ENERGY SYMPOSIUM

CONFERENCE REPORT

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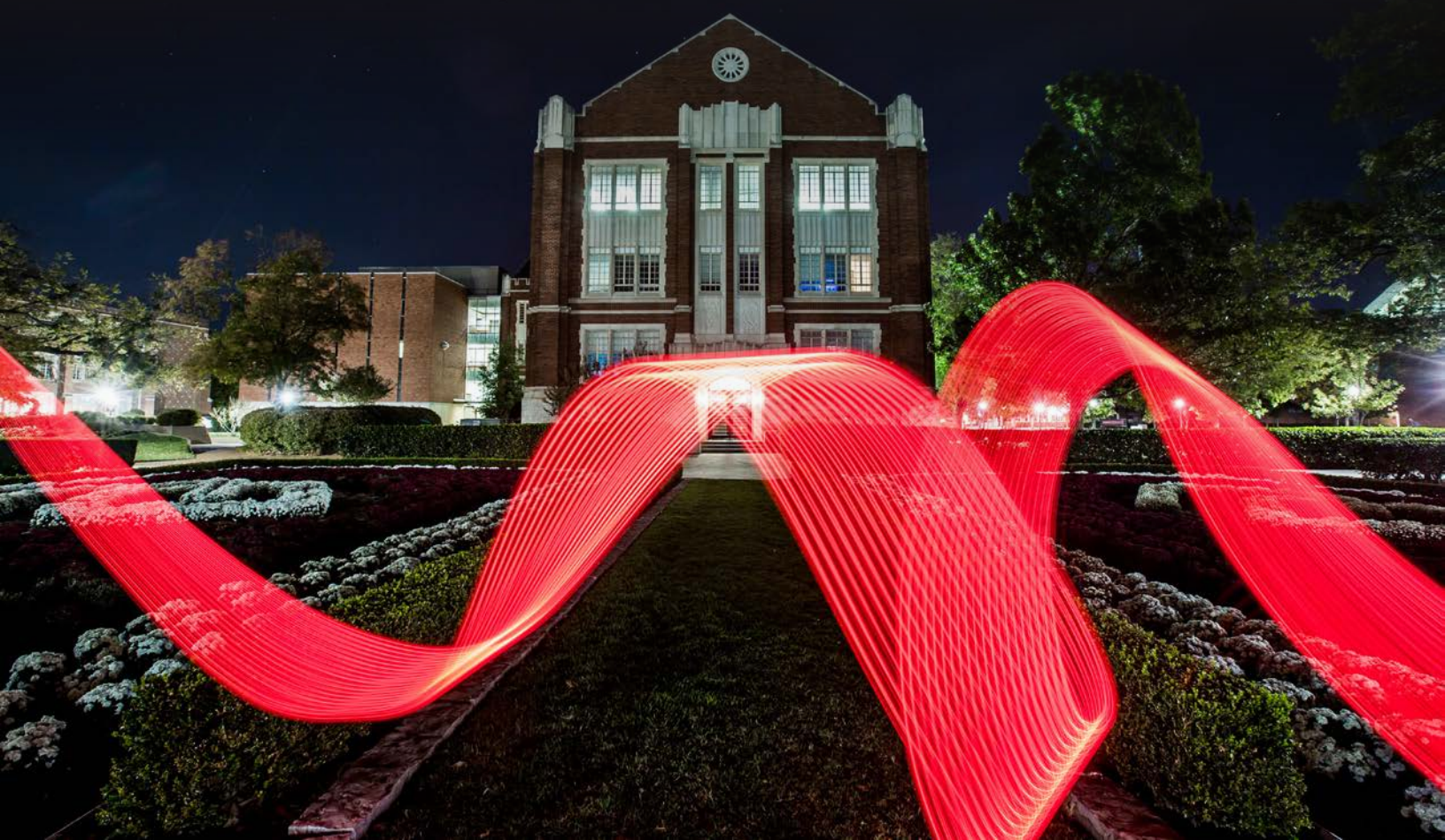


SIXTH ANNUAL ENERGY SYMPOSIUM:
The Future of Energy

Technology and Efficiency are Making Natural Gas a 'Destination' Fuel

Hydrocarbons find their role alongside renewables for the 21st Century

The sixth annual Energy Symposium, hosted March 15 in Oklahoma City by the Energy Institute at the University of Oklahoma Price College of Business, took up no less a main theme than the future of energy. "Companies have to follow their capital framework in terms of funding, whether than is dividends or projects," said David Lawler, CEO of BP America U.S. Lower 48 Onshore, in his keynote address. "But if you think beyond single-well economics you find dollars available. Simply, you cannot optimize the near term [only] and expect to have a long term."

Lawler was on solid ground for the long perspective because the event was held in the same building where he first worked for Kerr-McGee at the start of his career. Indeed the long-term prospects for oil and gas were a recurring theme through the symposium.

Lawler was proud that through its investments in U.S. wind farms, biofuels ventures, and other initiatives, it has become "the top renewable energy company in the world." Yet he and other speakers stressed the continuing importance of hydrocarbons in the global energy future for decades. "Natural gas in particular has a crucial role," he said, "not just as a bridge fuel, but as a destination fuel."

That calculation was hardly the first that Lawler had made on that site. "I started my career here in this building, working for Kerr McGee 30 years ago," Lawler recalled. "It was difficult work, doing repeat formation test analysis with very little computer support. That meant doing some calculations by hand. Coffee was 15 cents a cup and did not come out of a machine. There was a coffee cart that came around and rang a bell."

Reflecting on the changes in the industry over his career Lawler stressed that "the work of the Energy Institute has never been more important. There is demand for oil and gas, and there is also demand for us to take action on reducing greenhouse-gas emissions."

He listed five "key realities of global energy. First, the shift the shift to lower-carbon sources that has already started. Second, despite those rapid changes, the need for industry, government, and individuals to do more if we are to meet the goals of the Paris Climate Agreement. Third, energy must be both reliable and affordable. Fourth, even in a highly aggressive low-carbon scenario, oil and gas remain a significant part of the global energy mix for decades to come." Extending from that was the fifth point, already asserted, that gas is not just a bridge fuel but a destination fuel.

David Lawler, CEO of BP America U.S. Lower 48 Onshore, provided the keynote address

"If current trends continue," Lawler cited the 2018 BP Energy Outlook Report, "and we project to 2040, there will be a 35%, with the entire increase driven by developing countries. Within that there is going to be a 400% increase in use of renewables. That will account for 14% of total demand in 2040, an increase from just 4% [of total demand] in 2016. That is the fastest gain of in history."

Several of Lawler's points raise the question why the global major oil and gas companies do not seem to be putting their money into renewables. He stated in no uncertain terms that his firm was indeed doing just that, and that others were as well.

"BP has the largest renewable portfolio of any major," Lawler said proudly. "We have 12 wind farms and a massive biofuels business. We have a joint venture with DuPont in bio-isobutanol and another venture with Clean Energy Fuels which made BP the largest supplier of natural gas to the U.S. transportation sector. On the global level, we made a $200-million investment in Europe's largest solar development company."

More broadly Lawler cited the work of the industry group Oil & Gas Climate Initiative (OCGI), of which BP was a founding member. The group has committed $1 billion over the next 10 years to support low-carbon technology. "This is the kind of combination we have talked about, working together, getting everyone on board, for the collective good."

Within his own portfolio, Lawler noted that BP's Cooper River chemical complex near Charleston, South Carolina, recently completed a $200-million modernization project that reduced electrical use by 40% and cut 110,000 tons of carbon emission per year, while boosting overall production 10%.

Asserting that "BP is the top renewables company in the world," Lawler was quick to add, "we need to do a better job of getting that message out. That is something we can best do collectively through OGCI. The world is telling us that they want to take a different direction. We should not be defensive about that. Twenty years ago Lord Browne identified these issues and had the courage to step forward, but at the time his message was not well received." Former CEO of BP John Browne is now Baron Brown of Madingley.

Boldly, Lawler advocated carbon pricing. “This would be an example of what government can do. Energy issues have become deeply polarized. But energy production and environmental protection are not mutually exclusive. Governments can help us achieve these objectives by creating a market-based energy framework that encourages competition, efficiency, and innovation.”

The best way to do that, Lawler declared, “in BP’s view, would be to adopt a flexible, well-designed, economy-wide carbon pricing program. Across the world, carbon pricing has proven to be more effective, both from an economic perspective and from an environmental perspective, than top-down regulations intended to limit growth of oil and gas.”

Industry and Academia Joined at the Hip

In the lower-carbon future that was the unanimous vision of all speakers, there was no question that natural gas will have an enduring role. “The easy days of finding demand for gas in the U.S. are over,” said Andrew Bradford, CEO at BTU Analytics. “China still gets 65% of its electricity from coal. Hydro accounts for 20%, nuclear and wind each 4% and natural gas only 3%. In India coal accounts for 77% of power generation. That is a huge opportunity for gas, but also for wind and solar.”

The first big step in seizing that global opportunity for gas is getting molecules to market. There are now two large liquefied natural gas (LNG) export facilities in the U.S. with four more expected to come into service by the end of 2019.

It was noted that even with the first seriously cold winter in the U.S. in several years, there was no issue with the roughly 4 Bcf/d of gas moving to the existing liquefaction plants, but there was some question if the domestic market could sustain the further volumes that the additional export trains would draw. The roughly 4 Bcf/d of gas exported to Mexico also have to be figured into the equation. But most forecasts see gas staying in the $5-6/mcf range even out a decade or two.

The major concerns for producers are no longer availability of the resource, but the availability of water or sand. “The original model of using fresh water one time then disposing of it permanently is now a non-starter,” stated C. Michael Ming, vice president and executive liaison for marketing technology at Baker Hughes, a GE company.

Andrew Bradford, CEO of BTU Analytics

C. Michael Ming, Vice President and Executive Liaison for Marketing Technology at Baker Hughes, a GE Company

“For starters we have to use water that is not good for people, cows, and crops,” said Ming. “There are people who think that production of 5 million barrels a day of oil out of the Permian Basin is actually a stretch.” That is not for lack of oil or the ability to get it out of the ground, he explained. The doubt is the ability to manage the water that would be needed.

Tackling the big business issues of the time is the important work of the university, the institute, and the industry, said Daniel Pullin, dean of the Price College of Business at the University of Oklahoma. “We are joined at the hip and the future depends on our joint progress. The university takes a planetary view from geological to meteorological to sustainability and extending into environmental law. It extends from 18 year-old freshmen to 80-year-old business executives still participating in industry.”

Dr. Mike Stice, dean of Mewbourne College of Earth and Energy, and moderator of the first panel took up that topic and handed the baton to his panel asking how they see the future of hydrocarbons. Dr. Joseph Stanislaw, senior partner at Bright Star Capital Partners and formerly co-founder and CEO of Cambridge Research Group, replied, “the industry has done a good job of responding to questions about our social license, to questions about climate change, induced seismicity, and renewable energy.”

He contrasted that to the mind set in the industry in 1975 when he helped form one of the first energy research groups in the world at University of Cambridge. “The attitude in the oil and gas industry was ‘we don’t like renewables. We have to win the game.’ But the reality is that society needs everything, hydrocarbons and renewables. The two types of energy are not enemies. There are large- and small-scale solutions; whatever is appropriate.”

Beyond Petroleum

Even when industry pioneers turned their attention to the environment, there was resistance, Stanislaw recalled. “When BP started to use the expression ‘beyond petroleum,” Lord Browne was almost run out of the industry for embracing climate change. Total is also big in this. There is a challenge though, that you can’t simply plug an oil-and-gas executive into renewables.”

Ming at BHGE added Statoil and Shell to the list of majors with major renewables operations. “There is a lot more going on among the majors than is evident. In contrast, the independents are sticking to their knitting.”

Picking up the thorny issue of carbon pricing and subsidies, Stanislaw suggested that the lack of carbon pricing is an implicit subsidy for the hydrocarbon sector. He also refuted the argument that carbon pricing limits economic growth. “If we don’t address climate change, we limit growth because the technology to do that is economic growth.”

Ming, at BHGE, advocated a similarly dramatic shift in thinking at the micro level. “Historically we have used a physics-based model, but we can already see that we don’t really understand the physics when child wells perform differently than parent

Dean Daniel Pullin, Price College of Business (left) and Dean Mike Stice, Mewbourne College of Earth and Energy (right)

wells off the same pad. The move now is to a data-enhanced model. We are getting continuous data streams from multiple sensors and multiple points. There is a whole lot going on in the data."

He recalled "in my day, a pumper would take one reading a day. And recovery from reservoirs was 50-90%. Today recovery in oil in super-tight rocks is less than 10%, so just a few percentage points is a very big deal."

Bradford, at BTU Analytics, noted that even with such low recovery rates, U.S. oil and especially gas production and exports have blossomed. "LNG is only in the early innings, and seems to have passed the first stress test. We saw the coldest temperatures in the Northeast and [Cheniere's] Sabine Pass terminal chugged straight along at 3.5 Bcf/d. In comparison, Manhattan takes about 3.3 Bcf/d of gas from the three major lines in peak winter demand. This winter we saw Henry Hub prices peak at about $5 per mcf, and Sabine kept chugging along."

Noting that a second LNG export facility is now coming into operation by Dominion at Cove Point, Maryland, Bradford added that a further four export terminals are under construction. "We are expecting 10 Bcf/d of LNG export capacity to be on line by the end of 2019. We have also seen the emergence of a liquid cash market and a liquid futures market for LNG. The U.S. can compete in the global market. Good old U.S. contract law is a strong competitive advantage."

The North American economy both needs LNG exports and can handle them in terms of supply. Not only is there gas flowing from gas plays, but Bradford also illuminated associated gas. "In the Permian too many people have had their oil hat on and ignored their gas hat. Now there is so much gas in the Permian that there is dislocation at the local hubs. And that is on top of the 3.5 to 4 Bcf/d being exported to Mexico."

Compliance Lowers Costs

Not caught with rose-colored glasses, the panel also discussed possible rough patches for gas demand, notably the power-generation market. It was observed that the growth lever for gas is not really electricity any more. The power market, especially residential and commercial, has been flat. Industrial is still growing strong, especially in petrochemicals but that has to be kept in perspective with rising LNG exports.

Stanislaw at Bright Star noted that hydrocarbon exports are a prime example of how the industry can apply positive pressure and change political and legislative terms. "Industry does itself a disservice every time a regulation comes out: you moan and complain and argue, and then two years later you do it, and your overall cost structure is lower. So why moan and complain. Just do it, and get credit for the fact you are playing the game correctly?"

He continued, "We talk to ourselves too much. We need to talk more to our communities. They are not hearing the message that oil and gas companies have become technology companies. Show your communities the unbelievable things your are doing with technology to the benefit of consumers and the environment. It is an important story, but one that has to be done one by one."

Delving further into the flattening domestic power market, there was a lively discourse among the panel about the intended and unintended consequences of cheap and abundant gas. The sharp and likely permanent decrease in coal being burned was chief among the intended; the deflated market for high-efficiency steam turbines was a surprise among the unintended.

Joseph Stanislaw, Senior Partner at Bright Star Capital Partners and Former Co-founder and CEO of Cambridge Research Group

"GE came out a few years ago with a combined-cycle power system" said Ming from BHGE; that is essentially a static jet engine that spins one generator while the exhaust gases create steam to spin a second generator. "It is 62% thermally efficient almost twice as efficient as a single-cycle coal plan, and the next one is going to 65%.

But the market for those has collapsed. Utilities are going back to single cycle. Here is western Oklahoma City OG&E just put in a bank of combustion turbines instead of combined cycle." With a tone of incredulity he added, "In Louisiana a utility [Energy] is building a new gas-fired power plant using *reciprocating* engines!"

At that point Bradford noted that GE also keeps making bigger and bigger wind turbines. He then added, "I question whether we will still burn coal at all in this country in 10 years."

Ming agreed that "the competition for gas from renewables is compelling, but so far wind is not dispatchable as conventional power is. Natural gas is great for those evenings, and there will be a need for gas-fired power at those nodes."

Broadening the global view, Ming added, "in most of the developing world the issue is not fuel for power, it is fuel for cooking. They still use wood, or charcoal, or dung. The deaths from particulate inhalation exceed those of AIDS and tuberculosis. Yet funding for those diseases is ten times the research for cooking fuel."

Dean Stice then asked what is the single most dynamic for fossil fuels? Ming said it was water, as noted earlier. Stanislaw suggested education and recruiting. Bradford suggested that while capital continues to flow into the industry, recovery rates are being scrutinized. "We do a lot of work for private equity firms, and the big question is recovery rates [for unconventional developments, especially in the current price environment.] At $100 oil we saw rigs in the Everglades and eastern Washington. People were just playing games. Today Henry seems happy at $2.75 an mcf and crude seems to be holding at $60 a barrel."

Bradford handled the inevitable question from the audience about price outlook. He kept mostly the lower-for-longer current thinking. "We are looking at 10 Bcf/d of LNG exports. That could go to 12 or 14. Yet 10 to 20 years out we are still looking at a gas market at $5 or $6 an mcf. We are seeing recovery in the Haynesville. There is a lot of resource left in the Barnett. That play will have its other day, even if that is in 10 years. A lot of resource comes of the weeds at $4 and $5 an mcf."

Nevertheless he added, "if we have found all the great rock, and production efficiency is relatively flat, then we do move back toward resource constraint. We do start to move up the cost curve."

Bryan Hannegan moderates a panel discussion regarding the future of alternative energy with (from left) Tom Flaherty, Paul Dabbar and Michael Britt

Hydroelectric Pressure

The uncertainties upstream pale in comparison to the upheavals being wrought in the utility sector. This year the symposium convened an entire panel on that industry. Paul Dabbar, undersecretary for science at the U.S. Department of Energy noted that his department is a major operator of hydroelectric facilities, which are known as the baseline for inexpensive power.

"We are reaching a point now where natural gas, wind, and solar are seeing market prices so low that that even hydroelectric is getting pressure," said Dabbar. "Right here in Oklahoma, the state is third [in the nation] in wind energy. If any fuel type – coal, nuclear, hydro – does not advance in innovation and improvement then they will feel the pressure from fuel types that do innovate.

Moderator Dr. Bryan Hannegan, president and CEO of Holy Cross Energy put some numbers behind that assertion: according to U.S. Department of Energy data for 2009 to 2015, costs for on-shore wind energy costs have declined more than 40%; utility-scale solar, more than 60%; distributed solar, 50%; batteries, 67%; and light-emitting diodes (LEDs), 95%. "The data clearly demonstrate that renewable resources are coming into the market at levels that are giving oil and gas a run for their money."

Thomas Flaherty, senior vice president at Strategy& (a part of the PwC network), suggested that there are four main drivers to the utility sector. The first was local policy. "In the absence of national standards, state governors established their own. One governor would say the state would be using 15% renewables by 2020. Then another would stay 20%. It became a bidding war among political mandates."

The second and third factors are technical and economic. Renewable energy became reliable and adaptive, just as have batteries. They also have become more substantially efficient, in some cases by 50% or more. "It started with every appliance," said Flaherty, "and now it is every office building.

The fourth factor is sustainability. "Renewable energy has become a good business pursuit in its own right. Those companies that have adopted it and other clean energy options have performed better than those that have not," Flaherty stated. "We now see technology companies, like Microsoft and Google, building or buying renewable power directly. That is a combination of several factors—reliability, efficiency, and good business. End-use customers are now changing the way they interact with the power markets."

As a stark example Flaherty cited was when the company Nest sold 150,000 'smart' thermostats in one region of the country "and the utility company did not even know about it. It can be hard for big companies to think about the end-user voices, but the drums are clearly beating."

Michael Britt, vice president of the Energy Innovation Center, at major utility Southern Company noted that the first and most important thing that utilities have to adopt these days "is a culture of innovation. The 'make-move-sell' model [that has been in place in the industry for so long now] has an expiration date. But that date

has been smudged. We don't know exactly when we are going to get disrupted or disintermediated."

While technology has advanced, managing that technology has come more slowly. "We are still at the cave-painting stage," Britt admitted. "Homes today use just 30% of the energy as the 1950's home in which I grew up."

That led to a discussion of the most innovative, or disruptive, technology. Flaherty suggested it was in electrical storage. "Batteries with twice the energy density [of current best technology] and half the price are just about on top of us. And batteries with three times the energy density at just 20% the cost are easy to imagine."

Britt suggested that "the most disruptive development in energy is data and analytics. It is really hard to wrap the mind around the things that are possible with quantum computing."

Dabbar concurred. "We are building our first computer capable of 10 to the 18th power calculations per second. There are great possibilities for machine learning and artificial intelligence in energy management and grid management. The grid could begin to predict when a failure may happen and then not just send an alarm, but suggest a solution."

Pulling all the visions together Flaherty commented, "The question is not what the possibilities are, but how fast people can adapt. In any case we can see that the future of the energy industry will be distributed, digital, and domain based. In particular block-chain technology has great applications in the oil and gas sector where there is still a lot of paper processing."

He added that, "across the energy industry analytics are still failure based rather than predictive. Predictive analytics are less than embryonic yet."

Given all those brave new worlds, the panel turned its attention to the ways that operators and investors should choose to allocate their capital. Britt cautioned, "it is a bit like trying to catch a falling knife. There is so much we don't know about risk management on hardening the grid" as it exists today.

To that point Flaherty brought the discussion back to the near term with observations on how utilities can operate. "In power it is hard to be unique because regulations drive companies to the norm. Innovation and origination are different skill sets. As are developing new channels to market, unconventional ways to develop markets, and creative ways to deploy finance."

But that reality hardly means that utilities are hobbled. "There is a trillion dollars invested in utilities that cannot be so easily reinvested," he stated. "Energy is invisible unless it doesn't work, in contrast to something like a cell phone, which has known capabilities." The very utility of utilities, hiding in plain sight, is something of a liability. As is the low cost. For all that power makes possible in modern life, Flaherty noted that for most rate payers, electricity consumes just about 1.3% of their budget.

SYMPOSIUM SPEAKERS

David Lawler
CEO, BP America, Inc. – U.S. Lower 48 Onshore

David Lawler is the chief executive officer of BP's US Lower 48 (L48) Onshore exploration and production business and a director on the board of BP America Production Company. Headquartered in Denver, the L48 business operates across five states from Texas north through the Rocky Mountains and produces approximately 300 mboed from interests in over 20,000 wells.

Lawler joined BP in September 2014 from SandRidge Energy, Inc., (NYSE:SD) a US based oil and gas independent headquartered in Oklahoma City, where he served as executive vice president and chief operating officer. Prior to joining SandRidge in 2011, Lawler was the chief executive officer and president of PostRock Energy Corporation (NYSE:PSTRQ) and its predecessor entities where he worked for four years.

Lawler began his career as a production engineer with Conoco and later joined Burlington Resources where he served in drilling engineering and well site leadership positions. He then spent 10 years with Shell Exploration and Production Company in a series of roles with increasing responsibility, including business planning for the Americas and engineering and operations manager for the US Gulf Coast business unit.

In addition to his role with BP, Lawler serves as a board member for the Texas Oil & Gas Association and the Mewbourne College of Earth and Energy at the University of Oklahoma. Lawler served as a director of PennTex Midstream Partners, LP (NASDAQ:PTXP) and as a member of the Audit Committee from 2015 until its sale to Energy Transfer Partners, LP in 2017.

Lawler graduated from the Colorado School of Mines with a Bachelor of Science in Petroleum Engineering and earned his Master of Business Administration from Tulane University.

Andrew Bradford
CEO, BTU Analytics

Andrew Bradford is the co-founder and CEO of BTU Analytics where his responsibilities include commercial operations, business development, product development, and natural gas project consulting.

Prior to BTU Analytics, he was the commercial director of North American Natural Gas at Platts-Bentek Energy where he led the Bentek natural gas analytics team and ran commercial operations for Platts' publications; Gas Daily and Inside FERC Gas Market Report. In this role, he served on the National Petroleum Council's 2011 Prudent Development study. Bradford launched Bentek Energy's Northeast analysis in 2008 and consulted clients on many early Marcellus pipeline transportation strategies.

Bradford's 20 plus years of experience in the energy industry includes positions at Amoco Production Company and Constellation Energy. He holds a master's degree in Energy and Environmental Analysis from Boston University and a bachelor's degree in Geology from Colorado College.

C. Michael Ming
Vice President – Executive Liaison, Marketing Technology BHGE (Baker Hughes, a GE company)

C. Michael Ming currently serves as the marketing and technology vice president executive liaison for Baker Hughes, a GE company at the company'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 as an independent natural gas producer as a managing member and principal of K. Stewart Energy Group and K. Stewart Petroleum Corp.
He holds a bachelor's degree with distinction in Petroleum Engineering and a master's degree in Engineering Management, both from Stanford University, and is a registered professional engineer in Oklahoma.
At Stanford, Ming is 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 currently serves on the Oklahoma Business Roundtable Executive Committee, and the Central Oklahoma United Way and OKOGA Boards of Directors, and industry advisory boards at the University of Texas BEG, the University of Oklahoma and Tulsa University.
Ming formerly served on the MIT Future of Natural Gas Study, as an adjunct professor in Energy Management at the University of Oklahoma, on the Stanford School of Earth Sciences Dean's Advisory Board, and as an oil and gas strategic planning advisor to the Department of Energy.

Joseph Stanislaw
Senior Partner, Bright Star Capital Partners

Joseph A. Stanislaw is founder of the advisory firm, The JAStanislaw Group, advising 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, which is listed on the Abu Dhabi Stock Exchange and was previously a Board Member of Gulf Keystone Petroleum, a UK listed E&P company.
Stanislaw is a special advisor partner at private equity firm Wave Equity Partners and is also a senior partner at the private equity firm Brightstar Capital Partners. He is a member of the Council on Foreign Relations and an adjunct professor in the Nicholas School at Duke University, where he was a member of the Board of Advisors for the Nicholas Institute for Environmental Policy Solutions.
Stanislaw was one of three founders of Cambridge Energy Research Associates in 1983 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, Energy and Sustainability to Deloitte LLP.
Earlier in his career, Stanislaw was a Research Fellow of Clare Hall and lecturer in Economics at Cambridge University, where he was also a member of the Energy Research Group in the University's Cavendish Laboratory. He was senior economist at the Organization of Economic Cooperation and Development's International Energy Agency in Paris.
Stanislaw 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," used as the basis for a PBS Documentary, "Oil Shockwave." He has also authored and/or co-authored numerous reports and published papers on the geopolitics and economics of future energy supply and demand.

Mike Stice
Dean and Lester A. Day Family Chair, Mewbourne College of Earth and Energy, University of Oklahoma

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 George Washington University.

Michael Britt
Vice President, Energy Innovation Center Southern Company

Michael Britt is vice president of the Southern Company Energy Innovation Center, located in Atlanta's Technology Square. Under Britt's direction, the center focuses on developing and commercializing products and services that benefit customers as Southern Company extends its long-standing commitment to inventing the future of clean, safe, reliable and affordable.
The Energy Innovation Center is one Company's enterprise-wide approach to innovation, which includes the advancement of new nuclear in Georgia and an industry-leading commitment to robust research and development.
Prior to rejoining Southern Company – where he held multiple positions during the 1990s – Britt served as partner and utilities practice leader for the southeastern U.S. with Oliver Wyman Inc., based in Atlanta. In that role, he focused on market and growth strategies, acquisition strategy and due diligence, energy infrastructure, distributed energy, public policy, technology development and customer experience/retail strategy.
Prior to that, he served as chief operating officer for Accenture's Atlanta-based North American utilities strategy practice, managing practice operations and development initiatives. He also served as president and chief operating officer of LecStar Telecom Inc.
While at Southern Company during the late 1990s, Britt served as assistant to the chief information officer, director of mass-market strategy and vice president of the company's Southern Telecom subsidiary. Prior to that, he served as manager of strategic services, utilities and telecom practices for Accenture in San Francisco and Atlanta, as well as manager of utility and telecom practices for PA Consulting in Atlanta.
While at Accenture, Britt earned the company's highest honor for strategic achievement, the Ken Ernst Worldwide Innovation Award. He has served as vice president of Competitive Carriers of the South (CompSouth), a federal and state lobbying and joint regulatory organization, and is the author of numerous articles and papers on the continuing evolution of the electric utility industry.
Britt holds a bachelor of arts in English from the University of Pennsylvania and graduated with honors with a master's of business administration from the University of Notre Dame.

Paul Dabbar
Under Secretary for Science, U.S. Department of Energy

The Honorable Paul M. Dabbar, Under Secretary for Science, serves as the Department's principal advisor on fundamental energy research, energy technologies, and science. Dabbar drives this mission through programs including nuclear and high energy particle physics, basic energy, advanced computing, fusion, and biological and environmental research, and direct management over a majority of the Department's national labs and their worldleading user facilities. In addition, Dabbar manages the environmental and legacy management missions of the Department, addressing the U.S. legacy of nuclear weapons production and government-sponsored nuclear energy research.

Prior to confirmation as Under Secretary for Science, Dabbar worked in operations, finance, and strategy roles in the energy sector. As a managing director at J.P. Morgan, leading various energy business areas, he has over $400 billion in investment experience across all energy sectors including solar, wind, geothermal, distributed-generation, utility, LNG, pipeline, oil & gas, trading, and energy technologies, and has also led the majority of all nuclear transactions. In addition, he had a senior leadership role for the company's commodity trading business, including power, oil and gas.

Before joining J.P. Morgan, Dabbar served as a nuclear submarine officer in Mare Island, California, and Pearl Harbor, Hawaii, including deploying to the North Pole where he conducted environmental research. He also served on the Department of Energy Environmental Management Advisory Board. He has been a lecturer at the U.S. Naval Academy Economics Department, and conducted research at the Johns Hopkins Applied Physics Laboratory.

Dabbar received a bachelor's degree from the U.S. Naval Academy, and an MBA from Columbia University. Dabbar and his wife, Andrea, are the parents of two children.

Bryan Hannegan
President and CEO, Holy Cross Energy

Bryan Hannegan is President and CEO of Holy Cross Energy, a not-for-profit, member-owned electric cooperative utility providing electricity and energy products and services to more than 55,000 customers in Western Colorado. Prior to joining Holy Cross in July 2017, Bryan was the Associate Laboratory Director for Energy Systems Integration at the National Renewable Energy Laboratory (NREL), where he co-founded the U.S. Department of Energy's Grid Modernization Initiative and started up the successful Energy Systems Integration Facility (ESIF), a unique 'distribution grid in a box' enabling utilities, entrepreneurs and consumers to work together on cleaner, more affordable and more reliable energy systems.

Earlier in his career, Bryan served in multiple executive roles over seven years at the Electric Power Research Institute (EPRI), leading power sector industry R&D programs in environmental science, energy analysis, fossil generation and renewable energy. From 1999 to 2006, Bryan was an active high-level contributor to U.S. and global energy and environmental policy, first as Staff Scientist to the U.S. Senate Committee on Energy and Natural Resources, then as associate director for Energy and Transportation (and later Chief of Staff) for the White House Council on Environmental Quality (CEQ). He also served as acting special assistant to the President for Economic Policy, helping to formulate the Advanced Energy Initiative and to implement the Energy Policy Act of 2005.

Bryan holds a Doctorate in earth system science and a master's degree in engineering, both from the University of California, Irvine; and a bachelor's degree in meteorology from the University of Oklahoma.

Thomas Flaherty
Senior Vice President, PwC Strategy& Consulting Group

Thomas Flaherty has been involved in the majority of the power and gas mergers in the United States and a number of cross-border transactions involving companies in the United Kingdom, Canada, Australia, and New Zealand. He has worked with a number of private equity participants on the assessment, modeling, and operations transfer of acquisitions related to generation, transmission, and distribution assets or segments.

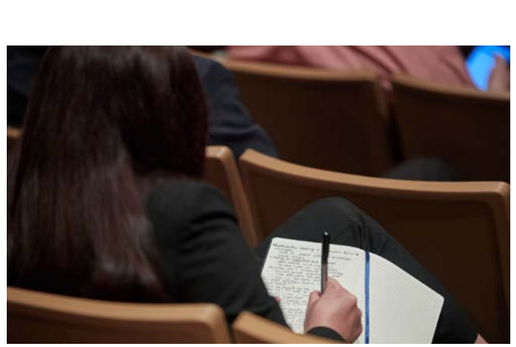
Flaherty also led several utility privatization programs involving gas, power, and water utilities in Argentina, Venezuela, Uruguay, Australia, and the United Kingdom. These programs focused on readiness for privatization, business plan development, financial valuation, buyer interface, and operations improvement.

Flaherty is a frequent speaker at industry conferences on topics such as enterprise strategy, merger and acquisition (M&A) strategy and industry evolution. He has published numerous articles on M&A, business strategy, project management and risk management.

He is a contributing author to the Booz and Company book, "Merge Ahead."

Prior to joining Strategy&, Flaherty led the Deloitte Consulting utilities strategy and operations practice area where he focused on M&A, including target screening, synergy identification and quantification, financial forecasting, performance management, organization design, business strategy, and turnover planning.

Flaherty holds a bachelor's degree in Accounting from the University of Oklahoma and is a certified management consultant.



PRICE COLLEGE OF BUSINESS

ENERGY INSTITUTE

The UNIVERSITY *of* OKLAHOMA

The Energy Institute at the Price College of Business aims to create a community of practitioners and academics with a results-oriented interdisciplinary perspective seeking to advance innovative and sustainable solutions to the critical energy challenges facing our country and, more broadly, the global community. The institute leverages OU's broad footprint in the energy industry and the nexus of energy-related firms, financial institutions and federal and state agencies with a vision of integrating the energy-focused initiatives at OU in a global context.
This is achieved through Education, Research and Outreach.

EDUCATION

Provides education opportunities for energy professionals related to managing the multiple facets of the business-energy interface.

RESEARCH

Fosters and promotes industry and policy relevant research and dialogue on contemporary issues which are at the interface of business and energy.

OUTREACH

Provides a forum for energy professionals and academics to address current topics in business and energy.