An Economic Reassessment of the Long Term Prospects for the UKCS: Can Vision 2035 Become a Reality?

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Economic Model

Large field-based financial simulation model incorporating Monte Carlo technique for risk analysis. Model incorporates all evolving taxation arrangements since 1960's. Large field database with following features:

a) Historic production, investment costs (drilling and facilities separately), operating costs (tariffs separately), decommissioning costs. Data from successive OGUK field databases plus other sources (e.g. OGA)

b) Data on sanctioned fields, probable and possible fields and incremental projects all relating to future activity sourced from above field databases. All these incorporate key data and expected phasing through time.

c) Currently numbers of fields are as follows:

    (i) Sanctioned fields   400

    (ii) Incremental projects   90

    (iii) Probable fields   14

    (iv) Possible fields   5

    (v) Technical Reserves   408

d) Separate database of fields classified as technical reserves. Information from private and public sources. Total number currently is 408. Some were formerly in possible category where substantial data exist. For many only data relate to location, type (oil, gas, condensate), block number, and expected size of reserves.

e) Future incremental projects. Currently incremental projects are generally planned to be executed over 3-year period. Future incremental projects are modelled to continue trends in sizes, costs, types, and locations experienced over the last few years. A 5-year running average of past trends employed to make projections. Such data include the considerable numbers of incremental projects where there is no directly attributable income.

New discoveries modelled according to the following procedures:

a) Exploration effort based on combination of (i) recent experience and (ii) prospective oil/gas price behaviour (sustained).

b) Success rates based on combination of (i) experience in recent years and (ii) size of effort. In relation to (ii) it is assumed that higher effort is associated with more discoveries but lower success rate than with medium effort. For whole of UKCS success rates:

Medium Effort = 26.5%

Low Effort = 32.5%

Technological progress maintains these success rates in the period to 2045.

c) The aggregate historic data on (i) exploration effort and (ii) discoveries were disaggregated according to main regions, namely SNS, CNS/MF, NNS, WOS and IS. Regional trends were established for relative exploration effort, discoveries and success rates. This includes splitting according to type (oil, gas and condensate).

Investment Screening Prices

Oil Price (real) $/bbl	Gas Price (real) P/therm
60	55
70	60

Current Tax System

1. Tax on Income
   - $= \text{CT} + \text{SC}$
   - $= 0.3 + 0.1$
   - $= \underline{40\%}$

2. Tax Relief for Investment
   - $= \text{CT} + \text{SC} + \text{IA (SC)}$
   - $= 0.3 + 0.1 + 0.625\,(0.1)$
   - $= \underline{46.25\%}$

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d) Using the above information the Monte Carlo technique was employed to project discoveries in all five regions in the period to 2045.

e) In the Monte Carlo modelling it was assumed that the size distribution of discoveries would be lognormal following historic evidence. The SD was set at 50% of the mean value. The mean size of field decline through the period was again based on recent historic evidence. Monte Carlo modelling was also used to calculate the field development cost (per boe) of fields sanctioned recently plus the probable and possible fields. The SD was assumed to be 20% of the mean.

The numbers of exploration wells (linear trend) in relation to the 2 price cases

	2018	2030	2040	2045
$60, 55p	14	12	10	9
$70, 60p	20	17	15	13

Total Number of Discoveries to 2045	
Medium effort/Lower Success Rate	137
Low Effort/Medium Success Rate	112

Costs of New Discoveries and Technical Reserves

For fields in the category of technical reserves average development costs were set at $5 per boe higher than those for probable and possible fields. Annual operating costs are modelled as a percentage of accumulated development costs with the percentage increasing the smaller the field size. Monte Carlo modelling was employed to determine the distribution of sizes of reserves and field development costs with SD equal to 50% of mean values for reserves and 20% for development costs.

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Operation of Model

The model calculates the post-tax returns on the probable and possible fields, and the new discoveries as they are made. If they pass the investment hurdle they go ahead. The fields in the technical reserves category are then tested. Generally there is no knowledge of the possible timing of any developments in this last category.

Operation of Model

To determine the order in which technical reserves may be developed each field is given a number and the Monte Carlo technique is used to draw randomly from a uniform distribution.

A selected field is then tested against the investment hurdle criterion. If it passes <u>and</u> the total for the year is within the financial and capacity constraint of the industry the development proceeds.

Operation of Model

If it fails the investment hurdle it does not proceed. Generally it was found that in the early years not many technical reserves fields were called on. In later years when the numbers of fields in the probable, possible and new discoveries categories were low more technical reserves were called on. But many failed investment hurdle.

Investment Hurdle Criteria

NPV (post tax) $/ \mathbf{I}$ (pre tax) ≥ 0.3 and NPV $/ \mathbf{I} \geq 0.5$
with discount rate
of 10% in real terms

Results

Number of Fields in Production
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3
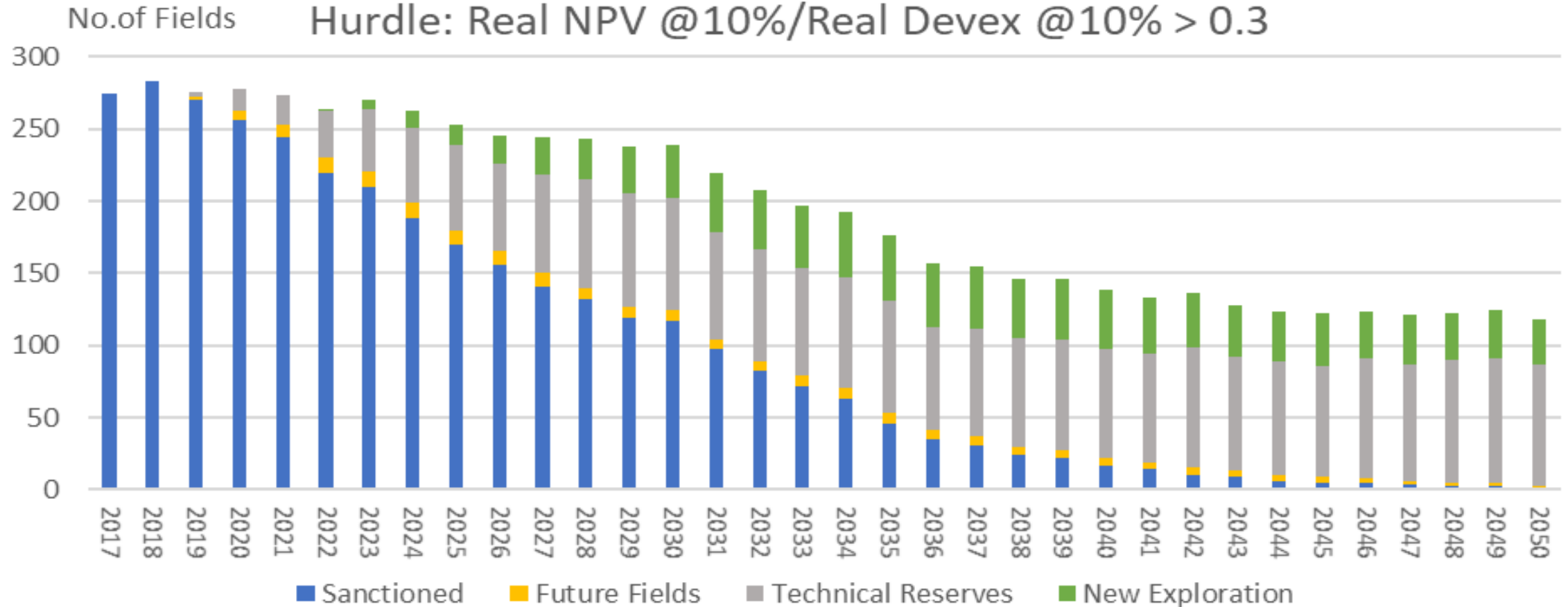
No.of Fields

Legend: ■ Sanctioned ■ Future Fields ■ Technical Reserves ■ New Exploration

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Number of Fields in Production
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3
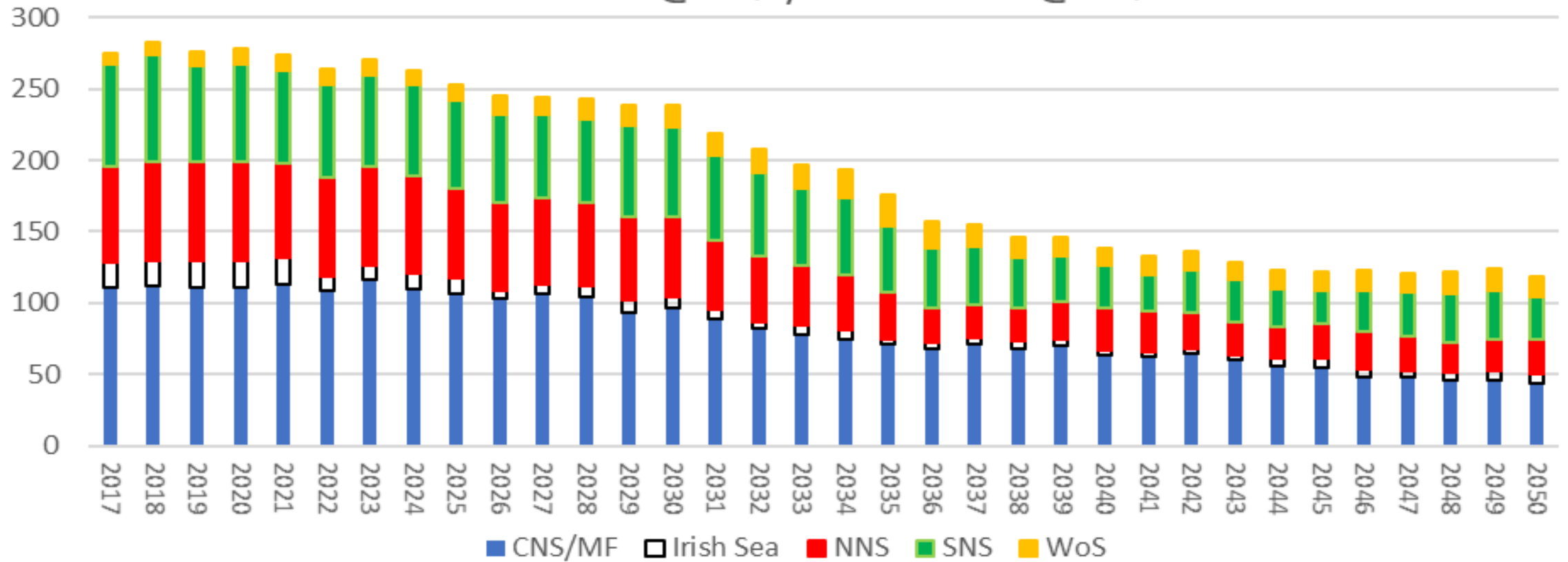
Potential Oil Production
$60/bbl and 55p/therm
Hurdle : Real NPV @ 10% / Real Devex @ 10% > 0.3

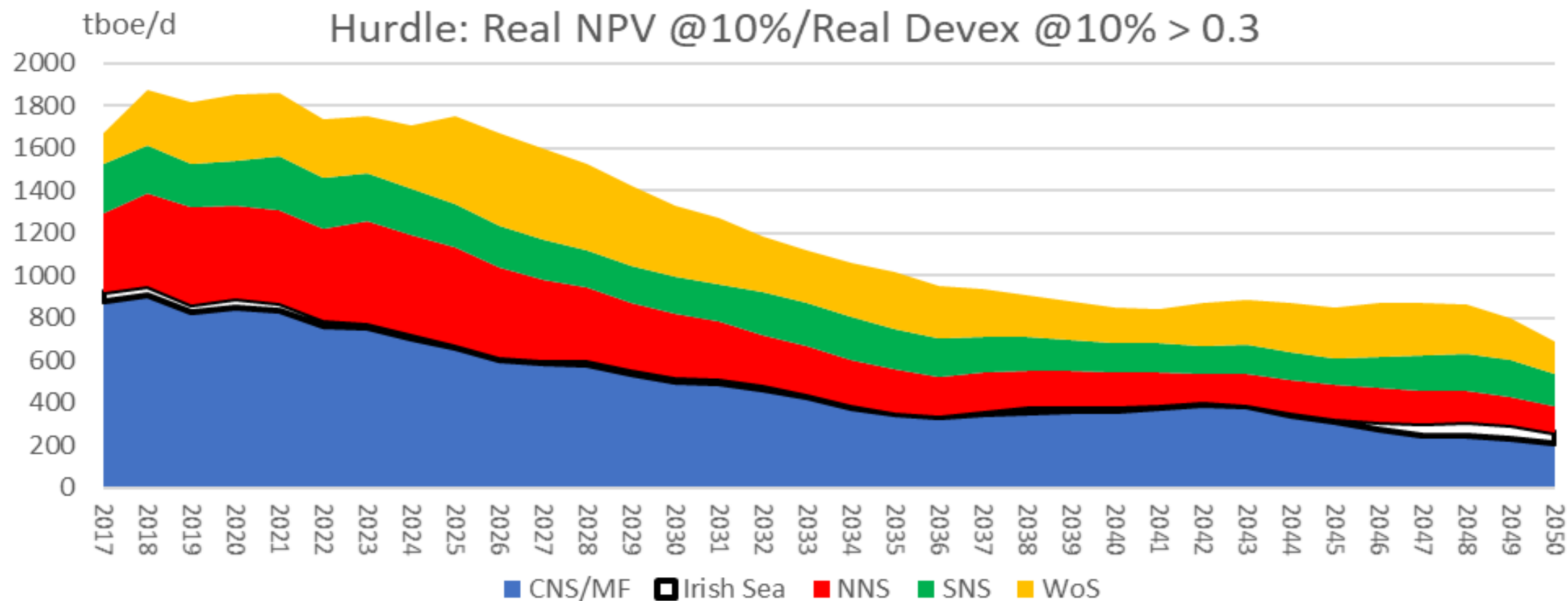Legend: Historic · Sanctioned · Incremental · Future Incremental · Future Fields · Technical Reserves · New Exploration

Potential Gas Production
$60/bbl and 55p/therm
Hurdle : Real NPV @ 10% / Real Devex @ 10% > 0.3

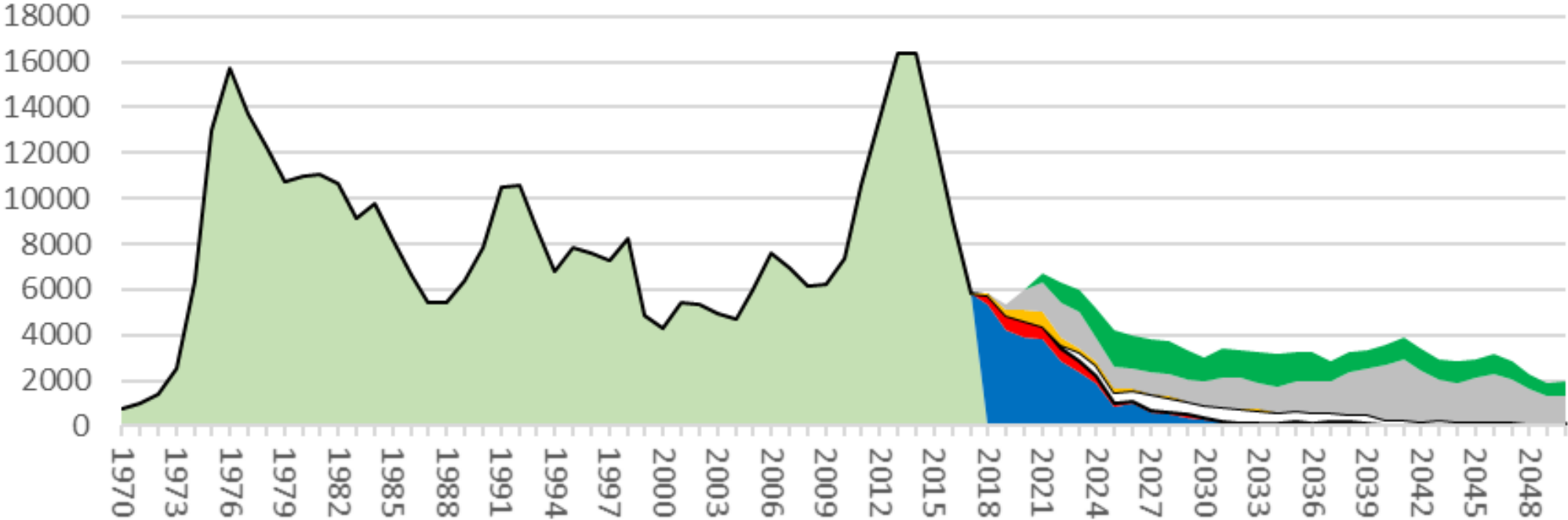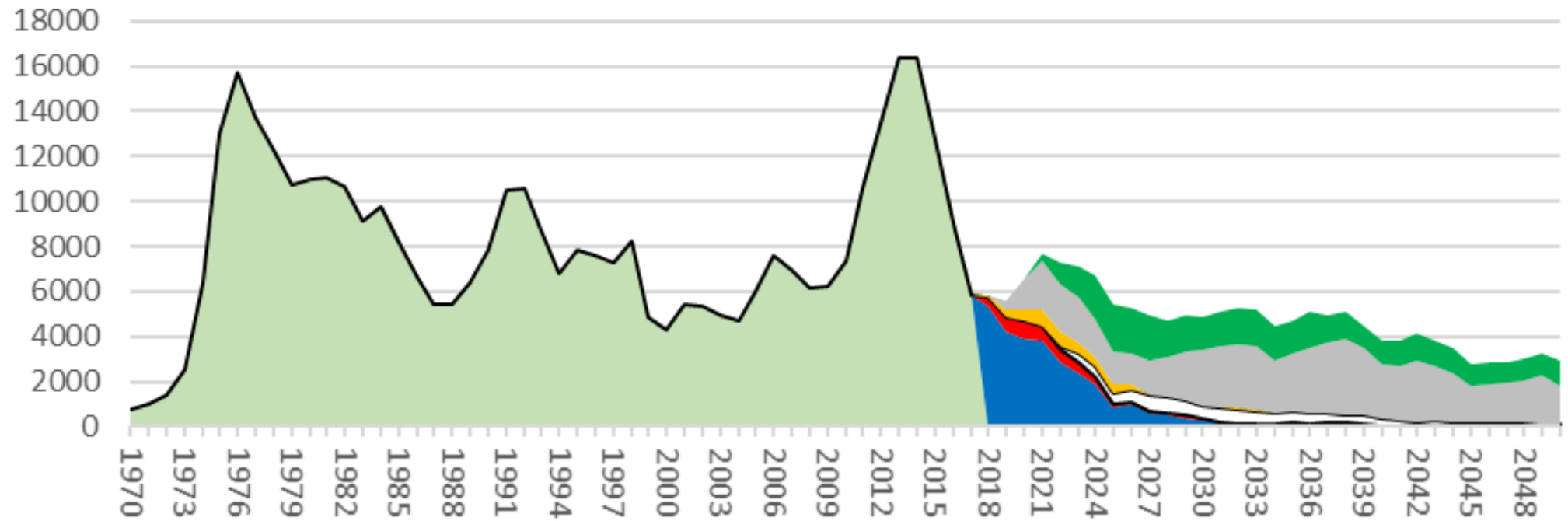Legend: Historic, Sanctioned, Incremental, Future Incremental, Future Fields, Technical Reserves, New Exploration

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Potential Total Hydrocarbon Production
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

tboe/d

Legend: Sanctioned, Incremental, Future Incremental, Future Fields, Technical Reserves, New Exploration

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Potential Total Hydrocarbon Production
$60/bbl and 55p/therm
Hurdle : Real NPV @ 10% / Real Devex @ 10% > 0.3

Legend: Historic | Sanctioned | Incremental | Future Incremental | Future Fields | Technical Reserves | New Exploration
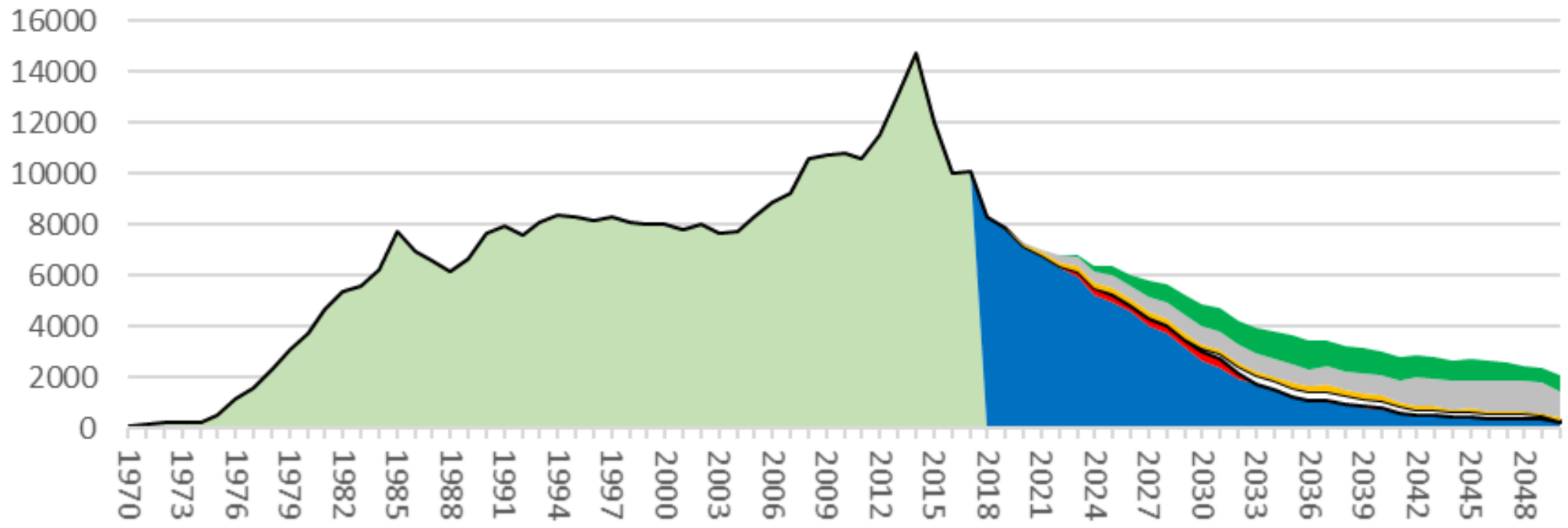
Potential Total Hydrocarbon Production
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

Potential Development Expenditure
$60/bbl and 55p/therm
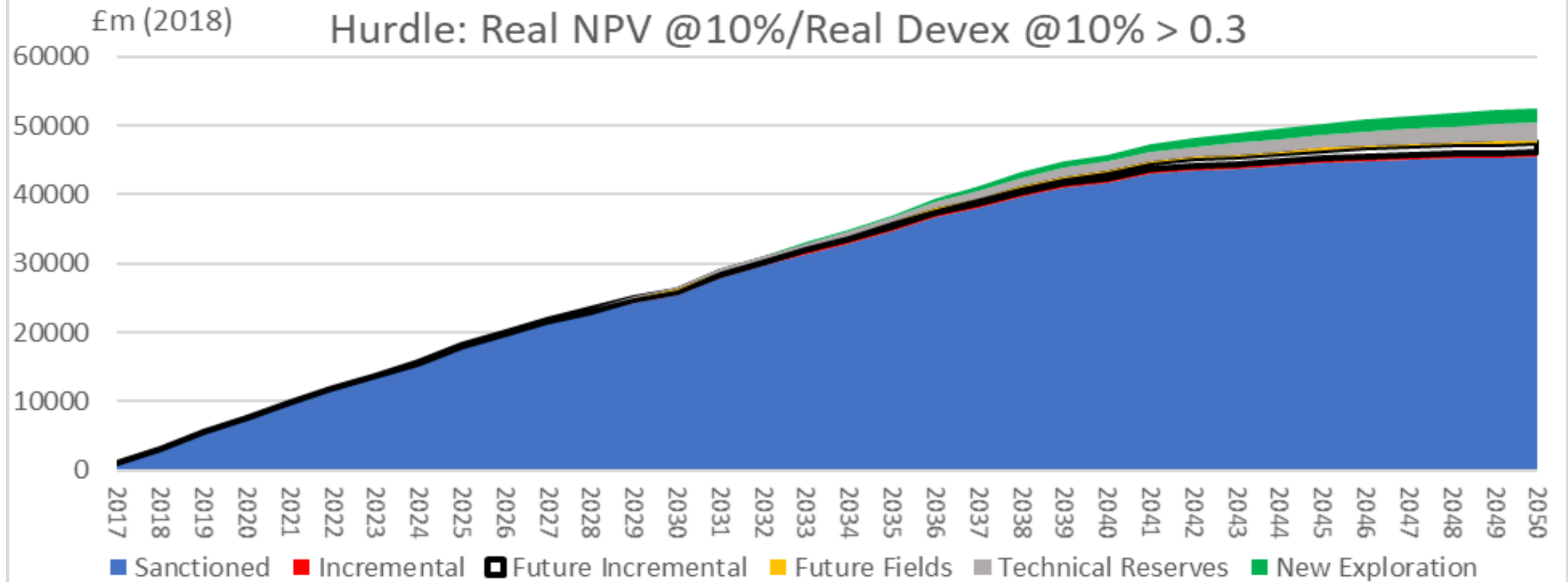Hurdle : Real NPV @ 10% / Real Devex @ 10% > 0.3

£m (2018)

Legend: Historic, Sanctioned, Incremental, Future Incremental, Future Fields, Technical Reserves, New Exploration

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Potential Development Expenditure
$70/bbl and 60p/therm
Hurdle : Real NPV @ 10% / Real Devex @ 10% > 0.3

£m (2018)

Legend: Historic | Sanctioned | Incremental | Future Incremental | Future Fields | Technical Reserves | New Exploration
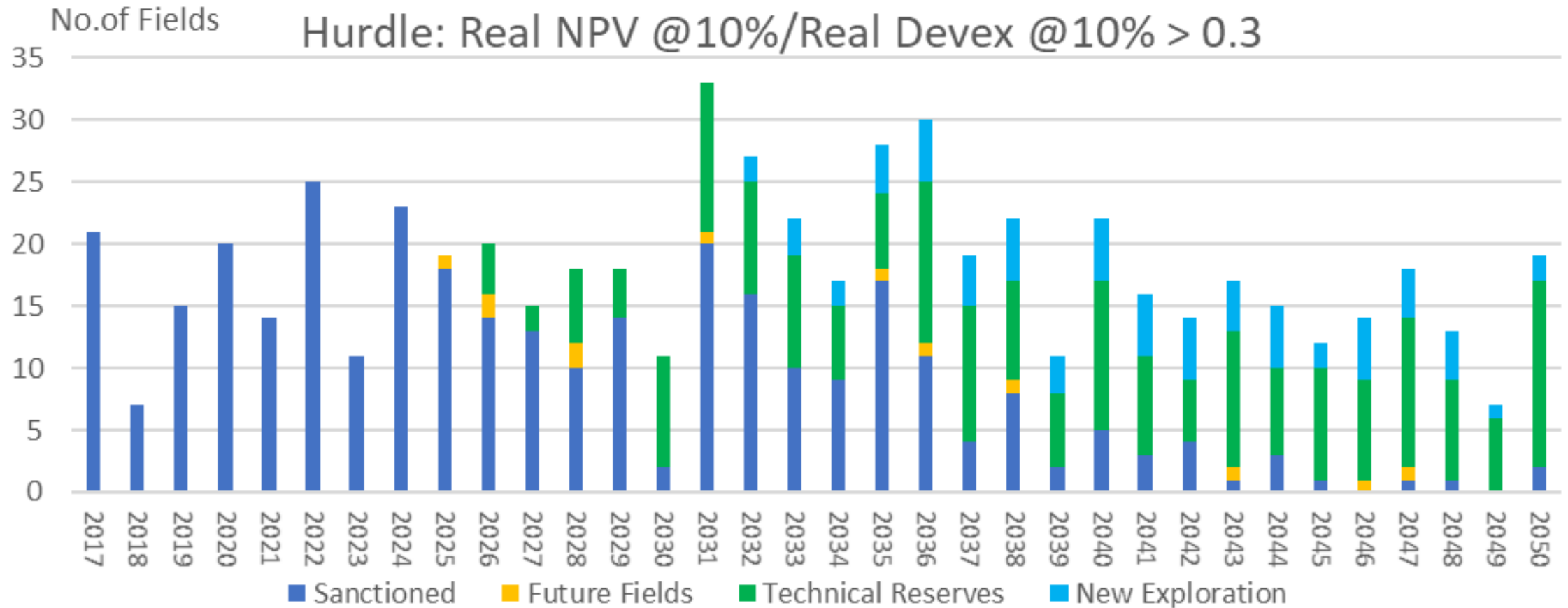
Potential Operating Expenditure
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

£m (2018)

Legend: Sanctioned, Incremental, Future Incremental, Future Fields, Technical Reserves, New Exploration

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Potential Operating Expenditure
$60/bbl and 55p/therm
Hurdle : Real NPV @ 10% / Real Devex @ 10% > 0.3

£m (2018)

Legend: Historic, Sanctioned, Incremental, Future Incremental, Future Fields, Technical Reserves, New Exploration

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Potential Cumulative Decommissioning Expenditure
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

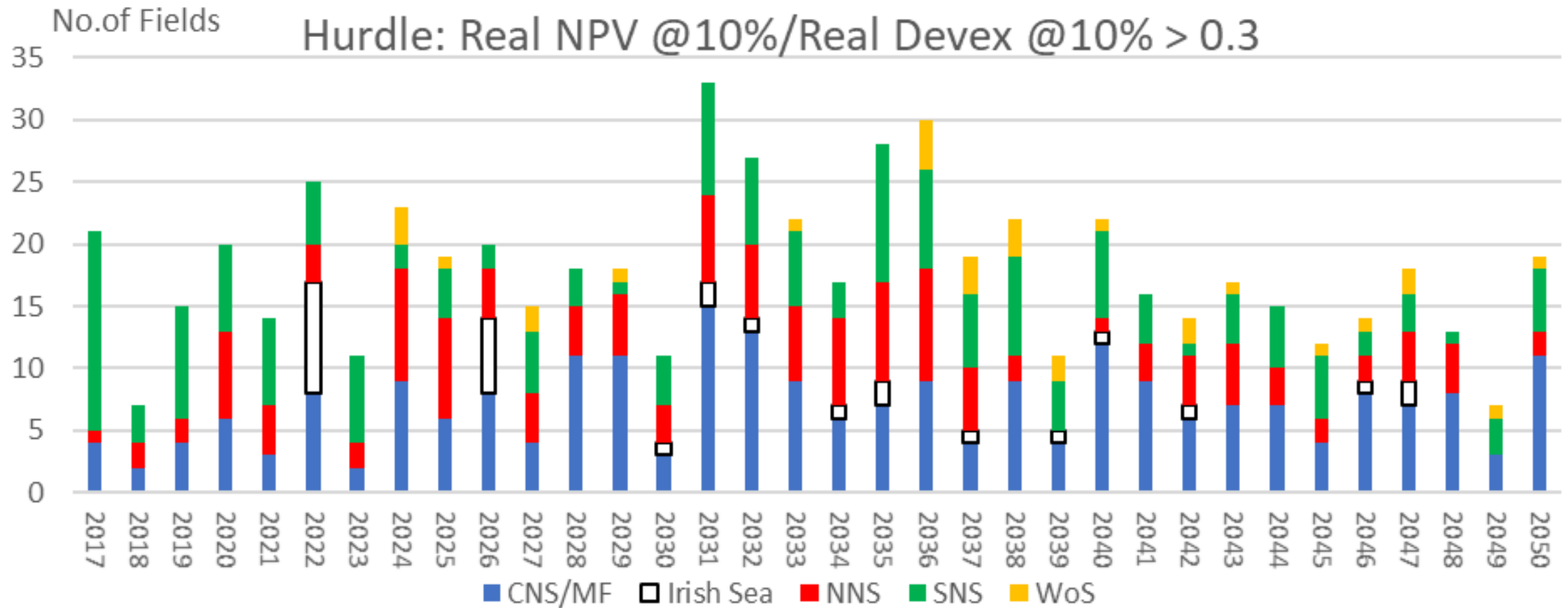Potential Number of Fields Decommissioning
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

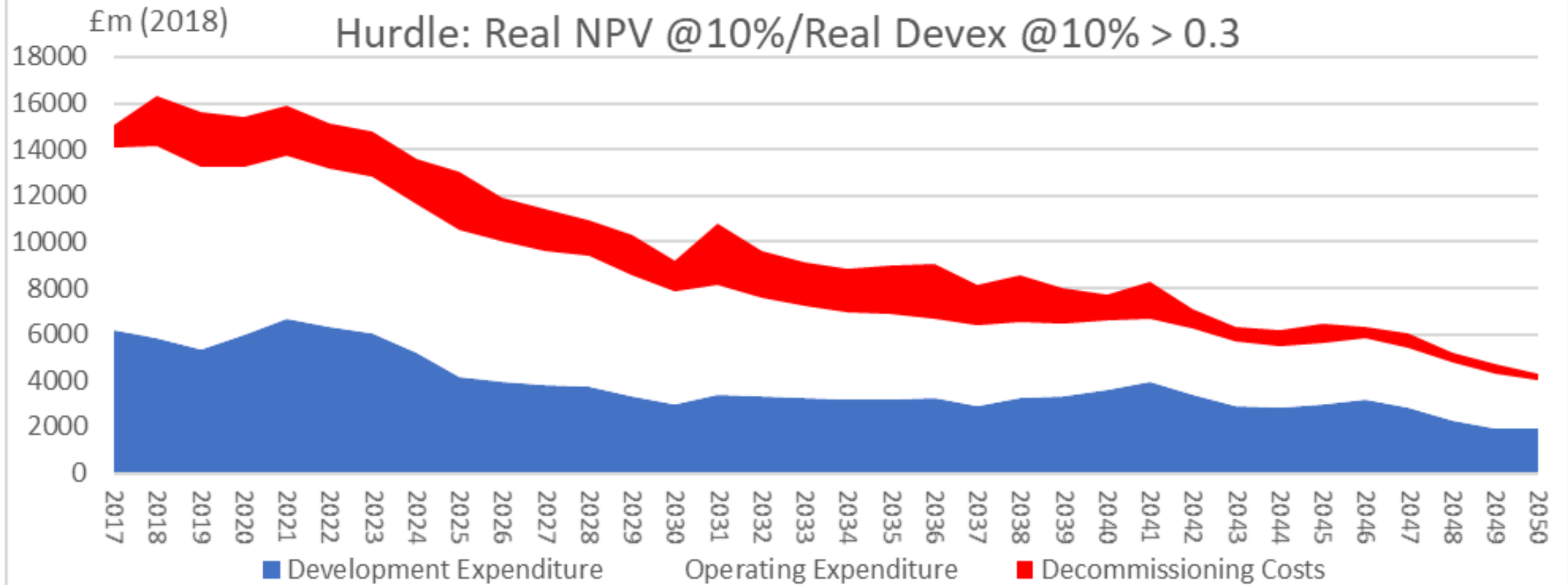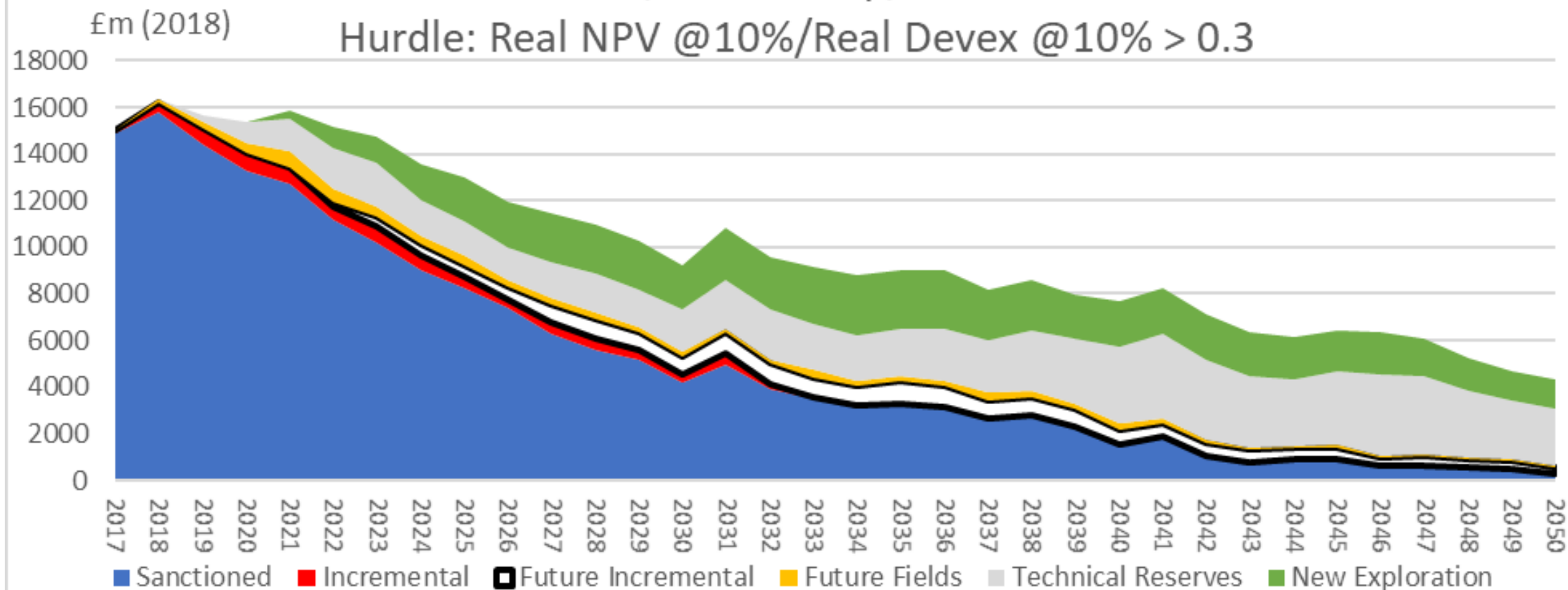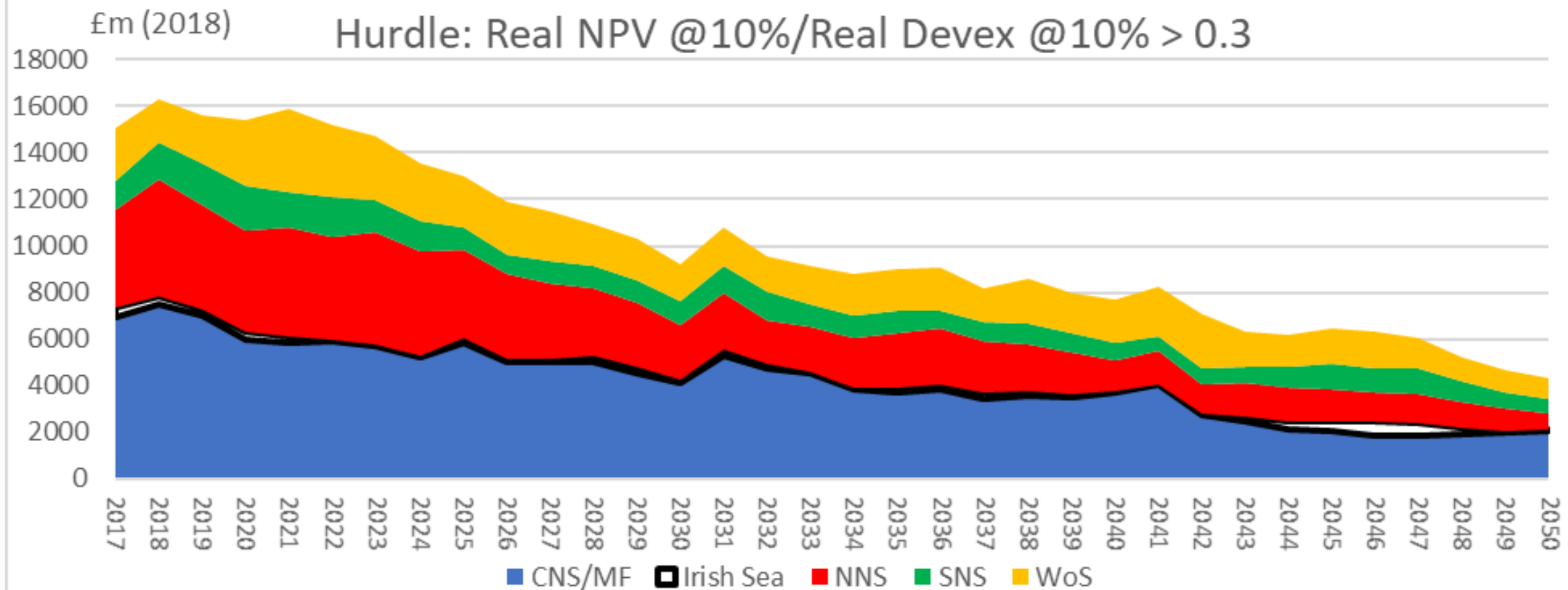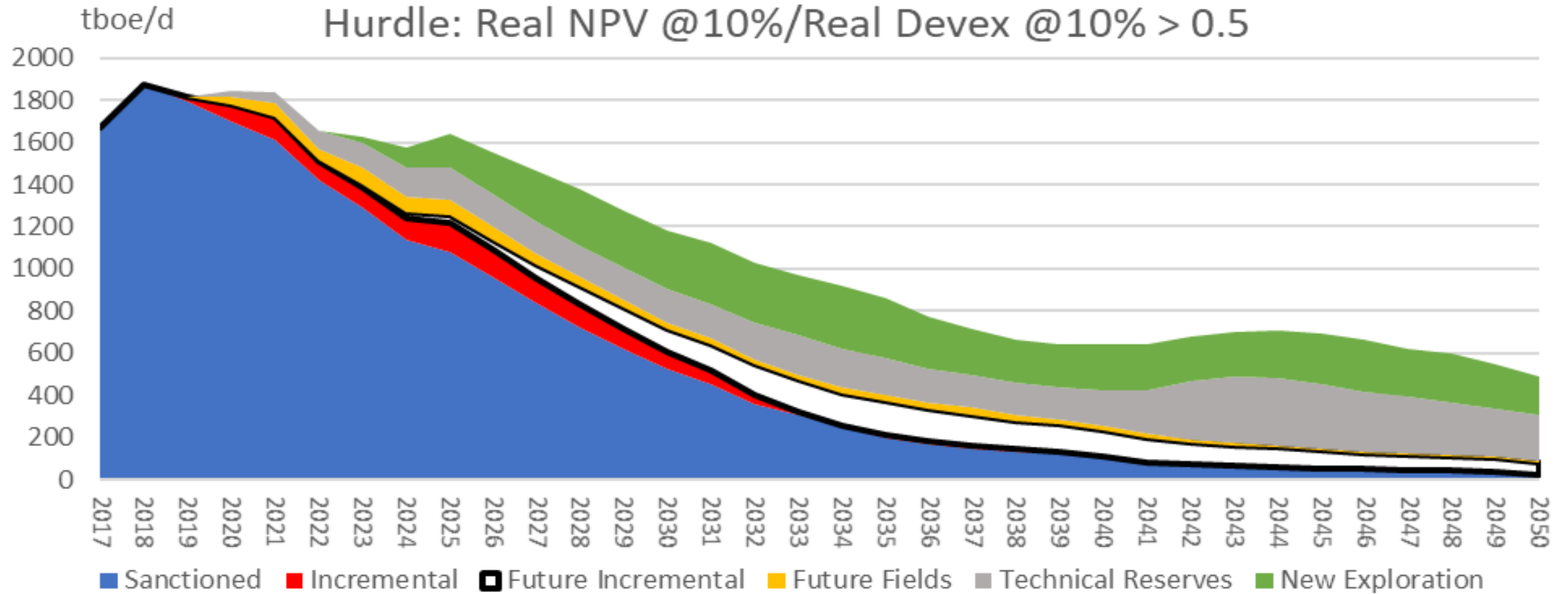Potential Number of Fields Decommissioning
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

No.of Fields

Legend: CNS/MF, Irish Sea, NNS, SNS, WoS

Potential Total Field Expenditure
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

£m (2018)

Legend: Development Expenditure | Operating Expenditure | Decommissioning Costs

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Potential Total Field Expenditure
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

£m (2018)

Legend: Sanctioned, Incremental, Future Incremental, Future Fields, Technical Reserves, New Exploration

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Potential Total Field Expenditure
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.3

£m (2018)
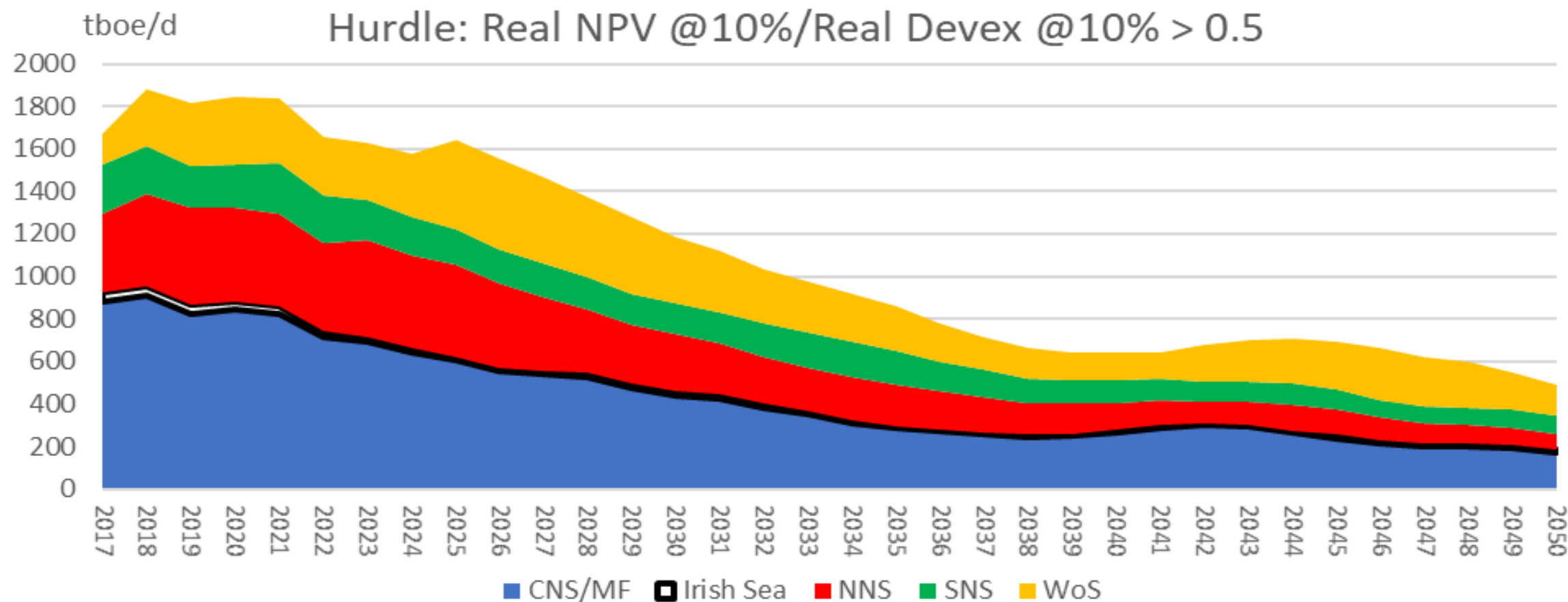
Legend: CNS/MF, Irish Sea, NNS, SNS, WoS

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Potential Total Hydrocarbon Production
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.5

Legend: Sanctioned, Incremental, Future Incremental, Future Fields, Technical Reserves, New Exploration

Potential Total Hydrocarbon Production
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Hurdle: Real NPV @10%/Real Devex @10% > 0.5
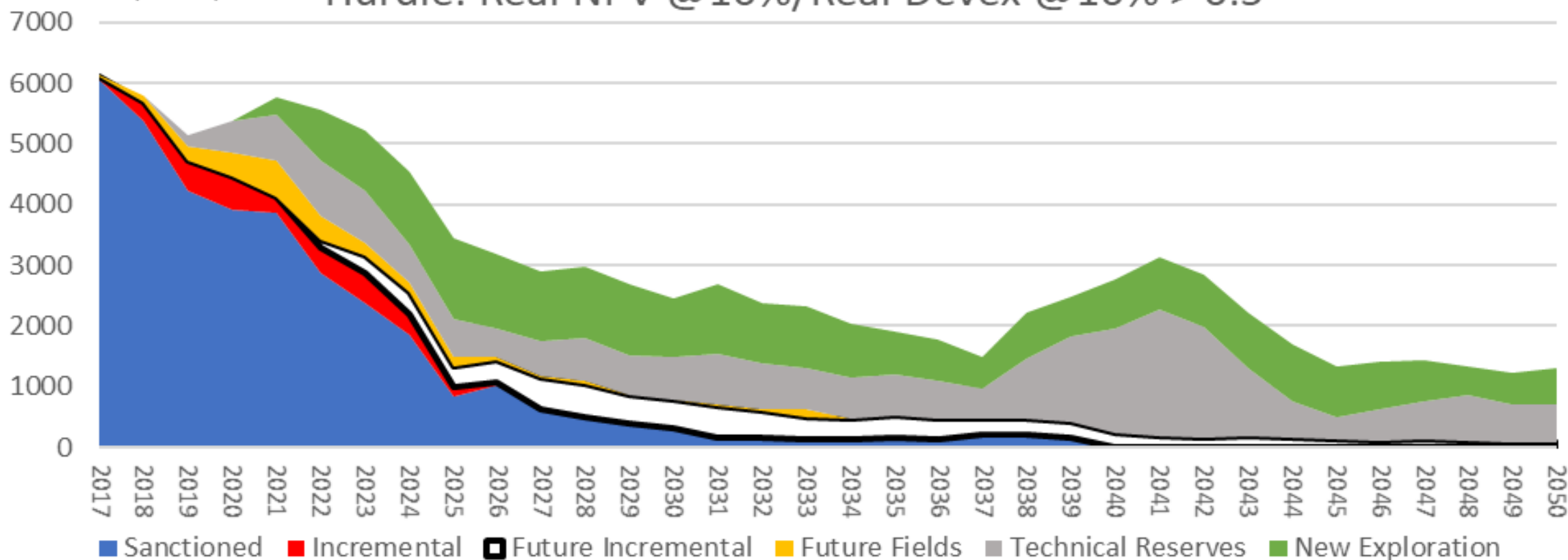
Potential Development Expenditure
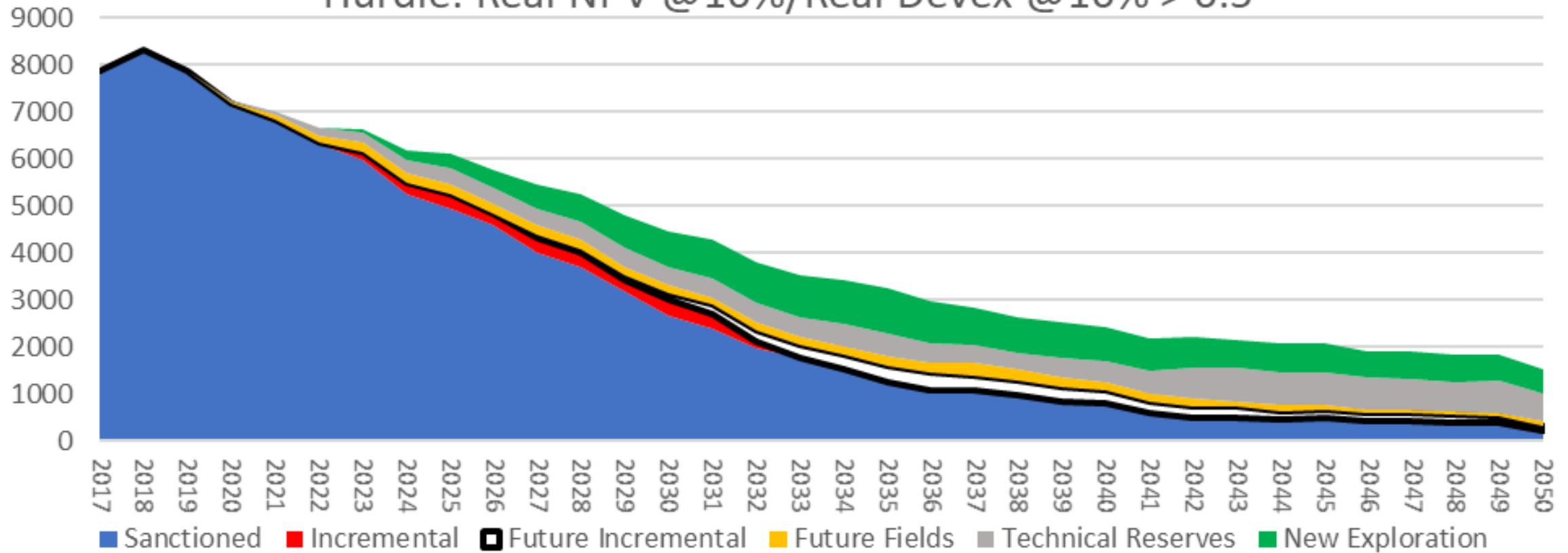$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.5

Potential Operating Expenditure
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.5

Potential Cumulative Decommissioning Expenditure
$60/bbl and 55p/therm
Hurdle: Real NPV @10%/Real Devex @10% > 0.5