Investors should consider this report as only a single factor in making their investment decision. For Reg AC certification, see the end of the text. Other important disclosures follow the Reg AC certification, or go to www.gs.com/research/hedge.html.
2020, and a peek at 2021

As we head into year-end, we continue our tradition of taking stock of our Top of Mind themes, updating/revisiting our favorite graphics, and highlighting what to look for next year.

In a word, 2020 was unpredictable. A once-in-a-century pandemic took the world by storm. The global economy experienced what’s likely the deepest and fastest recession since at least WWII. And yet many equity markets are set to end the year near record highs.

Indeed, the spread of 2020's Black Swan: Coronavirus, which at last count has sadly infected at least 74 million people and caused more than 1.6 million deaths worldwide, dominated growth, markets, and, of course, our daily lives, throughout the year. The lockdowns in China in Q1, followed by Europe, the US and much of the rest of the world in the spring, caused the global economy to screech to a halt, pushing the world into a uniquely sharp Recession—with global activity falling by an estimated 20% from January to the trough in April.

Risky assets collapsed, with the S&P 500 falling by 20% in just 16 trading days (Feb 19—Mar 12), marking the fastest bear market in history. And commodity markets bore the brunt of the hit; despite OPEC+ finally agreeing to a historic Oil production cut in the face of plummeting demand and a tremendous surplus of physical oil supplies with nowhere to go, on April 20 the nearby WTI oil price contract closed at 37.6/bbl—the first negative settle ever.

All of this ignited a massive policy response, with the Fed swiftly cutting rates to the zero lower bound and other central banks with room to cut also doing so. And the Fed, ECB and other central banks expanded existing asset purchase programs and, in some cases, initiated new ones. The Fed also created a number of new facilities to backstop credit markets and ensure market functioning, solidifying its position as the liquidity provider of last resort. On the fiscal side, policymakers implemented fiscal easing much larger than during the Global Financial Crisis—on the order of around 7-8% of global GDP—which pushed global public Debt levels to roughly 100% of GDP this year—the highest level on record.

But almost as swiftly as economies shut down, they began to Reopen, with the manufacturing and construction sectors—where social distancing and other virus control measures are easier to implement—leading the way. Although the reopening process has been far from smooth, today the GS Effective Lockdown Index implies that global GDP has made up about 75% of the sharp drop that occurred in the first part of the year, and that pandemicinduced shutdowns are now inflicting a roughly 8% drag (vs. 20% at the peak) on growth relative to pre-pandemic levels. This has translated into eye-popping double-digit sequential growth rates in many countries during the second half of the year, with the US in particular expected to realize average quarterly annualized growth of 19% in 2H20.

But a significant further recovery in growth—especially in consumer-facing sectors—will likely require a successful rollout of a COVID-19 Vaccine that facilitates the development of herd immunity. With the UK, Canada and the US recently approving the Pfizer/BioNTech vaccine for emergency use—and vaccinations of high-risk groups having already begun—achieving this goal seems increasingly likely.

As for the growth implications of the other key event this year—the US election—we believe that the election of Joe Biden as the next US president, likely alongside a Republican-controlled Senate (with the crucial Senate majority hinging on the outcome of the January 5 Georgia runoff races), suggests that Post-Election Policies will be moderately supportive of growth, but not nearly as much as they likely would have been with a Blue Wave election outcome.

All told, assuming large shares of the DM population are vaccinated by mid-2021 and the EM population by the end of 2021, continued but fading fiscal stimulus in most major economies (that will push debt-to-GDP levels even higher), and still dovish monetary policy across the major central banks next year (and beyond; we don’t expect first rate hikes by the Fed, ECB and BOE until 2025), we expect above-consensus global growth of 6.3% in 2021, with our growth expectations exceeding consensus in all major economies except China.

This favorable growth backdrop leads us to believe that procyclical assets remain well-positioned heading into 2021, and we expect higher equity and commodity prices, tighter credit spreads, steeper rates curves and a weaker Dollar. But given that the market has already moved in a procyclical direction in response to positive vaccine news, we see the largest potential gains where we see the furthest room to run: commodities, Emerging Market assets, and breakeven inflation. We also see a further 6% decline in the broad trade-weighted Dollar index over the next 12 months, with risks skewed toward an even weaker Dollar.

The other places where we expect continued laserfocus by governments, investors and corporates in 2021 and beyond? Climate, as Biden begins to implement his climate agenda, the EU Green Taxonomy moves forward, and investment vehicles like green bonds and carbon ETFs (as well as ESG investing products more broadly) continue to proliferate. And Racial Economic Equality, given the growing realization by all members of society that achieving such equality is not only a moral imperative, but also essential for the health and vibrancy of our economy and our world more generally.

We thank you for your readership during this very trying year, and wish you a healthy, happy, and prosperous 2021.

Allison Nathan, Editor
Email: allison.nathan@goldman.sachs.com
Tel: 212-251-7700
Goldman Sachs and Co. LLC
"It doesn’t do any good to think about what’s going to happen to the economy, or for how long the stock market is going to decline or to how low. These things are unknowable. What really matters is whether price is proportional to fundamentals. It’s all about value."

— Howard Marks, Co-Founder and Co-Chairman, Oaktree Capital Management

"The key [to ESG investing] is to clear out preconceptions and treat ESG like any other investing question, which requires forming a clear investment thesis."

— John Goldstein ‘83 Head of Sustainable Finance Group

"In many parts of the world, the virus still has a lot of room to run until we reach enough infections that herd immunity starts to slow virus spread."

— Dr. Marc Lipsitch, Professor, Harvard T.H. Chan School of Public Health

"In many parts of the world, the virus still has a lot of room to run until we reach enough infections that herd immunity starts to slow virus spread."

— Dr. Marc Lipsitch, Professor, Harvard T.H. Chan School of Public Health

"One of the lessons we learned from the financial crisis is that you can see extraordinary action at the peak moments of crisis, but even when things are still quite bad, people can tire of taking action, and not want to do anymore."

— Jason Furman, Professor, Harvard School of Government

"Without a doubt, the most pressing [foreign policy challenge over the next four years] will be the US-China relationship, and more broadly, the future orientation of global technology and data."

— Ian Bremmer, President and Founder, Eurasia Group

"In some ways, the rise in the incidence of non-work represents the most fundamental change in the outcomes for men, and Black men in particular, in this country in many decades. And it suggests that just focusing on “earnings” gaps… presents an increasingly poor picture of what’s happening in the population overall."

— Kerwin K. Charles, Dean and Professor, Yale School of Management

"By all logic, the Dollar’s dominance in the global monetary system should be declining… But the reality is that the Dollar’s position remains as dominant as ever."

— Eswar Prasad, Professor, Cornell University

"When you step back, recent [oil] developments are a culmination of an unsustainable supply management strategy that is coinciding with an enormous demand shock, and the answer has to be low prices."

— Gary Ross, CEO of Black Gold Investors and Founder of PIRA Energy Group

"In regards to both the transmission and severity of cases, this could be a very significant event."

— Dr. Michael Osterholm, Director of the Center for Infectious Disease Research and Policy, University of Minnesota

"The whole point of having a strong balance sheet is to be able to use debt aggressively when you’re faced with a full-on crisis. And this is one where I would have no problem with policymakers taking the same actions twice over if it means we get out of this in one piece."

— Kenneth Rogoff, Professor, Harvard University

"You don’t want to wait for that exponential growth to show up in the numbers before reimposing some restrictions."

— Dr. Zeke Emanuel. Vice Provost of Global Initiatives, University of Pennsylvania

"It’s not just the rate of global growth that matters for the Dollar’s value, it’s how global growth compares to US growth."

— Barry Eichengreen, Professor, University of California, Berkeley

"If you focus on the level [of activity], you might say that we assume a U-shaped recovery. But if you focus on growth rates, you’d probably call our forecast V-shaped. . . But whatever growth we get will come from a much lower level."

— Jan Hatzius, GS Chief Economist and Head of Global Investment Research

"If we end up choosing policies that are expensive, we’re going to run out of enthusiasm before we’ve made substantial progress against climate change… carbon pricing is our best bet to achieve carbon reductions on the cheap."

— Michael Greenstone, Director of the Energy Policy Institute at the University of Chicago

"The sense is that this infection will probably spread worldwide… stringent control measures… won’t stop an epidemic, but they will slow it down and ultimately reduce the total number of cases."

— Dr. Barry Bloom, Professor, Harvard T.H. Chan School of Public Health

"[Under President Biden] higher taxes will be critical to pay for the more permanent measures required to make our economy, cities, and people more resilient to adverse shocks… But I don’t believe these narrowly targeted taxes will hurt the economy, especially when we net out the benefits from what they’re paying for."

— Jared Bernstein, economic adviser to President-elect Joe Biden

"If we end up choosing policies that are expensive, we’re going to run out of enthusiasm before we’ve made substantial progress against climate change… carbon pricing is our best bet to achieve carbon reductions on the cheap."

— Michael Greenstone, Director of the Energy Policy Institute at the University of Chicago

"History shows that President Putin doesn’t respond to sanctions. Sanctions just strengthen the relationship between China and Russia that has been developing in common cause against what they see as US unilateralism."

— Daniel Yergin, Vice Chairman of IHS Markit

"When we initiated our COVID-19 vaccine development program in late January 2020, we ambitiously set a target of 12 to 18 months for the availability of a vaccine at scale. Six months into the development effort, we’re still on target for the first half of 2021."

— Dr. Richard Hatchett, CEO, Coalition for Epidemic Preparedness Innovations
Revisiting 2020 themes, crossword-style

**Across:**

3. The Fed cut interest rates by 150bp in 2020, which compares to average easing of ____ hundred bp during post-war recessions (Issue 87).

4. Testing ____ and vaccines are all critical parts of the medical response to the coronavirus (Issue 88).

7. The WHO uses this term for a major infectious disease that spreads within communities on multiple continents (Issue 86).

10. There are currently 18 vaccines globally in this phase of large-scale efficacy tests and 7 have been approved for limited use (Issue 92).

12. Esvar Prasad, Professor at Cornell University, argues that the ____ of the RMB was likely never an end goal for Chinese policymakers in itself, and certainly isn’t one today (Issue 94).

14. Barry Eichengreen, Professor at the University of California, Berkeley, believes that the Dollar’s global status has been modestly ____ for the US (Issue 94).

15. Alec Phillips, GS Chief Political Economist, argued that a Biden administration with a divided Congress—the most likely election outcome at this point—would likely result in only ____ changes to fiscal policy (Issue 93).

17. Jan Hatzius thinks it’s hard to see how larger ____ would lead to weaker growth; if anything, the causation runs in the other direction, in his view, especially in the near term (Issue 90).

18. According to Dr. Mark McClellan, former FDA commissioner and Director of the Duke-National Center for Health Policy, this type of testing is critical not only for measuring the extent of virus exposure in different communities, but also to better understand whether past infection provides sustained immunity (Issue 89).

19. Howard Marks, CoFounder and Co-Chairman of Oaktree Capital Management, said it’s best to buy when people are ____ (Issue 87).

24. Daniel Yergin, Vice Chairman of IHS Markit, argues that while ____ is still important as a framework for oil producers, the future of the oil market will be determined by Saudi Arabia, Russia and the US (Issue 88).

26. Jared Bernstein, economic adviser to President-elect Joe Biden, notes that increasing the federal government’s share of ____ spending was one of the most effective economic relief policies with the biggest multiplier in his experience (Issue 90).

27. Both Gary Ross and Daniel Yergin argue that Saudi Arabia and ____ would be reasonably well-prepared to weather a sustained period of low oil prices (Issue 88).

28. According to Dr. Michael Osterholm, Director of the Center for Infectious Disease Research and Policy at the University of Minnesota, the US was heading into a “perfect storm” as COVID-19 took hold owing to a lack of domestic supply of critical care drugs and ____ (Issue 96).

**Down:**

1. According to Sylvia Yeh, co-head of Goldman Sachs Asset Management’s Municipal Fixed Income business, ____ are unlikely to default irrespective of their circumstances given that they have broad powers of taxation, can cut their budgets, and continue to have access to capital markets (Issue 90).

2. A large number of coronavirus cases are mild or ____ , making it more difficult to contain the spread (Issue 86).

3. Timothy Knowles and Shayne Evans, Co-Founders and Managing Partners of The Academy Group, believe that both increased ____ and a better allocation of ____ is a large part of the solution to improving school quality (Issue 91).

5. The value of the Dollar is typically ____ correlated with the health of the global economy, reflecting the currency’s unique international role (Issue 94).

6. Dr. Barry Bloom, Professor at the Harvard School of Public Health, says that current estimates suggest 60-70% of the population will likely need to have protective antibodies to achieve ____ immunity (Issue 89).

8. These type of bonds were first issued in 2007, and issuance has grown over 18x from 2013-2018 (Issue 85).

9. While Kenneth Rogoff, former IMF Chief Economist and Professor at Harvard University, believes a large run-up in deficits and debt makes sense today given the size of the coronavirus shock, he cautions that they’re not a free ____ (Issue 90).

11. Many climate change experts argue that it’s hard to see a path to a green future that doesn’t run through more efficient ____ (Issue 85).

13. Kerwin K. Charles, Dean and Professor at the Yale School of Management, believes that the rise in the incidence of ____ represents the most fundamental change in the economic outcomes of men, and Black men in particular, in this country in many decades (Issue 91).

16. A comprehensive study has shown that one key reason for the persistence of the Black earnings and income gap is that upward income ____ is lower and downward ____ is higher for Black men than for white men (Issue 91).

20. Michael Greenstone, Professor at the University of Chicago, believes that the ____ cost of carbon is the most important number you’ve never heard of (Issue 85).

21. GS economists have found that ____ mandates can raise the rate of actual ____ usage by 25pp on average (Issue 92).

22. Dr. Richard Hatchett, CEO of the Coalition for Epidemic Preparedness Innovations (CEPI), argues that we still don’t know whether there will be sufficient vaccine ____ to achieve global herd immunity next year (Issue 92).

23. Ian Bremmer, President and Founder of Eurasia Group, believes that US policy towards China would likely look fairly similar under a Biden administration as under President Trump, with a ____ approach on issues including technology and trade (Issue 93).

24. Jeff Currie, GS Global Head of Commodities Research, explains that negative ____ prices can occur if abundant supplies overwhelm storage and pipeline capacity (Issue 88).

25. The roughly $2tn ____ Act provided small business loans, relief to affected industries, individual stimulus checks, expanded unemployment insurance, and state fiscal aid, among other provisions (Issue 87).

Crossword from previous page of this report:

S T H E R A P E U T I C S
H A T T Y N
T H R E E B R U P I
D S A N I N T E R N A T I O N A L I Z A T I O N
P O S I T I V E N H M
E R D E F I C I T S N A
I P E S S I M I S T I C
O O P E C C S N
I A L R U S S I A I
P P E S S

F I V E U N P A N D E M I C
G L M D G A
I N T E R N A T I O N A L I Z A T I O N
G I O N
L I M I T E D W
A N T I B O D Y R K
M E D I C A I D M T W
N A Y K N I S H
D I S H
Watching

- Globally, after a pandemic-induced contraction of an estimated 3.7% in 2020, we expect above-consensus global growth of 6.3% in 2021. Our optimism reflects the view that widespread immunization next year, accommodative monetary and fiscal policy, and limited scarring effects will support a continued recovery in economic activity, though the recent rise in virus cases is likely to trigger a period of softer growth this winter.

- In the US, we expect virus resurgence to weigh on activity throughout January, though services activity has proven more resilient than expected. We expect a large rebound in 1Q21 on the back of widespread immunization—with 50% of the population expected to be vaccinated by April—and forecast above-consensus 5.3% growth in 2021. We expect the unemployment rate to fall to 1.6% by year-end 2021.

- The Fed has adopted flexible average inflation targeting and outcome-based forward guidance, which we view as consistent with our expectation of liftoff around early 2025. The Fed has also adopted outcome-based forward guidance for asset purchases, committing to maintain them “until substantial further progress has been made toward the Committee’s maximum employment and price stability goals.” On the fiscal policy front, congressional leaders are currently negotiating a COVID-relief bill that is reportedly in the $900bn range, which could be passed in the next few days.

- In the Euro area, we expect a 2.1% qoq non ann. decline in real GDP in Q420 and 0.9% qoq non ann. growth in Q121 as countries continue to contend with virus spread, but see a sharp pickup in growth from Q2 on likely widespread vaccinations. We expect full-year growth of -7.2% and 5.5% in 2020 and 2021, respectively.

- We expect the ECB to adopt a symmetric 2% inflation aim but include “soft” elements of Average Inflation Targeting (AIT) by placing some emphasis on persistent inflation misses when the strategy review concludes next year. Given the subdued inflation outlook, we expect the ECB will keep rates on hold until 2H25. We expect the EUR 750bn Recovery Fund, which will provide fiscal support to the countries most affected by the virus, to be operational early next year.

- In China, we expect 2020 real GDP growth of 2.4% yoy, making China the only major economy to post positive real GDP growth this year. We expect 2021 real GDP growth of 8.0% yoy, reflecting a slightly more cautious view than consensus, based on our belief that policymakers will focus on policy normalization and the achievement of higher-quality growth next year.

- With CORONAVIRUS. While the trajectory of the coronavirus remains highly uncertain, our base case assumes that the path of new infections and fatalities will not prevent a continued recovery in global economic activity in 2021. With the recent vaccine approvals and the start of vaccinations in the UK, Canada, and the US, we expect most DMs to vaccinate 50% of their populations by late 2021 and EMs to follow by late 2021.

### Forecast

Source: Haver Analytics and Goldman Sachs Global Investment Research.

**Economics**

<table>
<thead>
<tr>
<th>GDP growth (%)</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>-3.7</td>
<td>2.7</td>
</tr>
<tr>
<td>US</td>
<td>-3.5</td>
<td>2.0</td>
</tr>
<tr>
<td>China</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Euro area</td>
<td>-2.4</td>
<td>4.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Policy rates (%)</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>0.13</td>
<td>0.11</td>
</tr>
<tr>
<td>US</td>
<td>-0.50</td>
<td>-0.60</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.10</td>
<td>-0.06</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Goldman Sachs Global Investment Research. For important disclosures, see the Disclosure Appendix or go to www.gs.com/research/hedge.html.

| Issue 94 | What’s in Store For The Dollar | October 29, 2020 |
| Issue 93 | Beyond 2020: Post-Election Policies | October 1, 2020 |
| Issue 92 | COVID-18: Where We Go From Here | August 13, 2020 |
| Issue 91 | Investing in Racial Economic Equality | July 16, 2020 |
| Issue 90 | Daunting Debt Dynamics | May 28, 2020 |
| Issue 89 | Reopening the Economy | April 28, 2020 |
| Issue 88 | Oil’s Seismic Shock | March 31, 2020 |
| Issue 87 | Roaring into Recession | March 24, 2020 |
| Issue 86 | 2020’s Black swan: COVID-19 | February 28, 2020 |
| Issue 85 | Investing in Climate Change | January 30, 2020 |
| Special Issue | 2019 Update, and a Peek at 2020 | December 17, 2019 |
| Issue 84 | Fiscal Focus | November 26, 2019 |
| Issue 83 | Growth and Geopolitical Risk | October 10, 2019 |
| Issue 82 | Currency Wars | September 12, 2019 |
| Issue 81 | Central Bank Independence | August 8, 2019 |
| Issue 80 | Dissecting the Market Disconnect | July 11, 2019 |
| Issue 79 | Trade Wars 3.0 | June 6, 2019 |
| Issue 78 | EU Elections: What’s at Stake? | May 9, 2019 |
| Issue 77 | Buyback Realities | April 11, 2019 |
| Issue 76 | The Fed’s Dovish Pivot | March 5, 2019 |
| Issue 75 | Where Are We in the Market Cycle? | February 4, 2019 |
| Issue 74 | What’s Next for China? | December 7, 2018 |
| Issue 73 | Making Sense of Midterms | October 29, 2018 |
| Issue 72 | Recession Risk | October 16, 2018 |
| Issue 71 | Fiscal Folly | September 13, 2018 |
| Issue 70 | Deal or No Deal: Brexit and the Future of Europe | August 13, 2018 |
| Issue 69 | Emerging Markets: Invest or Avoid? | July 10, 2018 |
| Issue 68 | Liquidity, Volatility, Fragility | June 12, 2018 |
| Issue 67 | Regulating Big Tech | April 26, 2018 |
| Issue 66 | Trade Wars 2.0 | March 28, 2018 |
| Issue 65 | Has a Bond Bear Market Begun? | February 28, 2018 |
| Issue 64 | Is Bitcoin a (Bursting) Bubble? | February 5, 2018 |
| Special Issue | 2017 Update, and a Peek at 2018 | December 14, 2017 |
| Issue 63 | Late-Cycle for Longer? | November 9, 2017 |

Disclosure Appendix

Reg AC

We, Allison Nathan, Gabriel Lipton Galbraith, Jenny Grimbry hereby certify that all of the views expressed in this report accurately reflect our personal views, which have not been influenced by considerations of the firm’s business or client relationships.

Unless otherwise stated, the individuals listed on the cover page of this report are analysts in Goldman Sachs’ Global Investment Research division.

Regulatory disclosures

Disclosures required by United States laws and regulations

See company-specific regulatory disclosures above for any of the following disclosures required as to companies referred to in this report: manager or co-manager in a pending transaction; 1% or other ownership; compensation for certain services; types of client relationships; managed/co-managed public offerings in prior periods; directorships; for equity securities, market making and/or specialist role. Goldman Sachs trades or may trade as a principal in debt securities (or in related derivatives) of issuers discussed in this report.

The following are additional required disclosures: Ownership and material conflicts of interest: Goldman Sachs policy prohibits its analysts, professionals reporting to analysts and members of their households from owning securities of any company in the analyst’s area of coverage. Analyst compensation: Analysts are paid in part based on the profitability of Goldman Sachs, which includes investment banking revenues. Analyst as officer or director: Goldman Sachs policy generally prohibits its analysts, persons reporting to analysts or members of their households from serving as an officer, director or advisor of any company in the analyst’s area of coverage. Non-U.S. Analysts: Non-U.S. analysts may not be associated persons of Goldman Sachs & Co. LLC and therefore may not be subject to FINRA Rule 2241 or FINRA Rule 2242 restrictions on communications with subject company, public appearances and trading securities held by the analysts.

Additional disclosures required under the laws and regulations of jurisdictions other than the United States

The following disclosures are those required by the jurisdiction indicated, except to the extent already made above pursuant to United States laws and regulations. Australia: Goldman Sachs Australia Pty Ltd and its affiliates are not authorised deposit-taking institutions (as that term is defined in the Banking Act 1959 (Cth)) in Australia and do not provide banking services, nor carry on a banking business, in Australia. This research, and any access to it, is intended only for “wholesale clients” within the meaning of the Australian Corporations Act, unless otherwise agreed by Goldman Sachs. In producing research reports, members of the Global Investment Research Division of Goldman Sachs Australia may attend site visits and other meetings hosted by the companies and other entities which are subject of its research reports. In some instances the costs of such site visits or meetings may be met in part or in whole by the issuers concerned if Goldman Sachs Australia considers it appropriate and reasonable in the specific circumstances relating to the site visit or meeting. To the extent that the contents of this document contains any financial product advice, it is general advice only and has been prepared by Goldman Sachs without taking into account a client’s objectives, financial situation or needs. A client should, before acting on any such advice, consider the appropriateness of the advice having regard to the client’s own objectives, financial situation and needs. A copy of certain Goldman Sachs Australia and New Zealand disclosure of interests and a copy of Goldman Sachs’ Australian Sell-Side Research Independence Policy Statement are available at: https://www.goldmansachs.com/disclosures/australia-new-zealand/index.html. Brazil: Disclosure information in relation to CVM Instruction 598 is available at https://www.gs.com/worldwide/brazil/garar/index.html. Where applicable, the Brazilregistered analyst primarily responsible for the content of this research report, as defined in Article 20 of CVM Instruction 598, is the first author named at the beginning of this report, unless indicated otherwise at the end of the text. Canada: Goldman Sachs Canada Inc. is an affiliate of The Goldman Sachs Group Inc. and therefore is included in the company specific disclosures relating to Goldman Sachs (as defined above). Goldman Sachs Canada Inc. has approved of, and agreed to take responsibility for, this research report in Canada and to the extent that Goldman Sachs Canada Inc. disseminates this research report to its clients. Hong Kong: Further information on the securities of covered companies referred to in this research may be obtained on request from Goldman Sachs (Asia) L.L.C. India: Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (India) Securities Private Limited, Research Analyst - SEBI Registration Number INH000001493, 351-A, Rational House, Appasheeb Marathe Marg, Prabhadevi, Mumbai 400 025, India, Corporate Identity Number U74140MH2006PTC160634, Phone +91 22 2616 3000, Fax +91 22 6612 4270, Goldman Sachs (India) may beneficially own 1% or more of the securities (as such term is defined in clause 2 (I) of the Indian Securities Contracts (Regulation) Act, 1956) of the subject company or companies referred to in this research report. Japan: See below. Korea: This research, and any access to it, is intended only for “professional investors” within the meaning of the Financial Services and Capital MarketsAct, unless otherwise agreed by Goldman Sachs. Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (Asia) L.L.C., Seoul Branch. New Zealand: Goldman Sachs New Zealand Limited and its affiliates are neither ‘registered banks’ nor ‘deposit takers’ (as defined in the Reserve Bank of New Zealand Act 1989) in New Zealand. This research, and any access to it, is intended for ‘wholesale clients’ (as defined in the Financial Advisers Act 2008) unless otherwise agreed by Goldman Sachs. A copy of certain Goldman Sachs, Australia and New Zealand disclosure of interests is available at: https://www.goldmansachs.com/disclosures/australia-new-zealand/index.html. Russia: Research reports distributed in the Russian Federation are not advertising as defined in the Russian legislation, but are information and analysis not having product promotion as their main purpose and do not provide appraisal within the meaning of the Russian legislation on appraisal activity. Research reports do not constitute a personalized investment recommendation as defined in Russian laws and regulations, are not addressed to a specific client, and are prepared without analyzing the financial circumstances, investment profiles or risk profiles of clients. Goldman Sachs assumes no responsibility for any investment decisions that may be taken by a client or any other person based on this research report. Singapore: Goldman Sachs (Singapore) Pte. (Company Number: 198802166W), which is regulated by the Monetary Authority of Singapore, accepts legal responsibility for this research, and should be contacted with respect to any matters arising from, or in connection with, this research. Taiwan: This material is for reference only and must not be reprinted without permission. Investors should carefully consider their own investment risk. Investment results are the responsibility of the individual investor. United Kingdom: Persons who would be categorized as retail clients in the United Kingdom, as such term is defined in the rules of the Financial Conduct Authority, should read this research in conjunction with prior Goldman Sachs research on the companies referred to herein and should refer to the risk warnings that have been sent to them by Goldman Sachs International. A copy of the “glossary of certain financial terms” used in this report, are available from Goldman Sachs International on request. European Union and United Kingdom: Disclosure information in relation to Article 6 (2) of the European Commission Delegated Regulation (EU) 2016/958 (supplementing Regulation (EU) No 596/2014 of the European Parliament and of the Council including as that Delegated Regulation is implemented into United Kingdom domestic law and regulation following the United Kingdom’s departure from the European Union and the European Economic Area) with regard to regulatory technical standards for the technical arrangements for objective presentation of investment recommendations or other information recommending or suggesting an investment strategy and for disclosure of particular interests or indications of conflicts of interest is available at https://www.gs.com/disclosures/eu/mepaanepolicy.html which states the European Policy for Managing Conflicts of Interest: Investment Research. Investments: Japan: Goldman Sachs Japan Co., Ltd. is a Financial Instrument Dealer registered with the Kanto Financial Bureau under registration number Kinsho 69, and a member of Japan Securities Dealers Association. Financial Futures Association of Japan and Type II Financial Instruments Firms Association. Sales and purchase of equities are subject to commission pre-determined with clients plus consumption tax. See company-specific
disclosures as to any applicable disclosures required by Japanese stock exchanges, the Japanese Securities Dealers Association or the Japanese Securities Finance Company.

Global product; distributing entities
The Global Investment Research Division of Goldman Sachs produces and distributes research products for clients of Goldman Sachs on a global basis. Analysts based in Goldman Sachs offices around the world produce research on industries and companies, and research on macroeconomics, currencies, commodities and portfolio strategy. This research is disseminated in Australia by Goldman Sachs Australia Pty Ltd (ABN 21 006 797 897); in Brazil by Goldman Sachs do Brasil Corretora de Títulos e Valores Mobiliários S.A.; Omuhfmd Soldier Man Goldman Sachs Brazil: 0800 727 5764 and/or ouvidoriagoldmansacs@gs.com. Available Weekdays (except holidays), from 9am to 6pm. Ouvridoria Goldman Sachs Brasil: 0800 727 5764 e/ou ouvidoriagoldmansacs@gs.com. Horário de funcionamento: segunda-feira à sexta-feira (exceto feriados), das 9h às 18h; in Canada by either Goldman Sachs Canada Inc. or Goldman Sachs & Co. LLC; in Hong Kong by Goldman Sachs (Asia) L.L.C.; in India by Goldman Sachs (India) Securities Private Ltd.; in Japan by Goldman Sachs Japan Co., Ltd.; in the Republic of Korea by Goldman Sachs (Asia) L.L.C., Seoul Branch; in New Zealand by Goldman Sachs New Zealand Limited; in Russia by OOO Goldman Sachs; in Singapore by Goldman Sachs (Singapore) Pte. (Company Number: 198902169W); and in the United States of America by Goldman Sachs & Co. LLC. Goldman Sachs International has approved this research in connection with its distribution in the United Kingdom and European Union.

European Union: Goldman Sachs International authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority, has approved this research in connection with its distribution in the European Union and United Kingdom. Effective from the date of the United Kingdom’s departure from the European Union and the European Economic Area ("Brexit Day") the following information with respect to distributing entities will apply:

Goldman Sachs International ("GS"), authorised by the Prudential Regulation Authority ("PRA") and regulated by the Financial Conduct Authority ("FCA") and the PRA, has approved this research in connection with its distribution in the United Kingdom.

European Economic Area: GS, authorised by the PRA and regulated by the FCA and the PRA, disseminates research in the following jurisdictions within the European Economic Area: the Grand Duchy of Luxembourg, Italy, the Kingdom of Belgium, the Kingdom of Denmark, the Kingdom of Norway, the Republic of Finland and the Republic of Ireland; GS-Succursale de Paris (Paris branch) which, from Brexit Day, will be authorised by the French Autorité de contrôle prudentiel et de resolution ("ACPR") and regulated by the Autorité des marchés financiers ("AMF") disseminates research in France; GS - Sucursal en España (Madrid branch) authorised in Spain by the Comisión Nacional del Mercado de Valores disseminates research in the Kingdom of Spain; GS - Sweden Bankfilial (Stockholm branch) is authorized by the SFSFA as a “third country branch” in accordance with Chapter 4, Section 4 of the Swedish Securities and Market Act (Sw. lag (2007:528) om värdepappersmarknaden) disseminates research in the Kingdom of Sweden; Goldman Sachs Bank Europe SE ("GSBE") is a credit institution incorporated in Germany and, within the Single Supervisory Mechanism, subject to direct prudential supervision by the European Central Bank and in other respects supervised by German Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin) and Deutsche Bundesbank and disseminates research in the Federal Republic of Germany and those jurisdictions within the European Economic Area where GS is not authorised to disseminate research and additionally, GSBE, Copenhagen Branch filial af GSBE, Tykstand, supervised by the Danish Financial Authority disseminates research in the Kingdom of Denmark; GSBE - Sucursal en España (Madrid branch) subject (to a limited extent) to local supervision by the Bank of Spain disseminates research in the Kingdom of Spain; GSBE - Succursale Italia (Milan branch) relevant to applicable extent, subject to local supervision by the Bank of Italy (Banca d’Italia) and the Italian Companies and Exchange Commission (Commissione Nazionale per le Società e la Borsa “Consob”) disseminates research in Italy, GSBE - Succursale de Paris (Paris branch), supervised by the AMF and by the ACPR disseminates research in France; and GSBE - Sweden Bankfilial (Stockholm branch), to a limited extent, subject to local supervision by the Swedish Financial Supervisory Authority (Finansinspektionen) disseminates research in the Kingdom of Sweden.

General disclosures
This research is for our clients only. Other than disclosures relating to Goldman Sachs, this research is based on current public information that we consider reliable, but we do not represent it is accurate or complete, and it should not be relied on as such. The information, opinions, estimates and forecasts contained herein are as of the date hereof and are subject to change without prior notification. We seek to update our research as appropriate, but various sources of information and restrictions may prevent us from doing so. Other than certain industry reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst’s judgment.

Goldman Sachs conducts a global full-service, integrated investment banking, investment management, and brokerage business. We have investment banking and other business relationships with a substantial percentage of the companies covered by our Global Investment Research Division. Goldman Sachs Co. LLC, the United States broker dealer, is a member of SIPC (https://www.sipc.org).

Our salespeople, traders, and other professionals may provide oral or written market commentary or trading strategies to our clients and principal trading desks that reflect opinions that are contrary to the opinions expressed in this research. Our asset management area, principal trading desks and investing businesses may make investment decisions that are inconsistent with the recommendations or views expressed in this research. We and our affiliates, officers, directors, and employees, will from time to time have long or short positions in, act as principal in, and buy or sell, the securities or derivatives, if any, referred to in this research, unless otherwise prohibited by regulation or Goldman Sachs policy.

The views attributed to third party presenters at Goldman Sachs arranged conferences, including individuals from other parts of Goldman Sachs, do not necessarily reflect those of Global Investment Research and are not an official view of Goldman Sachs.

Any third party referenced herein, including any salespeople, traders and other professionals or members of their household, may have positions in the securities or derivatives mentioned that are inconsistent with the views expressed by analysts named in this report.

This research is focused on investment themes across markets, industries and sectors. It does not attempt to distinguish between the prospects or performance of, or provide analysis of, individual companies within any industry or sector we describe.

Any trading recommendation in this research relating to an equity or credit security or securities within an industry or sector is reflective of the investment theme being discussed and is not a recommendation of any such security in isolation.

This research is not an offer to sell or the solicitation of an offer to buy any security in any jurisdiction where such an offer or solicitation would be prohibited. The recipient of this research is responsible for personal risk evaluation, take into account the particular investment objectives, financial situations, or needs of individual clients. Clients should consider whether any advice or recommendation in this research is suitable for their particular circumstances and, if appropriate, seek professional advice, including tax advice. The price and value of investments referred to in this research and the income from them may fluctuate. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur.

Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments. Certain transactions, including those involving futures, options, and other derivatives, give rise to substantial risk and are not suitable for all investors. Investors should review current options and future disclosures documents which are available from Goldman Sachs sales representatives at https://www.theacc.com/about/publications/characteristics.jsp and https://www.fidacommunication.org/file/regularanddisclosures_1faquniform-

Goldman Sachs Global Investment Research
Transaction costs may be significant in option strategies calling for multiple purchase and sales of options such as spreads. Supporting documentation will be supplied upon request.

**Differing Levels of Service provided by Global Investment Research:** The level and types of services provided to you by the Global Investment Research division of GS may vary as compared to that provided to internal and other external clients of GS, depending on various factors including your individual preferences as to the frequency and manner of receiving communication, your risk profile and investment focus and perspective (e.g., marketwide, sector specific, long term, short term), the size and scope of your overall client relationship with GS, and legal and regulatory constraints. As an example, certain clients may request to receive notifications when research on specific securities is published, and certain clients may request that specific data underlying analysts’ fundamental analysis available on our internal client websites be delivered to them electronically through data feeds or otherwise. No change to an analyst’s fundamental research views (e.g., ratings, price targets, or material changes to earnings estimates for equity securities), will be communicated to any client prior to inclusion of such information in a research report broadly disseminated through electronic publication to our internal client websites or through other means, as necessary, to all clients who are entitled to receive such reports.

All research reports are disseminated and available to all clients simultaneously through electronic publication to our internal client websites. Not all research content is redistributed to our clients or available to third-party aggregators, nor is Goldman Sachs responsible for the redistribution of our research by third party aggregators. For research, models or other data related to one or more securities, markets or asset classes (including related services) that may be available to you, please contact your GS representative or go to [https://research.gs.com](https://research.gs.com).

Disclosure information is also available at [https://www.gs.com/research/hedge.html](https://www.gs.com/research/hedge.html) or from Research Compliance, 200 West Street, New York, NY 10282.

© 2020 Goldman Sachs.

No part of this material may be (i) copied, photocopied or duplicated in any form by any means or (ii) redistributed without the prior written consent of The Goldman Sachs Group