NORTH SEA STUDY OCCASIONAL PAPER
No. 147

Prospects for Activity in the UKCS after the Oil Price Collapse

Professor Alexander G. Kemp
and
Linda Stephen

April, 2020

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

ISSN 0143-022X

NORTH SEA ECONOMICS

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

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

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

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

The authors are solely responsible for the work undertaken and views expressed. The sponsors are not committed to any of the opinions emanating from the studies.

Papers are available from: https://www.abdn.ac.uk/research/acreef/working-papers/

Recent papers published are:

OP	98	Prospects for Activity Levels in the UKCS to 2030: the 2005 Perspective By A G Kemp and Linda Stephen (May 2005), pp. 52	£20.00
OP	99	A Longitudinal Study of Fallow Dynamics in the UKCS By A G Kemp and Sola Kasim, (September 2005), pp. 42	£20.00
OP	100	Options for Exploiting Gas from West of Scotland By A G Kemp and Linda Stephen, (December 2005), pp. 70	£20.00
OP	101	Prospects for Activity Levels in the UKCS to 2035 after the 2006 Budget By A G Kemp and Linda Stephen, (April 2006) pp. 61	£30.00
OP	102	Developing a Supply Curve for CO_2 Capture, Sequestration and EOR in the UKCS: an Optimised Least-Cost Analytical Framework By A G Kemp and Sola Kasim, (May 2006) pp. 39	£20.00
OP	103	Financial Liability for Decommissioning in the UKCS: the Comparative Effects of LOCs, Surety Bonds and Trust Funds By A G Kemp and Linda Stephen, (October 2006) pp. 150	£25.00
OP	104	Prospects for UK Oil and Gas Import Dependence By A G Kemp and Linda Stephen, (November 2006) pp. 38	£25.00
OP	105	Long-term Option Contracts for CO2 Emissions By A G Kemp and J Swierzbinski, (April 2007) pp. 24	£25.00
OP	106	The Prospects for Activity in the UKCS to 2035: the 2007 Perspective By A G Kemp and Linda Stephen (July 2007) pp.56	£25.00
OP	107	A Least-cost Optimisation Model for CO_2 capture By A G Kemp and Sola Kasim (August 2007) pp.65	£25.00
OP	108	The Long Term Structure of the Taxation System for the UK Continental Shelf By A G Kemp and Linda Stephen (October 2007) pp.116	£25.00
OP	109	The Prospects for Activity in the UKCS to 2035: the 2008 Perspective By A G Kemp and Linda Stephen (October 2008) pp.67	£25.00
OP	110	The Economics of PRT Redetermination for Incremental Projects in the UKCS By A G Kemp and Linda Stephen (November 2008) pp. 56	£25.00

OP	111	Incentivising Investment in the UKCS: a Response to *Supporting Investment: a Consultation on the North Sea Fiscal Regime* By A G Kemp and Linda Stephen (February 2009) pp.93	£25.00
OP	112	A Futuristic Least-cost Optimisation Model of CO_2 Transportation and Storage in the UK/ UK Continental Shelf By A G Kemp and Sola Kasim (March 2009) pp.53	£25.00
OP	113	The <u>Budget 2009</u> Tax Proposals and Activity in the UK Continental Shelf (UKCS) By A G Kemp and Linda Stephen (June 2009) pp. 48	£25.00
OP	114	The Prospects for Activity in the UK Continental Shelf to 2040: the 2009 Perspective By A G Kemp and Linda Stephen (October 2009) pp. 48	£25.00
OP	115	The Effects of the European Emissions Trading Scheme (EU ETS) on Activity in the UK Continental Shelf (UKCS) and CO_2 Leakage By A G Kemp and Linda Stephen (April 2010) pp. 117	£25.00
OP	116	Economic Principles and Determination of Infrastructure Third Party Tariffs in the UK Continental Shelf (UKCS) By A G Kemp and Euan Phimister (July 2010) pp. 26	
OP	117	Taxation and Total Government Take from the UK Continental Shelf (UKCS) Following Phase 3 of the European Emissions Trading Scheme (EU ETS) By A G Kemp and Linda Stephen (August 2010) pp. 168	
OP	118	An Optimised Illustrative Investment Model of the Economics of Integrated Returns from CCS Deployment in the UK/UKCS BY A G Kemp and Sola Kasim (December 2010) pp. 67	
OP	119	The Long Term Prospects for Activity in the UK Continental Shelf BY A G Kemp and Linda Stephen (December 2010) pp. 48	
OP	120	The Effects of Budget 2011 on Activity in the UK Continental Shelf BY A G Kemp and Linda Stephen (April 2011) pp. 50	
OP	121	The Short and Long Term Prospects for Activity in the UK Continental Shelf: the 2011 Perspective BY A G Kemp and Linda Stephen (August 2011) pp. 61	
OP	122	Prospective Decommissioning Activity and Infrastructure Availability in the UKCS BY A G Kemp and Linda Stephen (October 2011) pp. 80	

OP 123 The Economics of CO_2-EOR Cluster Developments in the UK Central North Sea/ Outer Moray Firth
BY A G Kemp and Sola Kasim (January 2012) pp. 64

OP 124 A Comparative Study of Tax Reliefs for New Developments in the UK Continental Shelf after Budget 2012
BY A G Kemp and Linda Stephen (July 2012) pp.108

OP 125 Prospects for Activity in the UK Continental Shelf after Recent Tax Changes: the 2012 Perspective
BY A G Kemp and Linda Stephen (October 2012) pp.82

OP 126 An Optimised Investment Model of the Economics of Integrated Returns from CCS Deployment in the UK/UKCS
BY A G Kemp and Sola Kasim (May 2013) pp.33

OP 127 The Full Cycle Returns to Exploration in the UK Continental Shelf
BY A G Kemp and Linda Stephen (July 2013) pp.86

OP 128 Petroleum Taxation for the Maturing UK Continental Shelf (UKCS)
BY A G Kemp, Linda Stephen and Sola Kasim (October 2014) pp.94

OP 129 The Economics of Enhanced Oil Recovery (EOR) in the UKCS and the Tax Review
BY A G Kemp and Linda Stephen (November 2014) pp.47

OP 130 Price Sensitivity, Capital Rationing and Future Activity in the UK Continental Shelf after the Wood Review
BY A G Kemp and Linda Stephen (November 2014) pp.41

OP 131 Tax Incentives for CO_2-EOR in the UK Continental Shelf
BY A G Kemp and Sola Kasim (December 2014) pp. 49

OP 132 The Investment Allowance in the Wider Context of the UK Continental Shelf in 2015: A Response to the Treasury Consultation
BY A G Kemp and Linda Stephen (February 2015) pp. 27

OP 133 The Economics of Exploration in the UK Continental Shelf: the 2015 Perspective
BY A G Kemp and Linda Stephen (August 2015) pp. 71

OP 134 Prospective Returns to Exploration in the UKCS with Cost Reductions and Tax Incentives
BY A G Kemp and Linda Stephen (December 2015) pp.81

OP 135 Maximising Economic Recovery from the UK Continental Shelf: A Response to the Draft DECC Consultation Strategy
BY A G Kemp (January 2016) pp. 16

OP 136 Field Development Tax Incentives for the UK Continental Shelf (UKCS)
BY A G Kemp and Linda Stephen (March 2016) pp.66

OP 137 Economic and Tax Issues relating to Decommissioning in the UKCS: the 2016 Perspective
BY A G Kemp and Linda Stephen (July 2016) pp.63

OP 138 The Prospects for Activity in the UKCS to 2050 under "Lower for Longer" Oil and Gas Price Scenarios, and the Unexploited Potential
BY A G Kemp and Linda Stephen (February 2017) pp.86

OP 139 Can Long Term Activity in the UK Continental Shelf (UKCS) Really be Transformed?
BY A G Kemp and Linda Stephen (April 2017) pp. 30

OP 140 Can the Transfer of Tax History Enhance Later Field Life Transactions in the UKCS?
BY A G Kemp and Linda Stephen (July 2017) pp. 53

OP 141 The Implications of Different Acceptable Prospective Returns to Investment for Activity in the UKCS
BY A G Kemp and Linda Stephen (October 2017) pp. 61

OP 142 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
BY A G Kemp and Linda Stephen (February 2018) pp. 37

OP 143 An Economic Reassessment of the Long Term Prospects for the UKCS: Can Vision 2035 Become a Reality?
BY A G Kemp and Linda Stephen (October 2018) pp. 73

OP 144 The Potential Contribution of Cluster Developments to Maximising Economic Recovery in the UKCS
BY A G Kemp and Linda Stephen (July 2019) pp. 167

OP 145 Prospects for Activity in the UK Continental Shelf: The Late 2019 Perspective

Prospects for Activity in the UKCS after the Oil Price Collapse

Professor Alexander G. Kemp and Linda Stephen

Contents

Prospects for Activity in the UKCS after the Oil Price Collapse

Professor Alex Kemp and Linda Stephen

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

1 Introduction and Context

The last few weeks have witnessed some astonishing developments in the world oil market. The coronavirus problem has caused a substantial reduction in world oil demand, with guesstimates for 2020 of 20% - 40% from a peak of 100 mmb/d in 2019 being suggested. This has occurred at a time when OPEC and its collaborating non-members, principally Russia, failed to reach an agreement on production cuts in mid-March to counter the existing weakness in the market in the face of steadily increasing production from the USA. The reaction of Saudi Arabia to announce major increases in production perhaps to c.12 mmb/d and to signal large price discounts from April 2020 quickly resulted in a dramatic fall in oil prices. The result was renewed negotiations in April between OPEC and collaborators, principally Russia, resulting in an agreement to cut production by 9.7 mmb/d from May. This is nearly 10% of peak world demand. The agreement also indicated production cuts extending for specified periods into 2021. The result has been some rebound in the price reflecting the belief of traders that the agreement would have a significant effect, at least in the near term.

The world gas market also has shown signs of price weakness for some months reflecting the effects of growing production from several countries including Australia and the USA. Russia is a major gas exporter and it is noteworthy that their contract prices are generally indexed to oil prices. This puts further downward pressure on wholesale gas prices.

Where markets will evolve in is particularly difficult to predict. On the demand side, much depends on how long the virus problem persists. This clearly has a major influence on the behaviour of world oil demand. On the supply side, much depends on the behaviour of OPEC with and without its collaborators. Traders will be carefully watching the behaviour of the participants to the agreement to assess how closely they are keeping to the April agreement. It is known that some participants were reluctant to join. Russia were concerned that a main beneficiary of the agreement would be the USA whose shale oil sector was suffering from the low prices. This sector has shown remarkable growth over the last decade or so. But at current oil (and gas) prices the likely returns are unattractive. This applies not only to new field developments but to production from existing fields. Continuous drilling is necessary to prevent very rapid declines in production. At existing prices, such continuous drilling is not economically attractive. As a consequence, production from the shale sector is falling.

The above key factors determining world oil (and gas) prices each have much uncertainty surrounding their future behaviour both in the short and medium terms. The medium-term future of oil prices also depends on the reaction of Governments and consumers to the energy transition issues. It also depends on the attitudes and reactions of investors in the oil sector itself and their stakeholders and other financiers.

The present study examines the prospects for activity in the UKCS in the context of relatively low oil and gas prices used for investment screening purposes. An underlying assumption is that the extremely low prices likely to be experienced in 2020 will be modified somewhat in 2021, but a range of still relatively low prices by the standards of the last 20 years could prevail for a long time ahead.

2 Methodology and Data

In this study production and expenditure projections have been made by using financial simulation modelling including the use of the Monte Carlo technique to take account of various risks. The modelling made use of a large database consisting of more than 430 already sanctioned fields, plus information on 95 possible incremental projects, and 18 probable and 6 possible future fields being considered for development by the operators. This information was supplemented by projections of possible future incremental projects, the possible results of new exploration, and a large database of 411 fields in the category of technical reserves. Estimates of their reserves have been made from information obtained from a variety of sources. Further estimates have been made of their development and operating costs, production decline rates, and decommissioning costs.

The Monte Carlo technique was used to estimate the number of possible new discoveries for the period until 2051. The modelling was based on data regarding recent trends in the exploration effort, success rates, reserves found, and their type (oil, gas or condensate). For the CNS/MF, SNS, and NNS 5-year moving averages of effort, success rate, unit costs, reserves, and type were used to find the numbers of possible discoveries, their reserves, and their costs, using the Monte Carlo technique. For the Irish Sea and WoS assumptions were made for some of these variables because of the limited data available over the last five years in these two regions.

To undertake the modelling, assumptions had to be made regarding future oil and gas prices, $/£ exchange rate, exploration effort, and size of future discoveries. The assumptions are discussed in turn.

The assumptions regarding future oil and gas prices are shown in Table 1.

Table 1

Future Oil and Gas prices (2020 values)		
	Real Oil Price $/bbl	Real Gas Price p/therm
Low	25	20
Medium	35	25
High	45	30

The exchange rate used was £1 = $1.235.

Inflation was assumed to be at 2.5%. Thus, in MOD terms the oil prices in 2050 become $52.4 for the $25 price, $13.4 for the $35 price, and $94.4 for the $45 price.

The assumptions regarding exploration effort over the period are shown in Table 2.

Table 2

Exploration Effort (number of wells)				
	2020	2030	2040	2050
Low	6	4	3	1
Medium	8	6	4	2
High	10	8	6	3

The success rate for exploration was assumed to depend on the size of the effort and recent experience. Higher effort may yield more discoveries, but the success rate may be lower if the resulting higher exploration effort is concentrated on higher risk prospects. This study used three success rates as shown in Table 3.

Table 3

UKCS Success Rates	
Low Effort/ High Success	24.84%
Medium Effort/ Medium Success	21.84%
High Effort/ Low Success	18.84%

The success rate in each region varies depending on the 5-year moving average for each of the different regions.

The average size of discovery in recent years for each of the regions was calculated. It was then assumed that the average size of discovery would decline over time as shown in Table 4.

Table 4

Average discovery size (mmboe)				
	2020	2030	2040	2050
SNS	10	9	8	6
CNS/MF	25	21	17	13
NNS	18	16	13	11
WoS	40	36	31	26
IS	10	8	6	4

In the Monte Carlo modelling these values were taken as the mean values of a lognormal distribution. A standard deviation of 50% was then assumed to determine the distribution of sizes of reserves for new exploration finds. The total numbers of discoveries made over the period are shown in Table 5.

Table 5

Total number of discoveries to 2051	
Low Effort/ High Success	30
Medium Effort/ Medium Success	40
High Effort/ Low Success	47

The average development costs of the probable, possible and recent new developments were calculated separately for each of the five regions. For the UKCS as a whole, the average development costs were \$14.24/boe with a maximum of \$24.02/boe. Average development costs in the SNS were \$13.73/boe, in the CNS/MF area they were \$14.43/boe, in the NNS they were \$12.15/boe, in the WoS they were \$11.62/boe and in the IS the average UKCS value of \$17.21/boe was used.

Average operating costs for all of the fields in the above categories in the UKCS were found to be $8.54 boe. In the SNS they were $9.09/boe, in the CNS/MF area they were $15.15/boe, and in the WoS they were $11.77/boe. Average total costs were found to be $25.14/boe in the UKCS. In the SNS they were $23.54/boe, in the CNS/MF area they were $31.05/boe, and in the WoS they were $25.10/boe.

These values were used with the Monte Carlo technique to find the development costs of new discoveries from a normal distribution with a standard deviation of 20%. Annual operating costs were modelled as a percentage of cumulative development costs for the fields found, with the percentage declining as the field size increased to reflect economies of scale.

Given the physical and financial constraints of the industry it was assumed that there would be a limit on the number of new discoveries which could be developed each year. Thus, a cap on the annual number of new developments was introduced. The cap on the number of new development (excluding the incremental projects) was set at 10 for the low effort/ high success case, 12 for the medium effort/ medium success case, and 14 for the high effort/ low success case. The potential number of developments of fields in the category of technical reserves was assumed to be dependent on the difference between the numbers of fields in the categories of probable, possible and new discoveries and the cap.

It was assumed that the average development costs of the technical reserve fields would be $5 higher per boe than the development cost for new discoveries. The mean development costs ($ per boe) using a Monte Carlo distribution is shown below in Table 6 with the minimum and maximum values expected within three standard deviations.

Table 6

Mean Development Costs ($/boe) of Technical Reserves					
Devex	SNS	CNS/MF	NNS	WoS	IS
Mean	18.73	19.43	17.15	16.62	18.73
Min	7.54	8.06	5.52	6.08	7.54
Max	32.77	31.18	30.06	27.86	32.77

But it was also assumed that the technical reserves development costs would depend on the size of the reserves reflecting economies of scale. A formula was devised to assign development costs to each of the technical reserve fields where the cost assigned depended on (1) the average technical reserve field development cost, and (2) the difference between the reserve size and the average size in the region. If a technical reserve field was smaller than the average size found in the region, then the technical reserve cost assigned to that field would be higher than the average technical reserve cost for the region. Similarly, if the technical reserve field was larger than the average found in the region the development cost would be less than the average technical reserve costs for the region[1]. The mean, minimum and maximum values for development costs per boe using this formula are shown in Table 7.

[1] For a more detailed explanation see A.G. Kemp and L. Stephen, "The Potential Cotribution of Cluster Developments to Maximising Economic Recovery in the UKCS", North Sea Study Occasional Paper No. 144, University of Aberdeen Business School, July 2019, pp. 167 https://www.abdn.ac.uk/research/acreef/working-papers/

Table 7

Mean, Minimum and Maximum Development Costs for Technical Reserve Fields ($/boe)					
Technical reserve development costs	SNS	CNS/MF	NNS	WoS	IS
Mean	22.28	24.42	19.89	23.39	27.81
Min	7.54	8.06	5.52	6.08	5.61
Max	32.77	31.87	29.40	27.86	34.54
68% of distribution between	15.18	12.04	12.08	6.82	24.14
and	29.66	31.80	27.59	27.86	34.54
95% of distribution between	7.54	8.06	5.52	6.08	7.39
and	32.72	31.80	28.86	27.86	19.98

For the whole of the UKCS the average development costs per boe for the incremental projects is $17.68. In the CNS/MF area they are $12.88, in the NNS they are $15.88 and in the SNS they are $27.46. The average operating cost per boe is $9.78. It should be noted that 29 projects reported by operators have no operating costs. Also, of the 95 incremental projects three have no production.

It is highly likely that in future years more incremental projects will come forward. Using the 5-year moving average for costs and reserves of the incremental projects, future projections of incremental production and costs have been made.

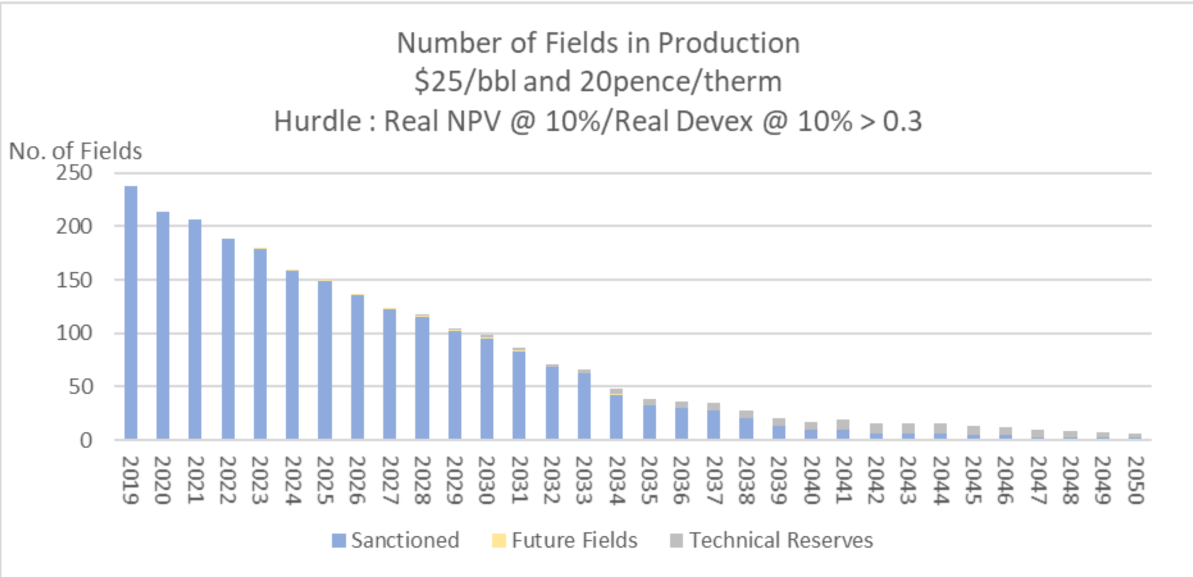
In this paper the investment hurdle rate used for probable fields, possible fields, new exploration discoveries, technical reserve fields, and incremental projects, is: Real Post-tax Net Present Value at 10% / Real Investment cost at 10% $\geq$ 0.3. For the purposes of tax, it is assumed that the operator of the sanctioned fields and the associated incremental projects is in an ongoing tax-paying position but for all the fields in categories of probable, possible, technical reserves, and new exploration finds it is assumed that the investor is in a project tax position. He thus carries forward his capital allowances and has access to the Ring Fence Expenditure Supplement (RFES).

3 Results

3.1 Fields in Production

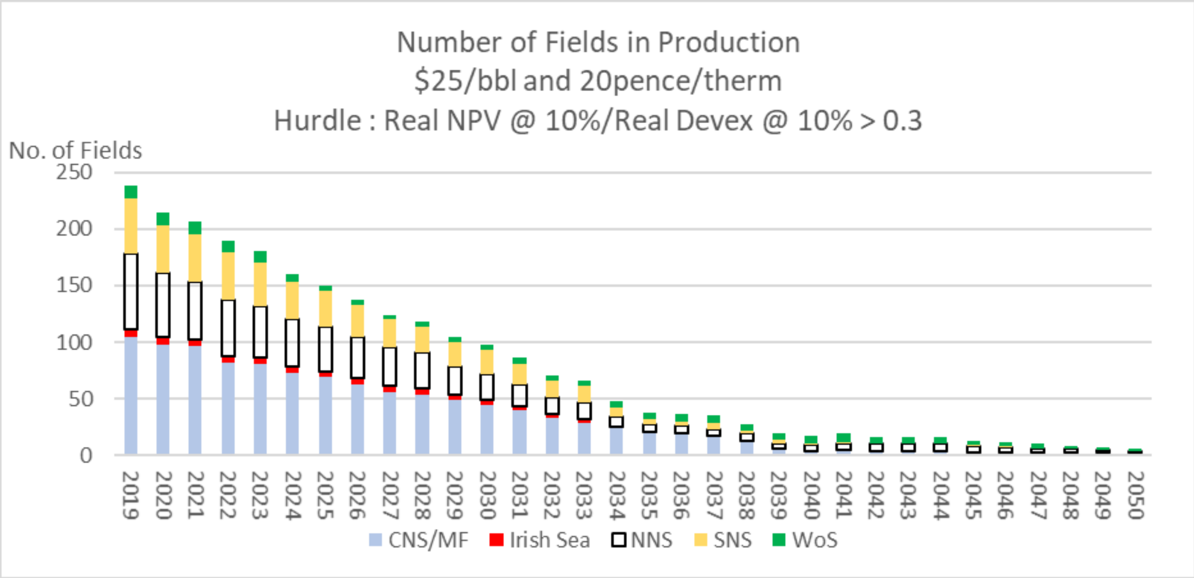
i. $25, 20 pence prices (real)

Chart 1



From Chart 1 it is seen that with the $25, 20 pence price case and NPV/I ≥ 0.3 hurdle the number of currently sanctioned fields falls rapidly to 33 in 2035, and 10 in 2040. There are 2 sanctioned fields which begin development in the period. Of the 18 probable fields 17 fail the hurdle, of the 6 possible fields all fail the hurdle. Of the 411 technical reserve fields 398 fail the hurdle, and of the 30 new exploration finds all fail. Only 1 probable field and 0 possible fields pass the hurdle as do 13 technical reserve finds. No new exploration finds pass the 0.3 hurdle. Of the 92 incremental projects 52 fail the hurdle of which 3 fail because the host field ceases production before the developments can start. There are 3 projects which are solely expenditures.

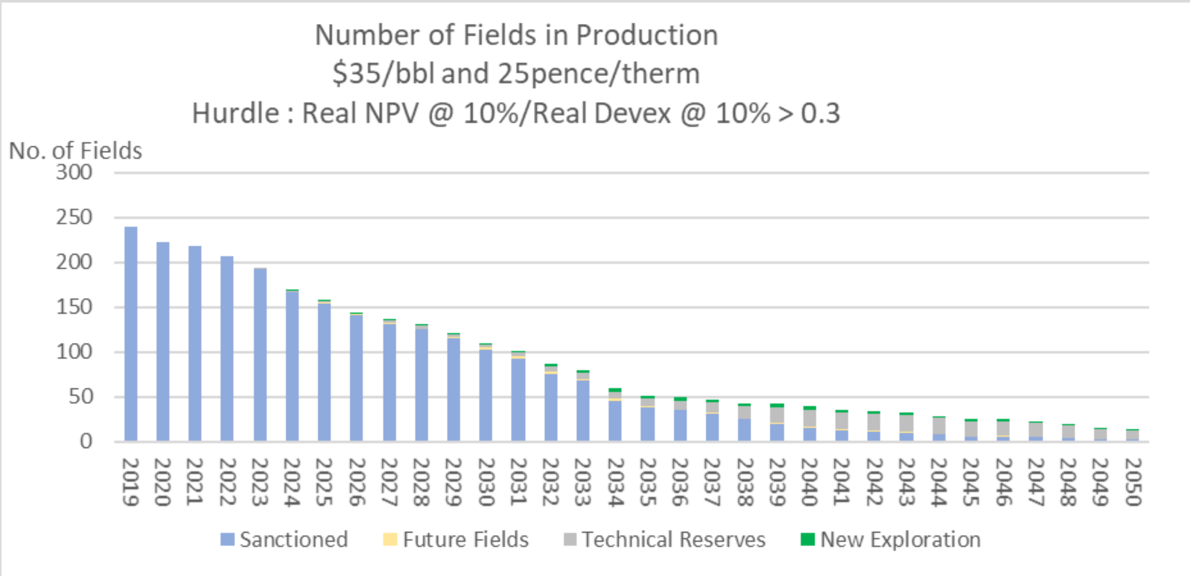
Chart 2



In Chart 2 the numbers of fields in production are shown by main geographic areas. Of the total of 465 potential new developments 186 are in the CNS/MF area, 16 are in the IS, 98 are in the NNS, 122 are in the SNS and 43 are in the WoS area. Of the 451 fields which fail the hurdle 185 are in the CNS/MF area, 16 are in the IS, 88 are in the NNS, 122 are in the SNS and 40 are in the WoS area. Of the 14 new fields which pass the hurdle only 1 is in the CNS/MF area. Ten fields in the NNS pass, 3 fields in the WoS pass, but none of the fields in the SNS or Irish Sea pass.

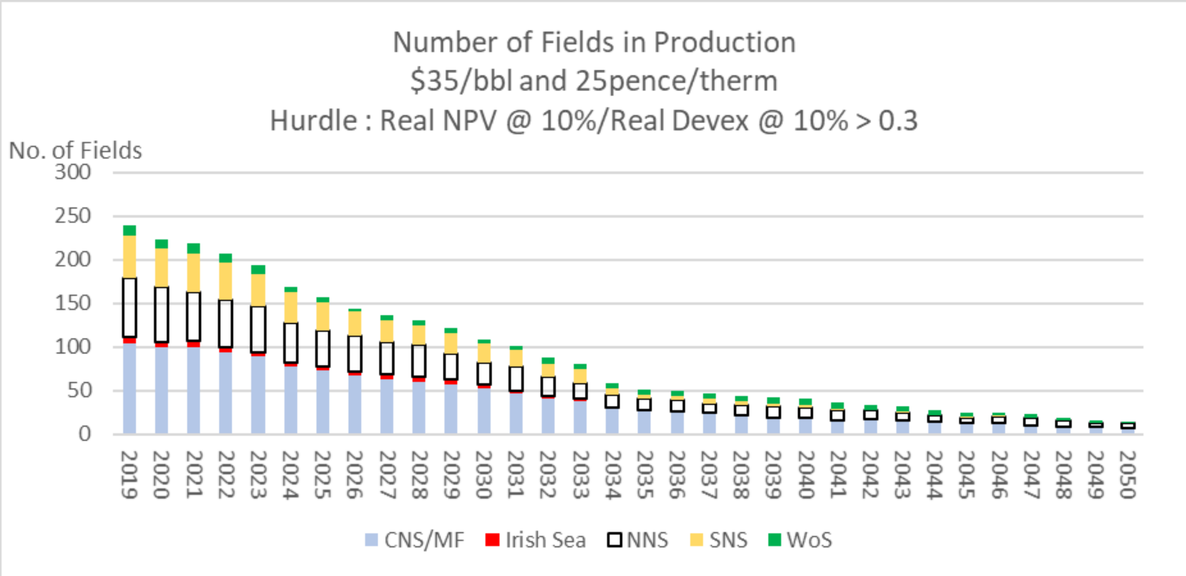
ii. **$35, 30 pence prices (real)**

Chart 3



With the $35, 25 pence price case and NPV/I ≥ 0.3 hurdle the number of currently sanctioned fields falls to 38 in 2035 and 16 in 2040. There are a total of 38 positive new field developments. Of the 18 probable fields 16 fail the hurdle, and of the 6 possible fields all fail the hurdle. Of the 411 technical reserve fields 381 fail the hurdle, and of the 40 new exploration finds 34 fail the hurdle. Only 2 probable fields pass the hurdle as do 30 technical reserve fields and 6 new exploration finds. Of the 92 incremental projects 43 fail the hurdle. Two fail because the host field ceases production before the developments can start. There are 3 projects which are solely expenditures.

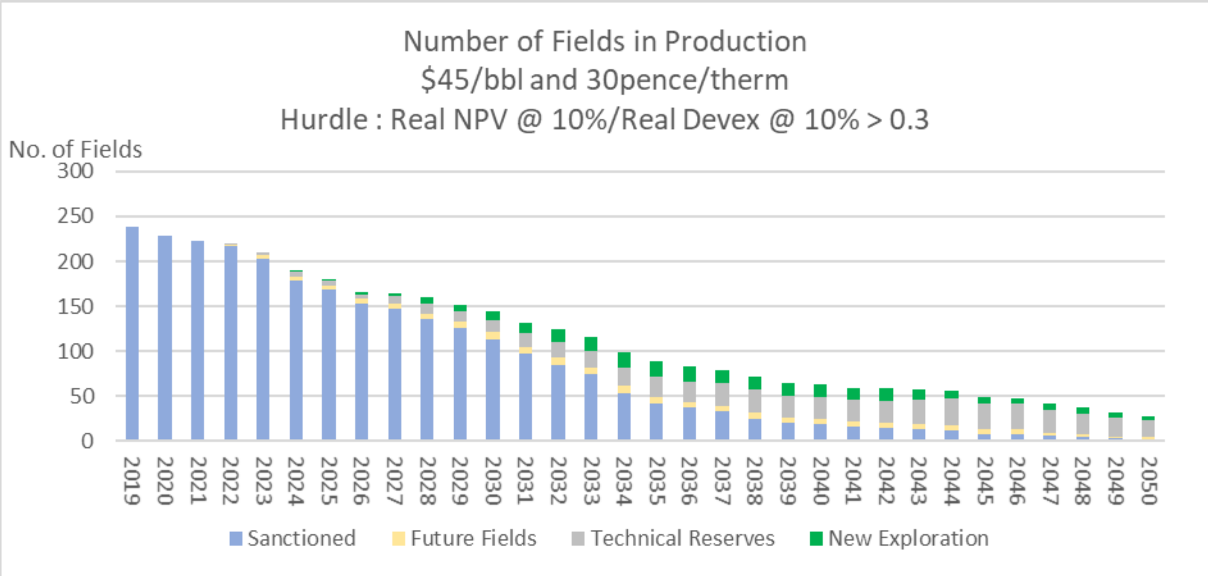
Chart 4



In Chart 4 the numbers of fields in production are shown by main geographic areas. Of the 475 potential new developments 188 are in the CNS/MF area, 16 are in the IS, 102 are in the NNS, 124 are in the SNS and 45 are in the WoS area. Of the 437 fields which fail the hurdle 172 are in the CNS/MF area, 16 are in the IS, 85 are in the NNS, 124 are in the SNS and 40 are in the WoS area. Sixteen fields in the CNS/MF area pass the hurdle, 17 fields in the NNS pass the hurdle, 5 fields in the WoS pass the hurdle but none of the fields in the SNS or Irish Sea pass.

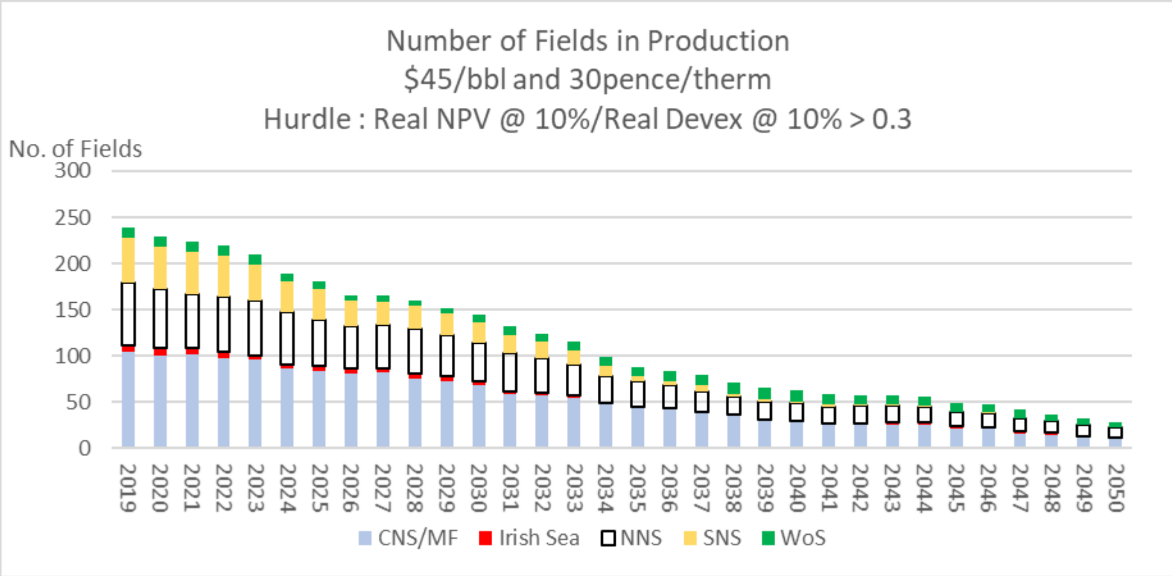
iii. $45, 30 pence prices (real)

Chart 5



With the $45, 30 pence price case and NPV/I ≥ 0.3 hurdle the number of currently sanctioned fields falls to 41 in 2035 and 7 in 2045. In total 83 fields pass the hurdle. Of the 18 probable fields 12 fail the hurdle, of the 6 possible fields 4 fail the hurdle. Of the 411 technical reserve fields 355 fail the hurdle, and of the 47 new exploration finds 28 fail the hurdle. Only 6 probable fields pass the hurdle as do 2 possible fields, 56 technical reserve finds, and 19 new exploration finds. Of the 92 incremental projects 35 fail the hurdle of which 2 fail because the host field ceases production before the developments can start. There are 3 projects which are solely expenditures.

Chart 6

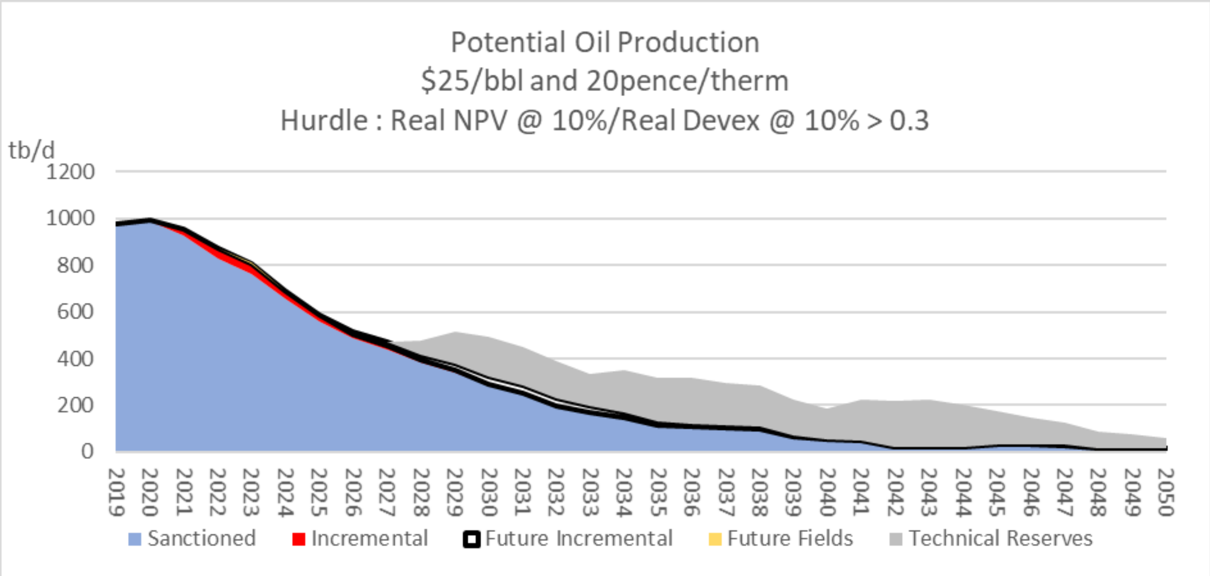


In Chart 6 the numbers of fields in production are shown by main geographic areas. Of the 482 potential new developments 190 are in the CNS/MF area, 17 are in the IS, 105 are in the NNS, 124 are in the SNS and 46 are in the WoS area. Of the 437 fields which fail the hurdle 151 are in the CNS/MF area, 15 are in the IS, 66 are in the NNS, 124 are in the SNS and 34 are in the WoS area. Thirty-nine fields in the CNS/MF area pass the hurdle, as do 39 fields in the NNS pass the hurdle, 12 fields in the WoS, 2 fields in the Irish Sea, but none of the fields in the SNS pass.

3.2 Production – Oil

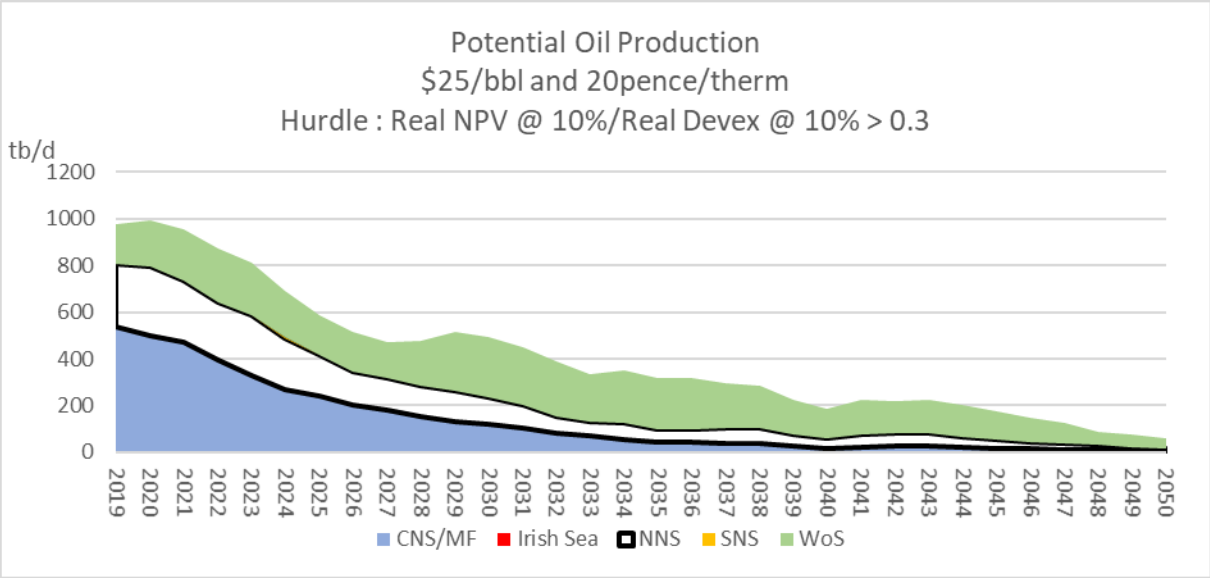
i. $25, 20 pence prices (real)

Chart 7



The results for oil production at the $25 price and the NPV/I ≥ 0.3 hurdle are shown in Chart 7. Over the period 2019-2050 cumulative oil production is 4,760 million barrels of which 3,344 million barrels come from the already sanctioned fields, 96 million barrels may come from the current incremental projects, 105 million barrels may come from future incremental projects, 2 million barrels may come from the probable and possible fields, 1,213 million barrels may come from the technical reserve fields but, none comes from new exploration fields. Production is seen to decline sharply till 2028, when technical reserve fields begin to make a contribution to production. In 2050 total production becomes less than 60 tb/d.

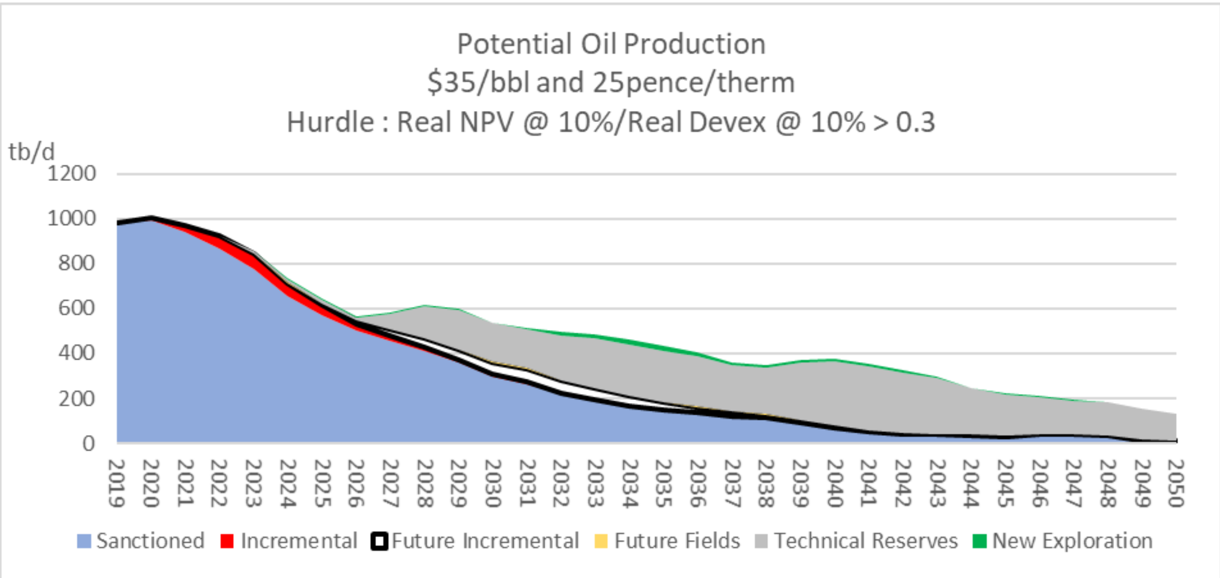
Chart 8



Production by geographic area is shown in Chart 8. Cumulative oil production from the CNS/MF is 1,525 million barrels, 1,227 million barres is from the NNS and 1,996 million barrels from the WoS.

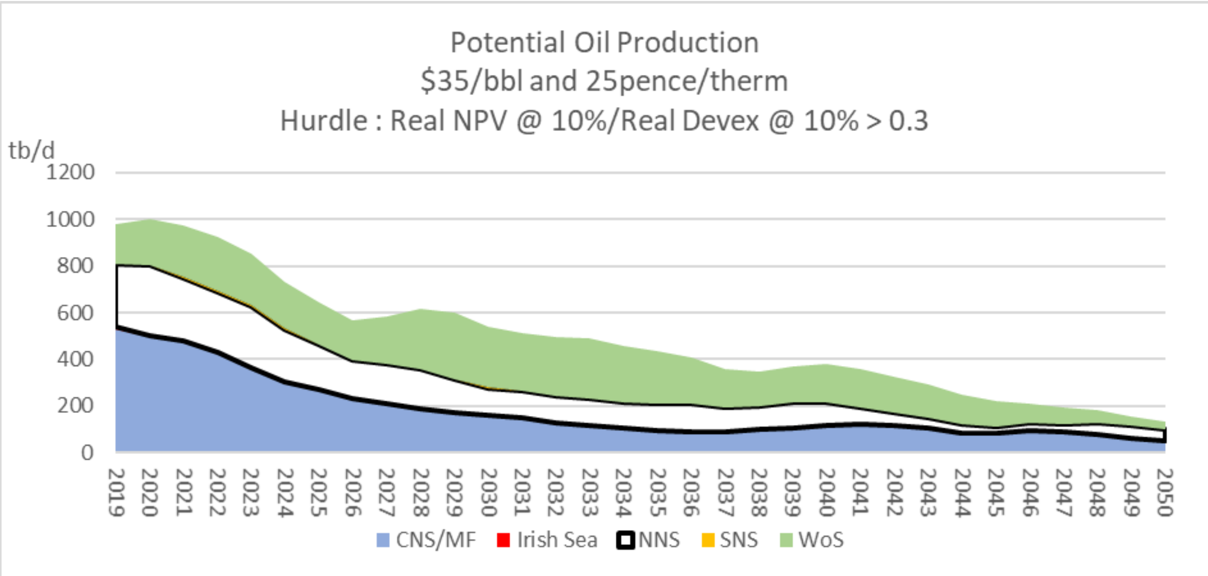
ii. $35, 25 pence prices (real)

Chart 9



The results for oil production at the \$35 price and the NPV/I ≥ 0.3 hurdle are shown in Chart 9. Over the period 2019-2050 cumulative oil production is 5,693 million barrels of which 3,520 million barrels come from the already sanctioned fields, 146 million barrels may come from the current incremental projects, 192 million barrels may come from future incremental projects, 11 million barrels may come from the probable and possible fields, 1,735 million barrels may come from the technical reserve fields, and 89 million barrels may come from new exploration fields. Production is seen to decline sharply till 2027, when technical reserve fields begin to make a contribution to production and in 2050 total production becomes just over 132 tb/d.

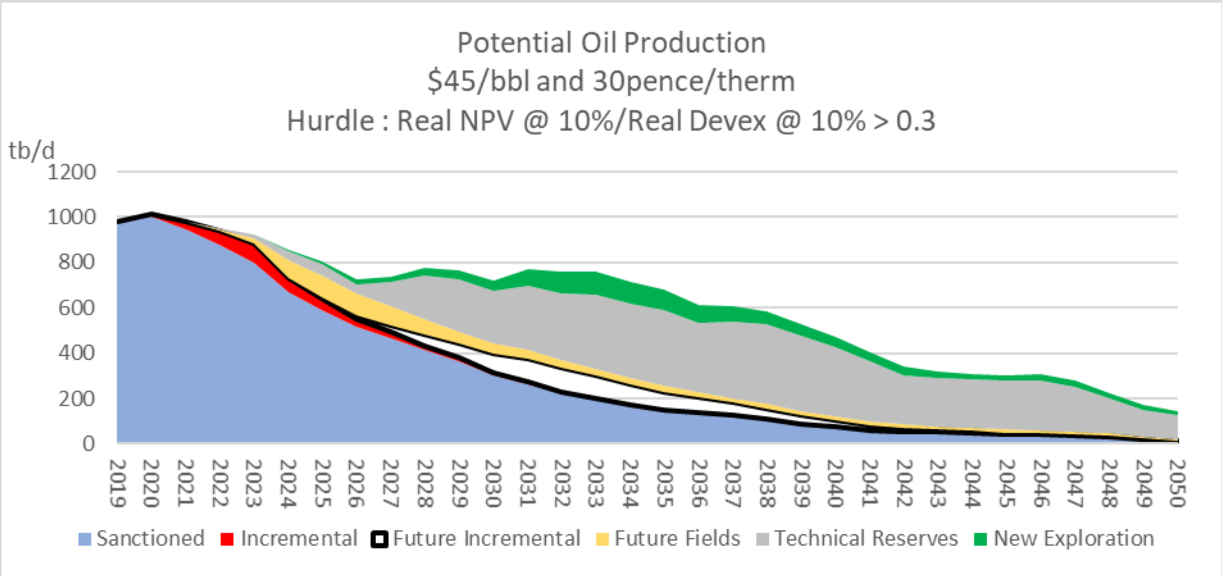
Chart 10



Production by geographic area is shown in Chart 10. Cumulative oil production from the CNS/MF is 2,120 million barrels, 1,501 million barres is from the NNS and 2,057 million barrels from the WoS.

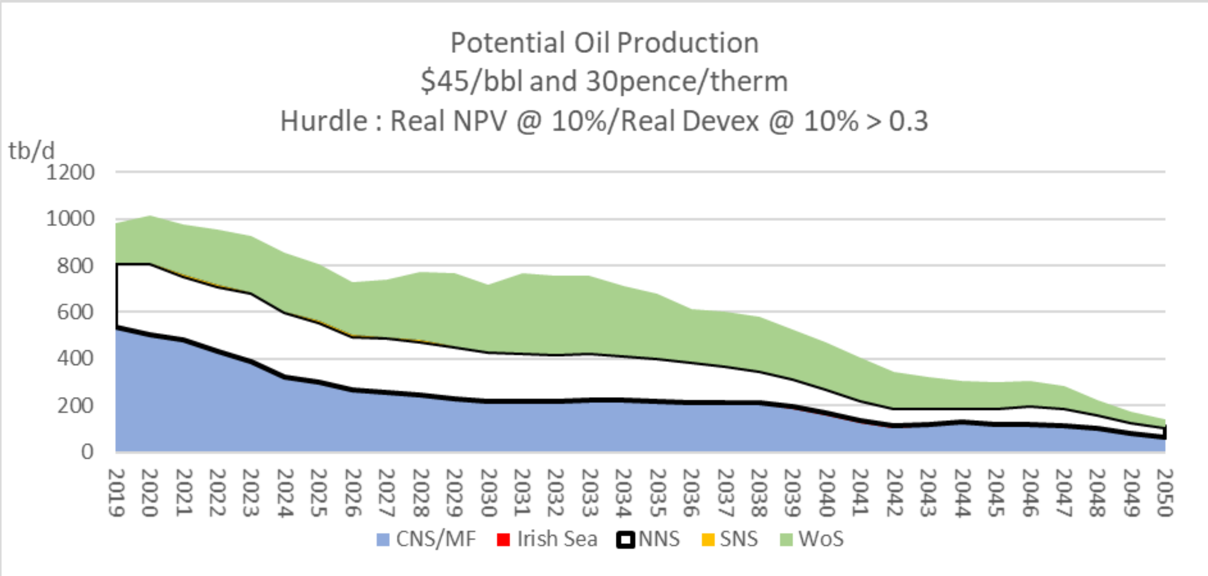
iii. $45, 30 pence prices (real)

Chart 11



The results for oil production at the $45 price and the NPV/I ≥ 0.3 hurdle are shown in Chart 11. Over the period 2019-2050 cumulative oil production is 7,120 million barrels of which 3,603 million barrels come from the already sanctioned fields, 157 million barrels may come from the current incremental projects, 380 million barrels may come from future incremental projects, 341 million barrels may come from the probable and possible fields, 2,207 million barrels may come from the technical reserve fields, and 434 million barrels may come from new exploration fields. Production is seen to decline till 2026 when technical reserve fields begin to make a contribution to production and in 2050 total production becomes just over 142 tb/d.

Chart 12

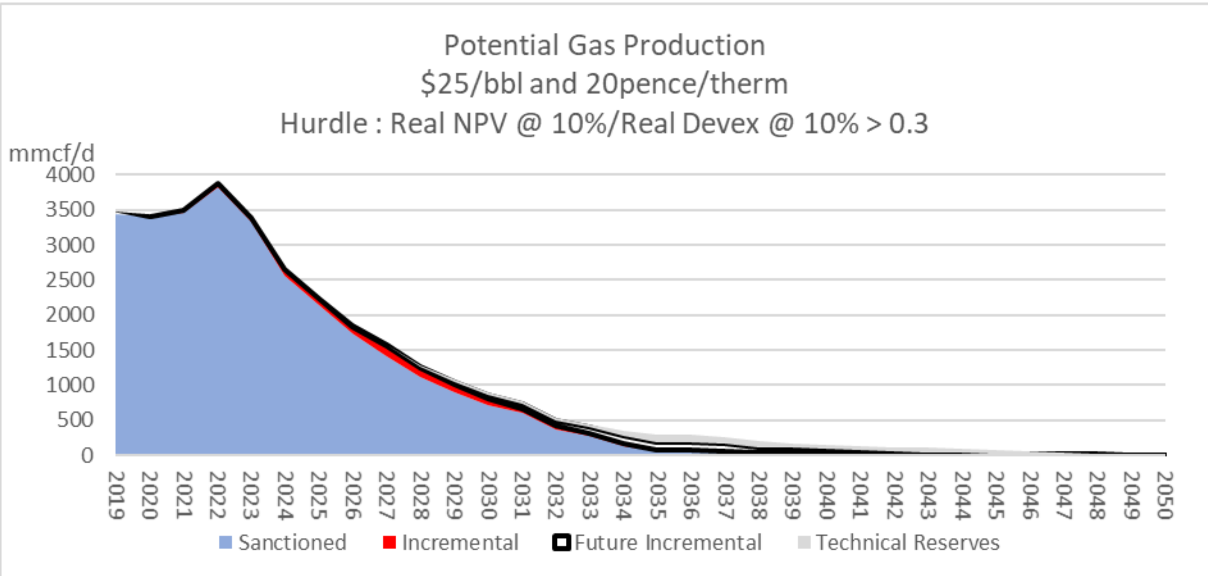


Production by geographic area is shown in Chart 12. Cumulative oil production from the CNS/MF is 2,655 million barrels, 2,003 million barres is from the NNS and 2,418 million barrels from the WoS.

3.3 Production – Natural Gas

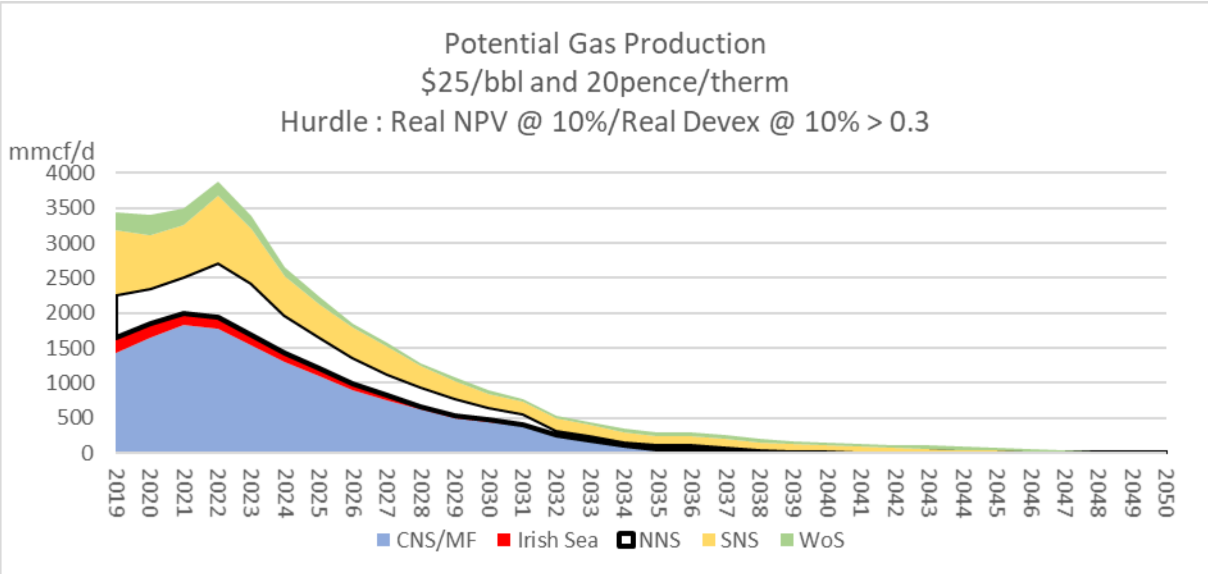
i. 20 pence price (real)

Chart 13



Over the period, with a $25 price and 20 pence gas price, with the NPV/I $\geq$ 0.3 hurdle, cumulative gas production is 2,167 million barrels of oil equivalent, of which 1,930 mmboe come from the already sanctioned fields, 79 mmboe come from the current incremental projects, 80 mmboe come from future incremental projects, and 78 mmboe come from the technical reserve fields. With this hurdle rate and the low price there is no gas production from the probable and possible fields and new exploration finds. It is seen that the decline rate in gas production is very much steeper than the corresponding rate for oil.

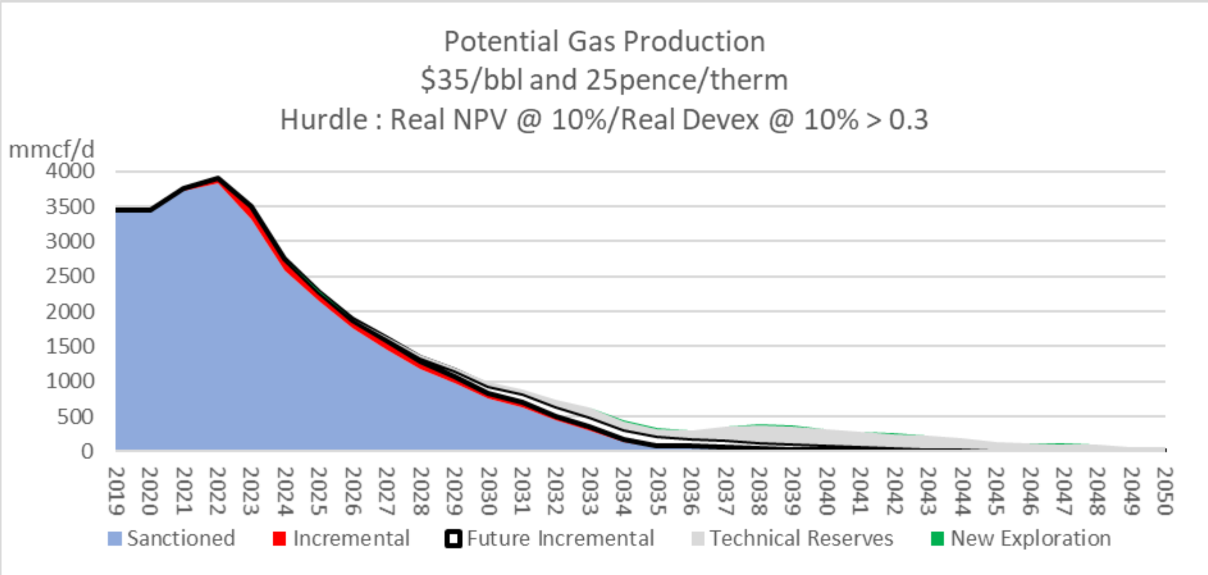
Chart 14



Over the period, it is seen (Chart 14) that with a $25 price and 20 pence gas price and the NPV/I $\geq$ 0.3 hurdle, cumulative gas production from the CNS/MF area is 973 mmboe, 95 mmboe come from the Irish Sea, 411 mmboe come from the NNS, 529 mmboe come from the SNS, and 158 mmboe come from the WoS.

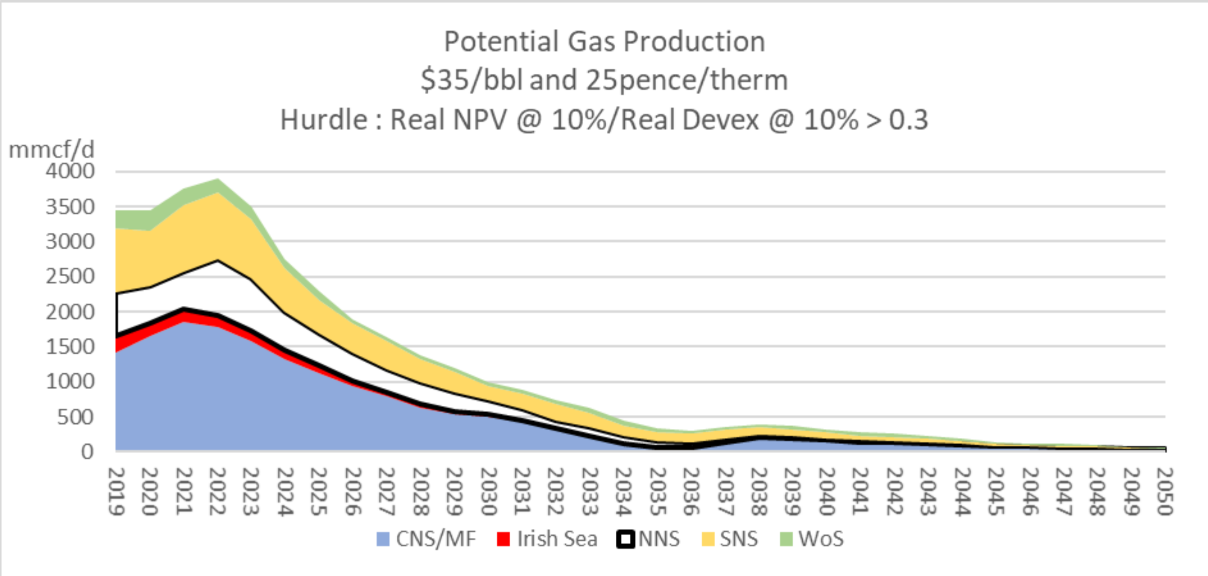
ii. 25 pence price (real)

Chart 15



Over the period, with a $35 price and 25 pence gas price, with the NPV/I ≥ 0.3 hurdle, cumulative gas production is 2,374 million barrels of oil equivalent, of which 1,978 mmboe come from already sanctioned fields, 94 mmboe come from the current incremental projects, 117 mmboe come from future incremental projects, 177 mmboe come from the technical reserve fields, and 8 mmboe from new exploration finds. With this hurdle rate and the medium price there is no gas production from the probable and possible fields.

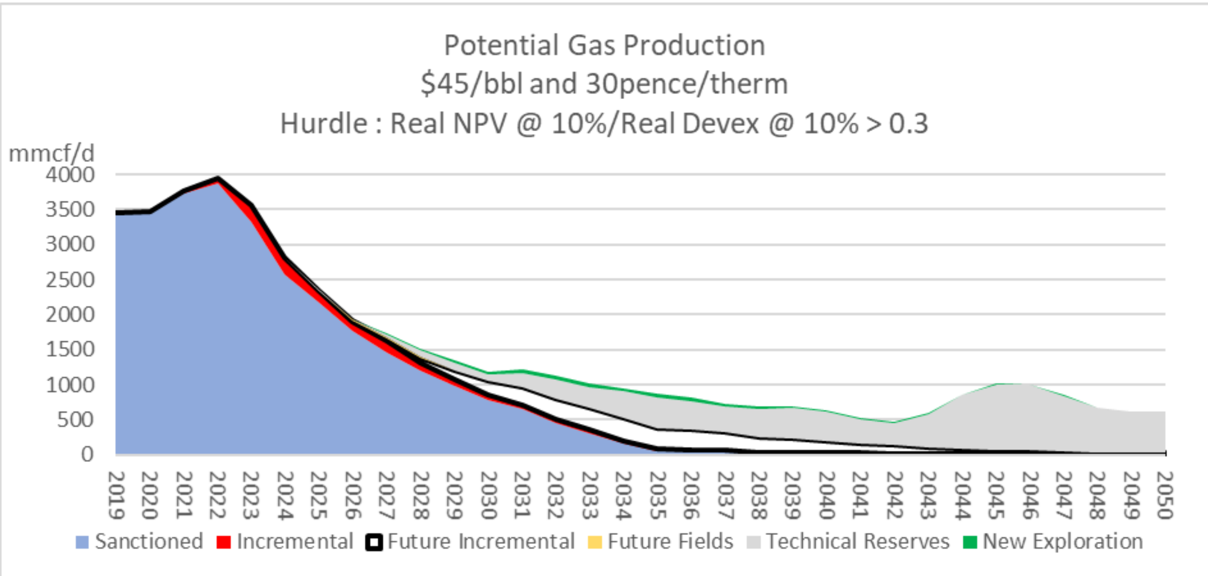
Chart 16



Over the period, it is seen (Chart 16) with a $25 price and 20 pence gas price and the NPV/I ≥ 0.3 hurdle, cumulative gas production from the CNS/MF area is 1,097 mmboe, 95 mmboe come from the Irish Sea, 437 mmboe come from the NNS, 583 mmboe come from the SNS and 161 mmboe come from the WoS.

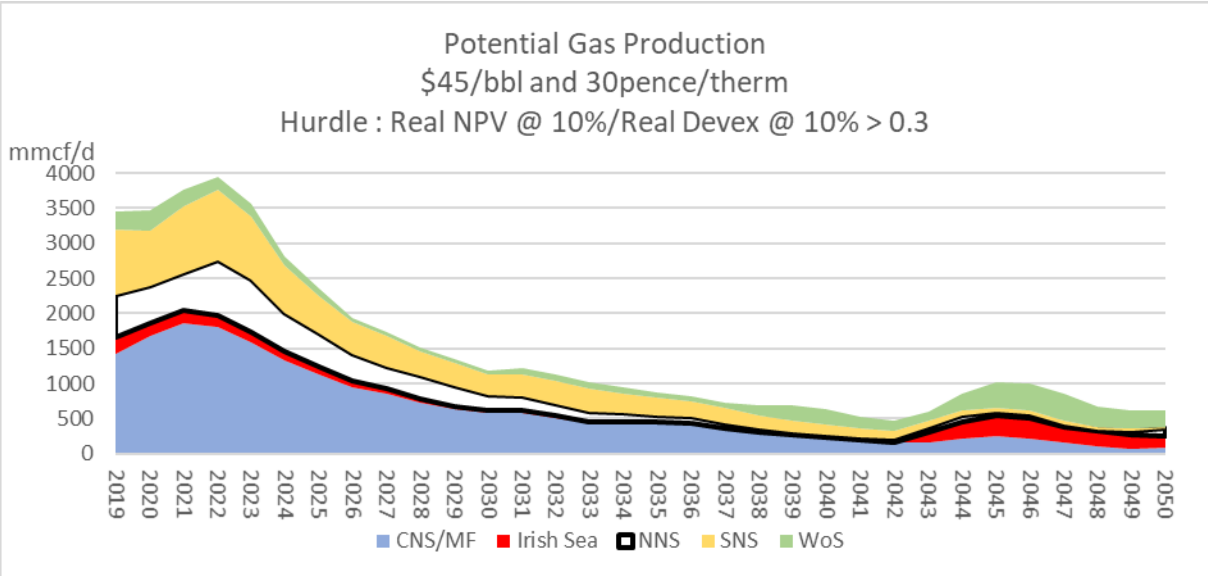
iii. 30 pence price (real)

Chart 17



Over the period, with a $45 price and 30 pence gas price, with the NPV/I ≥ 0.3 hurdle, cumulative gas production to 2050 is 3,065 million barrels of oil equivalent, of which 1,994 mmboe come from the already sanctioned fields, 106 mmboe come from the current incremental projects, 247 mmboe come from future incremental projects, 2 mmboe from the probable and possible fields, 669 mmboe come from the technical reserve fields, and 45 mmboe from new exploration finds.

Chart 18

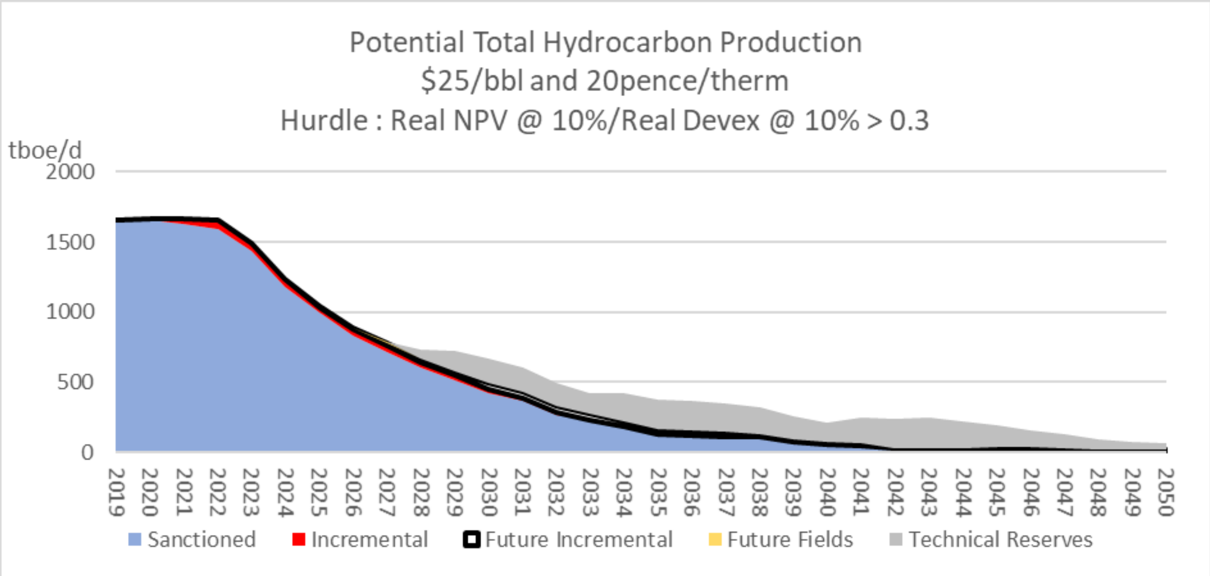


Over the period, it is seen (Chart 18) that with a $45 price and 30 pence gas price and the NPV/I ≥ 0.3 hurdle, cumulative gas production from the CNS/MF area is 1,134 mmboe, 212 mmboe come from the Irish Sea, 485 mmboe come from the NNS, 697 mmboe come from the SNS, and 356 mmboe come from the WoS.

3.4 Production – Total Hydrocarbons

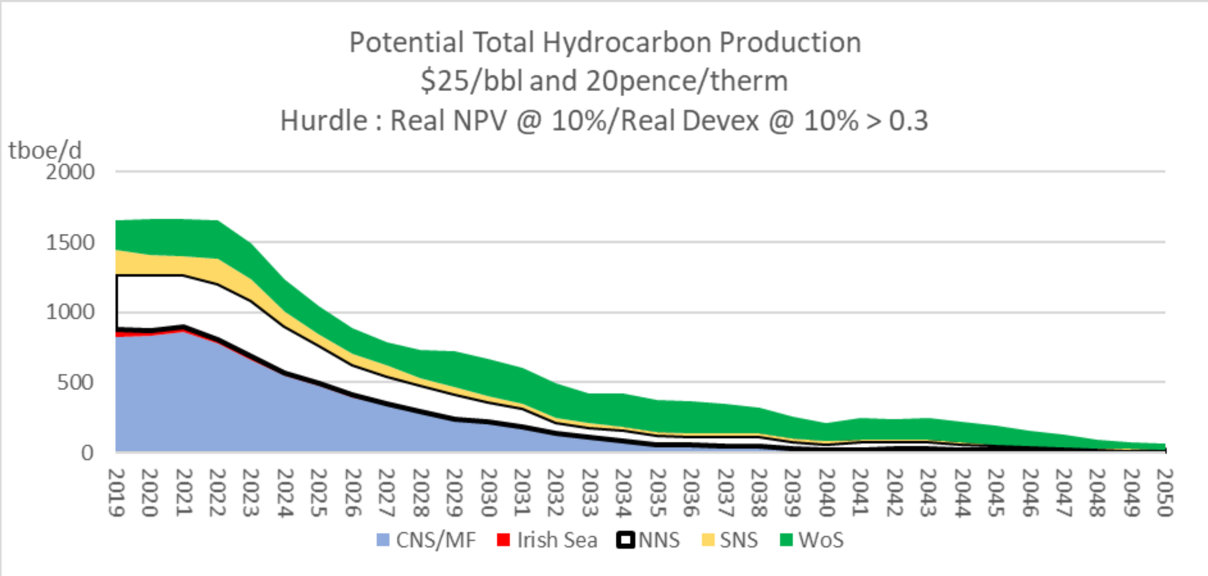
i. $25, 20 pence prices (real)

Chart 19



Over the period with a $25 and 20 pence price scenario and the NPV/I ≥ 0.3 hurdle, cumulative total hydrocarbon production (including NGLs) is 7,181 million barrels of oil equivalent (Chart 19). Of this 5,512 mmboe come from already sanctioned fields, 182 mmboe come from current incremental projects, 193 mmboe come from future incremental projects, 2 mmboe come from probable and possible fields, 1,291 mmboe come from the technical reserve fields, but none come from new exploration finds. The decline rate is seen to be quite brisk from 2025 onwards with only a very modest contribution from fields in the category of future fields.

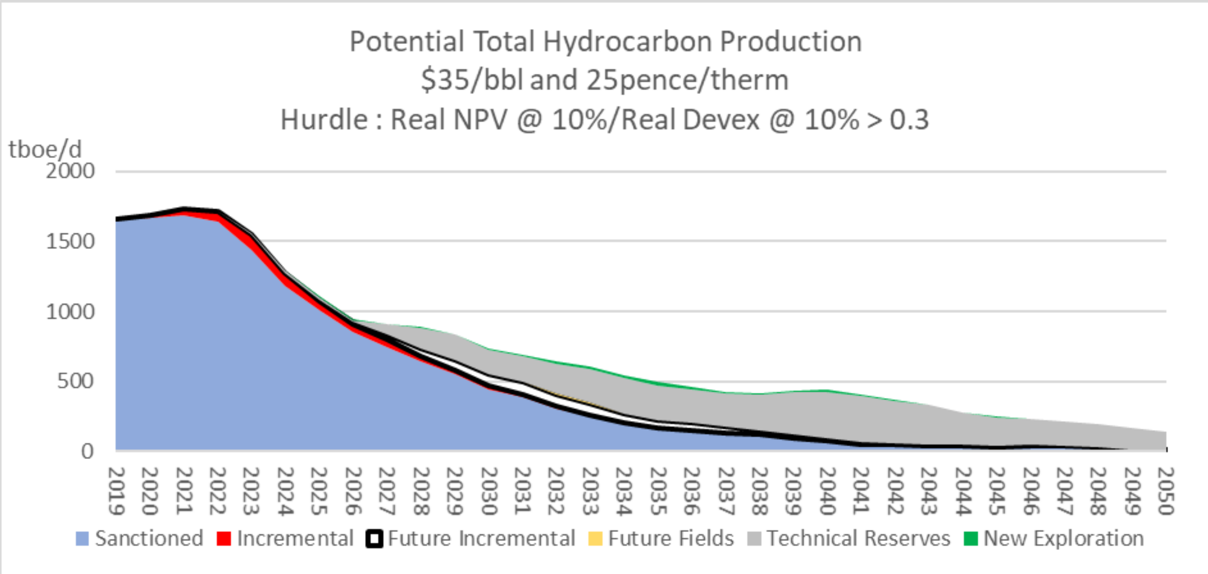
Chart 20



With the $25 and 20 pence prices and the NPV/I ≥ 0.3 hurdle, cumulative total hydrocarbon production from the CNS/MF area is 2,683 million barrels of oil equivalent, 102 mmboe come from the Irish Sea, 1,698 mmboe come from the NNS, 539 mmboe come from the SNS, and 2,158 mmboe come from the WoS. The results are displayed in Chart 20. The NNS and WoS regions display the slowest decline rates over the period.

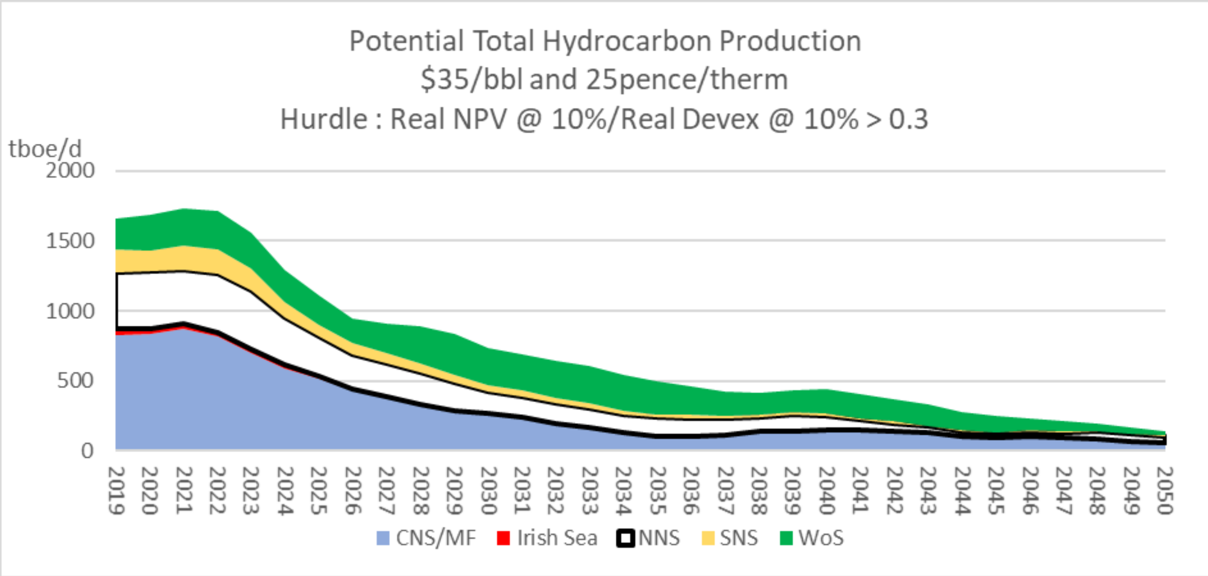
ii. $35, 25 pence prices

Chart 21



Over the period to 2050 with a $35 and 25 pence price scenario and the NPV/I ≥ 0.3 hurdle, cumulative total hydrocarbon production (including NGLs) is 8,334 million barrels of oil equivalent (Chart 21). Of this 5,740 mmboe come from already sanctioned fields, 251 mmboe come from current incremental projects, 323 mmboe come from future incremental projects, 11 mmboe come from probable and possible fields, 1,911 mmboe come from the technical reserve fields, and 97 mmboe come from new exploration finds.

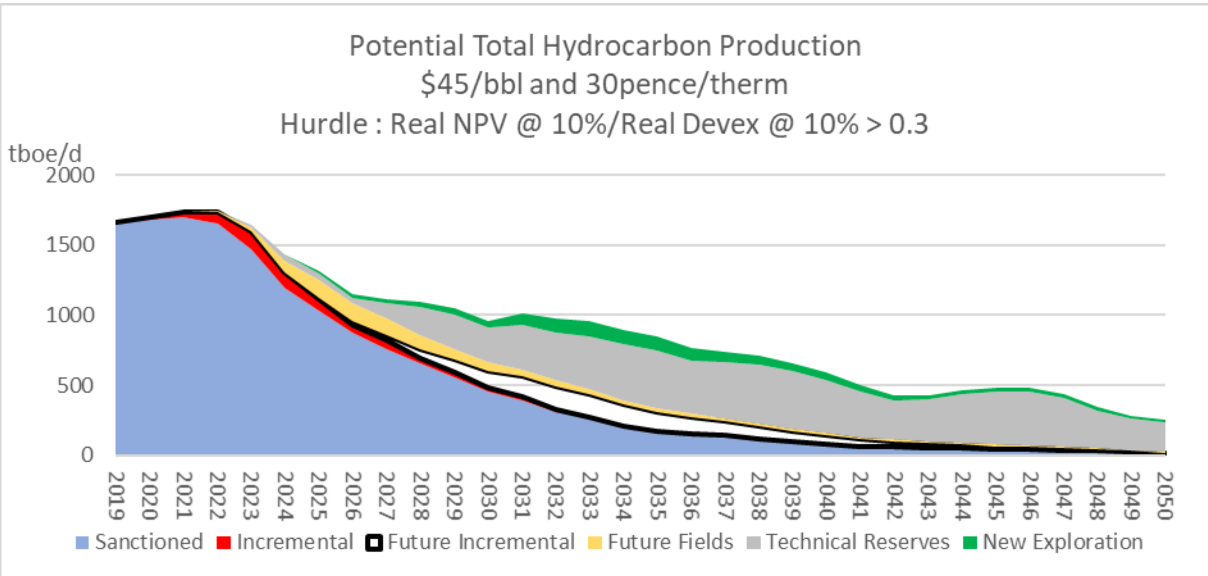
Chart 22



With the $35 and 25 pence prices and the NPV/I ≥ 0.3 hurdle, cumulative total hydrocarbon production from the CNS/MF area is 3,410 million barrels of oil equivalent, 103 mmboe come from the Irish Sea, 2,003 mmboe come from the NNS, 595 mmboe come from the SNS, and 2,222 mmboe come from the WoS. The results are displayed in Chart 22.

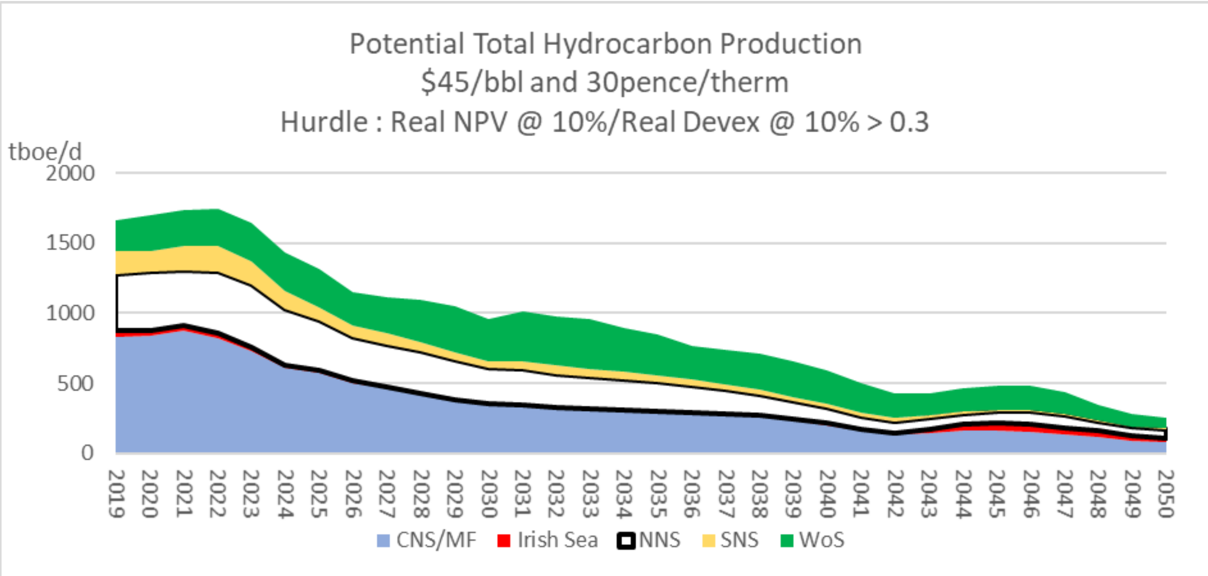
iii. $45, 30 pence prices (real)

Chart 23



Over the period with a $45 and 30 pence price scenario and the NPV/I $\geq$ 0.3 hurdle, cumulative total hydrocarbon production (including NGLs) is 10,529 million barrels of oil equivalent (Chart 23). Of this 5,841 mmboe come from already sanctioned fields, 273 mmboe come from current incremental projects, 652 mmboe come from future incremental projects, 408 mmboe come from probable and possible fields, 2,876 mmboe come from the technical reserve fields, and 479 mmboe come from new exploration finds.

Chart 24

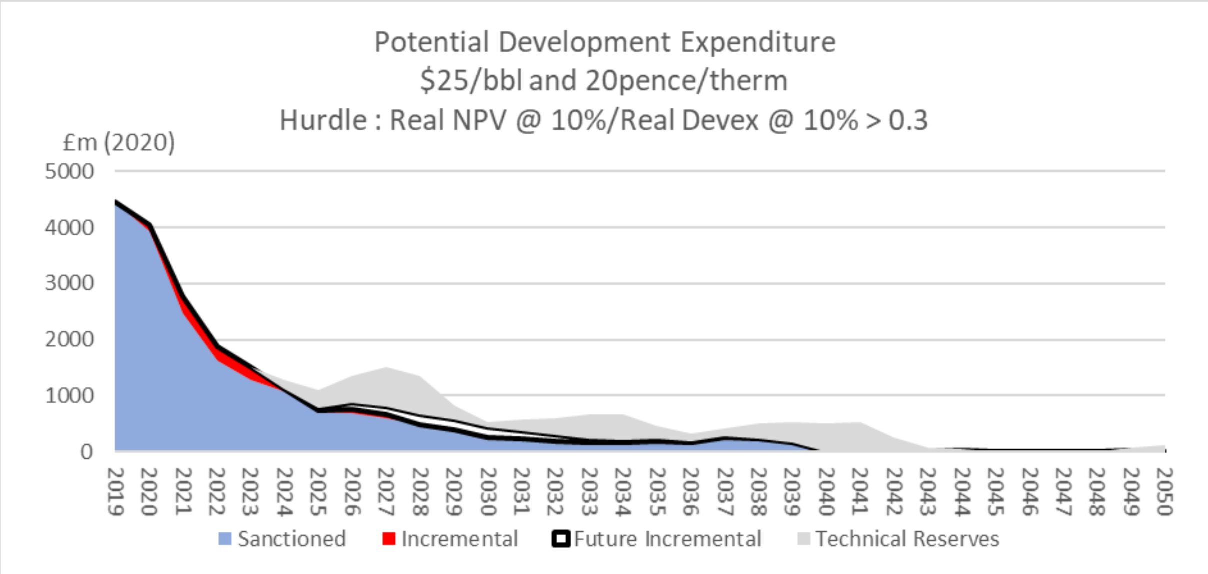


With the $45 and 30 pence prices and the NPV/I $\geq$ 0.3 hurdle, cumulative total hydrocarbon production from the CNS/MF area is 4,224 million barrels of oil equivalent, 248 mmboe come from the Irish Sea, 2,558 mmboe come from the NNS, 711 mmboe come from the SNS, and 2,788 mmboe come from the WoS. The results are displayed in Chart 24.

3.5 Development Expenditure

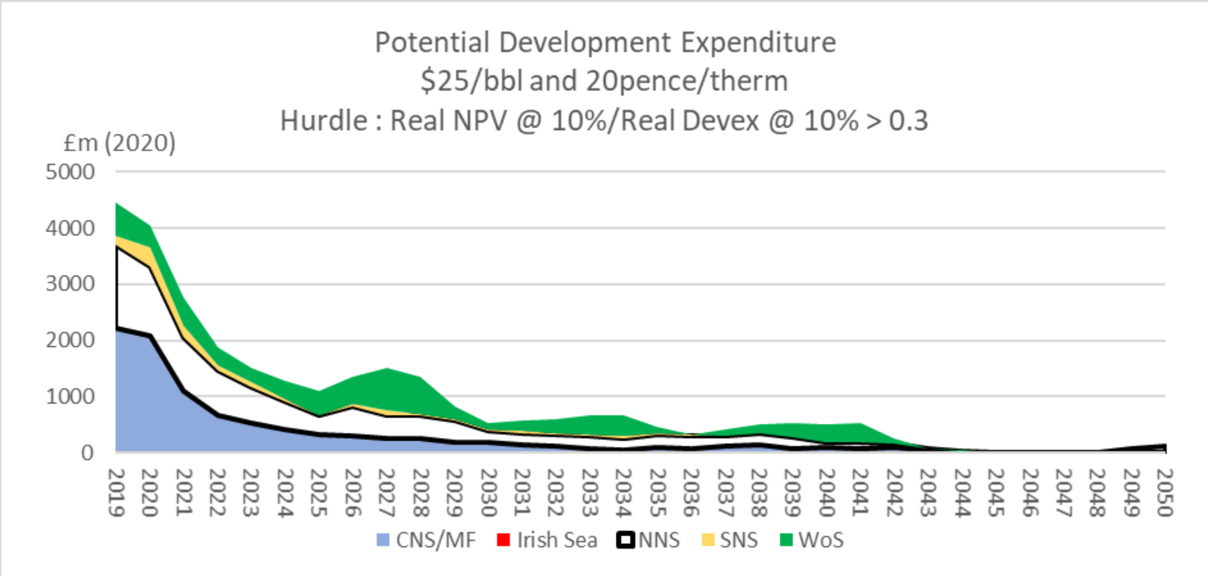
i. $25 and 20 pence prices (real)

Chart 25



Over the period to 2050, with $25 and 20 pence prices and the NPV/I ≥ 0.3 hurdle, cumulative development costs to 2050 are £28,934m at 2020 prices (Chart 25), with £19,738m coming from already sanctioned fields, £1,073m coming from current incremental projects, £1,368m coming from future incremental projects, nothing coming from probable and possible fields, £6,755m coming from technical reserve fields, and nothing coming from new exploration finds. From Chart 25 it is seen that field development investment falls dramatically from 2020 levels to only c.£1.5 billion in 2023, and c.£0.5 billion in 2030. The long-term investment levels are heavily dependent on the development of fields in the category of technical reserves.

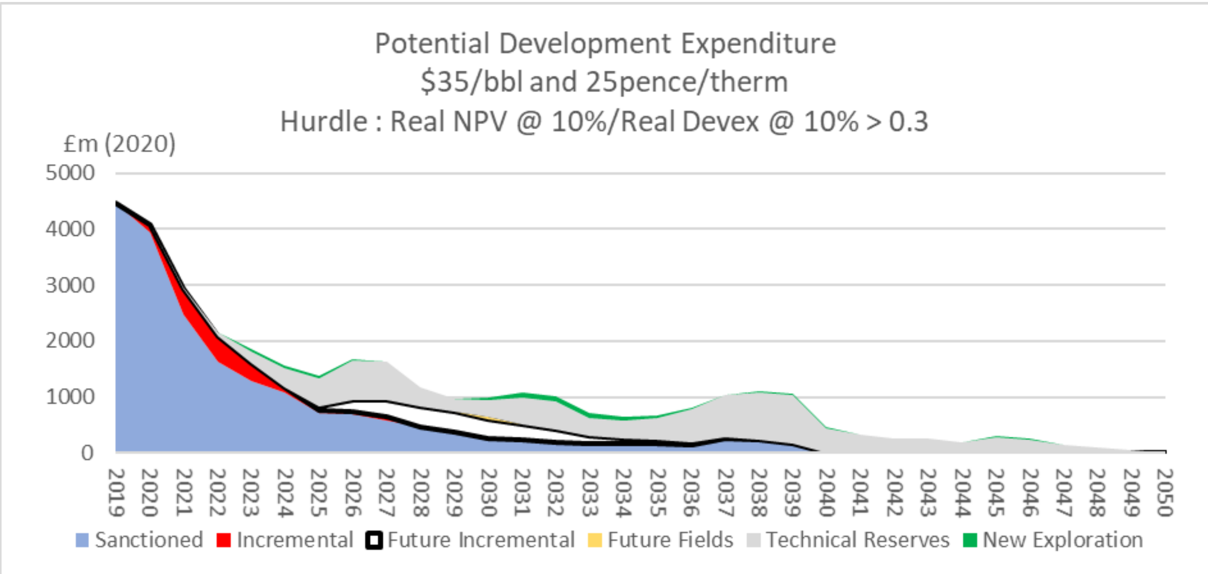
Chart 26



Cumulative development costs in the CNS/MF area are £9,576m (Chart 26), £102m in the Irish Sea, £10,195m in the NNS, £1,393m in the SNS, and £7,668m in the WoS.

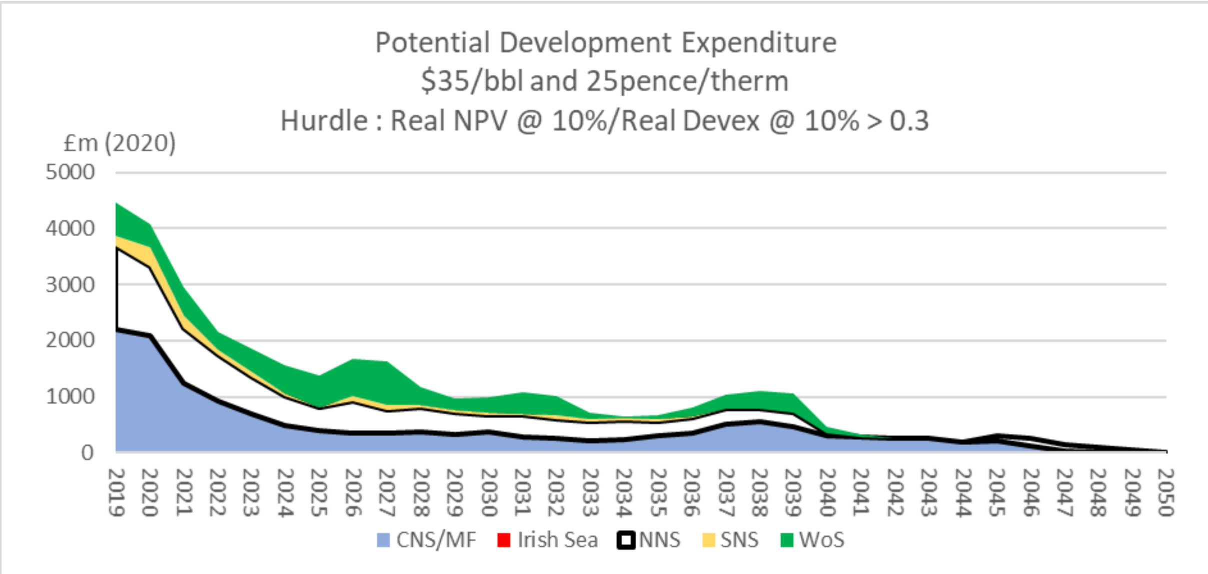
ii. $35 and 25 pence prices (real)

Chart 27



Over the period to 2050, with $35 and 22 pence prices and the NPV/I ≥ 0.3 hurdle, cumulative development costs are £35,431m at 2020 prices (Chart 27), with £19,759m coming from already sanctioned fields, £1,646m coming from current incremental projects, £2,485m coming from future incremental projects, £71m coming from probable and possible fields, £10,780m coming from technical reserve fields, and £690m coming from new exploration finds. From Chart 27 it is seen that field development investment falls dramatically from 2020 levels to only c.£1.8 billion in 2023, and c.£1 billion in 2030. The long-term investment levels are heavily dependent on the development of fields in the category of technical reserves.

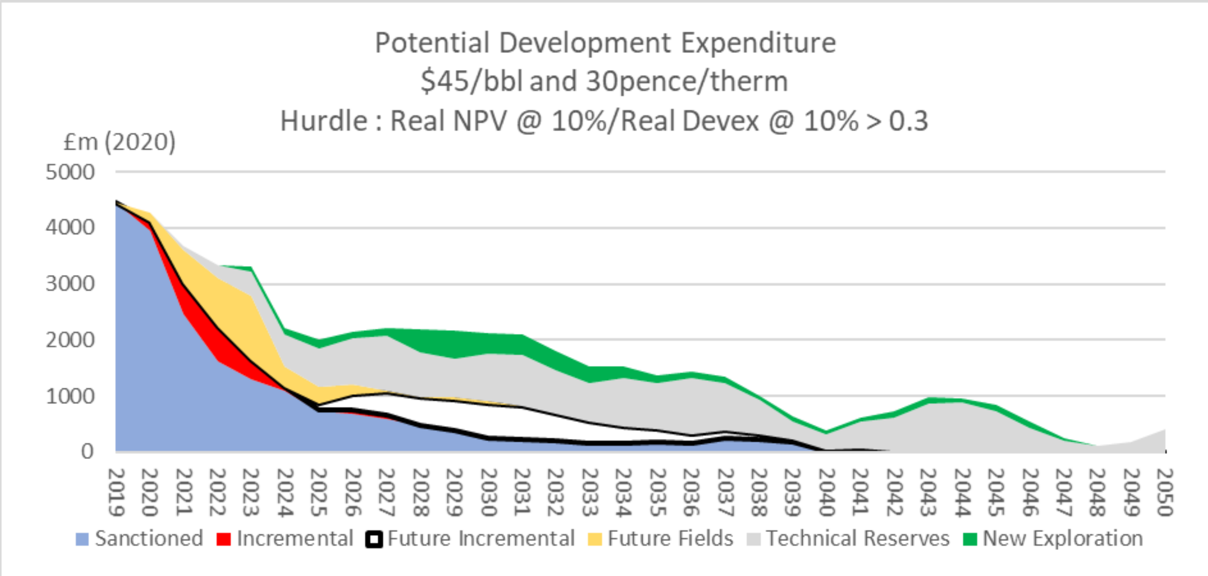
Chart 28



Cumulative development costs in the CNS/MF area are £15,558m (Chart 28), £102m in the Irish Sea, £11,560m in the NNS, £1,534m in the SNS, and £7,678m in the WoS.

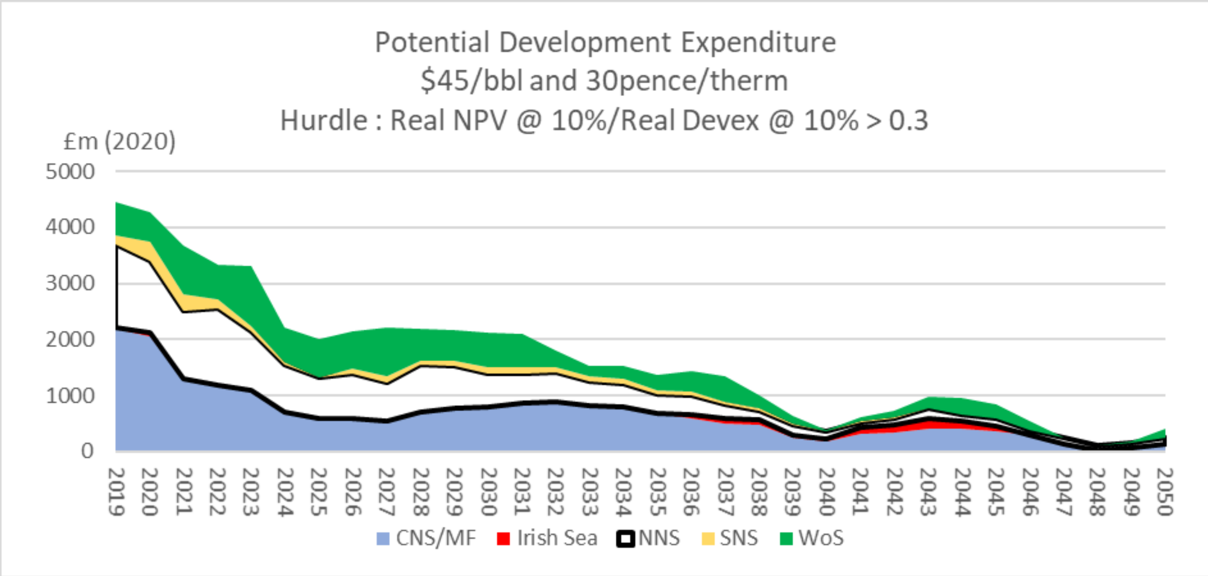
iii. $45 and 30 pence prices (real)

Chart 29



Over the period to 2050, with $45 and 30 pence prices and the NPV/I $\geq$ 0.3 hurdle, cumulative development costs to 2050 are £52,809m at 2020 prices (Chart 29), with £19,768m coming from already sanctioned fields, £1,909m coming from current incremental projects, £4,949m coming from future incremental projects, £3,773m coming from probable and possible fields, £18,050m coming from technical reserve fields, and £4,361m coming from new exploration finds. From Chart 29 it is seen that field development investment does not fall as dramatically as is the case with the lower prices. Near term investment is aided by the current incremental projects and probable and possible fields whilst investment from 2027 is heavily dependent on the development of fields in the category of technical reserves and new exploration finds.

Chart 30

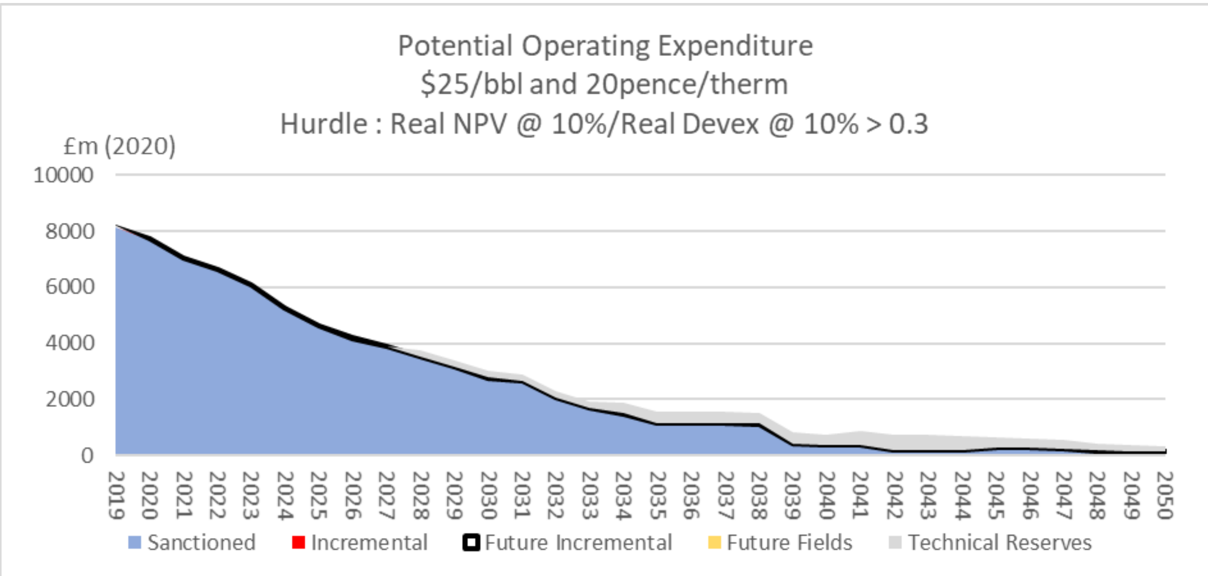


Cumulative development costs in the CNS/MF area are £20,969m (Chart 30), £1,060m in the Irish Sea, £16,159m in the NNS, £2,232m in the SNS, and £12,389m in the WoS.

3.6 Operating Expenditures

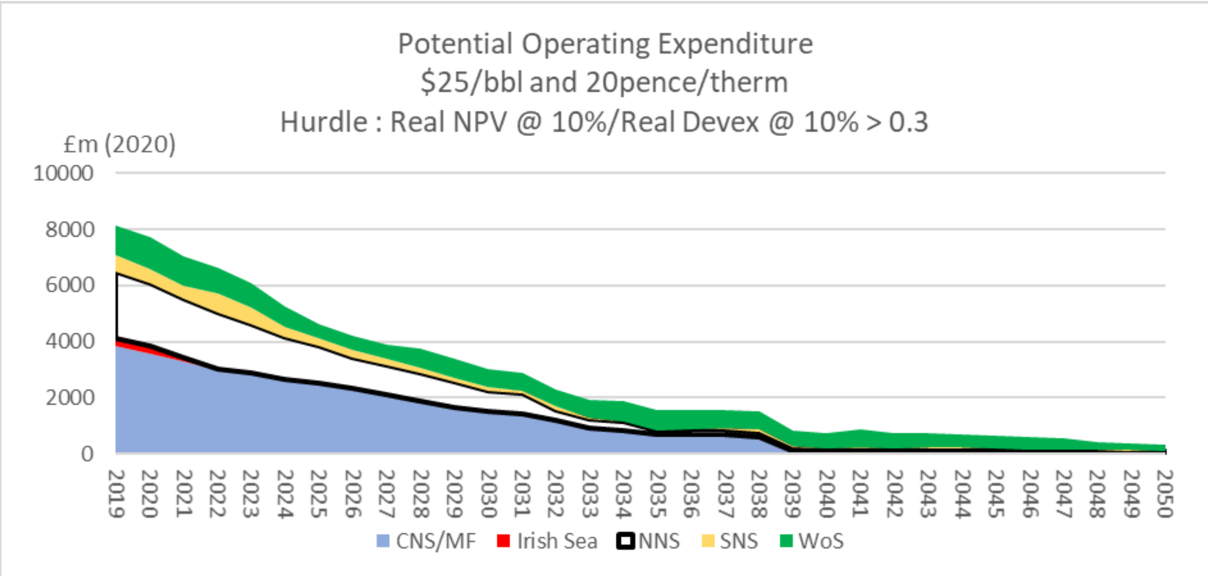
i. $25 and 20 pence prices (real)

Chart 31



Over the period to 2050 with $25 and 20 pence prices and NPV/I ≥ 0.3 hurdle, cumulative operating costs to 2050 are £86,339m at 2020 prices, with £77,946m coming from already sanctioned fields, £332m from current incremental projects, £347m from future incremental projects, £6m from probable and possible fields, £7,709m from technical reserve fields, and nothing from new exploration finds. The most obvious feature of the results is the continuous and sharp fall in operating expenditures from around £8 billion in 2019 to around £0.3 billion in 2050.

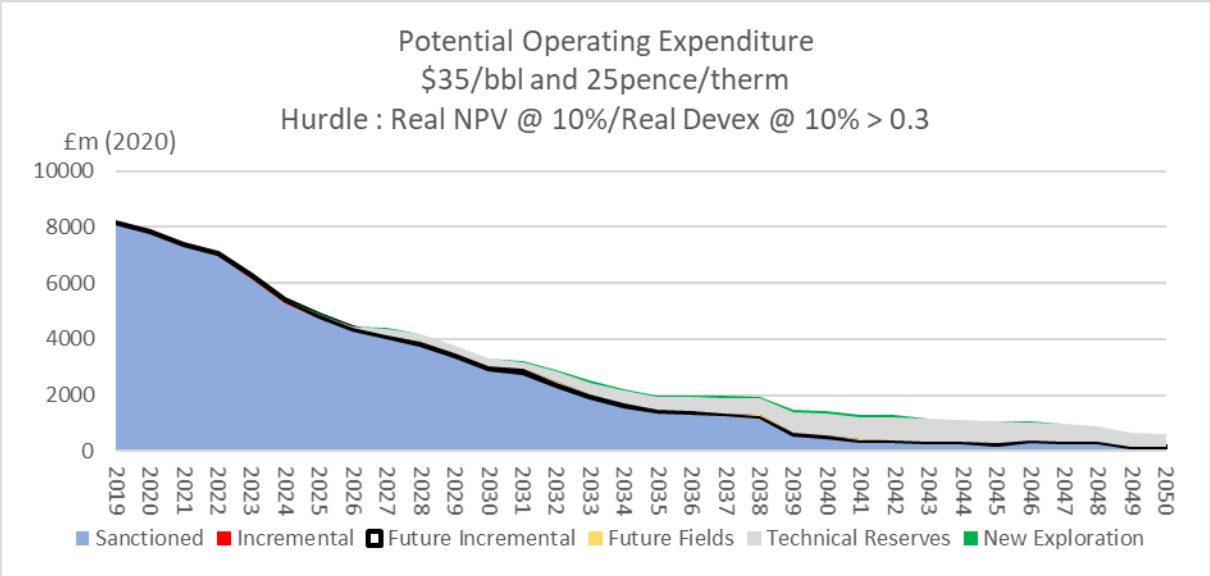
Chart 32



Cumulative operating costs in the CNS/MF area are £38,438m (Chart 32), £1,155m in the Irish Sea, £21,831m in the NNS, £5,043m in the SNS and £19,872m in the WoS.

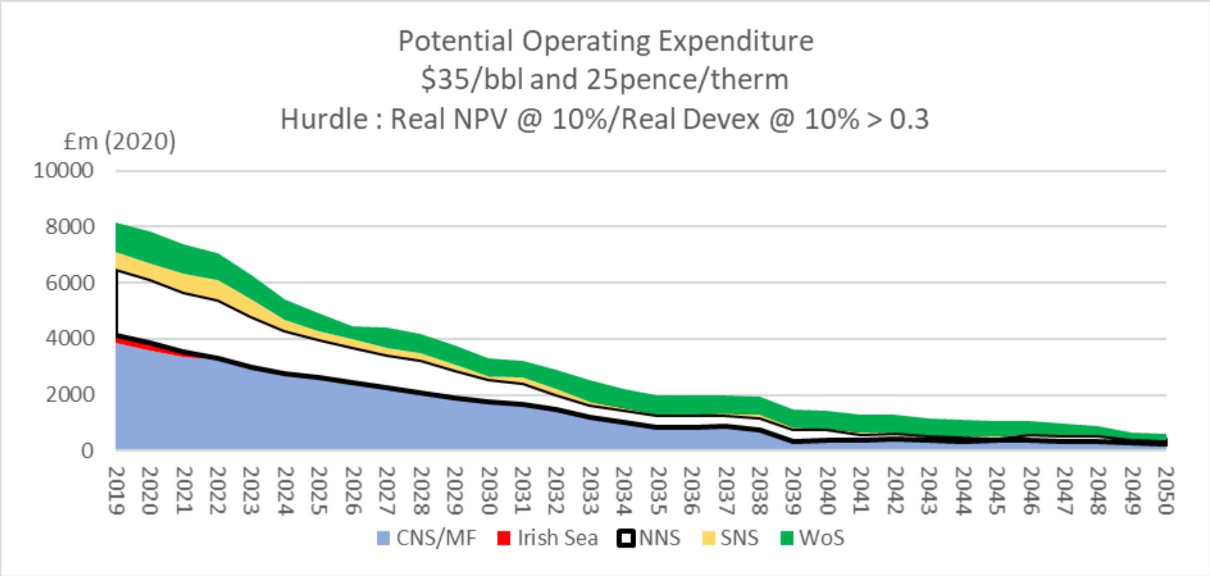
ii. $35 and 25 pence prices (real)

Chart 33



Over the period to 2050 with $35 and 25 pence prices and NPV/I ≥ 0.3 hurdle, cumulative operating costs to 2050 are £98,999m at 2020 prices with £83,161m coming from already sanctioned fields, £733m from current incremental projects, £965m from future incremental projects, £85m from probable and possible fields, £13,068m from technical reserve fields, and £987m from new exploration finds. The most obvious feature of the results is the continuous fall in operating expenditures from around £8 billion in 2019 to around £0.6 billion in 2050. The results are shown in Chart 33.

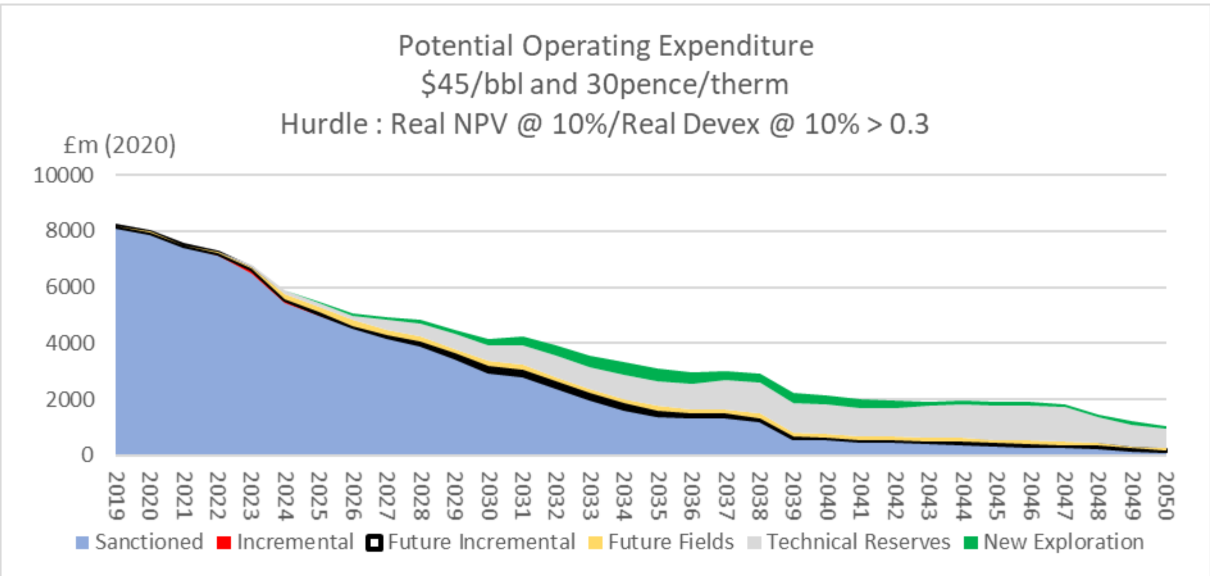
Chart 34



Cumulative operating costs in the CNS/MF area are £45,376m (Chart 34), £1,179m in the Irish Sea, £25,881m in the NNS, £5,493m in the SNS and £21,071m in the WoS.

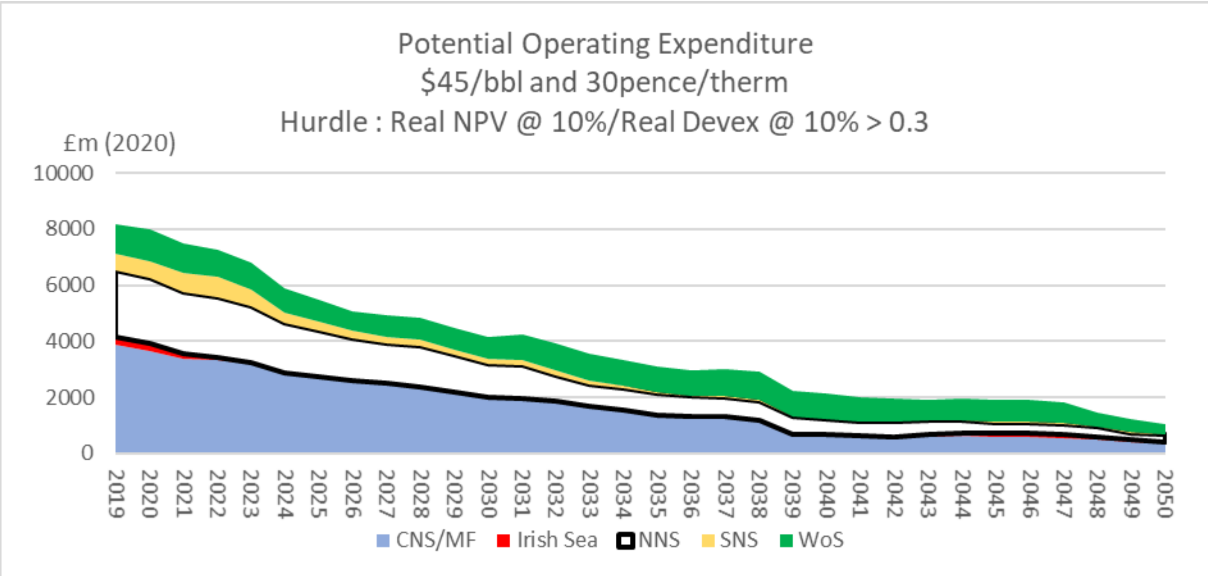
iii. $45 and 30 pence prices (real)

Chart 35



Over the period to 2050 with $45 and 30 pence prices and NPV/I ≥ 0.3 hurdle, cumulative operating costs are £121,048m at 2020 prices with £86,152m coming from already sanctioned fields, £799m from current incremental projects, £1,908m from future incremental projects, £4,217m from probable and possible fields, £21,949m from technical reserve fields, and £6,024m from new exploration finds. Operating expenditures fall from around £8 billion in 2019 to around £1 billion in 2050 (Chart 35).

Chart 36

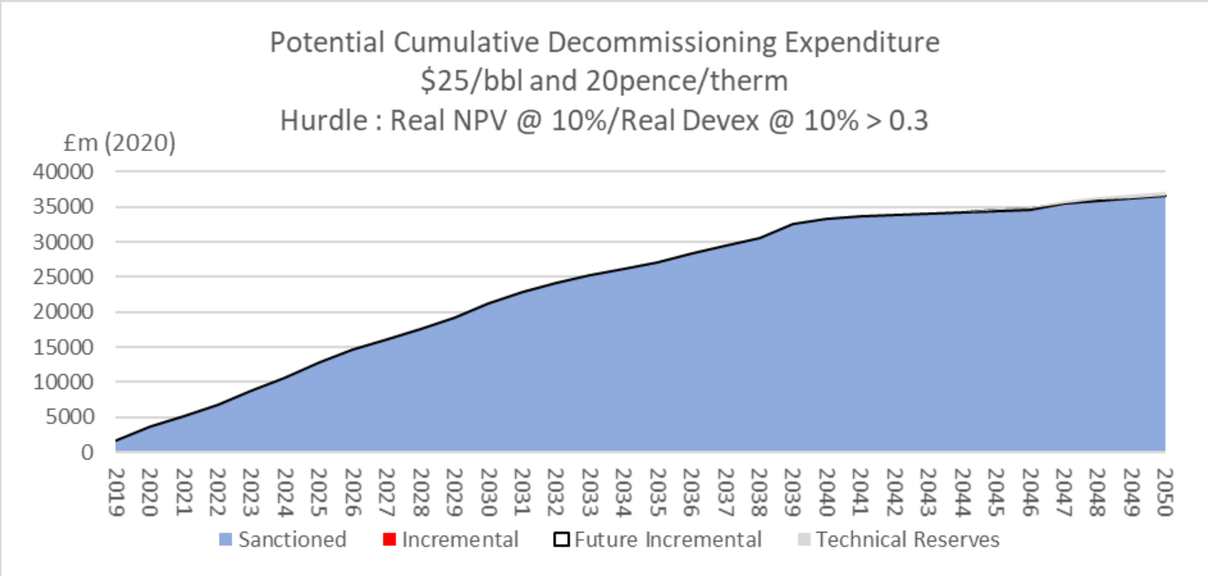


Cumulative operating costs in the CNS/MF area are £53,095m (Chart 36), £2,155m in the Irish Sea, £33,191m in the NNS, £5,827m in the SNS and £26,799m in the WoS.

3.7 Decommissioning Activity

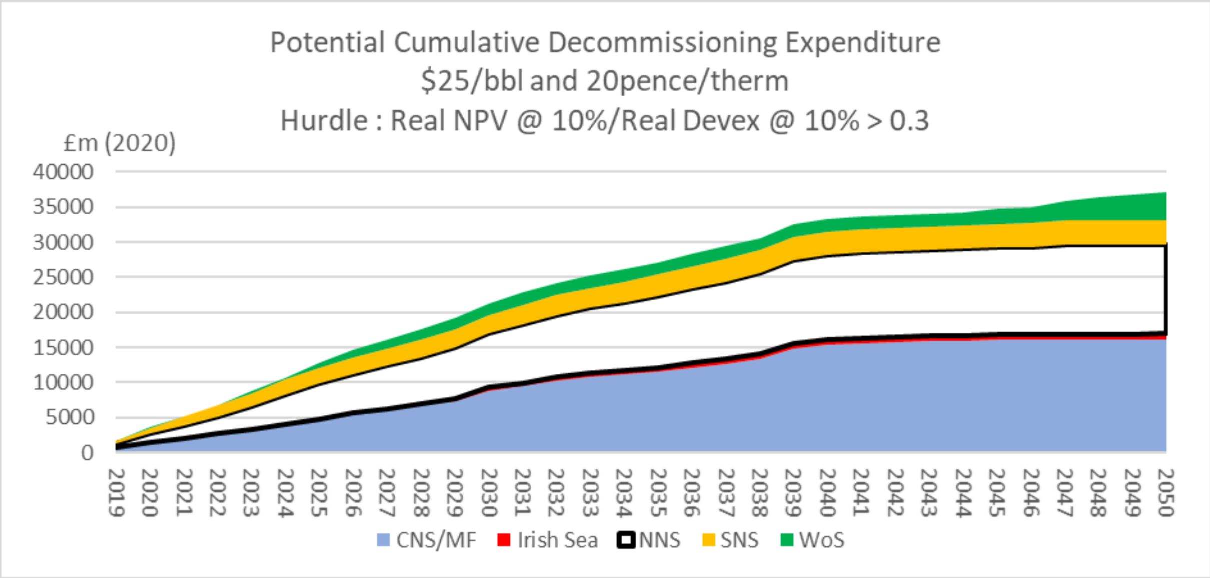
i. Cumulative Expenditures to 2050 - $25 and 20 pence prices (real)

Chart 37



With $25 and 20 pence prices and NPV/I ≥ 0.3 hurdle, cumulative decommissioning costs could be £37,079m by 2050 (Chart 37), with 98% coming from already sanctioned fields. They could account for £36,517m, current incremental projects could account for £55m, future incremental projects could account for £40m and technical reserves could account for £467m. Around 50% of the decommissioning spend will occur before 2029, and 80% will occur before 2038. The results reflect the very small number of future developments.

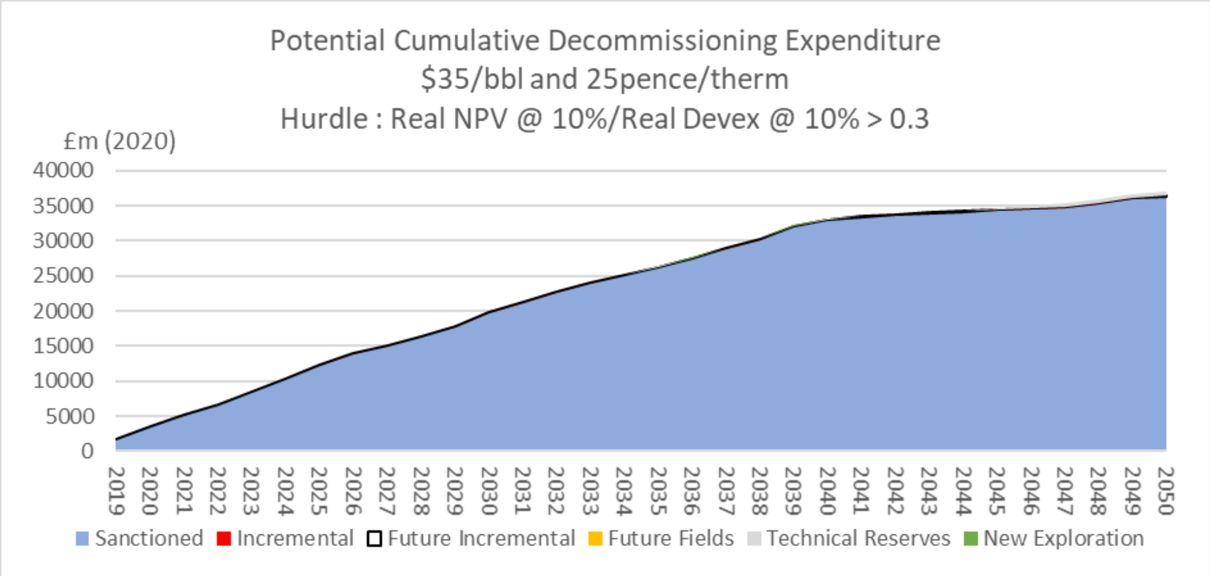
Chart 38



Cumulative decommissioning costs in the CNS/MF area could be £16,186m by 2050 (Chart 38), accounting for almost 44% of the decommissioning spend. Cumulative costs could be £770m in the Irish Sea which is more than 2% of the total spend. There could be £12,761m in the NNS, which is more than 34% of the decommissioning spend. There could be £3,488m in the SNS, which is more than 9% of the total spend. There could be £3,874m in the WoS which is more than 10% of the total spend.

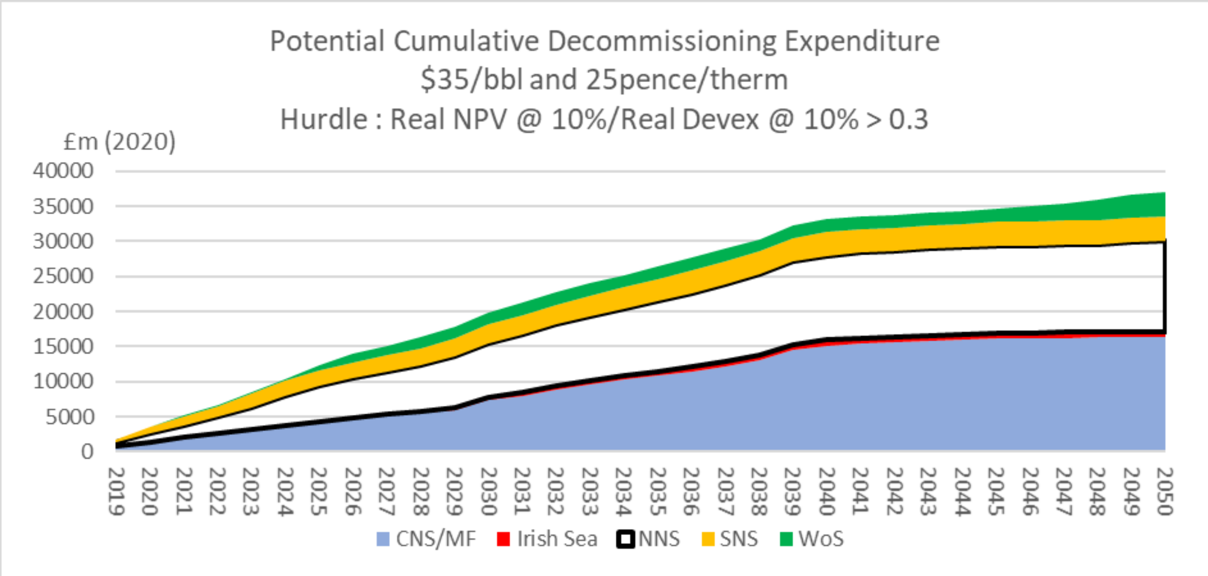
ii. Cumulative Expenditures to 2050 - $35 and 25 pence prices (real)

Chart 39



With $35 and 25 pence prices and NPV/I ≥ 0.3 hurdle, cumulative decommissioning costs could be £37,119m by 2050 (Chart 39), with 98% coming from already sanctioned fields. They could account for £36,258m, current incremental projects could account for £109m, future incremental projects could account for £75m, probable and possible fields could account for £11m, technical reserves could account for £603m and new exploration finds could account for £63m. More than 50% of the decommissioning spend will occur by 2030, and more than 80% will occur before 2038. The overall costs reflect the small number of new developments over the period.

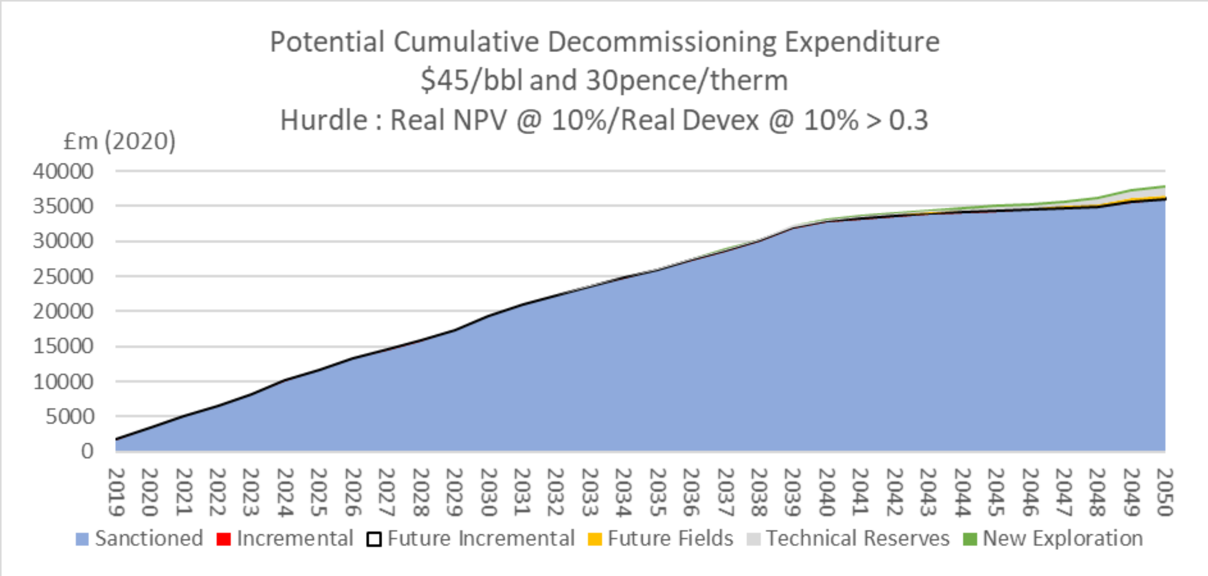
Chart 40



Cumulative decommissioning costs in the CNS/MF area could be £16,399m by 2050 (Chart 40), accounting for more than 44% of the decommissioning spend. Cumulative costs could be £770m in the Irish Sea which is more than 2% of the total spend. There could be £12,839m in the NNS, which is almost 35% of the decommissioning spend. There could be £3,615m in the SNS, which is more than 9% of the total spend. There could be £3,719m in the WoS which is almost 10% of the total spend.

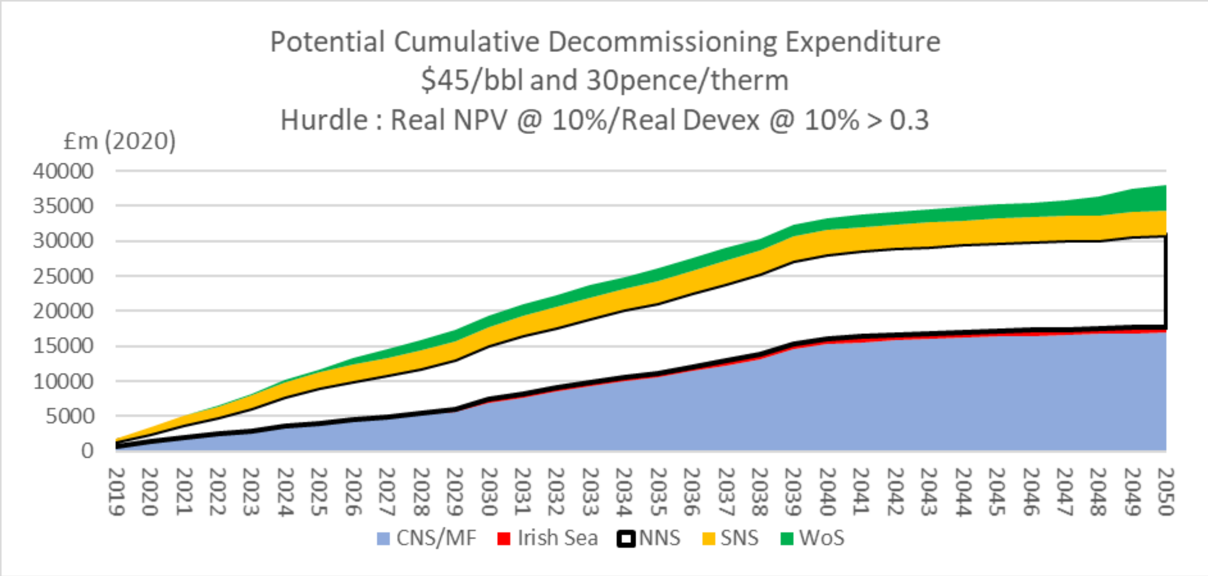
iii. Cumulative Expenditures to 2050 - $45 and 30 pence prices (real)

Chart 41



With $45 and 30 pence prices and NPV/I ≥ 0.3 hurdle, cumulative decommissioning costs could be £38,008m by 2050 (Chart 41), with 95% coming from already sanctioned fields. They could account for £35,940m, current incremental projects could account for £132m, future incremental projects could account for £184m, probable and possible fields could account for £286m, technical reserves could account for £1,091m and new exploration finds could account for £376m. More than 50% of the decommissioning spend will occur by 2030, and 80% will occur before 2038.

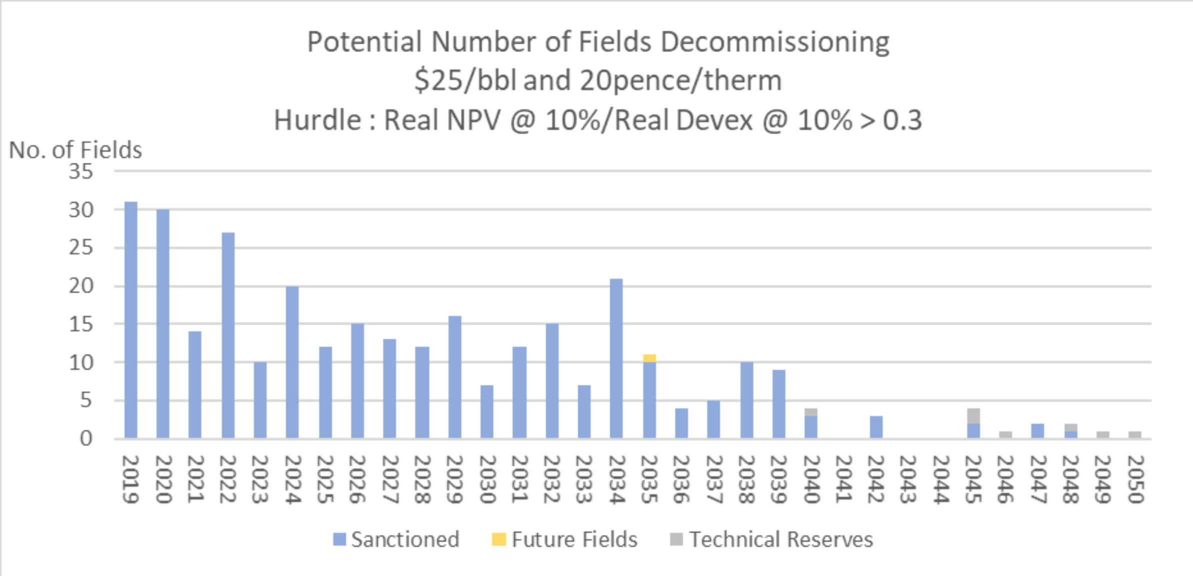
Chart 42



Cumulative decommissioning costs in the CNS/MF area could be £16,985m by 2050 (Chart 42), accounting for almost 45% of the decommissioning spend. Cumulative costs could be £796m in the Irish Sea which is more than 2% of the total spend. There could be £13,078m in the NNS, which is more than 34% of the decommissioning spend. There could be £3,522m in the SNS, which is more than 9% of the total spend. There could be £3,626m in the WoS which is almost 10% of the total spend.

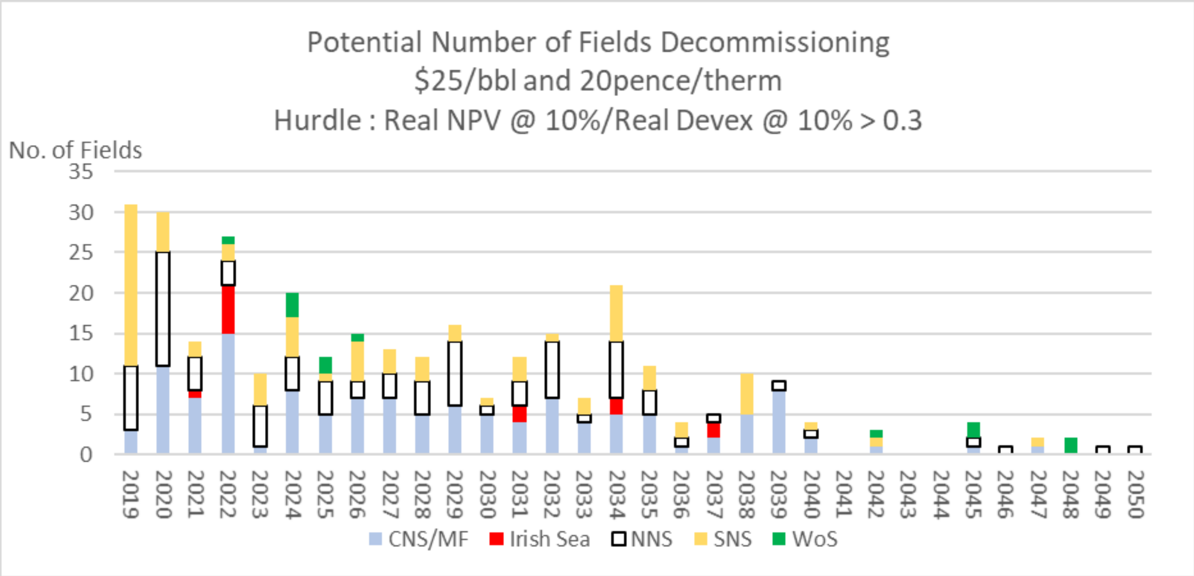
3.8 Number of Fields Being Decommissioned

Chart 43



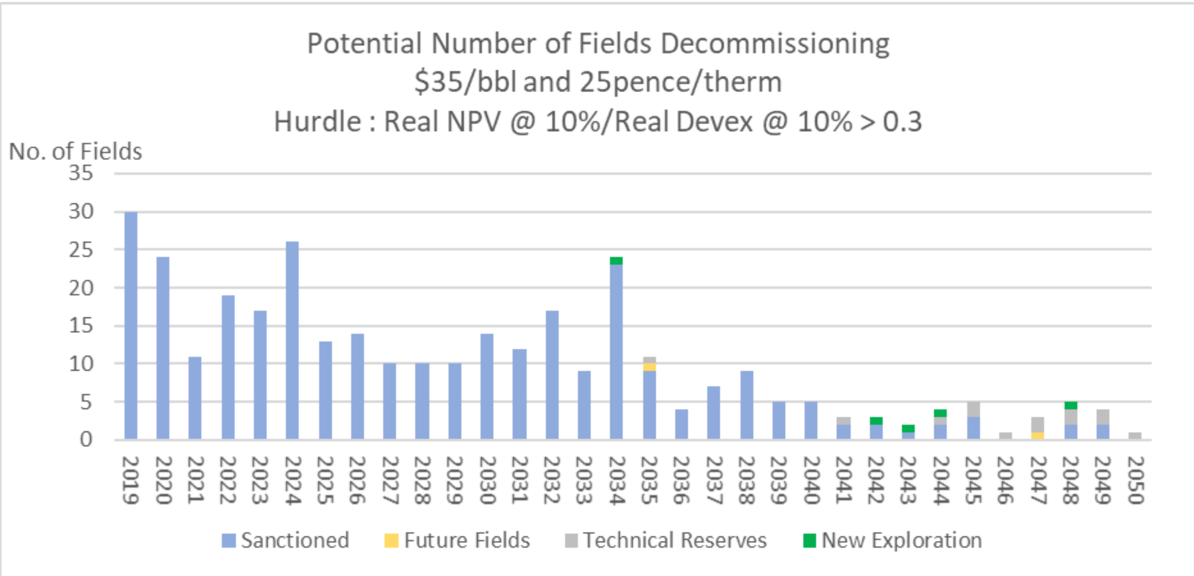
With \$25 and 20 pence prices and NPV/I ≥ 0.3 hurdle, there will be 144 fields either engaged in or having completed decommissioning by 2025. By 2030 the aggregate number becomes 207, and by 2050 there will be 319 fields either engaged in or having completed decommissioning. By 2035, 272 sanctioned fields and 1 probable and possible field finds will be either engaged in or having completed decommissioning. By 2050, 311 sanctioned fields, 1 probable and possible field and 7 technical reserve fields will be either engaged in or have completed decommissioning. Details are shown in Chart 43.

Chart 44



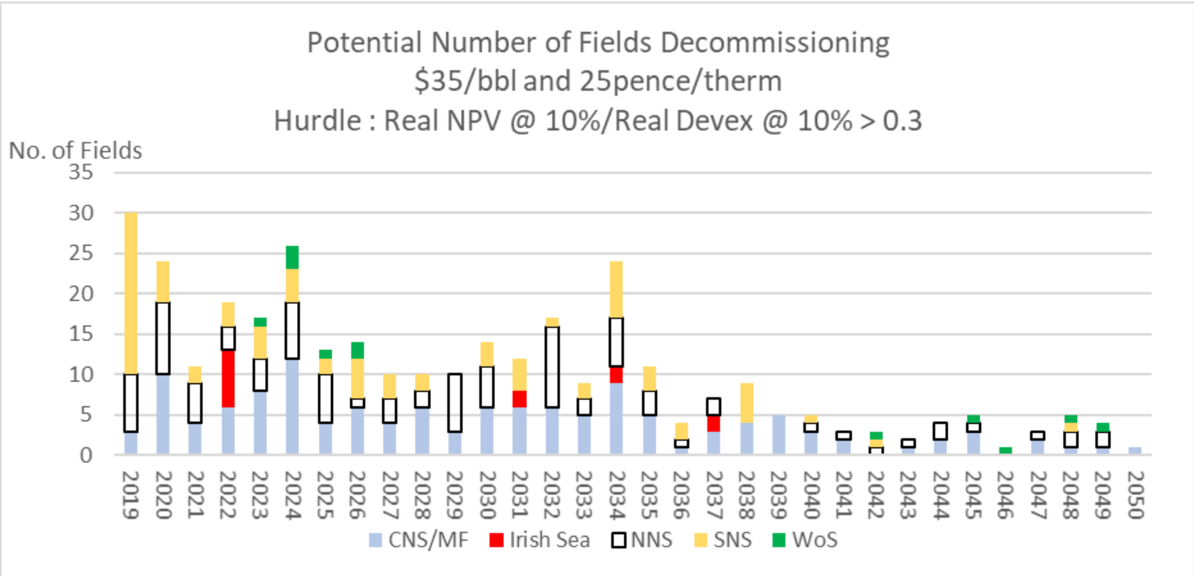
By 2035, 105 CNS/MF fields, 11 Irish Sea fields, 81 NNS fields, 69 SNS fields and 7 WoS fields will be either engaged in or have completed decommissioning. By 2050, 126 CNS/MF fields, 13 Irish Sea fields, 89 NNS fields, 79 SNS fields and 12 WoS fields will be either engaged in or have completed decommissioning. Details are shown in Chart 44.

Chart 45



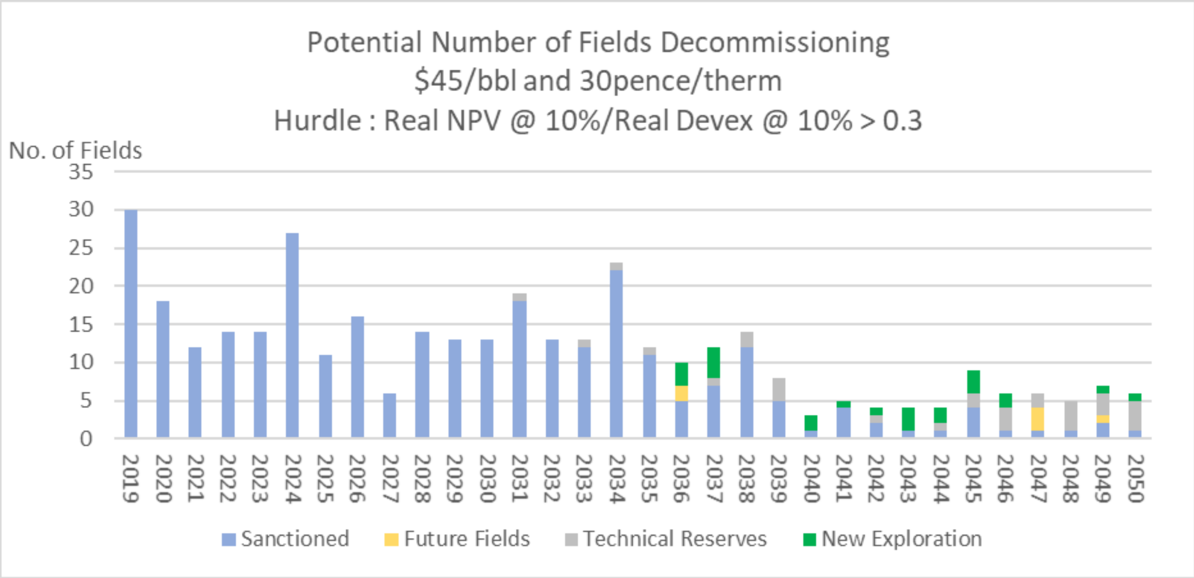
With \$35 and 25 pence prices and NPV/I ≥ 0.3 hurdle, there will be 140 fields either engaged in or having completed decommissioning by 2025. By 2030 there will be 198 fields either engaged in or having completed decommissioning, and by 2050 there will be 332 fields either engaged in or having completed decommissioning. By 2035, 268 sanctioned fields, 1 probable or possible field, 1 technical reserve field and 1 new exploration find will be either engaged in or have completed decommissioning. By 2050, 312 sanctioned fields, 2 probable or possible fields, 13 technical reserve fields and 5 new exploration finds will be either engaged in or have completed decommissioning. Details are shown in Chart 45.

Chart 46



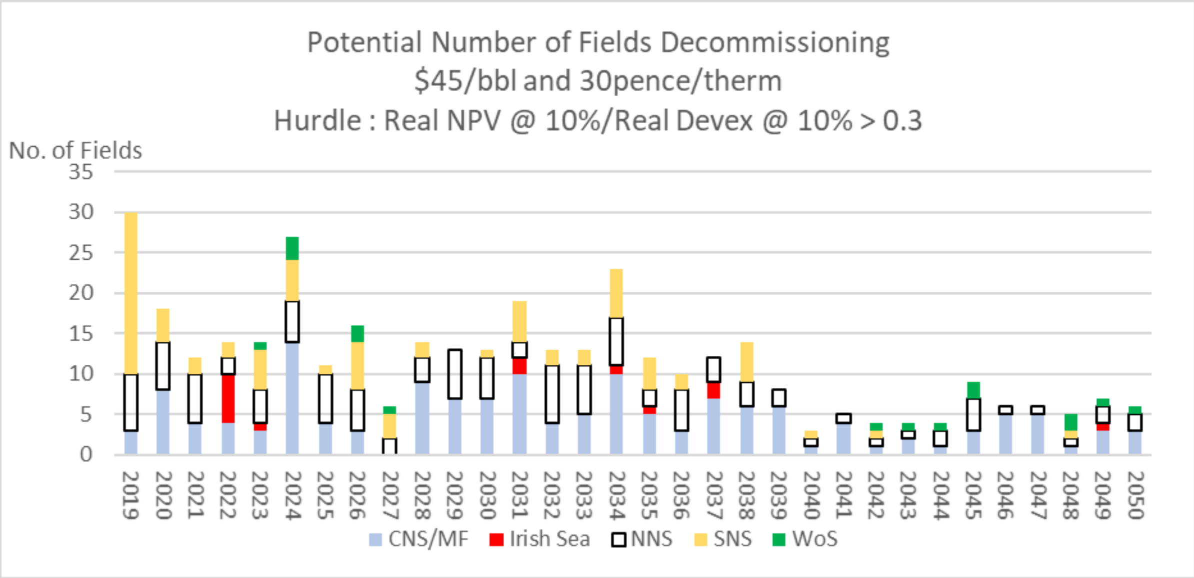
By 2035, 103 CNS/MF fields, 11 Irish Sea fields, 80 NNS fields, 70 SNS fields, and 7 WoS fields will be either engaged in or have completed decommissioning. By 2050, 132 CNS/MF fields, 13 Irish Sea fields, 95 NNS fields, 80 SNS fields and 12 WoS fields will be either engaged in or have completed decommissioning. Details are shown in Chart 46.

Chart 47



With \$45 and 30 pence prices and NPV/I ≥ 0.3 hurdle, there will be 126 fields either engaged in or having completed decommissioning by 2025. By 2030 there will be 188 fields either engaged in or having completed decommissioning, and by 2050 there will be 371 fields either engaged in or having completed decommissioning. By 2035, 264 sanctioned fields and 4 technical reserve fields will be either engaged in or have completed decommissioning. By 2050, 312 sanctioned fields, 6 probable or possible fields, 30 technical reserve fields and 23 new exploration finds will be either engaged in or have completed decommissioning. Details are shown in Chart 47.

Chart 48

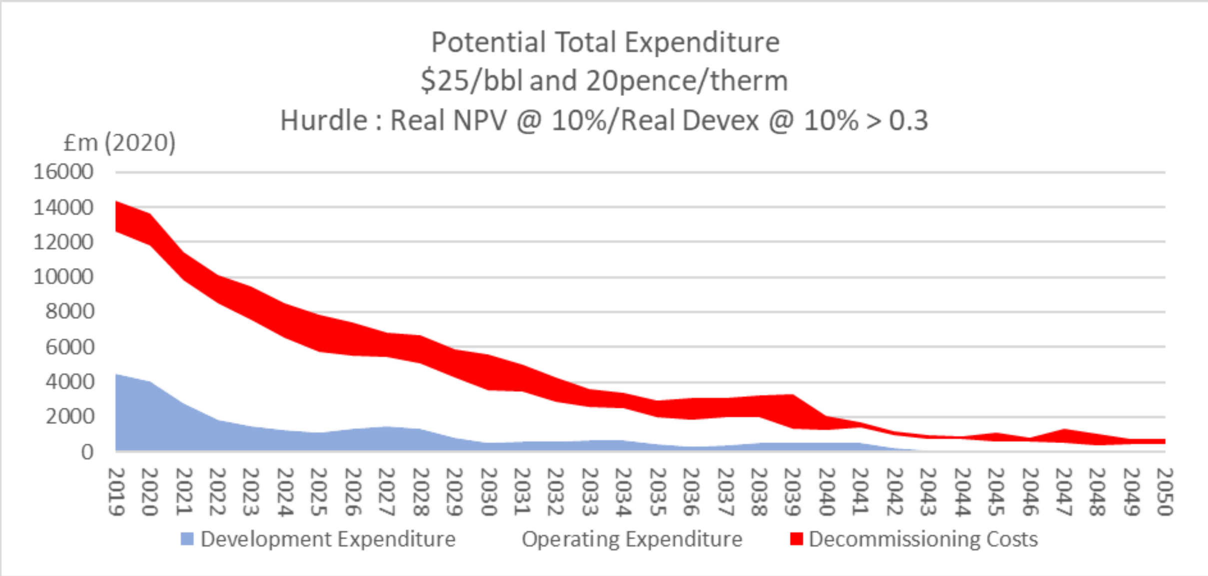


By 2035, 100 CNS/MF fields, 11 Irish Sea fields, 80 NNS fields, 70 SNS fields, and 7 WoS fields will be either engaged in or have completed decommissioning. By 2050, 151 CNS/MF fields, 14 Irish Sea fields, 110 NNS fields, 80 SNS fields and 16 WoS fields will be either engaged in or have completed decommissioning. Details are shown in Chart 48.

3.9 Total Field Expenditures

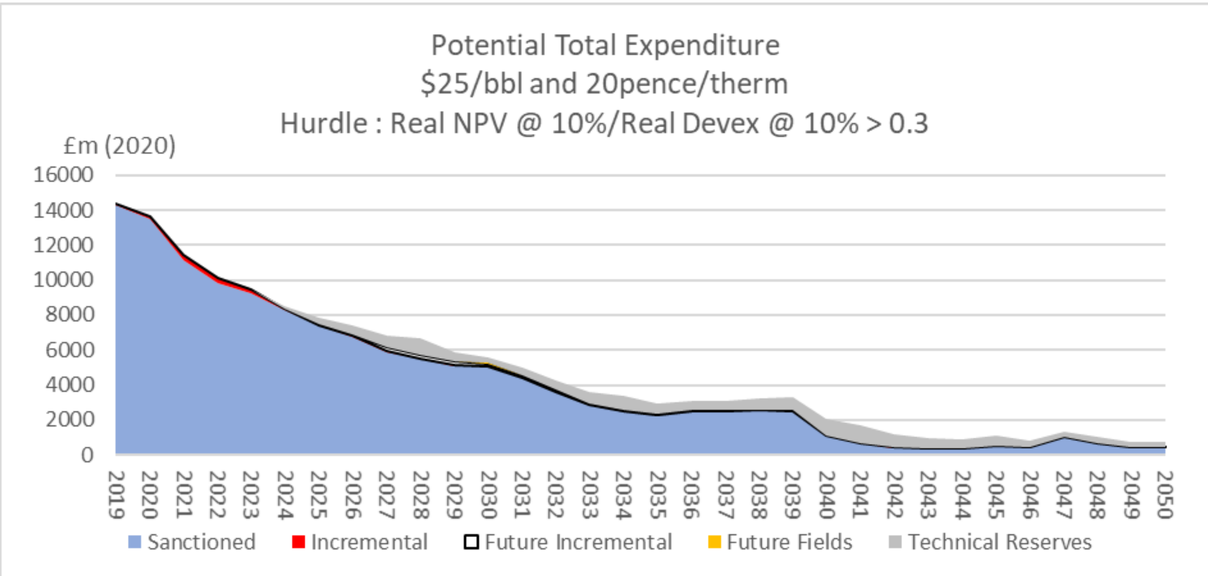
i. $25 and 20 pence prices (real)

Chart 49



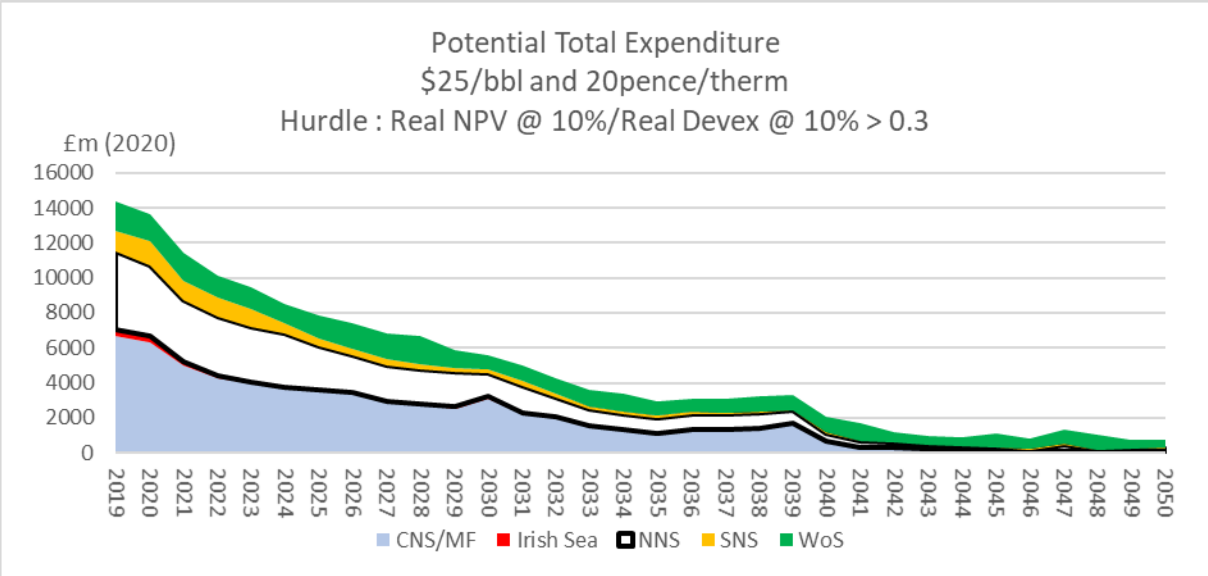
With $25 and 20 pence prices and NPV/I ≥ 0.3 hurdle, total field expenditure (development, operating and decommissioning expenditure) falls from recent levels of just over £14.3 billion to just over £0.7 billion by 2050. The decline in total expenditure is brisk. Operating expenditures constitute by far the largest element.

Chart 50



Total field expenditure is shown in Chart 50 by categories of fields and projects. Sanctioned fields dominate until late in the period but by 2041 expenditure from technical reserve fields becomes more important.

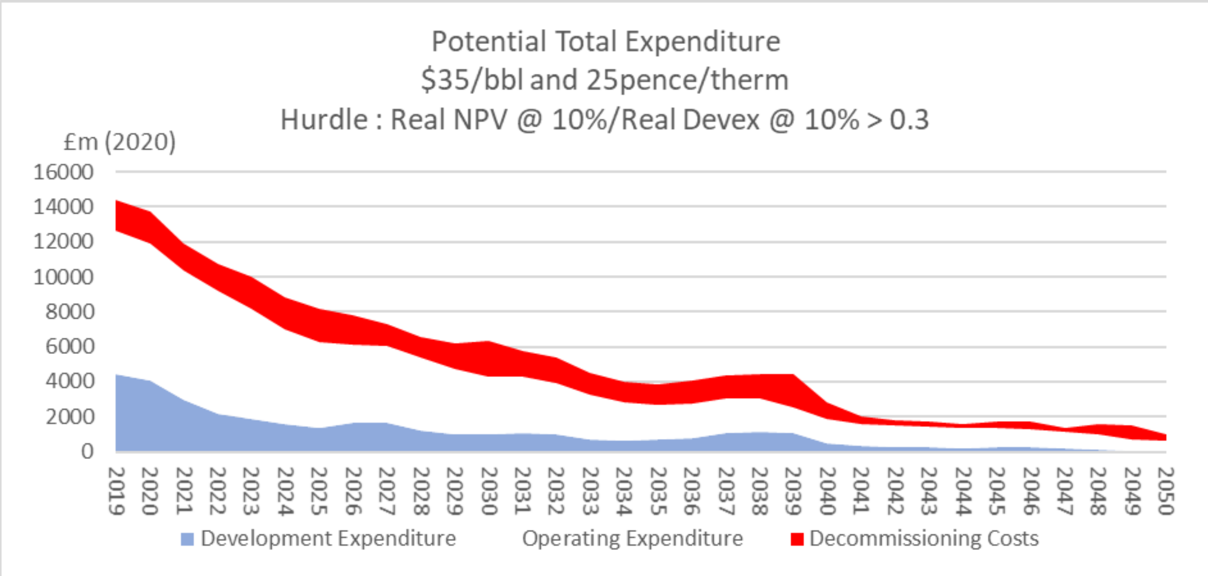
Chart 51



The contributions of the various geographic areas to total expenditure are shown in Chart 51 where it is seen that the CNS/MF area dominates until 2040 when the WoS area becomes more important.

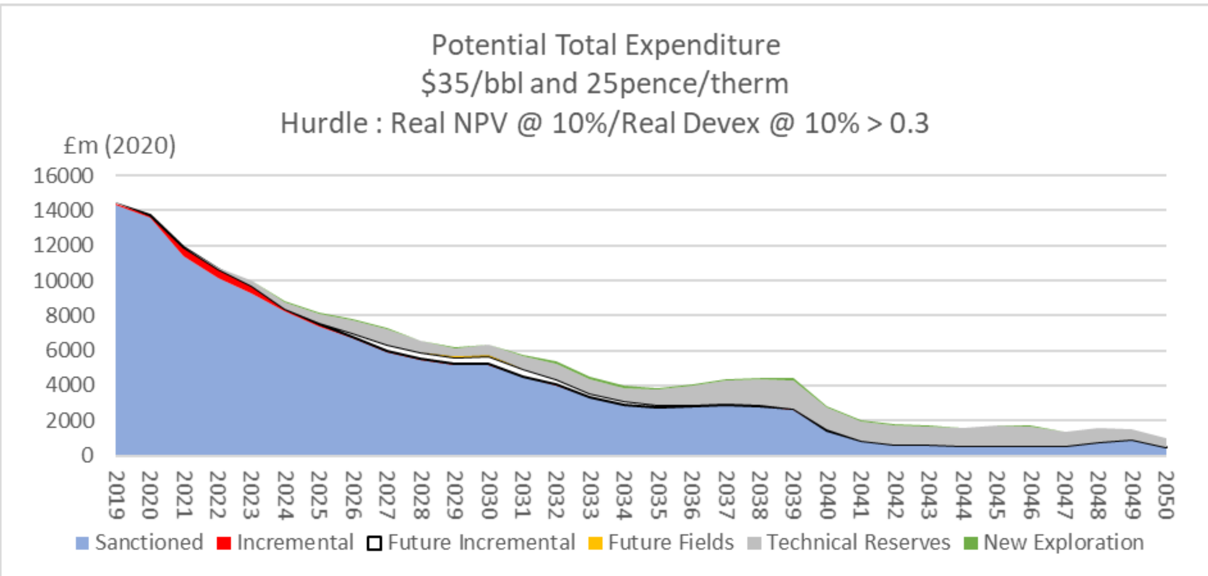
ii. $35 and 25 pence prices (real)

Chart 52



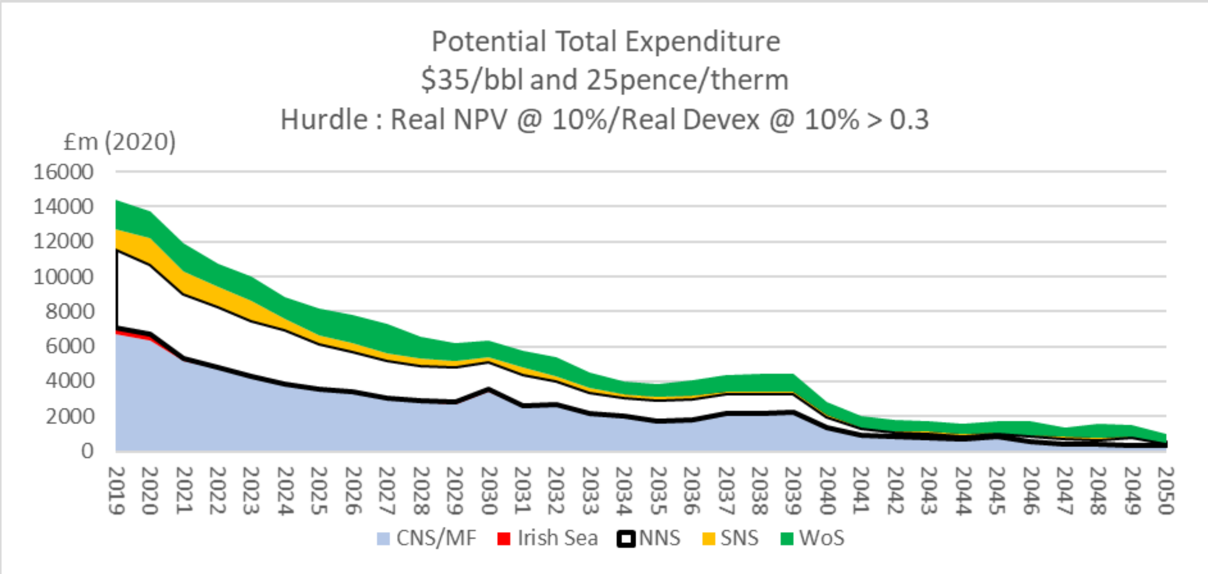
With $35 and 25 pence prices and NPV/I ≥ 0.3 hurdle, total field expenditure (development, operating and decommissioning expenditure) falls from recent levels of just over £14.3 billion to just over £1 billion by 2050. The decline in total expenditure is brisk. Again, operating expenditure constitute by far the largest element.

Chart 53



Total field expenditure is shown in Chart 53 by categories of fields and projects. Sanctioned fields dominate until late in the period, but by 2041 expenditure from technical reserve fields becomes more important.

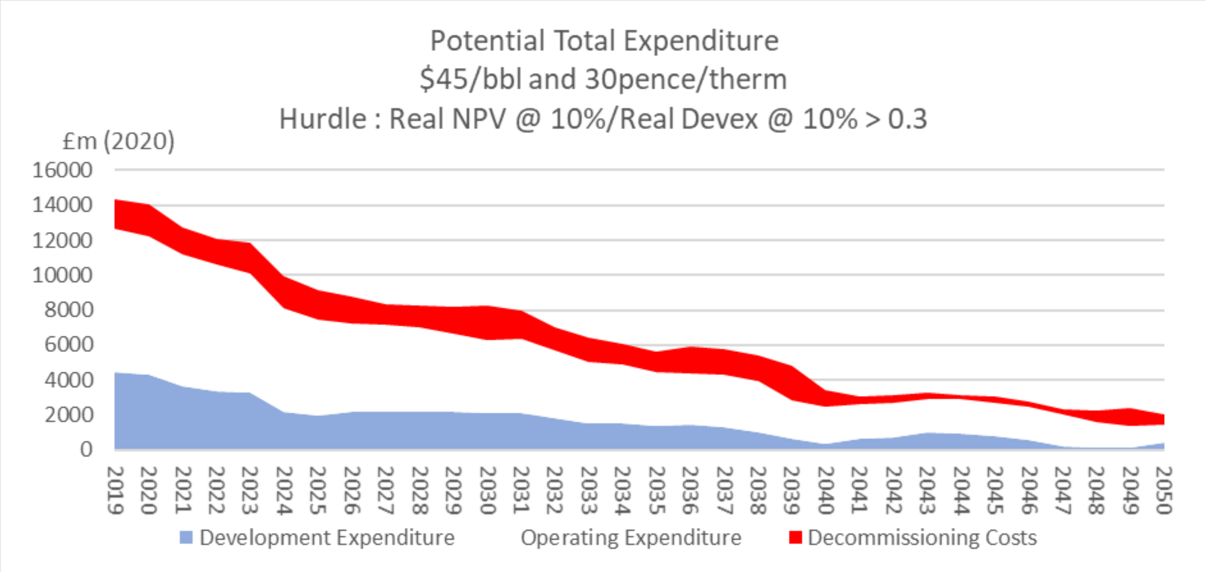
Chart 54



The contributions of the various geographic areas to total expenditure are shown in Chart 54 where it is seen that the CNS/MF area dominates until 2046 when the WoS area becomes more important.

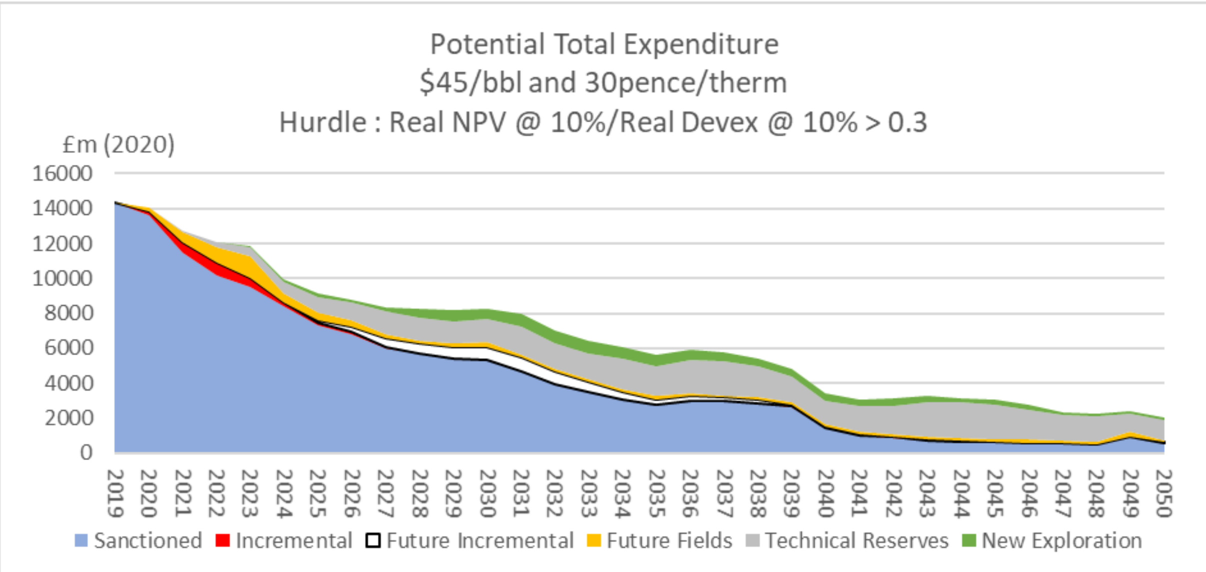
iii. $45 and 30 pence prices (real)

Chart 55



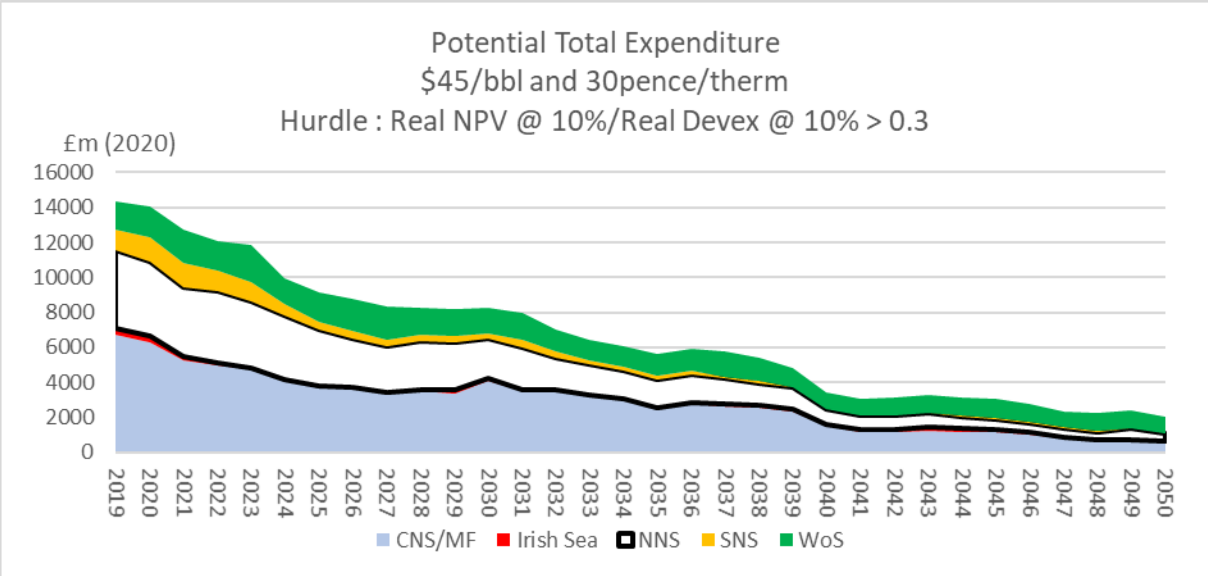
With $45 and 30 pence prices and NPV/I ≥ 0.3 hurdle, total field expenditure (development, operating and decommissioning expenditure) falls from recent levels of just over £14.3 billion to just over £2 billion by 2050. The decline in total expenditure is steady. Operating expenditure constitute by far the largest element.

Chart 56



Total field expenditure is shown in Chart 56 by categories of fields and projects. Sanctioned fields dominate until late in the period, but by 2041 expenditure from technical reserve fields becomes more important.

Chart 57



The contributions of the various geographic areas to total expenditure are shown in Chart 57 where it is seen that the CNS/MF area dominates until 2047 when the WoS area becomes more important.

4 Summary and Conclusions

This study has examined the prospects for activity in the UK Continental Shelf (UKCS) following the dramatic collapse in oil and gas prices. The economic modelling has been undertaken with oil prices of $25, $35 and $45 in real 2020 terms and corresponding gas prices of 20 pence, 25 pence and 30 pence, again in real terms. These prices increase yearly at an inflation rate of 2.5% p.a.. Thus the $25 price in MOD terms becomes $52.4 in 2050, the $35 price becomes $73.4, and the $45 price becomes $94.4. The modelling was undertaken with several large, updated databases covering (1) sanctioned fields, (2) current incremental projects, (3) probable and possible fields, (4) technical reserves, and (5) future discoveries. There are over 400 fields in the category of technical reserves. The investment hurdles employed to assess new developments reflects the current significant capital rationing facing the industry. The modelling and results cover the period 2019-2050. The results highlight the numbers of developments, oil and gas production, development expenditures, operating expenditures, and decommissioning including timing of the activity and the costs involved.

From the charts showing total hydrocarbon production, it is clear that there is a sharp decline in total production over the period especially for the sanctioned fields and the decline is faster at the lowest prices. The decline rate is sharper for gas production than it is for oil production.

For oil at the $25 real price 4,760 million barrels may be economically produced but fields containing 2,251 million barrels (which is more than 32% of all available oil) fail to pass the hurdle.

For gas at the 20 pence real price 2,167 mmboe may be economically produced but 1,432 mmboe (which is almost 40% of all available gas) fail to pass the hurdle.

For total hydrocarbons at the $25 price 7,181 mmboe may be economically produced but 3,963 million barrels (which is more than 35% of all available hydrocarbons) fail to pass the hurdle.

For oil at the $35 real price 5,693 million barrels is potentially produced but 2,430 million barrels (which is almost 30% of all available oil) fail to pass the hurdle.

For gas at the 25 pence real price 2,374 mmboe may be economically produced but 1,922 mmboe (which is almost 45% of all available gas) fail to pass the hurdle.

For total hydrocarbons at the $35 real price 8,334 mmboe may be economically produced but 4,630 million barrels (which is almost 36% of all available hydrocarbons) fail to pass the hurdle.

For oil at the $45 real price 7,120 million barrels may be economically produced but 1,945 million barrels (which is more than 21% of all available oil) fail to pass the hurdle.

For gas at the 30 pence real price 3,065 mmboe may be economically produced but 2,000 mmboe (which is more than 39% of all available gas) fail to pass the hurdle.

For total hydrocarbons at the $45 real price 10,529 mmboe may be economically produced but 4,171 million barrels (which is more than 28% of all available hydrocarbons) fail to pass the hurdle.

At the $25 real price annual development expenditure at 2020 prices falls below £1,000m by 2029. Development expenditure could total £28,934m over the period. At the $35 real price annual development expenditure falls below £1,000m by 2040. Development expenditure could total £35,431m over the period. At the $45 real price annual development expenditure falls below £1,000m by 2039. Development expenditure could total £52,809m over the period.

Operating expenditure falls sharply at all prices. At the $25 real price operating expenditure could total £86,339m over the period but it falls to less than £2,000m per year by 2033. At the $35 real price operating expenditure could total £98,999m over the period but it falls to less than £2,000m per year by 2035. At the $45 real price operating expenditure could total £121,048m over the period but it falls to less than £2,000m per year by 2042.

With lower prices fields become uneconomic earlier, and so decommissioning occurs earlier. Fields cease production before they are fully depleted and the lower the price the higher decommissioning costs are as a percentage of total costs. Brown field investment and near field small discoveries may be lost once a potential host field is decommissioned. With decommissioning cost amounting to more than £37,000m over the period and companies and government facing a cash shortfall it's likely that the industry and government may prefer to delay decommissioning.

This study uses costs as before the effects of the Covid-19 crisis were fully understood. Given the current restrictions on travel and the social distancing rules it is likely that some costs will increase. The future of the UKCS at the oil and gas prices employed in this study depends critically on technological innovations which can significantly enhance productivity.