Thursday, 10 December 2015

Fossil Fuel Supply Curves

Tender Reference Number: TRN 1089/10/2015A

Following our discussions Wood Mackenzie is pleased to submit this proposal to the Department of Energy and Climate Change (DECC) in relation to provision of supply curves for fossil fuels (for oil, gas and coal) as key inputs to DECC's long term fossil fuel cost of supply projections to be updated in 2016.

Supply curves provided will be sufficient to address the supply side of low, high and base case projections for long term fossil fuel prices and provide a plausible and evidence-based range and the inherent uncertainty. Overall, it is envisaged that this project will primarily comprise analysis of existing data and modelling that the contractor has collected and developed.

Our Understanding of your requirements

The Department of Energy and Climate Change ("DECC") wishes to appoint a Supplier to undertake a piece of research to help inform its fossil fuel price projections. The scope of the analysis is to depict long run global supply curves for oil, gas and coal and detail the underlying assumptions.

Wood Mackenzie is well known throughout the energy industry for supplying research and consulting services which includes the analysis of future supply trends across all major fuel types. From our previous work in this area and our own databases and products we are fully familiar with the intricacies of the questions that DECC has asked and the methodologies that need to be applied. Critical to the success of the project is the assumption that it is supply sources that are at the margin that will set long term prices in the energy sector.

Wood Mackenzie will use its databases and methodologies (outlined in the approach section of this document) to deliver against the methodology outlined in DECC's Invitation to Tender:

The supply curves should be built up from breakeven costs for investment/long run marginal costs for the key categories of supply. The supply curves should reflect variation in the technical/ geological/country characteristics within the key categories below and preferably be built up from a field by field/mine by mine analysis. Breakeven costs should be categorised by country and type of resource and should exclude sunk and committed investment costs. See more detail in the outputs section.

The contractor will need to explain in some detail how they have developed that evidence base and the underlying data sources.

It will be important to be transparent about a number of parameters and assumptions likely to be embedded in the contractor's evidence base including: cost of capital, de-risking cash flows, exchange rates, upstream capital costs, changes in industry unit costs, the value of associated production, assumptions on Hydrocarbon specific taxes and royalties (or subsidies), technology and efficiency gains, pipeline costs, decline rates and rates of discovery. These will need to be justified for example referencing to primary data sources or comparison with other external estimates. The contractor will need to demonstrate that the assumptions used can be justified as sustainable from a long term perspective.

It will also be important to be transparent and justify other constraints beyond cost and resource fundamentals that have been assumed. For countries where production is primarily state financed or controlled these might include

- Strategic Government decisions on how rapidly they wish to exploit their resource base, or exploitation of market power. This could include any assumptions about OPEC.
- Budgetary constraints on domestically funded investment to exploit the resource base (including investment in supporting infrastructure), or limits on national capability to deliver it.

Barriers to attracting foreign investment, where foreign technology or finance is required (e.g. absence of sustainable governance frameworks, unable to agree sufficient returns to foreign investors, sanctions).

Contractors should also be explicit about any other constraints being assumed, including regulatory and environmental constraints which limit the exploitation of the resource base e.g. environmental permitting for oil sands/arctic, regulatory approval of pipelines.

Particular issues we are likely to seek detailed justification from the contractor include

- Long term assumptions on industry unit costs, including the contractor's analysis of how far current levels vary from a long term sustainable level.
- Long term efficiency assumption and resource assumptions, including for tight oil and shale gas.
- The basis for reserve growth and decline rate assumptions.
- The basis for long term supply curves for key OPEC countries.
- Long term assumptions on hydrocarbon specific taxes and royalties for projects at the margin.

Wood Mackenzie is very well qualified for this project. We offer:

- An experienced and skilled project team who will work closely with DECC to develop and deliver the appropriate methodologies
- A broad background of knowledge and experience in the whole of the energy industry value chain with offices globally, providing on-the-ground research
- Global energy modelling experience through our Global Oil Supply Tool, Global Gas Model Coal Cost Model and Global Energy Balance Model products
- Proprietary supply databases in oil, gas (including LNG) and coal modelled at the individual asset level including economic analysis of supply projects that may be developed in the future
- Asset by asset projections

Wood Mackenzie's Proposed Approach

Wood Mackenzie's proposed approach will draw heavily upon the work that is carried out by our sector specific fuel teams and be internally consistent due to the work that is done to ensure that Wood Mackenzie's forecasts feed into our Energy Market Service which provides supply and demand forecasts across all fuels and sectors. An illustration of the integration of Wood Mackenzie's research products is provided below.

Wood Mackenzie's Integrated Research Schematic
Redacted
Source: Wood Mackenzie

Wood Mackenzie will provide the following information to DECC which will address the department's requirements on the supply side of it's long term forecasting:

- Excel based oil supply curves showing a base and possible low and high scenarios discussed and agreed with DECC, these scenarios will test the implications for supply should the breakeven price or volume of supply available on the market change;
- A 5 to 10 page report explaining how the underlying oil supply curves have been constructed, the key assumptions that have been used, key drivers for the supply curves and uncertainties
- Excel based gas supply curves showing gas supply into the North West Europe market for a base and possible low and high scenarios discussed and agreed with DECC, these scenarios will test the implications for supply should the breakeven price or volume of supply available on the market change;
- A 5 to 10 page report explaining how the underlying gas supply curves have been constructed, the key assumptions that have been used, key drivers for the supply curves and uncertainties
- Excel based coal supply curves showing coal supply into the North West Europe market for a base and possible low and high scenarios discussed and agreed with DECC, these scenarios will test the implications for supply should the breakeven price or volume of supply available on the market change;
- A 5 to 10 page report explaining how the underlying coal supply curves have been constructed, the key assumptions that have been used, key drivers for the supply curves and uncertainties

All data will be provided in Excel with clear headings. The final reports will be evidence based and written in the DECC template. These reports will be of a standard to allow publication on DECC's website.

Wood Mackenzie proposes providing supply curves for 2020, 2025, 2030 and 2035, Wood Mackenzie's current forecasting period extends to 2035 but mechanisms will be discussed with DECC to extend/trend projections.

Further details of the methodology and deliverables for each fuel type are given below.

Oil Supply

Redacted

Implicit in the supply curves will be the elements that DECC has requested in its RFP namely:

- The supply curves will be built up from breakeven costs for investment/long run marginal costs for the key categories of oil supply. The supply curves will reflect the variation in the technical/ geological/country characteristics within key categories.

- Breakeven costs will be categorised by country and type of resource (e.g. conventional onshore crude, NGLs, shallow water, deepwater, ultra deepwater, tight oil, oil sands, extra heavy, biofuels, GTL, CTL).
- Breakeven costs will include future capital investment over the time horizon for the projection excluding sunk costs.
- For countries where oil production is state controlled any assumptions will be clearly spelt out e.g. the assumed policy the government adopts for the development of its resources, any constraints it may have in developing resources and attracting foreign investment. This analysis is routinely carried out by Wood Mackenzie's regional experts who take into account the availability of capital and other factors in the phasing of projects.
- We will be explicit about constraints being assumed which will impact the speed that developments can come to market. These constraints will include regulatory and environmental constraints and much like the pace of developments in state controlled areas are routinely factored into Wood Mackenzie's outlooks.
- Unless there is clear evidence to the contrary all taxes assumed are consistent with the current view of terms available for assets. Any variations assumed to the terms will be spelt out.
- When necessary key assumptions will be spelt out such as cost of capital, de-risking cash flows, exchange rates, local content share of costs, changes in industry unit costs, the value of associated production, technology and efficiency gains, decline rates, pipeline costs where necessary to take oil to market, and rates of discovery. Typically these factors are considered at a global level and modified for specific markets when necessary e.g. Brazil and Australia in recent years where the cost base has been significantly higher than is the case elsewhere.
- The report will outline sensitivities to allow DECC to understand the relative impact of the underlying drivers, these sensitivities will be around the breakeven price or volume available in the market and will feed into two alternative scenarios agreed with DECC.

Gas Supply

Redacted

Implicit in the supply curves will be the elements that DECC has requested in its RFP namely:

- A range of breakeven costs for investment in different themes of natural gas supply to (North West) European markets for both short term and longer term horizons.
- The supply curves will be built up from breakeven costs will include future capital investment but exclude sunk costs.
- The breakdown of costs will be aggregated at an agreed acceptable level. For example Wood Mackenzie's Global Gas Model the supply nodes for Norway, existing and future, are provided for reference below:
    - **Redacted**
    - But in the final deliverables broader classifications will be used that can be clearly understood by DECC, e.g. Mid Norway existing, Mid Norway new developments, Mid Norway yet-to-find.
    - Breakeven costs will include cost of transport by pipeline or LNG (including liquefaction, transport, regasification), with these different costs separately identified – implicit in this is an assumption around the delivery point of each source of supply. Gas supply delivered costs will be to that supply source's key market:
        - **Redacted**
    - The geographical scope of the analysis and interactions with other (regional) gas markets will be captured in the written report and will include many of the assumptions shown above such as the way LNG supply will satisfy different markets etc..
    - For countries where gas production is state controlled any assumptions will be clearly spelt out e.g. the assumed policy the government adopts for the development of its resources, any constraints it may have in developing resources and attracting foreign investment. This analysis is routinely carried out by Wood Mackenzie's regional experts who take into account the availability of capital and other factors in the phasing of projects. The key countries impacting the North West Europe gas market are expected to be Russia and China and a full description of their assumed approaches will be given.

- We will be explicit about constraints being assumed which will impact the speed that developments can come to market. These constraints will include regulatory and environmental constraints and much like the pace of developments in state controlled areas are routinely factored into Wood Mackenzie's outlooks. In most instances we will only include commentary on these constraints if they are expected to vary significantly from the situation today.
- Unless there is clear evidence to the contrary all taxes assumed are consistent with the current view of terms available for assets.
- When necessary key assumptions will be spelt out such as cost of capital, de-risking cash flows, exchange rates, local content share of costs, changes in industry unit costs, the value of associated production, technology and efficiency gains, decline rates, pipeline costs where necessary to take gas to market, and rates of discovery. Typically these factors are considered at a global level and modified for specific markets where necessary.
- The report will outline sensitivities to allow DECC to understand the relative impact of the underlying drivers, these sensitivities will be around the breakeven price or volume available in the market and will feed into two alternative scenarios agreed with DECC.

Coal Supply

Redacted

Implicit in the supply curves will be the elements that DECC has requested in its RFP namely:

- A range of breakeven economic costs for key categories of thermal coal supply to North West European markets for both short term and longer term horizons.
- This range will reflect variation in the specific characteristics of supply source and be built up from a mine by mine analysis.
- Each breakeven cost will include all business costs incurred by the producer to realise the fair market value of the traded coal. Cost items will include mining costs and physical delivery costs. A discount rate of 15% will be used.
- Breakeven costs will be categorised by country and corrected to account for different coal qualities (cost of energy adjusted to benchmark specification 6322 kcal/kg gar basis equivalent to 6000 Nar basis).
- Breakeven costs will include the cost of overland and/or seaborne transport (including port handling fees and shipping freights) with an assumed ARA delivery point.
- The supply cost curves will be long run marginal costs and include all future capital costs for new mining projects and for existing projects where appropriate (i.e. to the extent that extra capital investment will be needed).
- The geographical scope of the analysis and interactions with other coal markets will be captured in the written report.
- We will be explicit about constraints being assumed which will impact the speed that developments can come to market. These constraints will include regulatory and environmental constraints which are routinely factored into Wood Mackenzie's outlooks.
- Unless there is clear evidence to the contrary all taxes assumed are consistent with the current view of terms available for assets.
- When necessary key assumptions will be spelt out such as cost of capital, de-risking cash flows, exchange rates, local content share of costs, trends in industry unit costs, fuel costs, technology and efficiency gains, decline rates and rates of discovery. Typically these factors are considered at a global level and modified for specific markets where necessary.
- The report will outline sensitivities to allow DECC to understand the relative impact of the underlying drivers, these sensitivities will be around the breakeven price or volume available in the market and will feed into two alternative scenarios agreed with DECC.

Wood Mackenzie Data Sources

Our research analysts conduct extensive and detailed research into their respective focus areas combining information from a wide variety of sources. We do not purchase data other than from entities which own the data and are entitled to sell it to us.

Key to the quality of Wood Mackenzie's analysis is the bottom up field by field, mine by mine commercial analysis that is carried out by our research analysts. The primary source for this information is direct dialogue with operators and JV participants to collect and review research data. In addition to these primary data sources we will use a number of external sources to collect, correlate and compile information. The typical sources are given in the table below.

Redacted

Quality Assurance

All of Wood Mackenzie's data is subject to a rigorous integrity checking and quality control process. We have developed a comprehensive set of checks, which are carried out on a regular basis, at a field, country, regional and global level. Where available, our figures for historic production are cross-checked against government publications, industry-specific agencies and company reports on a regular basis.

Given the importance of this project additional quality assurance steps will be incorporated for the purposes of this project. These quality assurance steps will take two forms:

- A biweekly project review meeting with experts not directly involved in the core team. These meetings will be internal Wood Mackenzie meetings and will consist of 30 minutes per fuel type. The key discussion points at each of these meetings will be shared with DECC.
- Prior to the submission of both the draft and final report the report will be reviewed by these same individuals and recommendations made on areas for improvement. Accompanying this review will be a sign-off which will document the suggested recommendations.

The experts for quality assurance will be agreed at project kick-off but are expected to be:

Oil Supply – **Redacted**

Gas Supply – **Redacted**

Coal Supply – **Redacted**

Working together: Wood Mackenzie's Project Team for this Assignment

We recognise that this is an important project for DECC, and we will commit a team of experienced resources to this project. **Redacted**

Oil Supply Specialists – responsible for advising on and collating the oil supply curve

Redacted

Gas Supply Specialists – responsible for advising on and collating the gas supply curve

Redacted

Coal Supply Specialists – responsible for advising on and collating the coal supply curve

Redacted

CVs for each member of the team have been provided as Attachment A. Each member of the team has been involved in projects that have involved the analysis of supply costs and each member of the team has extensive skill and knowledge against the three areas requested by DECC:

- Understanding of the global fossil fuel industry
- Evidence on fossil fuel production costs and resources
- Understanding of forecasting and modelling

The points of contact for DECC throughout the project will be **Redacted**.

Timing and Outputs

Assuming DECC awards the project inline with the schedule outlined in its Invitation to Tender Wood Mackenzie would be able to deliver the project according to the following timetable:

Action	**Timing – completed by**
Inception steering group meeting for project	16/12/2015
Draft report of interim findings to DECC	29/1/2016
Final Report agreed	31/3/2016

It is anticipated that there will be 5 face to face meetings between Wood Mackenzie and DECC throughout the project:

- Kick-off/Inception meeting
- Alignment meeting prior to submission of draft findings
- Delivery of draft report and interim findings
- Alignment meeting prior to submission of final report
- Delivery of final report

The exact timings for these meetings will be agreed at project kick-off alongside a detailed project plan with key milestones.

Throughout the project DECC will be informed of project progress and progress against plan through a weekly email.

The report for each fuel type will be written by Wood Mackenzie's consulting team before being passed to specialist research analysts and individuals earmarked for Quality Assurance review.

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- A 5 to 10 page report explaining how the underlying coal supply curves have been constructed, the key assumptions that have been used, key drivers for the supply curves and uncertainties.

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Fees and Expenses

See separate price schedule.

Terms and Conditions and Use of Deliverables

Wood Mackenzie would be happy to use DECC's standard T&Cs but would request that liability in clause 18.7 be limited to twice the contract value.

Given that many of the deliverables contain commercially sensitive only the reports can be used by DECC in the public domain. The underlying data will be made available to DECC and can be shared with DECC's advisers and consultants subject to the confidentiality provisions outlined in DECC's Invitation to Tender.

Conclusion

We believe that Wood Mackenzie is ideally placed to assist DECC with this important assignment and we look forward working on it with you.

Yours sincerely,

For and on behalf of Wood Mackenzie Limited

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Engagement Confirmation

If you would like to proceed with the **Fossil Fuel Supply Curves** project as described in this letter of 10 December 2015, please countersign a copy of and return it to us for our records.

Agreed and accepted by DECC

Signature:	
Name:	
Position:	
Date:	

Attachment A: Qualifications and Expertise of the Team

Redacted