Goldman Sachs | Equity Research

26 October 2022 | 6:52AM EDT

Buy

Lam Research Corp. (LRCX)

NDR Takeaways: Through-Cycle Growth, Margin, and Capital Return Profile Intact; Maintain Buy

LRCX	12m Price Target: **$434.00**	Price: **$379.86**	Upside: **14.3%**

Toshiya Hari
+1(646)446-1759 | toshiya.hari@gs.com
Goldman Sachs & Co. LLC

Mark Coates
+1(917)343-8465 | mark.coates@gs.com
Goldman Sachs & Co. LLC

We hosted investor meetings with Doug Bettinger (EVP, Chief Financial Officer and Chief Accounting Officer) and Tina Correia (CVP, Investor Relations and Corporate Finance). Investor questions were focused on, 1) China export controls announced by the Department of Commerce on 10/7, 2) the CY2023 Wafer Fab Equipment (WFE) market outlook, 3) share gain opportunities specific to Lam Research, 4) the attainability of the company's long-term gross margin target following the near-term setback, and 5) opex management. While the shape/depth of the downturn is difficult to predict, we believe significant weakness in memory WFE spending coupled with the China export restrictions will assist the WFE market (and thus the stocks) in forming a cyclical bottom earlier than otherwise. **We reiterate our Buy rating on LRCX as we expect a) continued share gains**, particularly in leading-edge logic and foundry, **b) gross margin expansion**, supported by a normalization in freight, component costs, and factory utilization as well as Lam's pricing actions, and **c) disciplined opex management**, to drive through-cycle earnings growth in excess of the industry average. Please see below for more details.

Key takeaways

China export controls: As stated on last week's earnings call, Lam Research expects a $2.0-2.5bn hit to revenue in CY2023 as a result of the export controls announced on 10/7 by the Bureau of Industry and Security (BIS) at the Department of Commerce. Based on our industry conversations, we believe the export controls will primarily impact tool shipments to and services revenue derived from, among others, YMTC (i.e. LSD/MSD% market share player in the global NAND market and currently on BIS' Unverified List) and, to a lesser extent, SMIC (i.e. China's largest and the world's fifth largest foundry supplier), while business with Chinese customers on

Key Data

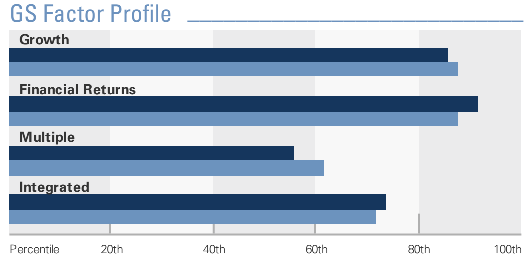
Market cap: $52.0bn
Enterprise value: $51.8bn
3m ADTV: $765.4mn
United States
Americas Semiconductors and Semi Equipment
M&A Rank: 3

GS Forecast

	6/22	6/23E	6/24E	6/25E
Revenue ($ mn)	17,227.0	18,303.0	13,890.3	17,572.0
EBITDA ($ mn)	5,732.2	5,934.4	3,889.5	5,740.1
EBIT ($ mn)	5,398.5	5,631.4	3,586.5	5,437.1
EPS ($)	33.12	35.32	23.06	37.48
P/E (X)	17.3	10.8	16.5	10.1
EV/EBITDA (X)	14.3	8.5	12.4	7.9
FCF yield (%)	3.2	10.2	6.1	9.8
Dividend yield (%)	1.0	1.8	1.9	2.0
Net debt/EBITDA (X)	0.2	(0.0)	(0.1)	(0.2)

	9/22	12/22E	3/23E	6/23E
EPS ($)	10.42	10.18	8.33	6.39

GS Factor Profile



LRCX relative to Americas Coverage
LRCX relative to Americas Semiconductors and Semi Equipment

Source: Company data, Goldman Sachs Research estimates. See disclosures for details.

Buy

Lam Research Corp. (LRCX)

Rating since Jul 21, 2019

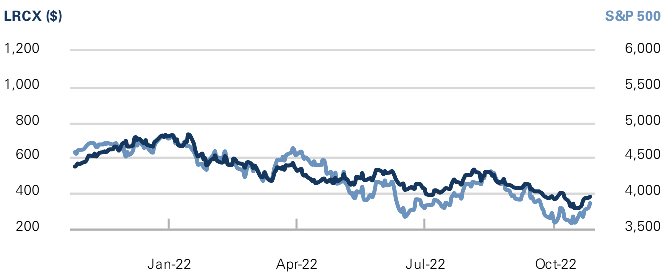
Ratios & Valuation

	6/22	6/23E	6/24E	6/25E
P/E (X)	17.3	10.8	16.5	10.1
EV/EBITDA (X)	14.3	8.5	12.4	7.9
EV/sales (X)	4.8	2.8	3.5	2.6
FCF yield (%)	3.2	10.2	6.1	9.8
EV/DACF (X)	16.3	9.7	13.5	8.7
CROCI (%)	45.2	44.0	28.9	39.4
ROE (%)	75.7	68.8	38.5	55.6
Net debt/EBITDA (X)	0.2	(0.0)	(0.1)	(0.2)
Net debt/equity (%)	19.8	(3.0)	(3.7)	(10.3)
Interest cover (X)	36.5	47.1	29.9	45.3
Inventory days	129.8	142.1	185.3	157.3
Receivable days	77.8	83.4	108.2	88.9
Days payable outstanding	30.0	26.9	32.2	28.3

Growth & Margins (%)

	6/22	6/23E	6/24E	6/25E
Total revenue growth	17.8	6.2	(24.1)	26.5
EBITDA growth	16.7	3.5	(34.5)	47.6
EPS growth	21.4	6.7	(34.7)	62.6
DPS growth	15.4	15.0	4.3	5.6
Gross margin	45.7	44.5	43.5	46.0
EBIT margin	31.3	30.8	25.8	30.9

Price Performance



	3m	6m	12m
Absolute	(17.0)%	(20.3)%	(31.2)%
Rel. to the S&P 500	(14.6)%	(11.2)%	(18.6)%

Source: FactSet. Price as of 25 Oct 2022 close.

Income Statement ($ mn)

	6/22	6/23E	6/24E	6/25E
Total revenue	17,227.0	18,303.0	13,890.3	17,572.0
Cost of goods sold	(9,359.4)	(10,159.1)	(7,852.7)	(9,493.6)
SG&A	(849.1)	(812.8)	(778.2)	(856.4)
R&D	(1,620.1)	(1,699.7)	(1,672.9)	(1,785.0)
Other operating inc./(exp.)	–	–	–	–
EBITDA	**5,732.2**	**5,934.4**	**3,889.5**	**5,740.1**
Depreciation & amortization	(333.7)	(303.0)	(303.0)	(303.0)
EBIT	**5,398.5**	**5,631.4**	**3,586.5**	**5,437.1**
Net interest inc./(exp.)	(147.9)	(119.7)	(120.0)	(120.0)
Income/(loss) from associates	–	–	–	–
Pre-tax profit	**5,250.6**	**5,511.7**	**3,466.5**	**5,317.1**
Provision for taxes	(587.8)	(768.3)	(520.0)	(744.4)
Minority interest	–	–	–	–
Preferred dividends	–	–	–	–
Net inc. (pre-exceptionals)	**4,656.5**	**4,743.5**	**2,946.5**	**4,572.7**
Net inc. (post-exceptionals)	**4,605.3**	**4,739.8**	**2,946.5**	**4,572.7**
EPS (basic, pre-except) ($)	**33.12**	**35.32**	**23.06**	**37.48**
EPS (diluted, pre-except) ($)	**33.12**	**35.32**	**23.06**	**37.48**
EPS (ex-ESO exp., dil.) ($)	**34.59**	**37.02**	**24.92**	**39.54**
DPS ($)	6.00	6.90	7.20	7.60
Div. payout ratio (%)	18.1	19.5	31.2	20.3
Wtd avg shares out. (basic) (mn)	140.6	133.9	128.0	122.0
Wtd avg shares out. (diluted) (mn)	140.6	133.9	128.0	0.0

Balance Sheet ($ mn)

	6/22	6/23E	6/24E	6/25E
Cash & cash equivalents	3,761.7	5,220.3	5,281.8	5,895.1
Accounts receivable	4,313.8	4,050.5	4,185.5	4,378.8
Inventory	3,966.3	3,945.3	4,025.8	4,158.1
Other current assets	347.4	305.6	305.6	305.6
Total current assets	**12,389.2**	**13,521.6**	**13,798.7**	**14,737.7**
Net PP&E	1,647.6	1,824.2	1,851.5	1,878.7
Net intangibles	1,617.0	1,617.2	1,607.0	1,596.8
Total investments	147.6	133.0	133.0	133.0
Other long-term assets	1,394.3	1,513.9	1,513.9	–
Total assets	**17,195.6**	**18,610.0**	**18,904.0**	**19,860.0**
Accounts payable	820.7	679.4	707.2	764.7
Short-term debt	7.4	7.1	7.1	7.1
Current lease liabilities	–	–	–	–
Other current liabilities	3,736.7	4,161.9	4,161.9	4,161.9
Total current liabilities	**4,564.8**	**4,848.4**	**4,876.2**	**4,933.7**
Long-term debt	4,998.4	4,990.8	4,990.8	4,990.8
Non-current lease liabilities	–	–	–	–
Other long-term liabilities	1,354.1	1,259.0	1,259.0	1,259.0
Total long-term liabilities	**6,352.5**	**6,249.8**	**6,249.8**	**6,249.8**
Total liabilities	**10,917.3**	**11,098.2**	**11,125.9**	**11,183.4**
Preferred shares	–	–	–	–
Total common equity	**6,278.4**	**7,511.8**	**7,778.1**	**8,676.6**
Minority interest	–	–	–	–
Total liabilities & equity	**17,195.6**	**18,610.0**	**18,904.0**	**19,860.0**
BVPS ($)	45.50	57.69	61.66	72.88

Cash Flow ($ mn)

	6/22	6/23E	6/24E	6/25E
Net income	4,605.3	4,739.8	2,946.5	0.0
D&A add-back	333.7	303.0	303.0	303.0
Minority interest add-back	–	–	–	–
Net (inc)/dec working capital	(1,796.2)	482.5	(187.7)	(268.2)
Others	(43.1)	105.4	238.9	250.9
Cash flow from operations	**3,099.7**	**5,630.8**	**3,300.8**	**4,858.4**
Capital expenditures	(546.0)	(465.1)	(320.0)	(320.0)
Acquisitions	–	–	–	–
Divestitures	–	–	–	–
Others	1,158.3	12.3	–	–
Cash flow from investing	**612.3**	**(452.8)**	**(320.0)**	**(320.0)**
Dividends paid	(815.3)	(891.0)	(919.2)	(925.0)
Share issuance/(repurchase)	(3,751.8)	(2,803.5)	(2,000.0)	(3,000.0)
Inc/(dec) in debt	–	–	–	–
Others	(1.0)	(0.6)	–	–
Cash flow from financing	**(4,578.9)**	**(3,701.9)**	**(2,919.2)**	**(3,925.0)**
Total cash flow	**(898.2)**	**1,458.6**	**61.5**	**613.3**
Free cash flow	2,553.6	5,165.7	2,980.8	4,538.4
Free cash flow per share (basic) ($)	18.16	38.59	23.29	37.19

Source: Company data, Goldman Sachs Research estimates.

lagging-edge or mature process nodes is unlikely to be impacted. Note that, in our CY2023/2024 Wafer Fab Equipment (WFE) market forecasts of $66.5bn/$72.9bn, we assume a net impact from China export controls of -$6.0bn/-$3.5bn or a larger gross impact partially offset by increases in foundry spending, and to a lesser extent NAND spending (i.e. to make up for SMIC and YMTC's challenges to grow leading-edge capacity) outside of China.

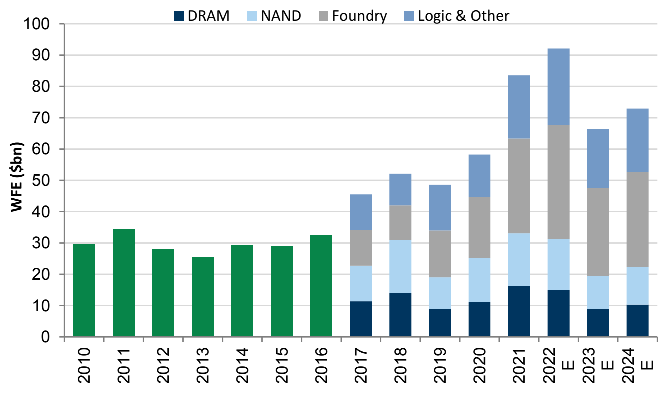
Exhibit 1: We estimate that export controls will reduce 2023 WFE by ~$6bn on a net basis

	2022E			2023E			2024E		
$bn	Absent Export Controls	With Export Controls	Impact of Controls	Absent Export Controls	With Export Controls	Impact of Controls	Absent Export Controls	With Export Controls	Impact of Controls
Total WFE	**94.1**	**92.1**	**-2.0**	**72.4**	**66.5**	**-6.0**	**76.4**	**72.9**	**-3.5**
yoy	13%	10%	-2%	-23%	-28%	-5%	5%	10%	4%
DRAM	**15.6**	**15.0**	**-0.6**	**10.4**	**8.9**	**-1.6**	**12.1**	**10.3**	**-1.8**
yoy	-5%	-8%	-4%	-33%	-41%	-8%	16%	16%	0%
NAND	**17.1**	**16.3**	**-0.8**	**12.8**	**10.5**	**-2.3**	**13.3**	**12.1**	**-1.2**
yoy	1%	-3%	-5%	-25%	-36%	-11%	4%	15%	11%
Foundry	**36.9**	**36.5**	**-0.4**	**29.5**	**28.2**	**-1.3**	**30.7**	**30.2**	**-0.4**
yoy	22%	21%	-1%	-20%	-23%	-3%	4%	7%	3%
Logic & Other	**24.6**	**24.4**	**-0.2**	**19.7**	**18.9**	**-0.8**	**20.3**	**20.3**	**0.0**
yoy	22%	21%	-1%	-20%	-22%	-2%	3%	7%	4%

Source: Goldman Sachs Global Investment Research

WFE market outlook: While Lam typically awaits for the current calendar year to conclude before providing its WFE market outlook for the subsequent year, management took a different approach this year and shared its preliminary view of the CY2023 WFE market (i.e. more than a 20% yoy decline off of a low $90bn range base in CY2022) to address growing investor questions and concerns. The company is not sharing specific estimates by application at this time, but has indicated that memory will drive the majority of the decline in CY2023, while leading-edge logic/foundry and other device types are expected to fare better, based on customer input and their own market intelligence. Note, in our October 13 industry note (here), we reduced our CY2022/2023 WFE market forecast from $94bn/$78bn to $92bn/$66bn, respectively, as we reflected recent industry datapoints, particularly those related to the memory market, as well as the China export controls. For CY2024, we currently model a 10% yoy increase in WFE demand, driven by a mid-teens (%) increase in memory WFE spend, and HSD (%) growth in logic and foundry. We continue to expect WFE intensity to trend flat or evolve with a slight positive bias as architectural transitions drive higher levels of process complexity. Furthermore, the headwinds that historically weighed on WFE intensity - specifically, the industry's transition from 200mm to 300mm, and consolidation of the customer base - are no longer a force and, if anything, there could be more fragmentation of semiconductor market share and capex dollars could sustain in response to localization initiatives and government funding.

Exhibit 2: We expect the WFE market to contract ~28% yoy in 2023 before growing 10% in 2024

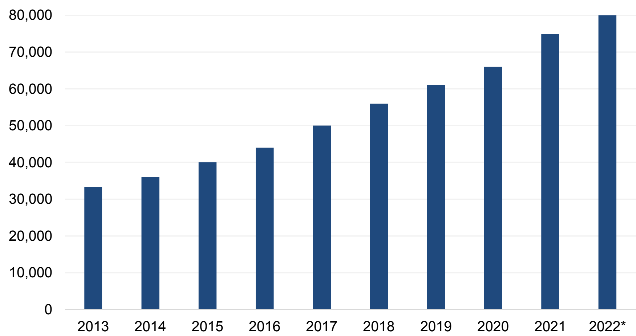


Source: SEMI, Goldman Sachs Global Investment Research

Market share growth opportunities that are idiosyncratic to Lam: While the progression in Lam's market share in CY2023 is likely to be flat at best given our expectation for WFE spending in memory to decline far more than logic/foundry, we remain constructive on Lam's medium- to long-term opportunities in or associated with **1) leading-edge logic** (to which the company remains under-indexed in Etch), **2) future architectural transitions** particularly across leading-edge logic/foundry (i.e. finFET to Gate-All-Around) and DRAM (i.e. 3D DRAM, albeit likely several years away from mass production) that will drive an increase in Etch and Deposition intensity, in our view, and **3) the ramp of relatively nascent products or technologies** including Atomic Layer Deposition (ALD) and Dry Resist. Recall that Lam shared its goal to gain 4-8% points of market share in Etch and Deposition by 2023 at its 2020 Analyst Day.

CSBG could be marginally more cyclical than in past downturns: The Customer Support Business Group (CSBG), which accounts for ~35% of total revenue per CY2022 GSe, consists of four segments; 1) spares, 2) Reliant (i.e. equipment business primarily targeting mature process nodes), 3) upgrades, and 4) services. Notably, Reliant has outgrown the overall segment over the past several quarters and, per management, is currently the second largest revenue contributor within CSBG. While we expect the growth in Lam's installed base (Exhibit 3) to support a revenue trajectory in CSBG that is much more resilient than the company's equipment business (ex Reliant), we nonetheless model a 15% yoy decline in segment revenue in CY2023, driven by a) the China export controls (i.e. a ~$700-800mn hit to CY2023 revenue, per our estimation), 2) a decline in Reliant revenue, albeit a more modest decrease compared to overall WFE, and 3) inventory dynamics in spares.

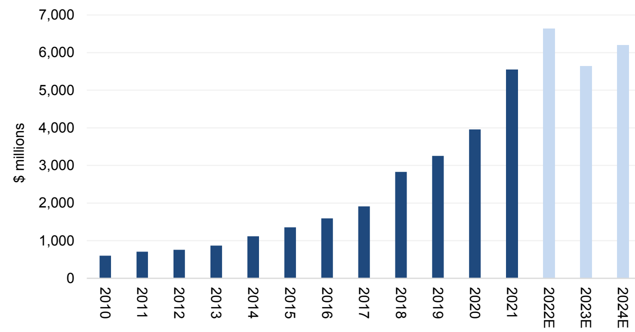
Exhibit 3: Lam's installed base is approaching ~80k chambers, up >30% since the last WFE cycle in 2019



*as of 3Q22

Source: Company data

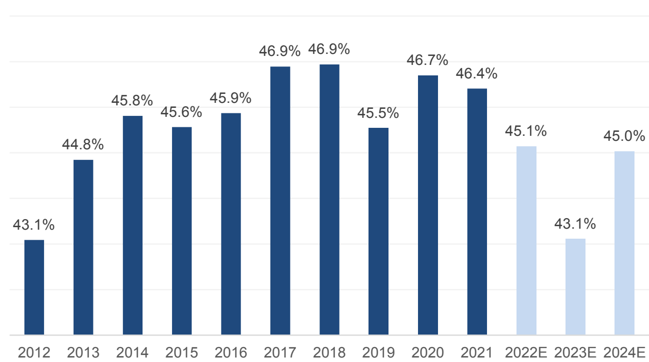
Exhibit 4: We expect CSBG revenues to contract 15% yoy in 2023 before rebounding ~10% yoy in 2024



Source: Company data, Goldman Sachs Global Investment Research

Gross margin outlook: Per Lam's guidance, China export controls and the resulting deterioration in customer mix are expected to drive a ~150bps sequential decline in non-GAAP gross margins to 44.5% (mid-point) in the December quarter. Looking ahead, we expect there to be a mix of tailwinds and headwinds – the tailwinds being a) a reversion in semiconductor pricing (note Lam procures a whole host of device types for their tools including MCUs, PMICs, and FPGAs), b) a decline in freight rates, and c) price actions to offset permanent cost inflation. While the bar in hitting its long-term profitability goals presented by Lam at its March 2020 Analyst Day is now higher, we believe management remains committed to its published targets and expect the company to take incremental actions to counter what is likely a permanent shift in customer mix. Lastly, we expect the ramp of its manufacturing facility in Malaysia will also, over time, be accretive to corporate gross margins given reduced labor cost and lower freight costs (i.e. closer to customers in Asia).

Exhibit 5: We expect non-GAAP gross margins to contract to 43% in 2023 but to rebound to 45% in 2024

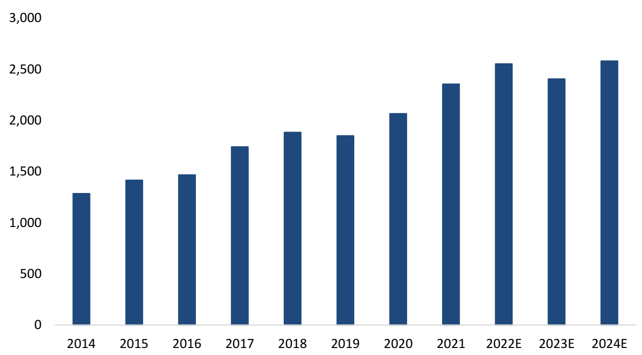


Source: Company data, Goldman Sachs Global Investment Research

Opex management: The company's implied opex guide for the December quarter is $663mn or +2.4% qoq. Consistent with statements from last week's call and execution during prior cyclical downturns, we expect Lam to adjust its opex (particularly, SG&A)

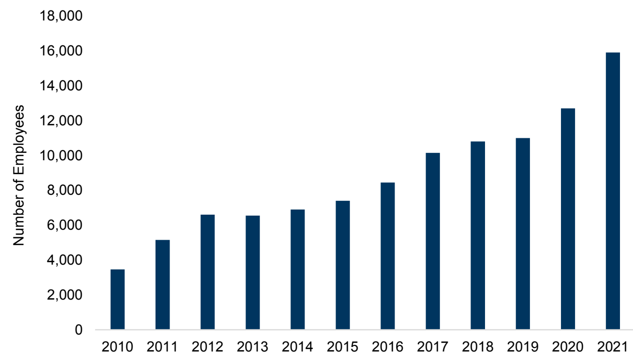
spend in accordance with the new demand environment. Recall, in CY2019, when revenue declined 12% yoy, the company reduced SG&A by 6% while R&D was kept essentially flat. In our current earnings model, we forecast CY2023 opex of -6% yoy within the context of a potential revenue decline of 23% yoy. We model a more significant decline in opex this cycle given the higher base (note the total number of employees has increased 88% over the past 5 years) and arguably a permanent decline in China business.

Exhibit 6: We forecast a 6% yoy decline in opex in CY2023 to reflect management's disciplined approach to profitability



Source: Company data, Goldman Sachs Global Investment Research

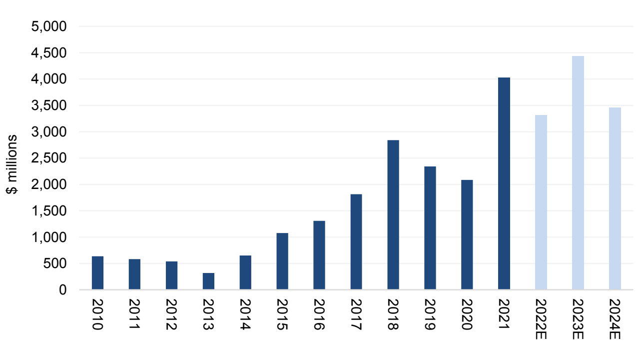
Exhibit 7: Total headcount has grown rapidly over the past few years, particularly in 2021, with the number of employees increasing by ~25% yoy



Source: FactSet

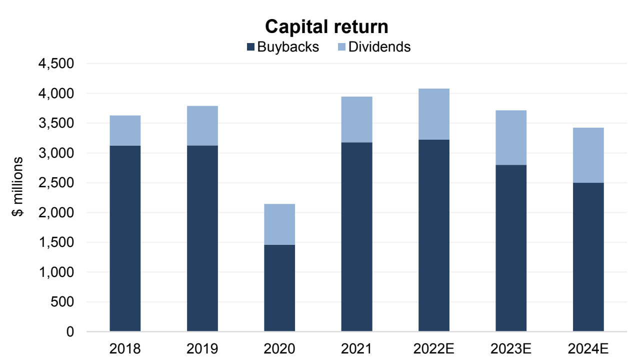
Capital return policy unchanged: Despite elevated macro uncertainty and the negative WFE market outlook, Lam's stated policy of returning 75-100% of FCF to shareholders in the form of dividends and buybacks is unchanged. We believe the combination of steady FCF generation (note FCF typically improves or is resilient during cyclical downturns as working capital requirements decline) and Lam's strong balance sheet will support this. Looking ahead, we model a gradual increase in Lam's dividend and $3.2bn/$2.8bn/$2.5bn in share repurchases in CY2022/2023/2024, respectively. Importantly, we expect these share repurchases to translate into a steady decline in Lam's share count as illustrated in Exhibit 9 below.

Exhibit 8: We envision robust FCF generation from Lam even during next year's expected downturn



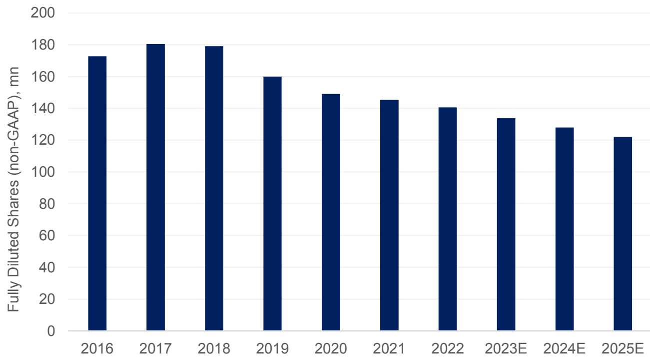
Source: Goldman Sachs Global Investment Research, Company data

Exhibit 9: We expect Lam to remain committed to returning a healthy amount of FCF to shareholders over the next few years



Source: Goldman Sachs Global Investment Research, Company data

Exhibit 10: We expect diluted share count to decline by ~13% between FY22 and FY25



By fiscal year, June-end

Source: Company data, Goldman Sachs Global Investment Research

Investment thesis, price target methodology, and key risks

We reiterate our Buy rating on LRCX as we believe the market is under-appreciating the company's superior through-cycle growth prospects associated with the architectural transitions that are ongoing or await across leading-edge Logic and Foundry (i.e. Gate-All-Around transistor structures), NAND (i.e. increase in layer count), and DRAM (i.e. 3D DRAM), as well as Lam's improving competitive position in the leading-edge Logic and Foundry markets. Furthermore, we expect management's execution power to be on full display over the next several quarters as the WFE industry experiences in 2023 what we expect to be its worst yoy decline since 2009.

Our 12-month price target of $434 is based on 14x our normalized EPS estimate of $31. Key risks to our estimates and constructive investment thesis include: 1) further deterioration in demand for end applications (e.g. smartphones, servers, and PCs), 2) a decline in memory spending above/beyond what we already model, 3) increased competition in Etch and Deposition, and 4) changes in the geopolitical backdrop, including the evolution of export controls, that adversely impact Lam's ability to conduct business, for example, in China.

Disclosure Appendix

Reg AC

We, Toshiya Hari and Mark Coates, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

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

GS Factor Profile

The Goldman Sachs Factor Profile provides investment context for a stock by comparing key attributes to the market (i.e. our coverage universe) and its sector peers. The four key attributes depicted are: Growth, Financial Returns, Multiple (e.g. valuation) and Integrated (a composite of Growth, Financial Returns and Multiple). Growth, Financial Returns and Multiple are calculated by using normalized ranks for specific metrics for each stock. The normalized ranks for the metrics are then averaged and converted into percentiles for the relevant attribute. The precise calculation of each metric may vary depending on the fiscal year, industry and region, but the standard approach is as follows:

Growth is based on a stock's forward-looking sales growth, EBITDA growth and EPS growth (for financial stocks, only EPS and sales growth), with a higher percentile indicating a higher growth company. **Financial Returns** is based on a stock's forward-looking ROE, ROCE and CROCI (for financial stocks, only ROE), with a higher percentile indicating a company with higher financial returns. **Multiple** is based on a stock's forward-looking P/E, P/B, price/dividend (P/D), EV/EBITDA, EV/FCF and EV/Debt Adjusted Cash Flow (DACF) (for financial stocks, only P/E, P/B and P/D), with a higher percentile indicating a stock trading at a higher multiple. The **Integrated** percentile is calculated as the average of the Growth percentile, Financial Returns percentile and (100% - Multiple percentile).

Financial Returns and Multiple use the Goldman Sachs analyst forecasts at the fiscal year-end at least three quarters in the future. Growth uses inputs for the fiscal year at least seven quarters in the future compared with the year at least three quarters in the future (on a per-share basis for all metrics).

For a more detailed description of how we calculate the GS Factor Profile, please contact your GS representative.

M&A Rank

Across our global coverage, we examine stocks using an M&A framework, considering both qualitative factors and quantitative factors (which may vary across sectors and regions) to incorporate the potential that certain companies could be acquired. We then assign a M&A rank as a means of scoring companies under our rated coverage from 1 to 3, with 1 representing high (30%-50%) probability of the company becoming an acquisition target, 2 representing medium (15%-30%) probability and 3 representing low (0%-15%) probability. For companies ranked 1 or 2, in line with our standard departmental guidelines we incorporate an M&A component into our target price. M&A rank of 3 is considered immaterial and therefore does not factor into our price target, and may or may not be discussed in research.

Quantum

Quantum is Goldman Sachs' proprietary database providing access to detailed financial statement histories, forecasts and ratios. It can be used for in-depth analysis of a single company, or to make comparisons between companies in different sectors and markets.

Disclosures

The rating(s) for Lam Research Corp. is/are relative to the other companies in its/their coverage universe: Advanced Micro Devices Inc., Analog Devices Inc., Applied Materials Inc., Arrow Electronics Inc., Avnet Inc., Broadcom Inc., Cohu Inc., Credo Technology Group, Entegris Inc., Impinj Inc., Intel Corp., IonQ Inc., KLA Corp., Lam Research Corp., Marvell Technology Inc., Microchip Technology Inc., Micron Technology Inc., NXP Semiconductors NV, Nvidia Corp., ON Semiconductor Corp., Qorvo Inc., Seagate Technology, Skyworks Solutions Inc., Teradyne Inc., Texas Instruments Inc., Western Digital Corp.

Company-specific regulatory disclosures

The following disclosures relate to relationships between The Goldman Sachs Group, Inc. (with its affiliates, "Goldman Sachs") and companies covered by the Global Investment Research Division of Goldman Sachs and referred to in this research.

Goldman Sachs has received compensation for investment banking services in the past 12 months: Lam Research Corp. ($379.86)

Goldman Sachs expects to receive or intends to seek compensation for investment banking services in the next 3 months: Lam Research Corp. ($379.86)

Goldman Sachs has received compensation for non-investment banking services during the past 12 months: Lam Research Corp. ($379.86)

Goldman Sachs had an investment banking services client relationship during the past 12 months with: Lam Research Corp. ($379.86)

Goldman Sachs had a non-investment banking securities-related services client relationship during the past 12 months with: Lam Research Corp. ($379.86)

Goldman Sachs had a non-securities services client relationship during the past 12 months with: Lam Research Corp. ($379.86)

Goldman Sachs makes a market in the securities or derivatives thereof: Lam Research Corp. ($379.86)

Goldman Sachs is a specialist in the relevant securities and will at any given time have an inventory position, "long" or "short," and may be on the opposite side of orders executed on the relevant exchange: Lam Research Corp. ($379.86)

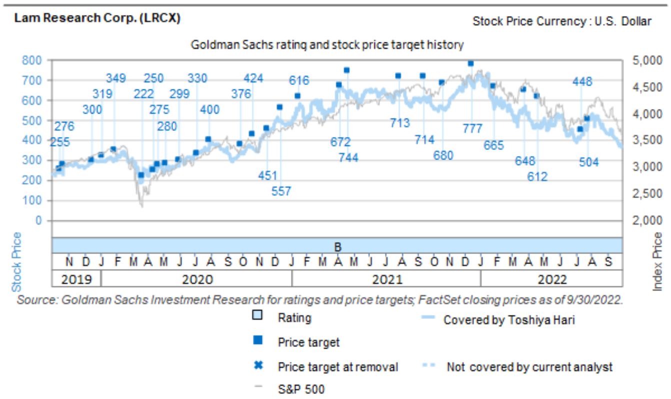
Distribution of ratings/investment banking relationships

Goldman Sachs Investment Research global Equity coverage universe

	Rating Distribution			Investment Banking Relationships		
	Buy	Hold	Sell	Buy	Hold	Sell
Global	48%	36%	16%	64%	59%	50%

As of October 1, 2022, Goldman Sachs Global Investment Research had investment ratings on 3,100 equity securities. Goldman Sachs assigns stocks as Buys and Sells on various regional Investment Lists; stocks not so assigned are deemed Neutral. Such assignments equate to Buy, Hold and Sell for the purposes of the above disclosure required by the FINRA Rules. See 'Ratings, Coverage universe and related definitions' below. The Investment Banking Relationships chart reflects the percentage of subject companies within each rating category for whom Goldman Sachs has provided investment banking services within the previous twelve months.

Price target and rating history chart(s)



The price targets shown should be considered in the context of all prior published Goldman Sachs research, which may or may not have included price targets, as well as developments relating to the company, its industry and financial markets.

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.

Distribution of ratings: See the distribution of ratings disclosure above. **Price chart:** See the price chart, with changes of ratings and price targets in prior periods, above, or, if electronic format or if with respect to multiple companies which are the subject of this report, on the Goldman Sachs website at https://www.gs.com/research/hedge.html.

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 the 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 is 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 Resolution n. 20 is available at https://www.gs.com/worldwide/brazil/area/gir/index.html. Where applicable, the Brazil-registered analyst primarily responsible for the content of this research report, as defined in Article 20 of CVM Resolution n. 20, is the first author named at the beginning of this report, unless indicated otherwise at the end of the text. **Canada:** This information is being provided to you for information purposes only and is not, and under no circumstances should be construed as, an advertisement, offering or solicitation by Goldman Sachs & Co. LLC for purchasers of securities in Canada to trade in any Canadian security. Goldman Sachs & Co. LLC is not registered as a dealer in any jurisdiction in Canada under applicable Canadian securities laws and generally is not permitted to trade in Canadian securities and may be prohibited from selling certain securities and products in certain jurisdictions in Canada. If you wish to trade in any Canadian securities or other products in Canada please contact Goldman Sachs Canada Inc., an affiliate of The Goldman Sachs Group Inc., or another registered Canadian dealer. **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, 951-A, Rational House, Appasaheb Marathe Marg, Prabhadevi, Mumbai 400 025, India, Corporate Identity Number U74140MH2006FTC160634, Phone +91 22 6616 9000, Fax +91 22 6616 9001. Goldman Sachs may beneficially own 1% or more of the securities (as such term is defined in clause 2 (h) 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 Markets Act, 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: 198602165W), 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 covered companies referred to herein and should refer to the risk warnings that have been sent to them by Goldman Sachs International. A copy of these risks warnings, and a 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/europeanpolicy.html which states the European Policy for Managing Conflicts of Interest in Connection with Investment Research.

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.

Ratings, coverage universe and related definitions

Buy (B), Neutral (N), Sell (S) Analysts recommend stocks as Buys or Sells for inclusion on various regional Investment Lists. Being assigned a Buy or Sell on an Investment List is determined by a stock's total return potential relative to its coverage universe. Any stock not assigned as a Buy or a Sell on an Investment List with an active rating (i.e., a stock that is not Rating Suspended, Not Rated, Coverage Suspended or Not Covered), is deemed Neutral. Each region's Investment Review Committee manages Regional Conviction lists, which represent investment recommendations focused on the size of the total return potential and/or the likelihood of the realization of the return across their respective areas of coverage. The addition or removal of stocks from such Conviction lists do not represent a change in the analysts' investment rating for such stocks.

Total return potential represents the upside or downside differential between the current share price and the price target, including all paid or anticipated dividends, expected during the time horizon associated with the price target. Price targets are required for all covered stocks. The total return potential, price target and associated time horizon are stated in each report adding or reiterating an Investment List membership.

Coverage Universe: A list of all stocks in each coverage universe is available by primary analyst, stock and coverage universe at https://www.gs.com/research/hedge.html.

Not Rated (NR). The investment rating, target price and earnings estimates (where relevant) have been suspended pursuant to Goldman Sachs policy when Goldman Sachs is acting in an advisory capacity in a merger or in a strategic transaction involving this company, when there are legal, regulatory or policy constraints due to Goldman Sachs' involvement in a transaction, and in certain other circumstances. **Rating Suspended (RS).** Goldman Sachs Research has suspended the investment rating and price target for this stock, because there is not a sufficient fundamental basis for determining an investment rating or target price. The previous investment rating and target price, if any, are no longer in effect for this stock and should not be relied upon. **Coverage Suspended (CS).** Goldman Sachs has suspended coverage of this company. **Not Covered (NC).** Goldman Sachs does not cover this company. **Not Available or Not Applicable (NA).** The information is not available for display or is not applicable. **Not Meaningful (NM).** The information is not meaningful and is therefore excluded.

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.; Public Communication Channel Goldman Sachs Brazil: 0800 727 5764 and / or contatogoldmanbrasil@gs.com. Available Weekdays (except holidays), from 9am to 6pm. Canal de Comunicação com o Público Goldman Sachs Brasil: 0800 727 5764 e/ou contatogoldmanbrasil@gs.com. Horário de funcionamento: segunda-feira à sexta-feira (exceto feriados), das 9h às 18h; in Canada by 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: 198602165W); 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.

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 ("GSI"), 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: GSI, 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, the Republic of Cyprus 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 de contrôle prudentiel et de resolution and the Autorité des marches financiers ("AMF") disseminates research in France; GSI - Sucursal en España (Madrid branch) authorized in Spain by the Comisión Nacional del Mercado de Valores disseminates research in the Kingdom of Spain; GSI - Sweden Bankfilial (Stockholm branch) is authorized by the SFSA 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 GSI is not authorised to disseminate research and additionally, GSBE, Copenhagen Branch filial af GSBE, Tyskland, 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) to the relevant 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 (Finansinpektionen) 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 regulations 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.

The analysts named in this report may have from time to time discussed with our clients, including Goldman Sachs salespersons and traders, or may discuss in this report, trading strategies that reference catalysts or events that may have a near-term impact on the market price of the equity securities discussed in this report, which impact may be directionally counter to the analyst's published price target expectations for such stocks. Any such trading strategies are distinct from and do not affect the analyst's fundamental equity rating for such stocks, which rating reflects a stock's return potential relative to its coverage universe as described herein.

We and our affiliates, officers, directors, and employees, excluding equity and credit analysts, 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.

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 products mentioned that are inconsistent with the views expressed by analysts named in this report.

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 illegal. It does not constitute a personal recommendation or 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 futures disclosure documents which are available from Goldman Sachs sales representatives or at https://www.theocc.com/about/publications/character-risks.jsp and https://www.fiadocumentation.org/fia/regulatory-disclosures_1/fia-uniform-futures-and-options-on-futures-risk-disclosures-booklet-pdf-version-2018. 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.

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