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SEVENTH ANNUAL ENERGY SYMPOSIUM

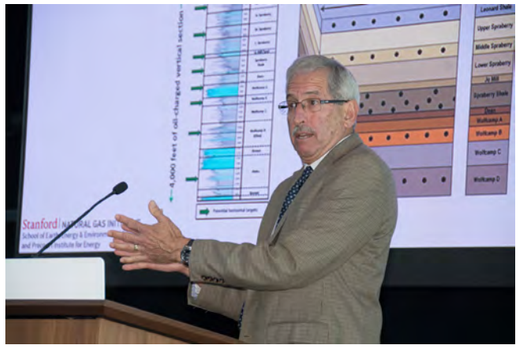
The Great Energy Disruption:

Competition for Capital, Customers and Public Sentiment

In the competition for markets, the U.S. oil and gas industry has turned the world upside down surging to the top three in exports just a few years after re-entering the deepwater trade. Coming to grips with the urgency of addressing and mitigating climate change – the competition for capital and public sentiment – gains have been much more modest. Speakers and panelists at the annual Energy Symposium held by the Price College of Business at the University of Oklahoma lauded the energy industry for its business accomplishments, and exhorted leaders to step up environmental efforts by citing evidence that sustainable business is profitable business.

"The resource is there as long as we extract it in an environmental and economical way, said opening speaker Dr. Mark Zoback, professor of geophysics and director of the Stanford Natural Gas Initiative, Stanford University. He noted that while the environmental implications for hydrocarbon fuels are complex, the economics are not as simple as they might appear.

That is especially true when balancing normal decline curves against net cumulative production. "there is almost unlimited potential even if we are only drilling in areas where we are already allowed," said Zoback. "Recovery of tight oil is still in the single digits [as a percentage of oil in place]. Tight gas is a little better. For the $77 billion invested we are doing a bit better [than at the start of the shale era] but we have a long way to go."



Zoback

As an example Zoback cited emerging research on hydraulic fracturing that indicates "we are doing a good job of opening formations that do not have hydrocarbons. Fractures will take the path of least resistance, up or down, but not both." He also noted that other countries are starting to see some traction in unconventional development, citing specifically the Vaca Muerta formation in Argentina, and activity in China.

There was a strong, if unspoken, implication that the global energy market could move into oversupply. In previous years speakers and panelists at the symposium have been frank about the rapid and dramatic shift in oil and gas from an era of scarcity to an era of abundance.

That theme was echoed this year in the panel topics: competition for capital, customers, and public opinion. Again the implication is that more producers of more molecules will be chasing demand growth that is changing quickly, and in some cases already facing limited growth.

"The oil and gas industry is in the era of decarbonization," said Zoback. "The new abundance of natural gas is an immediate opportunity to decarbonize the power-production sector," he said. "In that California is well ahead of other states and countries. If it were a separate country California would be the 5th largest economy in the world."

While most of the decarbonization attention is on reducing the use of coal and oil to generate electricity, Zoback noted important potential in heat, not just light. "Thermal fuels are a significant matter in the developing world." Natural gas liquids, especially propane have a significant opportunity to replace wood, charcoal, and dung as a fuel for cooking and heating.

"The importance of the industry is carbon capture and storage," (CCS) should not be overlooked, Zoback added.

Looking more closely at decarbonization of electrical power, Zoback stressed the danger, and potential: "there is 300 gigawatts of coal-fired generating capacity under construction across Asia. To put that into context, that is equal to all the coal-fired plants operating in the U.S. That means that even if we shut all of our coal-fired plants tomorrow, it would only be a net zero for emissions as the plants in Asia come into service."

Stepping into the Vanguard

It might be surprising that so much new gas-fired generation is being built, given all the gas being produced, and the boom in deepsea LNG. But LNG into India going for about $7 per million Btu, and coal costing less than $3 per million Btu.

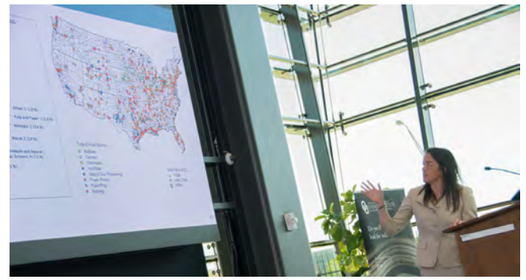
"However, there are 4 million deaths worldwide a year from indoor air pollution. In the developing world that is caused primarily by burning wood or dung for fuel and heat. So [nations have to] accounting for the health and are quality of gas over traditional fuels. What carbon price does that take? About $22 a ton." Even without a formal global carbon price, there is already action on that front. "India is providing 10 million propane canisters around the country," said Zoback.

All those efforts are necessary but not sufficient, said Zoback and other speakers and panelists through the course of the symposium. "The only to reduce CO2 is carbon capture and storage," Zoback stressed. "Green energy only reduces the rate of increase in carbon emissions." He again cited California, which has been vocal about decarbonization. "If California is going to meet its goals, it is going to need lots of natural gas, high standards for automobile emissions, and CCS."

And that is where the oil and gas industry can step to the vanguard, said Zoback. "The current estimate for CCS is 30 million tons a year injected as a super-critical fluid and sequestered," said Zoback. "The infrastructure required to do that is equivalent to the [scale and volume] of the global oil industry. The only realistic pathway to sequester that much carbon is to inject it into depleted formations. The infrastructure is in place, and the pore space is being created every year."

Just as the roots of a tree reflect the branches, Zoback's vision for the sustainable hydrocarbon industry is equivalent volumes of oil and gas out and CO2 in. "We know where it can go, and we know what we need to do."

The first steps are already being taken in that direction. Occidental Petroleum is already the largest consumer of CO2 in the country, said Hilary Moffett, senior director of government affairs. The company consumes 2.6 Bcf/d, or 50 million m.t./year of CO2 for enhanced oil recovery.



Moffett

The company has invested in 1.6 megawatts of solar power at its producing field near Goldsmith, Texas, and has a joint venture with White Energy in biofuels. Oxy has also invested in direct carbon capture, an eponymous project at Squamish, British Columbia, just up the coast from Vancouver. "This pilot plant with Carbon Engineering opens a pathway to a carbon-neutral or even carbon-negative barrel of oil," said Moffett.

The themes of public engagement and industry commitment were echoed throughout the seminar, and recapitulated in the closing remarks: a video-taped interview with George P. Shultz, who served in four different cabinet positions under three different presidents. "Two helpful things have been put into place," said Shultz. "There is a system that calls people's attention to the need to do something about the carbon dioxide they emit. My suggestion on that is a revenue-neutral carbon tax. There is also an effort into energy-efficient development."

On the latter point Shultz spoke of progress at the global and local scales. "By all

accounts the Montreal Protocol [which he helped to write] has been a huge success." And, he noted, "I have solar panels on my house." Collaborating with former Secretary of State James A. Baker, Shultz co-wrote the Carbon Dividends Plan for the Climate Leadership Council.

Decrying the partisan antipathy in Congress and the nation, Shultz reminded everyone that "President Reagan put his arms around those he disagreed with. He said, 'let's acknowledge this.' That is not solving problems, but it is working on problems. It's not like there is some answer out there and when we find it, problem solved. These are things we have to keep working on."

Natural Gas Role in Decarbonization

The first North American company to get LNG to those emerging global markets was Cheniere Energy. Its multi-train liquefaction terminal at Sabine Pass, Louisiana, loaded its first tanker in February 2016 and since then has sent 600 cargoes to 32 countries, said Wes Mitchell, manager of supply and trading for Cheniere. "We added seven new countries last year. Total exports in the two full calendar years of operation, 2017 and 2018 were 1.7 Tcf of gas. To put that into perspective, that is about what the U.S. draws from storage on a typical winter."

Cheniere has 5 Bcf/d of total liquefaction capacity among five trains at Sabine Pass and one more at Corpus Christi, Texas. That total will grow to 6 Bcf/d by the end of this year. The essential capability that makes the Bs fly is the trading desk. "We have five traders, including me, and eight schedulers. It is a lean machine, and we are very aware that we are the proof of concept for LNG exports."

The panel underscored the tone set by earlier remarks that gas is an essential part of the decarbonization equation, especially in the developing world. "At the Energies Futures Institute [EFI] we are very focused on deep decarbonization," said Melanie Kenderdine, former director of the energy policy office at the Department of Energy, and former executive director of the energy initiative at Massachusetts Institute of Technology. She is currently a principal at the EFI.

That focus comes naturally. "When I was in the Clinton administration, gas was viewed as a very green fuel. A lot has changed since then. My view now is that gas and renewables should work together. Even large-scale wind and solar will result in periods that require large-scale backup options."

Kenderdine

Kenderdine showed historical data indicating that there have been periods as long as 10 days in which the wind did not blow sufficiently to meet base demand in some regions. That may be mitigated by utility-scale storage, but only after significant time and investment. In the major North American regional wholesale markets actual storage available today is measured in hours, not days.

"California Independent System Operator has a bit of storage for 14 hours," said Kenderdine, "but most of it is only 4. PJM [the ISO for Pennsylvania, New Jersey, and Maryland] the storage is only about an hour. When you are talking about 10 days with no wind, you either need 10 days of storage, or 10 days of fuel."

Mitchell concurred, offering his perspective from the trading desk of Cheniere. "Five to seven years ago an energy trader would only discuss wind output at a cocktail party, to demonstrate knowledge. Now [the ability to understand wind output] is essential. On peak days the U.S. has 60 gigawatts of wind energy. That is the equivalent of 120 nuclear power plants. But the next day that might only be 30 gigawatts. That's like 60 nuclear plants being lost from one day to the next."

He hastened to add, "you never hear about that, which is a demonstration of a market that is working. Gas is there to back it up. It is fascinating to see the volatility in wind output and the ability for gas to fill it."

Balancing Gas Demand and LNG

Further on the subject of storage, Kenderdine brought a new foreign-policy perspective that has a great deal to do with energy security. "We think a lot about protecting the oil supply chain. We need to think about protecting the supply chain for metals that are used in storage, and other key materials for renewables. We need to pay attention to cobalt and lithium, and change the defense posture."

The larger question is whether storage is the enabling technology to arrest climate change. Kenderdine does not believe so. "We do need breakthrough technology, but I don't see that happening by 2030. I only see incremental improvements by then. We need the breakthrough technology by 2050 to meet the climate change goals by then. That could be direct capture. Or hydrogen—from electrolysis, not from steam reforming."

While acknowledging that LNG exports have gone to a wide range of countries, with more being added every year, Kenderdine cautioned that "69% of LNG exports go to other OECD countries." The Organization for Economic Co-operation and Development has 37 member countries, and is broadly taken to represent the industrialized nations of the world. That reality of exports mostly to other 'Western' countries throws some shade on the idea that cleaner-burning gas will quickly and easily displace coal for power generation and perhaps even wood for cooking and heating in developing countries.

Back at the export end of the tanker voyage, the number of liquefaction terminals is growing, with more planned. "There are massive new projects," said Mitchell at Cheniere, "and I am talking just about the ones that are actually under construction or approved by the Federal Energy Regulatory Commission, not ones that have not yet gotten to final investment decision." One new one came into service last year, two more are due this year, with two more approved. Meanwhile the price for LNG in Asia has tumbled.


Mitchell with Kenderdine, Moddelmog and Ming

By the time its 6th train is in service at Sabine Pass, and the second at Corpus Christi, Cheniere will have about 8.5 Bcf/d of liquefaction. That is roughly 10% of the entire U.S. gas market, and roughly as big as the entire Canadian market.

"We are now looking at the second and third waves of LNG facilities," said Mitchell. While he confirmed some projects have sound financials, he added, "it is difficult to see projects that are just extrapolations of current growth rates taken out 10 or 20 years. We could be looking at 20 to 25 Bcf/d of waterborne gas out of the U.S. That final 5 is going to be a challenge to think about. How are they going to get the gas, and how are they going to get it to the Gulf Coast?"

That raised the question of other LNG exporters keen to get in on the boom, particularly the flurry of interest in floating liquefaction vessels. "The lead opportunity outside the U.S. is Qatar," said Mitchell. "There will be opportunities for gas economies worldwide," and not necessarily in LNG," he elaborated. "China now produces half of the gas they need, and is developing more. That is on our radar. Also, liquefying gas is hard. Doing on a ship with dramatically condensed engineering is even more so. It will be interesting to see how that works, to see how these floating units do on reliability standards."

Kenderdine added a further dimension noting, “We have looked at African developments, the intention of which is African gas for Africans. In some cases those ideas include floating LNG as a way of developing [global] demand so they can develop the resource for themselves,” more fully.

New York’s ‘No Pasaran!’

Brian Moddelmog, vice president of strategic origination at Calpine noted dryly that “this past winter New England had to import LNG – at $12 per mcf.” Calpine is one of the largest utilities in the country, with 28,000 megawatts of generating capacity primarily in California, Texas, and New England. That capacity is primarily gas-burning, consuming about 2 Bcf/d of gas.

“California is a proxy for what we should expect to see in other parts of the country,” said Moddelmog. “If we can agree on that [model] the market design [for natural gas] becomes the next issue.”

Over the course of the day several speakers and panelists made reference to strong anti-hydrocarbon sentiments by the current governor of New York. The effect of that is to have prevented new or even expanded pipelines from the prolific Marcellus Shale developments in Pennsylvania from getting to dense markets in New York and New England that are currently paying high premiums for fuel.

Price ranges and fluctuations are the essential variable for all energy projects. While global oil markets are well established, as are regional gas markets, LNG is in its early days. “Contract terms are literally evolving as I sit here in this chair,” said Mitchell at Cheniere.

He explained that traditionally LNG was priced against an oil index at 6:1 because of the relative Btu value of crude and gas. “That was always mathematical, not actual,” he stated. As LNG has become a global commodity it is in the process of developing real price balances based on delivered costs and competition from other fuels.

“Today LNG prices in Asia have nothing to do with oil prices,” said Mitchell. “There is dealing based on price options and destinations. Is LNG priced against oil? Yes. Against Henry Hub? Yes. Against Rotterdam coal? Yes. Eventually LNG will be priced on its own merits.”

Kenderdine noted a fast-approaching inflection point. “Based on LNG projects currently in service or being built, not just project announcements, the volume of LNG worldwide will approximate the total pipeline volumes in the world by 2020 if all those projects are completed.”

The volumes in domestic pipelines are very much on the mind of LNG exporters. “We need investment in the midstream,” Mitchell stated flatly. “It is one thing to have a beautiful world-class terminal, and a whole other thing to get gas to it. We look for consistency, and we wonder how the midstream is going to support 50 million m.t. a year of exports, and 100, and 150. What is missing in the big conversations about LNG is the importance of the midstream.”

Sounding dire, Mitchell elaborated, “I we cannot get incremental pipes built, if we can’t get greenfield or even brownfield pipes, if all we are left with is looping and compression on existing lines, then the Marcellus will only have a limited role in U.S. LNG exports over the next decade.”

Looking Beyond Power Generation

Regardless of the region “it is very important for renewables and gas to work together,” said Moddelmog. “Electricity is the easiest to decarbonize. It is not easy per se, but the easiest sector because the others are more difficult. Industry is extremely difficult because there are no alternatives for process heat. Transportation is a matter of consumer decisions. There is also consumer resistance in the building sector.” For example commercial kitchens and most consumers want gas stoves. They don’t like to cook on electricity.

Even having said that the power generation sector is the easiest, Moddelmog added ruefully, “In California 49% of the generation is gas-fired. Getting to the goal of 60% renewables by 2030? That is a lot.”

Kenderdine emphasized a different set of ratios. “decarbonization of electricity is important, but in California, [that sector] is only 16% of emissions. The largest sector by far is transportation, followed by industrial, followed by buildings. The focus on electricity is important, but that is not going to get us to our emissions goals, certainly not by 2030. And in the meantime we have to worry about reliability.”

Kirt, Victor, Capper, Brownstein and Stone

Returning to an idea she mentioned earlier, Kenderdine advocated reusing fossil-fuel facilities to support renewable energy. For example, that could be using the existing natural-gas distribution system to carry “renewable gas” from agriculture, or as a way to move hydrogen to augment gas-fired combined-cycle generation.

She explained that there are several advantages to blending green energy into the existing infrastructure. Most obviously, the facility and economy of not having to make major new capital investments.

“Oil and gas companies have a fiduciary responsibility to protect their infrastructure,” said Kenderdine. “We need to understand that.” Still, she chastised the industry on the same point. Acknowledging that companies have been unwilling to abandon assets, Kenderdine added, “that unwillingness has delayed a response to the existential threat of climate change. Anything we can do to stop creating immovable objects is critical.”

No Crazy Advocacy Stuff

“Our energy program is known for using science, economics, and law to help shape the discussion and find solutions,” said Mark Brownstein, senior vice president at the Environmental Defense Fund. “Our goal is to work with the oil and gas industry to bend the curve toward the goal of a zero net-carbon economy worldwide by 2050, while supporting the quality of life worldwide that we enjoy in the U.S. We do not do crazy advocacy stuff. Our work is in line with the International Energy Agency sustainable development scenario.”

The EDF works across all four major sectors of the economy: power generation, transportation, buildings, and industry; and advocates both resource conservation as well as capture of two key pollutants, CO2 and methane. “None of that means we stop using hydrocarbons,” said Brownstein, “we just use less. Both strategies, reduction and capture, are necessary to meet agreed goals.”

Recycling is also a major component of water use. Consultancy CAP Resources focuses on energy with a concentration in water management. “We conduct an annual review of water use in the oil and gas sector,” said Laura Capper, principal of CAP Resources. “The industry is producing 8 to 8 billion barrels of water a year just out of the Permian Basin. Of that more than 8.5 billion is being injected for enhanced recovery or disposal. Our systems are already under stress at that volume, but within five year the output could double to 16 billion.” She is also founder and chief executive officer of another consultancy, the EnergyMakers Advisory Group.

She noted the recent history of induced seismicity in Oklahoma, and how that has been addressed by geologists, regulators, and industry. “In Texas the overpressure in many formations has meant less seismicity, but there are still pockets.”

There is also the question of space. “A third of [injection] formations are losing capacity,” Capper cautioned. If industry does not start recycling more water “tomorrow” to reduce the overall load of produced water, “there will be a crisis that will increase production costs. Big producers with contiguous acreage are recycling, but not so much the smaller ones.”

Despite billions of investment recently in water midstream development,

Capper lamented that “we have a lot of development assets, but insufficient infrastructure to manage the environmental problems arising from that production. We could pay a price for not keeping an eye on the water balance.”

Extending that idea, David Victor, professor of international relations at the School Of Global Policy And Strategy, University Of California, San Diego added, “the markets on their own are delivering modest emissions reductions, and shallow decarbonization. They are not going to deliver deep decarbonization. I am concerned about the gap, and what is really needed to address climate change.” Victor is also co-chair of the Cross-Brookings Initiative on Energy and Climate, part of the Brookings Institution.

Defining Success

At that point the discussion focused on what success in addressing climate change would look like, what can reasonably expect, and how companies can prevent getting bowled over on the way. Suggesting that energy companies step up and take the lead, Victor noted that “public attitudes are sticky, and risk averse. It is easier to lose a good reputation that it is to rebuild one. Also, people are good at connecting facts that are not really related. That is why there is such a disconnect between ideas of climate change and what the facts are.”

Human nature tends to overweight the present and discount the future, Victor explained. “It is almost biological. That is why we see more progress in areas like soot, because there is a proximate benefit.”

He added that the debate over genetically modified foods serves as an instructive case for hydraulic fracturing. “There was originally great potential, but that industry did not understand how attitudes against the technology formed in crucibles then reverberated around the world. That is very similar to fracking. You can laugh or say the public does not understand, and think that if I only show them more charts and figures they will understand. But that is not how the public forms attitudes.”

Which is not to say that companies don’t get it, or that management or investors have not responded. “The term ESG for transparency in environmental, social, and governance metrics was first coined in 2006,” said Chris Kirt, vice president of corporate governance, and secretary at Devon Energy, who is responsible for ESG at that firm. “All stakeholders want to see accountability, and they see ESG as an area for performance. More and more data show strong correlation between ESG and financial performance.”

Victor

Brownstein at EDF suggested that was a fair assessment on a broad level, but not necessarily deep. “At a time when a young workforce is looking for diversity and at a time when the energy supply and demand is becoming more global, too often U.S. oil and gas companies are looking inward. They are becoming more parochial. It’s almost like some companies are pulling the covers over their heads and hoping the debate passes by so they can go back to business as usual. I don’t see that happening, and the kids coming out of school don’t see that happening.”

To be sure Brownstein said “we do see more transparency, and more companies doing a better job of reporting data on their operations and emissions. We are seeing companies making commitments, like the 13 big energy companies that have joined the Oil & Gas Climate Initiative. They have made a commitment to reduce methane emissions. What we have not yet seen is investment to achieve those commitments. We are not seeing the capital flows to meet corporate aspirations. Do the data and the dollars reflect the commitment?”

Doing Well by Doing Good

Capper, at CAP Resources, said both industry and regulators had earned the grade of “a healthy C” for their efforts toward produced-water recycling. She concurred that “constraints on disposal systems are forcing recycling. In the past there was a debate between doing the right thing and doing the environmental thing. The assumption was that the environmental thing would cost more. But I can show pretty compelling data, at least in water, that if producers do the environmental thing now, it actually is going to cost a lot less over the long haul.”

Offering some hard numbers, Capper added that action today, rather than five years from now, “could have a 50% difference in the bill for water,” she stated. “We are finding alignment in the protection of resources and better economic output. For oil and gas companies, the key is to break barriers between completion and production. As long as budgets are siloed, operators are not really rolling in the true costs and expenses related to water.”

Victor, at UC San Diego, encouraged enlightened self interest, larger producers fostering smaller ones. “It is instructive to look at the nuclear industry. I sit on the advisory board of the Institute for Nuclear Power Operations, the industry group that oversees all U.S. reactors. They know that the health of their industry is only as good as the weakest actor. That model is important for the energy industry. What are the good companies going to do when the whole industry earn bad reputations that threaten all of their ability to survive.”

Kirt, at Devon, said that “transparency is a starting point. Some companies are not doing it, but the reality is that they are going to be dragged into this because investment capital decisions are being made based on ESG performance.”

He elaborated that “investors have a range of ways that they use ESG data. For some it is a gate item, a tick box. But more are more are looking into the quality of the data and will be looking for change over time. So transparency is not enough. It is a starting point. Performance will be key.”

Victor, at UC San Diego, added another factor to the timeline. “Industry has got to be better organized in helping people understand the pace of change in the industry. Steel in the ground dominates. We build models to estimate decarbonization rates in different sectors. It is slower if there is a higher cost versus the optimum. That creates a growing sense of foment that industry is not doing its part.”

Brownstein at EDF concurred. “What has bedeviled the [industry’s] ability to build new infrastructure is the public expectation that something will be done to address climate change and environmental quality. I am not at all confident that practices in place to review new pieces of infrastructure have reflected either of those expectations.”

Ironically, “industry is a victim of its own success,” Brownstein added. “It worked very hard to delay and forestall development of a coherent national climate-change policy. So in the absence of any national policy framework industry and the various states are left to fend for themselves. And so they do.”

Validating New Infrastructure

Noting examples that were cited of the heavy opposition to new gas pipelines to Long Island, New York, or across New York to get Marcellus gas to New England, Brownstein was frank. Without any formal process for evaluating energy and infrastructure development, “everyone is left wondering how a new natural gas pipeline into Long Island comports with public policy. Until the pipeline company has an answer to that, the suspicion is that it is at odds [with climate change and environmental quality].”

He hastened to add that he is not telling tales out of school. “I have told them this,” said Brownstein referring to the companies proposing such lines. ‘I can imagine a time that there is more gas capacity into New York City and New England. We can also agree that there needs to be more gas gathering in the Permian to reduce flaring.”

Stanislaw

The need to communicate directly and compellingly with the public was a central theme in the luncheon address by Joseph A. Stanislaw, senior partner at Brightstar Capital Partners, and founder of the Jastanislaw Group. “We are talking to the wrong audience,” he warned. “We should be talking to all the wives and husbands who are not in the business. All the people in [all the states] that are not in the business. [Instead], we are talking to ourselves a lot.”

In the first half of the symposium Stanislaw said that he heard “a new dynamic in the conversation that is welcome. But we are still missing a lot in to whom we are speaking. There is no tomorrow without oil and gas, and that will still be true for the next 20 or 30 years. Still, we are not moving fast enough to be using the resource wisely. Wise use of resources is basic economics, Adam Smith, The Wealth of Nations.”

As an environmentalist Brownstein expressed “great frustration with my ‘keep it in the ground’ colleagues. They don’t focus on the demand side of the equation, and if you don’t focus on the demand the resource will always find a way to the demand.”

Another variable in the evaluation to determine new or expanded infrastructure is the time such assets can be expected to be making returns. Recalling that several panelists and speakers had emphasized how gas-fired power-generation is essential to fill in the gaps for wind and solar, Brownstein cautioned that may not always be the case.

“How long will it be true for gas to support renewables? There may be a different answer in 10 or 15 years,” said Brownstein. “To finance new kit on the basis of a 30- or 40-year amortization is not economically rational. If you can justify new pipe on a 10- or 15-year amortization you have a good argument. But if you need 20 or 30 years, I’m not sure regulators should be approving that infrastructure.”

Situations where new or expanded lines or facilities that industry believes to be important are delayed or denied are going to become more common, advised Victor at UC San Diego. “Industry needs to make the case for gas infrastructure as part of a renewables integration, and coupling it to lower carbon energy, such as hydrogen. There are ways to raise the probability of success; it is not political rocket science.”

Extending that logic, Capper at CAP Resources, said that “produced water is the opportunity to reinvent ourselves as the world’s largest water producer. In 2012 the U.S. produced 20 billion barrels of water. In five years from now the Permian alone could be producing as much as 16 billion.”

She lauded some producers for their commitments to zero fresh water use, and suggested that all producers may be able to achieve that goal across the entire industry. She wondered, are regulators keeping up?”

Brownstein at EDF also recognized efforts to recycle water, and encouraged science and standardization. “There are currently no standards test methods for water, or ecological or public-health characteristics. There is a need to develop engineering and science [to establish] what is in the water to assure the public that [treated produced] water is safe for uses other than just reinjection.”

Competition for Capital

There are millions of people in the world who do not have access to clean and reliable light and heat, lamented Maynard Holt chief executive officer of investment firm Tudor, Pickering, Holt. “We need to get power to them, and to the [generations] who are coming after them. This has got to be the challenge for the next century. This is a moral problem, and it should attract the best brains on the planet.”

TPH has a team of four people “who do nothing but roam the world looking at oil and gas technology,” he added. Yet “there is a view that oil and gas is the buggy whip industry and that as soon as someone figures how to do renewables [economically, society] will leave oil and gas behind. About 99% of this year’s graduating senior class has not thought that the oil and gas industry might be the one to inject CO2 long before other industries do. We’ve got to work on the message.”

Holt, Harris, O’Sullivan and Stice

And while public minds and public markets remain cool to oil and gas, there is no convincing necessary among institutional capital. Matthew Harris, founding partner of Global Infrastructure Partners noted “energy is central to GIS. We have investments in crude and refining, natural gas, electricity, LNG, metals, and petrochemicals.” Indeed there are so many opportunities in energy infrastructure that GIS has to be selective. “We always ask what do we want to own, as opposed to just what is for sale.”

Despite the size and importance of the energy infrastructure sector, it seems to be hiding in plain sight. As an example, NextEra Energy Resources is “the largest company you have never heard of,” said Michael O’Sullivan, sr. vice president of development. “We are the largest utility in the world by market capitalization. Over the past 18 years we have invested $40 million in renewable energy. We have assets in 35 states, the renewable portfolio and we also operate a traditional utility in Florida.”

Regardless of the size of its renewable-energy portfolio, O’Sullivan insisted that his company is not just a “green” energy outfit. “We are financial firm that invests in infrastructure.”

Capital will definitely find its way to the oil and gas industry, assured Harris. “And some of it will come from the government. I believe that private capital and public-private partnerships are going to be central to energy development. I’m in the world of private equity, and candidly the returns in alternative investments, including infrastructure, have been better than anything else. The institutional investors and sovereign wealth funds will continue to be attracted. Energy will continue to be a great place to put capital.”

Harris added that energy and infrastructure “are the best way to lift economies out of poverty.” There is a great deal of disruption in those sectors, to be sure, but “there is always opportunity in dislocation.”

That said, not everything is in upheaval. “We are the second-largest burner of natural gas in the country, and that is not going to change,” said O’Sullivan. “We own eight nuclear power plants. We are retiring one next year, but the rest are not going to change.”

On capital O’Sullivan not only seconded the availability that Harris mentioned, O’Sullivan cautioned, “there is too much, especially in renewable energy and power generation. Returns are optimistic and low, given he amount of money flying into U.S. renewable technology.”

As an example O’Sullivan noted, “Greenfield investments will make a 10-12% unleveled, tax-efficient return, versus the merger and acquisition market clearing at 4-5% on the same assumptions. That is an arbitrage gap that says there is excess capital chasing yield. The spread is the widest I’ve seen in my 37 years. I don’t know how long that will persist. Everyone things they are smart enough to get out in time.”

Part of Public Policy

Panelists noted that investor pressure on traditional energy firms to be more environmentally responsible was manifest

most obviously in the recent decision to tie executive compensation at Shell to achievements in decarbonization.

"We are seeing the same thing first hand," said Harris at GIS. "We are in the process of raising a $20-billion fund and for the first time ever we have had investors scrutinize us about the carbon footprint of our portfolio. Not just today, but in 10 years. And not just projections, but asking are we prepared to commit to those expectations."

As if the point were not clear enough, Harris added that "For the first time we had three investors as for exemptions from any infrastructure investment that carried hydrocarbons produced through hydraulic fracturing."

Crude lines can transport different types of oil – light to heavy, sour to sweet –in discrete batches. How the hydrocarbon is produced, conventionally or by hydraulic fracturing, is irrelevant within the industry. As noted, output of many producers is comingled, so every major commercial system carries mixed fracked and unfracked volumes. Except for a local gathering system within a conventional field, it would not generally be possible to exclude unconventional crude, gas, or liquids.

Harris did not say whether or not the exceptions were accommodated, only that they were sought. "Our own view is that the shift to cleaner energy has got to be accomplished within the envelope of the existing hydrocarbon industry. The country is not simply going to turn off hydrocarbons and turn on renewables by 2030. That is just not going to happen."

O'Sullivan

Fifty Different Countries

Underscoring that point, O'Sullivan at NextEra highlighted the difficulties in coordinating the national electrical system. "The grid was not built for wholesale trading and moving power," he explained. "In electricity we have 50 different states, and they might as well be 50 different countries. What Oklahoma does, does not coordinate with Texas. What Florida does, does not even speak to the people in Georgia. And Nevada does not even know where California is when it comes to electricity."

Despite all the attention and effort to streamline and rationalize the national grid -- which includes Canada, another country with 10 provinces and three territories – progress has been slow.

"Over the years there have been tweaks," said O'Sullivan, "but there are not going to be significant changes in the lifetime of the people in this room, [even] the students. We will coexist, but not really get along. It's crazy to think that we are all going to sing Kumbaya and get along."

There is another important difference why the utility sector and the oil and gas sector will continue to have different approaches, O'Sullivan stated. "The chief financial officer of an oil company – a global major or one of the large independents – has an internal rate of return in mind for any project. That is the risk premium or hurdle rate they want for shareholder value, whether the project is traditional hydrocarbon or renewables.

"We have the same process," O'Sullivan continued, "what is the cost of capital? What is the premium it brings to us? What is the risk if we screw it up? But in our sector, the risk premiums are pretty thing. I say that given some of the projects that the infrastructure sector is buying into. There are very compressed rates of return."

The oil and gas sector has a far wider risk premium, O'Sullivan elaborated. "That is at least an extra zero for return expectations. I just don see that converging [for hydrocarbon investors to accept utility-scale returns for renewables]. Shareholders are not going to take lower returns just to save the planet."

Fair enough, Holt responded. Traditional oil and gas companies are not going to win any awards for saving the planet. "But the cleanest oil and gas company is going to dram more capital than one that is not clean."

Shultz via video

Putting a finer point on it, Holt specified, "If you are an oil and gas company, and you go to Europe, but you don't have a report on your environmental, social, and governance [ESG], and you don't have a bit of solar here or there, and you don't have methane monitoring and capture, you are not going to get any meetings. The entire continent is not going to listen to you."

Doing Good by Doing Well

"The biggest problem with oil and gas [in the competition for capital] is that it has not made money lately," said Holt. "You have got to make money and you have got to be cleaner. If you produce oil and gas, and you have a division that is sequestering CO2 and that grows over time, you can take it public. The line to invest will be down the street and around the block and out to Oregon. Because there is a strong social taste to what you own. That is how capital markets are different."

Warming to the task Holt added, "as shale is the source rock for oil and gas, the source rock in capital markets are university endowments and pension funds. They have strong views on where they would like to be invested. It is striking the amount of capital that would like to do the right thing. It is a very strong sentiment."

Social permitting is the expression that O'Sullivan at NextEra prefers for that. As an example he noted that his firm now has large groups for relations with native tribes in several states.

Taking the discussion back to the elemental issue of demand, O'Sullivan recalled that "15 years ago nuclear plus coal accounted for about 70% of the generating mix in the U.S. Today those two account for about half. Within the next 10 years that combined share will drop to 30% because of cheap natural gas and cheaper renewables."

In recent years gas took most of the share from coal, but at this point gas and renewables are gaining share on coal evenly. "This is being driven by basic economics," O'Sullivan stressed. "Public policy is influencing it as well, and that doesn't matter who is in the White House or Congress."

Addressing any concern about too much gas, especially as it is being produced in such abundance as a byproduct of oil in many basins, Harris at GIS stressed the emergence of new global markets. "Places like Bangladesh," he said. "The question is: are projects in places like that financeable? The answer is that the global major oil and gas companies, and commodity trading houses are taking on those financing risks. They are emerging as the bridge for any excess supply for places with growing demand. That is also essential for lifting these countries out of poverty."

Ming

Mark Brownstein is senior vice president of energy at Environmental Defense Fund, and a member of EDF's executive team. He leads the organization's work on electricity, oil and gas and transportation. The goal of the program is to deliver tangible environmental and public health gains while accelerating the energy sector's transition to a low carbon future. Brownstein is a member of the Electric Power Research Institute's public advisory board and the University of Pennsylvania's Kleinman Center for Energy Policy Advisory Board, and the National Petroleum Council. He is an adjunct professor of law at New York University Law School where he co-teaches a seminar on public policy and energy project finance. He has also taught energy policy at Columbia University's School of International and Public Affairs (SIPA).

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.

Matthew Harris is a founding partner of Global Infrastructure Partners (GIP) based in New York, where he focuses on strategic relationships and transactions for GIP's global energy industry investment team, including crude oil and refined product, natural gas, electricity, LNG, petrochemicals and metals and mining. Harris is an executive committee member of GIP and serves on its investment and portfolio valuation committees. He is a member of the board of directors of Enlink Midstream, LLC, Freeport LNG, LLC and Hess Infrastructure Partners. Prior to the formation of GIP in 2006, Harris was a managing director in the Investment Banking Department at Credit Suisse, co-head of the Global Energy Group and head of the EMEA Emerging Markets Group. Previously, he was a senior member of the Mergers and Acquisitions Group at Kidder Peabody & Co., Inc. Harris holds a B.A. in Political Science (cum laude) from the University of California at Los Angeles. He is a member of the Board of Directors of the Chopra Foundation and the World Wildlife Fund.

Maynard Holt serves as chief executive officer of the firm Tudor Pickering Holt & Co. He was previously a managing director with Goldman Sachs, where he worked in Leveraged and Structured Finance (1994 to 1998) and Energy & Power / Natural Resources (1999 to 2007). Holt holds a BA in economics and Russian from Rice University and a master's degree in public policy from the John F. Kennedy School of Government at Harvard University.

SYMPOSIUM SPEAKERS AND PANELISTS

Melanie A. Kenderdine served at the Department of Energy as director of the Office of Energy Policy and Systems Analysis and energy counselor to Secretary Moniz from May 2013-January 2017. Prior to her recent service at the DOE, Kenderdine worked as the executive director and associate director of the MIT Energy Initiative (MITEI). Before joining MITEI, she was the vice president of Washington Operations for the Gas Technology Institute (GTI) from 2001 to 2007. From 1993 to 2001, Kenderdine was a political appointee in President Bill Clinton's administration where she served in several key posts at DOE, including senior policy advisor to the secretary, director of the Office of Policy and deputy assistant secretary for Congressional and Intergovernmental Affairs. She has served on a council on Foreign Relations Task Force to develop a national energy strategy, on the Consumers Energy Council of America Working Group on Distributed Energy, has published articles in the "World Energy Forum" magazine, co-authored a chapter in "Energy Security in the 21st Century: A New Foreign Policy Strategy" and is a frequent lecturer on energy issues.

Chris Kirt is vice president of corporate governance and corporate secretary of Devon Energy. He also serves as associate general counsel and as chairman of Devon's Environmental, Social and Governance Steering Committee. He has been with Devon since 2008, holding positions of increasing responsibility within the company's legal team until 2018, when he was named to his current position. Before joining Devon, Kirt worked for Crowe & Dunlevy, most recently as a director of the law firm's Tulsa office. He holds a bachelor's degree in business administration from Trinity University and a law degree from the University of Oklahoma. He is a member of the Society of Corporate Secretaries & Governance Professionals and the Oklahoma Bar Association.

Wes Mitchell is manager of supply and trading at Cheniere Energy. He joined Cheniere in 2017 and is responsible for developing the price view and strategy for Cheniere's natural gas procurement. This includes maintaining a continuous understanding of market fundamentals and market positioning while executing to establish and preserve expected portfolio dynamics. Mitchell has over 15 years of industry experience with Koch Industries, Duke Energy, Ventum Commodity Trading and consulting work with Pace Global Energy Services and Energy Ventures Analysis. He received his bachelor of business administration from the University of Oklahoma and his master of business administration from the University of Notre Dame.

Brian Moddelmog is a vice president of strategic origination at Calpine Corporation. He joined Calpine as a director of marketing in August 2007. Prior to joining Calpine, he served in various roles at the Williams Company in Tulsa. He specializes in business development around new and existing assets primarily in the northeastern U.S. markets. He holds a bachelor's degree in business administration from the University of Oklahoma and an MBA from the University of Tulsa, and serves on the board of directors for a local non-profit.

Hilary Moffett is senior director of government affairs in Washington D.C. for Occidental Petroleum. She has over eight years of experience in Congressional, regulatory and advocacy capacities. Prior to joining Occidental, she led the Environmental Strategies Committee for the American Petroleum Institute, the largest oil and gas trade association, which represents over 600 companies across the oil and gas supply chain. Moffett has also served as majority counsel on the Senate Committee on Environment and Public Works under the chairmanship of Senator James Inhofe and Legislative Director to Congressman Dan Boren of Oklahoma. During her time working in Congress, she focused on energy and environment issues, specifically related to oil and gas. A native of Tulsa, Oklahoma, Moffett graduated from Washington University in St. Louis with a BA in international relations and received her juris doctorate from the University of Oklahoma College of Law.

Mike Ming retired as vice president executive liaison of Baker Hughes, a GE company. 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.

Michael (Mike) O'Sullivan is senior vice president of development at NextEra Energy Resources, the nation's leader in producing electricity from clean and renewable fuels and also the global leader in producing electricity from the wind and sun. NextEra Energy Resources, LLC (together with its affiliated entities, NextEra Energy Resources) is a clean energy leader and is one of the largest wholesale generators of electric power in the U.S., with approximately 21,000 megawatts of net generating capacity, primarily in 36 states and Canada as of year-end 2018. It is the world's largest generator of renewable energy from the wind and sun and a world leader in battery storage. The business operates clean, emissions-free nuclear power generation facilities in New Hampshire, Iowa and Wisconsin. O'Sullivan received his BS in Civil Engineering from the University of Notre Dame and earned an MBA from the University of Chicago.

George Pratt Shultz has had a distinguished career in government, academia and the world of business. He is one of two individuals who have held four different federal cabinet posts; he has taught at three of this country's great universities; and for eight years he was president of a major engineering and construction company. In 1957, Shultz joined the faculty of the University of Chicago's Graduate School of Business as a professor of industrial relations and named dean five years later. From 1968 to 1969 he was a fellow at the Center for Advanced Study in the Behavioral Sciences at Stanford University. He returned to government when he was appointed secretary of labor by President Nixon in 1969. In June 1970, he became the first director of the newly formed Office of Management and Budget. In May 1972, he was named secretary of the Treasury, a post he held for two years. During this period, Shultz also served as chairman of the Council on Economic Policy, negotiated a series of trade protocols with the Soviet Union, and represented the United States at the Tokyo meeting on the General Agreement on Tariffs and Trade.

Shultz left government service in 1974 to become president and director of the Bechtel Group, where he remained until 1982. Shultz held two key positions in the Reagan administration: chairman of the President's Economic Policy Advisory Board (1981–82) and secretary of state (1982–89). After leaving office, Shultz rejoined the Bechtel Group as director and senior counselor. He also rejoined Stanford as professor of international economics at the Graduate School of Business and as a distinguished fellow at the Hoover Institution. In 2001, Shultz was named the Thomas W. and Susan B. Ford Distinguished Fellow at the Hoover Institution.

In January 1989, Shultz was awarded the Medal of Freedom, the nation's highest civilian honor. He is also a recipient of the Seoul Peace Prize (1992), the West Point Sylvanus Thayer Award (1992), the Eisenhower Medal for Leadership and Service (2001), the Reagan Distinguished American Award (2002), and the Association for Diplomatic Studies and Training's Ralph Bunche Award for Diplomatic Excellence (2002). Shultz holds honorary degrees from Notre Dame, Columbia, Loyola, University of Pennsylvania, Rochester, Princeton, Carnegie-Mellon, City University of New York, Yeshiva University, Weizmann Institute of Science, Baruch College of New York, Hebrew University of Jerusalem, Tbilisi State University in the Republic of Georgia, Technion, Keio University in Tokyo, Williams College and Peking University.

Joseph Stanislaw is founder of The JAStanislaw Group and senior partner of Brightstar Capital Partners. 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.

SYMPOSIUM SPEAKERS AND PANELISTS

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.

Renzi Stone is founder and chief executive officer of Saxum, an issues-based marketing communications agency. Stone is a sought-after speaker and editorial contributor to national organizations and publications. He has extensive experience in marketing strategy, crisis communication and public affairs for energy companies, large foundations, healthcare entities and financial organizations. He has served on the board of directors for the PR Council in New York, and has been featured in PRWeek, Advertising Age, The New York Times and CNBC. He is a member of the University of Oklahoma Board of Regents, leads within the Young Presidents' Organization and is past-president of the Americas for IPREX.

David G. Victor is director of the Laboratory on International Law and Regulation and a professor at the School of Global Policy and Strategy at UC San Diego, where he also co-leads the university's Deep Decarbonization Initiative. His research focuses on how regulatory law affects the environment, technology choices, industrial structure and the operation of major energy markets. Prior to joining UC San Diego, Victor served as director of the Program on Energy and Sustainable Development at Stanford University where he was also a professor at the law school. He is a member of the board of directors of the Electric Power Research Institute (EPRI), on the advisory council for the Institute of Nuclear Power Plant Operators (INPO) and chairman of the Community Engagement Panel that is helping to guide the decommissioning of Units 2 and 3 at the San Onofre Nuclear Generating Station. He has contributed to numerous publications on topics such as energy market innovations and electric power market reform.

Mark D. Zoback is the Benjamin M. Page Professor of Geophysics at Stanford University, director of the Stanford Natural Gas Initiative and co-director of the Stanford Center for Induced and Triggered Seismicity. He is the author of "Reservoir Geomechanics," now in its 13th printing, and the author/co-author of about 400 technical papers. Zoback was the founder of GeoMechanics International, a software and consulting company that was acquired by Baker Hughes in 2008. His awards include the Emil Wiechert Medal of the German Geophysical Society, the Walter H. Bucher Medal of the American Geophysical Union, the Louis Néel Medal of the European Geosciences Union, the Robert R. Berg Outstanding Research Award of the AAPG and the American Geosciences Institute Award for Outstanding Contribution to Public Understanding of Geosciences. He's been elected to the U.S. National Academy of Engineering and the Honorary Membership in the Society of Exploration Geophysicists. He also serves as the Einstein Chair Professor of the Chinese Academy of Sciences.

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