserves additions for the Majors from IOR/EOR highlights declining contribution despite rising oil prices

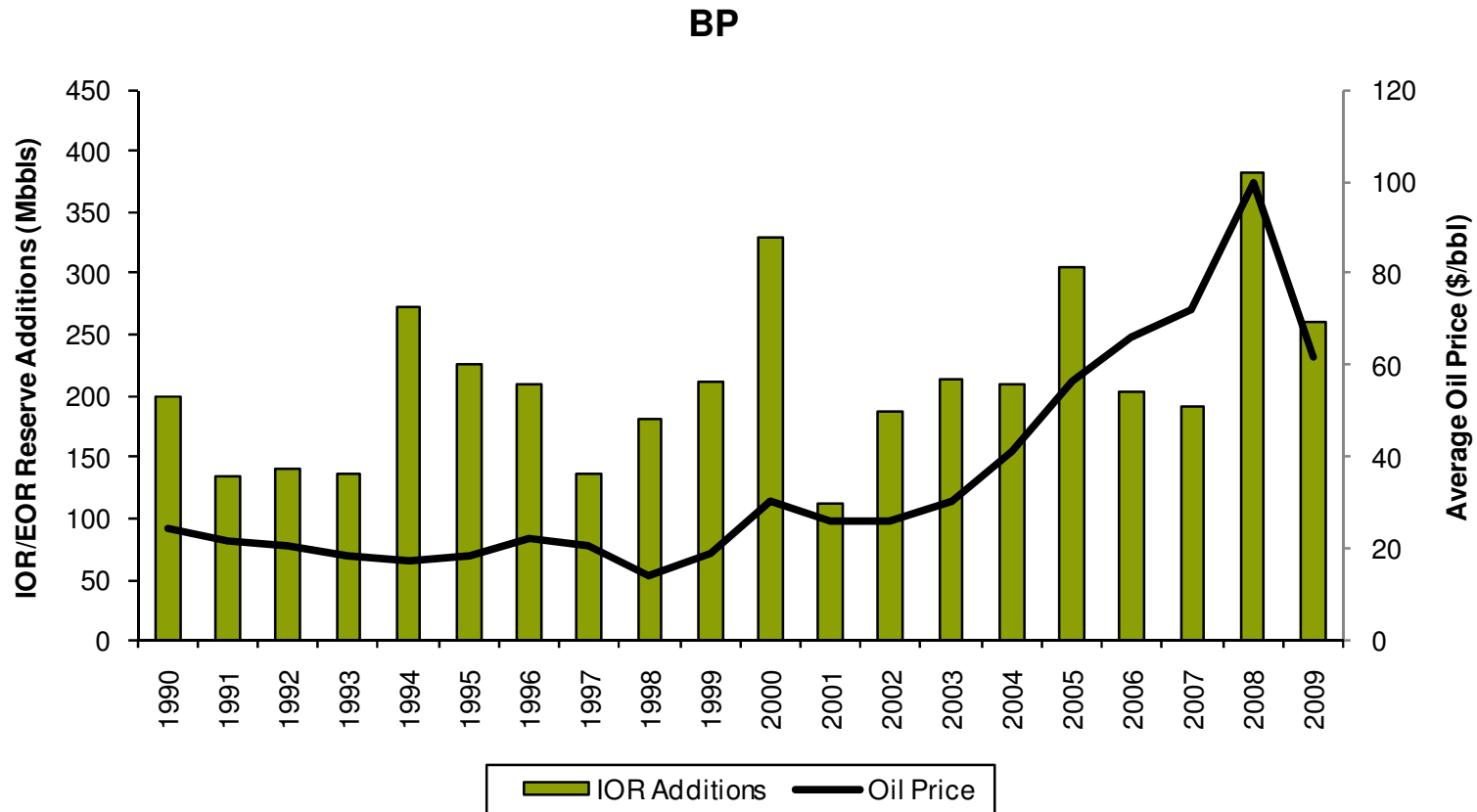


Note: data summed for RDS, BP, TOT, ENI, XOM, CVX, COP

Source: Company reports, Bernstein analysis

BP are one of most active in the IOR/EOR space

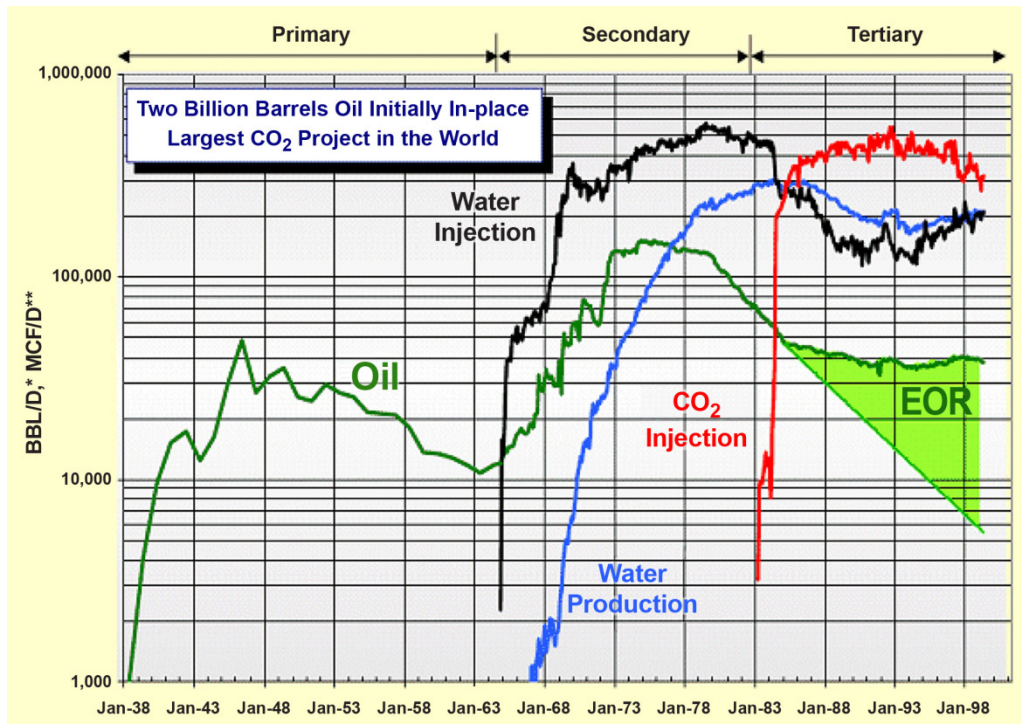
- BP have stated that a 1% improvement in recovery on BP's original hydrocarbons equates to 2 billion barrels of additional reserves



Source: Company reports, Bernstein analysis

DOE studies of Carbon dioxide injection estimate a \$15-25/bbl margin

- Shell's Denver Unit in the Wesson Field in Texas suggests a pre-tax margin of \$15-25/bbl
- Through end 2008 the field produced 32kboed, of which 27kboed was due to EOR



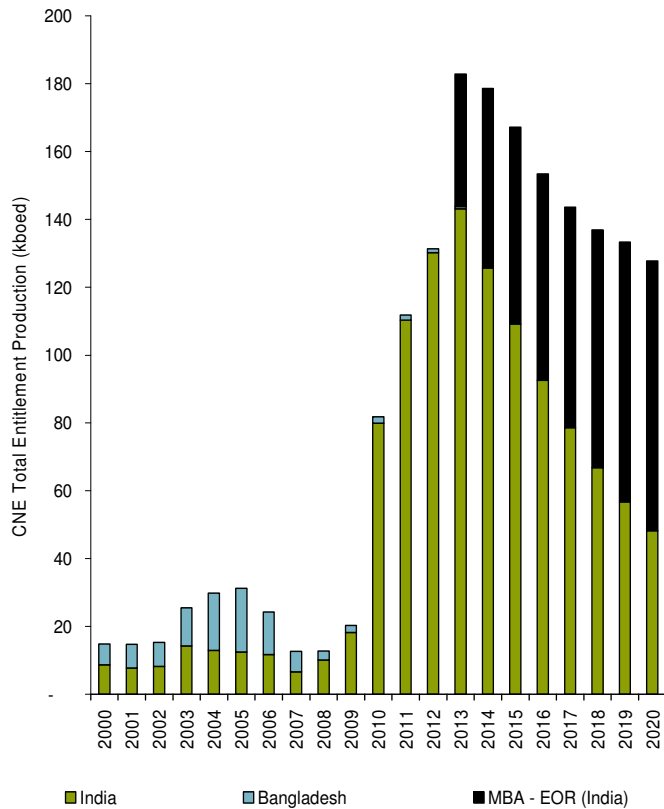
Illustrative Costs and Economics of a CO2 EOR Project

Oil Price (\$/Barrel)	70
Gravity/Basis Differentials, Royalties and Production Taxes	-15
Net Wellhead Revenues (\$/Barrel)	55
Capital Cost Amortization	5-10
CO2 Costs (at \$2/Mcf for purchase or \$0.70/Mcf for recycle)	-15
Well Operations and Maintenance	10-15
Economic Margin, Pre-Tax (\$/Barrel)	15-25

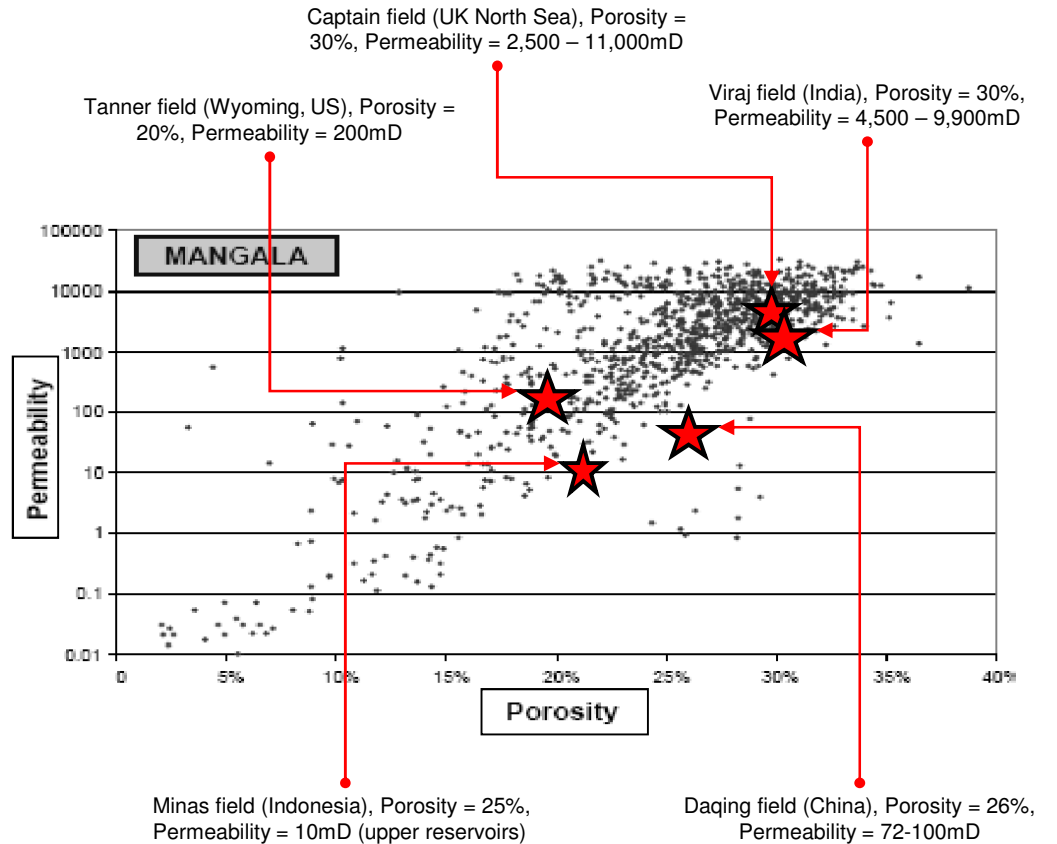
Source: United States Department of Energy

Cairn's chemical EOR project is currently being tested in India

Cairn's 2Bn bbls MBA field in Rajasthan, India



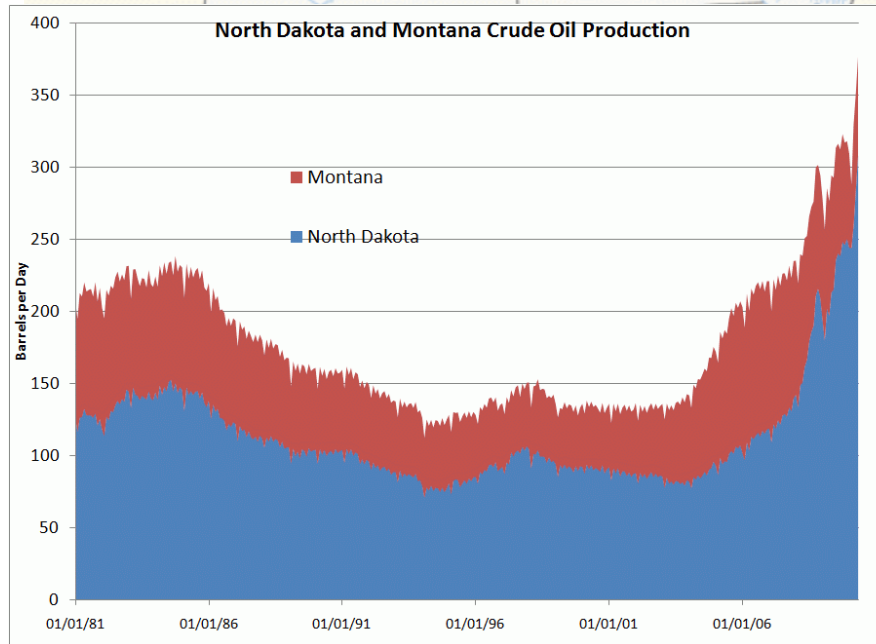
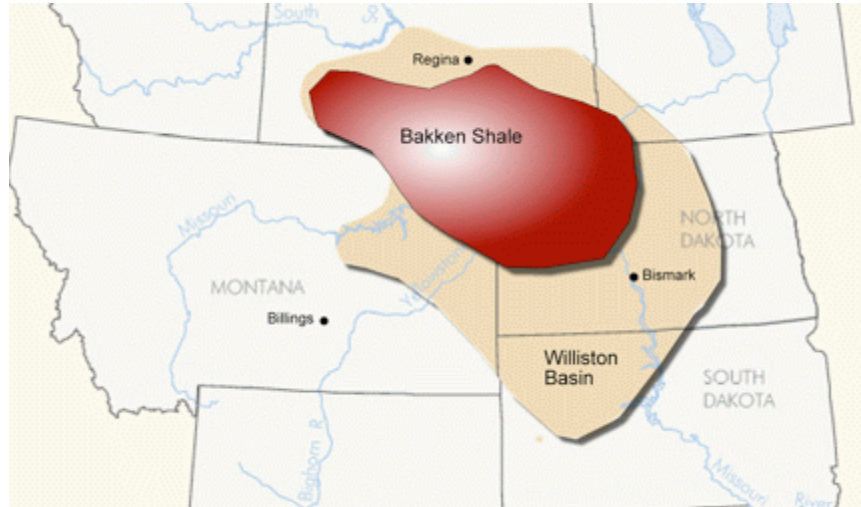
An extra 300Mbbls of reserves is expected to be unlocked using Enhanced Oil Recovery (EOR) – this technique works elsewhere



● Actual porosity & permeability data from reservoirs within Cairn's Mangala field

Source: Society of Petroleum Engineers, Company reports and Bernstein estimates

The rise of shale oil in the US



Source: EIA

New resource plays are now competing with EOR projects

Woodford Shale

Projected Well Stats	
EUR	750-1,000 MBOE
30-Day IP	600-900 BOED
Well & facility costs	\$7.5 MM
Spud-to-spud	45 Days
Operating costs (FLC)	\$2-\$3/BOE
Net development costs	\$10-\$15/BOE

Economic Margin Pre Tax (\$/bbl) = 52

Bakken Shale

Projected Well Stats	
EUR	280-500 MBOE
30-Day IP	250-600 BOED
Well & facility costs	\$6-\$7 MM
Operating cost (FLC)	\$5-\$6/BOE
Total discount to WTI	\$6-\$8 / BBL
Net development costs	\$15-\$20/BOE

Economic Margin Pre Tax (\$/bbl) = 36

Eagle Ford Shale

Projected Well Stats	
EUR	250-400 MBOE
30-Day IP	350-400 BOED
Well & facility costs	\$5.5 MM
Spud-to-spud	35 Days
Operating costs (FLC)	\$5-\$6/BOE
Net development costs	\$18-\$25/BOE

Economic Margin Pre Tax (\$/bbl) = 39

Summary

- Technological challenges remain, while regulations and costly implementation continue to restrict widespread usage of EOR techniques for the Majors
- Increased government interest and investment is needed together with continued technology improvements and availability of raw materials such as CO₂
- More and more countries are looking at it from US, to Europe, to Oman to Saudi but better economics within oil shale's could slow the rate of growth

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Ticker Rating Changes

BP	M (IC) 08/03/10	O (DC) 08/02/10	O (RC) 05/10/10	M (RC) 03/03/09
BP/.LN	M (IC) 08/03/10	O (DC) 08/02/10	O (RC) 05/10/10	M (RC) 03/03/09
E	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 11/21/08	
ENI.IM	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 11/21/08	
FP.FP	O (IC) 08/03/10	M (DC) 08/02/10	M (RC) 02/16/10	
RDS/A	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 02/16/10	
RDS/B	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 02/16/10	
RDSA.LN	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 02/16/10	
RDSA.NA	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 02/16/10	
RDSB.LN	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 02/16/10	
RDSB.NA	O (IC) 08/03/10	O (DC) 08/02/10	O (RC) 02/16/10	
TOT	O (IC) 08/03/10	M (DC) 08/02/10	M (RC) 02/16/10	

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