

Bloomberg Markets

VOLUME 28 ISSUE 4 AUGUST / SEPTEMBER 2019

The Energy Issue





Insights
propelling
sustainability.

Sustainability is a rapidly evolving field driven by billions of dollars in global investment. Join world-leading experts on BMO's **Sustainability Leaders** podcast as they seek to advance the dialogue on leading approaches to sustainability.

To listen to the podcast, visit
bmo.com/sustainabilityleaders



BMO Capital Markets is a trade name used by BMO Financial Group for the wholesale banking businesses of Bank of Montreal, BMO Harris Bank N.A. (member FDIC), Bank of Montreal Ireland p.l.c, and Bank of Montreal (China) Co. Ltd and the institutional broker dealer businesses of BMO Capital Markets Corp. (Member FINRA and SIPC) in the U.S., BMO Nesbitt Burns Inc. (Member Investment Industry Regulatory Organization of Canada and Member Canadian Investor Protection Fund) in Canada and Asia and BMO Capital Markets Limited (authorised and regulated by the Financial Conduct Authority) in Europe and Australia. "Nesbitt Burns" is a registered trademark of BMO Nesbitt Burns Inc., used under license. "BMO Capital Markets" is a trademark of Bank of Montreal, used under license. "BMO (M-Bar roundel symbol)" is a registered trademark of Bank of Montreal, used under license.

© Registered trademark of Bank of Montreal in the United States, Canada and elsewhere.

The Energy Issue

| | | |
|-----------|---------------------------------------|--|
| 11 | Investing in the Transition | Experts around the world explain how to capitalize on the changing landscape <i>By Bloomberg News</i> |
| 15 | The End of the Hydrocarbon Era | Not so long ago, the greatest energy fear was that the world would run out of oil. The real problem turns out to be very different but just as challenging <i>By Liam Denning</i> |
| 44 | Industry Focus | A chart-based summary of important trends in energy <i>By BloombergNEF and Bloomberg News</i> |
| 50 | Tiny Country Meets Big Oil | Exxon Mobil has a gusher off the coast of Guyana. What it means for the South American nation's people is far from clear <i>By Kevin Crowley</i> |
| 56 | Charging Ahead | Advances in batteries promise to reinvent the grid as we know it. Carmakers, oil companies—even utilities—are getting in on the act <i>By David Stringer</i> |
| 62 | Coal Clings On | The climate-threatening fossil fuel may be out of favor in the wealthiest countries, but in Pakistan and China demand is booming <i>By Adam Majendie and Faseeh Mangi</i> |
| 72 | Turbine Town | Aarhus, Denmark's second-largest city, is home to the world's biggest maker of wind turbines—and a burgeoning green economy <i>By Lars Paulsson</i> |

COVER ARTWORK BY
ERIC HOSFORD

“My goal for this illustration was to convey nature’s abundance of power. On the surface it’s chaotic and uncontrollable, but there’s a harmonious flow to the elements. The sun, wind, and water work together to provide endless renewable energy for us to harness.”

8

Markets Almanac

A few key events for your calendar in the coming months

18

<GO>

Alpine Energy

Dams produce more than half of Switzerland's electricity

22

The Green Bond Boom

Use {LEAG <GO>} to track the trends

24

Climate Divesting

Why some big fund managers are selling holdings in coal and oil

26

Storm Warning

When a hurricane or cyclone bears down, you can get a preview of what's in danger

28

Solar Solution

In China, fish farms provide a home for solar panels

31

Instant Insight

How to get an AI update on your portfolio

32

Finding Value

{FIW <GO>} can show you which energy bonds are cheapest

36

Frontier Energy

A London fund manager bets on African power plants

38

Tracking Tariffs

{AHOY <GO>} helps you see how trade wars are affecting solar panel shipments

40

Deals, Flows, and Debt

A few functions that can answer important questions about the oil market

42

Trendspotter

How Nancy Pfund became an early cleantech investor

48

Green Flops

A look at renewable energy ideas that have failed—so far—to work as businesses

82

Backstage With Mohammad Sanusi Barkindo

The OPEC secretary general reveals a few off-duty habits and preferences

83

Cheat Sheet

The most important functions you should know about right now

84

A Function I Love

How to dig into energy company production data

Corrections: "How Do You Bet Against Crowded Trades?" (June/July) should have stated that Koulajian received his MBA in 1994. In "The Research Industry Works on How to Win and Keep Clients," UBS's Evidence Lab became a separate business, but remained within the bank. In "Beyond the Ivory Tower," the endowment's diversity push started about 15 years ago. Robert F. Smith founded Vista Equity Partners. In "Moving Forward," Bonderman and Coulter are alumni of the Robert M. Bass Group.

HONDA

BEND TIME.
BLUR LINES.

EXPERIENCE THE FASTEST
JET IN ITS CLASS.

SAVE FUEL.
SPARK ADVENTURE.

EXPERIENCE THE MOST FUEL-EFFICIENT
JET IN ITS CLASS.

Conquer new frontiers, venture farther,
and climb higher. With HondaJet Elite,
your destinations and passions are
within reach and more.

RELENTLESSLYPURSUE.COM
1.336.387.0707

HondaJet
ELITE



The BNEF Summit has been convening leaders in energy, industry, transport, technology, finance and government since 2008, generating ideas, delivering insight, and making the connections that help them formulate successful strategies, capitalize on technological change and shape a cleaner future.

BNEF Summit

London

New Delhi

New York

San Francisco

Shanghai

BloombergNEF

Opportunities generated.

Learn more:

bnef.com/summit

[#BNEFSummit](https://twitter.com/BNEFSummit)

Get to the point of the news.

First Word on the Bloomberg Terminal and mobile delivers 40 laser-targeted, actionable subject areas, curated by experts who know what you need — and what you don't.

Choose your channel and focus on the sectors, companies, and topics that matter. Because the point of the news is you.

On-Terminal at **FIRST <GO>**
Learn more at bloomberg.com/first-word

Bloomberg

The Energy Issue

Markets use energy and trade energy. But what kinds, at what prices, and at what cost to the planet? Those questions fueled the Energy Issue's trip around the world. To get the answers, we joined with Bloomberg News's energy teams and BloombergNEF, Bloomberg LP's primary research service on energy transition.

Guyana, South America's only English-speaking country, has fewer than 1 million people. Most are very poor. A huge oil discovery offshore will soon gush money for Exxon Mobil Corp. But what about the Guyanese people? **Kevin Crowley** takes a look in "There Will Be Oil" (page 50).

Pakistan, also impoverished, needs cheap power for the world's fifth-largest population. With support from China, it's still mining coal. In "Where Coal Won't Die" (page 62), **Adam Majendie** and **Faseeh Mangi** investigate Asia's coal addiction. (Michael Bloomberg, founder and majority owner of Bloomberg LP, which owns *Bloomberg Markets*, has committed \$500 million to help phase out U.S. coal-fired power plants by 2030.)

Wind and solar power, niche sources of energy in most of the world, are finally inexpensive enough to start taking significant market share. BloombergNEF's *New Energy Outlook*, released in June, forecasts that almost half the world's electricity will come from the sun or wind by 2050. "Energy Outlook" (page 44) provides some key findings from that report and other sources.

Wind and sun can't provide a constant stream of energy the way oil and gas do—unless their power is stored in batteries. As batteries get cheaper and more powerful, carmakers, oil companies, and even utilities are starting to invest. **David Stringer** caught a glimpse of the future in Byron Bay, Australia, as he writes in "Power to the People" (page 56).

Denmark's Vestas Wind Systems A/S is riding a boom in demand for wind turbines. But it's just one of the renewable energy-related businesses in Aarhus, the country's second-largest city. **Lars Paulsson** visited to learn more in "Trade Winds" (page 72).

We hope you find the issue informative and thought-provoking. As always, we welcome any feedback.

Christine Harper, Editor

Editor

Christine Harper

Design Director

Josef Reyes

Features Editor

Stryker McGuire

<GO> Editor

Jon Asmundsson

Special Reports Editor

Siobhan Wagner

Graphics Editor

Mark Glassman

Bloomberg Markets draws on the resources of Bloomberg News, Bloomberg TV, Bloomberg Businessweek, Bloomberg Intelligence, Bloomberg Economics, BloombergNEF, and Bloomberg LP.

Editor-in-Chief

John Micklethwait

Deputy Editor-in-Chief

Reto Gregori

Advisory Board

Chris Collins, Tina Davis, Caroline Gage, David Gillen, Chris Nagi, Jenny Paris, Marty Schenker, Joe Weisenthal

Creative Director

Christopher Nosenzo

Photo Director

Donna Cohen

Managing Editor

Kristin Powers

Copy Chief

Lourdes Valeriano

Copy Editors

Mark Leydorf, Anne Newman

Production Manager

Susan Fingerhut

Map Manager

Ilse Walton

Production Associate

Loly Chan

Head of U.S. Sales

Anthony DeMaio /
1 646 324-3016

Head of Europe Sales

Damian Douglas / 44 20 3525-8974

Head of APAC Sales

Mark Froude / 65 6499-2664

Production/Operations

Steven DiSalvo, Debra Foley, Thomas Gambardella, Dan Leach, Daniel W. Murphy, Carol Nelson, Bernie Schraml

Chief Commercial Officer

Andrew Benett / 1 212 617-8225

comments@bloombergmarkets.com



"THERE IS A BEAUTY THAT REMAINS WITH US AFTER WE'VE STOPPED LOOKING."

CORY RICHARDS,
PHOTOGRAPHER AND EXPLORER, WEARS THE
VACHERON CONSTANTIN OVERSEAS.


VACHERON CONSTANTIN | ONE OF
GENÈVE NOT MANY.

A few key events for your calendar in the coming months.

| | | | |
|---|--|--|---|
| <p>Aug ▶</p> | <p>22–24 ◦</p> <p>Kansas City Fed’s Economic Policy Symposium</p> <p><i>Jackson Hole, Wyo.</i></p> <p>“Challenges for Monetary Policy” is this year’s theme</p> <p>{BE <GO>} is the home of Bloomberg Economics. For podcasts, including <i>Stephanomics</i>, with Bloomberg Economics’ Stephanie Flanders, visit {BPOD <GO>}.</p> | <p>27–29</p> <p>Intersolar South America</p> <p><i>São Paulo</i></p> <p>Event focused on energy storage, photovoltaic, and solar thermal technology</p> | |
| <p>Sep ▶</p> | <p>9–13</p> <p>European PV Solar Energy Conference</p> <p><i>Marseille</i></p> <p>36th gathering of the global photovoltaic community</p> | <p>17 ◦</p> <p>Israel Parliamentary Elections</p> <p><i>Israel</i></p> <p>Voters go to the polls for the second time this year</p> <p>To see Israel’s credit ratings, type {CSDR <GO>} and enter Israel in the amber Country search box, or {OTC ILS <GO>} for a window on Israel’s financial markets.</p> | |
| <p>17–19</p> <p>Gastech</p> <p><i>Houston</i></p> <p>Major exhibition and conference for gas, LNG, and related industries</p> | <p>17–30</p> <p>United Nations General Assembly</p> <p><i>New York</i></p> <p>The UN’s 74th annual meeting; debate begins Sept. 24</p> | <p>Oct ▶</p> | <p>2–3</p> <p>The Joburg Indaba</p> <p><i>Johannesburg</i></p> <p>Africa’s mining and resource industry gets together</p> |
| <p>7–14 ◦</p> <p>Nobel Prize Announcements</p> <p><i>Stockholm and Oslo</i></p> <p>Medicine, physics, chemistry, literature, peace, and economics</p> <p>Go to {TNI NOBEL TABLE <GO>} for lists of previous winners, and {TNI NOBEL FND BN <GO>} for stories about Nobel laureates and fund management.</p> | <p>8</p> <p>Bloomberg Invest</p> <p><i>London</i></p> <p>Top names in finance engage in frank discussions</p> | <p>13–15</p> <p>LBMA/LPPM Precious Metals Conference</p> <p><i>Shenzhen, China</i></p> <p>Gold and other valuable metals are the focus</p> | |

A STAR ALLIANCE MEMBER 

ENJOYABLE TIME IN THE AIR

25 world trips worth of entertainment will accompany you through your journey.



TURKISH AIRLINES

Products and services are subject to change depending on flight duration and aircraft.



**NATIONAL BANK
OF CANADA**
FINANCIAL MARKETS

640 professionals.
16 sectors of expertise.
1 mission.



Our proactive mindset drives us to go above and beyond our clients' expectations. We're ready when asked, "How do you add value?"

National Bank of Canada Financial Markets is a trademark of National Bank of Canada used under license. In the U.S.A. securities and investment products are offered through National Bank of Canada Financial Inc., an indirect wholly-owned subsidiary of National Bank of Canada, and member of FINRA and SIPC.

By BLOOMBERG NEWS

NO ONE DISPUTES THAT change is coming to the energy sector. A decade ago, integrated oil and gas companies such as Exxon Mobil Corp. and Chevron Corp. seemed like solid investments. They made up the biggest sub-index in the S&P 500, accounting for 7.8% . And yet, by this July, that same group had dropped to 11th place, with a 2.4% weighting. Over the past five years, the index featuring the once-mighty oil and gas majors has underperformed the S&P Global Clean Energy Index, composed of solar, wind, and other renewable energy stocks. How can investors position themselves for the future? Bloomberg News energy reporters around the world solicited opinions and insights from experts with an array of backgrounds. The responses are diverse, but one common theme emerges: Change means opportunity.

How Can Investors Capitalize on The Changing Energy Landscape?

“Renewable energy demand will grow dramatically in the context of global decarbonization. While wind power and solar power are more established than other parts of the renewable energy/cleantech theme, we see immense opportunity forthcoming in electric vehicles, fuel cells, and smart-grid technology.

“We believe investors should approach the theme in a balanced fashion, including select parts of the ‘renewable energy/clean technology value chain.’ This approach is embodied in an index that BP Capital [the investment vehicle part-owned by T. Boone Pickens] co-developed with Morningstar—the Morningstar North America Renewable Energy Index. Constituents are either involved in the renewable energy and green transportation fields directly, or they are significant users of clean energy sources.”

Toby Loftin

MANAGING PRINCIPAL,
BP CAPITAL FUND ADVISORS

“Asia-Pacific represents over half of the global renewables market and will be the leading destination for capital flows into the energy transition, including electricity storage, over the coming years.

“The energy landscape is developing at a pace more akin to a revolution than a transition, led by low-cost renewable energy. More than \$1 trillion of capital has already been invested into wind and solar projects globally, and renewable power infrastructure assets continue to represent compelling opportunities for investors seeking both growth and income.”

Charlie Reid

HEAD OF RENEWABLE POWER IN
ASIA-PACIFIC,
BLACKROCK REAL ASSETS

“A couple things are clear. The demand side for oil is going to significantly slow down, but the supply is not. There’s more oil coming, so we could be in a world of \$20 to \$30 oil in 10 years or so. If that’s the case, it’s all going to be in petrochemicals and petrochemical integration.

“A long-term structural decline in oil prices would make petrochemical feedstocks cheaper, while demand for products such as plastics is likely to keep rising to meet needs of growing economies.”

Fereidun Fesharaki

FOUNDER AND CHAIRMAN,
FGE

“Investors need to balance their portfolios. You need one that’s going to tap profits available now in the oil and natural gas space—maybe in midstream infrastructure—but is also going to allow you to transition into clean energy. Investors are interested in seed funds but cannot commit large sums from their portfolios because of the risk involved in startup ventures coming out of accelerators. That opens the opportunity for investment funds that allow an investor to participate at various stages of a venture through a structure called a stacked vehicle. A stacked vehicle is a venture fund that provides guaranteed optionality to invest larger amounts of money once a venture gets off the ground and starts to grow. Portfolio managers are increasingly turning to co-investment opportunities instead of just tapping the stock market once companies are public. That’s because the most exciting companies are not always coming to public markets.”

Amy Myers Jaffe

SENIOR ENERGY
AND ENVIRONMENT FELLOW,
COUNCIL ON FOREIGN RELATIONS

“One of the disruptive forces in the global energy markets has been rising U.S. oil and gas production and exports, which is required to meet growing energy demand in absence of alternative supply growth elsewhere. We see value in the U.S. midstream energy sector, the primary beneficiary of U.S. oil production growth due to the need to process, transport, store, blend, and export. The midstream sector, over the long term, offers the potential for organic growth well above nominal GDP growth, along with attractive yields and attractive valuations. Over the next one to three years, we also see opportunities in the oil market. Due to OPEC+ [Organization of Petroleum Exporting Countries plus other nations including Russia] actions thus far, both voluntary and involuntary, the oil market remains quite backwardated, meaning the spot price of oil is more expensive than the future price. Historically, this has been a strong buy signal.”

Greg Sharenow

MANAGING DIRECTOR AND
PORTFOLIO MANAGER,
PACIFIC INVESTMENT MANAGEMENT CO.

“The world’s energy system faces unprecedented disruption over the next three decades if we are to come anywhere close to the objective of limiting the catastrophic impacts of climate change. The transition will create significant risks and uncertainties for many companies. But there are likely to be areas of opportunity as well—for example, in natural resources like copper that we will need in ever increasing quantities.”

Nick Stansbury

HEAD OF COMMODITY RESEARCH,
LEGAL & GENERAL
INVESTMENT MANAGEMENT

“Over 70% of the world’s oil production growth over the past decade was driven by U.S. shale, an industry highly dependent on low interest rates. The shale phenomenon has helped sustain strong U.S. GDP rates, as it accounted for the bulk of the increase in domestic capital expenditure while simultaneously capping inflationary energy prices. The interplay between interest rates, inflation, and the central bank’s reaction function makes monetary policy a far more important component of the energy sector than in the past.

“From a speculator’s perspective, this landscape is unfolding just as **risk capital** is leaving the sector in droves. The majority of the large banks active in energy markets have either shut down or reduced their commodities divisions, because of regulatory concerns or a shift to more efficient uses of capital. Meanwhile, assets dedicated to energy hedge funds are a sliver of what they used to be. In our view, the lack of available risk capital has had two pronounced consequences:

“One, an increase in the magnitude of price swings and a heightened market sensitivity to the higher frequency of event risks. As a result, investors should shorten the time frame of their outlooks and more actively manage their exposures instead of trying to capture longer-term thematic market moves.

“Two, given the considerable producer hedging flows, taking the other side by warehousing risk and providing liquidity should be well compensated.”

Marwan Younes

PRESIDENT AND CHIEF INVESTMENT OFFICER,
MASSAR CAPITAL MANAGEMENT

“**Renewables** have become the best means of simultaneously addressing the emissions gap, delivering cheap power quickly, and, increasingly, the ability to deliver firm power. The fossil fuel industry in all its forms will decline more rapidly than people think as investors take flight fearing a medium- and long-term-returns risk.”

Andy Kinsella

GROUP CHIEF EXECUTIVE OFFICER,
MAINSTREAM RENEWABLE POWER

“The key success factors going forward are going to be flexibility, cost-advantaged assets, and driving margins through integration—all of which are underpinned by **technology** leadership. Investors will maximize their chance of returns by backing the market participants that credibly have and will continue to grow these characteristics.”

Andy Brogan

GLOBAL OIL & GAS SECTOR LEADER,
EY

“The energy transition has taken us to a crossroads on where to invest to create long-term value, as renewable energy has gone from being the cheapest source of electricity in 1% of the world five years ago to two-thirds of the world today. We’ve seen large financial institutions **divest** as a consequence of this, as they seek to ensure a solid return for future generations, but the many undecided investors need to make up their mind fast if they want to avoid stranded assets.”

Anders Runevad

FORMER CEO,
VESTAS WIND SYSTEMS A/S

“Look, utilities don’t want to radically improve their business. They won’t take risks. So, instead, serve the rebels: Sell to the people with a **vision**. Disruptive technologies don’t make money, that’s for foundations and endowments. Tesla was disruptive from a visionary standpoint, not from technology. It was edgy. Musk eventually added a bunch of disruptive technology. Be patient. Brand-new technologies take 20 years to get to market.”

Jigar Shah

PRESIDENT,
GENERATE CAPITAL

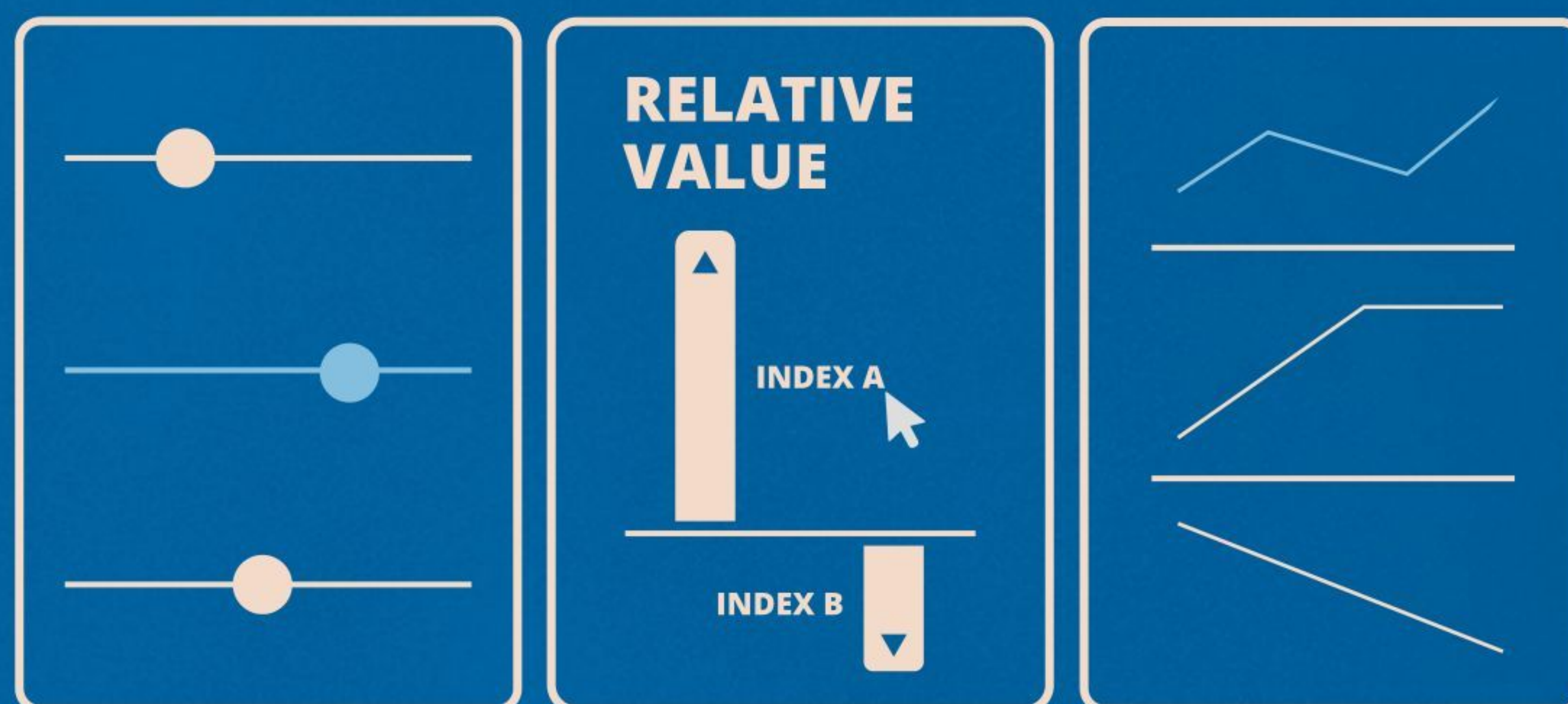
“The energy transition provides ample opportunities. You see banks and financial institutions providing loans, opportunities in replacing existing power facilities. I see also a lot of potential on cross-border investments such as cables, linking countries. In Germany, also I see opportunities for wind offshore, new technologies, and LNG [liquefied natural gas]. Looking forward, I see that hydrogen, electrolysis, and a combination of **storage technologies** would offer good opportunities. Offshore wind is a success in Europe now, but there are other countries entering that market, too, such as Taiwan, the U.S., and Japan.”

Thomas Brehler

GLOBAL HEAD OF POWER,
RENEWABLES, AND WATER,
KFW IPEX-BANK

Reporting by Kelly Gilblom and Jeremy Hodges in London; Catherine Ngai, Chris Martin, and Millie Dent in New York; Rachel Adams-Heard in Houston; Vanessa Dezem in Frankfurt; James Thornhill in Sydney; and Dan Murtaugh in Singapore.

Introducing the first Relative Weight ETFs from Direxion



Smart. Simple. Cost Efficient.

A new way to implement your relative value strategies.

RWGV

Growth vs. Value

RWVG

Direxion
ETFs | Funds

Call 866-716-0735 or go to
direxioninvestments.com/RelativeWeightETFs

An investor should carefully consider a Fund's investment objective, risks, charges, and expenses before investing. A Fund's prospectus and summary prospectus contain this and other information about the Direxion Shares. To obtain a Fund's prospectus and summary prospectus call 866-476-7523 or visit our website at direxioninvestments.com. A Fund's prospectus and summary prospectus should be read carefully before investing.

Shares of the Direxion Shares are bought and sold at market price (not NAV) and are not individually redeemed from a Fund. Market Price returns are based upon the midpoint of the bid/ask spread at 4:00 pm EST (when NAV is normally calculated) and do not represent the returns you would receive if you traded shares at other times. Brokerage commissions will reduce returns. Fund returns assume that dividends and capital gains distributions have been reinvested in the Fund at NAV. Some performance results reflect expense reimbursements or recoupments and fee waivers in effect during certain periods shown. Absent these reimbursements or recoupments and fee waivers, results would have been less favorable.

Direxion Relative Weight ETFs Risks – Investing involves risk including possible loss of principal. The Fund's investments in derivatives may pose risks in addition to, and greater than, those associated with directly investing in or shorting securities or other investments. Investing in, and/or having exposure to, growth and value securities involves risks. Risks of growth securities include the risk of sharp price movement, and susceptibility to increased volatility, which may cause them to perform differently than the market as a whole. Risks of value securities include the risk that their intrinsic value may never be fully realized by the market. There is no guarantee that the returns on the Fund's long or short positions will produce high, or even positive returns and the Fund could lose money if either or both of the Fund's long and short positions produce negative returns. Please see the summary and full prospectuses for a more complete description of these and other risks of the Fund.

Distributor for Direxion Shares: Foreside Fund Services, LLC.

The End of the Hydrocarbon Era

By LIAM DENNING

ILLUSTRATION BY MATT CHASE

DUSTIN YELLIN, a Brooklyn, N.Y.-based artist whose intricate 3D photomontages adorn the likes of New York's Lincoln Center, wants to draw your gaze to climate change. Not in a subtle way, either. He plans to stand an oil supertanker on its end in the ground—a structure soaring 1,000 feet into the air.

The Bridge, as Yellin dubs it, would repurpose a piece of energy infrastructure as a ready-made artwork, complete with elevators and a viewing platform for visitors, capturing the sheer scale of our energy system. The difficulty of hoisting thousands of tons of steel into the air would itself symbolize the monumental challenge of retooling our hydrocarbon-fueled civilization in the face of climate change.

The world depends on coal, oil, and natural gas for about four-fifths of its energy—just as it did when I was a boy. Back then, fears shaped by the 1970s centered on what would happen when our vital fuels ran out.

Our actual energy crisis turns out to be one of abundance, not scarcity. We've burned 1 trillion barrels of oil since 1980, yet global reserves are almost three times bigger. Natural gas is so plentiful that producers in Texas have been burning it off or even paying customers to take it off their hands. As for coal, the only thing many mines have run out of is jobs.

Carbon emissions are similarly inexhaustible, reaching a record last year. Abstract fears of "global warming" from the '80s have morphed into the present danger of climate change. Rather than ►



running out of hydrocarbons, we're running out of time to deal with their pollution.

Our species struggles to grasp gradual change. Tell people the gas pumps have run dry, and they focus in an instant. Tell people their cars produce an invisible gas that will engender biblical droughts and floods—not necessarily where they live—and their attention drifts. Hence Yellin's skyscraper-size exclamation point.

Similarly, it's hard for us to conceive of the end of the hydrocarbon era. And yet financial markets appear to be ahead of us on this.

This summer the energy sector's weighting in the S&P 500 fell below 5%, lower than at any time in the past four decades. That's quite a show of disdain for a set of giant companies raking in almost \$3 billion in revenue every day.

The most recent boom and bust ruined the industry's reputation with many investors. News flash: This isn't the first time that's happened. In the past, though, the ubiquity of fossil fuels preordained that consumption (and prices) would eventually rise and tempt investors back.

Now at least some of them worry that a new deep-water field might end up as a stranded asset in a little changed or shrinking market. Oil majors are deserting prior strongholds, such as Norway's frigid waters, and going all in on U.S. shale basins, which can be developed in months instead of years. BP Plc's head of strategy acknowledges that some of the company's resources "won't see the light of day." And members of OPEC, whose power always rested on the geological lottery of vast oil reserves, find themselves relying on the support of nonmember Russia to shore up their diminished credibility.

Hydrocarbons, dense with energy and intertwined with so much of our existing infrastructure, remain formidable incumbents. Roughly 150 years old, the oil business is still capable of sprightly disruption: Look at what hydraulic fracturing of shale hath wrought. Coal, an even older industry, isn't quite so vigorous—global demand peaked in 2013—but nor has it gone gently into that good night, especially in Asia.

Above all, hydrocarbon

consumption is just big: Last year we burned oil, gas, and coal with an energy equivalent of almost 12 billion tons of oil. Like *The Bridge*, it's hard to get your head around the scale.

But in a transition, scale only tells you where you are; marginal growth points to where you're going. Rather than focus on the mountain, get a feel for the gradient of travel.

Harry Benham, an oil industry veteran turned consultant, presents this as a math problem. Primary energy consumption grows at about 1% to 2% a year, and that rate has trended downward, more or less, since the 1960s. That's linear growth, meaning the world's sources of energy, no matter how big or small, must fight for a slice of that shrinking sliver of extra demand over time. Wind and solar power, while small, are expanding at a ferocious clip: 23% a year, compounded, over the past decade. Which means they grab a bigger share. Having generated less than 2% of the world's electricity a decade ago, wind and solar will likely surpass nuclear power this year or next.

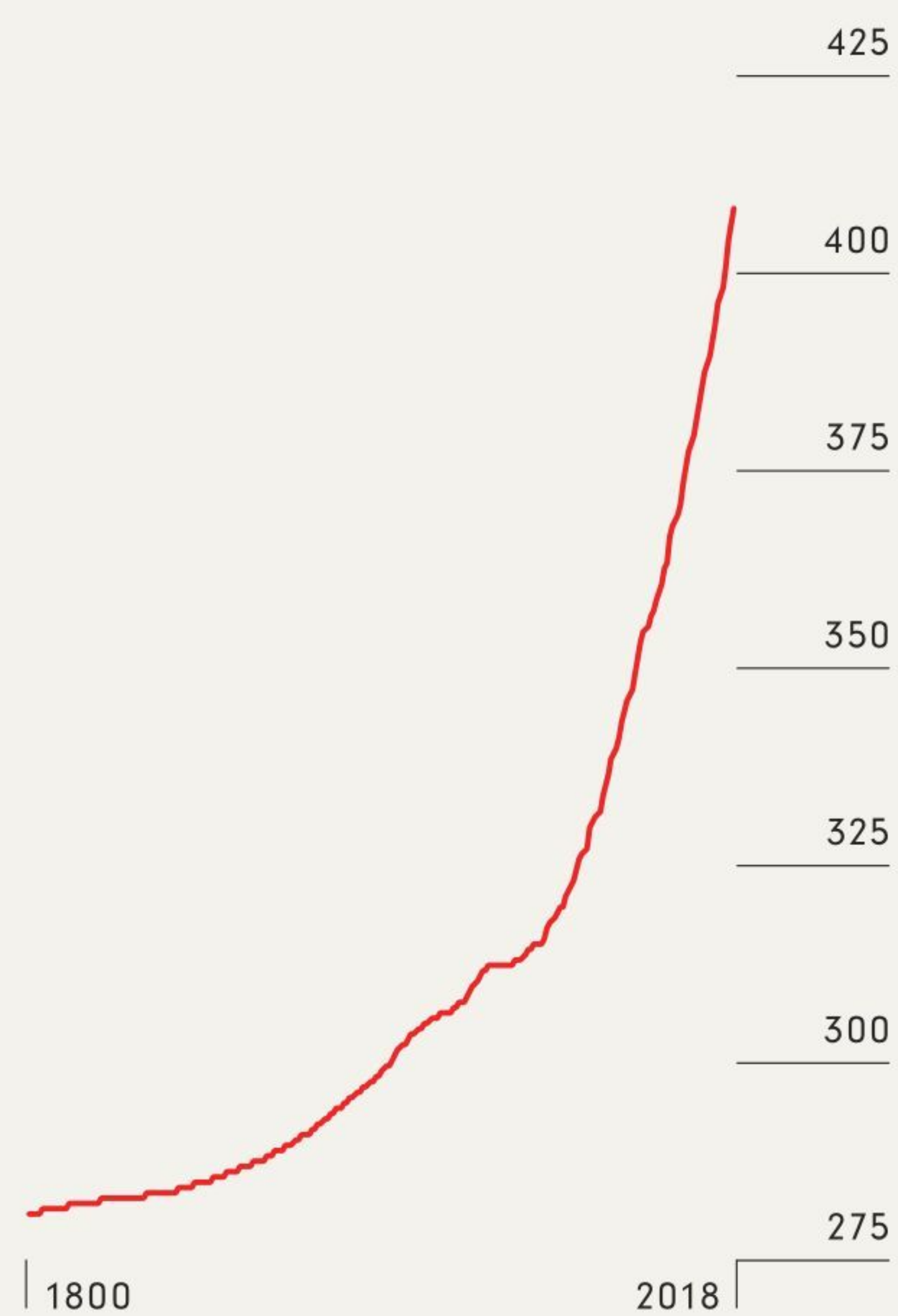
This collision course is driven by cost. Less than a decade ago, shale frackers needed maybe \$100 a barrel to break even. Now some need less than \$50. Impressive, but the all-in cost of solar power has dropped 85% since 2010, and BloombergNEF forecasts an additional 63% drop through 2050. In two-thirds of the world, up from 1% five years ago, new solar and wind projects undercut new plants that use either coal or natural gas.

If you think oil is safe in its internal-combustion fortress, consider that electric models accounted for all the growth in passenger-vehicle sales last year and are forecast to do the same this year. Again, it's scale vs. growth. Sales of traditional gas guzzlers, while still 80 million-odd strong, have declined. And investors, technology talent, and research and development budgets tend to start backing away from little changed or shrinking markets, no matter how big they are. Energy stocks are out of favor not because they're no longer dominant; they clearly are. But mortality has begun to creep into risk premiums.

Despite the falling costs and growing market share of renewable

Rise of a Greenhouse Gas

Atmospheric concentration of carbon dioxide, in parts per million



Sources: Institute for Atmospheric and Climate Science, National Oceanic and Atmospheric Administration

energies, they still lack the killer app: a price on carbon emissions that would expose the frequently hidden costs of fossil fuels. Conventional wisdom holds that Americans, especially, wouldn't stand for that.

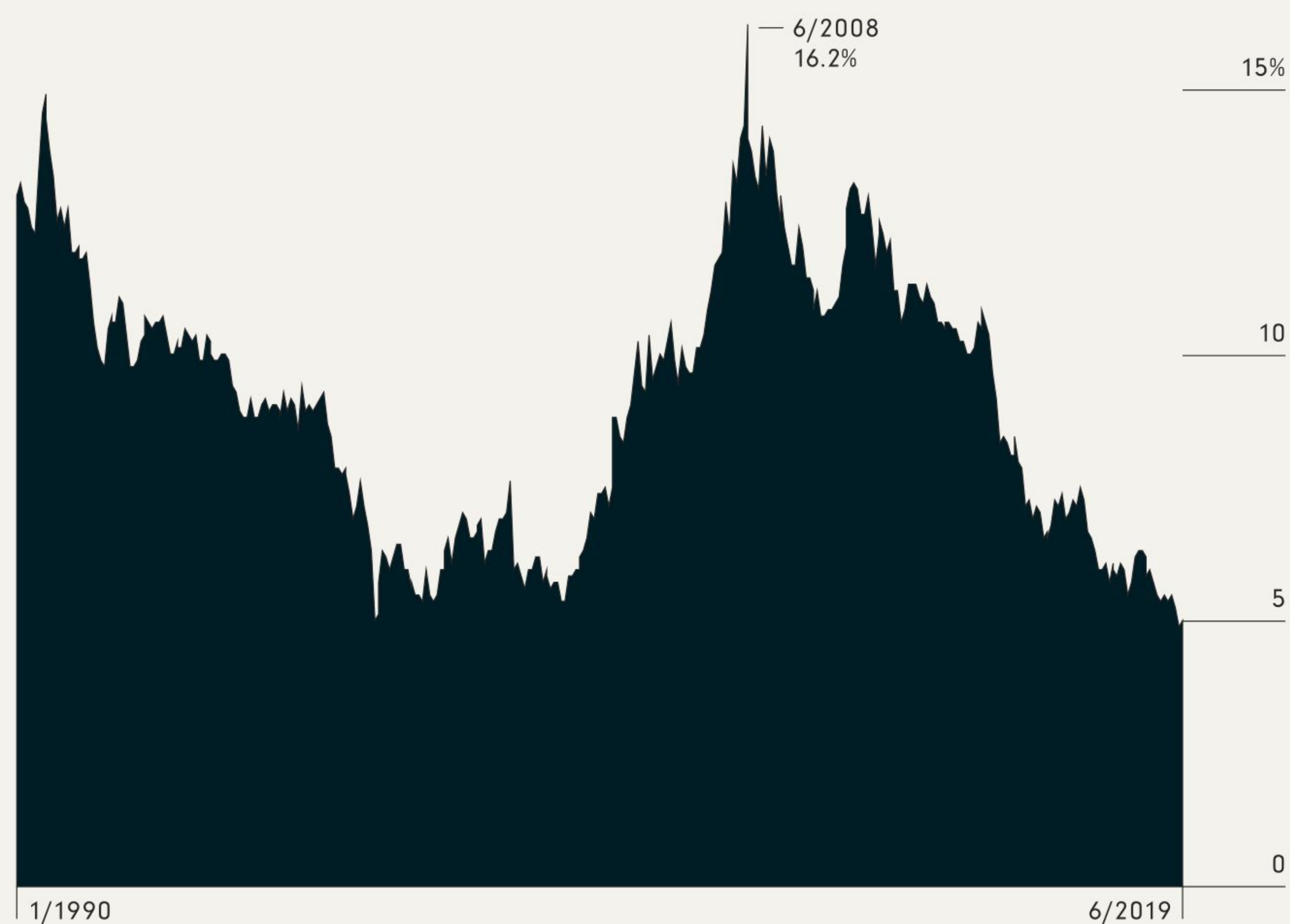
But aside from President Trump professing ardor for "beautiful" coal, few people love hydrocarbons—when was the last time you fist-pumped at the prospect of a trip to the gas station? Most folks don't even care about energy. What they love is what it provides: light for dark streets, cool offices on hot days, and, of course, the ability to travel. These hallmarks of modernity—the ends, not the means—persuade us to tolerate the drawbacks.

One is pollution. In the past, when society reached tipping points on industrial nasties such as leaded gasoline or smog, government acted to curb them. Carbon emissions, invisible and with a slow, diffuse impact, are of a different order. Even here, however, sentiment is shifting, and that gradient of public tolerance is steepening.

For example, oil majors' relatively recent touting of renewable energy investments may strike you as

Loss of Influence

Weighting of the energy sector in the S&P 500, monthly



Source: {SPX Index}

“greenwashing.” The point is that they’ve acknowledged that man-made carbon emissions cause climate change. That particular cat won’t go back in the bag.

It’s also easy to dismiss Pope Francis’ recent convening of oil bosses in the Vatican as political theater. But as Kevin Book of Washington-based ClearView Energy Partners says, the church epitomizes conservatism and tradition: “The activists are already persuaded about climate change, and now the Vatican is, too.” In a pleasing irony, the pope pushed the case for climate science in the same building where Galileo was tried by the church for his own bit of scientific insight.

Even in the U.S., where discussion of climate policy so often regresses into theological positions of “believing” or “disbelieving” scientific consensus, there are signs of a shift. Polls show rising concern about the dangers of climate change, particularly among younger voters. The Green New Deal may be a mere scrap of a proposal, but it’s nonetheless dragged the politics of climate left. There’s no chance anything like the #GND will be enacted into law while Kentucky Republican Mitch

McConnell runs the Senate. But Democratic presidential primary candidates now speak openly about scrapping the filibuster precisely to push through legislation on issues such as climate change. If the past few years have taught us anything, it’s that while nothing is a given, nothing is fixed, either.

The same applies to the seas on which fossil fuels are shipped across the world. In June, Trump unleashed a tweeted torpedo at the Carter Doctrine when he questioned the U.S. Navy’s role in ensuring freedom of navigation, especially for oil tankers.

Homo hydrocarbon is largely a product of the American-led free-trading era after 1945. Absent the U.S. Navy policing sea lanes, it’s debatable whether oil-importing countries would have allowed themselves to rely on barrels shipped from the Middle East and other hot spots. Yellin’s supertanker is a product of this: a bulk-storage technology adopted after the 1956 Suez Crisis, making it economical to ship oil on longer routes avoiding such chokepoints. Yet these lumbering leviathans wouldn’t have been feasible without the implicit protection of American sea power.

Today, with its shale-inspired sense of energy dominance, the U.S. is rethinking this. China’s planners have taken notice of the potential change: It’s one rationale for Beijing’s pro-electric-vehicle industrial policy. Likewise, faced with the upheaval of the Arab Spring and collapse of Venezuela, oil producers such as Saudi Arabia are trying to remake themselves for a world where oil’s primacy and U.S. backing aren’t guaranteed.

Like the shadow that *The Bridge* may cast one day, darkness is gathering on the hydrocarbon horizon. There will always be those who doubt climate change, but their platform is literally burning. Even many fossil fuel producers have leapt to politically safer ground. The end of the dominance of hydrocarbons begins with the end of innocence about their hidden costs. The implications of this knowledge will only grow.

Hydrocarbons achieved their preeminence on the back of one overriding imperative: growth. Growth in wealth, living standards, and population. This is how the 20th century world was made, and it’s why we fretted about energy running out. It’s also why we could ignore the environmental and political costs of an energy system that wastes two-thirds of its input as heat.

Now we know that such growth, unchecked, will ultimately undo us. A central argument for fossil fuels’ continued dominance is that humanity will surpass 10 billion at some point, and all those people will want something like the Western living standards built over the past 100 years on the back of coal, gas, and oil. Yet what a poverty of imagination this betrays, especially in light of climate change, which hits the poorest hardest. How can that be the pinnacle of civilization? What even constitutes “higher living standards” in a world where the costs of our existing technologies are so transparent? Far from securing hydrocarbon dominance for another 100 years, the needs and aspirations of future generations demand it give way to something more sustainable. ●

Denning writes about energy for Bloomberg Opinion in New York. This column doesn’t necessarily reflect the opinion of Bloomberg LP and its owners.

WHAT IS AVAXHOME?

AVAXHOME-

the biggest Internet portal,
providing you various content:
brand new books, trending movies,
fresh magazines, hot games,
recent software, latest music releases.

Unlimited satisfaction one low price

Cheap constant access to piping hot media

Protect your downloadings from Big brother

Safer, than torrent-trackers

18 years of seamless operation and our users' satisfaction

All languages

Brand new content

One site



AVXLIVE **ICU**

AvaxHome - Your End Place

We have everything for all of your needs. Just open <https://avxlive.icu>



High-Powered



SWITZERLAND, endowed with the Alps and thousands of lakes, is a global leader in sustainability. Hydroelectric dams, such as the one shown here at Lac d'Emosson in southern Valais, have supplied most of the nation's electricity for about 50 years. That share will probably increase after voters in 2017 approved a law that will phase out nuclear plants and increase the use of renewable energy, including hydropower.

Lac d'Emosson, on the French border, had its first dam in 1925. The 590-foot arch dam standing today, completed in 1973, is part of one of Europe's biggest hydroelectric projects. Visitors can tour the structure and the archosaur tracks preserved at a geological site nearby. Here, the fossils are separate from the fuel.

For news on Swiss energy, type **{[TNI SWISS NRG <GO>](#)}**. To find news about hydroelectric power, run **{[NI HYDRO <GO>](#)}**. Type **{[BNEF <GO>](#)}** for the latest from BloombergNEF. —*Andy Hoffman*



At 820 feet, Mauvoisin is the second-tallest dam in Switzerland and the biggest arch dam in Europe. (Arch dams curve inward toward the water they contain.) More than 1,800 workers built it over a decade, finishing in 1958. The tunnels they used are open to tourists today.



Located in the Italian-speaking canton of Ticino, the Luzzone dam is best known for its exterior. The world's highest artificial climbing wall rises 541 feet and features more than 650 man-made holds. Fewer see the interior of the dam, completed in 1963, and its pop art palette.



Grande Dixence, 935 feet high, is the world's tallest gravity dam. Built by 3,000 men in the middle of the last century, today it's part of a complex of dams and reservoirs that produces enough electricity to power about half a million homes.

League Tables Show How Fast The Green Bond Market Is Growing

By JAMES BATTY

AN INCREASINGLY LARGE corner of the bond world is going green as investors rush to get exposure to debt that will be used for environmentally conscious purposes. A decade ago the green bond market consisted of a mere handful of deals totaling less than \$1 billion. Now it's raised more than \$100 billion for the third consecutive year.

What's driving that growth? One key: The money raised in green bond deals goes toward goals that are valued by both buyers and sellers, says Christopher Flensburg, head of climate and sustainable finance at Skandinaviska Enskilda Banken. "As long as there is a mutual appreciation between investors and issuers of the societal and market benefits of use-of-proceeds language, then the green and sustainable bond market will continue its rapid growth," he says.

TO FIND A TABLE of all corporate and government green bonds issued this year, type "league" in the command line and select the LEAG League Tables item in the autocomplete matches. Click on the white header that says All Official Bond & Note Tables, then choose Global Green Bonds – Corporate & Government. (Please note: This search doesn't include U.S. municipal green bonds or green mortgages.) The shortcut is **{LEAG@GLBGRNBD <GO>}**.

Click the gray History tab, change the Role to Issuer and the Period to Half Year. Comparing the first half of 2019 with the same period last year shows the market's growth. This year 319 issues totaling more than \$98.6 billion had been sold as of June 30. The number of deals in the first half of 2019 was 25% higher than last

year, and volume was 45% higher. The Top Party section of the screen shows the largest issuer: the Federal Republic of Germany. With three bonds totaling \$4.3 billion, Germany accounted for 4.4% of total volume in the first half.

Now click the gray League Table tab. This lists all issuers in the set period. Five of the top 10 issuers were governments. Of them, the German, French, and Hong Kong governments issued the most, with more than \$11 billion raised among them. SNCF Réseau, the infrastructure unit of France's state-owned rail operator, raised \$3.2 billion. Beijing-based Industrial & Commercial Bank of China raised \$2.9 billion; French energy company Engie, \$2.8 billion; the government of Chile, \$2.4 billion; and Poland, \$2.3 billion. Spanish power company Iberdrola, with \$1.7 billion, and German bank Landesbank Baden-Wuerttemberg, with \$1.6 billion, round out the top 10.

The prevalence of European corporate and government issuers means that more than half the period's total was euro-denominated. Click the Analysis tab, and change the Group By drop-down to Currency. The pie chart in the bottom right shows euros accounted for 51% of all issuance, followed by the dollar (22%), the Swedish krona (9%), and the Chinese renminbi (8%).

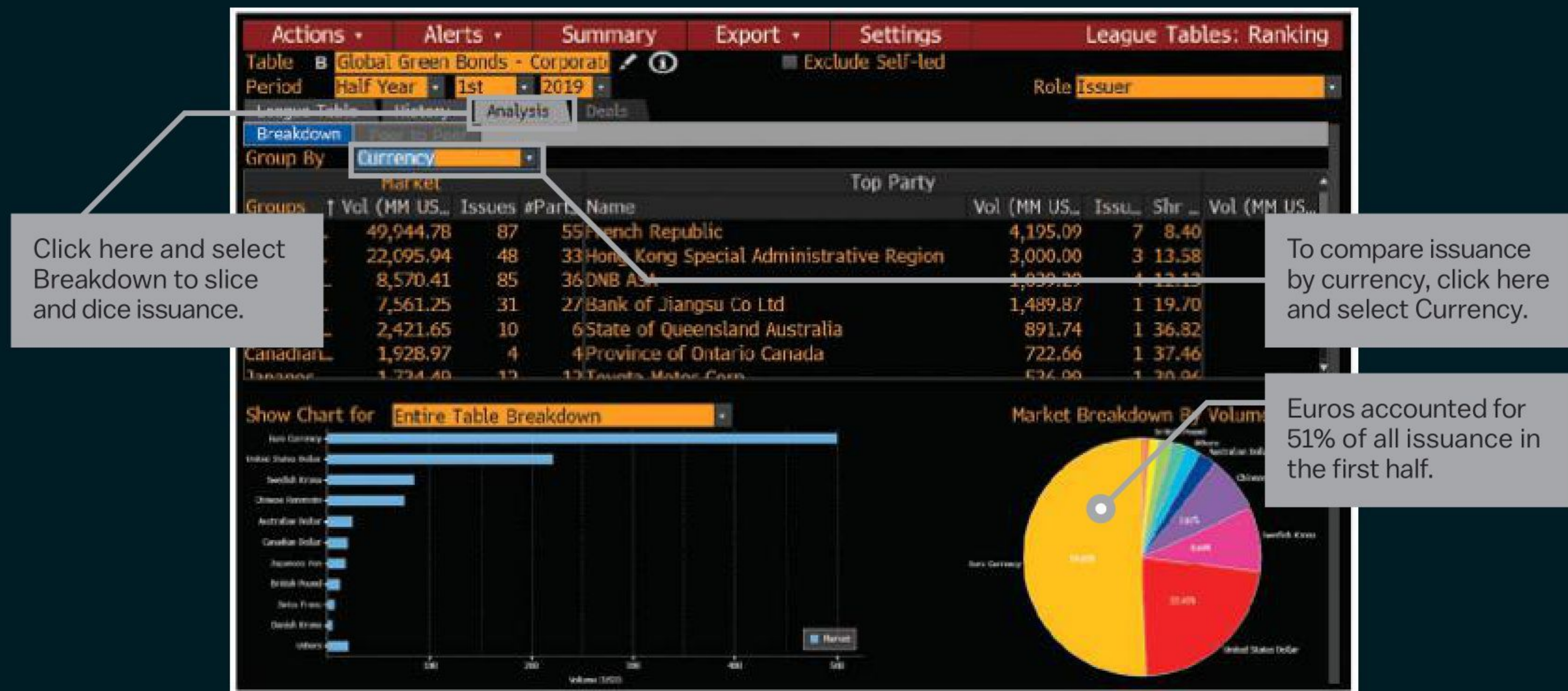
NEXT, SWITCH BACK to the League Table tab and change the Role to Manager. Crédit Agricole CIB was the top underwriter of green debt in the first half, working on a total volume of \$6.2 billion in 41 issues. HSBC, BNP Paribas, and Citi were the next largest.

The growth in the green bond market has been outpacing that of traditional credit issuance. While green bond volume jumped

Fig. 1 For league tables of global green bonds issued by corporations and governments, run `{LEAG @GLBGRNBD <GO>}`.



Fig. 2 The Analysis tab of LEAG lets you analyze the selected league table deals aggregated by sector, country of risk, currency, or rating.



45% in the first half, global sales of corporate bonds rose 7.6%, to a total \$1.3 trillion.

Investor demand for green bonds has spurred more companies to enter the hot market. That, in turn, has raised concerns among investors that some green bonds may not be truly green. To clarify, industry associations have developed sets of principles for green bonds. Run `{LEAG <GO>}` and click All Official Bond & Note Tables again. Then choose Global Green Bond Principles. Change the Role to Issuer, the Period to Half Year, and click the History tab. In the first half, \$79.7 billion of issuance would be classified as green bonds under the International Capital Market Association's Green Bond Principles. That's equivalent to about 80% of all green bonds issued in the period.

THE SUSTAINABLE FINANCE market, including green bonds and loans among other instruments, has come of age, according to BloombergNEF's lead analyst, Daniel Shurey. "What started off as a niche corner of clean energy financing has played a major role in the growth of environment, social, and governance investing," he says. To see BloombergNEF's analysis and forecasts for the sustainable finance market, type "BNEF" in the command line of a Bloomberg terminal and hit <GO>. Search for "green bonds" in the amber box to see all research on this corner of the debt market. Click the Sustainable Finance box in the Themes section. ●
—With Roberta Sgariglia and Jonathan Gardiner

Batty is a Functions for the Market editor in London.

Big Money Takes a New Approach to Climate Change Activism

By KELLY GILBLOM

PHOTOGRAPH BY FELICITY MCCABE

EARLIER THIS YEAR, one of Meryam Omi's deputies at Legal & General Investment Management sat down with board members and managers from Exxon Mobil Corp. to discuss how the oil giant could address climate change. LGIM, which manages about \$1.3 trillion, is one of Exxon's top 20 shareholders.

The Exxon delegation listened, but it didn't accept the suggestions, says Omi, LGIM's head of sustainability and responsible investment strategy. Around the same time, Exxon persuaded the U.S. Securities and Exchange Commission to block a shareholder resolution that pushed the oil giant to do more to address climate risks.

So, in June, London-based LGIM announced that it had dumped about \$300 million worth of its Exxon shares and would use its remaining stake to vote against the reappointment of Exxon Chairman and Chief Executive Officer Darren Woods. "There's got to be an escalation," Omi says.

As the risks of climate change have become more pronounced, so have efforts by major investment firms to push companies in greener directions. They tried talking. Then they started backing shareholder resolutions. Now, LGIM is at the forefront of a more aggressive, and controversial, tactic: divesting. "You cannot have the same conversation for 15 years with no results," Omi explains. (Exxon responded to LGIM's announcement by saying that it publishes an annual tally of emissions from its operations and is on track to meet targets for reducing methane emissions.)

Momentum is gathering, says Mark Lewis, who leads climate change investment research for Paris-based BNP Paribas Asset Management. He likens it to the divestment campaign that forced companies participating in apartheid-era South Africa to change course, and he invokes the spirit of Gandhi: "They've ignored us and laughed at us. I think now they're fighting us. So next we win."

But he knows it won't be easy. In March, as he helped the BNP Paribas press team put the finishing touches on an announcement that its actively managed funds would exit almost €1 billion (\$1.1 billion) of coal stocks as early as next year, he thought the news might cause a few "ripples" and not much more. In fact, Lewis was bombarded with emails and calls, not all of them polite. "It surprised me how big the reaction was," he says.

Lewis, who earlier in his career was a utilities analyst at Deutsche Bank AG and deputy head of investor relations for German power company E.ON SE, had formed close business relationships, even friendships, with coal executives. He says the decision to cut coal was painful, but ultimately he had to face the economics.

Demand for thermal coal, the kind used to generate electricity, is declining in much of the world as governments seek to cut carbon dioxide emissions. Some asset managers are deciding it's risky—for their clients and the planet—to keep shoveling capital into companies with environmentally unsustainable business strategies. This year almost every major public oil company faced at least one shareholder resolution about climate change. Those proposals won record support. (Michael R. Bloomberg, founder and majority owner of Bloomberg LP, in June launched an effort to phase out every U.S. coal-fired power plant by 2030.)

Most money managers prefer engagement to divestment, and funds designed to track indexes have no choice. Climate Action 100+, a group of money managers overseeing more than \$33 trillion, works to influence the largest corporate emitters of greenhouse gases. So far the organization has persuaded Royal Dutch Shell Plc to set short-term climate targets and publish a report on its lobbying of governments. Members backed a shareholder resolution that asked BP Plc to detail how each new capital investment aligns with the Paris Agreement adopted at the United Nations Framework Convention on Climate Change in 2015. That resolution, supported by BP's management, won the approval of 99% of shareholders in May. Mining company Glencore Plc has agreed to limit coal production.

Climate Action 100+ members "use this engagement, both the process and the outcomes, to inform their own voting and investment decisions," says Stephanie Maier, the director of responsible investment at HSBC Global Asset Management, who also serves as chairman of Climate Action 100+'s steering committee. "For certain investors this may ultimately include divestment, but that would only be when all other options have failed."

Climate activists say the awakening of the world's money to the perils of global warming is too little, too late. But for some people inside money management, the speed of change is hard to believe.

Omi



At LGIM, Nick Stansbury says he remembers the day in December 2016 when he was called into a meeting with about 25 of his fellow portfolio managers. Understanding the implications of climate change was going to become a priority, they were told.

Stansbury says he already had deep misgivings about the future of the oil market. Oil companies' value depends on investors believing that demand for crude will always grow. For 100 years, that belief had been justified. But if renewable energy sources gain market share and crude demand stutters, the market would go haywire, he says. That could trigger a huge re-rating of major oil companies—of which LGIM holds more than \$12 billion in shares. “It was a lightbulb moment,” he says.

He spent a year analyzing different parts of the energy market to try to draw some conclusions. But he knew his clients wanted more. On an airplane from Oslo to London in early 2018, staring at a blank piece of paper, he pondered how to build a comprehensive financial model. He'd need data (lots of it), a team of analysts, and months to work on it. He got what he needed. When the model ran for the first time in October, it took hours to go through its paces.

The results confirmed his fears: Tiny tweaks to government policies could cause oil demand to halve or to almost double by 2050. The crude market could become exceptionally volatile, and investors would probably start fleeing within the next five years. The model helped LGIM rank companies most at risk to climate change. “Uncertainty around the level of demand growth creates massive instability in the way oil markets work, and that has all sorts of implications for investors,” says Stansbury, who's now head of commodities research.

LGIM's Omi says this kind of rigorous analysis has persuaded big companies, typically resistant to change, to begin making serious strategic shifts. When LGIM divested some oil company stocks last year, she says, some of the fund managers protested, “These are really good stocks!” She replied, “I know they might be good stocks for you, but these are the rationales. This makes sense for our clients.” ●

Gilblom covers European oil companies for Bloomberg News in London.

Track Storms to See If They'll Hit Energy Assets and Supply Chains

By BOBBY SHACKELTON

Fig. 1 Run `{MAP <GO>}` and click on +Cyclones to track active cyclonic storms.



ON FRIDAY, JULY 12, Tropical Storm Barry was churning slowly northwest off the coast of Louisiana. It was a severe storm with sustained winds of more than 50 miles per hour. The U.S. National Hurricane Center issued a hurricane warning for a stretch of the Louisiana coast from Intracoastal City to Grand Isle, and the storm was expected to come ashore Saturday bringing heavy rains.

You can use the Bloomberg terminal to track cyclonic storms such as Barry around the world and see what's in their path. Type "map" on the command line of the Bloomberg screen and click on the MAP Custom Map match. The shortcut is `{MAP <GO>}`. Next,

under Suggested Data, click on the +Cyclones item (**FIG. 1**).

Are any energy assets in jeopardy? In the menu of Suggested Data on the right side of the screen, click on Oil and then tick the box next to Refineries. As of July 12, a number of refineries were in the expected path of Barry. How about oil and gas platforms in the Gulf of Mexico? Energy companies had cut 53% of oil output in the Gulf, according to news reports. Under Oil, tick the box next to Platforms (Gulf of Mex.). As you can see, Barry was heading right for an area of the Gulf that's densely populated with platforms.

What about ships? Use the scroll bar to navigate to Vessels

Fig. 2 To set an alert that will notify you of companies whose supply chains may be affected by storms, click on the Actions button on the red toolbar in **{MAP <GO>}** and select Alerts. Click on Sample Alerts and then subscribe to the Cyclone Impact on Factories alert.



Fig. 3 When you get an alert, click on the **{MAP <GO>}** link to analyze facilities in the storm's path.



in the list of Suggested Data and click on it. Click on the pencil icon to the right of Type to select tankers if that's not already selected. There was a lot of ship traffic in the area. To see which vessels are in the forecast path of the storm, use the scroll bar to move back to the top of the Map Content panel and then tick the box to the left of Show Assets in Path Only. For more detailed information on those ships, click on the Table button in the upper left of the screen.

To be alerted about factories and warehouses in the path of major storms, click on the Actions button on the red toolbar and select Alerts. In the Map Alerts page that appears, select the

Sample Alerts tab and click the Subscribe button for the Cyclone Impact on Factories. Once you subscribe to map alerts, you can specify how you want to be notified: pop-up, audio alert, or message (FIG. 2). When you get such an alert, click the Map About This Alert link to display a map of the factories and warehouses that may be affected by the storm (FIG. 3). Use the information to explore the potential impact on the supply chains of companies you follow. ●

Shackelton is geospatial business manager at Bloomberg in New York.

Fish Farms Are Now Hosting Almost 9% of China's Solar Power Panels

By JAMES BATTY

PHOTOGRAPHS BY BILLY H.C. KWOK

Workers at a solar farm outside Yueyang City on July 2. Panels are installed at a height that allows fishery vessels to pass underneath.



LOOK CLOSELY AT CHINA'S solar power market and you might come across something a little, well, fishy.

Fish farm solar plants represent almost 9% of the 135.7 gigawatts of sun-power capacity installed across the country, according to BloombergNEF's database. And, no, these aren't pools of cod with photovoltaic fins. A large number of these are banks of floating or fixed solar panels positioned over water where fish are farmed.

Land constraints are the main driver for this growing market. China may not be short of land overall, but near cities, which require the most electricity, there is a shortage of suitable space for solar installations. A solar plant needs roughly 2 hectares (5 acres) of land to generate a megawatt of power, so generating substantial power requires a lot of space. And China is the world's biggest farmer of fish, according to the Food and Agriculture Organization of the United Nations, with a lot of facilities located close to major cities.

To see where these fish farm power plants are, type "maps" in the command line of a Bloomberg terminal screen and hit <GO>. Click on Datasets and type "power" into the amber box. Tick the box next to pwr_plants Global Power Plants near the bottom of the search results and click the Open in Map button.

This will load all power plants globally. To drill down to fish farm plants, first click Clear Selection to the right of Status and then tick only the Operational box. Then click +Add Filter below the amber box at the bottom of the sidebar screen. Choose Name

from the drop-down and type "fish farm" in the amber box that appears. Click the Apply button. Next, make sure to change the drop-down next to the filter to Contains, to capture all plants that contain "Fish Farm" in their name.

Once the map loads, zoom in on China, where almost all such plants tracked by Bloomberg are located. Zoom further to just south of Shanghai and click on the plant near Cixi in Zhejiang province. The 100MW Cixi Fengling New Energy Ningbo Cixi Fish Farm PV Plant I is one of the nation's largest.

In addition to saving space, there are other benefits to combining solar plants with fish farms. "Due to environmental concerns and cost pressure, fish farmers are naturally looking at alternatives" to traditional energy sources, says Céline Paton, a senior financial analyst at the Solar Energy Research Institute of Singapore. "An obvious one is to look at distributed solar PV systems"—combined with batteries.

Fish farms require energy and often have to use polluting diesel generators to cope with their power demands. Solar panels can provide the power without any emissions, while also giving shade to the pool of water underneath, improving the environment for successful fish rearing. Another benefit is that solar panels positioned over water can be as much as 10% more efficient than ground-based panels because the water helps keep them cool, according to BNEF calculations. ▶

The project, developed by GCL New Energy Holdings and with a capacity of 100MW in its first phase, is located in a lake near the Hunan province city.



Fig. 1 To map fish farm power plants, go to **{MAPS <GO>}**. Click on Datasets, search for “power,” and select pwr_plants Global Power Plants in the results. Click on the Open In Map button.

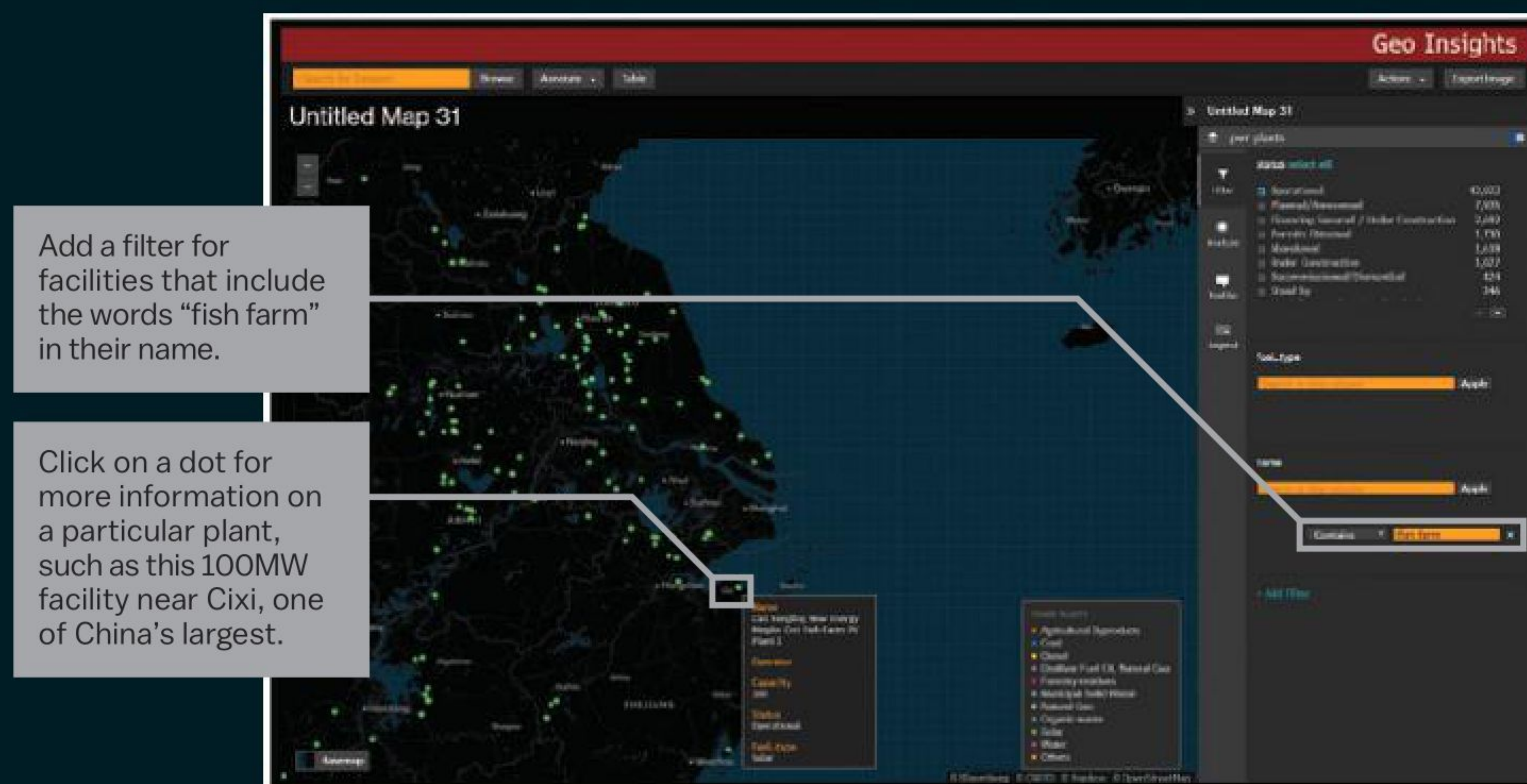


Fig. 2 Run **{BNEF <GO>}** and click on the BNEF website link. (You may need to get permission for this function.)



To see more details about these projects, type “bnef” into the command line and hit <GO>. Then click on the BNEF Website option. (You may need special permission for this.) Hover over Companies & Assets at the top of the page and choose Renewable Assets. Type “fish farm” (including the quotation marks) into the search bar and click on the Search button. Then choose the Advanced Filters button in the top right, tick Commissioned in the status section, and hit Apply Filters.

The List View tab shows individual plants. As of July 26, it included 365 facilities, ranging from 200MW down to 1MW. Their total capacity was 12GW.

China is not the only place where these types of projects have been built—there are similar developments in the Netherlands, Norway, and Taiwan—but there are far more solar fish farms in

China than in any other country. Beijing’s promotion of new solar technologies through a subsidy called Top Runner may be part of the reason for the large number of projects, says Jenny Chase, head of solar analysis at BNEF. “This application of solar technology to fish farming is a relatively new phenomenon, and there is still work to be done in figuring out how best to combine the two disciplines,” she adds. “How much shade is optimal to grow different species of fish in different climates, for example?”

The continuing drop in the cost of photovoltaic panels, a need for clean power near major centers of demand, and innovative ideas will ensure fish farms aren’t the last unconventional iteration of solar power. ●

Batty is a Functions for the Market editor at Bloomberg in London.

Here's an Easy Way to Report on What's Happening With Your Portfolio

By CONSTANTIN COSEREANU

Fig. 1 To generate an instant report on your tickerized portfolio, run `{AID <GO>}` for the Automated Intelligence on Demand function. (To be enabled to create and analyze tickerized portfolios, contact your Bloomberg representative.)



“HOW’M I DOING?” The late New York City Mayor Ed Koch practically trademarked that question. Yet you may also be interested in that line of self-interrogation—especially if you invest or manage other people’s money.

Here’s an easy way to find out: Use the Automated Intelligence on Demand (AID) function to generate an instant, detailed report on what’s happening with your portfolio. AID provides a snapshot of key information about a selected stock, equity index, or currency. Now you can use it to generate a report on your portfolio as well. The key is that you need to tickerize your portfolio—in effect, treating it as an index. (To be enabled for portfolio tickerization, contact your Bloomberg representative.)

To run the report, simply load the ticker and `<Index>` and run `{AID <GO>}`, or click on the yellow AID icon in the quote line (**FIG. 1**). Let’s say you run the report in the morning. It will provide your portfolio’s performance in the last session, how that compares with its benchmark, the portfolio’s market value, and its 52-week

high and low. The report will display a table of your total return and performance relative to your benchmark for one day, month to date, year to date, and one year.

In addition, it will generate a list of portfolio highlights, telling you how key valuation and risk metrics have evolved. Tables show the portfolio’s biggest equity gainers and losers over one day and other key time frames. Finally, at the bottom, you’ll find headlines of news stories about the day’s movers.

Once you’ve generated a report, you can share it with clients and colleagues. They might want to know how you’re doing, too. Click on the Save as Note button on the red toolbar to save and share with your community. Or click on the Send button to send it as a message you can customize by highlighting key data and adding charts or headlines and your own notes or observations. ●

—*With Kenneth Kohn*

Cosereanu is a portfolio and risk specialist at Bloomberg in New York.

Find Relative Value in the Energy Sector

By STEVEN GEE and KELLY MORAN

WHAT'S CHEAP IN ENERGY BONDS? Fixed Income Worksheet (FIW) is the most robust tool on the Bloomberg terminal for performing relative value analysis on a list of bonds. Let's examine how you can compare energy with other sectors and then take a deeper dive to understand how individual issues trade relative to one another.

A word of advice: Maintain focus lists of credits that interest you in discrete portfolios, lists, or monitors. That will enable you to simply and efficiently load those bonds into other Bloomberg functions so you can be more effective in your analysis.

(This article continues a series that began with "Using the Fixed Income Worksheet in Your Analysis: An Introduction." To see that intro, load bloom.bg/2MwwQdp in your browser.)

1. First, run **{FIW <GO>}**. Click into the field in the upper left corner of the screen and use autocomplete to choose from indexes, portfolios, RUNZ workbooks, searches, IMGR searches, monitors, and security workbooks, as well as exchange-traded funds or other funds. Let's use the Bloomberg Barclays US Aggregate Statistics Index in this analysis. Enter "US Agg Statistics" in the

field, and click on the LBUSSTAT Index item in the list of matches.

The Facets panel on the left side of the screen lets you specify criteria to drill down to the bonds that interest you. First, under Asset Class, select Corporates and unselect Governments and anything else that may be checked.

Next, let's focus on energy and compare that with communications and technology, for example. Under BCLASS Level 3, click on More ... and select those three sectors. Then click Update.

Finally, let's restrict this analysis to larger issues, those whose original size was more than \$300 million. Scroll down to Amount/Issue and click on the pencil icon next to it. In the Edit Amount Bucket window, enter "300" in the first field below To. Then click on the red Xs below that line until you're left with two buckets: less than or equal to 300MM and greater than 300MM. Click on Update and select >300MM.

As of late July these criteria trimmed the 10,663 bonds in the index down to a list of 1,321. Click on the Bond Chart tab (**FIG. 1**). This offers you a visual perspective of issuers' bonds, their average G-spread, and years to maturity. From this view, you can easily find which issuers are trading wider than others.

Fig. 1 Run **{FIW <GO>}** for the Fixed Income Worksheet function.



2. To use FIW's robust filters to analyze these bonds based on their sectors, select the Group By drop-down and choose BCLASS Level 4 Classification Name. Now the broader energy, communications, and technology groups will be broken down further. Right-click on the background of the chart and select Collapse All Groups. Using the Axes drop-downs, select G-Spread as the Y axis and Years to Maturity as the X. (G-spread is the spread to the matched point on the government curve.)

Note that the Midstream Group, Independent Group, Oil Field Services Group, and Refining Group were at the wider range of the G-spread scale as of late July, compared with the other sectors (FIG. 2).

Given the trade war and soft energy markets, midstream energy companies may merit further analysis. The U.S.'s growing exports of liquefied natural gas may be positive for midstream energy companies, especially the ones servicing LNG facilities: If you own the LNG pipelines leading into the transportation hubs while exports are booming, you should be OK. Midstream investment-grade credits are typically rated BBB. They trade wider than the rest of the investment-grade energy sector but are firmly entrenched in the lower rungs of the IG ratings spectrum. By contrast, high-yield midstream companies generally trade at tighter spreads compared with other HY energy credits, thanks to lower earnings and credit volatility.

Fig. 2 Here we've further broken down the energy, communications, and tech sectors.



3. Looking back over the past several months allows you to gauge the journey these issuers have been on. Supplement your FIW workflow by analyzing the change in spreads or other metrics. To do that, click on the Y-axis drop-down again and select More ... In the Customize Spread window that appears, select G-Spread, Change,

and over the past 6 months. Hit Close. The four energy sectors were tighter on average as of late July. Midstream was 29 basis points tighter. To display the individual bonds in the Midstream Group, hover over the blue plus sign, right-click, and select Expand Group. Use the zoom tool to focus on bonds of up to, say, 30 years (FIG. 3).

Fig. 3 Expanding the Midstream Group lets you see how individual bonds have traded over the past six months.



4. Explore the wide divergence between the Buckeye Partners LP and Kinder Morgan Inc. bonds further by performing spread analysis on them. From the chart, you can see that the BPL 4.125s have around eight years remaining to maturity. The KMI 7.75s have about 12.5 years to maturity. Select one of the bonds by clicking on its dot

in the chart so a white circle envelops it. Press the Ctrl and Shift keys and click on the other bond so that white circles it, too. Then right-click anywhere on your bond chart, select Two Bond Historical Spread Analysis, and click on HS Spread Chart to analyze the two bonds in the Spread Analysis (HS) function in a child window (FIG. 4).

Fig. 4 Selecting two bonds in the FIW chart enables you to perform two-security analysis such as charting the bonds' historical spread.

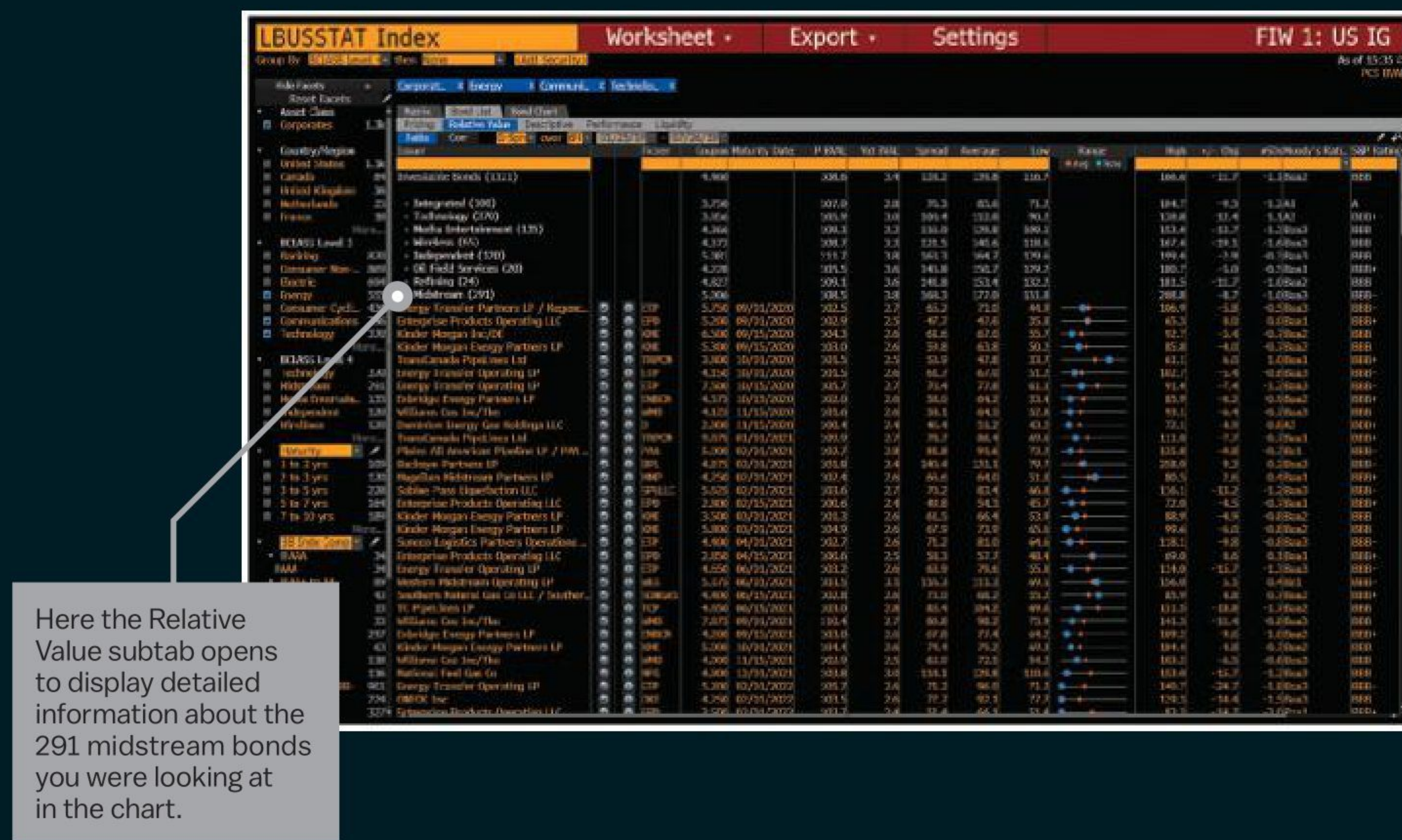


The difference in the spreads of these two bonds blew out starting in May.

The bonds were 150 basis points off average, 2.3 standard deviations from the mean.

5. The way FIW works across relative value tools is interactive. In this case we've expanded the midstream category in our chart. Now, to see more detail on those bonds in a list, click on the Bond List tab and then on the Relative Value subtab (FIG. 5).

Fig. 5 Click on the Bond List tab, and the securities you've been charting will be loaded on the page.



Here the Relative Value subtab opens to display detailed information about the 291 midstream bonds you were looking at in the chart.

Geie is a fixed-income market specialist and Moran is an advanced specialist at Bloomberg in New York.

Bloomberg Equality Summit

Data driven. Designed for action.

October 15, 2019 | Mumbai

Inequality remains one of the most pressing problems of our time. Economically, socially, culturally, digitally, the chasm is wide. Many countries have skewed gender ratios, the gap between the rich and the poor remains wide, caste and class remain dangerous fault lines.

Businesses need to face this ethical issue head-on. Creating and maintaining a diverse and inclusive workforce - to serve an increasingly diverse consumer base - is vital to the success of virtually every business operating today. At this pivotal time in our history, we have an opportunity to get it right.

Anchored in a full-day conference, Bloomberg Equality Summit will foster forward-looking conversations and spotlight influential business leaders who are paving the way for a more equal future.

Speakers include:

Peter Betzel
CEO, IKEA India

Rajnish Kumar
Chairman, State Bank of India

Bo Young Lee
Chief Diversity & Inclusion Officer, Uber

Reshma Qureshi
Author of *Being Reshma*

Request an invitation:
bloomberglive.com

Global Founding Sponsor:



Lead Sponsor:



Supporting Sponsor:



For Really Uncorrelated Returns, Try Investing in a Ghana Power Station

By JAMES CROMBIE

PHOTOGRAPH BY FINN TAYLOR

INVESTING IN AFRICAN POWER plants can boost returns, provide a hedge against global market shocks, and help lift people out of poverty, says Jerome Booth. The chairman of London-based New Sparta Asset Management Ltd. takes it a step further: For investors, not having such assets in a portfolio is “irresponsible,” he says.

Booth has strong opinions about emerging markets. An economist, he was part of the management group that in 1999 established Ashmore Group Plc, an emerging-markets-focused investment manager in London that now oversees \$92 billion. After retiring from Ashmore in 2013, Booth started New Sparta, wrote *Emerging Markets in an Upside Down World: Challenging Perceptions in Asset Allocation and Investment* (Wiley, 2014), and was appointed chairman of Anglia Ruskin University’s board of governors.

He personally invested about \$10 million in developing a power plant in Northern Ghana, alongside Erling Lorentzen, founder of Brazilian forest products producer Aracruz Celulose SA. That project has spent \$70 million on a forest of eucalyptus trees to provide biomass fuel and now awaits a so-called put and call option agreement, which is economically equivalent to a government guarantee, according to Booth. Once that’s in hand, the plant’s owners plan to raise up to \$350 million in financing, mostly debt, to get to production.

JAMES CROMBIE: Why are you investing in African power?

JEROME BOOTH: Energy is the biggest bottleneck to economic development in Africa. Investing in emerging markets—including in illiquid things like power stations—is a way to not just increase returns and diversify your portfolio, it’s a way fundamentally to reduce risk. If you don’t do it, you’re actually concentrating your portfolio in a highly risky way, which is imprudent and irresponsible.

I’ve got a significant investment in Ghana, and I wouldn’t be doing it if I didn’t think it was suitably important. I’m not investing just for the return. I’m also trying to send a message that this is the sort of thing that people should consider investing in.

The point of investing in emerging markets is that you get your cake and eat it. You get to exploit the fact that there’s a mispricing of risk. If the world blows up, Africa will still want power. Long term, it is immune to changes in consumer fads, the terms of trade, and other factors.

JC: What’s the project?

JB: The African Plantation for Sustainable Development. It’s a standard thermal-power plant with 67 megawatts of generating capacity, and the total investment is \$420 million. Once the forest is there and you’ve built all the roads and the infrastructure, marginal costs in the future are very low. If you scale up and build a second power station next to it, they go even lower. There’s huge economies of scale if this were to expand across West Africa.

JC: What do you expect to make on it?

JB: Returns could be 20%-ish, depending on whether you want to go through the build phase and sell, or just use it as an income stream for 20 years when it’s producing power.

JC: Isn’t there still a lot of risk in Ghana?

JB: There’s political risk everywhere. The difference between an emerging market and a so-called developed country is that in the emerging markets, the risk is perceived and priced in—sometimes overpriced.

JC: How does African power fit into a portfolio?

JB: You just can’t think of one type of risk. Obsessive concentration on past volatility of liquid prices is a distraction from a lot



of the really big risks, which are structural. There are lots of potential scenarios out there where there are highly correlated losses in developed world markets. There's an argument for investing in countries that are a little less connected, a little less levered, and with less bubblelike financial conditions.

JC: What's the appeal of emerging markets?

JB: They are growing strongly, there's not anything like as much financial sector development, and they're capital scarce. There are domestic demands, which aren't going away, driven by population growth. Scenario planning, if taken seriously, would lead most investors to invest much more in emerging markets. I'm not talking about putting 5% into emerging markets. I'm talking about putting half.

JC: How would you deploy that big increase in allocations?

JB: Invest in everything, and within that, make sure you have quite a good chunk which is not liquid, that is infrastructure, domestic-demand related. Do invest in stuff which is pre-IPO. A lot of these economies don't have huge stock markets. That doesn't mean they don't have firms or economic activity. A lot of these companies only list when they've made it—the big gains are before that.

JC: Why are emerging markets a hedge?

JB: The risks you care about most should be the ones that lead to large, permanent loss across a huge swath of your portfolio. Those very risks are best insured against through investing in emerging markets. We're going to see more pools of domestic savings getting into massive deficits. They've been putting far too much of their portfolios in their own domestic markets and other Western markets for far too long. If they'd been invested 30% in emerging markets for the last 20 years, they wouldn't be in deficit.

If you have a large pension fund and you don't have a

significant amount in emerging markets—and within that in nonliquid assets, infrastructure, and the like—you are missing an opportunity to add overall return and reduce risk. A pension fund with 15-year duration shouldn't be interested in volatility. The only risks they should really be focused on are large permanent losses.

If you look at productivity, growth, and economic activity, emerging markets get less and less risky every year, and they've been doing that now for several decades. Using PPP [purchasing power parity], they are now coming up for two-thirds of the global economy. They are 85% of global growth, they're not that levered, most of them are reasonably well run.

JC: Do you expect global markets to blow up?

JB: There is going to be a crisis, which is then going to create the political will to really clean up moral hazard in the financial sector. The issue where crisis happens and the taxpayer bails them out—that's got to stop.

JC: What's the trigger?

JB: There are a number of scenarios, including another '08-'09 financial crisis, but much more likely is a return to an inflationary environment. A lot of people are secretly much more worried now about inflation taking off rather suddenly as the yield curve inverts, governments find it difficult to finance themselves, and people's perception of long-term risk changes dramatically. Because of the amount of bond issuance out there, you could go from 30-year bonds with negative yields to 30-year bonds in double-digit yields very quickly. You need only one major economy to go down the inflationary route, and then everyone else's eyes will be opened. ●

Crombie is a senior editor at Bloomberg News in New York.

Bills of Lading Show How Tariffs Are Changing the Solar Industry

By JENNY CHASE and SUHYUNG SAGE

Fig. 1 For bill of lading data that lets you track the movement of cargo between the U.S. and other countries, go to [{AHOY USBOL <GO>}](#).



THE U.S.-CHINA TRADE WAR has changed the solar industry. Among other things, additional tariffs on Chinese-made panels caused buyers to source photovoltaic modules from factories in Malaysia, South Korea, and Vietnam instead of China.

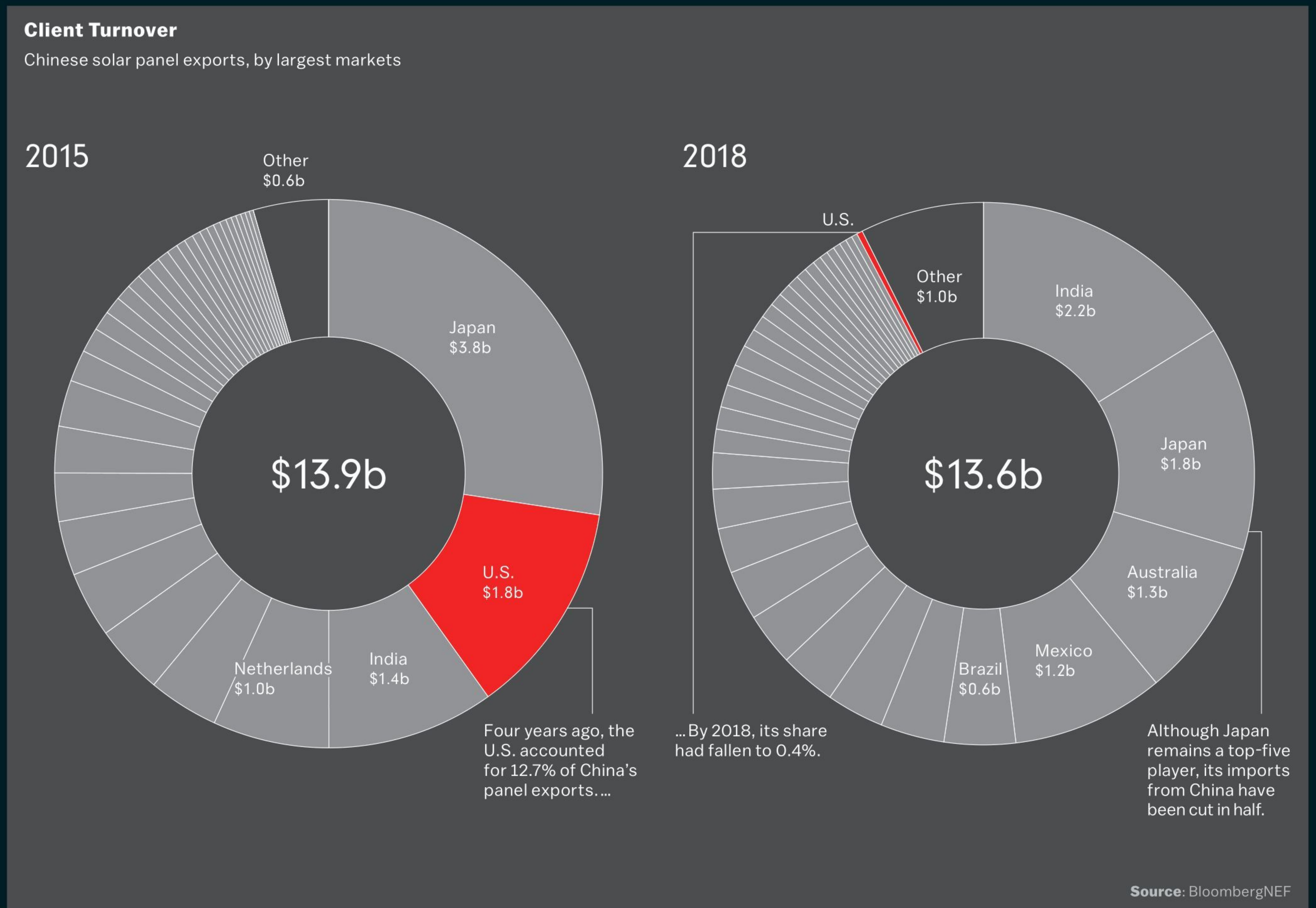
To track the effects of trade disputes on U.S. imports of solar panels, you can use new bill of lading data provided by IHS Markit on the Global Commodities Trade Flows (AHOY) function.

Bills of lading are legal documents for goods transported by ship. They include a description of the goods, their estimated value, and the shipper's name and address among other information. U.S. Customs and Border Protection collects and manages bill of lading data, which is usually available with less lag than U.S. Census Bureau or Department of Energy trade information. Bills of lading, however, typically don't include standardized

classifications of the goods they cover. So to enable aggregation of the data, vendor IHS Markit maps the descriptions in individual bills of lading to the Harmonized System, an international commodity classification system that uses six-digit HS codes to identify goods.

To dig into this data, run [{AHOY <GO>}](#) and click on the US BOL tab. The shortcut is [{AHOY USBOL <GO>}](#). For a sample view that shows U.S. imports of solar panels from China, click the Views drop-down button on the red toolbar, select USBOL Samples, and click on US PV (Solar Panel) Import from China in US Dollars (**FIG. 1**). The Export button on the red toolbar lets you see all the data in Excel.

In 2015, U.S. imports of solar panels from China averaged \$148 million a month, and China accounted for 41% of total imports

Fig. 2

into the U.S. Last year the figure had dropped to \$31 million a month on average, and China accounted for only 11% of total U.S. imports.

The total dollar amount of U.S. solar imports has decreased in the past few years, mainly because the price of solar cells and modules fell faster than installed volumes rose. The average price of a watt (a unit of output) of solar module imported to the U.S. halved from about 53¢ in 2015 to 26¢ in 2018. That excludes tariffs, which are not reported in the import data.

IN A SURPRISE CHANGE on June 12, the Office of the U.S. Trade Representative announced that modules with a special bifacial design that captures light on both sides of the panel would be exempt from tariffs, provided they don't come from China. This will speed up factory retooling for bifacial technology adoption in the factories of Southeast Asia and increase U.S. solar imports from these countries.

Solar factories in Malaysia and Vietnam have already benefited from the trade tariffs. Malaysia's share of the U.S. market rose to 32% this year, from 27% in 2017. Similarly, Vietnam's portion increased to 28%, from 15%.

U.S.-based First Solar Inc., the only company making cadmium telluride technology, has factories in both Malaysia and Vietnam. So the Tempe, Ariz.-headquartered company, whose modules are not covered under the measures the U.S. has put in

place to discourage imports, is contributing to the trend of rising imports from the two Southeast Asian countries.

Many major Chinese companies, such as Longi Green Energy Technology, JinkoSolar Holding, Trina Solar, and Zhejiang Chint Electrics (which sells under the brand names Chint and Astronergy), have factories in these two countries.

CHINA'S SOLAR INDUSTRY, meanwhile, powers along. Total exports from mainland solar factories have suffered little from the U.S. trade tariffs, according to Chinese customs data collected by data provider Sinoimex. The U.S. is no longer among the top 20 markets for Chinese solar exports (**FIG. 2**). Fast-growing solar industries in India, the Netherlands, South Korea, Ukraine, and other countries are more important to Chinese solar companies such as JinkoSolar, Trina Solar, and Wuxi Suntech Power.

BloombergNEF now tracks solar markets in 121 countries. By comparison, a decade ago only a handful of nations had significant policies driving solar build-out. The change is mainly a reflection of solar's increasing competitiveness with fossil fuels, creating unsubsidized demand for solar modules and encouraging governments and utilities to include solar in their plans for future power generation. ●

Chase is head of solar analysis at BloombergNEF in Zurich. Sage is a product manager for oil and shipping at Bloomberg in New York.

Answer Your Questions About The Oil Patch With These Functions

By ZEF LOKHANDWALLA

WHAT'S GOING ON IN the energy industry?

Oil prices this year have been mostly in the \$50 range, roughly half their level before the 2014 oil price crash. The Permian Basin in the U.S. is now producing more than 4 billion barrels per day, almost three times its production in 2013, before the shale revolution, according to BloombergNEF estimates. U.S. exports are rising. To track them, run **{AHOY USBOL <GO>}**, click on the Views button, select USBOL Samples, and then US Crude Exports in Metric Tons. Meanwhile, the Trump administration has been applying a policy of maximum pressure on Iran to cut the country's oil exports, and tensions in the region have been ratcheting up.

How are all these threads affecting industry consolidation, supply, and investment? Here are some Bloomberg functions you can use to find out.

1. How much consolidation is taking place in the oil and gas industry?

For an overview of deal activity, go to **{MA <GO>}** for the Mergers & Acquisitions function. To see oil and gas deals, use the scroll bar in the Industry Breakdown section of the screen to navigate to Energy. Click on Energy, and then on Oil&Gas. As the Date Range, select Year-to-Date. To omit terminated or withdrawn deals, click on the Settings button on the red toolbar and untick Withdrawn and Terminated next to Deal Status. Click on the Close button (**FIG. 1**).

This year, M&A in the Oil & Gas sector was running at a faster pace than last year. Through July 17, global deals totaled \$134 billion, an increase of 25.5% from the same period last year. In North America, M&A was \$95 billion, up 19%. Larger deals, such as Occidental Petroleum Corp.'s \$55 billion takeover of Anadarko Petroleum Corp., grab the headlines. Yet plenty of smaller deals have been happening, too.

2. How important is Iran to the global oil market?

In April, the Trump administration announced it would not renew exemptions that allowed countries such as China and India to import Iranian oil despite U.S. sanctions. The aim was to bring Iran's exports to zero, the White House said in a statement.

You can track oil exports from Iran by running **{LINE <GO>}** for the Global Commodity Flows function. Click on the Browse button, and then on Oil to select Crude Oil Trade Flows. Click the Close button (**FIG. 2**). Iran's crude exports were running at a rate of 400,000 barrels a day in June, according to Bloomberg estimates. By contrast, the

high earlier this year was 1.4 million barrels a day in March. For a detailed worksheet of data on Iranian oil, click on the gray Iran hub.

So who's filling the shortfall? Saudi Arabia has more than enough capacity to replace both light and heavy barrels from Iran, and the country has announced it would step in. Yet Saudi total exports were also down in June, at 6.8 million barrels per day on average.

3. How are price levels and production affecting industry investment?

Investment is shifting from finding oil to getting it to market. You can see that in a comparison of the aggregate debt levels of U.S. oil and gas exploration companies and that of midstream companies, the ones that provide pipelines and other transportation.

For a snapshot of the aggregate debt of different sectors of the U.S. energy industry, go to **{SRCH <GO>}** for the Fixed Income Search function. First, click on Asset Classes and select Corporates, Loans (Tranches), Loans (Deals), and Preferreds, and untick any other asset classes. Click on Consolidate Duplicate Bonds and then on Close. To specify a date, enter it in the "As of" field. Next, tab into the amber field, enter "exploration," and click on the matching BICS Classification item to limit the search to debt issued by companies classified as E&P. Finally, enter "domicile" in the field and select Country of Domicile. Enter "US" and select the match. Click on the Results button. On the results page, click on Settings and select Edit Statistics. Tick the box next to Sum and click Close (**FIG. 3**).

As of the end of last year, the aggregate debt of E&P companies was \$277 billion. That was \$29 billion less than it had been a year before. By contrast, the debt of U.S. companies classified as midstream (using the BCLASS Classification) was \$396 billion at the end of 2018, which was an increase of \$48 billion from 2017.

In addition, you can see this trend in Bloomberg Intelligence's capital expenditure data. Run **{BI INTO CAPEX <GO>}** for the Integrated Oils Dashboard. Capex at integrated oil companies increased 8%, to a consensus estimate for 2019 of \$211 billion, from \$196 billion in 2018. At North American E&P companies, it dropped 10%, to \$80 billion, from \$89 billion.

The oil majors have become the biggest producers in the prolific Permian shale basin in West Texas, whereas the growth rate of E&P companies' production is slowing. The majors have been gaining market share. ●

Lokhandwalla is an energy market specialist at Bloomberg in New York.

Fig. 1 To track oil and gas deals, run {MA <GO>}. In the Industry Breakdown section of the screen, click on Energy and then on Oil&Gas.



Fig. 2 Run {LINE <GO>} for the Global Commodity Flows function. Click on Browse and then on Oil to select Crude Oil Trade Flows.

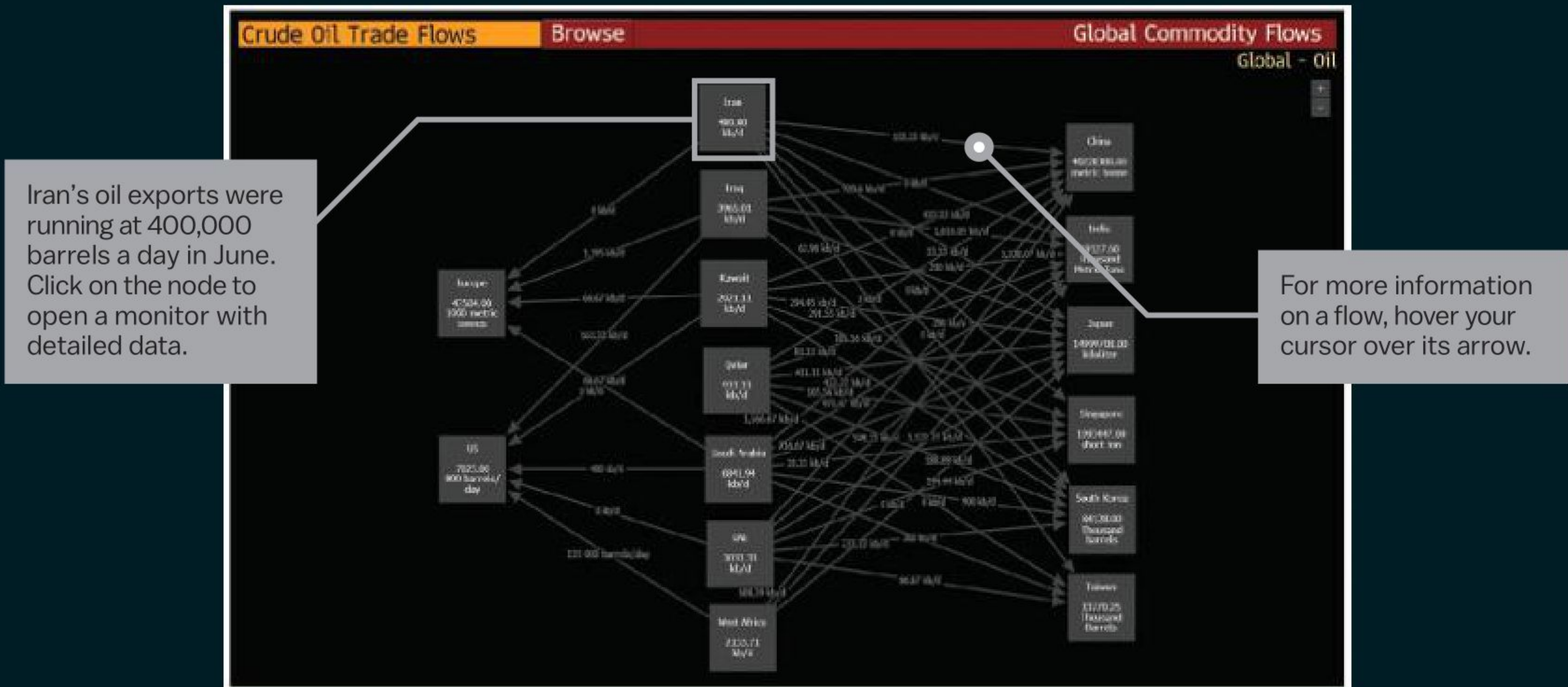


Fig. 3 Go to {SRCH <GO>} to find data on aggregated debt for companies in a sector such as exploration and production or midstream.



How Nancy Pfund Became A Cleantech Guru

By BRIAN ECKHOUSE

PHOTOGRAPH BY CHRISTIE HEMM KLOK

NANCY PFUND HAS BEEN turning ideas into businesses for most of her life. Soldering wires with her inventor father instilled an affinity for entrepreneurs that drew her to venture capital. Pfund made early investments in companies such as Elon Musk's Tesla Inc. and in 2008 spun off a "double-bottom-line" fund—focusing on both profits and social impact—from JPMorgan Chase & Co. San Francisco-based DBL Partners, where Pfund is co-founder and managing partner, has raised a total of \$750 million across four investment pools. Here, Pfund, 63, describes what she's learned and where she's investing now.

BRIAN ECKHOUSE: How did you find your way to venture capital?

NANCY PFUND: I didn't know what venture capital was when I was in college. I was very interested in innovation and policy and tech. I worked at Intel for a few years after business school and then moved to San Francisco. There weren't any tech companies there back then, which is hard to believe, but there were a few VCs and investment banks that were funding tech companies. I joined Hambrecht & Quist in 1984 as a securities analyst. But I switched a few years later to venture capital after realizing that I was much more interested in private companies than public stocks.

BE: What drew you to cleantech and policy?

NP: Well, my father was a patent attorney and an inventor. My mother was very involved in campaigns and policy. While in college at Stanford, I was part of a student group to identify whether gas prices were transparent. My first job out of college was with the Sierra Club, and I worked with Stanford Medical School on biotech policy. So it's always been in my DNA, kind of that intersection of where technology, innovation, and the environment meet policy.

BE: What did your father invent?

NP: He invented things that our family needed. Our car got stolen when I was in third grade. And so, long before antitheft devices were anywhere near cars, he invented something called a Stop Thief, which had three buttons that you wired to the steering wheel. If you didn't have the right combination of those buttons, the horn would go off. I have four sisters, and we handled marketing and manufacturing. We were soldering wires together in the basement for this product.

BE: How did you get your start in venture capital at H&Q? [H&Q was acquired by Chase Manhattan Corp. in 1999. Chase became JPMorgan Chase in early 2001.]

NP: Long before we went public and long before we were

acquired, H&Q had a very small fund that looked at environmental issues at our founder Bill Hambrecht's behest. We were the first investor in Odwalla [the juice company] when sustainability wasn't in anyone's vocabulary. It wasn't just an investment success. It created jobs. It made an environmental improvement.

BE: How did the idea of a double-bottom-line impact fund come about?

NP: The tech and dot-com booms created a lot of prosperity but didn't help the poor neighborhoods of the Bay Area. Community groups went to a business association called the Bay Area Council and said, "Look, all this wealth is not helping our neighborhood. Do something about it." The Bay Area Council started a venture capital fund to invest in interesting young companies—but one that paid attention to place.

The council came to me and to my boss [the late Dan Case] and asked if we'd be interested in raising and managing the fund. It ended up morphing many times during fundraising because we wanted the small companies to drive top-tier returns.

One of the first things we did as an early investor in Tesla in 2006 was to aid its search for a plant to eventually house the Model S sedan. We showed Tesla that there were ways to stay in the Bay Area that helped level the playing field against cheap labor in other parts of the world—using economic development programs that were already in place, like job-training programs or certain rent-abatement strategies, because we were going to create jobs. There's a whole toolkit that people use.

Now it's kind of famous because of companies like Amazon, but back then the only companies that knew about this were big companies that had the staff to do this. Tesla eventually found the factory in Fremont, Calif.

BE: How did you first get to know Tesla?

NP: Through a contact at Stanford, Jane Woodward, who runs Mineral Acquisition Partners. She was very interested in electric cars. She had us over to learn more—and that's when we met J.B. Straubel [Tesla's chief technical officer at the time]. That was our first encounter. And we were very excited about it.

Our mission drove us to invest at a time when it was very risky. It's well-chronicled that the 2007-2008 period was brutal for Tesla and [solar panel company] SolarCity. It was very difficult to find people who would invest, and the businesses were capital-intensive. There were some pretty scary moments. I don't think we knew how much of a phenomenon Tesla would become.



BE: You stayed in cleantech when many investors—you’ve described them previously as “drive-bys”—left. Why?

NP: We’ve fared extremely well. Tesla and SolarCity were big wins in part because we were in early, so our cost basis was extremely low.

After the dot-com crash, people had an allergic reaction to the internet. That led to some heated rounds in cleantech. But many people didn’t understand cleantech, including the policy and regulatory sides, and it was being politicized at the time. Some investments started going awry, and broader tech got healthy again. That was sort of the tourist phase of cleantech; it didn’t work well. But fast-forward to today, there are family offices and corporates doing cleantech. It’s a much healthier ecosystem.

BE: What technologies interest you today?

NP: Among other things, energy storage to reshape the grid and inverter technologies that can help drive down the cost of solar

power. Like what Zola Electric is doing in Nigeria. When you have a weak grid, people use diesel generators to fill in gaps. With better smart batteries and inverters, you can allow your solar and your battery to seamlessly take over for the grid and vice versa without blowing up your devices. There are at least 100 million diesel generators in Africa alone. We’re also looking at conservation; one company that we’re invested in, Better Place Forests, allows people to use protected trees in forests instead of tombstones in cemeteries to commemorate the dead.

BE: You’ve invested in cleantech. Do you use cleantech products at home?

NP: I have solar panels, two Teslas, and home-charging. I don’t have batteries yet—I got solar before batteries were available—but eventually I will. ●

Eckhouse covers energy at Bloomberg News in New York.

Energy Outlook

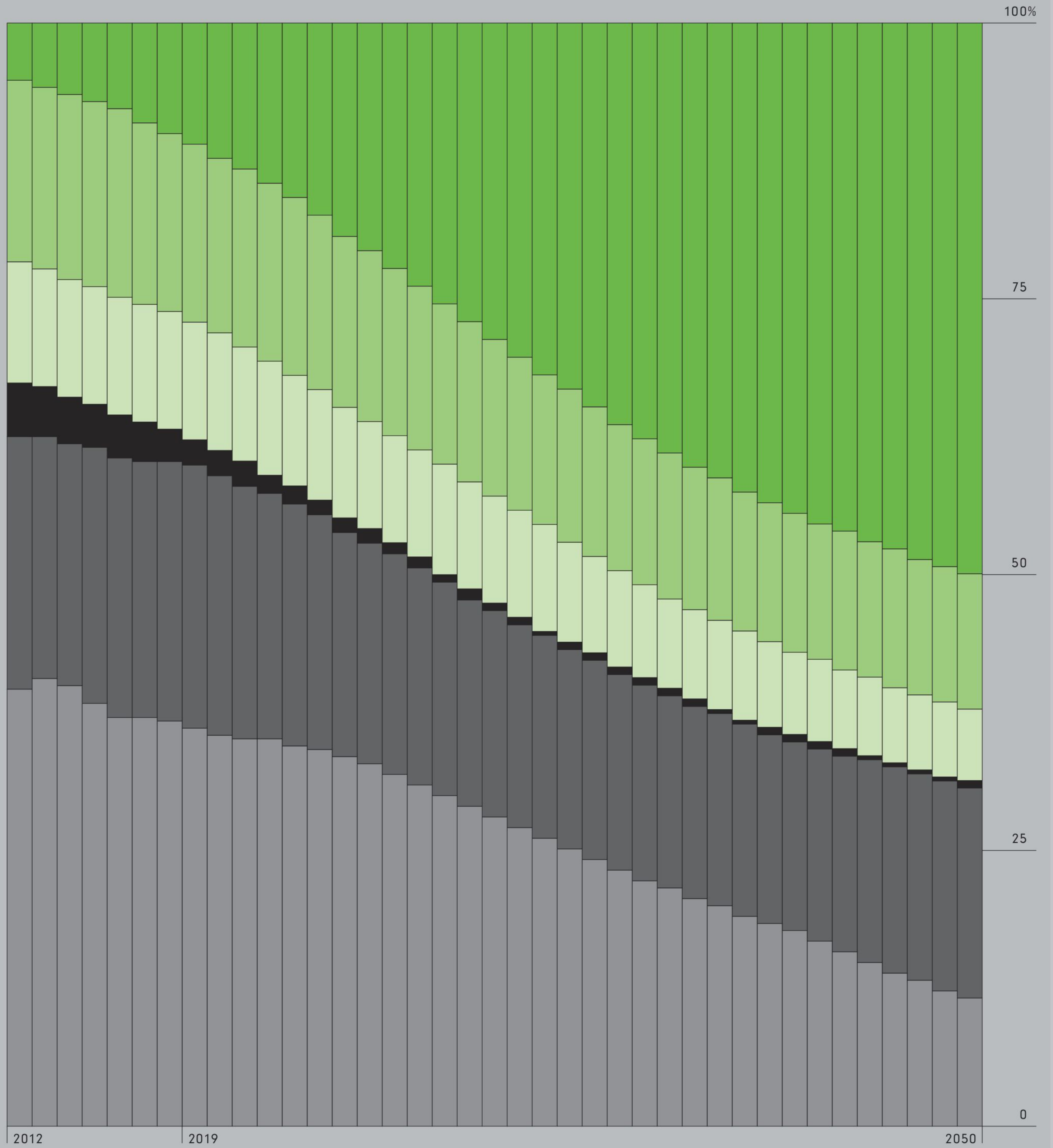
POWERED BY
BLOOMBERGNEF

The renewable energy transition promises to reduce carbon emissions, but it's happening at different speeds around the world. Read on for some key insights from BloombergNEF's *New Energy Outlook 2019*, which provides a detailed road map to the future. To take a look at the full report, type [{BNEF <GO>}](#). ▶

The New Energy Landscape

Share of global electricity generation (estimates and forecast)

■ Coal ■ Gas ■ Oil ■ Nuclear ■ Hydro ■ Renewables



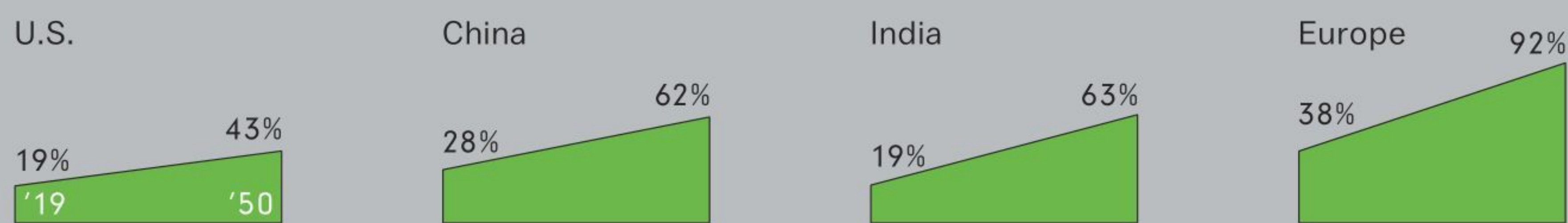
Source: BloombergNEF

The Old World Will Move the Fastest

■ Most regions are moving toward cleaner energy generation but not at the same pace. Europe is forecast to be almost fossil fuel-free by 2050. The U.S. lags the world.

Share of energy generated from renewables, including hydro

Estimate and forecast by region



Source: BloombergNEF

In Asia, Coal Will Rise, But Fall Again

■ Coal-fired electricity will peak in China in 2027 and in India in 2038.

Electricity generated from coal

Terawatt-hours



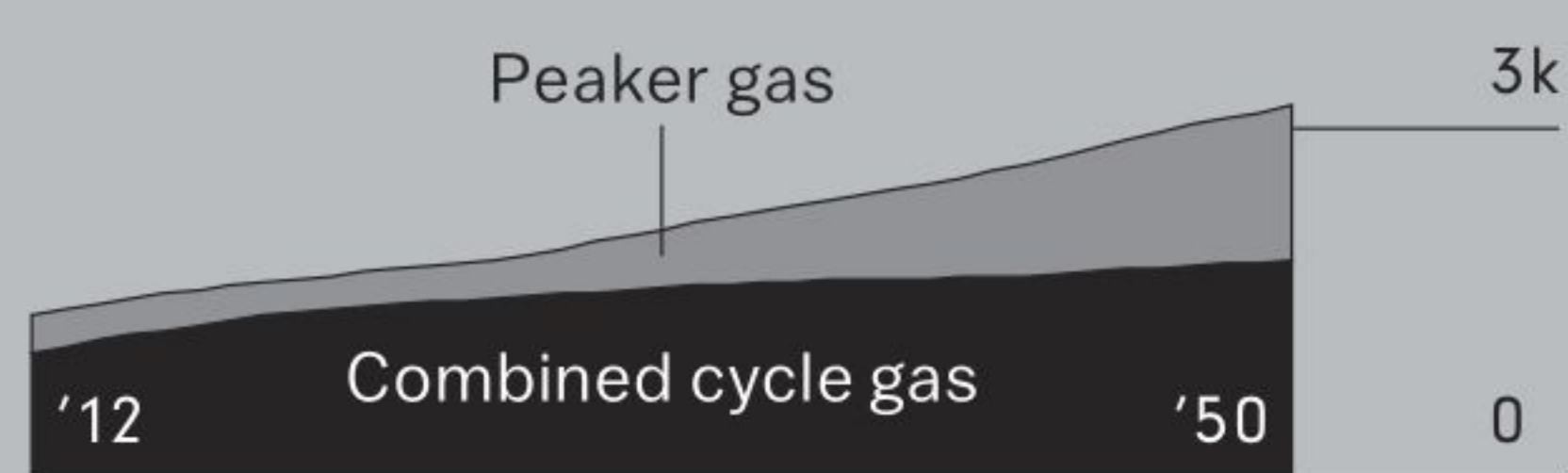
Source: BloombergNEF

Most New Gas Power Will Be On-Demand

■ Peaker plants, which are more responsive to changing needs, will push growth.

Cumulative installed capacity

Gigawatts



Source: BloombergNEF

The Money Is Headed for the Windmills

■ Over the next 30 years, the world will invest about \$2 trillion in new electrical capacity from fossil fuels and more than \$11 trillion in zero-carbon technologies.

Forecast investment in new capacity through 2050

■ Fossil fuels ■ Zero-carbon sources



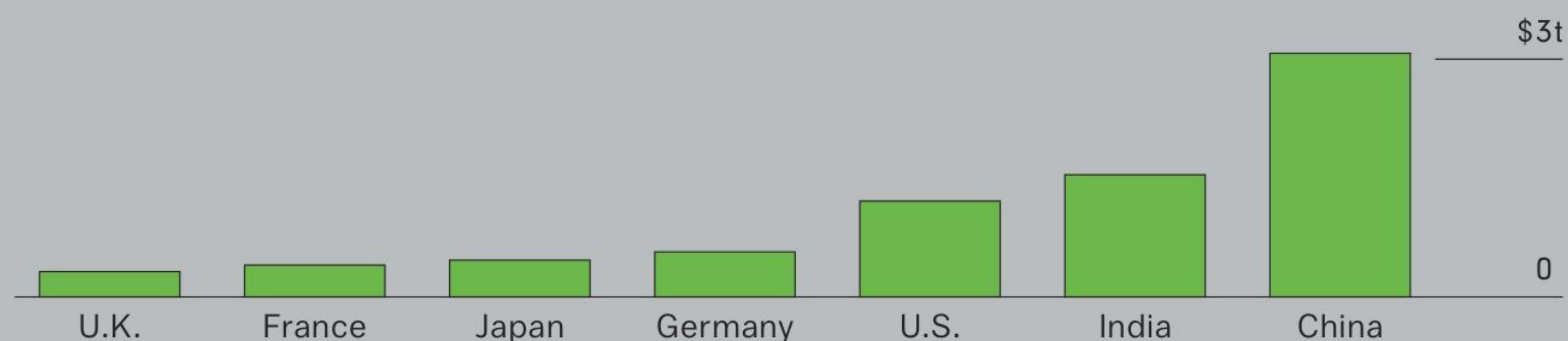
Source: BloombergNEF

\$4 of Every \$10 Spent on New Capacity Will Go to Asia

■ The region will get \$5.8 trillion in new capacity investments through 2050, roughly three-quarters of which will go to China and India.

Forecast investment in new capacity in selected nations through 2050

Real 2018 U.S. dollars

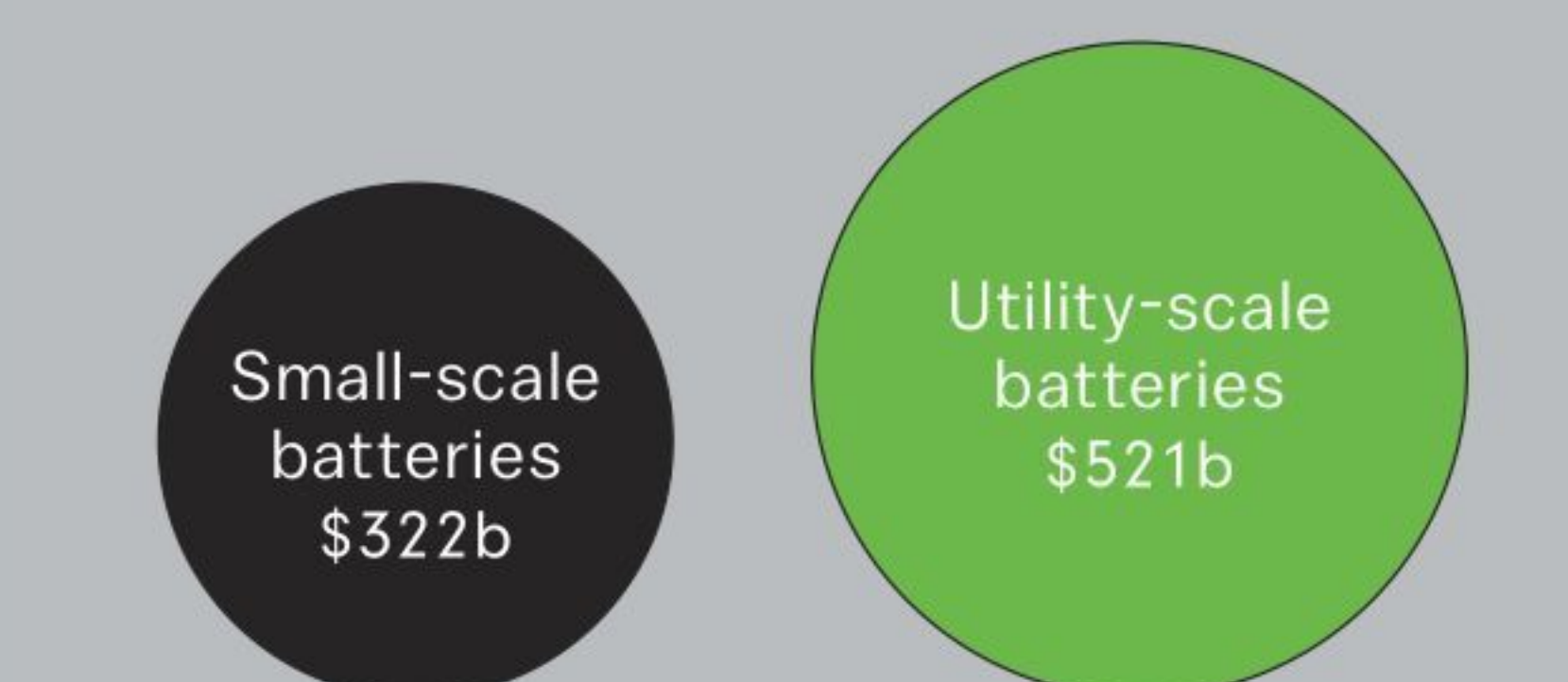


Source: BloombergNEF

Battery Investors Go Big

■ State programs and lower costs will encourage investment in utility-scale.

Forecast investment in new capacity through 2050



Source: BloombergNEF

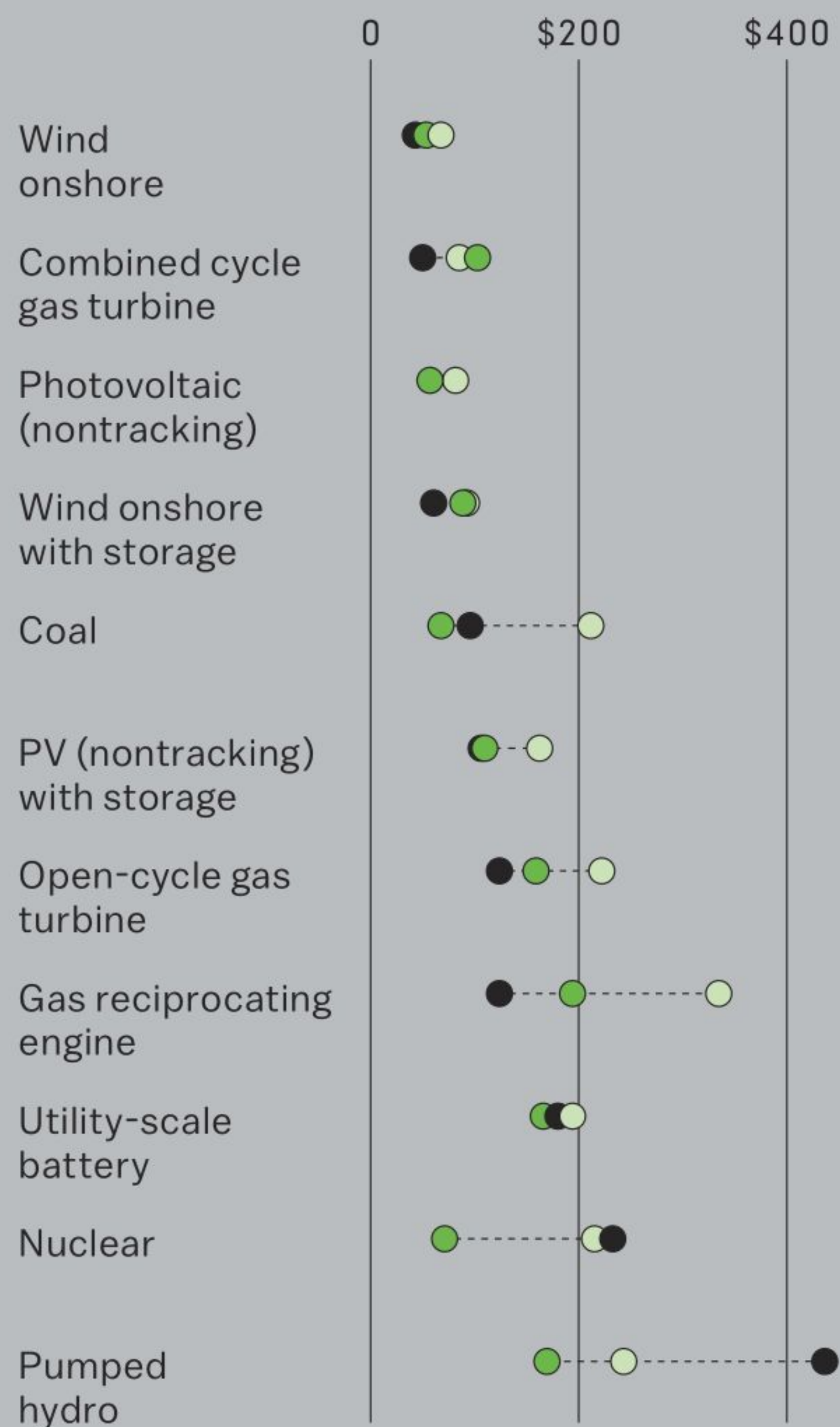
Where Green Power Is Cheapest Today

■ Clean (and dirty) energy prices vary globally. Coal is costly in the U.K.

Levelized cost of electricity, 1H 2019

U.S. dollars per megawatt-hour

● U.S. ● U.K. ● China



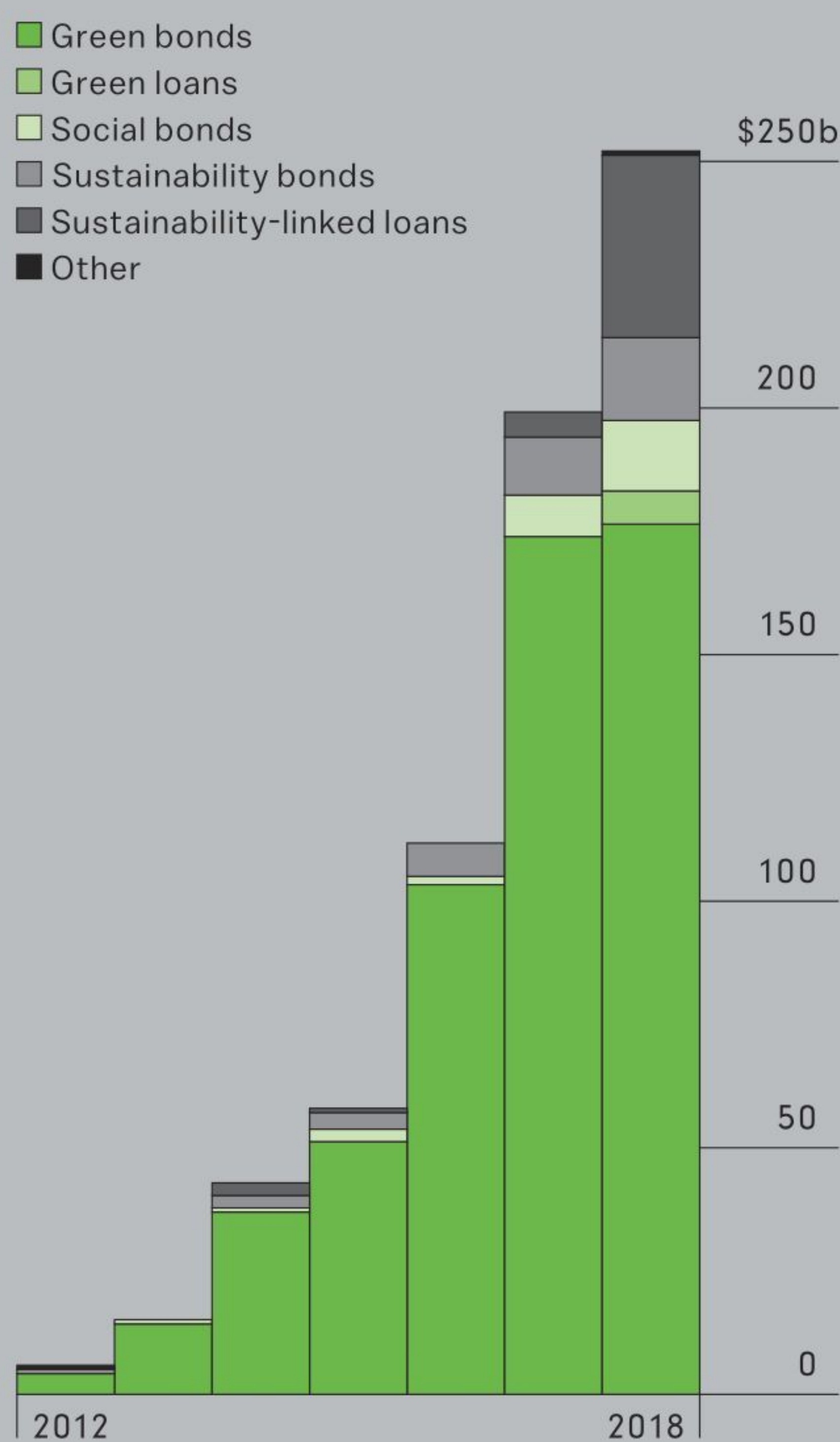
Source: BloombergNEF

The Debt Market for Sustainable Projects Has Exploded

■ Green bonds have driven sustainable debt issuance since 2012. Last year, financial, corporate, and mortgage-backed issuers accounted for two-thirds of sales.

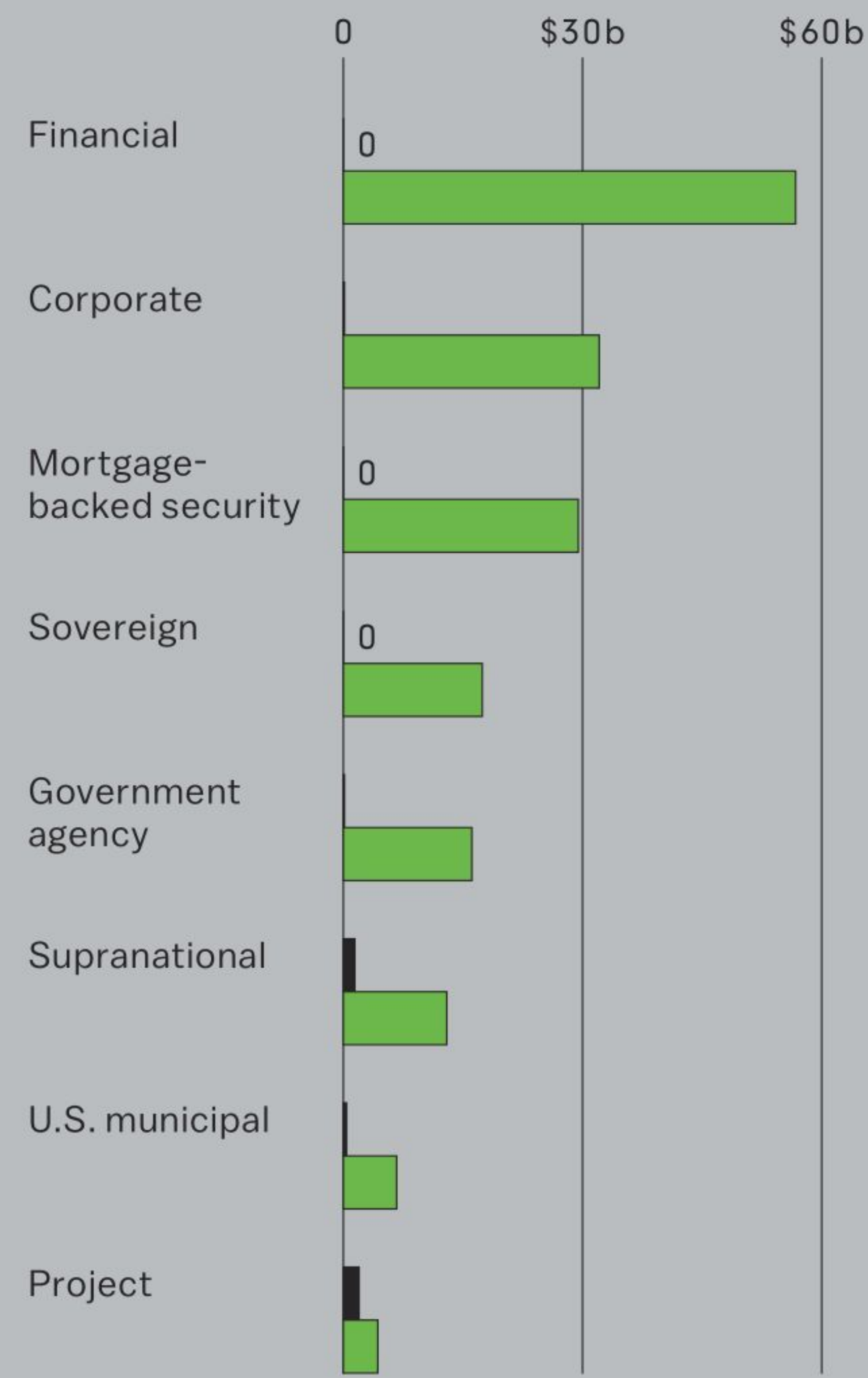
Sustainable debt financing issued

Total



Green bond issuance by type

■ 2012 ■ 2018



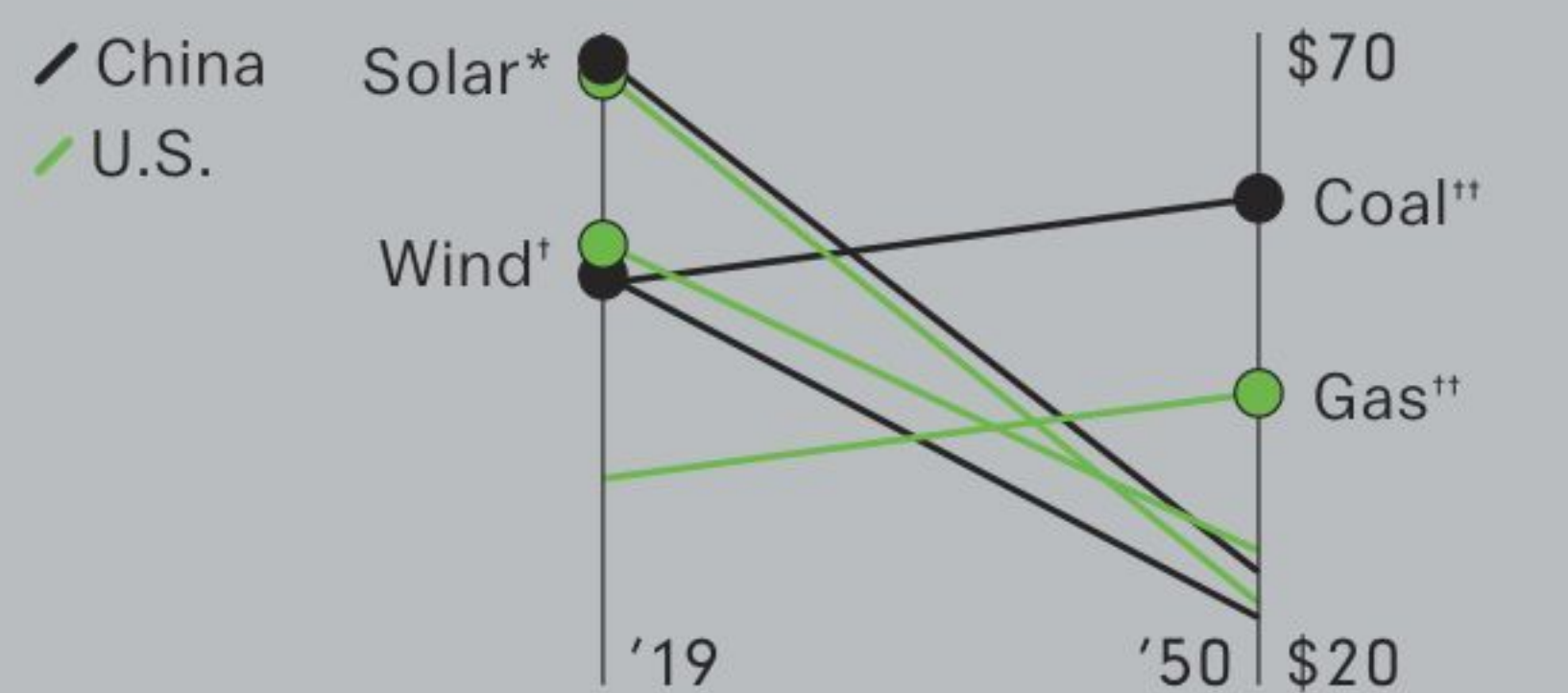
Source: BloombergNEF, Bloomberg

Green Technologies to Grow More Affordable

■ The relative costs of solar and wind will fall well below those of coal and gas.

Cost of electricity generation

U.S. dollars per megawatt-hour, high estimates



*Utility-scale *Onshore **Existing
Source: BloombergNEF

Not Everyone Is Participating In the New Energy Boom

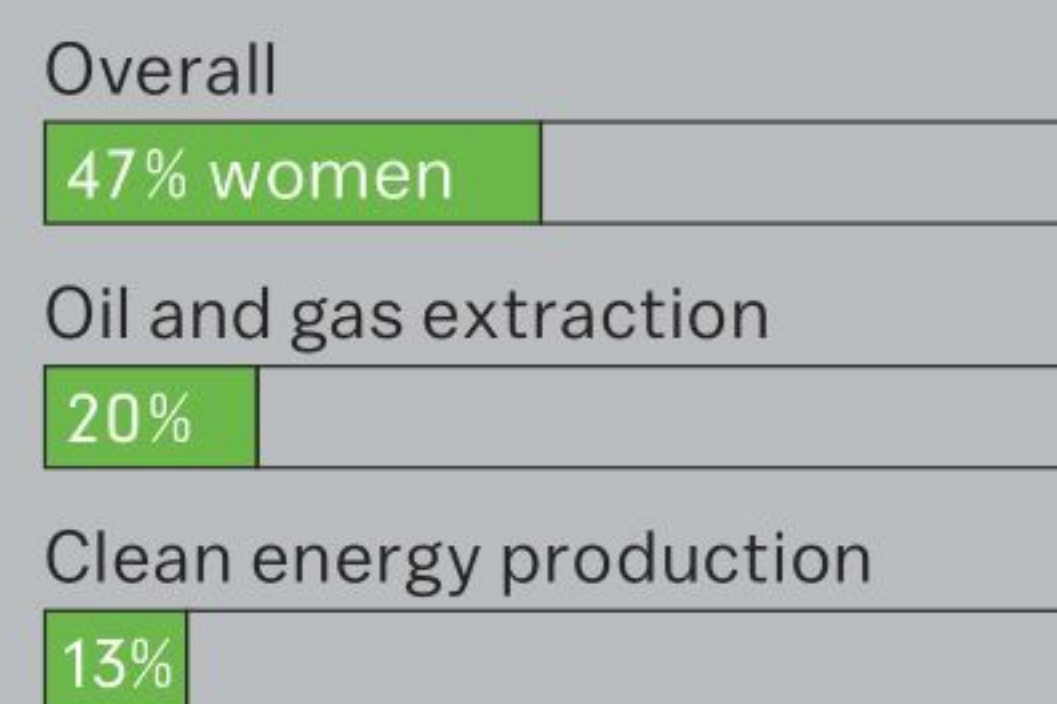
■ The number of U.S. solar jobs has climbed 159% since 2010, but women are disproportionately left out of the clean energy workforce—and underpaid within it.

Solar labor

U.S. solar industry workforce



U.S. workforce by gender



Median hourly wage, U.S. solar



Sources: Solar Foundation, Brookings Metropolitan Policy Program analysis

Green Flops

It must have seemed like a good idea at the time.

The annals of green energy are filled with people who devised brilliant solutions to vexing problems, delivering more power for less money, making things cleaner, easier, and better. Many became rich and famous in the process.

And then there are the folks who were... less successful. They created systems that generated electricity, but not cheaply. They struggled to move from the lab to the factory. Some had great ideas that were just ahead of their time.

Here's a sample of technologies that attracted considerable brainpower and resources, only to have us find that the world wasn't ready for them yet. In the end, they were simply the wrong thing at the wrong time. — *Will Wade*



1. CIGS Solar Cells

Solar power is now one of the cheapest sources of electricity, but it wasn't always this way. Most solar cells contain polysilicon, which was still very expensive a decade ago. Costs peaked at about \$475 a kilogram in 2008, prompting the search for alternative designs. Some used a thin film of copper-indium-gallium-selenide (CIGS) on glass or plastic.

The poster child was Solyndra LLC, which received \$535 million in U.S. loan guarantees to develop glass tubes with CIGS films. Meanwhile, burgeoning demand for clean energy led to a boom in polysilicon production, and prices plunged. Solyndra couldn't compete with its polysilicon rivals and filed for bankruptcy in 2011, triggering a political firestorm. Numerous other CIGS companies failed or were acquired in the following years. Polysilicon now costs about \$9 a kilogram and dominates the solar industry.

2. Flywheel Energy Storage

Power grid operators like to keep electricity flowing at a smooth and steady pace. To adjust for surges in supply or demand, they would ramp generation up or down. But big coal or natural gas-fired plants could sometimes take several minutes to respond.

Beacon Power Corp. offered an alternative with its first commercial flywheel facility in 2011. Two hundred carbon-fiber cylinders, each weighing 2,500 lb. (1,134kg), floated on magnetic fields and rotated as fast as

16,000 times a minute. All the kinetic energy could be converted into electricity and transferred to the grid as needed. It could also absorb excess energy from the grid.

Grid operators liked the technology, which allowed them to respond to imbalances in less than a second instead of minutes. But Beacon was ahead of its time: Existing regulations didn't make it possible for the company to charge different rates to provide a speedier alternative. Beacon ran out of money in 2011 while waiting for the Federal Energy Regulatory Commission to revise its rules. Its assets were acquired by a private equity fund.

The renamed Beacon Power LLC opened a second facility in 2014. In 2018 the two sites were acquired by a clean-energy developer. Today, the growing use of intermittent wind and solar power, which can fluctuate rapidly, has boosted demand for this type of service. But battery systems have emerged to quickly deliver power to the grid or absorb it.



3. Cellulosic Biofuels

The gas in your car's tank doesn't need to come from crude oil—you can grow it on a farm. That was the promise of a wave of companies that tried to develop cheap, renewable alternatives to petroleum-based fuels. Unlike the standard ethanol made from sugar in corn or sugar cane, this next generation would be produced from cellulose—the tough, stringy, indigestible fiber in plants or trees. That would be cheaper and easier to source

than food crops. Biofuels produce fewer carbon emissions than oil because the plants suck up carbon as they grow and because it's simpler to harvest plants than to drill for crude. The goal was to make a "drop-in compatible" fuel—one that could be used in a vehicle without modifying the engine.

It was a popular idea a decade ago as oil prices were well above \$100 a barrel, but it became a tougher sell when oil got cheaper. Biofuels remained stubbornly expensive. Kior Inc., a once-promising startup backed by the venture capitalist Vinod Khosla, made fuel from wood chips. With production costs above \$6 a gallon, it went bankrupt in 2014. Renmatix Inc. sought to convert wood into fuel but shifted to turning plants into specialty chemicals for the food and beauty industries. Solazyme Inc. engineered strains of algae that could be processed into fuels but eventually followed a similar path into chemicals. In 2016 the company changed its name to TerraVia Holdings Inc., and a year later it filed for bankruptcy.

4. Solar Power Tower

The power tower might be the most dramatic energy idea: miles of garage-door-size mirrors focusing sunshine onto a boiler at the top of a tall tower to generate steam and produce electricity. It's cool, but costly. California's Ivanpah, the world's biggest power-tower project with a cost of \$2.2 billion, has 377 megawatts of capacity. That just can't compete with photovoltaic solar. The beams of focused sunlight have also been known to fry birds midflight.

Bechtel Group, which built Ivanpah for owners BrightSource Energy, NRG Energy, and Google, has said power towers aren't competitive with other sources of electricity. But the technology has one advantage over solar panels: Developers can add vats of molten salt that retain heat for hours, enabling the towers to produce electricity after sundown. That's one reason the towers have the potential to provide electricity in remote areas, where it's expensive. Construction on a project in the Atacama Desert of northern Chile was resumed last year, two years after former co-owner Abengoa SA put it on



hold because of financial issues. SolarReserve Inc., which built the only other U.S. facility in Nevada, is developing projects in other parts of the world but this year canceled plans for Australia's first power tower when it couldn't line up financing.

5. Small Wind Turbines

You've probably seen homes topped with solar panels. What about rooftop wind power? Urban Green Energy Inc. tried that.

The company offered turbines small enough to be installed on homes, with curved blades that spun around a vertical axis. Larger models were provided for commercial rooftops, remote mobile phone towers, and public sites, and the company landed well-publicized deals to help power the Eiffel Tower and Lincoln Financial Field, home to the Philadelphia Eagles football team.

But the concept faced challenges. Wind turbines convert kinetic energy—the motion of the blades—into electricity. Smaller blades produce less power. The vertical design was less efficient than standard turbines. UGE struggled with high costs and maintenance issues. In 2016 the company sold its wind operations and shifted its focus to solar.

6. Marine Energy

The ocean's never-ending motion can be converted into electricity, but it's not easy. The sea is a harsh environment for mechanical systems. Still, the idea of harnessing the kinetic energy of waves, tides, or currents to generate power has fueled several startups.

Ocean Power Technologies Inc. developed a power buoy that's anchored offshore and moves up and down with the waves. The company teamed up with Lockheed Martin Corp. in 2012 to build a large-scale wave energy project in Australia that would have used rows and rows of the buoys. Ocean Power pulled the plug in 2014, saying the project wasn't "commercially viable," and changed its strategy. It's still pursuing the technology but is now seeking to power remote sites such as offshore oil rigs.

U.K.-based Tidal Lagoon Power Ltd. set out to build turbines on a barrage across Swansea Bay, in South Wales, that would draw power from the motion of the tides. The U.K. government rejected the £1.3 billion (\$1.6 billion) project in 2018, in part because offshore wind could supply the same amount of power for about one-third the cost.

Other companies are having more success with grid-scale marine power. Simec Atlantis Energy Ltd. operates the world's first commercial tidal stream project, the 6MW MeyGen facility that went into service in Scotland in 2016.



ON THE VERGE OF BECOMING THE WORLD'S NEWEST PETROSTATE, TINY GUYANA ISN'T READY

There's



By KEVIN CROWLEY

FOR THE MULTIBILLION-DOLLAR WINDFALL HEADING ITS WAY.

BUT EXXON MOBIL IS

ill Be Oil



PHOTOGRAPHS BY NATALIE KEYSSAR

The Caribbean beats of reggae and soca ease into American hip-hop at a roadside bar in Georgetown, Guyana. Outside, teenagers hoot as they whiz past palm trees on mopeds. But for Gavin Singh, a 36-year-old investment banker, this is no time for play or relaxation. “People out there don’t really get it,” he says, pushing aside his mojito to emphasize his point. “We have a tsunami coming.”

A tsunami of what?

“Of cash. Of opportunity.”

This tiny nation on the north coast of South America is about to become the world’s newest petrostate—and potentially the richest. In 2015, Exxon Mobil Corp. made what one of its executives described as a “fairy tale” discovery in the vast Stabroek exploration block off the Guyanese coast. Since then, it’s found so much oil that by the mid-2020s Guyana, with a population of about 778,000, will probably produce more crude per citizen than any other country.

Crucially, however, Guyana—a poor former colony, first of the Dutch, then of the British—is unprepared for what’s coming. Its petroleum laws were written in the 1980s. The Department of Energy has an annual budget of \$2 million. Five years after Exxon’s discovery, the country still hasn’t finished crafting relevant new laws or even established a regulatory body to oversee exploration and production. Last year the government set up a sovereign wealth fund to soak up as much as \$5 billion in oil revenue per year by 2025, but there are no plans for how to spend it.

Even as the windfall approaches, more and more questions are being raised about how the country sold exploration rights off its coast—not just to Exxon, but also to other outfits that followed in the supermajor’s wake. The State Assets Recovery Agency (SARA), an anticorruption unit looking into the leases, hasn’t named any targets. It’s too early for that, says its director, Clive Thomas. “We’re building up a case,” he says.

Guyana’s oil age is dawning at a rocky political moment in this still-evolving democracy. The current president, David Granger, who heads a coalition government, lost a no-confidence

ballot by a single vote in Parliament last December, triggering an election that as of late July hadn’t been scheduled. The parliamentary rebuff was a stinging reversal for Granger, who took office in May 2015, and the election could pave the way for the return of the People’s Progressive Party (PPP), which had held power for 23 years, including when Guyana first sold off its oil rights.

Then there’s the specter of Venezuela, which borders Guyana to the northwest and has historically laid claim to part of its rich offshore fields. Last year, Venezuelan gunboats sailed in to hinder Exxon’s activities, but drilling carried on to the south in the Stabroek block. So far Guyana has managed to weather its neighbor’s interference—no doubt aided by the cratering economy and widespread unrest that’s preoccupied Nicolás Maduro’s regime in Caracas.

The whiff of oil can be intoxicating, especially in a nation where the average income is \$385 a month. “It’s really a matter of how wealthy you’re going to be, rather than whether you’re going to be wealthy at all,” says Minister of Natural Resources Raphael Trotman.

But oil can sometimes be a curse. For every Norway or Qatar, there’s likely to be a grim counternarrative: an Angola or, for that matter, a Venezuela, which is a wreck even though it has the world’s largest oil reserves. “I keep hearing about how wealthy we will be as a country,” says Bharrat Jagdeo, a former president who’s now leader of the PPP. “People don’t realize the timelines. It requires hard work over an extended period of time to really get wealthy. That sense of caution is not there in this euphoria.”



WHEN MARK BYNOE, the director of Guyana’s Department of Energy, was a boy, he used to play cricket barefoot with friends in his village outside Georgetown. At the end of the day, his feet “would be shiny at the bottom,” he remembers. “We knew oil was around.”

Bordered by Venezuela, Brazil, and Suriname—all producers—Guyana always held the promise of oil. But for decades after independence from Britain in 1966, explorers drilled nothing but dry holes. “We were practically begging people to take a block offshore,” says Jagdeo. “Nobody wanted to come.”

Then along came Exxon. It was 1999, and Jagdeo was heading the government. Guyana and Exxon signed a production-sharing agreement that covered a 26,800-square-kilometer (10,348-square-mile) deep-water area spanning virtually the entire width of the country’s maritime borders. Given all the unsuccessful exploration, Exxon secured the rights to Stabroek under terms so generous that they would come back to haunt the country.

The early years were frustrating for Exxon. Border disputes with Venezuela and Suriname impeded exploration. After the Suriname quarrel was settled in 2007, Exxon began gathering data and conducting seismic imaging along the eastern reaches of Stabroek. Then, in 2013, the Venezuelan navy boarded and for four days detained an exploration vessel contracted by Anadarko Petroleum Corp., another U.S. producer that was surveying in the area.

Exxon plowed on. In 2014 oil prices crashed, and its partner in Stabroek, Royal Dutch Shell Plc, pulled out. Unwilling to shoulder the financial risks on its own, Exxon remained the operator responsible for exploration but brought in New York-based

Disputed Offshore Claims



Sources: Guyana Ministry of Foreign Affairs; Venezuela’s National Organization for Rescue and Maritime Safety of the Aquatic Areas



Guyana Shore Base in Georgetown is the main service hub for Exxon's operations in the vast Stabroek exploration block off the coast



Bynoe remembers that when he played cricket as a child, his bare feet would get shiny: "We knew oil was around"

Hess Corp. and China's state-backed Cnooc Ltd., handing them 30% and 25% stakes, respectively, in exchange for sharing drilling costs.

When Exxon began drilling the wildcat well Liza-1 in March 2015, Guyana was just a couple months away from a general election. On May 20, four days after Granger emerged as the surprise winner, Exxon announced it had struck oil.

The timeline would later prove controversial and become a focus of the SARA investigation. But one thing was clear: Oil was coming.



WHEN LIZA-1 struck oil, Lars Mangal, one of Guyana's foremost petroleum professionals, knew exactly what to do. He'd spent two decades working in oilfield services around the world for Houston-based Schlumberger Ltd. before ending up in the U.K. Now he needed to pack up his belongings, get back to Georgetown, lease a dockyard, and bid for the Exxon services contract. "This is the big one," Mangal, who turns 54 in August, recalls thinking.

He was right. His company is now one of the lead local investors in Guyana Shore Base Inc., which acts as Exxon's main service

hub in Georgetown. He has no doubt that Guyana needs to embrace Exxon's plans for Stabroek oil. "Damn it," he says. "Get it out of the ground."

Somebody has written a message on a whiteboard at Guyana Shore Base that reflects Mangal's attitude. It reads, "Don't obsess over who's baking the cake. Figure out how to get a slice."

Lars's younger brother, Jan, would almost certainly take issue with that. Jan Mangal, who also has a long track record in the oil industry, has become a leading critic of exploration deals that Exxon and other companies cut with the government.

Jan, 49, worked at Chevron Corp. for 13 years after earning a doctorate in engineering at the University of Oxford. He became Granger's energy adviser in 2017. From the start, he clashed with ministers who unsuccessfully resisted his call to have all of the country's oil contracts published and open to public scrutiny. He didn't last long in the role, leaving after a year when his contract wasn't renewed. He's now a consultant.

"Corruption is the main reason why countries like Guyana fail with oil and gas," Jan says. "It undermines everything." He says that Guyana didn't get a fair deal from Exxon—he calls it a dated, "colonial contract"—and that other leases have been awarded without due process, potentially costing the country ▶

billions of dollars in lost revenue and exposing vulnerable Guyana to the so-called resource curse.

Exxon's manager in Guyana, Rod Henson, disagrees. He says the contract reflects the high risk of drilling the first well. In any case, he says, "the revenues that are going to be generated from that give Guyana the flexibility and the opportunity to be anything they want to be."



THE MONTHS BEFORE Exxon struck oil in 2015 were an unsettled time in Guyana. Then-President Donald Ramotar had clashed with Parliament over government spending. Fearing a no-confidence vote and the end of his party's 23-year rule, he dissolved the legislative body and called a general election for May.

At the same time, unbeknownst to the wider world, Exxon was getting ready to drill Liza-1. Other companies, smelling oil, were circling Guyana's waters.

On March 4, Ramotar signed an exploration lease for the 6,100-square-kilometer Canje block with Mid-Atlantic Oil & Gas, a little-known company run by Guyanese businessman Edris Dookie. The next day, Exxon, whose Stabroek block abuts Canje, began drilling.

On April 28, Ramotar signed over another exploration lease, this time with the partnership of Tel Aviv-based Ratio Petroleum Energy Ltd. and Toronto-based Cataleya Energy Ltd. It covered the 13,535-square-kilometer Kaieteur block, also adjacent to Stabroek.

On May 7, then-Minister of Natural Resources Robert Persaud announced that Exxon had struck oil. The general election was four days later, and on May 16, Granger, leader of the then-opposition, was sworn in as president. Four days after that, Exxon confirmed the discovery to the stock market.

The award of oil leases in developing countries is one of the most secretive, competitive, and contested corners of the industry. Before oil is discovered, governments typically offer royalty rates and tax incentives that are favorable to exploration companies. As soon as a discovery is made, unsold leases nearby become extremely valuable overnight, allowing governments to set higher rates for them. This binary before-and-after phenomenon opens the door to abuse by people acting on inside information.

As Bloomberg News first reported in May, SARA is now probing the deals Guyana cut with oil companies over the years. "We're investigating the issuance of the licenses, for example, and the various blocks," says SARA chief Thomas. He stresses that the postmortem is in the very early stages, so he can't disclose much except to say the investigation is focused on the runup to the 2015 election.

"There are so many red flags," Jan Mangal says, looking back at that period. He says the government could have commanded much more favorable tax and royalty rates if the Canje and Kaieteur leases had been sold after Exxon's Stabroek discovery was announced and not before. "The country could have got 10 or 100 times what it got for these massive, massive blocks," he says.

Ramotar says he didn't know about the Exxon find when the Canje and Kaieteur deals were signed, adding, however, "I was told that the indications were good." He says that the SARA investigation is "politically motivated" and that contracts signed

under the current government should be looked at as well. He says he welcomes "any impartial international inquiry."

Persaud, the natural resources minister at the time, says focusing on the election timeline suggests "a wrong narrative." He says the Canje and Kaieteur leases had been all but signed, sealed, and delivered in 2013. But then the Venezuelan navy boarded the Anadarko-contracted exploration vessel, spooking Guyanese authorities. Not wanting to provoke Venezuela further, Persaud says, the government put the contracts on hold.

The Canje lease, which was published on government websites, could be interpreted as backing this version of events: "2013" has been crossed out and replaced with a handwritten "2015."

Representatives from Mid-Atlantic, Cataleya, and Ratio Petroleum concur with Persaud's timeline. "We were working away steadily in good faith for many, many years," Cataleya Chief Executive Officer Michael Cawood says. "This wasn't something that popped up all of a sudden."

About a year after the leases were signed, Exxon took a 50% stake in Kaieteur and a 35% stake in Canje and became the operator of both blocks. Cawood says his group took "no cash consideration" from Exxon for the stake in Kaieteur. Dookie says there were "terms" agreed to with Exxon for its Canje stake but declined to say what there were. Exxon wasn't the recipient of the Canje and Kaieteur blocks initially and had nothing to do with the talks at the time. Exxon declined to comment on terms. All the companies involved say they have acted entirely properly.



IN 2016, Exxon had a problem. Its deal with Guyana was 17 years old, and under the complex terms of the agreement, the supermajor was running out of time to find more oil. This was an opportunity for Guyana's new government, now led by Granger, to update the 1999 contract and extract better terms. Such negotiations are a fine balancing act for governments: Push too little, and you get too little; push too hard, and the company might walk away.

Natural Resources Minister Trotman took a different route: no negotiation at all. He says Guyana was worried, once again, about Venezuela, fearing Exxon's discovery would rile its prickly neighbor; neither Exxon nor the government wanted to get into a protracted negotiation.

Instead, in October 2016, the government and Exxon modified the terms of the existing 1999 deal.

This was a missed opportunity of epic proportions, says the PPP's Jagdeo, the opposition leader and former president. "They had 3 billion barrels of proven reserves," he says. "One would have thought you would have gotten a better contract."

Trotman counters that the government's overriding concern in the Exxon talks was finding "security in what it had." That included getting an \$18 million signing bonus that, Trotman says, "we believed we should use for ... the prosecution of our case" against Venezuela to settle territorial claims.

There was one hitch—a big one. The bonus was kept secret from the public for what Trotman describes as "national security" reasons. The 2016 contract that modified the terms of the original wouldn't be made public until 2017 (following the intercession of Jan Mangal), but in the small world of Guyana, it wasn't long before word leaked out and caused an uproar. "If this is what

they do with \$18 million, what will they do with all the billions to come?” says Charles Ramson, 35, a PPP politician.

Bynoe, the current energy director, says it was a mistake not to be more open about the \$18 million. In retrospect, Trotman agrees. “We should have confided in the people much earlier,” he says. In addition to the signing bonus, according to Exxon’s Henson, the government got more “rental type payments,” royalties, and commitments of local content as part of the deal. But, crucially, the modified terms also allowed Exxon more time to explore and develop Liza. Henson says that without the 2016 modifications he’s “absolutely certain we would not be producing oil in 2020.”

The controversy surrounding the 2016 contract doesn’t end there. According to an analysis of the agreement by Rystad Energy AS, an Oslo-based consultancy, Guyana will take about 60% of the oil’s profits, with the remainder going to Exxon, Hess, and Cnooc.

That’s considerably lower than the global average of 75% for offshore projects, Rystad said in a 2018 report. However, it also pointed out that countries in the early stages of oil and gas development, such as Mozambique and Mauritania, are often forced to “sweeten the pot” for the exploration companies. “Clearly we have to make a profit,” Henson says. “We understand there are benefits to us and our partners, but we truly want this to benefit the country.”

Bynoe takes a Goldilocks view of the whole affair. “Is it the greatest contract for government? I would say no,” he says. “Is it the worst contract? I would still say no.” Over time, he says, Guyana can “incrementally improve the conditions.”

With that in mind, he says, it’s time to look forward. “We have been looking back about the contract,” he says. “There’s been too little attention in how will we treat these resources when they begin to flow to us.”



AT EXXON’S Investor Day meeting at the New York Stock Exchange in March, Guyana took center stage. It’s not hard to see why. Senior Vice President Neil Chapman—the exec who’d once described the Stabroek find as a “fairy tale”—pointed to a chart featuring estimates from Wood Mackenzie Ltd., an Edinburgh-based energy consulting firm. It showed that Exxon’s Guyana wells will be the most profitable of all new deep-water projects by major oil companies.

Exxon expects the first Stabroek oil to flow to the *Liza Destiny*, a storage and offloading vessel, in early 2020, with production quickly ramping up to 120,000 barrels a day and rising by 2025 to 750,000 a day (roughly on a par with last year’s daily output in Indonesia, which has a population of 264 million).

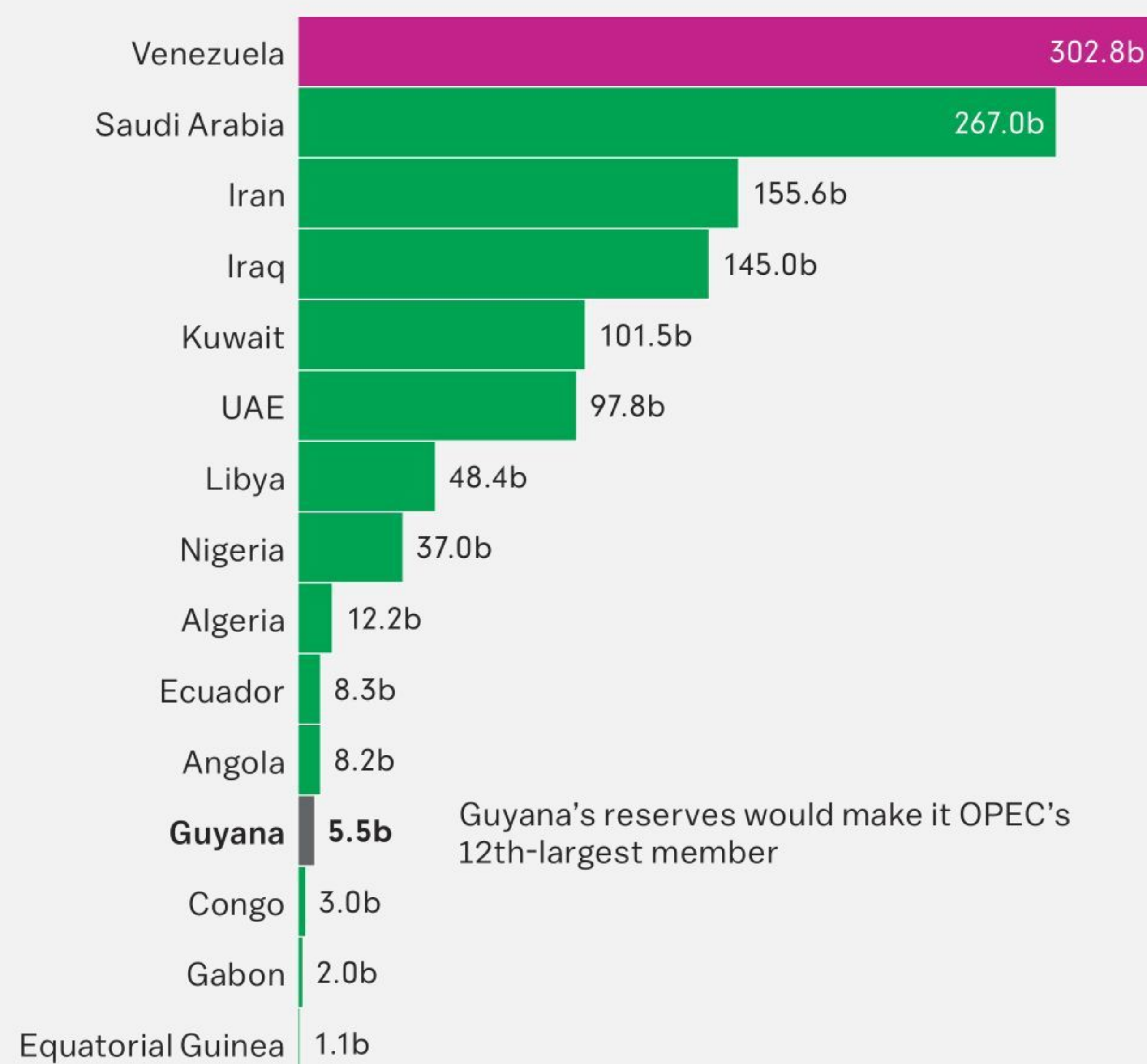
As for Guyana, the government estimates the Exxon deal will bring in \$300 million in 2020, or about a third of the country’s entire tax revenue, and surge to \$5 billion by 2025.

“They say Guyana will be one of the richest countries in the world,” says Melissa Garrett, a waitress who supplements her income by selling potatoes, eggplant, and plantains at a stall at Georgetown’s century-old Bourda market. “People are in the mood for change. They want it now.”

They also need to come to terms with the massive transformation coming their way, says Singh, the investment banker lingering over his mojito at the roadside bar. “Sitting back and doing nothing can be the worst mistake they can make,” he says.

A New Global Player

Barrels of oil reserves in 2018



Sources: OPEC, Exxon Mobil

Georgetown—its crumbling colonial buildings set amid canals built by the Dutch in the 18th century—resembles a developing-world Amsterdam that’s faded in the harsh sunlight. On its bustling narrow streets, Guyanese descendants of Indian indentured laborers and African slaves live and work side by side, shop at the same markets, and dream the same dreams of wonders coming their way thanks to oil.

Guyana’s political elite is torn over how to spend the money. The Granger government has said it wants to use the windfall to reshape the economy, pumping money into health and education, into the country’s vast natural resources, and into rail, road, and port projects that could provide an important pathway to the Atlantic for northern Brazil. Thomas, the head of SARA, favors bypassing government altogether in favor of a universal basic income-like stipend of \$5,000 per family.

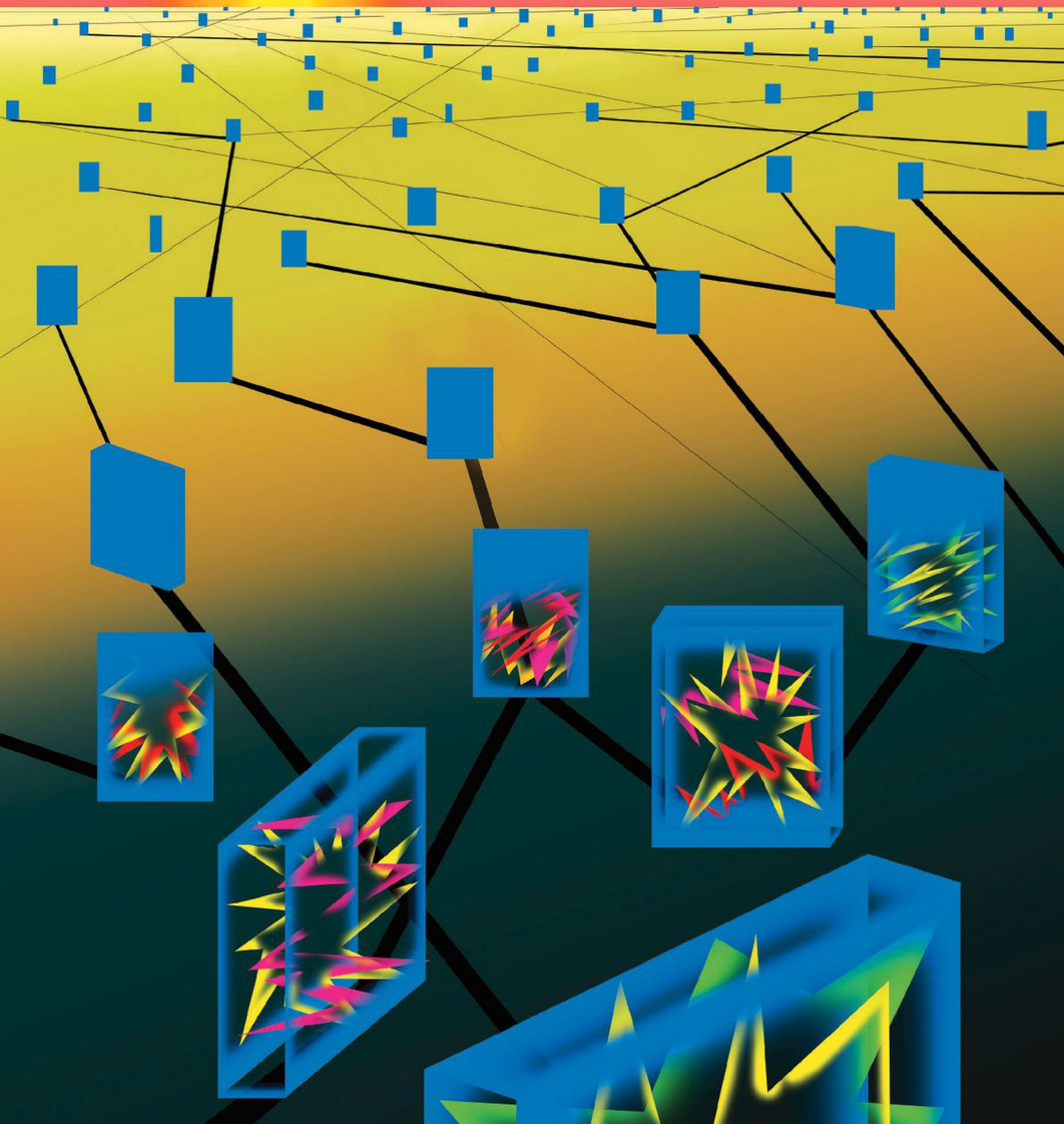
First things first, says Jan Mangal. “Guyana really needs to fix all of its existing problems now before the oil money flows,” he says. “If it doesn’t, the oil money will exacerbate the existing problems and make them worse.”

Chris Ram, a lawyer and former newspaper columnist (he broke the news about the \$18 million signing bonus), worries that, rather than taking a leap forward propelled by oil, Guyana could slip backward. In the 1980s, under left-wing strongman Forbes Burnham, Guyana shared many traits with today’s Venezuela. Although democracy took root in the 1990s, Ram fears for its fragility.

“We don’t have a culture of democracy,” he says over a meal in one of Georgetown’s many Indian curry houses. “The constitution is weak and open to abuse. Problems are swept under the carpet. It’s frightening. All the elements of a resource curse are there.” ●

Crowley covers oil for Bloomberg in Houston.

POWER to the PEOPLE



From sun-blessed Australia to medieval European cities, researchers are obsessing over energy storage—the key to the triumph of renewables over conventional fuels

ILLUSTRATION BY JON HAN

By DAVID STRINGER



It's just a marketing gimmick. But it casts a spell.

A pale orange-and-gold sunset bathes the macadamia plantations and avocado orchards that sweep down to Australia's Byron Bay. The coming dusk is a cue for two sleek Tesla battery packs in the garage at Amileka, a secluded holiday villa nearby. They stir silently into action—powering the appliances in the five-bedroom home's twin kitchens, recharging a \$100,000-plus Model X SUV, driving a filter pump for an 18-meter swimming pool sparkling in the shade of a century-old native black bean tree.

From first light on this Southern Hemisphere autumn day, a bank of 33 rooftop solar panels has been capturing the sun's energy. At times, the electricity is directed back to the local grid. But mostly it's funneled into the garage and stored in Powerwall units, in the same type of rechargeable cells that fuel the automaker's vehicles. The batteries—as tall as refrigerators, as thin as flat-screen TVs—will power this unusually energy-hungry villa deep into the evening.

But not all night. The solar array and batteries meet just half of Amileka's average energy needs. So after a few hours, the 25-acre, \$1,160-a-night miniresort that Tesla Inc. uses to promote its products must tap into the local electricity grid.

The photogenic demonstration on Australia's eastern coast presents a vision of what some see as the most significant shift in the energy sector since the late 19th century: rechargeable batteries—in electric vehicles, homes, industrial plants, and power grids—that will make the transition to renewable energy possible.

The actual future of energy may be less postcard-worthy. It may look more like a fleet of electric school buses. And the end of utility companies as we know them.



BY 2050 SOLAR AND WIND will supply almost half the world's electricity, bringing to an end an energy era dominated by coal and gas, according to forecasts by BloombergNEF, Bloomberg LP's primary research service on energy transition.

It can't happen without storage. The switch from an electricity system supplied by large fossil fuel plants that run virtually uninterrupted to a more haphazard mix of smaller, intermittent renewable sources needs energy storage to overcome two key hurdles: using power harvested during the day to supply peak energy demand in the evening and ensuring there's power available even when the wind drops or the sun goes down.

“We think storage can be the leapfrog technology that's really needed in a world that's focused on dramatic climate change,” says Mary Powell, chief executive officer of Green Mountain Power Corp., a utility based in Colchester, Vt., that's worked with Tesla to deploy more than 2,000 residential storage batteries. “It's the killer app in a vision to move away from bulk delivery systems to a community-, home-, and business-based energy system.”

Utilities aren't panicking yet. The prospect of large numbers of residential consumers moving fully off the grid is probably overstated, says Zak Kuznar, managing director of microgrid and energy storage development at Duke Energy Corp., a Charlotte-based utility that supplies electricity to more than 7.5 million customers in six American states. “If you are wanting to run your home just on solar and batteries,” he says, “from where the

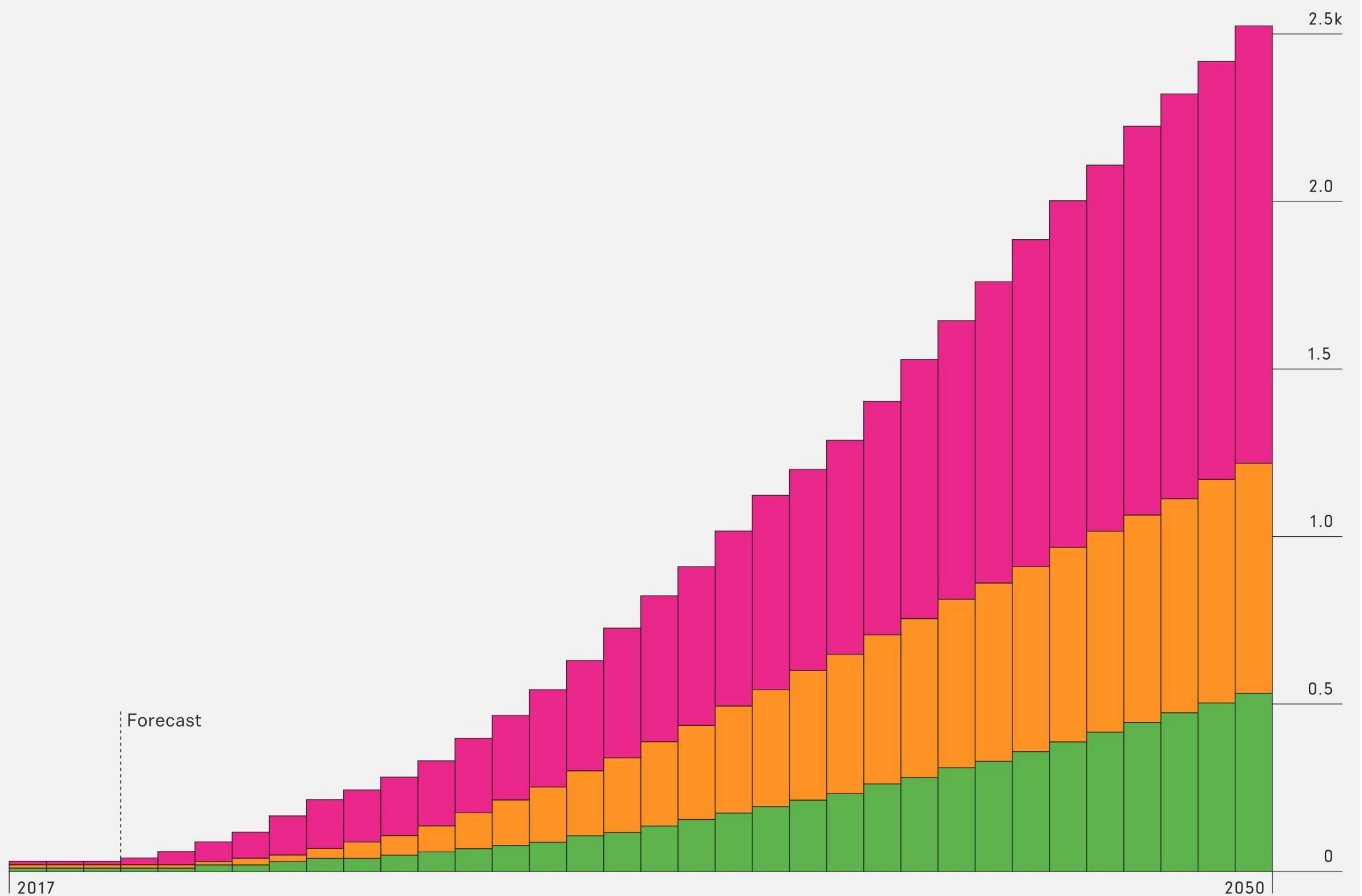
“If you are wanting to run your home just on solar and batteries... it's going to be tough.... At this point it's pretty overstated”



Storage Room

Cumulative global installed battery capacity, in gigawatt-hours

■ Residential small-scale ■ Commercial small-scale ■ Utility-scale



Source: BloombergNEF

Batteries Are Getting ...

Cheaper

- The cost of lithium-ion battery packs is down 85% since 2010
- It's forecast to fall 65% more by 2030

More powerful

- 1990s: Sony uses lithium-ion batteries for handheld video cameras
- 2019: Lithium-ion batteries propel cars at 250 mph and soak up energy from vast solar farms

More available

- Forecast: Residential, commercial, and utility-scale storage capacity will jump more than 100-fold to over 2,500 gigawatt-hours by 2050
- Forecast investment: \$843 billion, more than 60% on utility-scale batteries
- Growth in Tesla storage battery sales will "at least double" this year, Elon Musk said in June

Sources: Bloomberg, BNEF, Tesla Inc.

technology is today, it's going to be tough. It's something we are keeping an eye on, but at this point it's pretty overstated."

Lithium-ion batteries continue to have limits in terms of the amount of energy they can store, and they're typically able to supply energy to grids for just hours at a time, not days or weeks. What's more, concerns are rising over the environmental costs of mining lithium in Chile's parched Atacama Desert and over a cobalt industry that's tarnished by the use of child labor in the Democratic Republic of the Congo to supply battery manufacturers. And the sector is just beginning to prepare for the future need to recycle or dispose of a torrent of expired battery packs.

Still, optimism abounds. Battery storage technology is nearing a tipping point like the one that accompanied the "massive" adoption of solar power some years ago, says David Frankel, a partner at McKinsey & Co. in Los Angeles whose clients include energy and industrial companies.

Mainstream adoption of electric cars is the third great stage in the transformation of the global energy sector—a natural outgrowth of the first two: the spread of cheaper renewable energy and the evolution of batteries, says Marcus Fendt, a managing director at Mobility House GmbH, a tech company in Munich. ▶

And it's coming, however slowly. By 2040, according to a BNEF forecast in May, almost 60% of new car sales and about a third of passenger vehicles on the road will be electric.



ON THE PORTUGUESE ISLAND of Porto Santo, a 16-square-mile outpost in the Atlantic where Christopher Columbus lived for a time, the convergence of automaker and utility company is plain to see. Renault SA and Empresa de Electricidade da Madeira are testing a suite of storage technologies as the isolated community strives to curb imports of fossil fuels. Twenty electric cars—rising to 100 or so next year—cruise the streets. Some are taxis, some are shared by residents, and one is even used by the police as a patrol car.

Islanders are also testing a network of about 40 charging stations. Banks of second-life batteries—cells that are no longer powerful enough to be used in a car but remain adequate for less-intensive storage applications—have been connected to a local grid to soak up excess energy from wind and solar farms.

The French automaker has a second project on Belle-Ile-en-Mer, off the northwest coast of Brittany. At a school on the island, rooftop solar panels and batteries power classrooms during the week and a fleet of rental cars over the weekend. Renault has struck an agreement with Electricité de France SA to expand these experiments elsewhere.

The next step in storage technology is to turn electric cars into money makers for their owners. The latest global experiments along these lines entail hooking the cars' batteries directly to power grids. These vehicle-to-grid connections enable reversible charging, the two-way transfer of electricity from cars to houses or back to power grids. A vehicle's battery can power home appliances, sure. But more significantly, whenever it's parked and plugged in, the car can make money by storing energy or helping stabilize supply and demand on the grid.

Drivers will be able to carry renewable energy wherever they go. "You can be a virtual grid," says Fendt, of Mobility House, which works with Nissan Motor, Renault, the Dutch grid operator Tennet Holding, and other clients. "I take the sun around with me."

Fendt calls the pilot projects "playgrounds for the future." Renault has begun tests in Utrecht, in the Netherlands, where electric cars have been fitted with reversible chargers. In Utrecht and elsewhere in Europe, says Yasmine Assef, program director of Renault's new-energy business, "we're not so much testing the technical part. What we really want to test here is the business case."

Customers can already earn some money by charging their cars on a schedule determined by the availability of energy on the grid, Assef says. Under a program Renault operates in the Netherlands, a typical consumer makes €60 (\$67) a year from the utility for charging during low-demand periods only, she says. "As a customer," she says, "the journey is quite easy—you plug in, you forget, and you make money."

In Hagen, Germany, a Nissan Leaf has been connected to the country's power grid since January. By storing energy when there's a surplus and returning it to the grid as demand rises, the car could eventually earn about €1,000 a year, Fendt says.

America's iconic yellow school bus is getting into the act. To go electric, a vehicle that size—one that sits idle for much of the time—requires a huge battery. Macon, Ga.-based Blue Bird Corp., which sells battery-powered models that carry 84 passengers, says it will begin selling vehicles with two-way connections to the grid before the end of the year.

Ride-hailing companies such as Uber Technologies Inc. and other operators of large fleets will likely find ways to generate additional revenue from cars that are parked and not taking fares by plugging them into the grid, Fendt says: "They will connect the car and squeeze every last cent, every last euro out of it."



AUTOMAKERS ARE BECOMING "a part of the electricity ecosystem," as Renault's Assef puts it. They're not just making EVs that can return power to the grid. Like Tesla, Nissan produces and sells energy-storage products, while Volkswagen AG—the carmaker with the most aggressive timetable for adding electric models—plans to supply homes and small businesses with renewable energy through a retail power subsidiary, Elli Group GmbH.

Oil giants are also investing in storage. Through its New Energies division, Royal Dutch Shell Plc is spending about \$2 billion a year on these technologies. The company says it wants to become the largest electrical power company in the world by the early 2030s. In addition to acquiring a U.K. electricity provider and a car-charging operator, Shell this year bought Germany's Sonnen GmbH, a leading supplier of residential storage systems. In May, Shell announced plans to install industrial-scale batteries at two facilities in Ontario, a crude refinery and a motor oil plant. Chevron, Total, and BP have also made investments in electric car charging or storage companies.

In parts of the U.S., storage batteries are already a cheaper option than so-called peaking plants. These typically are environmentally unfriendly fossil-fuel-fired power stations that are needed only for a couple of weeks each summer, when electricity demand spikes, and are idle the rest of the time. As some coal-fired power stations are retired, "there could be a situation where, instead of

A Tesla Model X SUV fuels up at Amileka, a secluded holiday villa on Australia's eastern coast. On the building's roof, 33 solar panels collect the sun's energy, which is stored in Powerwall units and can be used to power the five-bedroom home and recharge electric vehicles.



PHOTOGRAPH BY NATALIE GRONO FOR BLOOMBERG MARKETS

“What might sound like science fiction is in reality only two or three years away”



building that new peaking plant, I am putting more storage on the grid,” says Duke Energy’s Kuznar.

Duke has outlined plans to invest more than \$500 million in battery storage projects over the next 15 years. Other utilities from California to China are also considering how battery systems can be added to existing networks, potentially deferring or eliminating the need for some investments in power plants.

Investors probably underestimate the impact falling battery prices will have on the energy sector, as well as the speed at which change will come, says Tom King, chief investment officer at Nanuk Asset Management Pty., a Sydney-based fund that focuses on renewables and energy efficiency. The consequences, he says, “will be profoundly negative for conventional utilities. That’s an almost unstoppable outcome.”



AT A REMOTE SITE about 150 miles north of Adelaide in the state of South Australia sits the Hornsdale Power Reserve. This is the world’s largest operating lithium-ion battery facility, a city block-size cluster of 2-meter-high Tesla battery units tethered to a field of 99 towering wind turbines.

The French renewable energy company Neoen SA spent €56 million on Hornsdale, which can deliver enough electricity to power 30,000 homes. But the plant’s key task is to help stabilize fluctuations in supply and demand, preventing outages in a state the size of Egypt where a rising share of renewables now accounts for almost half of power generation.

Australia is a natural testing ground for renewable energy

research. Vying with Africa as the world’s sunniest continent, the nation of 25 million people grapples with some of the highest power prices in the world. This year, as many as 60,000 homes—admittedly, a minuscule fraction of the total—will add battery storage systems, making Australia the world’s largest residential storage market.

Glorious beaches, fine weather, a counterculture vibe—these things have drawn surfers and eco-conscious hippies to Byron Bay since the 1960s. More recently, stylish resorts and swank holiday homes have moved in. Most, like Amileka, have installed rooftop solar panels. And more and more, storage batteries are joining the list of eco-accoutrements.

At the Arts & Industry Estate—a collection of boutiques, galleries, artist studios, and the like—a microgrid and storage battery setup will enable about 30 tenants to pool and share solar energy, lowering their bills. Nearby, a refurbished 1949 passenger train runs on solar power, shuttling tourists between the town’s main shopping strip and a beachside resort and sending surplus electricity back to the local grid. This isn’t exactly an eco-warrior’s utopia, but maybe it’s enough to give conventional electricity producers pause.

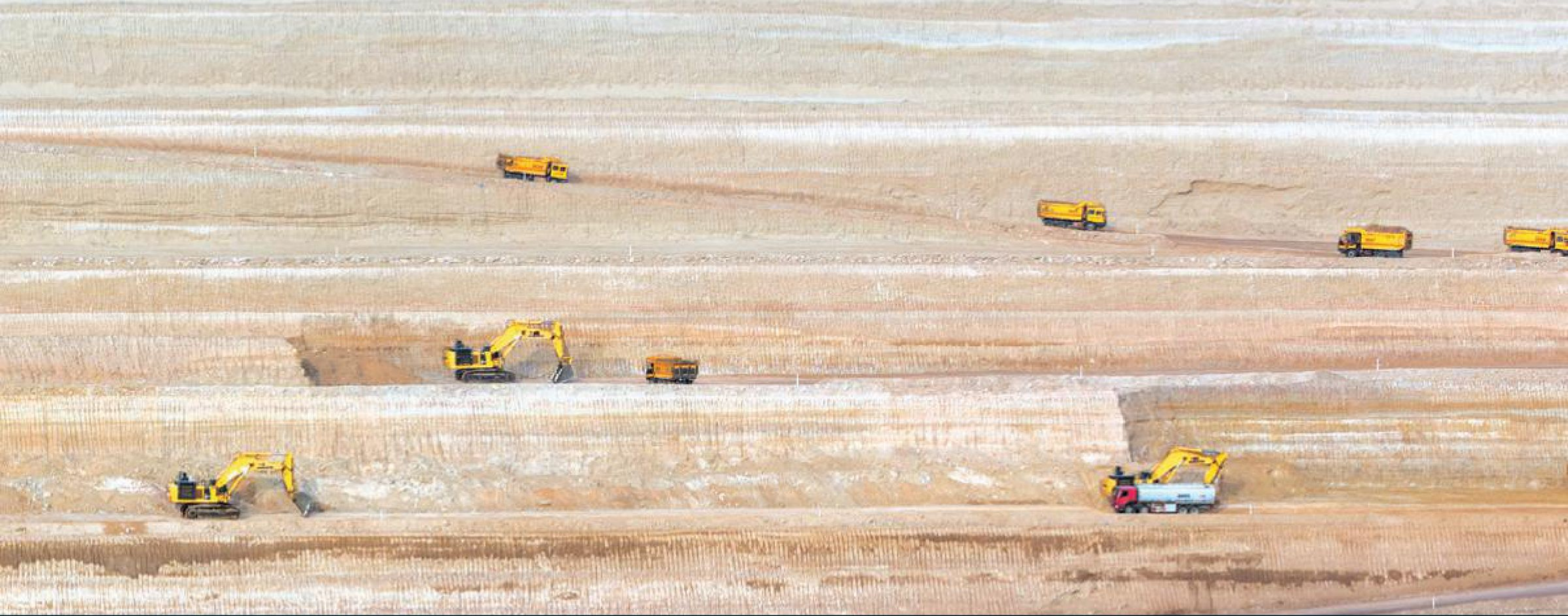
“I wouldn’t want to be a utility provider, particularly in the suburbs, in another 30 years,” says James Kennedy, chief technology officer at Brisbane-based Tritium Pty. The company, which manufactures some of the world’s fastest electric car charging stations two hours north of Byron Bay, is also studying the integration of vehicles into power grids. “What might sound like science fiction is in reality only two or three years away.” ●

Stringer covers energy and commodities in Melbourne.

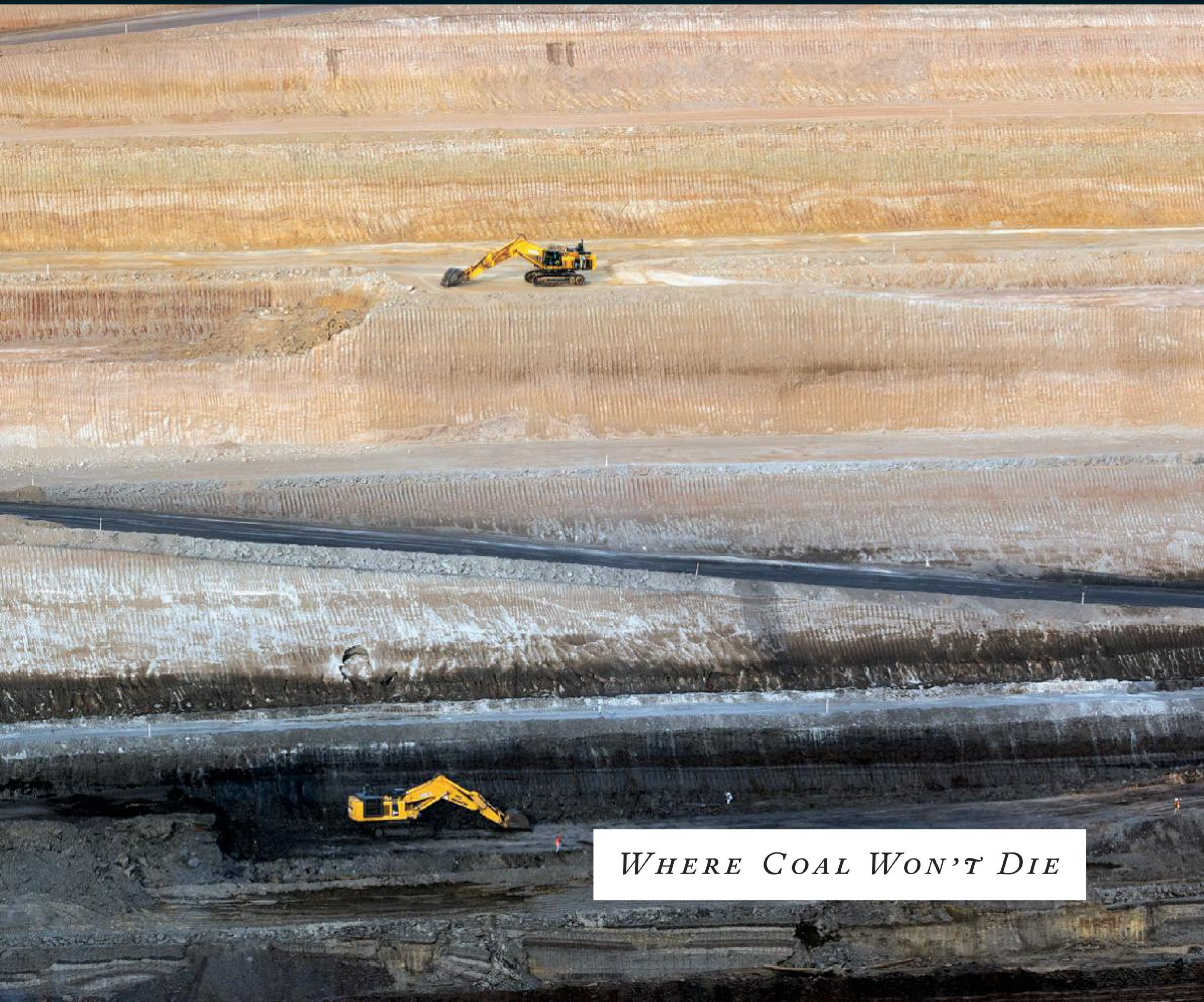


As this vast mine in Pakistan's Thar Desert attests,

despite the outcry against it



the world's No. 1 cause of carbon emissions will be a major source of electricity for decades,



WHERE COAL WON'T DIE

In the flat scrubland of Pakistan’s scorching Thar Desert, hundreds of workers have been toiling for two years in the vast open pit of the Sindh Engro Coal Mining Co. Taking three-hour breaks during the hottest part of the day and living in a makeshift village of shipping containers, they’re digging for fuel to sustain a \$3.5 billion power project. So far they’ve scraped away about 500 feet of Aeolian sand, dirt, and coal to create a milewide hole.

Seven hundred miles to the north, in the Cholistan Desert, lie the skeletal beginnings of a solar farm that’s supposed to expand to eight times the size of New York’s Central Park. It’s the largest solar project in Pakistan, where the government has recently announced an ambitious plan to generate 60% of its power from renewable sources such as sun, wind, and water in about a decade.

If these grand developments in the desert suggest that coal and solar are in a close-run contest, they’re not. Before 2016, Pakistan had a single coal-fired plant. It now has nine, supplying 15% of the nation’s electricity, with another four under construction. Solar power provides about 1% of energy needs and is getting a tiny sliver of investment compared with what’s going into coal. Solar and other renewables may someday eliminate Pakistan’s dependence on coal, but that day is probably decades away.

And that’s fine as far as Akhtar Mohammad is concerned. “Coal is good. It’s cheap,” he says at his roadside kiosk in Port Qasim on the outskirts of Karachi, where air pollution is “among the most severe in the world,” according to the nongovernmental Pakistan Air Quality Initiative. He sells sweets, sachets of Head & Shoulders shampoo, and other basics in the shadow of transmission lines that carry power from a new electricity plant that burns imported coal. What about carbon emissions? He shrugs. “This is a small problem,” he says. “There is a lot of smoke and bad air already. We need electricity—any fuel, it doesn’t matter.”

Mohammad’s pragmatism sums up the planet’s quandary. “Coal is the absolute No. 1 cause of carbon emissions globally and the leading driver of climate change,” says Tim Buckley, Sydney-based director of energy finance studies at the Institute for Energy Economics & Financial Analysis. But though wealthy nations may be able to afford to wean themselves off the combustible carbon that’s one of the biggest contributors of greenhouse gases, in countries where electricity is scarce, unreliable, or unaffordable, local politics often takes precedence over economics: Coal remains the cheap fallback.

Especially in Asia, dozens of coal plants have come on line in recent years or are in the planning stages—with a normal lifetime of almost a half-century. In South and Southeast Asia, coal burning is expected to increase about 3.5% a year for the next two decades, according to the International Energy Agency. Globally, the IEA predicts, coal demand won’t peak until 2040. And that may be optimistic. Forecasts such as the IEA’s often assume governments will choose the cheapest option based on optimum efficiency while factoring in environmental constraints and the falling cost of solar and wind power.

The world grew up on coal. People in China burned it to smelt copper 3,000 years ago. Britain used it to power the boilers of the Industrial Revolution in the 1700s. In the 19th century, Americans shoveled it into locomotives to connect the country. When Thomas Edison built the first power station for his electric lightbulbs in 1882, it was fired by coal. ▶





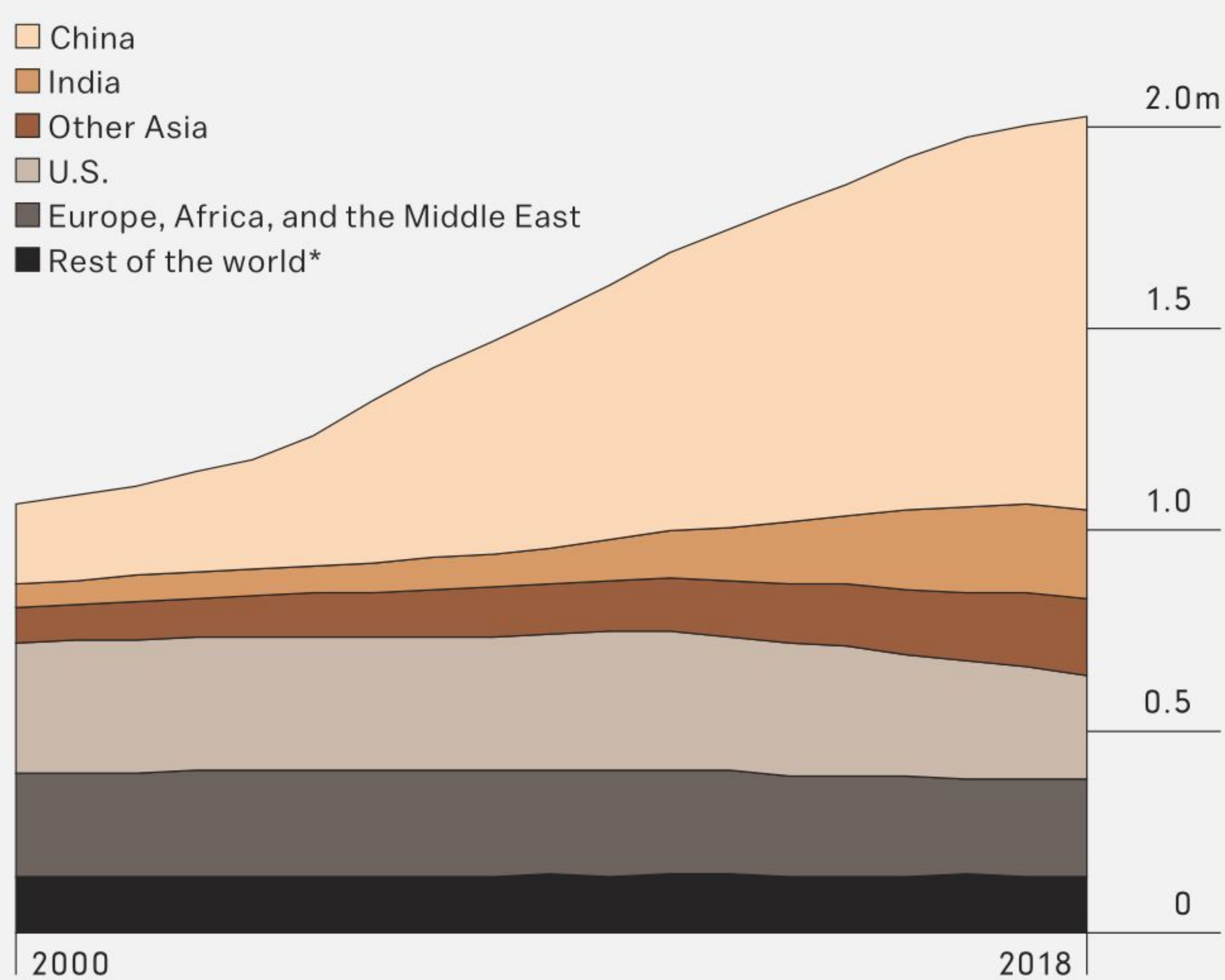
Mounds of imported coal accumulate at Port Qasim on the outskirts of Karachi



At Port Qasim, smoke from an older oil-fired power station (right) drifts across a newer plant that burns imported coal

A World of Carbon

Global coal power capacity, in megawatts



*Includes the former Soviet Union
Sources: Carbon Brief, Global Energy Monitor

And now? Coal consumption won't decline as significantly as people think, says Shirley Zhang, Wood Mackenzie Ltd.'s principal Asia-Pacific coal analyst. On the one hand, annual global seaborne coal trade probably peaked last year at 980 million tons. On the other hand, from now to 2040, it will decline by only 20 million tons, she says. Despite the rise of renewables, the roll call of governments adding coal-fired plants includes four of the world's five most populous nations: China, India, Indonesia, and Pakistan.

In 2018, when global carbon emissions rose 2.9%—the biggest jump in seven years—China, India, and the U.S. accounted for two-thirds of the increase, according to BP Plc's *2019 Statistical Review of World Energy*. As developed nations retired coal plants producing 17 gigawatts of power, consumption and production of coal advanced in Asia at the fastest rate in five years.

Which brings us back to Pakistan. On paper, it could be one of Asia's top economies. Twice the size of California, Pakistan is home to more than 200 million people between the icebound peaks of the Karakorum and the shores of the Arabian Sea, most of them in the fertile valleys of the Indus River and its tributaries that run down the center of the country. But it's hobbled by corruption, political turmoil, terrorism, and poverty. In July, shortly after the country got its 22nd bailout from the International Monetary Fund, the central bank raised its base ▶



Major opportunity. In a micro size.

Introducing the Micro E-Mini Futures.
Designed for individual traders,
these four new index contracts offer
more versatility and capital efficiency,
at a fraction of the cost.

Micro E-mini Futures

START TRADING TODAY
activetrader.cmegroup.com/microemini

S&P
500

Nasdaq-
100

Russell
2000

DJIA

rate to an eight-year high of 13.25% amid soaring inflation.

Add to Pakistan's woes a crippling shortage of energy. Although the government has made progress in tackling the power deficit, blackouts are a way of life. Tens of millions of people aren't connected to the grid. In 2015 inefficiencies in the power sector cost the economy \$18 billion, or 6.5% of gross domestic product, according to a World Bank report. When it comes to power, says James Stevenson, Sydney-based senior director for global coal research at IHS Markit Ltd., "it's having it or not that matters, not where it comes from. Governments wanting to be elected want people to have electricity. That's why coal has momentum."

THE SIGHTS AND SOUNDS at the Sindh Engro mine in the Thar tell you a lot. The coal being scooped out of the ever-deepening hole is soft, brown, and crumbly—lignite, one of the biggest producers of greenhouse gases. Lignite and hard black anthracite generate about twice the level of carbon dioxide as natural gas; gasoline and heating oils fall about halfway between the two.

The workers digging in the mine, where temperatures can reach 50C (122F), are Pakistani and Chinese. In total, China will provide financing—from 50% to 90% of total costs—for \$60 billion in projects to upgrade Pakistan's transport and energy infrastructure, making the South Asian country a standout partner of Beijing's "Belt and Road" initiative. Of the 10 biggest BRI power projects by capacity, eight are in Pakistan, and five of those are coal-fired.

China is a vivid example of the rich-poor quandary when it comes to weaning the world off coal. Like many developing nations, it has taken measures to curb climate change, shutting some of its most-polluting steel mills and power plants and relying increasingly on alternative sources. It added more renewable energy last year

than all of the 36 member countries of the Organization for Economic Cooperation and Development combined, according to the BP report.

But at the same time, China is the world's largest producer and user of coal. It's helping to pay for and build power plants in at least a dozen countries, and though many are solar, wind, natural gas, and hydro projects, the bulk of the Chinese investment is in coal. That doesn't bode well for the 2016 Paris Agreement on climate change, in which almost 200 nations, including China, pledged to take steps to limit the increase in global average temperature to well below 2C. That commitment basically requires the phasing out of coal: Since the Industrial Revolution, the Earth has warmed by 1 degree and is predicted to at least double that by the end of the century, the fastest pace since the end of the last Ice Age.

IT'S NOT AS IF Pakistan doesn't have alternatives to coal. The country's current natural gas fields are dwindling, but the IEA estimates its shale reserves could contain more than 9 billion barrels of recoverable oil and 105 trillion cubic feet of gas, enough to meet the nation's needs for decades. It has five nuclear reactors, fed with locally mined uranium, and plans to build two more with Chinese help.

Pakistan is also a regional leader in hydropower. About 29% of its electricity comes from harnessing water, including the massive 4.9GW Tarbela Dam on the Indus River, the largest earth-and-rock-filled dam in the world. Such big structures have come under increasing criticism from environmentalists because of their impact on local ecosystems and populations, but Pakistan plans to build more.

Another problem with hydropower infrastructure is the heavy cost of construction, which is hard to pay for without international support. Pakistan's proposed \$10 billion-plus Diamer-Bhasha Dam, upstream of Tarbela, has held at least five ►

**“Governments wanting to
be elected want people to have electricity.
That’s why coal has momentum”**



For your modern classic

Your home is more than a building or an address. It's where you experience life, family, connection, growth. Your home should be as exceptional as you are, and as you are going to be. For a lifestyle inspired by your potential, there is only
Sotheby's International Realty.



Only

Sotheby's
INTERNATIONAL REALTY

sothebysrealty.com | Napa, California | Property ID: VQXSB6

For those seeking an exceptional life

— Only —
Sotheby's
 INTERNATIONAL REALTY

PARADISE ISLAND, BAHAMAS



Ocean Club Estates
 \$15,995,000 Property ID | 28755
 sirbahamas.com
 Damianos Sotheby's International Realty
Nick Damianos
 Nick.damianos@sirbahamas.com +1 242.376.1841

PROVIDENCIALES, TURKS & CAICOS ISLANDS



Beach Enclave North Shore - Villa 6
 \$5,750,000 Property ID | WCEHZF
 turksandcaicosSIR.com
 Turks & Caicos Sotheby's International Realty
Nina Siegenthaler
 Nina@tcsobthebysrealty.com +1 649.231.0707

MILL VALLEY, CALIFORNIA



365 Lovell Avenue
 \$3,495,000
 globalestates.com
 Golden Gate Sotheby's International Realty
L. Sarkissian | M. Sarkissian | B. Bullock
 L.Sarkissian@ggsir.com +1 415.517.7720

GATEWAY, COLORADO



Gateway Canyons Ranches & Resort
 \$279,000,000
 GatewayCanyonsProperties.com
 LIV Sotheby's International Realty
Kerry Endsley
 kendsley@livsothebysrealty.com +1 303.570.0267

VAIL MOUNTAIN, COLORADO



424 Forest Road
 \$19,950,000
 424forestroad.com
 LIV Sotheby's International Realty
Tye Stockton
 tye@tsgvail.com +1 970.471.2557

VAIL MOUNTAIN, COLORADO



Golden Peak Penthouses, East
 \$21,500,000
 goldenpeakpenthouses.com
 LIV Sotheby's International Realty
Tye Stockton
 tye@tsgvail.com +1 970.471.2557

PLANTATION KEY, FLORIDA



158 Redwing Road
 \$2,950,000 Property ID | 6T25N5
 oceansir.com
 Ocean Sotheby's International Realty
Kim Thaler
 kthaler@oceansir.com +1 305.712.8888

NEW YORK, NEW YORK



990 Fifth Avenue, PH 12/13/14
 \$52,000,000
 990ph.com
 Sotheby's International Realty East Side Manhattan Brokerage
Harry Nasser | Lois Nasser
 Harry.Nasser@SothebysHomes.com +1 212.606.7706

NEW YORK, NEW YORK



111 West 67th Street, 35 DEF
 \$24,995,000
 TheWellnessApartment.com
 Sotheby's International Realty East Side Manhattan Brokerage
Allison B. Koffman | Juliette R. Janssens
 Allison.Koffman@sothebysHomes.com +1 212.606.7670

LIGONIER, PENNSYLVANIA



387 Fisher Lane
 \$1,950,000 Property ID | XPKCX5
 piattsir.com
 Piatt Sotheby's International Realty
Kate Balzer
 kbalzer@piattsir.com +1 702.553.5825

NASHVILLE, TENNESSEE



505
 \$395,000-\$6,000,000
 505Condos.com
 Zeitlin Sotheby's International Realty
Caroline Rigsby
 caroline.rigsby@zeitlin.com +1 615.306.4152

GREEN LAKE, WISCONSIN



Waterfront Development Property
 \$14,500,000
 HeidelHouse.com
 Jameson Sotheby's International Realty
Kurt Penn
 kurt@kurtpenn.com +1 773.206.0302



At the Sachal Energy wind farm in Sindh province, a worker washes solar panels for a water filtration plant that's part of the project

groundbreaking ceremonies over the decades without ever scoring enough financing to proceed.

Meanwhile, Pakistan is pursuing renewable options that require less startup capital. The government of Prime Minister Imran Khan has set a 2030 target to generate 30% of the nation's energy from large hydro plants and another 30% from other renewable sources that currently supply only about 4%, including arrays of wind turbines springing up along the coast in Jhimpir.

At the forefront of that plan is the Quaid-e-Azam Solar Park in the Cholistan Desert. Originally envisioned as a 1GW plant, it is also backed by Chinese money and technology. The first 100MW started flowing to the grid in 2015, and a contract for the remaining 900MW was awarded to a unit of Chinese telecommunications giant ZTE Corp. with the aim of completing the project by 2016.

But the park has been dogged by controversy—over the award of the contract, allegations of misappropriation of funds, and questions about its efficiency. So far, ZTE's Zonergy Co. has added only 300MW after the government reduced the price it agreed to pay for the power. Syed Faizan Ali Shah, Zonergy's deputy general manager for marketing and technical sales, says expansion stalled because the government changed the way it sets prices, which have fallen from 14¢ per kWh to about 6¢ since 2015. Scrutiny of past deals increased after the Khan government came to power last year,

including an investigation by the National Accountability Bureau, which also probed two coal-power projects.

Like all solar plants, the one at Quaid-e-Azam is at the mercy of environmental whims, such as variations in sunlight. It faces particular challenges as well, including the frequent dust storms off the Cholistan: If the panels aren't regularly cleaned, the accumulation of dust can drastically slash the plant's average power output. According to local media reports, doing the job could require up to 10 million liters of water a year—enough to meet the annual needs of 9,000 people. Shah says the panels only need to be cleaned about twice a month to meet company benchmarks.

In contrast to the stuttering start of Pakistan's renewable ambitions, the view of the future from the Thar coal mine is one of confidence. "When people talk about coal plants getting shut down or people moving away from coal, they don't understand what's happening," says Ahsan Zafar Syed, chief executive officer of Engro Energy Ltd., the Pakistani company leading the project. "Coal plants that are getting shut down have outlived their useful life. As I speak, there are 26 countries in the world where coal power plants are being constructed. They are everywhere." ● — *With Dan Murtaugh*

Majendie is a senior editor for Bloomberg in Singapore. Mangi covers the Pakistan economy in Karachi.

Transporting
a Vestas rotor blade
through Jutland

T

R

A

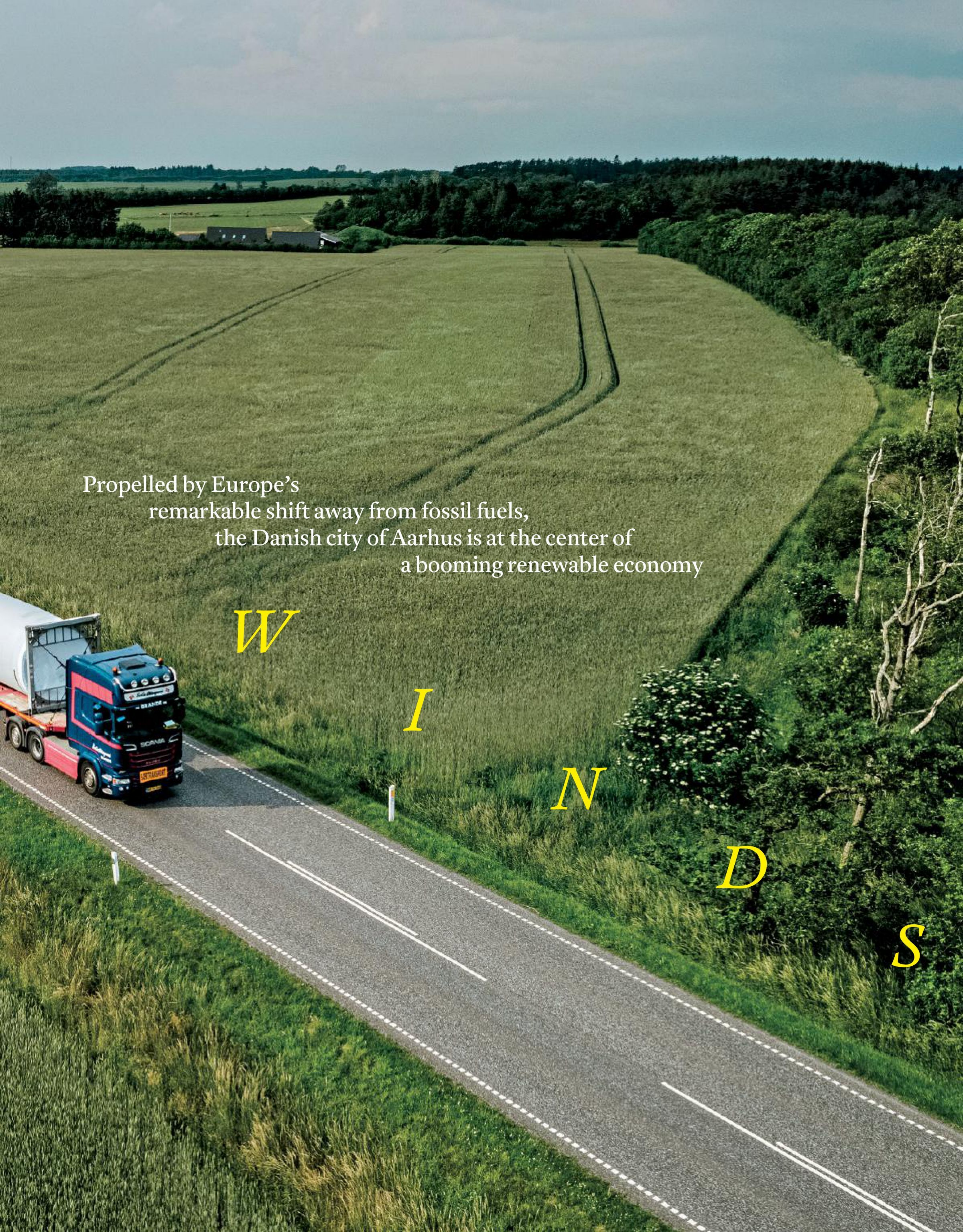
D

E

By LARS PAULSSON

PHOTOGRAPHS BY
RASMUS DEGNBOL



An aerial photograph of a paved road winding through a lush green landscape. A blue and red Scania truck is driving on the road. The word "WINDS" is written in large, yellow, serif capital letters across the middle of the image. In the background, there are rolling green hills, a line of trees, and a few buildings under a cloudy sky.

Propelled by Europe's
remarkable shift away from fossil fuels,
the Danish city of Aarhus is at the center of
a booming renewable economy

W

I

N

D

S

Navigating a specially modified traffic circle in Tarp





Inspecting
a 295-foot-tall
turbine





With its lively waterfront, tree-lined canal, and red-brick buildings topped by steep gunmetal-gray roofs, Aarhus looks like just another coastal city in Northern Europe. But get closer, and what comes into focus is a place central to the continent's remarkable shift to renewable energy. Down by the docks, at a facility nestled among huge oil tanks that reek of the past, the world's biggest wind-turbine maker tests parts for these gargantuan machines of the future. Meanwhile, in offices all across Denmark's second-largest city, fast-growing cadres of energy traders are making big bucks from the volatility that wind and solar power generate.

This didn't happen by accident. What would ultimately become Vestas Wind Systems A/S started as a blacksmith shop in 1898 on the western edge of Jutland, a windswept peninsula sandwiched between the North Sea and southern Sweden. Until the 1970s the company's products ranged from milk coolers to steel window frames. As Denmark, a net energy importer, was stung by that decade's oil crises, Vestas turned its hand to alternative energy. Early turbine prototypes—including one that looked like a giant egg whisk—were developed in secret. After several decades building up its wind-turbine business, the company moved its headquarters to Aarhus, Jutland's biggest city.

Today wind regularly meets more than half of Denmark's demand for power. As the country's reliance on wind has grown, Aarhus and surrounding towns have become a renewable energy melting pot—of manufacturers and suppliers, traders and analysts, specialist lawyers and academics. China's largest maker of wind turbines, Xinjiang Goldwind Science & Technology Co., has a ►

Denmark's Windy City

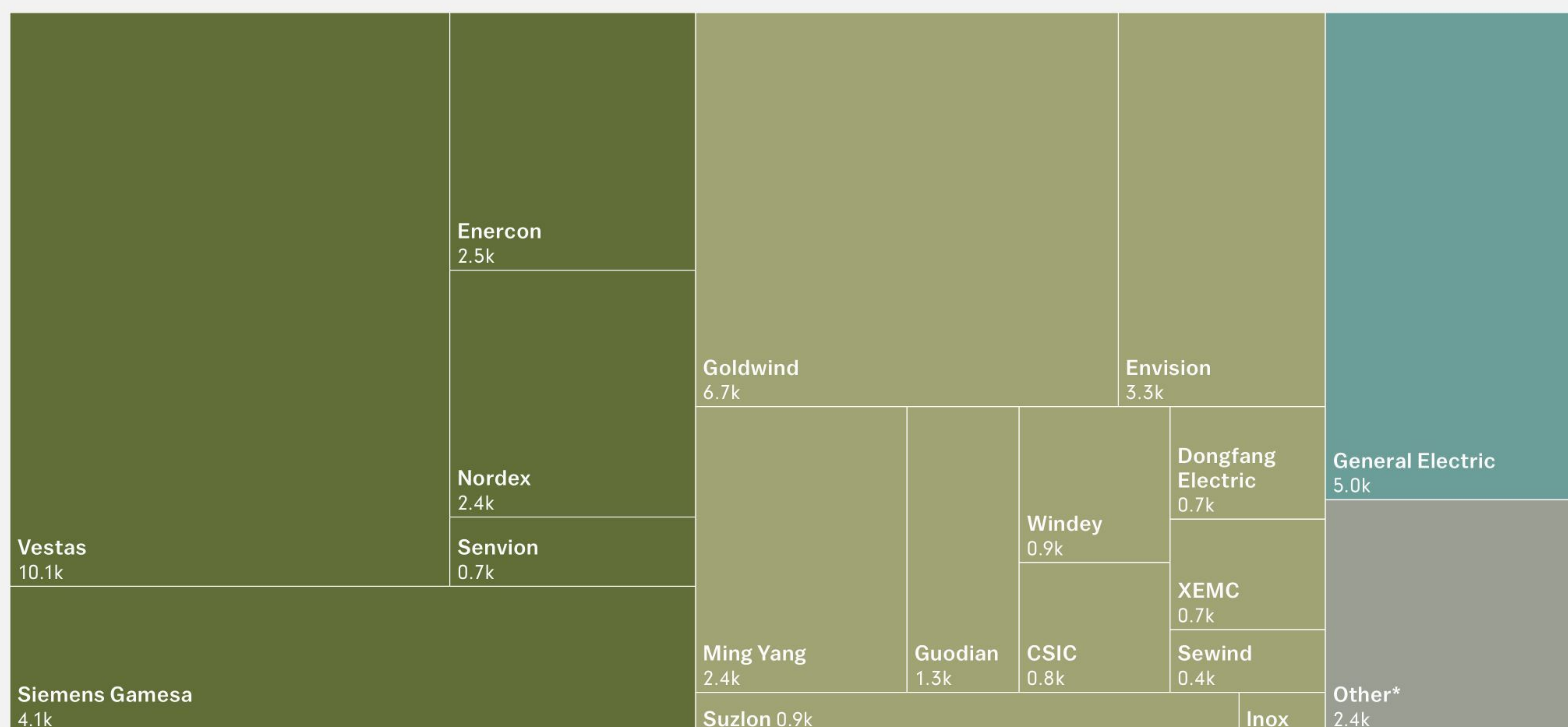


Source: Natural Earth

Big Wind Around the World

Onshore turbine manufacturer market share in 2018, by megawatts of commissioned capacity

Company's region of domicile ■ Europe ■ Asia ■ Americas ■ Other



*Includes companies in Europe, Asia, and the Americas

Source: BloombergNEF

research office here. In 2016 energy and environmental companies accounted for the port city's second-biggest export industry (after food), according to the latest available data from the municipality. "Renewable energy plays a huge role in the city," says Mayor Jacob Bundsgaard. "It's not just Vestas."

Traders sometimes liken Aarhus to the Swiss commodities hubs in Geneva or Zug. Judging from the low turnover rates at local trading firms, the city (population 345,000) offers enough to keep people from shoving off to Copenhagen or London or beyond. Besides the buzz of the work, the attractions range from the cosmopolitan ambiance provided by Aarhus University to four restaurants with Michelin stars. "Aarhus more than lives up to big brother Copenhagen's reputation as a foodie destination," says Soren Jessen, a Danish former banker who owns restaurants in London.

Bundsgaard, 43, has been mayor since 2011. Most mornings, typifying the municipality's mission to become carbon neutral by 2030, he cycles to work at city hall. Aarhus, where CO₂ emissions have been cut in half over the past decade, has built a 110-kilometer (68-mile) electric tram network and will introduce electric buses this year. Wastewater treatment plants are ordinarily very energy-intensive; Aarhus's produces 40% more power than it consumes.

Perhaps the most striking monument to Aarhus's place in the world of renewable energy is a biomass plant that opened in 2017. Atop a hill at Lisbjerg, on the edge of the city, three enormous 45-meter-high glass boxes soar above a landscape of farms and woodland. More than 60 trucks a day deliver agricultural straw to the plant when it's running at full capacity. Next door, in another

box, there's an older waste facility. Here, 150 trucks a day dump rubbish that's incinerated at 1,000C (1,832F). Both plants produce electricity and pump hot water into the Aarhus district's heating system. "We're almost free from coal now," Bundsgaard says.

Trading Places

To get onto one of the trading floors at Danske Commodities A/S, you take a glass walkway across a shallow pool of water whose murmuring lends an air of tranquility to the space. For the traders, it can be a place of respite: The markets they cover are anything but calm.

While many assets may move a percentage point or two at most during a daily session, intraday electricity contracts can jump or slump at many times that rate. All it takes is a sudden drop in wind or a few unexpected hours of sunshine. This volatility has spurred the development of a niche industry here. DC is the biggest of the 10 or so companies in Aarhus that specialize in Europe's power and natural gas markets, which together were worth €1.65 trillion (\$1.85 trillion) last year, according to Prospex Research Ltd.

A gas trader named Henrik Lind founded DC in 2004. He'd spotted an opportunity to profit from price differentials across geographical markets and began to move power between Denmark and Germany. The company, whose profit rose 28% to €72 million in 2018, has about 300 employees and operates in about 40 markets. Equinor ASA, a Norwegian oil major, bought out Lind, who owned a majority of DC, and other shareholders for €400 million in a deal that was completed in February. Lind is staying on as board member.

Bolstered by \$100 million in capital from Equinor in the second quarter of this year, DC is expanding, looking to buy more capacity on international power cables and more gas storage capacity on the continent. Pursuing an expansion strategy it calls Level Up (after the computer-gaming term), it will start trading in the U.S. power market this year following its foray into Australia last year.

Helle Ostergaard Kristiansen, DC's chief executive officer since April, says the expansion won't stifle the startup ethos instilled by Lind. "It is part of our DNA, that entrepreneurial culture that we want to maintain," says Ostergaard Kristiansen, who began working at DC in 2010.

That spirit is exemplified by Cagdas Ozan Ates, a Turk who acquired a master's degree in finance and international business at Aarhus University. He joined Lind at DC as one of its first employees when it was little more than a small office with a handful of computers and stayed for more than a decade in various senior roles. Last year, Ates was appointed CEO at MFT Energy A/S. In a departure from DC, which had been built around a strong majority owner, MFT's plan is to set up partnerships that will give traders a larger share of profits. Lind "always asked, 'What else can we do tomorrow, what can we do better?'" says Ates. "We learned a lot from him. And we took it with us."

As more countries turn to wind and solar to replace polluting fuels, markets have become more turbulent and rich in opportunities for trading companies. In Germany, the largest European electricity market, consumers have spent many billions of euros to help finance "climate chancellor" Angela Merkel's green economy agenda, her double-edged strategy to phase out both coal and nuclear energy. Trading in contracts for power delivered the same day in Germany last year surged 13% to a record high on Epex Spot SE, the main exchange for such markets.

As more companies pile into the intraday power market, margins on trades are decreasing and more and more deals are automated. While individual trading companies don't disclose the ratio of machine- to human-led transactions, 37% of the German intraday market was automated last year, according to Epex. Automation is constantly taking the speed of transactions

Ostergaard Kristiansen



As Denmark's reliance on wind has grown, Aarhus has become a renewable energy melting pot—of manufacturers and suppliers, traders and analysts



to new levels. DC has set up a server in Frankfurt that will cut execution time to 6 milliseconds from 24 milliseconds.

Jesper Johanson is taking no chances. He runs another Aarhus-based trader, InCommodities A/S. Since he co-founded the company in 2017, it's grown to almost 40 employees. To feed the next growth phase, Johanson says he's hiring developers as well as traders. "We are just as much an IT company as we are a commodity trader," he says.

The Wind Farmer

Vast swaths of flat farmland dominate the west coast of Jutland. About the only thing that breaks up the landscape is the dispersed forest of turbines that convert wind from the gusty North Sea into electricity. One of them, a Vestas V112 model, towers almost 100 meters above a farm that grows everything from carrots, cabbage, and potatoes to parsley and dill. The spread's proud owner also happens to be Vestas's chief technology officer, Anders Vedel, 62.

Vedel's interest in wind was first roused when he was a young child sailing the waters north of Copenhagen. This melded fortuitously with an attraction to tech: Also as a youngster, he built his own solar-heated water system. Even so, he remained a full-time farmer until he was in his early 30s, when he set out to receive a mechanical engineering degree.

When he got his start at Vestas in Lem, Jutland, in 1995, the biggest blades the company made were 19 meters long; today they stretch to 73 meters, or a bit longer than the wingspan of ►



Warehousing rubbish at Lisbjerg that will be incinerated to produce electricity and pump hot water into a district heating system

a Boeing 747. Over that time, the power capacity of the turbines has increased more than tenfold.

In the early days, the cost of producing power with wind was much higher than anybody would willingly pay. So a company like Vestas, with a tiny customer base at the time, was at the mercy of government subsidies, tax breaks, and tariff exemptions in the countries where it did business.

Last year wind supplied 5% of the world's total power output. As the industry has matured in recent years, nations have been able to scale back their support and switch to auctions, forcing both utilities and suppliers such as Vestas to narrow their profit margins.

Today onshore wind in Europe is competitive with conventional power sources, or nearly so. In Spain, wind technology's so-called levelized cost of energy (the unit cost of electrical energy over the lifetime of a generating asset) dropped 41% from 2016 through the first half of this year, according to BloombergNEF, Bloomberg LP's primary research service on energy transition.

Markets and the turbine industry are becoming increasingly linked. Vedel says his turbine is regularly switched off when wind speeds exceed about 9 meters per second because of plunging prices. And who's switching it off? The folks over at DC.

"It's good that we drive down the cost of energy, and we'll

still focus on that," Vedel says. The challenge is this: If energy costs fall too quickly, turbine manufacturers won't be able to get a sufficiently large return on their own investments. At that point, Vedel says, "the industry starts to have a problem."

So far, Vestas hasn't reached that stage, according to Jacob Pedersen, head of equity research at Sydbank A/S, based in Aabenraa, Denmark, who's tracked the company for almost two decades. "The sharp drop in prices has hit the competitors harder," he says. "Vestas still has the best profitability in the industry."

To stay ahead, Pedersen says, Vestas needs to keep doing what it's doing well and also to innovate. A team of more than 70 people in Aarhus has been tasked with thinking beyond wind to help the company become a global leader in sustainable energy—including connecting wind, solar, and storage batteries. Wind will always be at the center of what the company does. Bo Svoldgaard may be Vestas's head of innovation and concepts, but even he says wind is "our heart and soul."

It's clear where Vedel's heart is. "From my living room and kitchen, I can see 22 turbines," he says. "I wanted to tear down another building on the farm because some of them I can't see very well. But my wife said, 'Stop!'" ●

Paulsson covers energy companies and markets for Bloomberg in London.

Scan Completed: MAR 09 2019 9:28

| Symbol | Price OCT 26 2018 | Seq All c/d Daily OCT 26 2018 | Combo/2b All c/d Daily OCT 26 2018 | All Setup: Daily OCT 26 2018 | Seq 10-Min: Daily OCT 26 2018 |
|-------------------|----------------------|----------------------------------|---------------------------------------|---------------------------------|----------------------------------|
| INTC UN Equity | 45.69 | 9 | 10 | 10 | 10 |
| JNJ UN Equity | 136.97 | 9 | 10 | 4 | 10 |
| JPM UN Equity | 103.42 | 10 | 10 | 5 | 10 |
| KO UN Equity | 45.92 | 11 | 7 | 1 | 10 |
| MCD UN Equity | 173.34 | 10 | 10 | 10 | 10 |
| MMM UN Equity | 184.95 | 10 | 10 | 5 | 10 |
| MRK UN Equity | 70.40 | 10 | 9 | 3 | 10 |
| MSFT UN Equity | 106.96 | 10 | 10 | 5 | 10 |
| NKE UN Equity | 72.07 | 5 | 9 | 10 | 10 |
| Total Up | | 7 | 9 | 0 | 10 |
| Total Down | | 9 | 9 | 6 | 10 |



DeMARK RE/SEARCH 2.0

NOW AVAILABLE FOR BLOOMBERG

An entirely new DeMark® experience for the Bloomberg Terminal enabling customized, real-time, on-demand intraday and historical DeMark Indicator® scans. Monitor your full universe of Bloomberg portfolios, Worksheets, CIX and more to keep you in sync with the market.

FOR A 30-DAY **FREE TRIAL** TYPE APPS TDRS<GO>

A NEW DIMENSION OF

DeMARK®

DeMARK.com / DEMA<GO>

Mohammad Sanusi Barkindo

The secretary general of OPEC since 2016 had years of experience in Nigeria's government and petroleum industry. Here he divulges some of his off-duty habits and preferences to Bloomberg TV's Francine Lacqua, co-anchor of *Bloomberg Surveillance* and host of *Leaders With Lacqua*.



How many hours of sleep do you get a night?

Normally between seven and eight.

What time do you set your alarm to wake up?

For 6 a.m. to pray al-Fajr.

Are you a morning or evening person?

Evening.

Do you have an essential morning ritual?

My prayers. And a glass of water.

What's your typical workout?

It is more a mental workout for me.

What's your favorite sport or sports team?

Football. The Nigerian national football team, the Super Eagles.

Which app is in heavy rotation on your phone?

WhatsApp.

What's your go-to lunch spot?

Le Couscous in Vienna.

Who is your favorite author?

I have always loved reading Shakespeare. And the great poet and scholar Rumi.

What's your favorite place to go on vacation?

It has to be returning to my home city of Yola. It's where I can see family, relax, recharge, and reconnect with my roots.

What living or historical person do you truly admire?

Dr. Rilwanu Lukman, the former OPEC secretary general. The most decent person I have ever met.

If you had to take a year off, what would you do?

I think I would go back to university. To research and write.

What is your biggest fear?

The breakdown of international institutions and the global order.

If you were 20, what business would you get into?

It would be the oil and gas sector, with a focus on technologies that can help reduce emissions.

Do you ever expect to retire?

Yes, but to return to academia.

A Compendium of Functions— New or Featured In This Issue

FEATURED IN THIS ISSUE

| | | |
|----------------------|--|------------|
| LEAG | Provides league tables for debt and equity markets including green bonds | 22, 23 |
| MAP | Map assets in the path of hurricanes and other weather events so you can gauge their impact | 26, 27 |
| MAPS | Lets you specify datasets to create custom visualizations | 29, 30 |
| BNEF | Access BloombergNEF data on energy and transport including information on renewable assets | 30, 39 |
| AID | Generates an instant report on your tickerized portfolio, which includes key information such as total and relative return as well as key valuation and risk metrics | 31 |
| FIW | Enables you to analyze and compare pricing, performance, and liquidity across large lists of bonds so you can identify relative value | 32, 33, 34 |
| HS | Perform spread analysis on two bonds selected in the FIW function | 34 |
| AHOY | Lets you track the movement of cargo between the U.S. and other countries using bill of lading data | 38, 39, 40 |
| MA | Track trends in mergers and acquisitions | 40, 41 |
| LINE | See an overview of supply, demand, and flows of a particular commodity such as crude oil | 40, 41 |
| SRCH | Search for bonds and loans that match criteria you specify, and track aggregated data such as the outstanding debt of an energy sector | 40, 41 |
| BI INTO CAPEX | Displays Bloomberg Intelligence's capital expenditure forecasts for integrated oil and North American exploration and production companies | 40 |
| FA EN | Displays a breakdown of key production and reserves data for a selected oil or natural gas company | 84 |

NEW ENHANCEMENTS TO TRY RIGHT NOW

| | |
|-------------|---|
| WSJ | Bloomberg terminal subscribers now have broad access to Dow Jones Newswires, the <i>Wall Street Journal</i> , WSJ Pro verticals, <i>Barron's</i> , and soon MarketWatch and the <i>New York Post</i> , aggregated alongside Bloomberg's own editorial content. To start exploring Dow Jones news and analysis, go to {NH DJ <GO>}. For the <i>Wall Street Journal</i> , run {WSJ <GO>}. |
| TAGG | Trades Aggregation is a new function that collects post-trade fixed-income data disseminated under the European Union's Markets in Financial Instruments Directive II. Run {TAGG <GO>} to see the volumes traded and gauge market direction and liquidity. You can use the filters at the top of the screen to group the data by source, sector, or other criteria. In addition, TAGG lets you input a custom list to see trade data for those bonds. |
| CAST | The Capital Structure function has been updated with a number of enhancements. Among them: You can customize your wake-up view and access new data on whether an entity is a holding or operating company. Run {DUK US Equity CAST<GO>} to view the capital structure of Duke Energy, for example. Click on the box next to Debt Type Breakdown to color-code the type of debt. For a visualization of the payout rank of an entity selected in the tree, click on the Summary Chart tab. |
| FHR | Futures Hedge Ratios is a new function that shows you the short position necessary to hedge a long position in interest-rate futures. Run {FHR <GO>} for a list of contracts and the corresponding cheapest-to-deliver bonds. |
| HLIB | New function Holdings Library lets you slice and dice aggregated holdings datasets so you can get a bigger picture of market trends. Go to {HLIB <GO>}. |

Faster, better answers—24/7. <Help><Help> for Bloomberg Analytics

The BLOOMBERG PROFESSIONAL service ("BPS"), BLOOMBERG TERMINAL and Bloomberg data products (the "Services") are owned and distributed by Bloomberg Finance L.P. ("BFLP"), except that Bloomberg L.P. and its subsidiaries distribute the BPS in Argentina, Bermuda, China, India, Japan, and Korea. Bloomberg Tradebook is provided by Bloomberg Tradebook LLC and its affiliates and is available on the BPS. BLOOMBERG, BLOOMBERG PROFESSIONAL, BLOOMBERG MARKETS, BLOOMBERG NEWS, BLOOMBERG ANYWHERE, and BLOOMBERG TRADEBOOK, BLOOMBERG TELEVISION, BLOOMBERG RADIO and BLOOMBERG.COM are trademarks and service marks of BFLP or its subsidiaries. The information detailed within this document and all related information (whether oral or written) is (1) provided for your information and discussion only, (2) non-binding and (3) subject to modification by Bloomberg. It is not a solicitation or offer to buy or sell any security or other financial instrument, nor is it an invitation or inducement to engage in investment activity. Nothing in this document is designed to be, or should be treated as, advice. If you are in any doubt as to your obligations or seek advice, you should consult your own professional advisers. Bloomberg does not guarantee the accuracy or completeness of the content of this document. Bloomberg does not accept liability for any loss arising from use or reliance placed upon this document and its content. Information provided in this document should be treated as confidential and proprietary to Bloomberg. Customer may not share, reproduce, publish, distribute or communicate this Proposal or information of any kind relating to these responses to any company, third parties or persons other than within Customer and only to such persons on a need-to-know basis in connection with this review. Certain features, functions, products and services are available only to sophisticated investors and only where permitted. BFLP, BLP and their affiliates do not guarantee the accuracy of prices or other information in the Services. Information available via the Services should not be considered as information sufficient upon which to base an investment decision. Communicated, as applicable, by Bloomberg Tradebook LLC; Bloomberg Tradebook Europe Ltd., authorized and regulated by the U.K. Financial Conduct Authority; Bloomberg Tradebook (Bermuda) Ltd.; Bloomberg Tradebook Services LLC. This communication is directed only to market professionals who are eligible to be customers of the relevant Bloomberg Tradebook entity. Neither Bloomberg Finance L.P. nor any of its affiliates is a Nationally Recognized Statistical Rating Organization (NRSRO) in the U.S. or an officially recognized credit rating agency in any other jurisdiction. Bloomberg's ratings have not been solicited by issuers, and issuers do not pay Bloomberg any fees to rate them or their securities. Customers should not use or rely on Bloomberg's ratings to comply with applicable laws or regulations that prescribe the use of ratings issued by accredited or otherwise recognized credit rating agencies. Bloomberg's ratings and related data are not investment advice or recommendations of an investment strategy or whether to "buy," "sell," or "hold" an investment. BDVD does not express an opinion on the future value of a security and does not provide recommendations to "buy," "sell," "hold," or enter into any transaction or other strategy. No aspect of the BDVD forecasts or data is based on a customer's individual circumstances. BDVD should not be considered as information sufficient upon which to base an investment decision. BDVD is offered where the necessary legal clearances have been obtained. Employees involved in BDVD may hold positions in securities included in the BDVD Services. For information on the BLOOMBERG PROFESSIONAL service, contact the sales office in your region: New York 212-318-2000, San Francisco 415-912-2960, Frankfurt 49-69-920410, Hong Kong 852-2977-6000, London 44-20-7330-7500, São Paulo 55-11-2395-9000, Singapore 65-6212-1000, Sydney 61-2-9777-8686, Tokyo 81-3-3201-8900.

August/September 2019, volume 28, issue 4, BLOOMBERG MARKETS (ISSN 1531-5061) (USPS 008-897) is published six times a year with issues in March, May, July, September, November and December by Bloomberg Finance L.P., 731 Lexington Avenue, New York, NY 10022, and distributed free to subscribers of the BLOOMBERG PROFESSIONAL service. POSTMASTER: Send address changes to Circulation, BLOOMBERG MARKETS, P.O. Box 1583, New York, NY 10150-1583. Periodicals postage paid in New York and at additional mailing offices.

©2019 Bloomberg L.P. Bloomberg reserves the exclusive right to reproduce or authorize reproduction of articles. Advertisers and ad agencies assume liability for all ad content.



Energy Production

By TINA DAVIS

FA EN
<GO>

IT'S LIKE READING the genetic code for an energy company.

Market prices should reflect the intersection of supply and demand. When it comes to oil and natural gas producers, a single page can provide all the data you need on output. On your terminal, type in any oil or natural gas company equity ticker and run {FA EN <GO>} to see a breakdown of key production figures.

Not only can you see the company's output over time—and easily chart growth from the previous year—you can also see how much it costs the company to produce the energy. Naturally, a struggling company will spend more to generate less.

In addition, you can check the company's remaining number of “reserve life” years. If you think about production as the equivalent of walking up a down escalator (oil and gas companies are continually seeking new sources to replace what's already pumped out of the ground), this data point shows how many steps above the bottom the company is. Mind you, the number can change drastically—the industry had to erase billions of barrels of reserves from financial statements after the price of oil collapsed in 2014, making it uneconomic to produce. A low reserve life generally indicates a company is under pressure to buy or find new oil fields. Colombia's state-owned oil company

Ecopetrol SA is noteworthy for its very short reserve life—it hasn't risen above eight years since 2009, but, crucially, it hasn't fallen below six.

Another useful figure on this page is the production mix, which shows how much of the company's output is oil vs. natural gas. Most major international oil companies have been producing more natural gas, betting that it'll be a “bridge fuel” to a transportation future that relies less on gasoline and more on electricity. Exxon Mobil Corp., for example, had a production mix that was 61% oil in 2009. That fell to as low as 47% in 2013 after the company bought XTO Energy Inc. to bulk up its shale gas holdings. ●

Davis is managing editor for energy and commodity news in the Americas.

Registered Investment Advisors

Interactive Brokers turnkey services help you build a competitive advantage, efficiently manage your business and serve your clients at lower cost.¹

Our complete and integrated advisor solutions include a free CRM and PortfolioAnalyst, IBKR's portfolio management system, as well as trading, client onboarding, clearing, reporting and billing for advisors of any size, with no contract required. Our transparent low commissions and financing rates and support for best price execution help to minimize costs to maximize your return.

- Advisor Portal, our simple yet powerful CRM solution, is free to use and lets you manage the full client acquisition and client relationship lifecycle from any desktop or mobile device.
- Flexible fee structures, including percent of net liquidation value, blended or flat fees, percent of P&L, performance fee threshold and high-water marking. In addition, automated client billing simplifies the fee administration and invoicing process.
- Enjoy free access to PortfolioAnalyst, our easy to use tool for consolidating, tracking and analyzing clients' total financial health. Your clients can use PortfolioAnalyst to link investment, checking, savings, annuity, credit card and incentive plan accounts held at virtually any financial institution for a complete portfolio view.
- Access to IBKR's advanced trading technology, including a pre-trade allocation tool to allocate block trades to multiple client accounts with a single mouse click.
- Build client centric investment strategies with access to stocks, options, futures, forex, fixed income and more across 125 market centers in 31 countries and 24 currencies. Access market data 24 hours a day six days a week to stay connected to all global markets.
- White brand statements, client registration and other informational materials with your own organization's identity, including performance attribution reports created by PortfolioAnalyst.
- Trade large or complex orders with the help of an experienced broker on the IBKR Stock, Bond and Options Order Desk. Broker-assisted trading is ideal when you are away from your desk, need another set of eyes watching your order or when electronic liquidity is insufficient.

TYPE INTB <GO>



To find out more, contact an
IBKR representative by calling
+41 41 726 9689

or by visiting:
ibkr.co.uk/ria

07-IB19-1221-UK

Interactive Brokers (U.K.) Limited is authorised and regulated by the Financial Conduct Authority. FCA Register Entry Number 208159. Your account is cleared and carried by Interactive Brokers LLC and for certain limited products by Interactive Brokers (U.K.) Limited. Interactive Brokers LLC is regulated by the US SEC and CFTC and is a member of the SIPC (www.sipc.org) compensation scheme. Only FCA-regulated products carried by Interactive Brokers (U.K.) Limited are covered by UK FSCS. Certain financial products are not suitable for all investors. Customers should read the relevant risk warnings before investing. Your capital is at risk and your losses may exceed the value of your original investment. Supporting documentation for any claims and statistical information will be provided upon request. For more information, see ibkr.co.uk/info

ETF

The next generation of ETFs is born.

0.05%
ongoing charges



CheAper*, SmArter 2.0

The Cheapest ETF range, by the largest European Asset Manager⁽¹⁾:

- Must have physically replicated equity & fixed income exposures
- Single OGC of 0.05% for the whole range

amundiETF.com

Confidence
must be earned

Amundi
ASSET MANAGEMENT

INVESTORS MAY BE EXPOSED TO THE RISK OF CAPITAL LOSS.

For professional investors only. Financial Promotion issued in the UK by Amundi Asset Management London Branch, 41 Lothbury, London, EC2R 7HF represented by Amundi Asset Management which is authorised by the AMF under registration no. GPO4000036 - 90 boulevard Pasteur, 75015 Paris, France and subject to limited regulation by the Financial Conduct Authority under number 401883. This material is not intended for citizens or residents of the United States of America or to any "U.S. Person", as this term is defined in SEC Regulation S under the U.S. Securities Act of 1933. This advertisement is for information purposes only and does not constitute a recommendation to buy or sell. Investment in a Fund must only be made on the basis of the key investor information document ("KIID") and its prospectus, which include information on the investment risks, and are available in English upon request or on amundiETF.com. Transaction costs may occur when trading ETFs.

*Source Amundi: Comparison based on the ongoing charges (OGC) of equivalent "core" ETF ranges available in Europe. Data from Bloomberg as of 31/01/2019. Important: some individual Funds may not be cheaper than their European peers or may not have an equivalent to compare with and vice versa. Analysis excluding third party commissions/costs incurred directly by investors when trading. (1) Source IPE "Top 400 asset managers" published in June 2018 and based on AUM as of end December 2017. | W