

Selecting Defense Stocks  
Using the Govini National Security Scorecard:  
Critical Technologies Edition

Bruce D. Crawford  
Osher Lifelong Learning Institute  
at George Mason University  
February 2, 2023

# Disclaimer

- I am not licensed or qualified to provide investment advice. Consider your own situation carefully and consult with a properly licensed and accredited professional before making or disposing of any investments involving real money.
- Charts from the Member's Area of StockCharts.com are used by permission.

# Disclosure

- I currently have long positions in the following stocks mentioned in this report: BAH, CACI, ED, GD, HII, HON, J, LHX, LMT, MSFT, NOC, PFE, TTEK.

# Contents

- Introduction
- *The National Security Scorecard: Critical Technologies Edition* (Govini, 2022)
- Narrowing down our study topics: Zoom polls
- Division of labor for teams
- Fall 2022 presentation topics
- Prioritizing study sub-topics

# Contents (cont'd)

- Let's narrow it down some more: New polls with a deeper dive
- Companies and investors
- Technology accelerators
- University research partners
- Expanding our research focus: New polls with a broader perspective

# Contents (cont'd)

- Additional resources
- Summary and conclusion

# Introduction

# Secretary of Defense Establishes Office of Strategic Capital

Dec. 1, 2022



Secretary of Defense Lloyd J. Austin III today established the Office of Strategic Capital (OSC), a Department of Defense organization that will help build an enduring technological advantage by partnering with private capital providers.

OSC will connect companies developing critical technologies vital to national security with capital. Critical technologies such as advanced materials, next-generation biotechnology, and quantum science often require long-term financing to bridge the gap between the laboratory and full-scale production, often referred to as the "Valley of Death" in industry.

"We are in a global competition for leadership in critical technologies, and the Office of Strategic Capital will help us win that competition and build enduring national security advantages," said Secretary Austin. "By working with the private capital markets and by partnering with our federal colleagues, OSC will address investment gaps and add a new tool to the Department's investment toolbox."

Image source (portion shown):

<https://www.defense.gov/News/Releases/Release/Article/3233377/secretary-of-defense-establishes-office-of-strategic-capital/>



These technology companies also suffer from a limited supply of longtime-horizon "patient capital," which results in an inability to transition technology into military capabilities – even for technologies developed with the help of federal research grants or contracts. Moreover, many of these technologies are essential for future defense capabilities but are not purchased directly by the DoD, meaning existing procurement programs are unable to support the relevant companies' immediate capital needs.

"America's strategic competitors are working to influence U.S. technological innovation to their advantage," said Under Secretary of Defense for Research and Engineering Heidi Shyu. "OSC is part of a broader administration-wide effort to 'crowd-in' private capital in areas where our efforts can boost our future security and prosperity. Our hope is that OSC will be able to strike its first deals by early next year."

As an office overseen by the Secretary of Defense, the OSC will have an advisory council that includes the Under Secretaries of Defense. The OSC will work across policy, acquisition, and research efforts to increase the amount of capital available to critical technology companies. OSC will also help counter non-market actions by strategic competitors that use U.S. capital markets to advance their own technology goals.

<https://www.defense.gov/News/Releases/Release/Article/3233377/secretary-of-defense-establishes-office-of-strategic-capital/>

PPA

# Invesco Aerospace & Defense ETF

As of September 30, 2022



### Fund description

The Invesco Aerospace Defense ETF (Fund) is based on the SPADE® Defense Index (Index). The Fund will normally invest at least 90% of its total assets in common stocks that comprise the Index. The Index is designed to identify a group of companies involved in the development, manufacturing, operations and support of US defense, homeland security and aerospace operations. The Fund and the Index are rebalanced and reconstituted quarterly.

### ETF Information

Fund Name	Invesco Aerospace & Defense ETF
Fund Ticker	PPA
CUSIP	46137V100
Intraday NAV	PPAIV
30 Day SEC Unsubsidized Yield	0.64%
30 day SEC Yield	0.64%
Holdings	54
Management Fee	0.30%
Total Expense Ratio	0.58%
P/B Ratio	4.61
P/E Ratio	19.05
Return on Equity	17.29%
Listing Exchange	NYSE Arca
Weighted Market Cap (\$MM)	45,628.45

### Underlying Index Data

Index Provider	SPADE Indexes, LLC
Index Name	SPADE Defense Index
Index Ticker	DXSTR

### Growth of \$10,000

- Invesco Aerospace & Defense ETF: \$36,223
- SPADE Defense Index: \$38,342
- S&P Composite 1500 Aerospace & Defense Index (USD): \$34,940



Data beginning 10 years prior to the ending date of September 30, 2022. Fund performance shown at NAV.

### Performance as at September 30, 2022

Performance (%)	YTD	1Y	3Y	5Y	10Y	Fund Inception
ETF - NAV	-10.02	-9.43	-0.67	5.61	13.74	10.17
ETF - Market Price	-10.00	-9.44	-0.61	5.65	13.76	10.19
Underlying Index	-9.87	-9.16	-0.22	6.15	14.38	10.84
Benchmark <sup>1</sup>	-6.81	-6.51	-4.06	3.14	13.33	10.97

### Calendar year performance (%)

	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
ETF - NAV	7.19	0.37	39.56	-7.36	30.03	19.20	4.23	12.73	49.81	17.85
Underlying Index	7.79	0.85	40.41	-6.84	30.81	19.96	4.89	13.46	50.80	18.62
Benchmark <sup>1</sup>	12.60	-14.62	30.83	-7.61	40.69	19.45	4.65	10.72	55.63	14.54

Returns less than one year are cumulative. Performance data quoted represents past performance. Past performance is not a guarantee of future results; current performance may be higher or lower than performance quoted. Investment returns and principal value will fluctuate and Shares, when redeemed, may be worth more or less than their original cost. See [invesco.com](https://www.invesco.com) to find the most recent month-end performance numbers. Market returns are based on the midpoint of the bid/ask spread at 4 p.m. ET and do not represent the returns an investor would receive if shares were traded at other times. Fund performance reflects fee waivers, absent which, performance data quoted would have been lower.

Image source: PPA ETF Fact Sheet – September 30, 2022 (portion shown, emphasis added)

**ITA**

# iShares U.S. Aerospace & Defense ETF

Fact Sheet as of 09/30/2022



The iShares U.S. Aerospace & Defense ETF seeks to track the investment results of an index composed of U.S. equities in the aerospace and defense sector.

## WHY ITA?

- 1 Exposure to U.S. companies that manufacture commercial and military aircrafts and other defense equipment
- 2 Targeted access to domestic aerospace and defense stocks
- 3 Use to express a sector view

## GROWTH OF 10,000 USD SINCE INCEPTION



The Growth of \$10,000 chart reflects a hypothetical \$10,000 investment and assumes reinvestment of dividends and capital gains. Fund expenses, including management fees and other expenses were deducted.

## PERFORMANCE

	1 Year	3 Year	5 Year	10 Year	Since Inception
<b>NAV</b>	-11.71%	-5.61%	1.63%	12.21%	9.35%
<b>Market Price</b>	-11.66%	-5.60%	1.64%	12.22%	9.36%
<b>Benchmark</b>	-11.39%	-5.24%	2.06%	12.67%	9.82%

## KEY FACTS

Fund Launch Date	05/01/2006
Expense Ratio	0.39%
Benchmark	Dow Jones U.S. Select Aerospace & Defense Index
30 Day SEC Yield	1.09%
<b>Number of Holdings</b>	<b>35</b>
Net Assets	\$3,385,736,378

Ticker	ITA
CUSIP	464288760
Exchange	Cboe BZX formerly known as BATS

## TOP HOLDINGS (%)

RAYTHEON TECHNOLOGIES CORP	21.41
LOCKHEED MARTIN CORP	16.14
BOEING	7.42
NORTHROP GRUMMAN CORP	4.82
GENERAL DYNAMICS CORP	4.66
TEXTRON INC	4.51
L3HARRIS TECHNOLOGIES INC	4.46
TRANSDIGM GROUP INC	4.27
HOWMET AEROSPACE INC	4.18
HUNTINGTON INGALLS INDUSTRIES INC	3.24
	<u>75.11</u>

Holdings are subject to change.

Image source: ITA ETF Fact Sheet – September 30, 2022 (portion shown, emphasis added)

# SPDR® S&P® Aerospace & Defense ETF

# XAR

Fact Sheet

Equity

As of 09/30/2022

## Key Features

- The SPDR® S&P® Aerospace & Defense ETF seeks to provide investment results that, before fees and expenses, correspond generally to the total return performance of the S&P® Aerospace & Defense Select Industry™ Index (the "Index")
- Seeks to provide exposure to the Aerospace & Defense segment of the S&P TMI, which comprises the following sub-industries: Aerospace & Defense
- Seeks to track a modified equal weighted index which provides the potential for unconcentrated industry exposure across large, mid and small cap stocks
- Allows investors to take strategic or tactical positions at a more targeted level than traditional sector based investing

## About This Benchmark

The S&P Aerospace & Defense Select Industry™ Index represents the aerospace & defense segment of the S&P Total Stock Market Index™. The Index is modified equal weighted.

## Fund Information

Inception Date	09/28/2011
CUSIP	78464A631

## Total Return (As of 09/30/2022)

	NAV (%)	Market Value (%)	Index (%)
<b>Cumulative</b>			
QTD	-8.71	-8.65	-8.67
YTD	-21.02	-20.92	-20.87
<b>Annualized</b>			
1 Year	-22.77	-22.65	-22.57
3 Year	-4.31	-4.28	-4.00
5 Year	3.63	3.65	3.97
10 Year	13.13	13.14	13.54

Gross Expense Ratio (%)	0.35
30 Day SEC Yield (%)	0.42

Past performance is not a reliable indicator of future performance. Investment return and principal value will fluctuate, so you may have a gain or loss when shares are sold. Current performance may be higher or lower than that quoted. All results are historical and assume the reinvestment of dividends and capital gains. Visit [sga.com](http://sga.com) for most recent month-end performance. Performance is shown net of fees. Performance of an index is not illustrative of any particular investment. It is not possible to invest directly in an index. Index returns are unmanaged and do not reflect the deduction of any fees or expenses. Index returns reflect all items of income, gain and loss and the reinvestment of dividends and other income as applicable.

## Characteristics

Est. 3-5 Year EPS Growth	10.01%
Index Dividend Yield	0.83%
Price/Earnings Ratio FY1	20.97
Number of Holdings	33
Price/Book Ratio	2.73
Average Market Cap (M)	US\$24,869.57

Image source: XAR ETF Fact Sheet – September 30, 2022 (portion shown, emphasis added)

# Selecting Defense Stocks with the Govini *Federal Scorecard*

Bruce D. Crawford

AAll Philadelphia Chapter, Delaware  
Valley Equity Investors SIG

July 29, 2019

# Introduction

- On June 27, 2019 I attended the Defense One Tech Summit at the Newseum in Washington, DC.
- One of the vendors (Govini) displaying their wares gave me a copy of one of their publications entitled *The 2019 Federal Scorecard, Great-Power Competition Edition*.
- I quickly realized that this compendium of U.S. government defense contractors was organized in a way that would allow me to quickly survey investment possibilities in this space.

# *The National Security Scorecard*

The background is a dark blue aerial map of a city, overlaid with a light blue grid. Three specific areas are highlighted with orange squares and labeled with numbers: '0109252' in the middle-left, '0024711' in the top-right, and '0376521' in the bottom-right. The title text is centered on the left side of the map.

# THE NATIONAL SECURITY SCORECARD

CRITICAL TECHNOLOGIES EDITION

govini

<https://govini.com/wp-content/uploads/2022/06/Govini-National-Security-Scorecard-Critical-Technologies.pdf>



## CRITICAL TECHNOLOGIES OVERVIEW

govini

The Govini Critical Technologies Taxonomy illuminates spending on critical technologies by the U.S. Government (USG) from FY17-21, as well as the vendor ecosystems supporting federal investment in these technologies. It is derived from the Office of the Undersecretary of Defense for Research & Engineering's list of critical technology areas. The taxonomy's structure enables a granular examination of past spending priorities and trends, and provides a basis for assessing continuing efforts into the future.

The taxonomy is organized into 11 segments (orange nodes) and 41 subsegments (white nodes). Each of the 41 subsegments are further subdivided into sub-subsegments, which are depicted later in the Scorecard. This additional layer of granularity in effect creates 11 subordinate taxonomies, one for each critical technology segment, all nested under the overarching Critical Technologies Taxonomy.

Govini created the taxonomy by applying supervised machine learning (ML) and natural language processing to parse, analyze, and categorize large volumes of federal contracts data, including prime contracts, grants, and other transaction authority (OTA) awards. The use of artificial intelligence (AI) and supervised ML models enables analysis of the large volumes of irregular data contained in federal contracts—data that often are inaccessible through regular government reporting processes or human-intensive analytical approaches. Moreover, beyond simply making usable an expansive body of data sources, Govini's Decision Science Platform and National Security Knowledge Graph establish high fidelity standards

in categorized and fused data to produce a comprehensive and accurate depiction of federal spending, and the supporting vendor ecosystem, over time.

### KEY FINDINGS

- Overall USG spending on critical technologies skyrocketed over the period, nearly doubling from \$60.7B in FY17 to \$117.2B in FY21. After steady growth from FY17-19, spending levels jumped significantly in FY20 and FY21.
- The magnitude of the increase, however, is somewhat misleading. The massive spikes in FY20 and FY21 were primarily driven by exponential increases in the Biotechnology segment due to an influx of funding for COVID-19 related research in response to the pandemic.
- Spending on Space Technology remained essentially flat in FY21 compared to FY17, the only segment that did not see an increase in yearly spending levels. This is likely to change in the future with greater DoD focus on the space domain. An 8.5% decrease in the Launch Vehicles subsegment may reflect a shift towards greater reliance on commercial space launch.
- Despite recent attention on reshoring microchip production to the United States, yearly USG spending on semiconductor fabrication declined over the period. This trend could change in the future, however, if the CHIPS Act and other pending legislation are enacted, spurring increased USG investment.

Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 1 (emphasis added).



Offers



Search



Cart

Professor

Overview

Reviews (29)

Q&amp;A

**Introduction to Machine Learning** demystifies this revolutionary discipline in 25 try-it-yourself lessons taught by award-winning educator and researcher Michael L. Littman, the Royce Family Professor of Teaching Excellence in Computer Science at Brown University. Dr. Littman guides you through the history, concepts, and techniques of machine learning, using the popular computer language Python to give you hands-on experience with the most widely used programs and specialized libraries .

For those new to Python, this course includes a lecture that is a dedicated tutorial on how to get started with this versatile, easy-to-use language. Professor Littman includes approximately one Python demonstration in each lesson. Even if you have never written code in Python, or any language, you can still run these programs for yourself to get a feeling for the amazing power of machine learning.

### Get Started with Machine Learning

Backed by Bach-inspired music composed by a machine learning program, Professor Littman opens the course with playful displays of the technology: automatic voice transcription, word prediction, face aging, foreign language translation, voice simulation, and more. Then he launches into a real-world example: how to use machine learning to listen to heartbeats and diagnose heart disease. Traditional computer programs only do what you tell them to, and medical software would typically match a set of symptoms to already well-established diagnoses. But the advantage of machine learning is that the computer is set loose to find patterns that may have escaped human observation.

Image source: [thegreatcourses.com](https://www.thegreatcourses.com)

Narrowing down our study topics:  
Zoom polls

# Critical technologies topics 1 of 3

Poll | 1 question | 21 of 23 (91%) participated

1. Which topics should we discuss in the seminar? (Multiple Choice) \*

21/21 (100%) answered

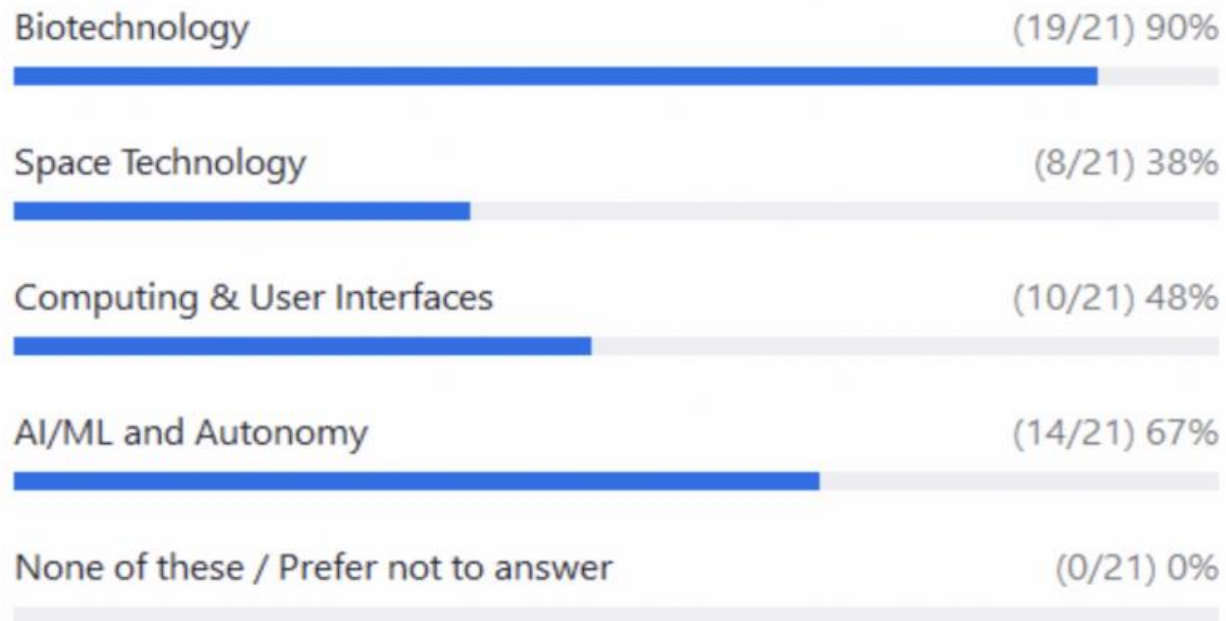


Image source: OLLI Investment Study Group poll, October 12, 2022.

## Critical technologies topics 2 of 3

Poll | 1 question | 22 of 23 (95%) participated

1. Which topics should we discuss in the seminar? (Multiple Choice) \*

22/22 (100%) answered



Image source: OLLI Investment Study Group poll, October 12, 2022.

# Critical technologies topics 3 of 3

Poll | 1 question | 22 of 23 (95%) participated

1. Which topics should we discuss in the seminar? (Multiple Choice) \*

22/22 (100%) answered

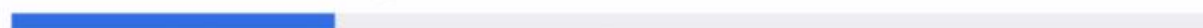
Directed Energy (13/22) 59%



Advanced Materials (18/22) 82%



Additive Manufacturing (6/22) 27%



None of these / Prefer not to answer (3/22) 14%

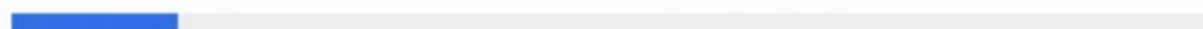


Image source: OLLI Investment Study Group poll, October 12, 2022.

# Division of labor for teams

## Division of labor for presentations:

- 1.) Analyst to research the assigned topic and the included subtopics
- 2.) Analyst to research specified publicly traded companies
- 3.) Analyst to research specified privately held companies
- 4.) Analyst to research specified technology accelerators
- 5.) Analyst to research specified investor groups
- 6.) Analyst to research specified university research partners



# Fall 2022 presentation topics

# CRITICAL TECHNOLOGIES TAXONOMY

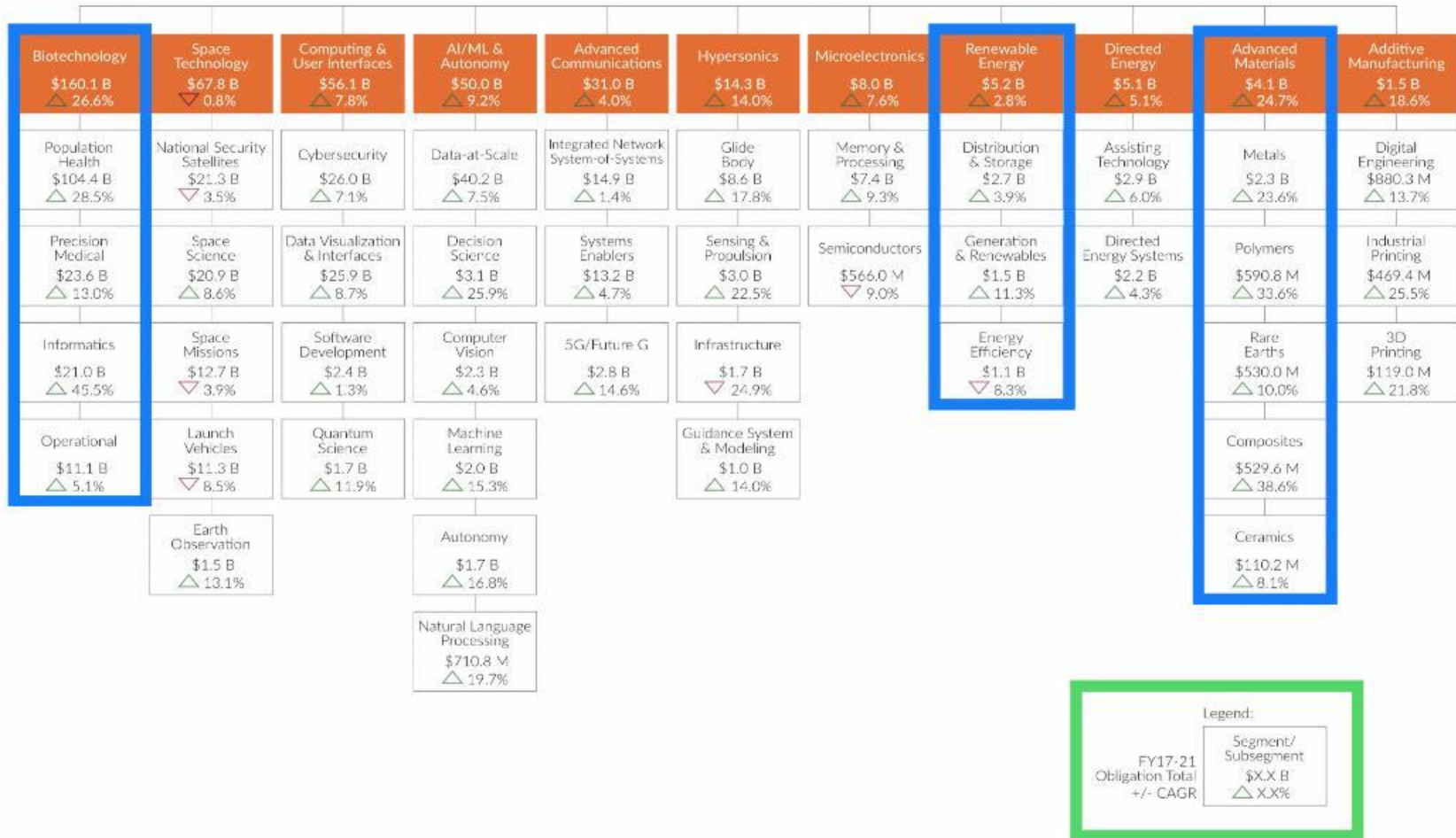
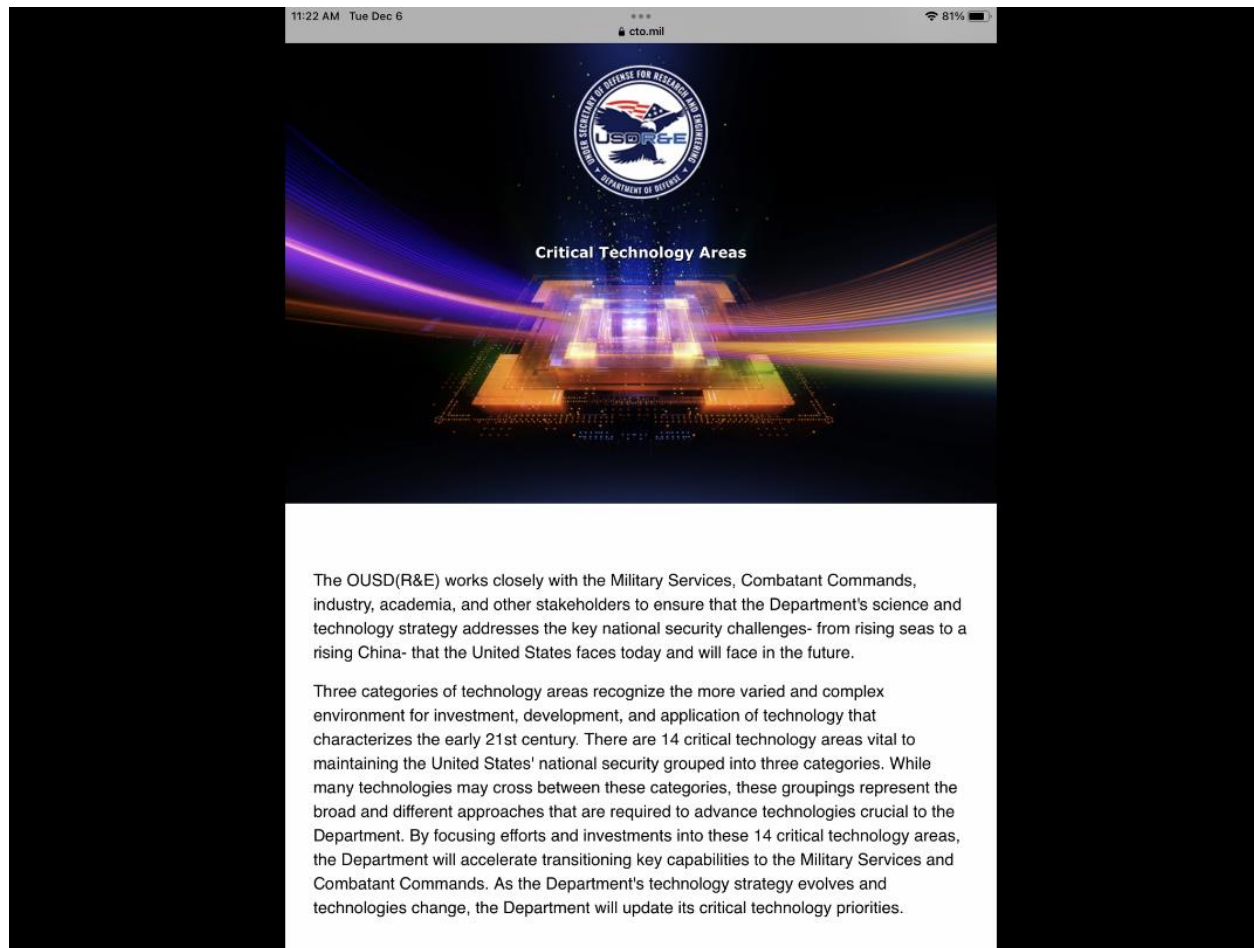


Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 2 (emphasis added)

# DoD Critical technologies



The OUSD(R&E) works closely with the Military Services, Combatant Commands, industry, academia, and other stakeholders to ensure that the Department's science and technology strategy addresses the key national security challenges- from rising seas to a rising China- that the United States faces today and will face in the future.

Three categories of technology areas recognize the more varied and complex environment for investment, development, and application of technology that characterizes the early 21st century. There are 14 critical technology areas vital to maintaining the United States' national security grouped into three categories. While many technologies may cross between these categories, these groupings represent the broad and different approaches that are required to advance technologies crucial to the Department. By focusing efforts and investments into these 14 critical technology areas, the Department will accelerate transitioning key capabilities to the Military Services and Combatant Commands. As the Department's technology strategy evolves and technologies change, the Department will update its critical technology priorities.

Image source (portion shown):

<https://www.cto.mil/usdre-strat-vision-critical-tech-areas/>

Fall 2022 Presentation Topics  
(3 teams - 6 analysts per team)

Team 1: Renewable Energy

Team 2: Biotechnology

Team 3: Advanced Materials

# Team 1: Renewable energy

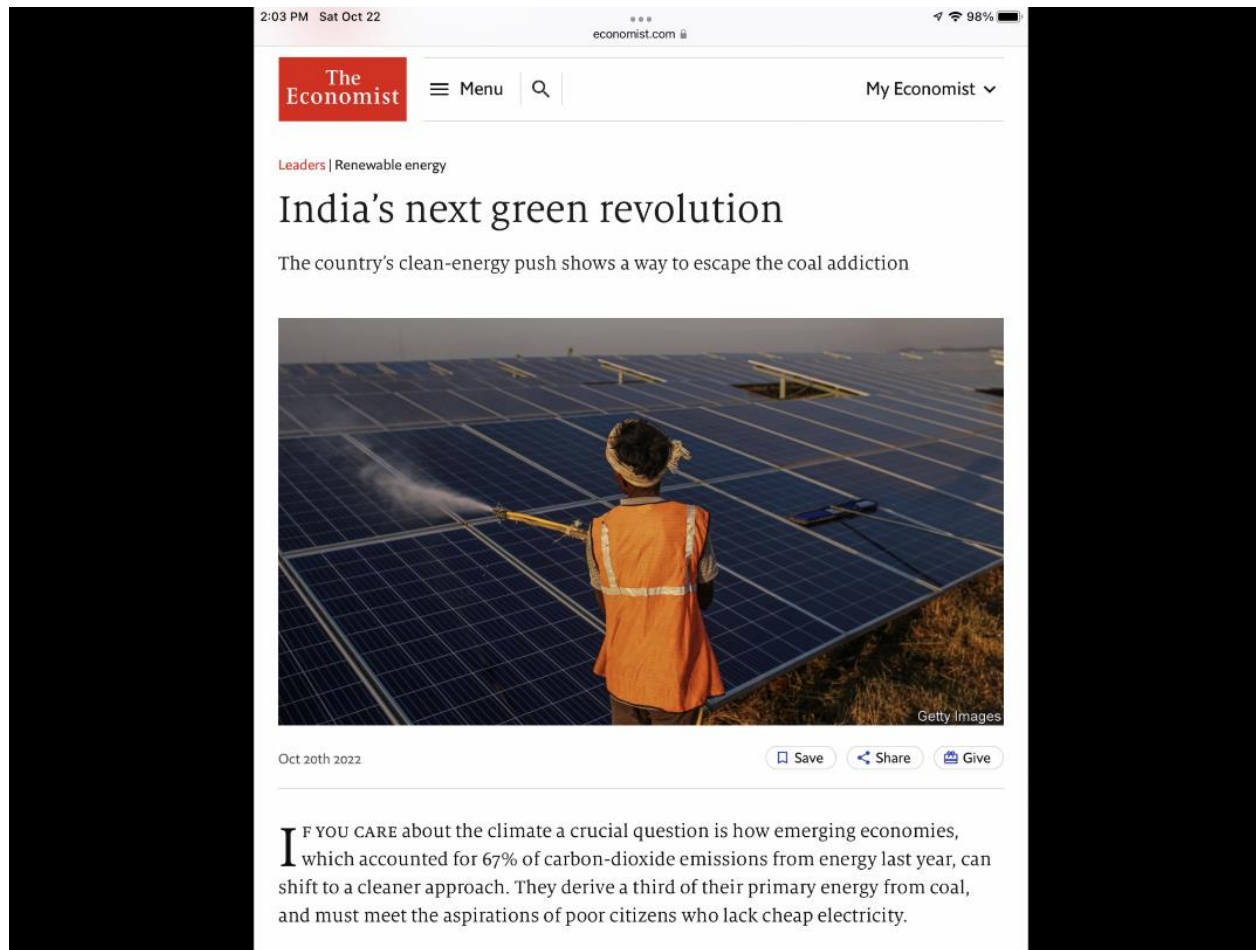


Image source: *The Economist*

# DoD Interest in renewable energy

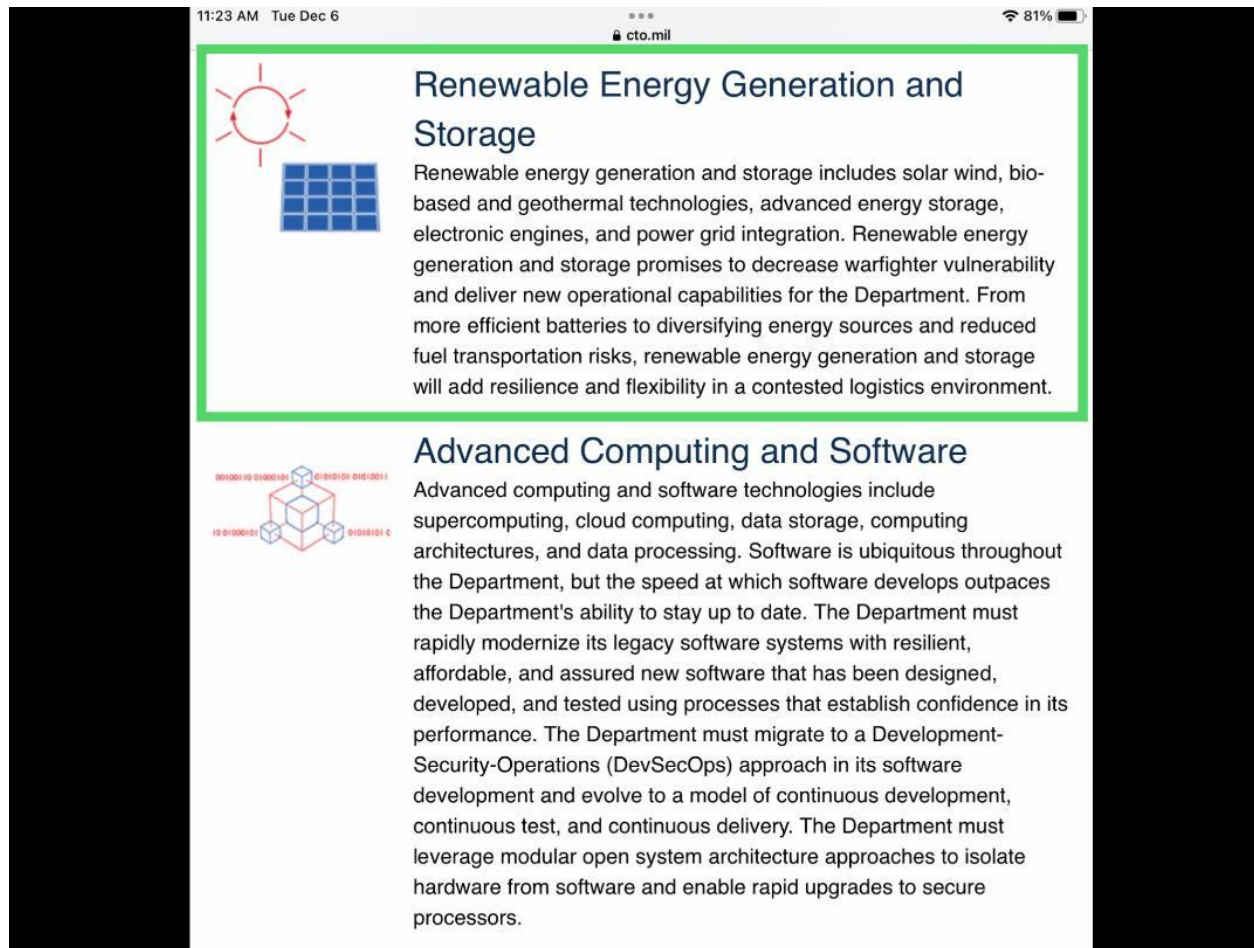


Image source: cto.mil (emphasis added)

# RENEWABLE ENERGY TAXONOMY

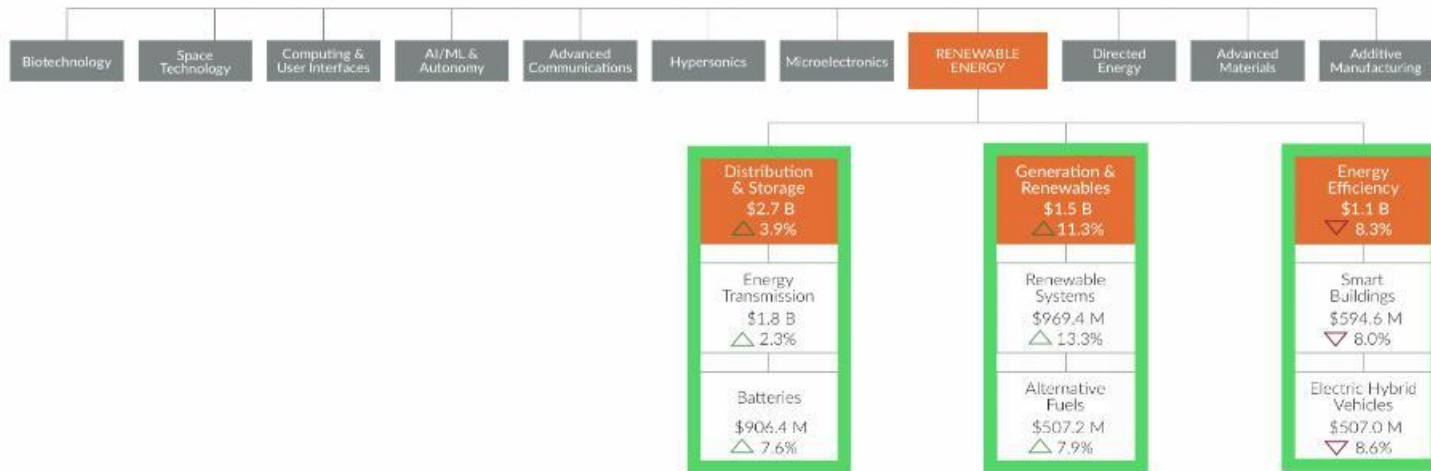


Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 41 (emphasis added)

# RENEWABLE ENERGY

## VENDOR RANKINGS

### TOP 10 VENDORS

RANK		VENDOR	SPEND				FINANCIALS	SOLE SOURCE
FY22	FY21	VENDOR NAME	AWARDED AMOUNT FY21	AWARDED AMOUNT FY17-21	ANNUAL GROWTH RATE FY17-21	AVG. AMOUNT PER CONTRACT ACTION	CREDIT GRADE	% SHARE OF AWARDED
1	△ 9	State of California	\$47.2 M	\$102.6 M	△ 29.4%	\$263.8 K	A (94)	0.0%
2	△ 35	Synergy Electric Company Inc.	\$45.3 M	\$67.3 M	△ 24.2%	\$1.8 M	A (93)	0.0%
3	▽ 2	Ford Motor Co. (F)	\$33.7 M	\$255.3 M	▽ 17.2%	\$37.6 K	A (93)	0.0%
4	— 4	APTIM AECOM Decommissioning LLC	\$28.8 M	\$71.7 M	▽ 7.6%	\$23.9 M	B+ (85-89)	0.0%
5	△ 15	Ameresco Inc.	\$26.3 M	\$77.8 M	△ 9.8%	\$810.6 K	A+ (96)	0.0%
6	△ 13	Power Pro Plus Inc.	\$25.6 M	\$56.1 M	△ 11.2%	\$1.5 M	B+ (89)	0.1%
7	— 7	Carrier Global Corp. (CARR)	\$22.9 M	\$104.8 M	△ 13.6%	\$1.0 M	A- (96)	2.7%
8	△ 129	Natron Energy Inc.	\$19.9 M	\$19.9 M	— -	\$9.9 M	B (83)	0.0%
9	△ 42	University of Illinois	\$19.9 M	\$33.3 M	△ 104.0%	\$374.7 K	A (94)	0.0%
10	▽ 1	Fluor Corp. (FLR)	\$17.5 M	\$67.5 M	▽ 18.9%	\$13.5 M	A- (99)	0.0%

### NOTABLE EMERGENT COMPANIES

COMPANY	LOCATION
Alto Ingredients (ALTO)	Sacramento, CA
Bloom Energy Corp. (BE)	Sunnyvale, CA
Clearway Energy Inc. (CWEN)	Princeton, NJ
First Solar Inc. (FSLR)	Tempe, AZ
Gevo Inc. (GEVO)	Englewood, CO

### NOTABLE INVESTORS

COMPANY	LOCATION
Clean Energy Venture Group	Boston, MA
Element 8 Angels	Seattle, WA
Energize Ventures	Chicago, IL
Energy Foundry	Chicago, IL
Manhattan Venture Partners	New York, NY

Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 45 (emphasis added)



Cite this page  
Wikidata item

Print/export

Download as PDF  
Printable version

In other projects

Wikimedia  
Commons

Languages

Deutsch

Español

فارسی

Français

한국어

Italiano

日本語

Русский

中文

5 more

Edit links

# Gartner hype cycle

From Wikipedia, the free encyclopedia

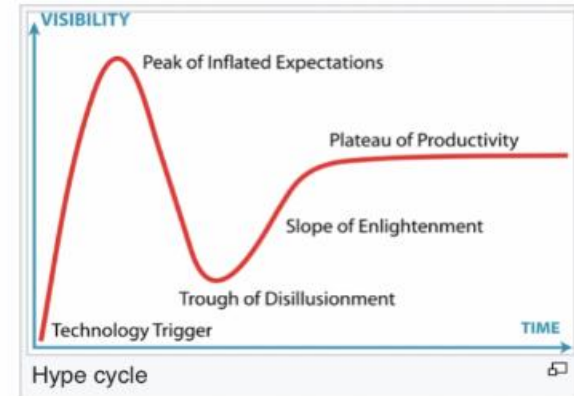
The **Gartner hype cycle** is a graphical presentation developed, used and branded by the American research, advisory and **information technology** firm **Gartner** to represent the maturity, adoption, and social application of specific **technologies**. The hype cycle claims to provide a graphical and conceptual presentation of the maturity of emerging technologies through five phases. The model is not perfect and research so far shows possible improvements for the model.<sup>[1]</sup>

## Contents [hide]

- 1 Five phases
- 2 Hype in new media
- 3 Criticisms
- 4 Counter Arguments
- 5 See also
- 6 References
- 7 Further reading
- 8 External links

## Five phases [ edit ]

Each hype cycle drills down into the five key phases of a technology's life cycle.



## Futures studies



### Concepts

Accelerating change · Cashless society · Existential risk · Future (Earth · Mathematics · Race · Climate · Space exploration · Universe) · Kardashev scale · Moore's law · Resource depletion · Singularity · Speculative evolution

### Techniques

Backcasting · Causal layered analysis · Chain-linked model · Consensus forecast · Cross impact analysis · Delphi (Real-time Delphi) · Foresight ·


# Team 2: Biotechnology

12:31 PM Sun Oct 23 economist.com

Business | More cash, stat!

## After a covid-fuelled adrenaline rush, biotech is crashing

Many firms will not survive



Aug 10th 2022

Save Share Give

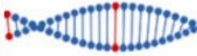
**T**HREE YEARS ago no one had heard of [BioNTech](#). Today the German biotechnology firm [enjoys global renown](#), as well as annual revenues of \$19bn. The company owes both the lustre and the lucre chiefly to the successful mRNA covid-19 vaccine which it developed in partnership with [Pfizer](#), an American drug giant. Yet even the effective jab has not immunised it from a downturn afflicting the biotech industry. On August 8th BioNTech reported that sales fell by 40% in the second quarter, year on year, as fewer people are left unjabbed and unboosted. Its share price tumbled by nearly 9%.

Image source: *The Economist*

# DoD Interest in biotechnology

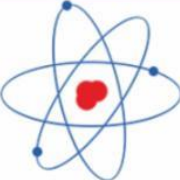
11:23 AM Tue Dec 6 cto.mil 81%

## Seed Areas of Emerging Opportunity



### Biotechnology

Biotechnology is an emerging engineering discipline that uses living systems to produce a wide range of technologies and capabilities. From fighting global pandemics and avoiding surprises to reducing logistics and sustainment costs and increasing energy efficiency, biotechnology can help change the way the Department conducts missions, performs in contested logistics environments, and adapts to major global changes.



### Quantum Science

Quantum Science is the study of physical properties at small, even atomic, scales. Defense applications include atomic clocks, quantum sensors, quantum computing, and quantum networks. Quantum science promises to enable leap-ahead capabilities. Quantum computing can provide unprecedented computational speeds and help solve the Department's hardest analytical problems. Quantum sensors promise the ability to provide unprecedented accuracy in position, navigation, and timing. From more accurate information to faster decision making, to significantly stronger encryption capabilities, quantum science has the promise to deliver cutting-edge technology.

Image source: cto.mil (emphasis added)

# BIOTECHNOLOGY

TAXONOMY

govini



Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 6 (emphasis added)

# BIOTECHNOLOGY

## VENDOR RANKINGS

### TOP 10 VENDORS

RANK		VENDOR	SPEND				FINANCIALS	SOLE SOURCE
FY22	FY21	VENDOR NAME	AWARDED AMOUNT FY21	AWARDED AMOUNT FY17-21	ANNUAL GROWTH RATE FY17-21	AVG. AMOUNT PER CONTRACT ACTION	CREDIT GRADE	% SHARE OF AWARDED
1	△ 299	Pfizer Inc. (PFE)	\$7.5 B	\$8.5 B	△ 64.7%	\$22.4 M	A+ (98)	87.8%
2	— 2	Moderna Inc. (MRNA)	\$7.3 B	\$9.6 B	△ 155.9%	\$234.5 M	B+ (88)	84.9%
3	△ 12	AstraZeneca PLC (AZN)	\$1.6 B	\$2.0 B	— -	\$49.8 M	A+ (99)	83.6%
4	△ 22	McKesson Corp. (MCK)	\$1.6 B	\$2.0 B	△ 95.9%	\$2.3 M	A+ (98)	5.8%
5	△ 40	Merck & Co. Inc.	\$1.5 B	\$3.1 B	△ 8.8%	\$22.4 M	A+ (98)	3.6%
6	— 6	Health Research Inc.	\$1.2 B	\$2.8 B	△ 41.3%	\$3.6 M	B (84)	0.0%
7	▽ 4	UChicago Argonne LLC	\$992.8 M	\$4.7 B	△ 4.8%	\$42.8 M	B+ (89)	0.0%
8	△ 17	Mass General Brigham Inc.	\$754.8 M	\$1.9 B	△ 27.2%	\$347.5 K	A+ (98)	26.0%
9	△ 15	University of Texas System	\$736.3 M	\$1.8 B	△ 30.9%	\$264.3 K	A+ (96)	7.4%
10	▽ 3	Chemionics International Inc.	\$724.2 M	\$5.3 B	▽ 7.0%	\$40.1 M	B+ (86)	0.0%

### NOTABLE EMERGENT COMPANIES

COMPANY	LOCATION
AavantiBio Inc.	Cambridge, MA
Capsida Biotherapeutics Inc.	Thousand Oaks, CA
Dyno Therapeutics Inc.	Watertown, MA
SomaLogic Inc. (SLGC)	Boulder, CO
Umoja Biopharma	Seattle, WA

### NOTABLE INVESTORS

COMPANY	LOCATION
SAM Ventures	San Francisco, CA
ARCH Venture Partners	Chicago, IL
Atlas Venture	Cambridge, MA
OrisMed Advisors LLC	New York, NY
Third Rock Ventures	Boston, MA

Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 10 (emphasis added)

### Conjecture Card: Biotechnology









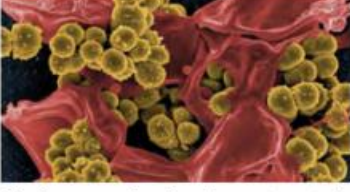
<p><b>G.1 Super Sensings</b></p>  <p>Enhance human senses and cognitive abilities to super-human levels to increase speed of learning/comprehension and reduce reaction times.</p>	<p><b>G.2 Body Self-Repair</b></p>  <p>Heal wounds, injury or illness using DNA restructuring or synthetic biology solutions (e.g. artificially grown body parts).</p>	<p><b>G.3 Bio-Databases</b></p>  <p>Store or process massive amounts of data in living organisms.</p>
<p><b>G.4 Human-Machine</b></p>  <p>Mechanically augment the human body either with exoskeleton or internal mechanical parts to gain super strength, balance and speed.</p>	<p><b>G.5 Chem or Bio Analysis</b></p>  <p>Instantly analyse and identify chemical or biological substances remotely or using hand-carried or unmanned systems.</p>	<p><b>G.6 Health Monitoring</b></p>  <p>Continuously monitor health and well-being of entire populations at the individual level, activating drugs or hormones or genes on demand.</p>
<p><b>G.7 Train in Reality</b></p>  <p>Deploy realistic virtual or augmented reality training environments to prepare soldiers in real-time for mission tasks.</p>	<p><b>G.8 Psychotic Effects</b></p>  <p>Remotely induce mass hysteria or hallucinations in groups or individuals.</p>	<p><b>G.9 Genetic Targeting</b></p>  <p>Design and develop targeted pathogens, antidotes or neutralising agents for CBRN agents from materials and knowledge available at low cost and to everyone.</p>

Image source: NATO Science & Technology Organization. (2020). *Science & Technology Trends 2020-2040*. Brussels: NATO, p. 103.

# Team 3: Advanced materials

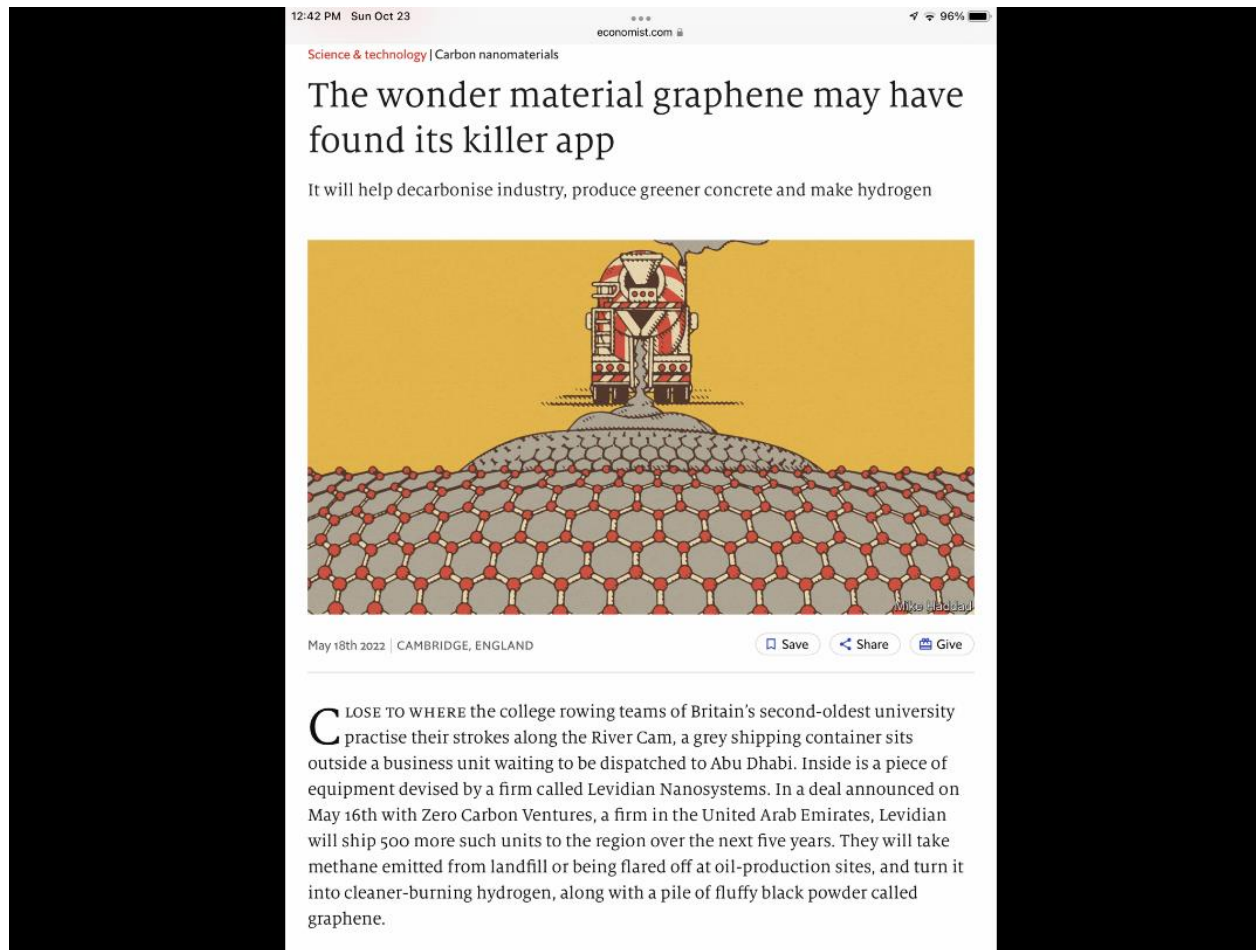
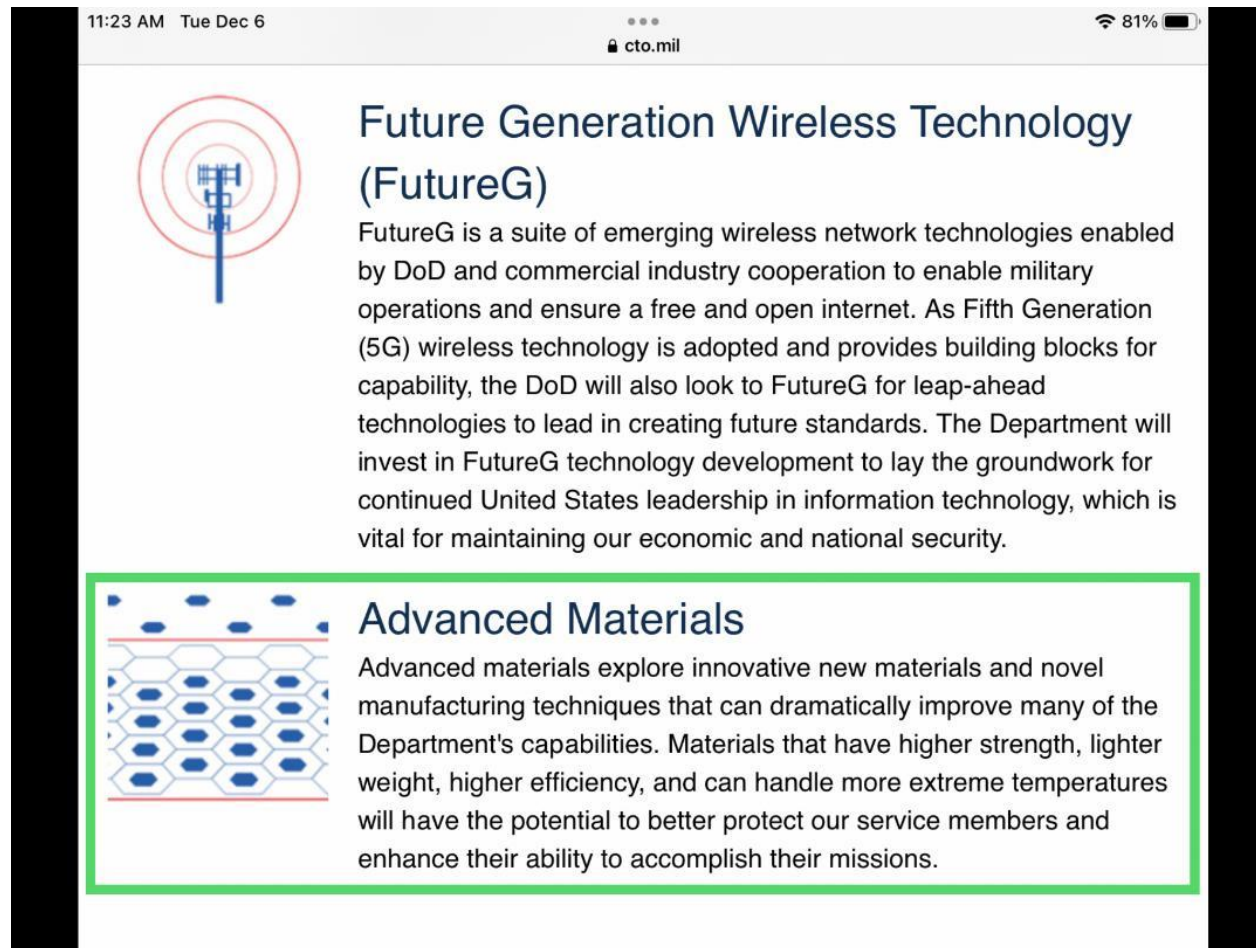


Image source: *The Economist*

# DoD Interest in advanced materials



11:23 AM Tue Dec 6

cto.mil

81%

## Future Generation Wireless Technology (FutureG)

FutureG is a suite of emerging wireless network technologies enabled by DoD and commercial industry cooperation to enable military operations and ensure a free and open internet. As Fifth Generation (5G) wireless technology is adopted and provides building blocks for capability, the DoD will also look to FutureG for leap-ahead technologies to lead in creating future standards. The Department will invest in FutureG technology development to lay the groundwork for continued United States leadership in information technology, which is vital for maintaining our economic and national security.

## Advanced Materials

Advanced materials explore innovative new materials and novel manufacturing techniques that can dramatically improve many of the Department's capabilities. Materials that have higher strength, lighter weight, higher efficiency, and can handle more extreme temperatures will have the potential to better protect our service members and enhance their ability to accomplish their missions.

Image source: cto.mil (emphasis added)



# ADVANCED MATERIALS

TAXONOMY

govini



Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 51 (emphasis added)

# ADVANCED MATERIALS

## VENDOR RANKINGS

### TOP 10 VENDORS

RANK		VENDOR	SPEND				FINANCIALS	SOLE SOURCE
FY22	FY21	VENDOR NAME	AWARDED AMOUNT FY21	AWARDED AMOUNT FY17-21	ANNUAL GROWTH RATE FY17-21	AVG. AMOUNT PER CONTRACT ACTION	CREDIT GRADE	% SHARE OF AWARDED
1	△ 250	Blue Star NBR LLC	\$123.1 M	\$123.1 M	— -	\$123.1 M	B (81)	0.0%
2	▽ 1	State of California	\$116.8 M	\$299.5 M	△ 29.9%	\$292.2 K	A (94)	0.0%
3	▽ 2	Iowa State University of Science & Technology	\$62.0 M	\$309.0 M	△ 0.2%	\$2.0 M	A+ (96)	0.0%
4	△ 15	State of Michigan	\$51.2 M	\$85.1 M	△ 36.9%	\$211.6 K	B+ (88)	0.0%
5	▽ 3	Commonwealth of Pennsylvania	\$38.0 M	\$100.4 M	△ 229.5%	\$475.9 K	A (91)	0.0%
6	△ 35	University of Texas System	\$27.7 M	\$58.0 M	△ 35.4%	\$197.9 K	A+ (96)	0.0%
7	△ 251	General Atomics Inc.	\$26.2 M	\$26.2 M	— -	\$8.7 M	A+ (98)	0.0%
8	△ 53	Wichita State University	\$18.5 M	\$50.4 M	△ 40.2%	\$1.4 M	A+ (96)	0.0%
9	△ 25	Northwestern University	\$18.0 M	\$34.8 M	△ 36.4%	\$211.1 K	A (94)	0.0%
10	△ 36	Trustees of Columbia University In The City of New York	\$17.9 M	\$32.2 M	△ 47.2%	\$203.7 K	A (91)	0.0%

### NOTABLE EMERGENT COMPANIES

COMPANY	LOCATION
Commonwealth Fusion Systems	Cambridge, MA
Infinium Metals	Natick, MA
MP Materials Corp. (MP)	Las Vegas, NV
NatureWorks LLC	Minnetonka, MN
Novomer Inc.	Rochester, NY

### NOTABLE INVESTORS

COMPANY	LOCATION
Khosla Ventures LLC	Menlo Park, CA
Kleiner Perkins	Menlo Park, CA
Main Street Capital Corp. (MAIN)	Houston, TX
Massachusetts Clean Energy Center	Boston, MA
Norwest Equity Partners	Minneapolis, MN

Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 55 (emphasis added)

## Conjecture Card: Materials

### H.1 Synthetic Biology



Use artificially grown or 3D printed human body parts for use for transplants to heal injured people or to upgrade humans.

### H.2 Smartlite Armor



Wear lightweight body armour or clothes that are extremely flexible, but resistant to bullets or directed energy fire.

### H.3 Reduce Energy Use



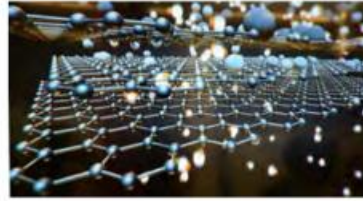
Harvest, store and optimise use of energy reducing resupply needs without significant loss of capability.

### H.4 Self-Charging Batteries



Generate and store renewable energy adequate for the daily needs of an individual soldier in ways that are soldier portable.

### H.5 Graphene



Use diamond hard graphene composite armour and corrosion resistant plating an order of magnitude lighter than 20th century systems.

### H.6 Temporary Shelters



Build large stable shelters from extremely resilient extremely lightweight material that remembers how it was packed and self-packs in minutes.

### H.7 Platform Printing



Rapidly develop and deploy task tailored land vehicles, naval vessels, aircraft, habitation and space craft.

### H.8 Textured Explosives



3D print embedded and hidden energetic materials in structures and systems (available to state, non-state actors, and individuals).

### H.9 Spider climbing



Climb walls or windows with sticky material applied to hands and knees or feet.

Image source: NATO Science & Technology Organization. (2020). *Science & Technology Trends 2020-2040*. Brussels: NATO, p. 111.

# Prioritizing study sub-topics

# Renewable Energy Topics

Poll | 1 question | 15 of 16 (93%) participated

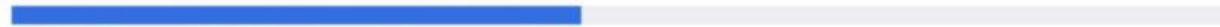
1. Which topics should we discuss in the seminar? (Multiple Choice) \*

15/15 (100%) answered

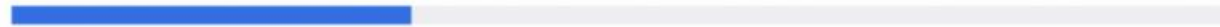
Distribution & Storage (9/15) 60%



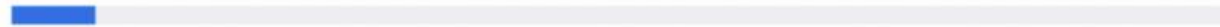
Generation and Renewables (7/15) 47%



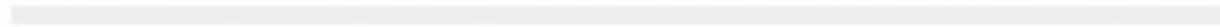
Energy Efficiency (5/15) 33%



Other (1/15) 7%



None of these / Prefer not to answer (0/15) 0%



# Biotechnology Topics

Poll | 1 question | 15 of 16 (93%) participated

1. Which topics should we discuss in the seminar? (Multiple Choice) \*

15/15 (100%) answered



# Advanced Materials Topics

Poll | 1 question | 14 of 16 (87%) participated

1. Which topics should we discuss in the seminar? (Multiple Choice) \*

14/14 (100%) answered



# Let's narrow it down some more (new polls with a deeper dive)

- Micro-focus on renewable energy
  - Batteries
  - Renewable systems
- Micro-focus on biotechnology
  - Infectious disease



# Let's narrow it down some more (new polls cont'd)

- Micro-focus on advanced materials
  - Alloys & superalloys
  - Rare earth development

# Companies and investors

# TECHNOLOGY SEGMENT ANALYSIS GUIDE

**RANK**

Vendors are ranked by greatest to least by FY21 awarded amount, in comparison to FY20 awarded amount

**FINANCIALS**

An estimation of an organization's creditworthiness in letter grade format. Calculations are made from company demographics such as employee counts, industry classification, number of years in business, number of locations, form of entity (public or private), and any documented bankruptcies or other legal filings.

TOP 10 VENDORS

RANK		VENDOR	SPEND				FINANCIALS	SOLE SOURCE
FY22	FY21	VENDOR NAME	AWARDED AMOUNT FY21	AWARDED AMOUNT FY17-21	ANNUAL GROWTH RATE FY17-21	AVG. AMOUNT PER CONTRACT ACTION	CREDIT GRADE	% SHARE OF AWARDED
1	△ 299	Pfizer Inc. (PFE)	\$7.5 B	\$8.5 B	△ 64.7%	\$224 M	A+ (98)	8.8%

**SPEND**

FY21 contract, grant, and OTA combined awards for each vendor; FY17-21 contract, grant, and OTA combined awards; the compound annual growth rate from FY17-FY21; and the average amount per contract action for each vendor

**SOLE SOURCE**

Percentage of awarded contracts for respective vendor that were sole-sourced, or not competed

NOTABLE EMERGENT COMPANIES

COMPANY	LOCATION
AvantBio Inc.	Cambridge, MA

NOTABLE INVESTORS

COMPANY	LOCATION
SAM Ventures	San Francisco, CA

**NOTABLE EMERGENT COMPANIES**

Emergent companies that focus all or part of their business on the respective technologies

**NOTABLE INVESTORS**

Investment companies that have one or more portfolio companies engaged in developing the respective technology

# Technology accelerators



RESEARCH  
AND ENGINEERING

UNDER SECRETARY OF DEFENSE  
3030 DEFENSE PENTAGON  
WASHINGTON, DC 20301-3030

February 1, 2022

SUBJECT: USD(R&E) Technology Vision for an Era of Competition

The Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) will spearhead a National Defense Science and Technology strategy for the Department of Defense (DoD), informed by the 2022 National Defense Strategy (NDS) and structured around three strategic pillars: mission focus, foundation building, and succeeding through teamwork. This technology strategy will chart a course for the United States' military to strengthen its technological superiority amidst a global race for technological advantage.

To maintain the United States military's technological advantage, the Department will champion research, science, technology, engineering, and innovation. From the earliest days of this country the role of technology in shaping military concepts and providing for the defense of the nation has been essential. The demands of the present era call for new operational concepts, increasingly joint operations, and quickly fielding emerging science and technology opportunities.

Strategic competitors to the United States have greater access to commercial state-of-the-art technologies than ever before and can wield these technologies to be disruptive to America's interests and its national security. The challenges facing our country are both diverse and complex, ranging from sophisticated cyber-attacks to supply chain risks, and from defending against hypersonic missiles to responding to biological threats. In an ever shifting and fast-moving global environment, technological advantage is not stagnant and the Department cannot rely on today's technology to ensure military technological dominance tomorrow.

It is imperative for the Department to nurture early research and discover new scientific breakthroughs to prevent technological surprise. The Department must harness the incredible innovation ecosystem both domestically and globally in order to stay ahead of our competitors.

Image source (portion shown):

[https://www.cto.mil/wp-content/uploads/2022/02/usdre\\_strategic\\_vision\\_critical\\_tech\\_areas.pdf](https://www.cto.mil/wp-content/uploads/2022/02/usdre_strategic_vision_critical_tech_areas.pdf)

# DEPARTMENT OF THE AIR FORCE

## VENDOR RANKINGS

govini

### TOP 10 VENDORS

RANK		VENDOR	SPEND				FINANCIALS	SOLE SOURCE
FY22	FY21	VENDOR NAME	AWARDED AMOUNT FY21	AWARDED AMOUNT FY17-21	ANNUAL GROWTH RATE FY17-21	AVG. AMOUNT PER CONTRACT ACTION	CREDIT GRADE	% SHARE OF AWARDED
1	△ 2	Lockheed Martin Corp. (LMT)	\$1.6 B	\$4.8 B	△ 11.6%	\$3.5 M	A+ (95)	65%
2	▽ 1	Raytheon Technologies Corp. (RTX)	\$654.9 M	\$4.2 B	▽ 2.5%	\$2.0 M	A+ (97)	22.0%
3	— 3	Northrop Grumman Corp. (NOC)	\$529.3 M	\$2.4 B	△ 13.2%	\$1.8 M	A+ (98)	26.0%
4	△ 32	Advanced Technologies Int.	\$232.1 M	\$308.4 M	△ 60.0%	\$4.3 M	C+ (78)	0.0%
5	▽ 4	United Launch Alliance LLC	\$202.5 M	\$1.6 B	▽ 11.1%	\$24.3 M	-	94.0%
6	△ 14	L3Harris Technologies Inc. (LHX)	\$146.7 M	\$740.8 M	▽ 4.4%	\$1.3 M	A+ (98)	68.0%
7	▽ 6	CACI International Inc. (CACI)	\$143.6 M	\$611.9 M	△ 7.3%	\$905.1 K	A+ (98)	1.0%
8	△ 15	Science Applications International Corp. (SAIC)	\$133.1 M	\$279.9 M	△ 21.7%	\$1.2 M	A+ (96)	11.0%
9	△ 125	Palantir Technologies Inc. (PLTR)	\$129.7 M	\$137.0 M	△ 204.0%	\$4.7 M	B+ (89)	89.0%
10	— -	Blue Star NBR LLC	\$123.1 M	\$123.1 M	— -	\$123.1 M	-	0.0%

### NOTABLE DEFENSE ACCELERATORS

ACCELERATOR	LOCATION
AF Techstars Accelerator	Boulder, CO
Air Force Research Laboratory (AFRL)	Dayton, OH
AFWERX	Washington, D.C.
Allied Space Accelerator	Boulder, CO
Catalyst Accelerator	Colorado Springs, CO

### TOP 5 CONTRACTING OFFICES

CONTRACTING OFFICE	AWARD SUM	AWARD COUNT
US Department of the Air Force	\$34.3 B	18,299
Air Force Research Laboratory (AFRL)	\$223.1 M	256
Defense Information Systems Agency (DISA)	\$345.7 M	144
Wright-Patterson AFB	\$248.7 M	98
DCMA-Los Angeles, CA	\$117.4 M	99

Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 70 (emphasis added)

# DEPARTMENT OF THE ARMY

## VENDOR RANKINGS

### TOP 10 VENDORS

RANK		VENDOR	SPEND				FINANCIALS	SOLE SOURCE
FY22	FY21	VENDOR NAME	AWARDED AMOUNT FY21	AWARDED AMOUNT FY17-21	ANNUAL GROWTH RATE FY17-21	AVG. AMOUNT PER CONTRACT ACTION	CREDIT GRADE	% SHARE OF AWARDED
1	—	Pfizer Inc. (PFE)	\$7.5 B	\$7.5 B	△ 581.0%	\$682.3 M	A+ (98)	100%
2	—	Moderna Inc. (MRNA)	\$6.9 B	\$8.1 B	△ 137.7%	\$509.1 M	B+ (88)	100%
3	—	AstraZeneca PLC (AZN)	\$1.9 B	\$1.9 B	△ 345.9%	\$138.3 M	A+ (99)	100%
4	—	Merck & Co. Inc.	\$1.4 B	\$1.4 B	△ 552.6%	\$92.4 M	A+ (98)	0%
5	▽	Science Applications International Corp. (SAIC)	\$501.3 M	\$1.6 B	△ 19.1%	\$2.1 M	A+ (96)	0%
6	—	CUE Inc.	\$480.9 M	\$480.9 M	—	\$60.1 M	B+ (89)	0%
7	—	Eli Lilly & Co.	\$413.7 M	\$413.7 M	—	\$59.1 M	A+ (98)	0%
8	▽	TRAX Int. Corp.	\$329.1 M	\$1.1 B	△ 26.2%	\$3.3 M	B+ (86)	0%
9	▽	Raytheon Technologies Corp. (RTX)	\$327.3 M	\$2.7 B	▽ 8.1%	\$2.6 M	A+ (97)	12%
10	▽	Leonardo S.p.A (FINMY)	\$281.4 M	\$1.2 B	△ 22.9%	\$3.0 M	-	7%

### NOTABLE DEFENSE ACCELERATORS

ACCELERATOR	LOCATION
Army Applications Lab	Austin, TX
Army SBIR/STTR Program	Washington, DC
Army Research Lab	Acelahi, MD
xTechSearch	Arlington, VA
U.S. Army Combat Capabilities Development Command Army Soldier Center	Natick, MA

### TOP 5 CONTRACTING OFFICES

CONTRACTING OFFICE	AWARD SUM	AWARD COUNT
US Department of the Army	\$60.5 B	16,601
USACE Engineering and Support Center, Huntsville	\$4.1 B	916
USACE St. Paul District	\$984.2 M	1,928
ACC-APG Orlando, FL	\$841.0 M	251
ERDC-Cold Regions Research and Engineering Laboratory (CRREL)	\$674.8 M	651

Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 64 (emphasis added)

# DEPARTMENT OF THE NAVY

## VENDOR RANKINGS

### TOP 10 VENDORS

RANK		VENDOR	SPEND				FINANCIALS	SOLE SOURCE
FY22	FY21	VENDOR NAME	AWARDED AMOUNT FY21	AWARDED AMOUNT FY17-21	ANNUAL GROWTH RATE FY17-21	AVG. AMOUNT PER CONTRACT ACTION	CREDIT GRADE	% SHARE OF AWARDED
1	1	Raytheon Technologies Corp. (RTX)	\$933.5 M	\$4.2 B	△ 10.4%	\$1.2 M	A+ (97)	48.0%
2	2	Lockheed Martin Corp. (LMT)	\$498.1 M	\$1.8 B	△ 37.1%	\$1.2 M	A+ (95)	15.0%
3	12	Leidos Inc. (LDOS)	\$488.5 M	\$1.1 B	△ 29.9%	\$632.3 K	A+ (98)	3.0%
4	3	BAE Systems PLC (BAESY)	\$420.7 M	\$1.8 B	△ 17.2%	\$529.7 K	A+ (98)	5.0%
5	7	L3Harris Technologies Inc. (LHX)	\$358.0 M	\$961.8 M	△ 38.8%	\$555.7 K	A+ (98)	36.0%
6	4	General Dynamics Corp. (IGD)	\$278.8 M	\$2.6 B	▽ 13.7%	\$798.6 K	A+ (98)	58.0%
7	14	Huntington Ingalls Industries Inc. (HII)	\$261.3 M	\$643.6 M	△ 38.2%	\$547.7 K	A (93)	29.0%
8	9	ManTech TSG-2 JV	\$259.2 M	\$498.7 M	△ 187.0%	\$1.8 M	A+ (97)	0.0%
9	10	Northrop Grumman Corp. (NOC)	\$223.0 M	\$1.3 B	▽ 8.3%	\$648.2 K	A+ (98)	20.0%
10	5	Viasat Inc. (VSAT)	\$207.9 M	\$1.0 B	△ 19.8%	\$1.4 M	A+ (98)	54.0%

### NOTABLE DEFENSE ACCELERATORS

ACCELERATOR	LOCATION
NavalX (Tech Bridges)	Multiple
Naval Research Lab	Washington, DC
Navy 8(a) Incubator	Arlington, VA
Department of the Navy (DoN) Rapid Innovation Fund (RIF)	Arlington, VA
NEPTUNE	Arlington, VA

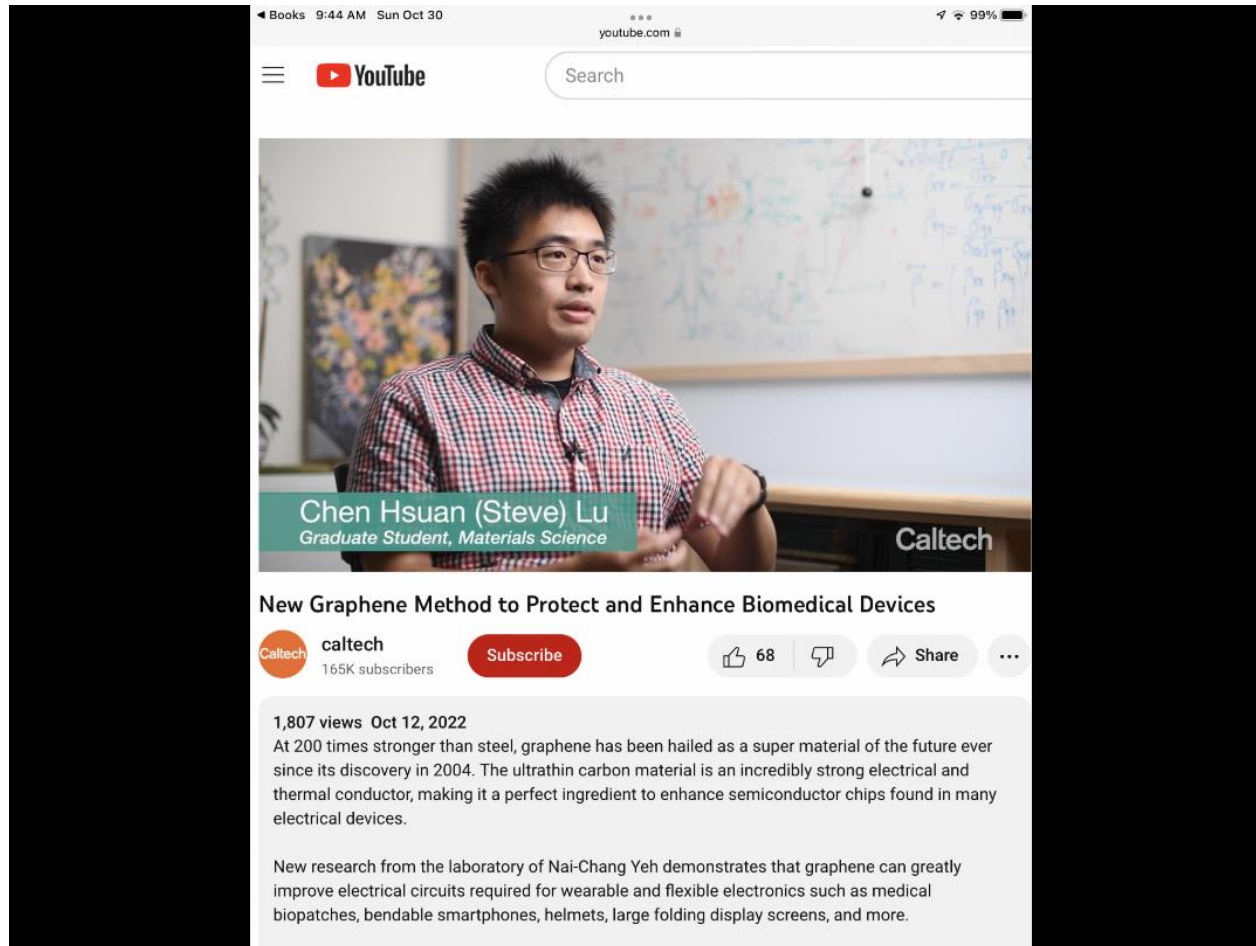
### TOP 5 CONTRACTING OFFICES

CONTRACTING OFFICE	AWARD SUM	AWARD COUNT
US Department of the Navy	\$15.2 B	14,351
Naval Sea Systems Command (NAVSEA)	\$6.9 B	1,208
NAWC Aircraft Division-Patuxent River	\$4.6 B	1,438
Naval Information Warfare Systems Command (NAVWARSSYSCOM)	\$2.8 B	1,163
Naval Air Systems Command (NAVAIR)	\$2.2 B	1,103

Image source: Govini. (2022). *The National Security Scorecard: Critical Technologies Edition*, p. 67 (emphasis added)



# University research partners



The image is a screenshot of a mobile YouTube interface. At the top, the status bar shows 'Books 9:44 AM Sun Oct 30' and 'youtube.com'. The YouTube logo and a search bar are visible. The video content shows a man, identified as Chen Hsuan (Steve) Lu, a Graduate Student in Materials Science at Caltech, speaking in a classroom setting with a whiteboard in the background. Below the video, the title 'New Graphene Method to Protect and Enhance Biomedical Devices' is displayed. The channel name 'caltech' is shown with a 'Subscribe' button and '165K subscribers'. Engagement icons for likes (68), comments, and shares are present. The video description follows, starting with '1,807 views Oct 12, 2022' and discussing the properties of graphene and its application in biomedical devices.

Books 9:44 AM Sun Oct 30

youtube.com

YouTube Search

Chen Hsuan (Steve) Lu  
Graduate Student, Materials Science

Caltech

**New Graphene Method to Protect and Enhance Biomedical Devices**

caltech  
165K subscribers

Subscribe

68

Share

1,807 views Oct 12, 2022

At 200 times stronger than steel, graphene has been hailed as a super material of the future ever since its discovery in 2004. The ultrathin carbon material is an incredibly strong electrical and thermal conductor, making it a perfect ingredient to enhance semiconductor chips found in many electrical devices.

New research from the laboratory of Nai-Chang Yeh demonstrates that graphene can greatly improve electrical circuits required for wearable and flexible electronics such as medical biopatches, bendable smartphones, helmets, large folding display screens, and more.

# Expanding our research focus (new polls with a broader perspective)

- Crossover topics for renewable energy: advanced materials, directed energy, space technology
- Crossover topics for biotechnology: advanced materials
- Crossover topics for advanced materials: renewable energy, space technology, microelectronics, additive manufacturing

Cite this page  
Wikidata item

Print/export

Download as PDF  
Printable version

In other projects

Wikimedia  
Commons

Languages

العربية

Español

Français

한국어

हिन्दी

Bahasa Indonesia

Italiano

Bahasa Melayu

Русский

23 more

Edit links

# Biomimetics

From Wikipedia, the free encyclopedia

**Biomimetics** or **biomimicry** is the emulation of the models, systems, and elements of nature for the purpose of solving complex human problems.<sup>[2]</sup> The terms "biomimetics" and "biomimicry" are derived from Ancient Greek: βίος (*bios*), life, and μίμησις (*mīmēsis*), imitation, from μιμεῖσθαι (*mīmeisthai*), to imitate, from μῖμος (*mimos*), actor. A closely related field is *bionics*.<sup>[3]</sup>

Living organisms have evolved well-adapted structures and materials over geological time through natural selection. Biomimetics has given rise to new technologies inspired by biological solutions at macro and nanoscales. Humans have looked at nature for answers to problems throughout their existence. Nature has solved engineering problems such as self-healing abilities, environmental exposure tolerance and resistance, hydrophobicity, self-assembly, and harnessing solar energy.



The tiny hooks on bur fruits (left) inspired Velcro tape (right).



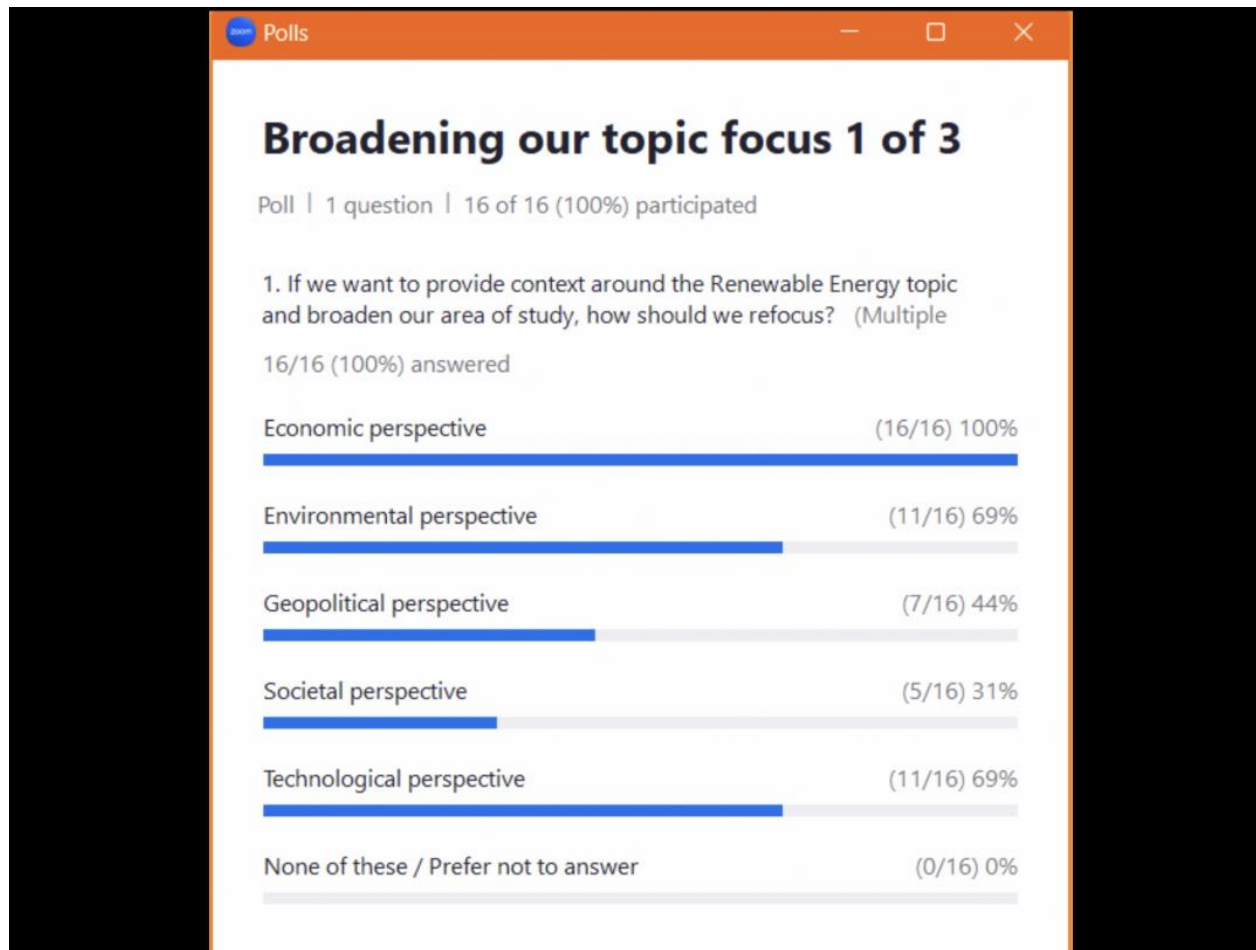
Giant axons of the longfin inshore squid (*Doryteuthis pealeii*) were Marine Biological Laboratory crucial for scientists to understand the action potential.<sup>[1]</sup>

## Contents [hide]

- History
- Bio-inspired technologies
  - Locomotion
  - Biomimetic architecture
    - Characteristics
    - Procedures
    - Examples

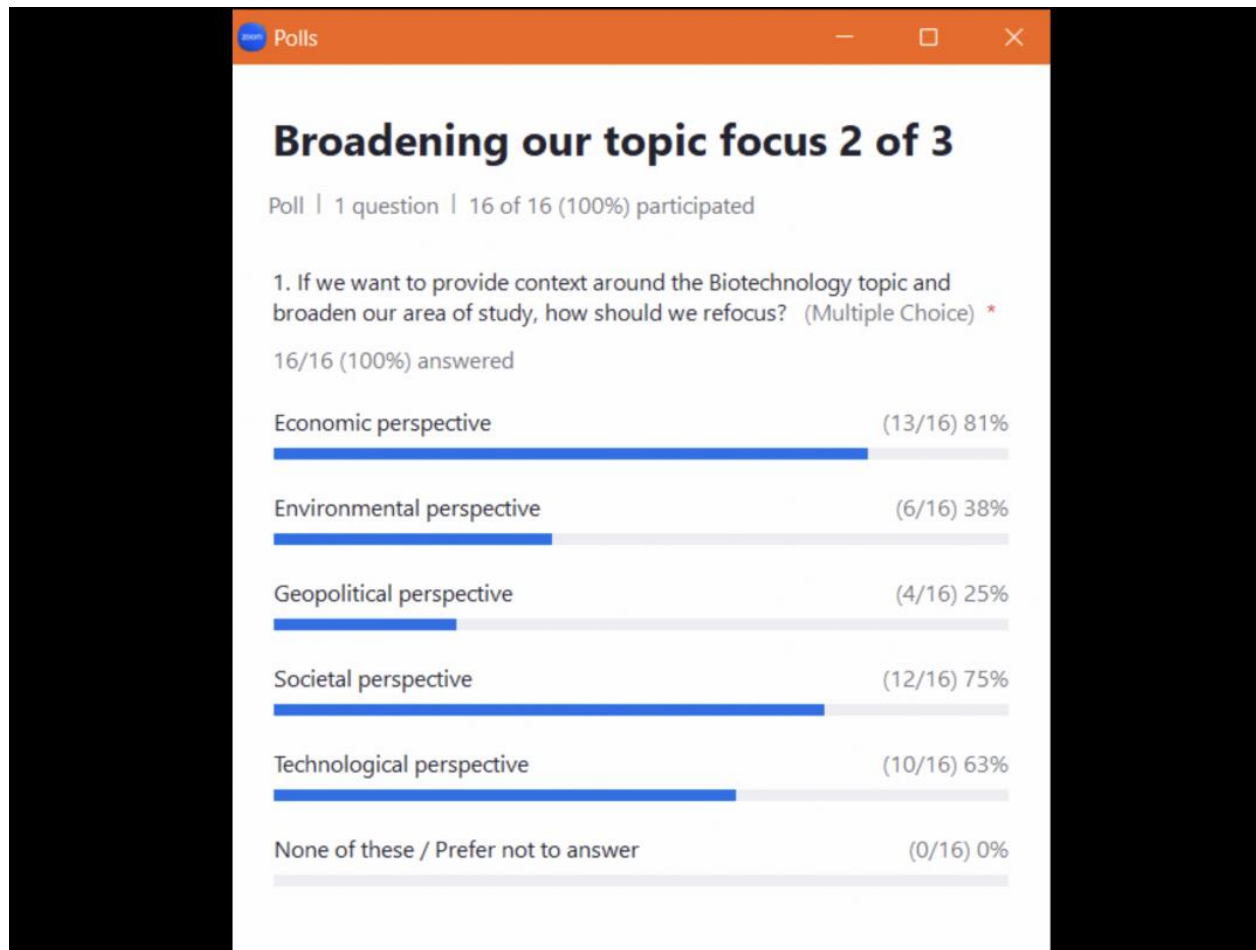
Image source: Wikipedia

# Expanding our research focus (new polls)



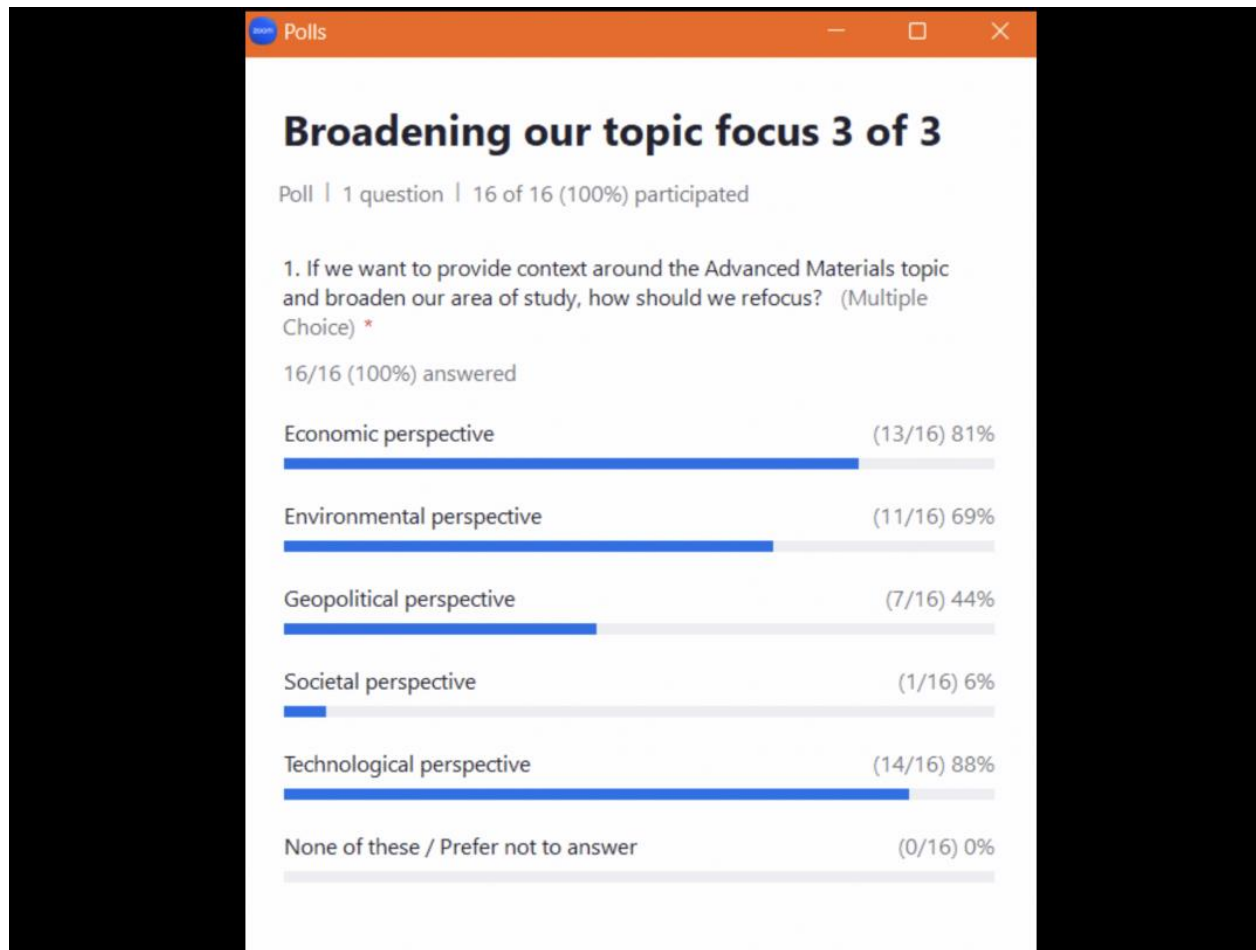
Perspectives to take on renewable energy topic (Nov 9, 2022 OISG poll)

# Expanding our research focus (new polls)



Perspectives to take on biotechnology topic (Nov 9, 2022 OISG poll)

# Expanding our research focus (new polls)



Perspectives to take on advanced materials topic (Nov 9, 2022 OISG poll)

# Additional resources

About 843,000 results (0.46 seconds)

<https://library.udel.edu/databases>  
**Databases – University of Delaware Libraries, Museums & Press**  
Research **Databases**. Browse by Subject: Choose Subject, BROAD SUBJECTS, Area, Ethnic & Gender Studies, Arts & Humanities, Business and Economics ...  
**New Databases · Artstor · Now on Trial**

<https://library.udel.edu>  
**UD Library, Museums and Press**  
Library, Museums and Press Home ... DELCAT Discovery · Research Guides · Support Us · **Databases** · Interlibrary Loan · About · Electronic Journals ...

<https://library.udel.edu/Databases>  
**DELCAT Discovery – Databases - UD Library**  
Search University of Delaware Library and libraries worldwide, for books, ...

<https://library.udel.edu/Databases>  
**JSTOR – Databases - UD Library - University of Delaware**  
Included are peer-reviewed scholarly journals, literary journals, and academic ...

<https://udayton.edu/libraries>  
**Libraries Home : University of Dayton, Ohio**  
Journals by Title or Subject · **Databases** by Title or Subject · Search Research Guides · Reserve a **Library Space** · Book a **Librarian** · Events and Exhibits · My...

Image source: Google (emphasis added)



## Results: Databases (Names Beginning with M)

[Having trouble? Report a problem](#)

Making of America	<a href="#">More info</a>
Making of Modern Law: Primary Sources, 1620-1926	<a href="#">More info</a>
Making of the Modern World	<a href="#">More info</a>
March of Time	<a href="#">More info</a>
Market Research and American Business, 1935-1965	<a href="#">More info</a>
<b>Marketscope Advisor (S&amp;P Global)</b>	<a href="#">More info</a>
Materials Science and Engineering Database <a href="#">Get It! enabled</a>	<a href="#">More info</a>
MathSciNet	<a href="#">More info</a>

Image source: UD Library (emphasis added)

The CFRA logo is positioned in the top right corner of the cover. It consists of the letters 'CFRA' in a bold, white, sans-serif font. The background of the cover is a blue sky with white clouds, and the bottom half features a perspective view of solar panels.

**CFRA**

# Industry Surveys

---

## Alternative Energy

MARCH 2022

**Richard Wolfe**  
Equity Analyst

**Fateh Yahaya**  
Industry Analyst

Image source: CFRA

Mergent Archives	More info
Mergent BondViewer	More info
Mergent Equity Research Reports	More info
Mergent Intellect	More info
Mergent Investext	More info
Mergent Online	More info
Meteorological and Geostrophysical Abstracts	Get It! enabled More info
Middle English Compendium	More info
Million Dollar Directory (MDDI)	More info
MLA Directory of Periodicals	Get It! enabled More info

Image source: UD Library (emphasis added)

**MERGENT Online** Log Out | Administration | Contact Us | Help  
Version 2.30 10/16/2022, 11:54:46 AM

Basic search | Advanced search | D&B 20 m plus private company search | Executive search | Government filings | Bond search | Country insight | Economic research

Industry analysis | Investext | Report viewer

My Mergent Tools +

Select one of the following criteria to begin search by:  
(Use \* to search within Company Name)  
^ require minimum 3-character word to search

USA Company Database (Active)

USA Company Database (Inactive)

International Company Database (Active)

International Company Database (Inactive)

D&B Private Company Database

Company Search - Enter symbol or Company Name ^

---

**D&B 20 Million Plus Private Company Search**

Search for an additional private companies below (Search by one of the criteria listed below) :

Company Search - Enter symbol or Company Name ^

Country

Duns Number

Classification Search - Select one of the criteria

Primary SIC

Primary NAICS

ICB (Industry Classification Benchmark)

(use code lookup...)

Index

Exchange

Country

Corporate Calendar

<Prev							Today	Next>
October							2022	
Su	Mo	Tu	We	Th	Fr	Sa		
							1	
2	3	4	5	6	7	8		
9	10	11	12	13	14	15		
16	17	18	19	20	21	22		
23	24	25	26	27	28	29		
30	31							

Today is Sun, Oct 16 2022

Country Profile

Looking for country Statistical Data with Country Map?

Select a country from the list:

Image source: Mergent Online via UD Library

# Summary and conclusion

# Stock symbol recognition

- The stock symbol recognition exercise is an in-class exercise designed to judge the awareness level of seminar participants regarding companies tied to specific stock symbols.
- Sixty-four publicly traded companies are referenced in the Govini scorecard (stock symbols listed were active as of November 2022).
- Seminar participants were presented with a sample of 40 symbols before in-depth group work began, and were polled about the extent to which they were familiar with each of the symbols.

# Stock symbol recognition (cont'd)

ABCL	BA	FSLR	J	MCK	PL	VLD
ACM	BAH	FLR	JCI	MRK	RTX	VSAT
AJRD	CACI	F	KBR	MSFT	RGTI	XRX
ALTO	CARR	GD	LHX	MRNA	SAIC	XMTR
AMRC	CWEN	GEVO	LDOS	MP	SIEGY	
ANET	CLF	GFS	FINMY	LASR	SLGC	
ASGN	ED	HON	LMT	NOC	STLA	
AZN	LLY	HII	MAIN	PLTR	SNX	
BAESY	EBS	NSIT	MRVL	PSN	SYSX	
BE	FSRD	IBM	MMS	PFE	TTEK	
Active stock symbols during Fall 2022 study period						

# Stock symbol recognition (cont'd)

ABCL	BA	FSLR	J
ACM	BAH	FLR	JCI
AJRD	CACI	F	KBR
ALTO	CARR	GD	LHX
AMRC	CWEN	GEVO	LDOS
ANET	CLF	GFS	FINMY
ASGN	ED	HON	LMT
AZN	LLY	HII	MAIN
BAESY	EBS	NSIT	MRVL
BE	FSRD	IBM	MMS

Highlighted stock symbols were recognized by at least one individual in the seminar prior to the commencement of work involving the Study Teams!

(75% symbol recognition in the sample)

Approx. 16 students responded to the polls.



# Stock symbol recognition (cont'd)

- This level of symbol recognition suggested that a pooling of knowledge within and across teams would be beneficial in this exercise as the collective knowledge level of the seminar participants spanned 30 of the 40 companies mentioned in the sample (at least at a very basic level).

# Just look at your team's assigned Govini page to get started!

- You really don't need to look at the full Govini report. Each team will initially be looking at a single page of the report.
- Renewable Energy (see page 45)
- Biotechnology (see page 10)
- Advanced Materials (see page 55)
- If you want to review the entire Govini document, there is a link to it on the class webpage for Week 8.

# How do team members contact each other?

- Team members use class time in their groups to look into the specified companies, major investors, tech accelerators and university partners listed on the page using whatever resources they think are best for this purpose.
- Optionally, teams may request access to email addresses of members on their team for the purpose of sharing information and completing the class project. Seminar participants must opt-in if they wish to share their email address.

# How do team members contact each other (cont'd)

- The plan is for members to leave their group Zoom room open while they open another browser window to do their research, coming back to ask other group members for help when they get stuck.
- Near the end of class, the three groups will re-join the class to discuss opportunities found and problems encountered.

# What is the next step?

- In the last session, we asked group members to divide up the six analyst roles among themselves. We also asked for a progress report.
- We will resume research explorations using class time during Bonus Weeks 1 & 2.
- Updates to this plan will be posted on the seminar webpage: <https://udel.edu/~oisg>

# What is the next step? (cont'd)

OISG Study Teams - Progress Report (November 30, 2022)

- 1.) What is the single most valuable resource that you discovered that informs your topic?
- 2.) How did you distinguish good from bad investments?
- 3.) What is your biggest insight so far?
- 4.) What problem would you still like to be able to solve?
- 5.) If you had to choose a single investment now, what would it be and why?
- 6.) Regarding your choice above, discuss the price stability of your candidate investment.
- 7.) When considering possible investments, did you run across any ethical concerns?
- 8.) How useful was the Govini report?
- 9.) Would your team be willing to give a 45 minute presentation on your topic at the beginning of the Spring semester?

Keep those great ideas coming!

<b>AEROJET RD. NYSE-AJRD</b>				<b>RECENT PRICE 40.41</b>				<b>P/E RATIO 43.9</b> (Trailing: 30.4 Median: NMF)				<b>RELATIVE P/E RATIO 3.05</b>		<b>DIV'D YLD Nil</b>		<b>VALUE LINE</b>					
<b>TIMELINESS</b> 3 Raised 9/23/22	High: 7.1	10.4	18.5	19.8	25.0	21.4	36.3	38.9	52.8	57.3	53.5	47.0					<b>Target Price Range</b>				
<b>SAFETY</b> 3 Raised 4/17/15	Low: 3.7	5.3	9.3	15.1	14.9	14.0	17.7	24.4	30.1	32.2	39.8	35.5					<b>2025</b>	<b>2026</b>	<b>2027</b>		
<b>TECHNICAL</b> 3 Raised 10/7/22	<b>LEGENDS</b> — 14.0 x "Cash Flow" p sh . . . . Relative Price Strength Options: Yes Shaded area indicates recession																				
<b>BETA</b> .75 (1.00 = Market)																					
<b>18-Month Target Price Range</b>																					
<b>Low-High</b> Midpoint (% to Mid)																					
\$33-\$62 \$48 (20%)																					
<b>2025-27 PROJECTIONS</b>																					
	<b>Price</b>	<b>Gain</b>	<b>Ann'l Total Return</b>																		
<b>High</b> 75	(+85%)	17%																			
<b>Low</b> 50	(+25%)	6%																			
<b>Institutional Decisions</b>																					
	4Q2021	1Q2022	2Q2022																		
<b>to Buy</b>	119	170	129																		
<b>to Sell</b>	116	119	144																		
<b>Hlds(000)</b>	74225	75358	76239																		
	Percent shares traded	36	24																		
		12																			
		<b>% TOT. RETURN 8/22</b>																			
		<b>THIS STOCK</b>																			
		<b>VL ARITH. INDEX</b>																			
		1 yr.	3.7	-12.0																	
		3 yr.	-17.5	43.2																	
		5 yr.	45.4	54.9																	
© VALUE LINE PUB. LLC 25-27																					
<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>25-27</b>			
11.13	13.17	12.95	13.60	14.64	15.61	16.89	23.09	28.07	27.12	25.42	26.78	24.95	25.63	27.75	27.32	<b>25.00</b>	<b>26.20</b>	<b>Sales per sh A</b>	<b>30.20</b>		
d.25	1.03	.52	1.33	.58	.47	.28	.38	.20	.76	1.20	1.83	2.76	2.65	2.73	2.56	<b>1.80</b>	<b>2.15</b>	<b>"Cash Flow" per sh</b>	<b>4.10</b>		
d.73	.53	.03	.70	.11	.05	d.09	d.19	d.91	d.29	.27	.73	1.75	1.56	1.67	1.75	<b>1.00</b>	<b>1.30</b>	<b>Earnings per sh AB</b>	<b>3.10</b>		
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<b>Nil</b>	<b>Nil</b>	<b>Div'ds Decl'd per sh</b>	<b>Nil</b>		
.34	.39	.37	.24	.29	.36	.63	1.06	.76	.58	.69	.42	.57	.56	.73	.47	<b>.55</b>	<b>.60</b>	<b>Cap'l Spending per sh</b>	<b>.80</b>		
d1.72	d.92	d.61	d5.04	d3.42	d3.60	d6.60	.83	d3.03	d2.31	.51	1.46	5.54	7.46	3.13	6.66	<b>7.40</b>	<b>7.85</b>	<b>Book Value per sh D</b>	<b>9.65</b>		
55.80	56.60	57.30	58.50	58.60	58.80	58.90	59.90	56.90	63.00	69.30	70.10	76.00	77.30	74.70	80.10	<b>82.00</b>	<b>82.00</b>	<b>Common Shs Outst'g C</b>	<b>82.00</b>		
--	24.6	NMF	5.2	48.6	NMF	--	--	--	--	NMF	34.0	17.8	27.0	25.7	26.8	<b>Bold figures are Value Line estimates</b>		<b>Avg Ann'l P/E Ratio</b>	<b>20.0</b>		
--	1.31	NMF	.35	3.09	NMF	--	--	--	--	NMF	1.71	.96	1.44	1.32	1.45			<b>Relative P/E Ratio</b>	<b>1.10</b>		
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.6%			<b>Avg Ann'l Div'd Yield</b>	<b>Nil</b>		
<b>CAPITAL STRUCTURE as of 6/30/22</b>																					
<b>Total Debt</b> \$456.0 mill. <b>Due in 5 Yrs</b> \$179.3 mill.																					
<b>LT Debt</b> \$276.7 mill. <b>LT Interest</b> \$19.2 mill.																					
(Total interest coverage: 8.8x) (35% of Cap'l)																					
<b>Leases, Uncapitalized</b> Annual rentals \$14.7 mill.																					
<b>Pension Assets-12/21</b> \$945 mill. <b>Oblig.</b> \$1.27 bill.																					
<b>Common Stock</b> 80,437,000 shares as of 7/23/22																					
<b>MARKET CAP: \$3.3 billion (Mid Cap)</b>																					
<b>CURRENT POSITION (\$MILL.)</b>	<b>2020</b>	<b>2021</b>	<b>6/30/22</b>																		
Cash Assets	1149.5	714.0	572.4																		
Receivables	75.6	60.6	170.3																		
Contract Assets	288.6	320.0	377.3																		
Other	146.5	142.0	125.7																		
Current Assets	1660.2	1236.6	1245.7																		
Accts Payable	99.1	132.2	115.1																		
Debt Due	299.9	166.7	179.3																		
Other	1056.7	576.8	668.8																		
<b>BUSINESS:</b> Aerojet Rocketdyne manufactures propulsion and electronic surveillance systems for aerospace and defense applications. Also operates a Real Estate business, which owns 11,414 acres of land near Sacramento, CA; is seeking zoning changes in order to develop. Lockheed Martin, NASA, and Raytheon made up 36%, 20%, and 18% of '21 sales. Employs about 5,100. Officers and directors own 2.1% of common shares; BlackRock, 14.1%; Vanguard Group, 9.2%; GAMCO Investors, 7.5%; Warren Lichtenstein's Steel Partners, 5.2% (3/22 proxy). Chairman: Warren Lichtenstein. Pres. & CEO: Eileen Drake. Incorpor.: Delaware. Address: 222 N. Sepulveda Blvd., Suite 500, El Segundo, CA 95742. Telephone: 916-355-4000. Internet: www.rocket.com.																					

Image source: Value Line (emphasis added)





## L3Harris acquiring Aerojet Rocketdyne for \$4.7B

The deal, which is subject to approval by the Federal Trade Commission, is expected to close in 2023.

By VALERIE INSINNA on December 18, 2022 at 8:10 PM



*A sign for Aerojet Rocketdyne at the AFA 2022 Air, Space and Cyber Conference. (Justin Katz/Breaking Defense)*

WASHINGTON — L3Harris Technologies has announced plans to acquire Aerojet Rocketdyne for \$4.7 billion — a transaction that, if approved, would see the nation's sole independent solid rocket motor manufacturer bought up by a major defense prime, albeit one currently without a major stake in the missile business.

The deal, which was announced tonight and is subject to approval by the Federal Trade Commission, is expected to close in 2023.

Image source: Breaking Defense

# Aerojet Rocketdyne Has a New Suitor. Will the Biden Administration Approve?

L3Harris Technologies has entered a \$4.7 billion deal to acquire the rocket manufacturer.

MARCUS WEISGERBER | DECEMBER 19, 2022 10:30 AM ET

INDUSTRY

SPACE

MISSILES

WHITE HOUSE



L3Harris Technologies has entered a \$4.7 billion agreement to buy Aerojet Rocketdyne, two years later and \$300 million sweeter than the Lockheed Martin deal scuttled by the Biden administration.

"We've heard the DoD leadership loud and clear: they want high-quality, innovative and cost-effective solutions to meet both current and emerging threats, and they're relying upon a strong, competitive industrial base to deliver those solutions," L3Harris CEO Chris Kubasik said in a statement on Sunday. "With this acquisition, we will use the combined talents of more than 50,000 employees to drive continuous process improvement, enhance business operations and elevate the performance of this crucial national asset."

Sponsor Message

**MILITARY PERISCOPE**

### China's Rapid Naval Modernization

China has invested heavily to accelerate and modernize its naval force. Learn how.

**DOWNLOAD NOW**

**What you need to know about the defense industry - in your inbox.**

Enter your email

Sponsor Message

KC-46A TANKER

Image source: Defense One



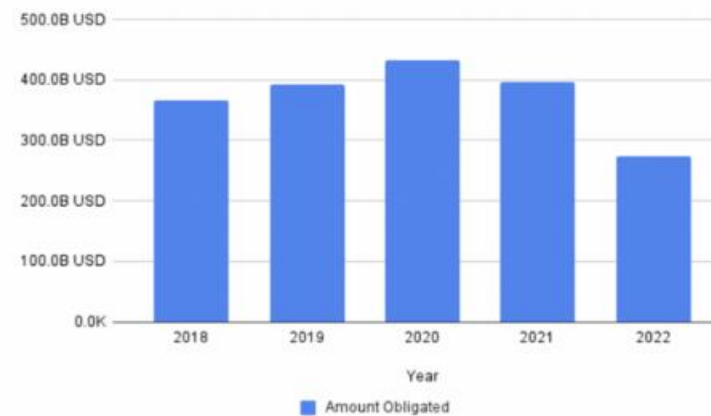
## HOW MUCH DO GOVERNMENT CONTRACTS CONTRIBUTE TO DEFENSE SUPPLIERS' REVENUE SHARE?

COMPANIES AND MARKETS

By Ivo Kolchev | December 8, 2022

To assess the financial health of defense sector companies, it's essential to track government contract awards. This is especially true amid the possibility of a recession. Government contracts could prove to be a lifeline to companies if their commercial businesses take a hit.

**Figure 1. Contract awards by the U.S. Department of Defense, 2018-Q3 2022**



Source: [TenderAlpha.com](https://www.tenderalpha.com)

This article reviews the latest quarterly and annual results across the four largest defense suppliers in the U.S.: Lockheed Martin, Boeing, Raytheon Technologies, and Booz Allen Hamilton. We also highlight the significance of government procurement for their revenue, using government contracts data by [TenderAlpha.com](https://www.tenderalpha.com), also available through the [TenderAlpha Global Defense and Military Contracting News Feed](https://www.tenderalpha.com).

Image source: Factset

<b>ASGN INC. NYSE-ASGN</b>				<b>RECENT PRICE</b> <b>94.84</b>		<b>P/E RATIO</b> <b>16.3</b> (Trailing: 18.3) (Median: 22.0)		<b>RELATIVE P/E RATIO</b> <b>1.06</b>		<b>DIV'D YLD</b> <b>Nil</b>		<b>VALUE LINE</b>									
<b>TIMELINESS</b> <b>4</b> Lowered 9/30/22	High: 11.9	20.9	35.7	39.9	51.0	45.8	65.7	94.3	72.7	87.5	131.0	131.9	<b>Target Price Range</b> 2025 2026 2027								
<b>SAFETY</b> <b>3</b> Raised 4/13/12	Low: 6.3	10.6	20.4	26.0	30.6	29.3	42.9	51.1	50.3	29.0	80.0	78.3									
<b>TECHNICAL</b> <b>3</b> Raised 9/30/22	<b>LEGENDS</b> --- 15.0 x "Cash Flow" p sh .... Relative Price Strength Options: Yes Shaded area indicates recession																				
<b>BETA</b> 1.10 (1.00 = Market)																					
<b>18-Month Target Price Range</b>																					
<b>Low-High</b> Midpoint (% to Mid)																					
\$76-\$157 \$117 (25%)																					
<b>2025-27 PROJECTIONS</b>																					
	Price	Gain	Ann'l Total																		
High	175	(+85%)	17%																		
Low	115	(+20%)	5%																		
<b>Institutional Decisions</b>																					
	4Q2021	1Q2022	2Q2022																		
to Buy	150	123	141																		
to Sell	129	147	134																		
Hlds(000)	48994	48570	48616																		
	Percent shares traded																				
	30																				
	20																				
	10																				
<b>% TOT. RETURN 8/22</b>																					
	THIS STOCK			VL ARITH*																	
	1 yr. -13.8			-12.0																	
	3 yr. 54.8			43.2																	
	5 yr. 102.7			54.9																	
<b>© VALUE LINE PUB. LLC 25-27</b>																					
<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>				
8.44	16.12	17.30	11.49	12.04	16.14	23.41	30.26	36.19	38.94	46.29	50.35	64.74	74.18	74.68	77.40	<b>92.00</b>	<b>97.95</b>	Revenues per sh	133.35		
.40	.88	.94	.46	.37	.90	1.27	1.56	2.28	2.32	3.02	3.55	4.82	5.03	5.48	6.20	<b>7.50</b>	<b>8.35</b>	"Cash Flow" per sh	10.10		
.29	.26	.53	.13	.15	.64	.89	1.00	1.46	1.35	1.81	2.38	2.98	3.28	3.76	4.33	<b>5.70</b>	<b>6.00</b>	Earnings per sh <sup>A</sup>	7.25		
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Div'ds Decl'd per sh	Nil		
.12	.17	.23	.13	.17	.23	.27	.31	.38	.47	.51	.47	.55	.62	.62	.67	<b>.80</b>	<b>1.00</b>	Cap'l Spending per sh	1.35		
4.87	5.49	6.12	6.25	6.03	6.67	10.06	11.87	12.35	14.80	16.48	19.01	22.51	26.02	30.00	36.01	<b>38.00</b>	<b>39.80</b>	Book Value per sh	45.55		
34.06	35.18	35.72	36.26	36.40	37.01	52.96	53.93	51.39	53.03	52.72	52.15	52.51	52.90	52.90	51.80	<b>50.00</b>	<b>49.00</b>	Common Shs Outst'g <sup>B</sup>	45.00		
37.4	40.0	13.0	35.0	41.4	14.7	18.6	28.5	22.3	29.0	20.6	21.8	25.7	19.0	17.0	24.3	<i>Bold figures are Value Line estimates</i>		Avg Ann'l P/E Ratio	20.0		
2.02	2.12	.78	2.33	2.63	.92	1.18	1.60	1.17	1.46	1.08	1.10	1.39	1.01	.87	1.33			Relative P/E Ratio	1.10		
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			Avg Ann'l Div'd Yield	Nil		
<b>CAPITAL STRUCTURE as of 6/30/22</b>																					
Total Debt \$1034.5 mill. Due in 5 Yrs Nil																					
LT Debt \$1034.5 mill. LT Interest \$40.0 mill.																					
(Total interest covered: 7.8x)																					
(36% of Cap'l)																					
<b>Leases, Uncapitalized</b> Annual rentals \$25.1 mill.																					
<b>No Defined Benefit Pension Plan</b>																					
Pfd Stock None																					
<b>Common Stock</b> 50,200,000 shs.																					
as of 8/4/22																					
<b>MARKET CAP: \$4.8 billion (Mid Cap)</b>																					
<b>CURRENT POSITION</b>				<b>2020</b>	<b>2021</b>	<b>6/30/22</b>															
<b>(\$MILL.)</b>																					
Cash Assets	274.4	529.6	490.6																		
Receivables	678.7	708.2	843.2																		
Other	41.3	71.6	32.5																		
Current Assets	994.4	1309.4	1366.3																		
Accts Payable	39.8	20.1	32.8																		
Debt Due	--	--	--																		
Other	376.4	430.8	459.6																		
<b>BUSINESS:</b> ASGN Incorporated (formerly On Assignment, Inc.) assigns temp, contract-to-hire, and direct-hire (permanent) professionals in the IT, engineering, healthcare, and life sciences sectors. Has two operating segments: <u>Commercial and Federal Government (formerly ECS)</u> . Acquired Whitaker Medical and CyberCoders Hldgs., 12/13. Sold Allied Healthcare and Nurse Travel '13; Oxford, 8/21. Has approximately 3,900 employees (12/21). Officers/directors own 3.0% of common stock; FMR LLC, 11.1%; BlackRock, Inc., 11.0%; Vanguard, 9.3% (4/22 proxy). Chairman: Arshad Matin. CEO & President: Theodore S. Hanson. Inc.: DE. Address: 4400 Cox Road, Suite 1100, Glen Allen, VA 23060. Telephone: 888-482-8068. Internet: www.asgn.com.																					

Image source: Value Line (emphasis added)

<b>BOOZ ALLEN</b> NYSE-BAH		RECENT PRICE <b>94.41</b>		P/E RATIO <b>21.7</b> (Trailing: 22.1) (Median: 18.0)		RELATIVE P/E RATIO <b>1.34</b>		DIV'D YLD <b>1.8%</b>		<b>VALUE LINE</b> <b>371</b>																																																																																																																																																																																																																																																																																																																																																																									
<b>TIMELINESS</b> 3 Raised 10/1/21	High: 20.3	19.2	22.3	27.8	31.3	38.5	39.7	52.9	78.0	91.2	100.3	97.9	Target Price Range 2025 2026 2027																																																																																																																																																																																																																																																																																																																																																																						
<b>SAFETY</b> 3 New 11/30/12	Low: 13.3	11.9	12.5	17.2	23.9	25.0	31.1	35.2	43.7	54.4	75.1	69.7																																																																																																																																																																																																																																																																																																																																																																							
<b>TECHNICAL</b> 2 Raised 8/19/22	<b>LEGENDS</b> — 17.0 x "Cash Flow" p sh . . . . Relative Price Strength Options: Yes Shaded area indicates recession																																																																																																																																																																																																																																																																																																																																																																																		
<b>BETA</b> .85 (1.00 = Market)	<b>18-Month Target Price Range</b> Low-High Midpoint (% to Mid) \$80-\$147 \$114 (20%)																																																																																																																																																																																																																																																																																																																																																																																		
<b>2025-27 PROJECTIONS</b> Ann'l Total Return High Price 140 Gain (+50%) 12% Low Price 95 (Nil) 2%																																																																																																																																																																																																																																																																																																																																																																																			
<b>Institutional Decisions</b> 3Q2021 4Q2021 1Q2022 to Buy 204 263 241 to Sell 249 204 261 Hlds(000) 119711 119805 117230																																																																																																																																																																																																																																																																																																																																																																																			
Booz Allen Hamilton Holding Corporation completed its initial public offering on November 16, 2010. At that time, 16.1 million shares were sold to the public at an average price of \$17.00 per share. The underwriting syndicate was led by Bank of America Merrill Lynch, Barclays, and Credit Suisse.																																																																																																																																																																																																																																																																																																																																																																																			
<b>CAPITAL STRUCTURE as of 6/30/22</b> Total Debt \$2783.9 mill. Debt Due 5 Yrs \$1.9 bill. LT Debt \$2715.5 mill. LT Interest \$99.0 mill. (Total interest coverage: 8.7x) (71% of Cap'l)																																																																																																																																																																																																																																																																																																																																																																																			
<b>Leases, Uncapitalized:</b> Annual Rentals \$64.5 mill.																																																																																																																																																																																																																																																																																																																																																																																			
<b>No Defined Benefit Pension Plan</b>																																																																																																																																																																																																																																																																																																																																																																																			
<b>Pfd Stock None</b>																																																																																																																																																																																																																																																																																																																																																																																			
<b>Common Stock</b> 132,185,735 shs. as of 5/17/22 <b>MARKET CAP:</b> \$12.5 billion (Large Cap)																																																																																																																																																																																																																																																																																																																																																																																			
<b>CURRENT POSITION (SMILL.)</b>																																																																																																																																																																																																																																																																																																																																																																																			
Cash Assets	991.0	695.9	497.8																																																																																																																																																																																																																																																																																																																																																																																
Receivables	1411.9	1623.0	1828.4																																																																																																																																																																																																																																																																																																																																																																																
Inventory	--	--	--																																																																																																																																																																																																																																																																																																																																																																																
Other	233.3	126.8	95.0																																																																																																																																																																																																																																																																																																																																																																																
Current Assets	2636.2	2445.7	2421.2																																																																																																																																																																																																																																																																																																																																																																																
Accts Payable	667.0	539.5	898.3																																																																																																																																																																																																																																																																																																																																																																																
Debt Due	77.9	68.4	68.4																																																																																																																																																																																																																																																																																																																																																																																
Other	546.2	926.1	549.3																																																																																																																																																																																																																																																																																																																																																																																
<b>BUSINESS:</b> Booz Allen Hamilton Corp. provides management and technology consulting services to the U.S. government (both defense and civil), major corporations, institutions, and not-for-profit organizations. In fiscal 2021, 97% of revenues were derived from contracts where the end client was an agency or department of the U.S. government, with the Navy Marine Corps accounting for 13% of the top line. Has had contracts with the U.S. Army and Navy for more than 70 years. At 6/30/22, total backlog was \$28.6 billion. Has about 29,300 employees. CEO & Pres.: Horacio Rozanski. Off./dir. own 2.2% of common stock; T.Rowe Price Assoc. 13.7%; (6/22 Proxy). Inc.: DE. Addr.: 8283 Greensboro Dr., McLean, Virginia 22102. Telephone: (703) 902-5000. Internet: www.boozallen.com.																																																																																																																																																																																																																																																																																																																																																																																			
<table border="1"> <thead> <tr> <th></th> <th>2012</th> <th>2013</th> <th>2014</th> <th>2015</th> <th>2016</th> <th>2017</th> <th>2018</th> <th>2019</th> <th>2020</th> <th>2021</th> <th>2022</th> <th>2023</th> <th>© VALUE LINE PUB. LLC</th> <th>25-27</th> </tr> </thead> <tbody> <tr> <td>Revenues per sh <sup>A</sup></td> <td>39.49</td> <td>36.85</td> <td>35.38</td> <td>36.53</td> <td>38.98</td> <td>43.03</td> <td>47.88</td> <td>53.81</td> <td>57.68</td> <td>63.08</td> <td><b>68.70</b></td> <td><b>74.05</b></td> <td></td> <td>86.30</td> </tr> <tr> <td>"Cash Flow" per sh</td> <td>2.01</td> <td>2.05</td> <td>1.98</td> <td>2.40</td> <td>2.10</td> <td>2.58</td> <td>3.33</td> <td>4.06</td> <td>4.61</td> <td>4.40</td> <td><b>5.55</b></td> <td><b>6.00</b></td> <td></td> <td>7.20</td> </tr> <tr> <td>Earnings per sh <sup>AB</sup></td> <td>1.45</td> <td>1.54</td> <td>1.52</td> <td>1.94</td> <td>1.67</td> <td>2.05</td> <td>2.76</td> <td>3.41</td> <td>3.90</td> <td>4.21</td> <td><b>4.35</b></td> <td><b>4.70</b></td> <td></td> <td>5.75</td> </tr> <tr> <td>Div'ds Decl'd per sh <sup>D</sup></td> <td>.36</td> <td>.40</td> <td>.46</td> <td>.54</td> <td>.62</td> <td>.70</td> <td>.80</td> <td>1.04</td> <td>1.30</td> <td>1.54</td> <td><b>1.72</b></td> <td><b>1.80</b></td> <td></td> <td>2.00</td> </tr> <tr> <td>Cap'l Spending per sh</td> <td>.23</td> <td>.14</td> <td>.24</td> <td>.45</td> <td>.36</td> <td>.55</td> <td>.68</td> <td>.92</td> <td>.64</td> <td>.60</td> <td><b>.55</b></td> <td><b>.60</b></td> <td></td> <td>.80</td> </tr> <tr> <td>Book Value per sh <sup>C</sup></td> <td>1.56</td> <td>1.15</td> <td>1.25</td> <td>2.76</td> <td>3.85</td> <td>3.87</td> <td>4.82</td> <td>6.17</td> <td>7.86</td> <td>7.89</td> <td><b>8.95</b></td> <td><b>10.75</b></td> <td></td> <td>17.35</td> </tr> <tr> <td>Common Shs Outst'g <sup>E</sup></td> <td>145.80</td> <td>148.69</td> <td>149.09</td> <td>147.99</td> <td>148.89</td> <td>143.45</td> <td>140.03</td> <td>138.72</td> <td>136.25</td> <td>132.58</td> <td><b>131.00</b></td> <td><b>130.00</b></td> <td></td> <td>126.00</td> </tr> <tr> <td>Avg Ann'l P/E Ratio</td> <td>10.0</td> <td>11.9</td> <td>16.4</td> <td>14.3</td> <td>19.2</td> <td>17.9</td> <td>17.3</td> <td>20.3</td> <td>20.9</td> <td>20.0</td> <td colspan="2"><i>Bold figures are Value Line estimates</i></td> <td></td> <td>20.5</td> </tr> <tr> <td>Relative P/E Ratio</td> <td>.64</td> <td>.67</td> <td>.86</td> <td>.72</td> <td>1.01</td> <td>.90</td> <td>.93</td> <td>1.08</td> <td>1.07</td> <td>1.08</td> <td></td> <td></td> <td></td> <td>1.15</td> </tr> <tr> <td>Avg Ann'l Div'd Yield</td> <td>2.5%</td> <td>2.2%</td> <td>1.8%</td> <td>1.9%</td> <td>1.9%</td> <td>1.9%</td> <td>1.7%</td> <td>1.5%</td> <td>1.6%</td> <td>1.8%</td> <td></td> <td></td> <td></td> <td>1.7%</td> </tr> <tr> <td>Revenues (\$mill)</td> <td>5758.1</td> <td>5478.7</td> <td>5274.8</td> <td>5405.7</td> <td>5804.3</td> <td>6171.9</td> <td>6704.0</td> <td>7463.8</td> <td>7858.9</td> <td>8363.7</td> <td><b>9000</b></td> <td><b>9625</b></td> <td></td> <td>10875</td> </tr> <tr> <td>Operating Margin</td> <td>9.0%</td> <td>9.7%</td> <td>9.9%</td> <td>9.4%</td> <td>9.4%</td> <td>9.5%</td> <td>10.0%</td> <td>10.1%</td> <td>10.7%</td> <td>11.2%</td> <td><b>10.8%</b></td> <td><b>11.0%</b></td> <td></td> <td>11.0%</td> </tr> <tr> <td>Depreciation (\$mill)</td> <td>74.0</td> <td>72.3</td> <td>62.7</td> <td>61.5</td> <td>59.5</td> <td>64.8</td> <td>68.6</td> <td>81.1</td> <td>84.3</td> <td>145.7</td> <td><b>146</b></td> <td><b>158</b></td> <td></td> <td>175</td> </tr> <tr> <td>Net Profit (\$mill)</td> <td>219.1</td> <td>232.2</td> <td>232.6</td> <td>294.1</td> <td>252.5</td> <td>305.1</td> <td>397.1</td> <td>482.6</td> <td>543.8</td> <td>570.6</td> <td><b>580</b></td> <td><b>620</b></td> <td></td> <td>730</td> </tr> <tr> <td>Income Tax Rate</td> <td>40.5%</td> <td>39.0%</td> <td>39.7%</td> <td>22.5%</td> <td>38.7%</td> <td>30.3%</td> <td>23.0%</td> <td>16.7%</td> <td>17.9%</td> <td>19.4%</td> <td><b>22.0%</b></td> <td><b>23.0%</b></td> <td></td> <td>23.0%</td> </tr> <tr> <td>Net Profit Margin</td> <td>3.8%</td> <td>4.2%</td> <td>4.4%</td> <td>5.4%</td> <td>4.4%</td> <td>4.9%</td> <td>5.9%</td> <td>6.5%</td> <td>6.9%</td> <td>6.8%</td> <td><b>6.4%</b></td> <td><b>6.4%</b></td> <td></td> <td>6.7%</td> </tr> <tr> <td>Working Cap'l (\$mill)</td> <td>459.7</td> <td>338.9</td> <td>314.2</td> <td>249.9</td> <td>193.1</td> <td>452.5</td> <td>520.1</td> <td>1000.5</td> <td>1345.1</td> <td>911.7</td> <td><b>950</b></td> <td><b>1175</b></td> <td></td> <td>1450</td> </tr> <tr> <td>Long-Term Debt (\$mill)</td> <td>1659.6</td> <td>1585.2</td> <td>1569.3</td> <td>1484.4</td> <td>1470.2</td> <td>1755.5</td> <td>1701.8</td> <td>2008.0</td> <td>2278.7</td> <td>2731.7</td> <td><b>2675</b></td> <td><b>2775</b></td> <td></td> <td>3150</td> </tr> <tr> <td>Shr. Equity (\$mill)</td> <td>226.8</td> <td>171.6</td> <td>186.5</td> <td>408.5</td> <td>573.6</td> <td>554.6</td> <td>675.4</td> <td>856.4</td> <td>1071.2</td> <td>1046.1</td> <td><b>1175</b></td> <td><b>1395</b></td> <td></td> <td>2190</td> </tr> <tr> <td>Return on Total Cap'l</td> <td>13.4%</td> <td>15.3%</td> <td>15.2%</td> <td>17.3%</td> <td>13.6%</td> <td>14.8%</td> <td>18.3%</td> <td>18.3%</td> <td>17.4%</td> <td>16.3%</td> <td><b>16.5%</b></td> <td><b>16.0%</b></td> <td></td> <td>14.5%</td> </tr> <tr> <td>Return on Shr. Equity</td> <td>96.6%</td> <td>135.3%</td> <td>124.7%</td> <td>72.0%</td> <td>44.0%</td> <td>55.0%</td> <td>58.8%</td> <td>56.4%</td> <td>50.8%</td> <td>54.5%</td> <td><b>49.0%</b></td> <td><b>44.5%</b></td> <td></td> <td>33.5%</td> </tr> <tr> <td>Retained to Com Eq</td> <td>75.3%</td> <td>100.6%</td> <td>88.2%</td> <td>52.4%</td> <td>27.4%</td> <td>36.2%</td> <td>41.9%</td> <td>39.2%</td> <td>33.9%</td> <td>34.6%</td> <td><b>30.0%</b></td> <td><b>27.5%</b></td> <td></td> <td>22.0%</td> </tr> <tr> <td>All Div'ds to Net Prof</td> <td>22%</td> <td>26%</td> <td>29%</td> <td>27%</td> <td>38%</td> <td>34%</td> <td>29%</td> <td>30%</td> <td>33%</td> <td>37%</td> <td><b>40%</b></td> <td><b>38%</b></td> <td></td> <td>35%</td> </tr> </tbody> </table>													2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	© VALUE LINE PUB. LLC	25-27	Revenues per sh <sup>A</sup>	39.49	36.85	35.38	36.53	38.98	43.03	47.88	53.81	57.68	63.08	<b>68.70</b>	<b>74.05</b>		86.30	"Cash Flow" per sh	2.01	2.05	1.98	2.40	2.10	2.58	3.33	4.06	4.61	4.40	<b>5.55</b>	<b>6.00</b>		7.20	Earnings per sh <sup>AB</sup>	1.45	1.54	1.52	1.94	1.67	2.05	2.76	3.41	3.90	4.21	<b>4.35</b>	<b>4.70</b>		5.75	Div'ds Decl'd per sh <sup>D</sup>	.36	.40	.46	.54	.62	.70	.80	1.04	1.30	1.54	<b>1.72</b>	<b>1.80</b>		2.00	Cap'l Spending per sh	.23	.14	.24	.45	.36	.55	.68	.92	.64	.60	<b>.55</b>	<b>.60</b>		.80	Book Value per sh <sup>C</sup>	1.56	1.15	1.25	2.76	3.85	3.87	4.82	6.17	7.86	7.89	<b>8.95</b>	<b>10.75</b>		17.35	Common Shs Outst'g <sup>E</sup>	145.80	148.69	149.09	147.99	148.89	143.45	140.03	138.72	136.25	132.58	<b>131.00</b>	<b>130.00</b>		126.00	Avg Ann'l P/E Ratio	10.0	11.9	16.4	14.3	19.2	17.9	17.3	20.3	20.9	20.0	<i>Bold figures are Value Line estimates</i>			20.5	Relative P/E Ratio	.64	.67	.86	.72	1.01	.90	.93	1.08	1.07	1.08				1.15	Avg Ann'l Div'd Yield	2.5%	2.2%	1.8%	1.9%	1.9%	1.9%	1.7%	1.5%	1.6%	1.8%				1.7%	Revenues (\$mill)	5758.1	5478.7	5274.8	5405.7	5804.3	6171.9	6704.0	7463.8	7858.9	8363.7	<b>9000</b>	<b>9625</b>		10875	Operating Margin	9.0%	9.7%	9.9%	9.4%	9.4%	9.5%	10.0%	10.1%	10.7%	11.2%	<b>10.8%</b>	<b>11.0%</b>		11.0%	Depreciation (\$mill)	74.0	72.3	62.7	61.5	59.5	64.8	68.6	81.1	84.3	145.7	<b>146</b>	<b>158</b>		175	Net Profit (\$mill)	219.1	232.2	232.6	294.1	252.5	305.1	397.1	482.6	543.8	570.6	<b>580</b>	<b>620</b>		730	Income Tax Rate	40.5%	39.0%	39.7%	22.5%	38.7%	30.3%	23.0%	16.7%	17.9%	19.4%	<b>22.0%</b>	<b>23.0%</b>		23.0%	Net Profit Margin	3.8%	4.2%	4.4%	5.4%	4.4%	4.9%	5.9%	6.5%	6.9%	6.8%	<b>6.4%</b>	<b>6.4%</b>		6.7%	Working Cap'l (\$mill)	459.7	338.9	314.2	249.9	193.1	452.5	520.1	1000.5	1345.1	911.7	<b>950</b>	<b>1175</b>		1450	Long-Term Debt (\$mill)	1659.6	1585.2	1569.3	1484.4	1470.2	1755.5	1701.8	2008.0	2278.7	2731.7	<b>2675</b>	<b>2775</b>		3150	Shr. Equity (\$mill)	226.8	171.6	186.5	408.5	573.6	554.6	675.4	856.4	1071.2	1046.1	<b>1175</b>	<b>1395</b>		2190	Return on Total Cap'l	13.4%	15.3%	15.2%	17.3%	13.6%	14.8%	18.3%	18.3%	17.4%	16.3%	<b>16.5%</b>	<b>16.0%</b>		14.5%	Return on Shr. Equity	96.6%	135.3%	124.7%	72.0%	44.0%	55.0%	58.8%	56.4%	50.8%	54.5%	<b>49.0%</b>	<b>44.5%</b>		33.5%	Retained to Com Eq	75.3%	100.6%	88.2%	52.4%	27.4%	36.2%	41.9%	39.2%	33.9%	34.6%	<b>30.0%</b>	<b>27.5%</b>		22.0%	All Div'ds to Net Prof	22%	26%	29%	27%	38%	34%	29%	30%	33%	37%	<b>40%</b>	<b>38%</b>		35%
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	© VALUE LINE PUB. LLC	25-27																																																																																																																																																																																																																																																																																																																																																																					
Revenues per sh <sup>A</sup>	39.49	36.85	35.38	36.53	38.98	43.03	47.88	53.81	57.68	63.08	<b>68.70</b>	<b>74.05</b>		86.30																																																																																																																																																																																																																																																																																																																																																																					
"Cash Flow" per sh	2.01	2.05	1.98	2.40	2.10	2.58	3.33	4.06	4.61	4.40	<b>5.55</b>	<b>6.00</b>		7.20																																																																																																																																																																																																																																																																																																																																																																					
Earnings per sh <sup>AB</sup>	1.45	1.54	1.52	1.94	1.67	2.05	2.76	3.41	3.90	4.21	<b>4.35</b>	<b>4.70</b>		5.75																																																																																																																																																																																																																																																																																																																																																																					
Div'ds Decl'd per sh <sup>D</sup>	.36	.40	.46	.54	.62	.70	.80	1.04	1.30	1.54	<b>1.72</b>	<b>1.80</b>		2.00																																																																																																																																																																																																																																																																																																																																																																					
Cap'l Spending per sh	.23	.14	.24	.45	.36	.55	.68	.92	.64	.60	<b>.55</b>	<b>.60</b>		.80																																																																																																																																																																																																																																																																																																																																																																					
Book Value per sh <sup>C</sup>	1.56	1.15	1.25	2.76	3.85	3.87	4.82	6.17	7.86	7.89	<b>8.95</b>	<b>10.75</b>		17.35																																																																																																																																																																																																																																																																																																																																																																					
Common Shs Outst'g <sup>E</sup>	145.80	148.69	149.09	147.99	148.89	143.45	140.03	138.72	136.25	132.58	<b>131.00</b>	<b>130.00</b>		126.00																																																																																																																																																																																																																																																																																																																																																																					
Avg Ann'l P/E Ratio	10.0	11.9	16.4	14.3	19.2	17.9	17.3	20.3	20.9	20.0	<i>Bold figures are Value Line estimates</i>			20.5																																																																																																																																																																																																																																																																																																																																																																					
Relative P/E Ratio	.64	.67	.86	.72	1.01	.90	.93	1.08	1.07	1.08				1.15																																																																																																																																																																																																																																																																																																																																																																					
Avg Ann'l Div'd Yield	2.5%	2.2%	1.8%	1.9%	1.9%	1.9%	1.7%	1.5%	1.6%	1.8%				1.7%																																																																																																																																																																																																																																																																																																																																																																					
Revenues (\$mill)	5758.1	5478.7	5274.8	5405.7	5804.3	6171.9	6704.0	7463.8	7858.9	8363.7	<b>9000</b>	<b>9625</b>		10875																																																																																																																																																																																																																																																																																																																																																																					
Operating Margin	9.0%	9.7%	9.9%	9.4%	9.4%	9.5%	10.0%	10.1%	10.7%	11.2%	<b>10.8%</b>	<b>11.0%</b>		11.0%																																																																																																																																																																																																																																																																																																																																																																					
Depreciation (\$mill)	74.0	72.3	62.7	61.5	59.5	64.8	68.6	81.1	84.3	145.7	<b>146</b>	<b>158</b>		175																																																																																																																																																																																																																																																																																																																																																																					
Net Profit (\$mill)	219.1	232.2	232.6	294.1	252.5	305.1	397.1	482.6	543.8	570.6	<b>580</b>	<b>620</b>		730																																																																																																																																																																																																																																																																																																																																																																					
Income Tax Rate	40.5%	39.0%	39.7%	22.5%	38.7%	30.3%	23.0%	16.7%	17.9%	19.4%	<b>22.0%</b>	<b>23.0%</b>		23.0%																																																																																																																																																																																																																																																																																																																																																																					
Net Profit Margin	3.8%	4.2%	4.4%	5.4%	4.4%	4.9%	5.9%	6.5%	6.9%	6.8%	<b>6.4%</b>	<b>6.4%</b>		6.7%																																																																																																																																																																																																																																																																																																																																																																					
Working Cap'l (\$mill)	459.7	338.9	314.2	249.9	193.1	452.5	520.1	1000.5	1345.1	911.7	<b>950</b>	<b>1175</b>		1450																																																																																																																																																																																																																																																																																																																																																																					
Long-Term Debt (\$mill)	1659.6	1585.2	1569.3	1484.4	1470.2	1755.5	1701.8	2008.0	2278.7	2731.7	<b>2675</b>	<b>2775</b>		3150																																																																																																																																																																																																																																																																																																																																																																					
Shr. Equity (\$mill)	226.8	171.6	186.5	408.5	573.6	554.6	675.4	856.4	1071.2	1046.1	<b>1175</b>	<b>1395</b>		2190																																																																																																																																																																																																																																																																																																																																																																					
Return on Total Cap'l	13.4%	15.3%	15.2%	17.3%	13.6%	14.8%	18.3%	18.3%	17.4%	16.3%	<b>16.5%</b>	<b>16.0%</b>		14.5%																																																																																																																																																																																																																																																																																																																																																																					
Return on Shr. Equity	96.6%	135.3%	124.7%	72.0%	44.0%	55.0%	58.8%	56.4%	50.8%	54.5%	<b>49.0%</b>	<b>44.5%</b>		33.5%																																																																																																																																																																																																																																																																																																																																																																					
Retained to Com Eq	75.3%	100.6%	88.2%	52.4%	27.4%	36.2%	41.9%	39.2%	33.9%	34.6%	<b>30.0%</b>	<b>27.5%</b>		22.0%																																																																																																																																																																																																																																																																																																																																																																					
All Div'ds to Net Prof	22%	26%	29%	27%	38%	34%	29%	30%	33%	37%	<b>40%</b>	<b>38%</b>		35%																																																																																																																																																																																																																																																																																																																																																																					

Image source: Value Line (emphasis added)

Date	Stock Splits	Name
6/8/2011	0.1428571429	ALTO
5/14/2013	0.0666666667	ALTO
11/18/2021		4 ANET
7/27/2015		2 AZN
5/16/2008		2 CLF
7/17/2008		2 FLR
4/21/2015	0.0666666667	GEVO
1/6/2017		0.05 GEVO
6/4/2018		0.05 GEVO
10/3/2016	1.0053282397	HON
10/1/2018		1.011 HON
10/29/2018		1.032 HON
11/4/2021		1.046 IBM
10/1/2012	2.0116676725	JCI
9/6/2016		0.955 JCI
5/11/2009	1.0584250635	LHX
9/30/2013		0.405 LDOS
7/1/2011		2 MMS
7/1/2013		2 MMS
6/3/2021		1.048 MRK
3/31/2011	1.1068068622	NOC
11/17/2020		1.054 PFE
4/3/2020		1.589 RTX
3/14/2017		2 SIEGY
1/3/2011	2.3041474654	STLA
1/4/2016		1.52 STLA
12/1/2020		2 SNX
1/3/2017		1.518 XRX
6/15/2017		0.25 XRX

Stock splits and other corporate actions affecting the stock price of select publicly-traded firms over the last 10 years. (Thanks Matt!)

The Private Markets Club at UD (article link):

<https://lerner.udel.edu/seeing-opportunity/the-private-markets-club/>

Private Markets Club at UD on Instagram (link):

<https://www.instagram.com/privatemarketsclub/>

Private Markets Club at UD on LinkedIn (link):

<https://www.linkedin.com/company/pmc-ud>

Video interview from Chartered Alternative Investment Analysis Association (CAIA) (link):

<https://caia.org/videos/conversation-caia-ceo-bill-kelly-and-regan-landrigan-private-markets-club-university>

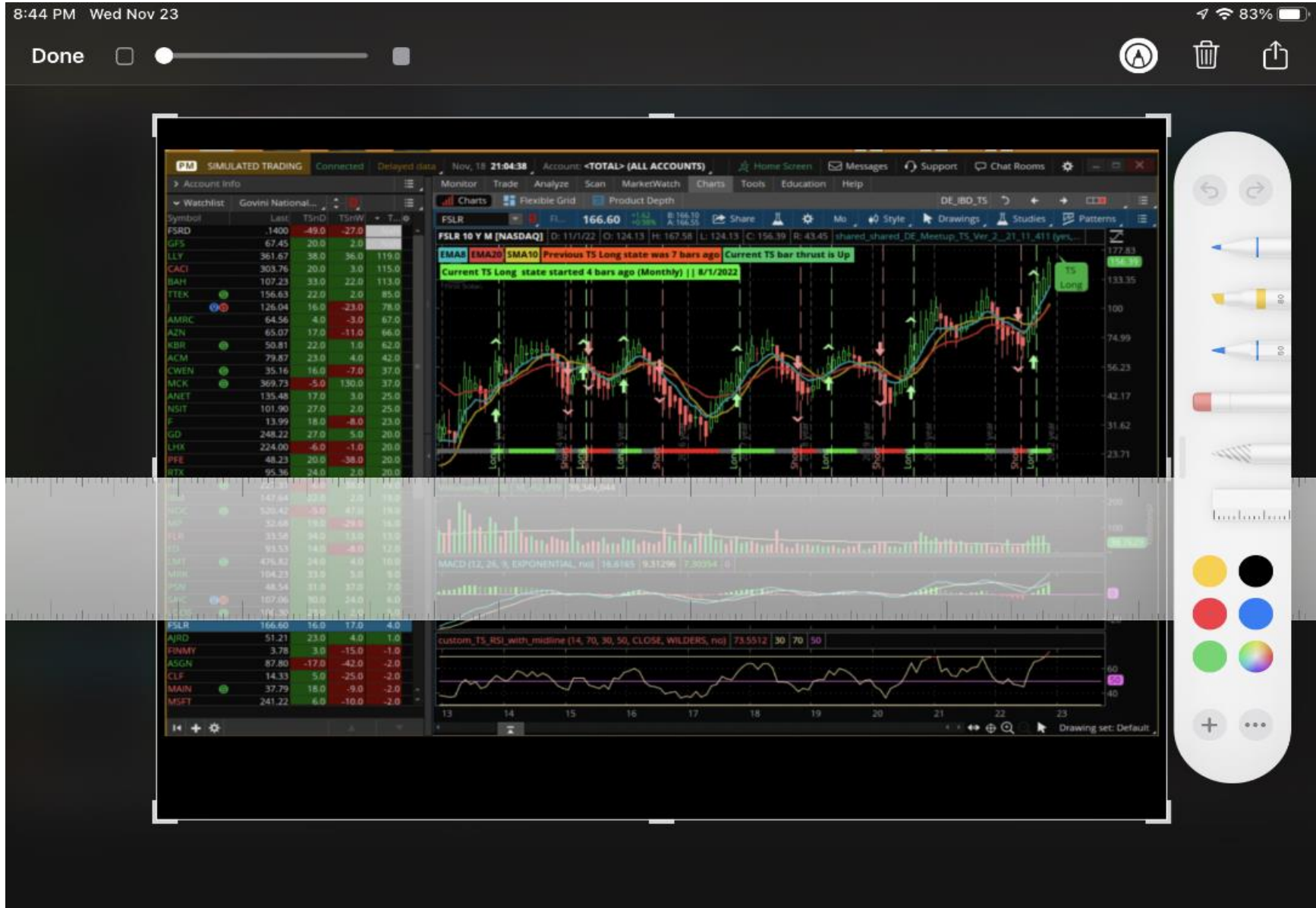
Graphene article link from Caltech:

<https://www.caltech.edu/about/news/graphene-boosts-flexible-and-wearable-electronics>

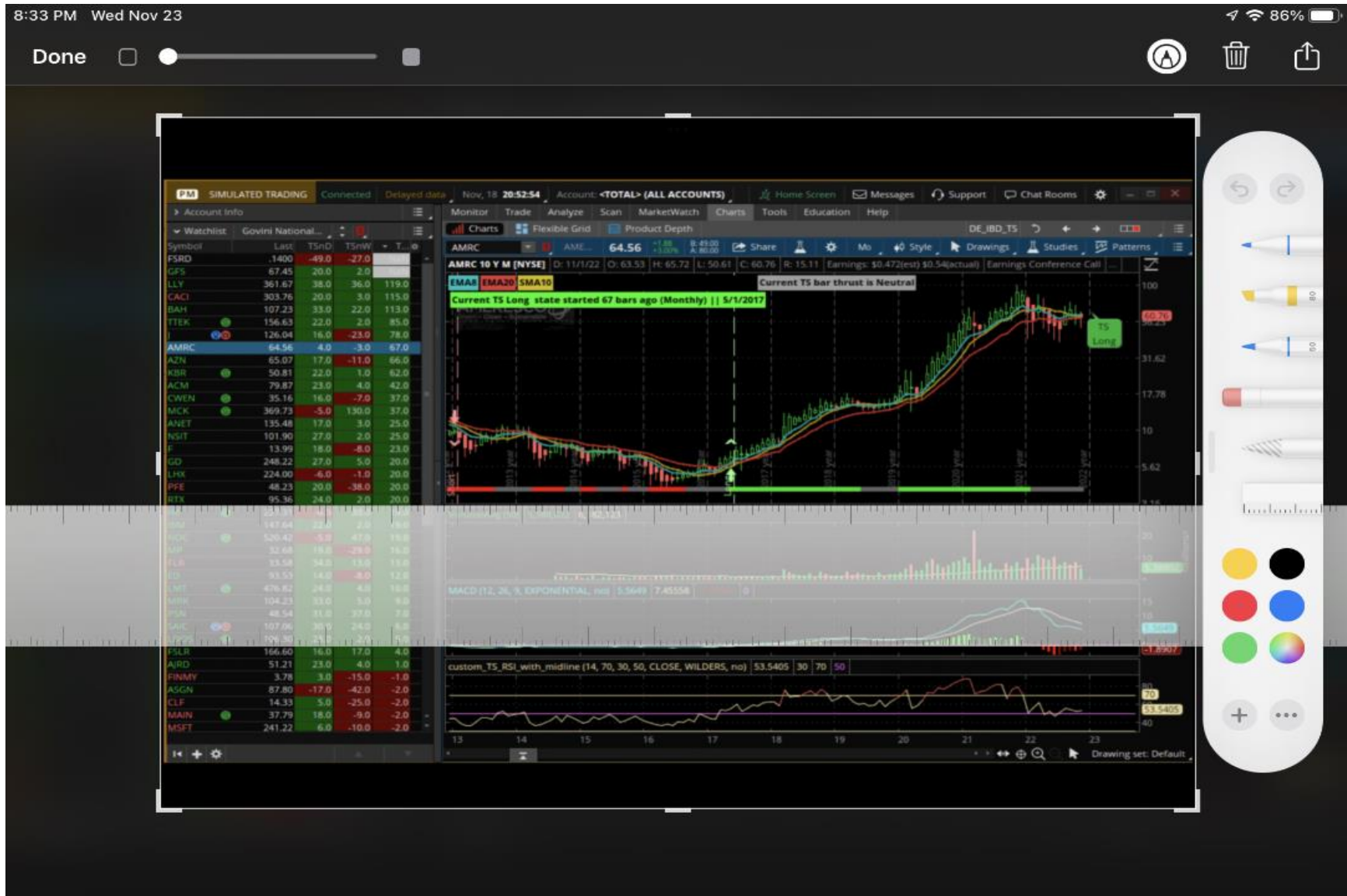
New Graphene Method to Protect and Enhance Biomedical Devices (video link):

<https://www.youtube.com/watch?v=cEQHm8bFcSY&t=2s>

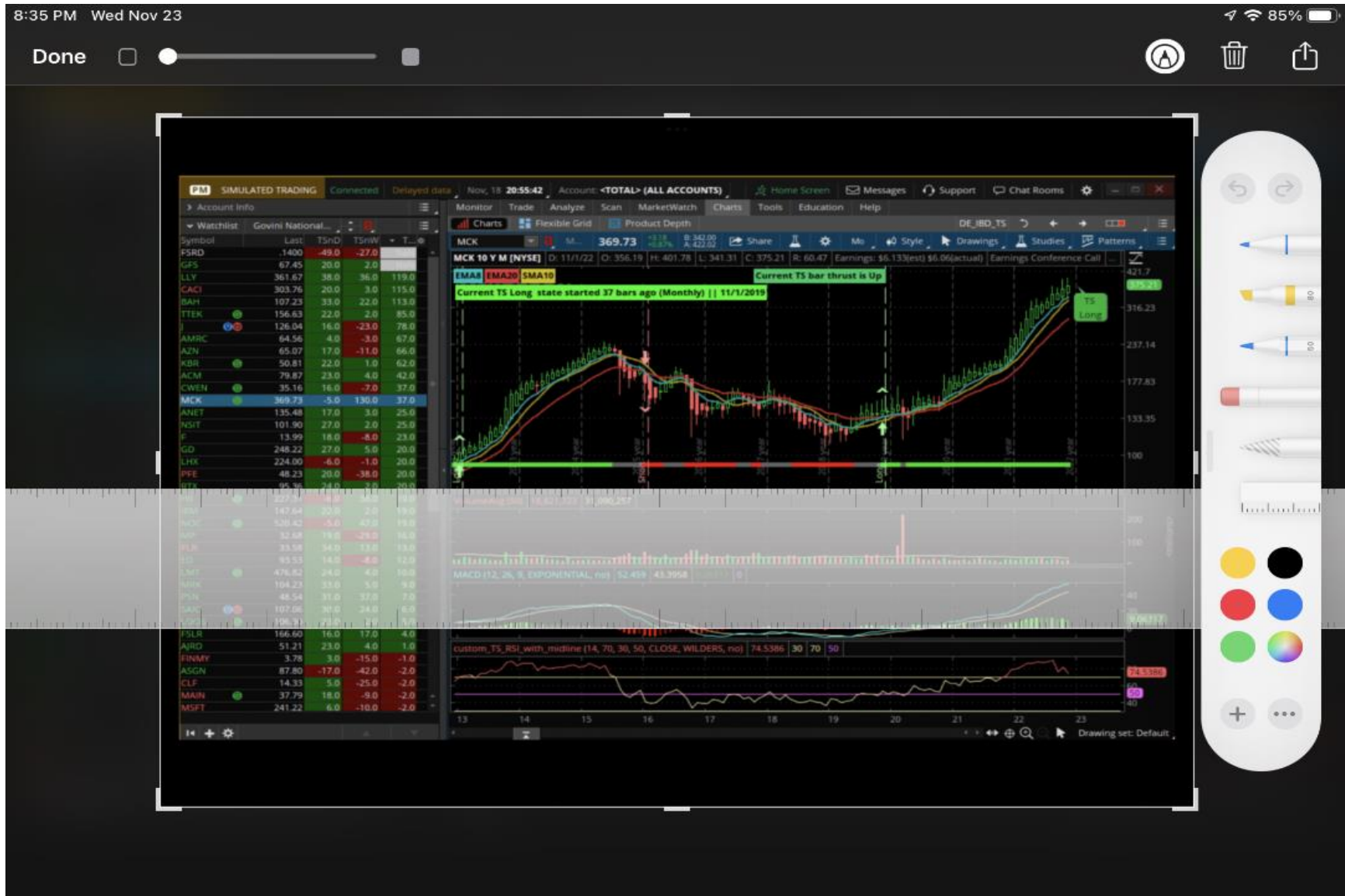




“Buy” and “sell” signals occur frequently on stocks like this one (triple screen using a momentum strategy and monthly charts).



One might measure the amount of time a particular stock had been on a “buy” or “sell” signal during the most recent 10-year period. (Past performance does not necessarily imply future results)!



Here's another example from the Govini scorecard (paper trading backtesting using a custom plug-in for the thinkorswim™ platform).

Triple screen signals on monthly charts using thinkorswim(tm) custom plug-in (12/1/22)								
Symbol	TS Signal	# of buy signals	# of sell signals	% of time on buy signal	Dividend-channel signal	SCTR score	Govini breadth	Evaluation
LLY	Buy	1	0	98	Buy	91		
CACI	Buy	1	1	97	N/A	70		
MSFT	Sell	1	2	96	Hold	41		
BAH	Buy	1	1	95	N/A	87		
NSIT	Buy	2	1	95	N/A	57		
LHX	Buy	2	1	93	Hold	27		
NOC	Buy	3	2	87	Buy	80		
HON	Buy	3	2	87	Hold	80		
MMS	Sell	2	2	87	Sell	87		
TTEK	Buy	3	2	83	Hold	73		
LMT	Buy	3	2	82	Buy	82		
J	Buy	2	1	81	Hold	30		
AZN	Buy	2	1	81	Sell	80		
ACM	Buy	4	3	81	N/A	89		
RTX	Buy	3	2	80	Hold	69		
HII	Buy	3	2	80	N/A	68		
PFE	Buy	4	3	79	Hold	50		
AJRD	Buy	4	3	79	Sell	94		
ASGN	Sell	3	3	79	N/A	22		
MAIN	Sell	3	3	78	Sell	40		
MRK	Buy	6	5	77	Buy	94		
GD	Buy	2	1	74	Buy	74		
MRVL	Sell	3	4	74	Sell	13		
LDOS	Buy	3	2	72	N/A	65		
SAIC	Buy	4	3	68	N/A	76		
ED	Buy	3	3	67	Buy	55		
EBS	Sell	3	4	65	N/A	7		
BA	Sell	2	2	63	Sell	94		
KBR	Buy	2	1	61	N/A	68		
MCK	Buy	2	1	60	Buy	83		
VSAT	Sell	4	4	59	N/A	22		
AMRC	Buy	1	1	57	N/A	82		
FSLR	Buy	7	6	57	N/A	100		
SNX	Sell	3	4	55	Sell	50		
JCI	Sell	4	4	51	Sell	93		
FINMY	Sell	3	3	51	N/A	18		
CLF	Sell	2	3	47	Sell	25		
XRX	Sell	3	3	44	Sell	45		
F	Buy	2	1	43	Sell	43		
ALTO	Sell	3	3	43	N/A	26		
FLR	Buy	4	3	41	Sell	95		
IBM	Buy	2	2	32	Buy	76		
GEVO	Sell	0	1	2	N/A	24		

Here's one way I thought of to evaluate Govini stocks using technical analysis (only stocks with a 10-year chart history are included)

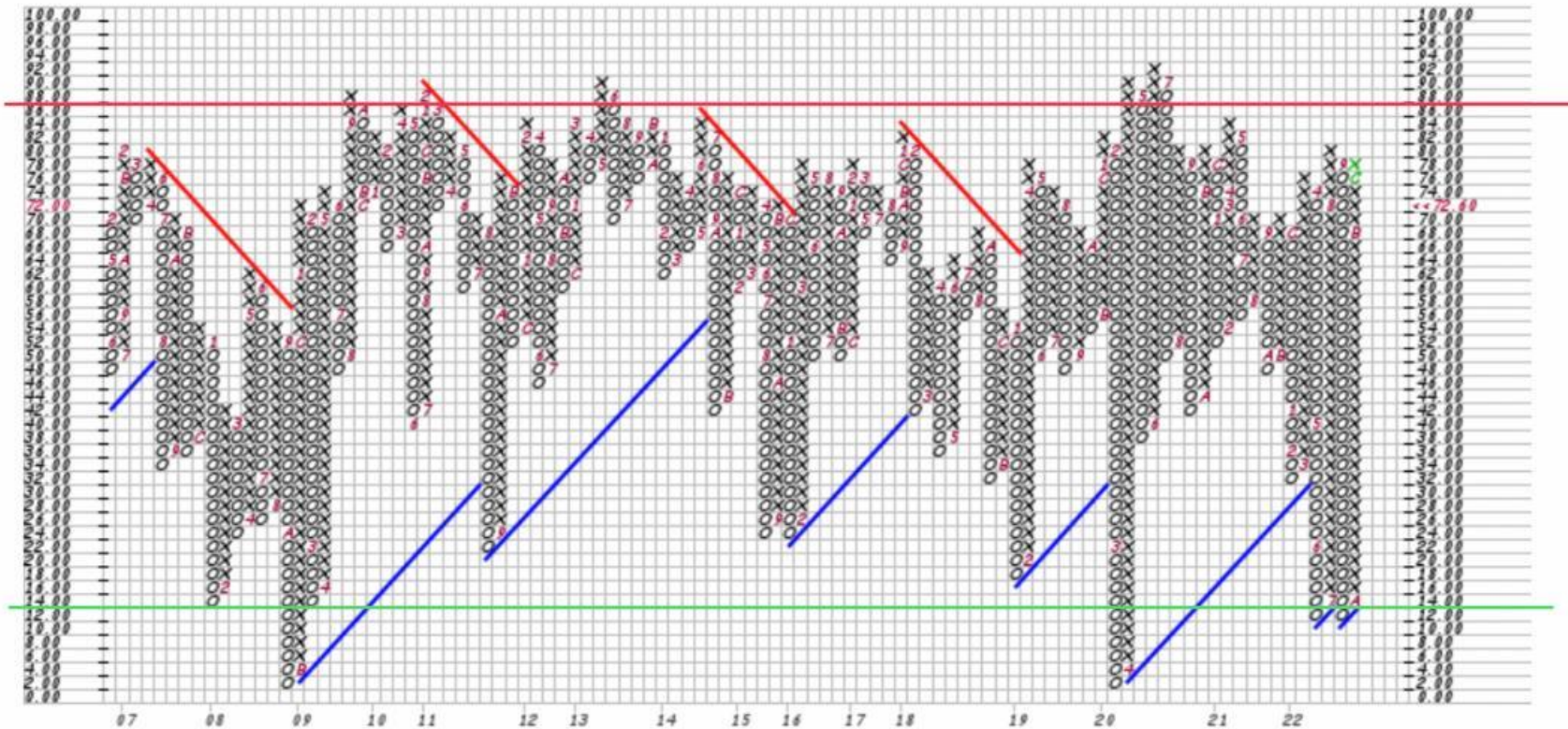
**\$BSPX** S&P 500 Bullish Percent Index INDX

06-Dec-2022, 11:40 ET, monthly, O: 75.80, H: 78.40, L: 72.60, C: 72.60, Chg: -2.20 (-2.94%)

Status Bull Confirmed on 01-Nov-2022

Scaling: User-Defined [Reversal: 3, Box Size:2.0]

(c) StockCharts.com



Print Share Permalink Past Data Instructions Report Problems

ChartStyles: - Predefined Settings - Save As Default

Chart Attributes

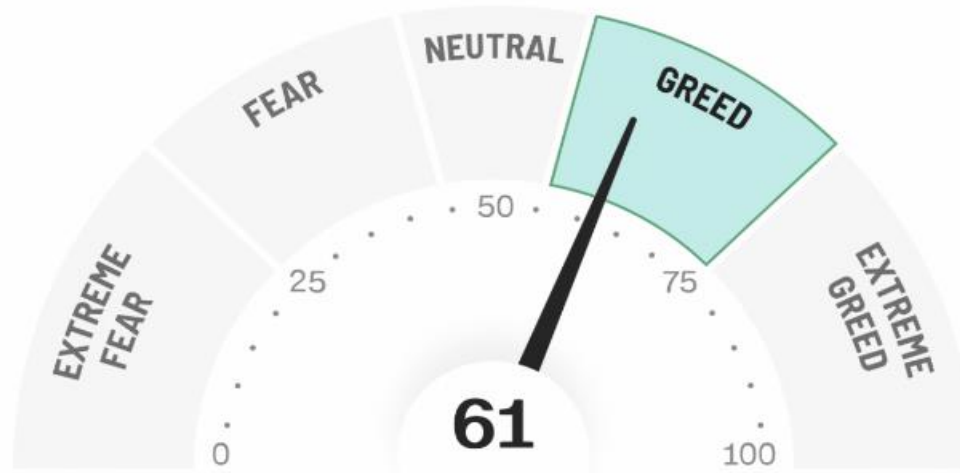
We should also be mindful of market conditions.  
Image source: stockcharts.com (emphasis added)

# Fear & Greed Index

What emotion is driving the market now?

[Learn more about the index](#)

Overview Timeline



Previous close

**Greed**

65

1 week ago

**Greed**

63

1 month ago

**Greed**

58

1 year ago

**Extreme Fear**

21

Last updated Dec 6 at 11:45 AM EST

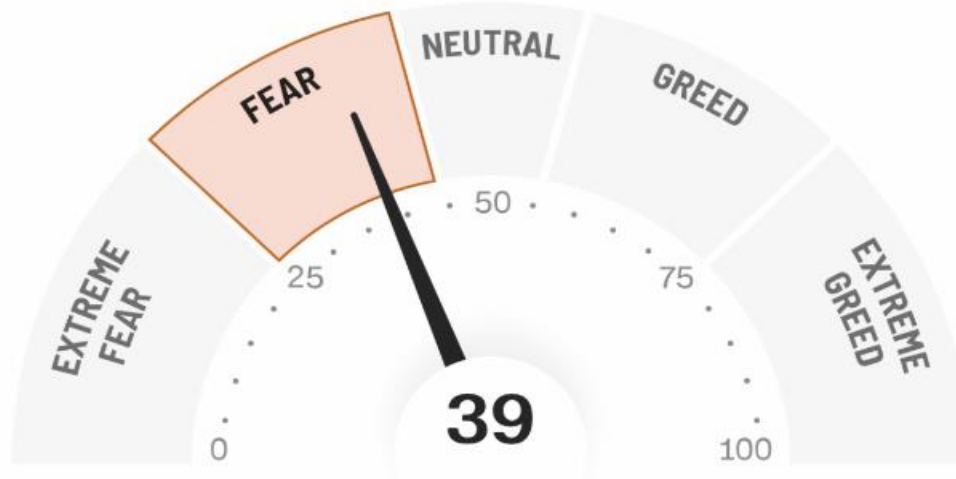
<https://www.cnn.com/markets/fear-and-greed>

# Fear & Greed Index

What emotion is driving the market now?

[Learn more about the index](#)

Overview Timeline



Previous close

**Fear**

35

1 week ago

**Fear**

43

1 month ago

**Greed**

62

1 year ago

**Neutral**

50

Last updated Dec 23 at 3:06 PM EST

<https://www.cnn.com/markets/fear-and-greed>

# Questions?

