Written evidence submitted by Professor Roy Thompson (OGI0006)

Scottish Affairs Committee The Future of the Oil and Gas Industry Inquiry - Written Evidence submitted by Professor Roy Thompson, FRSE, School of GeoSciences, University of Edinburgh.

Executive Summary

- A key gap in knowledge needs to be closed in order for the Inquiry’s five primary questions to be answered. The crucial point underpinning the whole issue is “What is our best estimate of UK oil and gas reserves?” Estimates currently vary between 4.8 and 80 billion barrels of oil equivalent (bboe). This discrepancy corresponds to a difference to Scotland’s economy of about $4 trillion – assuming approximately 90% of the oil lies in Scottish waters and commands an average price of $90 per barrel.
- The high estimates of reserves arise as a result of inconsistent reporting across the industry. Consequently public officials often do not have the facts to hand to address what the media report and to counter unsubstantiated opinions.
- Research at the University of Edinburgh suggests the UK’s oil and gas industry is entering the last decade of significant production owing to a depleting reserve base (Fig 1), caused by an absence of recent, large discoveries, too few exploration wells and the significant number of fields approaching abandonment.
- The University analysis shows that discoveries have consistently lagged behind output since the point of peak oil recovery in the late 1990s. The research finds that gas reserves are declining particularly briskly (Fig 1).
- It is recommended that in order to determine the likely size of the UK’s ultimately recoverable oil and gas reserves a poll of stakeholders be conducted, asking each to provide a quantitative, evidence-based estimate of economically viable production potential.

Introduction

1. Deep sedimentary basins on our continental shelf have provided the UK with substantial energy and income for decades. However, since 1999 hydrocarbon
production levels have been falling (Fig 1). Such a fall is inevitable in any mature oil province. This fall coupled with the recent drop in oil price meant UK production was hit particularly hard. Nevertheless, the UK offshore realm remains a highly valuable asset and optimism abounds, despite uncertainty about future oil prices. The wide-ranging series of recommendations proposed in the Wood Review (2014) have set the scene for modernisation in the new, tough, environment facing the oil and gas sector. And yet, after decades of work, no consensus has emerged over the important question of how long UK oil and gas is likely to last.

**Question 1 - What challenges does Scotland’s oil and gas industry face, and how can they be addressed?**

2. A broad spectrum of opinions can be anticipated to be submitted to the Committee on how best to meet the challenges in the oil and gas sector. A crucial consideration underpinning any assessment of the answers to Question 1 has to be a determination of the proven and ultimate potential recovery from the UK continental shelf. Currently there is a diverse range of views from industry experts.

**Challenges in estimating remaining economic potential**

3. Following her appointment as the UK Government’s Energy and Clean Growth Minister, Claire Perry recently declared “We want to squeeze every last drop at the right economic price out of the North Sea basin”, adding: “I think we’ve underestimated what we still have in terms of reserves … I understand that this will be a highly productive industry for many years to come.” Good, firm statements, but how should the likely reserves be assessed?

4. Evaluation, in principle, is straightforward. Operators provide and regularly update the regulator with detailed assessments of their individual fields’ reserves (326 producing fields in 2018). HM Treasury keeps a close watch on production and likely field abandonments. The well-known reserves-to-production ratio (R/P) provides a down-to-earth indicator of reserve durability, with the proviso that production will taper off rather than simply reaching an abrupt end (cf. Fig 1).

5. A useful refinement is to adjust the R/P ratio to take into account future changes, e.g. re-categorisation of reserve if new technical information becomes available or economic circumstances change. In a young basin (left-hand side of Fig 1) reserves grow. But in a mature basin (top-right of Fig 1) the opposite happens – they fall (cf. Hannon Westwood Insight Reports).

6. Long-term downward trends, such as those caused by stranded reserves being written off, tend to be under-reported in the news among more newsworthy items involving fresh discoveries.

7. Consequently many members of the public may not fully appreciate the unfortunate situation that declared reserves in mature basins often do not live up to expectations.

8. My best estimate for UK reserves is 5 bboe at end 2018 and $90/barrel (~10% of the 45 bboe produced to date). Thus significant production of offshore gas, and conceivably oil, could dissipate within a decade.

9. Other longevity estimates are in good agreement. BP (end 2016) tabulate R/P as 5 years for UK gas, 6.9 years for oil. Similarly the International Energy Agency predict “There is a risk of sharp decline in the not too distant future”. DUKES® put UK reserves (adjusted to end 2018) as oil 3.4 and gas 1.4 bboe.

10. However, most media reports are much more bullish. Here are six examples: when commenting, in the press, on Prof. Thompson’s estimate, a Scottish Government spokeswoman said: “The basin has up to 20 billion barrels remaining”. Similarly Deirdre Michie, chief executive of Oil & Gas UK (OGUK), rejoined: “some of the [current] largest fields will still be producing in 50 years”. Prof. Kemp, Aberdeen University, was also reported as refuting the findings by: “insisting that … there were
still around 11 billion barrels left". Other more recent pronouncements come from the Scottish Minister for Business, Innovation and Energy, Paul Wheelhouse: “Scotland’s oil and gas industry has a bright future for decades to come”, and from Alex Salmond, on a recent visit to Dundee: “20 billion barrels, 30 billion barrels’ – it’s a lot more than that actually, so there’s another 30 to 40 years or more.” Most recently Colin Clark (MP) interprets Vision 2035 to suggest: “what there could be” is 80 billion barrels. 11

11. The high estimates arise because they involve inconsistent, inaccurate or unsubstantiated reporting and because public officials have lacked the facts to address what the media reported. In short they are not based on good petroleum geology or on feasible estimates of commercially recoverable oil resources.

12. Consequently the Scottish public cannot easily know the extent to which oil and gas funds will be available in the medium- to long-term to pay for future visions presented to them.

13. To resolve this dilemma, namely – how large are our reserves? - I recommend that a small team (10 to 15 people) of experts, drawn from the oil majors most active offshore, also BGS, OGA, OGUK, market analysts and academia, meet as a working group to compare estimation techniques and collate results. The output would be an agreed set of resource ranges on which socio-economic benefits could be tested.

**Question 2 - How can the economic return from Scotland’s oil and gas reserves be maximised?**

14. Central to resolving this question is a dilemma of the Scottish Government’s own making, namely Scotland’s energy conundrum. While not answering the question directly, the conundrum is worth exploring briefly.

**Scotland’s energy conundrum**

15. The Minister for Energy and Clean Growth, Clair Perry, wants to maximise fossil fuel recovery, while on the other hand UK and Scottish Governments are setting exacting, legally binding, carbon reduction targets. Mark Ruskell MSP, Climate Change spokesperson for the Scottish Greens, has highlighted the conundrum. He notes how Scotland’s new Climate Change Bill, with its ambitious 90% target for emissions reduction by 2050, provides "an opportunity for all parties in Holyrood to agree tougher [carbon] targets", adding: “the Bill is a chance to address the reality we face as a society … climate emissions must be seriously reduced [but then] that has to mean leaving oil and gas in the ground”.

16. The UK oil and gas industry can however support clean growth plans and the creation of jobs in low-carbon industries. This can be achieved both through the development of carbon capture and storage capacity using depleted oil and gas reservoirs, and through the creation of energy storage facilities, at utility scale. The latter would use compressed air, or hydrogen, in geological structures such as salt domes or existing anticlinal traps.

17. Scotland’s energy conundrum forces a wider perspective than just hydrocarbon production alone. The British Geological Survey (BGS) should be used more fully to provide a broader perspective involving security of energy supply alongside reduced carbon emissions, maintenance of a suitable mix of future energy resources, and an awareness of novel opportunities (such as low-temperature geothermal energy from our extensive tectonic basins).

**Question 3 - What action is the UK Government taking to support the long-term future of the oil and gas industry in Scotland, and how effective has this been?**

**Data stewardship**
18. Following on from the Wood Review’s recommendation that “already existing petroleum-related geoscience information in the UK is better utilised”, and especially following the establishment of the Oil and Gas Authority (OGA), more co-operation and sharing of data has indeed been fostered.

19. However, there is one area of data stewardship where recent action has not helped. It is disappointing that the new regulator has chosen to discontinue updating the longstanding DECC spreadsheet “Complete production history for oil fields (from 1975)”. More preferable would have been enhanced reportage following, for example, the style and inclusiveness of the Danish Energy Agency’s reporting (1985 onwards) of reserve status. Here low, medium and high values of recoverable hydrocarbon are released for each field in their annual reports.

**Improved and accessible infrastructure**

20. Improved, high-grade infrastructure (e.g., harbour facilities; expanded quaysides; maintenance of critical, offshore production hubs) is an important factor in aiding the productivity and extending the longevity of the oil sector. Nevertheless, not all infrastructure will generate an equal payoff, or indeed any payoff. Poor, inappropriate infrastructure can be a drag on a country’s productivity growth. It is important to prioritise and evaluate investments appropriately. Alternative opportunities and courses of action abound. (See #15 to 17 above).

21. OGA has been very successful at getting people to sit down and work together, although there is a case that even more inclusivity could have been forged so as to involve the whole community. A particular accomplishment has been the encouragement of greater collaboration between operators, with the establishment of production clusters, with easier access to shared pipe-lines. This pipe-line success story will support both new ventures and redeveloped fields.

**Exploration and Drilling**

22. Fostering additional high-quality geophysical surveying and analysis, along with follow-up drilling, will be absolutely key to keeping the oil and gas sector profitable. Past action has not been effective as exploration and drilling are currently far too low to maintain future production. OGA’s last update (May 2018) tabulates only one exploration and no appraisal wells in 2018Q1 across all six UKCS geographical areas. This dismal, all-time low compares with the 157 exploration and 67 appraisal wells drilled in 1990 alone – a development expenditure that ushered in the peak oil and gas production of the late 1990s.

23. The recently announced 30th round saw a large number of bids, but only a small number of committed exploration wells, suggesting that future exploration and appraisal drilling activity will remain weak (10 wells / year?).

24. There has been speculation that frontier areas of the UKCS (Rockall, East Shetland Platform, Orcadian Basin, Wyville-Thomson Ridge) might yield substantial new discoveries. However the industry has been exploring these basins for many years so there is only a low probability that major new provinces can open up in these areas.

25. An opportunity exists (beyond OGA’s National Data Repository initiative) for reprocessed seismic data to be formally made more available. And for these critical data to feed into an improved geotechnical model of offshore physical properties that could help guide offshore drilling developments - through enhanced data reliability - and be used more widely. Current data release is via licence fees and is covered by restrictions on data sharing. A full free-to-users 3D model using the best released seismic- and well-data could underpin the development of new oil and gas exploration, encourage the development of carbon (and other gas) storage, and foster geothermal (and other marine renewable) energy production. This is an area for collaboration with BGS.
Question 4 - How well do the different stakeholders (UK Government, Scottish Government, companies) work together? Does the current devolution settlement enable all stakeholders to support the sector?

No comments on this question as beyond my knowledge.

Question 5 - How can Scotland maximise its expertise, technology and infrastructure in oil and gas industry to secure the industry’s future as reserves decline? What support is needed from Government to maximise these opportunities?

26. The answer to Question 5 on maximising opportunities, and the level of support that HM Treasury should provide, once again critically depends on the hydrocarbon volumes achievable. It is impossible to understand the future value of the oil business and its long-term development without ensuring a consistent and agreed range of outcomes.

27. There is great scope for technological transfer to opportunities abroad. For example transfer of UK expertise to sedimentary basins elsewhere, to deep-sea mining, to CO₂ storage. Trade missions should more strongly promote Scottish off-shore know-how, subsea technologies and downstream manufacturing capabilities.

28. Tax and regulatory regimes can have significant impacts. Margins of exploration, development timing, deployment of enhanced recovery techniques, overall recovery, abandonment decisions and finally, via a complex set of interrelated investment problems, government revenue are affected. Maximizing government revenue is very different to maximizing total production. The OGA’s Maximising Economic Recovery Strategy for the UK (MER UK), which came into force in 2016, aims to address these tensions. As recognised in the UK House of Commons debate on 19 April 2018, and as supported by the trade union Unite, the MER UK Strategy should continue to be strongly backed (especially its ‘Technology Strategy’ vision) as it drives forward change in the UK oil and gas industry. One example of where engineering research is having a major impact is in reducing the cost of well abandonment, which otherwise is a major cost in decommissioning. This will be an exportable technology as well as helping improve the chances of marginal field development in home waters.

29. Fiscal impacts and taxation of upstream oil and gas activities have been widely analysed for exploration and development in young, lively basins but much less so for mature basins such as the UKCS. Scotland’s legacy after over half a century of offshore exploration includes an expansive range of marginal fields. Indeed Westwood lists 496 unsanctioned discoveries on the UKCS, but perhaps only 9% of these are likely to become commercial without much stronger fiscal, or oil-price, stimulus. Herein lies much of the reason for the wide assortment of longevity estimates (detailed in #2 to 13). Output from the proposed working group would substantially help narrow the range by feeding directly into an improved understanding of the effect of the tax system on investment incentives in a mature basin.

30. My personal view is that gas in particular is in rapid decline (Fig 1) and that Scotland urgently needs a bold energy-transition plan. Instead of trusting to dwindling fossil fuel reserves and fracking we must act now and drive the necessary shift to a clean economy.

31. The gas reserves problem is particularly cogent because it impacts directly on security of supply – the reason being that gas is less easily transported from far-away fields and less easily stored than oil. Britain’s vulnerability, through the fragility of its gas supply, was exposed earlier in the year when extreme weather generated a huge, unseasonal, demand for energy and surging prices. Wholesale gas prices for same-day delivery (on Feb 28) rose by 400 per cent. Moreover, in a post-Brexit world, the UK cannot expect
to be buttressed by the EU energy “solidarity principle” which requires member states
to help one another in an emergency.

32. Both the Scottish and UK Governments need to place a greater emphasis on
renewables, carbon capture, energy storage and improved insulation and energy
efficiencies.

The future

33. Scotland’s onshore geology makes it extremely unlikely that a vibrant fracking industry
will ever become established\textsuperscript{14}, whereas in England deeper, more brittle, carbon-rich
shales may well allow future recovery of unconventional hydrocarbons, albeit probably
only on a local scale\textsuperscript{15}. So any outlook for the oil and gas industry in Scotland must
focus on the offshore.

34. Our offshore sector undoubtedly lies at a crossroads, making this Inquiry acutely timely.
Before the best way ahead can be planned, much greater clarity is needed, especially
on the resource portfolio

35. Options include: first, improved infrastructure and revised fiscal measures to facilitate
the recovery of ‘every last drop of oil’. Secondly, assisting industry with knowledge
transfer, developing new technologies and promoting transparency and stronger
collaboration thereby promoting the delivery of cost-effective decommissioning. Thirdly,
forging strongly ahead with clean growth is also possible.

36. But which route should Scotland follow? Government funding will not be sufficient for all
three. The time to decide is now.

Submittee’s background

37. Prof. Thompson is an Emeritus Professor and Senior Honorary Professorial Fellow at
the University of Edinburgh and a Fellow of the Royal Society of Edinburgh. Previously
he was Professor of Environmental Geophysics. He specialises in data- and time-series
analysis. A particular focus of his research is the potential for fracking in the UK,
resource estimation, and the impacts and economics of climate change. He receives no
funding from industry – neither from the oil and gas nor the renewable sectors. His
reason for submitting evidence, in a personal capacity, is simply his strong belief that
the central tenet of the Inquiry – the future of the oil and gas industry – is of
fundamental importance to Scotland’s well-being.

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\textsuperscript{2} https://www.commonspace.scot/articles/12254/uk-energy-minister-attacked-north-sea-oil-comments
\textsuperscript{3} https://www.westwoodenergy.com/news/ Why so many oil and gas projects fail to produce as planned.
\textsuperscript{4} http://edinburghgeol soc.org/eg_pdf s/edinburgh-geologist-62.pdf Can fracking, for gas and oil, power the
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\textsuperscript{7} http://www.heralds cotland.com/news/15545169.North_Sea_oil_and_gas_production_will_end_within_next_decade_academics_have_war/
\textsuperscript{8} https://www.pressreader.com/uk/the-press-and-journal-aberdeen/20170920/281998967635760
\textsuperscript{9} https://www.energylivenews.com/2017/06/16/scottish-oil-gas-gets-international-vote-of-confidence/
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https://www.ft.com/content/de6b2f96-1ca3-11e8-956a-43db76e69936
\textsuperscript{14} https://www.thetimes.co.uk/article/scotland-s-geology-will-not-allow-for-successful-fracking-says-academic-
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