

AM2020 ENERGY FORWARD

Baker Hug



The 21st Baker Hughes Annual Meeting was a resounding success—with record attendance of 1,750 industry leaders from around the world in two days of thoughtful discussion on the future of energy.

The program included plenary sessions featuring keynotes from eminent industry leaders and government representatives, as well as a variety of dynamic panel discussions.

The technical program and Solutions Fair presented the latest breakthrough technology developments, while exclusive break-out sessions dove deeper into specific topics including energy transition and carbon reduction, digital transformation, increasing productivity, driving efficiency, and enhancing safety for operations and end-customers.

Please also be sure to check the online version of the proceedings as we will be adding more content over the coming weeks, including video highlights of the plenary sessions and panel discussions and a gallery of images from the event.





Welcome and opening keynote

Lorenzo Simonelli Chairman & Chief Executive Officer, Baker Hughes

Mr. Simonelli began with a review of key industry and global challenges before moving to some examples of how Baker Hughes is investing in the technologies and partnerships to solve them. The industry, he said, is at a critical juncture and faces a dual challenge: how do we provide reliable, efficient, safe, and productive energy to meet the growing demand for energy, while transforming to lead in the energy transition. He was resolute in his belief that the answer begins and ends with technology.

Recent examples of technology advancement at Baker Hughes

- World's first successful remote-controlled, automated directional drilling project to provide a safer working environment while improving in-field costs and efficiency
- New partnerships with Microsoft and C3.ai to create a digital ecosystem that allow us to unlock the power of data and enable better industry collaboration through artificial intelligence at scale
- 450 parts now qualified for 3D printing. Combined with opportunities for new composites and non-metallics our additive manufacturing capabilities drive productivity and equipment reliability
- The first NovaLT application on 100% hydrogen. As we go forward, other opportunities will arise to play off the importance of gas
- LUMEN methane detection drone, and flare.IQ flare control platform for refineries, helping to monitor and lower emissions
- New carbon capture and sequestration technologies

Mr. Simonelli reminded the audience of the company's announcement last year to reduce its own carbon footprint 50% by 2030, and be net-zero by 2050. Having achieved a 34% emissions reduction since 2012, Baker Hughes is well on its way to achieving the 2050 goal.

He also discussed the company's new branding, which includes the descriptor "an energy technology company." This isn't simply a rebrand, he said, but a repositioning of the company and how it is committed to taking the industry forward in partnership with customers. Even the new logo is all about interconnectivity, progressing together, and being intertwined while transforming the industry to take energy forward.

"The answer begins and ends with technology."

Lorenzo Simonelli



The oil and gas industry in energy transition

Dr. Fatih Birol

Presentation

Executive Director, International Energy Agency (IEA)

Setting the stage, Dr. Birol recounted his recent experience at the 2020 Davos World Economic Forum, saying that climate change was at the heart of discussions for businesses, governments, investors, and everyone else. He had never seen it receive such focus in all his 14 years of attending Davos. While global energy transitions have happened throughout history—coal, oil, nuclear, gas, renewables—he said the important thing now is the pace and direction.

With about 80% of CO_2 emissions coming from the energy sector, Dr. Birol said it must play a key role in the climate solution. To make the sector more sustainable, he recommends first improving energy efficiency, then making more use of renewables, then making use of other technologies such as carbon capture and storage (CCUS).

While the oil and gas industry is responsible for about 18% of global emissions, he said a large portion of that can be easily and inexpensively reduced without any new technologies. His advice for the immediate term is to focus on reducing emissions, with methane as the top priority.

On average, Dr. Birol said about 1% of an oil and gas company's capital investment goes into non-core activities such as solar, hydrogen, CCUS, bio energy, etc. He feels most of these companies have "deep pockets" and can increase their investment, which would be a crucial boost toward the overall goal of mitigating global temperature rise.

At the same time, he said it would be wrong to cut investment in oil and gas because it will still be needed for years to come and, given depletion rates, investment is needed just to keep production levels where they are today. "No oil and gas company will be unaffected by cleanenergy transitions. If not today, it is tomorrow. And I have all the confidence that the oil and gas industry, looking at the past recourse, will respond rightly and positively."

Fatih Birol



Panel discussion

Ministerial panel discussion



How do you see the theme of this meeting, which is transitioning into the future of energy?

Minister Zhurebekov said around 65% of Kazakhstan's consumption is coal, followed by oil and oil products, then gas and, only small parts in renewables. So, they are targeting change for gas and renewables, and the government has adopted special programs to boost and subsidize them.

Secretary Winberg said the United States has an "all-of-the-above" energy strategy and he believes technology development will take us where we need to be. On CCUS in particular, he said the United States is investing \$200 million a year in it.

Minister Wheelhouse said they have to decarbonize road and rail transport, and heating which will be the biggest challenge. He says a key task will be identifying realistic, technically deliverable, cost effective heating alternatives.

Can you exploit new discoveries while remaining true to your climate goals?

Although Scotland is self-sufficient in oil and gas, Minister Wheelhouse said production is likely to decline, with an 80% drop in UK natural gas supply by 2050. He expects they'll get heavily into areas such as hydrogen, which he thinks is a great opportunity for North Sea diversification, and to invest in carbon capture. These are ways of maintaining the social license for production in the context of a falling emissions envelope.

The United States still imports crude for its refineries. Would you like to see a move away from that towards complete energy independence?

Secretary Winberg said no, that private operators will seek the best crude product to meet their individual refinery needs, and they'll compare its price against a capital investment to change the type of crude they can refine. He thinks that global crude market will continue and, overall, that it's a good thing.

Something you'd like to have in a different place by the Annual Meeting in 2021?

Minister Zhurebekov: renewables and petrochem.

Secretary Winberg: gasifying coal, biomass, and waste plastics to create hydrogen with negative CO_2 emissions.

Minister Wheelhouse: to be able to look back on 2020 as a year of a significant shift in approach.

Moderated by Mishal Husain, Broadcaster

Paul Wheelhouse

Member of Scottish Parliament, Minister for Energy, Connectivity & the Islands, Scottish Government, UK

Steven Winberg

Assistant Secretary for Fossil Energy, US Department of Energy, United States

Murat Zhurebekov

First Vice-Minister of Energy, Kazakhstan

Panel discussion

The path to decarbonization

"What's stopping us from getting there right now? It's really simple: we need a price on carbon."

Naomi Boness



What does "energy transition" actually mean? Is it the journey or is there an end game?

Mr. Brownstein said that it's about both reducing emissions, primarily methane, now, as well as providing energy resources that don't involve the combustion of fossil fuels at all. Ms. Boness, added that it's important to keep in mind that we have a CO_2 problem, not a fossil fuel problem, so we don't end creating policies that are restrictive. Mr. de Leeuw said there's a people/ society element in here as well, that we need to get it absolutely right—do a fair, sensible transition so everybody comes out better.

Where are traps that we haven't talked about?

Ms. Boness said that CCUS has to play a major role, and that the oil and gas industry is really the only player with the expertise, infrastructure, and capability to do CCUS at the scale that is needed.

Mr. Brownstein felt that carbon pricing is incredibly important. We added that the industry has been lagging behind and, in some cases, actually working against the development of good public policy to support our objective of getting to net zero by 2050—and that has to change. He'd also ask the industry to do is get better at assessing emissions, because they can't properly manage what they can't properly measure. Moderated by Allyson Book, VP Energy Transition, Baker Hughes

Mark Brownstein

Senior Vice President of Energy, Environmental Defense Fund (EDF)

Richard Newell

President and CEO, Resources for the Future

Naomi Boness

Managing Director, Natural Gas Initiative, Stanford University

Paul de Leeuw

Director, Energy Transition Institute, Robert Gordon University

Do you think there are any good examples of companies that really have it right that you can point to?

Mr. Brownstein said it's clear that Baker Hughes and other companies are on the right track. But, as it is a diverse industry, for every OIC that's taking the challenge seriously, there are many NOCs and independents who have yet to get engaged. So, it becomes our collective challenge to see that the entire industry goes on this journey.

Mr. de Leeuw said the UK's destination is clear, and they've collectively developed a roadmap. They are, he emphasized, beyond talking about it, that companies have money on the table and they're making it happen. Mr. Newell agreed that the expression of commitment from corporations is a very, very important first step, but that it's not enough—to enable companies to compete effectively in providing low carbon services, we need to create value for that.

Closing thoughts

Ms. Boness was concerned we're headed toward regional solutions. Unlike previous transitions driven by efficiency and economics, she feels this one is driven by a change in people's value measures; and that we still have a long way to go in understanding how they will impact the oil and gas industry.

Mr. de Leeuw said we have to make sure that the transition works for all populations. If we don't, he cautioned that we'll end up with "energy haves" and "energy have-nots" which is not a sustainable outcome.









Energy forward

Abdulaziz M. Al Gudaimi

SVP Downstream, Saudi Aramco

Mr. Al Gudaimi spoke optimistically about the energy future, and realistically about the industry's responsibilities—which he feels must be shared by all, and not driven solely by commercial objectives.

Over the last 20 years, he said the refining industry has invested about \$180 billion to meet new regulations, for example reducing diesel from 500 ppm to 10 ppm, and will spend another \$74 billion to continue that work over the next five years. He sees that as a testament to the industry's commitment to addressing climate change.

Mr. Al Gudaimi also stressed the importance of finding practical solutions for the 700 million people worldwide still living below the international poverty line. He reminded us of the need for gas and liquefied petroleum products in these societies, and said we must continue working toward energy solutions that are accessible and affordable by everyone.

He emphasized that the climate is everyone's business, and must be an integral part of industry priorities, citing the need for better public engagement to let them know about the work being done, and the gains being made.

Energy-forward examples from Saudi Aramco

- Mobile carbon capture (MCC) technology successfully demonstrated on large pickups and midsize cars
- Exhaust-treatment system for heavy-duty transport trucks that can reduce emissions by about 50% vs. the baseline vehicle
- Gasoline compression ignition (GCI) engine that improves fuel economy by up to 30% over spark-ignited gasoline engines, with CO₂ per km 17% below the 2021 European target for new vehicles
- Plant capacity to capture 45 million standard cubic feet of CO₂ per day that, since 2015, has helped double the company's oil production rates and win two international environmental awards
- Planted over 2.2 million mangrove plants (saving over 4 million tons of carbon dioxide) with the intention to add over 1 million desert trees and 4 million mangroves

"To achieve energy transition, invest in technology... we need to collaborate, and look at the future energy mix. We can make a difference."

Abdulaziz M. Al Gudaimi



Energy future

Where is the industry moving and what will it take to stay competitive in the future?

"We're not doing digital for digital's sake. I go back to the mission that we have: safe, reliable, affordable, and ever cleaner. And I think digital plays into every single one of them."

Joe Geagea



What's the number one thing you're doing in your business in the middle of this energy transition?

Mr. Geagea said that Chevron's priorities are to be the lowest-cost supplier, to lower the carbon footprint of its operations, and to invest in renewables and technology. Mr. Brekelmans said that providing customers with ever-cleaner energy choice is a focus at Shell. He added that the carbon competitiveness of the entire supply chain must be considered, as well as the suite of products that you're delivering. For Mr. Sultan, cost efficiency was the most important thing, including the cost of any activity in renewables. He believed that cost and efficiency are greatly dependent on service companies because they are typically more advanced in research and technology. Mr. Breuillac added that the industry must recognize that it's part of the problem and therefore needs to be part of the solution. He emphasized the need for them to perform better at what they can control, such as reducing emissions from operations, which is at the forefront of Total's priorities. Mr. Bayon agreed that emissions must be a key focus, but added that the industry needs to be more proactive and transparent, and be part of the solution not only to energy transition, but to helping people worldwide get out of poverty and have access to energy.

Moderated by Alix Steele, Bloomberg

Felipe Bayon CEO, Ecopetrol

Harry Brekelmans Projects & Technology Director, Shell

Arnaud Breuillac President Exploration & Production, Total

Joe Geagea

Executive Vice President, Technology, Projects & Services, Chevron

Emad Mahmoud Sultan CEO, Kuwait Oil Company

Reducing your own emissions, diversifying your portfolio with renewables, reducing your costs, and honoring your shareholders—can you actually do all four things?

The panelists all agreed that it was certainly possible, noting that the industry has a long hisotry of embracing challenges and change. Keenly focused on the environmental side of things, they also emphasizsed that no solution could come from them alone—but that governments, policy makers, customers, and individuals all had to contribute to reducing emissions and energy consumption.

Do you ever see your company as being less oil and more of something else?

Mr. Brekelmans pointed out that, although the five companies represented on stage are often generalized as being the same, they are actually very different when you look at the details, and that they have all changed in various ways over time. He views Shell as an energy company that wants to remain relevant whatever the future brings. He spoke of natural gas as an example of the company's and industry's ability to adapt, saying that what was thought impossible 40 or 50 years ago was embraced, and has grown into something very valuable.

How do digital and AI play into this? What's your company's strategy?

Mr. Sultan said that the service companies play a big role in that aspect because they are investing in the capabilities and intelligence to maximize the value of data. So it's a matter of going to the right service companies and tailoring their capabilities to suit your needs. Mr. Breuillac felt that most companies are under-estimating digital in terms of what it can bring to operations, and that the industry is just scratching the surface of what's possible. He said Total is being very pragmatic because they understand that it requires a lot of time and investment. Mr. Bayon gave the example of refinery engineers looking at throughput pressures and temperatures, while seeing the real-time dollar impact on the same screen. He said that digital has elimitated the separation between the operation and the outcomes, and he wonders about adapting similar tools for emissions. "We need to jointly develop a narrative that is more compelling than we have today. And that narrative will have to constitute in some way also what is possible. And we as companies have shown time and again that we do things that previously people felt were impossible."

Harry Brekelmans

"It's bigger than us sitting here. It's not a problem of industry or regulators or companies. It's something that we should all own."

Felipe Bayon



Delivering a lower carbon Canadian LNG project to meet global energy demand

Peter Zebedee

CEO, LNG Canada

Mr. Zebedee gave a candid account of his company's unusually smooth development process in British Columbia, where resource projects often meet strong opposition. LNG Canada is the country's first large-scale LNG export facility, and the largest private sector investment in Canadian history. Now in its second year of construction, the four trains will eventually deliver 28 million tons of LNG annually, destined primarily for Asian markets.

He said that perhaps the most important decision was to put environmental and social interests on a new footing. LNG Canada first focused on building relationships—inviting the community to co-create a charter, taking time to understand indigenous values and, in the absence of treaties, acknowledging indigenous rights, whether proven in court or not. Diversity is a common thread throughout the organization. The leadership team has always aand training women in the construction trades. The company also ensures that indigenous people have priority for contracting and procurement.

From a technical standpoint, the primary issue was whether to use electric drive or gas turbines for power and liquefaction. The all-electric option would have required significant transmission upgrades, power production and procurement, and was challenging from a capital cost perspective. He said it would have resulted in major schedule delays, but that the all-gas option would have resulted in unacceptably higher greenhouse gas emissions. The LNG Canada team decided on a hybrid option—using highly efficient Baker Hughes aeroderivative LMS100 gas turbines for the liquefaction trains, with auxiliary power from BC Hydro renewable energy. The facility will also use Shell's dual mixed refrigerant technology to make the project even more efficient.

This approach will result in the lowest CO_2 emissions per ton of LNG anywhere in the worldabout 55% lower than the average facility, and 35% lower than the next best.

Catching the wave

Gordon Birrell

Chief Operating Officer for Production, Carbon & Transformation, BP

Gordon Birrell discussed how he sees the oil and gas industry helping lead the energy transition. As this momentous change happens, he says conversations about climate change, and the criticism of oil and gas, are getting louder. Mr. Birrell believes the energy transition should be seen as an opportunity and not a threat.

In addition to the various ways in which the world needs oil and gas, he went on to say that there is now a societal demand for a change in how oil and gas is produced. Modern technology such as drones, crawlers, and rovers can help to improve the efficiency of facilities. BP believes that the industry must do more to measure methane emissions, and they are using technology to help identify and mitigate methane emissions.

Birrell emphasizes the importance of engaging, empowering, and inspiring the teams of talented scientists, engineers, and technologists who are employed in this industry. When their knowledge and experience is explored, innovation happens. BP has set up a \$100 million low carbon fund that is turning ideas into reality.

"Britain's former Prime Minister Sir Winston Churchill once said 'A pessimist sees the difficulty in every opportunity. An optimist, on the other hand, sees the opportunity in every difficulty."

Peter Zebedee





"We must continue to grasp technology to ensure we are constantly pushing the boundaries of what is possible in service of lower carbon energy."

Gordon Birrell

The role of CCUS technologies in the energy transition

Stefano Maione

Chief Development, Operations & Technology Officer, Eni

Stefano Maione began his presentation by discussing the challenge the energy industry faces with decarbonization. Eni has already included sustainability in its industrial strategy, and recently incorporated sustainable development goals into its corporate mission. It also plans to make its upstream business carbon neutral by 2030.

He said the consensus on Carbon Capture, Utilization, and Storage (CCUS) is that the best way forward is a hub-and-cluster model, which collects CO₂ from a variety of emission-intense facilities for conveyance into geological storage. Governments will support the development of the CCUS sector with a combination of regulation, tax breaks, and other incentive schemes. The EU and US are offering impressive incentives and doing great advocacy work to help offset growing costs.

In conclusion, Mr. Maione reiterated that the industry and global policymakers must work together to develop new and cheaper capture technologies. They also need to work closely with regulators in developing a new carbon network infrastructure, ensuring economies of scale and, most importantly, a second more sustainable life for industrial assets, avoiding unemployment and economic decline for local communities.

How Nigeria LNG is helping to realize the potential of natural gas

Tony Attah CEO, Nigeria LNG

Mr. Attah described his company's purpose as reducing or completely eliminating gas flaring, while monetizing gas and bringing it as a valuebased asset for the country. Nigeria LNG has already helped reduce gas flaring from 65% to less than 20%.

He said that a strong partnership with Baker Hughes underpins the efficiency needed for cost competitiveness going into the future. Nigeria will celebrate delivery of 22 million tons of LNG by mid 2020, and believes that is just the tip of the iceberg.

Mr. Attah touched on some of the most impactful programs Nigeria LNG is working on as a company. He is passionate about creating employment, reducing unemployment and poverty, and perhaps most importantly, they aim to eliminate malaria in the area in part by implementing health insurance programs. He believes it's time to change the conversation about the nearly one billion people without access to energy—50% of whom are in Africa. Nigeria LNG is positioned to make a difference in that space. As gas is cleaner, cheaper and, most importantly, available, they believe it's time for gas.



"A clear and sound regulatory framework will help to reduce the investment risk in CCUS, further reducing the cost of the capital with private lenders and therefore let the industry stand on its own legs more rapidly."

Stefano Maione





"Gas is cleaner. Gas is cheaper. But most, importantly, gas is available. And we believe it's time for gas."

Tony Attah



"As an industry, we should stop apologizing because, without gas, without pretty much everything that we stand for, we simply cannot have growth. It is just very much about being responsible, about how we grow that. And gas has to be a solution to that."

Amrita Sen



Is natural gas a transition fuel, or a fuel of the future?

Hitoshi Okawa remarked that LNG and natural gas are a long-term and fundamental solution to develop and maintain a low carbon economy. He believes that companies will need to shift their portfolios from oil to gas. Hamed Al Naamany pointed out that, in the Middle East, they are investing in LNG but also seeing increasing renewable energy in wind and solar. Renewable energy is seen as vital because of the growing demand for energy globally.

The panelists discussed Henry Hub, and Mark Gvetvay said that it is not the global benchmark anymore. Different factors now contribute to the regional price of oil, which has been recovering since 2016. He added that the industry must listen to its customers, and deliver the lowest cost, or they'll be out of the business.

The discussion turned to the topic of gas demand. Projected gas demand growth shows that there is going to be space for everybody, and today's partnerships will support the future. As technology supports growth in places like Asia and the Middle East, seasonality in gas prices will be eliminated. Moderated by Amrita Sen, Director of Research, Energy Aspects

Hitoshi Okawa

EVP and President Director Australia, INPEX

Mark Gvetvay

CFO and Deputy Chairman of the Board, Novatek

Hamed Al Naamany

Chief Corporate Service Officer, Oman LNG

Panel discussion

The impact of US LNG on worldwide gas demand and supply

"The regulatory environment matters a lot. And all of us in this industry and segment need to be supportive of improving, wherever we can, the regulatory process."

Mike Sabel

"LNG is not only a transitionary energy but also a destination energy. There is a lot of opportunity that exists today to take current technologies and boost them with renewables, or through existing facilities and other equipment configurations."

Jill Evanko



This panel featured a buyer, a supplier, and two export companies. Moderator Alix Steel asked Mike Savel and Matt Schatzman how they feel about two-dollar gas, since they're the ones who must build export terminals. They said it is very helpful to exporters because it continues to make US LNG very competitive in the global market. Unfortunately, the short-term benefits in the energy market are not indicative of the long-term requirements.

The current lower cost of natural gas is leading to a great deal of innovation in the United States as producers try to compete for market share. Hendrik Gordenker sees a lot of uncertainty in the industry, difficulty in predicting future demand; and is certain that the US market will need greater contract flexibility and greater diversity of supply.

Jill Evanko spoke about Chart Industries' strategies to work within the current state of the LNG industry, the uncertainty they face, and the need to diversify. They spend a lot of time on process technology and investigating different types of export facilities—from baseload to mid-scale, to micro and smaller scale terminals.

Mr. Gordenker, the buyer on the panel, spoke at length about dealing with the uncertainty of future LNG demand. Since buyers now have more energy choices, he said it becomes an issue of having the LNG storage potential, terminals, and transportation in place when and if demand requires. He said LNG should be combined with new types of renewable energy, and it can be used for purposes other than power, for example as a heating fuel to eliminate less-friendly alternatives like coal.

Finally, the conversation turned to what is most important to the customer, which was seen as low-cost, speed to market, and efficiency. With the climate discussion getting louder, the panel agreed it's important for customers to understand the statistics regarding the environmental impact of LNG.

Moderated by Alix Steel, Bloomberg

Jill Evanko President & CEO, Chart Industries

Hendrik Gordenker Chief Global Strategist, JERA Co.

Mike Sabel Co-founder & Co-CEO and Founder, Venture Global

Matt Schatzman Chairman & CEO, NextDecade

Petrobras business plan and E&P strategy and challenges

Rudimar Lorenzatto

Chief Production Development Officer, Petrobras

Rudimar Lorenzatto presented on behalf of Petrobras CEO Roberto Castello Branco, who was unable to attend.

In a video, Mr. Branco spoke about a new strategy underpinned by five pillars: maximization of return on capital employment; capital cost reduction; focus on lower costs; meritocracy; and respect for people, the environment, and safety. He went on to describe the future of the company, how it is focusing on technology, investing in digital transformation, and artificial intelligence to increase efficiency.

Mr. Lorenzatto then outlined the company's three key performance indicators for value creation: total reported injuries, which last year was just 0.8 per million men; debt which, with exposure to high price volatility, must be reduced; and an EVA program with a goal to increase by \$2.6 billion in 2020.

Petrobras is focusing on deep and ultra-deep water assets, while reducing its participation in onshore and shallow water assets. By focusing on one area, the goal is to increase the operational efficiency of those assets and increase the recovery factor. Its business model is now more than ever about valuable partnerships. The company sees its key challenges as occupational and process safety; reducing the time between discovery and first oil; enhancing its new procurement strategy; revitalizing major mature fields with a focus on increased recovery; digital solutions and technology innovations in wells and topsides; and low-cost solutions and innovations for decommissioning.



The green gas opportunity

Marco Alverà CEO, SNAM

Marco Alverà discussed the future of green gas as it relates to both Europe and the world. He identified three things the industry must do to meet the significant challenge of getting to net zero by 2050: get the electricity sector green, get electricity to take on a greater share, and decarbonize heating and the hard-to-abate sectors.

Mr. Alverà talked about the desire to replace coal with gas, and the more easily attainable switch from oil to gas. He described how green gas can play a big role in decarbonization, proposing that the only way heat can be decarbonized, is to find a medium in which to store energy for the long term. Green gases can be stored for a long time, transported over long distances, and transported and stored at a very low cost. He also discussed renewable energy, solar power in particular, and its prohibitive costs thus far. But he is optimistic that the costs are coming down.

SNAM is Europe's largest transporter of natural gas and the largest storage company for natural gas. To future-proof its network, it is also investing in downstream, bio-methane, and hydrogen—having fully tested a 10% hydrogen blend to illustrate that blending is easy and the cheapest way to integrate intermittent renewables into the energy system.

"I think until 2050, possibly even beyond 2050, there is a huge and growing role for gas to play."

Marco Alverà

New technologies and value streams for the energy transition



Panel members were invited to share their perspectives on hydrogen project investment and potential.

Ms. Hildebrand explained how Equinor is working to decarbonize hydrogen and move from natural gas to hydrogen in powering homes and businesses. They hope to achieve this in the near future, and see it as more than learning to produce hydrogen from natural gas, but as how to create the entire value stream.

Mr. Marx said that IVECO is designing a fully electric, zero-emission LNG truck that uses fuel-cell technology.

Mr. Muraki described how ammonia may be the most economical option for transporting hydrogen, and that it has no CO₂ emissions when combusted. He believes that ammonia is a game-changer in the energy market.

Ms. Kadri offered insight on the aviation industry, as Solvay has spent 30 years finding ways for aircraft to consume less fuel. They can do the same thing for cars, by replacing metal with lighter materials.

The discussion touched on the challenges faced when trying to create solutions to reach net zero by 2050. The industry is shifting its mindset toward the ultimate goal and the associated cost, and panelists felt that customers and governments must do the same.

Moderated by Mishal Husain, Broadcaster

Sophie Hildebrand

SVP Research & Technology & CTO, Equinor

Ilham Kadri CEO, Solvay

Gerrit Marx CEO, IVECO

Sam Muraki Chairman, Green Ammonia Consortium

The business of winning: enhancing performance with digitization

Mark Gallagher

Formula 1 Executive

Mr. Gallagher opened with a review of Formula I's engineering eras. Its first 20 years were about engines, gearboxes, transmissions, brakes, and tires. The next 25 years were about aeronautical engineering and lightweight material science—essentially turning cars into inverted jet fighters and flying them into the ground. And the last 25 years have been about digital transformation.

He could not emphasize enough how much digitalization had changed every facet of vehicle operation. He then focused on two overarching areas: risk mitigation and performance.

The first 45 years saw over 40 driver fatalities. But there's been only one in the last 25 years. He said the big change was the data that enables them to make better quality decisions, engineer better systems, and integrate solutions designed to avoid catastrophic outcomes. Driver Fernando Alonso made a mistake in the Australian Grand Prix three years ago that could have cost his life. Mr. Gallagher said it surely would have 20 years ago. But Alonso walked away essentially uninjured. Today's cars are designed and digitally enhanced so human error doesn't lead to the catastrophic outcomes of the past.

Regarding digital transformation and performance, Mr. Gallagher went on to say that digital transformation has empowered Formula 1 engineers, technicians, drivers, and teams to become an even better version of themselves, given them significantly better information, and enabled better collaboration. He described Formula 1 as a connected environment in which a car during a race is transmitting from 250 to 300 sensors, 600 to 800 hundred channels of data, which is relayed to the engineering team in the pit and, increasingly, at remote monitoring centers. Twelve workstations per car are running real-time predictive analytics during the race. The purpose is to avoid failure. To illustrate, he mentioned how Lewis Hamilton finished every Formula 1 race last season, either winning or scoring points. His car never broke down. Between 1950 and 2000, cars broke down, on average, 45% of the time. But last year, Lewis Hamilton's car was 100% reliable. That seismic shift was because of predictive analytics.

Mr. Gallagher concluded by saying that the digital transformation has enabled Formula 1 to guarantee optimized outcomes.

Digital transformation

Tom Siebel

Chairman and CEO, C3.ai

C3.ai has spent the last decade and nearly \$700 million building a unique model-driven architecture that enables its customers across a wide range of industries to rapidly design, develop, provision, and operate commercial industrial AI solutions. Its portfolio includes a large scale deployment at Enel spanning multiple use cases that can deliver hundreds of million euros a year in recurring economic benefit; a suite of applications for Bank of America with the cash management application alone delivering economic benefit of billions of dollars a year; and site-based predictive maintenance for the United States Air Force that has, among other benefits, increased the daily availability of its aircraft fleet by double digits.

With Royal Dutch Shell

C3.ai provides the AI platform for all of Shell's upstream, downstream, and midstream operations. This is a very large-scale project covering AI predictive maintenance for offshore oil rigs, reservoir production modeling, algorithmic machine vision, predictive maintenance for compressors, predictive and descriptive maintenance for half a million valves, optimization of coal seam gas operations, and more. It's a solution that Shell describes as "massive, not just for our business, but also for the planet."

With Baker Hughes

C3.ai has partnered with Baker Hughes and Microsoft for about eight months to build solutions for the entire oil and gas value chain. Several applications are already available on the Azure marketplace: BHC3 Reliability, BHC3 Predictive Maintenance, BHC3 Inventory Optimization, BHC3 Network Sensor Health, and BHC3 Energy Management. A report published this week by Bloomberg shows that Baker Hughes is strongly positioned versus the other oil and gas service companies as it relates to the ability to deliver tried, tested, and proven digital transformation solutions at scale.

"We are solving problems that were previously unsolvable. We're delivering safer energy, cleaner energy, more renewable energy. We're dramatically reducing accidents and reducing the climate impact of the operations in which we're engaged. It doesn't get more exciting than that."

Tom Siebel



Digitalization and the energy transition: thriving through times of unprecedented change

Yuri Sebregts

EVP and Chief Technology Officer, Shell

Mr. Sebregts said that the global energy system will have to change more in the next two decades than it has in the last five. This energy transition is underway, but how it will evolve will depend on many factors: economic growth, customer choice, emerging technologies, and national policies, just to name a few. Energy transition and digital transformation are, he says, in principle independent, but the ways we respond to them have a lot of commonality. He proposed three common ways in which we can respond and live up to these challenges.

Collaborating: different parties can bring different solutions into the same platform to engage with the data in a similar way. The system allows added value through much improved optimization decisions, and much faster field development. We have to rely on each other's strengths with partners.

Building capability: one way to bring capability is to acquire starter companies, as they come with higher entrepreneurial spirits and new, innovative perspectives. Bringing companies together helps us learn faster and, in turn, help each other grow faster beyond the current market. We learn fast from their experiences and then can bring that into our own. Building in-house capability is also key in the digitalization trend so we've chosen to build more in-house capability rather than acquire it through startups.

Giving our customers choice: how the energy transition will play out, depends in large part on the choices customers will make. The market, encouraged by government policies, will decide which particular cleaner energy solutions will thrive. Therefore, our opportunity is to put that decision making in front of the customer, and give them a range of cleaner options to choose from, and flexibility. "Shell has an ambition to reduce our net carbon footprint by approximately 20% by 2035 and 50% by 2050. This critically includes the scope 3 emissions, the emissions that come from the use of the products that we sell to customers. This is a very, very large challenge. We will not be able to do this alone. We have to rely on each other's strengths with partners."

Yuri Sebregts



Disruptive technologies and new approaches

"We have a huge task. We want to increase recovery, reduce costs, reduce footprint. And I think we also want to be proud of our industry again."

Grethe Moen

What is a challenge and an opportunity that the industry faces in the context of disruptive technology?

Ms. Elsenhans stated that climate change is unsurprisingly one of the industry's biggest challenges. If the industry can see climate change as an opportunity for companies to become cleaner, and differentiate from the pack, they may find success.

Mr. Faramawy is optimistic about the productivity and growing ambition within the industry, but also sees this as a challenge because these expectations can be difficult to manage. He says talent retention is of utmost importance as there is rapidly growing demand for the people who have the potential to see and implement solutions across all industries.

Ms. Moen sees technology as a tool that enables huge opportunities. She said one of the biggest challenges leaders face is the willingness change their perceptions, and to see new realities that become available when you have the right talent. Many companies look to historical data as an indicator of what they should do next but, with the transition that is currently happening, she says this approach no longer makes sense.

Mr. Howell echoed Moen's thoughts on the possibility of growth opportunities from technology and innovation, but said it isn't enough to just put technology into place. What is most important is to then evaluate the asset holistically to really see the effect this innovation has had.

The panel discussed the great importance of collaboration as it related to climate change. They agreed that, while there is competition among companies, they must also find a way to work together to solve this problem. The point was made that collaboration should extend beyond the oil and gas industry. For example, the transportation industry can provide a great deal of insight into some of the same problems the oil and gas industry faces. Howell pointed out that, even within his company, they have the unique opportunity to look into both upstream and downstream, and learn from each other. Moderated by Peter Bryant, Managing Partner, Clareo

Lynn Elsenhans

Board member, Baker Hughes and Saudi Aramco

Ali Faramawy Corporate VP, Microsoft Corp.

Andy Howell CEO, KBC

Grethe Moen CEO, Petoro Panel discussion

Global offshore development: opportunities and challenges

"If as an industry, we don't make a success of the future projects, we're going to have a hard time justifying future investment in deepwater. And for this, we need to be cognizant of the fact that there is limited spare capacity in the industry. And the only way to address the future is to be more standardized."

Bruno Chabas

Given the recent drop in oil prices, is there still an attraction to deepwater, and if so, is it still worth the effort?

Mr. Chabas said the deepwater industry has been prepared for moments like this. Since 2014, the industry has focused on decreasing development time and being more proactive to keep up. Mr. Chitangueleca added that he thinks it boils down to flexibility, contractual and legal, and to having a more streamlined approval process. Mr. El Bakly shared that most new discoveries are in deepwater, so he believes it is worth the effort—but the challenge is to find ways to improve economic viability.

Is old-fashioned diplomacy still needed to get deepwater products going?

Mr. Stover said that, although customer and business relationships may be in place, you must engage with governments early to get the support needed to move forward—that getting everybody's objectives and needs on the table upfront is the key. Although some might call it diplomacy, he just calls it being a good partner to everyone he's working with. Moderated by Nick Coleman, S&P Global Platts

Dave Stover CEO, Noble Energy

Bruno Chabas CEO, SBM Offshore

Belarmino Chitangueleca Executive Board Member, Angola National Oil, Gas & Biofuel Agency

Osama El Bakly

Chairman, Egyptian Natural Gas Holding Company (EGAS)

There is always a story for local content, creating jobs and local wealth. How do you see that that dynamic changing?

Mr. Chabas said the need to develop a field quickly and bring wealth to the nation was a dilemma for which SBM views standardization as the solution. Standardized products make localized training easier, and helps with development time and economics.

Regarding energy transition and the pressure to reduce emissions, is there a difference between a mature field like the North Sea versus Luanda for example? Is it a primary or secondary consideration?

Mr. Chitangueleca said that for a long time, they weren't banning flaring because they were only interested in oil, but they've since realized it was wasting resources. Now they rely on best practices from European IOCs who are committed to lower carbon emissions, and have solutions built into their proposals. For its own part, Angola is now targeting zero flaring. It already has one LNG plant, and is starting a big gas-to-power project. It also approves projects based on how they will manage gas, for which there are two options: injected to increase recovery, or as LNG.

Gas-to-power is a key focus in Egypt too, said Mr. El Bakly, as part of its work to control carbon emissions, along with improving the efficiency of its power generation. He said energy transition is part of the country's daily agenda now.



Evolving energy landscapes, energy reforms, and capital allocation decisions

"The reality is that too many Americans rely on affordable access to energy to start up their car in the morning to get to work. And I think it would behoove us all to try and narrow the gap."

Sir Frank Chapman

Thoughts on the tension between decarbonization desires and political reality in the United States?

Mr. Cantor and Ms. Croft both see a lack of political will to push the kind of agenda necessary to achieve a carbon-free future. They feel the government can help ease the transition by providing incentives, which has worked in other countries with a young population.

How do you see natural gas around the world as a bridge fuel to a cleaner future?

Sir Frank believes that gas has an important role to play. While we don't need to be apologetic about gas, he said we do need to be sensitive to the climate-change activists, and communicate that we are on the same journey to a net zero carbon future. He doesn't think it's right to expect the fuel to sell itself just because it happens to have positive attributes relative to other fossil fuels; and we need to work to ensure that we make that fuel even better.

Who's deploying capital in energy, and where is it going? And what realworld impact is ESG having on actual capital allocation decisions?

Ms. Kelley said the public equity side is somewhat handicapped by what's happening in ESG, and there is no real roadmap for that. So, some passive

Moderated by Bob McNally, Founder & CEO, Rapidan Energy Group

Eric Cantor

Vice Chairman and Managing Director, Moelis & Company

Sir Frank Chapman Board Member, NextDecade

Helima Croft

Managing Director and Global Head of Commodity Strategy, RBC Capital Markets

Ken Hao Chairman and Managing Partner, Silver Lake

Kathleen Kelley

Founder & CEO, Queen Anne's Gate Capital investors are still putting money to work in this space, but more active investors are pulling back from certain areas like coal or fossil fuels. Since investors tend to follow price, and because commodities are cyclical, she thinks we're closer to a trough than a peak in prices. As prices start to move higher, she believes investment will get more active again.

Are major countries and producers well prepared for a transition? And what does that mean for global stability?

Ms. Croft referenced a recent International Renewable Energy Agency report and discussed the negative geopolitics surrounding the energy transition, particularly for countries that derive a significant part of their GDP from fossil fuel exports. She said there is an urgency to help these governments pursue diversification strategies. But she was quick to emphasize that this transition should still be seen as an opportunity, particularly for agricultural countries with a lot of sun to find ways to make a different contribution.

Where do you see opportunities to show society that the industry can become more productive and less carbon intensive?

Sir Frank believes there are some very simple things we can do, first of which is to stop leaking methane because we know how powerful a greenhouse gas it is. With power being a big component for LNG manufacturing, he also said there's a need to get sustainable power into the manufacturing process, and replace the customary method of using the feedstock.





Panel discussion

The future of work

"Technology is in the fabric of our industry, but it's actually how we use the technology to empower our people that's really going to get us there."

Leslie Beyer

What can we do to attract a younger workforce with the unique skills needed to position oil and gas as part of a solution to the climate challenge?

Ms. Benfield stressed the importance of having an authentic message and demonstrating that you're going to be part of the solution. Ms. Pasini said that investment is needed to inspire younger people in secondary schools, and that companies must remove boxes, let people express themselves, and be fast in responding to them. Mr. Avuru talked of Seplat's elaborate recruitment process targeting the brightest young men and women fresh out of college, and putting them through an 18-month training collaboration with its technology partners and service providers. Mr. Al Aryani emphasized that the credible and serious companies in the area of sustainability are the ones that will resonate most with the values of prospective students because that is important to the workforce of the future.

How do partnerships with service and technology providers facilitate talent flow? What do those partnerships unlock for you?

Beyond the technology dimension, Mr. Al Aryani said there can be an amalgamation of cultures, training programs, training philosophies, and people-development philosophies.

He said ADNOC leverages partnerships to introduce a people development dimension, because partnerships can catalyze or accelerate the realization of the company's strategy to further unlock value. Moderated by Leslie Beyer, President, PESA

Mohamed Saif Al Aryani

Senior Vice President of Investment Strategy & Portfolio, ADNOC

Austin Avuru CEO, Seplat Petroleum

Haithem A. Al-Balawi Director, HR Systems Support Department, Saudi Aramco

Christine Benfield

Vice President Global Projects, BP Upstream

Alessandra Pasini

CFO & Chief International & Business Development Officer, SNAM Does a focus on mental health and well-being resonate, and how do you use that to attract a millennial workforce that is very focused on those issues?

At BP, flexible working is a key strategy. Ms. Benfield said they have tried 5,000 people in agile working methods, which it has found removes the typical hierarchal structure and barriers and, produces a healthier team environment that's more empowering for the individuals involved.

About "the future of work," what have we accomplished? What are some pitfalls? What still needs to be done on a macro level?

Mr. Al-Balawi commented that there has been a shift from vertical to horizontal skills, which often outpaces an organization's ability to adapt. So Saudi Aramco is taking steps to predict future needs and proactivity nurture horizontal skillsets. As an example, the company recently sent an HR employee to get a master's degree in data analytics and advanced computing. She now focuses on deep learning with robotics to predict attrition and address future skills requirements.



Closing and thank you

Lorenzo Simonelli Chairman & Chief Executive Officer, Baker Hughes

Lorenzo Simonelli thanked the participants, and all the organizers who helped make the Annual Meeting happen this year.

He reflected on the last two days, which began with discussions about the dual challenge the industry is facing: to be competitive while transforming; and he said industry leaders are ready to take on the challenge of climate change. Throughout the meeting, they looked at the energy transition, carbon footprint, digital transformation, and many other topics. All these topics come down to the crux of what we face as an industry: continuing to take energy forward.

Mr. Simonelli marveled at the unique opportunity that the Annual Meeting provides. He emphasized that none of it would be possible without the contributions of all the participants, and noted that the importance of partnership was made clear through many of the discussions.

Next year will bring another opportunity to see how far the industry has progressed. One thing will remain the same: our industry is an essential part of how the world continues to develop. "At the end of the day, people are what will allow us to have the technology that counts."

Lorenzo Simonelli



Technology sessions

These 1-hour sessions led by Baker Hughes domain experts provided deep dives into a range of our latest technologies and solutions, as well as market and application trends. Some popular sessions this year included turbomachinery solutions for LNG and FPSO, our path to reduce carbon emissions in the oil and gas value chain, and artificial intelligence for digital transformation.











Lightning talks

At just 8 minutes in length, these sessions, hosted by domain experts and situated in the Solutions Fair, provided an ideal opportunity for attendees to get a quick overview and top highlights about some of our key products and solutions.



Plant tours

As usual, we also conducted tours of our two local turbomachinery facilities. The Massa tour this year focused on the manufacturing, assembly, and testing of the LM9000 gas turbine, plus the service shop dedicated to aeroderivative gas turbines. The Florence tour looked at how digitization, advanced materials, and additive manufacturing are enhancing our capabilities for oil and gas and industrial applications.









Gallery

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Save the date for AM 2021

January 31 to February 2





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