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Investment Hurdles in the UKCS and their Effects: A Response to the OGA Consultation on the Approach to "*Satisfactory Expected Commercial Return*" in the MER UK Strategy

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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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<u>Investment Hurdles in the UKCS and their Effects: A Response to the OGA Consultation on the Approach to "*Satisfactory Expected Commercial Return*" in the MER UK Strategy</u>

Professor Alexander G. Kemp and Linda Stephen

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<u>Investment Hurdles in the UKCS and their Effects: A Response to the OGA Consultation on the Approach to "*Satisfactory Expected Commercial Return*" in the MER UK Strategy</u>

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1. Introduction and Context

The publication of a Consultation document by the OGA on the approach to a "satisfactory expected commercial return" in the MER UK Strategy may be regarded as a landmark in the development of UK Government policy towards the UKCS. It seeks to highlight an issue which traditionally has not been openly discussed. Investors generally regard investment hurdles and their application at a detailed level as commercially sensitive matters.

Individual investors are also likely to view investmet projects differently. This explains why there are sales and purchases of assets in the UKCS (and elsewhere). The future expected value obtainable from a given asset as seen by one company may very well differ from that as seen by another. Views can differ regarding several factors determining expected value from a field such as geological interpretation, reservoir behaviour, future capital and operating costs, scope for EOR projects, future oil and gas prices, and decommissioning costs. With respect to exploration projects geological interpretations may also vary. With regard to infrastructure provision for third parties views can vary regarding the prospective volumes of oil and gas and the potential tariffs obtainable.

Investors may thus view a given opportunity differently even when they have the same investment hurdle. When they have different investment hurdles this consititutes a further reason for the presence of differences in the definition of a satisfactory expected commercial return (SECR). There is a will of the wisp aspect to the question. Given all the above this paper sets out to elucidate the application of the concept to the conditions currently prevailing in the UKCS.

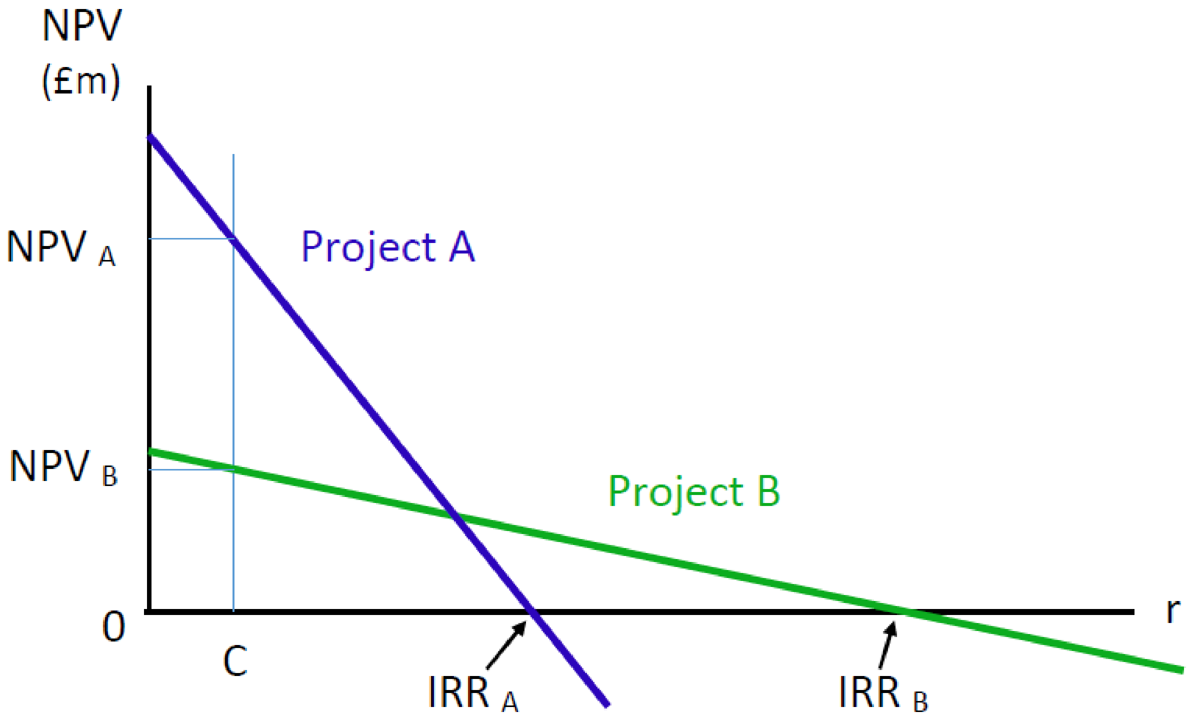
2. Investment Hurdles and the Current Characteristics of the UKCS

While explicit investment hurdles employed in the oil and gas industry are generally not openly published there is plenty casual empiricism on the subject as well as independent assessments on at least some aspects of the subject. Thus net present values (NPVs) at different discount rates, internal rates of return (IRRs), and ratios of net present value to investment (NPV/I) are commonly calculated. Payback periods and maximum cash exposure are also commonly calculated as relevant yardsticks.

These well-known criteria need to be seen in the context of the present position of the industry and the UKCS in particular. In terms of the overall investment environment the UKCS is a mature province reflected generally in (a) substantial numbers of mature fields, (b) large numbers of small, undeveloped discoveries, (c) relatively large development and operating costs per boe, reflecting the relatively low production per field in many cases and the age of the producing systems. With respect to exploration the prospectivity in most parts of the UKCS is for relatively small discoveries. The average is around 20 mmboe but the most likely sizes are less that this reflecting the lognormal distribution of field sizes. Larger discoveries are possible in the W of S region but the costs are also higher there. A consequence of the above is that the materiality of prospective returns (expressed as the size of net cash flows at the investor's discount rate) is relatively modest for the majority of projects, but much larger for some others. For the UKCS as a whole the NPV profiles of fields in relation to the discount rate very often intersect, giving conflicting rankings. An example of this phenomenon is shown in Figure 1.

Figure 1

NPV Profiles of Large and Small Fields in UKCS



In Figure 1 Project A is a large, long-lived field. The NPV profile falls at a relatively brisk pace as the discount rate increases reflecting its effect on a long-lived project. Project B is a small, short-lived field. The NPV profile falls much more slowly as the discount rate increases because there are no very distant cash flows.

The above issue is very common in the UKCS. A result is that the NPV and IRR hurdles give conflicting rankings. In Figure 1 Project A has a much larger NPV than Project B at the discount rate c which represents the cost of capital. But Project B has a higher IRR than Project A. Thus, if ranking of projects is required, the 2 criteria produce different answers.

But ranking is likely to be required because of the presence of capital rationing. A small project such as an infill well will typically have a relatively short life but could have a high IRR due to modest capital and operating costs.

Contrary to the impression gained in some textbooks on corporate finance, capital rationing is very prevalent in the oil and gas industry as elsewhere. It may be self-imposed or imposed by external factors such as restrictions by banks or other creditors. When the oil price collapsed in the period from late 2014 to 2016 the capital rationing problem clearly became more pronounced. Banks have always adopted a very conservative oil price for screening project loans, typically very considerably below that pertaining at the time of the loan application. For example, if the current market price were $65 a loan screening price could be as low as $45.

At any one time large oil companies will have investment opportunities exceeding their capital budget, sometimes by a considerable margin. Again a rationing mechanism has to be devised. From Figure 1 it is clear that to maximise NPV at the discount rate reflecting the cost of capital Project A should be ranked ahead of Project B. But typically in a capital rationing situation the post-tax NPV/pre-tax investment ratio is calculated and used for ranking projects. This is because it highlighs the return in terms of NPV per $ invested and thus measures the productivity of the scarce capital.

In the Consultation document much attention is given to the appropriate discount rate and in particular to the weighted average cost of capital on which it can be based. The Consultation document defines this as the rate which reflects systematic or market-correlated risks which cannot be mitigated or diversified away. Referring to a study carried out for the OGA by OXERA the document quotes for E and P companies a nominal, post-tax WACC in the range 6.9%-8.3%

for E and P companies, and for integrated companies a range of 5%-6.5%. For pipeline companies a range of 4.9%-7.2% is quoted.

Several questions arise here. The document argues that discount rates are best shown in nominal terms because taxes are paid in nominal terms. This is the case but it does not mean that prospective returns are not estimated in real terms by investors. The present authors routinely initially calculate project cash flows in MOD terms but subsequently calculate the post-tax returns in real terms. Investors can readily do this and may be well aware of the need to distinguish between returns before and after inflation.

Using the MOD numbers for the WACC in the Consultation document the precise values in real terms with inflation at 2.5% (below the current level) are shown in Table 1.

Table 1

WACC IN MOD TERMS (%)	WACC IN REAL TERMS (%)
6.9	4.29
8.3	5.658
5.0	2.439
6.5	3.9
4.9	2.34
7.2	4.585

These figures seem quite low. Other published studies on the WACC of oil companies give more detailed results. Every year the Texas Comptroller publishes the results of a study on the WACC of oil companies operating in Texas and with their shares quoted on the New York Stock Exchange. The latest issue entitled 2017 Property Value Study: Discount Rate Range for Oil and Gas Properties[1], provides the results of the WACC of 18 well-known oil companies. The data employed were for end 2016. The average pre-income tax WACC was found to be 14.64% with a standard deviation of 1.66. The average after income tax cost of equity was found to be 11.29% and the average cost of debt 4.5%. As an illustrative individual example the before income tax WACC of Chevron was found to be 13.32%, the before income tax cost of equity 14.96%, the post-income tax cost of equity 9.72%, and the cost of debt 3.01%. For Apache the before income tax WACC was 14.19%, the pre-income tax cost of equity 17.73%, the post-tax cost of equity 11.52%, and the cost of debt 4.22%.

An important feature of the results is the relatively low cost of debt. This has, of course, been a noticeable feature in recent years not only in the USA but the UK and elsewhere. While this reflects recent realities it would be unwarranted to assume that this will maintain over the long term.

Very broadly speaking the Texas study lends support to the view that integrated companies have a lower cost of capital than non-integrated ones, reflecting the greater degree of diversification among the former.

The Consultation document suggests a separate range of WACC for transportation companies. There are a few such companies operating in the UKCS but it is not clear how their WACC can be calculated. Whether the experience of transportation companies operating onshore in the electricity and gas markets is comparable to activities in the UKCS is open to debate. In the UKCS the price and volume risks may be relatively low in the short term, but in

[1] See Texas Comptoller of Public Accounts, Publication #96-1166, September 2017, see website: https://search.comptroller.texas.gov/viewer/index.jsp?start=0&proxy=%2F&sessionid=29154590-1cfa-4068-8145-68e46e6f9ca4

the longer term they may be greater. When volumes decline from existing fields they need to be replaced to maintain revenues. This is more uncertain than the position with onshore electricity and gas distribution activities.

The Consultation document does not mention the exploration activity as a separate one. There are such companies. Their risks are clearly greater. They will find it very difficult to raise debt finance. Banks generally do not lend for this activity. The equity costs of exploration companies will inevitably be higher than those of ingtegrated companies, (whether horizontal or vertical). In the present position in the UKCS it is argueable that the WACC of exploration companies should be separately considered.

While estimates of the WACC certainly add value to a discussion of discount rates the values resulting from calculations by using the CAPM, for example, cannot be conclusive. While direct empirical knowledge of discount rates actually employed is elusive it is known to the present authors that a 10% post-tax rate is very widely employed. Some use MOD and other real terms. Generally this would be used initially to screen all new investments. In this context it is noteworthy that in The Maximising Economic Recovery Strategy for the UK it is stated that, for the purposes of the Central Obligation, economicaly recoverable resources are to be calculated using a 10% pre-tax real discount rate. It is also noteworthy that, for purposes of calculating the Ring Fence Expenditure Supplement a 10% compound interest rate in MOD terms is used.

As discussed above the reality of capital rationing needs to be considered. A discount rate of 10% rather than the lower rates based on WACC may be used to reflect capital rationing. Potential projects are also likely to be ranked according to post-tax NPV/pre-tax I ratios using the discount rate discussed immediately above. Acceptability would depend on the resulting value and on the total budget available. The Consultation document indicates minimum NPV/I ratios for acceptability of 0.2 or 0.3. The authors' own knowledge is that a ratio of 0.3 could generally be acceptable (When the oil price was substantially below current levels OGUK considered that 0.5 might better reflect the effects of capital rationing). It is noteworthy that using the NPV/I ratio for ranking and screening purposes often gives different results compared to ranking by IRR. The NPV/I method gives more weight to the materiality of the project.

3. Methodology for Empirical Modelling

Financial modelling has been conducted to calculate the returns on a large number of currently undeveloped discoveries in the UKCS plus future discoveries which could be made in future years. The simulation modelling, including the use of Monte Carlo technique was informed by a large database of undeveloped fields, many validated by the relevant operators and covered the period to 2050. Other field data are a combination of public and private domain information and estimates made by the authors. The overall field database incorporates key, best estimate information on production, and investment, operating and decommissioning expenditures. They relate to 14 probable fields, and 14 unsanctioned fields which are currently being examined for development. In addition, there are 249 fields defined as being in the category of technical reserves. Only summary data on the reserves (oil/gas/condensate) and block locations are available for these, and estimates of production and cost profiles were made by the authors. These fields are not currently being examined for development by licensees.

Monte Carlo modelling was employed to estimate the possible numbers of new discoveries in the period to 2047. The modelling incorporated assumptions based on recent trends relating to exploration effort, success rates, sizes, and types of discovery (oil, gas, condensate). A moving average of the behavior of these variables over the past 5 years was calculated separately for 5 areas of the UKCS (Southern North Sea (SNS), Central North Sea/Moray Firth (CNS/MF), Northern North Sea (NNS), West of Shetlands (WoS), and Irish Sea (IS)). The results were employed for use in the Monte Carlo analysis. Because of the very limited data for the WoS and IS judgmental assumptions on success rates and average sizes of discoveries were made for the modelling.

It is postulated that the exploration effort depends substantially on a combination of (a) the expected success rate, (b) the likely size of discovery, and (c) oil/gas prices. In the present study 2 future oil/gas price scenarios were employed as follows:

Table 1

Future Oil and Gas Price Scenarios

	Oil Price (real) $/bbl	Gas Price (real) pence/therm
Medium	60	50
Low	50	40

These price scenarios are designed to reflect investment screening prices, not market values. In this context, it should be noted that, when oil prices were $100 or more banks typically employed oil prices in the $65-$75 range to assess loan applications. With market prices of c. $50 banks may use prices in the $35 - $46 range to assess loan applications. In MOD terms the price scenario starting with $60 in 2017 becomes $115 in 2050, and the scenario starting with $50 in 2017 becomes over $96 in 2050. The structure of costs between dollars and sterling in the modelling reflects the up-to-date position.

The postulated numbers of annual exploration wells drilled for the whole of the UKCS are as follows for 2017, 2030, 2040, and 2045:

Table 2

Exploration Wells Drilled

	2017	2030	2040	2045
Medium effort	15	12	10	9
Low effort	12	9	7	6

It is postulated that success rates depend substantially on a combination of (a) recent experience, and (b) size of the effort. It is further suggested that higher effort is associated with more discoveries, but with lower success rates compared to reduced levels of effort. This reflects the view that low levels of effort will be concentrated on the lowest risk prospects, and thus higher effort involves the acceptance of higher risk. For the UKCS as a whole 2 success rates were postulated as follows with the medium one reflecting the average over the past 5 years.

Table 3

Success Rates for UKCS

Low effort/Medium success rate	33%
Medium effort/Lower success rate	30%

It should be noted that success rates have varied considerably across the 5 sectors of the UKCS. The annual number of discoveries has been low since 2010 reflecting the large decline in the number of exploration wells since

2008. It is assumed that technological progress will maintain historic success rates over the time period.

The mean sizes of discoveries made in the historic periods for each of the 5 regions were calculated. It was then assumed that the mean size of discovery would decrease in line with recent historic experience. They are shown in Table 4.

Table 4 Mean Discovery Size MMboe		
Year	**2017**	**2045**
SNS	**20**	**15**
CNS/MF	**17**	**12**
NNS	**38**	**6**
WoS	**59**	**28**
IS	**9**	**4**

For purposes of the Monte Carlo modelling of the size of new discoveries the standard deviation (SD) was set at 50% of the mean value. In line with historic experience the size distribution of discoveries was taken to be lognormal.

Using the above information, the Monte Carlo technique was employed to project discoveries in the 5 regions to 2047. For the period to 2050 the total numbers of discoveries for the whole of the UKCS were as follows:

Table 5 **Total Number of Discoveries to 2050**	
Medium effort/Lower success rate	117
Lower Effort/Medium Success Rate	97

For each region the average development costs (per boe) of fields in the probable and possible categories were calculated. These reflect the cost reductions over the last few years. Investment costs per boe depend on several factors including not only the absolute costs in different operating conditions (such as water depth), but on the size of the fields. For all of the UKCS the average development cost was calculated to be $16.66 per boe with the highest being $21.72. In the SNS development costs were found to average $11.44 per boe. In the CNS/MF, they averaged $18.5 per boe, in the WoS average development costs were $15.78 per boe (reflecting the relative large size of fields), and in the NNS they averaged $21.6 per boe.

Operating costs over the lifetime of the fields were also calculated. The average has fallen from $19 per boe to $11.5 for all of the UKCS. They are now estimated at $6 per boe in the SNS, $13 per boe in the CNS/MF, $12.5 per boe in the WoS, and $14.6 per boe in the NNS. Total lifetime field costs (including decommissioning but excluding E and A costs) were found to have fallen from an average of $38.9 per boe for all of the UKCS to $34.8 per boe, with $23 per boe in the SNS, $38 per boe in the CNS/MF, $30 per boe in the WoS (reflecting the relatively large size of fields), and $41 per boe in the NNS.

Using these as the mean values the Monte Carlo technique was employed to calculate the development costs of new discoveries. A normal distribution with a SD = 20% of the mean value was employed. Annual operating costs were modelled as a percentage of accumulated development costs. This percentage varies according to field size. It was taken to increase as the size of the field was reduced reflecting the presence of economies of scale. The field lifetime costs in very small fields could become very high on a boe basis.

With respect to fields in the category of technical reserves it was recognised that there are many major challenges, and so the mean development costs in each of the basins was set at $5/boe higher than the mean for new discoveries in that basin. Thus for the CNS/MF the mean development costs are $23.5 per boe, and in NNS over $26 per boe. The distribution of these costs was assumed to be normal with a SD = 20% of the mean value. A binomial distribution was employed to find the order of new development of fields in this category.

The modelling has been undertaken under the current tax system. It is assumed that probable and possible fields, technical reserves, and new discoveries have to generate taxable income from the new projects before they can use their tax allowances. Thus the Ring Fence Expenditure Supplement (RFES) is employed. The modelling is initially undertaken in MOD terms with an inflation rate of 2%. This incorporates the effects of any fiscal drag. The results are then converted to real terms.

In the light of experience over the past few years some rephasing of the timing of the commencement dates of new field developments from those initially projected by operators was undertaken relating to the probability that the project would go ahead. Where the operator indicated that a new field development had a probability ≥ 80% of going ahead the date was left unchanged. Where the probability ≥ 70% <80% the commencement date was slipped by 1 year and where the probability ≥ 50% < 70% the commencement date was slipped by 2 years. Where the probability ≥ 40% < 50% the date was slipped by 3 years. Where the probability was ≥ 30% < 40% the date was slipped by 4 years, and where the probability was ≥ 20% < 30% it was slipped by 5 years. Where the probability was < 20% it was slipped by 6 years.

The modelling calculates the returns to all the projects using a variety of investment hurdles. These include the discount rates identified in the Consultation document for the WACC. Results are also shown in both real and MOD terms to highlight the effect of inflation. The results are shown post-tax except where pre-tax is clearly stated.

4. Results

A. $50, 40 pence prices in real terms

In Table 6 the numbers of fields which pass specified hurdles in real terms at the $50, 40 pence real price scenarios are shown. In Table 7 the numbers which pass the same hurdles in MOD terms are shown.

Table 6

Numbers of fields passing hurdles in real term @ $50, 40 pence prices

	10% RNPV/I 0.3 Hurdle Pass	10% RNPV/I 0.5 Hurdle Pass	Real IRR 10% Pass	Real IRR 15% Pass	Real Pre-tax Cashflow Pass	Real Pre-tax 10% Pass	10% RNPV>£10m Pass
Probable	4	3	7	7	11	7	7
Possible	3	2	7	3	11	7	6
Technical Reserves	51	18	118	96	158	118	81
New Exploration	45	22	78	75	90	78	77

Table 7

Numbers of fields passing hurdles in MOD terms @ $50, 40 pence prices

	10% NNPV/I 0.3 Hurdle Pass	10% NNPV/I 0.5 Hurdle Pass	Nominal IRR 10% Pass	Nominal IRR 15% Pass	Nominal Pre-tax Cashflow Pass	Nominal Pre-tax 10% Pass	10% NNPV>£10m Pass
Probable	6	4	7	7	11	7	7
Possible	4	2	8	6	11	8	8
Technical Reserves	55	27	134	100	162	133	105
New Exploration	60	34	83	76	91	83	82

The results indicate that the largest number of post-tax passes is with the IRR at10%. There are 22 fields which pass this hurdle in MOD terms but fail in real terms. Virtually all the fields which pass this hurdle pre-tax do continue to do so after tax.

A striking feature is the much lower numbers of passes when NPV/I > 0.3 is used as the hurdle compared to IRR@10%. The number of passes falls from 118 to 51 in real terms, and from 134 to 55 in MOD terms. This generally reflets the relatively small materiality of returns in fields in the categories of technical reserves and new discoveries.

When the hurdle is increased from IRR of 10% to IRR of 15% the numbers of passes in the categories of technical reserves and new discoveries fall by a significant but not dramatic number in both real and MOD terms. At the hurdle of IRR at 15% the number of passes in the 2 categories of fields remains very much greater than the case with the hurdle at NPV/I > 0.3. This applies to both real and MOD conditions.

When the hurdle is NPV/I > 0.5 the number of passes is dramatically less than when the pass is NPV/I > 0.3. The great majority of the fields in the categories of technical reserves and new discoveries cannot approach this very demanding hurdle.

In Table 8 the individual fields which fail the NPV/I hurdle in real terms but pass in MOD terms are listed. There are 22 in total. The timing of their development obviously varies over the period to 2050 and their development costs per boe in MOD terms are affected by the inflation.

Table 8

Fields which fail NPV/I > 0.3 hurdle in real terms but pass in MOD terms

$50 Nominal	10% NNPV/I 0.3 Hurdle	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m
K	Pass	+	+	Pass
A	Pass	+	+	Pass
B	Pass	+	+	Pass
Field 7	Pass	+	+	Pass
Field 126	Pass	+	+	Pass
Field 178	Pass	+	+	Pass

Field 194	Pass	+	+	Pass
Find 2	Pass	+	+	Pass
Find 11	Pass	+	+	Pass
Find 16	Pass	+	+	Pass
Find 35	Pass	+	+	Pass
Find 43	Pass	+	+	Pass
Find 53	Pass	+	+	Pass
Find 59	Pass	+	+	Pass
Find 69	Pass	+	+	Pass
Find 77	Pass	+	+	Pass
Find 78	Pass	+	+	Pass
Find 85	Pass	+	+	Pass
Find 88	Pass	+	+	Pass
Find 89	Pass	+	+	Pass
Find 94	Pass	+	+	Pass
Find 95	Pass	+	+	Pass

In Table 9 the fields which fail the NPV/I > 0.5 hurdle in real terms but pass in MOD terms are listed. There are 25 in total (though not the same as those shown in Table 8).

Table 9

Fields which fail NPV/I > 0.5 hurdle in real terms but pass in MOD terms

$50 Nominal	10% NNPV/I 0.5 Hurdle	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m
B2	Pass	+	+	Pass
Field 29	Pass	+	+	Pass
Field 34	Pass	+	+	Pass
Field 35	Pass	+	+	Pass
Field 150	Pass	+	+	Pass
Field 155	Pass	+	+	Pass
Field 163	Pass	+	+	Pass
Field 187	Pass	+	+	Pass
Field 209	Pass	+	+	Pass
Field 222	Pass	+	+	
Find 3	Pass	+	+	Pass
Find 12	Pass	+	+	Pass
Find 13	Pass	+	+	Pass
Find 14	Pass	+	+	Pass
Find 15	Pass	+	+	Pass

Find 33	Pass	+	+	Pass
Find 38	Pass	+	+	Pass
Find 41	Pass	+	+	Pass
Find 44	Pass	+	+	Pass
Find 49	Pass	+	+	Pass
Find 81	Pass	+	+	Pass
Find 97	Pass	+	+	Pass

In Table 10 the fields which fail the hurdle IRR ≥ 10% in real terms but pass in MOD terms are shown. Coincidentally there are 22 of them.

Table 10

Fields which fail IRR ≥ 10% hurdle in real terms but pass in MOD terms

$50 Nominal	Nominal IRR 10%	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m
T	Pass	+	-	
Field 3	Pass	+	-	
Field 45	Pass	+	-	
Field 114	Pass	+	-	
Field 142	Pass	+	-	
Field 148	Pass	+	-	
Field 164	Pass	+	-	
Field 167	Pass	+	-	
Field 192	Pass	+	-	
Field 200	Pass	+	-	
Field 207	Pass	+	-	
Field 210	Pass	+	-	
Field 212	Pass	+	-	
Field 219	Pass	+	-	
Field 225	Pass	+	-	
Field 233	Pass	+	-	
Field 239	Pass	+	-	
Find 21	Pass	+	-	
Find 24	Pass	+	-	
Find 31	Pass	+	-	
Find 70	Pass	+	-	
Find 74	Pass	+	-	

In Table 11 the fields which fail IRR ≥ 15% hurdle in real yterms but pass in MOD terms are shown.

Table 11

Fields which fail IRR ≥ 15% hurdle in real terms but pass in MOD terms

$50 Nominal	Nominal IRR 15%	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m	Nominal Devex/boe £
B	Pass	+	+	Pass	8.01
C	Pass	+	+	Pass	10.53
B3	Pass	+	+		10.55
Field 17	Pass	+	+	Pass	12.56
Field 46	Pass	+	+		22.87
Field 98	Pass	+	+		15.69
Field 110	Pass	+	+	Pass	23.09

The fields passing and failing the hurdles at the discount rates in the Consultaion document are now discussed. In Table 12 the numbers of fields which pass the hurdle NPV/I > 0.2 in MOD terms are shown at a wide range of discount rates below 10% in MOD terms. In Table 13 the results with hurdle of NPV/I > 0.3 in MOD terms are shown. It is seen that increasing the hurdle from NPV/I > 0.2 to NPV/I > 0.3 has a significantly adverse effect on the number of fields passing at all discount rates shown. A comparison with the results in Table 6 also indicates that, with the NPV/I ≥ 0.3 hurdle, the numbers passing are noticeably less when the discount rate is 10%.

The results in Table 13 show the number of fields passing the hurdle of NPV/I ≥ 0.3 at the same discount rates. There is seen to be a significant reduction in the number in the category of technical reserves compared to the NPV/I ≥ 0.2 hurdle. It should be recalled that these fields are relatively high cost. There is not so big a difference in the numbers in the category of future discoveries. A comparison with Table 7 indicates that the numbers passing are substantially less when the discount rate is 10%.

Table 12

Numbers of fields passing hurdle of NPV/I > 0.2 in MOD terms at different discount rates

$50 Nominal	4.9% NPV/I 0.2 Hurdle Pass	5% NPV/I 0.2 Hurdle Pass	6.5% NPV/I 0.2 Hurdle Pass	6.9% NPV/I 0.2 Hurdle Pass	7.2% NPV/I 0.2 Hurdle Pass	8.3% NPV/I 0.2 Hurdle Pass
Probable	6	6	6	6	6	6
Possible	7	7	7	7	7	6
Technical Reserves	106	104	91	90	88	84
New Exploration	77	77	77	77	76	75

Table 13

Numbers of fields passing hurdle of NPV/I > 0.3 in MOD terms at different discount rates

$50 Nominal	4.9% NPV/I 0.3 Hurdle Pass	5% NPV/I 0.3 Hurdle Pass	6.5% NPV/I 0.3 Hurdle Pass	6.9% NPV/I 0.3 Hurdle Pass	7.2% NPV/I 0.3 Hurdle Pass	8.3% NPV/I 0.3 Hurdle Pass
Probable	6	6	6	6	6	6
Possible	7	7	6	6	5	5
Technical Reserves	79	79	72	68	67	64
New Exploration	74	74	68	67	66	65

The fields which fail the MOD NPV/I ≥ 0.3 hurdle at 10% discount rate but pass with NPV/I ≥ 0.2 and lower discount rates are listed in Table 14. At 4.9% discount rate 71 fields pass. At the 8.3% discount rate 46 pass.

<u>Table 14</u>

<u>Fields which fail the MOD NPV at 10% MOD Devex > 0.3 hurdle but pass with a lower discount rate and a 0.2 hurdle</u>

$50	4.9% NPV/I 0.2 Hurdle	5% NPV/I 0.2 Hurdle	6.5% NPV/I 0.2 Hurdle	6.9% NPV/I 0.2 Hurdle	7.2% NPV/I 0.2 Hurdle	8.3% NPV/I 0.2 Hurdle
T	Pass	Pass	Pass	Pass	Pass	
C	Pass	Pass	Pass	Pass	Pass	Pass
G	Pass	Pass	Pass	Pass	Pass	Pass
Field 4	Pass	Pass				
Field 6	Pass	Pass	Pass	Pass	Pass	Pass
Field 11	Pass	Pass	Pass	Pass	Pass	Pass
Field 12	Pass	Pass	Pass	Pass	Pass	
Field 17	Pass	Pass	Pass	Pass	Pass	
Field 22	Pass	Pass	Pass	Pass	Pass	Pass
Field 30	Pass	Pass	Pass	Pass	Pass	Pass
Field 42	Pass	Pass	Pass	Pass	Pass	Pass
Field 43	Pass	Pass	Pass	Pass	Pass	Pass
Field 45	Pass	Pass				
Field 47	Pass	Pass				
Field 48	Pass	Pass	Pass	Pass	Pass	
Field 51	Pass	Pass	Pass	Pass	Pass	Pass
Field 55	Pass	Pass	Pass	Pass	Pass	Pass
Field 63	Pass	Pass	Pass	Pass	Pass	Pass
Field 74	Pass	Pass	Pass	Pass	Pass	Pass
Field 76	Pass	Pass	Pass	Pass	Pass	Pass
Field 85	Pass	Pass				
Field 88	Pass	Pass	Pass	Pass	Pass	Pass
Field 94	Pass	Pass	Pass	Pass	Pass	Pass
Field 98	Pass	Pass				
Field 101	Pass	Pass	Pass	Pass	Pass	Pass
Field 102	Pass	Pass	Pass	Pass	Pass	Pass
Field 104	Pass	Pass	Pass	Pass	Pass	Pass
Field 106	Pass					
Field 107	Pass	Pass	Pass	Pass	Pass	Pass
Field 110	Pass	Pass				
Field 111	Pass	Pass	Pass			
Field 119	Pass	Pass	Pass	Pass	Pass	Pass
Field 122	Pass	Pass				
Field 124	Pass	Pass	Pass	Pass	Pass	Pass
Field 125	Pass	Pass	Pass	Pass	Pass	Pass
Field 135	Pass	Pass	Pass	Pass	Pass	Pass
Field 136	Pass	Pass	Pass	Pass		
Field 138	Pass	Pass	Pass	Pass	Pass	Pass
Field 139	Pass	Pass	Pass	Pass	Pass	Pass

Field 161	Pass	Pass	Pass	Pass	Pass	Pass
Field 165	Pass	Pass				
Field 171	Pass	Pass	Pass	Pass	Pass	Pass
Field 174	Pass	Pass				
Field 189	Pass	Pass	Pass	Pass	Pass	Pass
Field 192	Pass					
Field 203	Pass	Pass	Pass	Pass		
Field 205	Pass	Pass	Pass	Pass	Pass	Pass
Field 207	Pass	Pass				
Field 211	Pass	Pass	Pass	Pass	Pass	
Field 219	Pass	Pass				
Field 228	Pass	Pass	Pass	Pass	Pass	Pass
Field 237	Pass	Pass				
Field 243	Pass	Pass				
Field 247	Pass	Pass	Pass	Pass	Pass	Pass
Find 22	Pass	Pass	Pass	Pass	Pass	Pass
Find 23	Pass	Pass	Pass	Pass	Pass	Pass
Find 26	Pass	Pass	Pass	Pass	Pass	Pass
Find 27	Pass	Pass	Pass	Pass		
Find 28	Pass	Pass	Pass	Pass	Pass	Pass
Find 34	Pass	Pass	Pass	Pass	Pass	Pass
Find 36	Pass	Pass	Pass	Pass	Pass	Pass
Find 42	Pass	Pass	Pass	Pass	Pass	Pass
Find 45	Pass	Pass	Pass	Pass	Pass	Pass
Find 54	Pass	Pass	Pass	Pass	Pass	Pass
Find 57	Pass	Pass	Pass	Pass	Pass	Pass
Find 65	Pass	Pass	Pass	Pass	Pass	
Find 72	Pass	Pass	Pass	Pass	Pass	Pass
Find 76	Pass	Pass	Pass	Pass	Pass	Pass
Find 84	Pass	Pass	Pass	Pass	Pass	Pass
Find 90	Pass	Pass	Pass	Pass	Pass	Pass
Find 93	Pass	Pass	Pass	Pass	Pass	Pass

In Table 15 the fields which failed the MOD NPV/I ≥ 0.3 hurdle but pass at lower discount rates are listed. At 4.9% discount rate 41 fields pass (compared to 71 when the hurdle was NPV/I ≥ 0.2). At 8.3% discount rate 15 pass (compared to 46 when the hurdle was NPV/I ≥ 0.3).

Table 15

Fields which fail the MOD NPV at 10% MOD Devex > 0.3 hurdle but pass with a lower discount rate and a 0.3 hurdle

$50	4.9% NPV/I 0.3 Hurdle	5% NPV/I 0.3 Hurdle	6.5% NPV/I 0.3 Hurdle	6.9% NPV/I 0.3 Hurdle	7.2% NPV/I 0.3 Hurdle	8.3% NPV/I 0.3 Hurdle
T	Pass	Pass				
C	Pass	Pass	Pass	Pass		
G	Pass	Pass	Pass	Pass	Pass	Pass
Field 6	Pass	Pass	Pass			
Field 11	Pass	Pass	Pass	Pass	Pass	
Field 22	Pass	Pass	Pass	Pass	Pass	
Field 30	Pass	Pass				
Field 42	Pass	Pass	Pass	Pass	Pass	Pass
Field 43	Pass	Pass	Pass			
Field 55	Pass	Pass	Pass			
Field 63	Pass	Pass	Pass	Pass	Pass	Pass
Field 74	Pass	Pass	Pass	Pass	Pass	Pass
Field 94	Pass	Pass	Pass	Pass	Pass	Pass
Field 101	Pass	Pass	Pass	Pass	Pass	Pass
Field 102	Pass	Pass	Pass	Pass	Pass	Pass
Field 104	Pass	Pass	Pass	Pass	Pass	
Field 107	Pass	Pass	Pass	Pass	Pass	Pass
Field 119	Pass	Pass				
Field 124	Pass	Pass				
Field 125	Pass	Pass				
Field 135	Pass	Pass				
Field 139	Pass	Pass				
Field 161	Pass	Pass	Pass	Pass	Pass	Pass
Field 171	Pass	Pass				
Field 189	Pass	Pass	Pass	Pass	Pass	Pass
Field 205	Pass	Pass	Pass			
Field 247	Pass	Pass	Pass	Pass	Pass	
Find 22	Pass	Pass				
Find 23	Pass	Pass				
Find 26	Pass	Pass	Pass	Pass	Pass	Pass
Find 28	Pass	Pass	Pass	Pass		
Find 34	Pass	Pass				
Find 36	Pass	Pass	Pass	Pass	Pass	Pass
Find 54	Pass	Pass				
Find 57	Pass	Pass	Pass	Pass	Pass	
Find 65	Pass	Pass				
Find 72	Pass	Pass	Pass	Pass	Pass	Pass
Find 76	Pass	Pass	Pass	Pass	Pass	Pass
Find 84	Pass	Pass				

Find 90	Pass	Pass	Pass			
Find 93	Pass	Pass	Pass	Pass	Pass	Pass

B. $60, 50 pence Prices in Real Terms

In Table 16 the number of fields passing various hurdles with real prices of $60 and 50 pence are shown. A comparison with the comparative results for the same hurdle with the $50, 40 pence prices case reveals that there is a dramatic increase in the numbers passing all the hurdles shown. With NPV/I $\geq$ 0.3 at 10% discount rate the number of passing fields in the category of technical reserves increases from 51 to 104. The number of new discoveries passing increases from 45 to 93. If IRR of 15% were the threshold the number of passes of fields in the category of technical reserves increases from 96 to 161. The number of new discoveries passing increases from 75 to 109. The results confirm the view that future activity in the UKCS is very sensitive to movements in oil prices between $50 and $60 when used for investment screening purposes. At the real NPV/I@10% > 0.3 hurdle the cumulative production 2017-2050 is 3.8 bn boe. At the real IRR > 10% hurdle total production is 7 bn boe, and at IRR > 15% hurdle it is 5.3 bn boe.

Table 16

Fields passing hurdles with prices of $60 and 50 pence in real terms

	10% RNPV/I 0.3 Hurdle Pass	10% RNPV/I 0.5 Hurdle Pass	Real IRR 10% Pass	Real IRR 15% Pass	Real Pre-tax Cashflow Pass	Real Pre-tax 10% Pass	10% RNPV> £10m Pass
Probable	7	4	13	11	14	13	13
Possible	7	5	12	10	13	12	11
Technical Reserves	104	60	184	161	229	184	160
New Exploration	93	69	115	109	117	115	114

In Table 17 the numbers passing the hurdles in MOD terms are shown.

Table 17

Fields passing hurdles in MOD terms with prices of $60 and 50 pence in real terms

	10% NNPV/I 0.3 Hurdle Pass	10% NNPV/I 0.5 Hurdle Pass	Nominal IRR 10% Pass	Nominal IRR 15% Pass	Nominal Pre-tax Cashflow Pass	Nominal Pre-tax 10% Pass	10% NNPV> £10m Pass
Probable	7	6	13	11	14	13	13
Possible	9	6	13	11	11	13	11
Technical Reserves	124	71	197	172	231	195	175
New Exploration	98	78	115	112	117	115	115

A comparison with the results in Table 7 again indicates that the numbers of future developments are much higher than those with the $50, 40 pence price. With the NPV/I @ 10% ≥ 0.3 hurdle the number of passing fields in the technical reserves category increases from 55 to 124 while the number of passes from fields in the new discoveries category increases from 60 to 98. If IRR of 15% were the hurdle the number of passes of technical reserves fields increases from 100 to 172. The number of passes in the new discoveries category increases from 76 to 112. With the MOD NPV/I@10% > 0.3 hurdle cumulative production 2017-2050 is 4.9 bn boe. With MOD IRR > 10% it is 7.5 bn boe, and with MOD IRR > 15% it is 6.1 bn boe.

A list of the fields which pass the NPV/I @ 10% ≥ 0.3 hurdle in MOD terms but fail in real terms is shown in Table 18. There are 27 such fields.

Table 18

Fields which fail NPV/I @ 10% ≥ 0.3 hurdle in real terms but pass in MOD terms

$60	10% NNPV/I 0.3 Hurdle	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m
G	Pass	+	+	
T	Pass	+	+	Pass
Field 3	Pass	+	+	Pass
Field 46	Pass	+	+	
Field 97	Pass	+	+	Pass
Field 115	Pass	+	+	Pass
Field 129	Pass	+	+	Pass
Field 133	Pass	+	+	Pass
Field 142	Pass	+	+	Pass
Field 167	Pass	+	+	Pass
Field 174	Pass	+	+	Pass
Field 186	Pass	+	+	Pass
Field 203	Pass	+	+	Pass
Field 205	Pass	+	+	Pass
Field 207	Pass	+	+	Pass
Field 210	Pass	+	+	Pass
Field 212	Pass	+	+	Pass
Field 217	Pass	+	+	Pass
Field 218	Pass	+	+	Pass
Field 219	Pass	+	+	Pass
Field 237	Pass	+	+	Pass
Field 243	Pass	+	+	Pass
Find 21	Pass	+	+	Pass
Find 24	Pass	+	+	Pass
Find 31	Pass	+	+	Pass
Find 39	Pass	+	+	Pass
Find 70	Pass	+	+	Pass

In Table 19 the fields are shown which fail the very demanding hurdle of NPV/I @ 10% ≥ 0.5 but pass in MOD terms. There are 23 in total. All but one have a positive real NPV@10%.

Table 19

Fields which fail NPV/I ≥ 0.5 hurdle in real terms but pass in MOD terms

$60	10% NNPV/I 0.5 Hurdle	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m
A	Pass	+	+	Pass
K	Pass	+	+	Pass
C	Pass	+	+	Pass
Field 11	Pass	+	+	Pass
Field 22	Pass	+	+	Pass
Field 30	Pass	+	+	Pass
Field 55	Pass	+	-	
Field 63	Pass	+	+	Pass
Field 74	Pass	+	+	Pass
Field 94	Pass	+	+	Pass
Field 102	Pass	+	+	Pass
Field 135	Pass	+	+	Pass
Field 161	Pass	+	+	Pass
Field 189	Pass	+	+	Pass
Find 36	Pass	+	+	Pass
Find 69	Pass	+	+	Pass
Find 72	Pass	+	+	Pass
Find 76	Pass	+	+	Pass
Find 85	Pass	+	+	Pass
Find 89	Pass	+	+	Pass
Find 93	Pass	+	+	Pass
Find 98	Pass	+	+	Pass
Find 102	Pass	+	+	Pass

In Table 20 the fields which fail the hurdle of IRR > 10% in real terms but pass in MOD terms are shown. There are 14 of them.

Table 20

Fields which fail IRR ≥ 10% hurdle in real terms but pass in MOD terms

$60	Nominal IRR 10%	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m
R	Pass	+	-	Pass
Field 20	Pass	+	-	
Field 31	Pass	+	-	
Field 41	Pass	+	-	
Field 49	Pass	+	-	
Field 56	Pass	+	-	
Field 57	Pass	+	-	
Field 89	Pass	+	-	
Field 90	Pass	+	-	
Field 132	Pass	+	-	
Field 144	Pass	+	-	
Field 177	Pass	+	-	
Field 236	Pass	+	-	
Field 241	Pass	+	-	

In Table 21 the fields which fail the hurdle of IRR > 15% in real terms but pass in MOD terms are listed.

Table 21

Fields which fail IRR ≥ 15% hurdle in real terms but pass in MOD terms

$60	Nominal IRR 15%	Real Pre-tax Cashflow	Real Pre-tax 10%	10% RNPV> £10m
G	Pass	+	+	
Field 18	Pass	+	+	Pass
Field 45	Pass	+	+	Pass
Field 118	Pass	+	+	Pass
Field 131	Pass	+	+	Pass
Field 172	Pass	+	+	
Field 190	Pass	+	+	
Field 213	Pass	+	+	Pass
Field 214	Pass	+	+	Pass
Field 220	Pass	+	+	Pass
Field 242	Pass	+	+	Pass
Field 248	Pass	+	+	
Find 68	Pass	+	+	Pass

Find 108	Pass	+	+	Pass
Find 111	Pass	+	+	Pass

Table 22

Fields which pass hurdle of NPV/I ≥ 0.2 in MOD terms at different discount rates

$60	4.9% NPV/I 0.2 Hurdle Pass	5% NPV/I 0.2 Hurdle Pass	6.5% NPV/I 0.2 Hurdle Pass	6.9% NPV/I 0.2 Hurdle Pass	7.2% NPV/I 0.2 Hurdle Pass	8.3% NPV/I 0.2 Hurdle Pass
Probable	12	12	12	12	11	11
Possible	12	12	11	11	11	11
Technical Reserves	175	175	164	162	161	157
New Exploration	115	115	112	112	112	111

In Table 22 the numbers of fields which pass the hurdle of NPV/I ≥ 0.2 in MOD terms are shown with the $60, 50 pence price scenario. A comparison with the corresponding results at the $50, 40 pence scenario reveals the much larger numbers with the higher price. At the 5% discount rate there are 314 passes at the higher price compared to 194 at the lower one. At the 8.3% discount rate there are 290 passes at the higher price compared to 171 at the lower price. At the $60 price with 5% discount rate cumulative production to 2050 is 6.3 bn boe.

Table 23

Fields which pass hurdle of NPV/I ≥ 0.3 in MOD terms at different discount rates

$60	4.9% NPV/I 0.3 Hurdle Pass	5% NPV/I 0.3 Hurdle Pass	6.5% NPV/I 0.3 Hurdle Pass	6.9% NPV/I 0.3 Hurdle Pass	7.2% NPV/I 0.3 Hurdle Pass	8.3% NPV/I 0.3 Hurdle Pass
Probable	10	10	9	9	9	10
Possible	11	11	11	11	11	10

Technical Reserves	155	155	149	146	144	140
New Exploration	108	108	106	105	104	101

In Table 23 the numbers of passes at the hurdle NPV/I ≥ 0.3 in MOD terms are shown at different discount rates. Again the numbers are much higher compared to the lower price. Thus at 5% discount rate there are 284 passes at the higher price compared to 166 at the lower price. At 8.3% discount rate there are 261 passes compared to 140 at the lower price. At the 5% discount rate with the $60 price cumulative production to 2050 from the fields is 6.5 bn boe. At the 8.3% discount rate it is 5.7 bn boe.

Table 24

Fields which fail the NPV/I@10% ≥ 0.2 in MOD terms but pass at lower discount rates

$60	4.9% NPV/I 0.2 Hurdle	5% NPV/I 0.2 Hurdle	6.5% NPV/I 0.2 Hurdle	6.9% NPV/I 0.2 Hurdle	7.2% NPV/I 0.2 Hurdle	8.3% NPV/I 0.2 Hurdle
C3	Pass	Pass	Pass	Pass	Pass	Pass
C4	Pass	Pass	Pass	Pass	Pass	Pass
J2	Pass	Pass	Pass	Pass	Pass	
L	Pass	Pass	Pass	Pass		
P	Pass	Pass	Pass	Pass	Pass	Pass
R2	Pass	Pass	Pass	Pass	Pass	Pass
A2	Pass	Pass	Pass	Pass	Pass	Pass
C5	Pass	Pass	Pass	Pass	Pass	Pass
R	Pass	Pass				
Field 5	Pass	Pass	Pass	Pass	Pass	Pass
Field 9	Pass	Pass	Pass	Pass	Pass	Pass
Field 18	Pass	Pass	Pass	Pass	Pass	
Field 25	Pass	Pass				
Field 28	Pass	Pass	Pass	Pass	Pass	Pass
Field 32	Pass	Pass	Pass	Pass	Pass	Pass
Field 36	Pass	Pass	Pass	Pass	Pass	Pass
Field 38	Pass	Pass	Pass	Pass	Pass	Pass
Field 45	Pass	Pass	Pass	Pass	Pass	Pass
Field 49	Pass	Pass				
Field 59	Pass	Pass	Pass	Pass	Pass	Pass

Field 64	Pass	Pass	Pass	Pass	Pass	Pass
Field 66	Pass	Pass	Pass	Pass	Pass	
Field 67	Pass	Pass	Pass	Pass	Pass	
Field 91	Pass	Pass	Pass	Pass	Pass	Pass
Field 114	Pass	Pass	Pass	Pass	Pass	Pass
Field 118	Pass	Pass	Pass	Pass	Pass	
Field 120	Pass	Pass				
Field 123	Pass	Pass				
Field 130	Pass	Pass	Pass	Pass	Pass	Pass
Field 131	Pass	Pass	Pass	Pass	Pass	Pass
Field 141	Pass	Pass	Pass	Pass	Pass	Pass
Field 148	Pass	Pass	Pass	Pass	Pass	Pass
Field 149	Pass	Pass	Pass	Pass	Pass	Pass
Field 152	Pass	Pass	Pass	Pass	Pass	Pass
Field 158	Pass	Pass				
Field 160	Pass	Pass	Pass	Pass	Pass	Pass
Field 164	Pass	Pass	Pass	Pass	Pass	Pass
Field 173	Pass	Pass	Pass	Pass	Pass	Pass
Field 176	Pass	Pass	Pass	Pass	Pass	Pass
Field 179	Pass	Pass	Pass	Pass	Pass	Pass
Field 181	Pass	Pass				
Field 182	Pass	Pass				
Field 188	Pass	Pass	Pass			
Field 190	Pass	Pass				
Field 192	Pass	Pass	Pass	Pass	Pass	Pass
Field 193	Pass	Pass	Pass	Pass	Pass	Pass
Field 200	Pass	Pass	Pass	Pass	Pass	Pass
Field 213	Pass	Pass	Pass	Pass		
Field 214	Pass	Pass				
Field 215	Pass	Pass	Pass	Pass	Pass	Pass
Field 220	Pass	Pass	Pass	Pass	Pass	Pass
Field 223	Pass	Pass				
Field 224	Pass	Pass	Pass	Pass	Pass	Pass
Field 225	Pass	Pass	Pass	Pass	Pass	Pass
Field 226	Pass	Pass				
Field 230	Pass	Pass	Pass			
Field 233	Pass	Pass	Pass	Pass	Pass	Pass
Field 238	Pass	Pass	Pass	Pass	Pass	Pass
Field 239	Pass	Pass	Pass	Pass	Pass	Pass
Field 242	Pass	Pass				
Find 20	Pass	Pass	Pass	Pass	Pass	Pass
Find 37	Pass	Pass	Pass	Pass	Pass	Pass
Find 40	Pass	Pass				
Find 55	Pass	Pass	Pass	Pass	Pass	Pass
Find 60	Pass	Pass	Pass	Pass	Pass	Pass
Find 61	Pass	Pass	Pass	Pass	Pass	Pass
Find 64	Pass	Pass	Pass	Pass	Pass	Pass

Find 68	Pass	Pass	Pass	Pass	Pass	Pass
Find 71	Pass	Pass				
Find 74	Pass	Pass	Pass	Pass	Pass	Pass
Find 79	Pass	Pass	Pass	Pass	Pass	Pass
Find 96	Pass	Pass	Pass	Pass	Pass	Pass
Find 103	Pass	Pass	Pass	Pass	Pass	Pass
Find 108	Pass	Pass	Pass	Pass	Pass	Pass
Find 110	Pass	Pass	Pass	Pass	Pass	Pass
Find 111	Pass	Pass				

In Table 24 the fields which fail the NPV/I@10% ≥ 0.2 hurdle but pass at lower discount rates are shown. There are 76 in total. All of them pass at the 5% discount rate and the great majority at 7.2% and 8.3% rates. With the $60 price at 5% discount rate total production to 2050 from the passing fields is 7.6 bn boe. At the 7.2% discount rate it is 6.6 bn boe, and at 8.3% discount rate 6.3 bn boe.

<u>Table 25</u>

<u>Fields which fail the MOD NPV@10% / MOD Devex > 0.3 hurdle but pass with a lower discount rate and 0.3 hurdle</u>

$60	4.9% NPV/I 0.3 Hurdle	5% NPV/I 0.3 Hurdle	6.5% NPV/I 0.3 Hurdle	6.9% NPV/I 0.3 Hurdle	7.2% NPV/I 0.3 Hurdle	8.3% NPV/I 0.3 Hurdle
C3	Pass	Pass	Pass	Pass	Pass	Pass
J2	Pass	Pass				
P	Pass	Pass	Pass	Pass	Pass	Pass
R2	Pass	Pass	Pass	Pass	Pass	Pass
A2	Pass	Pass	Pass	Pass	Pass	
C5	Pass	Pass	Pass	Pass	Pass	Pass
Field 5	Pass	Pass	Pass	Pass	Pass	
Field 9	Pass	Pass	Pass			
Field 28	Pass	Pass				
Field 36	Pass	Pass	Pass	Pass	Pass	Pass
Field 38	Pass	Pass				
Field 45	Pass	Pass	Pass	Pass	Pass	Pass
Field 59	Pass	Pass	Pass	Pass	Pass	
Field 64	Pass	Pass	Pass	Pass	Pass	Pass
Field 91	Pass	Pass				

Field 114	Pass	Pass	Pass	Pass	Pass	Pass
Field 130	Pass	Pass	Pass	Pass	Pass	
Field 131	Pass	Pass	Pass	Pass		
Field 141	Pass	Pass	Pass	Pass	Pass	Pass
Field 148	Pass	Pass				
Field 149	Pass	Pass				
Field 152	Pass	Pass	Pass	Pass	Pass	Pass
Field 160	Pass	Pass	Pass	Pass		
Field 164	Pass	Pass	Pass	Pass	Pass	Pass
Field 173	Pass	Pass				
Field 176	Pass	Pass	Pass			
Field 179	Pass	Pass	Pass	Pass	Pass	Pass
Field 192	Pass	Pass	Pass	Pass	Pass	Pass
Field 193	Pass	Pass	Pass	Pass	Pass	
Field 200	Pass	Pass	Pass	Pass	Pass	Pass
Field 215	Pass	Pass				
Field 220	Pass	Pass				
Field 224	Pass	Pass	Pass			
Field 225	Pass	Pass	Pass	Pass	Pass	
Field 233	Pass	Pass	Pass	Pass	Pass	Pass
Field 238	Pass	Pass	Pass	Pass	Pass	Pass
Field 239	Pass	Pass	Pass	Pass	Pass	Pass
Find 20	Pass	Pass				
Find 55	Pass	Pass	Pass			
Find 60	Pass	Pass	Pass	Pass	Pass	Pass
Find 61	Pass	Pass	Pass	Pass	Pass	
Find 64	Pass	Pass				
Find 68	Pass	Pass	Pass	Pass	Pass	
Find 74	Pass	Pass	Pass	Pass	Pass	Pass
Find 103	Pass	Pass	Pass	Pass		
Find 108	Pass	Pass	Pass	Pass	Pass	
Find 110	Pass	Pass	Pass	Pass	Pass	Pass

In Table 25 the fields which fail the NPV/I@10% ≥ 0.3 hurdle in MOD terms but pass at lower discount rates are listed. There are 47 in total. All pass at the 5% discount rate but at the 8.3% rate only 20 pass.

In Table 26 the cumulative production in the period 2017-2050 from the fields passing the various hurdles are shown.

Table 26

Production from 2017 to 2050 from new fields passing hurdles with $60, 50 pence prices

	10% RNPV/I 0.3 Hurdle	Real IRR 10%	Real IRR 15%	10% NNPV/I 0.3 Hurdle	Nominal IRR 10%	Nominal IRR 15%
MMboe	**3823.4**	**6989.9**	**5301.6**	**4860.9**	**7503.6**	**6089.3**

	5% NPV/I 0.2 Hurdle	7.2% NPV/I 0.2 Hurdle	8.3% NPV/I 0.2 Hurdle	5% NPV/I 0.3 Hurdle	7.2% NPV/I 0.3 Hurdle	8.3% NPV/I 0.3 Hurdle
MMboe	**7644.6**	**6576.1**	**6346.8**	**6461.0**	**5774.0**	**5669.4**

The differences in the recovery of petroleum over the period to 2050 in relation to the hurdle rates employed are very noticeable. To the extent that the relatively low rates noted in the Consultation document reflect in part the current low borrowing costs they may not be appropriate for investments taking place over the long period to 2050 because the current low interest rates are unlikely to remain over the next 30 years. Inflation rates are also unlikely to remain at 2% for the next 30 years. Higher inflation rates increase the difference between returns in MOD terms and real terms. Investors should be primarily interested in returns in real terms.

5. Summary and Conclusions

Hurdle rates employed to make investment decisions are likely to depend on several factors. These certainly include the WACC of the investor as emphasised in the Consultation document, but in the context of current conditions in the UKCS there are other releveant considerations. A feature of the operating environment is the prevalence of many small undeveloped discoveries. These can generate only modest NPVs even with a very low WACC being used as the discount rate. In an environment of capital rationing a project with a very modest (but positive) materiality may not be acceptable even though the IRR is well above the WACC. The size of the expected NPV is more important. Reflecting the presence of capital rationing a discount rate higher than the WACC may be employed to calculate the NPV. Thus a rate of 10% in post-tax terms is very commonly employed in the industry, sometimes in real and sometimes in MOD terms.

The indicative range of WACC in the Consultation document to a substantial extent reflects current very low costs of debt which may not prevail over the long term. The finding that the WACC for large, vertically integrated companies is generally lower than for smaller, non-integrated companies is in accordance with first principles reflecting the risk-reducing advantages of large, diversified portfolios of projects. But these larger companies still operate in a capital-constrained environment in the UKCS, as they have to compare multiple opportunities around the world, and the UKCS has to compete for investment funds. Capital rationing can be reflected by employing the NPV/I ratio as a screening and ranking device. It directly measures the productivity of the capital employed. It is widely employed in the industry. The Consultation document refers to minimum acceptable ratios of 0.2 or 0.3 with the NPV on a post-tax basis. These ratios are consistent with practive believed to be common in the industry.

The modelling undertaken in this study highlights the numbers of new field developments in different categories which pass or fail the various investment hurdles discussed above under (real) price scenarios of (1) $50, 40 pence and (2) $60, 50 pence over the period to 2050. It was found that there was a large increase in the number of passes at the $60, 50 pence price case compared to the $50, 40 pence one under all the investment hurdles examined. It was found that the number of passes with hurdles of (real) IRR > 10% and IRR > 15% greatly exceeded the number using NPV/I@10% > 0.3 as the hurdle. The modest materiality of many of the fields was a key factor. There was also found to be a worthwhile increase in the number of developments when the threshold returns used a discount rate of 10% in MOD terms compared to 10% in real terms.

When lower discount rates such as are employed in the Consultation document were employed it was found that the numbers of passes increased significantly with all the hurdles examined, compared to the case with 10% discount rate. This applied to both oil/gas price scenarios.

The consequences of employing the different hurdles for production from new fields in the period to 2050 were then examined under the $60, 50 pence price case. The variations were found to be striking. Thus with the hurdle of real NPV/I@10% > 0.3 cumulative production from new fields to 2050 is 3.8 bn boe while with real IRR of 10% it is nearly 7 bn boe. At IRR of 15% it is 5.3 bn boe. If the hurdle were MOD or nominal NPV/I@10% > 0.3 the cumulative production from new fields to 2050 becomes 4.9 bn boe. With MOD or nominal NPV/I@8.3% > 0.3 hurdle the cumulative production is 5.7 bn boe. With MOD or nominal NPV/I@8.3% > 0.2 hurdle the cumulative production becomes 6.35 bn boe. These results clearly highlight the importance of the different hurdles and discount rates in considering the future economic recovery from the UKCS. Empirical and reliable knowledge of these is thus clearly important. This also applies to investors in infrastructure transportation. There now are such independent investors but it is not clear how their discount rates are best measured. Infrastructure investment in the UKCS is likely to have more risks than in onshore transmission of electricity and gas. For example, the volume risk is likely to be greater.

In sum the measurement of satisfactory expected returns on investment in the UKCS should incorporate key characteristics of the sector which include modest materiality of many of the project and capital rationing. Further thought could also be given to the position of stand-alone exploration investors.