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*Enhancing the Business of Energy*

# ENERGY SYMPOSIUM

CONFERENCE REPORT

March 30, 2017

# ENERGY SYMPOSIUM

*Fifth OU Energy Symposium Highlights Industry Recovery*

## **A New Spring in Their Step as Oil and Gas Leaders Meet New Challenges**

Emerging from one of the deepest and longest down cycles in its history, the energy industry saw and heard its ambition and optimism on display at the fifth annual University of Oklahoma Energy Symposium, sponsored by the OU Energy Institute and held Thursday, March 30, at the Devon Energy Auditorium, Oklahoma City. The theme was “Preparing for the Future of Energy, Thriving in Complex and Uncertain Times.”

Daniel Pullin, Dean of the Michael F. Price College of Business at The University of Oklahoma struck a positive and progressive note in opening the symposium. “There is more to energy than just extracting hydrocarbons from the ground. We are not stopping. While others are tapping the brakes, we are pushing the accelerator.”

Putting a perspective on the vast changes the industry has undergone in just the last few years, keynote speaker Kenneth Hersh, CEO of the George W. Bush Presidential Center and co-founder and advisory partner, of the major private-equity firm NGP Energy Capital Management noted, “I’m always nervous saying ‘this time is different,’ but this time is different, at least for us.”

As a direct result of the unconventional development bonanza, oil and gas have moved from its history of scarcity to an era of abundance. Hersh explained that means the hydrocarbon industry has become “just like every other business. Oil markets were insulated because of the export ban. That is now gone. Gas markets were insulated because of the lack of ocean transport. Now there are LNG export terminals. U.S. oil and gas are now both on global markets.”

To underscore how different the industry has become, Hersh noted dryly that there are no more dry holes. The exploration part of exploration and production has all but vanished onshore. “There is no more E in E&P. People are not finding and prospecting. All that front-end stuff doesn’t really exist any more, at least not in the U.S. and Canada.”

In the opening panel session business and academic leaders addressed the difficulty in forecasting demand even in the short term, but concluded that the long-term demographic trends favored continued growth of hydrocarbon energy supply development. That said, the nature and course of that development has new variables, such as the need for deepwater development to reduce costs as had been demonstrated in onshore unconventional development.

The afternoon concluded with incisive and unflinching panels on the most complex and vexing challenges facing the energy sector at home in Oklahoma, across the country, and around the world: the rise in seismic activity related to disposal wells, the need to manage water, and the realities of climate change.

The new reality in global oil and gas markets, Hersh stated, is that “your oil and gas have to compete with that of others like it’s breakfast cereal. So you have to know your customers [and their needs]. You have to consider price points and supply chain. You can produce whatever you want, but so can your competition. The risks are no longer below ground, but above. You used to have to go where the oil is. Now it is a matter of wanting to go. Angola or west Texas? It’s like real estate. Do you want to build in Oklahoma City or Tulsa? Dallas or Fort Worth?”

## Welcome to the Party!

With a big smile Hersh offered a hearty, “Congratulations! You and your industry are now just another business, like everyone else. Welcome to the party! You don’t have to consider below-ground risks much any more, but you have new above-ground risks. And not just mechanical and operational costs, environmental compliance, and tax. You have to be concerned with corporate culture. That was never a worry. It used to be if you had a geologist who could find oil, it didn’t matter if he was the biggest jerk in the industry.”

Energy companies now have to know their customers too, he added. “Customers? You are thinking, ‘I have customers? I have gatherers, and truckers, but customers?’ This industry never had to know it’s customers until now. That is why people in other businesses are saying, welcome to the party.”

As a cautionary tale, Hersh related, “Nigeria had customers for their light oil. Then along came the people in this room. Nigeria had no relationship with their customers, so its customers went elsewhere. Now they are scrambling to sell their light oil. So, yes, now you have to know your customers. We are now a global business all around, exporting and importing crude and refined products. We are international players. Even you are a one-field player selling to one refinery.” It is all one market now, just like any other business.

Hersh cited another example of the new global business reality for energy. “The Saudis did battle with the entrepreneurs in this room and lost. So there was a production cut, which was called an OPEC cut, but fewer than half of the producing countries that agreed to the cut were actually members of OPEC. So how is that anything other than the market deciding there was overcapacity? It was just like car makers or airlines all looking at the same market conditions and making their own decisions.”

There have always been myriad decisions in the oil and gas business, such as whether or where to drill. “But now strategy matters more than [tactics]. Do you want to drill core or non-core? Do you want to [prove up] and flip, or drill the heck out of the rock? Or do you just want to buy mispriced options? People have been saying for several years now that energy is now a manufacturing business. Exactly. Do you want to be Toyota or Lexus? Same factory, different strategy, different skill set.”

Offering some insight that runs counter to common perceptions, Hersh asserts that “the Saudis get this. Can they go from 10 million barrels a day to 12? Maybe. Can they go to 20? No. That is why they are trying so hard to diversify their economy.” In contrast, “Venezuela is on the wrong side of the cost curve.”

Completing the pivot to petropolitics, Hersh stressed that Russia is punching way above its weight. “Nothing will happen in global oil markets without Russia. Every international deal will now require

a Russian at the table. This is Putin's agenda. In the last three years he has become the most important person in the world. He wants to get NATO off his doorstep and to reestablish the Soviet Union, in practice if not officially. The provocations, the Baltic over-flights, the cyber interference in the U.S. election, the funding of nationalist candidates in /Europe. It's all remarkable for a country with a GDP of only \$1.3 trillion. That's just Apple and Google together."

Bringing geopolitics back to energy Hersh expects that global demand for oil will continue to rise at 1 to 1.5 million barrels a year for the next 10 years. "There will be gain in efficiency that will cut demand in the developed world, but increasing demand from others will take up the slack." As a result there will be continued incentive to produce and continued competition among producers. "Welcome to the party."

## 100 Million Barrels a Day

"The future of energy is going to be exciting," said first-panel moderators Bruce Stover, member of the Energy Institute board, founding member and retired executive vice president of Endeavour International, a former North Sea exploration and production company. "Demand for oil is 96.6 million barrels a day globally, and that is forecast to reach 100 million barrels a day by 2020, so adding roughly 1 million barrels a day of demand each year."

James Smith, professor of finance and Cary M. Maguire Chair of Oil and Gas Management (retired) at Southern Methodist University, did not disagree with that outlook, but noted, "Demand certainly could get to 100 million barrels a day in three years, but with all the headwinds that global economic development has even forecasting three years out is tough."

Keeping to the globalist theme, Joe Stanislaw, founder of the consultancy JAStanislaw Group quoted the Arab proverb, "he who foretells the future lies even if he tells the truth. Yes, this year the world will add a million barrels a day of demand. But that cannot be assumed for the future. Washington could be going back to the 30's [in terms of protectionism]. Will there be a major incident in the Middle East? We just don't know. Reaching 100 million barrels a day global demand for oil is plausible, but there could be roadblocks, not just headwinds."

Stanislaw related that he had spent much of his professional life studying and working on the Middle East, and detailed just how complex the interplay of interests is. Even though the U.S. is no longer dependent on the region as a source of oil, the world is, and events there still move markets.

"In Yemen there is a proxy war between Saudi Arabia and Iran," said Stanislaw. "In Syria the U.S. is now giving direct aid to the Kurds because they are the best fighters in the region. That makes sense, but it is the last thing that Turkey wants. Turkey [a NATO ally] is in bed with Russia, who is in bed with Iran." These complexities will continue to create uncertainties in the market.

Mark Mills, senior fellow at the Manhattan Institute, and a partner with venture-capital firm Cottonwood Venture Partners, agreed those conflicts were important and serious, but questioned how much they would change long-term demand trends. "We have had 50 years of post World War II demand growth. Through the history of the world people want more of the things that energy provides. Absent exogenous events such as a major war, minor wars don't change things much," outside the affected region.

What has changed, noted Stanislaw, “is that we grew up with a mentality of scarcity in energy. There is no longer scarcity, there is abundance. But it is tough to change a mind set.”

Running with that theme, Stover added that the nature of supply has changed. North American unconventional production is broad and deep, and volumes tend to rise and fall smoothly in aggregate. In contrast, offshore development is “chunky. For three years we have had very little exploration offshore [because prices have not supported big capital expenditures]. In the overall decline in production, the underlying decline in offshore is significant. Some think that the incremental increases in shale will not be able to keep up if demand grows faster than anticipated.” This could put upward pressure on oil prices in the new few years.

Mike Ming, general manager of GE Global Research Oil & Gas Technology Center, took up the baton. “For offshore to come back it will have to drive down costs the same way shale did. We definitely are going to need those resources, but the bar on operational efficiency and cost control has now been reset by the shale operators.” All the panelists agreed that technology will continue to improve economic viability in deepwater offshore.

## Gas Goes Global

Another step change has been the entry of the U.S. into the LNG market, turning that global business from a specialized one into a common commodity business. “It used to be that natural gas was a continental commodity,” said Stover, “Now we see a global market for LNG.”

Ming said that was a positive development, even if more producers have made for lower prices at present. “Nodes make a network more robust. The global economy for gas is huge. Right now the limiting factor is not demand, it is capital. These things are hugely expensive.”

Ming contrasted the current cautious investment in North American LNG liquefaction with the rush to build regasification plants two decades ago. “In the early 2000’s the U.S. pushed the panic button and built a massive LNG import infrastructure, of which we have used none. And unfortunately, you can’t just run these things backwards.”

For the units running forwards he added that the U.S. is likely to become a major global competitor. “The new, enlarged Panama Canal becomes important. U.S. gas can now supply Chile.”

Smith noted that the U.S. competitiveness is boosted not just by abundant supply, but also by the flexible contract terms being offered by sellers. “The rest of the world is limited by oil-linked, long-term contracts. That limits their ability of the existing nodes to function efficiently in the network.”

Mills stressed two recent milestones in the global LNG market, “there is now a futures market, and for the first time ever, we have seen a shipment change direction en route. That is common for oil tankers, but used to be prohibited for LNG. So if you are looking for a signal in LNG, it’s behind us. The previously existing producers have already started to renegotiate their terms.”

Taking a geopolitical perspective, Stover said, “the ability to move gas anywhere is significant. China is trying to shift away from coal for power generation. Natural gas has to be a part of that answer. Their pipeline to Russia is behind schedule and over budget. Selling LNG to China would be good for



our balance of trade, and also defuse tensions in the Pacific. The geopolitical benefits of LNG are off-the-charts good. Not just for the upstream and midstream guys in the U.S., but for the country as a whole.”

The advantage for North America, added Ming, is the above-ground resources. “There is unconventional rock everywhere. By definition if you have conventional reservoirs you have shale. But the rest of it is rare: the capital, the technology, the law and regulation, the markets.” The panel agreed that shale exploitation outside North America would be limited and slow to follow due to land access issues, lack of infrastructure and lack of an experienced service sector.

A final conclusion of this first panel was that the global outlook for hydrocarbon energy supply growth, driven by technology, is bright—with oil resource life now measured in centuries and gas potential... infinite.

## **Challenges Close to Home—Getting Ahead of Induced Seismicity**

Jeremy Boak, director of the Oklahoma Geological Survey (OGS) had some ground-shaking news. “There have been serious questions about the cumulative effects of magnitude 3+ earthquakes in our state, especially in regards to the structural integrity of buildings.” He stressed that “the quakes are deep in the crust, well below the level of oil and gas operations. But they are closely oriented to injection wells.”

He detailed that while the water going down those wells is technically produced water, only a tiny fraction is the flow back from water used for hydraulic fracturing. “About 97% of this is formation water. It is what is left of ancient seas, and is more saline than the Dead Sea. Only about 3% is frac flowback.”

Jake Walter, lead seismologist for OGS elaborated. “There is a clear correlation of earthquakes to injection. There is some natural seismicity in the state, but we believe the rise in seismicity is tied to the vast injection into the Arbuckle formation. It is difficult to tie individual wells to individual events because there has been so much injection for so long. We need more funding to study and we need more sensors. But we do know that this is a hazard to homeowners, but also to the industry.”

Michael Teague, Secretary of Energy and Environment for Oklahoma, lauded the research that has brought some certainty to the issue already, especially the collaboration among industry, regulators, and academia. “The governor has established a Coordinating Council. “We have got to get out to all the work being done by the University of Texas, by Cornell, by Stanford. Also to the work being done across the industry, connecting with the Oklahoma Independent Petroleum Association and Kansas Oil & Gas Association. This is how we do things. If there is a problem, you own it, you fix it, and you move on.”

Mike Stice, Dean, Mewbourne College of Earth and Energy at the University of Oklahoma underscored that point. “This is one of the major challenges facing the industry: how do we work together for the common good?”

Noting the shift of in-state development to the South Central Oklahoma Oil Province (SCOOP) and Sooner Trend Anadarko (STACK) basin plays, Walter suggested there is “an opportunity to mitigate the implications of new development,” even as more data and research are being accumulated on the existing situation. “Oklahoma should emerge as a leader in collaboration between industry and academia. We have a chance here to get ahead of induced seismicity.”

# The Oil & Gas & Water Industry

Water is incompressible, which is what makes it so good for fracturing pay zones and so troublesome when injected into naturally occurring fault zones. It is also expensive for producers to acquire, so by way of solving several problems at once producers are looking into ways of using less water overall. And of the volumes they do use, they are seeking ways of using less fresh water and more lower-purity water, and then recycling most or even all of it.

“Producers are shifting their attention [from just oil] to water,” said OGS hydrogeologist Kyle Murray. “Brackish water has been added to the equation, and some companies are moving toward being freshwater neutral. To the standard menu of enhanced oil recovery, reinjection, and disposal is being added beneficial reuse among other options. We hope that and others will grow.”

One of the few companies to achieve the status of being freshwater neutral is Southwestern Energy. Bill Way, president and CEO of Southwestern, said it was just good business. “We want to be a contributor, not a disruptor. That is why we needed a water strategy. We had a goal of being freshwater neutral by the end of last year. We did it. And at a cost of \$10 million. That is not a lot of money to do the right thing.”

It helps that Southwestern is fully integrated with its own frac crews and midstream operation. “We have a natural gas gathering and processing system, and we have a water gathering and processing system,” said Way. “It is structured the same way. In our Arkansas acreage the wells are not arranged in the same way, but even there we are making progress in moving less water over the road and more by pipeline.”

Not surprisingly, the energy industry’s forays into desalination have challenged the capabilities of existing technology in the field. That is because for all the massive size and scale of desalination, its major use worldwide is to turn seawater into drinking water. “Seawater is about 35,000 parts per million salt,” said Laura Capper, founder and president of energy and environmental consultancy Cap Resources. “Those systems fall flat for the oil industry where concentrations in brine run four times that.”

There is also the challenge of variability. “A municipal water treatment plant will be handling the commingled streams from 100,000 or so households,” she explained. For all the variability among individual sources, “all the merging households get a steady state. That is in sharp contrast to oilfields where in any day the flowback may be highly saline and the next day be low in salt but high in chemical composition.”

There has been a fundamental shift in the way water is thought about said Jim Summers, CEO of H2O Midstream. “For every barrel of oil produced, the industry gets six barrels of water. One third of drilling and completion cost is water, and half a well’s overall cost is water. The costs for water acquisition and disposal all went unnoticed when oil was \$100 a barrel. No one cared about costs. At \$40 oil, everyone cares.”

He recalled that when the Marcellus was first being developed, Pennsylvania did not allow disposal wells, and was reluctant to allow pipelines to transport produced water out of state. The only

option in many cases was to truck the water to disposal wells in Ohio at a rate of \$10-15 a barrel.

“Now, in the Permian, we are moving away from trucks to pipelines for water,” said Summers. “There is a drive for reuse because there is not enough supply. Just as we used to talk about the oil industry and now talk about the oil-and-gas industry, in 10 years we will talk about the oil-and-gas-and-water industry.”

Water seems to have burst into the industry’s consciousness, but Summers explained that several factors came together. “Not only did the shift to unconventional drilling and development mean more water produced, but it also means that less water was used for things like enhanced recovery. Sixty years ago we talked about gas as a waste product of oil. Today it has evolved into a full commodity in its own right. That evolving growth is from use in power generation, but also from cryogenic separation into ethane for petrochemicals and propane for rural heating and cooking.” He sees the same thing happening for water—it will be further processed and segmented and new markets will be found.

There is also a greater tolerance for water purity variation as a source for drilling and completion operators. “Five years ago industry needed drinking water for frac fluid,” said Summers. “Now I have drillers who say they can use peanut butter.” That may be something of an exaggeration, but by degree and not direction.

Cappers lauded the industry effort. “In the past we have had the attitude of the industry versus the world. But here is the industry solving problems that can benefit the world. The industry can solve its water problem because within the industry we only use 5% of water for beneficial reuse.”

Stice added a cautionary note: “the damage that brine can do in an uncontrolled situation should not be underestimated.”

## **Better Data, Better Decisions**

To open the panel on carbon, Stice highlighted the industry’s reticence to discuss carbon issues by noting that no one responded to his call to moderate the panel. So he had to do it himself.

“We are staying away from the polarizing politics that tend to devastate this discussion,” said Stice. “Forget the politics, and look at deep time, back to pre-hominid levels. It is critical to recognize that the accumulation of greenhouse gases in the atmosphere. There is no denying the effect of these gases. And it is known that these are anthropogenic because of the carbon isotope fingerprint.”

Steven C. Wofsy, Abbott Lawrence Rotch Professor of Atmospheric and Environmental Science at Harvard University, explained the simple science. “To maintain heat equilibrium the earth has to export to space the heat it gets from the sun. Anything that increases absorption or reduced radiation adds heat to the atmosphere. The complication is that there is a long lag in response. The oceans have to heat before there is any climate change. The earth moves heat around all the time so it is impossible to observe the human impact directly. We can detect what carbon in the atmosphere is anthropogenic, but heat is heat.”

Complimenting the energy industry Wofsy added, “in the oil and gas industry people understand that better data helps them make better decisions. There is a large analogy here to having better data to



make better decisions that is not being reflected in the policy and political debate.”

Berrien Moore, Dean of the College of Atmospheric and Geographic Sciences at the University of Oklahoma, noted an additional complicating factor to climate change. In the 1950’s it was observed that as the amount of atmospheric carbon absorbed by the ocean increases, the resistance to further absorption rises. “It now seems that a quarter of the atmospheric carbon is taken up by the terrestrial biosphere. Another quarter is absorbed by the oceans. That leaves half that just stays in the atmosphere.”

New satellites have been launched to gather more specific data, and Stice said he welcomed that prospect. “As an industry we need not shy away from challenges. What we need to do is gather more knowledge. There is a lot we don’t know, but I do know that our industry does not shy away from challenges that stand in the way of our success.”



# SYMPOSIUM SPEAKERS



**JEREMY BOAK** has been director of the Oklahoma Geological Survey since July 2015. He served as the co-chair of the Oil Shale Symposia from 2006-2015, a role he started as director of the Center for Oil Shale Technology and Research (COSTAR) at the Colorado School of Mines. He was an environmental and nuclear materials project manager at Los Alamos National Laboratory, and manager for performance assessment of Yucca Mountain at the U. S. Department of Energy (DOE) in Nevada. Boak was also an exploration geologist at ARCO Oil and Gas, Inc., in Anchorage, Denver and Bakersfield.

He received his doctorate in geological sciences from Harvard University. Boak also received his AB and MS degrees from Harvard and an MS from the University of Washington, all in geological sciences.



**LAURA CAPPER** is a founder and CEO of CAP Resources and a principal in EnergyMakers Advisory Group. She specializes in oilfield-related market assessment, strategy development for emerging market issues, technology commercialization, operations planning, and due diligence / transaction support services for oil and gas technology and service companies and their investors. Capper and her partners have authored a series of in-depth reports tracking the state of water management and investment opportunities in U.S. and world unconventional shale plays, with 2014 reports published by IHS. CAP Resources has helped assess some 400+ providers of water treatment technologies, numerous water management software platforms, logistics management approaches and fixed facilities, and a breadth of proprietary technology providers.

Capper currently serves as director of five privately held companies, and is a director or advisor to four non-profits tasked with advancing technology development and access to education. She is a B.S.E.E. from Rice University with minors in bioengineering and computer science.



**KENNETH HERSH** is co-founder and advisory partner of NGP Energy Capital Management where he assists with the strategic direction of the firm, and also served as CEO through 2015. He also serves as president, CEO and board member of the George W. Bush Presidential Center, and is senior advisor and deputy chief investment officer for The Carlyle Group's natural resources division. He also sits on the dean's council of the Harvard Kennedy School. Hersh is a member of the Council on Foreign Relations, the National Council of the American Enterprise Institute and the World Economic Forum.

He serves on the boards of the Communities Foundation of Texas, Baylor Health Care System Foundation, the National Association for Urban Debate Leagues and the Texas Rangers Baseball Club. He is also a member of the Dallas Citizens Council.

After graduating from St. Mark's School of Texas, Hersh earned a bachelor's degree in politics from Princeton University. He also earned his MBA from Stanford University's Graduate School of Business.





**MARK MILLS** is a senior fellow at the Manhattan Institute, and a faculty fellow at the McCormick School of Engineering and Applied Science at Northwestern University. He is also a partner and co-founder of Cottonwood Venture Partners, a tech-centric digital oilfield fund, and serves on the advisory board of Notre Dame's Reilly Center for Science, Technology and Values. He formerly served as chairman and CTO of ICx Technologies, helping take it public in a 2007 IPO. He writes the Energy Intelligence column for Forbes and is co-author of the book *The Bottomless Well*. Previously, Mills was a tech advisor for Bank of America Securities, co-authored an energy-tech investment newsletter, served in the White House Science Office under President Reagan and worked in his early career as a semiconductor, development engineer and scientist where he holds patents.



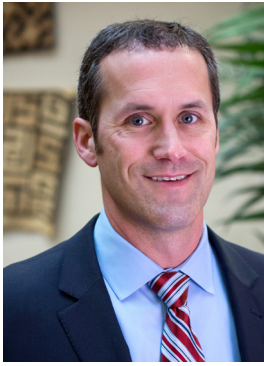
**MIKE MING** currently serves as the general manager of General Electric's Oil & Gas Technology Center in Oklahoma City. He formerly served as the Oklahoma Secretary of Energy under Governor Mary Fallin, the president of the Research Partnership to Secure Energy for America (RPSEA) and managing member and principal of K. Stewart Energy Group and K. Stewart Petroleum Corp.

Ming is also an emeritus member and past chairman of the Petroleum Investments Committee and co-sponsored the MAP/Ming Visiting Professorship on Energy and the Environment. He also serves on the Central Oklahoma United Way, OIPA, and OKOGA Boards of Directors, and industry advisory boards at the University of Texas BEG, the University of Oklahoma and Tulsa University. He formerly served on the MIT Future of Natural Gas Study and was an oil & gas strategic planning advisor to the Department of Energy. He holds a BS degree with distinction in petroleum engineering and an MS degree in engineering management, both from Stanford University, and is a Registered Professional Engineer in Oklahoma.



**Berrien Moore** serves the University of Oklahoma in a number of capacities, including vice president of Weather & Climate Programs, dean of the College of Atmospheric & Geographic Sciences, Chesapeake Energy Corporation Chair in Climate Studies and director of the National Weather Center. Moore began his academic career at the University of New Hampshire, where he was recognized for research excellence and served as the director of the Institute for the Study of Earth, Oceans and Space. He also held several visiting scientist and senior research fellow positions before leaving UNH to become executive director of Climate Central, a think-tank based in Princeton, New Jersey.

He has published extensively on the global carbon cycle, biogeochemistry, remote sensing, environmental and space policy, and mathematics. Moore has been honored by National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA). He received his BS in mathematics from the University of North Carolina and his PhD in mathematics from the University of Virginia.



**KYLE MURRAY** is a hydrogeologist for the Oklahoma Geological Survey and adjunct faculty for the ConocoPhillips School of Geology and Geophysics at the University of Oklahoma. As the OGS hydrogeologist, he investigates physical and chemical properties of geologic materials that store and produce fluids, and conducts regional-scale studies of water, earth, and environmental resources.

Water management in the energy industry is his current primary research area, which includes the study of water use in exploration and production, co-production of petroleum and water, saltwater management, disposal, recycle and reuse. Because of the recent increase in seismic activity in Oklahoma, Murray is partnering with other geoscientists to understand relationships between geologic factors, resource management and seismicity.



**JAMES SMITH** holds the Cary M. Maguire Chair in Oil and Gas Management at Southern Methodist University. Dr. Smith has been a prolific researcher and author in energy studies for the past four decades. His publications on OPEC, energy markets, real options, auction theory and the oil and gas business have appeared in numerous academic and trade journals, including the American Economic Review, the Journal of Economic Perspectives, the Quarterly Journal of Economics, Mathematical Geology, the Oil and Gas Journal and World Oil.

Smith is a senior fellow and immediate past president of the United States Association for Energy Economics, and has served as co-editor of The Energy Journal since 2006. In addition to his academic duties at SMU, he provides consulting services to numerous energy companies, regulatory agencies and other organizations in the U.S. and abroad. He received his PhD in economics from Harvard University.



**JOE STANISLAW** is founder of The JAStanislaw Group, a firm that advises boards of directors and institutions on strategic thinking, sustainability and environmentally sound investment in energy (all forms) and technology. He currently serves on the international advisory board of Dana Gas, is an affiliate partner at the private equity firm Lindsey Goldberg and a special equity partner at the private equity firm Wave Equity Partners. He is a member of the council on foreign relations, and an adjunct professor and advisory board member for the Nicholas Institute for Environmental Policy Solutions at Duke University.

Stanislaw is a co-founder of Cambridge Energy Research Associates and served as president and CEO from 1997 until the sale of the firm in 2004. From 2006 to 2014, he served as independent senior advisor for energy and sustainability to Deloitte LLP. He is the co-author of “The Commanding Heights: The Battle for the World Economy”, and the author of “Energy in Flux: The 21st Century’s Greatest Challenge.” He received a BA from Harvard College, an MA from the University of Cambridge and a PhD in economics from the University of Edinburgh. He is one of only several people to have been awarded an Honorary Doctorate and Professorship from Gubkin Russian State University of Oil and Gas in Moscow.



**MIKE STICE** is the current dean and Lester A. Day Family Chair of the Mewbourne College of Earth and Energy at the University of Oklahoma. Stice began his career in Oklahoma, serving for more than 28 years in technical and managerial positions with ConocoPhillips. In 2008, Stice joined Chesapeake and served as president of Chesapeake Midstream Development and senior vice president of Natural Gas Projects for Chesapeake Energy. He retired in 2015 as CEO of Access Midstream. Stice serves on the board of directors for U.S. Silica, Marathon and EIM, a private equity firm in Mexico. He is also an adjunct professor and advisory board member for the Price College of Business and the Gallogly College of Engineering.

Stice earned a bachelor's degree in chemical engineering from OU and an MBA from Stanford University, where he served as a Sloan Fellow. He also earned an international director's diploma from Sydney University, and completed his doctorate of education at The George Washington University.



**BRUCE STOVER** is a retired executive vice president, and was a founding member, of Endeavour International Corporation, an independent North Sea - focused oil and gas exploration and production company.

With more than 38 years of experience in the oil and gas industry, Stover has an extensive background in international business development, previously serving as senior vice president, worldwide business development for Anadarko Petroleum Corporation. In that role, he was responsible for evaluating and securing both domestic and international business opportunities, including the oversight of mergers and acquisitions. He also served as president and general manager of the company's Algerian subsidiary and was one of principal players in the 2000 merger of Anadarko with Union Pacific Resources and the 2001 acquisition of Berkley Petroleum Corporation in Canada.



**JIM SUMMERS** is the chief executive officer for H2O Midstream, a private equity funded midstream company focused exclusively on water. Summers is a 25-year veteran of the energy industry, having held senior leadership positions at major integrated oil and gas companies, as well as privately held start-ups. As the former chief operating officer at Energy Water Solutions, and sector leader for both Midstream and Integrated Water Management at ERM, he is recognized as an industry expert in the use of midstream infrastructure for strategic water management.

Summers holds an industrial engineering degree from the University of Oklahoma and is a graduate of Conoco's Management Development program as well as BP's High Potential program.





**MICHAEL TEAGUE** serves as Oklahoma's first Secretary of Energy and Environment. Appointed in 2013, he is responsible for coordinating over 30 state agencies, boards, compacts and commissions in advancing policies that encourage energy production and environmental stewardship throughout Oklahoma. Prior to his appointment, Teague served in the U.S. Army for nearly 30 years before retiring with the rank of Colonel. Throughout his career, Teague has dealt with construction, power generation and distribution, water supply and flood control, and environmental impact studies. He has facilitated and negotiated numerous solutions involving federal and state agencies, tribes, and local stakeholders.

Teague received a bachelor's degree in civil engineering from Norwich University. He also received master's degrees in operations analysis from the Naval Postgraduate School and in National Security and Strategic Studies from the Naval War College.



**JAKE WALTER** was named the lead seismologist of the Oklahoma Geological Survey in November 2016. He was previously a research associate at the Institute for Geophysics at the University of Texas at Austin. Walter's research interests include ice sheet and glacier dynamics; tectonic tremor and slow slip; earthquakes; and seismic triggering of earthquakes. He has conducted research in Antarctica, Costa Rica, Solomon Islands, Greenland, Texas, and Alaska.

Walter earned his BA in geology at the University of Colorado at Boulder and his PhD in Earth Sciences at the University of California, Santa Cruz. He acquired professional experience as a geologist at the Trihydro Corporation in Laramie, Wyoming, and served as a postdoctoral fellow at the Georgia Institute of Technology in Atlanta.



**BILL WAY** is president and chief executive officer of Southwestern Energy Company. He joined Southwestern as executive vice president and chief operating officer in October 2011. Prior to joining Southwestern, he was senior vice president of Americas of BG Group with responsibility for E&P, Midstream and LNG operations in the U.S., Trinidad and Tobago, Chile, Bolivia, Canada and Argentina. From 1981 until 2007, he held various senior technical and leadership positions at ConocoPhillips.

He holds a bachelor's degree in industrial engineering from Texas A&M University and an MBA from the Massachusetts Institute of Technology. He serves on the board of directors for the Mays MBA Program and International Programs Board at Texas A&M University; the board of directors for the Cameron School of Business at the University of St. Thomas in Houston; as well as the board of directors for the Boys and Girls Country.



**STEVEN WOFSY** is the Abbott Lawrence Rotch Professor of Atmospheric and Environmental Science at Harvard University. His current research emphasizes emissions of greenhouse gases and pollutants to the atmosphere, both natural and human-related. He has published over 300 journal articles during a career spanning four decades. His awards include the AGU's Macelwane prize and Revelle Medal, and NASA's Distinguished Public Service Medal, and is a member of the National Academy of Sciences. He has chaired the NASA Earth System Science and Applications advisory committee and served on the NASA advisory council, as well as on the Carbon Cycle Science Plan Working Group and North American Carbon Program writing group. Recent National Academy reports include Indicators for

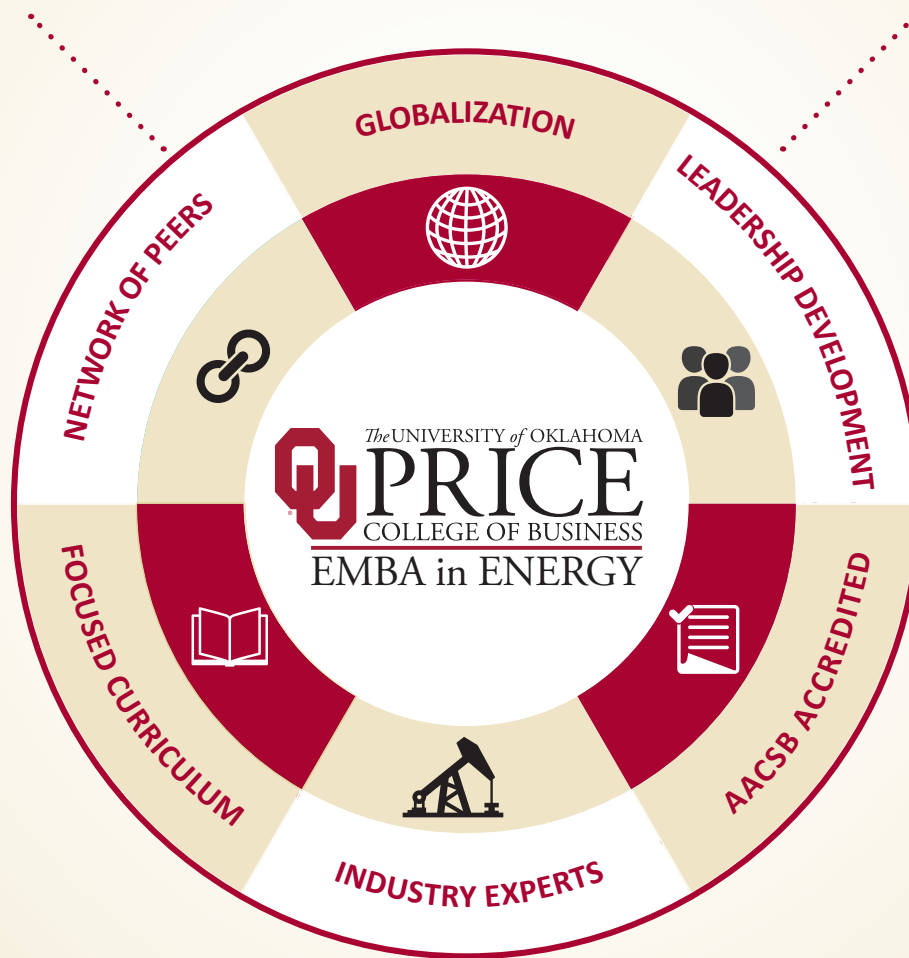
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