

2016 COLUMBIA GLOBAL ENERGY SUMMIT



Left to right: Dr. Dan Yergin, Vice Chairman, IHS; Patrick Pouyanné, Chairman of the Board and CEO, Total

On April 27, 2016, the Center on Global Energy Policy at Columbia University's School of International and Public Affairs brought together senior energy and climate leaders to discuss pressing issues at the intersection of energy policy, financial markets, the environment and geopolitics for the 2016 Columbia Global Energy Summit. The summit opened with a keynote conversation between Total CEO Patrick Pouyanné on the outlook for energy investment, geopolitical issues in energy, the need for a carbon price to address climate change and how Total is adapting to changes in the sector. Subsequent panel discussions focused on the follow-up to the Paris climate agreement and how businesses can adapt their business models; the outlook for the global natural gas sector, the importance of US LNG exports and the role of gas in reducing global emissions; the changes underway in the power generation sector and how technological innovations may increase access in developing countries; and how US oil production was reacting to the current price environment and the pressures it was creating for other oil producing nations. The following is a summary of the discussions.

KEYNOTE CONVERSATION WITH PATRICK POUYANNÉ

Patrick Pouyanné, Chairman of the Board and CEO, Total
Dr. Dan Yergin, Vice Chairman, IHS [Moderator]

In a far-ranging and candid keynote interview with Daniel Yergin, Total CEO Patrick Pouyanné covered many pressing issues at the forefront of today's oil and gas markets, from the supply and demand response to the oil price collapse and the global outlook for oil and gas prices. He also spoke about Total's counter-cyclical approach to upstream investment, its support for carbon pricing, and a tour d'horizon of some of the world's leading oil producing countries.

Pouyanné was unequivocally bullish on oil markets, noting the impact of massive spending cuts that have resulted in the cancellation of most large projects and the steep acceleration of decline rates due to deferred maintenance and investment. "In three to four years, there will be a lack of supply, it's obvious," he said, noting that "only two big projects were approved in 2015, one in Norway and one in the US Gulf of Mexico. It's clearly insufficient." While inevitable, spending cuts of that magnitude amount to an "overreaction," especially when production lags are taken into account. "In a commodity business, the right way to make money is generally to invest when the prices are low [...] and then to have your new production coming onstream when the prices are high."

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On Iran, Pouyanné voiced a mix of caution and optimism. While the country is too formidable an oil and gas player to be overlooked, investment terms there are still less than compelling, he said, adding Total will “look at it” but “will not rush.” If the company were to invest in the country, it would be in natural gas, not oil. Russia, where Total is heavily invested in the Yamal LNG project, is another story. Pouyanné expressed skepticism regarding economic sanctions, which he said would not likely change Russian policy or resolve the Ukrainian dispute. He said that while he hoped sanctions would be lifted, Total was fully complying with them, even as it finds ways to get around currency restrictions to finance its Yamal project. In Libya, Total’s onshore operations have been totally destroyed by Islamic State. After years of ignoring the crisis in the country, Western countries are finally turning their attention to it, but Pouyanné stressed: “Today it is premature to say it is stabilized.”

While the demand response to low prices has been vigorous, long-term demand prospects look less rosy. The oil market is “quite mature,” and “it is not impossible to see in 20 years an oil market which could be lower than the oil market of today,” Pouyanné said. The gas market faces better growth prospects, as do renewables.

This is partly why, Pouyanné said, Total is reinventing itself as an energy company, branching out into the electricity value chain, including trading, on top of its renewable portfolio and strong solar presence in the United States through its SunPower investment, he said.

More broadly, the world after COP21 has changed, Pouyanné noted. Climate policy is gaining unprecedented momentum. Oil companies must be part of the solution, not part of the problem, and must take responsibility for their share of emissions – hence Total’s full support of carbon pricing. “We can be really a player in implementing a strategy which will help the world to go towards a more responsible energy mix,” he said.

IF WE WANT THE GAS MARKET TO BE DEVELOPED, WE NEED TO PUT IN THE PRICE OF ENERGY THE COST OF THIS POLLUTION [...] CARBON PRICING IS IMPORTANT.”

-PATRICK POUYANNÉ

AMERICA'S ENERGY POSITION AFTER THE OIL PRICE COLLAPSE



From left to right: Scott Sheffield, Chairman and CEO, Pioneer Natural Resources; Christopher Smith, Assistant Secretary for Fossil Energy, U. S. Department of Energy; Phil Sharp, President, Resources for the Future; Dr. Dan Yergin, Vice Chairman, IHS; Antoine Halff, Senior Fellow, Center on Global Energy Policy



Phil Sharp, President, Resources for the Future

Panel Participants:

Phil Sharp, President, Resources for the Future
 Scott Sheffield, Chairman and CEO, Pioneer Natural Resources
 Christopher Smith, Assistant Secretary for Fossil Energy, U. S. Department of Energy
 Dr. Dan Yergin, Vice Chairman, IHS
 Antoine Halff, Senior Fellow, Center on Global Energy Policy [Moderator]

The panel session opened with a discussion of how lower prices will reshape the US shale oil industry by top experts from industry, government, consulting and policy analysis. “Despite falling steeply in response to the very price collapse it helped trigger, US light tight oil production will still loom large in future energy supply,” said Dan Yergin. “When the price started down, it was thought that the shale was really the high-cost oil, and it turns out it’s the medium-cost oil,” he said. As the market turns, he noted, “the US will have a big role in terms of bringing additional supply to the market,” because many large, longer-term projects have been cancelled. However, Scott Sheffield cautioned against expecting a quick rebound in shale supply as prices recover, noting such factors as the lagged impact of recent rig count declines, the drag of deleveraging on reinvestment, and the challenge of replacing laid-off drilling contractors. With deleveraging needs of at least \$50 billion-\$100 billion, “it’s going to take \$60 (a barrel oil) plus, maybe as high as \$70, to get US production to start growing again,” he reckoned.

Phil Sharp and Chris Smith discussed the scope for decarbonization in a low oil-price environment and the respective roles of government and the private sector in the energy and climate space. Sophisticated CEOs or aspiring CEOs of US energy companies understand that they cannot wait for government mandates to manage climate risk, Sharp noted, but insufficient climate policy nevertheless exacts a cost on industry by fostering more disorderly grassroots, ad hoc opposition movements to specific projects in the absence of adequate guidelines. “What we really need to get on to,” he said, “is a serious conversation in this country about what is a cost-effective way for us to change the trajectory of emissions rather than just opposing every project that comes down the pike.” Smith echoed this view, noting that in terms of carbon capture and sequestration, “it’s a mixed bag of collaborators that we have in the private sector.” Smith suggested that the coal industry might have avoided a \$28 billion loss in market capitalization in the last five to six years if it had had the foresight to invest some of that amount in carbon capture and sequestration technologies. So “it is encouraging to see in the oil and gas industry some shadow pricing of CO2 being folded into economic projects,” he noted. “We’d like to see more of that, because in the future, these are things the companies will have to deal with to make sure that all forms of domestic energy are part of the energy landscape in a carbon-constrained world.”

While the shale oil industry and oil price collapse have put OPEC under pressure, these are not the only challenges facing the producer group, Yergin said, citing heightened tensions between Iran and Saudi Arabia. “Geopolitical context and tension is a very central point in the oil market right now,” he noted. “Otherwise, an OPEC framework would have been working, and the countries would have found a way to work things out.” Despite these frictions, he cautioned against writing off the group: “There have been a number of times that obituaries have been written about OPEC, and when it is convenient for the major producers to have the framework of OPEC, then it will become active again.”

While panelists did not make any predictions on the outright price of oil, there seemed to be a shared view that oil markets were rebalancing but would remain volatile. It was noted that tectonic price shifts such as that just experienced by the oil market are inherently unpredictable. “The world is going to be more volatile in regard to oil prices,” said Sheffield. “We’re not going to have a period of five to six years of \$70-\$80 (a barrel), even of \$60-\$70 or \$80. It’s not going to stay flat for five years.” Higher prices would facilitate political action on climate policy, Sharp said, noting “price rises are like a blow torch on the rear end of Congress.” Yet low prices also open a window of opportunity for policymaking: “If we want to do carbon pricing, this is a hell of a good time to do it.” But low prices are not an unmitigated blessing for consumer countries, said Yergin: “You’re starting to see around the world a concern, even in industrial consuming countries, that if oil prices are too low, it is also as big a problem as oil prices that are too high.”



Christopher Smith, Assistant Secretary for Fossil Energy, U. S. Department of Energy

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-DAN YERGIN

THE NEW GLOBAL GAS MARKET



From left to right: Fred Krupp, President, Environmental Defense Fund; Charif Souki, Co-Founder, Tellurian Investments; Nick Butler, Visiting Professor and Chair of the Kings Policy Institute, Kings College London; Peter Coleman, CEO, Woodside Energy; Mona Sutphen, Partner, Macro Advisory Partners



Mona Sutphen, Partner, Macro Advisory Partners

Panel Participants:

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 Peter Coleman, CEO, Woodside Energy
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 [Moderator]

LNG industry veterans Peter Coleman and Charif Souki agreed that the appetite for long-dated capital projects is currently very low across the LNG industry. Woodside has recently delayed a major liquefaction project (Browse LNG) and the global LNG market has just started to absorb the vast amount of new LNG export capacity that is being added in the US and Australia. The prospects for some other new LNG projects look similarly bleak. Nick Butler said that the offshore gas deposits in the Eastern Mediterranean will largely remain a stranded asset, for example, as Europe, the primary target market for these gas volumes, is facing a prolonged period of weak gas prices. However, Souki thought that the current oversupply will not last much beyond 2021-2022. He cautioned that the global LNG market may once again experience shortages in five years' time if companies do not make the necessary investments today in future liquefaction capacity.

The global gas market has reached an inflection point, panelists noted. Global demand for energy continues to grow, but natural gas—more than ever—has to earn its place in the global energy supply mix. Coleman noted that the relationship between buyers and sellers is changing. What used to be a very “orderly” market has now been completely disrupted. LNG exporters like Woodside now have to recognize that they need to “go further downstream.” Coleman added: “We need to think about how we can create markets [for natural gas] rather than wait for markets to be created for us.” Souki said that the root cause for the rift between buyers and sellers of natural gas is that they “can no longer agree on a pricing mechanism that they can sustain for the next 20 years.” As a result, the global gas industry is now “in search of a new pricing model,” according to Souki, and—until a truly liquid global spot LNG market develops—sellers will have to find new innovative business models to keep natural gas attractive for energy importers around the world.

Coleman said US LNG is giving a “gift to the world” in the form of cheap Henry Hub prices, which will increasingly set a natural gas price floor in other regions, as increasing volumes of American gas reach the global market. The panelists noted, however, that the global LNG business is in a state of flux. It is highly uncertain at the moment where the demand for LNG will come from, how much of it Europe can absorb, how much of it will go to Asia or at what utilization rate US LNG plants will actually operate.

Butler said that there is little room for American LNG in the European market, and the price impact of trying to sell more LNG there would quickly undermine the economics of US LNG exports. Souki noted that the US shale boom has fundamentally disrupted the global natural gas industry. US shale has introduced a measure of volatility, which means that the price cycle has now shortened to about 18 months (from peak to trough). The global LNG industry, which has to make investment decisions 20+ years into the future, will urgently have to find new business models to cope with this increased volatility.

The panelists agreed that natural gas can play a critical role in global emission reductions by displacing coal in electricity generation, and that natural gas-fired power plants are particularly well suited to complement intermittent renewable energy sources in the power generation mix. Fred Krupp remarked that natural gas could very well be a bridge fuel to zero carbon energy sources. But its ability to do so will greatly depend on the oil and gas industry's willingness to address the problem of methane leakage. "Natural gas, when not burnt, is an extraordinarily potent greenhouse gas," according to Krupp, and "the [oil and gas] industry is really shooting itself in the foot by not taking aggressive action to clean up [methane] leaks." Reducing methane emissions from oil and gas production "is the lowest hanging fruit in the field of public policy," which could deliver very substantial greenhouse gas reductions at a negligible cost to oil and natural gas producers. The panelists agreed that carbon pricing is desirable and likely represents the most economically efficient way to address the global climate problem (as opposed to picking technology winners). Souki noted that carbon pricing would not alter the cost structure of LNG

exporters materially; exporters of US gas are much more exposed to seasonal demand swings, interest rate changes or productivity improvements in drilling and production technologies, among many other things.

“THE GLOBAL GAS INDUSTRY IS NOW IN SEARCH OF A PRICING MODEL: BUYERS AND SELLERS CAN NO LONGER AGREE ON A PRICING MECHANISM THAT THEY CAN SUSTAIN FOR THE NEXT 20 YEARS.”

-CHARIF SOUKI



Fred Krupp, President, Environmental Defense Fund

WHAT'S NEXT FOR THE PARIS CLIMATE AGREEMENT?



From left to right: Laurence Tubiana, Special Representative for the 2015 Paris Climate Conference, French Minister of Foreign Affairs; Todd Stern, former US Special Envoy for Climate Change, US Department of State; Carlos Pascual, former US Special Envoy for International Energy Affairs, US Department of State; William Reilly, Senior Advisor, TPG, former US EPA Administrator; David Sandalow, Inaugural Fellow, Center on Global Energy Policy



Carlos Pascual, former US Special Envoy for International Energy Affairs, US Department of State

Panel Participants:

Carlos Pascual, former US Special Envoy for International Energy Affairs, US Department of State
William Reilly, Senior Advisor, TPG, former US EPA Administrator

Todd Stern, former US Special Envoy for Climate Change, US Department of State

Laurence Tubiana, Special Representative for the 2015 Paris Climate Conference, French Minister of Foreign Affairs
David Sandalow, Inaugural Fellow, Center on Global Energy Policy [Moderator]

Bill Reilly opened the panel by recalling the 1992 Rio Earth Summit, where the UN Framework Convention on Climate Change was adopted. (As US EPA Administrator, Reilly led the US delegation to the Rio Earth Summit.) Reilly recalled that President George H.W. Bush was the first leader of a developed country to propose ratification of the Framework Convention and that the United States was the first developed country to ratify the treaty.

Laurence Tubiana and Todd Stern spoke about the Paris Agreement adopted in December 2015. Tubiana said the philosophy of the Paris Agreement is totally different than the philosophy of the 1997 Kyoto Protocol. She said the Paris Agreement has measures that encompass all countries; authorizes certain forms of differentiation; sets a clear and ambitious global goal; requires all countries to strengthen their contributions over time; and has strong elements on transparency, finance and adaptation. Stern said the legal structure of the Paris Agreement, with some binding and other nonbinding provisions, was very important. He said the most important element of the Paris Agreement, in his view, is the notion of five-year cycles for evaluating and strengthening country commitments.

Tubiana and Stern also spoke about the forces that led to the Paris Agreement. Tubiana said that the agreement “looks like a little miracle.” She said forces that contributed to reaching an agreement included clear and compelling science, the availability of solutions, the involvement of civil society and the US-China climate agreement, in which Stern played a central role. Stern said that, recognizing the factors Tubiana had listed, “nobody should have the idea that it felt at any time until very late in the day that [the Paris Agreement] was in the bag.” He agreed that the readiness among many countries to arrive at an agreement was in part driven by increasing levels of concern about climate change. He said there was also a sense that, if the Framework Convention tried and failed to reach agreement, as it was seen to have done in the past, it would have been very difficult for it to maintain its station as the world’s principal place for addressing climate change. Stern praised the role of the French Presidency, including Foreign Minister Fabius and Tubiana, as well as the roles of President Obama and Secretary of State Kerry.

Carlos Pascual and Bill Reilly spoke about the business reaction to the Paris Agreement. They agreed that the impact of the Paris Agreement in the business community will be significant. Pascual said that three factors together — big data, technology and policies — are having a massive impact in the way businesses view climate change. He said that adapting business models will be key and spoke about a paper he wrote with CGEP Founding Director Jason Bordoff proposing a tool for financing low carbon development in developing countries. Reilly said that ten years ago there was very little sensitivity to climate risk on the part of major institutional investors, but that has changed significantly. In preparation for the Paris conference, a number of large pension funds and other institutional investors made decisions not to invest in coal for power. Reilly said that, “if you want to be on the right side of history, not just morally but economically, you’re going to take Paris seriously.”

The session closed with moderator David Sandalow noting that this was Todd Stern’s last public appearance as a U.S. government official. Stern said that the Special Climate Envoy job is “the best job I’ve ever had” and that it was an enormous privilege to serve.

“THESE THREE FACTORS TOGETHER -- BIG DATA, TECHNOLOGY AND POLICY -- TOGETHER ARE HAVING A MASSIVE IMPACT IN THE WAY BUSINESSES VIEW [CLIMATE] ISSUES.”

-CARLOS PASCUAL

“AS A NEXT STEP WE MUST FINALIZE THE RULEBOOK FOR THE PARIS AGREEMENT, BUT WE MUST ALSO KEEP GOING ON ALL OTHER ELEMENTS SUCH AS THE MONTREAL PROTOCOL, AVIATION EMISSIONS AND MARITIME EMISSIONS. EVERYTHING MUST MOVE.”

-LAURENCE TUBLIANA



Laurence Tubiana, Special Representative for the 2015 Paris Climate Conference, French Minister of Foreign Affairs

ELECTRICITY MARKETS IN TRANSITION



Cathy Zoi, CEO, Frontier Power

Panel Participants:

Ralph Izzo, CEO, PSEG Inc.

Cheryl Martin, former Acting Director, ARPA-E, US Department of Energy

Jim Rogers, former President, Chairman and CEO, Duke Energy

Cathy Zoi, CEO, Frontier Power

Sue Tierney, Senior Advisor, Analysis Group
[Moderator]

The panel opened with a discussion about the role of natural gas and renewables in making the power sector greener. Jim Rogers pointed out that as natural gas had eroded the use of coal in the United States power sector, carbon emission had dropped by 20 percent from 2005-2015. Cathy Zoi said that given the current structure of utilities, it is easy for them to manage gas, whereas the increased reliance on distributed energy resources requires a different set of skills that utilities are in the process of learning. Work underway to develop technologies that burn natural gas with zero carbon emissions would make natural gas much more competitive against renewables, Rogers noted, especially given its ability to run 24-7 independent of weather conditions. Cheryl Martin noted that utilities have already learned a lot about utility-scale solar and other renewables, and that the pace of technology was advancing faster than people think, with examples of utility-scale wind farms now being fully balanced and dispatchable.

Panelists shifted to discuss subsidies and their role in promoting use of renewables in the energy mix, and the difficulties in removing subsidies once they are in place. Izzo said the most efficient mechanism for delivering a public subsidy is the regulated utility, as they can segment the market as they see fit and regulate the return. In contrast, the creation of “artificial markets” and renewable energy credits have little intrinsic value other than designating a “magic number” and then “letting the market work.” This ultimately allows good credit customers to deploy technology while lower credit customers miss out because they cannot afford it. Higher income homeowners in New Jersey were more able to take advantage of the net metered solar than households with lower incomes, due to subsidies which were in effect being paid for by the families earning less. If that is the case, Izzo said: “you have to rethink the design of the subsidy – not the fact that there is a need for the subsidy.” Zoi noted that there were many examples of good policy design in cases where the market needs to be juiced to get it going, but then offers declining support later. Rogers also discussed the appetite for change to the electric system due to the small amount each family pays for electricity. “There are a group of people in this country who would like to be their own supplier for electricity and this democratization is occurring, but I would question how many. And the reason I say it that way is because today for the average family in America, the cost of electricity is 1.3 percent of the disposable income. It is less than the cable bill, it is less than their cell phone cost. I’m not sure there is a clamoring for an alternative approach.”

Regarding improving electricity access in developing countries, Martin said that sub-Saharan Africa is struggling with the existing installed base, which is highly inefficient, and that they are struggling to draw the capital they need to improve it. Rogers, who recently authored a book on using sustainable solutions to help address energy poverty, noted that there are a billion people in developing economies that are connected to the grid, but that this grid does not function all the time, and that billions of dollars in investment is needed to make them reliable. For those unconnected to any grid, Zoi said that with developments in technology and big data, and with development banks interested in working to solve issues around energy access, renewable energy solutions are

becoming more profitable. “The reason I’m doing this as a business is that there are not enough philanthropic dollars to get the job done as quickly as we need to do it,” Zoi said.

In the United States, questions were raised about the role of utilities and how to control a grid where there is more variable renewable generation. Rogers noted that the more the grid moves from analog to digital, the more potential there will be for the two-way communication with devices that receive power. Martin said that such technologies will unlock efficiencies that are not possible today. Looking to the future, Izzo said that currently there is not enough government money going into material sciences, adding that once projects start seeing some viability for commercial applications, government can back away. Battery storage was the most important area where more research was needed, Zoi said. Rogers noted that overall government investment in research and development in these areas has been flat since 2010 and was only ten percent of the expenditure put into the military R&D. Martin said that she believes the ARPA-E model is critical to achieve the best results, by providing funds to several companies and projects at the same time and not picking up front winners, surrounding these projects with the right kinds of people, and then ensuring the good projects get into the hands of people who understand the market so that the best technologies are advanced.



From left to right: Ralph Izzo, CEO, PSEG Inc.; Cathy Zoi, CEO, Frontier Power; Jim Rogers, former President, Chairman and CEO, Duke Energy; Cheryl Martin, former Acting Director, ARPA-E, US Department of Energy; Sue Tierney, Senior Advisor, Analysis Group

“WITH ALL THE PROGRESS AND THE TECHNOLOGY, AND WITH THE BIG DATA, AND WITH THE DEVELOPMENT BANKS HAVING THE APPETITE TO SOLVE THIS PROBLEM, YOU CAN NOW MAKE RENEWABLE ENERGY SOLUTIONS PROFITABLE. THEY ARE ECONOMIC, THEY ARE A VALUE PROPOSITION FOR LOW INCOME IMPOVERISHED PEOPLE IN VILLAGES. TODAY.”

-CATHY ZOI

“GAS HAS PLAYED A DRAMATIC ROLE IN THE POWER SECTOR IN REDUCING THE CARBON FOOTPRINT. AT THE SAME TIME, SIGNIFICANT INVESTMENTS ARE BEING MADE IN RENEWABLES, SO I DON’T VIEW THIS AS EITHER/OR (GAS OR RENEWABLES) ... I THINK WE NEED BOTH TO MAKE THE TRANSITION.”

-JIM ROGERS



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