




**Barnett
Waddingham**
a true partnership approach

Oil and Gas Consultancy

**Actuarial and risk management services
for the Upstream Oil and Gas industry**



Actuaries are acknowledged as the leading profession for understanding and quantifying risk, pricing risk transfer products, valuing contingent assets and liabilities, and risk management.

We are uniquely placed to help bridge the gap between technical disciplines and risk, natural, geopolitical or economic uncertainty, and finance.

“The Upstream Oil and Gas industry has heavy requirements for capital and operating expenditure, and faces unique and complex problems associated with natural uncertainty, project and engineering risks, unpredictable commodity prices, and the associated operational and financial risks”

Barnett Waddingham brings a variety of actuarial and risk management skills to bear on the problems faced alike by the Upstream Oil and Gas industry, and those who provide its finance and manage its risk.

Barnett Waddingham is the largest independent firm of actuarial professionals in the UK; our consultants have many years' experience across a broad spectrum of actuarial skills.

The present environment of low commodity prices, rising exploration costs, and constrained access to capital has increased the need for in depth, accurate and complete analysis of uncertainty, risks and valuation. Many investors and providers of capital recognise that accurate assessment of the quality of assets is inherently difficult, but of key importance.

Working where needed in tandem with industry professionals such as geoscientists, reservoir engineers and facilities engineers, we can provide in depth analyses for the industry at project, portfolio or company level.

We can give a professional opinion on the statistical assessment of the quality of valuations, assets, production forecasts and field development proposals. We can also support assessment of insurable risks such as supply chain interruption, political risks or natural hazard, integrating this with review of non-insurable or hedgeable risks to provide a holistic risk assessment.

For investors and financiers, we can provide an actuarial and financial perspective to support your valuation and due diligence process, for example reviewing the effectiveness of a company's risk management strategy. Statistical and financial modelling and risk based valuations are core skills for the actuarial profession.

OUR AREAS OF EXPERTISE INCLUDE:

- assisting with any aspect of your modelling development, validation and quality control requirements
- integrate modelling with every aspect of risk analysis and decision analysis, to support a consistent approach across projects and stages
- integrate modelling with your internal and external reporting, including PRMS and local regulatory compliance
- specific skills in stochastic, econometric and catastrophe modelling as well as options and insurance pricing, scenario and stress testing



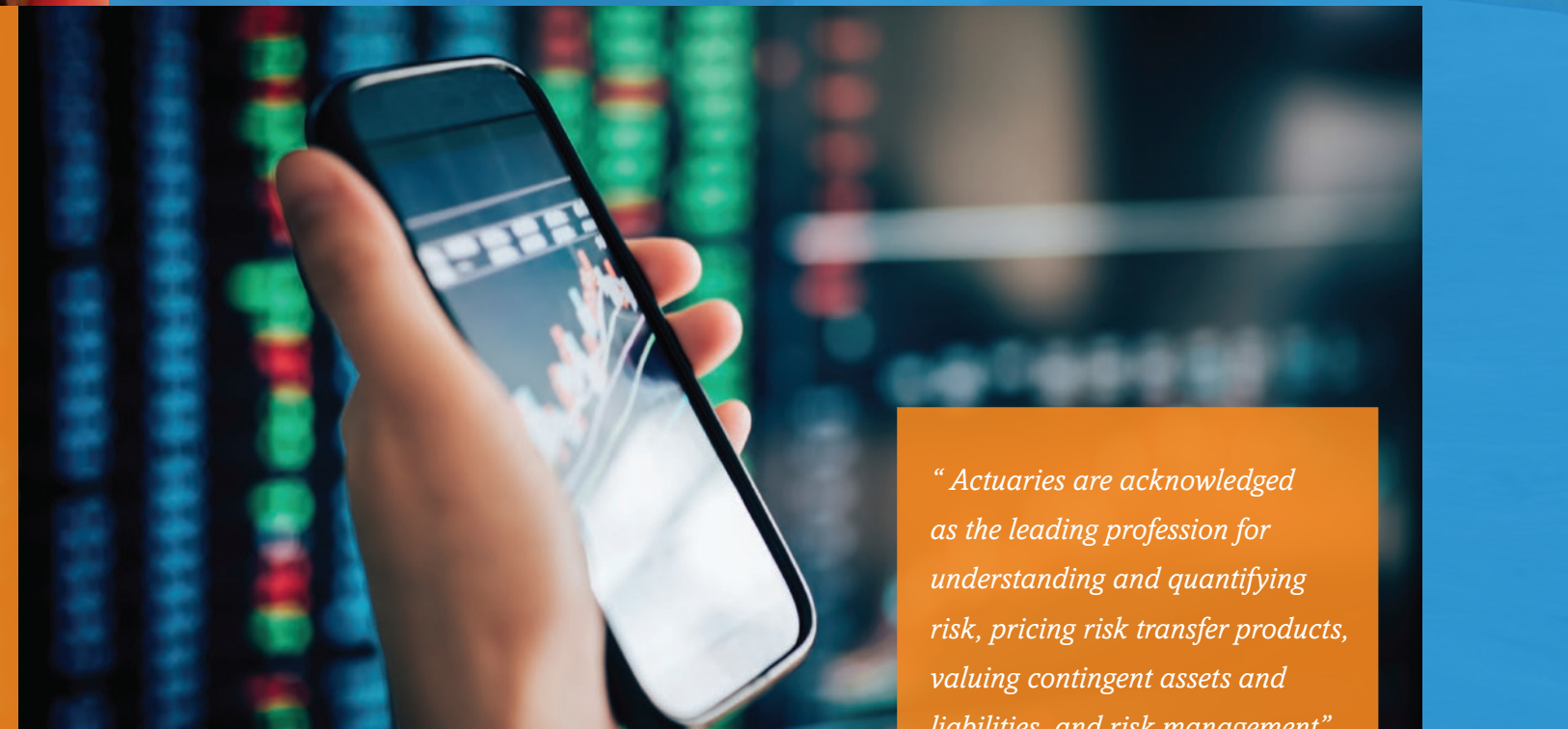
Uncertainty and Risk: Analysis and Valuation

The Upstream Oil and Gas industry faces unique and complex problems associated with natural uncertainty, project and engineering risks, unpredictable commodity prices, and the associated operational and financial risks. Understanding, managing and valuing the risks associated with uncertainty and natural variation are core skills for the actuarial profession.

OUR AREAS OF EXPERTISE INCLUDE:

- independent assessment of uncertainty and variability, probabilistic modelling of impact and severity of the associated risks
- independent assessments of all types of risk, including classification, valuation, degree of exposure, and transferability, whether 'insurable' or not
- assessment of the significance of uncertainty, sources of bias or over-confidence, and the impact these may have on production forecasting and asset valuation
- review and valuation of the risks and opportunities inherent, for example, in reserve estimates, production forecasts, decline analyses
- due diligence: if you are a potential counterparty, we can assist you to assess the quality and value of potential acquisitions, farm-ins, equity shares or divestment options
- analysis and valuation of operational or development project risk
- advice on optimum risk transfer strategy, where this can be done financially or contractually
- advice on optimum capital management strategy for covering non-transferrable risks
- valuation of risks which exist only at an aggregate portfolio level, such as exposure to a specific country, and the benefits of diversification
- advanced analysis of correlation and its effect on aggregated values, using copulas and state of the art analytical methods
- holistic views of all types of internal and external risk, whether controllable or not, at project, country, portfolio or company level

We have in-house Insurance and Financial Risk teams, who work with our Oil and Gas team and industry experts at all stages of the asset lifecycle and have access to the best available data to support modelling of all natural and man-made insurable risks.



“Actuaries are acknowledged as the leading profession for understanding and quantifying risk, pricing risk transfer products, valuing contingent assets and liabilities, and risk management”



Risk transfer

Risk transfer products are priced to reflect both estimated risk (calculated according to some model) and model risk (which depends on confidence in accuracy and appropriateness of the risk model itself).

As a rule, you always pay for uncertainty; reducing model risk will go towards ensuring that you get the best possible quotes, based on the true underlying risk.

- Actuarial opinion on your project, portfolio or global risk profile can help maximise insurability, and the cost at which risk transfer can be achieved. We can answer such questions as:
 - What is the value of risk transfer to you, and how does this compare with the market cost of a specific contract?
 - How much insurance or hedging is optimum?



Decision Analysis, Value of Information

In a high cost, low commodity price environment, the depth and quality of decision analysis is ever more important.

Bringing an actuarial approach to framing complex decision problems, we can ensure that risk and uncertainty are modelled in full depth in influence diagrams or decision trees. Analysis can include full stochastic modelling, accounting for correlations and dependencies. We can present complex analyses involving multiple value criteria such as NPV or values at risk. We can present the resilience underlying decisions in clear, scenario-based reports: how likely is it that an "optimum" decision will be correct?

OUR AREAS OF EXPERTISE INCLUDE:

- Designing governance procedures, preserving both the knowledge base and rationale for decisions for audit and future knowledge development.
- Framing decisions and applying single or multiple decision value criteria.
- Ensuring that the value criteria in a decision model reflect the impact of the decision on your asset or aggregated risk profile.
- Estimating the true value of information.
 - It is often said that the value of information derives entirely from its ability to affect a decision choice. We disagree! Decision analysis and risk assessment are very closely related, as almost any decision will affect the risk profile for the company, and risk assessment is a prerequisite for credible estimation of criterion values such as NPV.
- Estimating the value of flexibility.
 - How does the ability to change track in future, when circumstances change, affect the optimum decision now?
- Estimating the resilience and robustness of a decision
 - As the probabilities and payoffs in a decision model are uncertain, how likely is it that a particular decision is not in fact optimal? If the probability estimates are wrong, which factors are most likely to bite, leading to the wrong choice and loss of value?
- How much appraisal is enough?
 - A recent study by IPA has shown that lack of sufficient appraisal is one of the key indicators for unnecessary loss of value, or poor project performance in the development and production stages of the asset lifecycle.

Analysis of Data

We recognise that data quality is fundamental to the quality of risk and decision analysis, and that effective transfer across stage gates can unlock significant value.


Uncertainty and risk can persist as a project advances, but information may be lost as the focus of attention shifts, for example from geosciences to reservoir engineers to economists and the legal team. Such losses increase financial risk; we can quantify the impact, and help to ensure that valuable risk data is retained across disciplines.

Using our practical experience of data transfer in the insurance sector we can ensure that knowledge, which will have a material impact on future analysis, is successfully transferred across stage dates to minimise uncertainty and ensure optimal decisions are made.

OUR AREAS OF EXPERTISE INCLUDE:

- statistical analysis and pattern recognition
- advice on optimum data preservation strategy, and the risks associated with data transfer
- assessment of data quality and governance, answering questions such as:
 - How good are accuracy and completeness? How material are the risks arising from any deficiencies?
 - How can data be transferred effectively across stage gates?

“Uncertainty and risk can persist as a project advances, even though information may be lost as the focus of attention shifts, for example from geosciences to reservoir engineers to economists and the legal team.”



“We can provide economic assumption setting, projections for commodity price, interest and inflation, exchange rates, availability of financing options”

Asset Valuation, Due Diligence and Petroleum Economics

By integrating our high quality analysis of uncertainty and risk, decision analysis, stochastic and financial modelling, we can more accurately validate technical estimates and valuations at asset, portfolio and corporate level, providing reports for both internal and public use, compliant with PRMS or local standards as required.

OUR AREAS OF EXPERTISE INCLUDE:

- assessment of country risks such as repudiation of contracts, regime change, corruption, civil unrest
- review of fiscal and legal systems, specific contractual terms
- valuation and risk assessment for prospective farm-in or joint venture opportunities
- actuarial commentary on risks inherent in competent person reports, field development plans, infrastructure and commercialisation strategies
- assessment of the volatility and risk-sharing implications of terms in production sharing, joint venture, joint operating or tariff contracts
- economic assumption setting, projections for commodity price, interest and inflation, exchange rates, availability of financing options
- real and financial options pricing
- assessment of project dependencies, critical path analysis
- assessment of project data such as scheduling, capital and operating costs, G&A and G&G estimates, reserves estimates, production profile and forecast

Funding

Mergers, Acquisitions and Divestments

We have many existing relationships with providers and managers of private equity and debt finance, as well as Insurance, Options and other risk transfer products.

We can advise industry clients on the perspective which such providers have on industry proposals, and present proposals for optimal chance of success.

Our core expertise includes the valuation of anything involving uncertainty and risk, and capital management. As actuaries, we offer a rigorous set of statistical, analytical and reporting skills and strong professional conduct standards, all of which are core to the actuarial profession.

If you need to raise capital or finance, or transfer financial risk, we can help you present your proposals and analyses tailored specifically for the financial community. Highlighting the factors of greatest interest to investors can greatly improve their confidence, by simplifying their analysis of technical reports written from an engineering or geological perspective.

OUR AREAS OF EXPERTISE INCLUDE:

- review of the availability and impact of different methods of financing
- review of proposals for raising finance, tailored presentation, and possible introductions to suitable sources of funding
- independent review of forecasts and risk analysis, for your existing assets or potential acquisitions, for a clear opinion on risks and potential reward
- valuation input to contract negotiation
- review of strategic effects on your portfolio of proposed acquisitions and divestments
- review the effect of fiscal regime and commodity price assumptions on economic lifetime or asset valuation, and the likelihood that these may change

Our Oil and Gas services are tailored specifically for the industry, combining a view of technical uncertainties with a commercial risk and decision perspective across the lifecycle.



Financial Community, Investors and Counterparties

We recognise that technical asset risk is a major concern for the Financial community, investors and counterparties. What is the real geological structure in the subsurface? How producible are the hydrocarbons? How reliable is a production forecast? How achievable is the commercialisation plan? How reliable is a company's internal validation process? It may be difficult to be sure of the quality of information available.

Technical risk associated with a particular asset, project, or proposal for financing is often harder to assess, or more uncertain, than the traditional financial risks.

Building on our in-depth knowledge of the upstream Oil and Gas industry and applying our actuarial expertise in statistics and financial modelling, we can provide independent statistical reviews, in depth. To give confidence, from a financial profession's perspective, we can advise on the accuracy of, for example:

- production forecasts
- reportable quantities such as HCIP
- reserves classified by PRMS categories or similar national standards

Barnett Waddingham has extensive actuarial resources. We have the capacity to react quickly when our advice is needed promptly.

Working with professionals such as geophysicists, reservoir engineers and petroleum economists, we can undertake thorough, technically competent review of technical asset risk. We have an in-house validation framework of checkpoints, developed with industry partners, to support rapid initial review of the technical aspects of a proposal.

If multiple partners or state interests are involved, for example in a proposed acquisition of a share of an asset, we can assist in reviewing the associated risks, such as dependence on a partner's financial soundness, continued participation, equipment or skilled personnel.

Supporting your due diligence process, we can apply actuarial valuation and pricing techniques to give you a fully integrated view of risk, including:

- non-transferrable, inherent risks such as subsurface risk
- inherent risks transferrable through hedging or insurance arrangements
- external risks such as commodity pricing, or fiscal regime change
- traditional financial risks such as credit and liquidity
- development project risks, delay and cost over-runs
- assessment of the impact on corporate valuation and capital management
- assessment of the quality of existing risk management processes



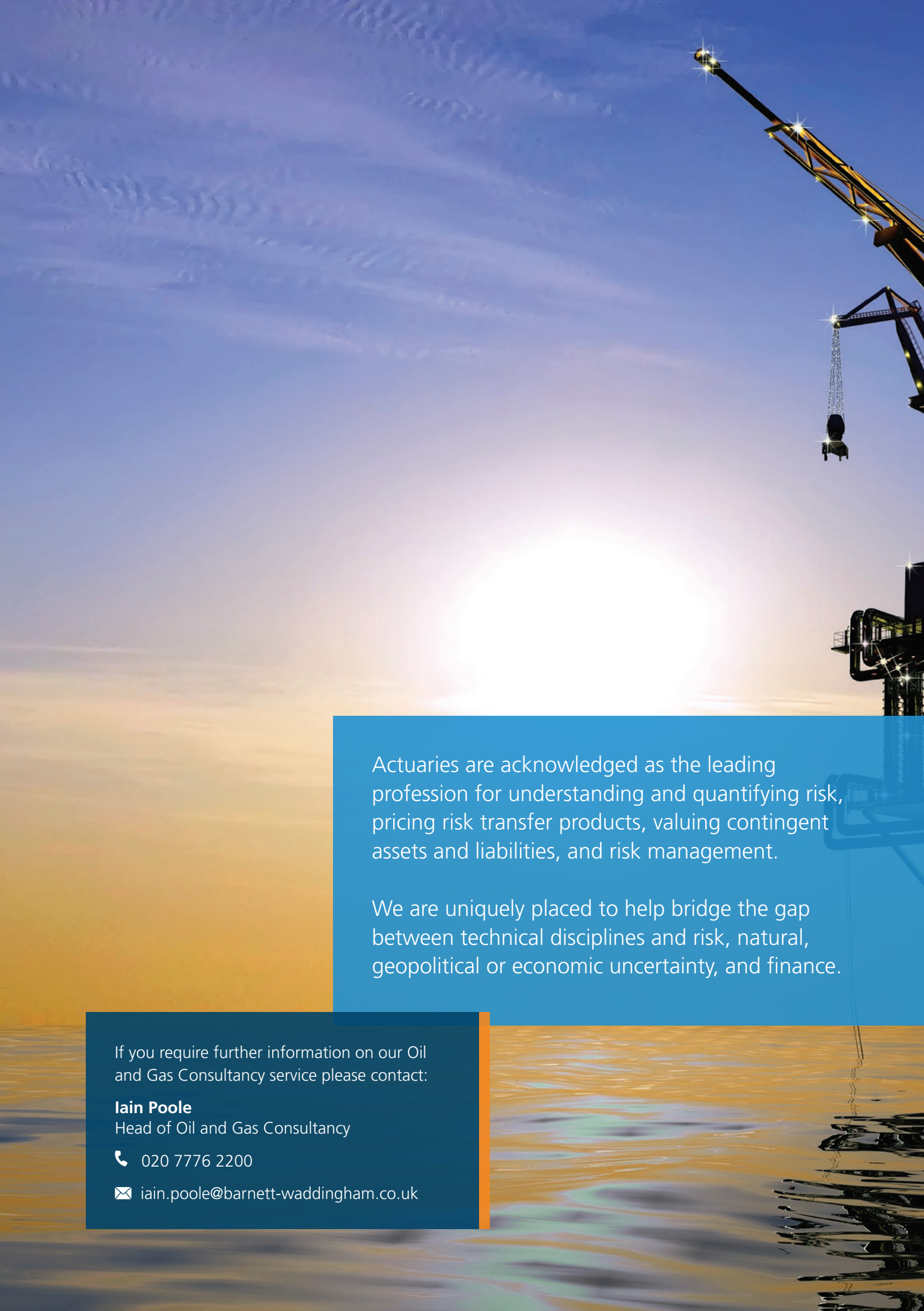
Barnett Waddingham

a true partnership approach

Oil and Gas Consultancy

“Working with professionals such as geophysicists, reservoir engineers and petroleum economists, we can undertake thorough, technically competent review of technical asset risk. We have an in house validation framework of checkpoints, developed with industry partners, to support rapid initial review of the technical aspects of a proposal.”





Actuaries are acknowledged as the leading profession for understanding and quantifying risk, pricing risk transfer products, valuing contingent assets and liabilities, and risk management.

We are uniquely placed to help bridge the gap between technical disciplines and risk, natural, geopolitical or economic uncertainty, and finance.

If you require further information on our Oil and Gas Consultancy service please contact:

Iain Poole

Head of Oil and Gas Consultancy

☎ 020 7776 2200

✉ iain.poole@barnett-waddingham.co.uk