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No. 127

**The Full Cycle Returns to Exploration  
in the UK Continental Shelf**

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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 CO<sub>2</sub> 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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# **The Full Cycle Returns to Exploration in the UK** **Continental Shelf**

Professor Alexander G. Kemp  
And  
Linda Stephen

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# **The Full Cycle Returns to Exploration in the UK**

## **Continental Shelf**

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### **1. Introduction**

The rate of return on investment in the UK Continental Shelf (UKCS) has generally been discussed in terms of individual field developments. But full cycle returns to the exploration effort are important in understanding the investment climate and how it is changing. It is clear that the geological prospectivity and the size and costs of new developments have been changing over the years. Oil and gas prices have also varied markedly technological change has been continuous. All these factors affect the prospective returns to the overall exploration effort. This paper examines the prospective returns to exploration undertaken in the period 2003 to 2012. Two time periods for the exploration activities were considered, namely 2003-2007 inclusive, and 2008-2012 inclusive. They were chosen in order that any changes in the expected returns over the past decade could be detected.

### **2. Methodology and Data**

The data employed in the study for the numbers of exploration and appraisal wells and their costs are taken from the DECC website ([www.gov.uk/oil-and-gas-wells](http://www.gov.uk/oil-and-gas-wells)). The data on discoveries and actual and potential field developments were obtained from the OGUK field database.

The exploration success rates for the two time periods were calculated and gave the following results:

**Table 1**

<b>Exploration Effort, Discoveries and Success Rates</b>		
		2008-2012
Exploration Wells	291	131
Discoveries	104	48
Success Rate (%)	35.74	36.64

It is noteworthy that the number of discoveries reported by operators was considerably higher than those recorded as “significant discoveries” in the [www.gov.uk/oil-and-gas-wells](http://www.gov.uk/oil-and-gas-wells) site. The DECC website indicates 80 significant discoveries in the 2003-2012 period while the operators indicate 104 discoveries. The DECC website indicates 36 significant discoveries in the period 2008-2012 whilst the operators indicate 48. Definitional differences explain the variations.

The OGUK database provided information on the discoveries which were either (a) sanctioned developments (42 from 2003 and 17 from 2008), (b) probable developments (11 from 2003 and 6 from 2008), and (c) possible developments (9 from 2003 and 6 from 2008). These together indicated appraisal success. The results were that the successful appraisal rate was 59.62% in the period 2003 to 2012 and 60.42% in the period 2008 to 2012. Thus the overall exploration and appraisal success rates were 21.3% for the 2003-2012 period and 22.1% for the 2008-2012 period.



The next step was to estimate the number of appraisal wells attributable to the exploration effort and discoveries. In the period 2003-2012 there were 1.38 appraisal wells for every exploration well and in the period 2008-2012 the corresponding figure was 1.49 appraisal wells for each exploration one. In the first (optimistic) case it was assumed that there would be one appraisal well for each discovery. It was assumed that there were no attributable appraisal wells in the first year of the exploration period considered (i.e. 2003 and 2008). It was then assumed that the number of appraisal wells in the following years was equal to the 3-year moving average of the number of discoveries. Thus by 2015 the appraisal programmes associated with the discoveries were assumed to have been completed. In the second case 2 appraisal wells per discovery were assumed. The year 2013 was chosen as the base year. Thus historic costs were uplifted not only for inflation but to 2013 values for discounting purposes.

Up to 2012 the average exploration and appraisal costs enhanced to the base year of 2013 were employed. From 2013 onwards the cost was assumed to be £32.69 million (real) per well (including associated seismic).

The next step was to calculate the cash flows associated with the discoveries and potential field developments. The present tax system was assumed to continue. Details of recent changes are shown in Appendix 1.

#### 1) Existing Tax Paying Ongoing Basis

In this scenario the investor is assumed to be already in a tax-paying position. Thus relief at 100% first year for corporation tax and SC was assumed for all exploration and appraisal expenditures. Cashflows (at

2013 prices and base year) from 62 fields + incremental projects (sanctioned 42 + probable and possible fields 20 + incremental projects 6) were calculated to indicate the cashflows generated from the 59.62% appraisal success rate in the 2003 to 2012 period. Similarly, the cashflows (again at 2013 prices and base year) from the 29 fields (sanctioned 17 + future fields 12 + incremental projects 2) were calculated to represent the cashflows generated from the 60.42% appraisal success rate in the 2008 to 2012 period.

## 2) Project Basis.

In this scenario the investor is not in a tax-paying position when the E and A expenditures are undertaken. He is assumed to carry forward his allowances including the Ring Fence Expenditure Supplement (RFES for SC). This incorporates the changes made in 2006 and 2012. The allowances are utilised when income from the discoveries is generated.

Discoveries which are not currently regarded as potential developments are here termed technical reserves. It is, however, conceivable that they will be developed at a later date. The analysis took this into account by estimating the possible costs and phasing of these developments. Firstly, the expected phasing of development through time of the fields in the sanctioned, probable, and possible categories as seen by the operators was calculated. It was assumed that a broadly similar phasing would apply to the potential development of the technical reserves. The technical reserve fields were thus assumed to be developed over the period 2017 to 2028. In the 2003-2012 period with the 59.62% appraisal success rate case there were 42 discoveries in the technical reserves category. In the 2008-2012 with the 60.42% appraisal success rate there were 19 discoveries in the technical reserve category. One further appraisal well

was assumed to be drilled for each of these fields in the year prior to development in the first case and two further appraisal wells in the second case.

It is by no means certain that the fields in the technical reserves category will actually be developed in the time period postulated (or, indeed, in any future period). The uncertainty surrounding this was analysed with the aid of the Monte Carlo technique. The appraisal success rates noted above relating to sanctioned probable and possible field developments were defined as the base (appraisal) success rates. It was then postulated that there would be a distribution of enhanced appraisal success rates from that base to a maximum of 100%. This distribution was assumed to be lognormal and could have any value from zero to (1- base value). Experiments were undertaken to determine a mean value which ensured that there were very few observations outside the postulated range. A mean enhanced appraisal success value of 0.13 with a standard deviation of 60% of that mean was found to produce a satisfactory distribution. A distribution indicating the chances of different numbers of fields in the technical reserves category becoming developed was then established. The Monte Carlo technique was employed to determine the distribution of the particular fields consistent with this overall distribution.

The costs of developing of the technical reserves are not reported in the OGUK database, as they are not currently being examined for development. Accordingly, estimates were made. It was felt that the costs would be higher than the average for current and prospective new developments. The average development costs for recent new developments (rounded) are \$15/boe in the SNS, \$21/boe in the CNS, \$18/boe in the NNS, and \$18/boe in WoS. When no figures exist for the

development costs of the technical reserves a premium of \$5/boe was added to those for the average of the new developments noted above.

Based on the above assumptions the post-tax cash flows pertaining to the fields in the technical reserves category were calculated. The aggregate cash flows emanating from the whole range of enhanced success rates from the base value to 100% were calculated.

The real post-tax internal rates of return (IRR) and real post-tax net present values (NPV) at various discount rates were then calculated to the base year 2013. The price scenarios employed from 2013 onwards were (a) \$70/bbl and 40 pence/therm, and (b) \$90 and 55 pence in constant real terms.

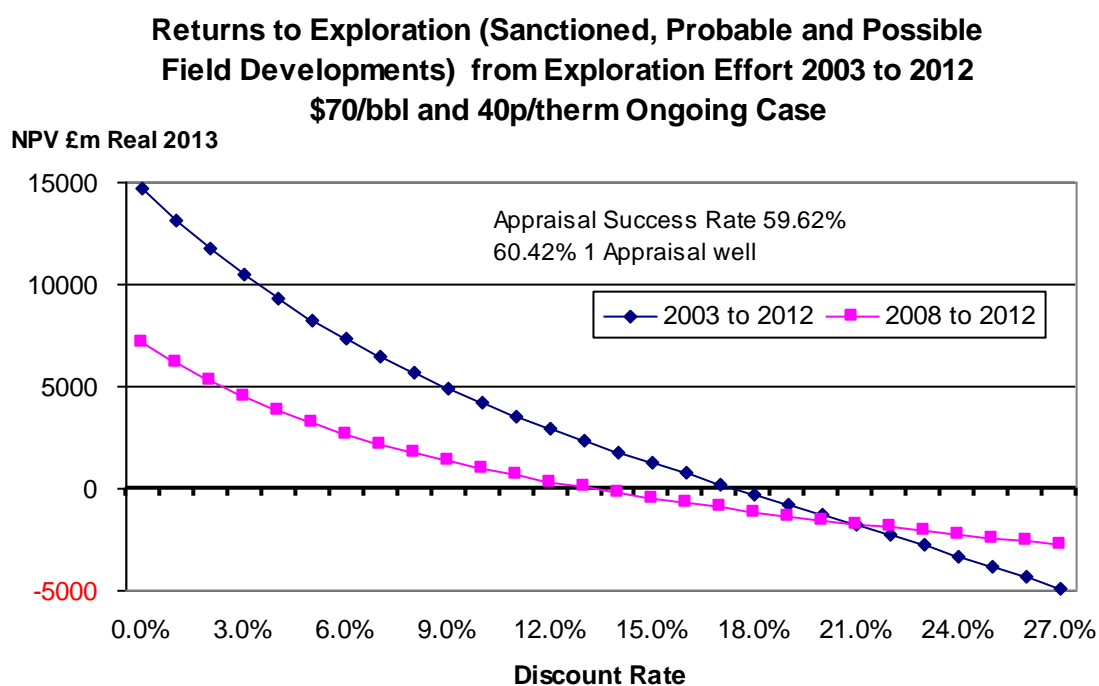
A breakdown of the returns was undertaken to show the returns when the developed fields from the exploration effort were categorised into (a) sanctioned, (b) sanctioned plus incremental, (c) sanctioned plus incremental, plus probable, (d) sanctioned plus incremental, plus probable, plus possible, and (e) sanctioned plus incremental, plus probable, plus possible, plus technical reserves.

### 3. Results

#### (a) Existing Tax-Paying Ongoing Basis, \$70, 40 pence Screening Prices

The results under the \$70, 40 pence price scenario are shown in Chart 1 for the sanctioned, probable and possible field developments under the ongoing tax-paying case.

Chart 1

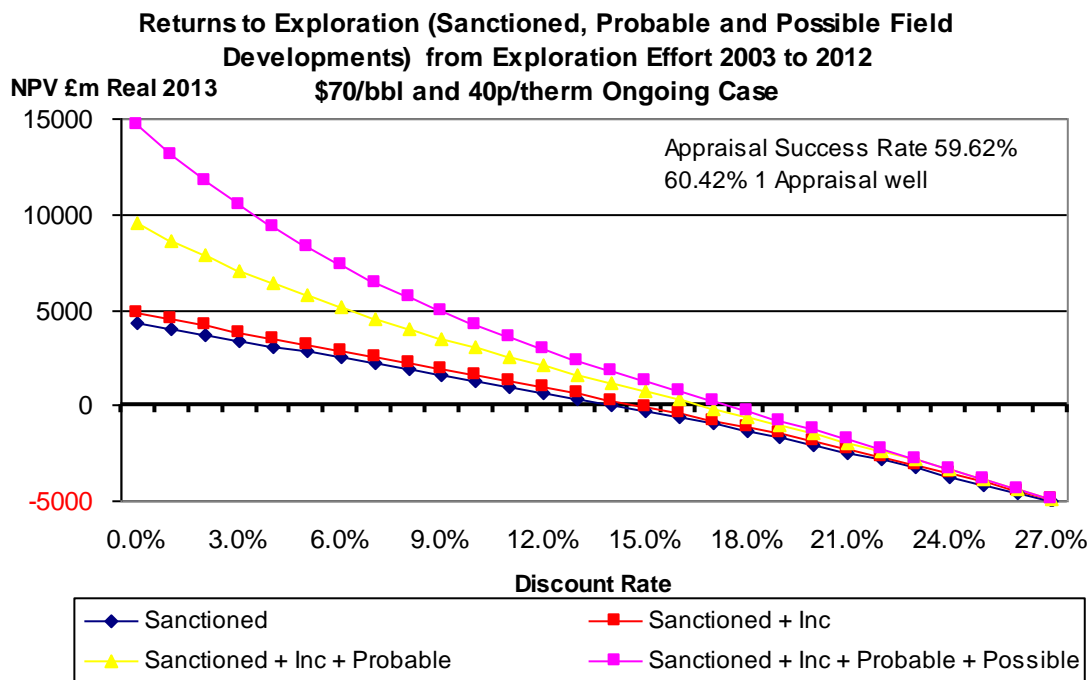


For the exploration effort in the 2003-2012 period the real, post-tax internal rate of return (IRR) is 17.46% and for the period 2008-2012 13.21%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £4.22 billion, and for the 2008-2012 period it is £0.98 billion. The NPV profile for the 2008-2012 period is obviously at a lower level than that for the period because of the much lower number of

developments. The profile for the 2003-1012 case falls at a faster pace as the discount rate increases because of the longer time period involved.

In Chart 2 the returns are categorised according to the status of field developments for the effort.

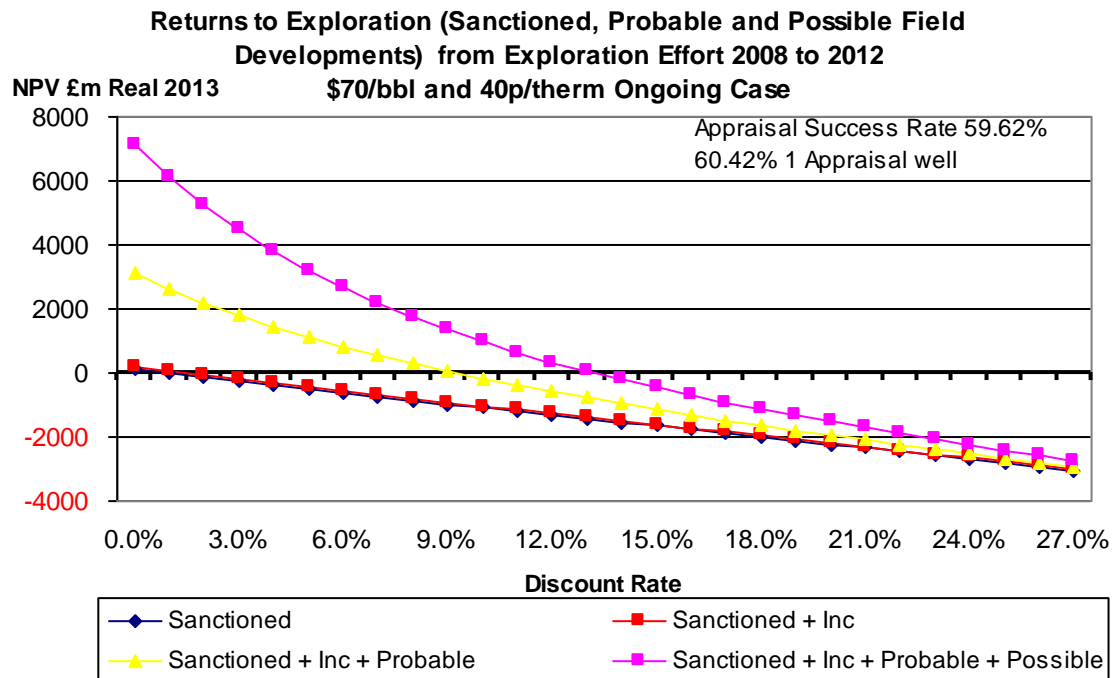
Chart 2



If only sanctioned fields are developed the IRR is 14.15%. The aggregate NPV at 10% is £1.3 billion. When incremental projects are added the IRR becomes 14.82% and the aggregate NPV at 10% is £1.58 billion. When probable fields are added the IRR increases to 16.66%. The aggregate NPV at 10% becomes £3.0 billion. When the possible fields are added the IRR becomes 17.46% and the aggregate NPV at 10% becomes £4.2 billion.

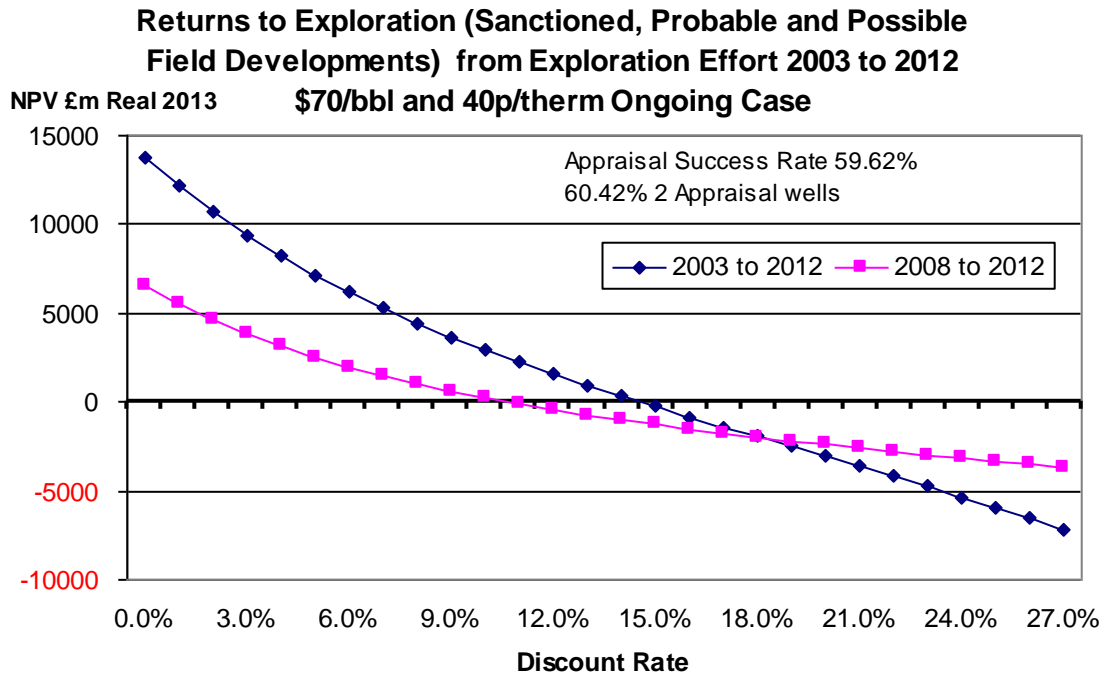
In Chart 3 the returns are categorised according to the status of field developments for the 2008-2012 effort.

Chart 3



If only sanctioned fields are developed the IRR for the 2008-2012 effort is 0.98%. The aggregate NPV at 10% is negative £1.1 billion. When incremental projects are added the IRR becomes 1.52%. The aggregate NPV at 10% is negative £1.0 billion. When probable fields are added the IRR increases to 9.23%. The aggregate NPV at 10% becomes negative £172 million. When the possible fields are also added the IRR becomes 13.21%. The aggregate NPV at 10% becomes £986 million.

Chart 4



If two appraisal wells per exploration success were to be required the IRR for the period 2003-2012 is 14.58% and for the period 2008-2012, 10.72%. The aggregate NPV at 10% becomes £2.9 billion for the 2003-2012 exploration effort and £250 million for the 2008-2012 period.

If only sanctioned fields are developed and 2 appraisal wells are required the IRR for the 2003-2012 effort is 10.02%. The aggregate NPV at 10% is £7 million. When incremental projects are added the IRR becomes 10.78%. The aggregate NPV at 10% is £283 million. When probable fields are added the IRR increases to 13.38% and the aggregate NPV at 10% becomes £1.7 billion. When the possible fields are also added the IRR becomes 14.58% and the aggregate NPV at 10% becomes £2.9 billion.

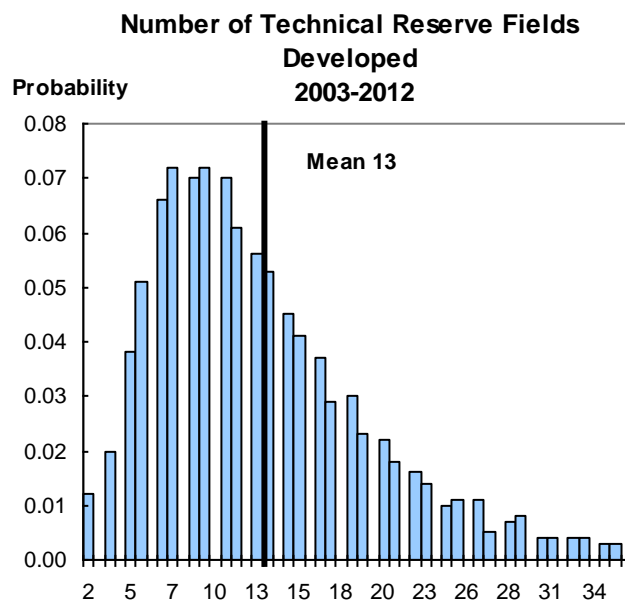


If only sanctioned fields are developed and 2 appraisal wells are required the IRR for the 2008-2012 effort is negative 3.32%. The aggregate NPV at 10% is negative £1.8 billion. When incremental projects are added the IRR becomes negative 2.77%. The aggregate NPV at 10% is negative £1.8 billion. When probable fields are added the IRR increases to 6.45% and the aggregate NPV at 10% becomes negative £907 million. When the possible fields are also added the IRR becomes 10.72%. The aggregate NPV at 10% becomes £250 million.

The Monte Carlo analysis produced a probability distribution for the number of field developments from the pool of technical reserves discovered in as shown in Chart 5.

Chart 5

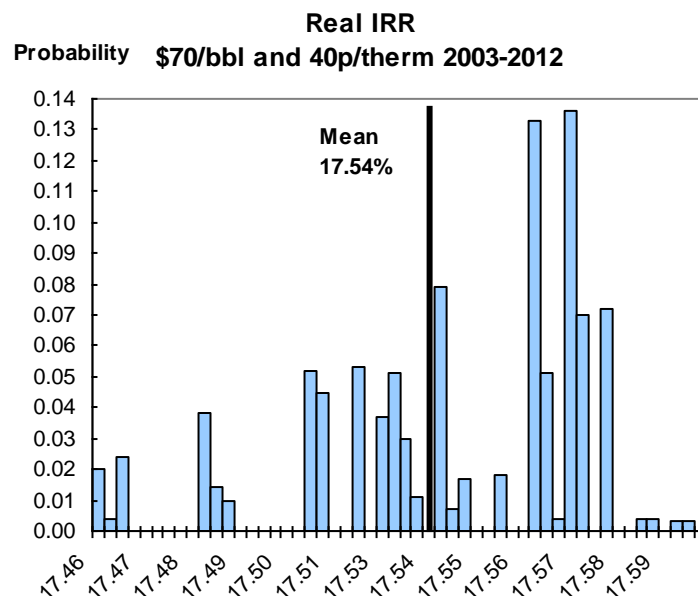
**Probability Distribution of Number of Field Developments from Technical Reserves from Exploration Effort**



The mean number of additional developments is 13 and the median number 11. The maximum is 41.

The possible enhancement to the IRR from these developments is shown in Chart 6. When the technical reserves are discovered there is 1 appraisal well associated with it, but, prior to development, there is assumed to be another appraisal well. The cashflow of the sanctioned, probable and possible fields with 1 appraisal well was then added to the cashflow of the technical reserves with 1 extra appraisal well to give the IRR in Chart 6.

Chart 6  
**Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70 40 pence Price Scenario (2 Appraisal wells)**

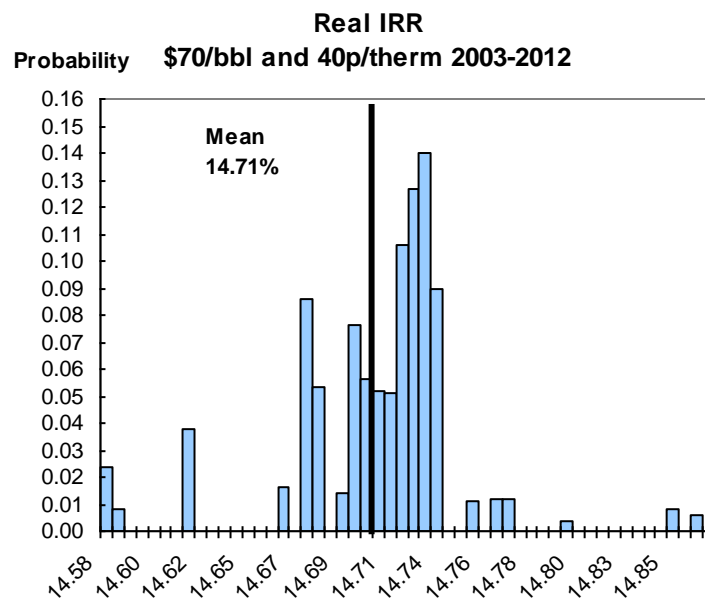


The development of the technical reserves slightly increases the overall expected IRR under this price scenario. The mean expected IRR becomes 17.54%, the median is 17.55%, and the maximum 17.85%. If

all 42 technical reserves had been developed the IRR would have been 17.86%.

The cashflow of the sanctioned, probable and possible fields with 2 appraisal wells was then added to the cashflow of the technical reserves with 2 extra appraisal wells to give the IRR in Chart 7.

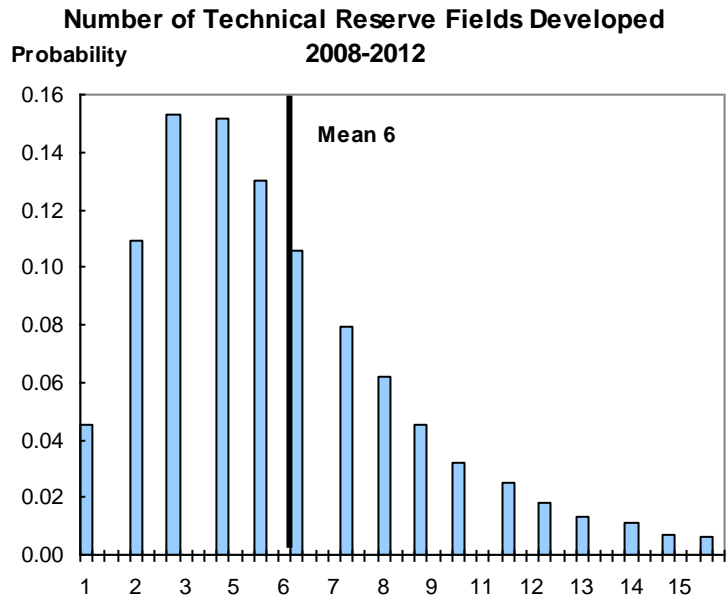
Chart 7  
**Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70 40 pence Price Scenario (3 Appraisal wells)**



With 2 appraisal wells the expected IRR is 14.71%, the median is 14.7%, and the maximum 15.16%. If all technical reserves had been developed the IRR would have been 15.18%.

The distribution of the number of field developments from technical reserves from the discoveries in the period 2008-2012 is shown in Chart 8.

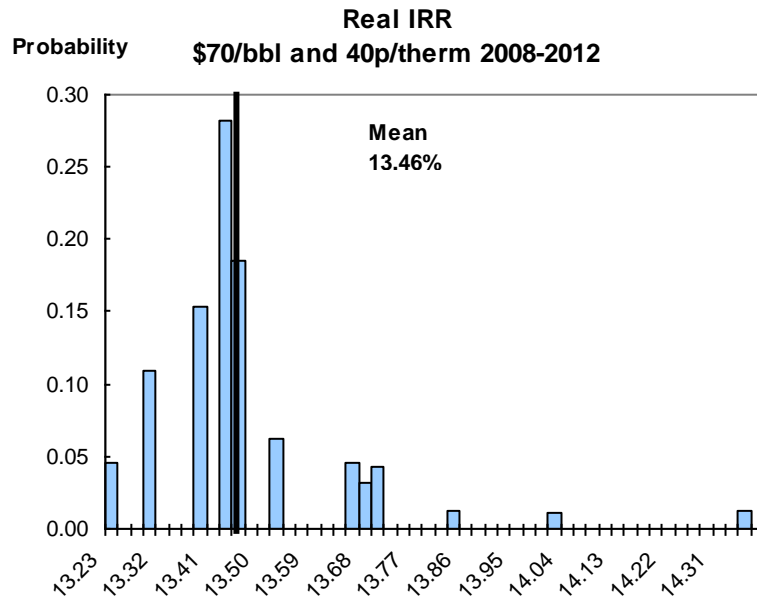
Chart 8  
**Probability Distribution of Number of Field Developments from  
 Technical Reserves from Exploration Effort 2008-2012**



The mean number of additional developments is 6 and the median number 5. The maximum is 18.

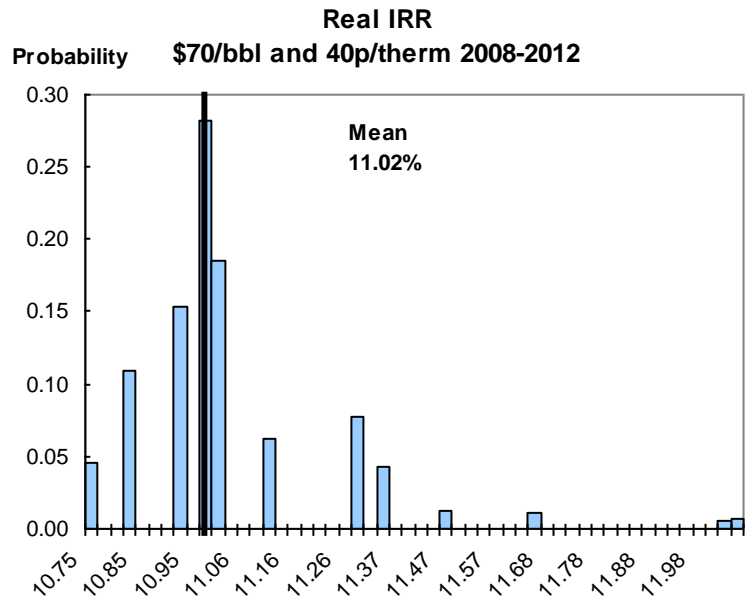
The possible enhancement to the IRR from these developments is shown in Chart 9.

Chart 9  
**Probability Distribution of Enhanced IRRs from Development of  
 Technical Reserves from Exploration Effort 2008-2012 under \$70, 40  
 Pence Price Scenario (2 Appraisal wells)**



Again the development of the fields in the technical reserves category slightly improves the expected rate of return. The mean overall IRR becomes 13.46%. The median value is 13.43% and the maximum value 14.45%. If all 19 technical reserves had been developed the IRR would have been 14.48%

Chart 10  
**Probability Distribution of Enhanced IRRs from Development of  
 Technical Reserves from Exploration Effort 2008-2012 under \$70, 40  
 Pence Price Scenario (3 Appraisal wells)**



With 3 appraisal wells the expected IRR is 11.02%, the median is 11%, and the maximum 12.15%. See Chart 10. If all technical reserves had been developed the IRR would have been 12.19%

The comparative contributions to the prospective returns from sanctioned, probable, and possible fields in the 2 periods are summarised in Charts 11 and 12.

Chart 11

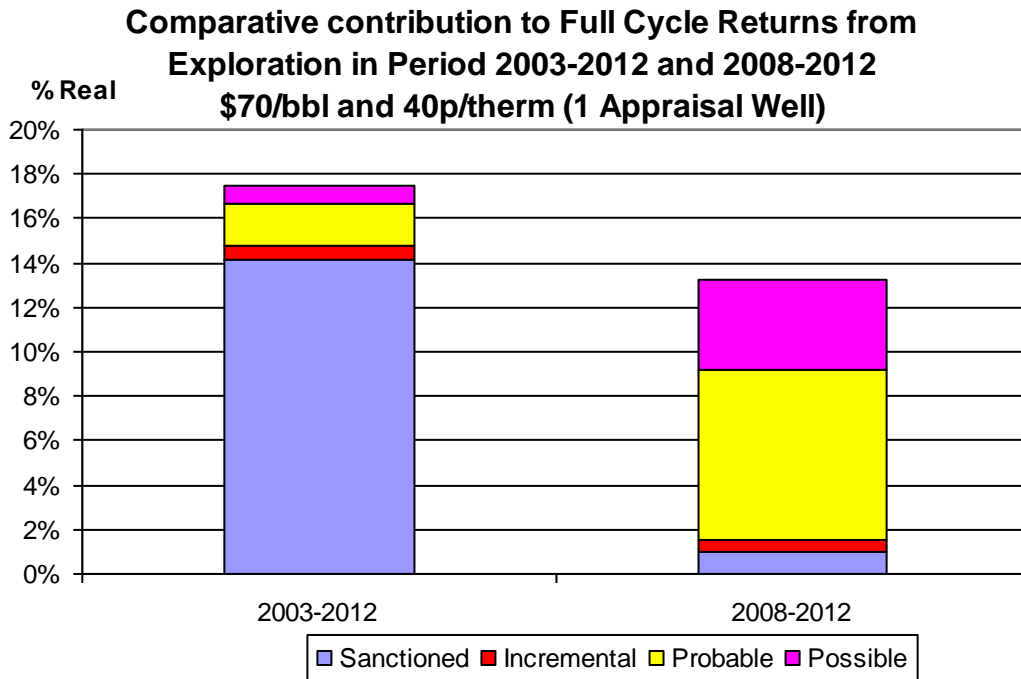
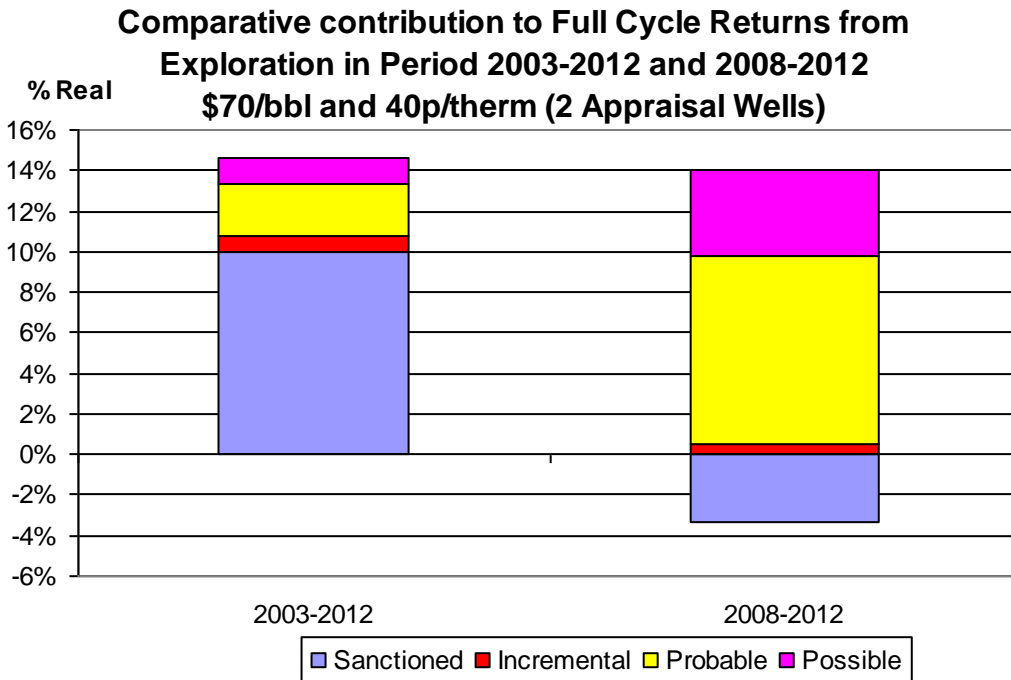


Chart 12

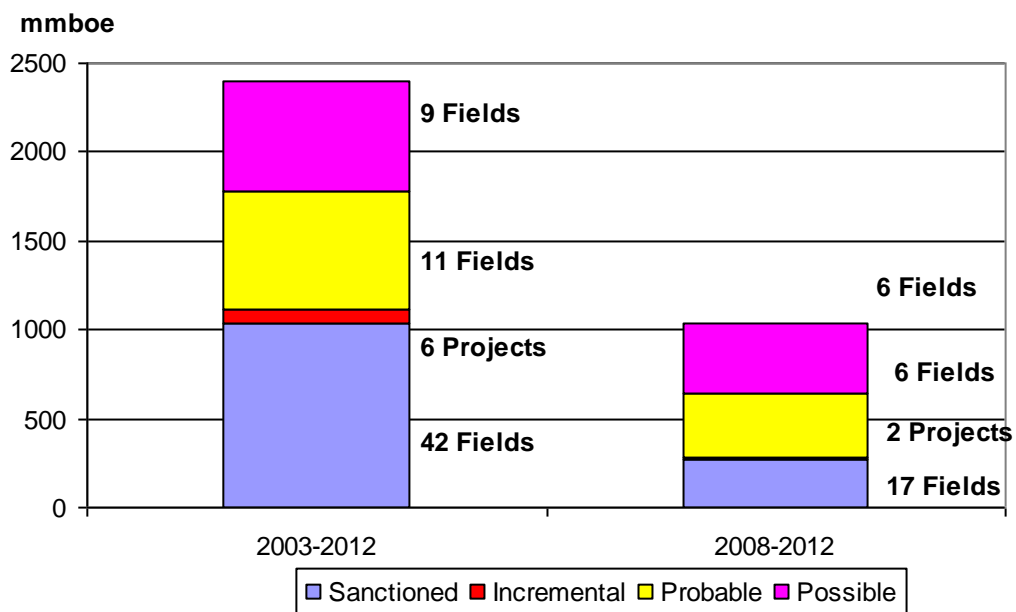


In the 2003-2012 period the sanctioned fields contribute most to the exploration IRR whether there is 1 appraisal well or 2. The probable fields' contribution follows that of the sanctioned fields and their contribution to the IRR increases with the number of wells. In the 2008-2012 period the sanctioned fields contribution to the IRR is greatly reduced. In fact the contribution is negative with 2 appraisal wells. In the shorter time period the probable fields make the largest contribution to the exploration IRR. These results are to be expected.

In Chart 13 the volumes of reserves and the numbers of fields in the sanctioned, probable, and possible categories are shown.

Chart 13

**Reserves Discovered by Development Category**



For the 2003-2012 period 62% of the fields and 43% of the reserves are in the sanctioned category. For the 2008-2012 period almost 55% of the fields and almost 26% of the reserves are in the sanctioned category. For the 2003-2012 period almost 28% of the reserves were in the probable



category, while for the period 2008-2012 almost 36% of reserves fall into this category.

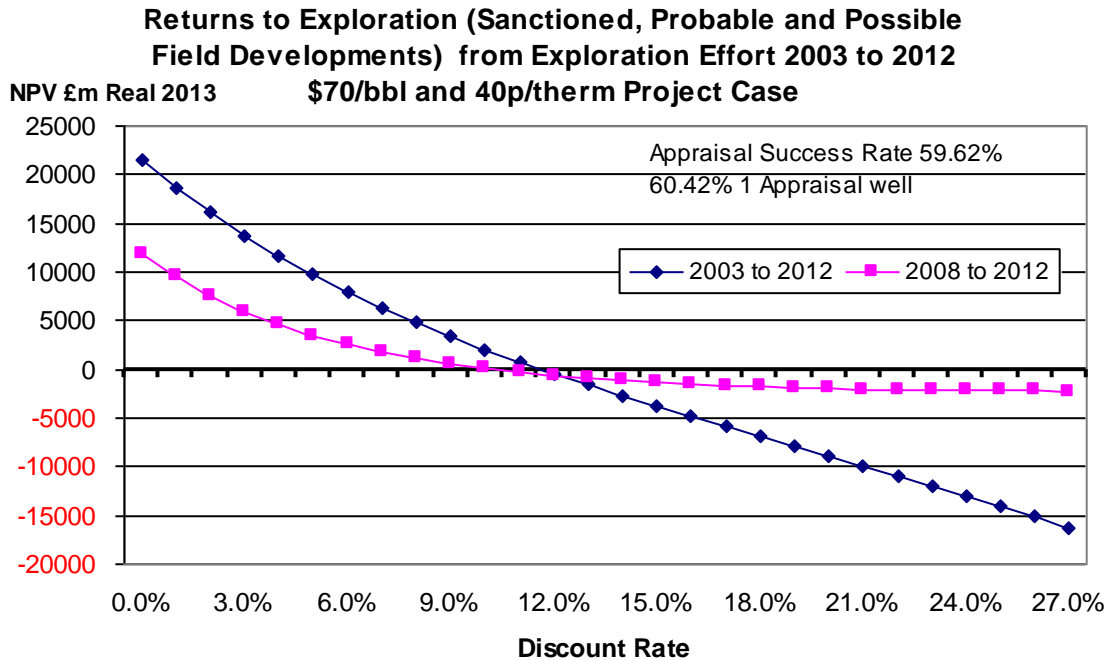
From this it can be deduced that, for the 2008-2012 period, the sanctioned fields, while accounting for 43% of the reserves, can produce only a tiny return (7.5%) on the total exploration effort. The successful development of the probable fields is essential to the achievement of a modest overall return. These fields are generally not yet on stream. They still face multiple risks including development cost and completion, and reserves risks as well as those relating to oil and gas prices.

The lower prospective return from the exploration effort in the 2008-2012 period compared to the one is due to a number of factors. Although the oil price exceeded \$100/bbl in 2008, 2011 and 2012 there were few fields discovered in the 2008-2012 period in a position to benefit from this. Real well costs in the 2008-2012 period were higher than they were in the earlier period. Development costs have also risen over time.

**(b) Project Basis, \$70, 40 pence Screening Prices**

The results under the \$70, 40 pence price scenario are shown in Chart 14 for the sanctioned, probable and possible field developments under the Project case.

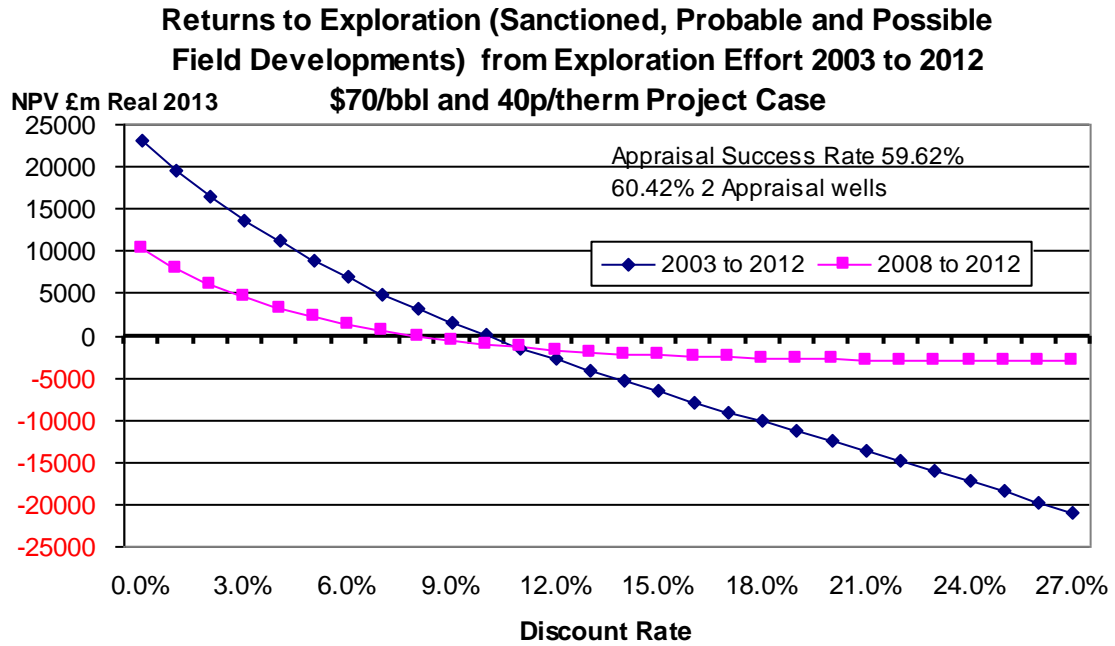
Chart 14



For the exploration effort in the 2003-2012 period the real, post-tax internal rate of return (IRR) under the Project basis is 11.65% and for the period 2008-2012 it is 10.12%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £2.04 billion, and for the 2008-2012 period £50 million.

The results for 2 appraisal wells are shown in Chart 15.

Chart 15

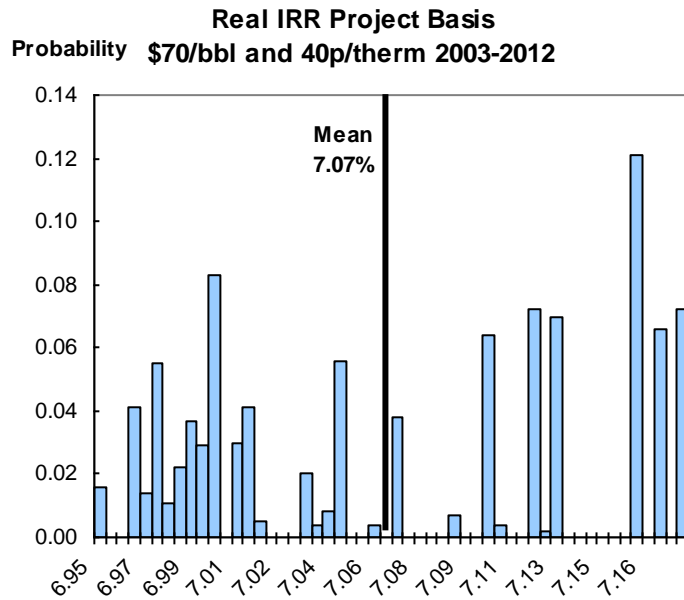


If two appraisal wells per exploration success were to be required the IRR for the 2003-2012 exploration effort falls to 10.02%, and for the 2008-2012 period to 7.8%. The NPV at 10% becomes £29 million for the 2003-2012 exploration effort and negative £1.1 billion for the 2008-2012 period.

The Monte Carlo analysis produced a probability distribution for the possible enhancement to the IRR from the addition of technical reserves under the Project basis as shown in Chart 16.

Chart 16

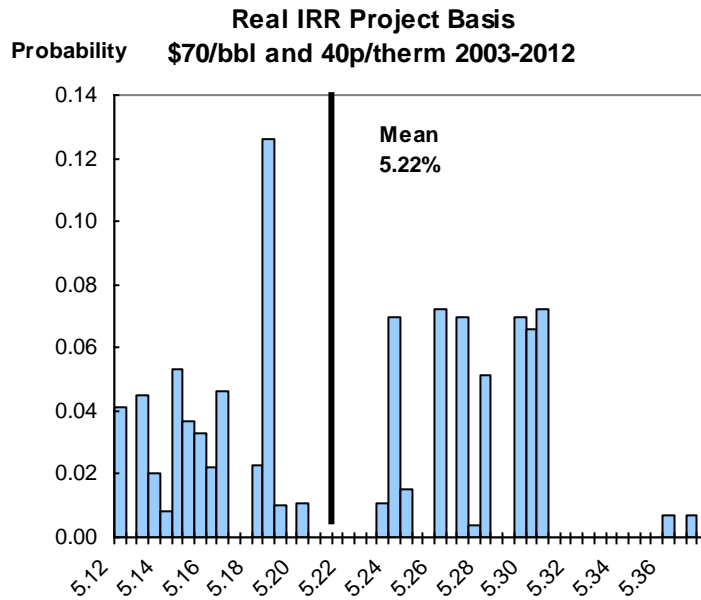
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70, 40 Pence Price Scenario (2 Appraisal wells)**



The development of the technical reserves reduces the overall expected IRR under this price scenario with Project based assumptions. The mean expected IRR changes from 11.65% to 7.07%, the median is 7.06%, and the maximum 7.4%.

Chart 17

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70, 40 Pence Price Scenario (3 Appraisal wells)**

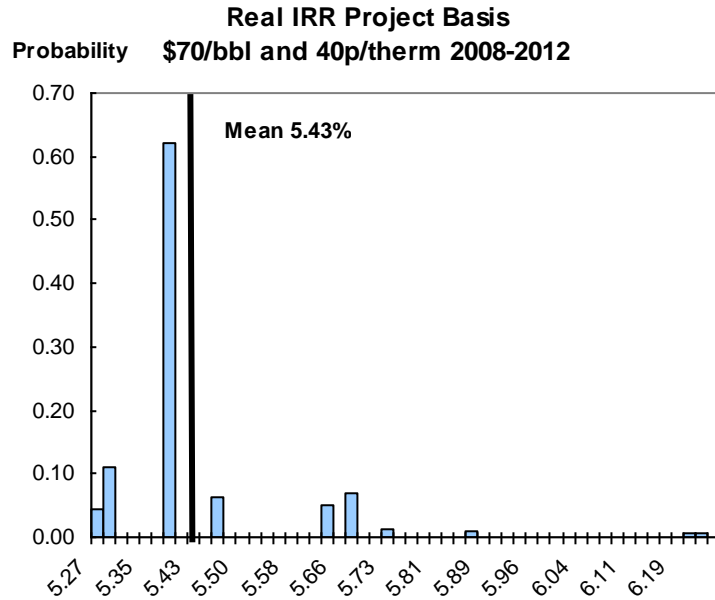


With 3 appraisal wells the expected IRR from the technical reserves is 5.22%, the median is 5.24%, and the maximum 5.71%.

The possible enhancement to the IRR from all the developments from exploration discoveries in the period 2008-2012 is shown in Chart 18.

Chart 18

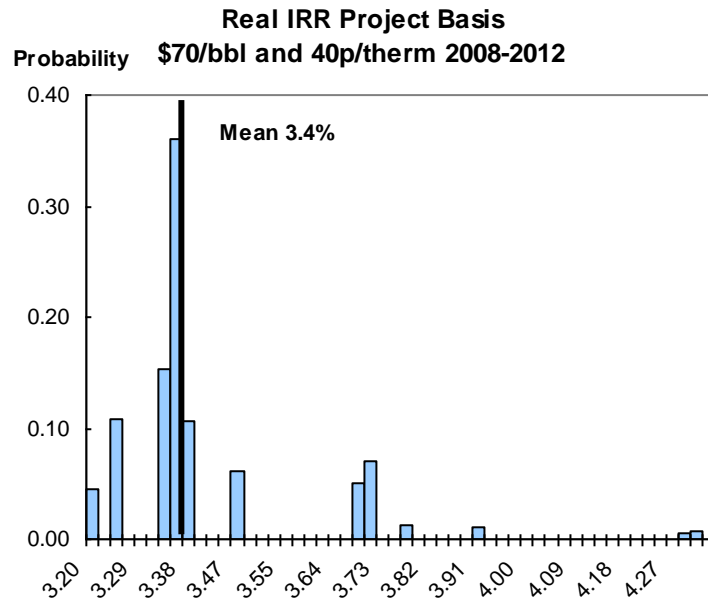
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (2 Appraisal wells)**



The development of the fields in the technical reserves category reduces the expected rate of return from 10.12% to 5.43%. The median value is 5.39% and the maximum value 6.34%.

Chart 19

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (3 Appraisal wells)**

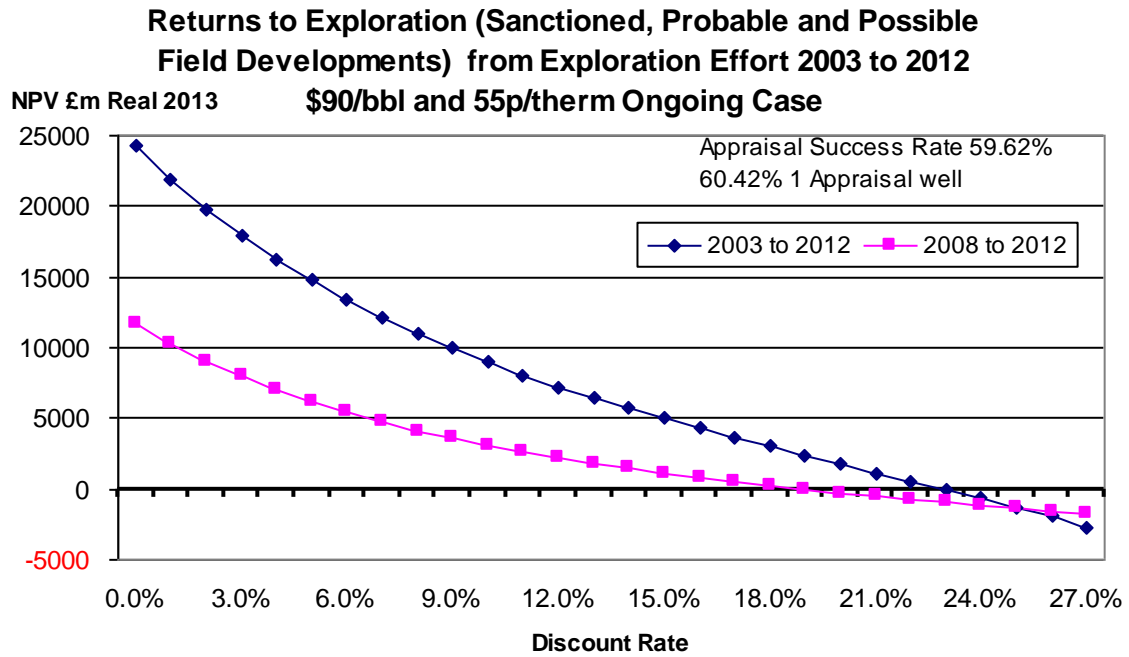


With 3 appraisal wells the expected IRR is 3.4%, the median is 3.3%, and the maximum 4.45%.

**(c) Existing Tax Paying Ongoing Basis, \$90, 55 pence Screening Prices**

The results under the \$90, 55 pence price scenario are shown in Chart 20 for the sanctioned, probable and possible field developments under the ongoing tax paying case.

Chart 20

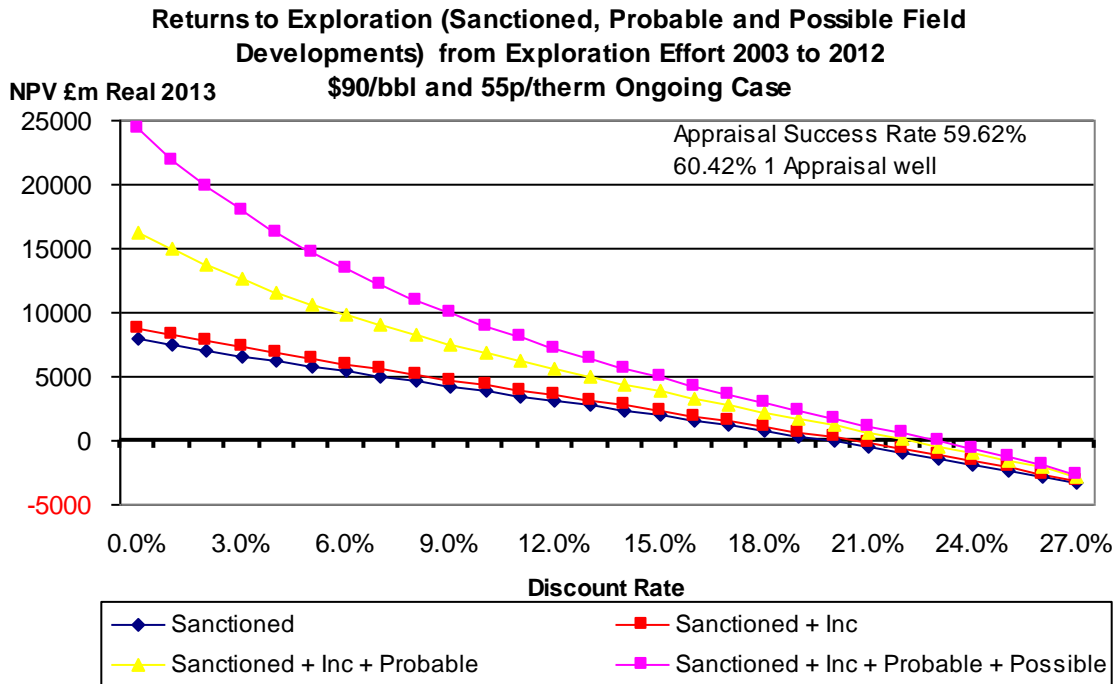


For the exploration effort in the 2003-2012 period the real, post-tax IRR is 22.92% and for the period 2008-2012 18.91%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £8.9 billion, and for the 2008-2012 period almost £3.1 billion.

In Chart 21 the returns are categorised according to the status of field developments for the 2003-2012 effort.



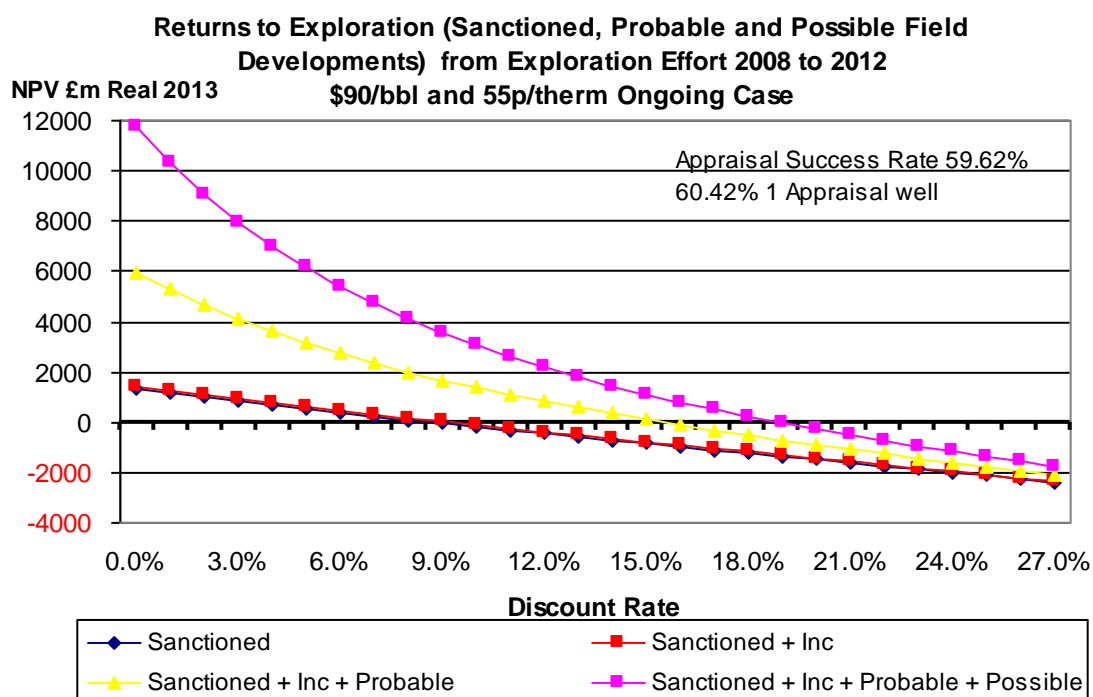
Chart 21



If only already sanctioned fields are developed the IRR is 19.92%. The aggregate NPV at 10% is £3.87 billion. When incremental projects are added the IRR becomes 20.59%. The aggregate NPV at 10% is £4.3 billion. When probable fields are added the IRR increases to 22.26%. The aggregate NPV at 10% becomes £6.88 billion. When the possible fields are also added the IRR becomes 22.92% and the aggregate NPV at 10% becomes £8.97 billion.

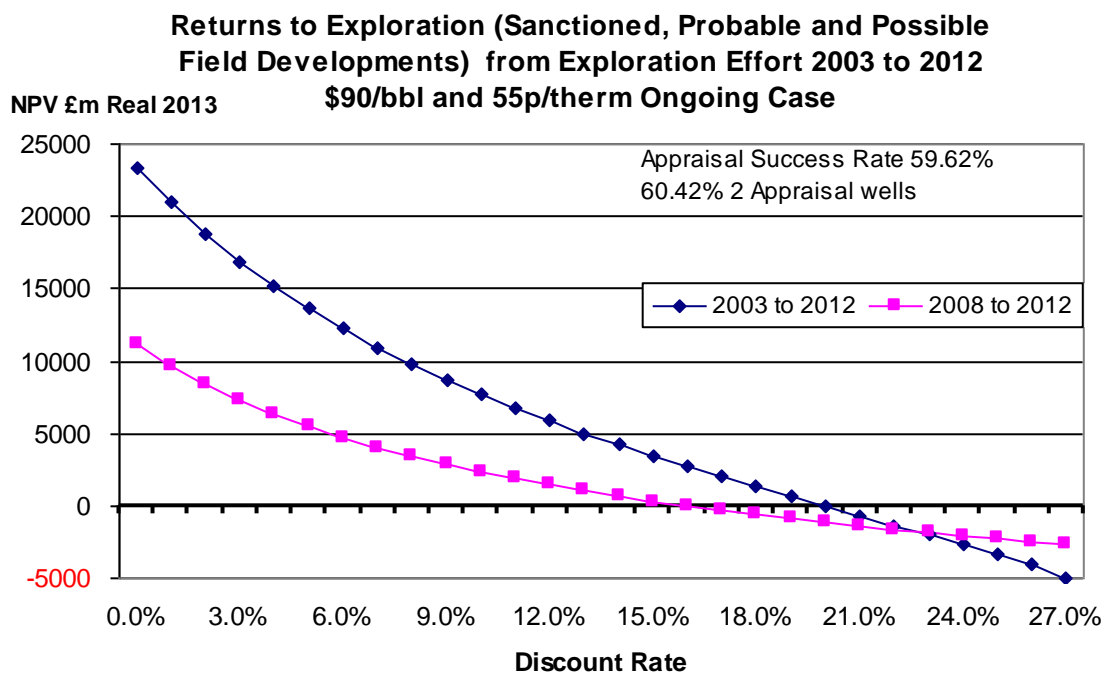
In Chart 22 the returns are categorised according to the status of field developments for the 2008-2012 effort.

Chart 22



If only already sanctioned fields are developed the IRR for the 2008-2012 effort is 8.71%. The aggregate NPV at 10% is negative £177 million. When incremental projects are added the IRR becomes 9.22% and the aggregate NPV at 10% is negative £108 million. When probable fields are added the IRR increases to 15.54%. The aggregate NPV at 10% becomes £1.38 billion. When the possible fields are also added the IRR becomes 18.91% and the aggregate NPV at 10% becomes £3.1 billion.

Chart 23



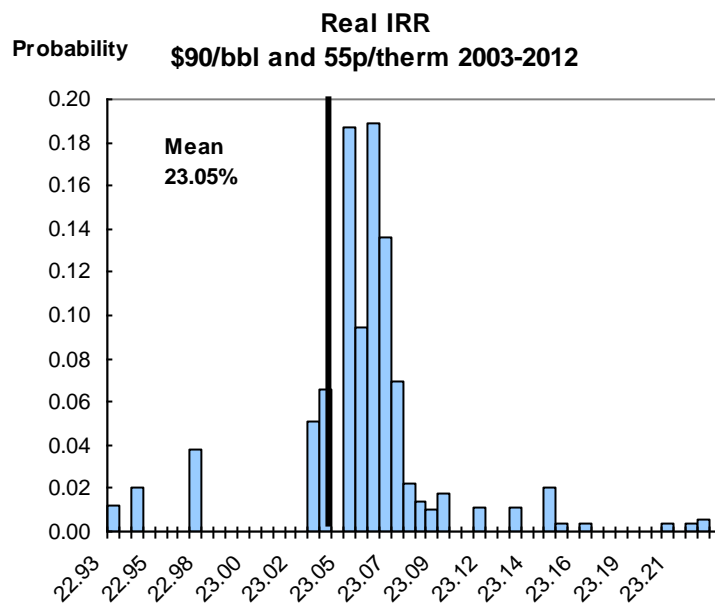
If two appraisal wells per discovery were to be required the IRR for the period 2003-2012 is 19.95% and, for the period 2008-2012, 16%. The aggregate NPV at 10% becomes £7.7 billion for the 2003-2012 exploration effort, and £2.3 billion for the 2008-2012 period.

If only already sanctioned fields are developed and 2 appraisal wells are required the IRR for the 2003-2012 effort is 16.05%. The aggregate NPV at 10% is £2.57 billion. When incremental projects are added the IRR becomes 16.79% and the aggregate NPV at 10% is £3.0 billion. When probable fields are added the IRR increases to 19%, and the aggregate NPV at 10% becomes £5.6 billion. When the possible fields are also added the IRR becomes 19.95% and the aggregate NPV at 10% becomes £7.7 billion.

If only already sanctioned fields are developed and 2 appraisal wells are required the IRR for the 2008-2012 effort is 4.07%. The aggregate NPV at 10% is negative £913 million. When incremental projects are added the IRR becomes negative 4.6%. The aggregate NPV at 10% is negative £844 million. When probable fields are added the IRR increases to 12.28% and the aggregate NPV at 10% becomes £646 million. When the possible fields are also added the IRR becomes 16%. The aggregate NPV at 10% becomes £2.3 billion.

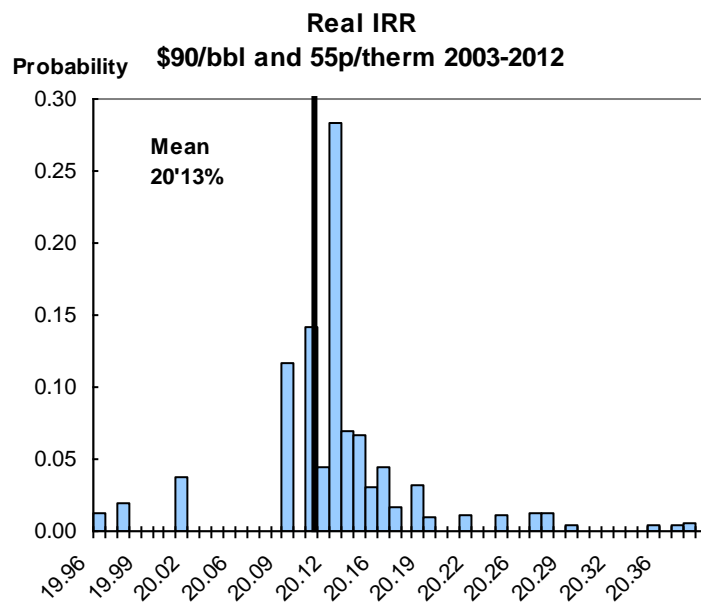
The Monte Carlo analysis produced a probability distribution for the number of field developments from the pool of technical reserves discovered in as shown in Chart 5 and the possible enhancement to the IRR from these developments with the \$90 price is shown in Chart 24.

Chart 24  
**Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90 55 pence Price Scenario (2 Appraisal wells)**



The development of the technical reserves slightly increases the overall expected IRR. The mean IRR is 23.05%, the median is 23.05%, and the maximum 23.44%. If all 42 technical reserves had been developed the IRR would have been 23.44%.

**Chart 25**  
**Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90 55 pence Price Scenario (3 Appraisal wells)**

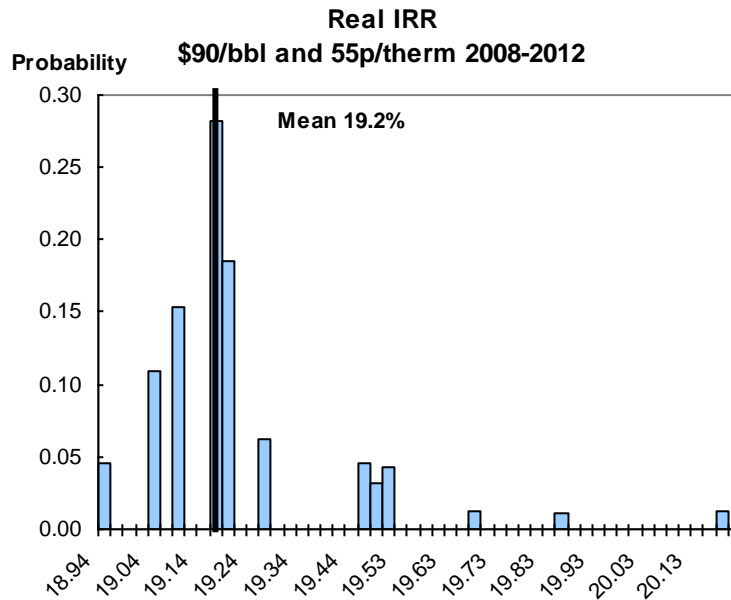


With 3 appraisal wells per discovery the expected IRR is 20.13%, the median is 20.12%, and the maximum 20.64%. If all 42 technical reserves had been developed the IRR would have been 20.65%.

The distribution of the number of field developments from technical reserves from the discoveries in the period 2008-2012 is shown in Chart 8 and the possible enhancement to the IRR from these developments is shown in Chart 26.

Chart 26

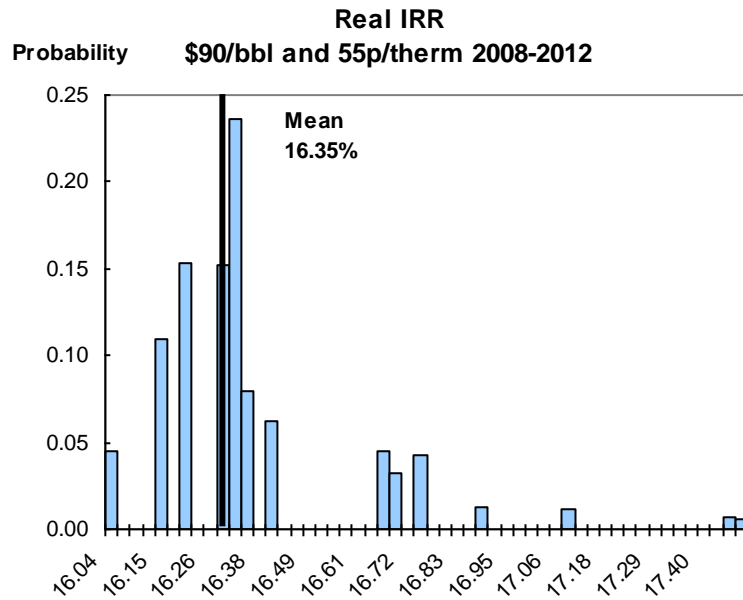
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (2 Appraisal wells)**



Again the development of the fields in the technical reserves category slightly improves the expected rate of return. The mean overall IRR becomes 19.2%. The median value is 19.16% and the maximum value 20.25%. If all 19 technical reserves had been developed the IRR would have been 20.27%.

Chart 27

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

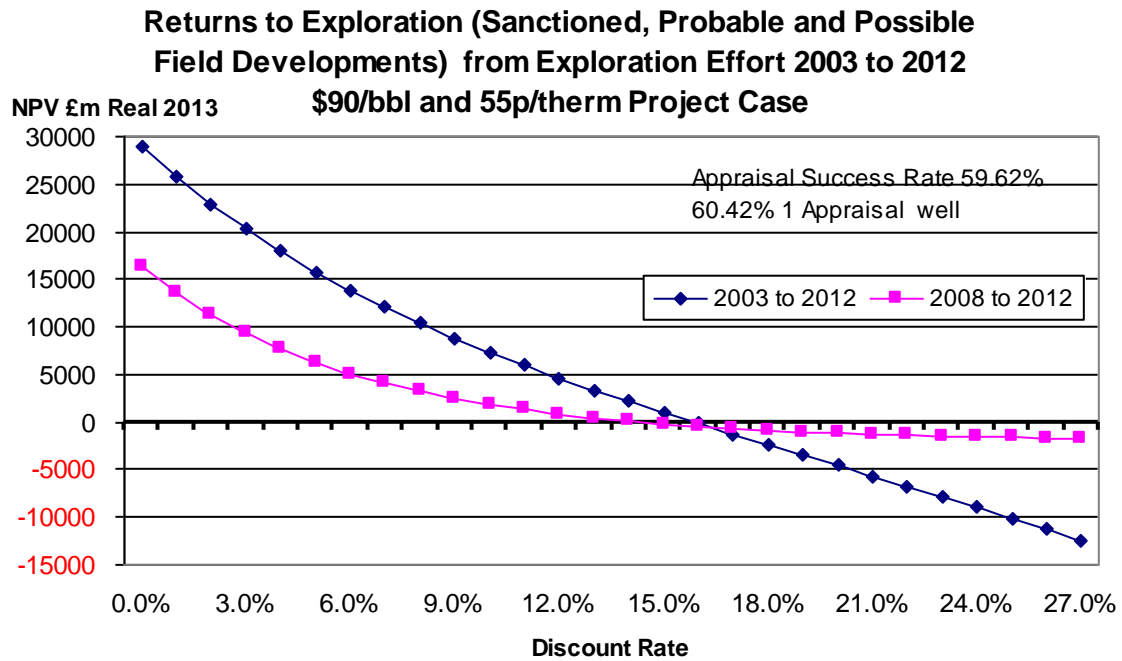


With 3 appraisal wells per discovery the expected IRR is 16.35%, the median is 16.29%, and the maximum 17.55%. If all 19 technical reserves had been developed the IRR would have been 17.58%.

**(d) Project Basis, \$90, 55 pence Screening Prices**

The results under the \$90, 55 pence price scenario are shown in Chart 28 for the sanctioned, probable and possible field developments under the Project case.

Chart 28

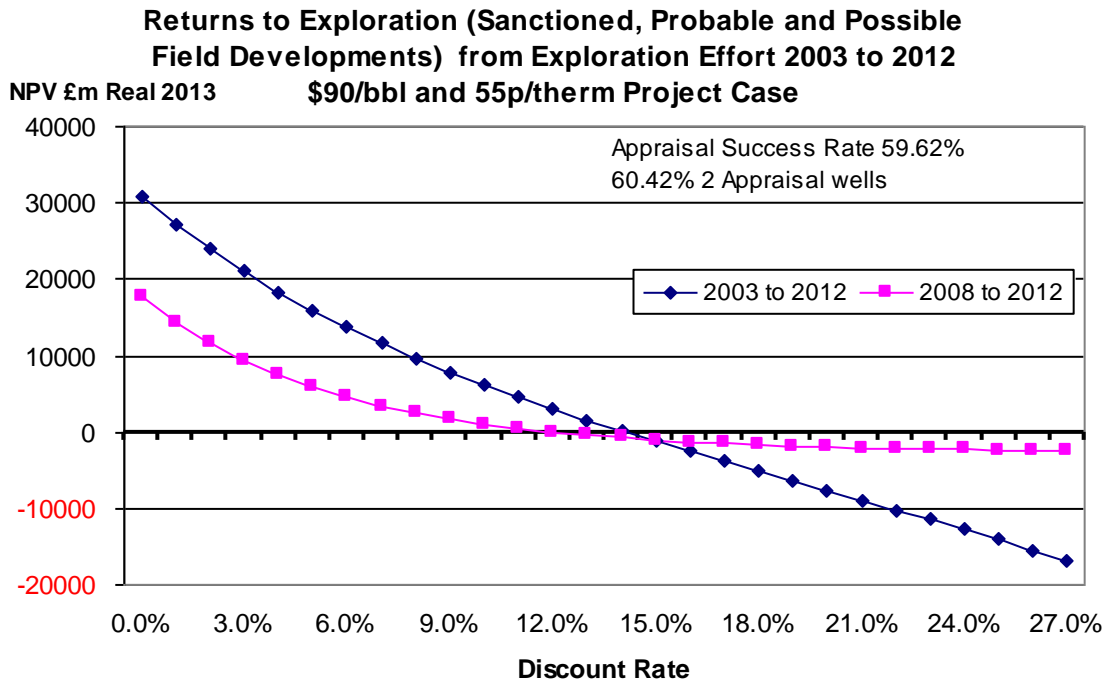


For the 2003-2012 exploration effort in the period the real, post-tax IRR under the Project basis is 15.86%, and for the period 2008-2012 it is 14.31%. At 10% discount rate the NPV for the 2003-2012 exploration period is £7.32 billion, and for the 2008-2012 period £1.8 billion.

The results for 2 appraisal wells are shown in Chart 29.



Chart 29

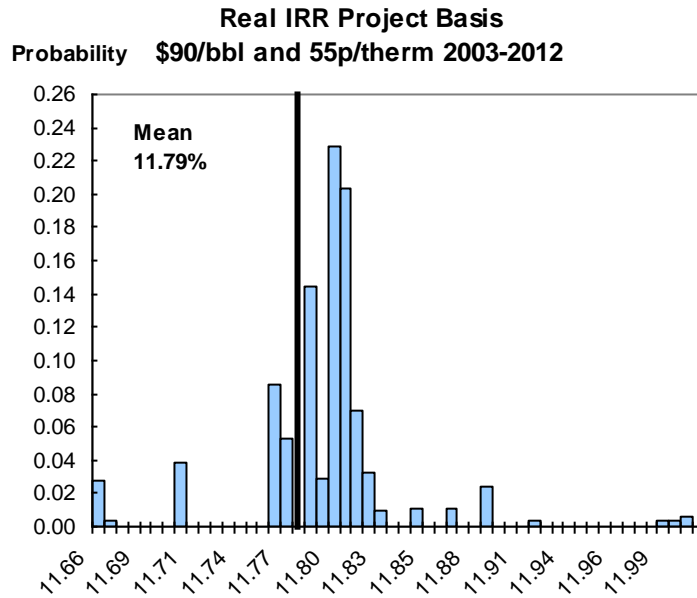


If two appraisal wells per discovery were to be required the IRR for the 2003-2012 exploration effort falls to 14.14%, and for the 2008-2012 period to 12.04%. The NPV at 10% becomes £6.2 billion for the 2003-2012 exploration effort and £1.1 billion for the 2008-2012 period.

The Monte Carlo analysis produced a probability distribution for the possible enhancement to the IRR under the Project basis as shown in Chart 30.

Chart 30

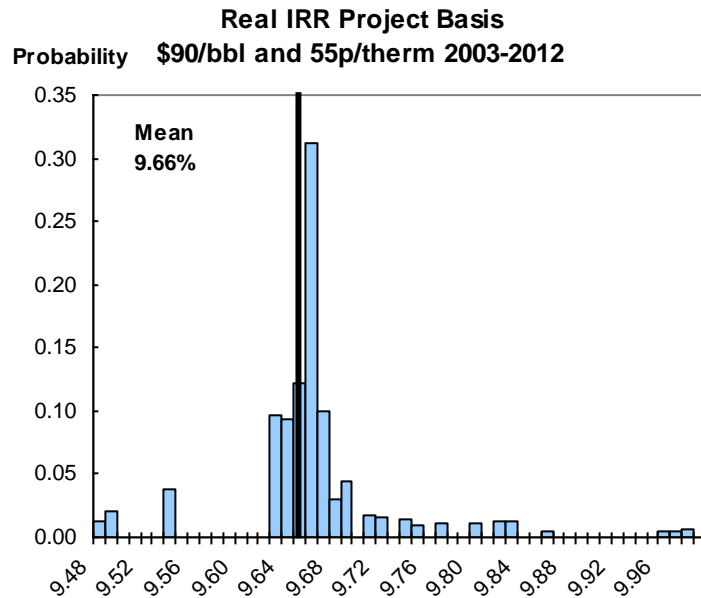
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (2 Appraisal wells)**



The development of the technical reserves generally reduces the overall expected IRR under this price scenario with Project based assumptions. The mean expected IRR changes from 15.86% to 11.79%, the median is 11.8%, and the maximum 12.3%.

Chart 31

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

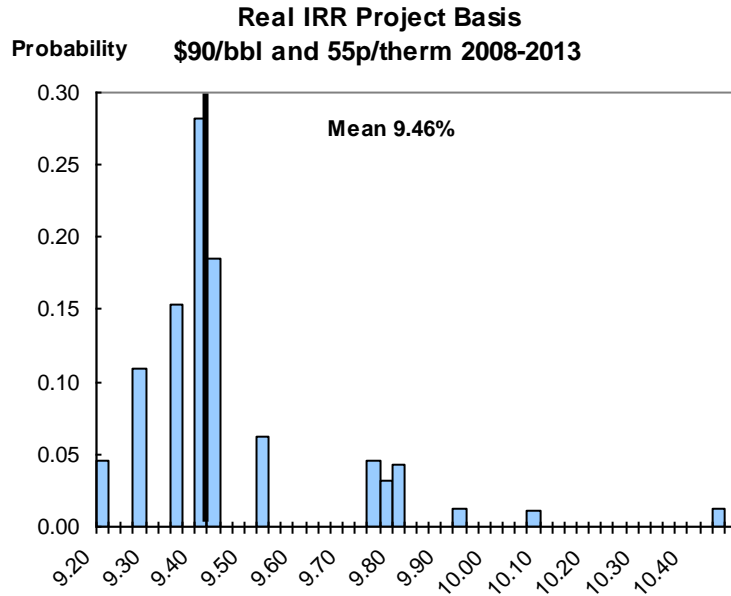


With 3 appraisal wells per discovery the expected IRR is 9.66%, the median is 9.65%, and the maximum 10.3%.

The possible enhancement to the IRR from developments from exploration discoveries in the period 2008-2012 is shown in Chart 32.

Chart 32

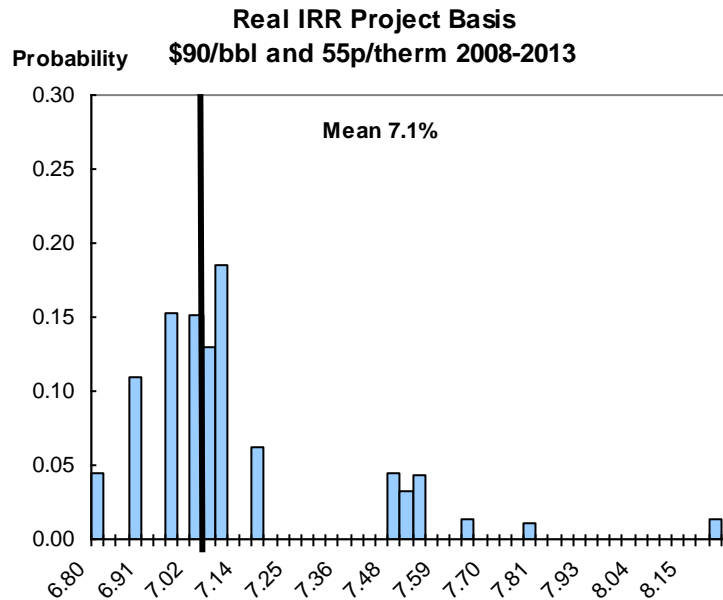
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (2 Appraisal wells)**



The development of the fields in the technical reserves category reduces the expected rate of return from 14.31% to a mean value of 9.46%. The median value is 9.4% and the maximum value 10.56%.

Chart 33

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

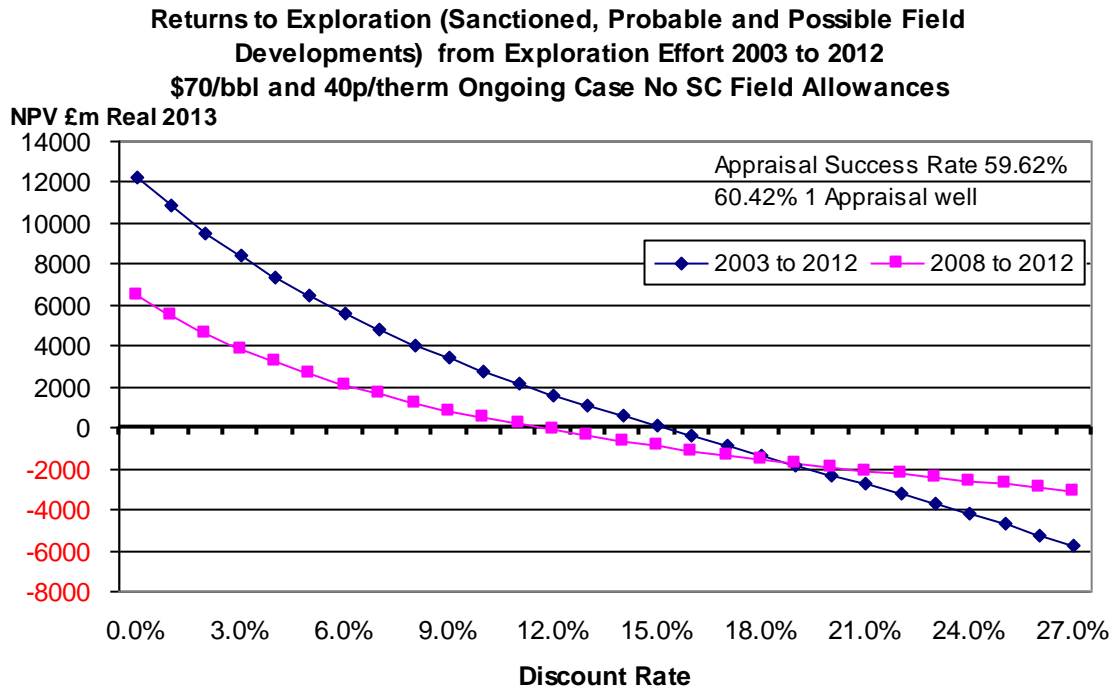


With 3 appraisal wells per discovery the expected IRR is 7.1%, the median is 7%, and the maximum 8.4%. See Chart 33.

**(e) Existing Tax Paying Ongoing Basis, No Field Allowances for SC, \$70, 40 pence Screening Prices**

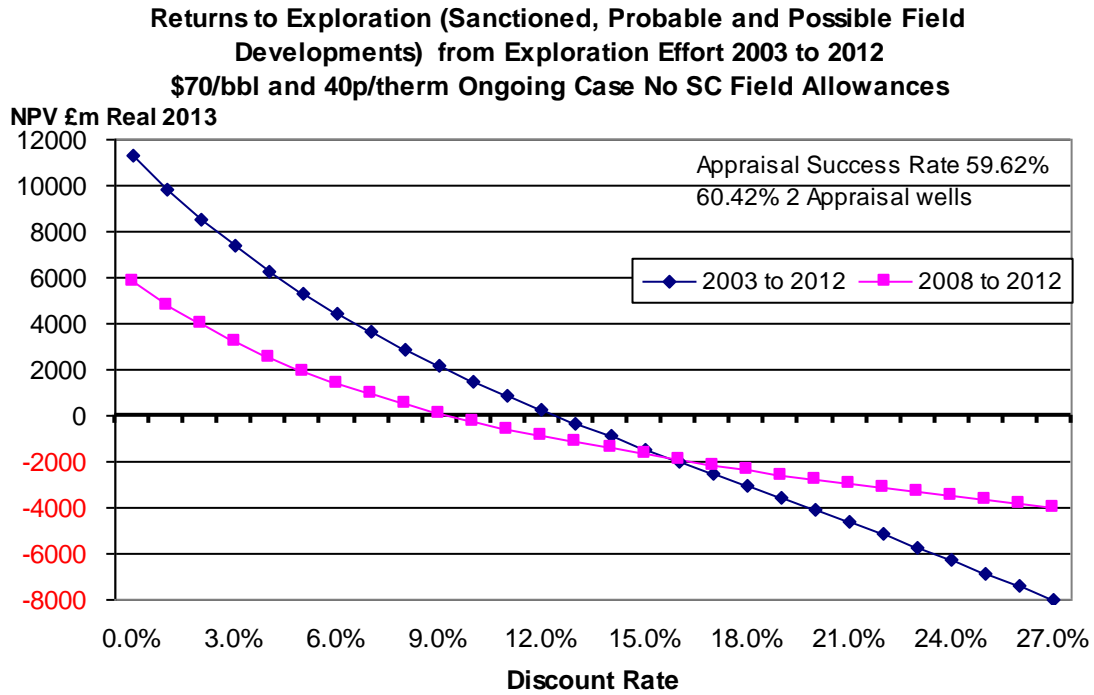
Chart 34 shows the results for the \$70, 40 pence case when field allowances for SC are removed and the investor is in a tax paying position.

Chart 34



For the exploration effort in the period 2003-2012 when SC field allowances are removed the real, post-tax IRR is 15.16% and for the period 2008-2012 11.58%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £2.7 billion, and for the 2008-2012 period £0.49 billion.

Chart 35

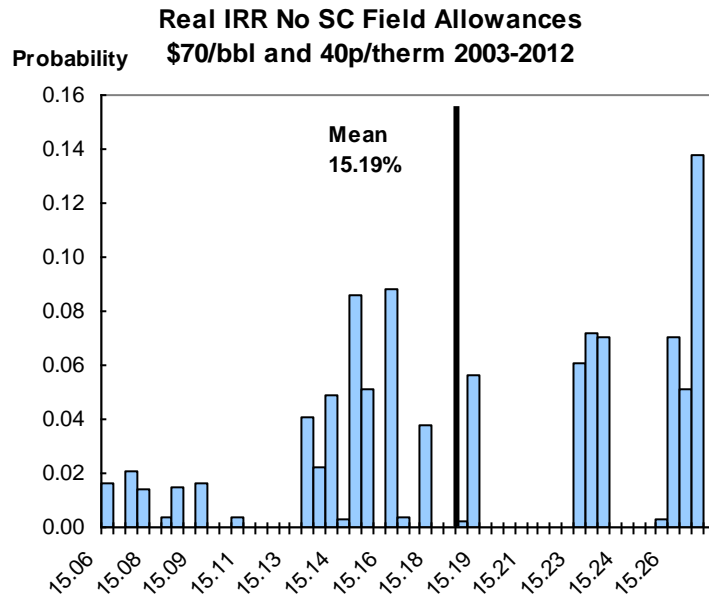


If two appraisal wells per exploration success were to be required the IRR for the period 2003-2012 when SC field allowances are removed is 12.42% and for the period 2008-2012, 9.32%. The aggregate NPV at 10% becomes £1.5 billion for the 2003-2012 exploration effort and negative £242 million for the 2008-2012 period.

The possible enhancement to the IRR from the development of technical reserves is shown in Chart 36.

Chart 36

**Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70 40 pence Price Scenario (2 Appraisal wells)**

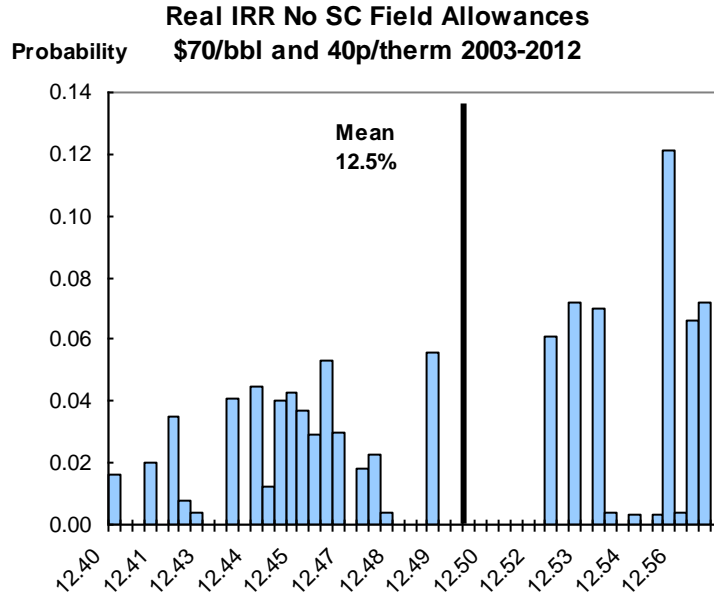


The development of the technical reserves slightly increases the overall expected IRR. The mean becomes 15.19%, the median 15.19%, and the maximum 15.44%.



Chart 37

**Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70 40 pence Price Scenario (3 Appraisal wells)**

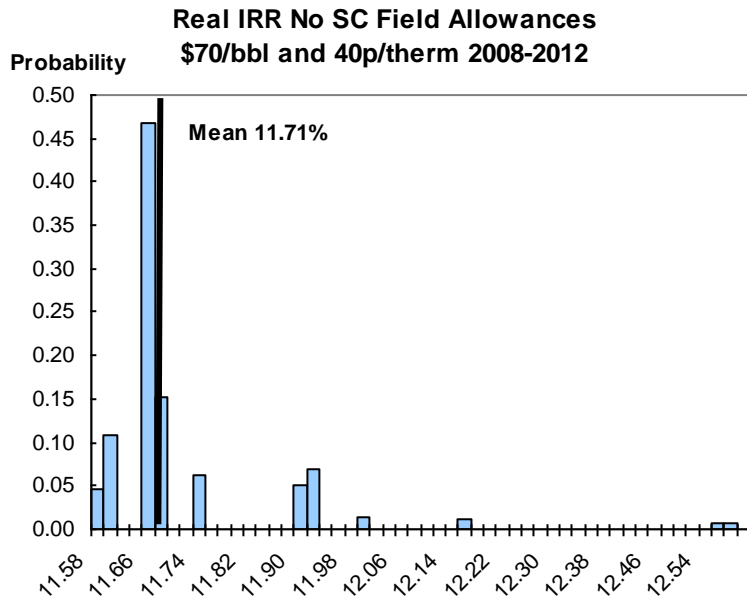


With 3 appraisal wells per discovery the expected IRR is 12.5%, the median is 12.5%, and the maximum 12.9%.

The possible enhancement to the IRR from these developments in the period 2008-2012 is shown in Chart 38.

Chart 38

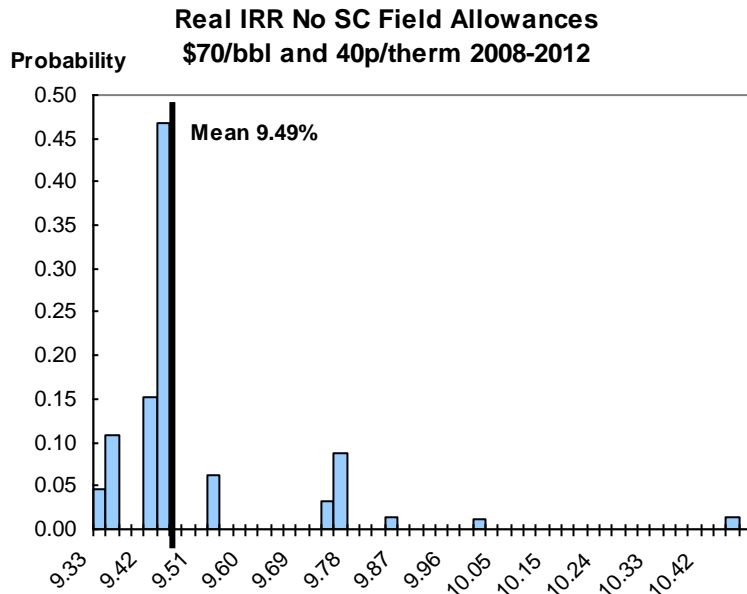
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (2 Appraisal wells)**



Again the development of the fields in the technical reserves category slightly improves the expected rate of return. The mean overall IRR becomes 11.71%. The median value is 11.66% and the maximum value 12.66%.

Chart 39

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (3 Appraisal wells)**

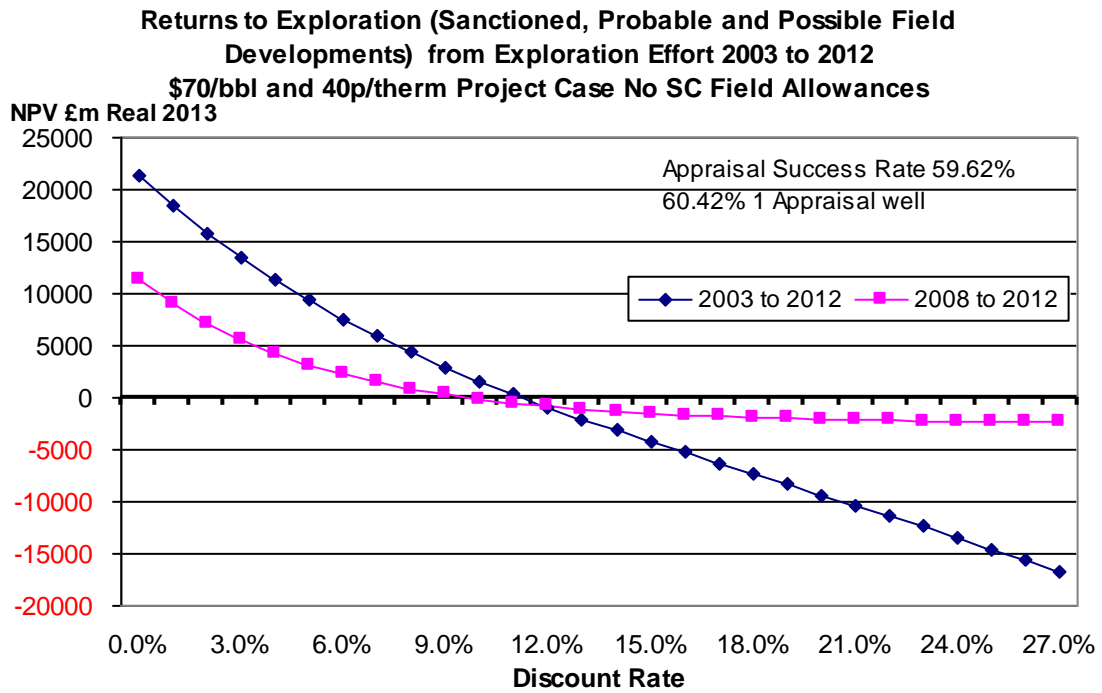


With 3 appraisal wells the expected IRR is 9.49%, the median is 9.4%, and the maximum 10.57%.

**(f) Project Basis, No Field Allowances for SC, \$70, 40 pence Screening Prices**

The results under the \$70, 40 pence price scenario are shown in Chart 40 for the sanctioned, probable and possible field developments under the project case when SC field allowances are removed.

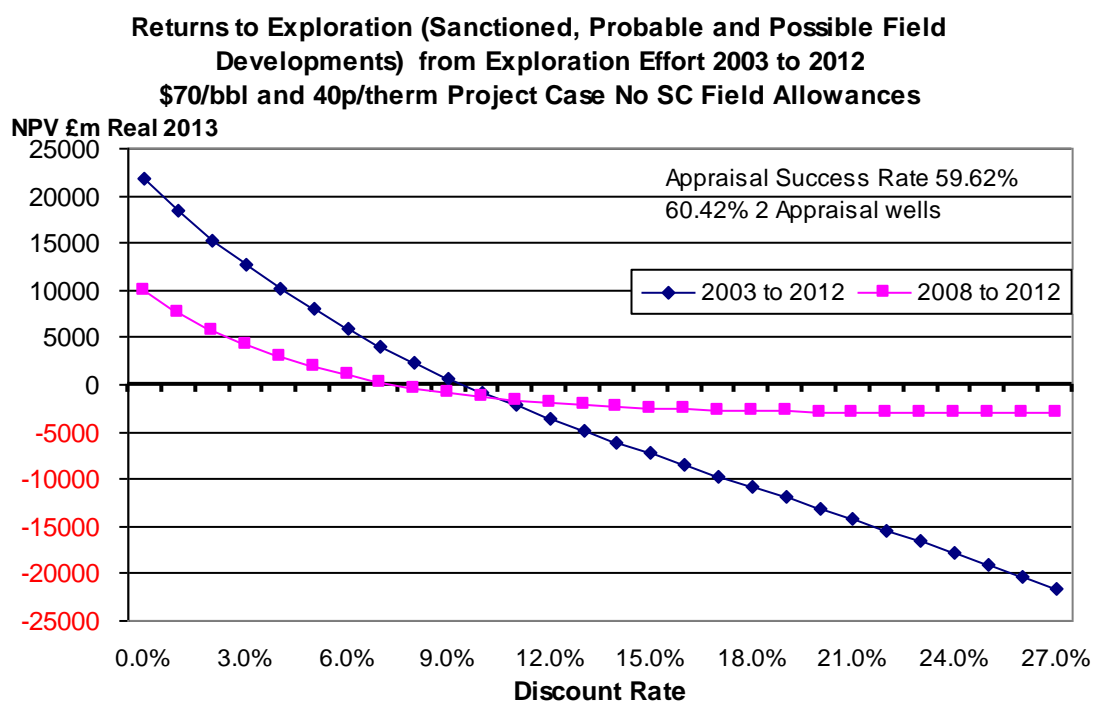
Chart 40



For the exploration effort in the period 2003-2012 with SC field allowances removed the real, post-tax IRR under the Project basis is 11.27% and for the period 2008-2012 it is 9.66%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £1.6 billion, and for the 2008-2012 period negative £143 million.

The results for 2 appraisal wells are shown in Chart 41.

Chart 41

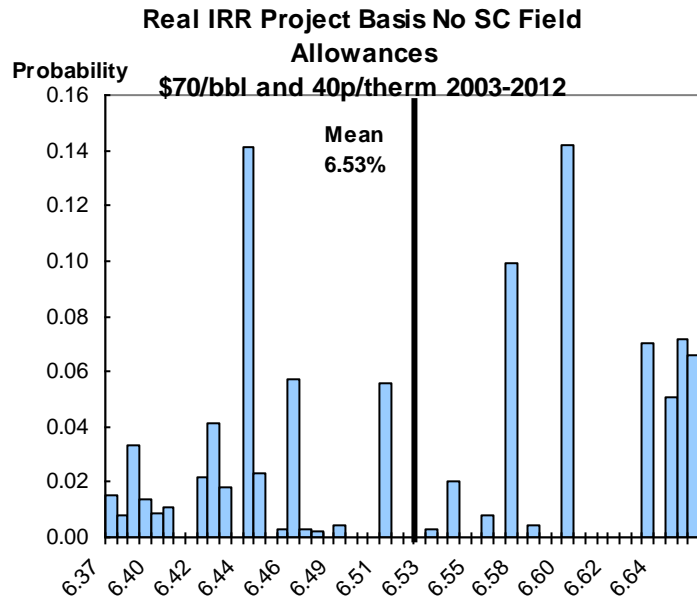


If two appraisal wells per discovery were to be required and the SC field allowances are removed the IRR for the 2003-2012 exploration effort falls to 9.48%, and for the 2008-2012 period to 7.4%. The aggregate NPV at 10% becomes negative £770 million for the 2003-2012 exploration effort and negative £1.26 billion for the 2008-2012 period.

The Monte Carlo analysis produced a probability distribution for the possible enhancement to the IRR from technical reserves under the Project basis as shown in Chart 42.

Chart 42

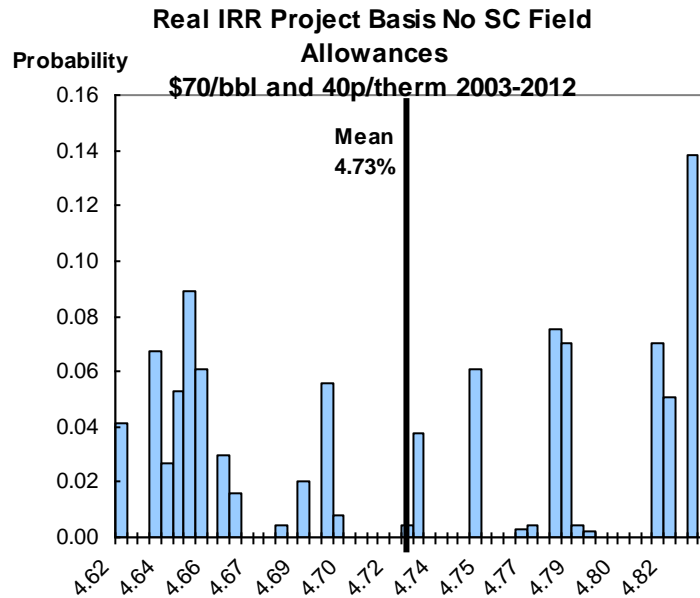
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70, 40 Pence Price Scenario (2 Appraisal wells)**



The development of the technical reserves generally reduces the overall expected IRR under this scenario with Project based assumptions. The mean expected IRR changes from 11.27% to 6.53%, the median is 6.56%, and the maximum 6.76%.

Chart 43

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70, 40 Pence Price Scenario (3 Appraisal wells)**

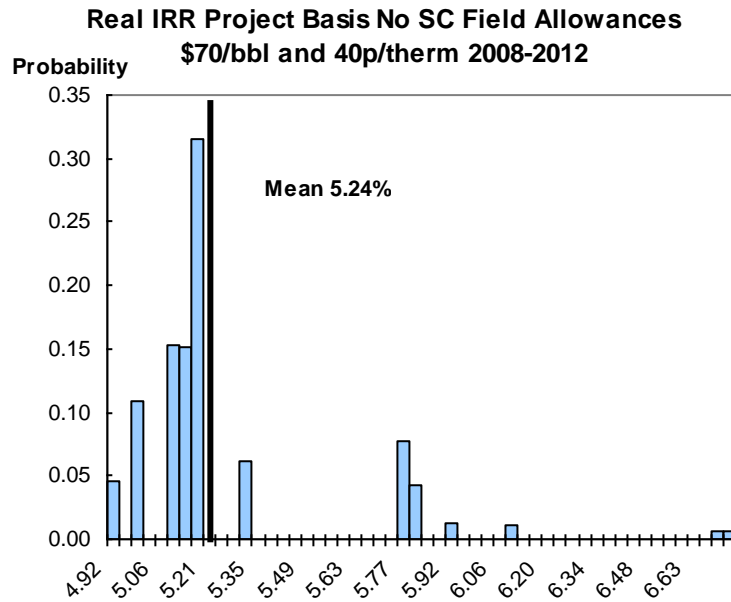


With 3 appraisal wells per discovery the expected IRR is 4.73%, the median is 4.7%, and the maximum 5.1%.

The possible enhancement to the IRR from the developments of technical reserves from exploration discoveries in the period 2008-2012 is shown in Chart 44.

Chart 44

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (2 Appraisal wells)**

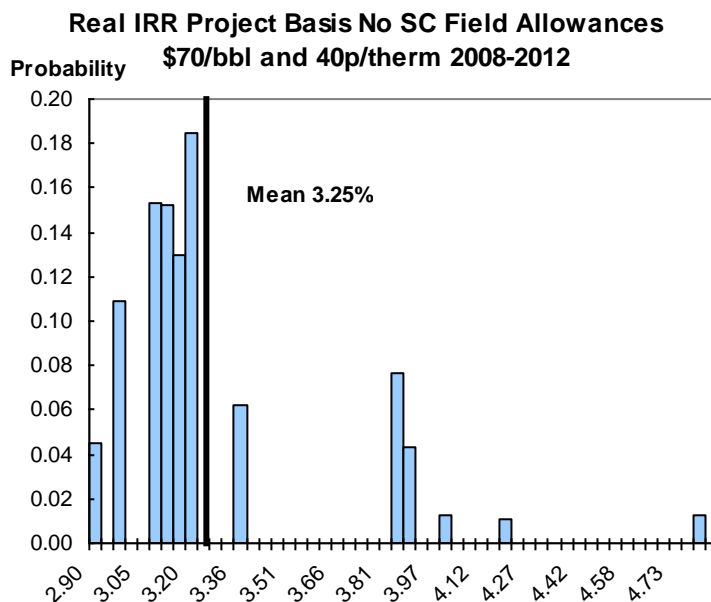


The development of the fields in the technical reserves category reduces the expected rate of return from 9.66%. The mean overall IRR becomes 5.24%. The median value is 5.14% and the maximum value 6.88%.



Chart 45

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (3 Appraisal wells)**

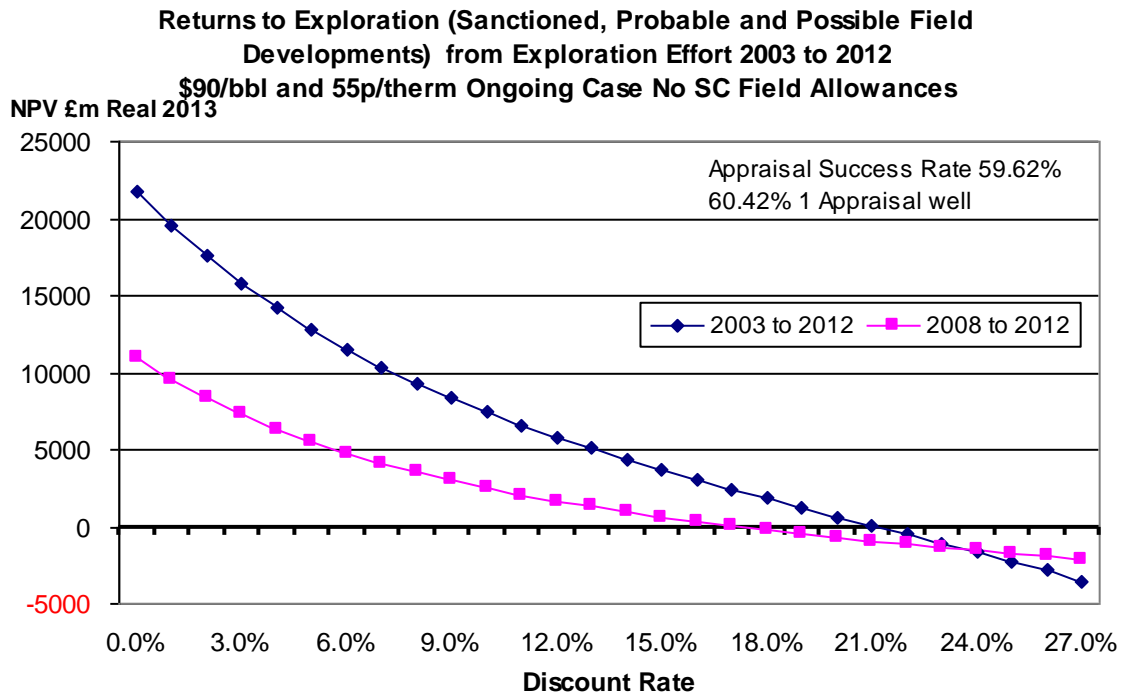


With 3 appraisal wells the expected IRR is 3.25%, the median is 3.1%, and the maximum 5.02% (Chart 45).

**(g) Existing Tax Paying Ongoing Case, No Field Allowances for SC, \$90, 55 pence Screening Prices**

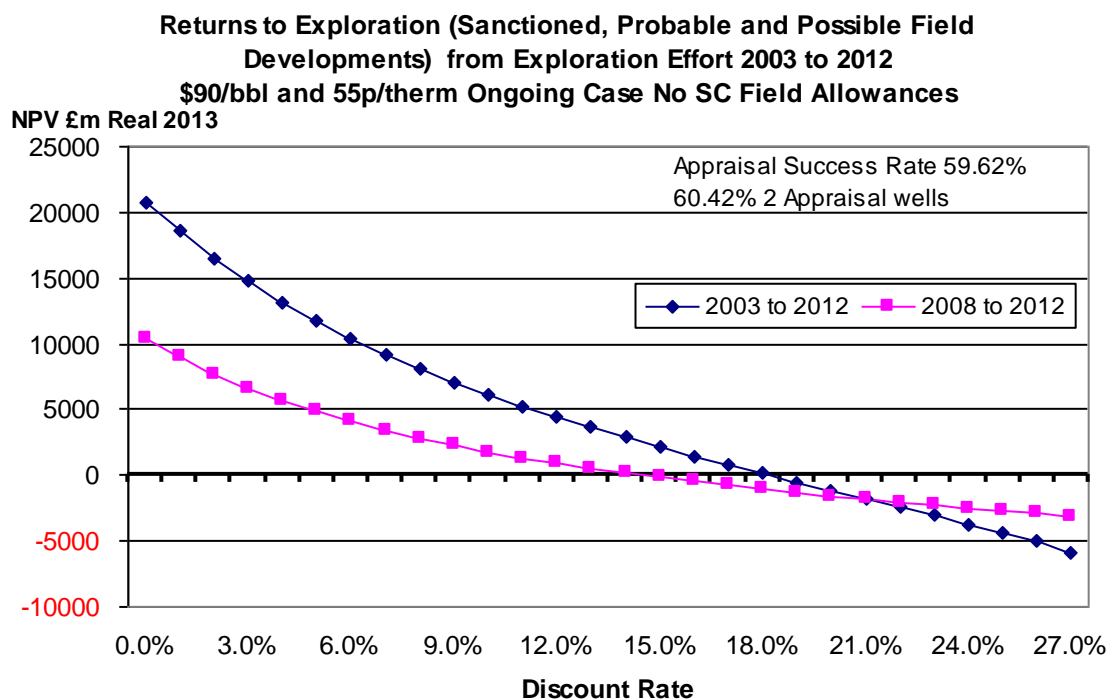
Chart 46 shows the results for the \$90, 55 pence case when field allowances for SC are removed.

Chart 46



For the exploration effort in the 2003-2012 period when SC field allowances are removed the real, post-tax IRR is 21.11% and for the period 2008-2012 17.21%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £7.43 billion, and for the 2008-2012 period £2.5 billion.

Chart 47

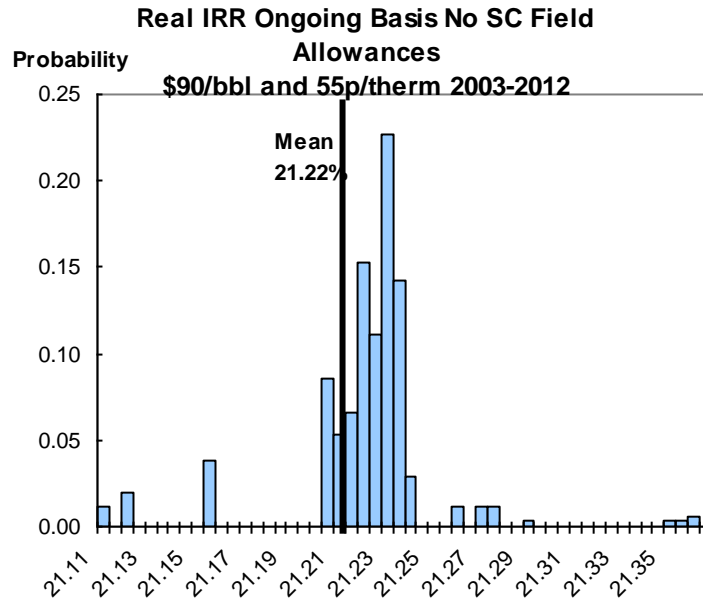


If two appraisal wells per exploration success were to be required the IRR for the 2003-2012 period when SC field allowances are removed is 18.22% and for the period 2008-2012, 14.52%. The aggregate NPV at 10% becomes £6.1 billion for the 2003-2012 exploration effort, and £1.8 billion for the 2008-2012 period.

The possible enhancement to the IRR from the developments of technical reserves is shown in Chart 48.

Chart 48

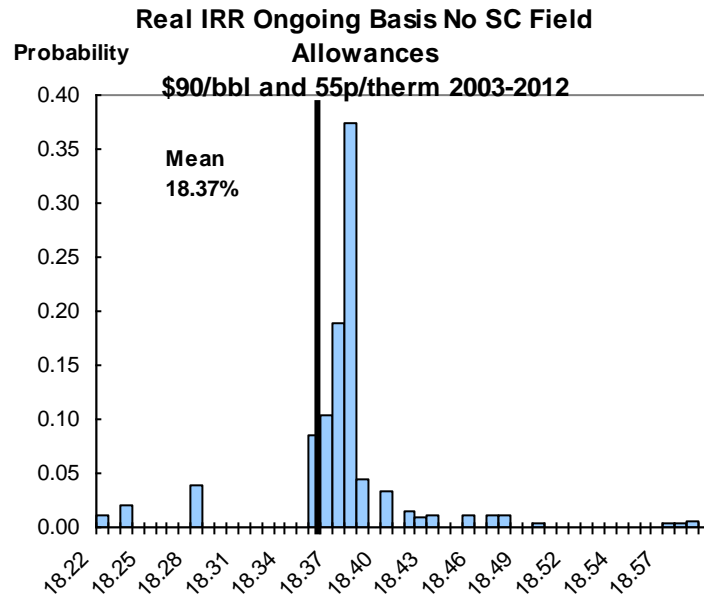
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (2 Appraisal wells)**



The development of the technical reserves slightly increases the overall expected IRR under this price scenario. The mean expected IRR is 21.22%, the median is 21.22%, and the maximum 21.6%.

Chart 49

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

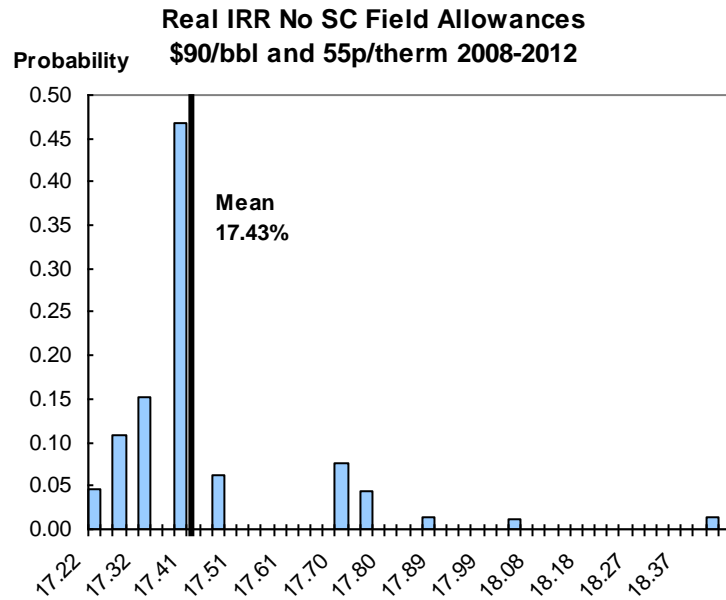


With 3 appraisal wells the expected IRR is 18.37%, the median is 18.4%, and the maximum 18.88%.

The possible enhancement to the IRR from the developments of technical reserves in the period 2008-2012 is shown in Chart 50.

Chart 50

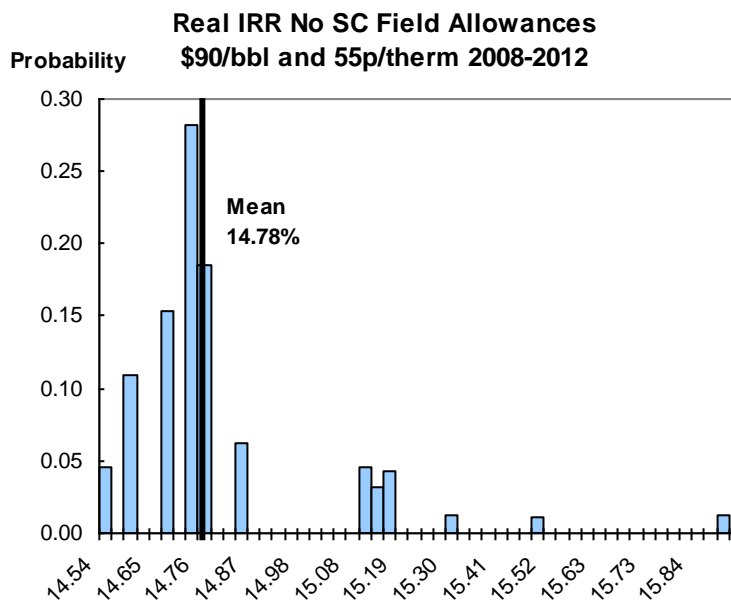
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (2 Appraisal wells)**



Again the development of the fields in the technical reserves category slightly improves the expected rate of return. The mean overall IRR becomes 17.43%. The median value is 17.37% and the maximum value 18.49%.

Chart 51

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

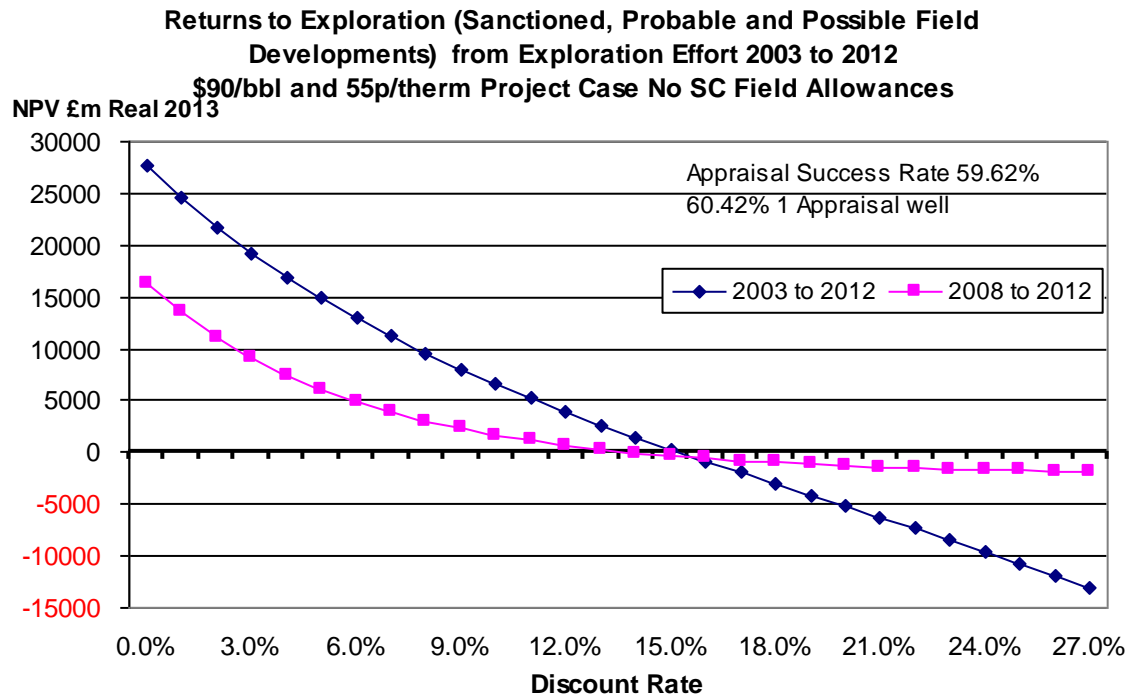


With 3 appraisal wells the expected IRR is 14.78%, the median is 14.7%, and the maximum 15.99%. See Chart 51.

**(h) Project Basis, \$90, 55 pence Screening Prices, No SC Field Allowances**

The results under the \$90, 55 pence price scenario are shown in Chart 52 for the sanctioned, probable and possible field developments under the project case when SC field allowances are removed.

Chart 52

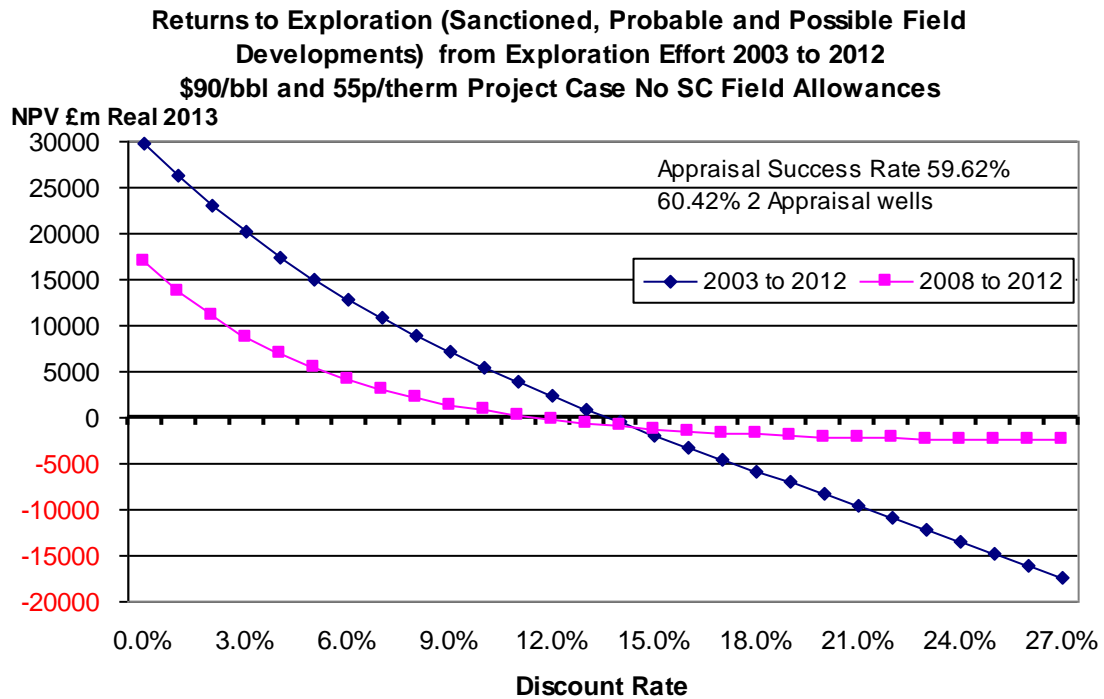


For the exploration effort in the 2003-2012 period the real, post-tax IRR under the Project basis is 15.26% and for the period 2008-2012 it is 13.82%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £6.55 billion, and for the 2008-2012 period £1.6 billion.

The results for 2 wells are shown in Chart 53.



Chart 53

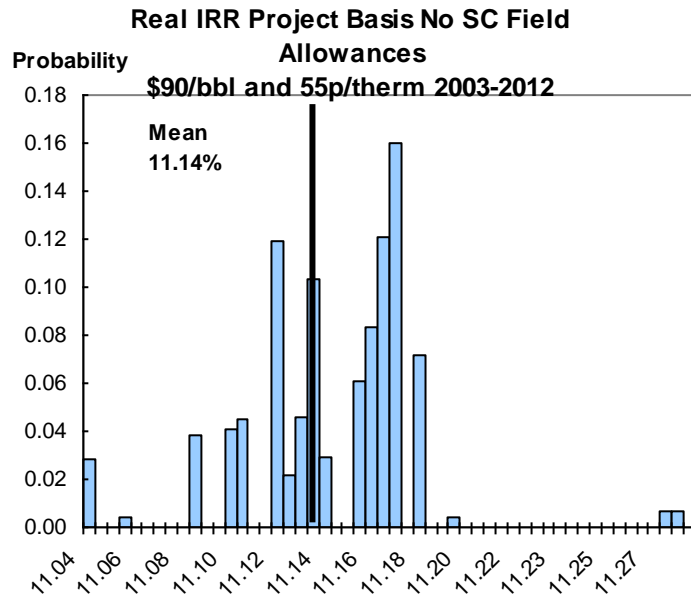


If two appraisal wells per discovery were to be required and the SC field allowances are removed the IRR for the 2003-2012 exploration effort falls to 13.62%, and for the 2008-2012 period to 11.48%. The aggregate NPV at 10% becomes £5.4 billion for the 2003-2012 exploration effort and £771 million for the 2008-2012 period.

The Monte Carlo analysis produced a probability distribution for the possible enhancement to the IRR from technical reserves under the Project basis as shown in Chart 54.

Chart 54

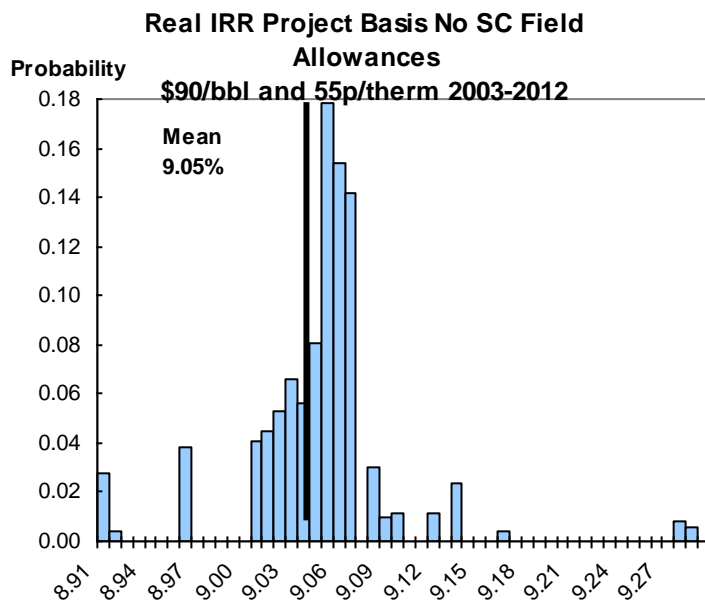
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (2 Appraisal wells)**



The development of the technical reserves reduces the overall expected IRR under this price scenario. The mean expected IRR changes from 15.26% to 11.14%, the median is 11.15%, and the maximum 11.57%. The results highlight the importance of the field allowances for SC in incentivising the development of high cost discoveries.

Chart 55

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

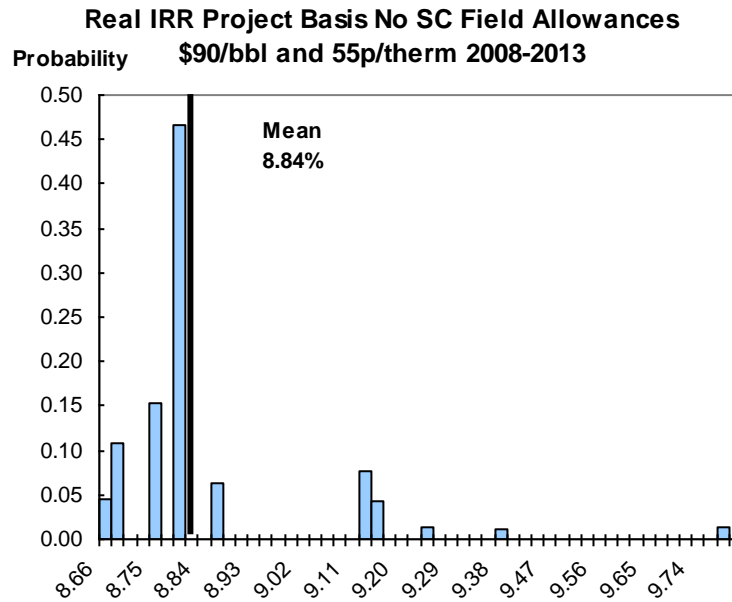


With 3 appraisal wells per discovery the expected IRR is 9.05%, the median is 9.1%, and the maximum 9.62%. See Chart 55.

The possible enhancement to the IRR from developments from exploration discoveries in the period 2008-2012 is shown in Chart 56.

Chart 56

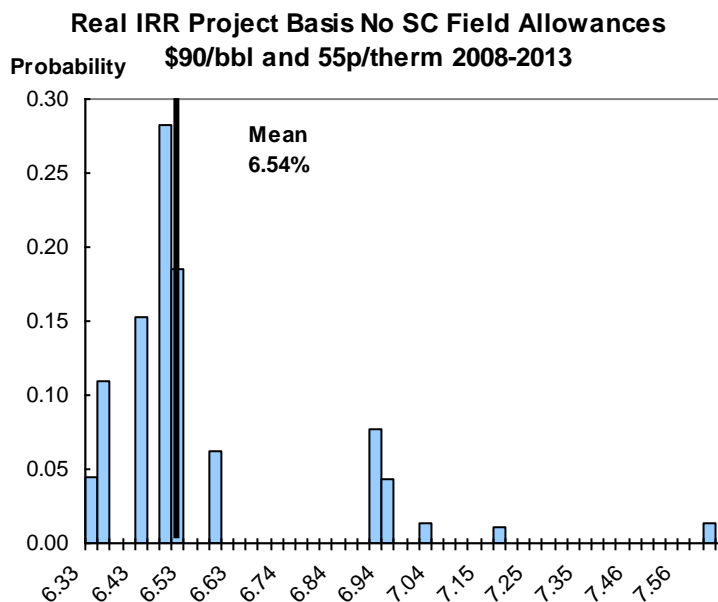
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (2 Appraisal wells)**



The development of the fields in the technical reserves category reduces the expected rate of return from 13.82%. The mean overall IRR becomes 8.84%. The median value is 8.78% and the maximum value 9.89%.

Chart 57

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

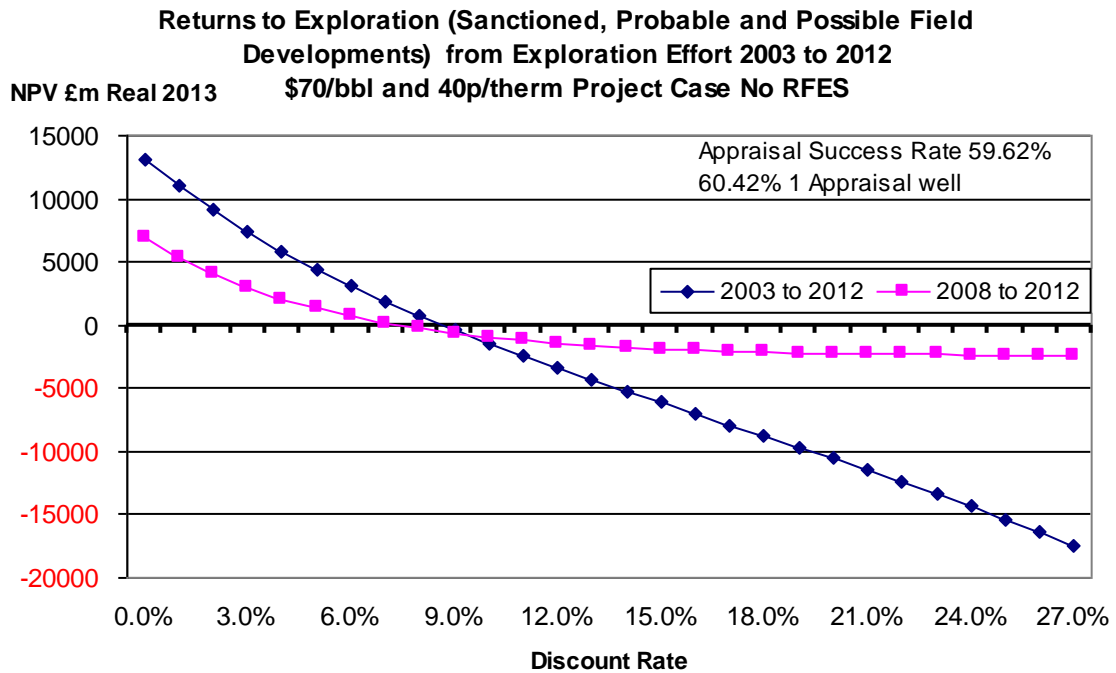


With 3 appraisal wells the expected IRR is 6.54%, the median is 6.5%, and the maximum 7.74%.

**(i) Project Basis, \$70, 40 pence Screening Prices, No RFES, SC Field Allowances in Place**

Chart 58 shows the results for the \$70, 40 pence Project basis case when E & A and development cost supplements (RFES) are removed. SC field allowances are in place.

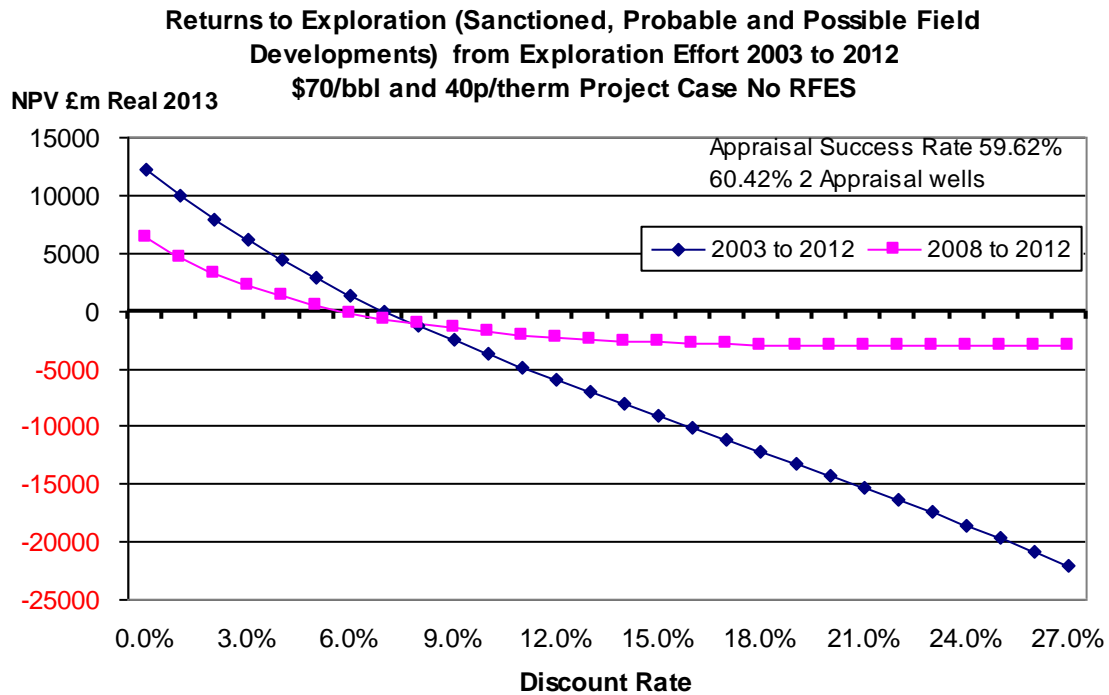
Chart 58



For the exploration effort in the 2003-2012 period with the RFES removed the real, post-tax IRR under the Project basis is 8.67% and for the period 2008-2012 it is 7.4%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is negative £1.4 billion, and for the 2008-2012 period negative £932 million.

The results for 2 appraisal wells per discovery are shown in Chart 59.

Chart 59

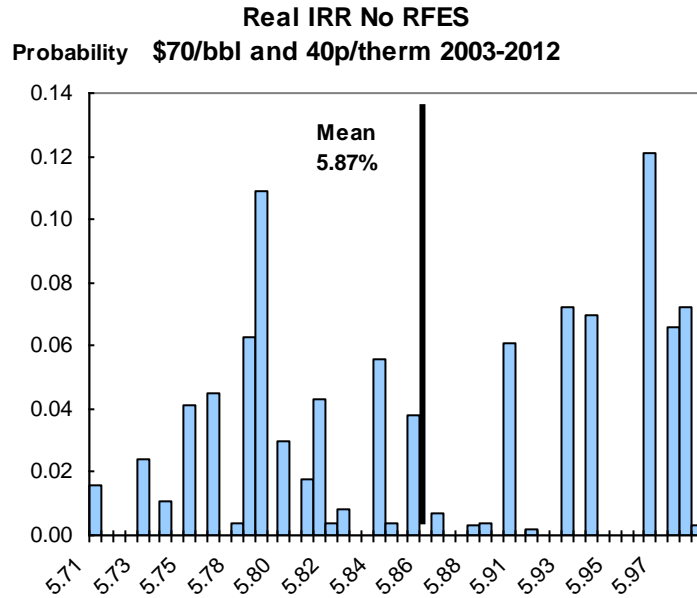


If two appraisal wells per discovery were required and the RFES is removed the IRR for the 2003-2012 exploration effort falls to 6.98%, and for the 2008-2012 period to 5.74%. The NPV at 10% becomes negative £3.7 billion for the 2003-2012 exploration effort and almost negative £1.8 billion for the 2008-2012 period.

The Monte Carlo analysis produced a probability distribution for the possible enhancement to the IRR under the Project basis from technical reserves when the RFES is removed as shown in Chart 60.

Chart 60

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70, 40 Pence Price Scenario (2 Appraisal wells)**

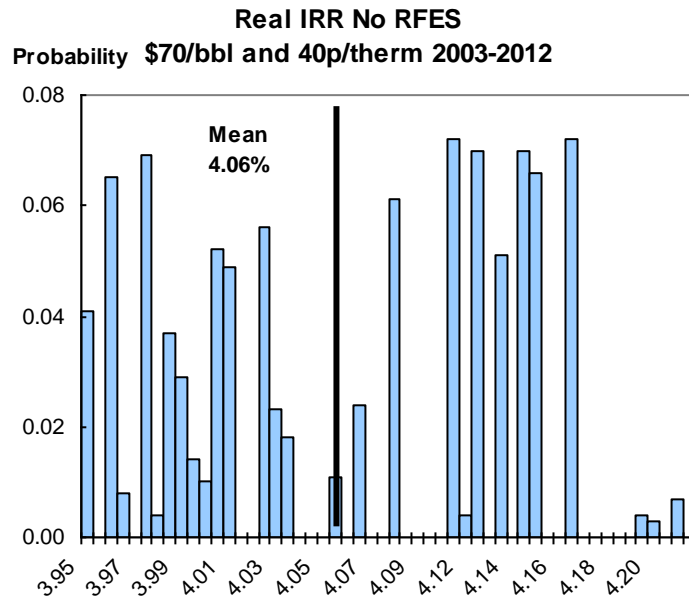


The development of the technical reserves reduces the overall expected IRR under this price scenario with Project based assumptions when the RFES is removed. The mean expected IRR changes from 10.89% to 5.87%, the median is 5.85%, and the maximum 6.23%.



Chart 61

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$70, 40 Pence Price Scenario (3 Appraisal wells)**

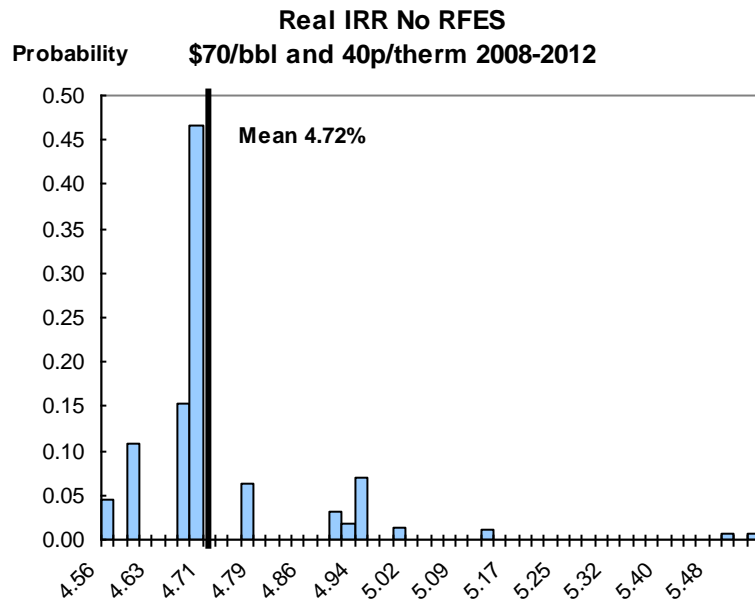


With 3 appraisal wells per discovery the expected IRR is 4.06%, the median is 4.07%, and the maximum 4.6%. See Chart 61.

The possible enhancement to the IRR from developments of technical reserves from exploration discoveries in the period 2008-2012 is shown in Chart 62.

Chart 62

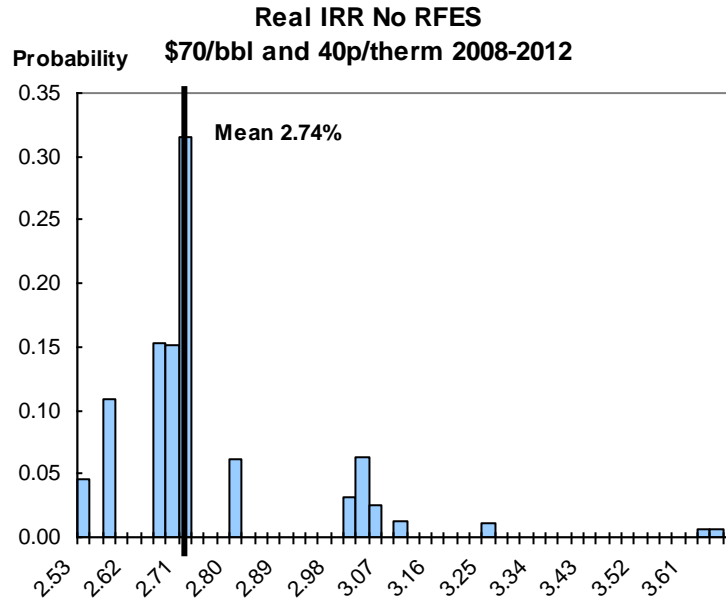
**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (2 Appraisal wells)**



The development of the fields in the technical reserves category reduces the expected rate of return from 7.4%. The mean overall IRR becomes 4.72%. The median value is 4.68% and the maximum value 5.64%.

Chart 63

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$70, 40 Pence Price Scenario (3 Appraisal wells)**

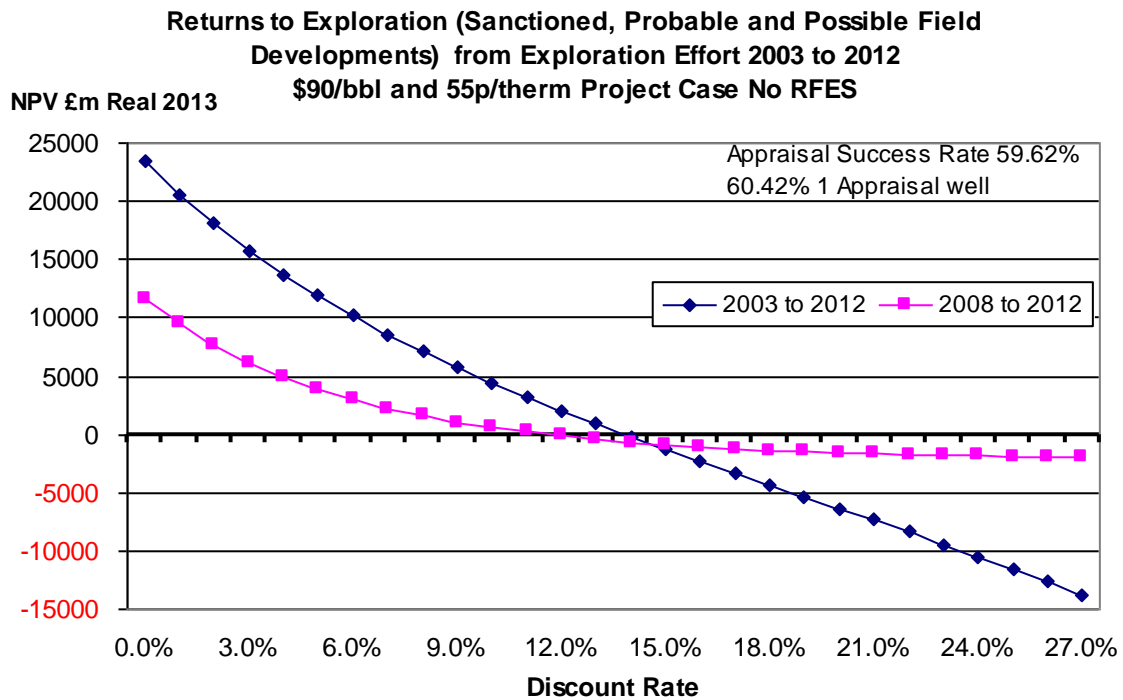


With 3 appraisal wells per discovery the expected IRR is 2.74%, the median is 2.69%, and the maximum 3.81%.

**(j) Project Basis, \$90, 55 pence Screening Prices, No RFES, SC Field Allowances in Place**

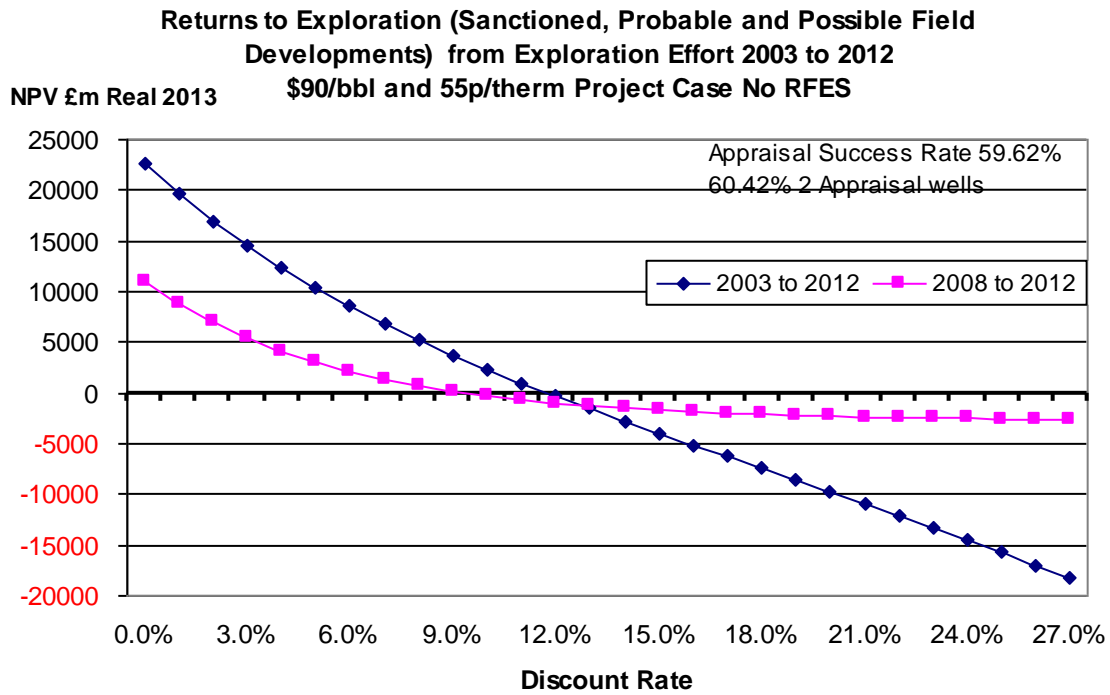
Chart 64 shows the results for the \$90, 55 pence case when the REFS is removed.

Chart 64



For the exploration effort in the 2003-2012 period when the RFES is removed the real, post-tax IRR is 13.83% and for the period 2008-2012 11.56%. At 10% discount rate the aggregate NPV for the 2003-2012 exploration period is £4.43 billion, and for the 2008-2012 period £0.586 billion.

Chart 65



If two appraisal wells per discovery were to be required the IRR for the period 2003-2012 when supplements are removed is 11.77% and for the period 2008-2012, 9.47%. The aggregate NPV at 10% becomes almost £2.36 billion for the 2003-2012 exploration effort, and negative £233 million for the 2008-2012 period. See Chart 65.

The possible enhancement to the IRR from the development of technical reserves is shown in Chart 66.

Chart 66

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (2 Appraisal wells)**

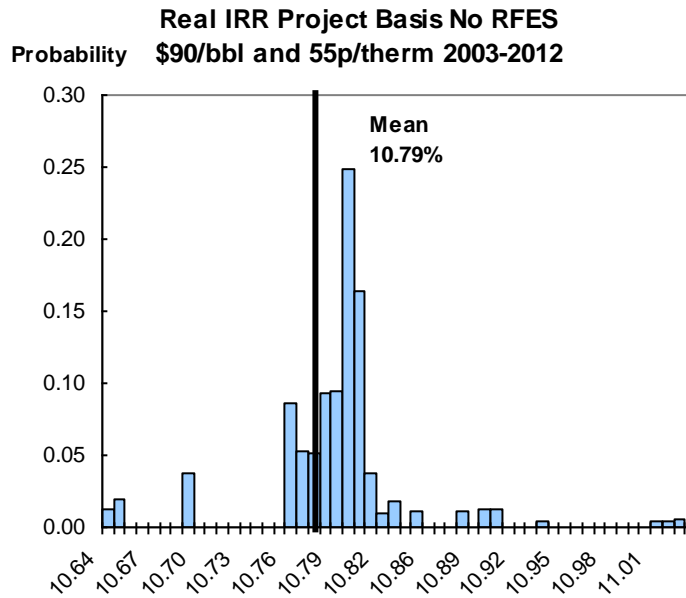
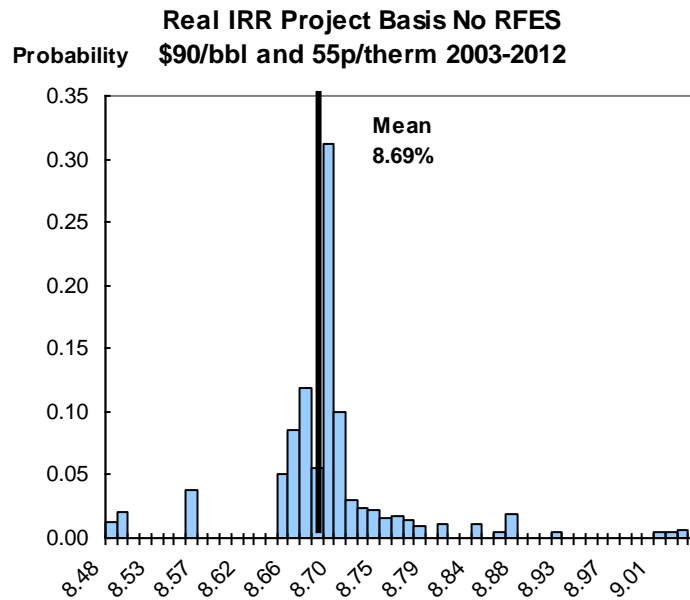


Chart 67

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort under \$90, 55 Pence Price Scenario (3 Appraisal wells)**

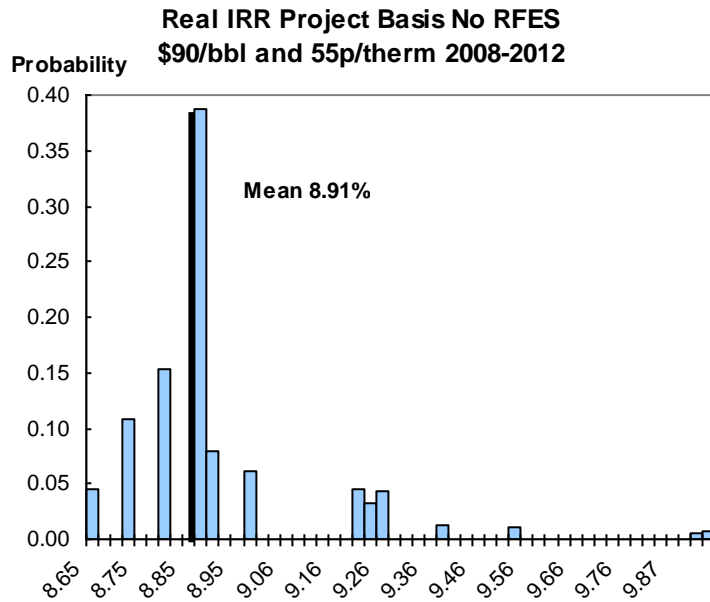


With 3 appraisal wells per discovery the expected IRR is 8.69%, the median is 8.68%, and the maximum 9.4%. See Chart 67.

The possible enhancement to the IRR from the development of technical reserves in the period 2008-2012 is shown in Chart 68.

Chart 68

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (2 Appraisal wells)**

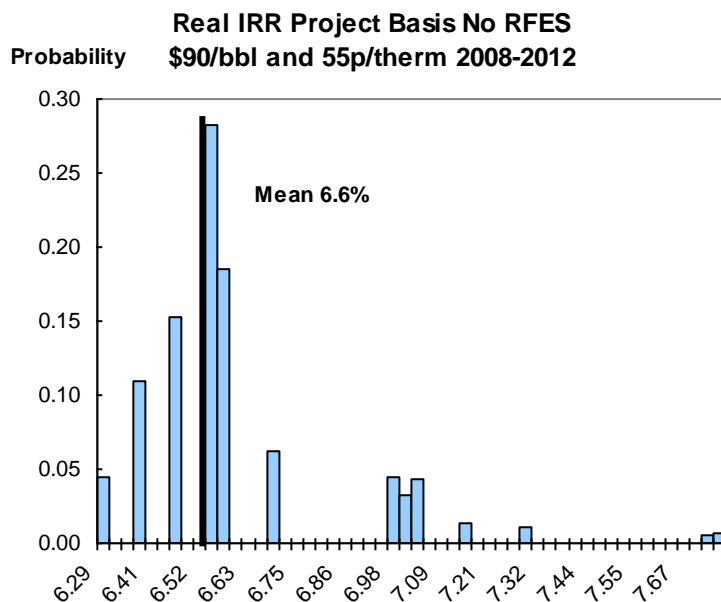


Again the development of the fields in the technical reserves category reduces the expected rate of return. The mean overall IRR becomes 8.91%. The median value is 8.86% and the maximum value 10.05%.



Chart 69

**Probability Distribution of Enhanced IRRs from Development of Technical Reserves from Exploration Effort 2008-2012 under \$90, 55 Pence Price Scenario (3 Appraisal wells)**



With 3 appraisal wells per discovery the expected IRR is 6.6%, the median is 6.5%, and the maximum 7.88%. See Chart 69.

**4. Summary and Conclusions**

This paper has examined the full cycle returns to the exploration effort in the UKCS in two periods, namely 2003-2012 inclusive, and 2008-2012 inclusive. The methodology emphasises the total exploration effort in these periods based on official data. The discoveries emanating from that effort and the possible returns to it are calculated with the help of a field database validated by operators. The methodology takes account of all discoveries, including those for which the operators are not currently planning any development (termed technical reserves). In the optimistic case there is assumed to be 1 appraisal well for each of the discoveries in the sanctioned, probable and possible categories, and 2 appraisal wells for the discoveries in the technical reserves category. In the less-optimistic

case there is assumed to be 2 appraisal wells per discovery and 3 appraisal wells for technical reserves.

The study examines the returns to (1) investors who are currently in a full tax-paying, ongoing position and (2) other project investors who have no existing tax shelter. The study examines the returns including and excluding the field allowances for Supplementary Charge (SC), and with/without the Ring Fence Expenditure Supplement (RFES).

The full cycle returns were measured with two future oil and gas price scenarios. Under the \$70, 40 pence price scenario (constant real terms) the rates of return (IRR) for an existing tax paying investor on the optimistic assumptions regarding the appraisal required are 17.6% for the exploration effort in the 2003-2012 period, and 13.5% for the 2008-2012 period. Under the less-optimistic assumptions regarding the appraisal required the rates of return become 14.7% and 11%. For a project investor the returns fall to 7.07% and 5.43% respectively in the two time periods with the optimistic appraisal requirement, and to 5.22% and 3.4% with the less-optimistic appraisal programme. It should be noted that for most of the exploration/appraisal period the interest rate under the RFES was 6%. To a large extent this explains the lower returns for project investors. It also supports the decision to raise the interest rate to 10% in 2012.

When the SC field allowances were removed the rates of return for an investor with tax shelter were 15.2% for the 2003-2012 period and 11.7% for the 2008-2012 period under the optimistic assumptions regarding the appraisal requirements. Under the less-optimistic assumptions regarding the necessary appraisal the returns become 12.5% and 9.49% for the

2003-2012 and 2008-2012 periods respectively. The field allowances for SC increase the IRR by 2% in the longer exploration period and 1.75%/1.53% in the shorter period. For a project investor the returns fall to 6.53% and 5.24% in the two time periods with the optimistic appraisal requirements, and to 4.73% and 3.25% with the larger appraisal programmes. The field allowances increase the IRR by 0.6% in the longer exploration period and by 0.2% in the shorter time period.

When E & A and development cost supplements (RFES) were removed the returns for a project investor are 5.9% for the 2003-2012 period and 4.7% for the 2008-2012 period with the optimistic appraisal requirement. With the larger appraisal requirements the returns become 4.1% and 2.7% for the two exploration periods. The supplements increase the IRR by 1.2% in the longer exploration period and by 0.71% in the shorter one. It is again clear that the increase in the interest rate for the RFES in 2012 was fully justified.

Under the \$90, 55 pence price scenario (constant real terms) the returns for an investor already in a tax-paying position are just over 23% for the 2003-2012 period and 19.2% for the 2008-2012 period with the optimistic appraisal requirements. With the less-optimistic appraisal programmes the returns become 20.13% and 16.35%. For a project investor the returns fall to 11.79% and 9.46% in the two exploration periods with the optimistic appraisal requirements. They become 9.66% and 7.1% in the two exploration periods with the less optimistic assumptions regarding the necessary appraisal work.

When the SC field allowances were removed the returns for an investor in a tax paying position are reduced to 21.22% for the 2003-2012 period and

17.43% for the 2008-2012 period with the optimistic assumptions regarding appraisal. With the less optimistic assumptions regarding appraisal the returns become 18.37% and 14.78% for the longer and shorter exploration periods.

For a project investor removal of the field allowances for SC reduce the returns to 11.14% and 8.84% for the two time periods with optimistic assumptions regarding the appraisal effort. With the less-optimistic appraisal programmes the returns fall to 9.05% and 6.54% for the two exploration periods. The field allowances increase the IRR by 0.65% and 0.61% for the longer exploration time period, and by 0.63% and 0.56% for the shorter period.

When E & A and development cost supplements (RFES) were removed the returns for a project investor were less than 10.8% for the 2003-2012 period and 8.91% for the 2008-2012 period with the optimistic appraisal requirements. With the less optimistic appraisal requirements the returns become 8.69% and 6.6% respectively in the two periods. The RFES increases the IRR by 1% in the longer exploration period case and by 0.55% in the shorter period.

The oil price was relatively high in the 2006-2008 time period and was over \$100/bbl in 2011 and 2012. Fields developed in the early time period were able to benefit from these high oil prices. Although there was some production from fields discovered in the later time period (from 2010 onwards) overall it was low. The sanctioned fields contributed most to the returns for fields developed in the earlier time period and all, bar 1 at the \$70 price, has a positive IRR when E & A are excluded. The average size of the sanctioned fields is 25 mmboe for the longer

exploration period and 16 mmboe in the shorter period. There are 4 fields with more than 75 mmboe in the longer exploration period but none in the shorter time period.

As expected, in the shorter exploration period the bulk of the returns comes from the probable and possible fields. The average size of the probable fields is 60 mmboe for fields discovered in the 2003-2012 period, and 61 mmboe for fields discovered in the 2008-2012 period. There are 4 fields with more than 75 mmboe in the 2003-2012 discoveries and 2 in the 2008-2012 discoveries. The average size of the possible fields is 69 mmboe for fields discovered in the 2003-2012 period, and 65 mmboe for fields discovered in the 2008-2012 period. There are 2 fields with more than 150 mmboe in the 2003-2012 discoveries, and 1 in the 2008-2012 discoveries.

Overall, the results indicate that at the \$90, 55 pence screening prices the expected rate of return generally exceeds the likely cost of capital for investors already in a tax paying position. But the expected rate of return is significantly lower for exploration undertaken in the more recent time period. The fall in exploration activity in recent years is consistent with this finding. Under the \$70, 40 pence case the returns for investors are markedly lower, and often less than the cost of capital for the risky exploration activity. The presence of field allowances for SC plays a noteworthy role in facilitating the development of high cost discoveries which in isolation can often reduce the overall return to the exploration effort. Historically, the explorer who is not already in a tax paying position has been at a major disadvantage compared to an existing tax payer. The increase in the interest rate for the RFES to 10% from 6%

significantly improves the relative position of a project investor, though, of course, he may receive no relief for unsuccessful exploration.

## Appendix

### Recent Tax Changes in UKCS

CT at 30%

SC at 32% (from 2011)

All E and A and D costs deductible on 100% first year basis

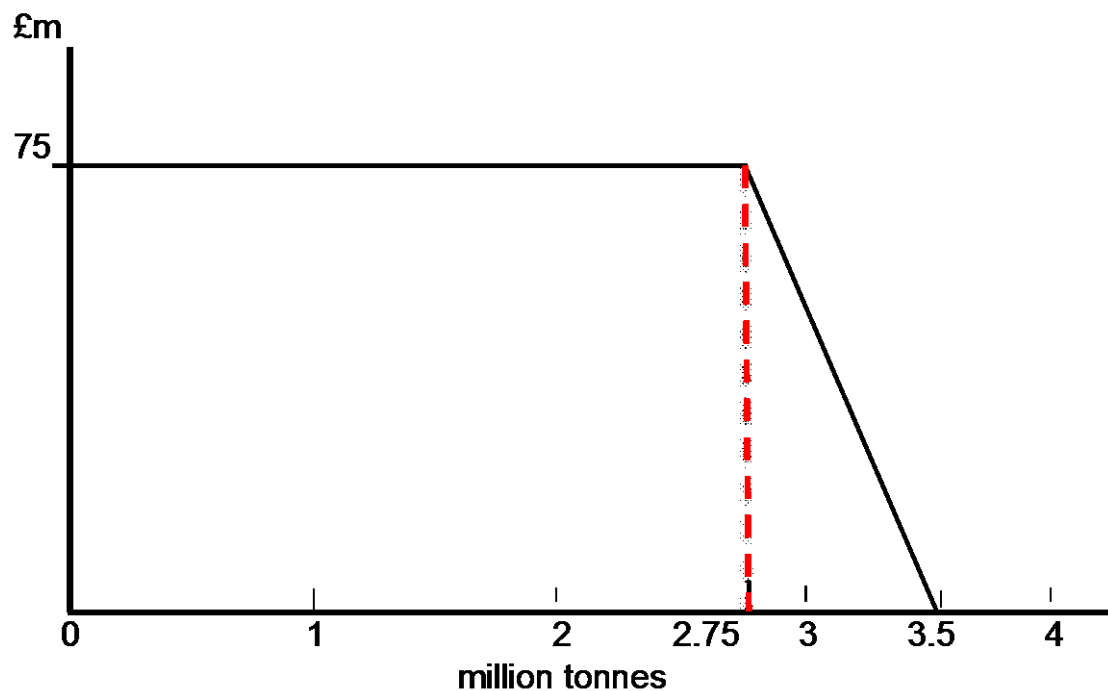
Budget 2009 introduced:

Field Allowance for Supplementary Charge

### Budget 2009

- The field allowance for small fields is £75 million for fields with oil reserves (or gas equivalent) of 2.75 million tonnes or less, reducing on a straight line basis to nil for fields over 3.5 million tonnes. In any one year the maximum field allowance (for a field with total allowance of £75 million) is £15 million.

**Field Allowance for Small Fields (2009)**



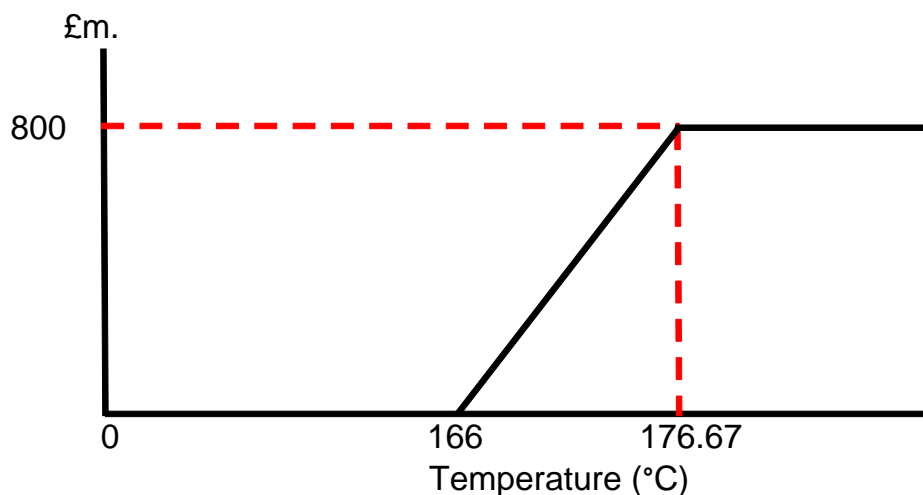
- The field allowance for ultra heavy oil fields is £800 million for fields with an American Petroleum Institute gravity below 18 degrees and a viscosity of more than 50 centipoise at reservoir temperature and pressure. In any one year the maximum field allowance is £160 million.
- The field allowance for ultra high temperature/pressure fields is £800 million for fields with a temperature of more than 176.67 degrees Celsius and pressure of more than 1034 bar in the reservoir formation. In any one year the maximum field allowance is £160 million.

Pre-Budget Report 2009

- In PBR 2009 qualifying criteria for HP/HT fields modified to 166°C and 862 bar. Allowance increases on SL basis from £500m. at 166°C to £800m. at 176.6°C.

**Field Allowance for HP/HT Fields**

Pressure of over 862 bar required

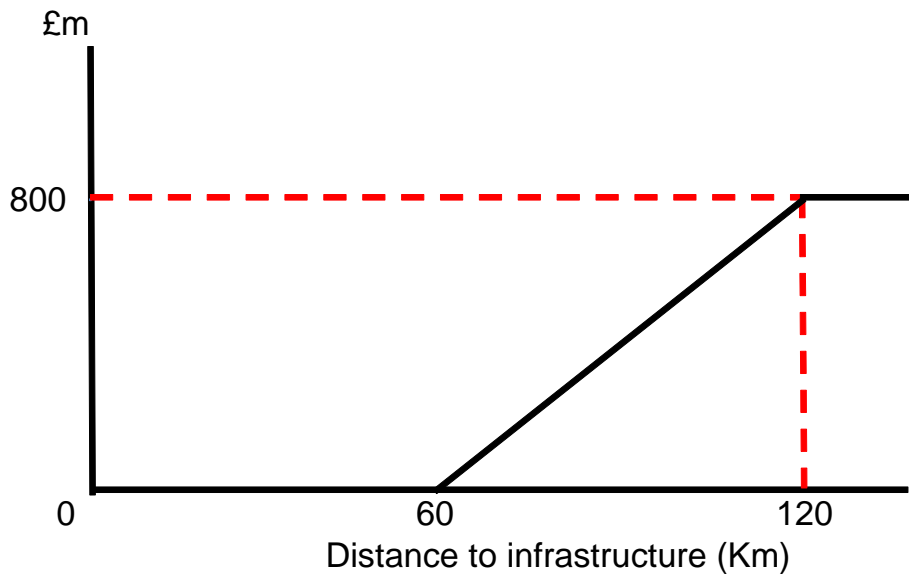


- In January 2010 field allowance of up to £800m. (max. £160m. in any 1 year) extended to remote, deep-water gas fields.
- Qualifying criteria:



- (a) gas more than 75% of reserves
- (b) field located in water depth > 300 metres
- (c) distance from field to relevant infrastructure > 60 km. Allowance increases linearly from £0 at 60k. to £800m. at 120 km.

**Field Allowance for Remote, Deep Water Gas Fields**



Budget 2011

SC increased from 20% to 32%

	Tax Rates	
	Pre Budget	Post Budget
PRT fields	75%	81%
Non-PRT fields	50%	62%

	Decommissioning Relief	
	Pre Budget	Post Budget
PRT fields	75%	69%/75%
Non-PRT fields	50%	50%

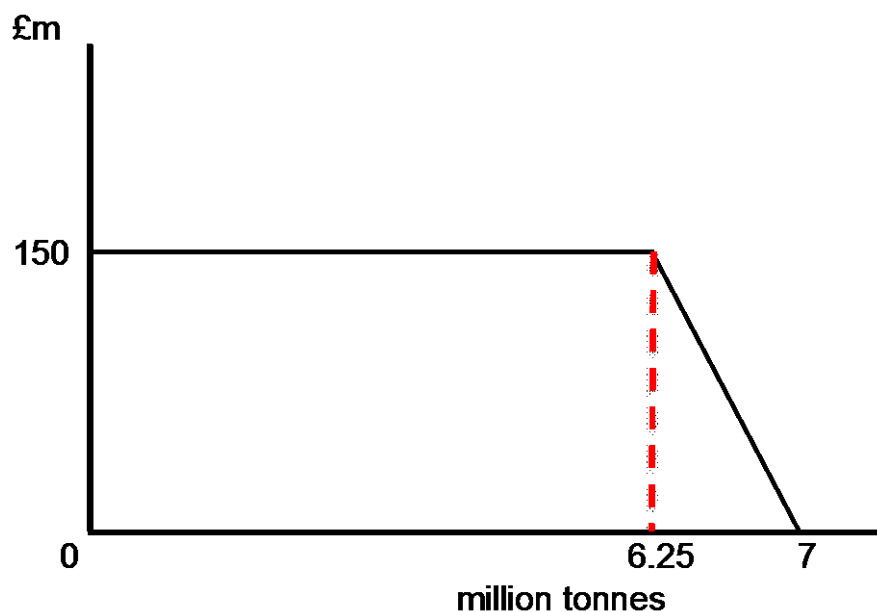
July 2011

- Increase in Ring Fence Expenditure Supplement interest rate from 6% to 10%, taking effect from January 2012. (In 2003 exploration /appraisal supplement (EES) was introduced allowing unused exploration and appraisal allowances to be carried forward at 6% compound interest for a maximum period of 6 years. From January 2006 the allowance was extended to development costs and renamed the Ring Fence Expenditure Supplement (RFES)).

Budget 2012

- Field allowances extended to fields already developed (incremental projects).
- Small field allowance increased from total of £75m. to £150m. and size of qualifying fields increased from 2.75m. tonnes or less to 6.25m. tonnes or less. The extended allowance is tapered to zero at 7m. tonnes (compared to 3.5m. tonnes).

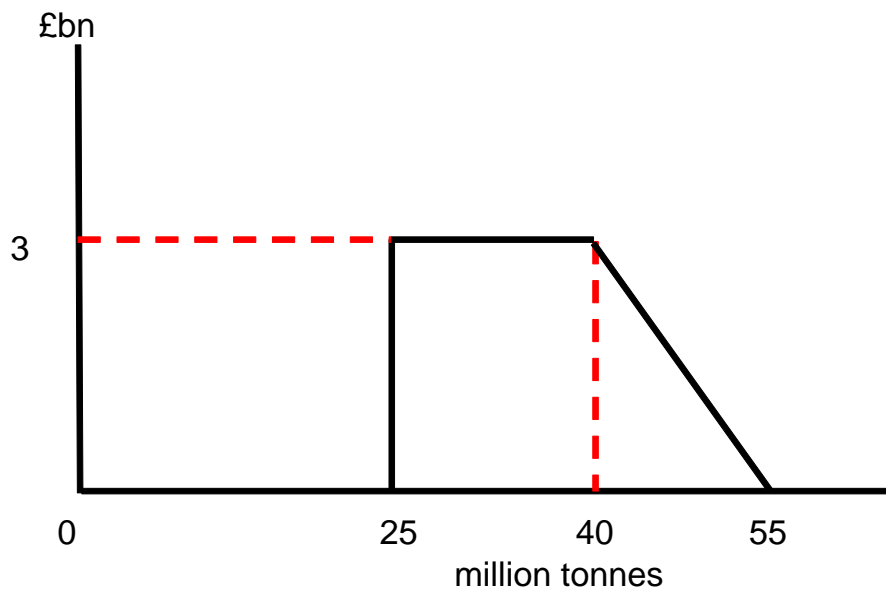
**Field Allowance for Small Fields (2012)**



- £3bn. field allowance (over 5 years) for new fields with qualifying criteria:

- (a) Water depth > 1000 metres
- (b) Minimum reserves of 25m. tonnes
- (c) Maximum reserves of 40m. tonnes with taper to £0 at 55m. tonnes

### Field Allowance for Large, Deep Water Fields

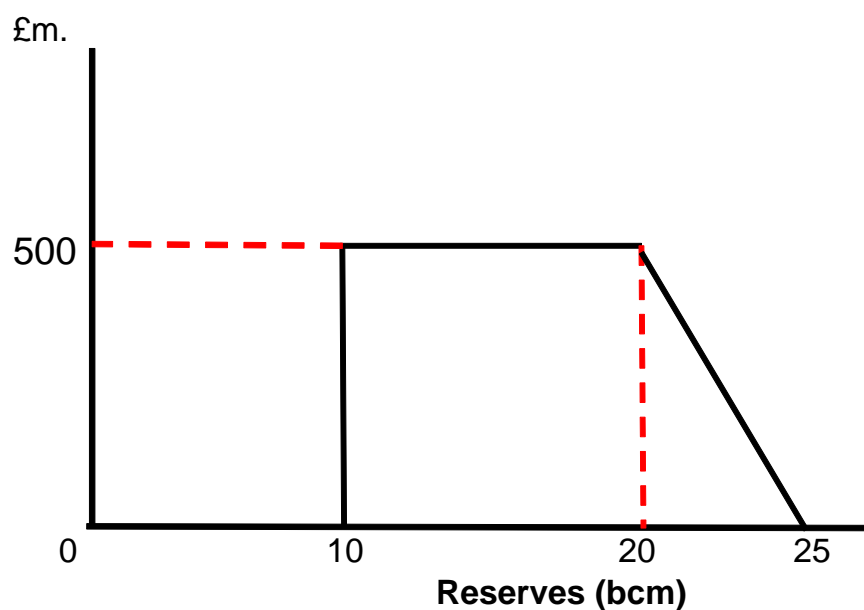


- The Government to introduce legislation in Finance Bill 2013 giving it statutory authority to sign contracts with companies operating in the UK an UK Continental Shelf, to provide assurance on the relief they will receive when decommissioning assets.

### July 2012

- Announcement of field allowance of £500 million. (over 5 years) for large, shallow water, gas fields.
- Qualifying criteria:
  - (a) Water depth < 30 metres
  - (b) Reserves more than 10 bcm and less than 20 bcm with taper to 25 bcm

## Field Allowance for Large, Shallow Water Gas Fields



### September 2012

- Announcement of Brownfield Allowance (BFA) for incremental projects in producing fields.
- Qualifying criteria: capital costs per incremental tonne of reserves exceeding £60. Allowance increases linearly to maximum of £50 per tonne when capital costs reach £80 per tonne.
- Allowance spread over 5 years.
- Maximum allowance: £250m. in non-PRT-paying fields  
£500m. in PRT-paying fields.

### Brownfield Allowance

