Goldman Sachs

Global Investment Research

The Goldman Sachs Group, Inc.

A View from Wall Street

North American Dealer Conference

November 2022

Jerry Revich, CFA	Goldman Sachs & Co. LLC	212-902-4116	jerry.revich@gs.com
Clay Williams, CFA	Goldman Sachs & Co. LLC	212-357-4433	clay.c.williams@gs.com
Adam Bubes, CFA	Goldman Sachs & Co. LLC	212-357-9824	adam.bubes@gs.com
Jatin Khanna	Goldman Sachs India SPL	212-934-2034	jatin.x.khanna@gs.com

Goldman Sachs does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that the firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision. For Reg AC certification and other important disclosures, see the Disclosure Appendix, or go to www.gs.com/research/hedge.html. Analysts employed by non-US affiliates are not registered/qualified as research analysts with FINRA in the U.S.

Table of Contents

Goldman Sachs & Investment Research overview	**Page**	**3**
Agriculture Soft Commodity Outlook	Page	6
US Ag Machinery Outlook	**Page**	**12**
Top Developments We're Tracking in North America Ag Equipment	Page	19
Precision Ag Technologies to Boost Yield & Input Efficiency	**Page**	**32**
Stock Views	Page	43
Disclosures & Appendix	**Page**	**48**

I. Goldman Sachs & Investment Research overview

Machinery, Infrastructure, Sustainable Tech Coverage overview

Goldman Sachs Machinery, Infrastructure, Sustainable Tech Coverage

Construction & Ag Machinery		
AGCO Corp.	AGCO	Buy
Caterpillar Inc.	CAT	Buy
Deere & Co.	DE	Buy
Manitowoc	MTW	Neutral
Oshkosh Corp	OSK	Buy
Terex Corp	TEX	Neutral

Construction Rentals		
Herc Holdings	HRI	Buy
United Rentals Inc.	URI	Buy

Diversified Industrials		
Gates Industrial Corp.	GTES	Buy
Wabtec Corp.	WAB	Neutral

Construction Materials		
Eagle Materials Inc.	EXP	Buy
Martin Marietta Materials	MLM	Neutral
Summit Materials Inc.	SUM	Neutral
Vulcan Materials Co.	VMC	Neutral

Truck Machinery and Suppliers		
Allison Transmission Holdings	ALSN	Sell
Cummins Inc.	CMI	Neutral
Paccar Inc.	PCAR	Neutral
Rev Group	REVG	Sell

Engineering & Construction		
Granite Consturction Inc.	GVA	Sell
Primoris Services	PRIM	Sell

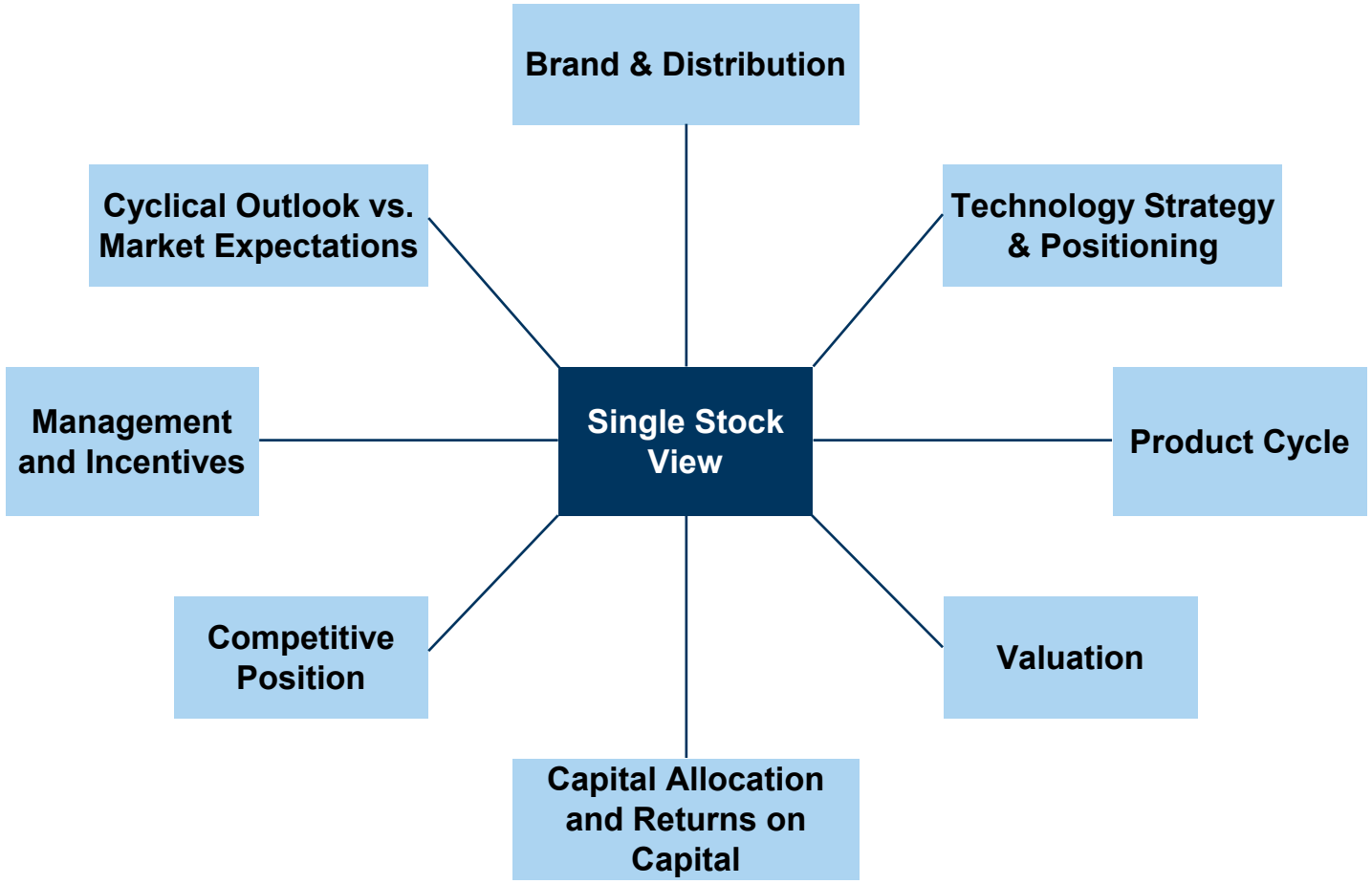
Enviromental Services		
Clean Harbors Inc.	CLH	Neutral
GFL Enviromental	GFL	Buy
Republic Services Inc.	RSG	Buy (CL)
Waste Connections Inc.	WCN	Buy
Waste Management Inc.	WM	Buy

Sustainable Technology		
CalAmp Corp.	CAMP	Sell
Generac Holdings	GNRC	Buy
Jacobs	J	Buy
KBR Inc.	KBR	Buy
Trimble Inc.	TRMB	Buy
Xos Inc.	XOS	Neutral

*RSG is on the regional Conviction List

Source: Goldman Sachs Global Investment Research.

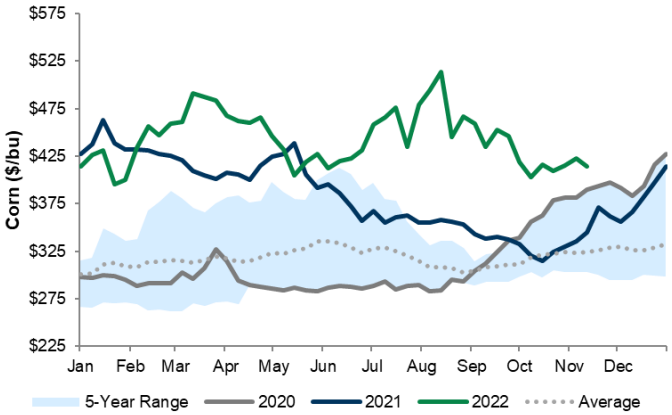
How we look at the Machinery, Infrastructure, Sustainable Tech sector

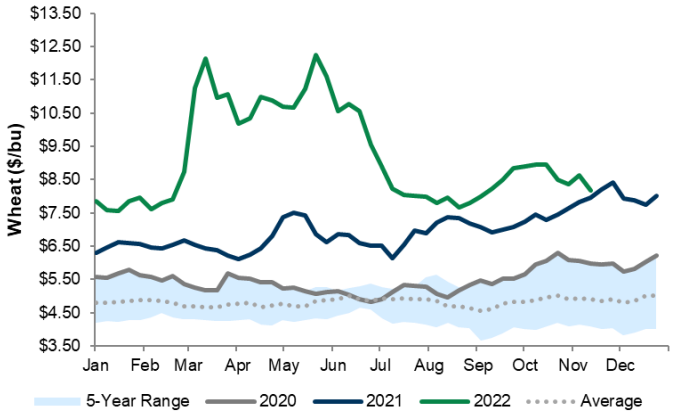


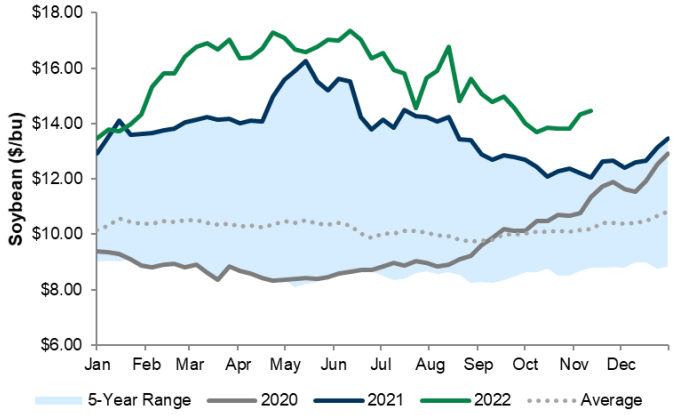
Source: Goldman Sachs Global Investment Research.

II. Agriculture soft commodity outlook

Global grain & oilseeds have receded from their previous highs from earlier this year



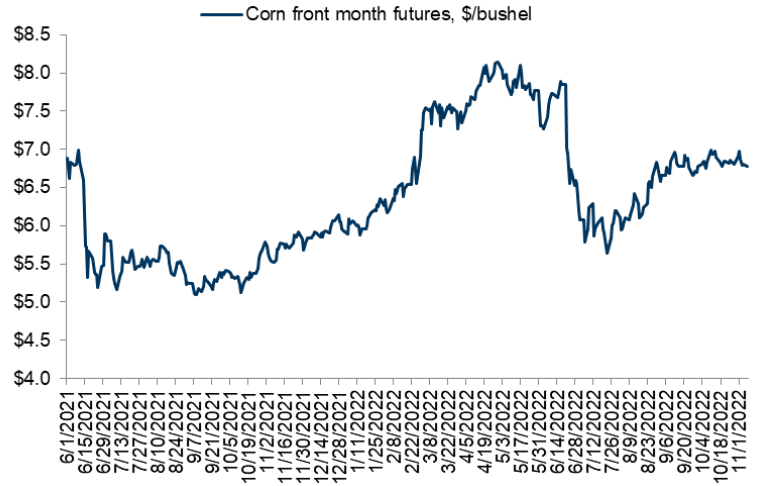




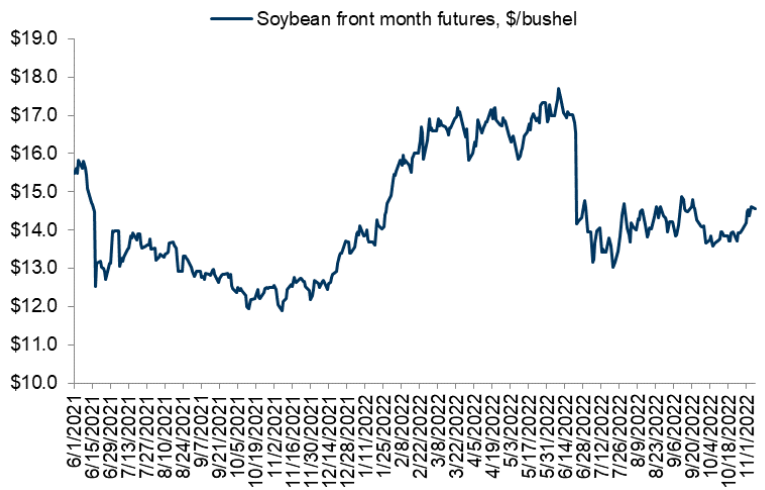
Source: Thomson Reuters Eikon, Goldman Sachs Global Investment Research

Corn and Soybean futures have declined off their 2022 highs from earlier this year

Corn front month futures moved higher recently, but are off their highs from earlier this year

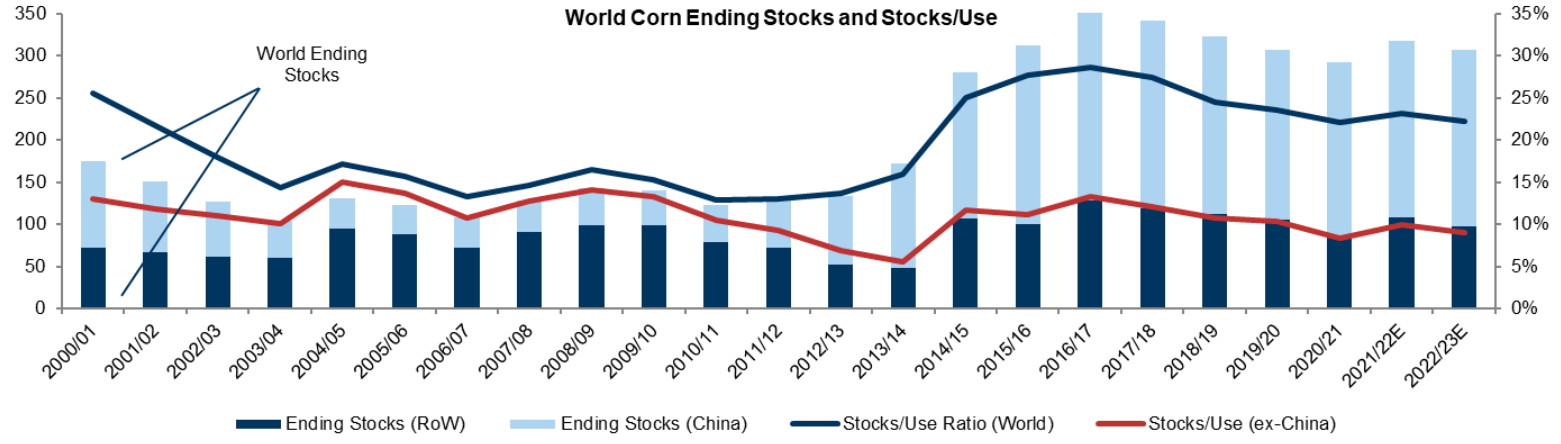


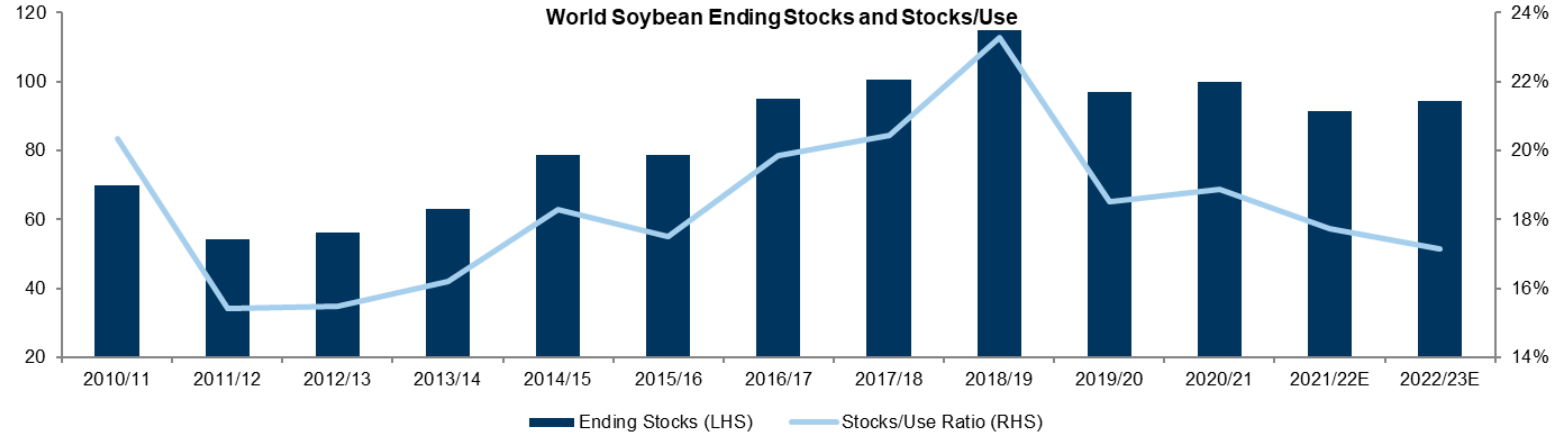
Soybean front month futures have declined since earlier this year



Source: FactSet

Global grain balances were tight heading into the year, with little weather-cushion this season



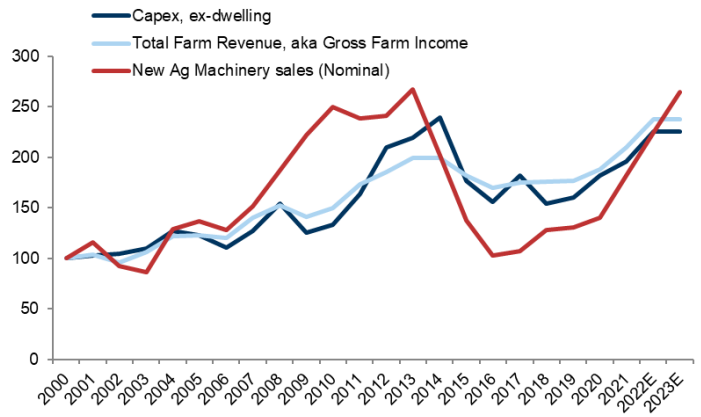


Source: USDA, Goldman Sachs Global Investment Research

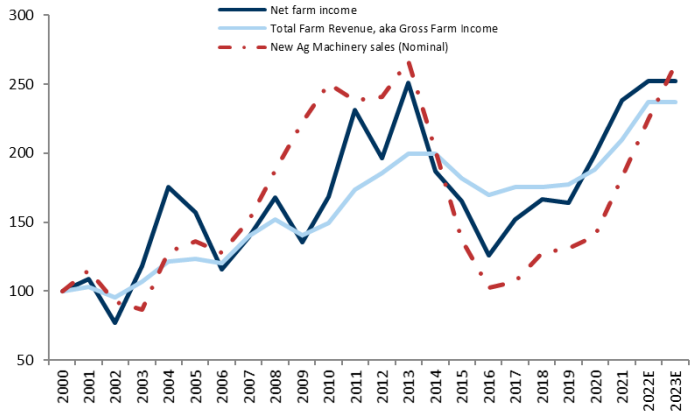
III. US Agricultural Machinery Outlook

US farmer income provides visibility on a sustained capex recovery

Farmer allocation of capex towards new equipment purchases is normalizing after years of underinvestment



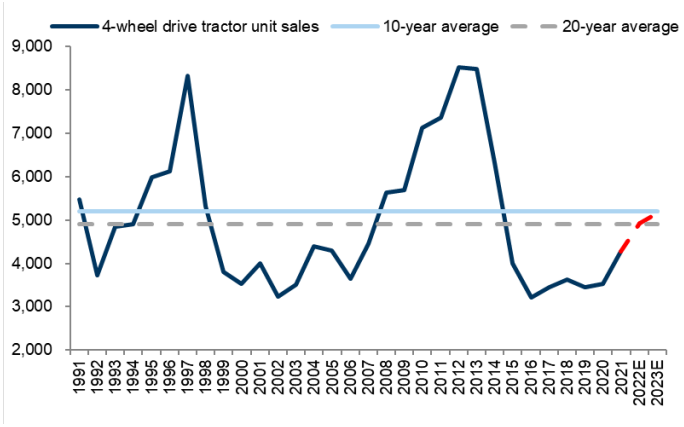
We estimate US farmer income will be flat year over year in 2023



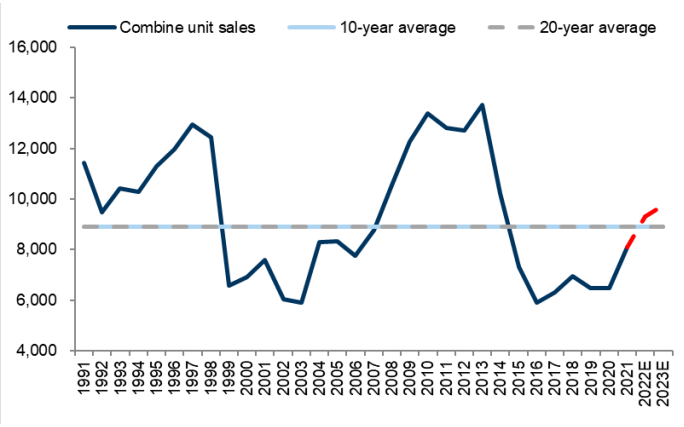
Source: AEM, USDA, Goldman Sachs Global Investment Research, BLS, Sandhills Global

Demand: Approaching normalized levels of ag equipment demand in 2023

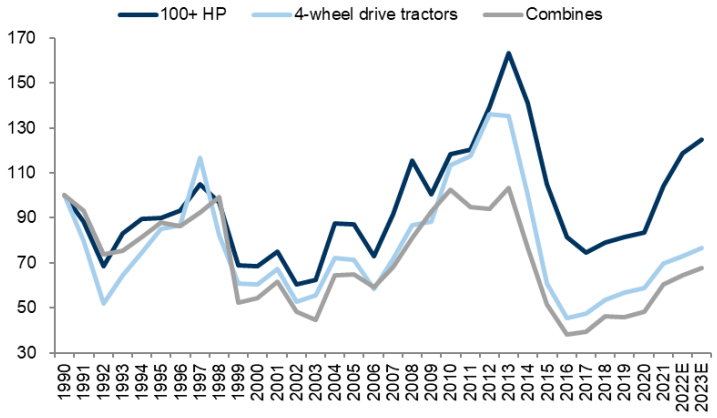
We expect 4WD tractor sales to exceed historical averages



We expect combine sales to exceed historical averages



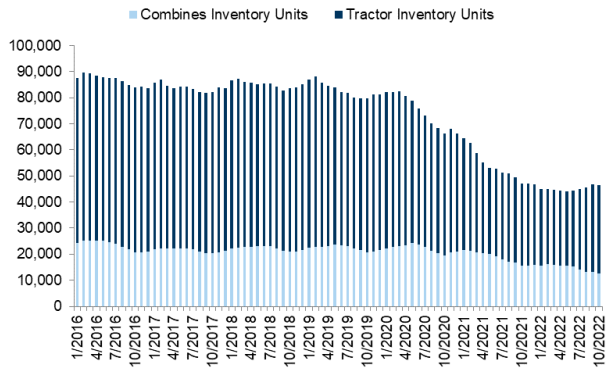
Combine and 4-wheel drive tractor sales were at 30+ year lows



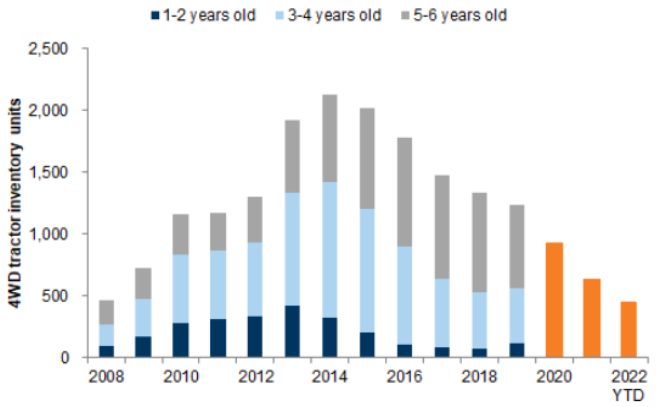
Source: AEM, Machinery Pete, Sandhills Global, Company data, Goldman Sachs Global Investment Research

Inventory declines have stabilized but capital stock remains historically tight

Used equipment inventories have declined for both combines and tractors



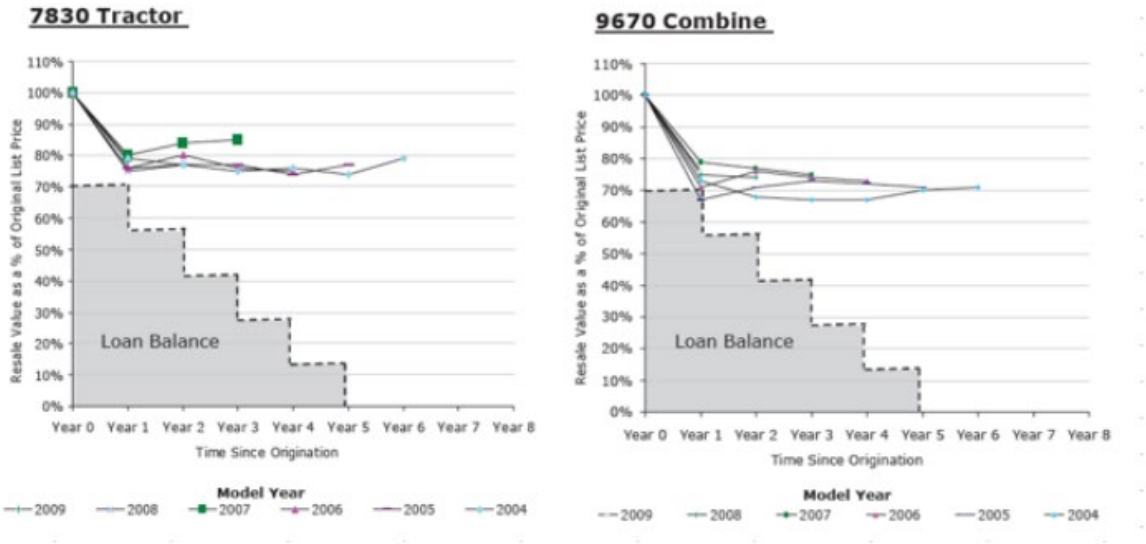
Used late-model year 4WD tractor inventories are at historically low levels



Source: AEM, USDA, Goldman Sachs Global Investment Research, BLS, Sandhills Global

Ag equipment has historically shown strong residual values

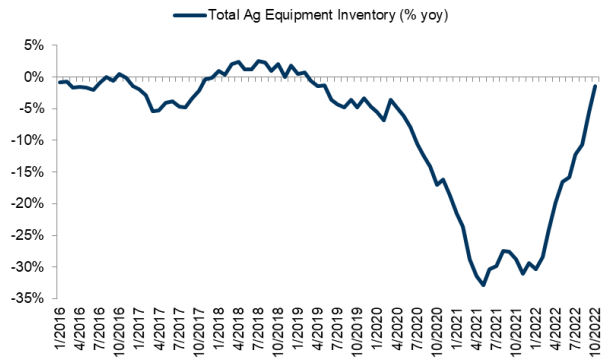
DE U.S. residual values



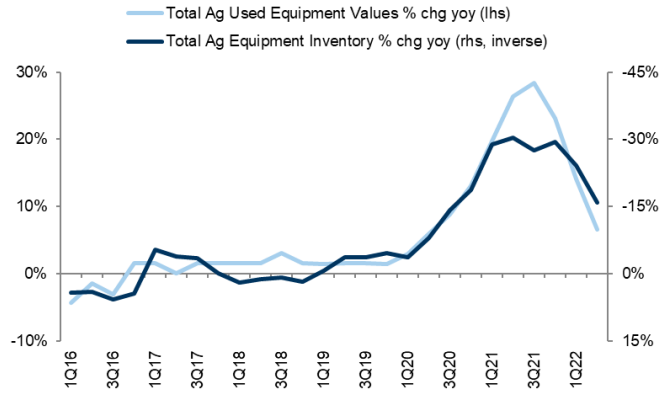
Source: Sandhills Global, Machinery Pete, Company data

As used equipment inventories have begun to normalize, we've seen a similar move in equipment values

Total ag equipment inventories were down -1% yoy in October vs. -6% yoy in September



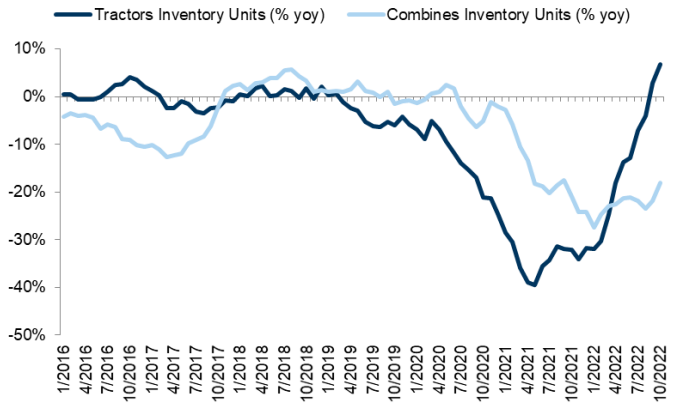
Used equipment inventories highly correlated with used equipment values



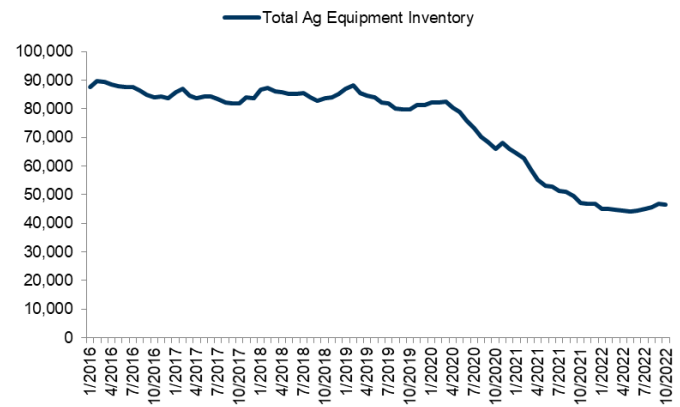
Source: Sandhills Global, Machinery Pete, Company data

Utilization recovering, tightening capital stock

Used tractor inventories increased +7% yoy in October
Used combine inventories declined -18% yoy in October



Absolute used inventory levels have stabilized in recent months

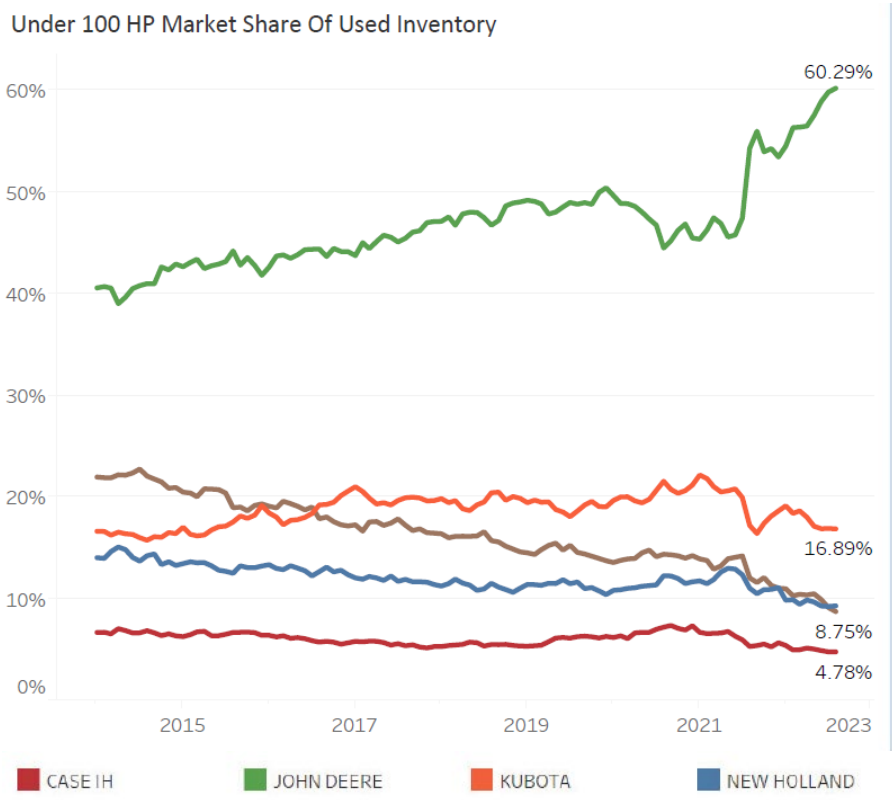


Source: Census Bureau, Komatsu, Sandhills Global, Rouse, Company data, Goldman Sachs Global Investment Research

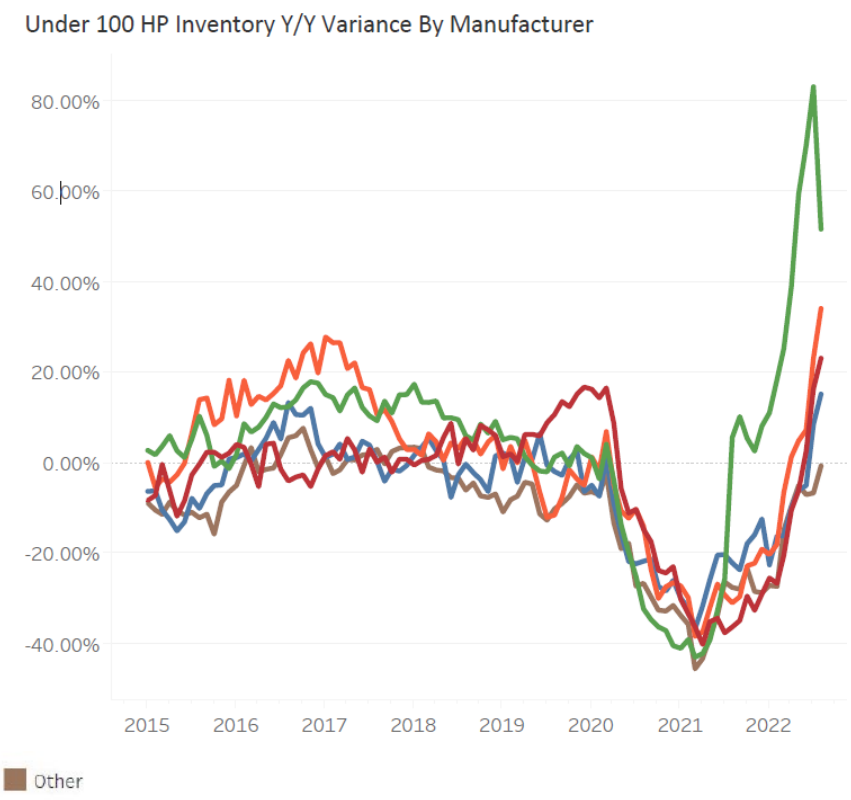
IV. Top Developments We're Tracking in North America Agricultural Equipment

Tractors under 100 HP: Increases in low HP tractors are beginning to impact used prices

Market share (of used inventories)



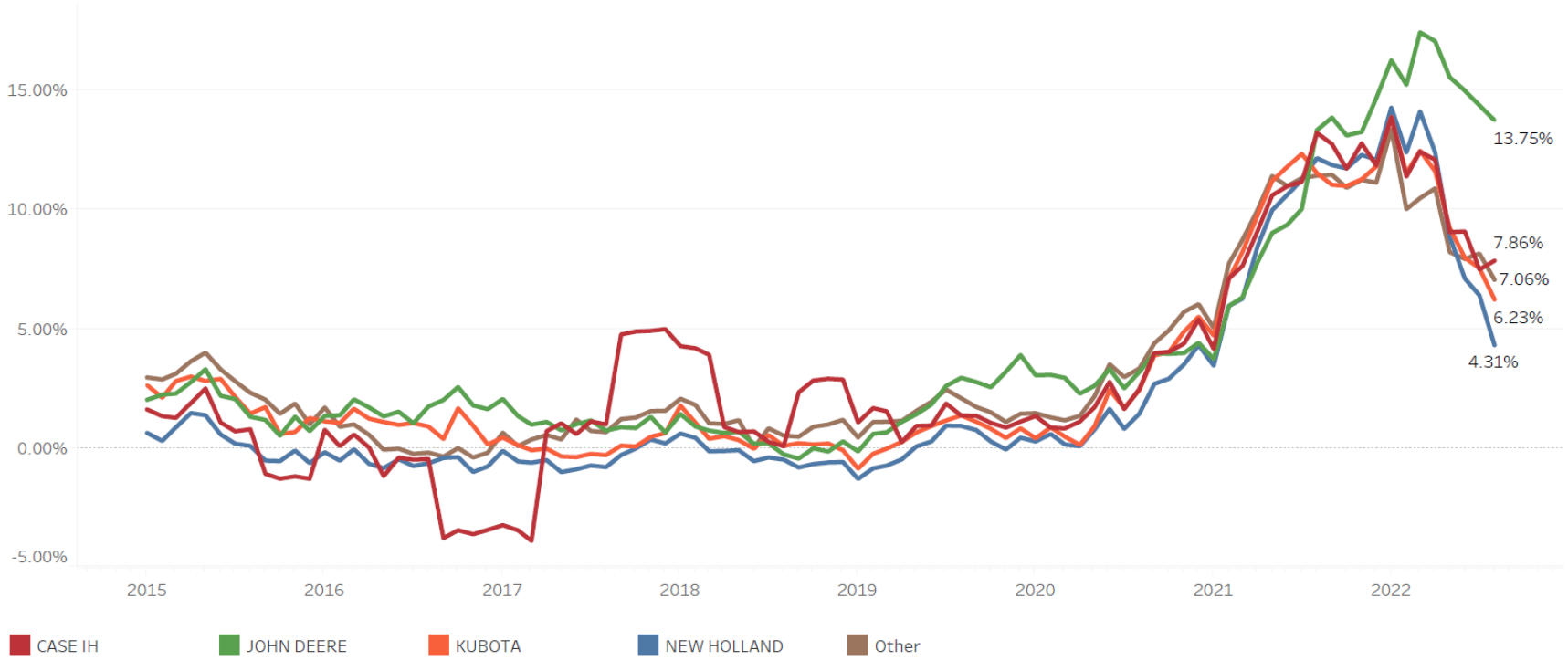
Used tractor inventories, % chg yoy



Sources: Sandhills Global

Tractors under 100 HP: Used tractor prices have started to normalize

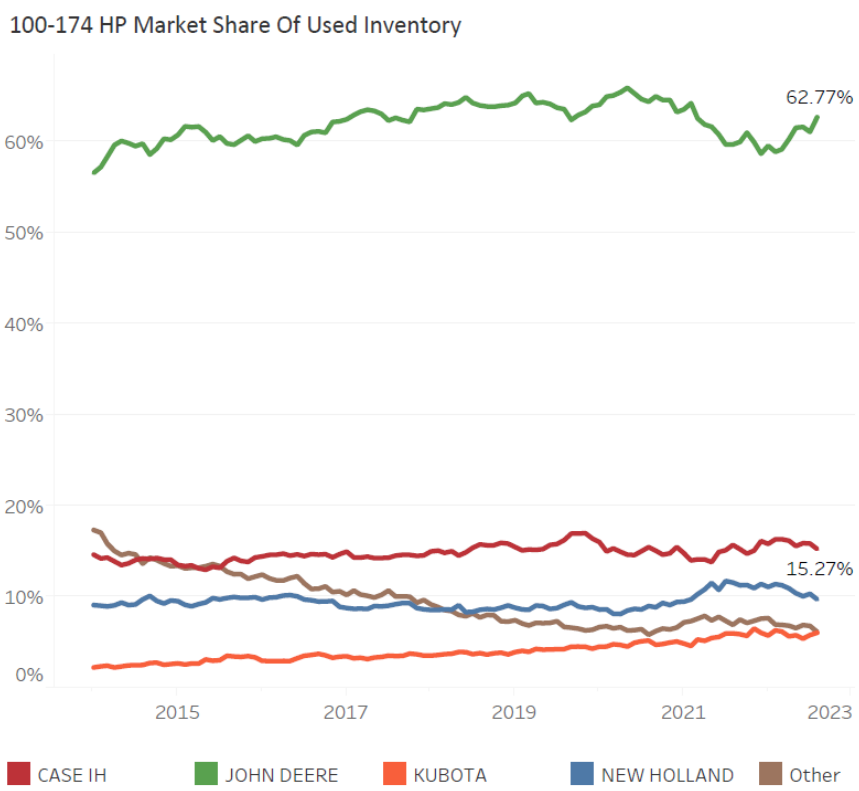
Under 100 HP Asking EVI Y/Y Variance by Manufacturer



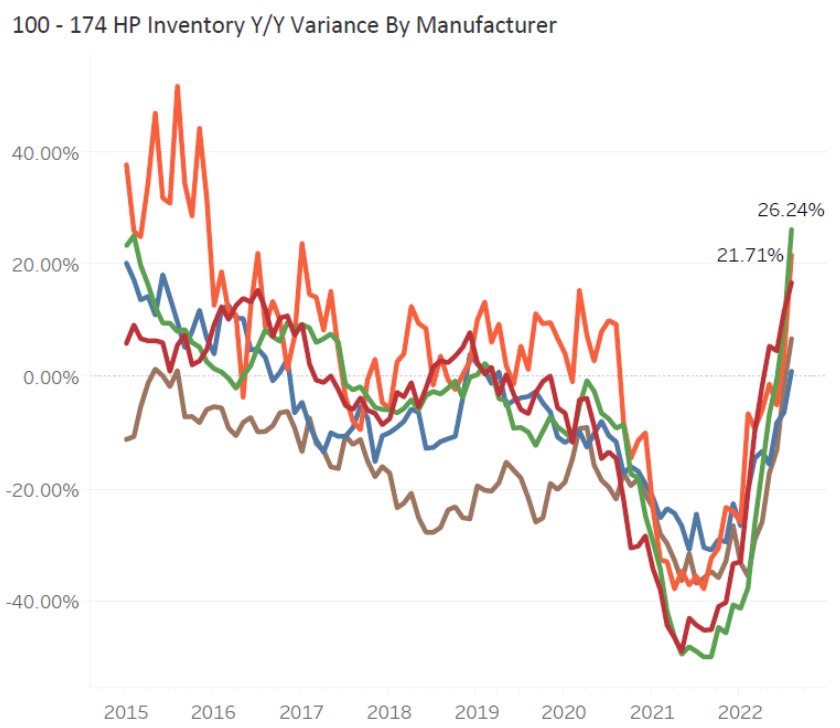
Sources: Sandhills Global

Tractors 100-174 HP: Top 4 OEMs have gained or maintained share at the expense of smaller brands

Market share (of used inventories)



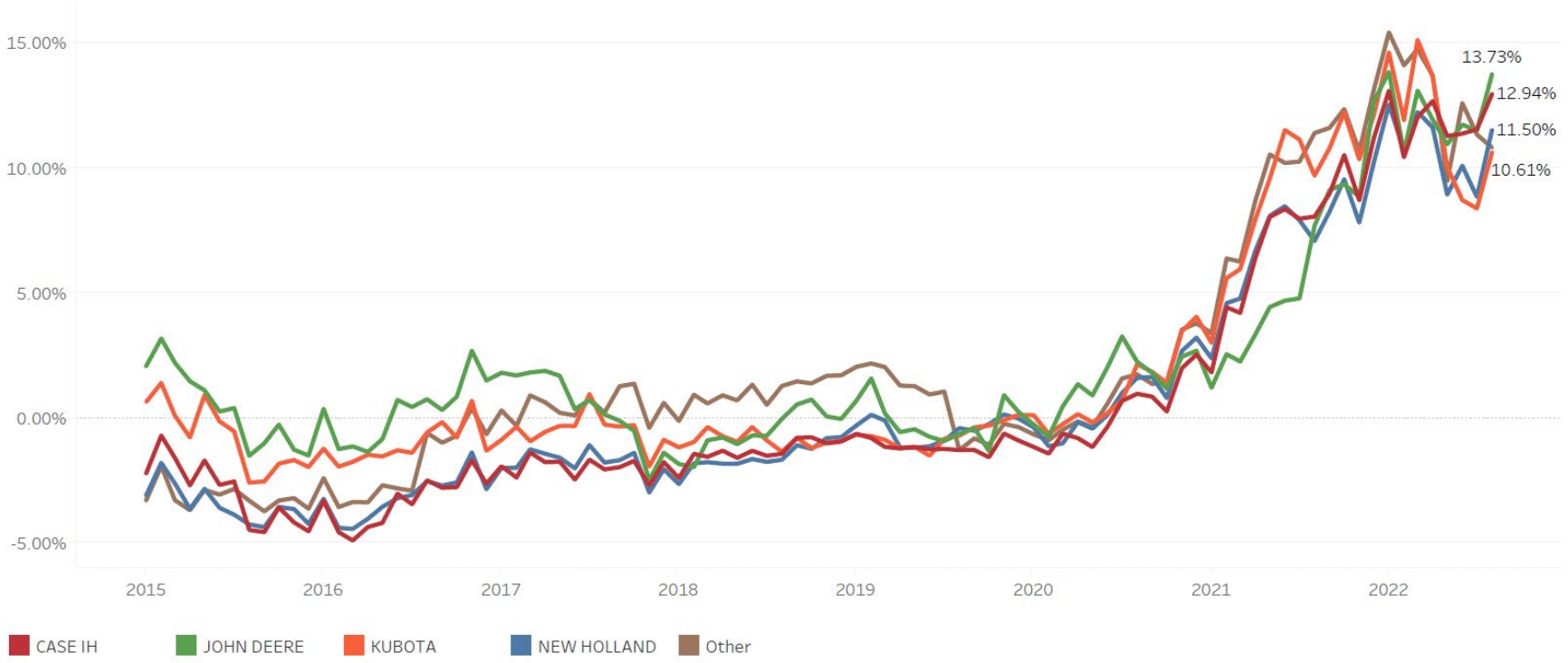
Used tractor inventories, % chg yoy



Sources: Sandhills Global

Tractors 100-174 HP: We have seen a recent pickup in lower mid-sized tractor values

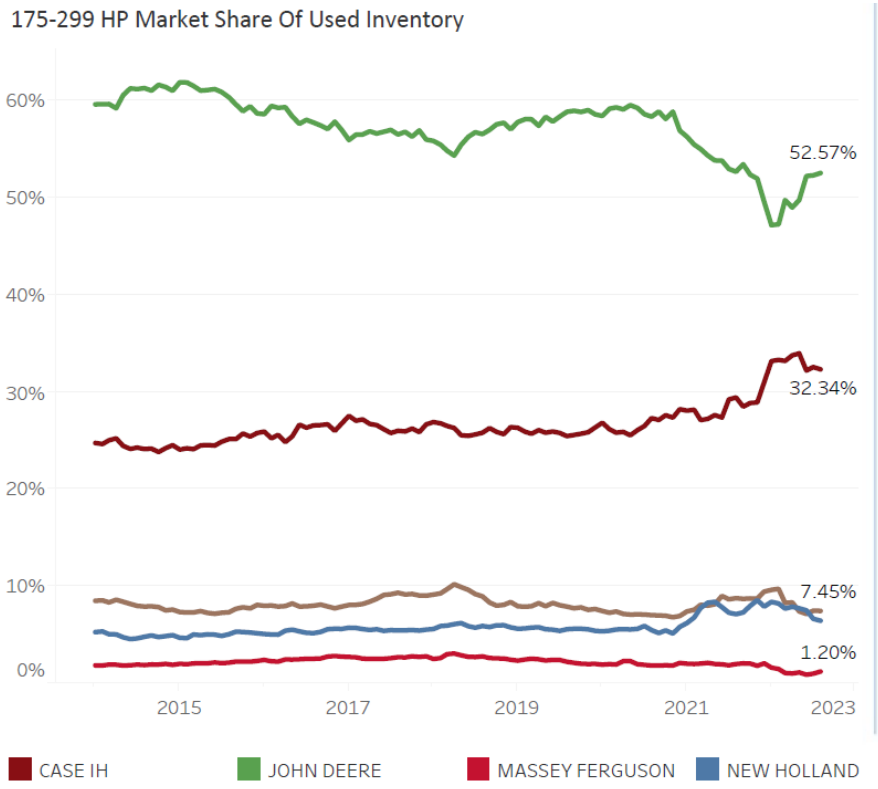
100-174 HP Asking EVI Y/Y Variance by Manufacturer



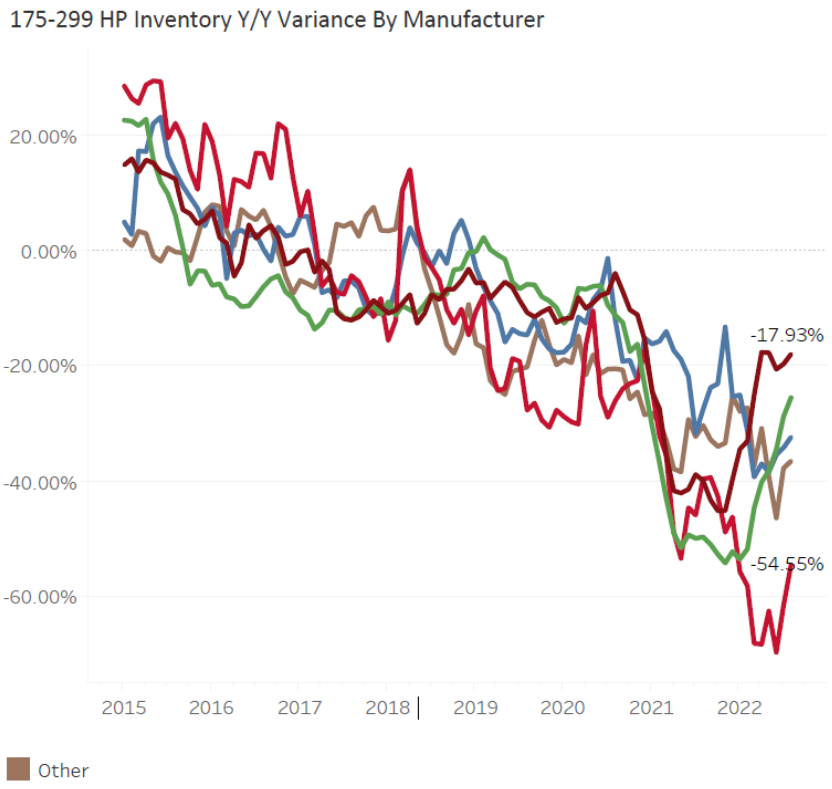
Sources: Sandhills Global

Tractors 175-299 HP: Case IH has improved share of mid-sized tractors in the US at Deere's expense

Market share (of used inventories)



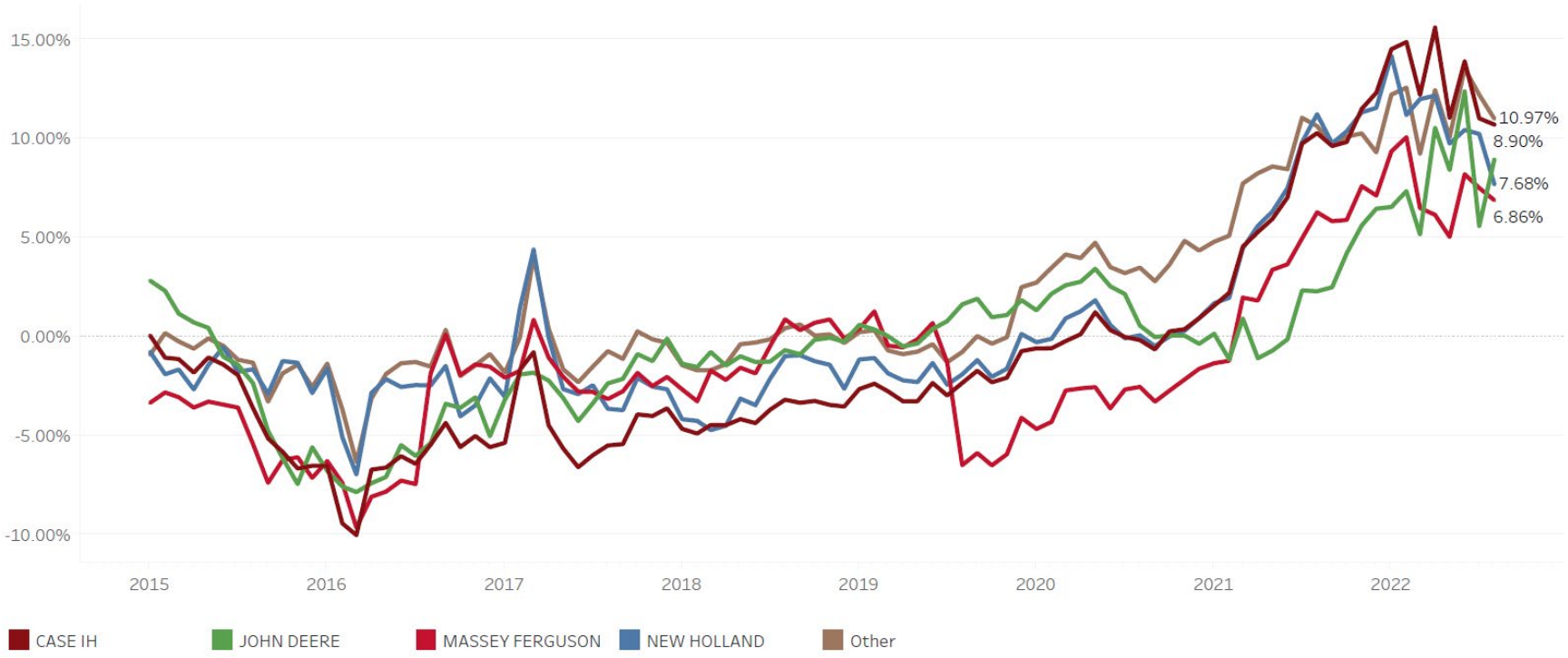
Used tractor inventories, % chg yoy



Sources: Sandhills Global

Tractors 175-299 HP: Mid-horsepower tractor values have stabilized from their highs earlier this year

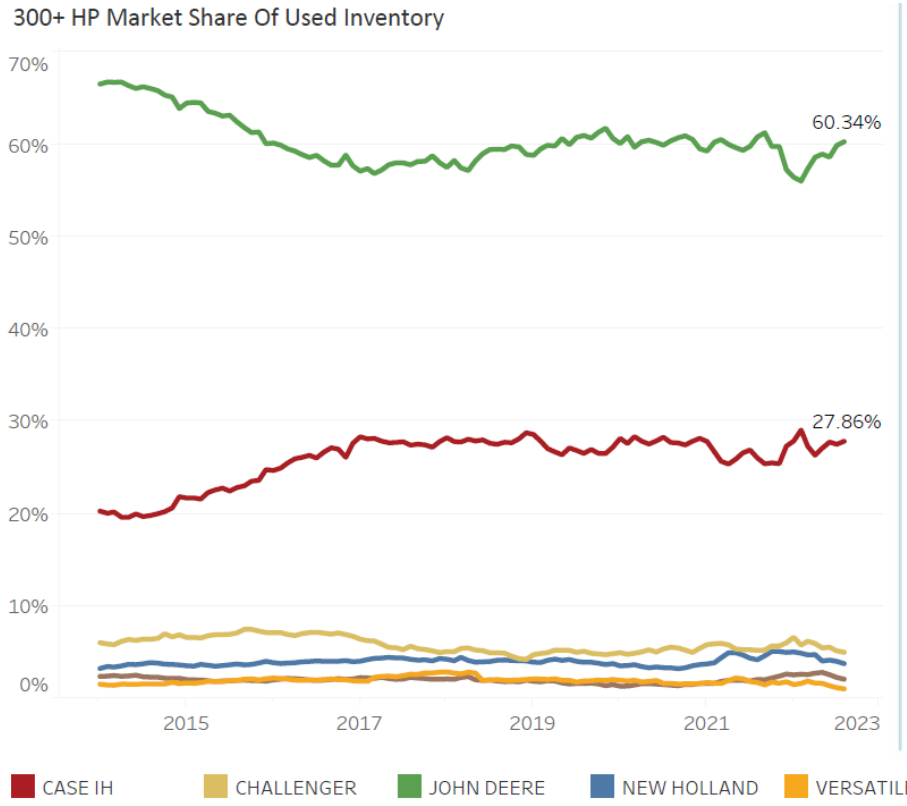
175-299 HP Asking EVI Y/Y Variance by Manufacturer



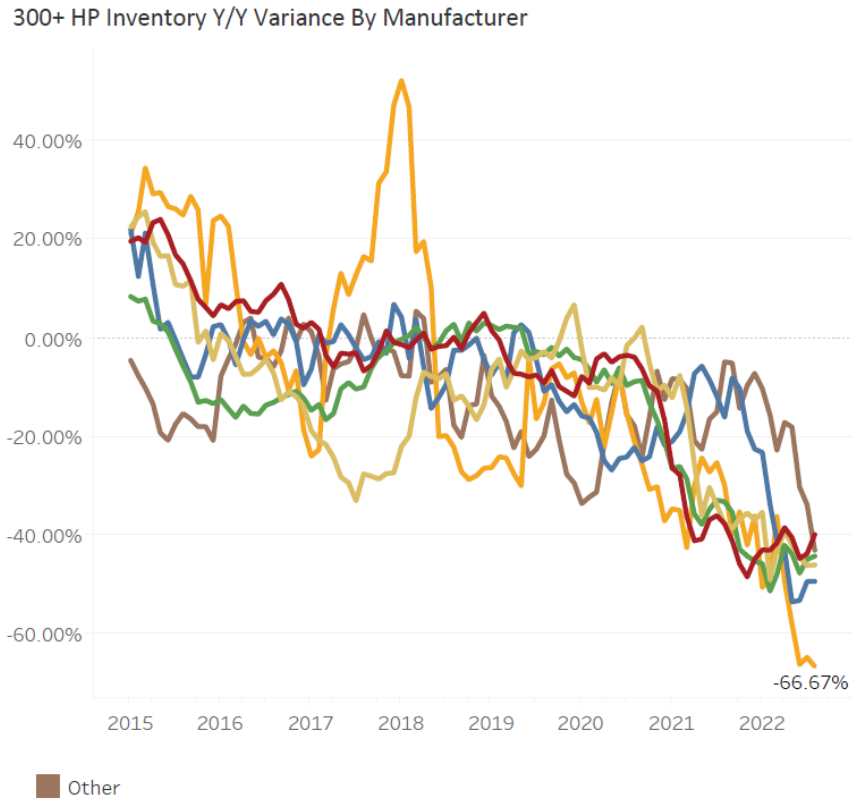
Sources: Sandhills Global

Tractors 300+ HP: Case IH has also improved market share in high horsepower tractors

Market share (of used inventories)



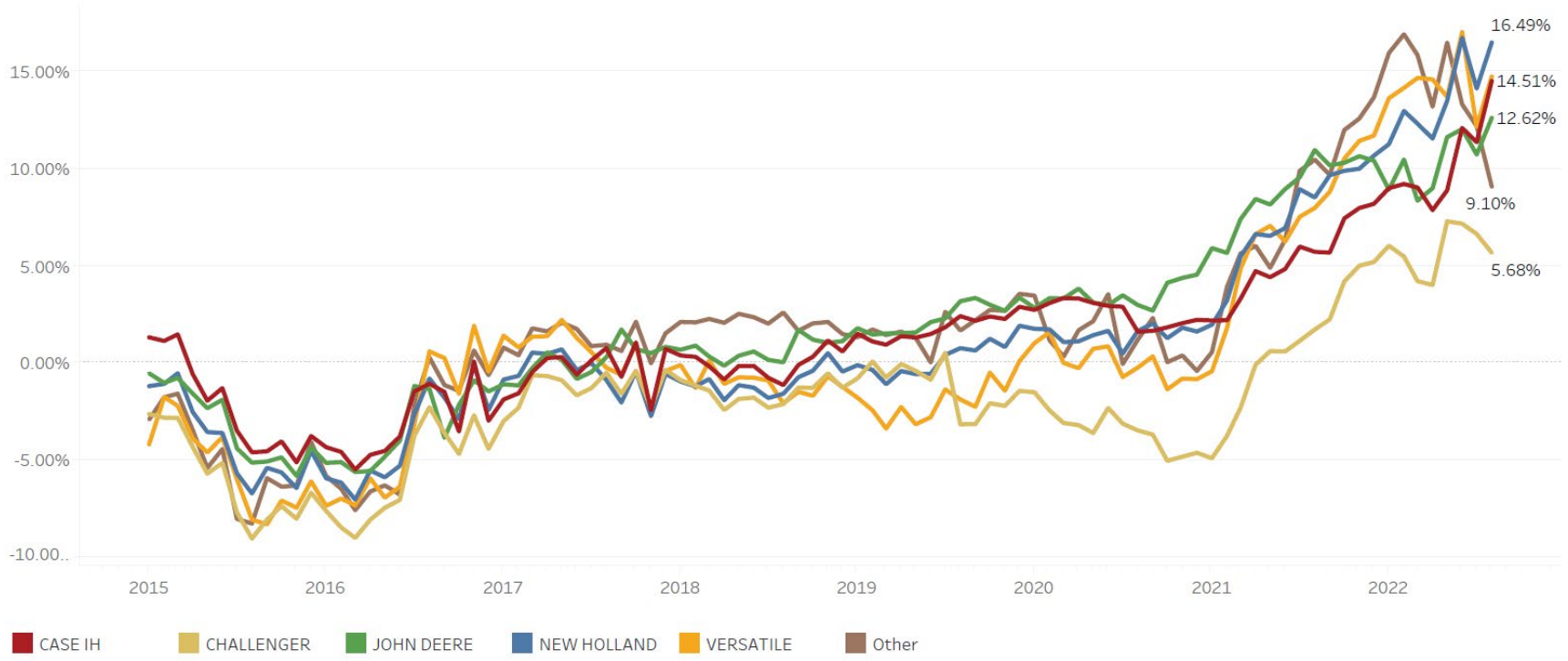
Used tractor inventories, % chg yoy



Sources: Sandhills Global

Tractors 300+ HP: Values remain robust for high horsepower tractors

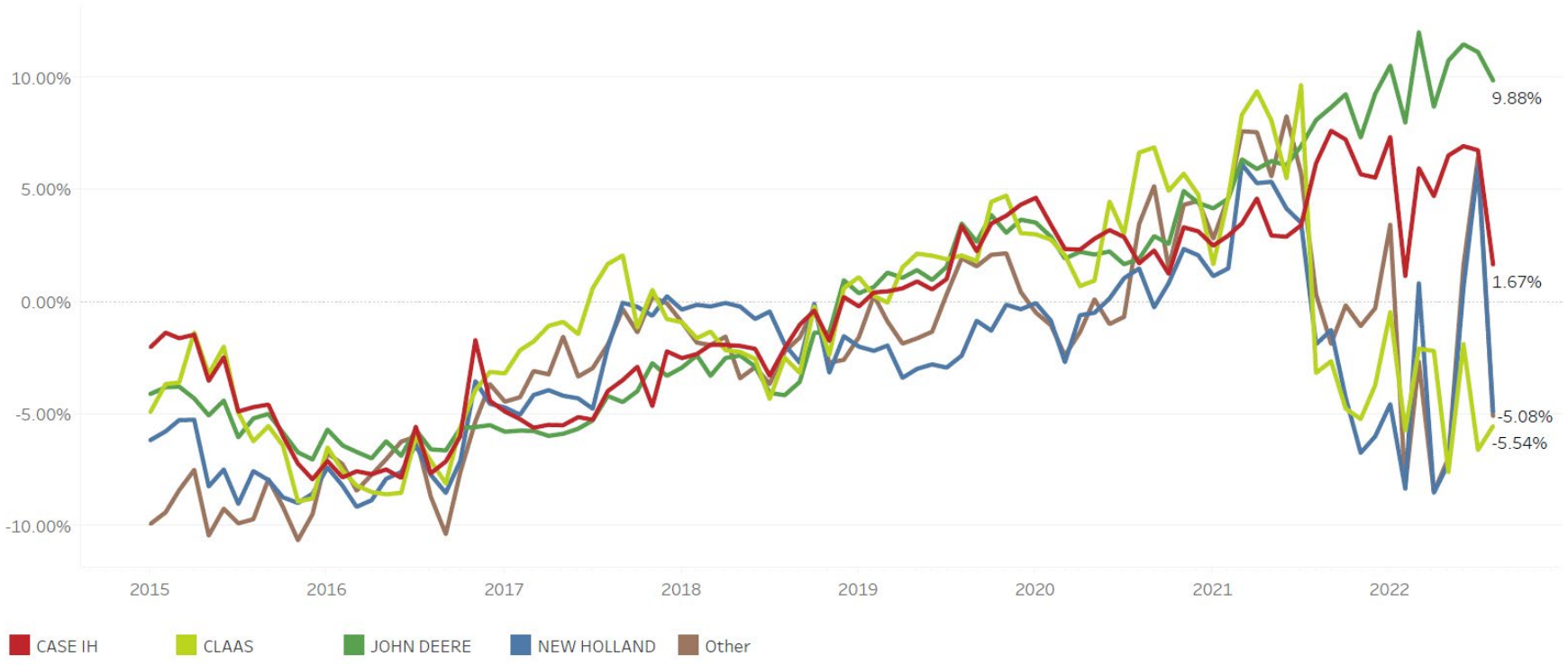
300+ HP Asking EVI Y/Y Variance by Manufacturer



Sources: Sandhills Global

Combines High HP: Deere has outperformed on price in 2022

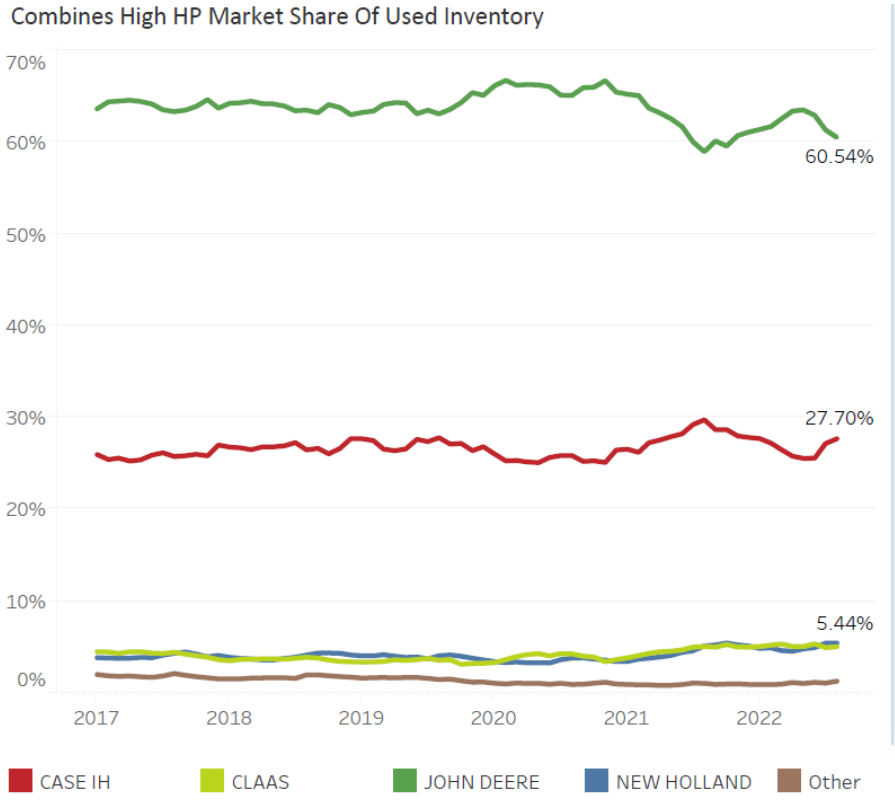
Combines High HP Asking EVI Y/Y Variance by Manufacturer



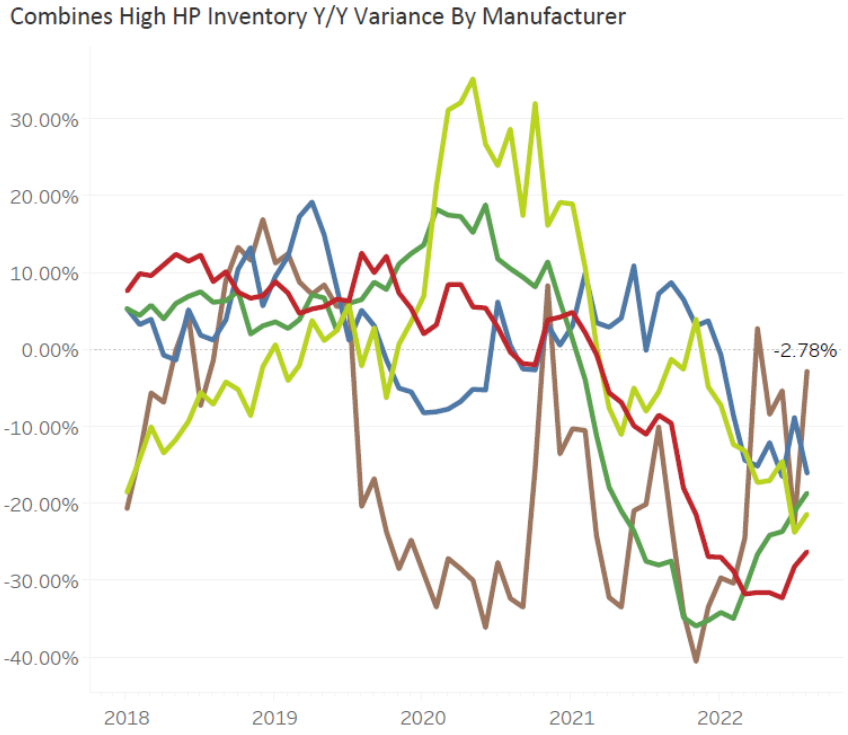
Sources: Sandhills Global

Combines High HP: Combine share relatively stable over the last several years

Market share (of used inventories)



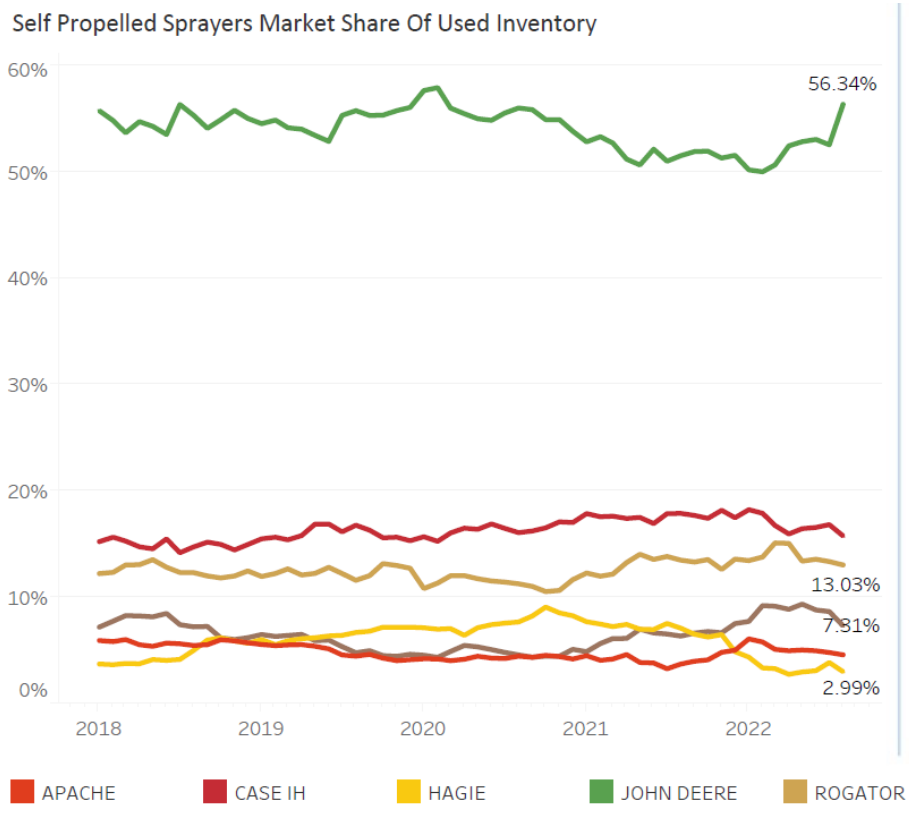
Used combine inventories, % chg yoy



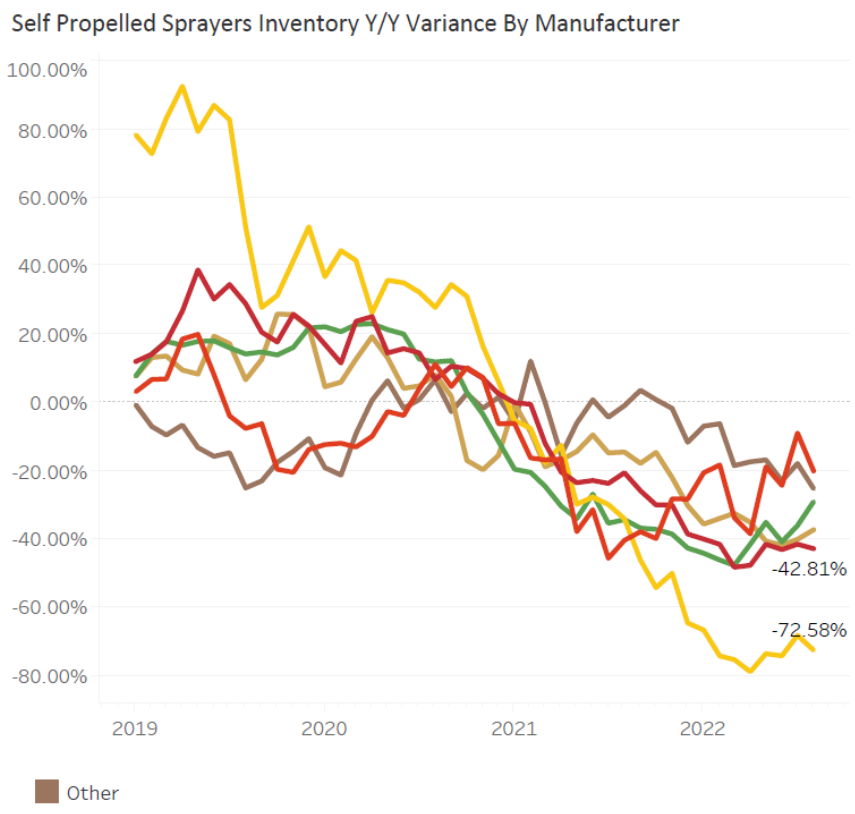
Sources: Sandhills Global

Sprayers: Deere has shed share slightly in Sprayers but still holds a dominant position

Market share (of used inventories)



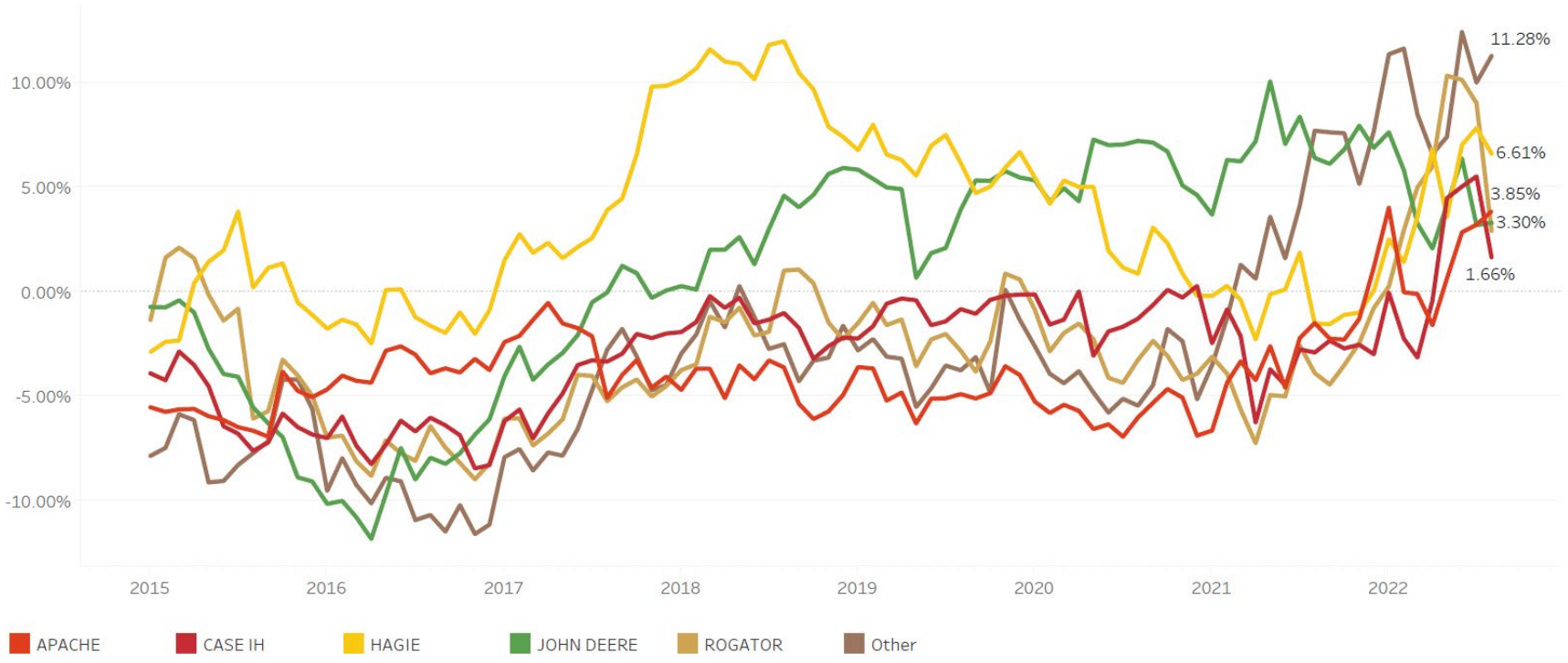
Used sprayer inventories, % chg yoy



Sources: Sandhills Global

Sprayers: Deere & Hagie have outperformed on price until recently

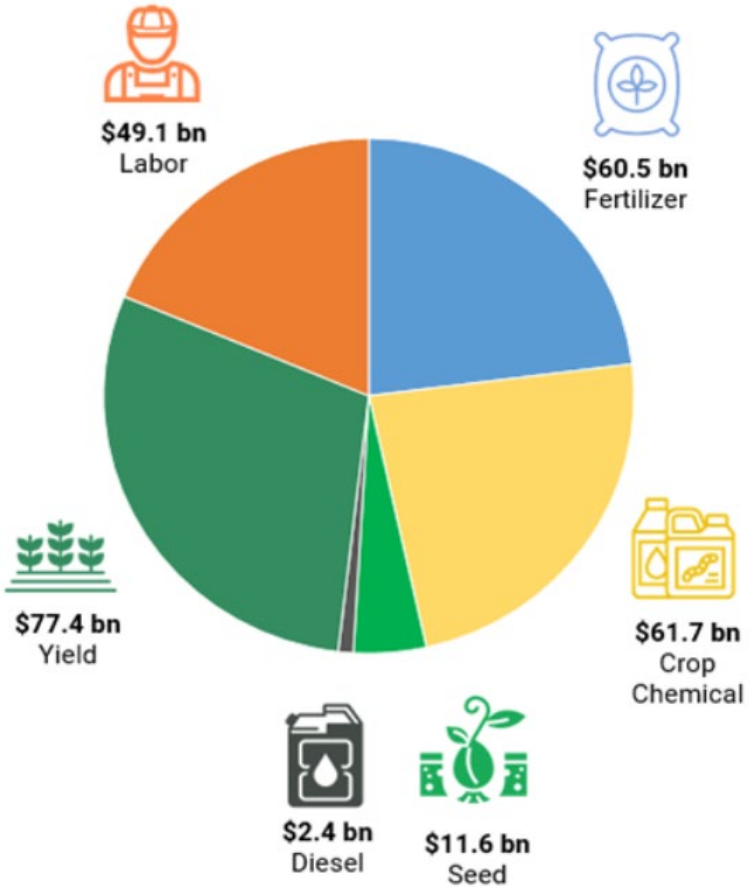
Sprayers Asking EVI Y/Y Variance by Manufacturer



Sources: Sandhills Global

V. Precision Ag Technologies to Boost Yield & Input Efficiency

We see a $265 bn addressable market of farmer inputs based on the value Precision Ag products can create



Source: USDA, Bayer, Company data, Goldman Sachs Global Investment Research

We see a $265 bn addressable market of farmer inputs based on the value Precision Ag products can create

% reduction in Fertilizer use	0%	10%	20%	30%	40%	50%	60%	70%
Fertilizer expense - US ($ bn)	$0.0	$1.1	$2.1	$3.2	$4.2	$5.3	$6.4	$7.4
Capture rate	100%	100%	100%	100%	100%	100%	100%	100%
DE US Addressable Market - Fertilizer, $ bn	**$0.0**	**$1.1**	**$2.1**	**$3.2**	**$4.2**	**$5.3**	**$6.4**	**$7.4**
Nitrogen Fertilizer expense - Global (ex-US, $ bn)	$0.0	$7.6	$15.2	$22.7	$30.3	$37.9	$45.5	$53.1
Capture rate	100%	100%	100%	100%	100%	100%	100%	100%
DE Global (ex-US) Addressable Market - Fertilizer, $ bn	**$0.0**	**$7.6**	**$15.2**	**$22.7**	**$30.3**	**$37.9**	**$45.5**	**$53.1**
DE Total Addressable Market - Fertilizer, $ bn	**$0.0**	**$8.6**	**$17.3**	**$25.9**	**$34.6**	**$43.2**	**$51.8**	**$60.5**

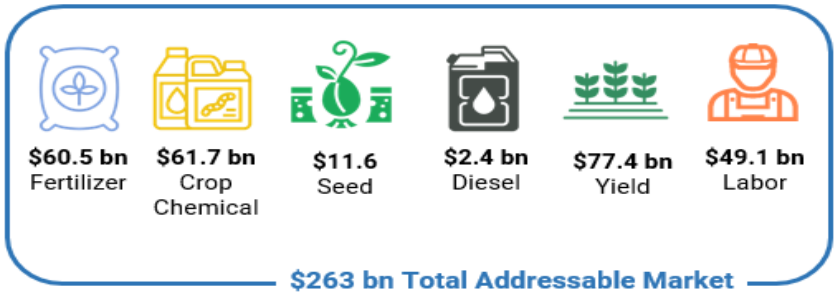
% reduction in Crop Chemical use	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%
Crop Chemical expense - US ($ bn)	$0.0	$1.6	$3.1	$4.7	$6.3	$7.8	$9.4	$10.9	$12.5	$14.1
Capture rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
DE US Addressable Market - Crop Chemical, $ bn	**$0.0**	**$1.6**	**$3.1**	**$4.7**	**$6.3**	**$7.8**	**$9.4**	**$10.9**	**$12.5**	**$14.1**
Crop Chemical expense - Global (ex-US, $ bn)	$0.0	$5.3	$10.6	$15.9	$21.2	$26.5	$31.7	$37.0	$42.3	$47.6
Capture rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
DE Global (ex-US) Addressable Market - Crop Chemical, $ bn	**$0.0**	**$5.3**	**$10.6**	**$15.9**	**$21.2**	**$26.5**	**$31.7**	**$37.0**	**$42.3**	**$47.6**
DE Total Addressable Market - Crop Chemical, $ bn	**$0.0**	**$6.9**	**$13.7**	**$20.6**	**$27.4**	**$34.3**	**$41.1**	**$48.0**	**$54.8**	**$61.7**

% reduction in Seed use	0%	5%	10%	15%	20%
Seed expense - US ($ bn)	$0.0	$1.1	$2.1	$3.2	$4.3
Capture rate	100%	100%	100%	100%	100%
DE US Addressable Market - Seeds, $ bn	**$0.0**	**$1.1**	**$2.1**	**$3.2**	**$4.3**
Seed expense - Global (ex-US, $ bn)	$0.0	$1.8	$3.7	$5.5	$7.3
Capture rate	100%	100%	100%	100%	100%
DE Global (ex-US) Addressable Market - Seeds, $ bn	**$0.0**	**$1.8**	**$3.7**	**$5.5**	**$7.3**
DE Total Addressable Market - Seeds, $ bn	**$0.0**	**$2.9**	**$5.8**	**$8.7**	**$11.6**

% reduction in Diesel use	0%	2.5%	5.0%	7.5%
Diesel expense - US ($ bn)	$0.0	$0.2	$0.4	$0.6
Capture rate	100%	100%	100%	100%
DE US Addressable Market - Diesel, $ bn	**$0.0**	**$0.2**	**$0.4**	**$0.6**
Diesel expense - Global (ex-US, $ bn)	$0.0	$0.6	$1.2	$1.9
Capture rate	100%	100%	100%	100%
DE Global (ex-US) Addressable Market - Diesel, $ bn	**$0.0**	**$0.6**	**$1.2**	**$1.9**
DE Total Addressable Market - Diesel, $ bn	**$0.0**	**$0.8**	**$1.6**	**$2.4**

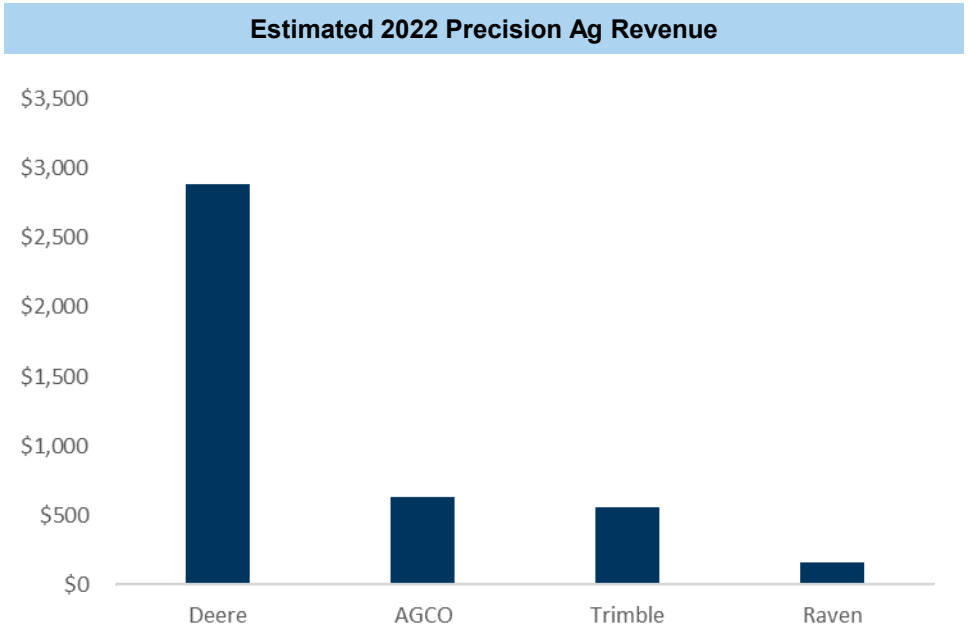
% Yield improvement	0%	5%	10%	15%	20%
Row crop revenue - US ($ bn)	$0.0	$4.5	$8.9	$13.4	$17.9
Capture rate	100%	100%	100%	100%	100%
DE US Addressable Market - Yield, $ bn	**$0.0**	**$4.5**	**$8.9**	**$13.4**	**$17.9**
Row crop revenue - Global (ex-US, $ bn)	$0.0	$14.9	$29.8	$44.7	$59.5
Capture rate	100%	100%	100%	100%	100%
DE Global (ex-US) Addressable Market - Yield, $ bn	**$0.0**	**$14.9**	**$29.8**	**$44.7**	**$59.5**
DE Total Addressable Market - Yield, $ bn	**$0.0**	**$19.3**	**$38.7**	**$58.0**	**$77.4**

% Labor improvement	0%	10%	20%	30%
Labor expense - US ($ bn)	$0.0	$3.8	$7.6	$11.4
Capture rate	100%	100%	100%	100%
DE US Addressable Market - Labor $ bn	**$0.0**	**$3.8**	**$7.6**	**$11.4**
Labor expense - Global (ex-US, $ bn)	$0.0	$12.6	$25.1	$37.7
Capture rate	100%	100%	100%	100%
DE Global (ex-US) Addressable Market - Labor, $ bn	**$0.0**	**$12.6**	**$25.1**	**$37.7**
DE Total Addressable Market - Labor, $ bn	**$0.0**	**$16.4**	**$32.7**	**$49.1**



Source: USDA, Bayer, Company data, Goldman Sachs Global Investment Research

Precision Ag Revenue by Company

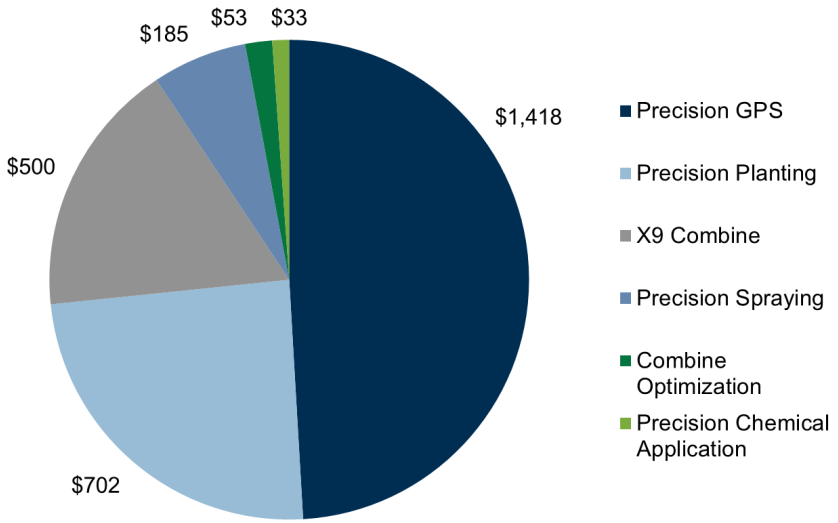


Source: Company data, Goldman Sachs Global Investment Research

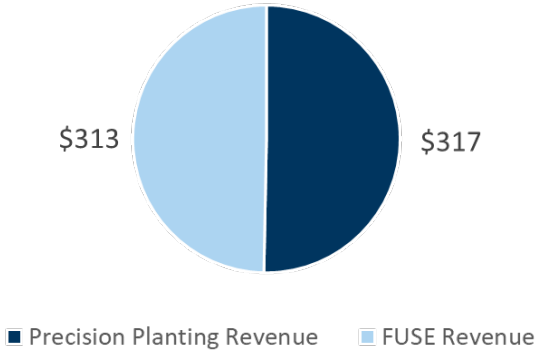
Note: CNHI/Raven estimate based on Raven's disclosed Ag revenue at time of acquisition (6/21/21)

Precision Ag Breakdown

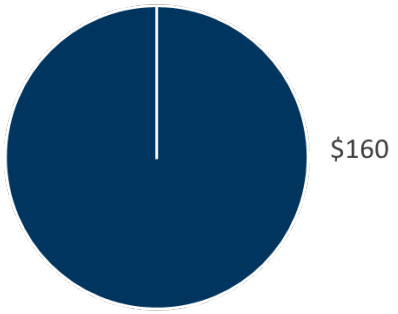
Deere precision ag portfolio is estimated at $3 bn in sales



AGCO's precision ag portfolio is estimated $630 mn in sales



CNHI/Raven precision ag portfolio is estimated at $160 mn in sales

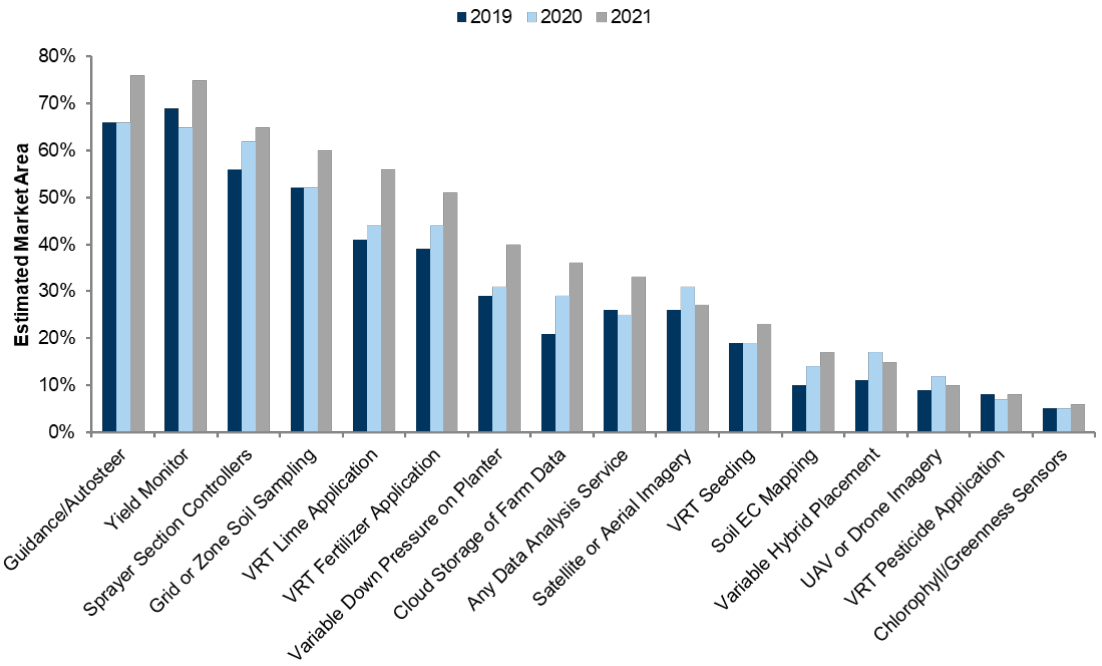


Source: Company data, Goldman Sachs Global Investment Research

Note: CNHI/Raven estimate based on Raven's disclosed Ag revenue at time of acquisition (6/21/21)

Precision Ag Adoption

Precision Ag adoption rates increasing

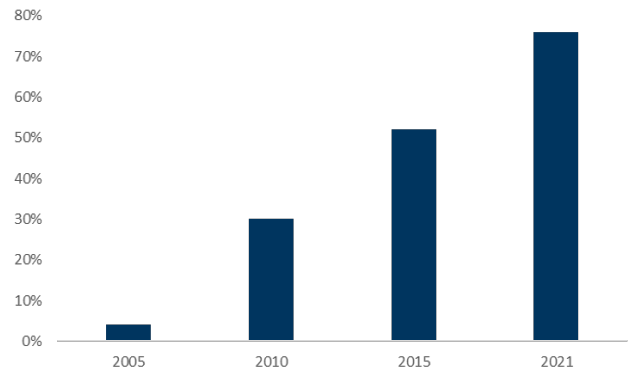


Source: Purdue

Precision GPS Technology

GPS/Autoguidance

Farmer adoption of guidance/autosteer has gone from niche to mainstream over the past 15 years



Trimble

- Trimble offers a range of guidance displays and steering solutions for farmers and equipment manufacturers

Raven

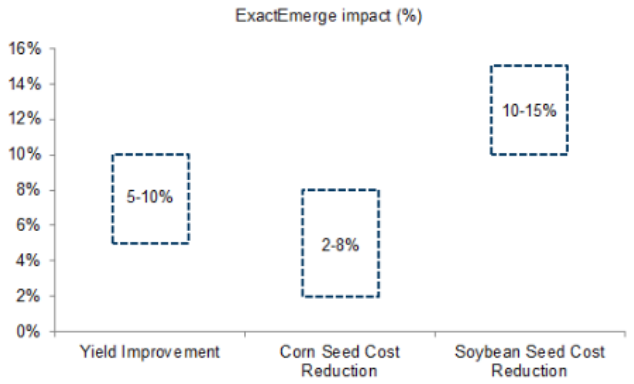
- Raven has a broad line of third-party guidance systems from GNSS to RTK sub-inch accuracy.
- Other guidance products include VSN visual guidance for better guidance through emerged to full canopy crops and Raven Implement Steering

Source: Purdue, Deere.com, ravenind.com, trimble.com, Goldman Sachs Global Investment Research

Precision Planting

Deere's ExactEmerge precision planting unit

Yield improvement from full adoption of Deere's current Precision Ag Portfolio (add an exactemerge chart)



AGCO

- AGCO's Precision Planting business is focused on retrofit across precision planting & precision fertilizer application

Raven

- Raven offers third party rate control and fertilizer distribution systems through its Rate Control Module and AccuFlow technologies

Source: Deere.com, agcocorp.com, ravenind.com Company data, Goldman Sachs Global Investment Research

Precision Chemical Application

AGCO offering precision ag products for both the retrofit market and OEM

- Retrofit options
  - Vision: vision technology for sprayer
  - Symphony: precise nozzle control system
  - ReClaim: boom priming and recirculation

Deere introducing See & Spray Ultimate

- See & Spray
  - See & Spray Ultimate offers green on green spraying capability
  - We've estimated it will take 10 years for full adoption across its customer base

Case IH Sprayer with integrated Raven technology

- Precision Ag Tech
  - Hawkeye 2: Individual nozzle control system
  - Raven VSN: Visual guidance system which increases efficiency and performance in full canopy crops
  - AutoBoom XRT: automatic boom height control

Blue River See and Spray

Source: Bluerivertechnology.com

Autonomy: Next frontier for ag machinery

Levels of Autonomy

- Level 1: Precision Farming
  - Machine level automation
  - Product: Rate Control
- Level 2: Coordination & Optimization
  - Task level automation
  - Product: Connected workflows
- Level 3: Operator Assisted Autonomy
  - Environment can control basic propulsion, guidance or application
  - Product: Auto boom technology
- Level 4: Supervised Autonomy
  - Driverless machine is directly operated from outside the machine but within the field
  - Product: Deere Autonomous Tillage / CASE IH Trident 5550 applicator
- Level 5: Full Autonomy
  - Driverless machine requiring no in-field operator or in-field supervision
  - Deere has targeted fully autonomous corn and soy production year-end 2030

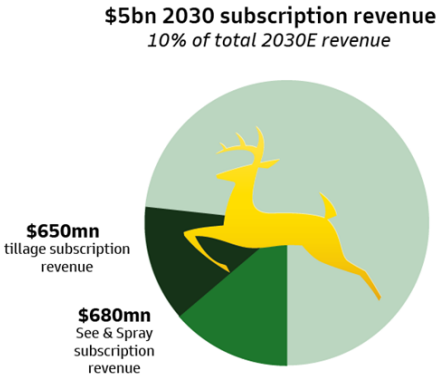
The Case IH debuted its autonomous spreader at Farm Progress

- Features
  - Level 4 autonomy
  - Able to run from a mobile device
  - Remotely command or supervise in the field or from another cab

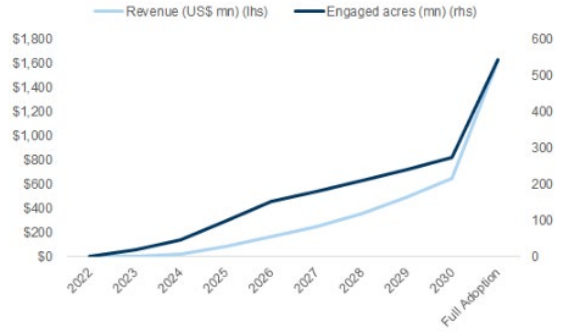
Source: ravenind.com, caseih.com

Autonomy: Deere has targeted fully autonomous row crop farming by 2030

We believe that Deere's tillage offering can achieve ~$650 mn of subscription revenue by 2030



Assuming steady growth in highly engaged acres and a 50% penetration, we estimate revenue contribution of autonomous tillage would be about $650 mn by 2030 .



- Deere has outlined a plan to make the US row crop industry fully autonomous by automating work streams spanning tillage, planting, spraying, and harvesting.
- Deere management also outlined a plan to address automation in other crops after row crop applications.
- Deere will have 12 cameras in every autonomous tractor.
- Deere's images are uploaded to a training set and the system continuously improves.

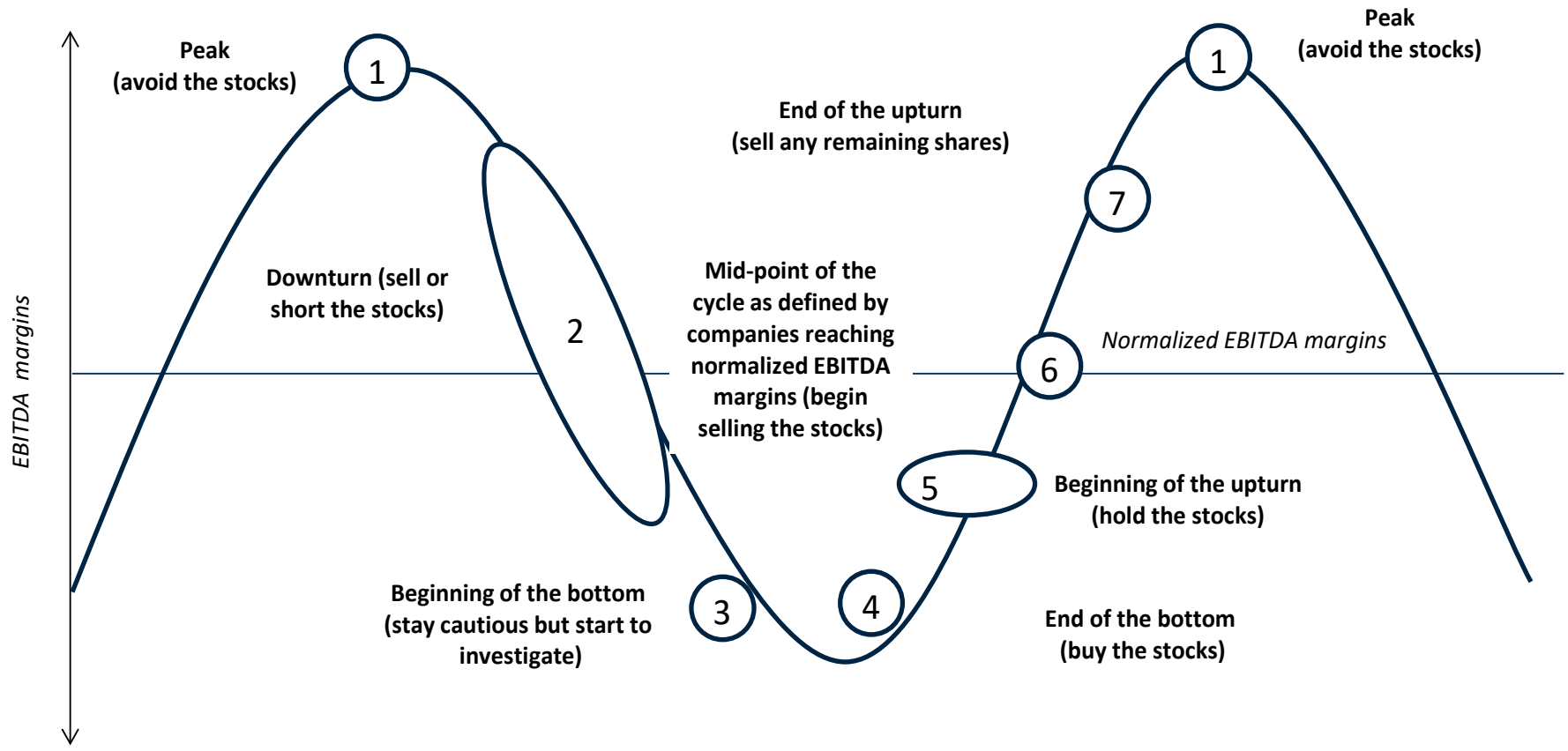
Source: Bluerivertechnology.com, deere.com

VI. Stock Views

Cyclical investing framework

The seven stages of a pure cyclical

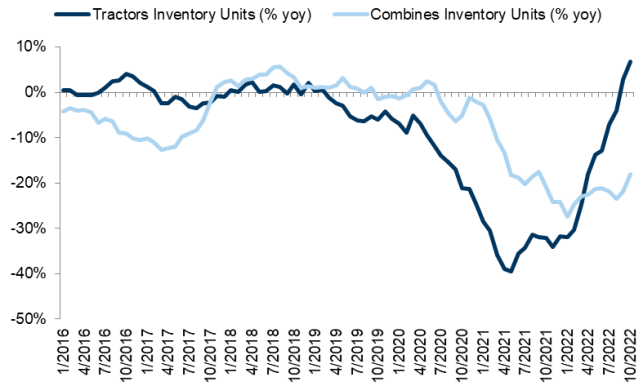
The seven stages of a cyclical business



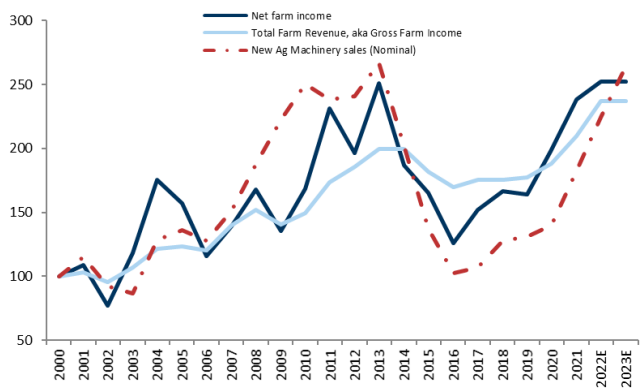
Source: Goldman Sachs Global Investment Research.

Ag Machinery Back Drop

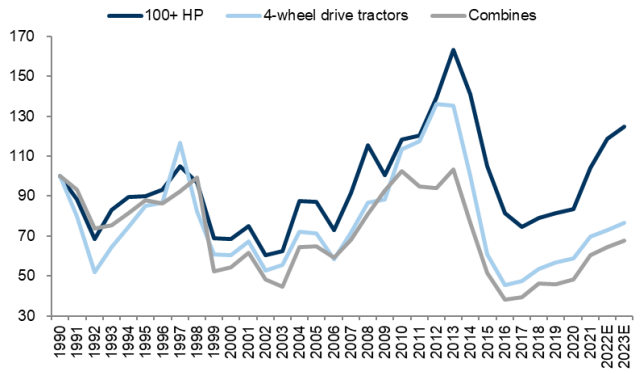
Total ag equipment inventories were down -1% yoy in October vs -6% yoy in September



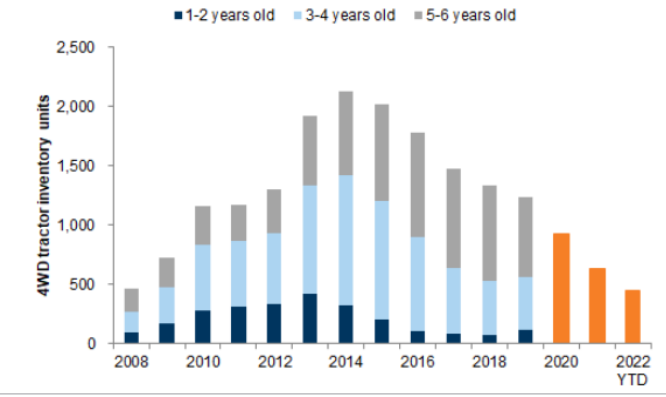
We estimate US farmer income will be flat year over year in 2023



Combine and 4-wheel drive tractor sales were at 30+ year lows



Used late-model year 4WD tractor inventories are at historically low levels

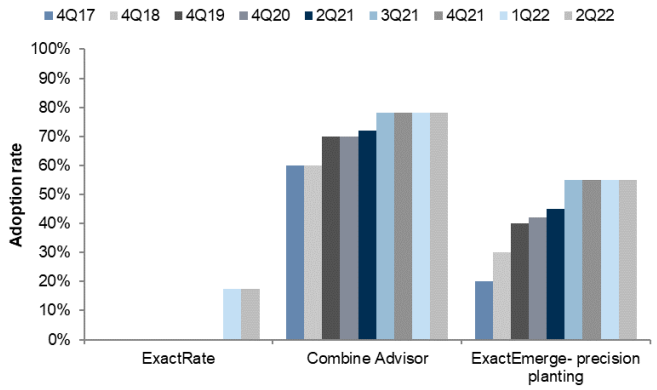


Deere is covered by Jerry Revich

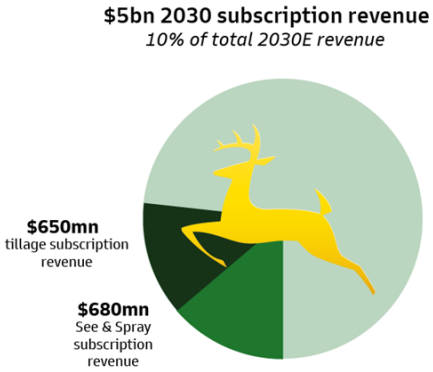
Sources: BLS, AEM, USDA, WASDE, Machinery Pete, Sandhills Global, Goldman Sachs Global Investment Research

Ag Machinery Back Drop

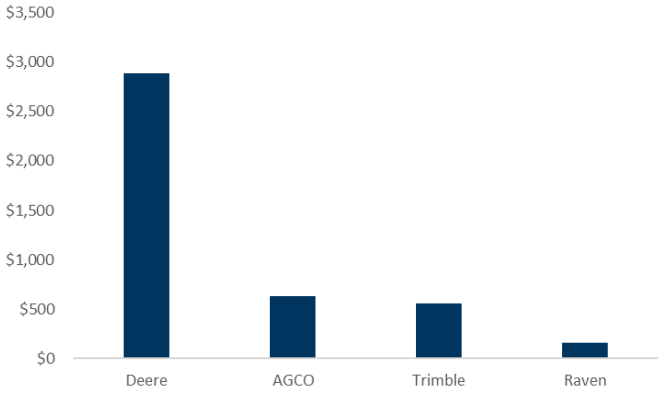
Deere has seen accelerating adoption rates for its precision ag products



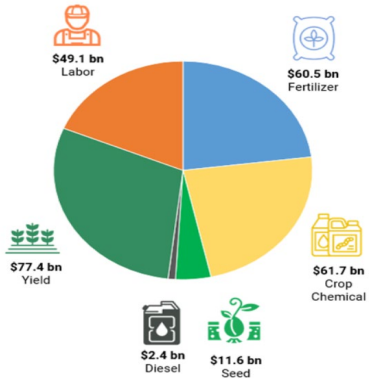
We believe that Deere's tillage offering can achieve ~$650 mn of subscription revenue by 2030



Estimated 2022 Precision Ag Revenue



Large Addressable Market for Precision Ag

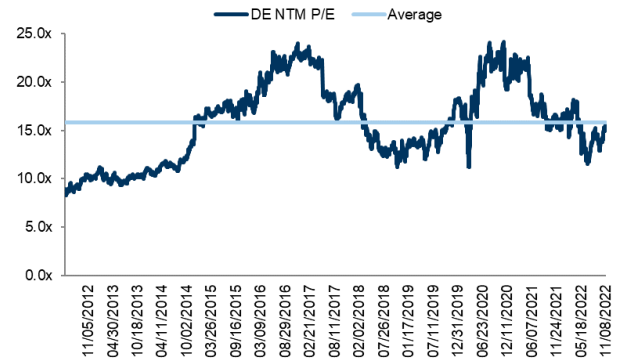


Deere is covered by Jerry Revich

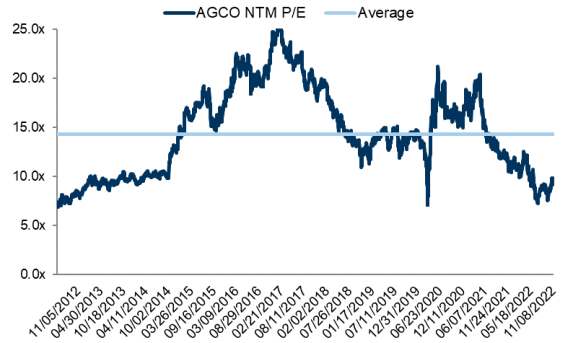
Sources: company reports, Goldman Sachs Global Investment Research

Valuation summary

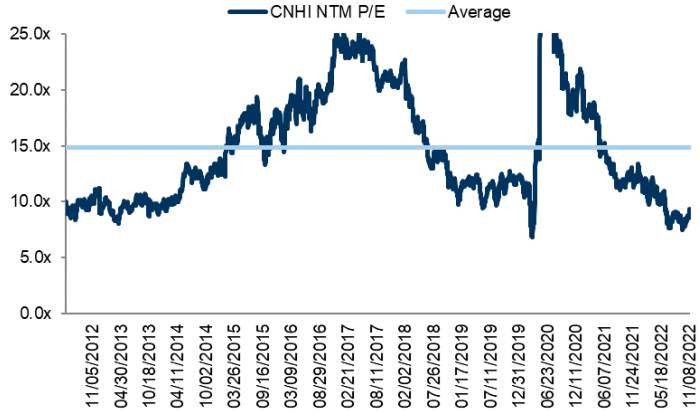
DE is trading at 16x NTM earnings



AGCO is trading at 10x NTM earnings



CNHI is trading at 10x NTM earnings



Source: FactSet, Goldman Sachs Global Investment Research

Disclosure Appendix

November 14, 2022

Disclosure Appendix

Reg AC

We, Jerry Revich, CFA, Clay Williams, CFA, Jatin Khanna, and Adam Bubes, CFA, 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.

Disclosure Appendix

Disclosures

Rating and pricing information

AGCO Corp. (Buy, $127.84), Allison Transmission Holdings (Sell, $42.79), CalAmp Corp. (Sell, $3.59), Caterpillar Inc. (Buy, $236.49), Clean Harbors Inc. (Neutral, $115.56), Cummins Inc. (Neutral, $248.17), Deere & Co. (Buy, $406.03), Eagle Materials Inc. (Buy, $133.76), GFL Environmental (Buy, $28.27), Gates Industrial Corp. (Buy, $11.92), Generac Holdings (Buy, $114.08), Granite Construction Inc. (Sell, $33.64), Herc Holdings (Buy, $135.89), Jacobs (Buy, $125.72), KBR Inc. (Buy, $49.32), Manitowoc Co. (Neutral, $10.32), Martin Marietta Materials (Neutral, $362.19), Oshkosh Corp. (Buy, $92.56), Paccar Inc. (Neutral, $102.62), Primoris Services Corp. (Sell, $22.34), REV Group (Sell, $14.05), Republic Services Inc. (Buy, $131.06), Summit Materials Inc. (Neutral, $30.54), Terex Corp. (Neutral, $45.21), Trimble Inc. (Buy, $62.00), United Rentals Inc. (Buy, $349.31), Vulcan Materials Co. (Neutral, $178.96), Wabtec Corp. (Neutral, $101.07), Waste Connections Inc. (Buy, $136.25), Waste Management Inc. (Buy, $158.16) and Xos Inc. (Neutral, $1.05)

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.

Disclosure Appendix

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.

Disclosure Appendix

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.

Disclosure Appendix

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.

Disclosure Appendix

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.

© 2022 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, Inc.