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**Prospective Returns to Exploration  
in the UKCS  
with Cost Reductions and Tax Incentives**

Professor Alexander G. Kemp  
and  
Linda Stephen

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**Aberdeen Centre for Research in Energy Economics and  
Finance (ACREEF)**

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## **NORTH SEA ECONOMICS**

Research in North Sea Economics has been conducted in the Economics Department since 1973. The present and likely future effects of oil and gas developments on the Scottish economy formed the subject of a long term study undertaken for the Scottish Office. The final report of this study, The Economic Impact of North Sea Oil on Scotland, was published by HMSO in 1978. In more recent years further work has been done on the impact of oil on local economies and on the barriers to entry and characteristics of the supply companies in the offshore oil industry.

The second and longer lasting theme of research has been an analysis of licensing and fiscal regimes applied to petroleum exploitation. Work in this field was initially financed by a major firm of accountants, by British Petroleum, and subsequently by the Shell Grants Committee. Much of this work has involved analysis of fiscal systems in other oil producing countries including Australia, Canada, the United States, Indonesia, Egypt, Nigeria and Malaysia. Because of the continuing interest in the UK fiscal system many papers have been produced on the effects of this regime.

From 1985 to 1987 the Economic and Social Science Research Council financed research on the relationship between oil companies and Governments in the UK, Norway, Denmark and The Netherlands. A main part of this work involved the construction of Monte Carlo simulation models which have been employed to measure the extents to which fiscal systems share in exploration and development risks.

Over the last few years the research has examined the many evolving economic issues generally relating to petroleum investment and related fiscal and regulatory matters. Subjects researched include the economics of incremental investments in mature oil fields, economic aspects of the CRINE initiative, economics of gas developments and contracts in the new market situation, economic and tax aspects of tariffing, economics of infrastructure cost sharing, the effects of comparative petroleum fiscal systems on incentives to develop fields and undertake new exploration, the oil price responsiveness of the UK petroleum tax system, and the economics of decommissioning, mothballing and re-use of facilities. This work has been financed by a group of oil companies and Scottish Enterprise, Energy. The work on CO2 Capture, EOR and storage was financed by a grant from the Natural Environmental Research Council (NERC) in the period 2005 – 2008.

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# **Prospective Returns to Exploration in the UKCS with Cost Reductions and Tax Incentives**

Professor Alexander G. Kemp and Linda Stephen

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# **Prospective Returns to Exploration in the UKCS with Cost Reductions and Tax Incentives**

Professor Alexander G. Kemp  
and  
Linda Stephen

## **1. Introduction and Context**

Exploration activity in the UK Continental Shelf (UKCS) has been falling for some years, even when the oil price has been very high. This century the average annual number of exploration wells drilled has been 25.8 with the maximum being 44 in 2008 and the lowest 14 in both 2013 and 2014. The figure for 2015 may will be lower. The average number of appraisal wells drilled this century has been 36.5, with the highest being 77 in 2007 and only 18 in 2014. The figure for 2015 will be even lower. The low figures for 2014 are arguably not primarily the consequence of the collapse in the oil price in the later part of the year. Other factors including the very high cost of drilling wells and relatively low views of prospectivity are also likely to have influenced investment decisions. The tax increases introduced in 2011 by reducing full cycle returns to investors could also have played a role in curtailing exploration and appraisal over the past few years. Clearly the continued low price in 2015 has been a major cause of the reduced E and A activity.

The numbers of discoveries are determined by the volume of exploration wells drilled and the associated success rates. Using DECC definitions the numbers of significant discoveries have declined in recent years from 13 in 2007 to 11 in 2008, 10 in 2009, 6 in 2010, 9 in 2011, 3 in 2012, 4 in 2013, and only 1 in 2014. The reserves discovered per well have also decreased in recent years. The cost inflation for E and A activities has

also been remarkably high in recent years. The average cost per E and A well (including sidetracks) increased from just under £12 million in 2009 to over £32 million in 2012, £36.4 million in 2013 and £34.3 million in 2014.

The purpose of this paper is to assess the prospective pre-tax and post-tax returns to new exploration taking into account the recent behaviour of the key factors which determine these returns. These include prospectivity, oil and gas prices, the costs of exploration and development, and the tax arrangements. The emphasis is on prospective returns after substantial cost reductions have been realised, and highlights the effects of various further tax incentives. The position of the investor is examined in two tax situations, namely (1) when he is currently in a full tax-paying position, and (2) when he is not paying tax at the time of his investment.

## **2. Methodology and Assumptions**

A Monte Carlo financial simulation model has been constructed to estimate the distribution of expected monetary values (EMVs) from a specified exploration effort. In the modelling the investor undertakes exploration with a success rate determined by recent experience. When a discovery is made it is appraised. There is again a success rate determined by recent experience. Appraisal success means that there is a potential commercial development. The consequences of developing the discovery are assessed with the use of the Monte Carlo technique. Key stochastic variables are the size of the discovery, the development costs, and oil and gas prices.

The time taken from initial exploration to first production has a significant effect on the full cycle returns when expressed in present

value terms. The returns also depend on the extent of the exploration and appraisal efforts required. In this study two scenarios were modelled reflecting the experience and performance of the industry over the past few years. For ready convenience these are termed the “fast” and “slow” cases. The phasing under the two cases is shown in Table 1.

Table 1

Phasing of Exploration, Appraisal and Development to First Production

	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>	T <sub>7</sub>
Fast	E <sub>1</sub>	-	A <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	P <sub>1</sub>		
Slow	E <sub>1</sub>	-	A <sub>1</sub>	A <sub>2</sub>	-	D <sub>1</sub>	D <sub>2</sub>	P <sub>1</sub>

The prospective returns obviously depend on the costs at the various stages of the cycle. It is assumed that the industry succeeds in its present cost reduction initiatives. After examining the experience to date in 2015 estimates of E and A well costs were derived at levels considerably below those of earlier years. The study examines the Southern North Sea (SNS), Central North Sea (CNS), Northern North Sea (NNS), and West of Shetlands/Scotland (W of S) separately. (The Irish Sea is not modelled because of the very low E and A activity there in recent years). For the SNS E and A costs per well were estimated at 50% of the average for the UKCS. For the W of S region the costs were estimated at 1.25 times the average for the UKCS. The values employed in the study are shown in Table 2 below for each of the four regions.

Development costs vary markedly across the four regions studied. Separate estimates were made for each region, again taking into account the reductions felt to be plausible from recent reported experiences. For modelling purposes development costs per barrel (or barrel of oil equivalent (boe)) were calculated. Accordingly, the average size of significant discovery in the period 2005-2014 was calculated. These are

16.4 million boe for the SNS, 39.1 million boe for the CNS, 16.5 million boe for the NNS, and 112.6 million for the W of S. The average development costs per boe after cost reductions were then found to be \$11.39 for the SNS, \$23.67 for the CNS, \$17.15 for the NNS, and \$11.52 for W of S. The absolute costs for W of S are higher than elsewhere but the larger volumes pull down the relative unit costs. Development costs were phased over 2 to 5 years depending on the size of discovery. Annual operating costs were modelled as a percentage of accumulated development costs with the percentage increasing as the size of field decreased, reflecting economies of scale.

The above figures are average costs and average field sizes. This study employs the Monte Carlo technique to reflect the uncertainties facing the explorationist and field developer. The average values noted above were made part of distributions of the stochastic variables which determine the range of returns facing the explorationist. The details of the input distributions obviously vary across each of the four regions, but have some common features. Thus the distribution of field sizes is taken to be lognormal with a standard deviation expressed as 50% of the mean. The distribution of development costs per boe is taken to be normal with a common standard deviation of 20% as a percentage of the mean value. The mean oil price was set at \$55 per barrel in real terms with the assumption that it follows a mean-reverting behaviour through time. The standard deviation was set at 20% of the mean. (Minimum and maximum values from the modelling were \$11 per barrel and \$99 per barrel respectively in real terms). The mean gas price was set at 40 pence per therm in real terms with a standard deviation of 10% of the mean. Mean-reverting behaviour is assumed. (The minimum value from the modelling was 24 pence and the maximum 56 pence, both in real terms).

Other modelling assumptions relate to exploration and appraisal success rates. Significant discoveries are defined as all those published by DECC plus others known to the authors covering the period 2008-2014 inclusive. Appraisal success covers all fields for which development has been started, firmly planned, or contemplated. This definition excludes discoveries for which no field development plan is currently contemplated.

Details of the modelling assumptions for the four regions are summarised below in Table 2. All financial values are in real terms.

Table 2  
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

The taxation system incorporated in the modelling reflects the changes instigated in 2015 including the investment allowance of 62.5% for Supplementary Charge (SC), and the reduction in the rate of SC to 20%. The effects of several further tax incentives are modelled. These are (1) the granting of eligibility of unsuccessful exploration costs for the investment allowance for Supplementary Charge, (2) a refundable tax credit for exploration to be paid to an investor who has no other current income against which to set his allowances, (3) the ability to offset the investment allowance against income other than that to which the new investment relates, and (4) the award of interest (as for the Ring Fence Expenditure Supplement) when the investment allowance, though eligible to be activated, cannot in practice be used because the income available

to the investor is insufficient to absorb the allowance. Two scenarios regarding the tax position of the investor are modelled. The first assumes that the investor is in an ongoing tax-paying position and is able to obtain tax relief on his exploration, appraisal and development expenditures against income from other fields. The second scenario assumes that the investor has no other income against which he can relieve his costs and so utilises the Ring Fence Expenditure Supplement (RFES) to obtain later relief against income from a future discovery. The RFES is assumed not to apply to the IA in the modelling.

### **3. Results**

#### **A. Investment Allowance Eligible for All Exploration Costs**

##### **(a) Investor in Tax-Paying Position, Fast Cycle Time**

###### **i. CNS**

The distribution of EMVs at 10% after the cost reductions for an investor in a tax-paying position and with the fast cycle time assumptions in the CNS is shown in Chart 1 (pre-tax) and Chart 2 (post-tax). There is a very wide range of outcomes, namely from –£104.24 million to +£124.33 million before tax, and –£40.15 million to +£86.12 million after tax. There is more than a 42% chance that the pre-tax EMV will be positive, and a 20% chance that it will exceed +£12.55 million. 68% of the pre-tax EMV distribution lies in the range -£21.76m. to +£15.63m. and 95% of the distribution lies in the range -£45.01m. to +£52.61m.. After tax there is a 37% chance that the EMV will be negative. There is a 30% chance that it will exceed +£8 million, and a 10% chance that it will exceed +£17.61 million. 68% of the post-tax EMV distribution lies in the range -£5.79m. to +£13.55m. and 95% of the distribution lies in the range -£16.99m. to +£34.62m.

In sum the prospect facing the investor is a negative but very small pre-tax mean expected EMV, a substantial chance of a loss, and very limited upside potential.

Chart 1  
 CNS - Ongoing (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Pre-Tax EMV @10% Statistics	
Trials	1000
Mean	-2.40
Median	-3.43
Standard Deviation	23.42
Variance	548.64
Skewness	0.62
Kurtosis	3.27
Coefficient of Variability	-9.74
Minimum	-104.24
Maximum	124.33
Range	228.57
Mean Standard Error	0.74
Trimmed Mean (98%)	-2.61

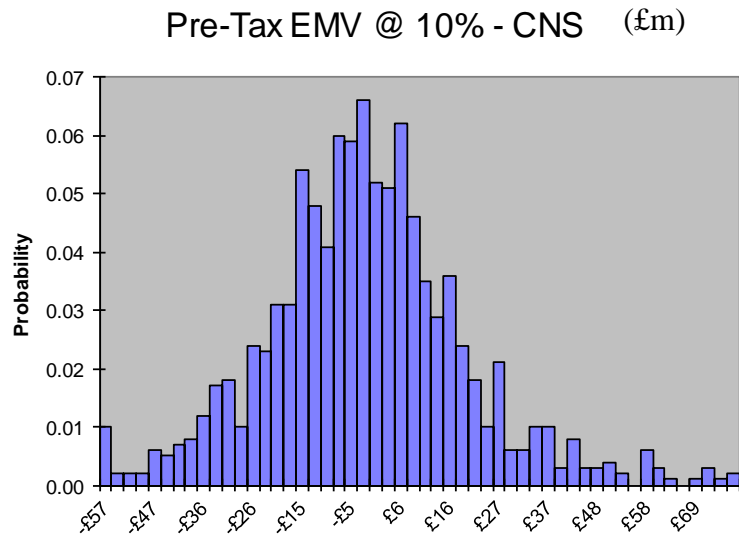
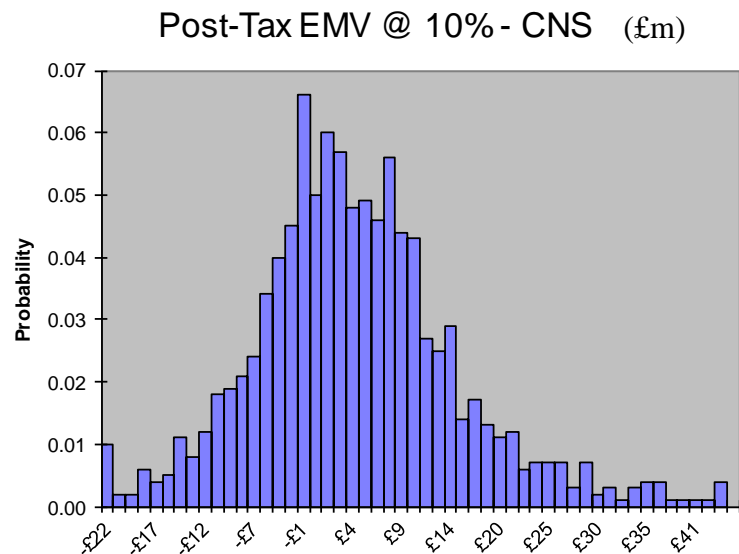


Chart 2

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	4.03
Median	2.78
Standard Deviation	12.26
Variance	150.41
Skewness	1.13
Kurtosis	4.67
Coefficient of Variability	3.04
Minimum	-40.15
Maximum	86.12
Range	126.27
Mean Standard Error	0.39
Trimmed Mean (98%)	3.82





i. NNS

In Charts 3 and 4 the prospective EMVs for the investor in the NNS after the cost reductions are shown before and after tax respectively. The mean values are just positive in both situations. There is a wide range of possible outcomes from a minimum of –£21.76 million to +£117.43 million before tax. There is a 66% chance that the EMV will be positive before tax, and a 20% chance that it will exceed +£15.07 million. 68% of the pre-tax EMV distribution lies in the range -£4.78m. to +£17.68m. and 95% of the distribution lies in the range -£11.58m. to +£41.6m. After tax there is an 81% chance that the EMV will be positive, and a 20% chance that it will exceed +£10.65 million. 68% of the post-tax EMV distribution lies in the range -£0.26m. to +£12.1m. and 95% of the distribution lies in the range -£3.16m. to +£24.23m.

In sum the prospect facing the investor is a positive but small mean expected EMV, a modest chance of a loss, and modest upside potential.

Chart 3

**NNS - Ongoing (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

Pre-Tax EMV @10% Statistics	
Trials	1000
Mean	6.68
Median	4.45
Standard Deviation	13.49
Variance	182.03
Skewness	1.81
Kurtosis	7.35
Coefficient of Variability	2.02
Minimum	-21.76
Maximum	117.43
Range	139.18
Mean Standard Error	0.43
Trimmed Mean (98%)	6.30

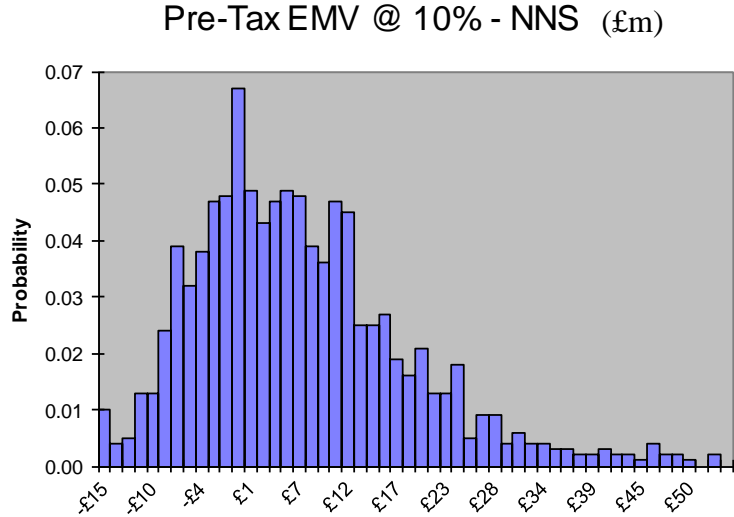
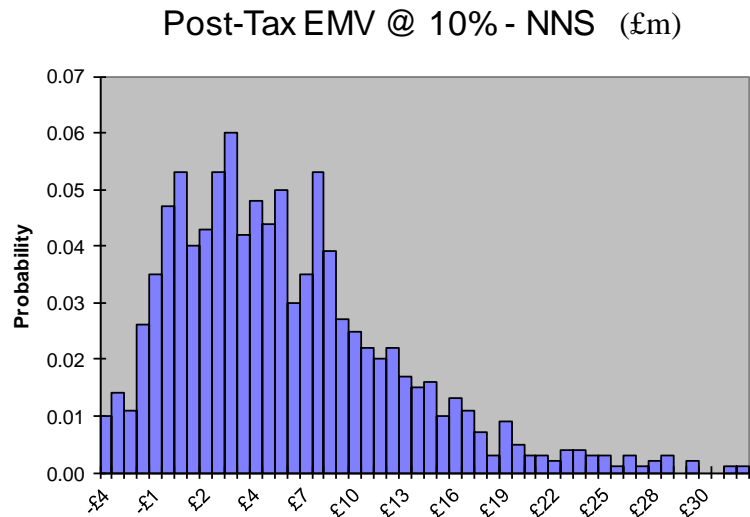


Chart 4

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	6.12
Median	4.90
Standard Deviation	7.31
Variance	53.49
Skewness	2.01
Kurtosis	9.17
Coefficient of Variability	1.19
Minimum	-7.18
Maximum	71.16
Range	78.34
Mean Standard Error	0.23
Trimmed Mean (98%)	5.89



ii. SNS

The distributions of EMVs for the investor in the SNS after cost reductions are shown in Chart 5 (pre-tax) and Chart 6 (post-tax). There is only a 5% chance that the pre-tax EMV will be negative, and a 20% chance that it will be more than +£7.96 million. 68% of the pre-tax EMV distribution lies in the range +£1.26m. to +£8.98m. and 95% of the distribution lies in the range -£0.58m. to +£16.36m. After tax there is only 1% chance that the EMV will be negative. However, there is only a 10% chance that the value will exceed +£6.6 million. 68% of the post-tax EMV distribution lies in the range +£1.39m. to +£5.56m. and 95% of the distribution lies in the range +£0.29m. to +£9.57m.

In sum the prospect facing the investor is a positive but modest mean expected EMV, a very low chance of a loss, and very limited upside potential.

Chart 5

**SNS - Ongoing (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

Pre-Tax EMV@10% Statistics	
Trials	1000
Mean	5.13
Median	4.22
Standard Deviation	4.36
Variance	19.00
Skewness	1.46
Kurtosis	3.30
Coefficient of Variability	0.85
Minimum	-2.30
Maximum	30.65
Range	32.95
Mean Standard Error	0.14
Trimmed Mean (98%)	5.01

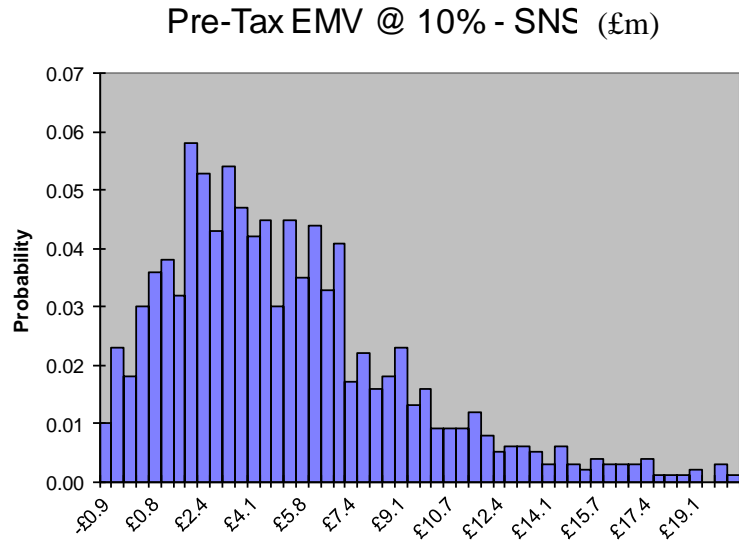
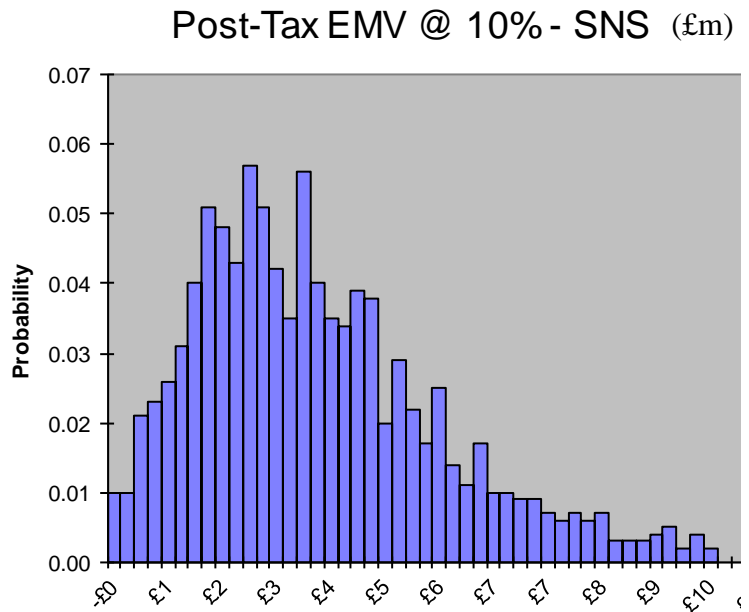


Chart 6

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	3.52
Median	3.10
Standard Deviation	2.43
Variance	5.91
Skewness	1.44
Kurtosis	3.31
Coefficient of Variability	0.69
Minimum	-0.44
Maximum	17.95
Range	18.39
Mean Standard Error	0.08
Trimmed Mean (98%)	3.46



iii. W of S

The distributions of EMVs for the investor in the W of S region after cost reductions are shown in Chart 7 (pre-tax) and Chart 8 (post-tax). It is seen that the mean values are substantially positive both before and after tax for the investor already in a tax-paying position. However, the spread of outcomes is extremely wide with a pre-tax minimum value of -£153.91 million and a maximum of +£1042.31 million. There is a 10% chance that the EMV will be negative and a 20% chance that it will exceed +£212.29 million before tax. 68% of the pre-tax EMV distribution lies in the range +£16.09m. to +£237.27m. and 95% of the distribution lies in the range -£54.63m. to +£452.22m. After tax the chance that the EMV will be negative is less than 5%, and there is a 20% chance that it will exceed +£127.58 million. 68% of the post-tax EMV distribution lies in the range +£21.97m. to +£140.44m. and 95% of the distribution lies in the range -£7.83m. to +£264.01m.

In sum the prospect facing the investor is a substantial positive mean expected EMV, a modest chance of a loss, and large upside potential. But investment costs are very high in this region.

Chart 7

WoS - Ongoing (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Pre-Tax EMV@10% Statistics	
Trials	1000
Mean	126.46
Median	101.08
Standard Deviation	126.47
Variance	15994.12
Skewness	1.40
Kurtosis	4.14
Coefficient of Variability	1.00
Minimum	-153.91
Maximum	1042.31
Range	1196.21
Mean Standard Error	4.00
Trimmed Mean (98%)	123.63

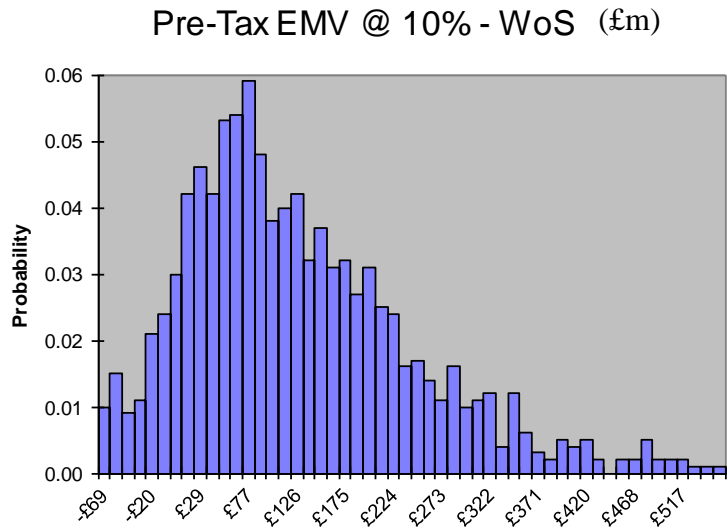
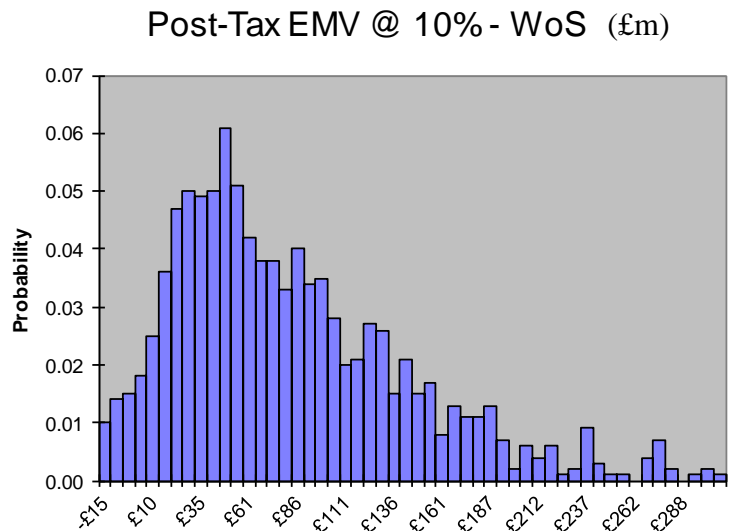


Chart 8

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	81.17
Median	65.61
Standard Deviation	67.88
Variance	4607.26
Skewness	1.55
Kurtosis	4.87
Coefficient of Variability	0.84
Minimum	-48.77
Maximum	604.11
Range	652.89
Mean Standard Error	2.15
Trimmed Mean (98%)	79.45



(b) Project Investor, Fast Cycle Time

i. CNS

The distribution of EMVs for the project investor after cost reductions is shown in Chart 9 (post-tax). Of course, pre-tax is as

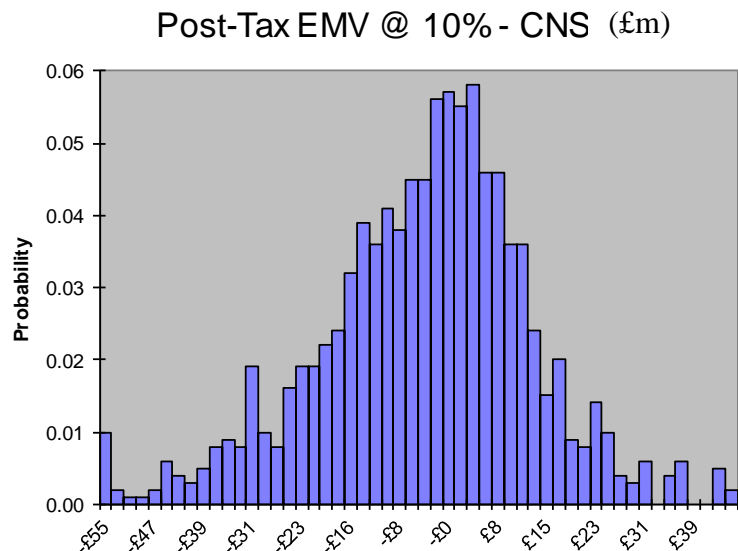
for the ongoing investor with cost reductions. The mean value is negative at -£4.58 million after tax. After tax the chance of a negative EMV is 59%, but there is a 30% chance that it will be greater than +£3.86 million. 68% of the post-tax EMV distribution lies in the range -£20.59m. to +£10.17m. and 95% of the distribution lies in the range -£43.24m. to +£30.79m.

With a deterministic system where all variables are as the mean values, the project investor with an oil find can write off his costs and take advantage of the RFES but he can only use 28% of the IA to which he is entitled. The project investor with a gas find can write off his costs but can only take advantage of 34% of the RFES and none of the IA to which he is entitled.

Chart 9

CNS - Project (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	-4.58
Median	-3.07
Standard Deviation	18.32
Variance	335.64
Skewness	-0.36
Kurtosis	2.56
Coefficient of Variability	-4.00
Minimum	-102.31
Maximum	73.01
Range	175.33
Mean Standard Error	0.58
Trimmed Mean (98%)	-4.48



In sum the prospect facing the investor is a negative mean expected EMV, a high chance of a loss, and modest upside potential.

ii. NNS

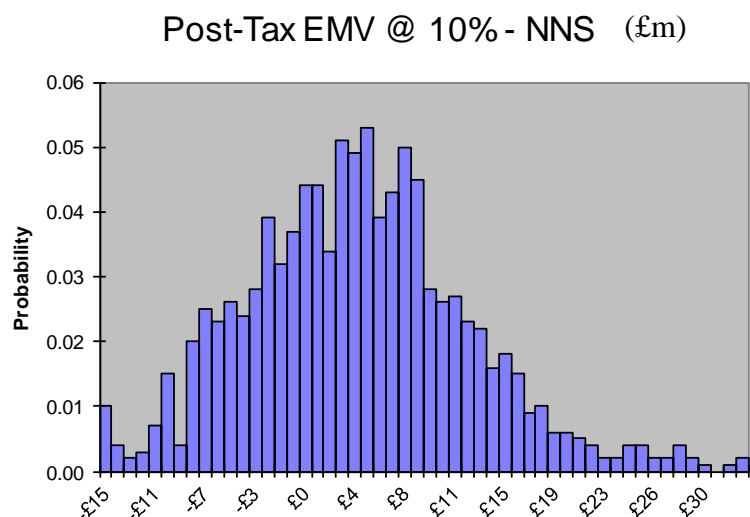
In the NNS the distribution of EMVs for the project investor is shown in Chart 10 (post-tax). The mean value is positive to a modest degree. After tax the chance of the EMV being negative is just over 33%, but there is a 20% chance that it will exceed +£10.18 million. 68% of the post-tax EMV distribution lies in the range -£4.4m. to +£11.76m. and 95% of the distribution lies in the range -£10.9m. to +£24.72m.

With a deterministic system where all variables are as the mean values, the project investor with an oil find can write off his costs and take advantage of the RFES, but he can only use 70% of the IA to which he is entitled. The project investor with a gas find can write off his costs but can only take advantage of 65% of the RFES, and he cannot use any of the IA to which he is entitled.

Chart 10

**NNS - Project (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	4.02
Median	3.63
Standard Deviation	8.98
Variance	80.67
Skewness	0.96
Kurtosis	3.82
Coefficient of Variability	2.23
Minimum	-20.92
Maximum	68.21
Range	89.12
Mean Standard Error	0.28
Trimmed Mean (98%)	3.86



In sum the prospect facing the investor is a positive but small mean expected EMV, a significant chance of a loss, and modest upside potential.



iii. SNS

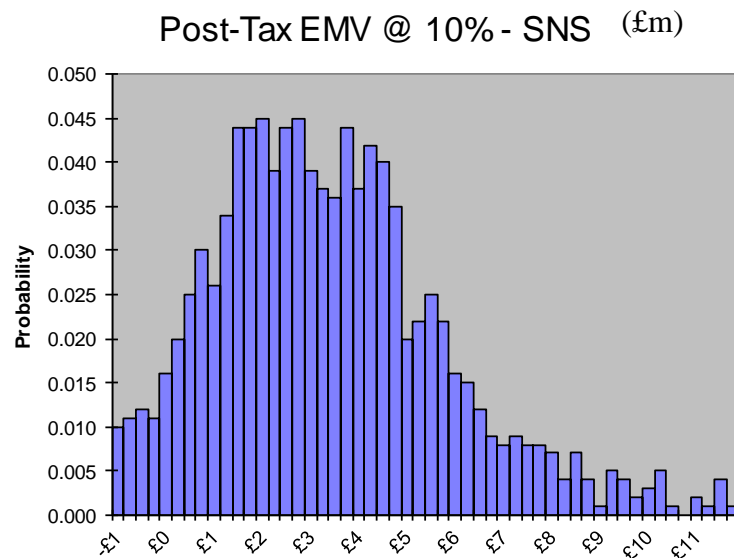
The distribution of EMVs at 10% for the project investor in the SNS is shown in Chart 11 (post-tax). The mean values are just negative before and after tax. After tax the chance of a negative EMV is 4%, and there is only a 10% chance of the value exceeding +£6.56 million. 68% of the post-tax EMV distribution lies in the range +£1.12m. to +£5.64m. and 95% of the distribution lies in the range -£0.51m. to +£9.72m.

With a deterministic system where all variables are as the mean values, the project investor can write off his costs, take advantage of the RFES and use 100% of the IA to which he is entitled.

Chart 11

SNS - Project (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	3.44
Median	3.11
Standard Deviation	2.53
Variance	6.39
Skewness	1.09
Kurtosis	2.34
Coefficient of Variability	0.74
Minimum	-2.16
Maximum	17.52
Range	19.68
Mean Standard Error	0.08
Trimmed Mean (98%)	3.38



In sum the prospect facing the investor is a positive but small mean expected EMV, a very low chance of a loss, and very small upside potential.

iv. W of S

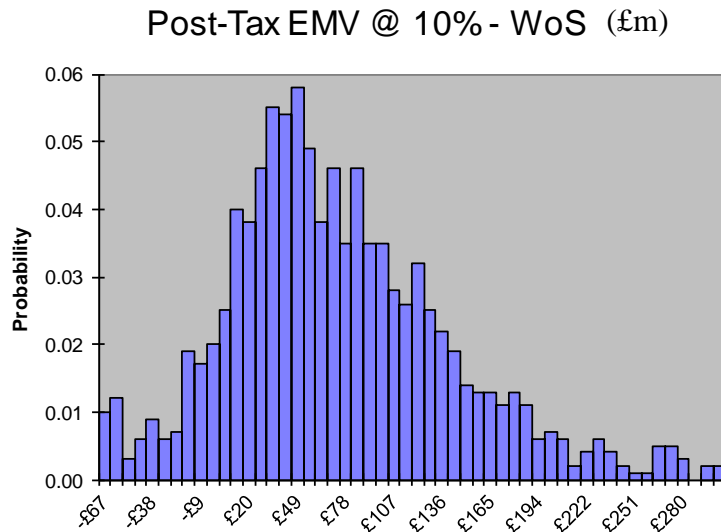
The distribution of EMVs for the project investor in the W of S region is shown in Chart 12 (post-tax). The mean value is healthily positive at £71.82 million after tax. After tax there is an 11% chance that the EMV will be negative, a 30% chance that it will exceed +£97.02 million, and a 10% chance that it will exceed +£163.61 million. 68% of the post-tax EMV distribution lies in the range +£10.11m. to +£134.73m., and 95% of the distribution lies in the range -£52.24m. to +£253.67m.

With a deterministic system where all variables are as the mean values, the project investor with an oil find can write off his costs, take advantage of the RFES and use 100% of the IA to which he is entitled. The project investor with a gas find can write off his costs but can only take advantage of 68% of the RFES, and he cannot use any of the IA to which he is entitled.

Chart 12

WoS - Project (Fast) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	71.82
Median	60.26
Standard Deviation	73.05
Variance	5336.22
Skewness	1.02
Kurtosis	3.26
Coefficient of Variability	1.02
Minimum	-149.83
Maximum	571.94
Range	721.77
Mean Standard Error	2.31
Trimmed Mean (98%)	70.79



In sum the prospect facing the investor is a substantial mean expected EMV, a modest chance of a loss, and large upside potential. But the investment costs are very high.

B. Tax Credit for Exploration

(a) Project Investor, Fast Cycle Time

i. CNS

The distribution of EMVs at 10% to an investor who has no tax capacity at the time of the investment and receives an exploration tax credit is shown in Chart 13 (post-tax). (The pre-tax is, of course unchanged). After tax the spread is from -£100.32 million to +£73.16 million. There is a greater than 56% chance that the EMV will be negative, and a 30% chance that the value will be -£10.09 million or worse. There is just over a 17% chance that the EMV will exceed +£10 million. 68% of the post-tax EMV distribution lies in the range -£18.59m. to +£10.11m., and 95% of the distribution lies in the range -£41.25m. to +£30.52m.

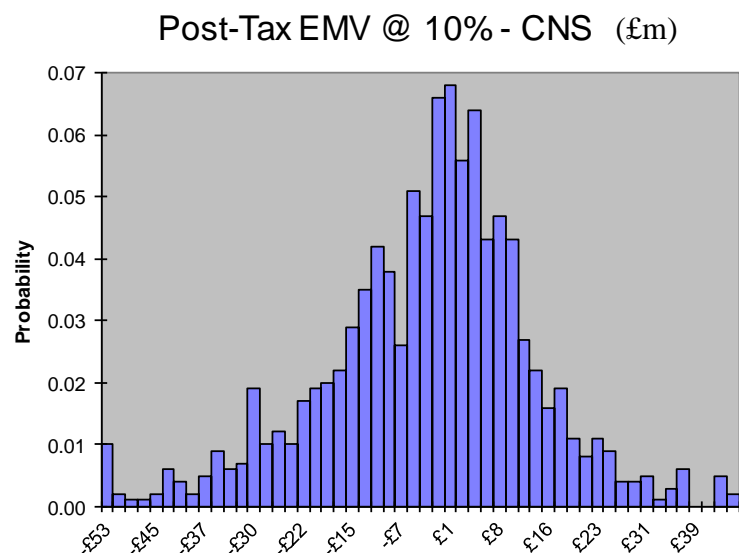
With a deterministic system, where all variables are as the mean values, with a tax credit, the project investor with an oil find can write off his costs and take advantage of the RFES (which is reduced with the credit), but he can only use 42% of the IA to which he is entitled. The project investor with a gas find and tax credit can write off his costs but can only take advantage of 47% of the (reduced) RFES and he cannot use any of the IA to which he is entitled.

In sum the prospect facing the investor is a negative mean expected EMV, a high chance of a loss, and limited upside potential.

Chart 13

CNS - Project (Fast) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	-3.51
Median	-1.89
Standard Deviation	17.61
Variance	309.94
Skewness	-0.42
Kurtosis	2.98
Coefficient of Variability	-5.02
Minimum	-100.32
Maximum	73.16
Range	173.47
Mean Standard Error	0.56
Trimmed Mean (98%)	-3.40



ii. NNS

The distribution of EMVs at 10% to a project investor in the NNS with the tax credit and reduced costs is shown in Chart 14 (post-

tax). The chance of a negative EMV is 26%, but there is only a 10% chance that the value could be +£14.05 million or better. 68% of the post-tax EMV distribution lies in the range -£2.17m. to +£11.25m., and 95% of the distribution lies in the range -£8.43m. to +£23.87m.

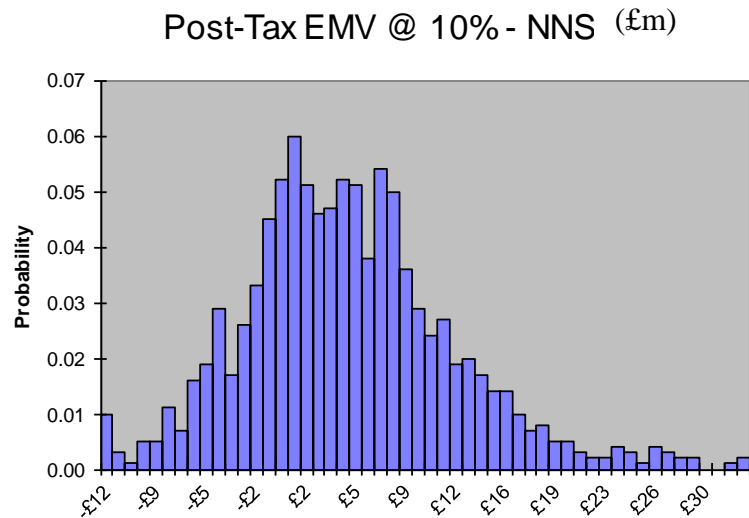
With a deterministic system where all variables are as the mean values and a tax credit, the project investor with an oil discovery can write off his costs and take advantage of the RFES (which is reduced with the credit) and use all of the IA to which he is entitled. The project investor with a gas find and a tax credit can write off his costs and take advantage of the (reduced) RFES, but he can only use 12% of the IA to which he is entitled.

In sum the prospect facing the investor is a positive but small mean expected EMV, significant chance of a loss, and modest upside potential.

Chart 14

NNS - Project (Fast) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	4.67
Median	3.93
Standard Deviation	8.09
Variance	65.49
Skewness	1.29
Kurtosis	5.65
Coefficient of Variability	1.73
Minimum	-18.45
Maximum	67.82
Range	86.27
Mean Standard Error	0.26
Trimmed Mean (98%)	4.51



iii. SNS

The distribution of EMVs to a project investor in the SNS with a tax credit and reduced costs is shown in Chart 15 (post-tax). In this case the chance of a negative EMV is only 3% after tax. 68% of the post-tax EMV distribution lies in the range +£1.21m. to +£5.41m., and 95% of the distribution lies in the range -£0.04m. to +£9.52m. These are very modest values.

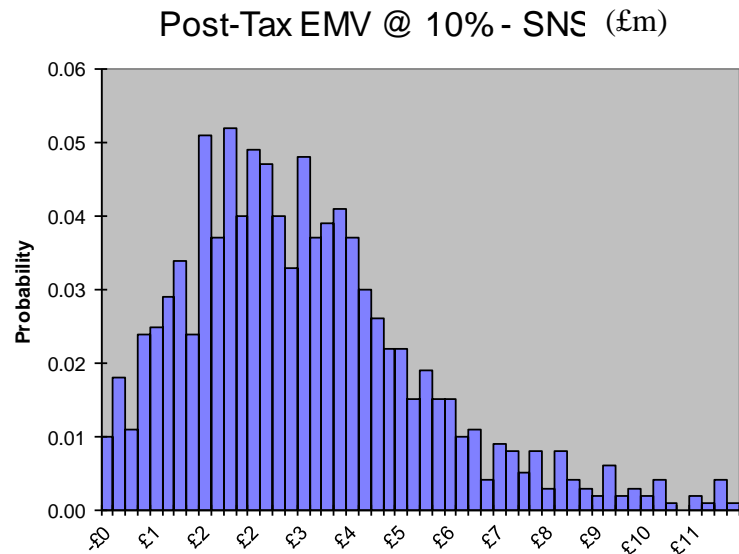
With a deterministic system where all variables are as the mean values with the tax credit the project investor can write off his costs, take advantage of the (reduced) RFES and use 100% of the IA to which he is entitled.

In sum the prospect facing the investor is a positive but very small mean expected EMV, a low chance of a loss, and very limited upside potential.

Chart 15

SNS - Project (Fast) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	3.38
Median	2.99
Standard Deviation	2.40
Variance	5.77
Skewness	1.30
Kurtosis	2.93
Coefficient of Variability	0.71
Minimum	-1.41
Maximum	17.36
Range	18.77
Mean Standard Error	0.08
Trimmed Mean (98%)	3.32



iv. W of S

The distribution of EMVs for a project investor in the W of S region with the tax credit and reduced costs is shown in Chart 16 (post-tax). There is a 10% chance that the EMV will be negative. There is a 20% chance that the EMV could be +£121.65 million or better, and a 10% chance that it could be +£163.22 million or better. 68% of the post-tax EMV distribution lies in the range +£11.15m. to +£134.27m., and 95% of the distribution lies in the range -£47.96m. to +£249.25m.

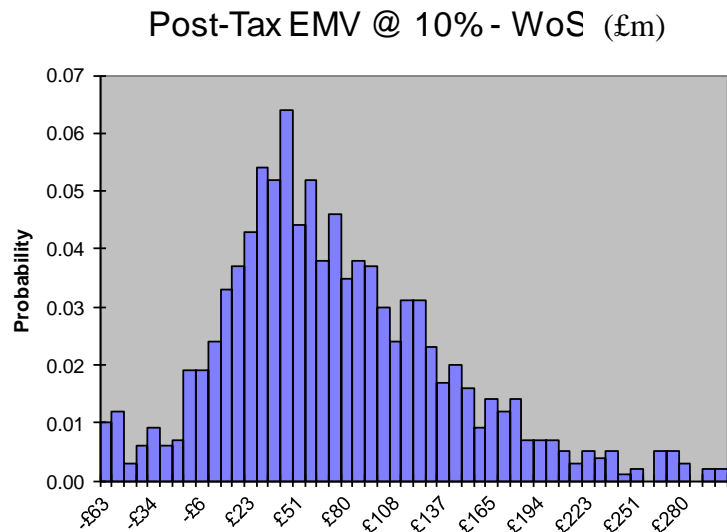
With a deterministic system where all variables are as the mean values, the project investor with an oil find and a tax credit for exploration can write off his costs, take advantage of the RFES, and use 100% of the IA to which he is entitled. The project investor with a gas find and a tax credit can write off his costs and take advantage of the (reduced) RFES, but he can only use 79% of the IA to which he is entitled.

In sum the prospect facing the investor is a substantial mean expected EMV, modest chance of a loss, and high upside potential. But investment costs are also very high.

Chart 16

WoS - Project (Fast) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	71.92
Median	59.84
Standard Deviation	72.11
Variance	5200.51
Skewness	1.08
Kurtosis	3.42
Coefficient of Variability	1.00
Minimum	-145.54
Maximum	571.36
Range	716.90
Mean Standard Error	2.28
Trimmed Mean (98%)	70.86



### C. Investment Allowance Limited to Successful Exploration

#### (a) Investor in Tax-Paying Position, Fast Cycle Time

##### i. CNS

In Chart 17 the post-tax EMVs at 10% real discount rate is shown when the IA for exploration is limited by the exploration success rate and costs are reduced. This is the current tax position. The chance of a negative post-tax EMV is 38%. There is only a 7% chance that the EMV will exceed +£20 million after tax. 68% of the post-tax EMV distribution lies in the range -£5.87m. to +£13.43m., and 95% of the distribution lies in the range -£16.99m. to +£34.51m.

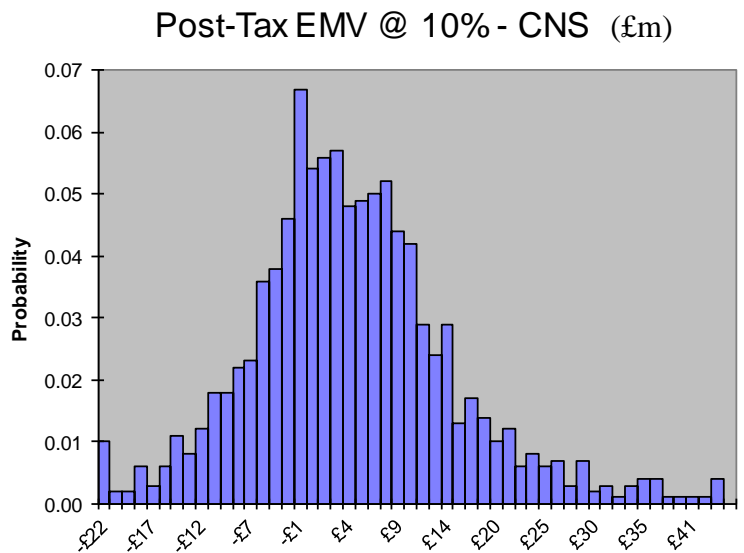


In sum, the prospect facing the investor is a positive but small mean expected EMV, a substantial risk of a loss, and modest upside potential.

Chart 17

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

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	3.95
Median	2.69
Standard Deviation	12.24
Variance	149.72
Skewness	1.14
Kurtosis	4.71
Coefficient of Variability	3.10
Minimum	-40.15
Maximum	86.02
Range	126.17
Mean Standard Error	0.39
Trimmed Mean (98%)	3.74



ii. NNS

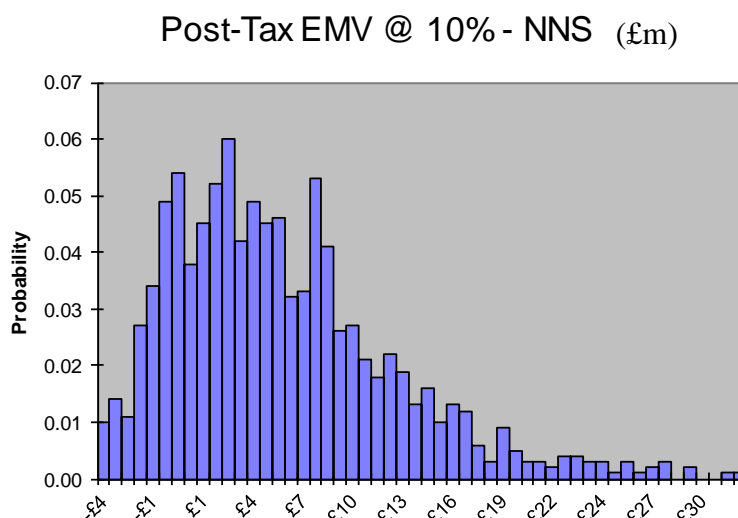
When the key risks are included, the IA for exploration is restricted, and costs are reduced, the distribution of EMVs at 10% is shown in Chart 18 (post-tax). There is a 19% chance that the EMV will be negative. 68% of the post-tax EMV distribution lies in the range -£0.4m. to +£11.94m., and 95% of the distribution lies in the range -£3.27m. to +£24.07m.

In sum, the prospect facing the investor is a positive but small mean expected EMV, a modest chance of a loss, and modest upside potential.

Chart 18

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

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	5.98
Median	4.75
Standard Deviation	7.31
Variance	53.39
Skewness	2.02
Kurtosis	9.21
Coefficient of Variability	1.22
Minimum	-7.26
Maximum	71.02
Range	78.28
Mean Standard Error	0.23
Trimmed Mean (98%)	5.74



iii. SNS

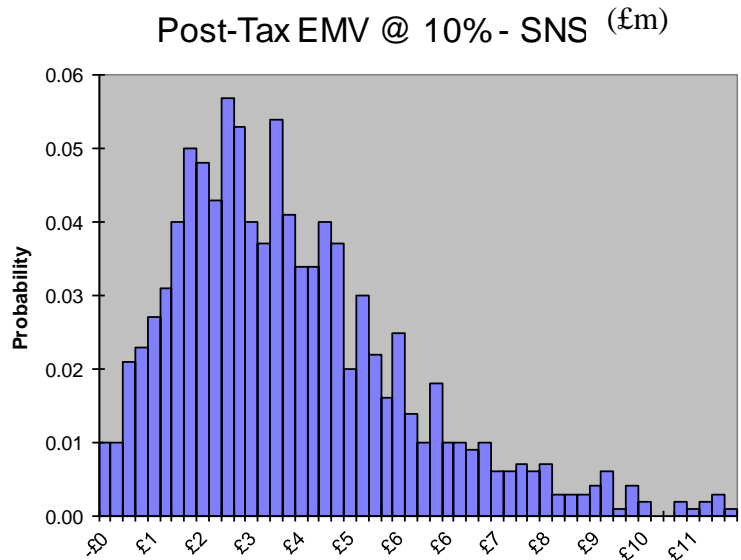
When the key risks are considered, the IA for exploration is restricted, and costs are reduced, the post-tax distribution of EMVs is shown in Chart 19. The chance of a negative EMV is only 1%. 68% of the post-tax EMV distribution lies in the range +£1.33m. to +£5.51m., and 95% of the distribution lies in the range +£0.24m. to +£9.52m.

In sum, the prospect facing the investor is for a positive but modest mean expected EMV, a very small chance of a loss, and very limited upside potential.

Chart 19

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

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	3.47
Median	3.04
Standard Deviation	2.43
Variance	5.92
Skewness	1.44
Kurtosis	3.31
Coefficient of Variability	0.70
Minimum	-0.49
Maximum	17.90
Range	18.39
Mean Standard Error	0.08
Trimmed Mean (98%)	3.41



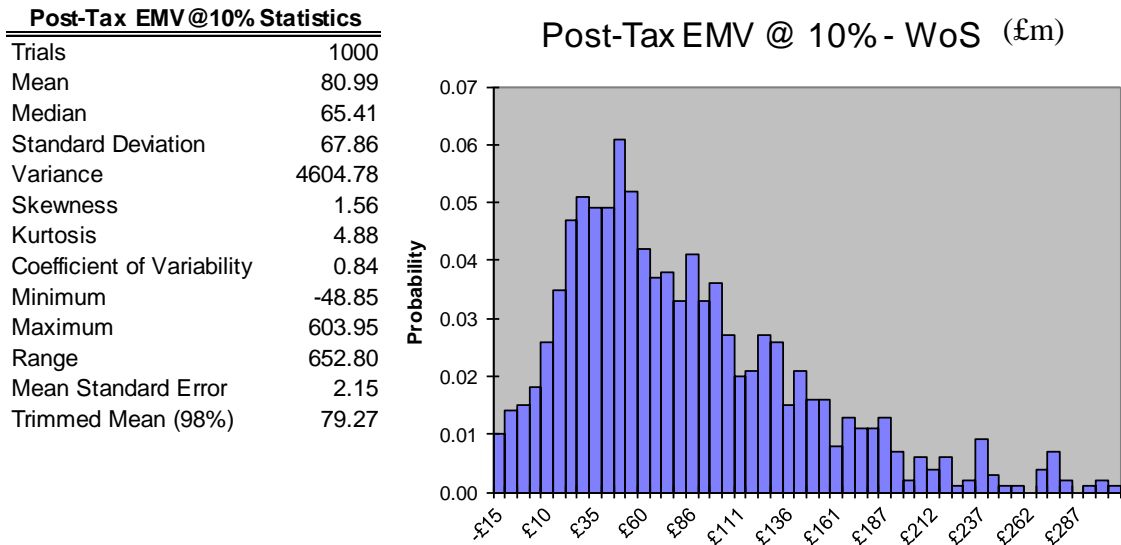
iv. W of S

When the key risks are taken into account, the IA for exploration is restricted, and costs are reduced, the post-tax distribution of EMVs at 10% is shown in Chart 20. The chance of a negative EMV is 4%. There is a 30% chance that the EMV could exceed +£100 million. 68% of the post-tax EMV distribution lies in the range +£21.81m. to +£140.25m., and 95% of the distribution lies in the range -£7.95m. to +£263.8m.

In sum, the prospect facing the investor is a large mean expected EMV, small chance of a loss, and substantial upside potential. But investment costs are very high.

Chart 20

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



(b) Project Investor, Fast Cycle Time

i. CNS

The distribution of EMVs at 10% to an investor who has no tax capacity at the time of the investment, restricted IA for exploration, and reduced costs is shown in Chart 21 (post-tax). The spread is from -£102.31 million to +£72.96 million. There is a more than 58% chance that the EMV will be negative, with a 30% chance that the value will be -£11.99 million or worse. There is only a 16% chance that the EMV will exceed +£10 million. 68% of the post-tax EMV distribution lies in the range -£20.59m. to +£10.1m., and 95% of the distribution lies in the range -£43.24m. to +£30.69m.

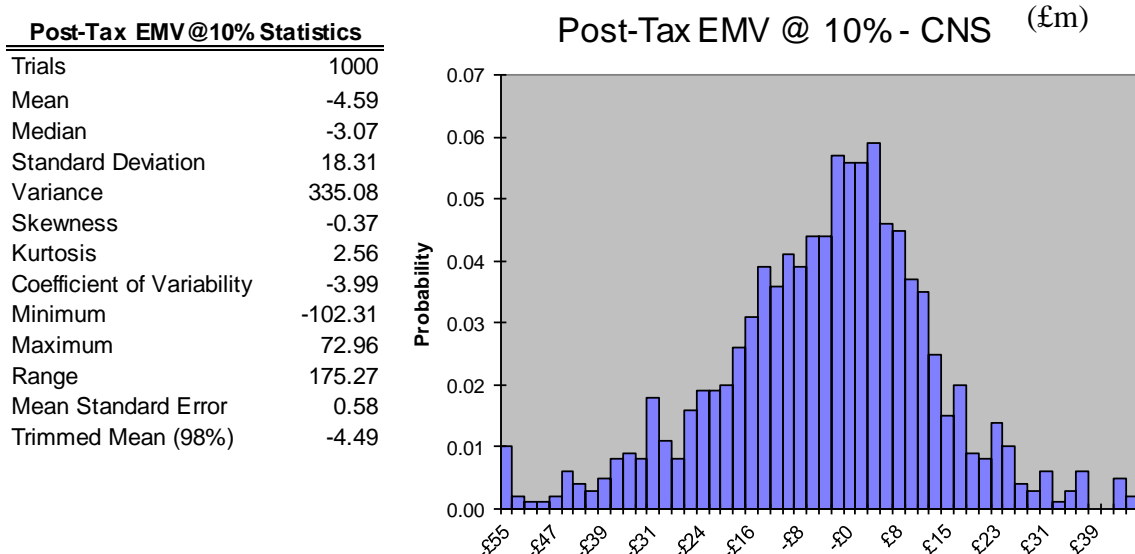
With a deterministic system where all variables are as the mean values with limited IA the project investor with an oil find can write off his costs and take advantage of the RFES, but he can only use 29% of the IA to which he is entitled. The project investor with a gas find can write off his costs, but can only take advantage

of 34% of the RFES, and he cannot use any of the IA to which he is entitled.

In sum the prospect facing the investor is a small negative mean expected EMV, large chance of a loss, and limited upside potential

Chart 21

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



ii. NNS

The distribution of EMVs at 10% to a project investor in the NNS with restricted IA for exploration and reduced costs is shown in Chart 22 (post-tax). The chance of a negative EMV is 33%, and there is only a 10% chance that the value could be +£14.43 million or better. 68% of the post-tax EMV distribution lies in the range -£4.4m. to +£11.68m., and 95% of the distribution lies in the range -£10.9m. to +£24.62m.

With a deterministic system where all variables are as the mean values, with restricted IA, the project investor with an oil find can

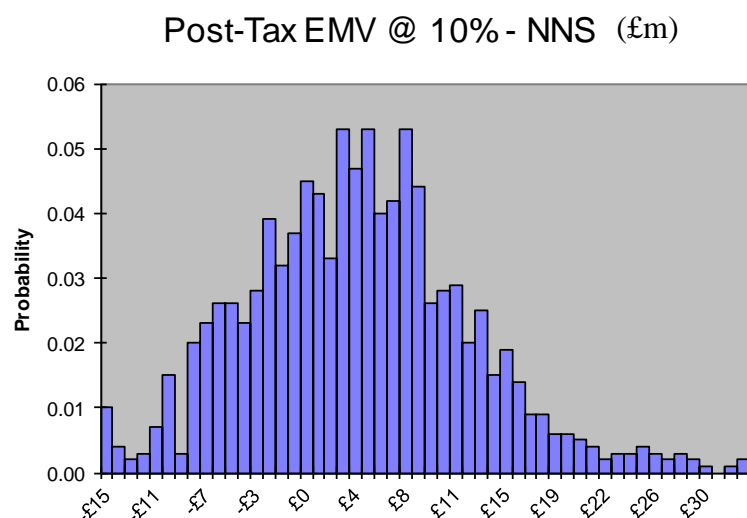
write off his costs and take advantage of the RFES, but he can only use a 75% of the IA to which he is entitled. The project investor with a gas find can write off his costs and take advantage of 65% of the RFES, but he cannot use any of the IA to which he is entitled.

In sum the prospect facing the investor is a positive but small mean expected EMV, substantial risk of a loss, and limited upside potential.

Chart 22

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



iii. SNS

The distribution of EMVs to a project investor in the SNS with restricted IA for exploration and reduced costs is shown in Chart 23 (post-tax). The chance of a negative EMV is only 4%. 68% of the post-tax EMV distribution lies in the range +£1.12m. to +£5.6m., and 95% of the distribution lies in the range -£0.51m. to +£9.68m.

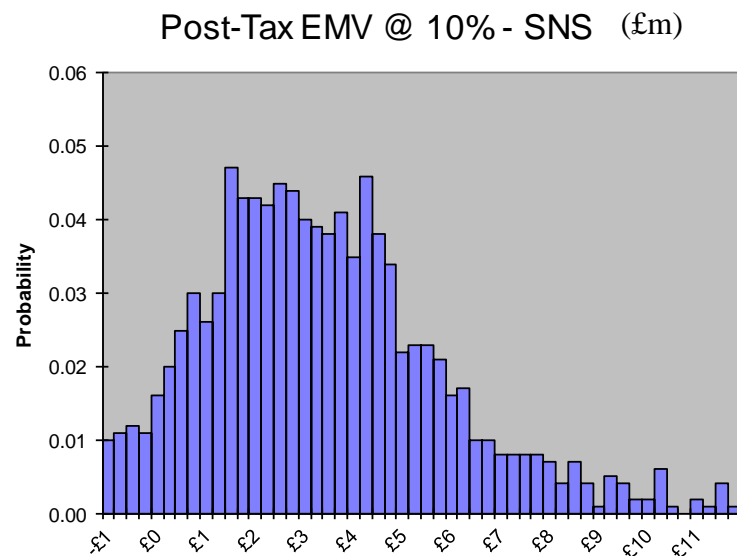
With a deterministic system where all variables are as the mean values the project investor can write off his costs, take advantage of the RFES, and use 100% of the IA to which he is entitled.

In sum, the prospect facing the investor is a positive but small mean expected EMV, low chance of a loss, and very limited upside potential.

Chart 23

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



iv. W of S

The distribution of EMVs for a project investor in the W of S region with restricted IA for exploration and reduced costs is shown in Chart 24 (post-tax). There is an 11% chance that the EMV will be negative, and a 20% chance that the value could be +£17.31 million or worse. There is a 10% chance that the EMV could +£163.45 million or better. 68% of the post-tax EMV distribution lies in the range +£10.11m. to +£134.64m., and 95% of the distribution lies in the range -£52.24m. to +£253.51m.

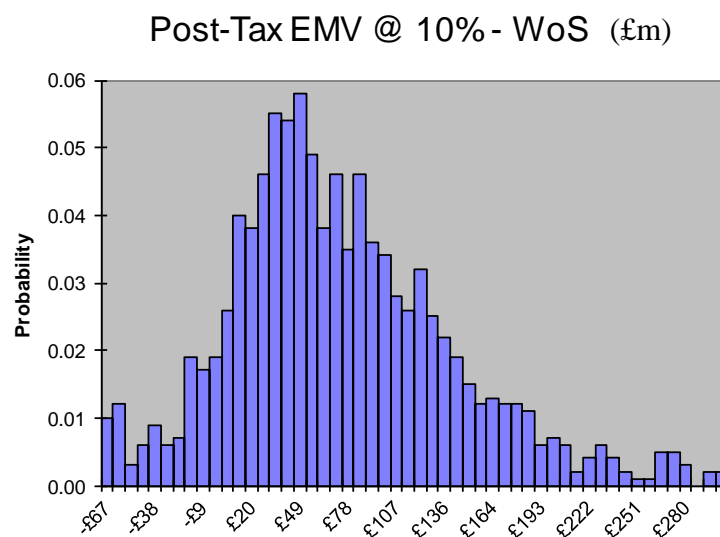
With a deterministic system where all variables are as the mean values the project investor with an oil find can write off his costs, take advantage of the RFES and use 100% of the IA to which he is entitled. The project investor with a gas find can write off his costs, but can only take advantage of 69% of the RFES, and he cannot use any of the IA to which he is entitled.

In sum, the prospect facing the investor is a substantial mean expected EMV, modest chance of a loss, and large upside potential. But investment costs are very high.

Chart 24

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





## D. Immediate Relief for Investment Allowance

### (a) Investor in Tax-Paying Position, Fast Cycle Time

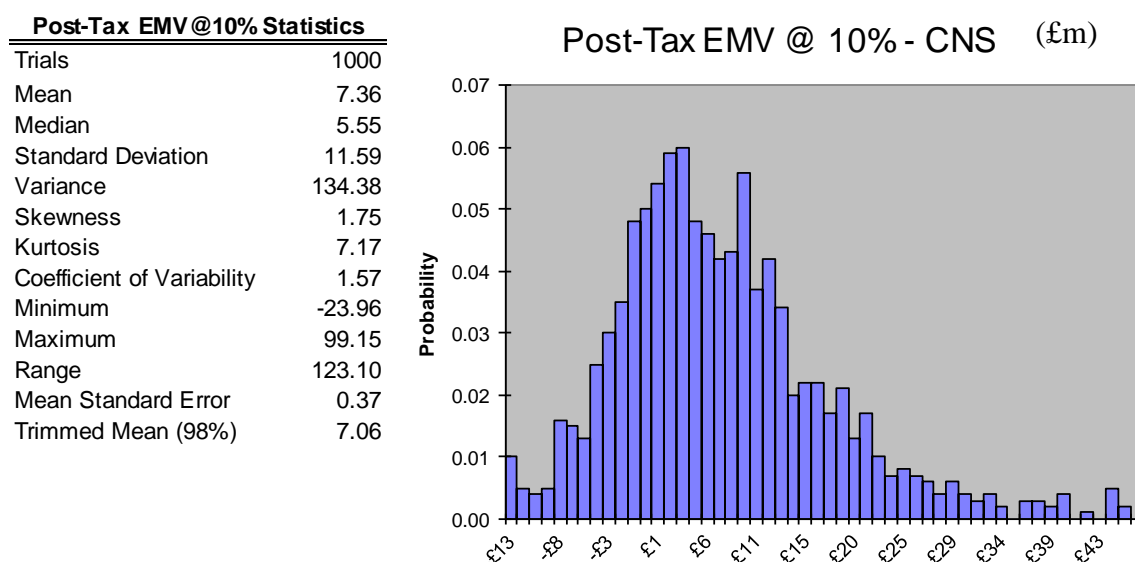
#### i. CNS

In Chart 25 the post-tax EMVs at 10% real discount rate with immediate relief for IA and reduced costs are shown. The chance of a negative post-tax EMV is 24%. There is a 10% chance that the EMV will exceed +£20 million. 68% of the post-tax EMV distribution lies in the range -£2.07m. to +£16.51m., and 95% of the distribution lies in the range -£8.99m. to +£36.84m.

In sum the prospect facing the investor is a positive but small mean expected EMV, significant downside risks, and modest upside potential.

Chart 25

CNS - Ongoing (Fast Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction



#### ii. NNS

When the key risks are included and there is immediate relief for IA and reduced costs the distribution of EMVs at 10% is shown in Chart 26 (post-tax) for the explorer in the NNS. There is an 8%

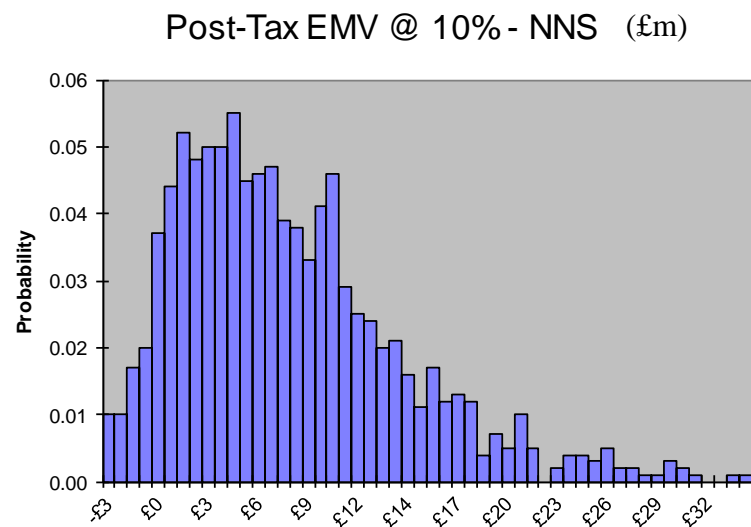
chance that the EMV will be negative. 68% of the post-tax EMV distribution lies in the range +£1.05m. to +£13.58m., and 95% of the distribution lies in the range -£1.77m. to +£25.78m.

In sum, the mean expected post-tax EMV is positive but modest, the downside risk is low, and the upside potential moderate.

Chart 26

NNS - Ongoing (Fast Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	7.53
Median	6.09
Standard Deviation	7.40
Variance	54.76
Skewness	2.07
Kurtosis	9.70
Coefficient of Variability	0.98
Minimum	-4.42
Maximum	74.69
Range	79.11
Mean Standard Error	0.23
Trimmed Mean (98%)	7.28



### iii. SNS

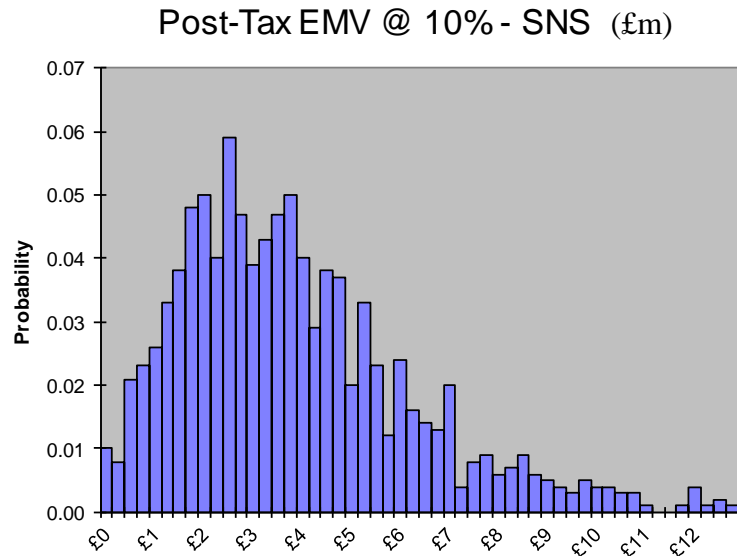
When the key risks are considered and relief is given for IA immediately and costs are reduced the post-tax distribution of EMVs is shown in Chart 27 for the explorer in the SNS. The chance of a negative EMV is less than 1%. 68% of the post-tax EMV distribution lies in the range +£1.73m. to +£6.11m., and 95% of the distribution lies in the range +£0.6m. to +£10.14m.

In sum, the mean expected post-tax EMV is just positive, the downside risk is low, and the upside potential modest.

Chart 27

SNS - Ongoing (Fast Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @ 10% Statistics	
Trials	1000
Mean	3.96
Median	3.51
Standard Deviation	2.51
Variance	6.30
Skewness	1.42
Kurtosis	3.21
Coefficient of Variability	0.63
Minimum	-0.11
Maximum	18.79
Range	18.90
Mean Standard Error	0.08
Trimmed Mean (98%)	3.89



iv. W of S

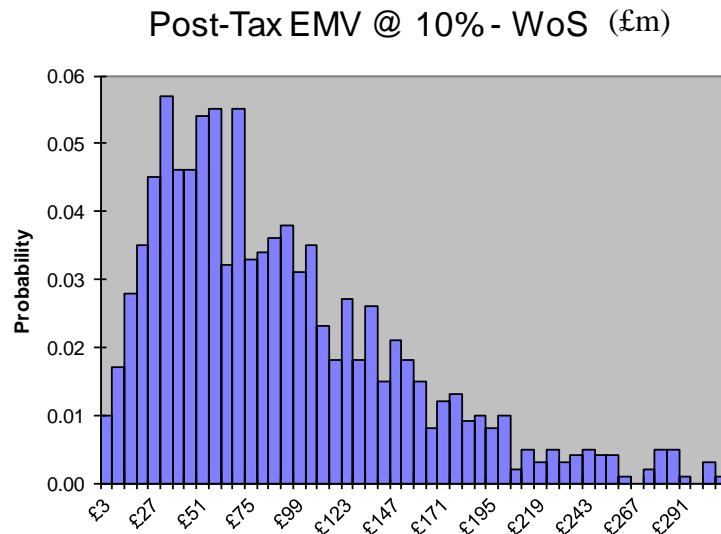
When the key risks are taken into account, relief for IA is immediate, and costs are reduced the post-tax distribution of EMVs at 10% is shown in Chart 28 for the explorer in W of S. The chance of a negative EMV is less than 1%. There is a 33% chance that the EMV could exceed +£100 million. 68% of the post-tax EMV distribution lies in the range +£29.65m. to +£148.2m., and 95% of the distribution lies in the range +£8.45m. to +£268.59m.

In sum, the mean expected post-tax EMV is very substantially positive, and there is a large upside potential. But the investment costs are very large.

Chart 28

WoS - Ongoing (Fast Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	89.03
Median	71.88
Standard Deviation	67.56
Variance	4563.84
Skewness	1.74
Kurtosis	6.11
Coefficient of Variability	0.76
Minimum	-14.17
Maximum	648.19
Range	662.36
Mean Standard Error	2.14
Trimmed Mean (98%)	87.09



#### E. Interest on Unutilised IA from time of Eligibility for Activation

##### (a) Project Investor, Fast Cycle Time

##### i. CNS

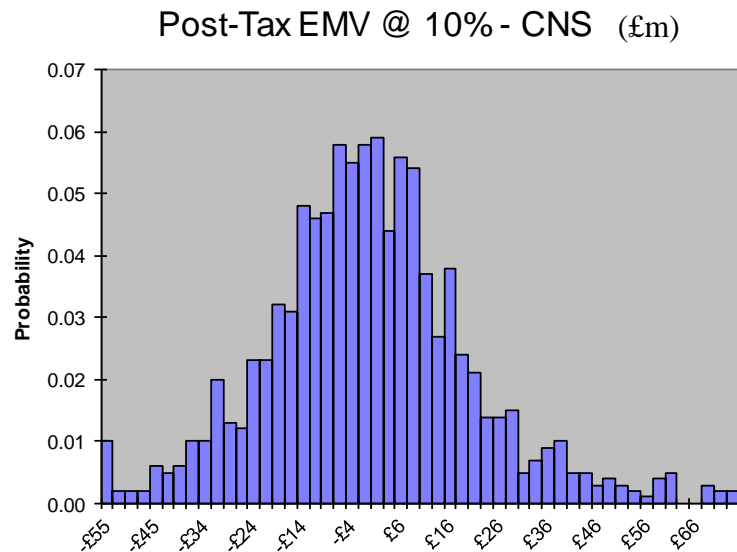
The distribution of EMVs at 10% to an investor who has no tax capacity at the time of the investment and interest is given on unutilised IA at the RFES rate, is shown in Chart 29 (post-tax). There is a more than 56% chance that the EMV will be negative, with a 30% chance that the value will be  $-\text{£}11.94$  million or worse. There is only a 24% chance that the EMV will exceed  $+\text{£}10$  million. 68% of the post-tax EMV distribution lies in the range  $-\text{£}20.59\text{m.}$  to  $+\text{£}16.58\text{m.}$ , and 95% of the distribution lies in the range  $-\text{£}43.24\text{m.}$  to  $+\text{£}53.466\text{m.}$

In sum, the mean expected post-tax EMV is just negative, there is substantial downside risk, but also substantial upside potential.

Chart 29

CNS - Project (Fast Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @ 10% Statistics	
Trials	1000
Mean	-1.40
Median	-2.58
Standard Deviation	23.10
Variance	533.74
Skewness	0.63
Kurtosis	3.20
Coefficient of Variability	-16.54
Minimum	-102.31
Maximum	126.22
Range	228.54
Mean Standard Error	0.73
Trimmed Mean (98%)	-1.60



ii. NNS

The distribution of EMVs at 10% to a project investor in the NNS when interest is given on unutilised IA and costs are reduced is shown in Chart 30 (post-tax). The chance of a negative EMV is 35%, and there is only a 10% chance that the value could be +£23.35 million or better. 68% of the post-tax EMV distribution lies in the range -£4.4m. to +£18.19m., and 95% of the distribution lies in the range -£10.9m. to +£41m.

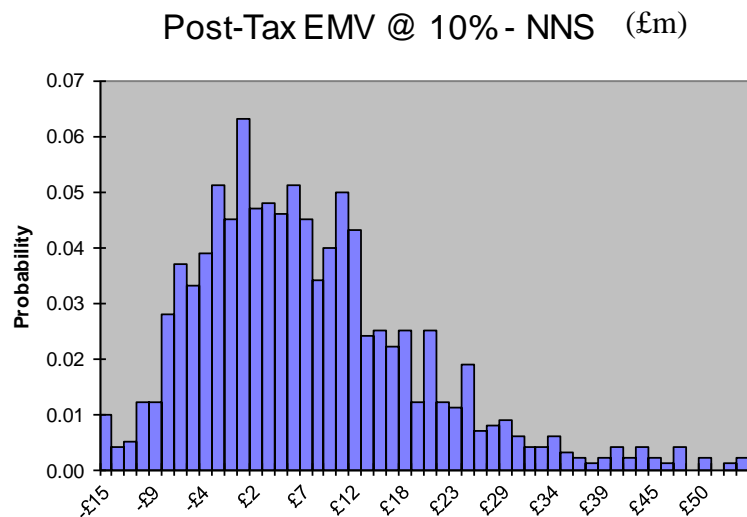
When interest is given on unused IA, the project investor with an oil find can write off his costs, but can only use 5% of his RFES, and cannot use any of the IA to which he is entitled. With a gas find and interest on unused IA the project investor can write off his costs, but he can only use 2% of his RFES and none of the IA to which he is entitled.

In sum, the mean expected post-tax EMV is modest, the downside risks are noteworthy, and the upside potential modest.

Chart 30

NNS - Project (Fast Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	7.13
Median	4.93
Standard Deviation	13.39
Variance	179.25
Skewness	1.77
Kurtosis	7.28
Coefficient of Variability	1.88
Minimum	-20.92
Maximum	119.30
Range	140.22
Mean Standard Error	0.42
Trimmed Mean (98%)	6.76



### iii. SNS

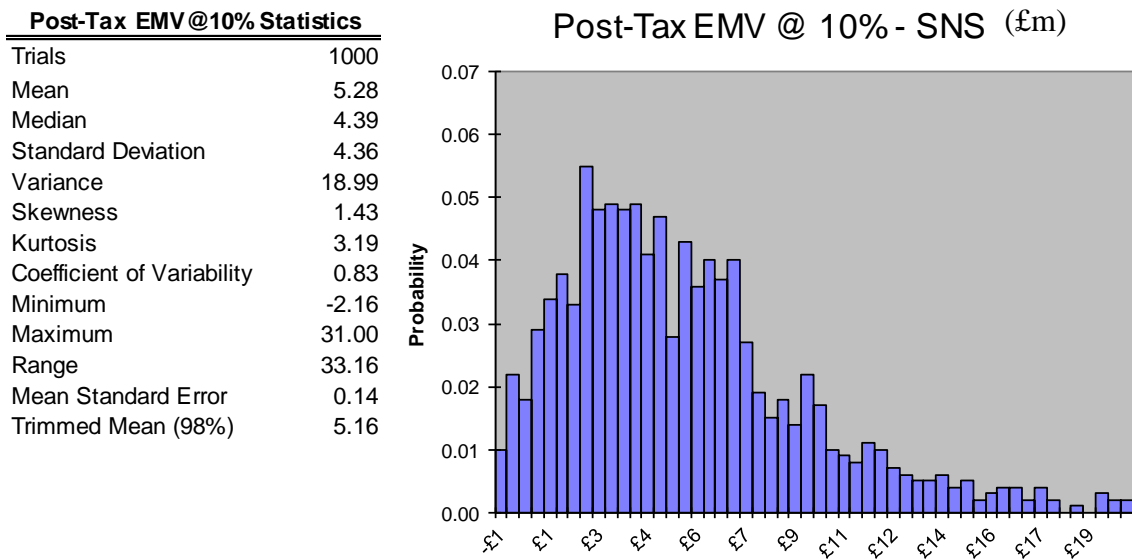
The distribution of EMVs to a project investor in the SNS when interest is given on IA and costs are reduced is shown in Chart 31 (post-tax). The chance of a negative EMV is 4%. 68% of the post-tax EMV distribution lies in the range +£1.39m. to +£9.18m., and 95% of the distribution lies in the range -£0.51m. to +£16.45m.

With interest on unused IA the project investor can write off his costs but he can only use 6% of his RFES and none of the IA to which he is entitled.

In sum, the post-tax expected EMV is positive but small, the downside risks are modest, and the upside potential modest.

Chart 31

SNS - Project (Fast Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction



iv. W of S

The distribution of EMVs for a project investor in the W of S region with interest on IA and reduced costs is shown in Chart 32 (post-tax). There is a 10% chance that the EMV will be negative. There is a more than 50% chance that the EMV could be +£100 million or better, and a 10% chance that it could be +£265.93 million or better. 68% of the post-tax EMV distribution lies in the range +£17.98m. to +£219.9m., and 95% of the distribution lies in the range -£52.24m. to +£385.18m.

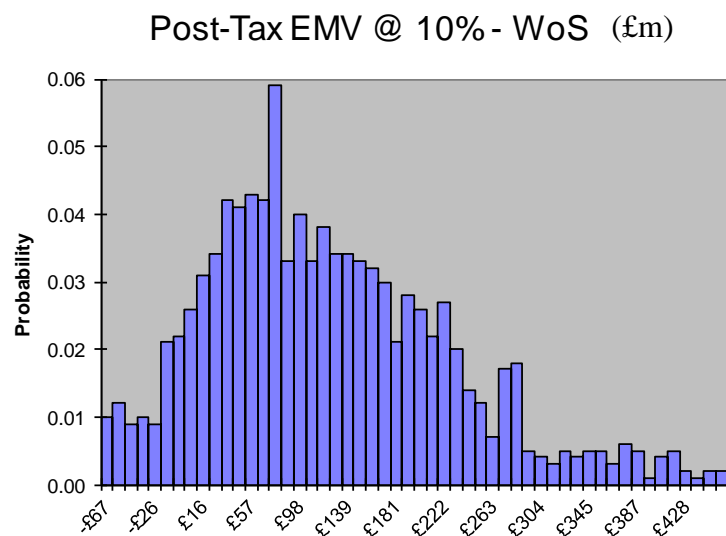
When interest is given on unused IA, the project investor with an oil find can write off his costs, but can only use 7% of his RFES, and 16% of the IA to which he is entitled. With a gas find and interest on unused IA the project investor can write off his costs, but he can only use 4% of his RFES, and none of the IA to which he is entitled.

In sum, the mean expected post-tax EMV is substantial. The interest on the large IA (in turn reflecting the very large investment costs) is large. The downside risks are modest, and the upside potential very substantial. But the investment costs are very large.

Chart 32

WoS - Project (Fast Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	120.76
Median	102.52
Standard Deviation	113.73
Variance	12935.23
Skewness	1.31
Kurtosis	5.13
Coefficient of Variability	0.94
Minimum	-149.83
Maximum	1049.95
Range	1199.78
Mean Standard Error	3.60
Trimmed Mean (98%)	118.47



F. Investment Allowance Eligible for All Exploration Costs  
(a) Investor in Tax-Paying Position, Slow Cycle Time

i. CNS

The distribution of EMVs with IA eligible for all exploration costs for an investor under slow cycle conditions from first exploration to first production is shown in Chart 33 (pre-tax) and Chart 34 (post-tax). It is seen that the mean value is negative pre-tax (£6.26 million) and positive post-tax (£1.3 million). The pre-tax range is very wide, namely from -£86.67 million to +£116.84 million. There is a 68% chance that the pre-tax EMV will be negative, and a 30% chance that it will exceed +£0.81 million. There is a 20% chance that it will exceed +£6.25 million. 68% of the pre-tax EMV



distribution lies in the range -£21.84m. to +£8.9m., and 95% of the distribution lies in the range -£43m. to +£37.6m. There is a 48% chance that the post-tax EMV will be negative. 68% of the post-tax EMV distribution lies in the range -£6.77m. to +£9.18m., and 95% of the distribution lies in the range -£16.83m. to +£25.62m.

In sum, there is in prospect a very small positive post-tax mean expected EMV, along with substantial downside risks, and a modest upside potential.

Chart 33

**CNS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

<b>Pre-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	-6.26
Median	-7.35
Standard Deviation	19.41
Variance	376.75
Skewness	0.63
Kurtosis	3.80
Coefficient of Variability	-3.10
Minimum	-86.67
Maximum	116.84
Range	203.51
Mean Standard Error	0.61
Trimmed Mean (98%)	-6.42

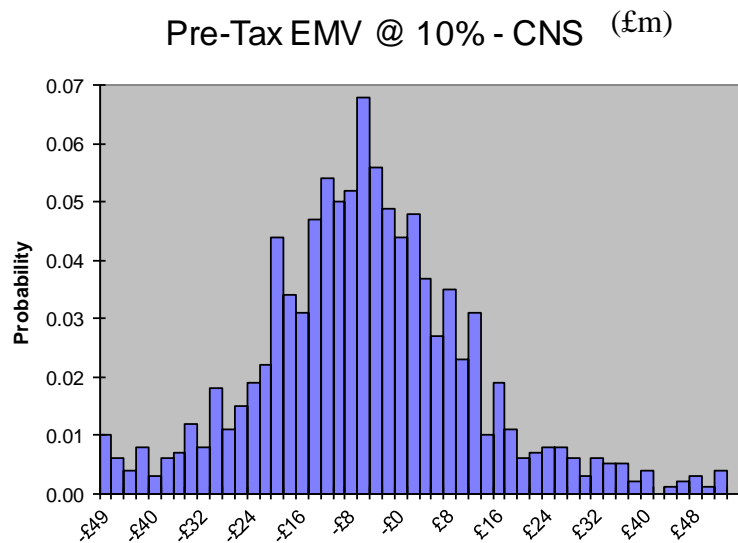
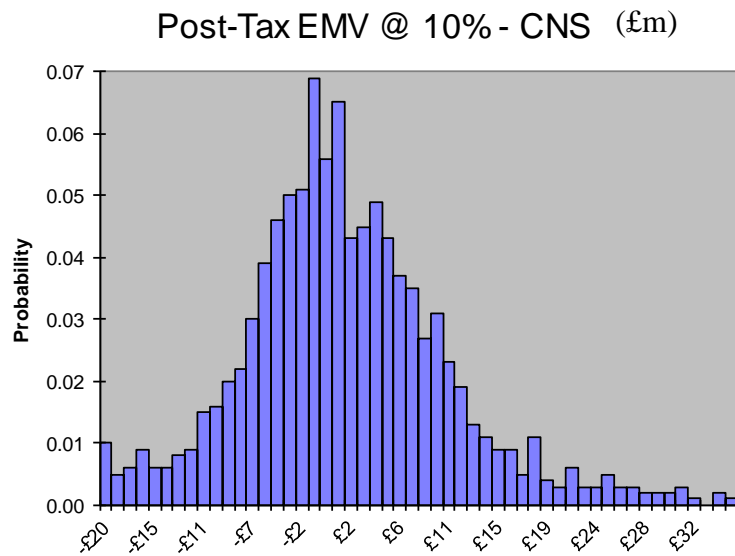


Chart 34

CNS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	1.30
Median	0.26
Standard Deviation	10.24
Variance	104.93
Skewness	1.17
Kurtosis	5.85
Coefficient of Variability	7.85
Minimum	-34.05
Maximum	81.19
Range	115.24
Mean Standard Error	0.32
Trimmed Mean (98%)	1.14



ii. NNS

The distribution of EMVs for the investor in the NNS is shown in Chart 35 (pre-tax) and Chart 36 (post-tax). The mean value is just positive. There is a 57% chance that the EMV will be negative before tax. There is a 20% chance that it will exceed +£7.22 million. 68% of the pre-tax EMV distribution lies in the range -£9.32m. to +£9.28m., and 95% of the distribution lies in the range -£15.12m. to +£27.92m. After tax there is a 38% chance that the EMV will be negative, and a 20% chance that it will exceed +£6.52 million. 68% of the pre-tax EMV distribution lies in the range -£2.68m. to +£7.55m., and 95% of the distribution lies in the range -£4.99m. to +£17.47m.

In sum there is in prospect a very small mean expected post-tax EMV, substantial downside risk and modest upside potential.

Chart 35

**NNS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

<b>Pre-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	0.21
Median	-1.55
Standard Deviation	11.13
Variance	123.99
Skewness	1.73
Kurtosis	6.91
Coefficient of Variability	52.65
Minimum	-23.36
Maximum	92.53
Range	115.89
Mean Standard Error	0.35
Trimmed Mean (98%)	-0.09

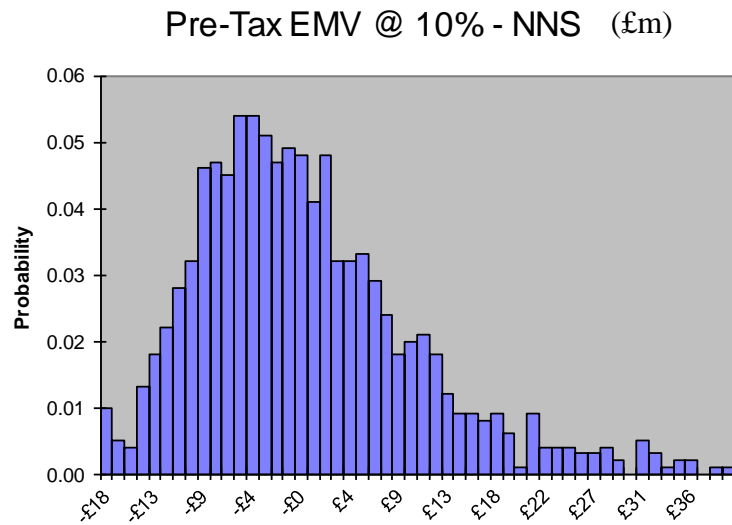
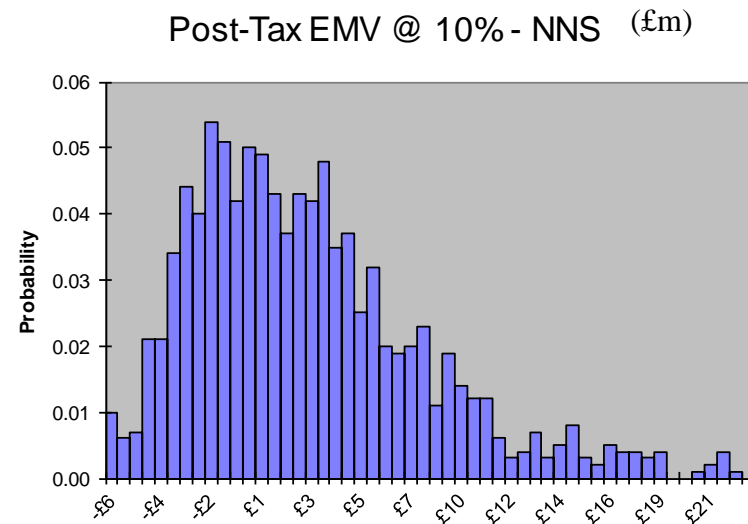


Chart 36

**NNS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	2.58
Median	1.45
Standard Deviation	6.05
Variance	36.61
Skewness	1.92
Kurtosis	8.38
Coefficient of Variability	2.34
Minimum	-8.62
Maximum	56.13
Range	64.75
Mean Standard Error	0.19
Trimmed Mean (98%)	2.40



iii. SNS

The distribution of EMVs for the investor in the SNS is shown in Chart 37 (pre-tax) and Chart 38 (post-tax). The mean value is

modestly positive. There is a 25% chance that the EMV will be negative before tax. Because of loss-sharing through the tax system the chance of a post-tax negative EMV is around 8%. 68% of the pre-tax EMV distribution lies in the range -£0.52m. to +£5.78m., and 95% of the distribution lies in the range -£1.97m. to +£12.18m. 68% of the post-tax EMV distribution lies in the range +£0.4m. to +£3.89m. and 95% of the distribution lies in the range -£0.49m. to +£7.23m.

In sum, the prospect is of a very small positive mean expected EMV, small chance of a loss, plus a very modest upside potential.

Chart 37

**SNS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

<b>Pre-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	2.64
Median	1.87
Standard Deviation	3.60
Variance	12.97
Skewness	1.56
Kurtosis	4.03
Coefficient of Variability	1.36
Minimum	-3.54
Maximum	25.04
Range	28.58
Mean Standard Error	0.11
Trimmed Mean (98%)	2.54

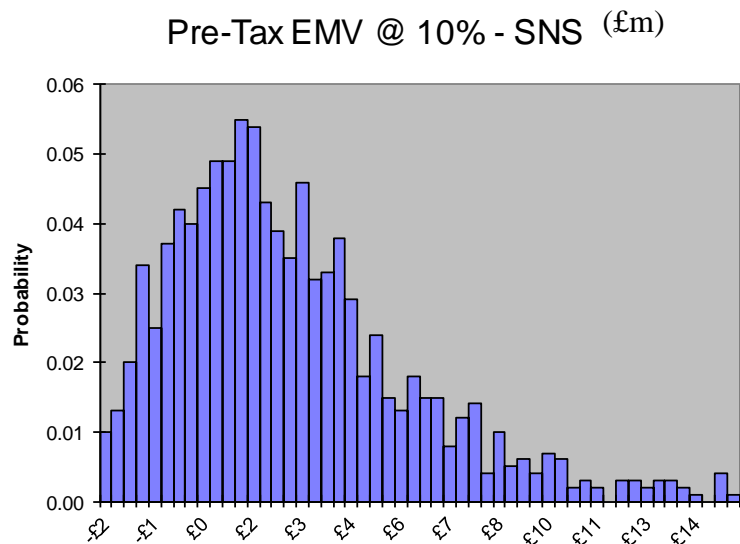
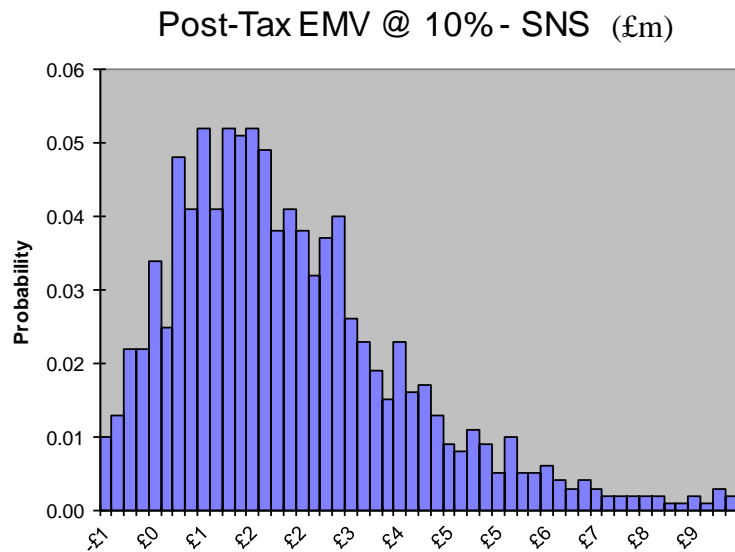


Chart 38

SNS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @ 10% Statistics	
Trials	1000
Mean	2.17
Median	1.75
Standard Deviation	2.01
Variance	4.03
Skewness	1.54
Kurtosis	4.08
Coefficient of Variability	0.92
Minimum	-1.27
Maximum	14.78
Range	16.05
Mean Standard Error	0.06
Trimmed Mean (98%)	2.11



iv. W of S

The distribution of EMVs in the W of S region is shown in Chart 39 (pre-tax) and Chart 40 (post-tax). The mean value is healthily positive at £95.47 million before tax, and £62.85 million after tax. There is a chance of just over 14% that the pre-tax EMV will be negative, and a 10% chance that it will be -£11.24 million or worse. On the upside potential there is a 30% chance that the EMV will exceed £131.08 million, and a 20% chance that it will exceed +£164.4 million. 68% of the pre-tax EMV distribution lies in the range +£4.91m. to +£187.54m., and 95% of the distribution lies in the range -£54.8m. to +£361.85m. After tax the chance of the EMV being negative is just over 6%, and there is a 20% chance that it will exceed +£100.64 million. 68% of the post-tax EMV distribution lies in the range +£14.81m. to +£112.71m., and 95% of the distribution lies in the range -£10.24m. to +£206.91m.

In sum, the prospect is for a substantial mean expected post-tax EMV, a modest chance of a loss, and substantial upside potential. But the investment costs are very high.

Chart 39

WoS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Pre-Tax EMV @10% Statistics	
Trials	1000
Mean	95.47
Median	73.18
Standard Deviation	104.74
Variance	10971.45
Skewness	1.47
Kurtosis	4.95
Coefficient of Variability	1.10
Minimum	-139.61
Maximum	913.43
Range	1053.05
Mean Standard Error	3.31
Trimmed Mean (98%)	93.06

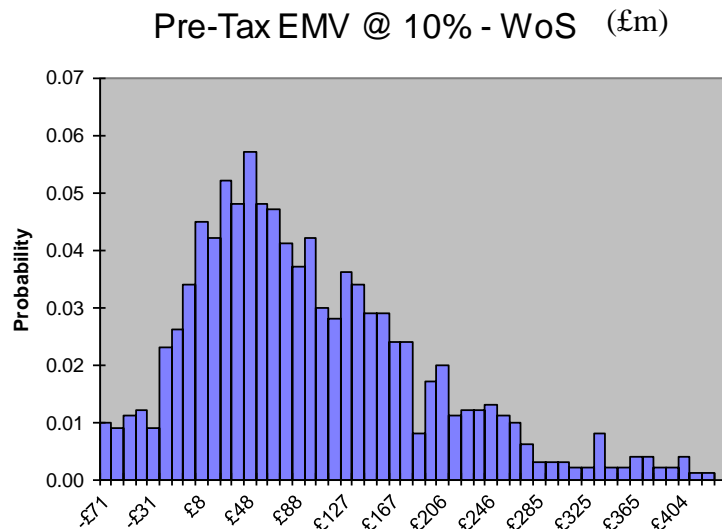
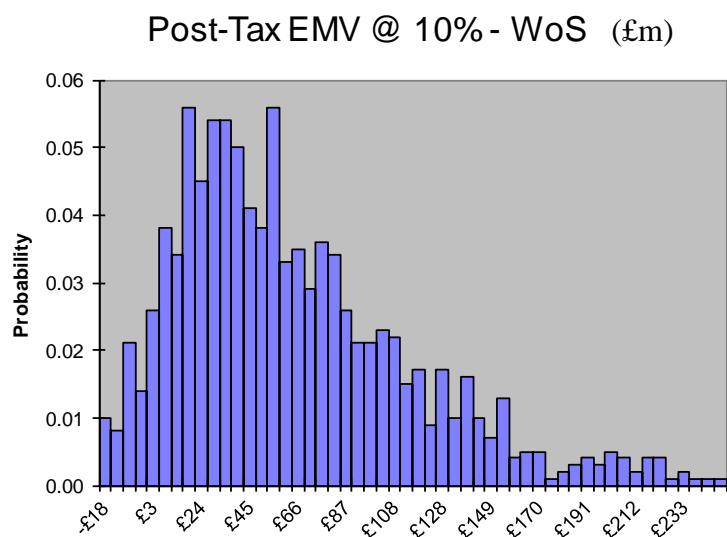


Chart 40

WoS - Ongoing (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	62.85
Median	51.34
Standard Deviation	56.37
Variance	3177.55
Skewness	1.65
Kurtosis	5.94
Coefficient of Variability	0.90
Minimum	-46.08
Maximum	529.96
Range	576.04
Mean Standard Error	1.78
Trimmed Mean (98%)	61.39



(b) Project Investor, Slow Cycle Time.

i. CNS

The distribution of EMVs for the project investor in the CNS with IA applicable to all exploration costs is shown in Chart 41 (post-tax). There is a 68% chance that the EMV will be negative, and a 30% chance that it will exceed +£0.72 million. 68% of the post-tax EMV distribution lies in the range -£20.81m. to +£6.53m., and 95% of the distribution lies in the range -£41.55m. to +£23.71m.

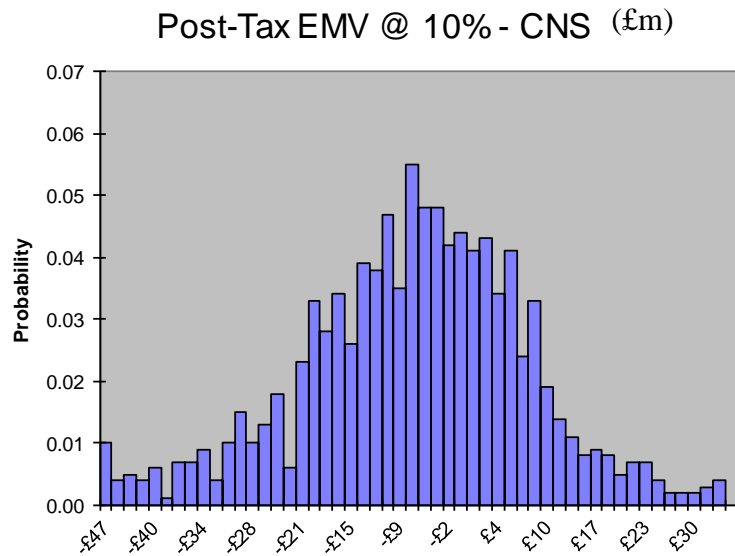
With a deterministic system where all variables are as the mean values, the project investor with an oil find can write off his costs and take advantage of the RFES, but he can only use 5% of the IA to which he is entitled. The project investor with a gas find can write off his costs, but can only take advantage of 23% of the RFES, and he cannot use any of the IA to which he is entitled.

The prospect facing the investor is thus a combination of negative mean expected post-tax EMV, a substantial downside risk, and modest upside potential.

Chart 41

CNS - Project (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @ 10% Statistics	
Trials	1000
Mean	-7.15
Median	-6.62
Standard Deviation	16.09
Variance	258.93
Skewness	-0.26
Kurtosis	2.37
Coefficient of Variability	-2.25
Minimum	-85.08
Maximum	74.01
Range	159.10
Mean Standard Error	0.51
Trimmed Mean (98%)	-7.07



ii. NNS

The distribution of EMVs for the investor in the NNS with IA allowance applicable to all exploration costs is shown in Chart 42 (post-tax). The mean value is negative to a modest extent. After tax the chance of a negative EMV is 55%. 68% of the post-tax EMV distribution lies in the range -£9.05m. to +£7.47m., and 95% of the distribution lies in the range -£14.61m. to +£18.52m.

With a deterministic system where all variables are as the mean values, the project investor with an oil find can write off his costs, and take advantage of the RFES, but he can only use 5% of the IA to which he is entitled. The project investor with a gas find can write off his costs, but can only take advantage of 33% of the RFES, and he cannot use any of the IA to which he is entitled.

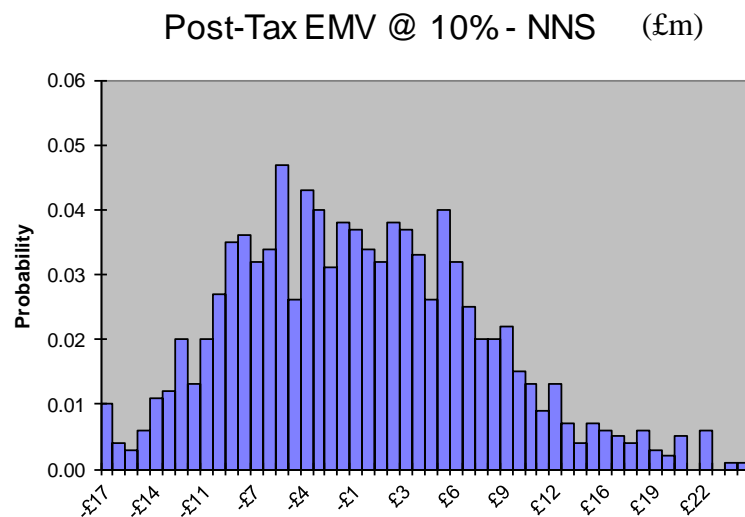


The investor is thus faced with a combination of a (small) negative mean expected EMV, a significant downside risk, and modest upside potential.

Chart 42

**NNS - Project (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	-0.58
Median	-1.23
Standard Deviation	8.71
Variance	75.82
Skewness	0.79
Kurtosis	2.04
Coefficient of Variability	-14.90
Minimum	-22.67
Maximum	55.20
Range	77.87
Mean Standard Error	0.28
Trimmed Mean (98%)	-0.72



iii. SNS

The distribution of EMVs for the investor in the SNS region is shown in Chart 43 (post-tax). The chance of a negative EMV is around 21% after tax. 68% of the post-tax EMV distribution lies in the range -£0.42m. to +£4.21m., and 95% of the distribution lies in the range -£1.88m. to +£7.71m.

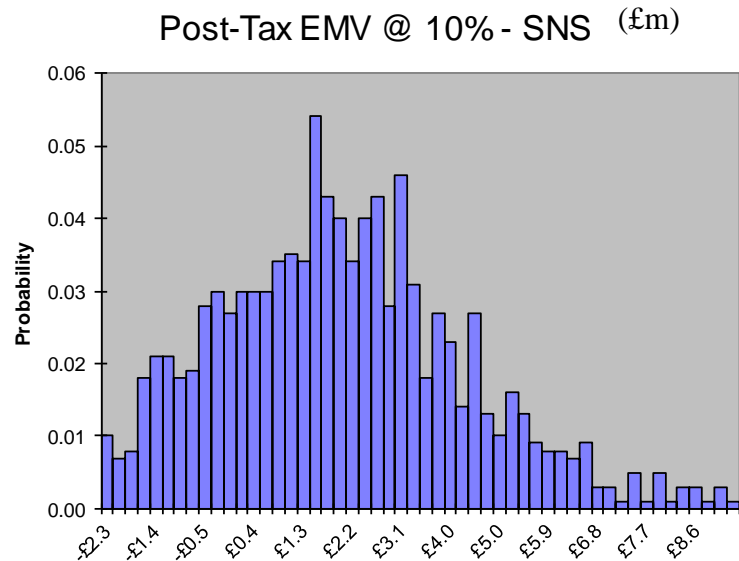
With a deterministic system where all variables are as the mean values, the project investor can write off his costs, take advantage of the RFES, but can only use 36% of the IA to which he is entitled.

In sum, the investor is faced with a very small positive mean EMV, noteworthy downside risks, and very modest upside potential.

Chart 43

SNS - Project (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	1.99
Median	1.79
Standard Deviation	2.44
Variance	5.94
Skewness	0.81
Kurtosis	1.58
Coefficient of Variability	1.23
Minimum	-3.46
Maximum	14.90
Range	18.37
Mean Standard Error	0.08
Trimmed Mean (98%)	1.94



iv. W of S

The distribution of EMVs for the investor in the W of S region with IA applicable to all exploration costs is shown in Chart 44 (post-tax). The mean value is healthily positive, at +£55.58 million after tax. The chance of a negative EMV is 14%, and there is a 40% chance that the EMV will exceed +£61.63 million. There is a 20% chance that it will exceed +£98.62 million. 68% of the post-tax EMV distribution lies in the range +£2.72m. to +£110.41m. and 95% of the distribution lies in the range -£52.53m. to +£204.68m.

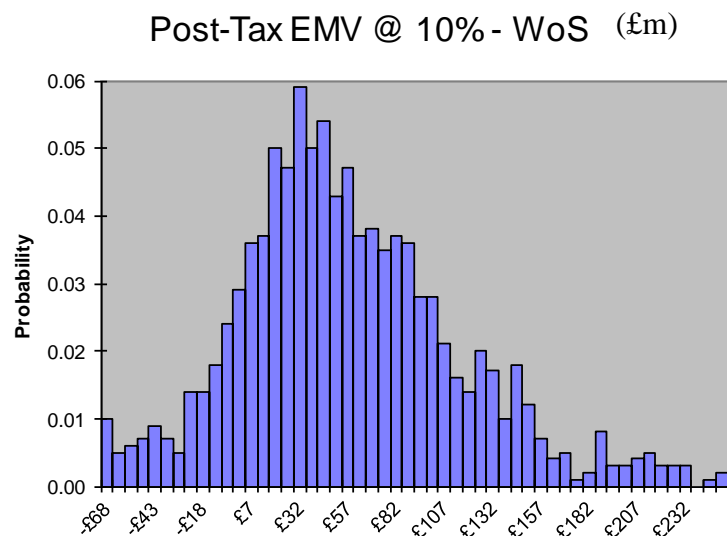
With a deterministic system where all variables are as the mean values, the project investor with an oil find can write off his costs, take advantage of the RFES, and use 100% of the IA to which he is entitled. The project investor with a gas find can write off his costs and take advantage of the RFES, but he can only use 50% of the IA to which he is entitled.

In sum, the investor is faced with a significantly positive mean expected EMV, a modest risk of a loss (which in absolute terms could be notable), and a substantial upside potential. But the investment costs are very high in this region.

Chart 44

**WoS - Project (Slow) - Initial Price \$55 p/b and 40p/therm Cost Reduction**

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	55.58
Median	47.09
Standard Deviation	62.30
Variance	3881.15
Skewness	1.00
Kurtosis	3.68
Coefficient of Variability	1.12
Minimum	-136.24
Maximum	509.55
Range	645.80
Mean Standard Error	1.97
Trimmed Mean (98%)	54.71



**G. Tax Credit for Exploration Costs**

**(a) Project Investor, Slow Cycle Time.**

**i. CNS**

The distribution of EMVs at 10% to the project investor in the CNS with a tax credit under the slow cycle time assumptions with reduced costs is shown in Chart 45 (post-tax). The mean value is clearly negative. There is a greater than 67% chance that the EMV will be negative. 68% of the post-tax EMV distribution lies in the range -£18.81m. to +£6.55m., and 95% of the distribution lies in the range -£39.56m. to +£22.89m.

With a deterministic system where all variables are as the mean values, the project investor with an oil find and a tax credit can

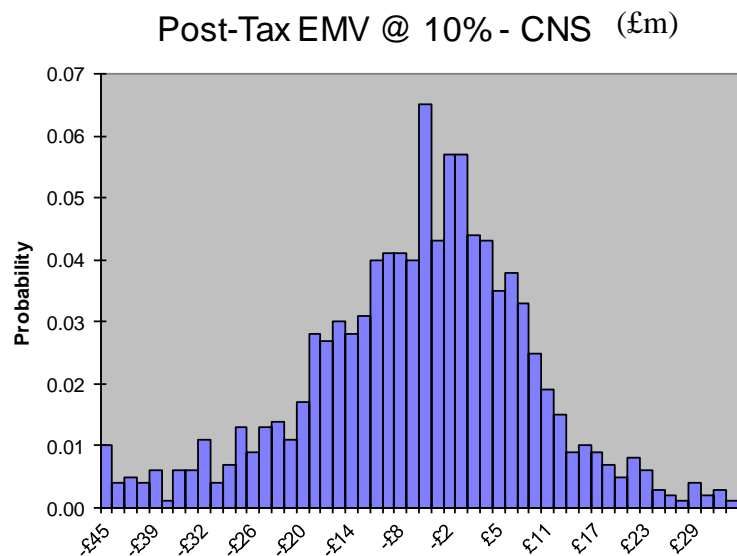
write off his costs and take advantage of the RFES (which is reduced with the credit), but he can only use 26% of the IA to which he is entitled. The project investor with a gas find and a tax credit can write off his costs, but can only take advantage of 33% of the (reduced) RFES, and he cannot use any of the IA to which he is entitled.

In sum, the investor is faced with a negative mean expected EMV, a very large downside risk, and a modest upside potential.

Chart 45

CNS - Project (Slow) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV @10% Statistics</b>	
Trials	1000
Mean	-5.95
Median	-4.86
Standard Deviation	15.34
Variance	235.17
Skewness	-0.36
Kurtosis	2.83
Coefficient of Variability	-2.58
Minimum	-83.09
Maximum	73.63
Range	156.71
Mean Standard Error	0.48
Trimmed Mean (98%)	-5.86



ii. NNS

The distribution of EMVs at 10% for the project investor in the NNS with a tax credit and reduced costs is shown in Chart 46 (post-tax). The chance that the EMV will be negative is just over 47% after tax. 68% of the post-tax EMV distribution lies in the range -£6.58m. to +£7.36m., and 95% of the distribution lies in the range -£12.14m. to +£17.34m.

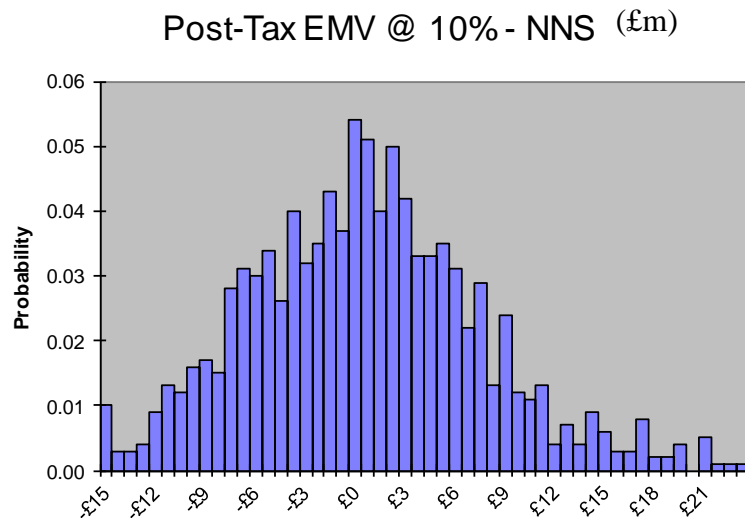
With a deterministic system where all variables are as the mean values, the project investor with an oil find and a tax credit can write off his costs and take advantage of the RFES (which is reduced with the credit), but can only use 66% of the IA to which he is entitled. The project investor with a gas find and a tax credit can write off his costs, and take advantage of the (reduced) RFES, but he can only use 61% of the IA to which he is entitled.

In sum, the investor is faced with a tiny positive mean EMV, a very large downside risk, and a modest upside potential.

Chart 46

NNS - Project (Slow) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	0.67
Median	0.38
Standard Deviation	7.59
Variance	57.54
Skewness	0.88
Kurtosis	3.28
Coefficient of Variability	11.38
Minimum	-20.20
Maximum	54.27
Range	74.47
Mean Standard Error	0.24
Trimmed Mean (98%)	0.55



### iii. SNS

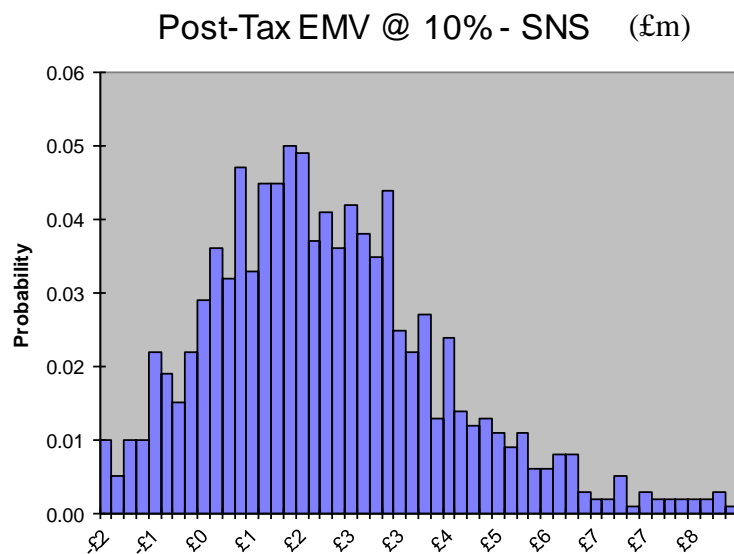
The distribution of EMVs for the project investor in the SNS with a tax credit and reduced costs is shown in Chart 47 (post-tax). There is a 13% chance that the post-tax EMV will be negative. 68% of the post-tax distribution lies in the range +£0.16m. to +£3.97m., and 95% lies in the range -£1.13m. to +£7.25m.

With a deterministic system where all variables are as the mean values, the project investor with a tax credit for exploration can write off his costs, take advantage of the (reduced) RFES, but can only use 95% of the IA to which he is entitled.

Chart 47

SNS - Project (Slow) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	2.09
Median	1.80
Standard Deviation	2.12
Variance	4.50
Skewness	1.13
Kurtosis	2.80
Coefficient of Variability	1.01
Minimum	-2.72
Maximum	14.58
Range	17.30
Mean Standard Error	0.07
Trimmed Mean (98%)	2.05



iv. W of S

The distribution of EMVs for the project investor in the W of S region with a tax credit and reduced costs is shown in Chart 48 (post-tax). The chance of the EMV being negative is 13%. There is a 20% chance that the value will be +£96.62 million or better. 68% of the post-tax EMV distribution lies in the range +£3.75m. to +£108.63m., and 95% of the distribution lies in the range -£48.25m. to +£202.87m.

With a deterministic system where all variables are as the mean values, the project investor with an oil find and a tax credit for exploration can write off his costs, take advantage of the RFES,

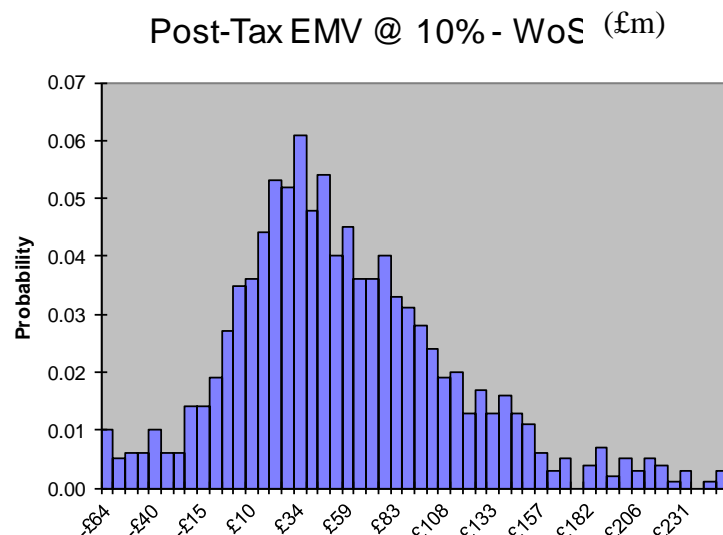
and use 100% of the IA to which he is entitled. The project investor with a gas find and a tax credit can write off his costs and take advantage of the (reduced) RFES, but he can only use 67% of the IA to which he is entitled.

In sum, the investor is faced with a worthwhile mean expected EMV, modest downside risk and substantial upside potential. But the investment costs are very high.

Chart 48

WoS - Project (Slow) Tax Credit - Initial Price \$55 p/b and 40p/therm Reduced Costs

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	55.19
Median	45.35
Standard Deviation	60.86
Variance	3704.53
Skewness	1.09
Kurtosis	4.04
Coefficient of Variability	1.10
Minimum	-131.96
Maximum	508.38
Range	640.34
Mean Standard Error	1.92
Trimmed Mean (98%)	54.29



## H. Investment Allowance Restricted to Successful Exploration

### (a) Investor in Tax-Paying Position, Slow Cycle Time

#### i. CNS

When the cycle time from first exploration to first production becomes longer and extra appraisal costs are incurred the discounted expected returns are reduced. When the IA for exploration is limited and costs are reduced there is a more than 48% chance that the post-tax EMV will be negative. 68% of the

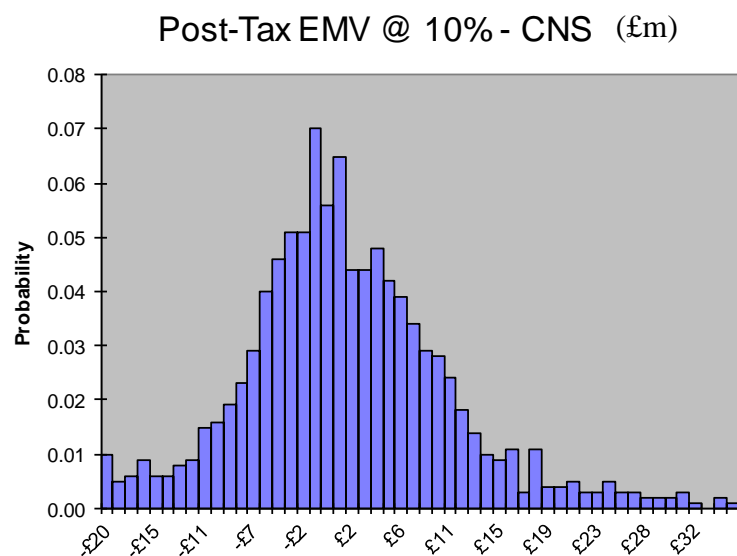
post-tax EMV distribution lies in the range -£6.78m. to +£9.08m., and 95% of the distribution lies in the range -£16.83m. to +£25.5m.

In sum, the investor is faced with the prospect of a positive but tiny mean expected EMV, a high chance of a loss, and modest upside potential.

Chart 49

CNS - Ongoing (Slow) Limited IA - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV @10% Statistics</b>	
Trials	1000
Mean	1.24
Median	0.17
Standard Deviation	10.22
Variance	104.47
Skewness	1.18
Kurtosis	5.89
Coefficient of Variability	8.24
Minimum	-34.05
Maximum	81.10
Range	115.16
Mean Standard Error	0.32
Trimmed Mean (98%)	1.08



ii. NNS

When the key risks are considered and the IA for exploration is limited and costs are reduced the distribution of EMVs at 10% are shown in Chart 50 (post-tax). The chance of a negative EMV is 39% after tax. 68% of the post-tax EMV distribution lies in the range -£2.79m. to +£7.43m. and 95% of the distribution lies in the range -£5.09m. to +£17.36m.

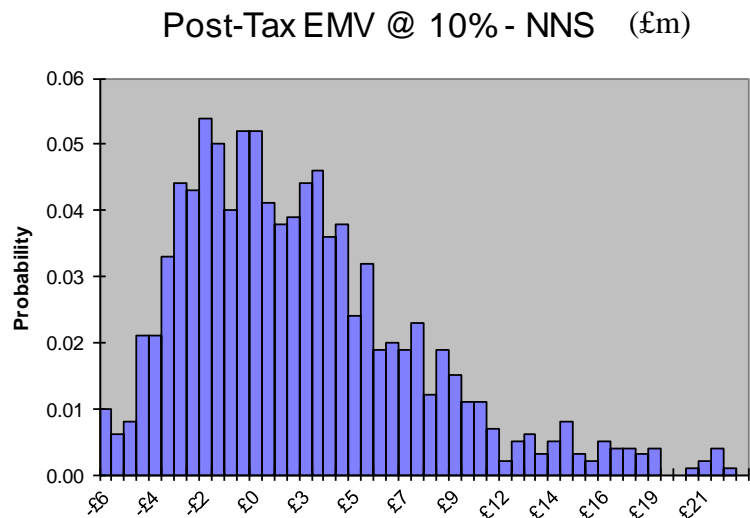
In sum, the investor is faced with a very small positive expected mean EMV, a substantial risk of a loss, and very modest upside potential.



Chart 50

NNS - Ongoing (Slow) Limited IA - Initial Price \$55 p/b and 40p/therm Reduced Costs

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	2.47
Median	1.34
Standard Deviation	6.04
Variance	36.52
Skewness	1.92
Kurtosis	8.43
Coefficient of Variability	2.44
Minimum	-8.62
Maximum	56.02
Range	64.63
Mean Standard Error	0.19
Trimmed Mean (98%)	2.29



iii. SNS

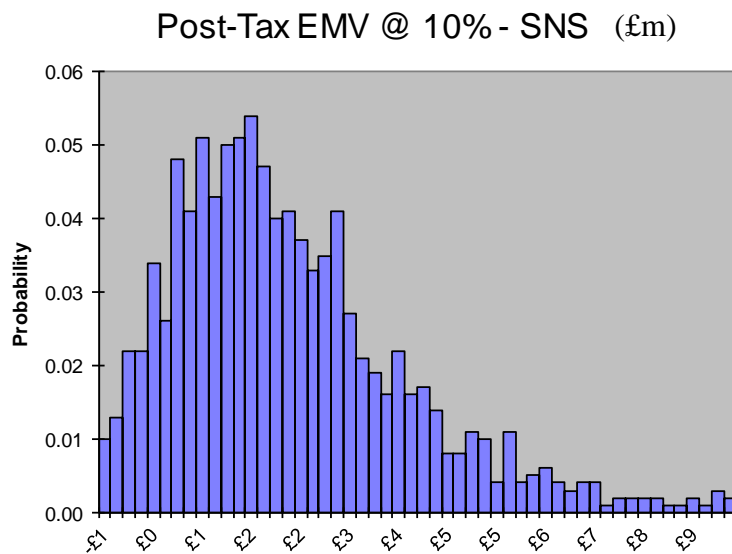
When the key risks are introduced and the IA for exploration is restricted and costs are reduced the mean value post-tax is just positive. See Chart 51. The chance of a negative EMV is 9%. 68% of the post-tax EMV distribution lies in the range +£0.36m. to +£3.85m., and 95% of the distribution lies in the range -£0.52m. to +£7.19m.

In sum, the investor is faced with the prospect of a positive but very small mean expected EMV, a low chance of a loss, and very limited upside potential.

Chart 51

SNS - Ongoing (Slow) Limited IA - Initial Price \$55 p/b and 40p/therm Reduced Costs

<u>Post-Tax EMV@10% Statistics</u>	
Trials	1000
Mean	2.13
Median	1.71
Standard Deviation	2.01
Variance	4.03
Skewness	1.54
Kurtosis	4.08
Coefficient of Variability	0.94
Minimum	-1.30
Maximum	14.74
Range	16.04
Mean Standard Error	0.06
Trimmed Mean (98%)	2.08



iv. W of S

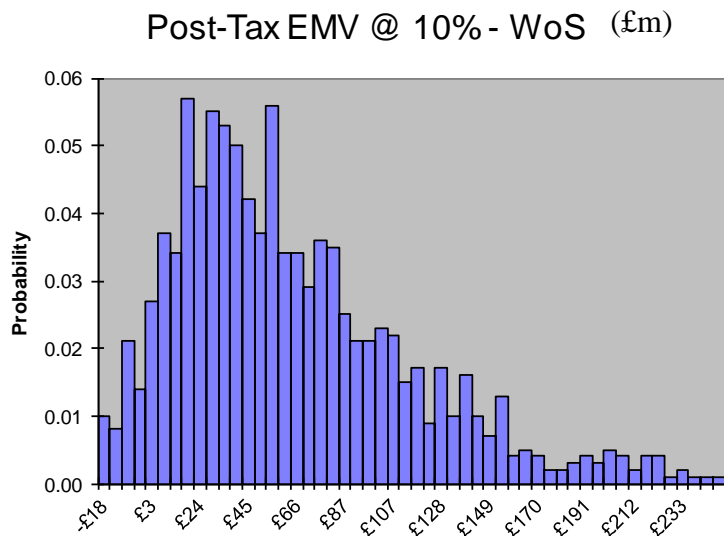
When the key risks are considered and the IA for exploration is limited and costs are reduced the distribution of EMVs at 10% is shown in Chart 52 (post-tax). The mean values are positive before tax and after tax. After tax there is more than a 6% chance that the EMV will be negative. There is a 20% chance that the EMV will exceed +£100.52 million, and a 10% chance that it exceeds +£136.18 million. 68% of the post-tax EMV distribution lies in the range +£14.69m. to +£112.54m., and 95% of the distribution lies in the range -£10.32m. to +£206.75m.

In sum, the investor is faced with the prospect of a significantly positive mean expected EMV, a small chance of a loss, and very substantial upside potential. The investment costs are particularly large in this region.

Chart 52

WoS - Ongoing (Slow) Limited IA - Initial Price \$55 p/b and 40p/therm Reduced Costs

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	62.71
Median	51.18
Standard Deviation	56.36
Variance	3175.89
Skewness	1.65
Kurtosis	5.95
Coefficient of Variability	0.90
Minimum	-46.14
Maximum	529.82
Range	575.96
Mean Standard Error	1.78
Trimmed Mean (98%)	61.25



(b) Project Investor, Slow Cycle Time

i. CNS

The distribution of EMVs at 10% to the project investor in the CNS under the slow cycle time assumptions with restricted IA for exploration and reduced costs is shown in Chart 53 (post-tax). There is a greater than 68% chance that the EMV will be negative. 68% of the post-tax distribution lies in the range -£20.81m. to +£6.53m., and 95% of the distribution lies in the range -£41.55m. to +£23.63m.

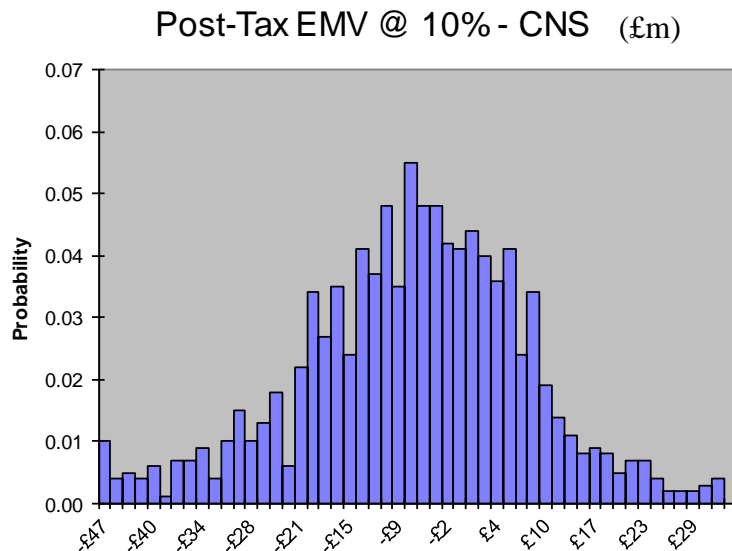
With a deterministic system where all variables are as the mean values, with limited IA the project investor with an oil find can write off his costs and take advantage of the RFES, but he can only use 6% of the IA to which he is entitled. The project investor with a gas find can write off his costs, but can only take advantage of 23% of the RFES, and he cannot use any of the IA to which he is entitled.

In sum, the investor is faced with the prospect of a negative mean expected EMV, a very high chance of a loss, and limited upside potential.

Chart 53

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

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	-7.16
Median	-6.62
Standard Deviation	16.08
Variance	258.67
Skewness	-0.26
Kurtosis	2.37
Coefficient of Variability	-2.25
Minimum	-85.08
Maximum	73.97
Range	159.05
Mean Standard Error	0.51
Trimmed Mean (98%)	-7.08



ii. NNS

The distribution of EMVs at 10% for the project investor in the NNS with limited IA for exploration and reduced costs is shown in Chart 54 (post-tax). The chance that the EMV will be negative is over 55%. 68% of the post-tax EMV distribution lies in the range -£9.05m. to +£7.47m., and 95% of the distribution lies in the range -£14.61m. to +£18.44m.

With a deterministic system where all variables are as the mean values with limited IA the project investor with an oil find can write off his costs and take advantage of the RFES, but he can only use 6% of the IA to which he is entitled. The project investor with a gas find can write off his costs, but can only take advantage of

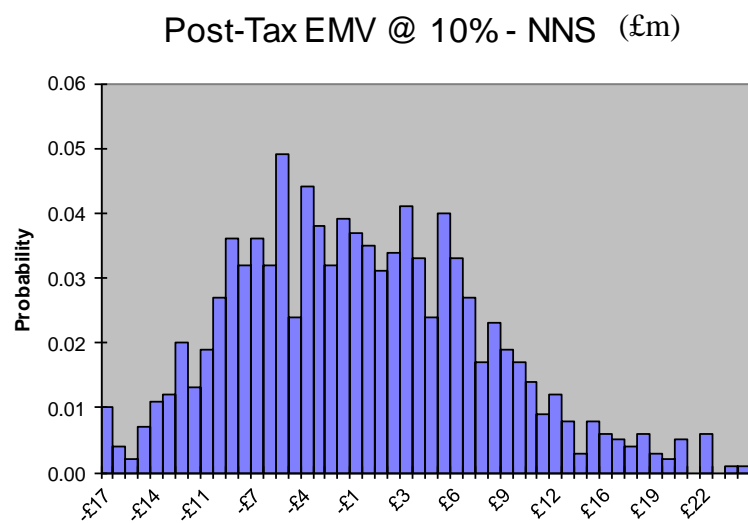
33% of the RFES, and he cannot use any of the IA to which he is entitled

In sum, the investor is faced with the prospect of a small negative mean expected EMV, a large chance of a loss, and very limited upside potential

Chart 54

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

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	-0.59
Median	-1.23
Standard Deviation	8.69
Variance	75.60
Skewness	0.78
Kurtosis	2.03
Coefficient of Variability	-14.72
Minimum	-22.67
Maximum	55.11
Range	77.78
Mean Standard Error	0.27
Trimmed Mean (98%)	-0.72



iii. SNS

The distribution of EMVs for the project investor in the SNS with limited IA for exploration and reduced costs is shown in Chart 55 (post-tax). There is a more than 21% chance that the value will be negative. 68% of the post-tax distribution lies in the range -£0.42m. to +£4.21m., and 95% lies in the range -£1.88m. to +£7.68m.

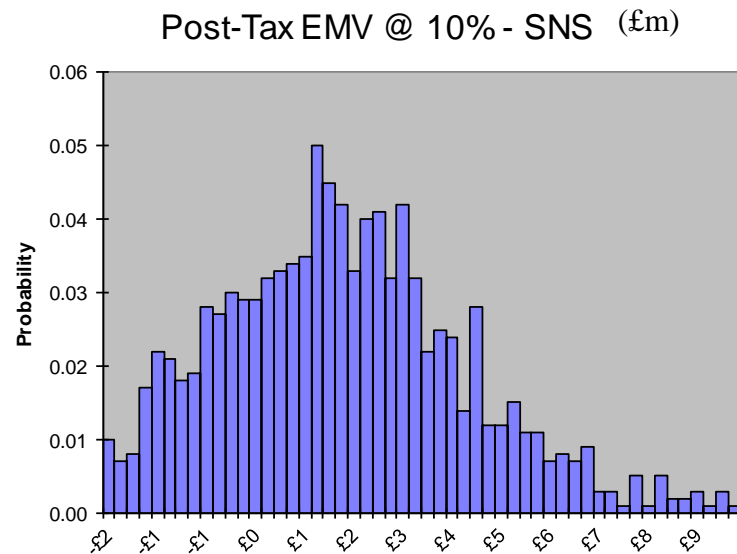
With a deterministic system where all variables are as the mean values, with limited IA the project investor can write off his costs, take advantage of the (reduced) RFES, but can only use 38% of the IA to which he is entitled.

In sum, the investor is faced with the prospect of a positive but very small mean expected EMV, a moderate chance of a loss, and very limited upside potential.

Chart 55

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

<b>Post-Tax EMV @10% Statistics</b>	
Trials	1000
Mean	1.98
Median	1.79
Standard Deviation	2.43
Variance	5.90
Skewness	0.80
Kurtosis	1.58
Coefficient of Variability	1.23
Minimum	-3.46
Maximum	14.87
Range	18.34
Mean Standard Error	0.08
Trimmed Mean (98%)	1.94



iv. W of S

The distribution of EMVs for the project investor in the W of S region with IA limited for exploration and reduced costs is shown in Chart 56 (post-tax). The chance of the EMV being negative is 14%. There is a 20% chance that the value will be +£98.47 million or better. 68% of the post-tax EMV distribution lies in the range +£2.72m. to +£110.27m., and 95% of the distribution lies in the range -£52.53m. to +£204.53m.

With a deterministic system where all variables are as the mean values, with limited IA the project investor with an oil find can write off his costs and take advantage of the RFES, and he can use

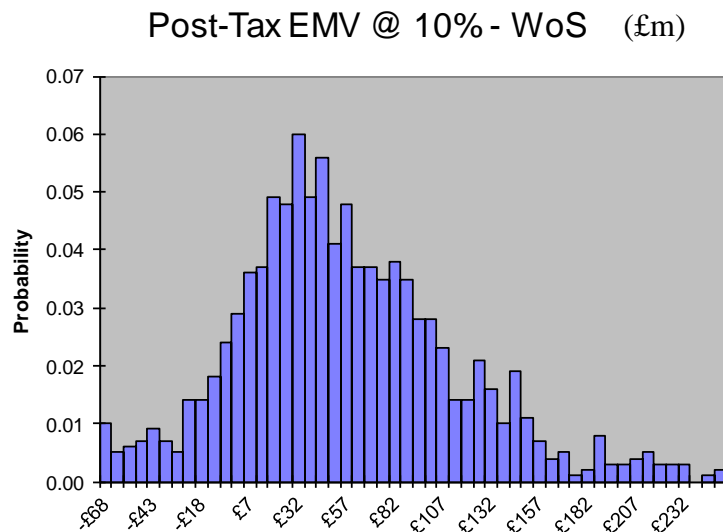
all of the IA to which he is entitled. The project investor with a gas find can write off his costs and take advantage of the RFES, but he can only use 51% of the IA to which he is entitled.

In sum, the prospect facing the investor is a significantly positive mean expected EMV, a modest chance of a loss, and substantial upside potential. But the investment costs are relatively large in this region.

Chart 56

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

Post-Tax EMV @10% Statistics	
Trials	1000
Mean	55.51
Median	47.04
Standard Deviation	62.25
Variance	3875.18
Skewness	1.00
Kurtosis	3.70
Coefficient of Variability	1.12
Minimum	-136.24
Maximum	509.44
Range	645.68
Mean Standard Error	1.97
Trimmed Mean (98%)	54.64



## I. Immediate Relief for IA

### (a) Investor in Tax-Paying Position, Slow Cycle Time

#### i. CNS

When the cycle time from first exploration to first production becomes longer and extra appraisal costs are incurred the discounted expected returns are reduced. When the key risks are taken into account and IA relief is immediate and the costs are reduced the mean post-tax value for the EMVs at 10% is shown in Chart 57. There is a 33% chance that the post-tax EMV will be

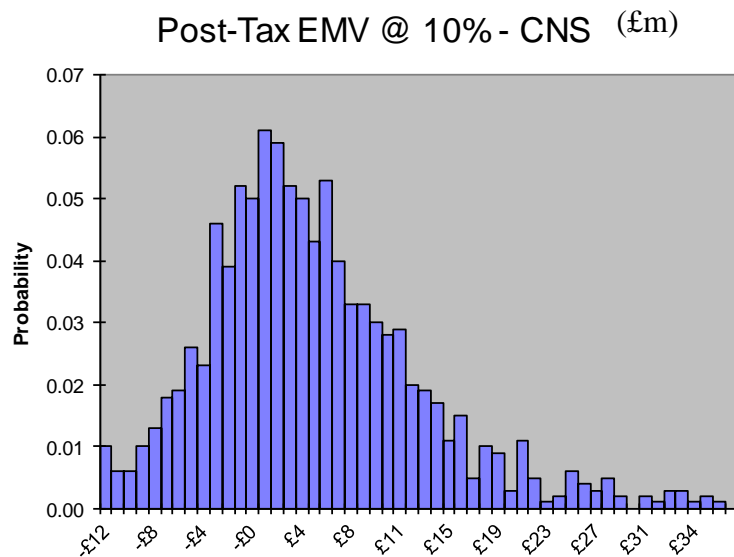
negative. 68% of the post-tax EMV distribution lies in the range -£3.41m. to +£12.02m., and 95% of the distribution lies in the range -£9.46m. to +£27.53m.

In sum, the prospect facing the investor is a positive but small mean expected EMV, a substantial risk of a loss, and moderate upside potential.

Chart 57

CNS - Ongoing (Slow Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	4.48
Median	2.94
Standard Deviation	9.66
Variance	93.24
Skewness	1.85
Kurtosis	9.00
Coefficient of Variability	2.15
Minimum	-20.12
Maximum	90.98
Range	111.10
Mean Standard Error	0.31
Trimmed Mean (98%)	4.23



ii. NNS

When the key risks are considered and IA relief is immediate and costs are reduced the distribution of EMVs at 10% are shown in Chart 58 (post-tax). The chance of a negative EMV is 24%. 68% of the post-tax EMV distribution lies in the range -£1.09m. to +£9.12m., and 95% of the distribution lies in the range -£3.42m. to +£19.17m.

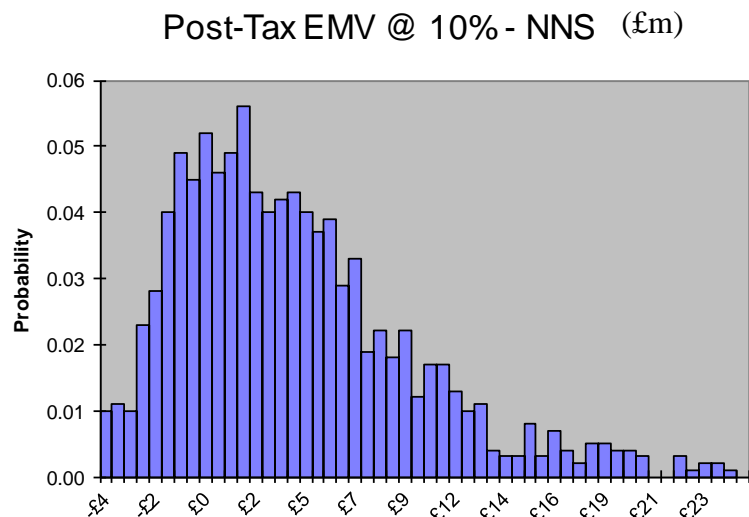


In sum, the prospect facing the investor is a positive but small mean expected EMV, a significant risk of a loss, and very modest upside potential.

Chart 58

NNS - Ongoing (Slow Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction

<u>Post-Tax EMV@10% Statistics</u>	
Trials	1000
Mean	4.22
Median	3.05
Standard Deviation	6.11
Variance	37.37
Skewness	2.01
Kurtosis	9.28
Coefficient of Variability	1.45
Minimum	-5.69
Maximum	60.13
Range	65.82
Mean Standard Error	0.19
Trimmed Mean (98%)	4.03



### iii. SNS

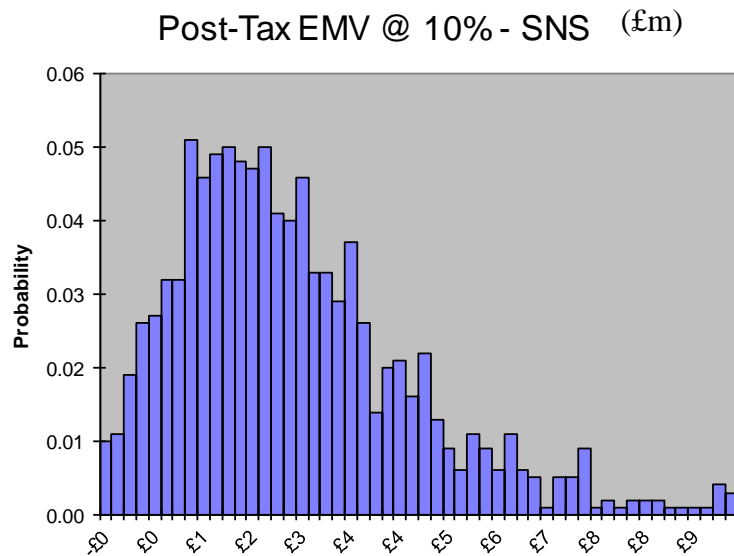
When the key risks are introduced, relief for IA is immediate, and costs are reduced the mean expected value post-tax is shown in Chart 59. After tax the chance of a negative EMV is only 3%. 68% of the post-tax EMV distribution lies in the range +£0.86m. to +£4.45m., and 95% of the distribution lies in the range -£0.06m. to +£7.69m.

In sum, the prospect facing the investor is a positive but very small mean expected EMV, a small downside risk, and a very small upside potential.

Chart 59

SNS - Ongoing (Slow Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	2.67
Median	2.26
Standard Deviation	2.07
Variance	4.30
Skewness	1.51
Kurtosis	3.93
Coefficient of Variability	0.78
Minimum	-0.83
Maximum	15.59
Range	16.41
Mean Standard Error	0.07
Trimmed Mean (98%)	2.61



iv. W of S

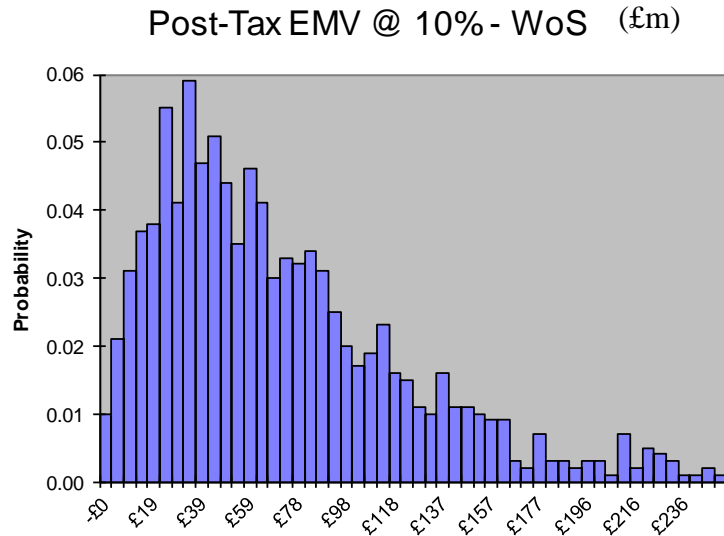
When the key risks are considered, relief for IA is immediate, and costs are reduced the distribution of EMVs at 10% is shown in Chart 60 (post-tax). There is only a 1% chance that the EMV will be negative. There is a 20% chance that the EMV will exceed +£108.23 million, and a 10% chance that it exceeds +£142.59 million. 68% of the post-tax EMV distribution lies in the range +£21.51m. to +£119.32m., and 95% of the distribution lies in the range +£2.78m. to +£216.31m.

In sum, the prospect facing the investor is a substantial mean expected EMV, low risk of a loss, and substantial potential. But the investment costs are notably high.

Chart 60

WoS - Ongoing (Slow Tax Saved) - Initial Price \$55 p/b and 40p/therm Cost Reduction

Post-Tax EMV@10% Statistics	
Trials	1000
Mean	70.21
Median	57.31
Standard Deviation	56.09
Variance	3146.04
Skewness	1.83
Kurtosis	7.25
Coefficient of Variability	0.80
Minimum	-17.10
Maximum	562.85
Range	579.95
Mean Standard Error	1.77
Trimmed Mean (98%)	68.56



J. Interest on Unutilised IA from time of Eligibility of Activation

(a) Project Investor, Slow Cycle Time

i. CNS

The distribution of EMVs at 10% to the project investor in the CNS under the slow cycle time assumptions with interest on IA and reduced costs is shown in Chart 61 (post-tax). There is a greater than 67% chance that the EMV will be negative. 68% of the post-tax EMV distribution lies in the range -£20.81m. to +£9.81m., and 95% of the distribution lies in the range -£41.55m. to +£39.23m.

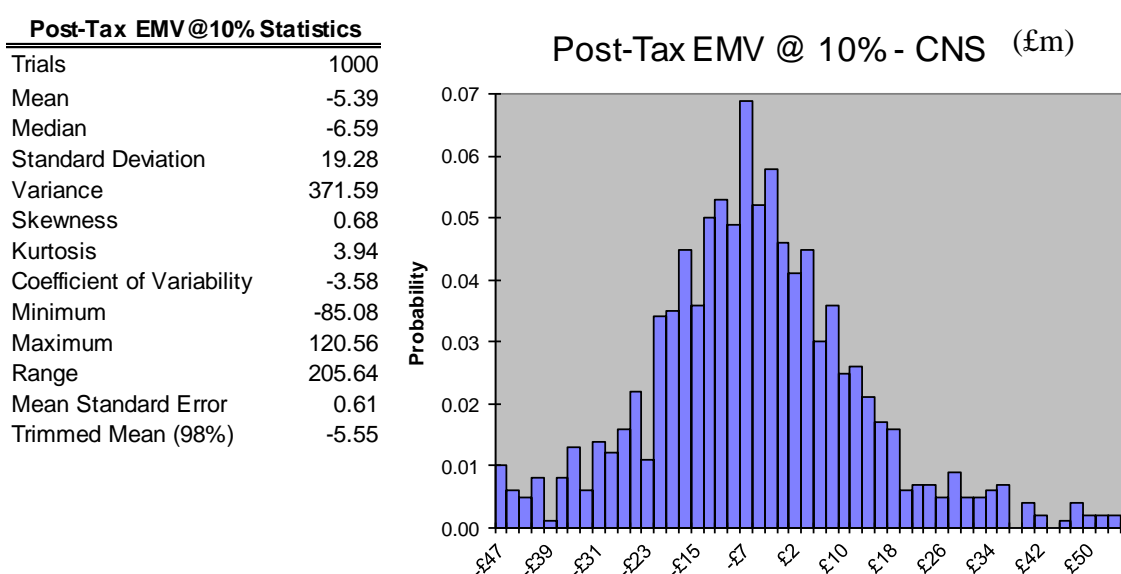
With a deterministic system where all variables are as the mean values and interest is given on unused IA, the project investor with an oil find can write off his costs but can only use 3% of his RFES, and cannot use any of the IA to which he is entitled. With a gas find and interest on unused IA the project investor can write off his

costs but he can only use 1% of his RFES, and none of the IA to which he is entitled.

In sum, the prospect facing the investor is a negative mean expected EMV, a large risk of a loss, and modest upside potential.

Chart 61

CNS - Project (Slow Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction



ii. NNS

The distribution of EMVs at 10% for the project investor in the NNS with interest on IA and reduced costs is shown in Chart 62 (post-tax). The chance that the EMV will be negative is over 55%. 68% of the post-tax EMV distribution lies in the range -£9.05m. to +£9.75m., and 95% of the distribution lies in the range -£14.61m. to +£28.4m.

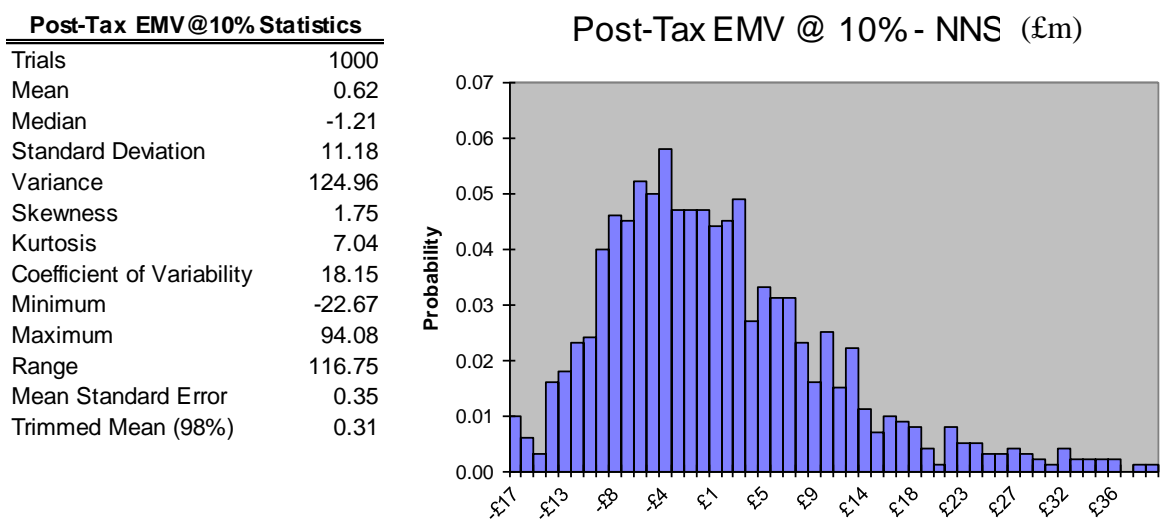
With a deterministic system where all variables are as the mean values and interest is given on unused IA, the project investor with an oil find can write off his costs but can only use 4% of his RFES,

and cannot use any of the IA to which he is entitled. With a gas find and interest on unused IA the project investor can write off his costs, but he can only use 2% of his RFES, and none of the IA to which he is entitled.

In sum, the prospect facing the investor is a positive but tiny mean expected EMV, a substantial risk of a loss, and modest upside potential.

Chart 62

NNS - Project (Slow Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction



### iii. SNS

The distribution of EMVs for the project investor in the SNS with interest on IA and reduced costs is shown in Chart 63 (post-tax). There is a 21% chance that the post-tax EMV will be negative. 68% of the post-tax distribution lies in the range -£0.42m. to +£5.95m., and 95% lies in the range -£1.88m. to +£12.36m.

With a deterministic system where all variables are as the mean values and interest is given on unused IA the project investor can

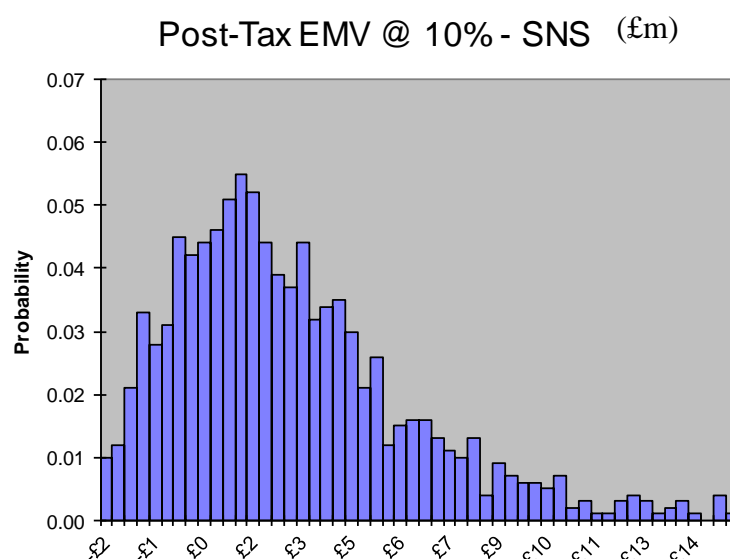
write off his costs, but he can only use 5% of his RFES, and none of the IA to which he is entitled.

In sum, the prospect facing the investor is a positive but small mean expected EMV, significant risk of a loss, and modest upside potential.

Chart 63

SNS - Project (Slow Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction

<b>Post-Tax EMV@10% Statistics</b>	
Trials	1000
Mean	2.78
Median	1.96
Standard Deviation	3.63
Variance	13.17
Skewness	1.55
Kurtosis	3.97
Coefficient of Variability	1.31
Minimum	-3.46
Maximum	25.33
Range	28.80
Mean Standard Error	0.11
Trimmed Mean (98%)	2.67



iv. W of S

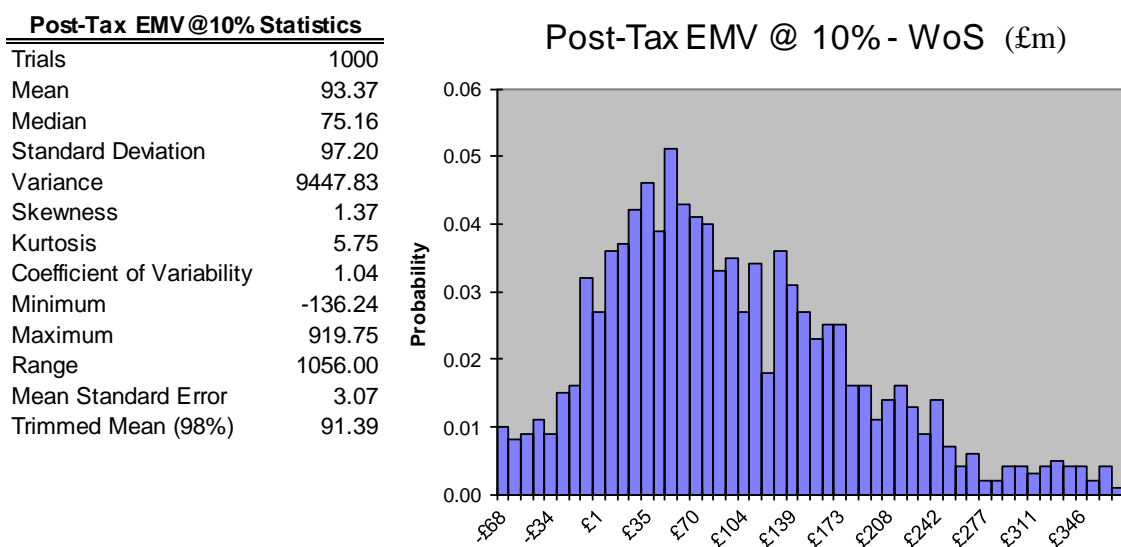
The distribution of EMVs for the project investor in the W of S region with interest on IA and reduced costs is shown in Chart 64 (post-tax). The chance of the EMV being negative is 13%, with a 20% chance that it will be +£16.06 million or worse. There is a 20% chance that the value will be +£164.53 million or better. 68% of the post-tax EMV distribution lies in the range +£6.55m. to +£179.95m., and a 95% of the distribution lies in the range -£52.53m. to +£325.9m.

With a deterministic system where all variables are as the mean values and interest is given on unused IA, the project investor with an oil find can write off his costs, but can only use 8% of his RFES, and none of the IA to which he is entitled. With a gas find and interest on unused IA the project investor can write off his costs, but he can only use 5% of his RFES, and none of the IA to which he is entitled.

In sum, the prospect facing the investor is a substantial mean expected EMV, a modest risk of a loss, and a large upside potential. But the investment costs are very large in this region.

Chart 64

WoS - Project (Slow Interest on IA) - Initial Price \$55 p/b and 40p/therm Cost Reduction



### K. Comparison of Results

Table 3 below allows a ready comparison of the various systems with a fast cycle time. After the cost reductions employed in this study it is seen that the mean expected EMVs are positive in 3 of the regions, the exception being the CNS. In this latter area the investment costs per boe

are relatively high. The highest prospective returns are in the W of S region. This reflects the relatively high success rate and the comparatively large sizes of discoveries. This latter factor reduces the investment costs per boe, though in absolute terms they are highest of all the regions in the UKCS.

It is also seen from Table 3 that the mean post-tax EMVs are higher for the investor already in a tax-paying position compared to the project investor. The chances of making a loss are also greater for the project investor compared to one already in a tax-paying position. A fully neutral tax system should not discriminate in this way. This does not only result in circumstances when the investor's discount rate exceeds the RFES interest rate. In the study many cases were found where the project investor could not obtain the full benefits from the IA and the RFES to which he was entitled because of lack of adequate income against which to set the allowance. This happens for investors in the CNS, NNS, and W of S to a greater extent than in the SNS where the probability of a negative return is generally low. Thus both the mean expected EMV and the range of EMVs in the SNS for the project investor are quite close to those obtained by the tax-paying investor.

When further tax incentives were examined it was found that the project investors were often less able to take advantage of them compared to the investor already in a tax-paying position because of inadequate income. This helps to explain the finding that of all the further tax incentives considered in this study the most potent for the tax-paying investor differs from that for the project investor. Thus, for the investor already in a tax-paying position the most potent further incentive in all the four regions of the UKCS is immediate tax relief for the IA. For the project investor the



most potent extra incentive was found to be interest on the IA eligible for activation. Of course, the investor already in a tax-paying position should not have a need for this facility.

Table 3

Comparative Returns After Cost Reductions, Fast Cycle Time

<b>Tax-Paying Investor, Fast Cycle Time, full IA relief</b>	<b>CNS</b>	<b>NNS</b>	<b>SNS</b>	<b>W of S</b>
Pre-Tax Mean EMV (£m.)	-2.40	6.68	5.13	126.46
68% of EMV range (£m.)	-21.76 to +15.63	-4.78 to +17.68	+1.26 to +8.98	+16.09 to +237.27
95% of EMV range (£m.)	-45.01 to +52.61	-11.58 to +41.6	-0.58 to +16.36	-54.63 to +452.22
Chance of negative EMV	58%	34%	5%	10%
30% Chance EMV will Exceed (£m.)	5.72	10.75	6.42	168.85
Post-Tax Mean EMV (£m.)	4.03	6.12	3.52	81.17
68% of EMV range (£m.)	-5.79 to +13.55	-0.26 to +12.1	+1.39 to +5.56	+21.97 to +140.44
95% of EMV range (£m.)	-16.99 to +34.62	-3.16 to +24.23	+0.29 to +9.57	-7.83 to +264.01
Chance of negative EMV	37%	19%	1%	4%
30% Chance EMV will Exceed (£m.)	8.00	8.22	4.24	101.38
<b>Project Investor, Fast Cycle Time, full IA Relief</b>				
Post-Tax Mean EMV (£m.)	-4.58	4.02	3.44	71.82
68% of EMV range (£m.)	-20.59 to +10.17	-4.4 to +11.76	+1.12 to +5.64	+10.11 to +134.73
95% of EMV range (£m.)	-43.24 to +30.79	-10.9 to +24.72	-0.51 to +9.72	-52.24 to +253.67
Chance of negative EMV	59%	33%	4%	11%
30% Chance EMV will Exceed (£m.)	3.86	7.64	4.36	97.02
<b>Project Investor, Fast Cycle Time Tax Credit</b>				
Post-Tax Mean EMV (£m.)	-3.51	4.67	3.38	71.92
68% of EMV range (£m.)	-18.59 to +10.11	-2.17 to +11.25	+1.21 to +5.41	+11.15 to +134.27
95% of EMV range (£m.)	-41.25 to +30.52	-8.43 to +23.87	-0.04 to +9.52	-47.96 to +249.25
Chance of negative EMV	56%	26%	3%	10%
30% Chance EMV will Exceed (£m.)	4.22	7.53	4.15	96.66
<b>Tax-Paying Investor, Fast Cycle Time IA limited</b>				
Post-Tax Mean EMV (£m.)	3.95	5.98	3.47	80.99

68% of EMV range (£m.)	-5.87 to +13.43	-0.4 to +11.94	+1.33 to +5.51	+21.81 to +140.25
95% of EMV range (£m.)	-16.99 to +34.51	-3.27 to +24.07	+0.24 to +9.52	-7.95 to +263.8
Chance of negative EMV	38%	19%	1%	4%
30% Chance EMV will Exceed (£m.)	7.91	8.07	4.19	101.20

**Project Investor, Fast Cycle Time IA limited**

Post-Tax Mean EMV (£m.)	-4.59	3.99	3.42	71.72
68% of EMV range (£m.)	-20.59 to +10.10	-4.4 to +11.68	+1.12 to +5.6	+10.11 to +134.64
95% of EMV range (£m.)	-43.24 to +30.69	-10.9 to +24.62	-0.51 to +9.68	-52.24 to +253.51
Chance of negative EMV	58%	33%	4%	11%
30% Chance EMV will Exceed (£m.)	3.86	7.64	4.32	96.88

**Tax-Paying Investor, Fast Cycle Time immediate IA relief**

Post-Tax Mean EMV (£m.)	7.36	7.53	3.96	89.03
68% of EMV range (£m.)	-2.07 to +16.51	+1.05 to +13.58	+1.73 to +6.11	+29.65 to +148.2
95% of EMV range (£m.)	-8.99 to +36.84	-1.77 to +25.78	+0.6 to +10.14	+8.45 to +268.59
Chance of negative EMV	24%	8%	1%	1%
30% Chance EMV will Exceed (£m.)	10.65	9.80	4.74	107.84

**Project Investor, Fast Cycle Time interest on IA**

Post-Tax Mean EMV (£m.)	-1.40	7.13	5.28	120.76
68% of EMV range (£m.)	-20.59 to +16.58	-4.4 to +18.19	+1.39 to +9.18	+17.98 to +219.9
95% of EMV range (£m.)	-43.24 to +53.46	-10.9 to +41	-0.51 to +16.45	-52.24 to +385.18
Chance of negative EMV	56%	32%	4%	10%
30% Chance EMV will Exceed (£m.)	6.45	11.13	6.59	163.09

The mean expected pre-tax EMVs are seen to be positive in 3 of the 4 regions, but the values are clearly less than the case with the fast cycle time, reflecting the larger appraisal costs and the longer time to first production. The prospective return is highest in the W of S region. In the other 3 regions the expected returns to a tax-paying investor are low. Prospective returns to project investors are distinctly below these to the tax-paying investor, with a notably greater chance of making a loss. Even

with full IA relief for exploration the expected returns are negative for the project investor in the CNS and NNS.

Many cases were again found where the project investor was unable to obtain the full benefits of the tax allowances. The findings follow the pattern discussed above for the fast cycle case. It was again found that, for the tax-paying investor, the most potent of the allowances was immediate IA relief against other field income. This finding applies to all 4 regions of the UKCS. For project investors the most potent of the allowances examined was found to be interest on unused IA allowances from the time at which the allowance was eligible to be activated. This finding applied to 3 of the 4 regions. In the case of the NNS the tax credit scheme was slightly more potent than interest on the unused IA allowance. The investor already in a tax-paying position has no need of this allowance.

Table 4

Comparative Returns After Cost Reductions Slow Cycle time

**Reduced Costs**

**Tax-Paying Investor,  
Slow Cycle Time, full IA  
relief**

Pre-Tax Mean EMV (£m.)	<b>-6.26</b>	0.21	2.64	95.47
68% of EMV range (£m.)	-21.84 to +8.9	-9.32 to +9.28	-0.52 to +5.78	+4.91 to +187.54
95% of EMV range (£m.)	-43 to +37.6	-15.12 to +27.92	-1.97 to +12.18	-54.8 to +361.85
Chance of negative EMV	68%	57%	25%	14%
30% Chance EMV will Exceed (£m.)	0.81	3.51	3.68	131.08
Post-Tax Mean EMV (£m.)	1.30	2.58	2.17	62.85
68% of EMV range (£m.)	-6.77 to +9.18	-2.68 to +7.55	+0.4 to +3.89	+14.81 to +112.71
95% of EMV range (£m.)	-16.83 to +25.62	-4.99 to +17.47	-0.49 to +7.23	-10.24 to +206.91
Chance of negative EMV	48%	38%	8%	6%
30% Chance EMV will Exceed (£m.)	4.75	4.31	2.77	80.07

**Project Investor, Slow  
Cycle Time, full IA  
Relief**

Post-Tax Mean EMV (£m.)	-7.15	-0.58	1.99	55.58
68% of EMV range (£m.)	-20.81 to +6.53	-9.05 to +7.47	-0.42 to +4.21	+2.72 to +110.41
95% of EMV range (£m.)	-41.55 to +23.71	-14.61 to +18.52	-1.88 to +7.71	-52.53 to +204.68
Chance of negative EMV	68%	55%	21%	14%
30% Chance EMV will Exceed (£m.)	0.72	3.46	2.99	78.60

**Project Investor, Slow  
Cycle Time Tax Credit**

Post-Tax Mean EMV (£m.)	-5.95	0.67	2.09	55.19
68% of EMV range (£m.)	-18.81 to +6.55	-6.58 to +7.36	+0.16 to +3.97	+3.75 to +108.63
95% of EMV range (£m.)	-39.56 to +22.89	-12.14 to +17.34	-1.13 to +7.25	-48.25 to +202.87
Chance of negative EMV	67%	47%	13%	13%
30% Chance EMV will Exceed (£m.)	1.17	3.63	2.88	76.61

**Tax-Paying Investor,  
Slow Cycle Time IA  
limited**

Post-Tax Mean EMV (£m.)	1.24	2.47	2.13	62.71
68% of EMV range (£m.)	-6.78 to +9.08	-2.79 to +7.43	+0.36 to +3.85	+14.69 to +112.54
95% of EMV range (£m.)	-16.83 to +25.5	-5.09 to +17.36	-0.52 to +7.19	-10.32 to +206.75
Chance of negative EMV	48%	39%	9%	6%
30% Chance EMV will Exceed (£m.)	4.67	4.19	2.73	79.89

**Project Investor, Slow  
Cycle Time IA limited**

Post-Tax Mean EMV (£m.)	-7.16	-0.59	1.98	55.51
68% of EMV range (£m.)	-20.81 to +6.53	-9.05 to +7.47	-0.42 to +4.21	+2.72 to +110.27
95% of EMV range (£m.)	-41.55 to +23.63	-14.61 to +18.44	-1.88 to +7.68	-52.53 to +204.53
Chance of negative EMV	68%	55%	21%	14%
30% Chance EMV will Exceed (£m.)	0.72	3.46	2.99	78.48

**Tax-Paying Investor,  
Slow Cycle Time  
immediate IA relief**

Post-Tax Mean EMV (£m.)	4.48	4.22	2.67	70.21
68% of EMV range (£m.)	-3.41 to +12.02	-1.09 to +9.12	+0.86 to +4.45	+21.51 to +119.32
95% of EMV range (£m.)	-9.46 to +27.53	-3.42 to +19.17	-0.06 to +7.69	+2.78 to +216.31
Chance of negative EMV	33%	24%	3%	1%
30% Chance EMV will Exceed (£m.)	7.26	5.85	3.29	85.18

**Project Investor, Slow  
Cycle Time interest on  
IA**

Post-Tax Mean EMV (£m.)	-5.39	0.62	2.78	93.37
68% of EMV range (£m.)	-20.81 to +9.81	-9.05 to +9.75	-0.42 to +5.95	+6.55 to +179.95
95% of EMV range (£m.)	-41.55 to +39.23	-14.61 to +28.4	-1.88 to +12.36	-52.53 to +325.9
Chance of negative EMV	67%	55%	21%	13%
30% Chance EMV will Exceed (£m.)	1.52	3.97	3.82	131.60

#### 4. Summary and Conclusions

In this paper the prospective pre-tax and post-tax returns facing an explorationist in the UKCS have been examined. The analysis highlights the risks involved in the cycle of activities through the exploration, appraisal, development and production stages. Extensive use is made of the Monte Carlo technique to acknowledge these risks and measure their consequences for the expected returns.

The analysis requires several assumptions to be made regarding the factors which determine the expected returns. Their values vary across the regions of the UKCS, and the modelling was conducted separately for the CNS, NNS, SNS and W of S regions. Exploration and appraisal success rates were based on the experience over the past few years. It is assumed that substantial cost reductions for exploration, appraisal, development, and operations in the CNS, NNS, W of S and SNS are attained. Two cases regarding the cycle time from first exploration to first production (termed fast and slow) were modelled.

For the Monte Carlo simulations the size of field which could be discovered in a region was made a stochastic variable. The distribution was modelled as lognormal, with the mean based on experience over the past few years. The standard deviation selected was designed to incorporate the wide range that could be anticipated, again based on recent experience. Field development costs were also considered as a

stochastic variable. The distribution was taken to be normal with the mean value determined by experience over the past several years plus the attainment of substantial cost reductions. The standard deviation was selected to reflect the range which could be expected. Oil and gas prices were also modelled as stochastic. The mean oil price was set at \$55 per barrel in real terms and the gas price at 40 pence per therm. The distributions were set as normal, with the standard deviations chosen reflecting a wide range of possible values for the oil price and a lesser range for the gas price. The behaviour of both prices was taken to be mean-reverting through time.

The modelling was undertaken with two scenarios regarding the tax position of the investor. In the first he is taken to be in a tax-paying position at the time of the exploration and can thus set off his allowances against income from other fields. In the second scenario it is assumed that the investor is not in a tax-paying position at the time of the exploration, appraisal, and development, and thus carries forward his allowances to be set against the income from a discovery.

Several tax arrangements were examined in addition to the present scheme. These are (1) the granting of eligibility of unsuccessful exploration costs for the investment allowance for Supplementary Charge, (2) a refundable tax credit for exploration to be paid to an investor who has no other current income against which to set his allowances, (3) the ability to offset the investment allowance against income other than that to which the new investment relates, and (4) the award of interest (as for the Ring Fence Expenditure Supplement) when the investment allowance, though eligible to be activated, cannot in practice be used because the income available to the investor is

insufficient to absorb the allowance. All have been discussed in recent months.

Key findings of the study are that mean expected pre-tax returns in the CNS, NNS, and SNS are modest with substantial chances of losses. In the W of S region mean prospective returns could be significantly positive though the investment costs are very high there. The present tax system reduces prospective returns on investments which are only modestly profitable, and share in the losses when these occur. Prospective post-tax returns to investors already in a tax-paying position are higher than those for a project investor. The RFES does not always fully compensate for the inability of the project investor to utilise his eligible allowances.

For the investor already in a tax-paying position the allowance which was found to be most potent was the ability to utilise the IA for SC against income from fields other than the one to which the investment relates. This is consistent with the ring fence applied to all fields in the UKCS, and represents a timing improvement to the investor. The enhancement to prospective returns to the explorer is generally worthwhile. When expected returns are extremely low or negative the loss-sharing can result in the post-tax EMV exceeding the pre-tax value. But this is most unlikely to occur for projects being seriously examined.

For the project investor the most potent allowance was found to be interest on the IA which could not be used at the time it was eligible for activation. This was found to be the case for the CNS, SNS and W of S regions. For the NNS the tax credit for exploration was slightly more potent. The effect of the interest allowance was generally found to be

quite potent in enhancing returns. At the RFES interest rate it could happen that expected post-tax returns could exceed pre-tax returns, though this is unlikely in situations where serious consideration to exploration is likely to be considered. Restrictions to the interest allowance could, of course, be introduced.

In the current investment environment in the UKCS it was found that in many cases the investor could not utilise the full reliefs to which he was entitled. This was particularly the case with the project investor who often did not have enough income from his discovery against which to offset all his allowances. Nevertheless, interest on the IA to which he was entitled did increase his overall return.

The study found that the tax credit for exploration costs produced moderate increases in prospective returns for the project investor, despite the fact that the benefits accrue in the early years of the cycle of events determining the prospective returns. The many other factors determining the investor's returns, including the timing of effective relief for all his allowances, play a major role in determining the integrated returns<sup>1</sup>.

In the absence of more radical changes to the tax system, (which currently does not appear very likely), the conclusion is that the modifications discussed above can contribute to the enhancement of the exploration effort. Given the continuation of relatively low oil and gas

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<sup>1</sup> Experiments were undertaken to quantify the possible benefits of the tax credit from the perspective of reducing the net cost of an exploration programme and thereby increasing the size of the exploration effort. For example, with a 50% tax credit and an exploration budget of \$100m. 2 exploration wells rather than 1 well could be drilled. If the prospective success rate was 30% for each of the wells the chance of making at least one discovery becomes  $0.3+0.3^2=0.39$ . The consequence of this was modelled. The effect on investor returns was found to be not very strong in the typical case when the prospective integrated returns were quite modest. The inability of the project investor to utilise all his allowances contributed to this result. In the case where the prospective integrated returns were larger the effect of the enhanced success rate was found to be stronger.



prices the study demonstrates the importance of the interaction of the tax system with all the exploitation costs. If costs can be reduced further, investors, particularly those not in a current tax-paying position, can obtain fuller use of all the allowances to which they are entitled. There is thus a double benefit from cost reduction in the present difficult environment.