

# Reinventing the Wheel: Mobility and Energy Future

A new IHS Markit subscription service

The global automotive ecosystem will undergo more change in coming years than it has over the past century. The pace of change is the question-not whether change occurs. Will it be of a revolutionary nature, toppling incumbents in the automotive and energy industries, and dramatically reshaping the automotive and energy landscape including oil demand? Or will it be gradual and provide opportunities for companies—incumbents and new entrants-to adapt to changing technology, government policies, business models, and consumer behavior? These are existential guestions for the industries involved.

Reinventing the Wheel: Mobility and Energy Future is a new IHS Markit service providing insight, analysis, and data to keep members ahead of the curve in understanding how regulations, technology, new business models, and consumers are impacting oil, energy demand, and the automotive industry and its supply chain.

Changes are occurring beyond the much discussed shift to electric vehicles. The century-old model of selling cars for personal use is giving way to a new multi-dimensional rivalry involving electric vehicles, driverless cars, and mobility service companies.



The competition of the 21<sup>st</sup> century: Mobility services, driverless technology, and electric

# What's really happening?

An independent, in-depth understanding of emerging realities is essential for any company that could be affected by sweeping changes in how automobiles are built, sold, financed, used, fueled or powered and regulated. Trillions of dollars of investment capital are at stake. *Reinventing the Wheel (RTW): Mobility and Energy Future* delivers research that addresses the latest developments and insights while also providing a scenario framework for decision-making.



# Integrated, Cross-Industry Perspectives

As the forces that shape tomorrow's world are already in motion, it is vital to prepare today by understanding what is driving change, the direction and pace of the transformation, and industry impacts. An integrated, cross-industry perspective is necessary to understand the impacts in the energy, automotive, and chemical industries. This will identify emerging trends, new entrants, and potential surprises.

*RTW: Mobility and Energy Future* is a joint effort of IHS Energy, IHS Automotive, and IHS Chemical. Our proprietary database, modeling capabilities, and experts in these industries deliver comprehensive research, analytics, and datasets—a high value combination to guide decisionmaking during what will be a tumultuous period for the future of cars, energy, and chemicals.

This new service is a successor to the IHS Markit Multi Client Study entitled *Reinventing the Wheel: The future of oil, cars, chemicals, and electric power.* The 12-month study established IHS Markit as a thought leader with unique intellectual capital, industry relationships, data, and insights in the automotive ecosystem.

IHS Markit's deep expertise across industries and expansive databases give it unparalleled knowledge and resources to look beyond the perspective of a single industry and to see how changes in one industry impact others.

- For the oil and gas industry, light duty vehicles (LDVs) represent the most important end-market.<sup>1</sup>LDVs represent one-third of global oil demand and nearly 40% of total oil demand growth since 2000. Understanding the evolving automotive landscape is essential to discerning the future path of oil demand, which is key to undertaking multi-billion dollar investment decisions in the oil and gas industry. For example the question of peak oil demand is directly related to changes in the automotive system.
- For the automotive industry, understanding the patterns of future car ownership and use will be vital in preparing for tomorrow's market. The market will become more complex – mobility as a service (ride-hailing and ride sharing), driverless cars, and electric powertrains will give consumers an increasing number of options for personal mobility. Automakers and suppliers will need to adapt their products and business models to ensure they are prepared for greater diversity, the resizing of markets, battery charging needs, regulatory changes, and impacts on electric power markets.
- The chemicals industry will also be affected as the transformation in the automotive world ripples through the refining industry, resulting in changes in chemical feedstock prices and availability. Changes in LDV powertrains and design will also affect materials demand coming from the automotive sector. These changes have critical global implications for company investments and competitive strategy.
- As electric cars become more widespread around the world, the electric power industry will develop more ties with transportation as cars become a source of power demand growth. New demand will have to be priced and managed by the industry at a time of wider transformation.
- Repercussions of change in the automotive ecosystem will reverberate in many other industries as well, including **finance**. Financial firms are directly involved because of their investments in the energy industry and with vehicles throughout their life-cycle dealer inventory, initial purchase/lease, and resale. Will LDVs depreciate in line with historical norms—or will risks to the finance sector increase until values for new types of cars are established?

<sup>1</sup>LDVs are cars and light trucks.

# **RTW Deliverables**

The deliverables of the service are a comprehensive package of insight, analysis, and data relevant to both short and long-term decision-making. The service includes written analysis, extensive datasets, and two member gatherings during the year that will bring together perspectives across the automotive, energy, and chemical industries. Our focus is on light duty vehicles (LDVs – passenger cars and lights trucks) that account for about one-third of world oil consumption and nearly 40% of the growth in world oil demand since 2000.

- What's really happening: Context and assessment of new developments.

Announcements by governments, companies, media and others about the future automotive ecosystem need context and understanding to discern facts from aspiration. An example of an "understanding the news" report is our analysis from our team in China on what China's discussions about eliminating sales of oilpowered cars mean. Depending on the subject in question, these reports shed light on implications for specific industries, such as oil or automobiles. These reports are released periodically.

- The pulse of change—monthly LDV sales for select markets with electric vehicles (EVs) broken out. We provide data and commentary on monthly sales data as an indicator of the pace of change and how government policy and vehicle price trends impacts sales. We also periodically include updates on US miles traveled and fuel economy of newly sold LDVs.
- Bi-annual Mobility Watch provides qualitative and quantitative assessments that evaluate the pace of transformation of the automotive ecosystem.
  Included are "Signposts"—developments and events—and whether they point to an evolutionary or revolutionary pace of change. Each Mobility Watch will address one or more issues such as fuel economy standards, government incentives for electric vehicles, moves by regulatory agencies, government plans that impact sales and use of oil powered cars, commercialization of driverless technology, EV battery costs, growth of mobility as a service, and implications for auto companies, oil producers, oil refiners, and electricity companies.
- Interactive member workshops twice a year to review recent developments, discuss ideas and projections about the future automotive ecosystem and implications for auto, energy, and chemical companies.<sup>2</sup> A member company can send 2 participants to each of the workshops.

<sup>2</sup>The location and timing of each workshop will be determined 2-3 months in advance.

- Scenario projections to 2050 covering key variables shaping the future of the automotive and oil industries. We provide global and regional historical data and projections of key elements of the automotive ecosystem:
  - LDV sales by powertrain
  - LDV fleet by powertrain
  - Total miles driven
  - New vehicle fuel economy
  - On-road fleet-wide fuel economy
  - Energy consumption by LDVs and prices for crude oil, gasoline, diesel, and electricity

In addition to global coverage, we provide deep "mobility channel" analysis and projections for 4 key markets that account for most of the world's LDV fleet and new sales: China, Europe, United States and India. Mobility channel projections illustrate how demand for "robo-taxis" (driverless mobility services) compares to human-driven cars--including how these LDVs are powered. Understanding demand from different mobility channels is necessary to identify changes in LDV sales volume and energy demand, especially market share for oil-powered versus electric-powered LDVs.

The global, regional, and country datasets are accompanied by PowerPoint reports that highlight key assumptions and perspectives that shape the outcomes in each of our two scenarios. These projections are done once per year for two scenarios. Rivalry, our base case, is a scenario of evolutionary change in the automotive ecosystem. Our second scenario, Autonomy, illustrates a revolution in mobility with radical change to the automotive ecosystem. The scenario framework is a decision-making tool to develop or test decisions and strategy under different views of the future with the aim of helping a company succeed no matter what future unfolds.

The annual long-term update also assesses the impacts on the **chemical industry**, including feedstock availability and demand for petrochemical products resulting from changes in powertrains for new vehicles, changes in the LDV fleet, and miles traveled. We also highlight any major shifts in the use of chemical and plastic materials in new car manufacture, reflecting trends in both powertrains and design.



#### Contact with IHS Markit experts.

Members will have up to 3 hours of research time annually to call on IHS Markit experts to discuss or address questions and issues related to our research.

# Biographies



## Daniel Yergin, Project Chairman

Daniel Yergin is a highly respected authority on energy, international politics, and economics. He is Vice Chairman of IHS Markit and cofounded IHS Cambridge Energy Research Associates<sup>®</sup>. In selecting Dr. Yergin as one of the "hundred people who mattered" worldwide, *Time* magazine said, "If there is one man whose opinion matters more than any other on global energy markets, it's Daniel Yergin." *Fortune* said that he is "one of the planet's foremost thinkers about energy and its implications."

A Pulitzer Prize winner, Dr. Yergin is the author of the recent bestseller *The Quest: Energy, Security, and the Remaking of the Modern World. The Quest* has been called "a masterly piece of work" by *The Economist* and was described by the *Financial Times* as "a triumph." Dr. Yergin is known around the world for his book *The Prize: The Epic Quest for Oil, Money, and Power*, which was awarded the Pulitzer Prize. It became a number one *New York Times* best seller and has been translated into 17 languages.

Dr. Yergin was awarded the United States Energy Award for "lifelong achievements in energy and the promotion of international understanding." In 2014 India's prime minister presented him with a Lifetime Achievement Award, and the US Department of Energy presented him with the first James Schlesinger Medal for Energy Security. Dr. Yergin chaired the US Department of Energy Task Force on Energy R&D. He is a member of the National Petroleum Council, a trustee of the Brookings Institution, and a director of the United States Energy Association and the Council on Foreign Relations. He is a member of the Advisory Board of the Massachusetts Institute of Technology Energy Initiative and Singapore's International Energy Panel. He holds a BA from Yale University and a PhD from Cambridge University, where he was a Marshall Scholar.





# James Burkhard, Project Director

James Burkhard is head of global oil markets and leads IHS Markit research on the future of the automotive ecosystem and its impacts across industries. He leads the team that analyzes and assesses the global crude oil market and changes in the oil industry's competitive environment. He also leads the development and delivery of the IHS Markit global scenarios that cover macroeconomics, geopolitics, and the energy and automotive industries. He was co-leader of the *Reinventing the Wheel* multi-study done in 2016-17. He is also Vice Chairman of CERAWeek, the prestigious global energy conference. He has testified numerous times to the US Congress on energy issues and was a leader of the National Petroleum Council's Hard Truths study that provided energy policy guidance to the US Secretary of Energy. He holds a BA from Hamline University and an MS from the School of Foreign Service at Georgetown University.

# Tom De Vleesschauwer, Project Director

Tom De Vleesschauwer leads the Automotive Transport & Mobility group at IHS Markit, where he also directs the long-term planning and sustainability activities. He has led many special projects assessing technical, business, regulatory, and societal trends, and is the author of numerous contributions to automotive publications among which was *Automotive Agenda—Urbanisation Special: What is the role of the car in the city of tomorrow.* He is certified by the Institute of the Motor Industry and holds an HBO Automotive Management from IVA Driebergen, BBA from Northwood University, and an MBA from the Cardiff Business School.

### Nigel Griffiths, Chief Automotive Economist

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Nigel Griffiths is Chief Automotive Economist for IHSMarkit. He has 30 years of experience analyzing and forecasting detailed trends in automotive markets around the world especially the development of automotive sales and the composition of the vehicle fleet. He oversees much of the short term sensitivity and long term scenario modelling capability in the IHS automotive group. In 2013 he was a key member of the 'new urban mobility project' (NUM) responsible for the development of the world's first quantitative model aggregating the potential impact of city level motorization policies and developments to a national and global level. Recently he has directed the development of a set of complex systems simulation models aimed at assessing potential changes to automotive markets and mobility behavior brought about by new possibilities of autonomous cars and shared mobility services as part of the IHS team working on '*Reinventing the Wheel*'.

#### Fellipe Balieiro, Principal Researcher

Fellipe Balieiro is a principal researcher with IHS Markit's Refining and Marketing team. His primary role is leading the development of the Automotive Planning Scenarios while also leading the interface with the energy cross-business practice. In this capacity, he models the light duty vehicle market by integrating macroeconomic factors, the energy supply chain, and price forecasts with detailed data, research, and analysis on the automotive market, including vehicle sales, segmentation, powertrains, current and future government policies, and changing consumer demand.

#### Kurt Barrow, Vice President

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Kurt Barrow is Vice President of Oil Markets, Midstream and Downstream Insights for IHS Markit. Kurt is a thought leader, advising executives on strategic market and industry trends. He is actively involved in the global team's research that provides expert-based analysis and forecasts based on market and industry fundamentals. He has also managed consulting projects, including public reports on the Volcker Rule, US crude export policy, and the impact of the IMO bunker fuel rules. Kurt began his career as an engineer at the Exxon Baytown Refinery and was a Vice President at Purvin & Gertz.

#### Paul Blanchard, Principal Researcher

Paul currently serves as Senior Director - Engineering Plastics at IHS Markit Chemicals, where he provides subject matter and planning expertise for engineering plastics market advisory services and single client projects. Paul has over thirty years of industry experience, having held product management, sales & marketing management and financial management positions at GE Plastics, Clariant, LNP Engineering Plastics and Albis Plastics.

#### Jeremy Carlson, Principal Analyst and Manager

Jeremy Carlson leads IHS Markit research in the areas of autonomous driving, mobility and automotive technology. He has worked in automotive electronics market research and analysis for 9+ years in the analyst role, and he leads the Autonomous Driving practice for IHS Markit in addition to being a key contributor to new mobility and emerging technology topics. Primary areas of expertise include driver assistance technologies and sensors that evolve into automated and autonomous driving systems; complementary research covers technical standards, regulation and legislation, connectivity, and the deployment and uptake of new technologies over time.

## Daniel Evans, Vice President

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Dan Evans leads the IHS Markit Global Refining and Marketing research. A major component of his role involves identifying global trends in energy demand and determining how they are likely to play out on a regional and national level. Prior to assuming his current role, he had a lead role in IHS Markit's consulting team where he focused on strategic projects, investment analysis and transaction advisory. Recent assignments have involved developing and stress-testing refining and marketing strategies to ensure that companies are well-positioned to adapt to different potential oil demand profiles. Prior to joining IHS Markit, he worked for Statoil in corporate strategy where he was responsible for analyzing the long-term trends impacting the Oil and Gas industry. He holds a Masters degree in Civil Engineering from Leeds University, and studied jointly at the University of California, Berkeley.

#### Kate Hardin, Commercial Director

Kate Hardin is an Executive Director with IHS Markit and has led several IHS Markit analytics teams, including Russian and Caspian Energy Analysis and Global Institutional Investor Research. She was the commercial leader of the *Reinventing the Wheel* multi-client study and worked closely with members to match their concerns and needs with the study's content. Prior to joining IHS Markit, Ms. Hardin was an energy consultant with PricewaterhouseCoopers, advising on power sector privatization throughout Russia and the Caspian region. Her own research focuses on transportation but also on energy developments in Russia and the CIS. Ms. Hardin holds a BA from Wesleyan University, an MA from Yale University and an MBA from Yale School of Management.

#### Chelsea Havill, Project Manager

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Chelsea Havill, Project Manager for *Reinventing the Wheel*, is a member of the Energy-Wide Perspectives team at IHS Markit, which delivers energy scenarios, integrated modeling, carbon and climate analysis, and other analysis that extends globally across energy sectors. She has held both analytical and commercial roles at IHS Markit, including project managing the recent webinar series entitled, *The Great Shakeout: Strategies for an Uncertain World*. She holds a BA from Furman University and an MBA from Babson College.

#### Egil Juliussen, Director

Egil has over 35 years' experience in computers, mobile devices and automotive electronics. He has extensive experience in technology and market forecasting and competitive analysis. Egil's recent research is focused on autonomous driving, self-driving cars, automotive software, connected cars, cyber-security and apps in the car. Egil was co-founder of Telematics Research Group, which was acquired by IHS via iSuppli.

#### Jeff Meyer, Director

Jeff Meyer is a Director at IHS Markit, focusing on the world oil market and industry trends. He currently coordinates writing of the company's monthly Global Crude Oil Markets Short-Term Outlook, which anticipates shortterm oil market developments based on analysis of oil demand and supply; macroeconomics; geopolitics; and upstream cost and investment trends. Jeff has been the primary author of a number of strategic reports on oil industry dynamics, including: Making Ends Meet: How the Oil Industry is Cutting Costs To Make Up For Lower Prices; Ahead of the Curve: The Oil Cost Curve and What It Can Tell Us; and Running to Stand Still: Answering the Questions About Oil Field Decline Rates. He holds MAs from Johns Hopkins University School of Advanced International Studies and New York University, and a BA from Haverford College. He is proficient in Mandarin.

#### Anthony J. Palmer, Commercial Director

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Anthony J. Palmer is Vice President in the Chemicals group at IHS Markit where he is responsible for the East and West Coast operations of the Americas Chemical Consulting Group. Mr. Palmer directs engagements for clients with interests in the business, technical, and financial aspects of the chemicals, plastics, and related process industries. Mr. Palmer holds both Bachelors and Masters Degrees in Chemical Engineering from Manhattan College, and an MBA in Finance and International Business from Fordham University.

#### Elena Pravettoni, Senior Economist

Elena Pravettoni is a Senior Economist at IHS Energy. Since 2015, she has worked as the lead researcher for Daniel Yergin's forthcoming book on the geopolitics of energy. Ms. Pravettoni has also contributed to several research and consulting projects across IHS Markit. Most recently, she conducted research for the multi-client study '*Reinventing the Wheel*', which analyzed the implications of changes in the automotive ecosystem on the energy industry. For that study, she led research on ride-hailing, on emerging partnerships across automotive and technology companies, and on the supply chain risks of raw materials in electric vehicle batteries. Ms. Pravettoni has also conducted research in the area of climate policy, where she co-authored a report entitled: "Do Investments in Oil and Gas Pose Systemic Risk?", examining concerns by some central banks and financial regulators on whether an energy transition could disrupt financial stability. Ms. Pravettoni holds a Master's degree from Johns Hopkins University School of Advanced International Studies (SAIS) and a bachelor's degree from King's College London.

#### Jamey Rosenfield, Project Advisor

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Jamey Rosenfield is cofounder with Daniel Yergin of IHS Cambridge Energy Research Associates and Co-chair of CERAWeek— the world's leading senior global energy gathering, which he has overseen since its inception in 1983. He also leads strategic initiatives and multi-stakeholder dialogues, including the recent *Fueling North America's Energy Future, The Unconventional Gas Revolution and the Carbon Agenda*, and *America's New Energy Future*. He was Senior Fellow at the Center for Business and Government at Harvard, received his undergraduate education at Harvard College, and holds an MBA from Boston University.

#### Wade Shafer, Associate Director

Wade Shafer's research focuses on North American power market fundamentals, leveraging his background in renewables and distributed generation. As the lead power researcher in IHS Markit's *Reinventing the Wheel* Multi-Client Study, Mr. Shafer evaluated the impact of electric vehicles on global power market fundamentals and new electric vehicle opportunities in the power industry. Mr. Shafer has also led IHS Markit's long-term North American electricity demand forecasts, using his knowledge of econometrics, energy efficiency, and distributed solar generation to inform our outlook. Mr. Shafer earned an MS from Johns Hopkins University and a BS from The George Washington University.

#### Robin Waters, Principal Researcher

Robin's currently serves as Director, Plastics Planning and Analysis at IHS Markit, where he provides subject matter and planning expertise for polyolefins market advisory services and single client projects. He has over 30 years of industry experience with major polymer producers, inlcuding. DuPont and LyondellBasell.

#### Mark Wegenka, Principal Researcher

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Mark Wegenka is a Managing Director in the Chemical Consulting Group of IHS Markit, Inc. He has over 40 years of experience in the chemical industry focused on corporate finance, strategic decision analysis, business cash flow modeling, price/volume forecasting, statistical risk analysis, Mergers and Acquisition (M&A) analysis, new product development and capital planning & authorizations. Prior to joining IHS Markit, Mark worked for 33 years with The Dow Chemical Co.

#### Xizhou Zhou, Senior Director

Xizhou Zhou is a leader of IHS Markit research in Asia where he heads the Power, Gas, Renewables and Coal (PGCR) group. Mr. Zhou is the author of numerous reports and multiclient studies on Asia's fast-growing energy markets and is responsible for PGCR activities in the Beijing, Singapore, Tokyo and Delhi offices that cover Asia's many sub-regions. With deep expertise in the Chinese energy sector, he has managed a variety of consulting engagements for both international companies investing in China and Chinese companies looking for growth opportunities globally. He worked for Cambridge Energy Research Associates (CERA), now part of IHS Markit. Previously he was a consultant on regulatory and energy economics for Industrial Economics, Inc. in Boston, Massachusetts, US. Earlier in his career, he served as a research analyst at the World Resources Institute in Washington, D.C., where he focused on energy and transportation in developing Asian and Latin American markets. Fluent in Mandarin Chinese and proficient in Spanish, Mr. Zhou holds a Bachelor of Arts and a Master of Environmental Management, both from Yale University, Connecticut, US. Mr. Zhou is currently an editorial board member of China Petroleum Society's official journal, Guoji Shiyou Jingji (International Petroleum Economics). He also serves on the Board of Trustees of the Yale-China Association. He is based in Beijing.

# IHS Markit forecast models and datasets provide a rigorous foundation for *Reinventing the Wheel: Mobility and Energy Future*

IHS Markit is a dynamic team that includes more than 5,000 analysts, data scientists, financial experts and industry specialists. Our global information expertise spans numerous industries, including leading positions in transportation, energy, chemicals, and finance.

IHS Markit provides a deep and broad foundation for business-critical decisions through some of the most comprehensive and technical industry insights available over a wide geographic scope. The automotive, energy, electric power and chemical insight services allow clients to create robust, flexible strategies and make informed decisions in the face of change. We bring together the insights of IHS Markit experts and analysis with worldclass databases and models. Below are some of the models and datasets that will be used in *Reinventing the Wheel: Mobility and Energy Future*.

#### Automotive models and datasets

- Light Duty Vehicle Sales Forecast provides detailed and accurate insights with regards to global vehicle sales outlooks. The forecast offers unparalleled insights to inform original equipment manufacturers (OEMs), suppliers, financial institutions, government agencies, and other stakeholders for critical business decisions.
- China Province Forecast provides a vehicle sales forecast at the provincial level. Based on registration actuals, IHS Markit has a unique ability to forecast macroeconomic data at the provincial level and for major metropolitan areas to produce critical planning insights. This provincial and local detail is the foundation of the national LDV and energy outlooks for China that are in *Reinventing the Wheel*.
- Light Vehicle Production Forecast provides vehicle production forecast insight to suppliers and auto manufacturers, allowing them to evaluate production capacity and utilization as well as validate volumes for request for quote responses and business planning needs.
- Light Vehicle Powertrain Forecast System provides industry stakeholders with engine and transmission forecasts, which can also be combined with the Alternative Propulsion Forecast, Driveline Module, or Component Forecasts to enable seamless analyses across all powertrain systems.
- Vehicle Performance & Compliance Monitor (VPaC), in partnership with Novation Analytics, provides critical insight into the single greatest area of research and development in the automotive industry. Starting with a view into OEM fleets and competitive CO<sub>2</sub> performance, VPaC identifies who will strike the best balance between performance and emissions (by brand, segment, or model line) and which OEM may face financial penalties. VPaC offers a one-stop shop for vehicle performance and compliance insight.

#### - Oil and gas models and datasets

- Global Energy-Economy Model is IHS Markit's own in-house energy balance model, which covers 113 countries with 60 regional aggregates that cover the entire world. Full energy balances cover 29 sectors and 34 fuels for each country annually from 1990 to 2040 --to be extended to 2050 in 2018. Econometric time series and stock models are based on EViews software that links with other modeling outputs and a global gas trade model to produce a comprehensive global energy outlook that is used in IHS Markit Global Scenarios analysis and projections. A front-end application has been developed that links all of these elements and stores the results in an SQL Server. In this way, it creates a centralized system that enables multiple, simultaneous use by end users.
- IHS Markit proprietary LDV energy demand models take vehicle sales volumes across 10 LDV segments and forecast powertrain adoption, vehicle fuel economy, miles traveled, on-road vehicle fleet volumes, and energy demand by type (gasoline, diesel, LPG, biofuels, electricity, hydrogen) globally.
- *IHS Vantage*<sup>®</sup> leverages world-class tools, proprietary IHS Markit E&P data, industry intelligence, and a transparent methodology to support complex upstream commercial planning, making it possible to analyze over 15,000 global assets including undeveloped discoveries modeled at project and phase level.
- **Performance Evaluator** provides unique well-by-well insight into the shale oil industry, its cost structure, and output under different scenarios.

#### Electric power models and datasets

- *Regional Electric Demand Models* broken down by sector and drivers, including technology.
- Regional Power Supply and Price Models incorporating fuel supply and plant investment and operations economics as well as local resources and policies.
- **Technology Evolution Models** for power generation covering gas, wind and solar plant performance and cost.
- Demand by sector by country in Europe through 2040.
- LCOE evolution for CCGT and renewable power.

#### Chemicals models and datasets

- Chemical Capacity Dataset. IHS Markit's in-house dataset to manage capacity data information is an extensive proprietary program called Commercial Analysis & Planning System (CAPS). CAPS uses capacity information to establish how much of a chemical material can be produced or consumed in a country or region, who the major producers of each product are, and how the industry has changed in terms of ownership. This database contains existing and planned capacity, where planned capacity is either under construction or announced for completion over the next five years.
- Chemical Supply/Demand Forecasting Model. IHS Markit's in-house model for historical and forecast demand for basic petrochemicals, such as ethylene, propylene, and benzene, is based on preparing demand and production forecasts for all of the derivatives. The production data generated on a country basis are fed back into the "intermediate" or "petrochemical" balances in order to derive demand for these products.
- Chemical Pricing & Margin Forecasting Model. IHS Markit's in-house dataset and model used in the development of chemical product price forecasts is based on a production cost forecast, a margin/profitability forecast, and, where applicable, a forecast of tariffs. IHS Markit's price forecast methodology provides a cycle forecast for one future cycle, generally five to seven years, and then reverts to a trend forecast for the long term based on a margin high enough to provide sufficient return to encourage investment in additional capacity as required to meet demand growth.



#### For more information about membership and fees:

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#### About IHS Markit

IHS Markit (Nasdaq: INFO) is a world leader in critical information, analytics and solutions for the major industries and markets that drive economies worldwide. The company delivers next-generation information, analytics and solutions to customers in business, finance and government, improving their operational efficiency and providing deep insights that lead to well-informed, confident decisions. IHS Markit has more than 50,000 key business and government customers, including 85 percent of the Fortune Global 500 and the world's leading financial institutions. Headquartered in London, IHS Markit is committed to sustainable, profitable growth.

#### www.ihs.com/RTW