The Future of the UK Oil and Gas Industry

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1. The United Kingdom Continental Shelf (UKCS) is a mature petroleum province generally personified by falling average field sizes, declining overall production, reduced exploration prospectivity, and increasing unit costs. The long term historic behaviour of volumes discovered and average size of discovery are shown in Charts 1 and 2 respectively (2P, P50 basis). Currently the average size of a new discovery is around 20 million barrels of oil equivalent, but, as the distribution is lognormal, the most likely size is less than this.

2. The long run behaviour of oil and gas production is shown on Charts 3 and 4. The remarkable increase in oil production in the period 1975 – early 1980’s reflects the development of a few giant fields such as Forties, Brent, Piper and Ninian. The brisk pace of decrease in the period 1999 – 2014 reflects the maturity of the early generation of fields plus the fast decline rate in the generally smaller fields developed in the last 20 years or so. These reach peak or plateau output early in field life and subsequently exhibit a much faster decline rate than the first generation of fields. Incremental investments in the giant fields have moderated their decline rates to a significant extent. A logistic curve best defines the behaviour of production in the large mature fields. The behaviour of gas production exhibits the same basic features, though the lack of a freely functioning gas market in the period before privatisation produced a slower pace of development in that period.
3. The net effect of the above has been a decline of total hydrocarbon production from a peak of around 5.4 mmboe/d in 1999 to around 1.44 mmboe/d in 2014. Encouragingly, this decline has been reversed and for 2017 aggregate production has increased to over 1.7 mmboe/d.

4. An important indicator of activity is wells drilled. In Chart 5 the annual number of exploration wells drilled is shown over a long historic period to provide perspective. A striking feature is the decline in recent years to around 14 per year. Such levels were apparent before the price collapse in late 2014 and so this cannot fully account for the collapse. In comparison to recent experiences, it is seen from Chart 5 that, following the oil price collapse to $10 or so in 1986, the exploration effort was maintained at around levels exceeding 70 wells. In Chart 6 the annual wells count is shown for appraisal and development wells as well as exploration. The decline over the last few years is quite marked.

5. In Chart 7 the numbers of significant discoveries are shown using the UK Government’s definition of significant. Clearly, they have fallen in recent years. This reflects the decline in the exploration effort more than the behaviour of the success rate which is shown in Chart 8. The latter has kept up reasonably well over the longer term though it has fallen very recently. At times of lower oil prices the (reduced) exploration effort is likely to be concentrated on lower-risk prospects.

6. In Chart 9 the expenditures of the industry by major category are highlighted. Key features are the dramatic increase in field development investment in the 1970’s and in the period 2009-2014. The major increase in the latter period should be viewed as exceptional and the sharp decrease since 2014 should be seen within this perspective.
7. The period since 2009 has witnessed dramatic changes in unit operating and development costs. The averages for all of the UKCS are shown in Chart 10. The conspicuous features are the sharp increase in the period 2009-2014 and the large decrease since then. The latter has been achieved with very painful consequences for employment in the industry with total employment (direct, indirect and induced) falling from a peak of nearly 464,000 in 2014 to 302,200 by the end of 2017 according to OGUK estimates.

8. An encouraging feature of the industry’s response to the price collapse has been the increase in production efficiency. This is defined as the ratio of actual production to the maximum efficient rate. This fell continuously from c.84% in 2004 to c.62% in 2012. Since then it has increased yearly to reach 74% in 2017 according to OGA estimates. In turn this has helped to produce the encouraging total production increase in recent years. A note of caution may be appropriate here. Some disquiet has sometimes been expressed that the increase has been accompanied by an increase in the backlog of safety-critical maintenance.

9. The remaining resource base remains substantial. The OGA produces annual estimates and summarises the ultimate remaining recoverable potential as being in the 10-20 billion boe range. This includes not only existing proven and probable reserves, but contingent resources, other discoveries within areas of existing discoveries, and yet-to-find resources. To put the above in perspective around 44 bnboe have been produced since first production in the UKCS in 1967.

10. The present author and Linda Stephen have modelled future activity levels in the UKCS to 2050 employing financial simulation modelling, including the use of the Monte Carlo technique, and a very large field database. The
study also incorporates discoveries from future exploration where the effort, success rates, and distribution of sizes and types of discoveries are based on recent trends. The exercise was conducted separately for the five main regions of the UKCS, namely the SNS, CNS/MF, NNS, W of S, and IS. The sizes, costs, and types of discovery vary across the five regions. The base case modelling was undertaken at oil prices of $60 per barrel and gas prices of 50 pence per therm both in real terms, and so increasing with the general inflation rate\(^1\).

11. Key results in terms of total hydrocarbon production are shown in Chart 11 by categories of fields and incremental projects. Total economic recovery over the period 2017-2050 is nearly 11 bnboe. By far the largest contribution comes from fields already sanctioned. Relatively modest amounts come from probable and possible fields which are currently being examined for development by operators. In the longer term significant amounts come from fields in the category of technical reserves. These are not currently being assessed for development. Further worthwhile contributions come from future discoveries.

12. The results of the modelling by main geographic area are shown in Chart 12. A noticeable feature is the growing importance of production from the W of S region.

13. The field-related expenditures on development, operating and decommissioning costs under the $60, 50 pence scenario are shown in Chart 13. This highlights the importance of already-sanctioned fields in the aggregate profile over the period to 2050. In the longer term it is seen

\(^1\) For details of all the modelling see A.G. Kemp an L. Stephen, “The Prospects for Activity in the UKCS to 2050 under “Lower for Longer” Oil and Gas Price Scenarios, and the Unexploited Potential”, North Sea Study Occasional Paper No. 138 (February 2017), pp. 86, University of Aberdeen Business School, [www.abdn.ac.uk/research/acreef/working-papers/](http://www.abdn.ac.uk/research/acreef/working-papers/)
that there is increased reliance on the development of fields in the categories of technical reserves and future discoveries. Over the period 2017-2050 cumulative development expenditure exceeds £89 billion (at 2017 prices), total operating costs are nearly £124 billion, and total decommissioning costs exceed £54 billion.

14. There is a significant oil price sensitivity to activity levels. With investment decisions based on $50 and 40 pence price (in real terms) cumulative production from 2017 to 2050 is only 8.8 billion boe and total development costs below £64 billion. If oil prices of $70 were employed for investment screening investment and production by 2050 would be considerably higher than the estimates at the $60 price.

15. The above statement reflects in large part the finding that, with the $60 price investment screening price, there remains a large unexploited potential above that displayed in Chart 11. This amounts to 5.6 billion boe contained in 183 fields. Key features of these fields are shown in Chart 14. It is seen that a high proportion of the total has small reserves. The overwhelming majority have potential recoverable reserves less than 50 million boe, with many having less than 10 million boe.

16. In pursuit of MER UK a major challenge for the industry and the OGA, but also for the OGTC and OGIC, is to facilitate the development of many of these fields. Long term activity levels could then be significantly enhanced. The benefits from increased investment, operating expenditures and eventually decommissioning expenditures would enhance the value-added generated not only by the extra production but by the benefits to the supply chain, a high proportion of which is located in Scotland. Increased activity in the UKCS would also help to anchor the oil-related supply chain in Scotland and the rest of the UK for a longer time period.
17. The formation of the OGA with its enhanced regulatory powers, resources, and industry expertise should have a positive effect on activity levels. The enhanced powers include the facilitation of increased investment when bottlenecks are present (for example, relating to infrastructure), and also the ability to impose penalties when activity is not being expeditiously progressed in a manner deemed to be necessary to maximise economic recovery.

18. To encourage exploration the UK Government instigated a scheme whereby seismic information was procured and provided free of charge to the industry for selected areas of the UKCS where it was felt that there was unexploited potential. This type of scheme has been employed in other countries and is essentially treating the data as a public good. Potentially it could reduce the exploration failure rate. Any increased success rate could be reflected in higher appraisal and development work. It is likely that the cost benefit will be of more importance of very small exploration companies.

19. R and D activity relating to the UKCS has been at low levels over the last two decades compared to the 1980’s. In recognition of this, the OGTC was established by the UK and Scottish Governments via the Aberdeen City Deal in early 2017 to inspire, accelerate, and fund technology innovation. Co-funding with industry-led projects has amounted to £37 million. The projects include 10 involving field trials which have often been difficult to arrange in the past. Subjects include asset integrity and well-construction projects.

20. The OGIC was established with Scottish Government funding in 2014 with the aim of supporting and funding early-stage technology innovation from
inception to early prototype stage. The aim of the Centre is to support 45 new projects by the end of 2018.

21. Over the last decade the tax system applicable to the upstream oil and gas sector has been subject to a bewildering number of changes in both upward and downward directions. There are signs that some stability has been reached so far as major issues are concerned, though detailed technical changes are still in progress. The key features of the current arrangements are Ring Fence Corporation Tax (RFCT) at 30%, and Supplementary Charge (SC) at 10%. Capital allowances are on 100% first year basis. There is an investment allowance of 62.5% for SC. Thus the overall tax rate on income is 40% and the relief for investment at 46.25%. For investors not in a tax-paying position there is a Ring Fence Expenditure Supplement (RFES) whereby unrelieved losses can be carried forward at 10% compound interest for specified periods. The operation of the system is such that on small fields little SC may be payable because of the shelter provided by the various allowances. Where tax is payable it obviously affects the materiality of returns which is an issue in an environment of capital rationing and modest field sizes.

22. The results of licensing rounds can provide some insights into industry perceptions of the operating environment. Those for the 30th Round have recently been announced. Key features are the total of 229 blocks or part-blocks being offered to 61 companies. In current circumstances this can be interpreted as reflecting considerable interest among investors. The offers of blocks relate to areas of all the main regions of the UKCS. Given their general maturity this result may be regarded as encouraging. The offers are made to a wide range of players, including the major oil companies and a large number of small companies, involving many new or
recent entrants. It may be that the latter are willing to pursue leads or prospects where the materiality of the discoveries may be quite modest but is still considered acceptable by small players. This view is reinforced by the interesting revelation that 14 licences have been offered to companies which will now proceed to field development planning relating to existing discoveries.

23. The main high level features of the current tax system are generally defensible, though other structural arrangements could enhance investment incentives without a radical overhaul. For example, if the RFCT rate were reduced from 30% to 20% and the SC rate was increased to 20% the headline rate of tax is unchanged at 40% but returns to investment in fields of low profitability could be increased. This is because the value of the Investment Allowance for the SC is increased from 6.25% to 12.5% of the investment. The UK Government may be reluctant to reduce the rate of RFCT even though it is far above the normal corporation tax rate because of possible infringement of the EU state subsidy rules given the 100% first year relief for investment.

24. There is a clear, agreed objective of enhancing economic recovery from the UKCS. The Investment Allowance for SC is available for investment costs relating to incremental projects. But some types of incremental projects are very intensive in what are defined as operating costs for tax purposes. A key example is polymer flood schemes. The purchase costs of the polymers constitute a large element of the total costs of these schemes but are not eligible for the Investment Allowance for SC. It is

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arguable that these costs are fundamentally akin to capital costs when the purpose is highlighted. There is thus an argument in favour of allowing the Investment Allowance for SC to be applicable to the purchase costs of polymers for EOR purposes. A flexible approach to this general issue was adopted in 2009 when the UK Government agreed that the purchase costs of gas for purposes of developing gas storage projects could be regarded as a capital item.

25. Over the last decade or so there have been many asset transactions for mature fields, generally from the major companies to medium or smaller ones, often recent or new entrants. Recently a significant number have related to new entrants financed by private equity. They all plan to extend field lives and thus enhance economic recovery. In principle the tax system should not inhibit such transfers. It has become clear that the tax system is often not neutral in this respect. It can happen that, when the decommissioning costs are taken into account, the remaining prospective return facing the potential buyer is less than the expected return facing the potential seller. This is because the decommissioning tax relief for the buyer is less than that for the seller. Under current rules the seller can carry back losses for RFCT and SC as far as April 2002 whereas the buyer can do so only to the time of the transaction. A study undertaken by the present author confirms that, when the transaction occurs very late in field life, the prospective return to the seller (including decommissioning relief) can exceed that of the seller\(^3\). The UK Government has now agreed in principle that, to deal with this possible impediment to asset transactions, transfer of tax history from the seller to the buyer can be included in the details of the contract. Safeguards to the Government’s tax revenues will be included in

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\(^3\)See A.G. Kemp and L. Stephen, “Can the Transfer of Tax History Enhance Later Field Life Transactions in the UKCS?”, North Sea Study Occasional Paper No. 140, University of Aberdeen Business School, July 2017, pp. 53 [https://www.abdn.ac.uk/research/acreef/working-papers/](https://www.abdn.ac.uk/research/acreef/working-papers/)
the complex legislation due to be introduced in the Finance Bill for 2018. The net result should be an increase in transactions and subsequently in economic recovery.

26. The economic health of the oil-related supply chain should be regarded as an important policy objective for Scotland and the UK as a whole. Maximising the total value-added not only from the offshore production activity but from the related supply chain deserves to be a key high-level objective. The value-added of the supply chain located in Scotland and the UK now depends not only on activity in the UKCS but also on exports. Over the last two decades export activities have become increasingly important to the supply chain. The subsea sector in particular has become very competitive internationally. The success of the Scottish-based supply chain over the years is shown in Chart 15 which shows the development of sales to both domestic and overseas markets. Currently export-related turnover now accounts for around 50% of the total turnover of the Scottish supply chain when sales of overseas subsidiaries are included. Looking forward it is clear that the enhancement of exports will become increasingly important to the economic welfare of the supply chain. In turn it is important that the supply companies remain strongly anchored in Scotland and the UK for a long period ahead. Policies which enhance activity in the UKCS will also enhance the export performance of the companies based here.

27. In conclusion the policies introduced by the UK and Scottish Governments in recent years have the potential to enhance economic recovery from the UKCS and to facilitate further growth of oil-related exports. But the policies discussed above need to be pursued with vigour if they are to make a notable difference. The development and application of new technologies can clearly play a major role. Enhanced collaboration with effective intervention by the OGA can also play a major role.
sympathetic tax system which incorporates the maximisation of economic recovery and the maximisation of the value-added from the associated supply chain as objectives can also make a large difference to the future of the whole sector.

Chart 1

Resource Discovery on UKCS, 1965 - 2009
Chart 2

Average Discovery Size on UKCS, 1965 - 2009

Chart 3

Historic UKCS Oil Production by Production Start Date
Chart 4

Historic UKCS Gas Production by Production Start Date

Chart 5

Exploration Wells Drilled in UKCS 1964-2017

Source: OGA
Chart 6

Total Wells Drilled in UKCS 1964-2017

Source: OGA

Chart 7

Significant Discoveries

Source: OGA
Chart 8

Success rate (%)

Chart 9

Source: OGA

Source: OGA
Chart 10

Unit Cost ($/boe, MOD)

Source: OGUK

Chart 11

Potential Total Hydrocarbon Production
$60/bbl and 50p/therm
Hurdle: Real NPV @ 10%/Real Devex @ 10% > 0.3

Source: OGUK
Chart 14

Undeveloped Fields
$60/bbl and 50p/therm
Hurdle: Real NPV @ 10% / Real Devex @ 10% > 0.3

No. of Fields

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Total of 183 fields unexploited

Chart 15

Scottish Oil and Gas Supply Chain
International and UK Market Sales 1997-2016, £m (MoD)
(including overseas sales of Scottish subsidiaries)

Source: SE, AGCC, SCDI