Maximising Economic Recovery (MER) in a Mature Petroleum Province

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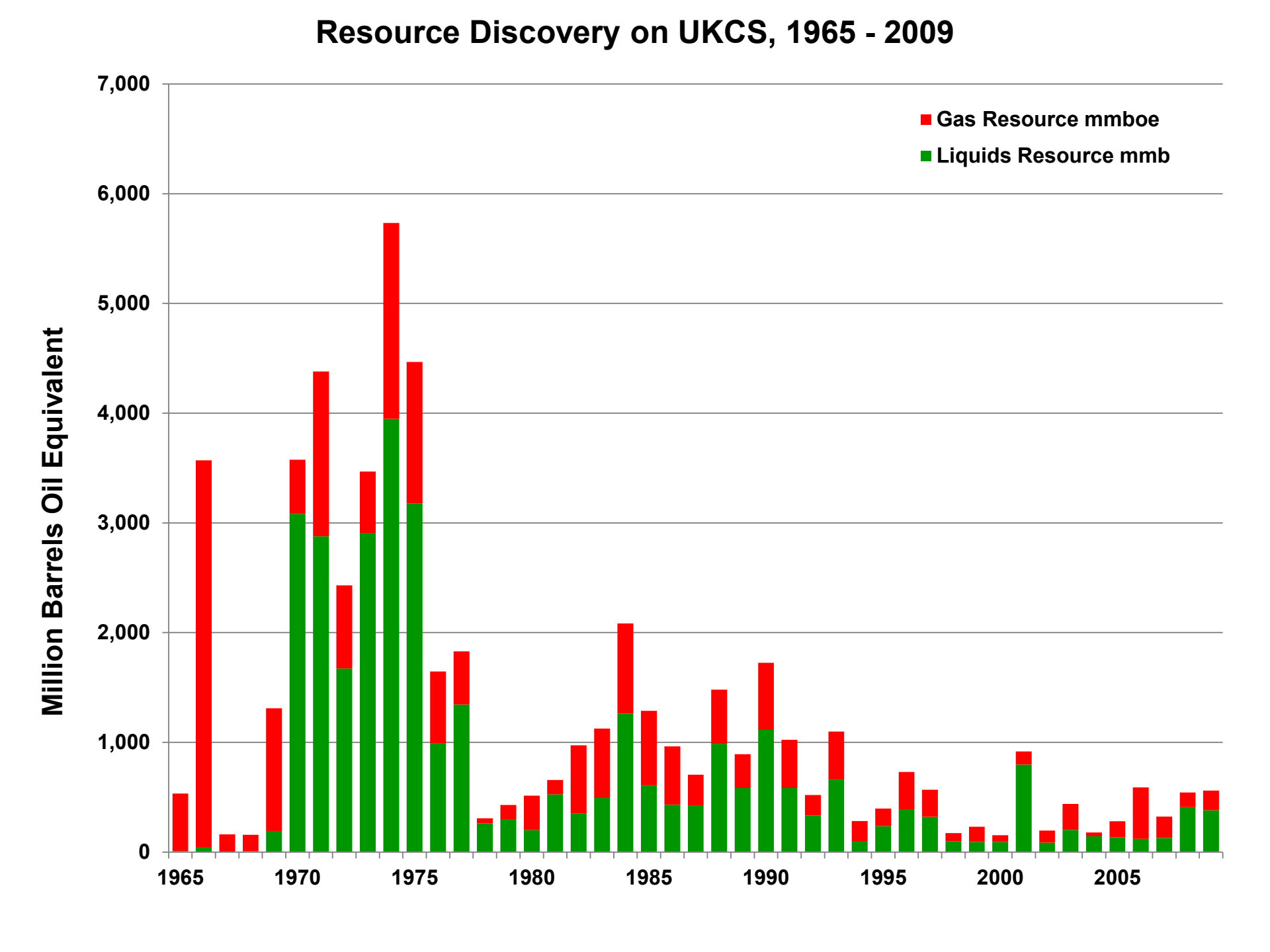
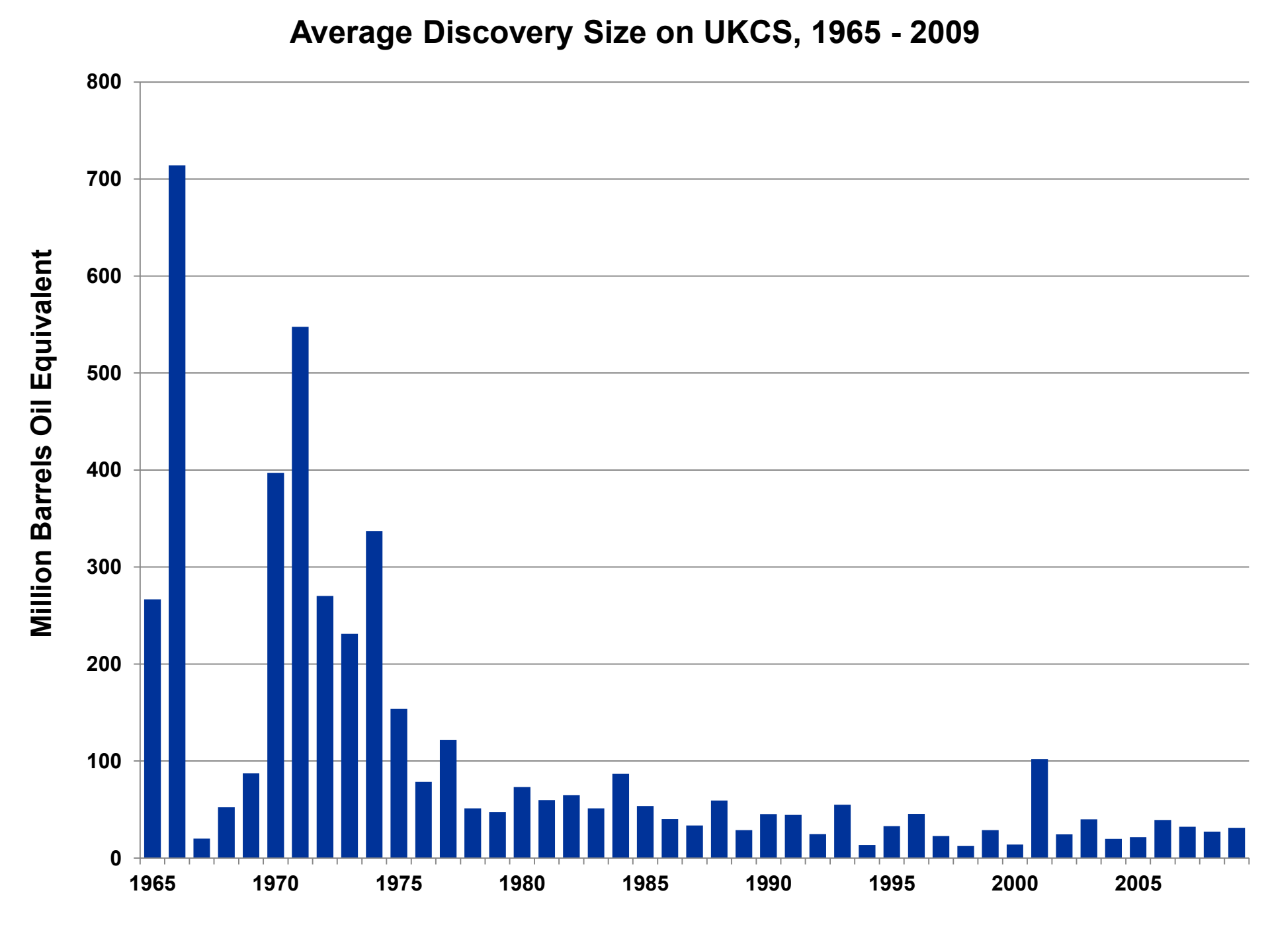
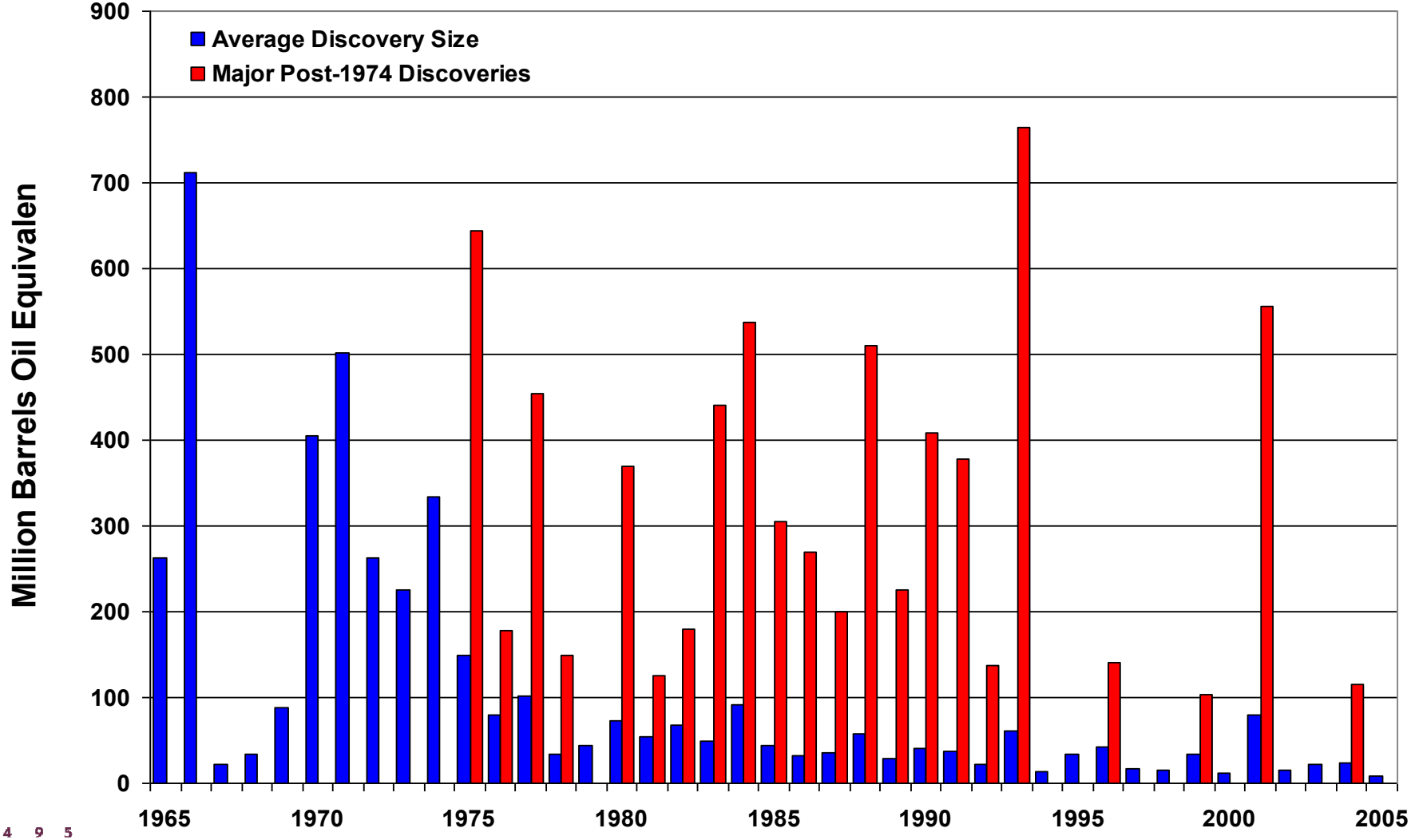

Resource Discovery on UKCS, 1965 - 2009
Million Barrels Oil Equivalent
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
Gas Resource mmboe
Liquids Resource mmb


Average Discovery Size on UKCS, 1965 - 2009
Million Barrels Oil Equivalent
800
700
600
500
400
300
200
100
0
1965
1970
1975
1980
1985
1990
1995
2000
2005

Average Discovery Size on UKCS, 1965 - 2005, with Major Post-1974 Discoveries



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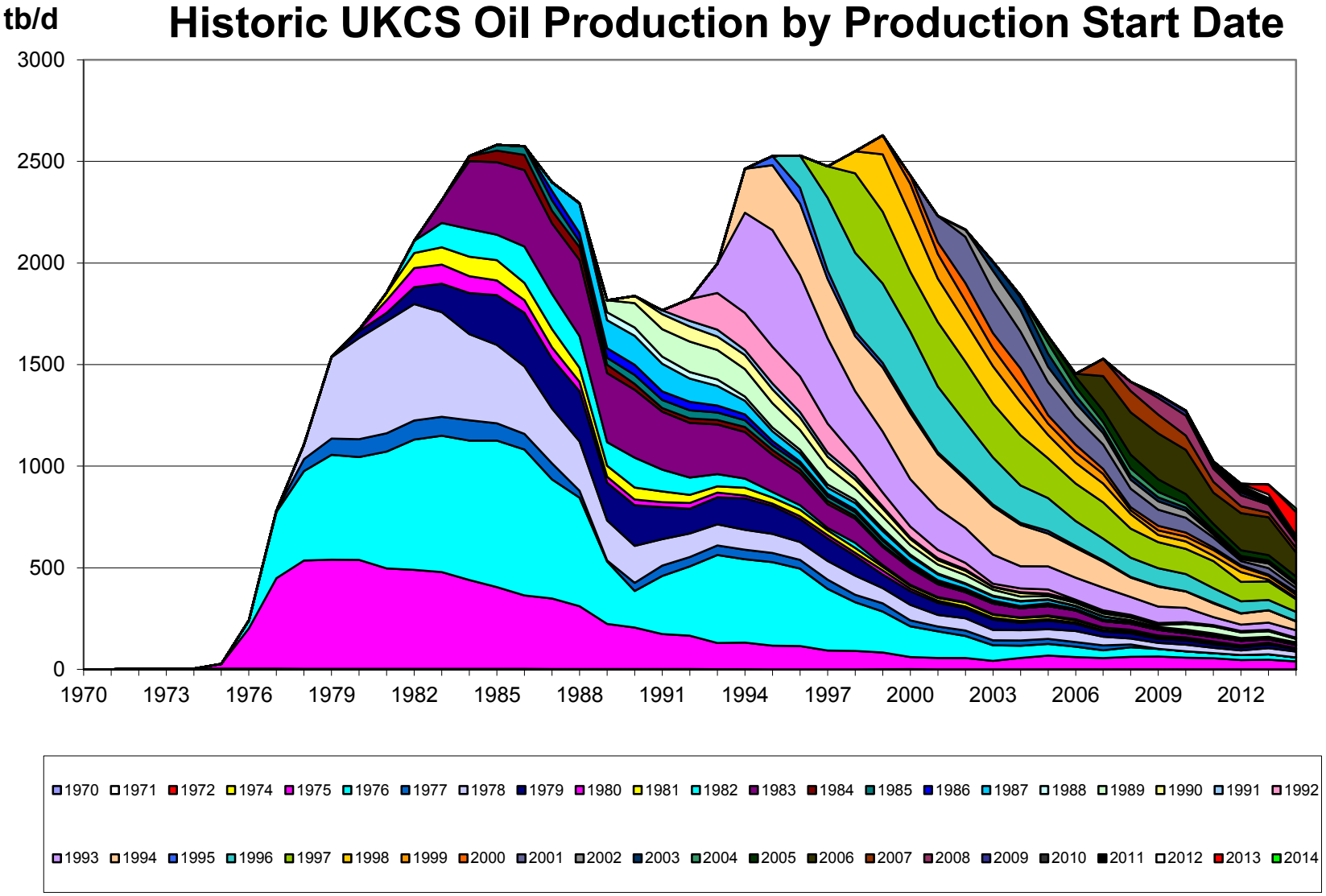
Historic UKCS Oil Production by Production Start Date



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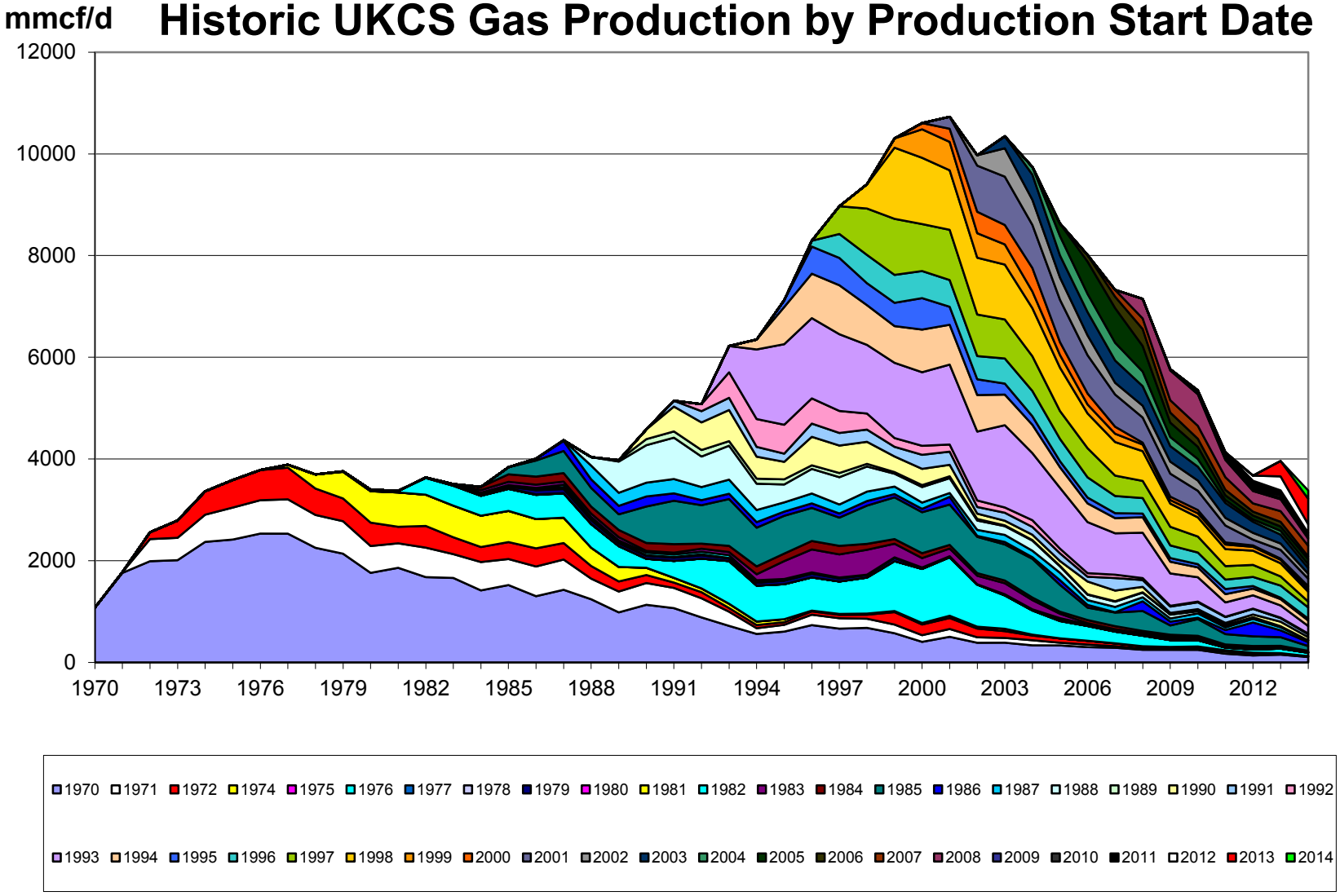
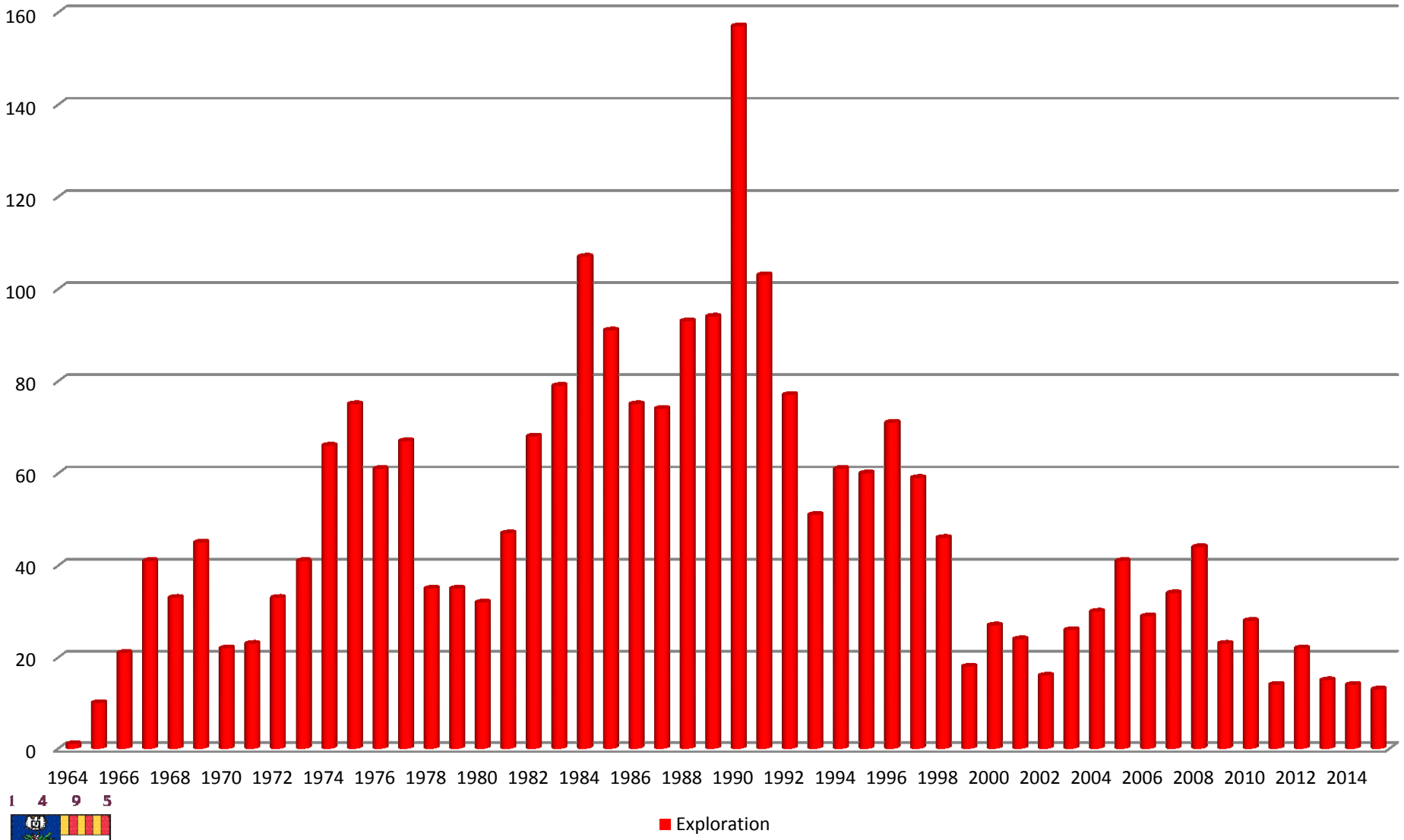
Historic UKCS Gas Production by Production Start Date



Exploration Wells Drilled in UKCS 1964-2015



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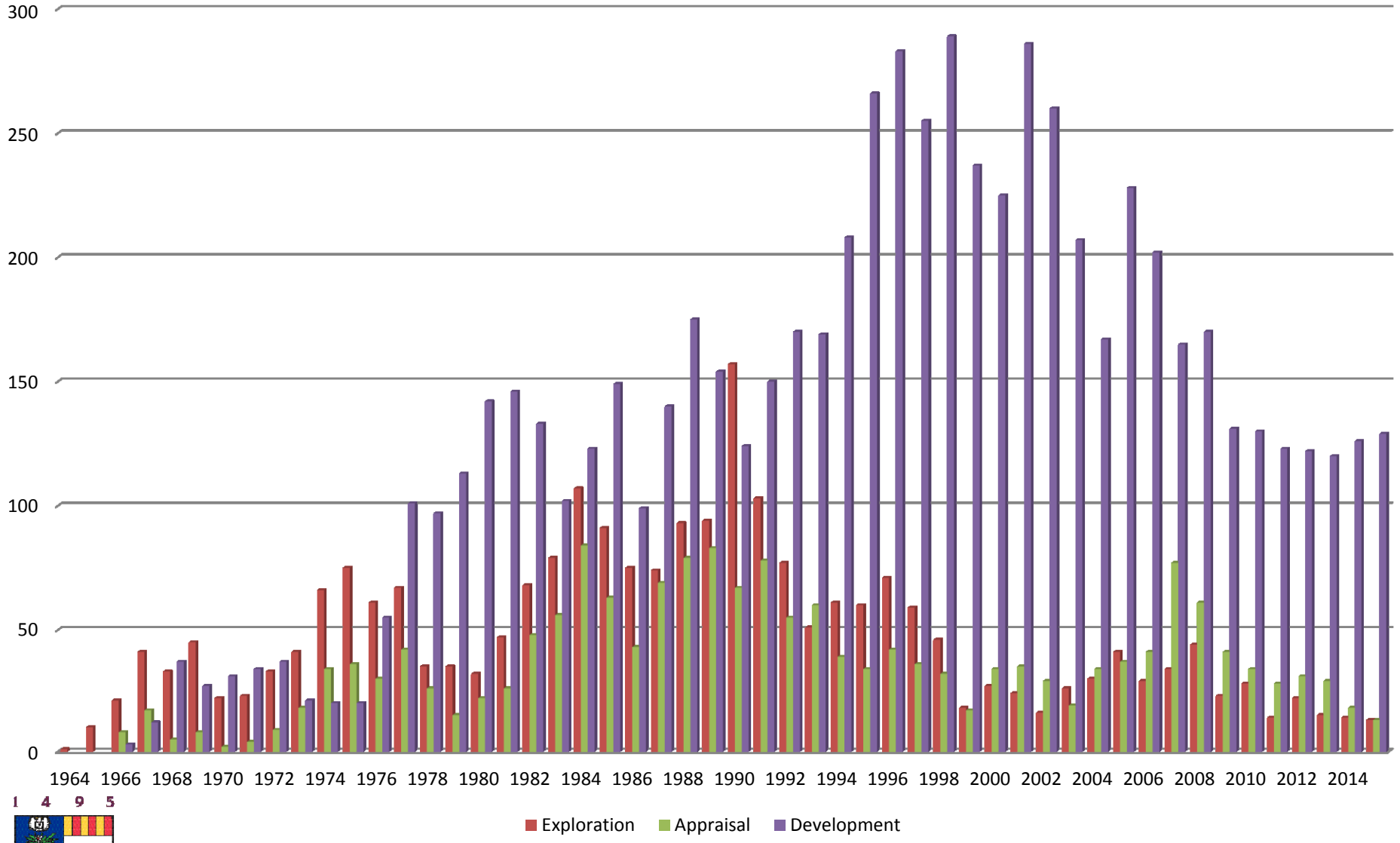
Source: OGA

Total Wells Drilled in UKCS 1964-2015



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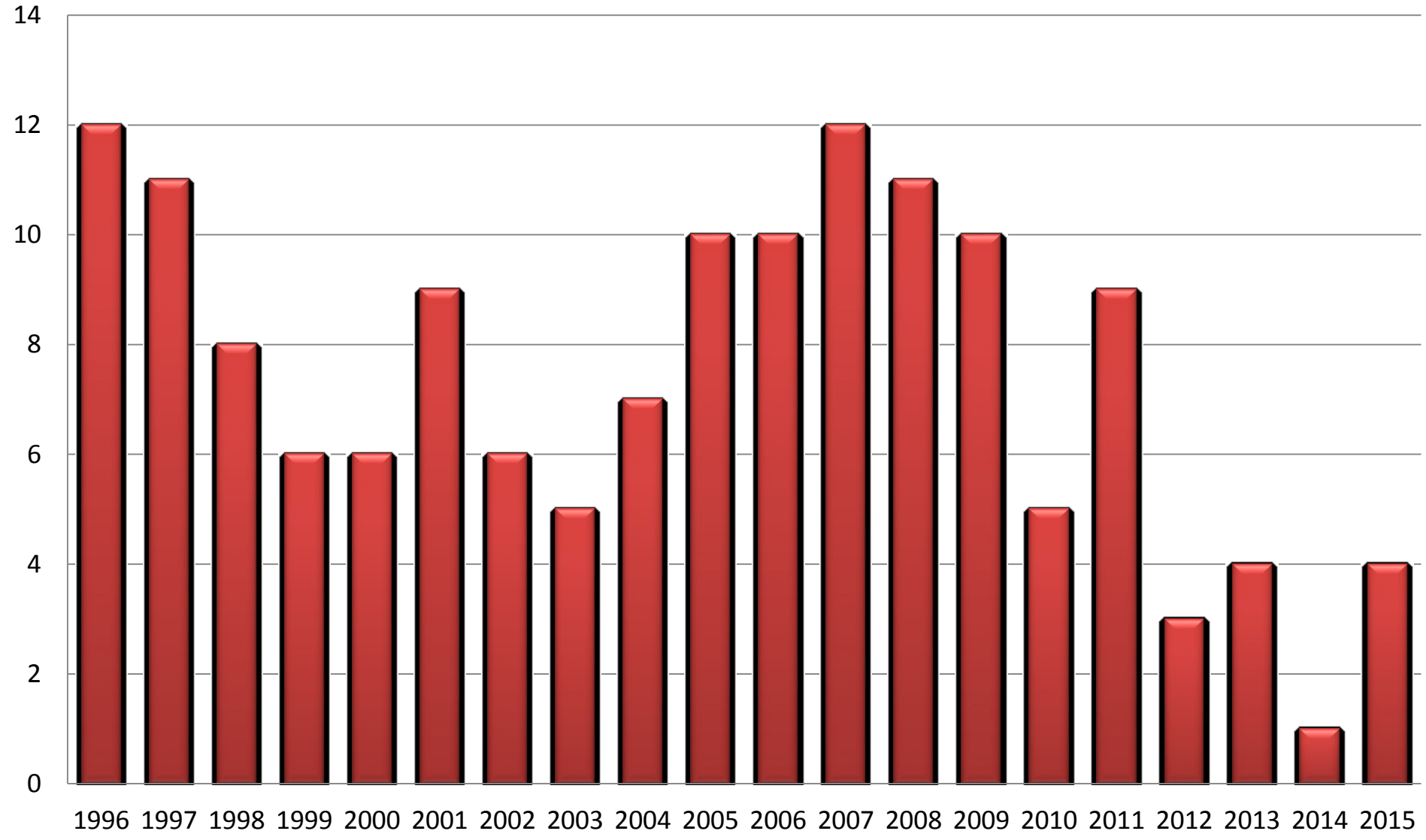
Source: OGA

Significant Discoveries



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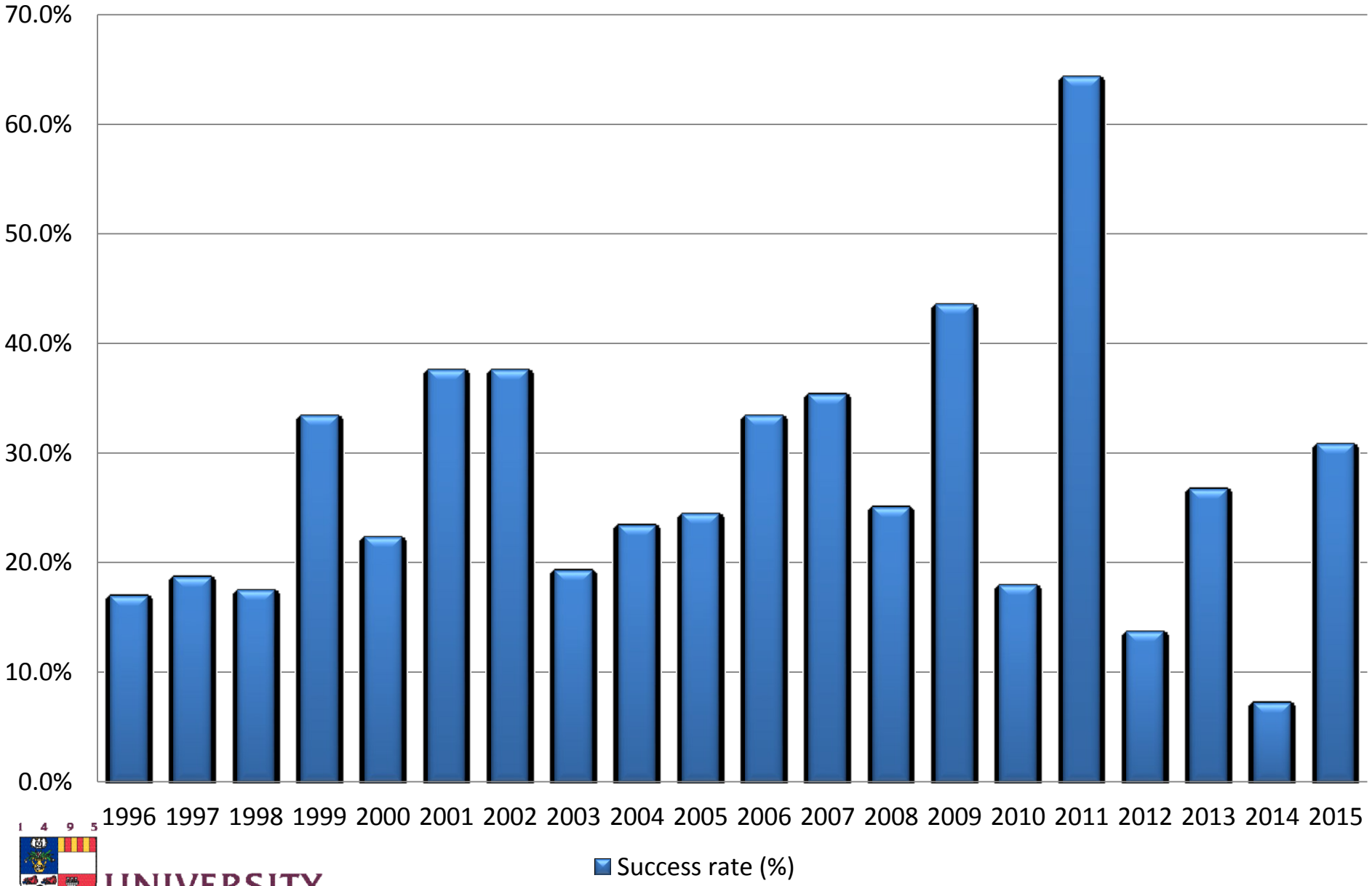
Source: BEIS

Exploration Success rate (%)



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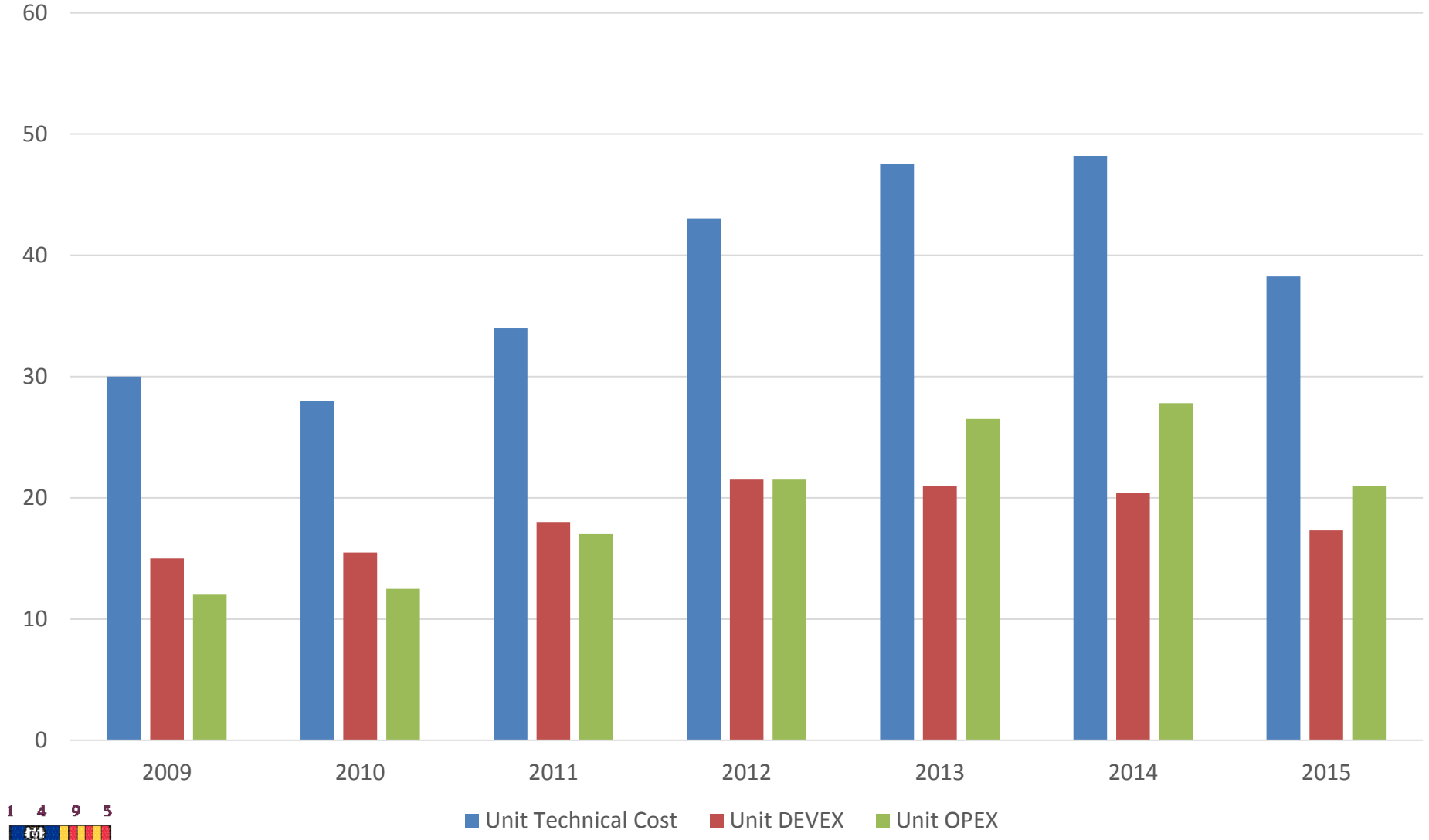
Source: BEIS

Unit Cost ($/boe, MOD)



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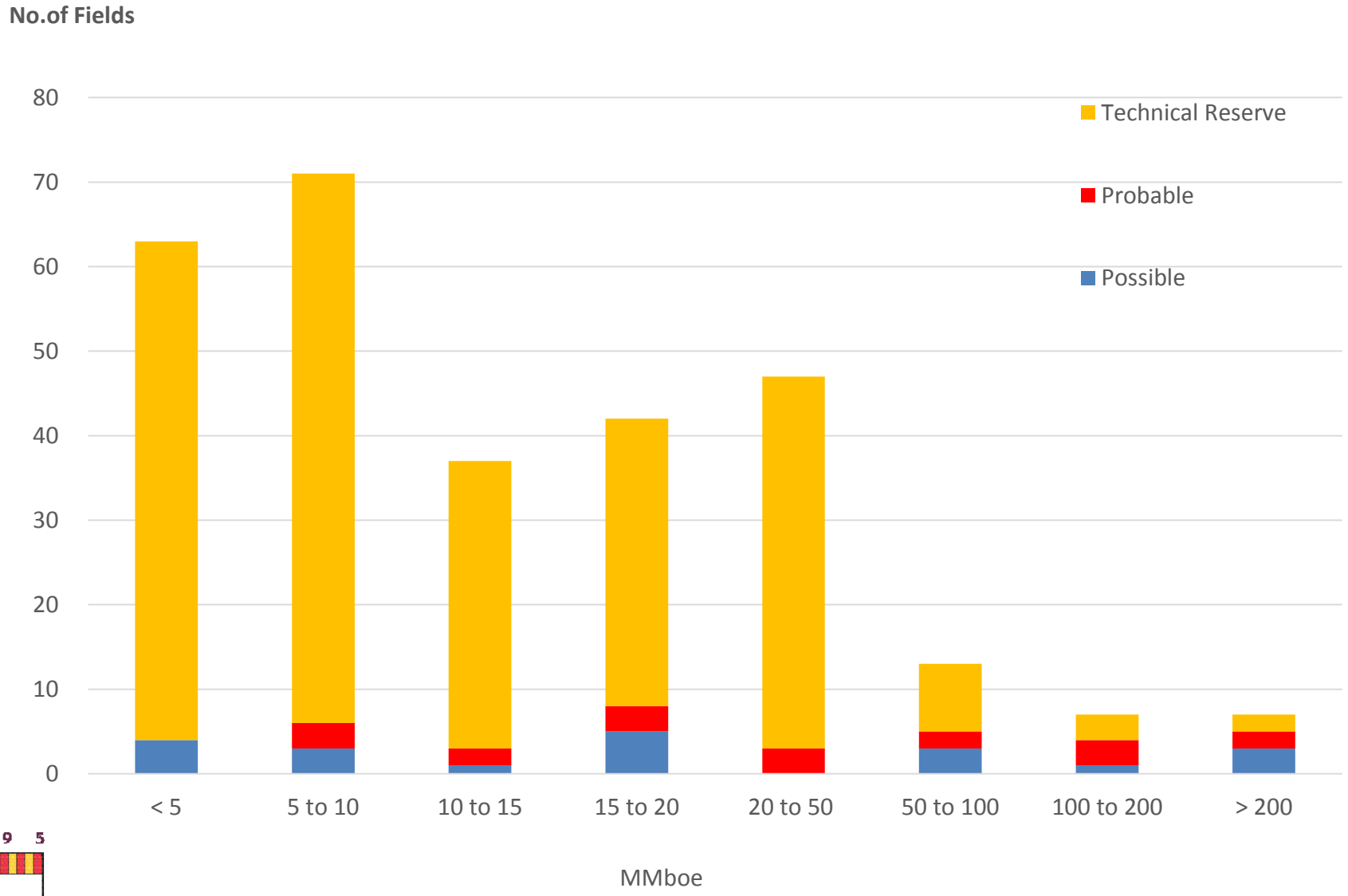
Source: OGUK

UK Oil and Gas Reserves and Resources (bnboe)			
	Low	Central	High
Reserves	3.9	6.3	8.2
Contingent Resources	0.6	1.4	2.6
PAR	1.5	3.6	7.2
Undiscovered Resources (Risked)	1.9	6.0	9.2

Source: OGA, July 2016

Undeveloped Discoveries



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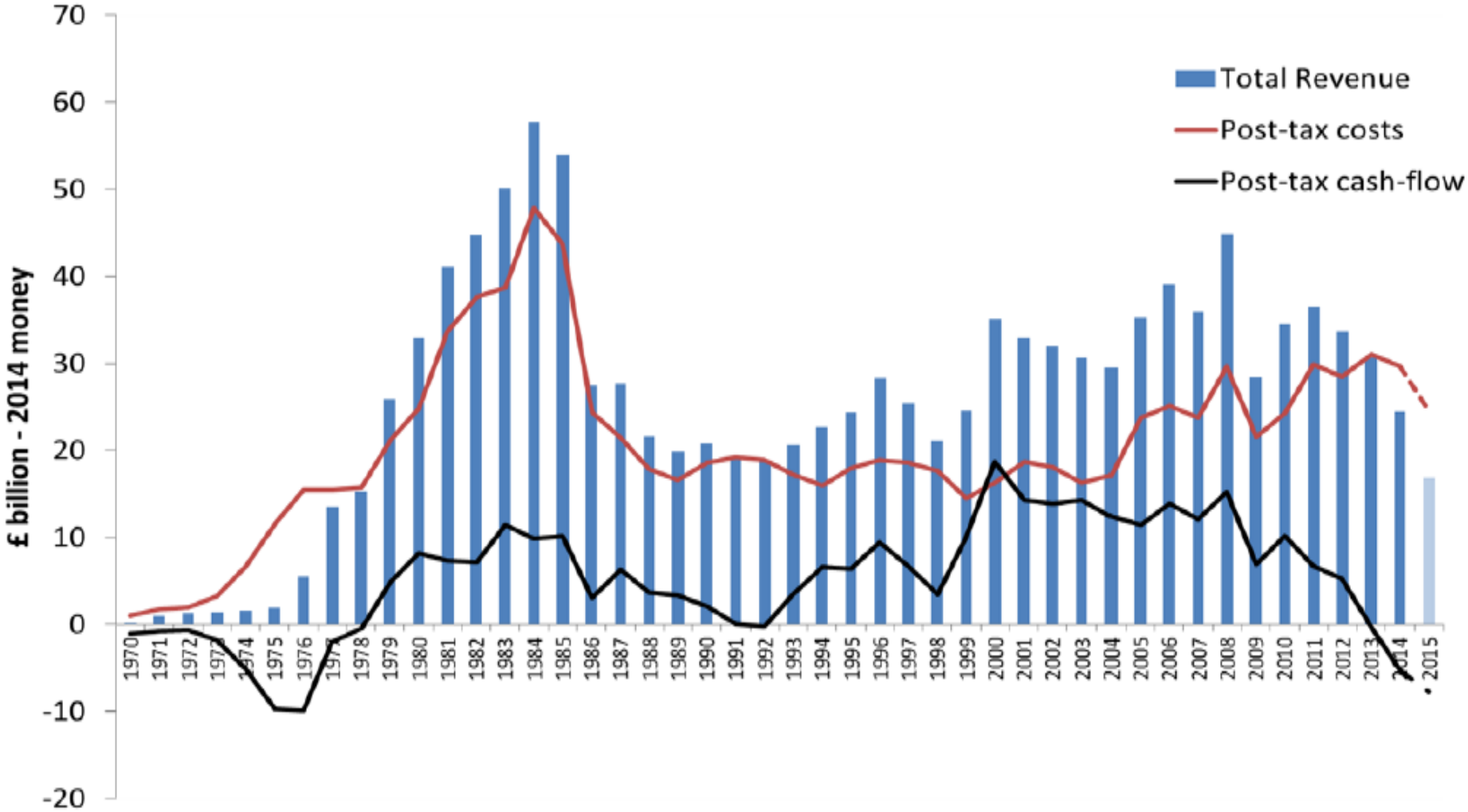
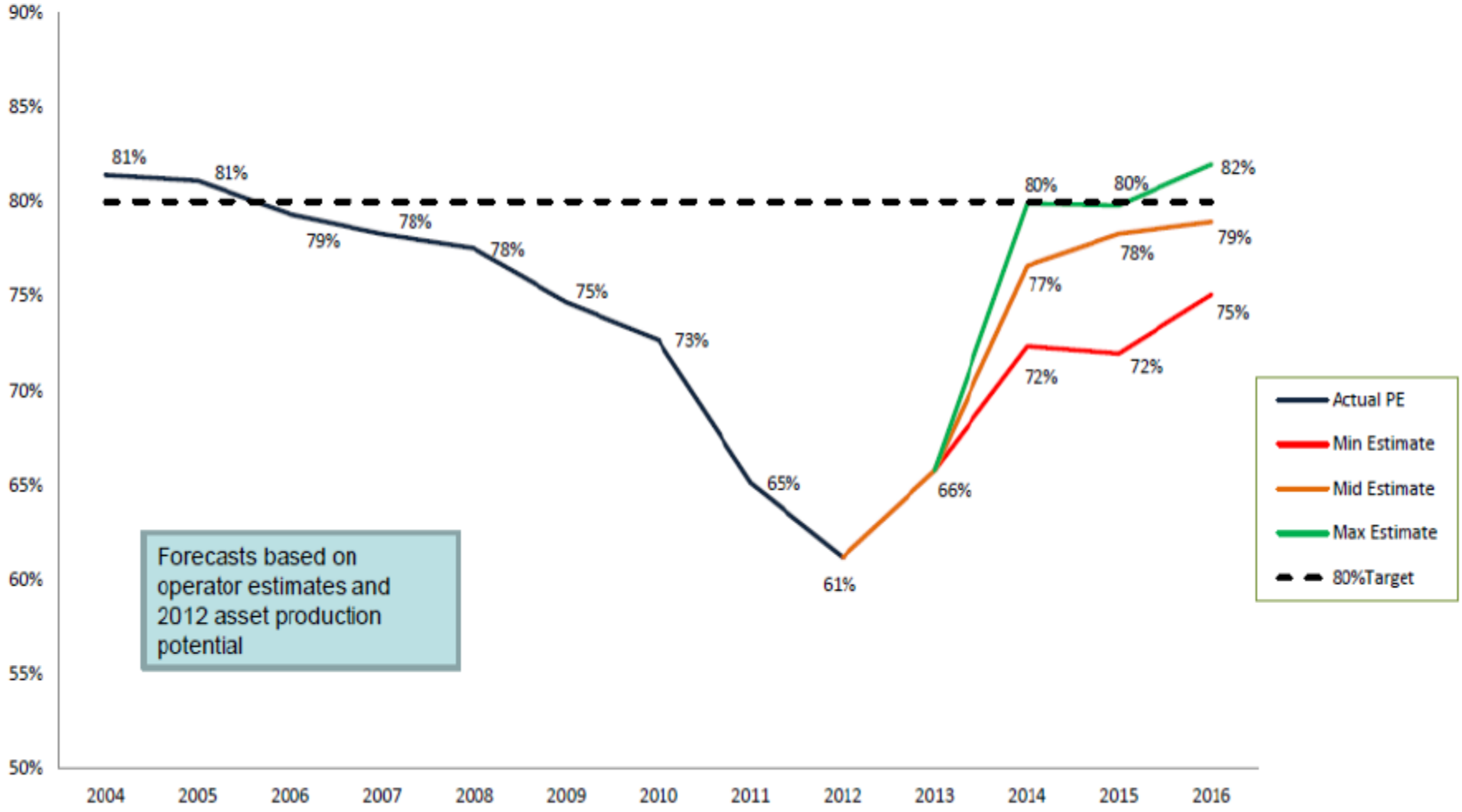
Cash Flows from the UKCS



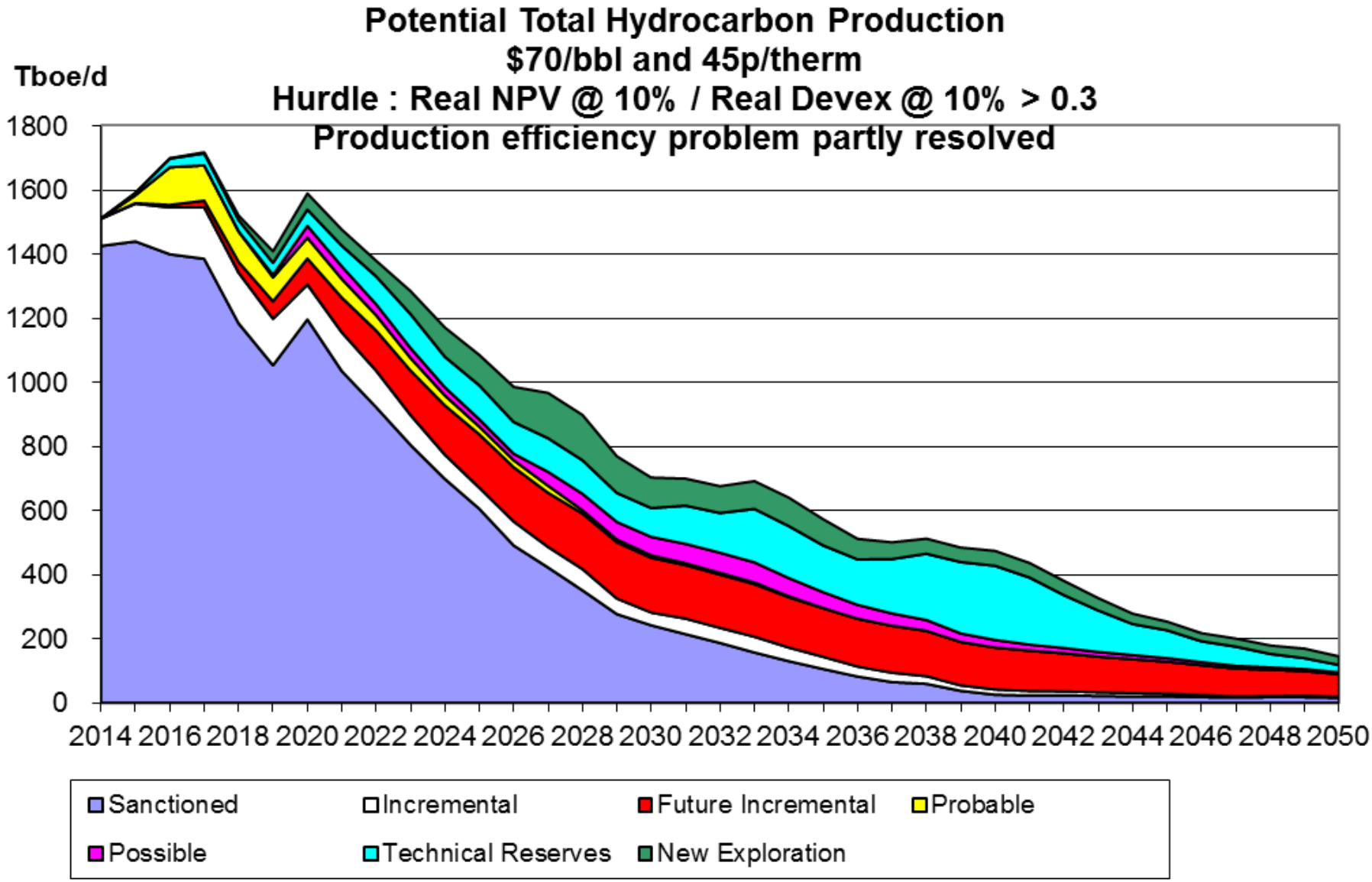
Source: Oil & Gas UK

Production efficiency

UK Continental Shelf PE (actual and forecast)



Some Results of Future Activity in the UKCS using Financial Simulation including Monte Carlo Technique before Cost Reductions $70, 45p



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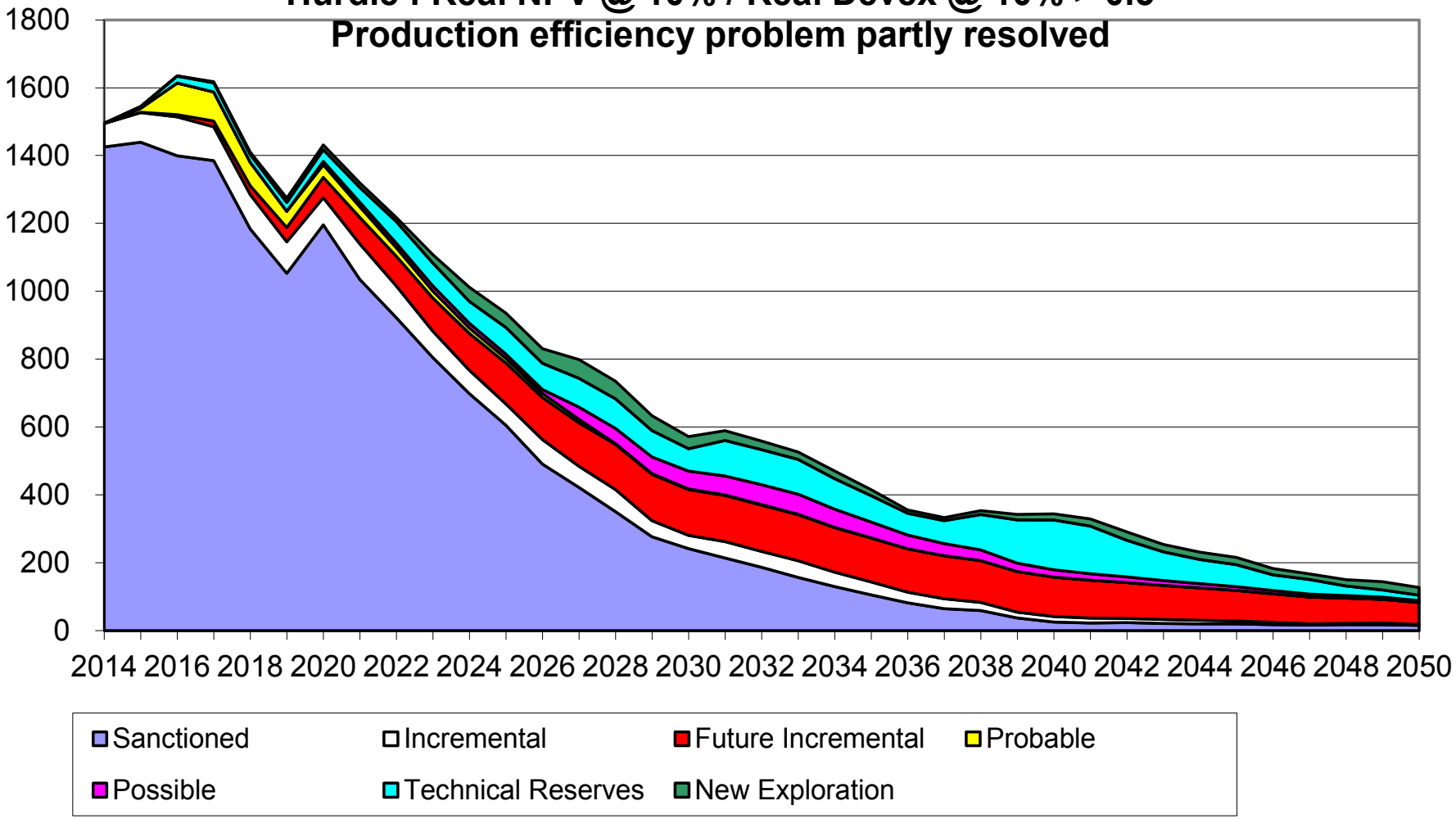
Potential Total Hydrocarbon Production
$70/bbl and 45p/therm
Hurdle : Real NPV @ 10% / Real Devex @ 10% > 0.5
Production efficiency problem partly resolved



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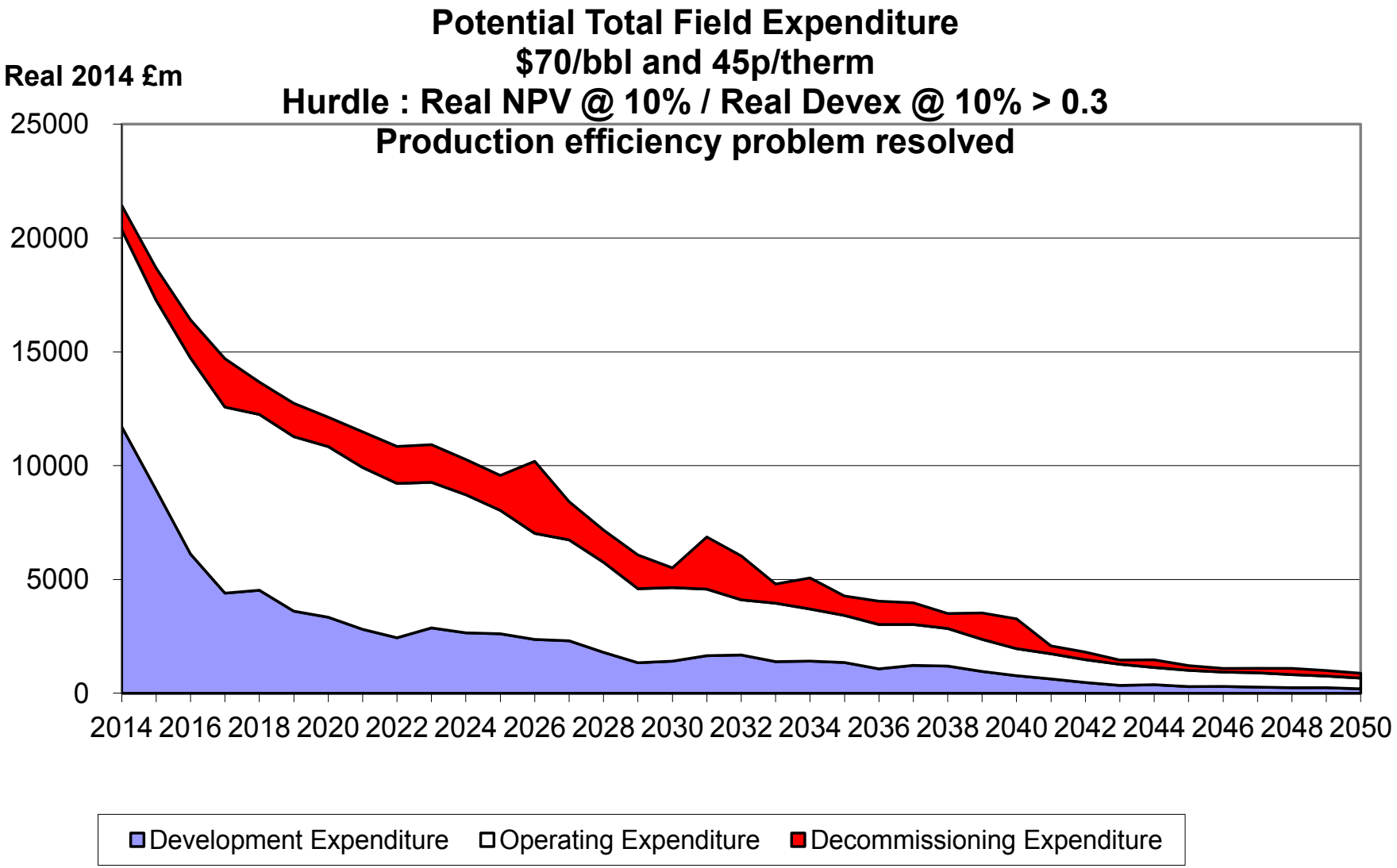

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Cumulative Hydrocarbon Production (UKCS)

Real Price	2014-2050, bn boe	
$70, 45 pence	NPV/I > 0.3	NPV/I > 0.5
Production Efficiency Problem Resolved	11.9	10.4
Production Efficiency Problem Unresolved	11.0	9.5

Cumulative Expenditures (£bn.2014)

Development	81.4
Operating	135.0
Decommissioning	41.8
TOTAL	**258.2**

Investment Allowance of 62.5% for SC, plus Cost Reductions of 15% and SC at 20%
$70/bbl and 45p/therm

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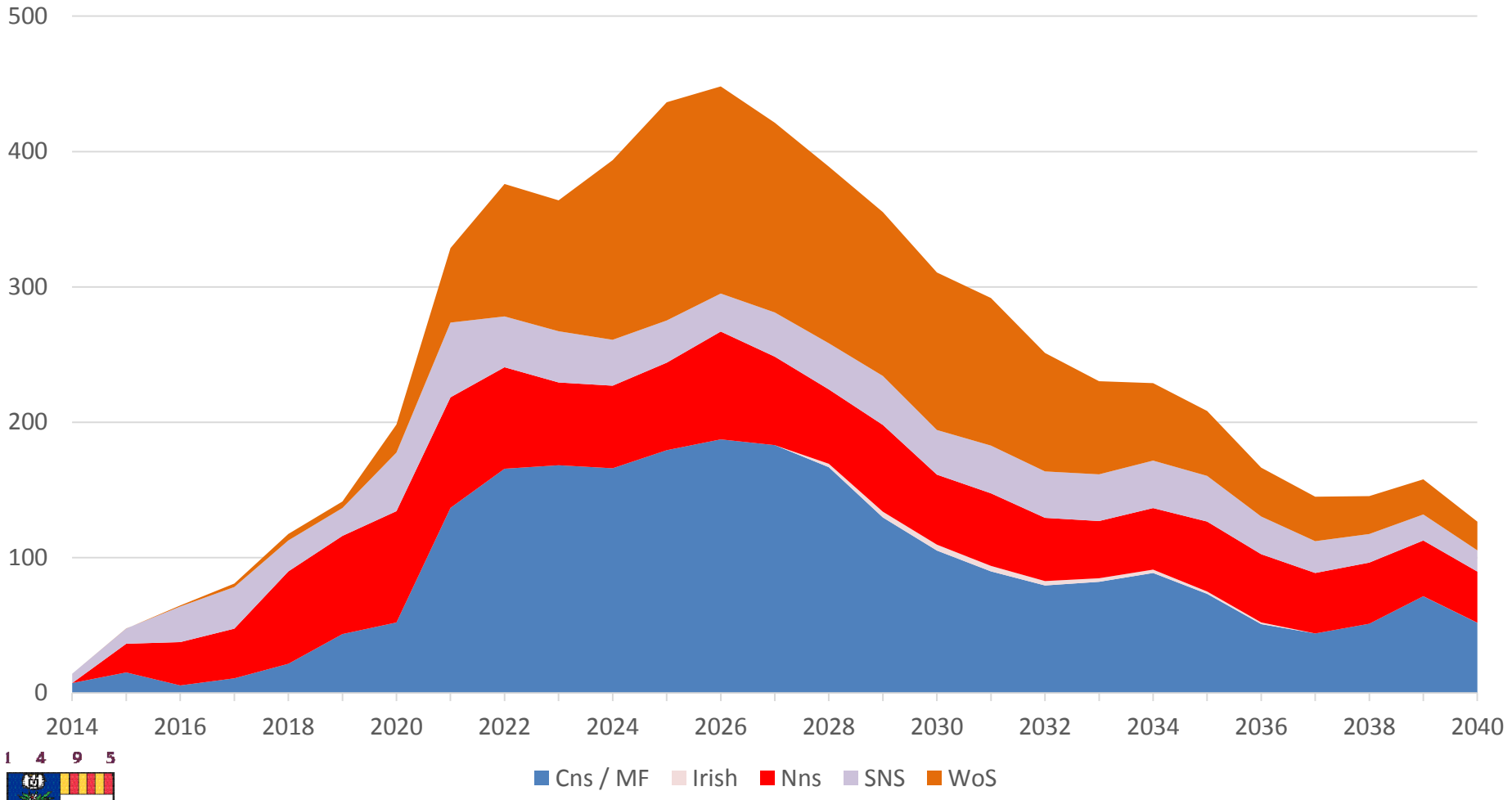
Change in Potential Hydrocarbon Production
SCT 20% Uplift 62.5% Devex and Opex reduced by 15%
$70bbl and 45p/therm
Hurdle : Real NPV @ 10%/Real Devex @ 10% > 0.3



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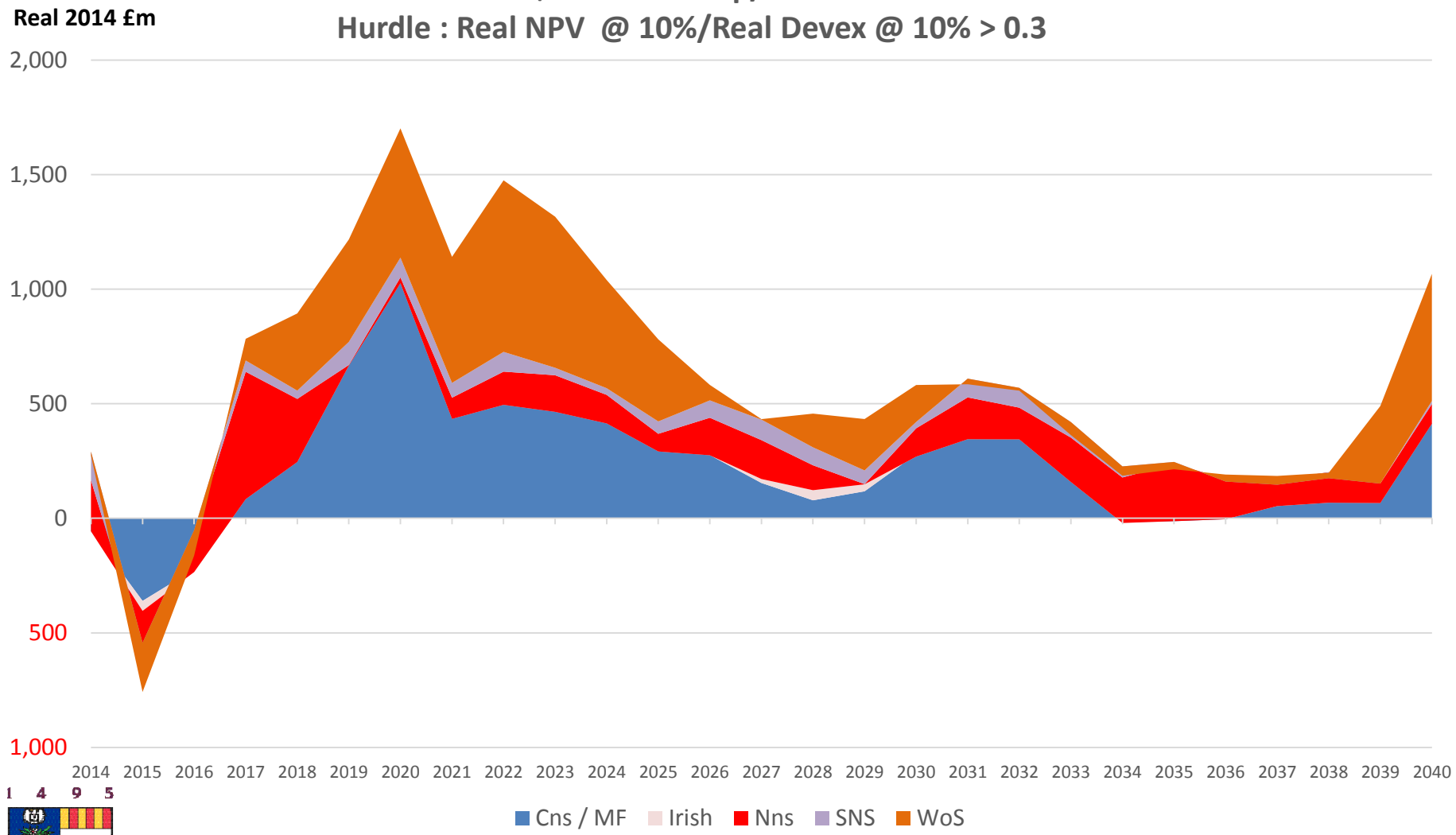
Change in Potential Development Expenditure
SCT 20% Uplift 62.5% Devex and Opex reduced by 15%
$70bbl and 45p/therm
Hurdle : Real NPV @ 10%/Real Devex @ 10% > 0.3



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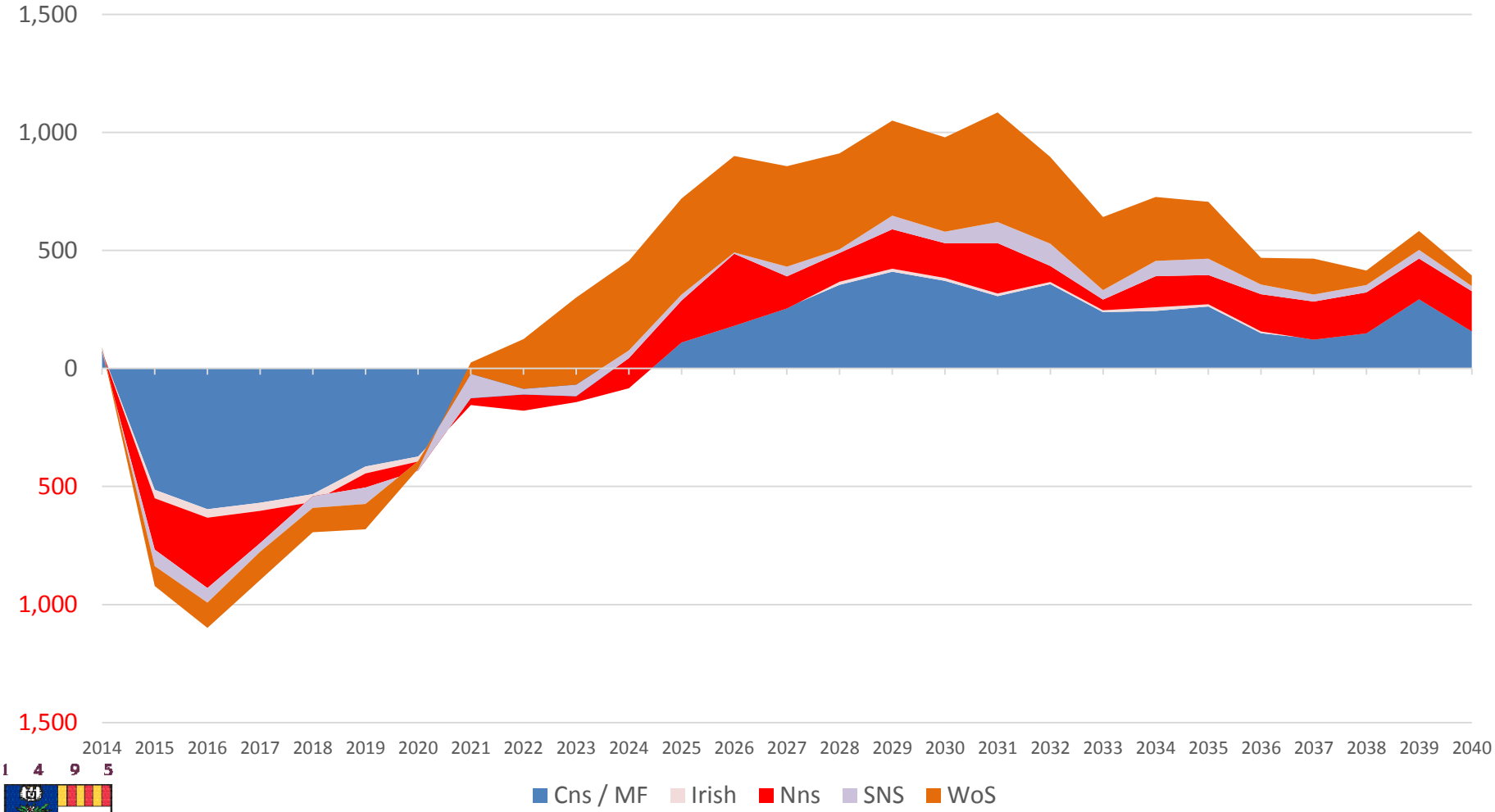
Change in Potential Operating Expenditure
SCT 20% Uplift 62.5% Devex and Opex reduced by 15%
$70bbl and 45p/therm
Hurdle : Real NPV @ 10%/Real Devex @ 10% > 0.3

Real 2014 £m



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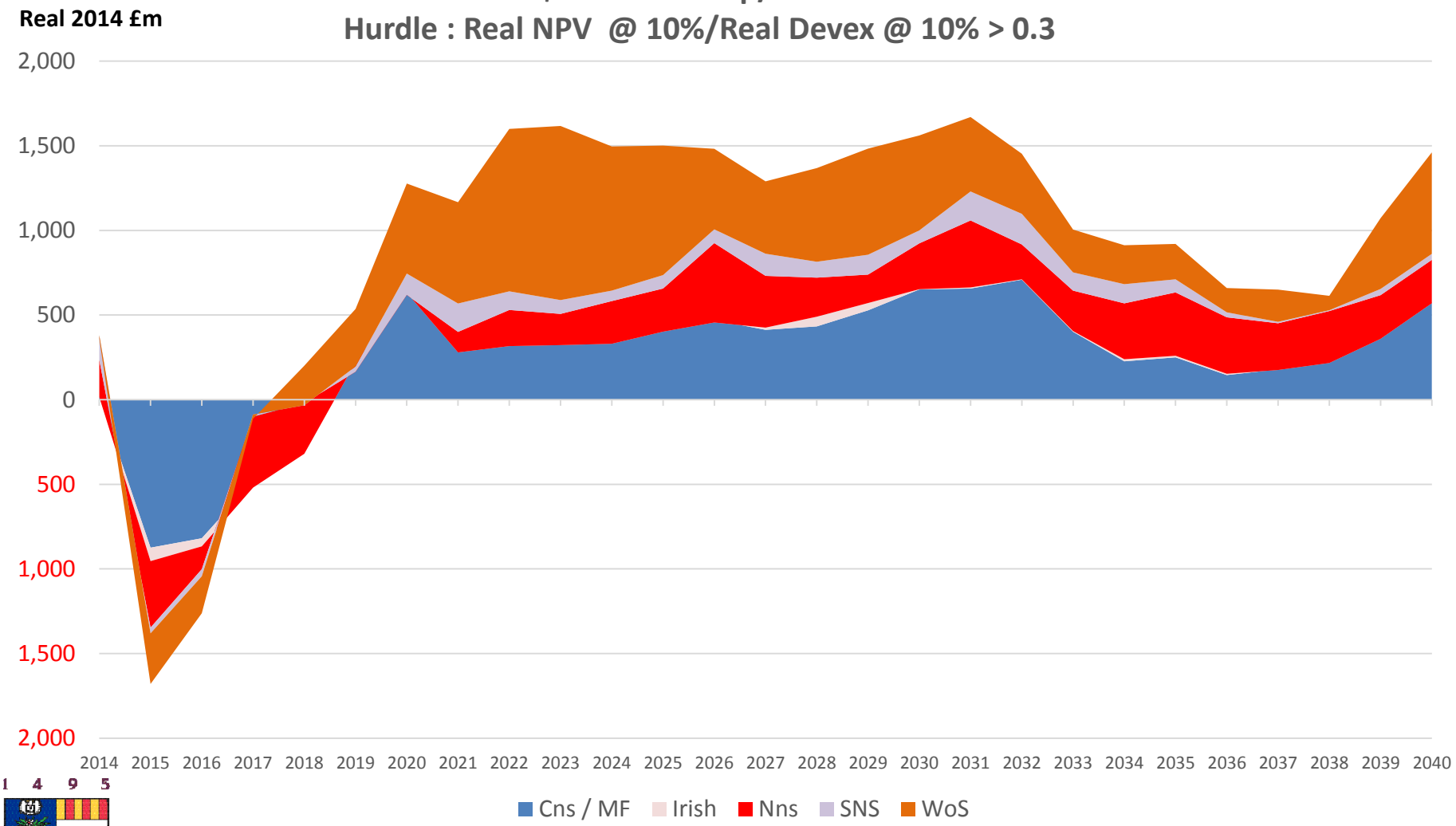
Change in Potential Total Expenditure
SCT 20% Uplift 62.5% Devex and Opex reduced by 15%
$70bbl and 45p/therm
Hurdle : Real NPV @ 10%/Real Devex @ 10% > 0.3



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Change in period 2015-2050
from 62.5% investment allowance
+ SC at 20% + cost reduction of 15%

Cumulative production	+ 2.8 bnboe
[redacted]	
Cumulative field opex	+ £23.4 bn
[redacted]	

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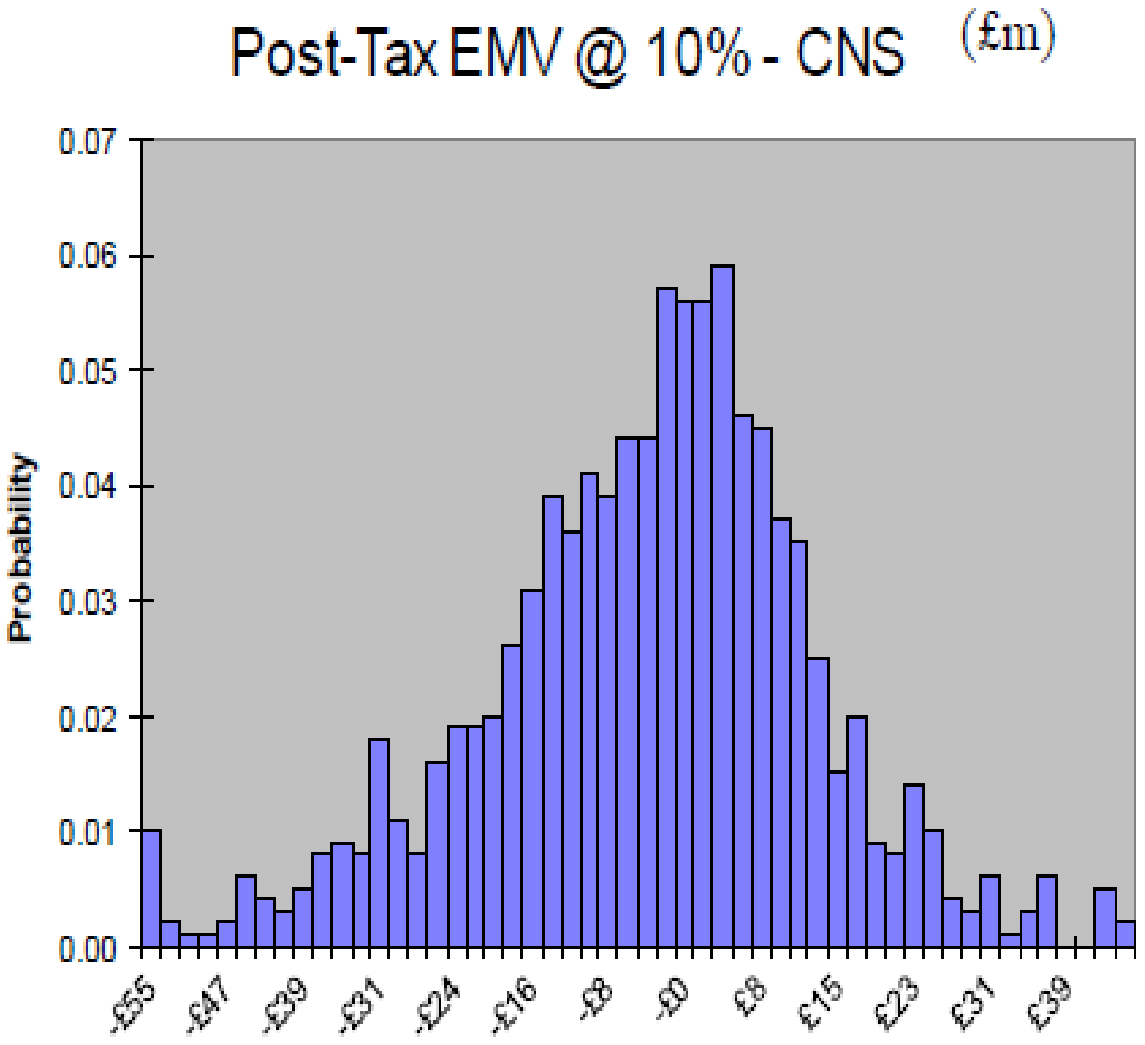
Assumptions for Monte Carlo Modelling by Region After Cost Reductions

		Central North Sea	Southern North Sea	Northern North Sea	West of Shetlands
Exploration success		34.2%	35.3%	40%	50%
Chance of Oil		82%	0%	88%	75%
Chance of Gas		18%	100%	12%	25%
Appraisal success		47.4%	30%	50%	55.6%
Reserves	Average	39.1 mmboe	16.4 mmboe	16.5 mmboe	112.6 mmboe
	Minimum significant size	8.5 mmboe	3.55 mmboe	3.6 mmboe	24.4 mmboe
	Maximum significant size	110 mmboe	50 mmboe	50 mmboe	320 mmboe
Well costs for E & A		£24.68m.	£14.1m.	£24.68m.	£30.85m.
Average devex per boe		$23.67	$11.392	$17.152	$15.82
Minimum devex per boe		$9.47	$4.56	$6.86	$6.33
Maximum devex per boe		$37.88	$18.23	$27.44	$25.32

CNS - Project (Fast) Limited IA - Initial Price $55 p/b and 40p/therm Reduced Costs

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	-4.59
Median	-3.07
Standard Deviation	18.31
Variance	335.08
Skewness	-0.37
Kurtosis	2.56
Coefficient of Variability	-3.99
Minimum	-102.31
Maximum	72.96
Range	175.27
Mean Standard Error	0.58
Trimmed Mean (98%)	-4.49



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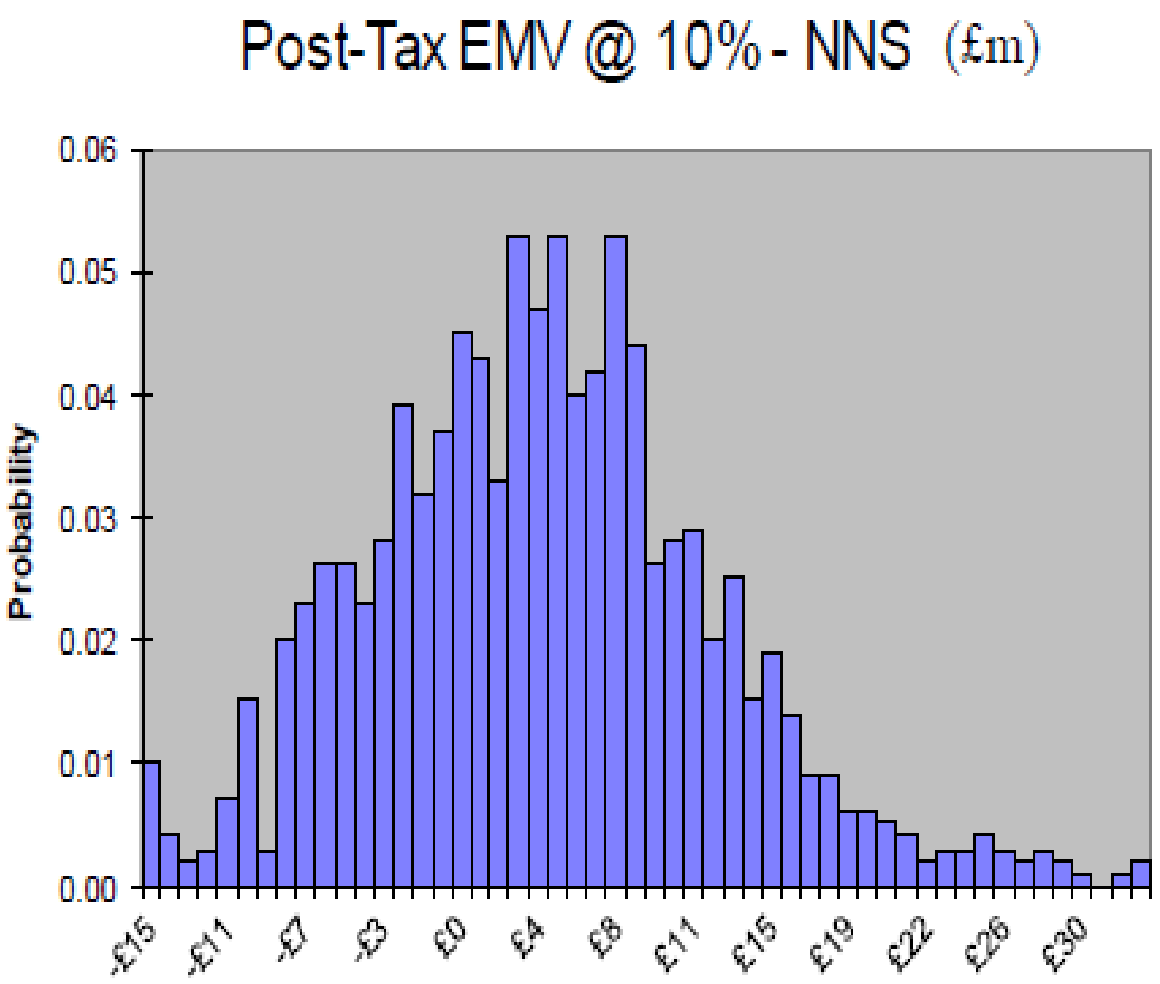
NNS - Project (Fast) Limited IA - Initial Price $55 p/b and 40p/therm Reduced Costs

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	3.99
Median	3.63
Standard Deviation	8.95
Variance	80.10
Skewness	0.96
Kurtosis	3.84
Coefficient of Variability	2.24
Minimum	-20.92
Maximum	68.09
Range	89.01
Mean Standard Error	0.28
Trimmed Mean (98%)	3.84



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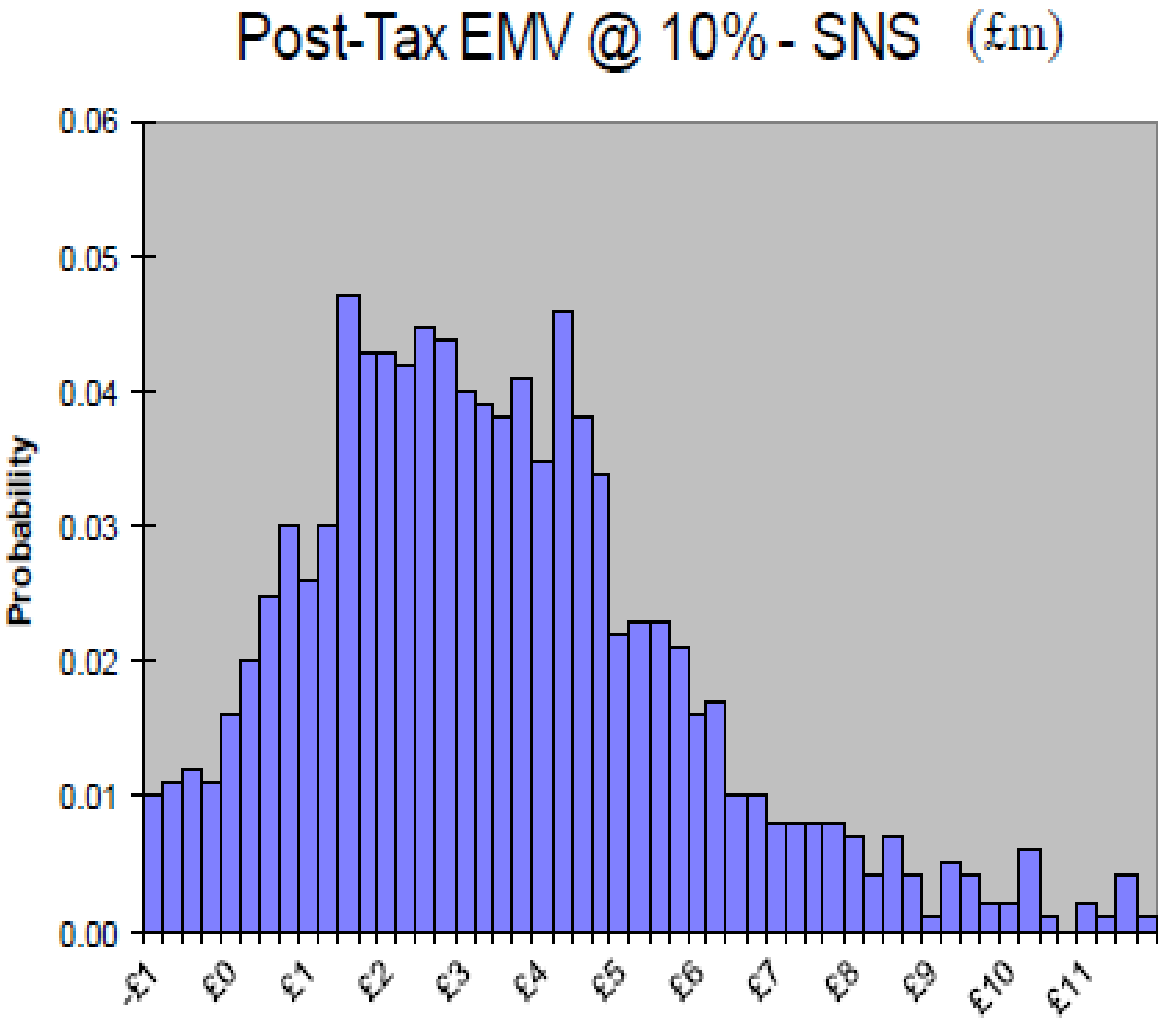
SNS - Project (Fast) Limited IA - Initial Price $55 p/b and 40p/therm Reduced Costs

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	3.42
Median	3.10
Standard Deviation	2.51
Variance	6.32
Skewness	1.10
Kurtosis	2.39
Coefficient of Variability	0.73
Minimum	-2.16
Maximum	17.48
Range	19.64
Mean Standard Error	0.08
Trimmed Mean (98%)	3.37



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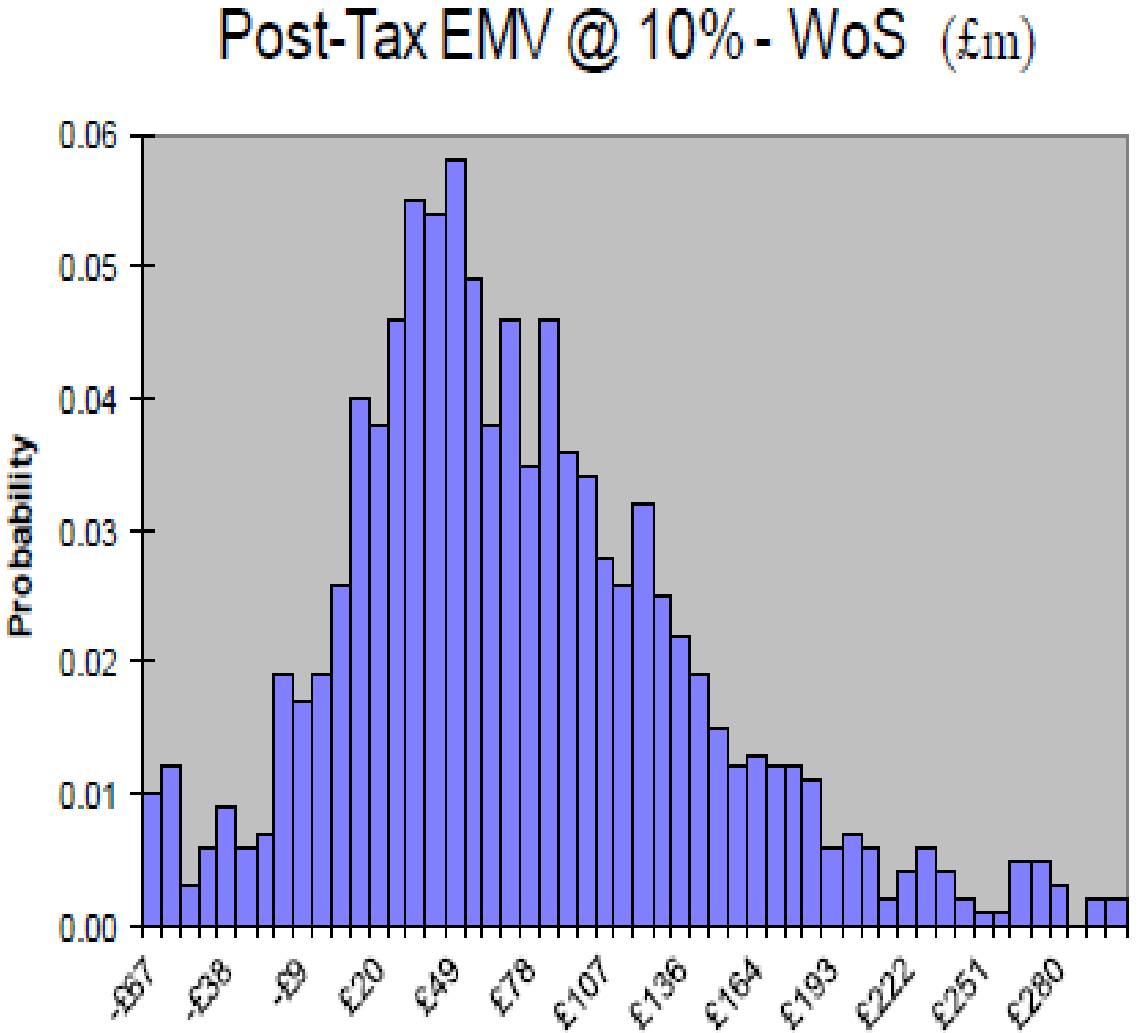
WoS - Project (Fast) Limited IA - Initial Price $55 p/b and 40p/therm Reduced Costs

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	71.72
Median	60.17
Standard Deviation	72.99
Variance	5327.65
Skewness	1.02
Kurtosis	3.27
Coefficient of Variability	1.02
Minimum	-149.83
Maximum	571.80
Range	721.63
Mean Standard Error	2.31
Trimmed Mean (98%)	70.69



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Rates of Tax on Income and Rates of Effective Relief for Investment in the UKCS

	Tax on Income	Relief for Investment
1. Non-PRT fields		
(a) 2015 terms	0.3+0.2 = <u>0.5</u>	0.3+0.2+0.625 (0.2) = <u>0.625</u>
(b) 2016 terms	0.3+0.1 = <u>0.4</u>	0.3+0.1+0.625(0.1) = <u>0.4625</u>
2. PRT fields		
(a) 2015 terms	0.35+0.3(0.65)+0.2(0.65) = <u>0.675</u>	0.35+0.3(0.65)+0.2(0.65)+0.625 (0.2(0.65)) = <u>0.75625</u>
(b) 2016 terms	0.3+0.1 = <u>0.4</u>	0.3+0.1+0.625(0.1) = <u>0.4625</u>

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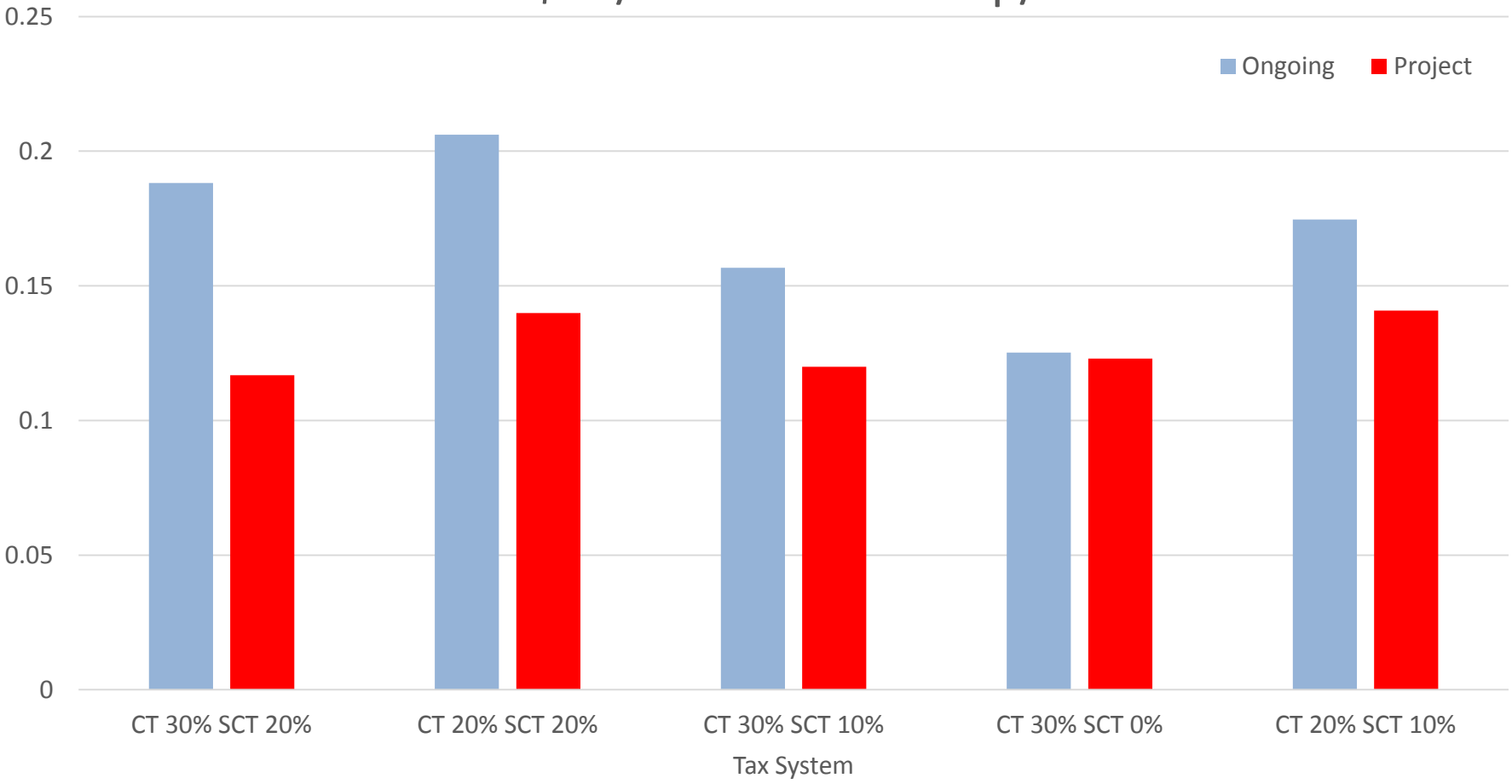
Results of Modelling Returns to Investment in Oil/Gas Fields under Different Tax Schemes with Major Cost Reductions

CNS Oil 10 Mboe
Real Post-tax NPV @ 10% / Real Devex @ 10%
Oil Price $50/bbl Gas Price 40p/therm



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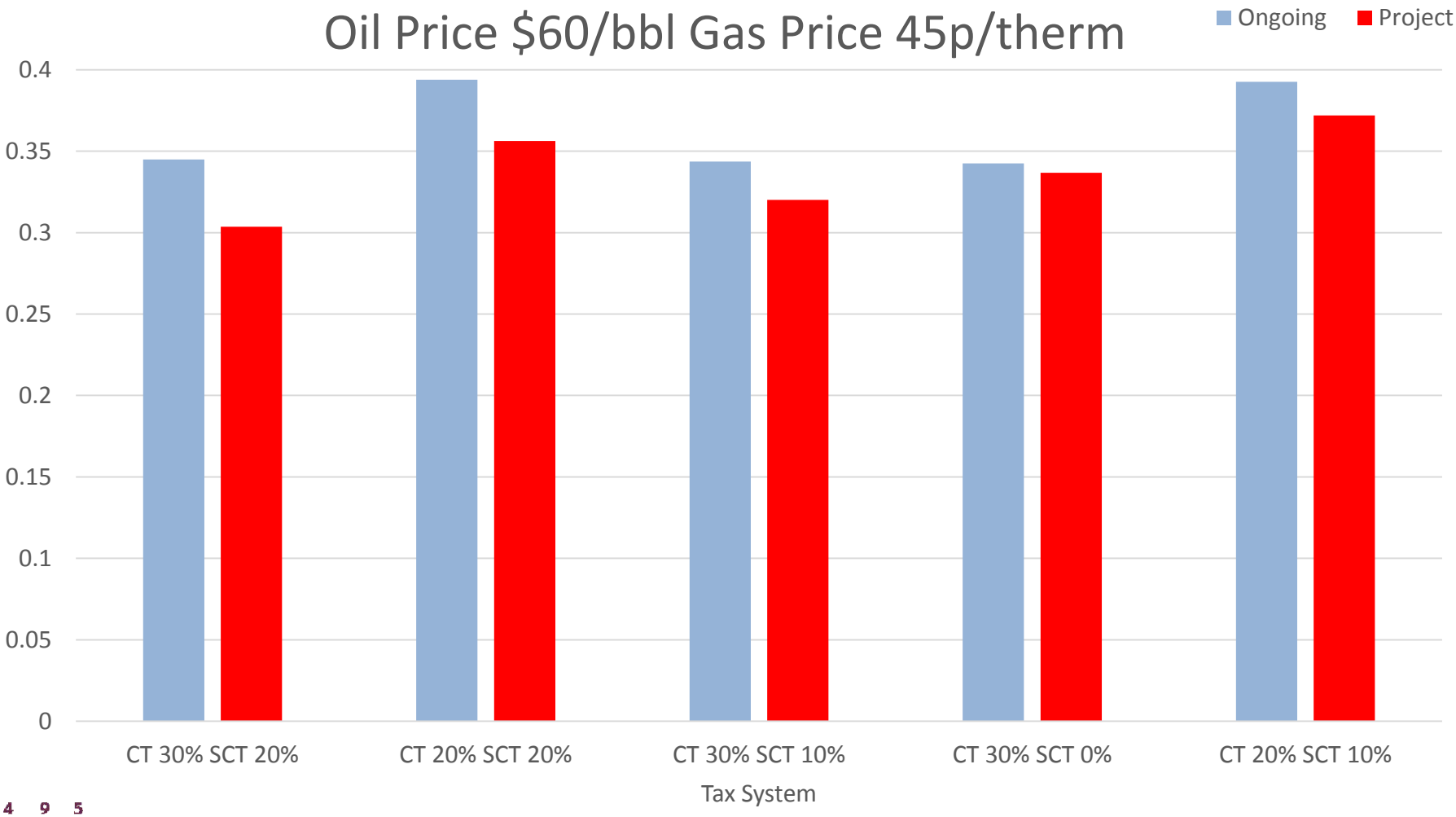
CNS Oil 10 Mboe
Real Post-tax NPV @ 10% / Real Devex @ 10%
Oil Price $60/bbl Gas Price 45p/therm



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CNS Oil 20 Mboe
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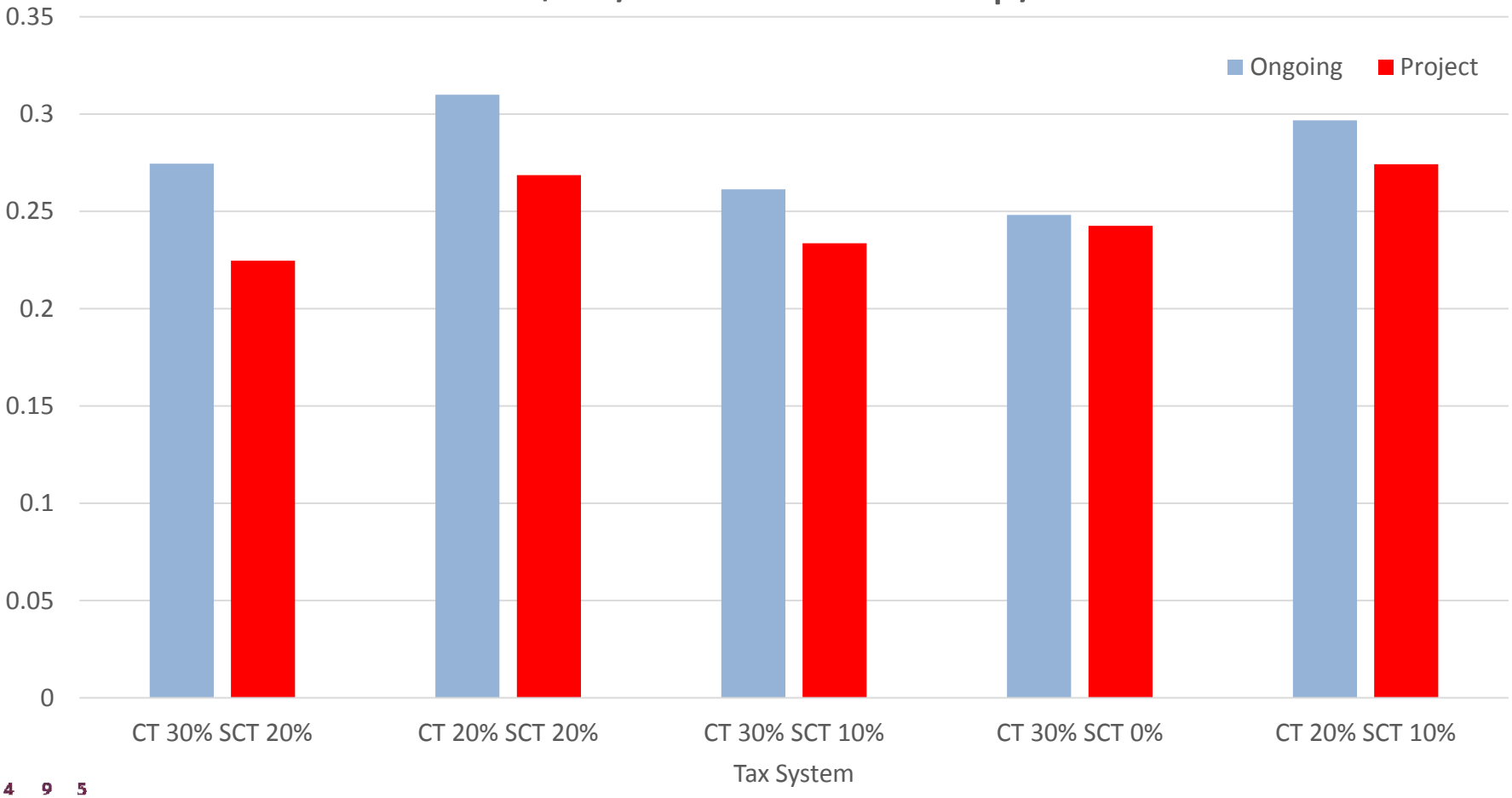

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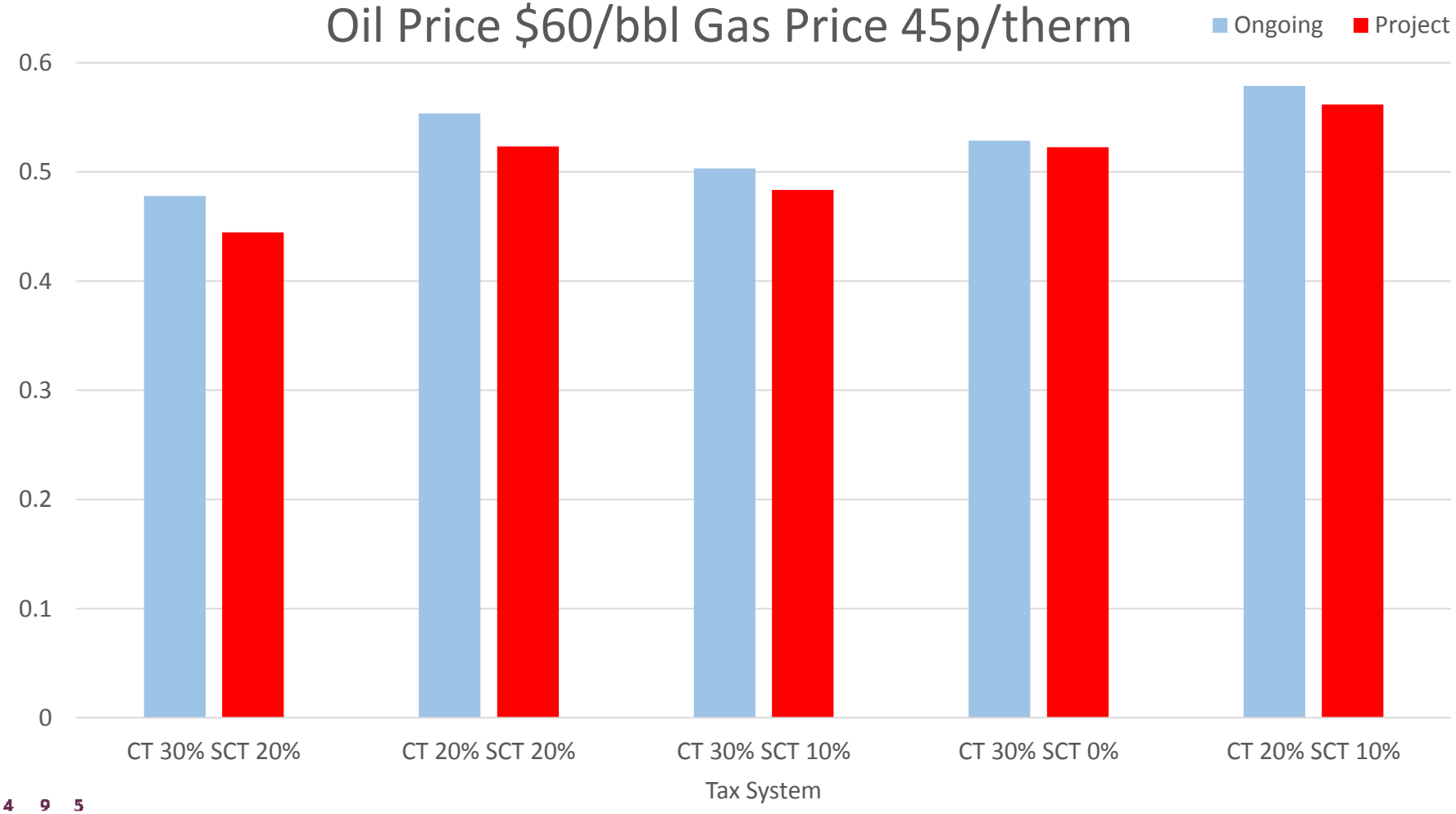
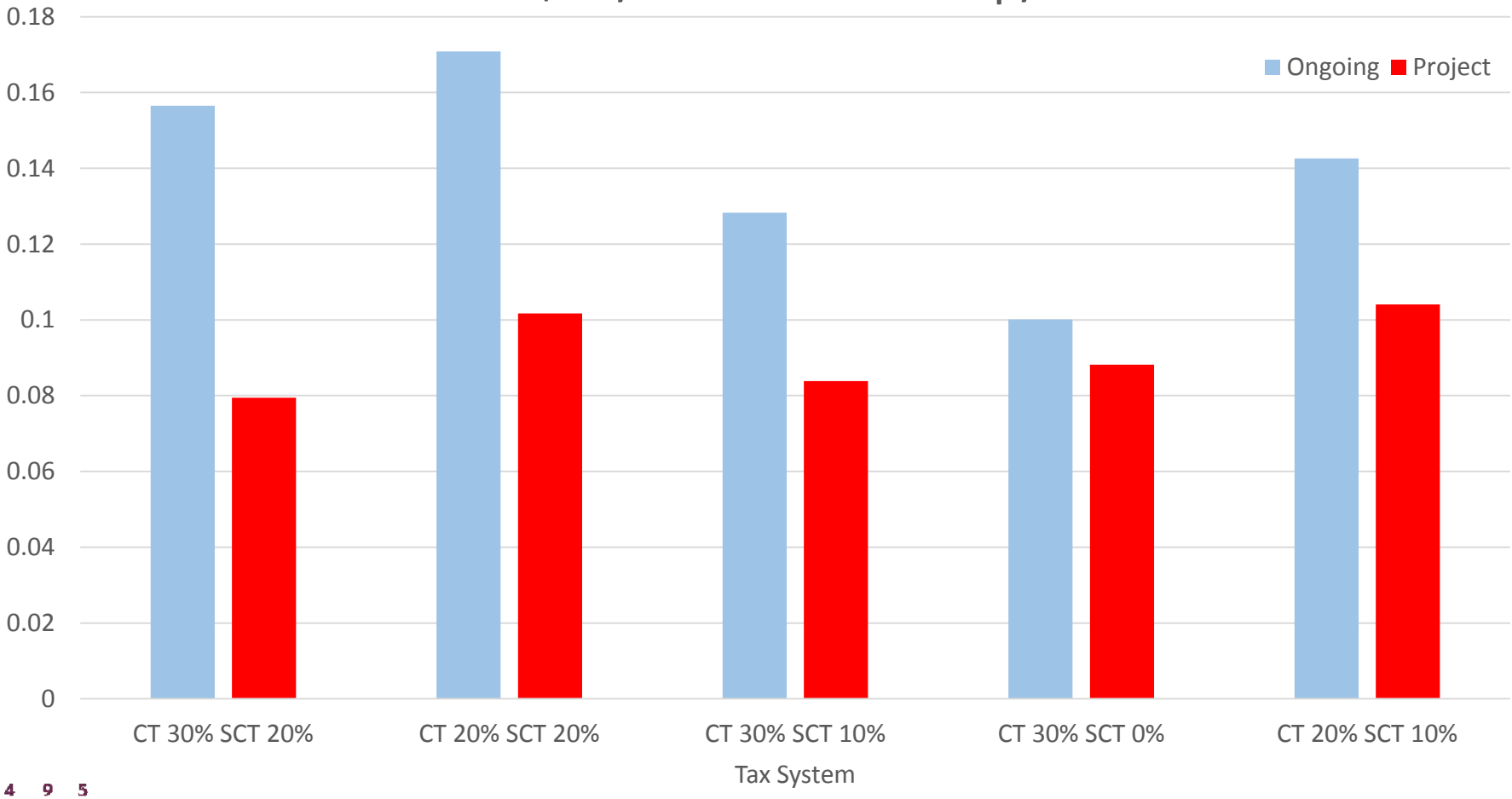
CNS Oil 20 Mboe
Real Post-tax NPV @ 10% / Real Devex @ 10%
Oil Price $60/bbl Gas Price 45p/therm



WoS Oil 100 Mboe
Real Post-tax NPV @ 10% / Real Devex @ 10%
Oil Price $50/bbl Gas Price 40p/therm



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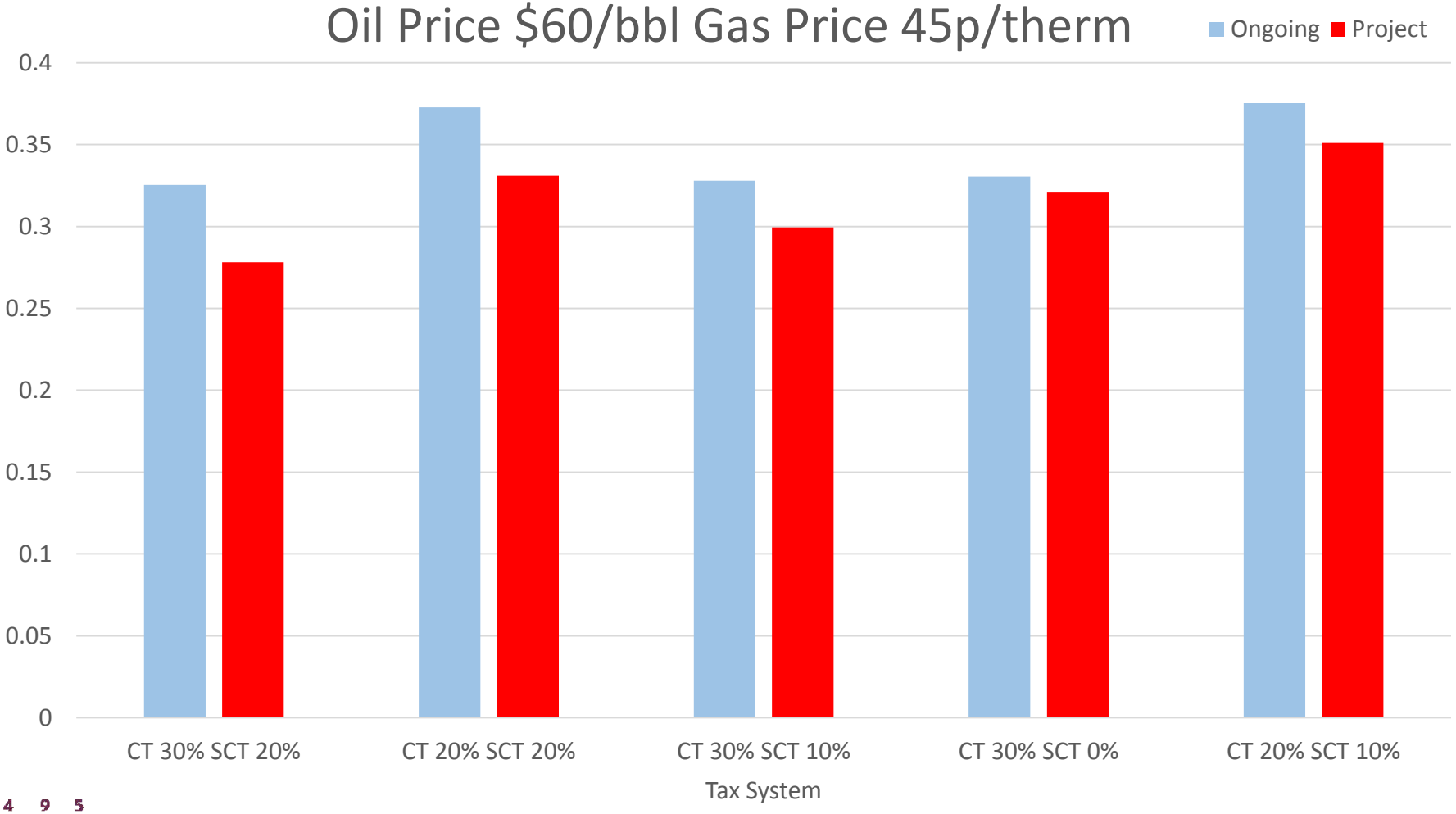
WoS Oil 100 Mboe
Real Post-tax NPV @ 10% / Real Devex @ 10%
Oil Price $60/bbl Gas Price 45p/therm



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Further Tax Incentives

1. Reducing the rate of CT would help cash flows from existing operations and incentivise new investments. EU State Aids issue a problem.
2. To encourage EOR projects consideration should be given to allowing the IA for SC to apply to purchases of raw materials such as polymers, miscible gas, and CO_2.

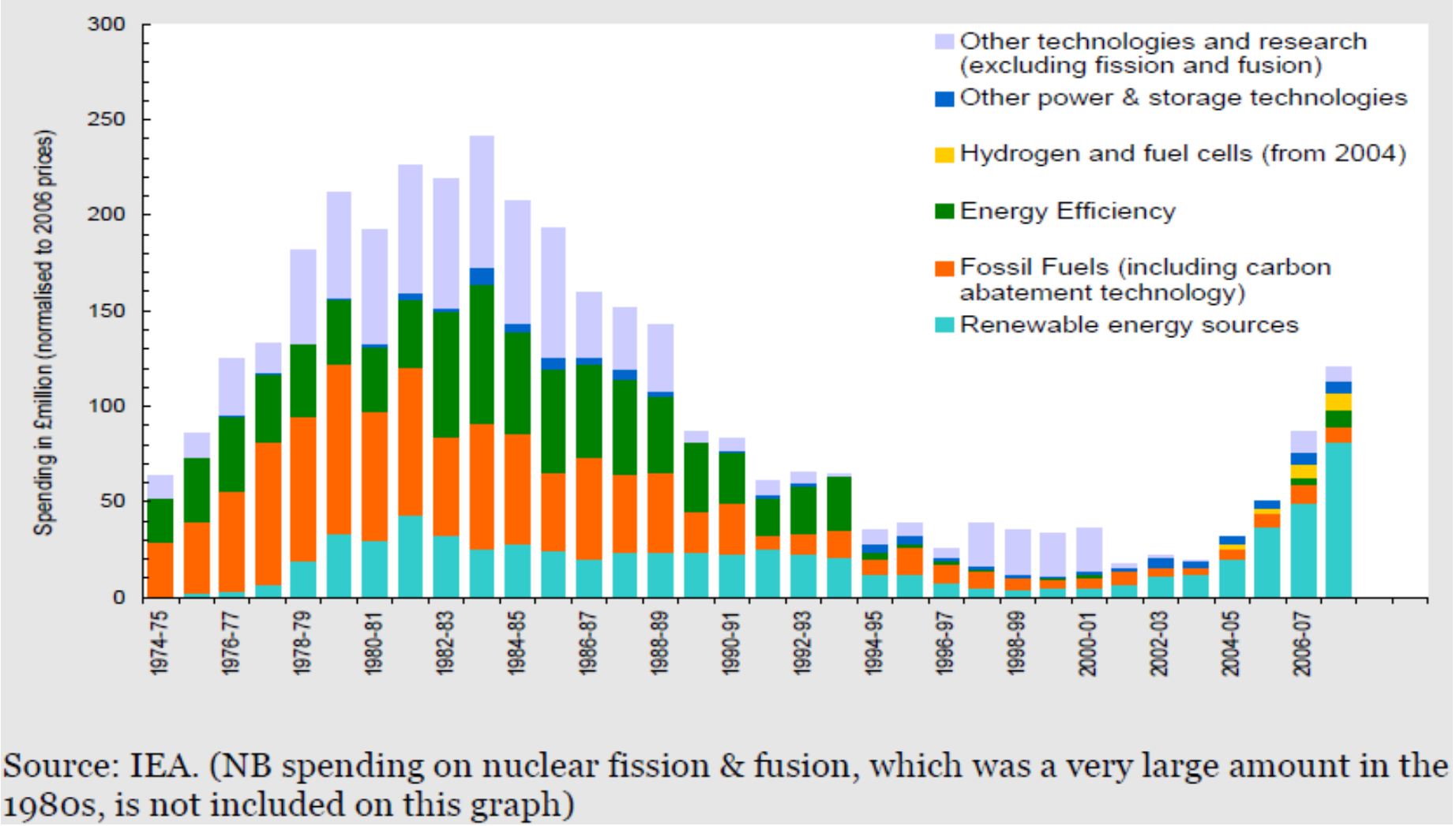
Further Tax Incentives

3. IA could be activated earlier and employed against any SC income.
4. When IA can be activated but investor does not have income against which to use it interest on the IA could be given.
5. To facilitate late field life transactions a transferable tax credit from seller to buyer for CT and SC could be introduced.

Reinforcing MER Strategy

1. To reduce potential conflict between competition laws and collaboration CMA and OGA could produce Guidance Notes on what collaborative arrangements are consistent with competition laws and what are inconsistent.
2. OGA to be very proactive with respect to encouraging enhancement of asset integrity. Short term gains can be very large.

UK energy R&D spending 1974-2007



Source: IEA. (NB spending on nuclear fission & fusion, which was a very large amount in the 1980s, is not included on this graph)

Secondary source: M. Wicks (2009)

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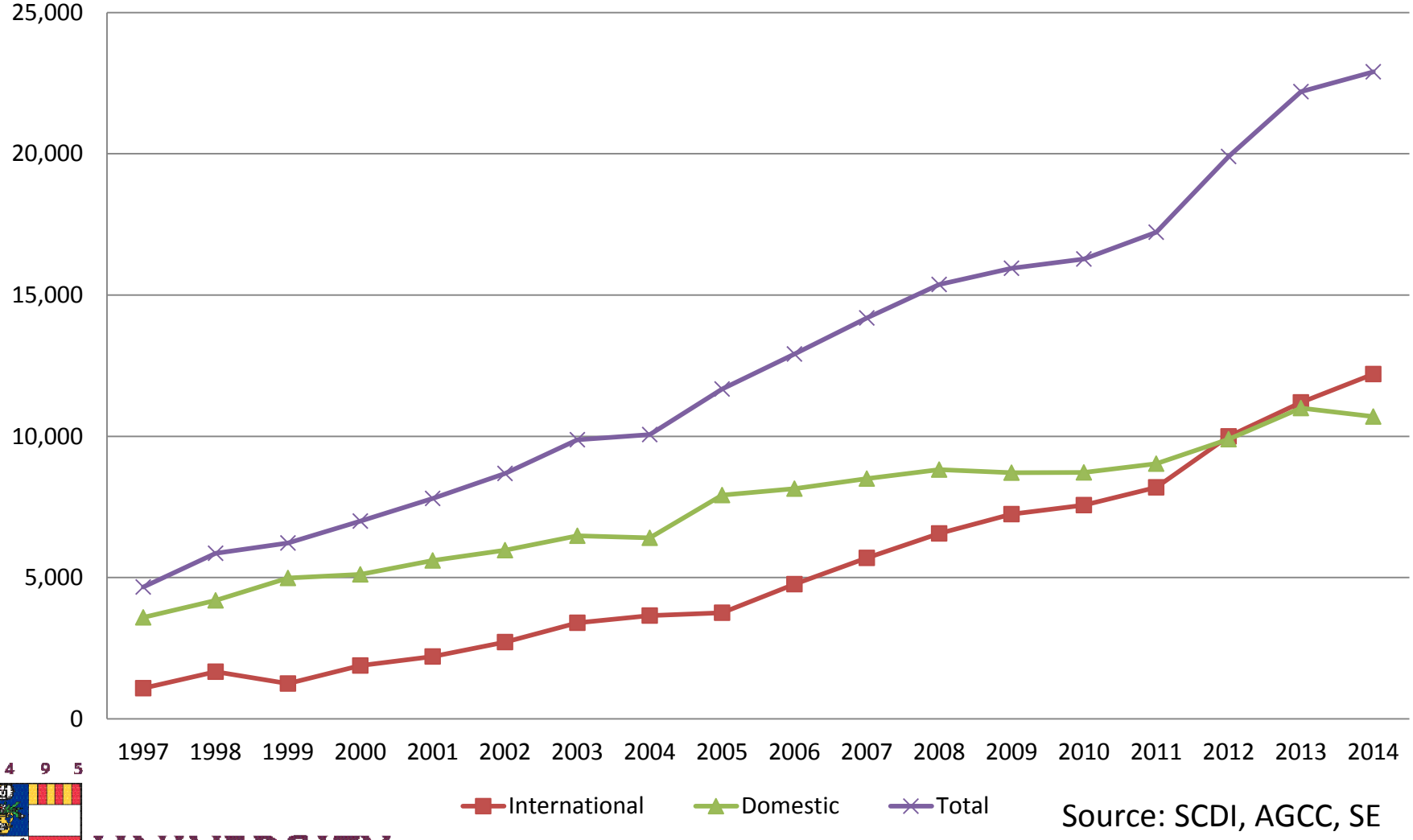
Reinforcing MER Strategy

3. Optimising the use of infrastructure may require further consideration to be given to terms of access including tariffs.
4. Emphasis could be more geared to Maximisation of Total Value Added where role of supply chain is given more prominence.

Scottish Oil and Gas Supply Chain
International and UK Market Sales 1997-2014, £m (MoD)
(including overseas sales of Scottish subsidiaries)



Source: SCDI, AGCC, SE

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