



SEPTEMBER 2015

# OIL AND GAS RECOVERY AND ENHANCED RECOVERY TECHNIQUES

IHS Proposal

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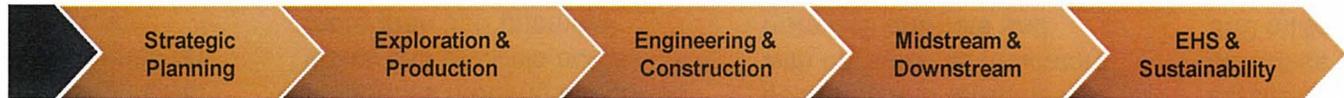
Our Expertise & Qualifications



# About IHS



## Advancing Decisions Across the Oil & Gas Value Chain



IHS Inc. (NYSE: IHS) is a leading source of information and insight in pivotal areas that shape today's business landscape: chemicals, energy, economics, geopolitical risk, and sustainability. Businesses and governments around the globe rely on the comprehensive content, expert independent analysis and flexible delivery methods of IHS to make high-impact decisions and develop strategies with speed and confidence. IHS has been in business since 1959 and became a publicly traded company on the New York Stock Exchange in 2005. Headquartered in Englewood, Colorado, USA, IHS employs more than 8,500 people in more than 40 countries around the world.



# IHS Industries

### AEROSPACE & DEFENSE

100+ years' experience delivering unrivaled news, insight and intelligence on defense and security equipment, markets, industries and risk

### CHEMICAL

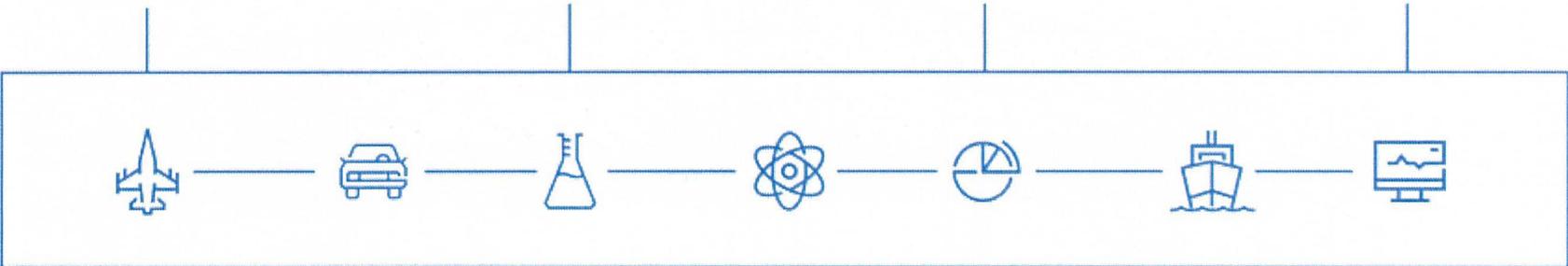
Over 200 leading industry authorities creating integrated views and analysis across more than 300 chemical markets and 2,000 processes for 95 industries

### FINANCE

Research on 200+ countries and territories with harmonized indicators from IHS analysts and economists

### TECHNOLOGY

World's largest electronics component database with more than 350 million parts



### AUTOMOTIVE

The world's largest team of automotive analysts with hundreds of experts located in 15 key markets around the world covering the entire automotive value chain

### ENERGY

Extensive Oil & Gas well information on 5.5+ million wells worldwide dating back as far as 1860

### MARITIME

World's largest maritime database with an information gathering heritage of 250+ years with comprehensive information on all vessels 100 GT and over



## Who we Serve

Our clients include decision-makers at every level, across virtually every industry. Whether you represent a multinational enterprise or a municipal government, we can scale our offering to the scope of your needs.

IHS serves:

Corporations and governments in

**165**

countries

**Small  
businesses  
to  
Fortune  
500**

**75+%**  
of the  
Global Fortune 500

**70+%**  
of the  
Fortune 1000

## Who we Employ

**1,200**

world-class experts  
and researchers

**1,400**

industry analysts

**140+**

global offices

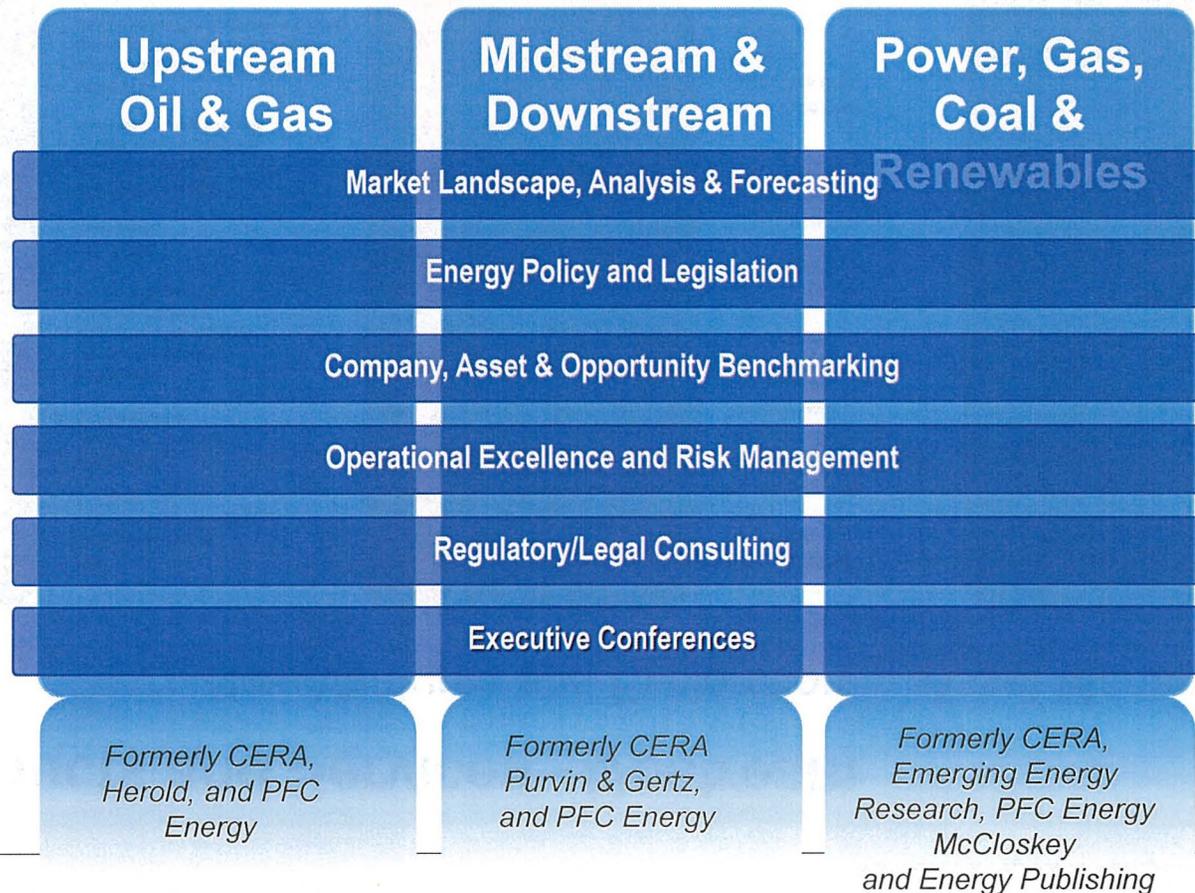
**800**

software developers

# IHS Energy: Global & Local View of Energy Markets

*IHS Energy Insight helps decision makers anticipate the energy future and formulate timely plans in the face of rapid change and uncertainty. Our **experts** are known for independence, fundamental research and original insight.*

**Integrated Research & Consulting**  
*Global, Regional and Cross-Discipline*

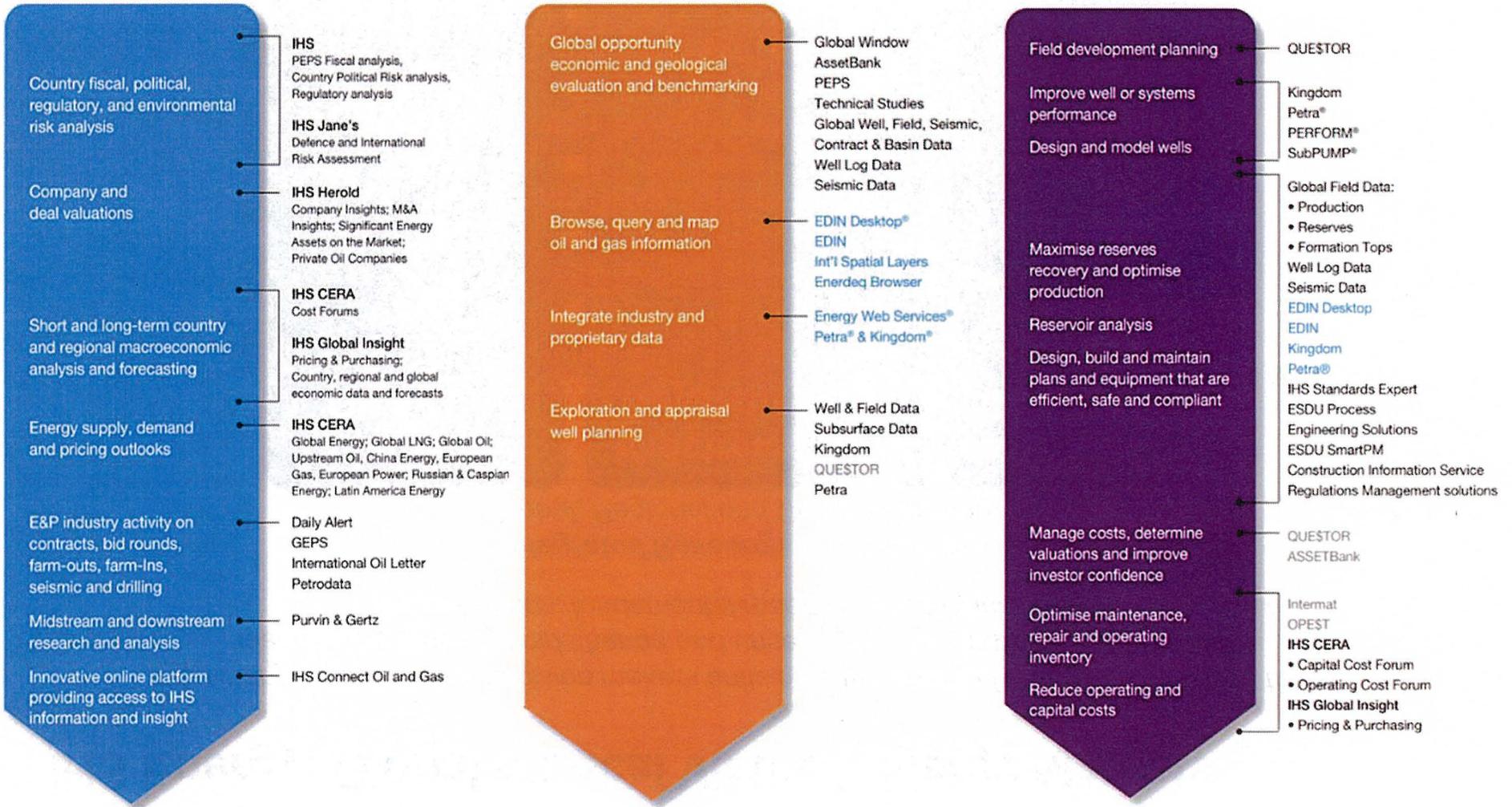


# IHS Products and Services - Upstream

## Strategy

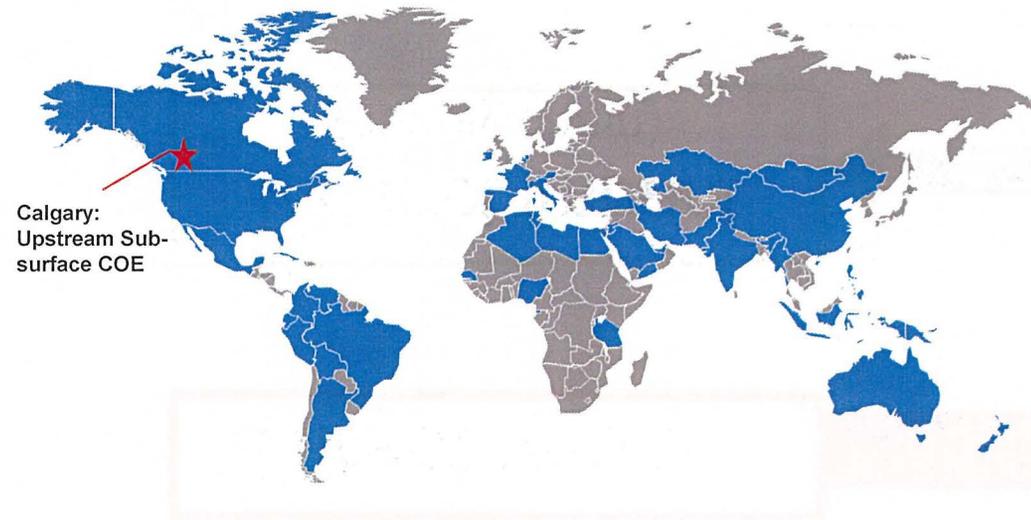
## New Ventures and Exploration

## Asset Management



## Calgary-based team experienced in optimizing reservoirs across the globe

### Eminent Worldwide Project Experience: Upstream Sub-surface Consulting



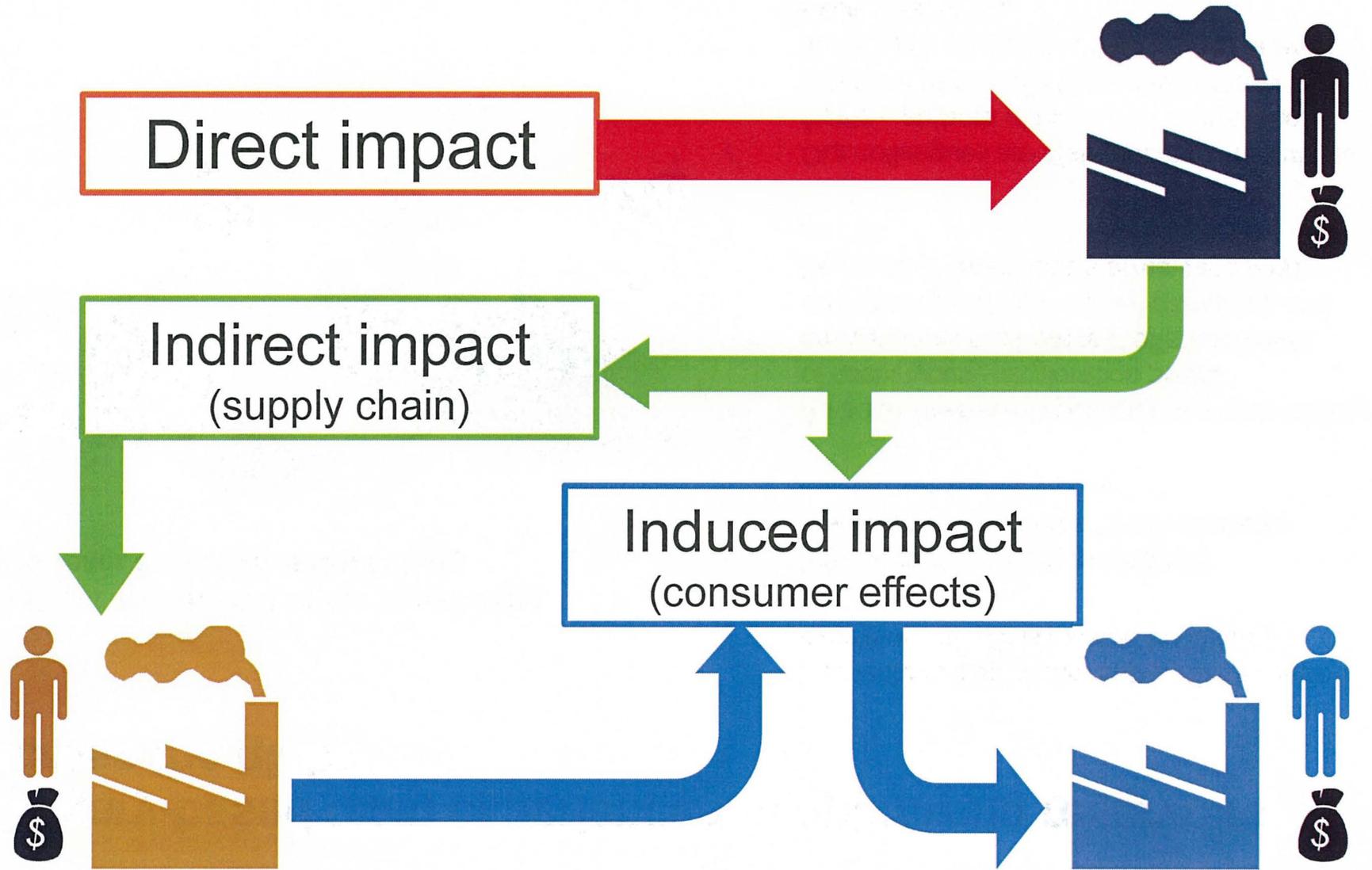
**Our technical upstream sub-surface centre-of-excellence (COE) is located in Calgary.**

**This team has delivered reservoir management solutions for client assets located across the world.**

**As such, we have experience in a wide variety of asset types – exploration plays, conventional onshore and offshore fields, unconventional tight oil and gas plays, and heavy oil (primary and thermal recovery) assets.**

**Our colleagues are distinguished on multiple fronts – authors of hundreds of published technical papers (SPE), contributors to industry forums and called upon to provide expert testimony.**

# Economic Impact Analysis measures more than just a company's or industry's direct contributions



# IHS Regulatory Insight

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IHS regulatory insight consulting provides insights with respect to petroleum legislation, fiscal terms and contractual models in over 150 jurisdictions worldwide.

Whether the issues are industrywide or client specific, our ongoing objective is to support clients in managing regulatory risks.

## What we bring

### Global Reach and Integrated Energy Focus

- Expertise across the full value chain
- Expertise across the globe
- Blend of quantitative fundamental analysis and expert judgment
- Access to proprietary IHS databases and software

### Energy Policy and Regulation Expertise

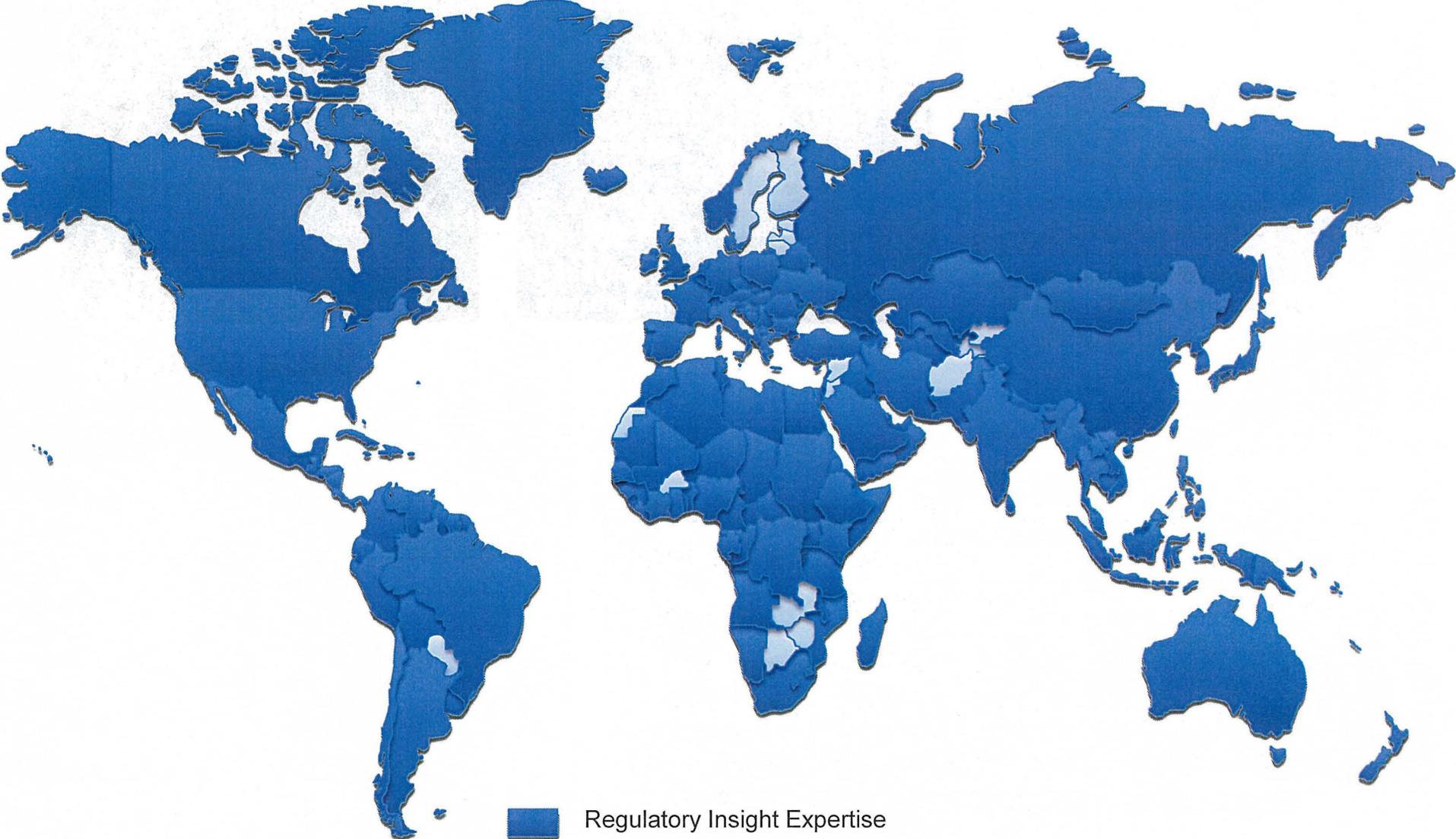
- A team of legal and policy consultants that integrates research, consulting and industry expertise
- Experience in formulating energy policy & developing legislation and contractual terms
- Extensive legal databases covering energy legislation of over 150 countries across the globe

### Oil and Gas Economics and Fiscal Terms Expertise

- Proprietary petroleum economics and fiscal terms solutions
- Over 400 E&P fiscal models worldwide
- Global E&P databases and G&G expertise



# IHS Regulatory Expertise



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# Proposed Scope of Work

## Scientific Information on Enhanced Oil Recovery

- a. Use of CO2 in enhanced oil recovery
- b. Feasibility in implementing enhanced oil recovery
- c. Potential timelines in implementing enhanced oil recovery

## Oil and Gas Recovery Economics and Future Economic Impact

Take into account:

- a) Oil formations within the state
- b) Application of existing tax incentives to current and foreseeable conditions
- c) Recommendations for elimination, or addition of tax incentives and impact it may have on interests of:
  - i. The state
  - ii. Political subdivisions
  - iii. The environment, and
  - iv. The fossil fuel energy, including the lignite industry

# Task 1.a – Use of CO<sub>2</sub> in Enhanced Oil Recovery

## Three Stage Approach

<p>CO<sub>2</sub> EOR technique background and fundamentals</p>	<ul style="list-style-type: none"> <li>• Provide extensive scientific technical information on CO<sub>2</sub> EOR recovery method             <ul style="list-style-type: none"> <li>• Objective: help the legislature obtain a scoping level estimate of the potential incremental oil recovery from fields within basins that fall in the scope of this study</li> </ul> </li> </ul>
<p>Reservoir and Operational Characteristics of CO<sub>2</sub> EOR Process</p>	<ul style="list-style-type: none"> <li>• Screening to select and rank suitable reservoirs for successful implementation of CO<sub>2</sub> EOR</li> <li>• Questions to be addressed by screening criteria to be developed by IHS:             <ul style="list-style-type: none"> <li>• Does the reservoir have enough residual oil saturation?</li> <li>• Is the reservoir deep enough to allow the project to operate at the desired pressure (above minimum miscibility pressure for miscible process)?</li> <li>• Is the reservoir homogenous enough to provide sufficient connectivity?</li> <li>• Does oil property suit the desirable gravity and viscosity range?</li> </ul> </li> <li>• Main operational concerns and associated best practices that each operator should consider before implementing this recovery method</li> </ul>
<p>State of Commercial CO<sub>2</sub> EOR Process in North America: Opportunities and Challenges</p>	<ul style="list-style-type: none"> <li>• Performance review of the global reservoirs that currently apply CO<sub>2</sub>-EOR as a recovery method (consider both performance opportunities and challenges)</li> <li>• Review, compile, and report the technical challenges that could cause obstacle to the implementation of CO<sub>2</sub>-EOR method             <ul style="list-style-type: none"> <li>• Favorable geology</li> <li>• Interaction between CO<sub>2</sub> and reservoir fluids</li> <li>• Integrity of wellbores, surface facilities and relevant equipment</li> <li>• Operating environment</li> <li>• Reservoir surveillance</li> <li>• Application to unconventional reservoir</li> </ul> </li> </ul>

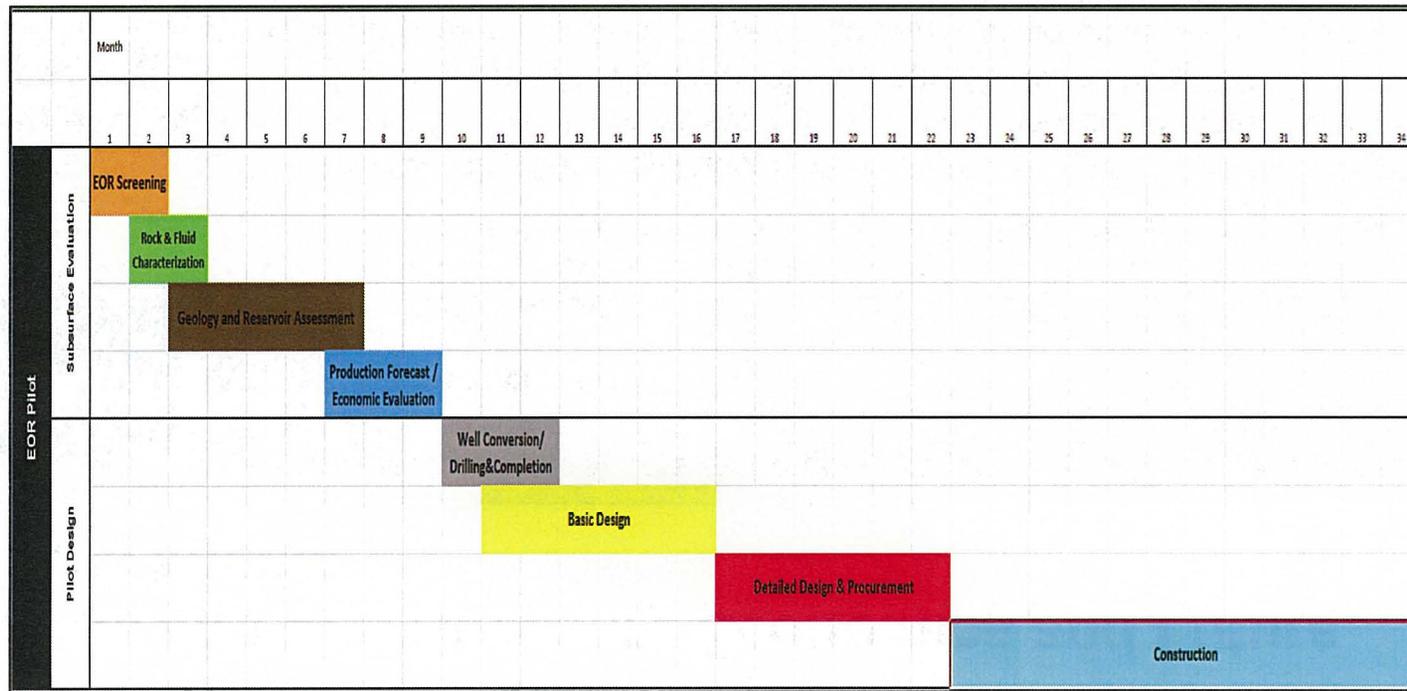
# Task 1.b – Feasibility of Implementing Enhanced Oil Recovery

## Four Stage Approach

<p>EOR Screening</p>	<ul style="list-style-type: none"> <li>• EOR processes such as Gas-flooding, CO2-EOR, WAG and Chemical-flooding will be considered</li> <li>• Assessment of the most important technical uncertainties                         <ul style="list-style-type: none"> <li>• <b>Reservoir Uncertainty:</b> degree of heterogeneity, geometry, extension and presence of top gas and aquifer, reservoir temperature and pressure</li> <li>• <b>Rock-Fluid Uncertainty:</b> range of gas-oil relative permeability data set, compositional effect, rock-fluid interaction via chemical reaction</li> <li>• <b>Fluid-Fluid Uncertainty:</b> Minimum Miscibility Pressure (MMP)</li> </ul> </li> <li>• Range of uncertainty associated with each parameter will be defined under three categories of “<b>High</b>”, “<b>Medium</b>”, and “<b>Low</b>”</li> </ul>
<p>EOR Evaluation &amp; Ranking</p>	<p>Evaluate each process which will allow us to rank the EOR alternatives in order to replace the most favorable technique with CO2-EOR method</p>
<p>Analytical Simulation</p>	<p>Performance prediction will be defined using analytical and numerical simulations and the most important uncertainties that can affect the efficiency of the selected EOR processes will be defined</p>
<p>Numerical Simulation to Forecast EOR Methods</p>	<ul style="list-style-type: none"> <li>• IHS will use a compositional modeling approach to model gas/solvent injection phase behavior and the ability of the injectant to mobilize and recover incremental oil</li> <li>• The numerical simulation model should be able to take into account different considerations such as the effect of water invasion, gravity segregation, rock-fluid interaction etc.</li> <li>• The results of numerical simulation will be combined with economic criteria to determine the best process based on recovery improvement.</li> </ul>

# Task 1.c – Potential Timeliness Associated with EOR Implementation

Subsurface Evaluation	Pilot Design
<ul style="list-style-type: none"> <li>• EOR Screening</li> <li>• Rock and Fluid Characterization</li> <li>• Geology and Reservoir Assessment</li> <li>• Production Forecast/Economic Evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Well Conversion/Drilling &amp; Completion</li> <li>• Basic Design</li> <li>• Detailed Design and Procurement</li> <li>• Construction</li> </ul>



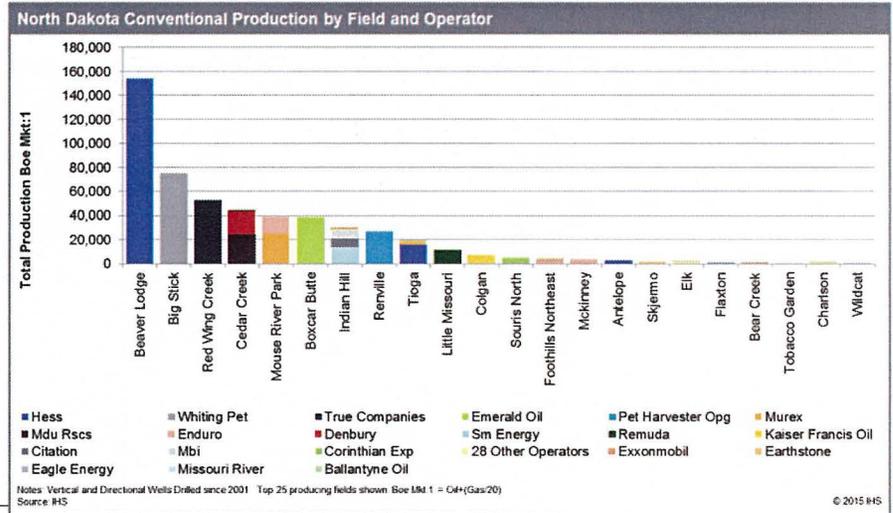
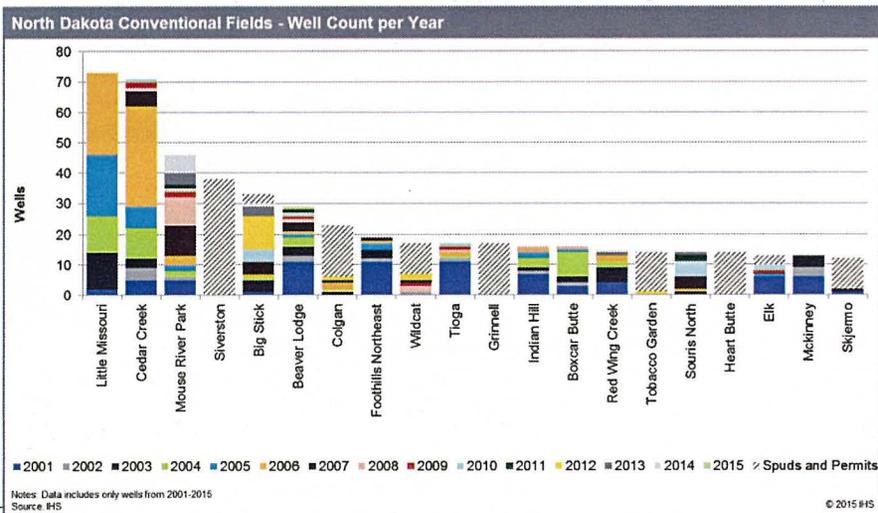
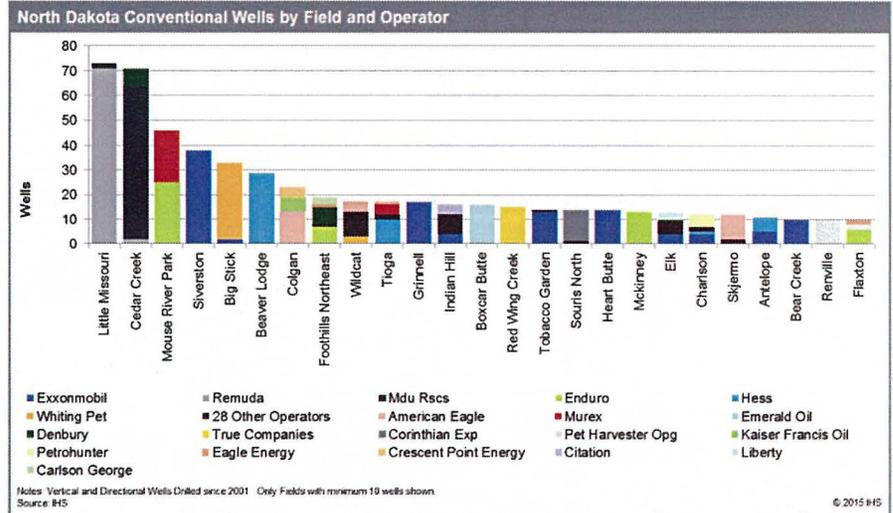
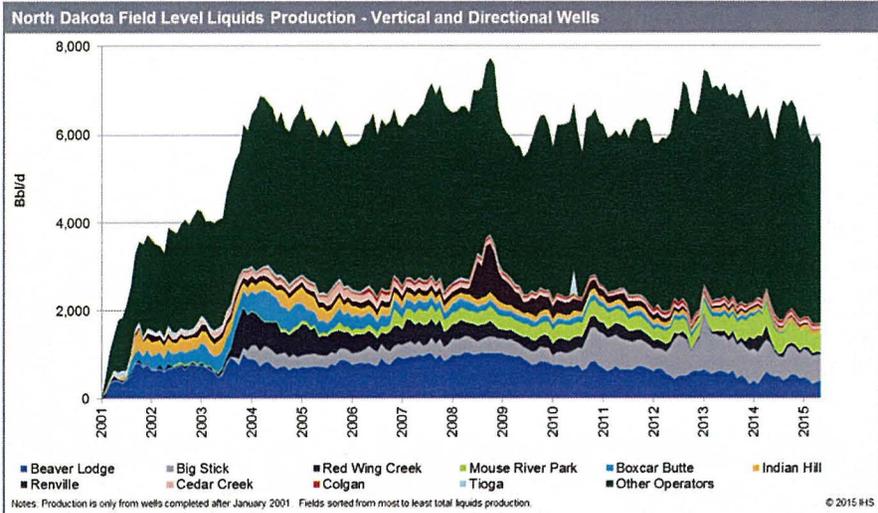
## Task 2: Oil and Gas Recovery Economics and Future Economic Impact

<p><b>Oil Formations in North Dakota</b></p>	<p>Study each of the key relevant reservoirs for EOR in ND. Characterize them in terms of:</p> <ul style="list-style-type: none"> <li>• reservoir quality</li> <li>• production,</li> <li>• known reserves</li> <li>• hydrocarbon types</li> <li>• and statistical estimate of yet-to-find (YTF) (if sufficient data is available)</li> </ul>
<p><b>Application of Existing Tax Incentives to Current &amp; Future Conditions</b></p>	<ul style="list-style-type: none"> <li>• Review of existing ND fiscal system</li> <li>• Compare the ND fiscal system with other producing states, federal lands and the Canadian provinces of Alberta and Saskatchewan</li> <li>• Apply the current fiscal system to current and expected future conditions <ul style="list-style-type: none"> <li>• A prediction of future activity can be made that takes into account the tax and commercial competitiveness of the plays in North Dakota given IHS's price forecast of supply and demand or any other forecast (e.g. EIA)</li> </ul> </li> </ul>
<p><b>Recommendations on Elimination, Modification or Addition of Incentives</b></p>	<ul style="list-style-type: none"> <li>• Develop an economic model <ul style="list-style-type: none"> <li>• Capital and operating costs</li> <li>• Production profile</li> <li>• Fiscal system (including federal, state, county level taxation, including royalty owners)</li> </ul> </li> <li>• Introduce alternative scenarios and run sensitivity analysis</li> <li>• Generate economic impact analysis for: <ul style="list-style-type: none"> <li>• State level</li> <li>• Political subdivisions</li> <li>• Environment</li> <li>• Fossil fuel production</li> </ul> </li> </ul>



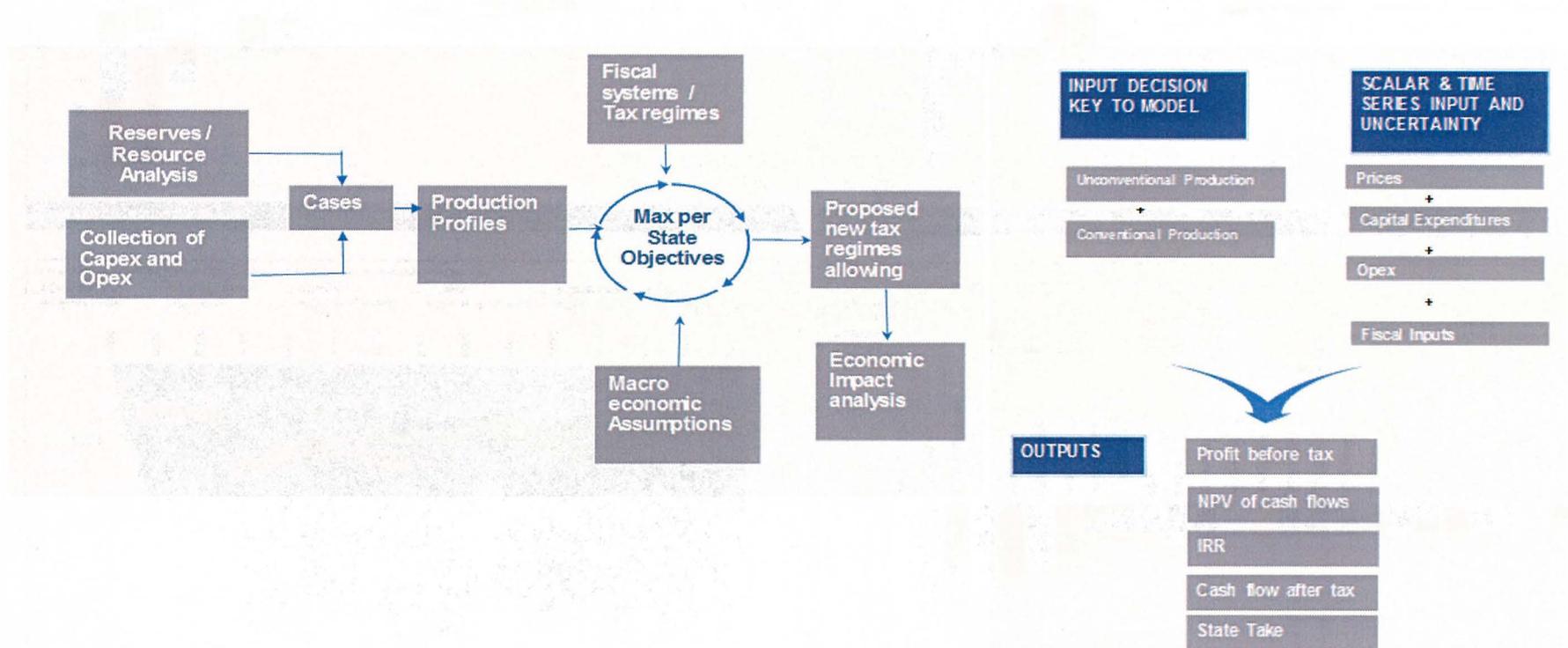
# IHS North Dakota Information

## Current and historical well and production data by field and operator

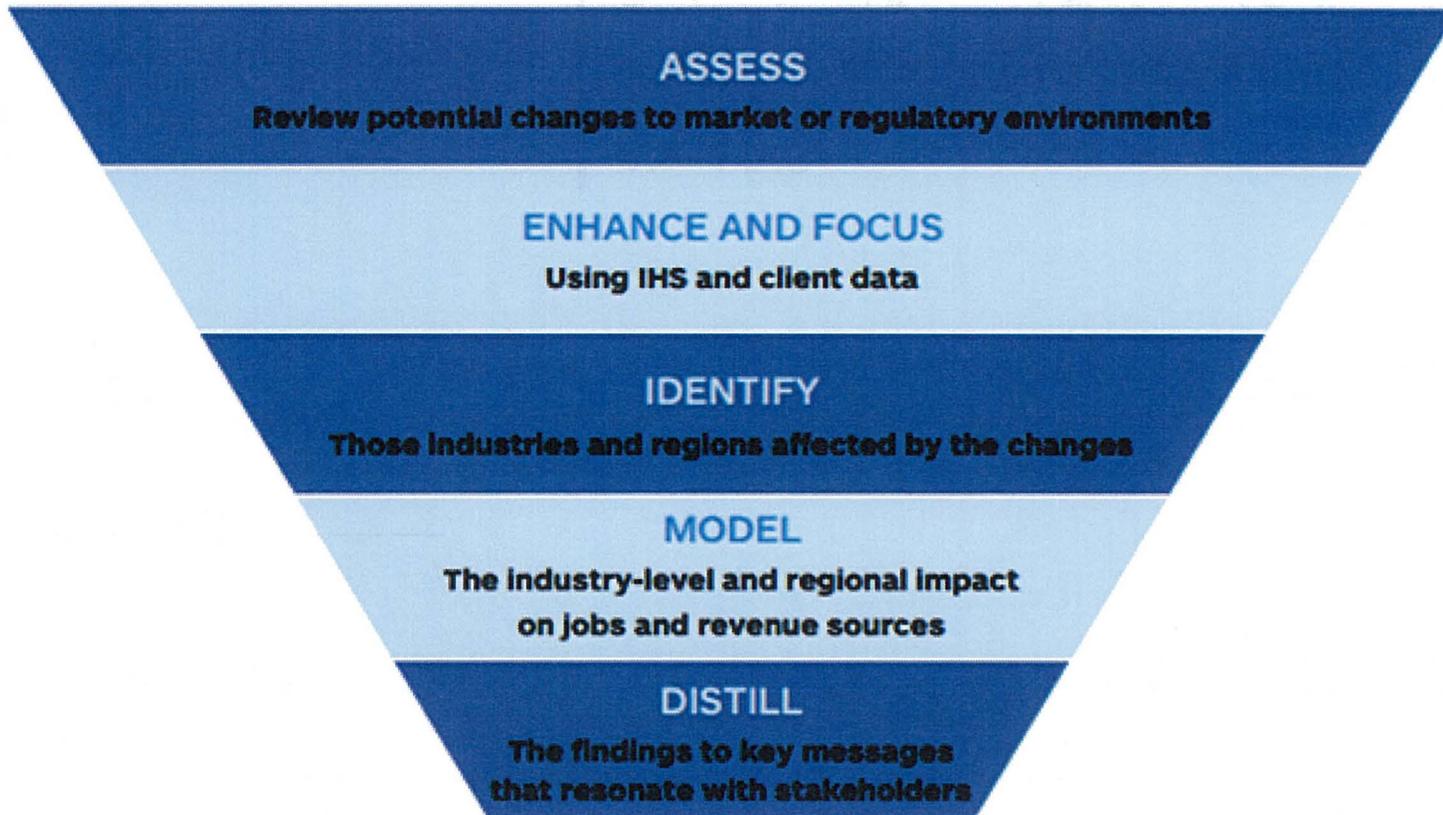


# Economic Analysis

## Workflow



# Economic Impact Analysis Model





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## Professional Fee and Timing of Deliverables

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No.	Task to be performed	Professional Fee	Schedule
1	Technical analysis	\$150,000	8 weeks from effective date
2	Tax and economic analysis	\$245,000	10 weeks from effective date
3	Ongoing Support	\$240,000	Throughout 2016
Total		\$635,000	

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## Main Project Team

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Name	Title	Background	Role in the Project
Irena Agalliu	Managing Director	Tax and Regulatory	Project Manager
Dan Bendig	Director	Geology and Geophysics	Project Consultant
Mohammad Tavallali	Principal Reservoir Engineer	Reservoir Engineering	Project Consultant
Ray Mireault	Senior Reservoir Specialist	Reservoir Engineering	Project Consultant
Aube Montero	Director	Economics and Modelling	Project Consultant
Mohsen Bonakdarpour	Managing Director	Macroeconomics	Project Consultant

# Irena Agalliu



## Background

- Irena is a Managing Director in IHS CERA Consulting Practice. She brings 18 years of contract negotiation, commercial and regulatory risk assessment, company activity analysis, bid evaluation, petroleum economics and policy and regulatory consulting experience.
- Prior to joining IHS, Irena was Legal Advisor for the National Petroleum Agency of Albania.
- Irena holds an LL.M. with distinction in Petroleum Law and Economics from Centre for Energy, Petroleum and Mineral Law and Policy (CEPMLP), University of Dundee, Scotland, and a JD from University of Houston Law Center. She is licensed to practice law in the state of Texas.
- Irena is a member of the State Bar of Texas and Association of International Petroleum Negotiators (AIPN). She was elected to the Board of AIPN in 2008 and served as Vice President of External Affairs for the 2009-2011 terms and VP of Planning for the 2011-2012 term. She co-chairs the AIPN Oil and Gas Asset Valuation workshop.

## Industry Experience

- Regulatory
- Oil & Gas
- Upstream
- Midstream
- LNG
- Climate Change
- Energy Policy

## Selected Experience

- **Development of Legislation & Energy Policy** – Led and managed the development of the CBM contractual framework for a South American nation, which involved identifying environmental, commercial as well as other above ground challenges associated with CBM development as well as the drafting of guidelines and model contract to promote investment in CBM.
- Led and managed the development of onshore related legislation for an African nation which involved identification of worldwide best practices and drafting of petroleum regulations related to land access, transportation of oil and gas by road, rail and sea as well as development of a gas market. Was also involved in drafting and development of energy related legislation in Albania, in particular in designing the government's policy for the deregulation and privatization of the national oil company.
- Provided independent expert review of proposed legislation governing petroleum upstream, midstream and downstream activities, revenue management in the oil and gas sector as well as local content participation in several African nations.
- **Unconventional Gas Regulatory Environment** – Led and managed the analysis of unconventional gas regulatory environment of 10 jurisdictions worldwide focusing on historical evolution of legislation governing coalbed methane, tight gas and shale gas in the respective jurisdictions identifying critical issues, key enablers and show stoppers, environmental concerns, management of overlapping mineral interests as well as regulatory trends and proposed legislation.
- Managed the above ground challenges and regulatory aspects of CERA's multiclient study "*Breaking with Convention: Prospects for Unconventional Gas in Europe*". The analysis focused on the role of unconventional gas in the EU Energy Policy, land access and permitting challenges in Europe, water management and suitability of existing legal framework for unconventional gas development.

# Irena Agalliu (continued)



## Background

- Irena is a Managing Director in IHS CERA Consulting Practice. She brings 18 years of contract negotiation, commercial and regulatory risk assessment, company activity analysis, bid evaluation, petroleum economics and policy and regulatory consulting experience.
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## Industry Experience

- Regulatory
- Oil & Gas
- Upstream
- Midstream
- LNG
- Climate Change
- Energy Policy

## Selected Experience

- **Bid Evaluation & Contract Negotiation** – was involved in bid evaluation and negotiation of enhanced oil recovery licenses in Albania on behalf of the National Petroleum Agency. Was also involved as advisor to the Board of Directors of the national oil company of Albania for the negotiation of joint venture agreements for enhanced oil recovery. Developed a negotiator's handbook for development contracts for an Asian NOC as well as a workshop on Development of Government Policy and Negotiation of Petroleum Agreements for an African nation. Recently advised the government of a Caribbean nation on bid evaluation for their offshore licensing round.
- **Comparative Analysis of Fiscal Terms** – has led the IHS research and consulting engagements related to comparison of fiscal terms by writing articles and presenting in industry forums on recent trends in fiscal terms, advising governments on optimization of their fiscal regime and supporting IHS CERA's expert testimonials before legislatures or in support of international arbitration of investment disputes.
- Is currently managing a study for the US Department of the Interior comparing the US Federal oil and gas fiscal systems with other international and north jurisdictions competing for investments in upstream oil and gas sector.
- **Country Entry and Company Activity** – has prepared new country entry reports and company activity analysis for various national oil companies and international oil companies assessing the commercial and regulatory risks, providing competitive peer reviews and advising on investment strategies.
- **Institutional Organization & Process Design** – led the legal analysis and developed the regulatory process roadmaps in connection with institutional re-organization and process design for a national oil company.

# Dan Bendig



## Background

- Dan is a Director-Consulting at IHS in Houston. He brings over 28 years experience in oil and gas industry. His expertise is in international exploration from new venture to development projects. Project management experience includes multi culture virtual teams with up to 15 contributing team members. He has worked both 2-D and 3-D seismic data onshore and offshore as well as being proficient at workstation interpretations.
- Prior to joining CERA, Dan has been VP of Exploration, Chief Geophysicist and senior geophysicist. His early career was with a major oil company with assignments in London (twice), Aberdeen, Jakarta and Houston. Areas covered include the North Sea, North Africa, Indonesia, West Africa, northern South America and central USA.
- Dan holds a BS in Physics, a MA in Geology and a MSc in Stratigraphy. DPA # 5649

## Industry Experience

- Exploration - Worldwide
- Development- North Sea
- Asset valuation – Worldwide
- SMT workstations
- Computer or paper interpretation
- Project Management
- Asset valuations

## Selected Experience

### Rank Wildcat Exploration

- Developed rank wildcat exploration along the northern margin of the Gulf of Mexico. This play is an analogue of the pre salt Brazilian oil play found along the South Atlantic margin. Lacustrine carbonates are interpreted to form during the opening of the GOM sourced by coeval organic rich carbonates. Seals are provided by the overlying Louann salt beds.

### Regional Exploration

- Completed block screening study for the current Brazilian 11<sup>th</sup> round. Completed block evaluation and risking for the current Ecuadorian Surorientado round. Compared clients Africa and South American exploration performance to their set of peers highlighting the success factor that the peers were using. Project leader for a team charged with evaluating the petroleum potential of Algeria. Project involved multiple trips to data rooms in Algeria including trips to the Sahara. Later data evaluation and analysis identified the sweet spots in the eastern section of the county.

### Appraisal and Development

- Led multiple teams of geologists, geophysicists and reservoir engineers assigned with moving exploration discoveries to producing fields in the North Sea. Project scope usually involved the planning and execution of 3-D seismic surveys, appraisal drilling to establish commerciality and the final drafting of a development plan.

### Project Management

- Planned, budgeted and executed multi year programs involving up to 15 geotechnical staff. Annual budgets per project were in the six figure range with total operating costs exceeding \$1MM. Capital costs for seismic were \$2-5MM with well costs up to \$25MM.

# Aube Plop-Montero



## Background

- Aube is a Director in the IHS Energy Insight Upstream Consulting Practice.
- Aube specializes in both international and North American upstream economics and strategic planning. Aube brings 12 years of experience in the oil and gas industry.
- Prior to joining IHS Aube spent 5 years with Schlumberger as a Business Analyst in the UK and in the US.
- Aube holds a Master degree in Finance from the University Rene Descartes (Paris V). Aube also completed a certificate in Petroleum Projects Evaluation and Management at Texas A&M Harold Vance School of Engineering .
- Aube speaks fluent English, French and Spanish.

## Industry Experience

- Upstream Oil & Gas
- Petroleum economics modeling
- Advanced GIS analysis
- Basins and Plays Statistical Analysis
- Reserves and Production Analysis
- Cost analysis and market forecasting
- Conventional Gas in the U.S.
- Unconventional oil and gas plays
- Petroleum Geology
- Local Content

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## Selected Experience

### **International Resource Assessment (Basins and Plays) (2008- 2009- 2010- 2012-2013)**

Ran and/or participated in strategic analyses for large projects focusing on resources located in Latin America, West Africa and Australia. Leveraged the IHS international databases to help rank and rate basins and plays. Conducted the related Yet-To-Find analyses. Led or participated to the score cards designs for the same projects.

### **Emerging Plays Upstream Strategic study : Latin America & Africa (2012)**

Enabled client understanding emerging plays and successful participants strategy in Africa and Latin America by conducting play level statistical analysis and assessing entry strategies of top operators.

### **Due Diligences, North American Unconventional Resources: (2010-2011-2012)**

For several clients considering acquiring assets in unconventional plays (Eagle Ford, Barnett, Utica, Marcellus, Wolfcamp), managed and/or participated in valuation projects estimating future production, costs, above the ground risks, acreage development risk and economics.

### **North America Unconventional Oil and Gas Play Ranking:(2011-2012-2013)**

Participated in 4 different large projects focusing on unconventional resources in the US. Roles varied from contributor to project manager. Leveraged IHS US database to provide a detailed geological and commercial framework analysis of the selected plays. Managed and delivered maps illustrating most of Unconventional North America plays activity, development type, productivity. Designed and maintained plays and operators scorecards.

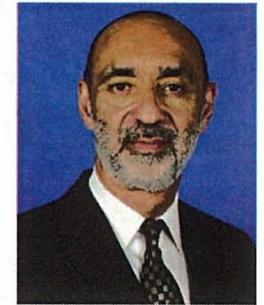
### **Major Project Development Support: (2010-2011)**

Delivered, for a government entity, a portfolio of deterministic economic models covering 32 different fiscal systems in 19 different countries. Models were developed in MS excel 2007 and allowed comparison of fiscal terms on key metrics such as NPV, IRR, Government Take, PI, economic limit and payout. Models also provided sensitivity analysis and break-even price calculations. Constructed and delivered a 3 days training course at the client site.

### **Worldwide Offshore High Pressure Drilling: (2012)**

Built detailed wall size maps providing deep water high pressure drilling potential in DW GOM, North East South America, South East Brazil, West Coast of Africa (Gulf of Guinea to Congo Basin), East Coast of Africa, Eastern Mediterranean Sea, Frontier North Sea, South East Asia and South Australia.

# Mohsen Bonakdarpour



## Background

- Mohsen is a Managing Director in the Technology Markets practice of IHS Global Insight and is responsible for directing advisory projects and product development for the telecommunication services and equipment industry. He brings more than 25 years of experience in telecommunication, industry, and macroeconomic analysis. He has worked with a wide range of clients, helping them to size their markets, predict product demand, and better target their marketing efforts. Mohsen has been responsible for development of a global communication component of IHS Global Insight ICT capability.
- Prior to joining IHS Global Insight, he worked in the Telecommunication Group at PNR & Associates and at the Center for Social Policy and Community Development.
- Bonakdarpour holds a Bachelor of Science in economics and computer science and a Master of Arts in economics from Temple University.

## Industry Experience

- Telecommunication
- U.S. industries
- Network technology
- Macroeconomics

## Selected Experience

- **Global market intelligence:** Worked with global networking companies to determine the potential size of their market by technology, vertical, segment, and geography. Key analyses included segmentation of their detailed technologies by market dimensions. The study was used to identify new areas of market opportunity and growth.
- **Global information and communication technology:** Participated in the development of IHS Global Insight ICT capabilities. Market sizing of information technology and telecommunication products and services by detailed dimensions on a global basis.
- **U.S. telecommunication segmentation:** Led the development and delivery of a detailed market segmentation model of telecommunication products and services to better forecast fixed-line product and services demand by region and vertical. He also directed a project for a wireless service provider to segment the .U.S wireless business market into voice versus data usage by region, vertical, and occupation.
- **Economic impact analysis:** Led a series of studies and developed methodologies to undertake economic impact analysis of events, economics, and trade policies. A simultaneous systems—macroeconomic and industry—were utilized to arrive at the comprehensive set of impacts.
- **Business market insight:** Managed the development and maintenance of IHS Global Insight's Business Market Insight (BMI), designed to support strategic planning, market segmentation, and economic development analysis. BMI tracks business activity by detailed market segment and geography and provides forecasts by state, metropolitan area, and counties of the United States.



# Ray Mireault – Senior Reservoir Development Specialist

## Background:

- Leads multi-disciplinary technical teams responsible for integrated assessment and development of new and existing oil and gas fields. Scope of work encompasses geology, geophysics, reservoir engineering, well drilling and completions, design and construction of production facilities, economic evaluations, development planning and regulatory applications. Provides quality control and mentors technical staff and regularly called upon as an expert witness for regulatory hearings and legal actions.
- Technical expertise encompasses reservoir engineering, waterflood optimization, well performance assessment, well completions, H<sub>2</sub>S/CO<sub>2</sub> disposal and sequestration, and Monte Carlo resource/reserve assessments.
- Technical advisor to IHS' Reservoir Engineering software development team for wellbore modeling, reservoir surveillance and Monte Carlo risk assessment of exploration/development prospects.
- Member of the Association of Professional Engineers and Geoscientists of Alberta (APEGA) and the Society of Petroleum Engineers (SPE).
- Holds a B.Sc. Agricultural Engineering, University of Manitoba at Winnipeg, Manitoba.

## Work Experience:

### **IHS Fekete, 1997 to Present**

- Senior Specialist, Reservoir Development
- Manager, Production Optimization

### **Independent Petroleum Engineering Consultant, 1995 to 1997**

### **Gulf Canada Resources Limited, 1978 to 1995**

- Senior Engineer, Deep Plains Reserve Additions
- Specialist Exploitation Engineer, Western Canada
- Exploitation Engineer, Western Canada
- Reservoir Engineer, Western Canada
- Field Production Engineer, East Central Alberta
- Facility Project Engineer, Western Canada

## Selected Publications:

- *R. Mireault SPE, P. Eng. R. Stocker Ph.D., P. Eng., D. Dunn SPE, P. Eng., M. Pooladi-Darvish SPE, Ph.D., P. Eng. Wellbore Dynamics of Carbon-Sequestration Injection Well Operation. SPE Paper 135485 presented at the SPE International Conference on CO<sub>2</sub> Capture, Storage, and Utilization held in New Orleans, Louisiana, USA, 10-12 November 2010.*



# Ray Mireault – Senior Reservoir Development Specialist cont'd.

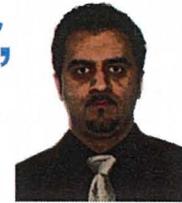
## Selected Publications Cont'd:

- *R. Mireault SPE, P. Eng. R. Stocker Ph.D., P. Eng., D. Dunn SPE, P. Eng., M. Pooladi-Darvish SPE, Ph.D., P. Eng.* Wellbore Dynamics of Acid Gas Injection Well Operation. CSUG/SPE Paper 135455 presented at the Canadian Unconventional Resources & International Petroleum Conference held in Calgary, Alberta, Canada, 19-21 October 2010.
- *Dean, L., Mireault, R.A.,* "Understanding Reservoir Geometry Helps Optimize Your Waterflood", Canadian Society of Petroleum Geology Newsletter, November 2006.
- *Mathison, J.E., Mireault, R.A., Wilhelm, J.K., Alwast, N.K. and Williams, S.K.* 2005. Reservoir Characterization of the Wabiskaw B in the Kirby Area, Alberta, Canada. SPE/PS-CIM/CHOA SPE-97926-PP, International Thermal Operations and Heavy Oil Symposium, Calgary, Alberta, Canada.
- *Mireault, R.A.* Pages 106-110 Chapter 6, Probability Analysis for Estimates of Hydrocarbons In Place In: Determination of Oil and Gas Reserves. CIM Petroleum Society Monograph No. 1 1994.

## Selected Project Experience:

- Horizon Oil Ltd.; Production and injection well modeling for gas cycling/condensate recovery project Papua New Guinea.
- Confidential Client; Assessment of Marcellus Shale Gas Development Potential in Eastern U.S.
- Oilexco Inc.; Integrated Reservoir Simulation Studies, Drilling and Production plans for the Shelley and Brenda Oilfields, North Sea, U.K.
- REPSOL YPF; Integrated geology-reservoir field development studies for oilfields near Comodoro Rivadavia, Patagonia, Argentina.
- Husky Energy; Evaluation of Horizontal Drilling Performance in the Viking Formation, Redwater, Alberta.
- Enerplus Resources Fund; Slave Point Oil Development Geology/Reservoir Study, Golden Field, Alberta.
- Enerplus Resources Fund; Pouce Coupe South Boundary Lake B Pool Waterflood Optimization, Alberta.
- Enerplus Resources Fund; Progress Field Boundary Lake B&C Pools Waterflood Optimization. Alberta.
- EnCana Corp.; Maxhamish Chinkeh Formation Reservoir Study and Future Oil Development Potential.
- EnCana Corp.; Waterflood Optimization Studies for Chauvin Field; Sparky D, I, K, L & M Pools and Lloyd D Pool.

# Dr. Mohammad Tavallali – Principal Reservoir Engineer, Reservoir Solutions



## Background:

- Assists in the reservoir modelling and simulation group, specializing in analytical and numerical modelling of hydrocarbon recovery and reservoir characterization.
- Involved in optimization of hydraulic fracturing for shale gas and CBM reservoirs, gas storage evaluations, wellbore modelling and flow characterization in pipes, fittings and wellhead facilities.
- Holds B.Sc. and M.Sc. degrees from Iran, and a Ph.D. in Petroleum Engineering from the University of Alberta.
- Member of Society of Petroleum Engineers (SPE).

## Work Experience:

### **IHS Fekete, 2011 to Present**

- Reservoir Engineer, Reservoir Solutions

### **ATECH Application Technology, 2008 to 2011**

- Reservoir Engineer

### **University of Calgary, 2006 to 2012**

- Ph.D. Research

### **National Iranian Oil & Engineering Company (NIOEC), Tehran, Iran**

- Process Engineer

## Selected Publications:

- MORAD, K., *Tavallali, M.*, "The benefits of reworking declining CBM wells", CSUG/SPE Conference, 15-17 November 2011, Calgary, Alberta, Canada.
- *Tavallali, M.*, Maini, B., Harding, T., "Evaluation of New Well Configurations for SAGD in Athabasca McMurray Formation", SPE EUROPEC/EAGE Annual Conference and Exhibition, 23-26 May 2011, Vienna, Austria.
- *Tavallali, M.*, Maini, B., Harding, T., "Numerical Optimization of Clearwater Formation's Response to SAGD under New Well Configurations", SPE Western North American Region Meeting, 7-11 May 2011, Anchorage, Alaska, USA.
- *Tavallali, M.*, Maini, B., Harding, T., B. Busahmin "Assessment of SAGD Well Configuration Optimization in Lloydminster Heavy Oil Reserve", SPE EUROPEC/EAGE Annual Conference and Exhibition, 20-22 March 2012, Vienna, Austria.

# Dr. Mohammad Tavallali – Principal Reservoir Engineer, Reservoir Solutions cont'd



## Selected Project Experience:

- Reservoir/Wellbore/PVT modeling to estimate the Cumulative Volume of Released Oil from the MC252 Macondo Well in Gulf of Mexico (United States Department of Justice).
- Experimental and numerical modeling of SAGD under new well configurations for three selected reservoirs of Athabasca, Cold Lake, and Lloydminster
- Deterministic analysis and numerical modeling of multi-fractured horizontal wells (more than 30 wells) in the Black Oil/Volatile Oil/Gas Condensate window of the Duvernay play. Studied the impact of Hydraulic Fracture Azimuth and well density on RF of the tight oil pool.
- Conducted reservoir simulation modeling to history match and optimize water flooding and infill drilling. Performed sensitivity studies to evaluate and select the best production scenario.
- Developed a stochastic methodology for history matching and sensitivity study of CSS project; CMG-STARs and Monte Carlo Simulation.
- Gas storage evaluation and optimization; Compositional modeling (CMG-GEM) and pseudo-miscibility option in Black-oil modeling (CMG-IMEX).
- Conducted history match and field development plan for conventional and unconventional reservoirs; CMG-IMEX/GEM.

## Selected Project Experience:

- Optimization of SAGD assessment for low viscous heavy oil of REX and GP Formations at Lloydminster area.
- Calibration and optimization of vertical and horizontal fracture extension in tight oil formations.
- Transient and Steady State multi phase flow modeling; OLGA HD/Well Module, MAXIMUS, and F.A.S.T VirtuWell™, PIPESIM.
- Optimization of hydraulic fracturing and well density for Unconventional reservoirs; CMG: IMEX/GEM
- Phase behavior modeling; CMG-WINPROP, PVT+, Calsep-PVTSim.
- Evaluation of hydraulic fracturing for declining CBM reservoirs; CMG-GEM, F.A.S.T CBM™.
- Conducted single well-test and interference test analysis; F.A.S.T WellTest™, PanSystem.
- Conducted analytical and numerical Rate Transient Analysis.
- Decline Analysis of oil and gas wells for future field development.

# Shawn Gallagher



## Background

- Shawn Gallagher is a Senior Consultant in the IHS regulatory group. She brings 14 years experience in the oil and gas industry.
- Previously, Shawn was product manager for the IHS Herold Global Projects database, which tracked financial and operating details of significant upstream oil and gas development projects. While in this role, she researched, wrote, and reviewed content for the database. Additionally, she helped design and implement expansion, enhancements, and marketing program for the database.
- Prior to joining IHS, Shawn worked in government and media relations for the National Petrochemical & Refining Association (NPRA). While at NPRA, Shawn handled media requests, oversaw the website development and content, and tracked federal energy and environmental legislation and regulations relevant to the refining and petrochemical industries.
- Shawn is a member of the State Bar of Texas. She has a B.A. from American University in Washington, DC, an M.B.A. from Thunderbird School of Global Management, and a JD from South Texas College of Law.

## Industry Experience

- Oil and Gas
- Energy Policy
- Compliance
- Environmental Policy
- Regulatory Issues

## Selected Experience

- **US Unconventional Transactions:** Researched and compiled background, data, and metrics on transactions in U.S and Canadian unconventional oil and gas plays for clients interested in developing facilities or evaluating which regions of the U.S. to invest or acquire property.
- **Review of Proposed Legislation & Energy Policy:** Reviewed a proposed legislative package for an IOC which involved benchmarking the proposed laws against worldwide best practices. The scope included a full review of the proposed laws, analysis of the impact on current and future IOC investments, and a comparison to comparable countries.
- **GE Regulatory Compliance Profile:** Researched key legislation, regulation, and authorities for targeted regulatory risk topics. Key deliverable was a spreadsheet detailing around 200 legislative and regulatory documents that would impact GE targeted categories. The regulatory profile included an of the UK energy sector, accreditation and certification processes, and regulatory overviews of 19 topics, ranging from renewable energy, health and safety, to environmental compliance.
- **International Upstream Development Projects:** Instrumental in the development of IHS Herold's Global Projects database, which sourced project information from publicly available data (financial filings, investor materials, etc.) and IHS sources. Familiar with IHS Herold databases, including the M&A Transactions and financial and operations databases.
- **International Regulatory Issues Impacting Unconventional Gas Projects:** researched key legislation, rules, and regulations on land use, water use and availability, transportation, and environmental reporting requirements in China and southeastern Europe. The findings were a included in the IHS CERA Multiclient Studies on Unconventional Gas Frontier.

# Stephen Adams



## Background

- Stephen is a Sr. Consultant in the IHS Consulting Practice. He brings 6 years of upstream petroleum economics and software design experience.
- Prior to joining IHS, Stephen was an Economist for ECD/CID within IHS developing software and database content for oil and gas business development scoping and portfolio modeling tools. He also was engaged in all financial decision product marketing, client relations, training and support within North and South America. Before that, Stephen worked with ConocoPhillips leases and contracts.
- Stephen holds a B.A. in Economics from the University of Texas at Austin and is fluent in Spanish

## Industry Experience

- Fiscal Regimes
- Accounting
- Finance
- Portfolio Economics
- Decision Analysis
- Probabilistic Modeling
- Cost Estimation

## Selected Experience

- **Play Analysis-** Reviewed and developed Roy/Tax calculation models for onshore U.S. and Canada shale, developed price differentials by play and developed the economic methods for the project. Additionally, provided research, financial interpretation and spreadsheet support.
- **Due Diligence of a Large Portfolio Bid-** Reviewed a client data room to develop threshold economics for prospective Middle East and CIS oil and gas discoveries within the portfolio by forecasting cost, production and delivery under varied reserve assumptions and modeling the fiscal systems of those discoveries in order to produce a series of project outcomes. Also, provided spreadsheet support.
- **Portfolio Transaction Analysis-** developed cost information for model wells in North American shale plays and assisted in the valuation of the transaction options by developing price differentials, advising on implementation of taxes into spreadsheet model. Ran Chrystal Ball simulations of the deal transactions. Prepared slides for client presentations. Reviewed Seller's data room to investigate peculiarities of the seller's valuation.

# Contents

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Proposed Scope of Work and Approach

Professional Fee and Timing of Deliverables

IHS Team Bios

**Our Expertise & Qualifications**

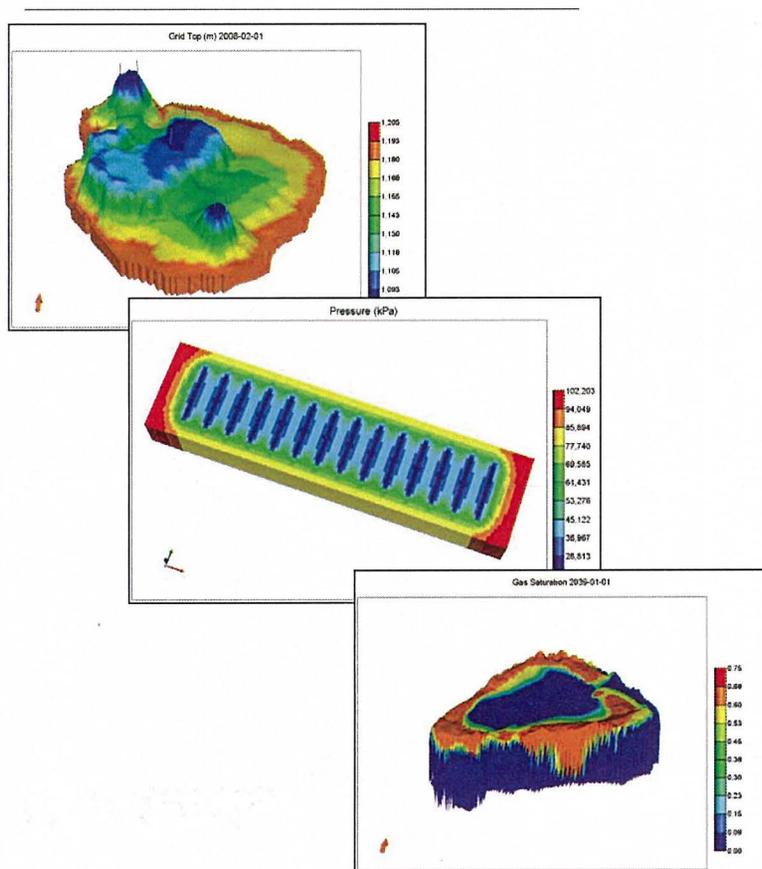
# Reservoir Engineering & Simulation

IHS provides an integrated team of reservoir engineers, geologists, geophysicists, petrophysicists, production engineers, simulation engineers, and computer specialists. Our results combine static and dynamic modeling into a comprehensive reservoir model that yields additional reserves and successful drilling locations. Simulation projects begin with a detailed review of data quality and a scoping analysis of data uncertainty. Simulation proceeds only after the analysis determines that the model is representative of the reservoir, that it will generate dependable results, and that it is economically justified.

In addition to its specific suite of services, IHS is often engaged to investigate unique reservoir situations for which no precedent exists and the solution path is unclear. Software: IHS Harmony™, Eclipse (Black Oil and Thermal), CMG (IMEX, GEM, STARS and CMOST).

Our project list includes:

- Waterflood design and optimization
- Thermal oil recovery
- Tertiary EOR schemes
- Infill drilling and pool depletion strategies
- Shale gas/oil development and optimal well spacing
- Coalbed methane
- Gas storage
- Carbon sequestration
- Gas hydrates



# Reservoir Modeling Study of CO<sub>2</sub> EOR Potential for an Ohio Naturally Fractured Tight Sandstone Reservoir

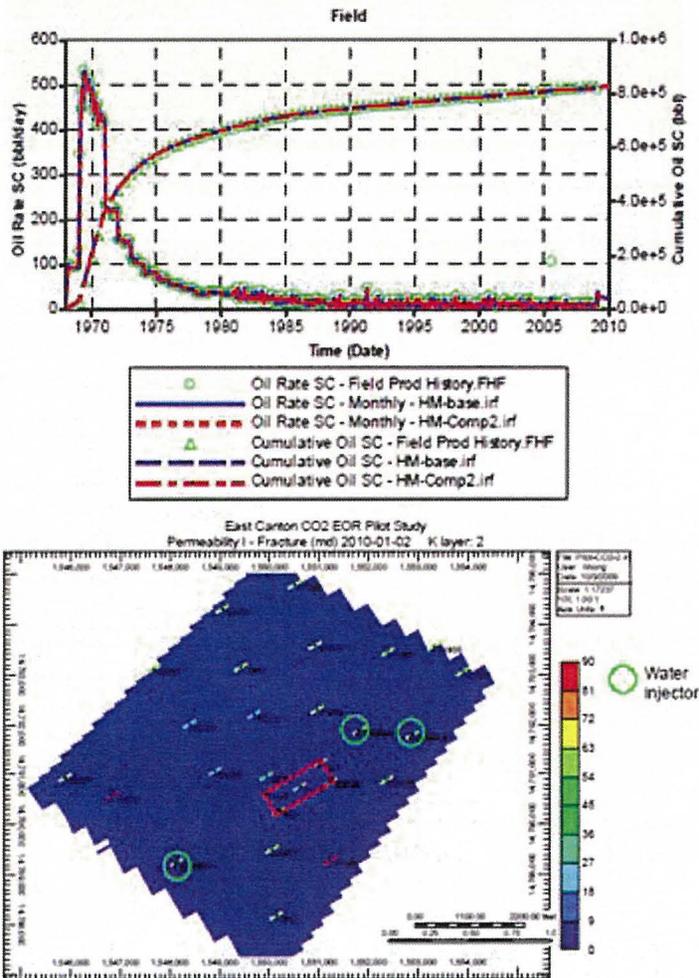


Figure 33: Map of the study area, showing pilot area-3 and designated water injectors. The colours represent permeability (in mD), with the hot colours identifying the high permeability in the hydraulic fractures.

## Initial situation

- An operator developed a tight naturally fractured reservoir under primary production, achieving a recovery factor of 7% after 40 years of operations. IHS was asked to evaluate the viability of an immiscible CO<sub>2</sub> EOR scheme.
- The client requested a detailed technical study and a sub-surface design for a CO<sub>2</sub> pilot injection project.

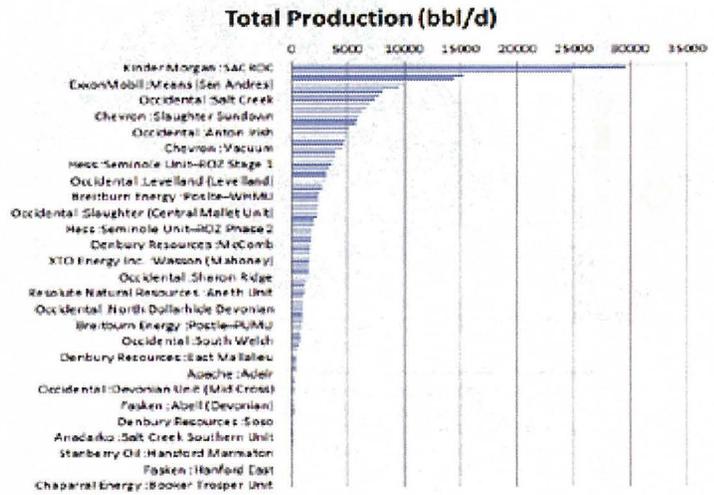
## What IHS Consulting did

- IHS undertook an extensive static and dynamic data review including geology, past performance, fracture spacing, relative permeability, and PVT.
- A dynamic field model was generated and used to history match production to date. The model was then used to design the pilot project by optimizing well placement and spacing.
- Sensitivity studies were done to assess the impact of uncertainty in PVT and reservoir characteristics on simulation results.
- Fluid and reservoir characterization work necessary to reduce uncertainty and calibrate the model was recommended.

## Impact

- The study showed that an additional 20% of oil can be mobilized with CO<sub>2</sub> injection, 60% of which can be captured by production wells within the pilot area.
- A range of production scenarios was generated taking into account uncertainty in input data.
- A pilot project was designed. Optimal well placement and spacing as well as optimal injection rates were specified.
- Recommendation were made to convert a number of producers into water injectors to create a shielding effect on the edges of the pilot area.

# Survey of Miscible CO2 Projects in North America



**Table with multiple columns and rows, likely representing project characteristics and metrics.**

## Initial situation

- A Japanese operator was pursuing a participation interest in an operating CO2 EOR project in North America.

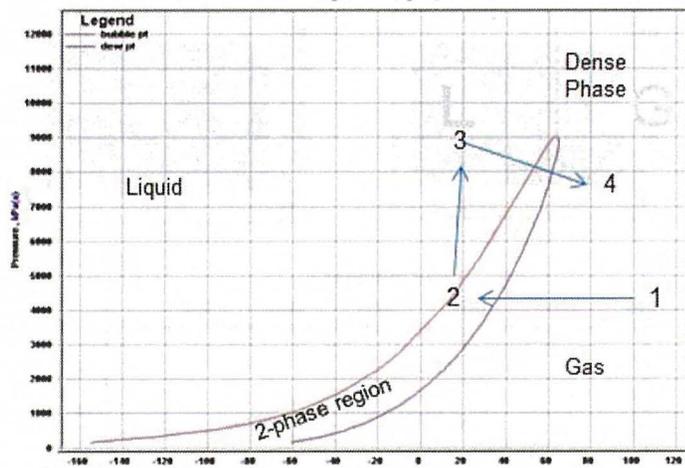
## What IHS Consulting did

- IHS conducted a survey and screening of all active projects (136 in USA and 10 in Canada). Investment opportunities and barriers to investment were identified.
- Typical project economics and fiscal terms were reviewed across various jurisdictions.
- Recent CO2 EOR property transactions were reviewed for valuation comparison purposes.
- The projects were assessed based on economic success, ease of CO2 sourcing, expected maturity and reservoir characteristics.

## Impact

- Following the initial screening, each candidate project was reviewed on an individual basis.
- The projects were ranked as marginal, potential, reasonable and good candidates.
- Finally, a few top picks were selected and recommended to the client.

# CO<sub>2</sub>/H<sub>2</sub>S Injection Well Pressure Modelling



1. Gas at Compressor Discharge Pressure and Temp.
2. Liquid or 2-phase at Wellhead Pressure and Temp
3. Liquid at bottom of wellbore
4. Gas at Reservoir Conditions

## Initial situation

CO<sub>2</sub> injection well operating pressures and temperatures are very different than industry experience with water injection wells or hydrocarbon gas storage wells. A methodology was required to accurately predict well and reservoir pressure behaviour through time

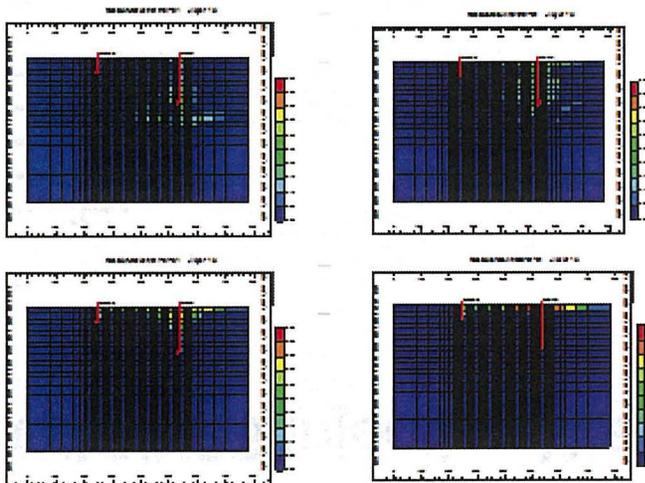
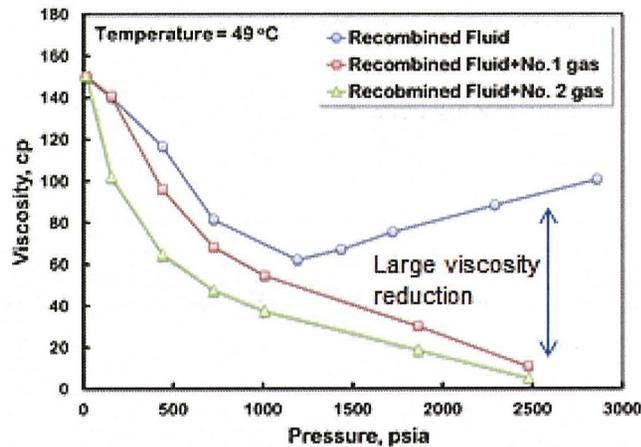
## What IHS Consulting did

- Identified the phase behavior of the injectate as it travels from the compressor to the wellhead and down the wellbore into the reservoir.
- Modeled the pressure and temperature profile through the reservoir for a given injection rate to estimate injection pressure and temperature at the bottom of the wellbore.
- Modeled the phase behaviour, flow patterns, friction pressure losses, temperature changes and hydrostatic head to determine the wellhead operating pressure using equation of state and finite element methods.
- Estimated operating conditions at the compressor discharge for compressor equipment design purposes.

## Impact

- Several projects have demonstrated that the methodology generates reliable wellhead operating pressure estimates through time.
- Wellhead pressure is constant over a wide range of injection rates and as depleted reservoirs re-pressure, which is unlike water or hydrocarbon injection systems.
- Forecasts of lower wellhead operating pressures than would otherwise have been estimated have proven accurate and led to less installed compression with capital and operating cost savings. Installing too much compression has been a chronic issue for the industry.
- Overdesign of the compressor for too high a discharge pressure can create a catastrophic safety hazard if a backpressure control valve is used to compensate for the pressure mismatch.

# WAG and Gas Injection – Heavy Oil



## Initial situation

A client was interested in investigating feasibility of various EOR process for improving the recovery of its heavy oil reservoir in Japan. Because of availability of local gas, immiscible gas injection and WAG were of special interest.

## What IHS Consulting did

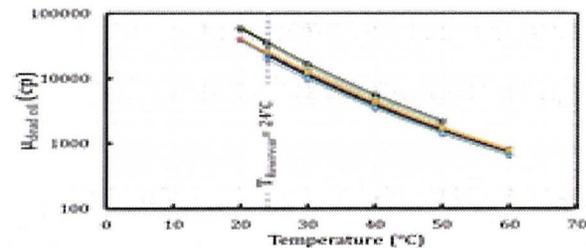
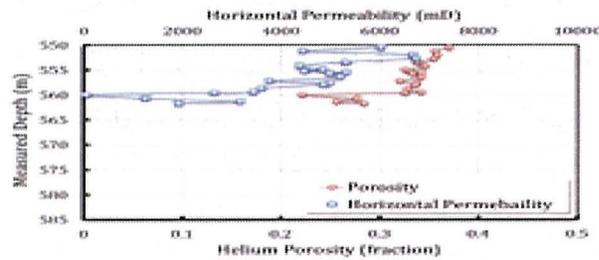
- An EOR screening method and numerical simulation were used to estimate the impacts of WAG and gas injection
- A single-well numerical model was built to estimate production under different injection scenarios. Of special interest were the unfavourable mobility ratio and how gravity forces could affect sweep efficiency

## Impact

- First-pass EOR screening suggested that none of the EOR processes are suitable. However, based on the large degree of under-saturation along with the viscosity measurements suggesting significant mobility improvement associated with immiscible gas injection at the virgin reservoir pressure, a WAG-based EOR was recommended.
- An analogue operation was identified and used to draw learnings.
- Injection and production profiles for a number of cases were simulated and provided to the client for economic evaluations

# Screen EOR Potential of a Heavy Oil Reservoir

Screening Criteria	Unit	Reservoir Value	?	Passing Value	Result
Depth	m	565		(150 - 1800)	Pass
Live Oil Viscosity @ 10 <sup>2</sup>	cp	10000		(2 - 5000)	Fail
Horizontal Permeability	mD	3500	>	50	Pass
Bottom Water		Local	<	Local	Pass
Gas Cap		Local	<	Local	Pass
Fracturing		NO	<	NO	Pass
Net Pay Thickness	m	10	>	3	Pass
Porosity		0.33	>	0.18	Pass
Dil Transmissibility	mD.m/cp	3.5	>	1.5	Fail
Oil Content		0.136	>	0.065	Pass



## Initial situation

A client with experience in cold production from the shallow Wabiskaw formation in Alberta, was interested to explore whether enhanced oil recovery (EOR) processes could be considered to improve production and expected ultimate recovery from its properties.

## What IHS Consulting did

Addressing the client's question only required a first-pass screening-level assessment rather than an in-depth technical evaluation. IHS applied two different approaches: 1) use of EOR screening criteria, and, 2) study of analogues.

## Impact

- The EOR screening criteria suggested that none of the steam-based techniques were suitable for this reservoir as a result of the combination of small pay thickness and high viscosity. Thus we determined that further study of polymer flooding and in-situ combustion was warranted.
- The evaluation of analogues suggested that though polymer flooding had proven successful for reservoirs with oil viscosities greater than those indicated by the screening criteria, this was not the case for viscosities as high as the property of interest.
- Although an in-situ combustion pilot project in a formation with similar properties was identified, there was insufficient data to permit further analysis.
- Given the client's relatively low risk tolerance and the complexities of in-situ combustion, we recommended they continue with the cold production depletion strategy, at least until more data for the combustion pilot was available to further assess the viability of this method.

# IHS Energy Regulatory Framework Engagements

*Experience developing energy legislation, fiscal terms, and contractual frameworks*

- Commissioned by Governments, or by National Oil Companies
- Benchmark against, and introduce international best practices
- Seek stakeholder engagement and feedback
- Gap analysis of existing legal framework
- Benchmarking of fiscal terms, development of economic models and scenario analysis to determine alternative fiscal systems and fiscal incentives
- Market analysis to determine competitiveness in the global market
- Drafting of energy policy, legislation, contractual framework and model agreements
- Support in explaining the need for, and benefits of the proposed legislation
- Cover a wide range of topics such as:
  - Upstream operations regulation
  - Oil and gas taxation
  - Health and safety
  - Environment
  - Land access
  - Resource conservation
  - Local content
  - Natural gas market regulation
  - LNG taxation, etc.

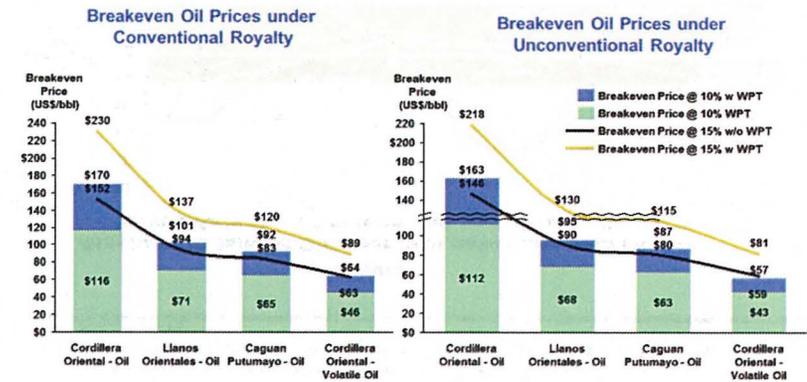


# Energy Policy and Legislation Drafting

## Selected Highlights

### Colombia: Shale Gas and Tight Oil Contractual Framework

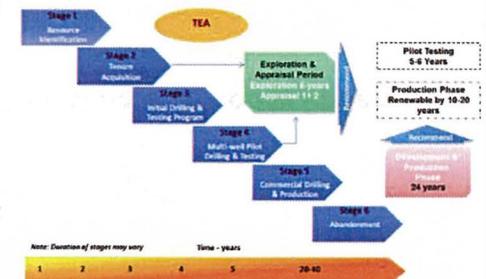
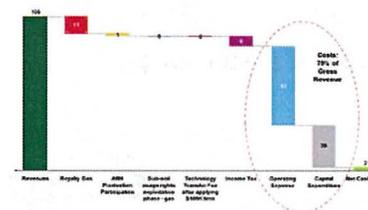
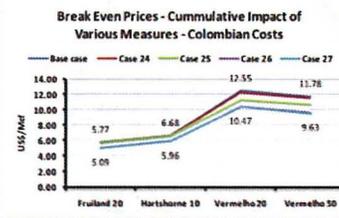
- IHS conducted an analysis of the economic scenarios that would serve as the basis for the formulation of the fiscal terms for tight oil and shale gas model contract
- IHS conducted sensitivity analysis of key variables of the fiscal system such as royalty, taxes, the threshold price for windfall profits tax. The analysis took into consideration project size, type and location; types of fluid; oil and gas price projections; operating costs; market conditions etc.
- Recommended alternative fiscal systems focusing on measures needed to attract investment under the projected oil and gas prices.
- Reviewed and evaluated comments submitted by various stakeholders regarding fiscal terms and provisions of the model contract.
- Made recommendations regarding legal and contractual provisions necessary to enable the development of shale gas and tight oil in Colombia.



### Colombia: Development of CBM Contractual Framework

The project consist of three phases:

- Identification of the specific challenges associated with CBM exploration and production. We drew from international experience with CBM development with particular focus on US, Canada and Australia.
- Development of guidelines governing exploration and production of CBM in Colombia. The guidelines covered various aspects with regard to overlapping mineral rights, fracing, water management, and other environmental aspects including surface footprint.
- Design of a contractual model for designation of areas for exploration and production of CBM as well as mechanisms for resolving possible conflicts between coal and CBM producers.



# Energy Policy and Legislation Drafting

## Selected Highlights

### Russia: Optimization of Oil and Gas Sector Taxation

- IHS CERA was invited to advise the ministry on fiscal reform, and to advance a fact-based policy dialogue for the oil industry in Russia through a series of working group meetings involving representatives of leading Russian oil companies.
- Provided the Energy Ministry with a report on trends and problems in the Russian oil industry, including factors affecting capacity and production.
- Leveraging the global oil upstream expertise of IHS, provided the Energy Ministry with a comparative analysis of oil taxation in global perspective.
- Participated in a series of workshops involving representatives of the Energy Ministry, other consulting organizations, and oil companies.

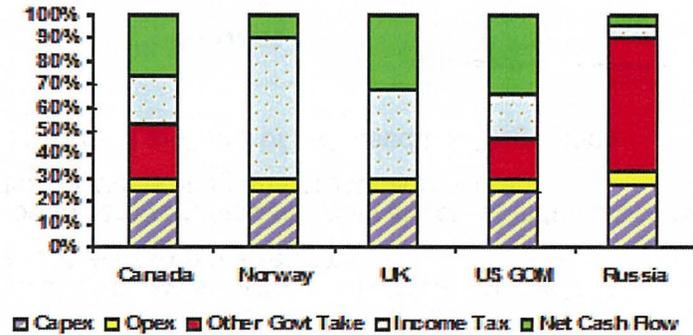
### Canada: Assessing the Impact of Proposed GHG Policies on existing and future investments

The Canadian government was considering the introduction of minimum GHG intensity reduction obligations for upstream oil and gas developments based on 2012 GHG emission intensity baseline data.

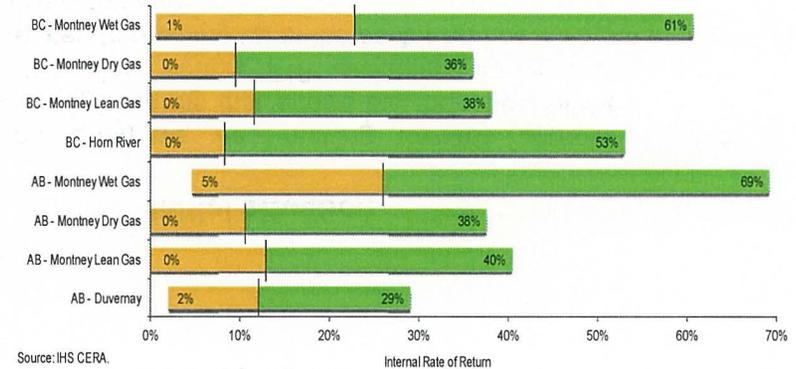
Organizations failing to achieve the minimum reduction obligation through physical reductions or offsets would be assessed a carbon tax (\$/ton CO2 charge) for all GHG emissions over the target amount

The Canadian Association of Petroleum Producers engaged IHS to assess the impact of the potential federal GHG policy scenarios on the competitiveness of new Canadian oil and gas upstream projects

**Figure TK**  
How Different Countries Tax a Barrel of Oil:  
(Price \$100/bbl)



**Range of Canadian Shale Gas Project IRRs under various GHG Policy Scenarios**



# Assisted PEMEX with Regulatory and Commercial Aspects of the Energy Reform

## Dependence on Oil Revenues Shapes Policy Decisions

Restricted Access

- Do not offer acreage on a regular basis
- Experience periods of high and low investments due to decisions to withdraw acreage when commodity prices are low

Oil Revenue Share of GDP of Major Exporting Countries

	Oil Revenue as % of GDP	Oil Revenue as % of Exports	Role of Regulator	Commercial
Angola	40%	92%	X	X
Algeria	30%	95%	-	X
Venezuela	30%	95%	X	X
Libya	25%	95%	X	X
Russia	17%	60%	-	X
Kazakhstan	11%	90%	-	X
Malaysia	10%	11%	X	X

Source: IHS PEPS

Expeditious Development

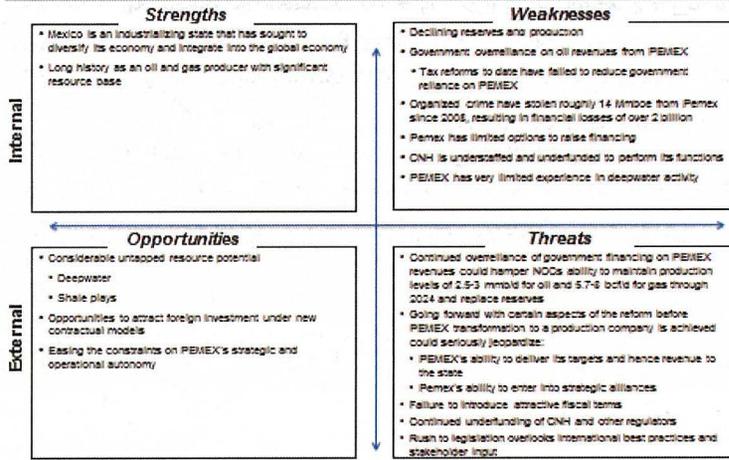
- Hold regular licensing rounds on annual or by-annual basis

Oil Revenue Share of GDP of Major OECD Countries

Country	Oil Revenue as % of GDP
Canada	5%
Australia	4%
United Kingdom	2%
United States	1%

Source: U.S. Bureau of Economic Analysis (BEA), International Monetary Fund

## Mexico Upstream Hydrocarbon Sector – SWOT Analysis



## Initial situation

- As Mexican Congress was moving towards approval of the sweeping energy reforms that ended the monopoly of the state oil company, the client sought IHS assistance to understand best practices related to opening up of the sector and assist them in their strategy moving forward.

## What IHS Consulting did

- IHS drew best practices from other national oil companies that had undergone reforms over the past two decades with respect to: strategic partnerships; success factors; contractual mechanisms for various types of assets; NOC autonomy; role of regulator, round zero process etc.
- SWOT analysis of Mexico's upstream hydrocarbon sector and challenges associated with the reform
- Provided a round zero roadmap to assist the client in the process to justify retention of exploration and production acreage
- Provided independent analysis of proposed E&P legislation

## Impact

- IHS's assistance enabled client to
  - influence certain aspects of the energy reform,,
  - prepare for the round zero application process
  - Develop a plan for strategic alliance in the framework of round zero as well as open acreage
  - Influence changes in proposed Petroleum Revenue Bill and Hydrocarbon Law

# Energy Policy and Legislation Drafting

## Selected Highlights

### Mexico: Assistance in Development of Health and Safety Legislation for Upstream Activities

IHS is drawing from best practices applicable in Alberta, Brazil Norway, UK and US to develop comprehensive regulations related to health and safety and environment.

Conducted gap analysis of existing legislation

Is developing the HSE framework to apply to onshore and offshore activities

Drafting environmental regulations related to pollution from oil and gas and environmental impact assessment

Is drafting regulations related to shale gas and tight oil activities.

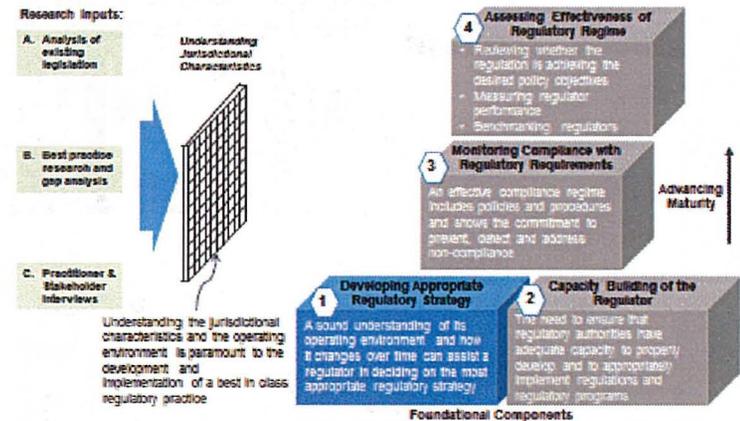
### Angola: Development of Legislation and Regulations for LNG Exports

IHS was engaged to assist in reviewing existing terms and developing legislation to encourage investment in LNG integrated projects as well as development of a domestic market for gas.

- IHS conducted a market analysis of LNG supply demand around the globe, breakeven price analysis of Angola's integrated LNG projects, benchmarking of fiscal terms and modeling of alternative fiscal terms
- IHS conducted a gap analysis of existing regulatory framework governing natural gas E&P development and taxation
- IHS developed draft legislation for taxation of integrated and non-integrated LNG projects as well as amendment of existing regulations to grant IOC's title over natural gas discoveries and associated gas.

### Regulatory Framework Philosophy

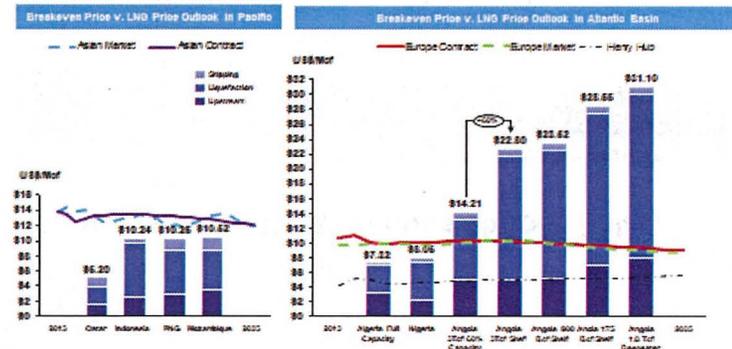
Understanding operating environment is critical in building the regulatory framework



© 2014 IHS

### Angolan non-associated gas projects are not competitive in the Atlantic basin

The special levy for LNG exports results in 60% increase of the breakeven price required for non-associated gas LNG projects. The levy is designed on the assumption of zero feed cost of associated gas.



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# Energy Policy and Legislation Drafting

## Selected Highlights

### Mexico: Assisted client with commercial and regulatory aspects of the Energy Reform

IHS drew best practices from other national oil companies that had undergone reforms over the past two decades with respect to: strategic partnerships; success factors; contractual mechanisms for various types of assets; NOC autonomy; role of regulator, round zero process etc.

SWOT analysis of Mexico's upstream hydrocarbon sector and challenges associated with the reform

Provided a round zero roadmap to assist the client in the process to justify retention of exploration and production acreage

Analyzed and provided independent expert review of proposed legislation

### Yemen: Development Legal and Contractual Environment for Oil and Gas Investment

Revision of the legal and contractual environment. This involved assessment of the experiences and opinions of the MOM and the holders of PSAs in relation to the model PSA, and benchmarking against the legal framework of other countries;

Revision of organisational arrangements of the Ministry of Oil and Minerals. This involved assessment of the operational relationships between the MOM and stakeholders (e.g. governmental organisations, contractors etc.) in order to identify where improvements might be made in terms of procedural clarity, transparency, efficiency and governance practices;

Revision of Yemen's licensing round strategy. This involved assessment of existing processes for the organization of exploration licensing rounds in order to provide recommendations to put in place a clear and transparent framework and secure the long-term monetisation of national resources, including gas reserves.

### Dependence on Oil Revenues Shapes Policy Decisions

**Restricted Access**

- Do not offer acreage on a regular basis
- Experience periods of high and low investments due to decisions to withdraw acreage when commodity prices are low

**Oil Revenue Share of GDP of Major Exporting Countries**

	Oil Revenue as % of GDP	Oil Revenue as % of Exports	Role of Regulator	Role of NOC Commercial
Angola	40%	92%	X	X
Algeria	30%	95%	-	X
Venezuela	30%	95%	X	X
Libya	25%	95%	X	X
Russia	17%	60%	-	X
Kazakhstan	11%	90%	-	X
Malaysia	10%	11%	X	X

Source: IHS PEPS

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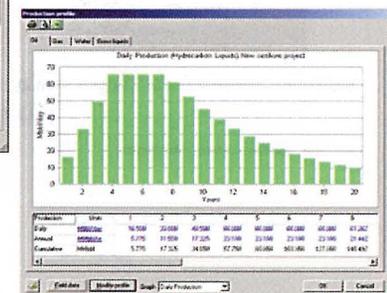
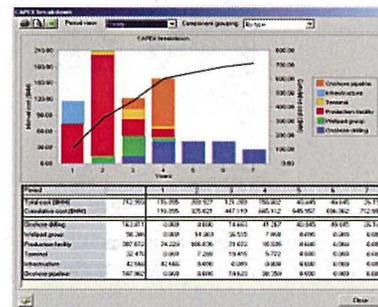
**Expeditious Development**

- Hold regular licensing rounds on annual or by-annual basis

**Oil Revenue Share of GDP of Major OECD Countries**

Country	Oil Revenue as % of GDP
Canada	5%
Australia	4%
United Kingdom	2%
United States	1%

Source: U.S. Bureau of Economic Analysis (BEA), International Monetary Fund



# Energy Policy and Legislation Drafting

## Selected Highlights

### Barbados: Development of offshore petroleum legislation

IHS was engaged by the Ministry of Finance, Economic Affairs and Energy of Barbados to undertake the development of a new offshore legislative regime for Barbados

Developed a proposed framework for the new legislative regime, which due to the experience of the Ministry in offshore matters and the lack of resources available to the Ministry, was based on a royalty / tax model;

Based on best industry practice reviews undertaken utilizing the PEPS product and the government objectives determined at early meetings, drafted three documents to govern the offshore oil and gas industry, the Offshore Petroleum Act, the Offshore Petroleum (Taxation) Act and the Offshore Petroleum Regulations.

### Kuwait: Development of Regulations for Conservation of Petroleum Resources

IHS was contracted by Kuwait 's Ministry of Energy to assist in the upgrading and modernization of the national regulatory system as it relates to upstream and downstream (refining and petrochemicals) petroleum activities. IHS carried the following tasks:

Re-drafted Kuwait's 1989 *Petroleum Conservation Regulations*, which cover all aspects of petroleum development and operations, both upstream and downstream.

Drafted Health and Safety guidelines for the oil and gas sector and define facility based inspection checklists

Benchmarked Kuwait's contractual arrangements against international best practice using IHS proprietary information.

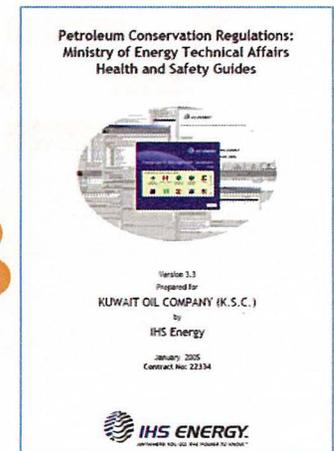
Developed recommendations for the re-organization of the Ministry of Energy's Technical Affairs Department

Developed an effective hierarchy-based supervision and auditing system, to assist the Ministry of Energy to manage and regulate petroleum activities in Kuwait

Policy Changes as Industry Matures

Economic Environment	Hydrocarbon Policy	Extraction Strategy	Development of Supply Chain	Oil Company Buying Behaviour	Possible Development Policy
Priority on reducing budget deficit and/or producing energy for industry.	Accelerated production policy.	Introduction of IOC to accelerate production.	Immature, little competitive strength.	International/fastest/ most competitive suppliers.	Low (~10%) local content rules. Supplier creation and FDI promotion through information; provision of capital etc. Offset project.
Balanced budget. Fairly stable economy. Longer term issues considered.	Maximised production policy.	NOC/IOC relationships develop over time. Interest in technological applications.	Local capability developing. Mix of indigenous, FDI and FDI.	Often in-country for basic elements. International buyout of technology.	Medium (~50%) local content rules. Supplier development. Technology focused JOINT VENTURE activity. Pricing preference policies to strengthen local capability.
Positive balance of payments. Well-managed economy. Access to alternative energy resources.	Industry placating. Fiscal adjustments to optimise sector performance.	Strong IOC presence. Right of extraction without recourse to NOC. Significant technological applications.	Well-developed local capability. Capable of regional exporting, often with a technological focus.	Predominantly in-country for both basic requirements and some technologies.	High (~75%) local content achieved without regulation. Focus on technology aspects of supplier development. Exporting initiatives. No price preference. Domestic industry becoming internationally competitive.
Globally competitive economy, accessing international energy sources.	Mature industry of global significance.	Low-risk/low-return harvesting. Free market. Multiple IOCs. Some end of life new entrants.	Comprehensive local capability. Frequently exporting globally. Strong technological focus. Second and third generation merger and acquisitions.	Frequently in-country for most requirements. Close relationship with suppliers to forge new technologies and new operating relationships.	No local content rules. Free market practices. Domestic industry globally competitive, requiring no protection. Industrial development focused on access to capital markets to sustain growth. Promotion of exports and diversification.

### Health and Safety Issues

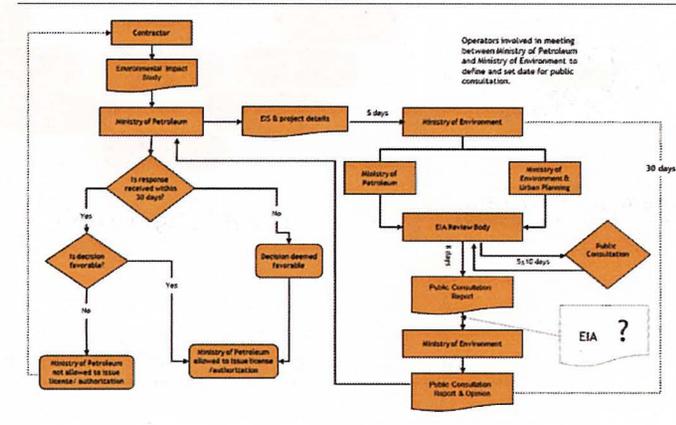


# Energy Policy and Legislation Drafting

## Selected Highlights

### Angola: Development of E&P Regulations

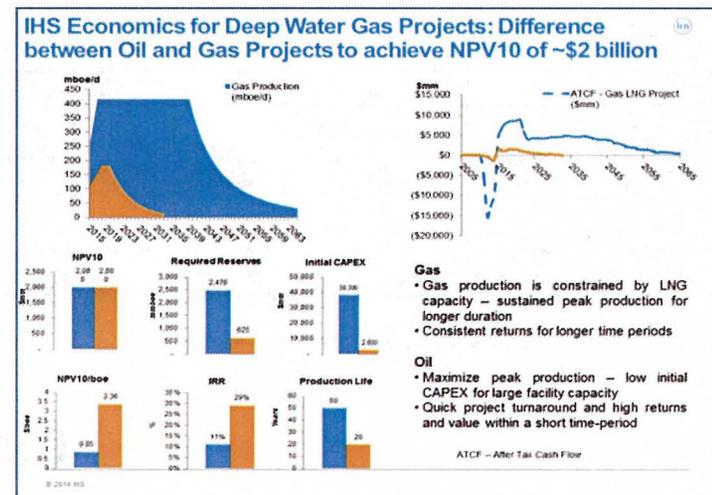
- IHS Energy researched and reported on laws, policies and procedures that were:
- IHS Energy, in collaboration with client, identified and reported on where gaps existed within the host country's legal framework, and developed regulatory permitting roadmaps.
- IHS Energy assisted the host government with drafting proposed legislation and regulations governing access to land, health and safety and transportation by road and pipeline.
- IHS Energy provided assistance, to arrange and facilitate any requirement for public or industry consultations and the reporting of comments to the Ministry or any other government agency or interested industry parties.



### Israel: Assisting Ministry of Energy and Water Resources with Regulatory and Commercial Developments

Support has been both strategic and operational, including the following:

- Review of insurance documentation and comparison with best practice;
- identifying an organisation that has the capabilities/capacity to act as a proxy for the MEWR in terms of HSE inspections/audits;
- Drafting Operator Guidelines;
- Reviewing wholesale gas prices and review of the domestic market;
- Providing guidance & advice on the calculation of well-head royalties;
- Review of best practice in drafting operating agreements;
- Definition of criteria for selecting operators;
- Review of performance guarantee requirements;
- Establishing a national data repository;
- Reserves assessment studies for specific fields;
- Facilitating a basin review study
- Petroleum law Review & establishing a road map for regulatory change;
- Reviewing opportunities/options for an international licensing round.

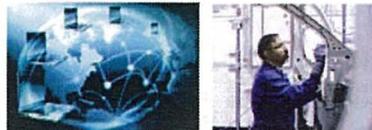


# The Tear Sheet – Economic Contribution on One Page

## Local Commitment

Highlights a local partner to demonstrate local commitment and build goodwill

Through continued commitments from Company X, I have been able to grow my business tenfold. This year alone, I will bring on probably another 100 employees.  
*Stakeholder Quote, Company Z*



## Key Messages

Summary of how the local community has benefitted from Company X's regional presence

Company X's spending helps support roughly 0.6% of gross domestic product and backs jobs over a diverse set of industries. Plus, the average wage for professions stimulated by Company X's presence between 2009 to 2013 was \$59,500; that's 21% higher than the national average.

Higher wages mean people have more discretionary income to spend with local businesses, triggering even more economic growth for the US economy.

Company X's spending with companies in the US sets in motion a cascade of economic activity: as their suppliers spend further with local companies, those employees, in turn, spend their income on consumer goods and services.

In fact, over a five-year period, Company X stimulated a total of \$140 billion in sales for US businesses; Company X's direct spending of \$87 billion fueled an additional \$103 billion of sales activity nationwide.

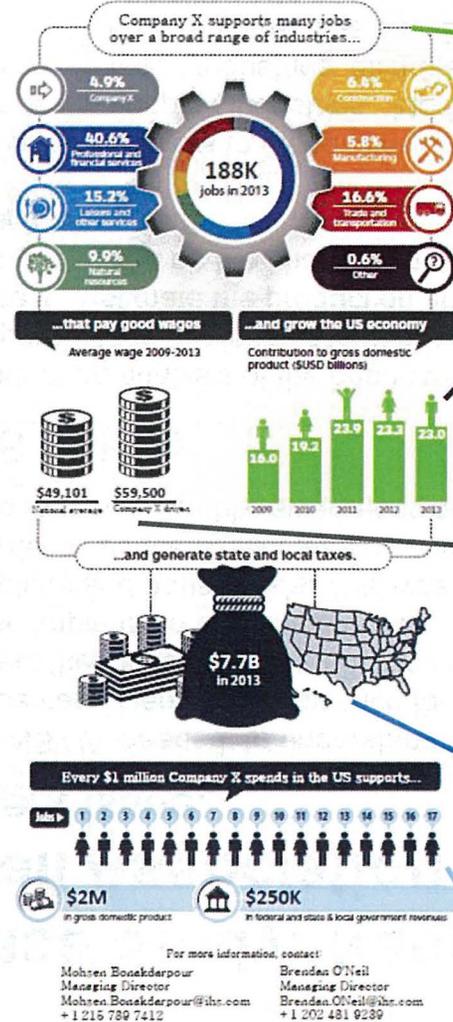
## Branding

Releasing the tear sheet in the public domain increases IHS brand awareness



Information  
Analytics  
Expertise

## Economic Impact of Company X in the United States



## Jobs

Company X supports a diverse supply chain – much more than just its direct operations

## Growth

The regional economy is bigger due to Company X's local operations

## Wages

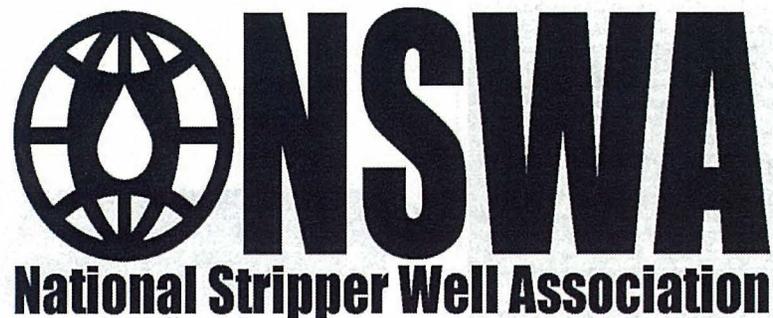
Higher average wages = more purchasing power

## Taxes

Government revenues that can be used to fund infrastructure, education, etc.

## Return on Investment

Shows the regional return on Company X's investment, as measured by economic indicators



[www.nswa.us](http://www.nswa.us)  

## Case Study: National Stripper Well Association

### Client Issue:

The NSWA needed to understand how eliminating the Percentage Depletion Allowance for federal tax purposes would impact their industry. Further they needed to understand how these impacts on their industry would ripple through to their suppliers and households. This was considered essential for them in order to educate law makers contemplating this change as well as to increasing public awareness of the issue.

### IHS Solution:

Conduct an analysis of the change in cash flows with and without the percentage depletion allowance for companies eligible to utilize it. Estimate the production and capital expenditure changes based on the changes in cash flow (and profitability) for these companies.

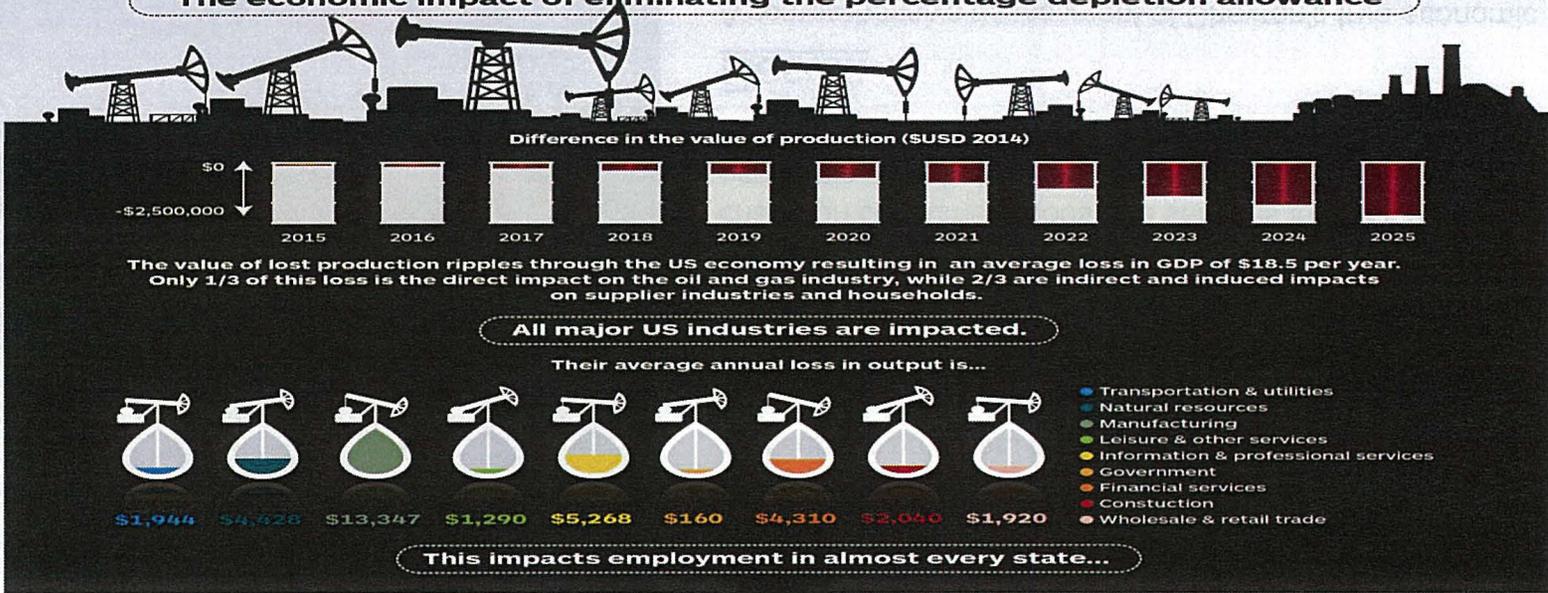
Trace the suppliers to these companies and thus spending changes in supplier industries. Model how the direct spending changes in these industries ultimately impact employment, wages, government revenues and GDP/GSP.

### Result:

A comprehensive assessment of the policy impact on industries, states, royalty owners and the federal and state and local governments in easy-to-communicate terms: jobs, wages, etc.

# Case Study – Economic Impact of Percentage Depletion

## The economic impact of eliminating the percentage depletion allowance



### Average employment impact 2015-2025\*

- >10,000
- 1,000-9,999
- 100-999
- <100

\*Job losses due to the elimination of the percentage depletion allowance



### ...this also affects royalty owners...

#### Top 5 states with largest royalty impact 2015 and 2025

Year	1	2	3	4	5
2015	Texas: \$171,348	Oklahoma: \$31,207	Louisiana: \$12,751	Colorado: \$8,578	Kansas: \$7,254
2025	Texas: \$4,821,874	Louisiana: \$830,237	Oklahoma: \$764,365	Colorado: \$397,259	North Dakota: \$339,803

### ...and federal taxes.

#### Federal tax implications of eliminating the percentage depletion allowance for oil & natural gas 2015-2024 (USD millions)



\* "Estimated Budget Effects Of The Revenue Provisions Contained In The President's Fiscal Year 2015 Budget Proposal" Submitted (4/15/2014) at <https://www.jct.gov/publications.html?func=startdown&id=4585>.

\*\* IHS estimates were inflated to constant dollars to match JCT's constant dollar estimates.



## Case Study: Chevron

### Client Issue:

Chevron needed an effective way to communicate the economic contributions its operations make to the regions in which it operates. This was considered vital to enhancing on-going negotiations with local governments and to increasing public awareness.

Previous efforts by Chevron's Government Relations and Public Relations teams to communicate local social investments and direct employment were incomplete and marginally effective.

### IHS Solution:

Conduct an analysis of Chevron's spending with local suppliers and service providers by industry.

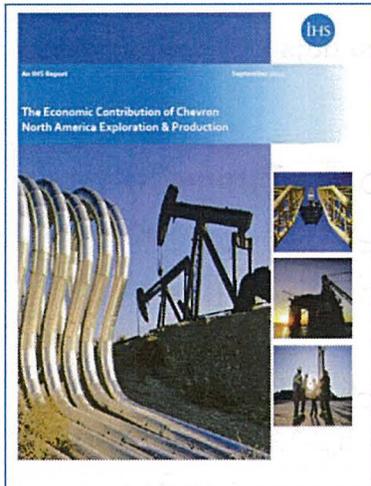
Model how this spending contributes to local employment, wages, government revenues and GDP/GSP.

Model how local spending by employees (Chevron and supply chain) on consumer goods and services induces additional economic contributions.

### Result:

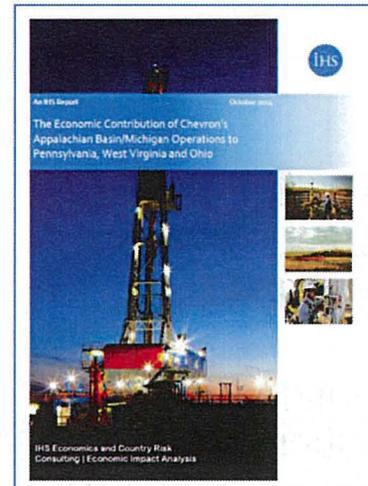
A comprehensive assessment of Chevron's true economic contribution in easy-to-communicate terms: jobs, wages, etc.

# The Chevron Economic Contribution Series of Reports



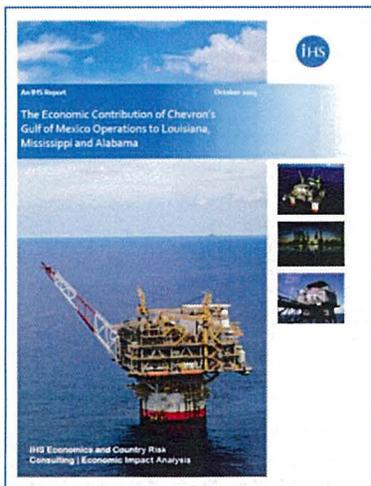
## Chevron CNAEP

- 172K jobs (2013)
- 0.1% US GDP (2013)
- Average supply chain wage of \$65K, 27% above the national average



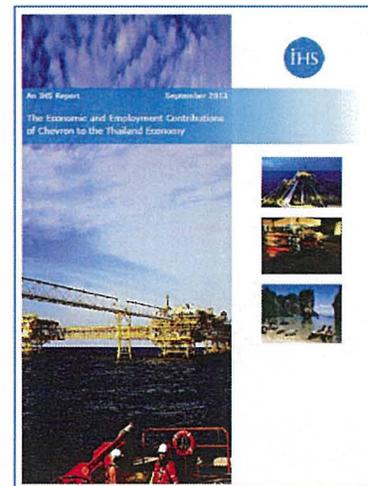
## Chevron AMBU

- 19K jobs nationally; 7K+ in AMBU region (2013)
- \$1.7B in US GDP; \$500M in AMBU GRP (2013)
- Supply chain wages above regional averages: PA, 22%; WV, 61%; OH, 25%



## Chevron GOM

- 62K jobs nationally; 39K in GOM region (2013)
- 2% of Louisiana GDP (2013)
- Supply chain wages of \$57K, 40% above the regional average



## Chevron Thailand

- 200k+ Jobs (2012)
- 2.4%+ of Thai GDP (2012)
- For every Chevron job, 29 additional jobs are supported in Thailand

+ Chevron Indonesia is due in February 2015; Chevron Angola 2H15

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