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**BEFORE THE**
**HOUSE SELECT COMMITTEE ON THE**
**COMPETITION BETWEEN THE UNITED STATES AND**
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**ON**

# "COMPETING WITH CHINA FOR THE CENTURY: HOW TO WIN THE TECH RACE"

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# Competing with China for the Century

## How to Win the Tech Race

Michael Brown[1]

## Executive Summary

The People's Republic of China (PRC) plans to displace the United States as the world's leading technological and economic superpower by 2049 (its hundredth anniversary) or sooner. At its head is Xi Jinping, General Secretary of the Chinese Communist Party (CCP) who commands a ruthless, authoritarian regime whose principal objective is ensuring loyalty to and survival of the Party. In its relationship to the world, the PRC aims to displace the U.S.-rules-based order with a new world order based purely on relative power. The competition with the U.S. is primarily economic and technological, yet there are dangerous military and foreign policy implications of Chinese leadership in the world.

We have already experienced many Sputnik moments of Chinese achievements and disturbing behaviors which should have galvanized us to act in creating a strategy to win the tech race and economic competition underway but none has so far. The U.S. government must act before the PRC outpaces us in a technology, and consequently a military, lead that proves difficult, if not impossible, to catch up. Winning the tech race means we must innovate faster and better as well as scale innovations across our economy. In human history, the benefits of technology leadership for economic growth or wielding military power have never been more rapid or more dramatic.

Winning the tech race includes the following dimensions and future outcomes:

- The U.S. and its allies are leaders in the *critical and emerging technologies* which enable the formation of entirely new advanced industries and along with them create many high paying jobs. The Biden Administration has defined 19 technologies as critical and emerging including semiconductors, AI, quantum sciences, space technology, hypersonics, and others. (The list is Appendix A.). Almost all (90%) of these technologies are dual use—of importance to the military as well as commercially.
- The U.S. has an advanced industries policy focused on these critical and emerging technologies to coordinate government policy and align private sector incentives.
- The U.S. economy continues to be the largest and among the most productive in the world since economic security is the best predictor of strong national security.

[1] Michael Brown is a partner at Shield Capital, a visiting scholar at the Hoover Institution at Stanford University and the former Director of the Defense Innovation Unit (2018-2022) at the U.S. Department of Defense. His biography is Appendix F.

- The U.S. has fortified alliances with allies and partners enabling the free flow of ideas, talent and capital among nations with like-minded interest in preserving the rule of law.
- Laws and enforcement actions prevent China from using our liberal, open society to strengthen its own technology base at our expense through stolen IP, cyber theft, industrial espionage and one-sided mercantilist trading relationships.
- A "free and open Indo-Pacific" forms the basis of peace and stability in the region.

While the government alone cannot make this future happen, the government is responsible for an integrated strategy that synchronizes policy choices across government and sets the conditions for the private sector and academia to align to priorities of technology leadership, increased competitiveness and building of national capabilities.

The competitive framework to win the tech race with China would consist of five pillars:

1. **Communicate to the American people** the stakes and investments required.
2. **Create a comprehensive advanced industries strategy**—through Executive Branch actions and legislation—to ensure leadership in basic science, applied research for and widespread adoption throughout our economy of critical and emerging technologies.
    a. **Investment in basic science, applied research and technology adoption**
    b. **Talent development** to ensure we have the educated and trained labor force to capitalize on leadership in new technologies.
    c. **Economic statecraft** to ensure coordinated government policies
    d. **Align trade policy** to strengthen allied development of technology and create trading and growth opportunities for U.S. companies.
    e. **Leverage the Defense Department**'s buying power to shape the industrial base for markets where it can still lead such as autonomy and space infrastructure.
3. Engage the private sector by providing **long-term incentives in U.S. capital markets.**
4. **Invest in productivity growth and U.S. infrastructure** to widen the gap between the size of our GDP and China's.
5. **Increase the asymmetric strength of U.S. allies and partners** in a global coalition that creates economic and technological advantage for each other.

Thirty specific recommendations (see Appendix C) support this competitive framework. While more powerful together, these can be implemented as a subset or in various combinations. I am recommending what would be required to *win*—not limited by what is politically feasible. Our actions to date, such as the CHIPS and Science Act, are moving us in the right direction but are piecemeal and slow. We cannot afford the consequences of waiting longer for China to gain more relative advantage technologically, economically or militarily. The creation of the House Select Committee on the Competition between the U.S. and the CCP is an historic opportunity to shape the competition already underway and set the conditions to win the tech race.

## The Sputnik Moment Has Long Since Passed

The People's Republic of China (PRC) has emerged as the United States' pacing competitor with aims to displace the United States as the world's leading technological and economic superpower. Our National Security Strategy acknowledges that the "PRC is the only competitor with both the intent to reshape the international order and, increasingly, the economic, diplomatic, military, and technological power to do it."[2] The PRC is a far greater threat with a much larger economy relative to the U.S. than the Soviet Union at its peak and an economy, in contrast to the Soviet Union, that is well integrated globally. The competition is certainly diplomatic, military and ideological in its dimensions but the basis of the competition is technological and economic. The PRC realizes that leadership in advanced technology and dominance in advanced industries *is* national security. With technology leadership and industry dominance, the PRC aims to increase its power and influence by imposing its will on neighbors through economic coercion and military intimidation. Xi has numerous initiatives underway including *Made in China 2025* and *China Standards 2035* to support China's rise as a technology superpower and increase economic growth, military capability while reducing dependence on other countries—especially the U.S.[3] (through the PRC's "dual circulation policy"[4]). As the leader of a ruthless, authoritarian regime, Xi Jinping has eliminated competing viewpoints in the CCP with the benefit of moving all elements of society—government, business, academia—in the same direction, and likely faster than a democracy like ours, to support an audacious goal that he views as his destiny: the "great rejuvenation of the Chinese nation" making China "the biggest player in the history of the world."[5]

While these trends have been increasingly apparent since the end of the Obama Administration, the U.S. has not sufficiently come to grips with the scale of the threat to coordinate its actions as a government. Our policies thus far have been more focused on preventing more intellectual property theft, countering unfair trade practices (with tariffs) and strengthening our military rather than improving our posture to win the technology race. The CHIPS and Science Act and the Inflation Reduction Act, all passed by the Congress last year, are counterexamples and significant steps forward in investing in semiconductors, physical infrastructure and green

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[2] The White House, "National Security Strategy," October, 2022, p. 23.
https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf
[3] John Pomfret and Matt Pottinger, "Xi Jinping Says He Is Preparing China for War," *Foreign Affairs,* March 29, 2023.
https://www.foreignaffairs.com/united-states/xi-jinping-says-he-preparing-china-war
[4] Frank Tang, "What is China's dual circulation economic strategy and why is it important?" *South China Morning Post,* November 19, 2020.
https://www.scmp.com/economy/china-economy/article/3110184/what-chinas-dual-circulation-economic-strategy-and-why-it
[5] Graham Allison, "What Xi Jinping Wants," *The Atlantic,* May 31, 2017.
https://www.theatlantic.com/international/archive/2017/05/what-china-wants/528561/

technologies. These represent initial steps in crafting an industrial strategy that invests in ourselves and sets the conditions for winning the tech race.[6]

**What's needed now is an advanced industries strategy focused on the critical and emerging technologies where leadership in these technologies will determine the global economic contours for the next century.** An advanced industries strategy prioritizes government investments for research, provides incentives to engage and align the private sector, and coordinates government policy. Both the Trump and Biden Administrations have created similar lists of critical and emerging technologies which include semiconductors, artificial intelligence, advanced computing, biotechnology, hypersonics, space systems, and others (reproduced in Appendix A).[7] Of the 19 listed technologies, the private sector is leading in the research, development and fielding of 17 (almost 90%); only one is purely defense-oriented (directed energy: high-powered lasers or electromagnetic pulses) and one is only partially defense-oriented—hypersonics—since private companies are now developing hypersonic commercial air travel. The remaining 17 technologies are dual-use—of importance to both the military and to businesses and consumers. Given that these technologies are being led by the private sector, it is crucial that private sector incentives align with the national need to lead in these technologies. **However, too little has been done to set the conditions for technology leadership with coordinated government action and incentives which encourage academia and the private sector alignment to focus in these areas.**

Even without future investment, technology is already the cornerstone of the U.S. economy: nearly one-fifth of *all* private sector jobs in the U.S. economy (19%) are enabled by *just one segment of tech*—information technology (IT)—through direct employment, supplier jobs, or jobs made possible by IT. On average, IT jobs are growing twice as fast as those in the rest of the economy and pay 50% more.[8] The strength of our tech sector today, including the dominance of U.S.-based global platforms, results from government investment in the internet, miniaturized electronics and the Global Positioning System (GPS) begun a half century ago and now widely adopted throughout our economy. Disturbingly, however, the share of GDP of all advanced or high technology industries in the U.S. (excluding software) is only 80% of the global average whereas China is increasing its high-tech concentration and is 134% of the global average.[9] As a share of GDP, U.S. strength in advanced industries (other than software) has declined in the last

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[6] The issue is whether and how a democracy can compete with a powerful and efficient totalitarian state. The U.S. proved capable on a wartime footing during WWII. But this threat is more insidious since it's not just a military threat and the question is can we develop a coordinated strategy and investment plan in peace?

[7] National Science and Technology Council, "Critical and Emerging Technologies List Update"; Complete list reproduced in Appendix A. https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf

[8] Robert D. Atkinson, "How the IT Sector Powers the U.S. Economy," Information Technology and Innovation Foundation, September, 19, 2022. https://itif.org/publications/2022/09/19/how-the-it-sector-powers-the-us-economy/

[9] Robert D. Atkinson, "Assessing National Performance in the Competition for Advanced Industries," Information Technology and Innovation Foundation, June 8, 2022. https://itif.org/publications/2022/06/08/the-hamilton-index-assessing-national-performance-in-the-competition-for-advanced-industries/

two decades.[10] This is a direct result of the CCP's focus on increasing the technology share of its GDP through industrial policy versus the *laissez faire* approach of the U.S.

In this past decade, we have experienced many Sputnik moments, each of which should have spurred us to act:

- The Chinese spy balloon which traversed U.S. skies from January 28-February 3, 2022—not because of its technological achievement but its brazen disregard for our borders and sovereign airspace[11]
- China's hypersonic missile launch involving an orbital bombardment system which Chairman of the Joint Chiefs Mark Milley called a "near Sputnik moment" in August, 2021[12] since the U.S. does not have equivalent capability nor means to defend against it
- Two Chinese breaches of the U.S. government's Office of Personnel Management (OPM) in 2015 which stole sensitive personnel information from 21.5 million Americans including 18.9 million who had applied for security clearances[13]
- China's launch of more rockets into space than the U.S. in 2018, 2019, 2020 and 2021[14] including mankind's first landing on the far side of the moon with an operating rover[15]
- China's supercomputer lead as the world's fastest from 2016-2018, which has since been leapfrogged by IBM; however, China has since stopped sharing data on its supercomputers to assess which country has the fastest supercomputers[16]
- Through leading the rollout of 5G communications globally, Huawei's enabling CCP communications surveillance anywhere the equipment was installed—thwarted by coordinated efforts of the U.S. and our allies[17]
- And in March of this year, a study by the Australian Strategic Policy Institute concluded that the U.S. leads in only 7 of 44 critical technologies of the future while China leads in the rest;[18] in January, an Information Technology and Innovation Foundation (ITIF) study warned that China's innovation outputs and outcomes (science and engineering articles, international patents awarded, value added in many advanced industries, supercomputer production, industrial robot use and broadband subscriptions per household) already

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[10] *Ibid*.

[11] CBS News, "What We Know So Far About the Chinese Spy Balloon, February 20, 2023. https://www.cbsnews.com/live-updates/chinas-spy-balloon-unidentified-objects-shot-down-what-we-know-so-far/

[12] Gabriel Honrada, "Superheated Race for Hypersonic Supremacy," *Asia Times,* July 12, 2022. https://asiatimes.com/2022/07/superheated-race-for-hypersonic-supremacy/

[13] U.S. Office of Personnel Management Website, "Cybersecurity Incidents" https://www.opm.gov/cybersecurity/cybersecurity-incidents/

[14] Theresa Hitchens, "China Tops U.S. in Defense-Related Satellites Orbited in 2022: Report," *Breaking Defense,* January 6, 2023. https://breakingdefense.com/2023/01/china-tops-us-in-defense-related-satellites-orbited-in-2022-report/

[15] Andrew Jones, "1000 Days on the Moon; China's Chang'E 4 Hits Big Milestone," *Space News,* October 6, 2021. https://www.space.com/china-chang-e-4-moon-far-side-1000-days

[16] Coco Feng, "China's Supercomputer Sunway TaihuLight Falls to Sixth Place Amid Reluctance to Share Data over US Sanctions Fears," *South China Morning Post,* June 1, 2022. https://www.scmp.com/tech/big-tech/article/3180037/chinas-supercomputer-sunway-taihulight-falls-sixth-place-amid

[17] Melanie Hart and Jordan Link, "There Is a Solution to the Huawei Challenge," Center for American Progress, October 14, 2020. https://www.americanprogress.org/article/solution-huawei-challenge/

[18] Dr. Jamie Gaida, Dr. Jennifer Wong Leung, Stephan Robbin, Danielle Cave,"Critical Technology Tracker", Australian Strategic Policy Tracker, March 3, 2023. https://www.aspi.org.au/report/critical-technology-tracker; technologies and leaders reproduced in Appendix B.

exceed the U.S.[19]; a Harvard Kennedy School Belfer Center Study from more than a year earlier concluded that "In some races, it [China] has already become No. 1. In others, on current trajectories, it will overtake the U.S. in the next decade."[20]

Any one of these events *could have* been a Sputnik moment to stimulate a national strategy which is whole-of-government, bipartisan, and intended to last through multiple Administrations…but none has. The Biden Administration's policy to "invest, align and compete" outlined by Secretary Blinken[21] is a reasonable framework but does not provide the scale of investment, scope of alignment or set the conditions for the degree of competition required. We must prepare the American people for a multi-generational competition which will require larger investments in science and technology, investments to increase productivity for economic growth and engaging the private sector for building national capabilities. While there is a real possibility of military conflict in Taiwan, if deterrence is successful in averting this disaster, we will continue to be in a strategic competition with the PRC for decades to come. The U.S. government's role is to set the conditions for a successful outcome of that competition.

## What Does Winning Look Like?

Winning the tech race means the U.S. and its allies reverse the recent trends in technology leadership highlighted in several recent studies to restore American leadership in science and technology. Why is this important? The ability to innovate faster and better as well as scale innovations broadly so they fuel economic growth and productivity will likely determine the outcome of the great power competition between the United States and China.[22] In other words, just as important as increasing research is assimilating new technology across our economy to ensure we benefit from our investment in research.[23]

In previous eras where technology shaped geopolitics, it was a single technology that determined the outcome— such as the ability to produce bronze or harness steam power. In contrast, today, multiple technologies are being invented, adopted and adapted simultaneously with a benefit to the country that can invent and adopt on a broader base of cumulative technology.[24] "Rather than

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[19] Ian Clay and Robert D. Atkinson, "Wake Up, America: China Is Overtaking the United States in Innovation Capacity," January 23, 2023. https://itif.org/publications/2023/01/23/wake-up-america-china-is-overtaking-the-united-states-in-innovation-capacity/

[20] Graham Allison, Kevin Klyman, Karen Barbesino, Hugo Yen, "The Great Tech Rivalry: China vs. the U.S." Harvard Kennedy School Belfer Center for Science and International Affairs, December 2021. https://www.belfercenter.org/sites/default/files/GreatTechRivalry_ChinavsUS_211207.pdf

[21] Department of State, "The Administration's Approach to the People's Republic of China," May 26, 2022. https://www.state.gov/the-administrations-approach-to-the-peoples-republic-of-china/

[22] Eric Schmidt, "Innovation Power: Why Technology Will Define the Future of Geopolitics," *Foreign Affairs,* March/April 2023, p. 40

[23] This important distinction between research and assimilation of R&D in the economy is discussed by former Navy Secretary Richard Danzig in his remarks to the first meeting of President Biden's Council of Advisors on Science & Technology (PCAST), September 28, 2021. https://www.whitehouse.gov/ostp/news-updates/2021/10/01/readout-of-the-first-meeting-of-the-presidents-council-of-advisors-on-science-and-technology-pcast/ beginning at minute 35.

[24] To be accurate, multiple technologies have been utilized together to drive change: the combination of the cotton gin and the steamship changed the production and global delivery of cotton -or- the German use of *blitzkrieg* benefited from multiple existing technologies such as the airplane, the radio, and coordinated ground and air operations. However, today there are more combinations of technology driving more significant changes to our society than ever before.

natural resource wealth or mastery of a given technology, the source of a country's power now lies in its ability to continuously innovate."[25] And this ability arises "from clusters of scientists attracting, teaching and training other great scientists at research universities and large technology companies…But it also does so because innovation builds on itself…and relies on a feedback cycle that fuels yet more innovation."[26] Never before have we seen so many technologies used in combination; for example, AI, autonomy and space will be used together to create smart satellites and these will be powered by advanced semiconductors, computation and telecommunications capability. In human history, the benefits of technology leadership for economic growth or wielding military power have never been more rapid or more dramatic.

Winning the tech race would include the following dimensions and future outcomes:

- The U.S. and its allies are leaders in the critical and emerging technologies which will enable the formation of new advanced industries and create many high paying jobs.
- Congress has enacted laws to establish an advanced industries policy focused on the critical and emerging technologies, most of which have a dual use—of importance to the military as well as businesses and consumers. This industrial policy is in contrast to an overall economic policy that favors growth in any and all sectors or a competitiveness policy that favors growth in all sectors traded with other nations.[27] (The case for a *strategic* industrial policy favoring advanced industries as opposed to an economic growth or competitiveness policy is made in Appendix D; these are not mutually exclusive approaches but each has a different target with different implied policies.) An advanced industries policy would make the investments, align the incentives for the private sector and coordinate government policy to support U.S. and allied leadership in critical and emerging technologies.
- The U.S. economy continues to be the largest and among the most productive in the world since economic security is the best predictor of strong national security. At $17 trillion, China has the second largest economy in the world today compared to the U.S. at $23 trillion.[28] The U.S. should widen this lead through investments in productivity.
- Stronger alliances with allies and partners which enable the free flow of ideas, talent and capital among nations with like-minded interest in preserving the rule of law.
    - The combined GDP of the U.S. and its allies and partners is $50 trillion compared to the combined GDPs of China, Russia, North Korea and Iran at $19 trillion in a global GDP of $85 trillion.[29] The U.S. and its allies can wield a lot more economic power in combination than China can with its allies.

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[25] Schmidt, p. 41

[26] Schmidt, p. 44

[27] Robert D. Atkinson, "Computer Chips vs. Potato Chips: The Case for a U.S. Strategic Industrial Policy," Information Technology and Innovation Foundation (ITIF) paper, January 3, 2022.
https://itif.org/publications/2022/01/03/computer-chips-vs-potato-chips-case-us-strategic-industry-policy/

[28] Caleb Silver, "The Top 25 Economies in the World," *Investopedia,* September 1, 2022.
https://www.investopedia.com/insights/worlds-top-economies/

[29] *Ibid.*

    - These alliances reinforce democratic ideals such as freedom of speech, assembly, religion, a free press and basic human rights.
    - A Pan-Pacific defense and trading alliance exists building on AUKUS to include Canada and Japan with the strength of NATO's Article 5 provision for mutual defense and aiming to deter China from seizing Taiwan or other territory in Asia.
- Laws and enforcement actions prevent China from using our liberal, open society to strengthen its own technology base at our expense through stolen IP, cyber theft, industrial espionage and one-sided mercantilist trading relationships.
- A "free and open Indo-Pacific" forms the basis of peace and stability in the region and includes freedom of navigation, the rule of law, freedom from coercion, respect for sovereignty, private enterprise, and open markets, and the freedom and independence of all nations.[30]

While the government alone cannot make this future happen, the government is responsible for an integrated strategy that synchronizes policy choices across government and sets the conditions for the private sector and academia to align to the priorities of technology leadership, increased competitiveness and building of national capabilities.

Today, we have many examples of where we are not coordinated. At the U.S. Commerce Department's Bureau of Industry and Security (BIS), 70 export licenses have been approved representing $23 billion of revenue to U.S. companies for technology products exported to China. As another example, the FTC or DOJ does not explicitly consider national security as part of an antitrust agenda. Regulatory intervention beginning with the breakup of AT&T/Bell Labs struck a decisive blow in ending American strength in the critical telecommunications sector which would later be a weakness in competing with Huawei. In the private sector, companies still pursue growth strategies of penetrating Chinese markets even when these require joint ventures designed to transfer technology and where company executives acknowledge that short-term profits are being pursued to support current stock prices without regard to the long-term damage from intellectual property theft. Within the government and across the nation, we are only now beginning to prevent China from strengthening its technology base at our expense. However, more important than highlighting where we are not coordinated, winning the tech race requires a proactive, long-term competitive framework that goes well beyond the CHIPS Act.

## Five Pillars to Win the Tech Race

There are five pillars to a long-term framework designed to win the tech race with China centering around an advanced industries strategy to ensure the U.S. and its allies achieve leadership in critical and emerging technologies.

[30] Mark J. Valencia, "What Does a Free and Open Indo-Pacific Actually Mean?" *The Diplomat*, March 30, 2018. https://thediplomat.com/2018/03/what-does-a-free-and-open-indo-pacific-actually-mean/

1. **Communicate to the American people** the importance of the competition, its long-term nature and the investment required and associated budget tradeoffs. We must better ensure that the threat the CCP represents to our economy, our national security, and our ideals be well understood across the government, the private sector, and academia, namely, that we are in a strategic race every bit as threatening to our national security as the Soviet threat was; only with China, the competition is with a much more formidable economic power. To date and despite the many potential Sputnik moments, we have not galvanized public opinion as to the importance of this competition nor the consequences of losing. Too many believe, wrongly, that the United States will remain ahead in technology simply because we have since 1945. We have to raise the profile of what's at stake and what will be required to prevail in a multi-generation competition: primarily investing in ourselves and leveraging American strengths of competitiveness and innovation for the future. On the other hand, we advance our interests through our actions and not our rhetoric. The worst outcome would be to elevate a hawkish China sentiment without making the hard choices or doing the hard work implementing the remaining four pillars of this framework.

2. **Create a comprehensive advanced industries strategy—**through Executive Branch actions and legislation—to ensure U.S. leadership in basic science and applied research in —*as well as widespread adoption of*—the critical and emerging technologies. China has prioritized technology development as critical to its rising economic growth and military capability. In the Chinese model, the government subsidizes a chosen company to be a winner or national champion representing China's interests globally such as Baidu does for artificial intelligence (AI). The U.S. cannot expect an uncoordinated *laissez faire* approach will be successful when competing with a country that has a larger population, a well-articulated industrial strategy and consistent, large investments in that strategy. In contrast to the Chinese model, the U.S. should focus on the critical and emerging technologies (not specific companies) with policies to ensure that we lead in the technology. In other words, a U.S. or an allied company is the leader in that technology as a result of competitive forces—not because the government designated a particular company as a winner. A rigorous domestic competitive environment trading freely with allies is the best means to ensure that a U.S. or allied company emerges as the technology leader. Such an advanced industries strategy would, in itself, have several components:

    a. **Investment in basic science, applied research, engineering and technology adoption**: increasing federally-funded R&D to 2% of GDP annually—its historical high point from the 1960s and up from the current 0.35% of GDP invested for national security; this is an investment of more than 7X the CHIPS Act, or $400 billion *annually*. This investment for our future is necessary because

the government is the only source of long-term, risk-seeking capital that can afford to pursue breakthrough technologies which can change the nature of the competition. The U.S. cannot lead in critical and emerging technologies if we are not leading in the basic science and applied research that create the technologies. While some might expect the private sector to make these investments, company CEOs and venture capitalists are more focused on shorter-term time horizons and increasingly so since the 1980s as a result of the shareholder revolution.[31] "The rise of venture capital helped accelerate adoption and commercialization [of new technologies], but it did little to address higher-order scientific problems."[32] Government investments to address scientific problems can result in the creation of new industries, companies that create global platforms and millions of high-paying jobs just as they have for the past seven decades. But we must go beyond increasing research to provide incentives for companies to apply innovations at scale and manufacture advanced technology products in the United States. "Without technology diffusion [throughout the economy] as a key element of a national industrial policy, research universities, government agencies, and corporations may allow the United States to lead the world in breakthroughs in basic science and technology, but the benefits in wealth and power will be gained by other countries, including military rivals."[33]

b. **Talent development** to ensure we have the educated and trained labor force to capitalize on leadership in new technologies. Even with the planned investments of semiconductor firms benefiting from the CHIPS and Science Act, one of their concerns is that, as a result of globalization, there are not enough educated workers to design and manufacture advanced chips. We must develop more scientists, researchers, engineers and technicians (or STEM workers—those skilled in science, technology, engineering and mathematics) to leverage our increased investment in science and technology development. This will require both an increase in STEM education, particularly at the college and graduate level, as well as immigration reforms to encourage more global talent to contribute to our economy. "The U.S. boasts the world's top startups, incumbent companies, and universities, all of which attract the best and brightest from around the world."[34] We can improve our policies to ensure this remains a strong positive for the U.S. in the tech race with China.

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[31] Mark S. Mizruchi and Howard Kimeldorf, "The Historical Context of Shareholder Value Capitalism," *Political Power and Social Theory,* Volume 17 (2005), pp. 213-221. https://scholar.harvard.edu/files/dobbin/files/mizruchi2005a.pdf

[32] Schmidt, p. 47

[33] Michael Lind, "Past Lessons on Diffusing New Technologies," *The American Conservative,* April 6, 2023. https://www.theamericanconservative.com/past-lessons-on-diffusing-new-technologies/

[34] *Ibid,* p. 49

c. **Economic statecraft** to ensure coordinated government policies that mutually reinforce one another. Given the government's size and complexity, it's difficult to achieve mutually reinforcing policies and actions as we did in the Cold War through a multi-Administration, bipartisan commitment to a containment policy that thwarted the ambitions of the Soviet Union. In particular, the political-military tools are concentrated in the Departments of Defense and State while the geoeconomic tools are diffused across the federal government and the private sector. Adding complexity, Congress controls the spending priorities of all of these Departments. The closest form of a coordinating body is the National Security Council although it was created in the Cold War primarily for a military threat. There is a separate council—the National Economic Council— created to coordinate domestic economic policy, with only limited oversight of international economic policy, depending on the priorities of the Director.[35] However, the strategic competition with China requires that we align our policies across all departments and agencies to ensure U.S. leadership and economic growth in critical and emerging technologies, gains in economic competitiveness, and support across the globe for our values. If all our agencies and departments were aligned with an advanced industries strategy and directed to reinforce these five pillars of a long-term framework, there would be much clearer guidance as to priorities and reinforcing policies across the federal government.

d. **Align trade policy** to strengthen allied development of technology and create trading and growth opportunities for U.S. companies. We need to encourage trade among allies and partners who also view China as a pacing adversary rather than an economic opportunity: lowering trade barriers and encouraging development of allied markets as growth opportunities for our companies. This creates a powerful trading bloc which is triple the size of China's economy and may form the basis of a new world trading organization which can act as a counter to the attractiveness of China's market. This trading bloc should raise the trading costs of importing technology products from China and exporting technology to China to deny the CCP further advantages from its mercantilist policies.

e. **Leverage the Defense Department**'s buying power to shape the industrial base for markets where it can still lead such as autonomy, space infrastructure and green energy. In the Cold War, the Defense Department was an early adopter of new technologies (like semiconductors) which allowed these industries to achieve scale, cost declines and subsequent penetration of commercial markets. There is an opportunity again for the Defense Department to create a strong industrial base

[35] Michael Brown, Eric Chewning and Pavneet Singh, "Preparing the United States for the Superpower Marathon with China," Brookings AI and National Security Series, April 2020.https://www.brookings.edu/research/preparing-the-united-states-for-the-superpower-marathon-with-china/

relative to China through early investment and adoption in these technologies but today we are not on that path.

3. Fully engage the private sector by providing **long-term incentives in the U.S. capital markets.** Long-term incentives will encourage companies to pursue investments with longer payoffs, that may involve more risk but are also more likely to develop national capabilities. Two 50-year-long trends have reinforced short-term incentives within corporations: globalization and the shareholder revolution (valuing shareholders above and instead of other stakeholders). Globalization based on Ricardian economic principles achieves great results if we assume full-employment economies (jobs lost through trade are easily replaced) as well as free and fair trading relationships in a world of allies. Neither of these are real-world outcomes as we've seen through the continued migration of U.S. manufacturing jobs to China since it joined the WTO in 2001.[36] Similarly, we've seen the limits of corporations' focus on short-term shareholder value which encourages short-term results and thinking. With the increase in institutional ownership of companies, companies increasingly focus on current financial returns since institutional investors hold stocks for less than one year (compared to eight years in the 1950s).[37] Actors in our capital markets such as activist investors and private equity firms also have shorter investment time horizons than long-term owners and encourage CEOs to use company cash flow to buy back stock and optimize for quarterly earnings-per-share (EPS) rather than investing in long-term R&D. In the last decade alone, $3.8 trillion has been spent by corporations in buying back their own shares rather than investing in long-term capabilities.[38] As a result, leading companies have eliminated corporate R&D labs (such as Bell Labs which invented the transistor and IBM which invented the disk drive, automated teller machines (ATMs) and dynamic random access memory (DRAM)). To optimize financial returns, companies have also increasingly shed hardware product lines—instead focusing on software and services—and shed manufacturing which, in turn, means losing supporting supplier infrastructure. We did not realize that we were also shedding design capability and high-paying jobs that would not be replaced. In a world without strategic competitors, exclusive focus on shareholder value *does* optimize financial outcomes in the short term. However, another consequence of this approach in a world with adversaries is dangerous dependence on supply chains from countries, like China, which use economic power coercively. In the pandemic we discovered our dependence on antibiotics from China—97% sourced from China—and pharmaceutical ingredients—80% sourced from China.[39] Imagine if the PRC had not

[36] Clyde Prestowitz, *The World Turned Upside Down: China, America and the Struggle for Global Leadership,* Yale University Press, New Haven and London, January 2021.
[37] Ryan Beck and Amit Seru, "Short Term Thinking Is Poisoning American Business," The New York Times, December 21, 2019, https://www.nytimes.com/2019/12/21/opinion/sunday/capitalism-sanders-warren.html.
[38] Jerry Useem, "The Stock-Buyback Swindle," The Atlantic, August 2019, https://www.theatlantic.com/ magazine/archive/2019/08/the-stock-buyback-swindle/592774/
[39] Yanzhong Huang, "U.S. Dependence on Pharmaceutical Products From China," Council on Foreign Relations, August 14, 2019, https://www.cfr.org/blog/us-dependence-pharmaceutical-products-china.

enforced a lockdown in the early days of the pandemic, how much more domestic demand in China there would have been for pharmaceutical ingredients or protective gear; there is little doubt that China would have prioritized its own domestic use rather than exports to the U.S. To give another example, our dependence on rare earth minerals—where China controls 85% of the processing[40]—is also concerning since these minerals are required to manufacture automobiles, high-end electronics and defense materiel. To reverse these trends, we need to bring better balance to these two trends of globalization and short-term shareholder value: aligning our trade policy with our national strategy and modifying the incentives in our capital markets to better balance our long-term national interests. In contrast, China's corporations are aligned with its long-term interests through the CCP's representative member of the management team, execution of the PRC's well-articulated industrial policy, such as *Made in China 2025,* and relief from delivering short-term profitability. From a macroeconomic standpoint, China's private sector is not as capital efficient as the U.S. but the PRC's incentive system with its long-term focus has advantages in achieving technological breakthroughs. Certainly, to the extent that the U.S. does not change its capital market incentives to focus longer-term, there is an even stronger need for the government to invest in federally-funded R&D to ensure that longer-term payoff, higher risk projects are funded.

4. **Invest in productivity growth and U.S. infrastructure** (as begun with the Bipartisan Infrastructure Law as well as the Inflation Recovery Act) to widen the gap between the size of our GDP and China's. McKinsey estimates there is $10 trillion of growth in the U.S. economy (an astounding 40% of the size of today's economy) available through productivity improvement.[41] To counter the trends towards stagnating productivity growth and increase the opportunity to grow a larger U.S. economy (relative to China), we need a larger, more educated and more highly-trained labor force. "Since 2005, U.S. labor productivity has grown at a lackluster 1.4 percent [about half its historical average since World War II]. At the same time, real wages have slowed and workforce participation has declined."[42] To spur labor productivity, we need to reconcile the differences across geographies and sectors in the U.S. where productivity rates vary widely. Sectors employing digital technologies have moved ahead and left industries behind such as manufacturing, real estate, utilities, food services and healthcare. Incentives in these lagging industries to spur the use of digital technologies and to make capital investments would likely increase productivity. Additionally, reskilling workers to newer, growing industries like energy transition or cybersecurity would ease worker shortages. We also need to ensure that improvements in the U.S. capital stock leverage

[40] Schmidt, p. 47

[41] Charles Atkins, Olivia White, Asutosh Padhi, Kweilin Ellingrud, Anu Madgavkar, and Michael Neary, "Rekindling U.S. Productivity Growth for a New Era," *McKinsey Institute Report*, February 16, 2023.
https://www.mckinsey.com/mgi/our-research/rekindling-us-productivity-for-a-new-era

[42] *Ibid.*

these labor investments and make additional investments in broadly-defined infrastructures: regional or sectoral clusters focused on a particular technology, supplier clusters to support new industries, and research consortia supporting new technologies.[43] A historical example is SEMATECH formed in 1987 as a public-private partnership with 14 U.S.-based semiconductor manufacturers to solve common manufacturing problems for advanced chips. Another would be NASA's Commercial Orbital Transportation Services (COTS) program to coordinate the development of vehicles for the delivery of crew and cargo to the International Space Station by private companies at great savings to taxpayers.[44] There is much we can learn about how to optimize the results of such public-private partnerships but history has proven that regional or sector clusters that include talent and suppliers both stimulate new firms and increase the widespread adoption of new technologies as it has in Silicon Valley. As Nobel-prize winning economist Paul Krugman has said, "Productivity isn't everything, but in the long run, it's almost everything."[45]

5. **Increase the asymmetric strength of U.S. allies and partners** in a global coalition that creates economic and technological advantage for each other. This would be a new rules-based international order for nations that support the rule of law both within countries and globally. We have long recognized that the asymmetric advantage for the U.S. in great power competition *is* our network of allies and partners. The scale of this network relative to China is the only practical way to influence China's behavior economically, diplomatically and militarily. With the scale we would jointly bring as allies, we can coordinate on technology research to avoid duplication, share the costs of higher investment and measure our progress relative to China. Importantly, we should also create a trading bloc which encourages trade among allies in these technologies to build market opportunities for allied firms and discourage joint ventures with China which are ultimately mechanisms to transfer intellectual property. With partners, we can rebuild supply chains to eliminate Chinese-controlled choke points and develop alternatives to China for low cost manufacturing such as Mexico, Vietnam and India. Finally, we can collaborate to offer project financing for developing countries which can be an alternative to the punitive debt loads of the CCP's Belt and Road strategy and, in doing so, attract an even greater set of allies and partners.

These five pillars comprise what would be required to *win* the tech race—not necessarily what's feasible politically. Underlying these pillars are 30 specific recommendations that could be implemented as a subset or in different combinations rather than in their entirety.

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[43] Gregory Tassey, "Why the U.S. Needs A New, Tech-Driven Growth Strategy," Information Technology and Innovation Foundation, February 2016. https://www2.itif.org/2016-us-tech-driven-growth-strategy.pdf

[44] NASA COTS Final Report, May 2014. https://www.nasa.gov/content/cots-final-report

[45] McKinsey Chart of the Day, February 16, 2021. https://www.mckinsey.com/featured-insights/sustainable-inclusive-growth/chart-of-the-day/productivity-isnt-everything-but-in-the-long-run-it-is-almost-everything

## Most Important Tools To Use and Investments To Make Now

(30 Recommendations—included as Appendix C—are summarized here)

To better communicate the tech race and what's required to win, we will not only need the traditional tools of government like speeches and Congressional hearings but must prioritize passing legislation and executive actions that will shape the tech race. There are clear budget trade offs required with so much proposed investment for research and commercialization of emerging technologies. Taxpayers must be informed about what we are investing in and why as well as what we cannot afford to fund. Separately, we must also lead a cultural shift to engage Americans in this race: celebrating the Americans and their achievements in science and technology to give visibility to those who are helping win the race and encourage more Americans to do so just as we celebrated the astronauts during the first space race.

The key investments to implement a winning advanced industries strategy would be three-fold:
(1) increase federal spending on R&D to emphasize basic and applied research for longer-term and higher risk projects which also strengthens our world-class academic institutions,
(2) increase the talent base of U.S. citizens studying STEM fields and enable more foreign students with STEM skills to work in the U.S., and
(3) create a critical technology industry fund, modeled after the CHIPS Act, for building or expanding R&D and advanced production facilities in the United States. To complement these steps, we need a reinforcing trade policy which keeps tariffs in place for Chinese technology goods and eases tariffs for non-strategic industries (commodities like lumber and textiles). To make our trade policy more effective, we should harmonize our policies with our allies and partners including our investment screening process—led by the Committee on Foreign Investment in the U.S. (CFIUS)—and implement an outbound screening process (reverse CFIUS) so U.S. investment is not funding the modernization of the PLA. If we fail to harmonize our policies with allies, we simply forego U.S. sales of products which China will buy from allies. Along with our allies, we should also make it easier for national trade representatives to deny markets to Chinese companies which benefit from mercantilism, industrial espionage or cyber theft as well as reform laws making it easier to sue Chinese companies in U.S. courts.

Additionally, Congress can make better use of export controls by directing the Commerce Department's Bureau of Industry Security to consider expanding the controls used for semiconductors to other critical and emerging technologies. Given its buying power, the Defense Department can also play a larger role in investing in the emerging technologies where it remains the principal customer such as with creating space-based infrastructure (rocket launches, small satellites, space-based communications, etc.), fielding autonomous vehicles (in air, on the ground, on the ocean surface and underwater) and deploying clean energy (both energy-saving technology as well as fossil fuel alternatives). This is the role defense played during the first

space race which created so many spillover economic benefits for commercial industry. Lastly, given the complexity of developing and maintaining a well-articulated industrial strategy, we should create a new Assistant to the President position reporting to both the NSC and NEC Directors who can ensure effective implementation of this strategy.

To fully engage and align the private sector in the tech race, we need to change the incentives in our capital markets to lengthen our investment horizons and focus on critical technologies. We can do this by creating differentiated tax rates for the R&D tax credit and the capital gains rates to reflect increased benefits for investment where we need it—in the critical and emerging technologies—and for holding investments longer. We should also ask the SEC and the business community to develop performance metrics (in addition to quarterly earnings) that highlight longer-term capability development or the productivity of R&D. Today, the capital markets discourage long-term investments and riskier projects since these expenses reduce quarterly earnings per share.

To set the conditions for a more productive and faster growing U.S. economy, we should implement policies that increase the labor force participation rate, upgrade skill levels to fill the higher technology jobs we anticipate being created and subsidize workers learning new skills enabling them to move to growing industries. We should further stimulate productivity improvements with incentives to invest in capital equipment and adopt new technologies, especially for those industries with lagging productivity. Additionally, we should continue to make infrastructure investments in our transportation sector and ports, those that support emerging technologies such as research consortia or supplier clusters, and those that facilitate digital transformation such as investments in smart cities, smart manufacturing or smart agriculture. As we make these investments, we need to reduce the regulatory and permit burden which is prohibitive to both high tech and capital-intensive industries. Consequently, when companies move offshore to benefit from environmental arbitrage by moving their manufacturing to locations without environmental controls, the U.S. loses on two fronts: losing the high tech industries and exporting harmful pollution elsewhere on our planet.

To increase the asymmetric strength of our allies and partners, we should consider formalizing a strong Pan-Pacific treaty alliance, building on AUKUS and adding additional countries such as Canada and Japan. The purpose of this alliance would be both mutual defense reinforced by interoperable capabilities and a stronger allied defense industrial base but also a trading bloc to expand markets. With our allies, we can coordinate on major research priorities to share—rather than duplicate—technology development, ensure stronger participation in international standards bodies, rebuild supply chains (to reduce our dependence on Chinese antibiotics or rare earths processing, for example) and offer alternative investment programs and vehicles to compete with China's Belt and Road Initiative to support developing countries. These efforts should be aimed

at making our vision of a "free and open Indo-Pacific" a reality by increasing our ties with more developing nations in the region.

Now is the time to make these investments and establish the long-term framework to ensure the U.S. wins the tech race. Thirty specific actions which support this framework are included as Appendix C. The alternative is to lose the tech race—as is already happening in many specific technologies—with negative consequences for our economic prosperity and national security.

## What Does Losing a Tech Race Look Like?

*Three years ago,* China was already leading the U.S. in the deployment of hypersonics, small drones, quantum communications, 5G, facial recognition software using AI, e-commerce and mobile payments (with 700 million internet users), electric vehicles, clean power technology (wind and solar), high-speed rail, and the world's largest database of genetic engineering data. Since then, China has increasingly challenged the U.S. in AI, quantum computing, quantum sensors and other critical and emerging technologies.[46] China's goal is clear:  in Xi's own words, "catch up and surpass" the U.S.[47]

The importance of a dual-use tech race—of importance to commercial industry as well as the military—can be illustrated in the communications sector's transition from the 3rd generation (3G) to the 4th generation (4G) where the U.S. maintained its technology lead, in contrast to the subsequent transition to 5G where China strove to undermine that lead and threaten the security of global communications. Through its technology leadership, the U.S. introduced 4G and LTE network services in 2008 featuring data transfer rates of 10 times those of 3G by leveraging IP (internet protocol) networks enabling video and mobile applications. The introduction of 4G contributed to 70% revenue growth in the wireless industry (2011-2014) and increased jobs by more than 80%. By leading this race, the U.S. built a global ecosystem of network providers, device manufacturers and app developers which, in turn, created an economic boom.[48] Mobile wireless is indicative of the first-mover advantage where the leader—or first mover—enjoys a network effect by setting the foundational infrastructure and specifications for future products.

The 5G transition will further improve network speeds and reduce latency to enable applications such as autonomous vehicles and other Internet of Things (IoT) capability such as AI-powered health care. Supported by the CCP as a national champion with subsidies of land and capital from the government, Huawei attempted to displace the U.S. in the transition from 4G with an early lead in deployments of 5G base station hardware. Huawei further aimed to use 5G in

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[46] Brown, *et al, p. 9*

[47] Julian Baird Gewirtz, "China's Long March to Technological Supremacy," Foreign Affairs, August 27, 2019, https://www.foreignaffairs.com/articles/china/2019-08-27/chinas-long-march-technological-supremacy.

[48] Milo Medin and Gilman Louie, "The 5G Ecosystem: Risks and Opportunities for DoD," (Arlington, VA: Defense Innovation Board, April 3, 2019), https://media.defense.gov/2019/Apr/03/2002109302/-1/-1/0/ DIB_5G_STUDY_04.03.19.PDF.

replacing U.S. and European telecommunications infrastructure both to benefit economically (as the U.S. did in the 4G race) and enable the military capabilities of global surveillance, denial-of-service to adversaries, and reduced latencies for military IoT applications like swarming drones.[49] Were Huawei to succeed at leading the 5G transition, the CCP would not only have access to spy on global communications but China would capture tremendous economic benefits by creating a *Chinese* ecosystem of network providers, device manufacturers and app developers. The PLA would benefit by having a first-mover advantage with access to new military technologies such as more capable autonomous systems like swarming drones.

If China succeeds in its plans for industry dominance of critical and emerging technologies as outlined in *Made in China 2025* and *China Standards 2035,* then it will capture trillions of dollars in economic output, the U.S. and its allies will become dependent on China for a host of new technologies critical for economic development and national security such as quantum computing and cryptography, advanced computing, advanced telecommunications, synthetic biology and more. China's coercive power will grow and the U.S. economy will be limited in its growth potential with a reduced number of high-paying jobs linked to these new technologies. China would like to leverage such success to overtake the overall U.S. economy in size and limit it to concentration in sectors such as financial services, agriculture and low-skill services. U.S. military leadership would also decline due to both technological disadvantages and lower affordability. Consequently, we would find ourselves making large trade-offs in our international security posture such as whether we could afford to maintain freedom of navigation operations in the Western Pacific, uphold our treaty obligations or defend Taiwan. Inevitably and eventually, the U.S. military would have to retreat to principally defending the homeland. This military outcome would be accelerated were the U.S. to lose a war to China in defending Taiwan. In that scenario, the U.S. military may be weakened permanently and our place in the world would be diminished as our Pacific allies question how reliably we can protect them which, in turn, would force a realignment of relationships favoring the PRC.

## Conclusion

Creating a multi-year framework to win the tech race with China is an ambitious goal but required to meet the threat that China represents to the collective interests of not only our nation but all nations committed to democratic principles and the rule of law. While we have had many potential Sputnik moments to spur us to create this framework, none has galvanized our government to act. Our actions to date are moving us in the right direction but are piecemeal and slow. We cannot afford the consequences of waiting longer for China to gain more relative advantage technologically, economically or militarily. As the National Security Strategy cautions us, "The world is now at an inflection point. This decade will be decisive, in setting the terms of

[49] Daniel Araya, "Huawei's 5G Dominance in the Post-American World," Forbes, April 5, 2019, https:// www.forbes.com/sites/danielaraya/2019/04/05/huaweis-5g-dominance-in-the-post-american- world/#6296c64d48f7.

our competition with the PRC…If we do not act with urgency and creativity, our window of opportunity to shape the future of [the] international order and tackle shared challenges will close."[50] The creation of the Select Committee on the Strategic Competition Between the U.S. and the CCP represents the beginning of a bipartisan body working together to enact a comprehensive strategy.

We have a historic opportunity to establish the framework for a long-term strategy:

1. **Communicate to the American people** the stakes and investments required.

2. **Create a comprehensive advanced industries strategy**—through Executive Branch actions and legislation—to ensure leadership in basic science, applied research for and widespread adoption of the critical and emerging technologies throughout our economy.

3. Fully engage the private sector by providing **long-term incentives in U.S. capital markets.**

4. **Invest in productivity growth and U.S. infrastructure** to widen the gap between the size of our GDP and China's.

5. **Increase the asymmetric strength of U.S. allies and partners** in a global coalition that creates economic, technological and security advantage for its members.

These five pillars will set the conditions for the U.S. to win the tech race with China which is already underway.

[50] The White House, "National Security Strategy," pp. 12-13

## List of Appendices

A: National Science & Technology Council's Critical and Emerging Technologies List (2022)
B: Australian Strategic Policy Institute's Critical Technology Tracker (2023)
C: Framework: Most Important Tools To Use and Investments to Make (30 Recommendations)
D: The Need for Strategic Industrial Policy
E: Criticisms of Strategic Industrial Policy
F: About the Author

## Appendix A:

### Critical and Emerging Technologist List Update (2022)[51]

The following critical and emerging technology areas are of particular importance to the national security of the United States. (*Author provided the color coding*)

- Advanced Computing
- Advanced Engineering Materials
- Advanced Gas Turbine Engine Technologies
- Advanced Manufacturing
- Advanced and Networked Sensing and Signature Management
- Advanced Nuclear Energy Technologies
- Artificial Intelligence
- Autonomous Systems and Robotics
- Biotechnologies
- Communication and Networking Technologies
- Directed Energy
- Financial Technologies
- Human-Machine Interfaces
- Hypersonics
- Networked Sensors and Sensing
- Quantum Information Technologies
- Renewable Energy Generation and Storage
- Semiconductors and Microelectronics
- Space Technology and Systems

Blue = Technology led by the private sector
Red = Technology led by the defense sector (Defense Department labs + defense primes)
Black= Technology led primarily by the defense sector but with commercial uses

## Appendix B:

[51] National Science and Technology Council, "Critical and Emerging Technologies List Update"; Complete list reproduced in Appendix A. https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf

## Australian Strategic Policy Institute Critical Technology Tracker (2023)[52]

Table 1: Lead country and technology monopoly risk.

| Technology | Lead country | Technology monopoly risk |
|---|---|---|
| **Advanced materials and manufacturing** | | |
| 1. Nanoscale materials and manufacturing | China | high |
| 2. Coatings | China | high |
| 3. Smart materials | China | medium |
| 4. Advanced composite materials | China | medium |
| 5. Novel metamaterials | China | medium |
| 6. High-specification machining processes | China | medium |
| 7. Advanced explosives and energetic materials | China | medium |
| 8. Critical minerals extraction and processing | China | low |
| 9. Advanced magnets and superconductors | China | low |
| 10. Advanced protection | China | low |
| 11. Continuous flow chemical synthesis | China | low |
| 12. Additive manufacturing (incl. 3D printing) | China | low |
| **Artificial intelligence, computing and communications** | | |
| 13. Advanced radiofrequency communications (incl. 5G and 6G) | China | high |
| 14. Advanced optical communications | China | medium |
| 15. Artificial intelligence (AI) algorithms and hardware accelerators | China | medium |
| 16. Distributed ledgers | China | medium |
| 17. Advanced data analytics | China | medium |
| 18. Machine learning (incl. neural networks and deep learning) | China | low |
| 19. Protective cybersecurity technologies | China | low |
| 20. High performance computing | USA | low |
| 21. Advanced integrated circuit design and fabrication | USA | low |
| 22. Natural language processing (incl. speech and text recognition and analysis) | USA | low |
| **Energy and environment** | | |
| 23. Hydrogen and ammonia for power | China | high |
| 24. Supercapacitors | China | high |
| 25. Electric batteries | China | high |
| 26. Photovoltaics | China | medium |
| 27. Nuclear waste management and recycling | China | medium |
| 28. Directed energy technologies | China | medium |
| 29. Biofuels | China | low |
| 30. Nuclear energy | China | low |
| **Quantum** | | |
| 31. Quantum computing | USA | medium |
| 32. Post-quantum cryptography | China | low |
| 33. Quantum communications (incl. quantum key distribution) | China | low |
| 34. Quantum sensors | China | low |
| **Biotechnology, gene technology and vaccines** | | |
| 35. Synthetic biology | China | high |
| 36. Biological manufacturing | China | medium |
| 37. Vaccines and medical countermeasures | USA | medium |
| **Sensing, timing and navigation** | | |
| 38. Photonic sensors | China | high |
| **Defence, space, robotics and transportation** | | |
| 39. Advanced aircraft engines (incl. hypersonics) | China | medium |
| 40. Drones, swarming and collaborative robots | China | medium |
| 41. Small satellites | USA | low |
| 42. Autonomous systems operation technology | China | low |
| 43. Advanced robotics | China | low |
| 44. Space launch systems | USA | low |

[52] Gaida, Jamie, et al. Australian Strategic Policy Institute, 2023, *Policy Brief: ASPI's Critical Technology Tracker: the Global Race for Future Power*, https://www.aspi.org.au/report/critical-technology-tracker.

## Appendix C:

## Most Important Tools To Use and Investments to Make: 30 Recommendations

Communication

1. Provide a budget and ask for the President to communicate through a variety of media the importance of the competition, the consequences and what's required for the U.S. to win
2. Ask Congressional leadership to prioritize the competition with China in scheduling legislative votes and in communicating Congress' priorities which is an opportunity for bipartisan leadership on an issue which unites the American people
3. Consider ways to recognize the contributions of Americans in science, technology and industry who contribute to U.S. leadership in these areas; we must change our culture to value and celebrate these achievements more than Tik Tok influencers, billionaires and sports stars. For example, we should ensure there is an award each year for the National Medal of Technology and Innovation which was established in 1985 but last awarded in 2014.[53]

Strategic Industrial Strategy

4. Increase federally-funded R&D to 2% of GDP through a revived Endless Frontiers Act which would provide ~$400 billion for basic research in the named emerging and critical technologies as well as strengthen our world-class academic institutions (up from ~$80 billion R&D dedicated to national security fields and $80 billion for health-related fields)
5. Promote the growth of STEM talent for the future at the primary and secondary educational level through work with the States; create more opportunities for those STEM graduates at the graduate university level at universities, government labs and in private industry (through incentives to hire and educational loan forgiveness)
6. Create a series of moonshot goals for each of the critical and emerging technologies; initiate prize challenges for these moonshots and celebrate those who are the researchers and inventors of these breakthroughs
7. Reform our immigration laws specifically to ensure the most savvy technical talent across the globe comes to the U.S., found new ventures and contribute to U.S. GDP. *This may be the single highest impact action that does not have significant budget tradeoffs.*
    a. Dramatically increase the H1-B visa program
    b. Eliminate limits on immigration of tech savvy talent from anywhere in the world (including China) with an appropriate increase in counter-espionage resources for the FBI

[53] United States Patent and Trademark Office website
https://www.uspto.gov/learning-and-resources/ip-programs-and-awards/national-medal-technology-and-innovation/recipients

c. Provide automatic green cards for foreign students with masters and PhD students in STEM fields

8. Create a Critical Technology Industry Fund (CTIF), which would provide incentives to companies in emerging and critical technology industries "and be matched by state and local governments, for building or expanding R&D and advanced production facilities in the United States. This would be similar to the incentives program in the Creating Helpful Incentives to Produce Semiconductors (CHIPS) Act, but it would be applied to a broader set of advanced industries. U.S.-headquartered firms, as well as firms from allied nations, would qualify for incentives. Ideally, Congress would provide at least $25 billion per year, to be matched dollar-for-dollar by state and local governments. To ensure that the investments are widely distributed geographically, there could be limits on how much each state could receive in matching funds for their incentives, based on their share of the U.S. population. This program should be run by the Department of Commerce…These kinds of capital-focused incentives are critical because U.S. capital markets today reward firms that take an asset-light strategy. In other words, firms are pressured by Wall Street to shed capital assets to boost returns on net assets. All too often, the firms that keep or grow capital assets are foreign. We see this in the semiconductor industry where the United States leads in the fabless sector of the market, but lags in the capital-intensive fab sector. Absent a serious overhaul of the U.S. equity markets, providing incentives to invest in assets such as buildings, machinery, and equipment will be needed to restore U.S. production in capital-heavy advanced industries."[54]
9. Keep tariffs in place on technology products with China; eliminate other tariffs, especially those in commodities, such as lumber and textiles
10. Committee on Foreign Investment in the U.S. (CFIUS): harmonize U.S. investment screening with allies to ensure that it's more costly for China to circumvent our restrictions on investing in or buying IP or assets which have national security implications; enact legislation to create a "reverse CFIUS" process to screen U.S. investments in China prohibiting those that assist China's development of technologies and especially those that support the PLA modernization.
11. Require the FTC and Department of Justice to explicitly consider national security when ruling on antitrust interventions so we do not inadvertently harm critical technology industries or provide a scale advantage in competing for global markets to an adversary such as the PRC.
12. Enact legislation to prohibit Chinese companies to sell into U.S. markets if they benefit from IP theft or industrial espionage; amend the Foreign Sovereign Immunities Act (FSIA) to require that Chinese companies participating in U.S. markets are subject to the jurisdiction of U.S. courts; accordingly, make it easier to sue Chinese companies in the

[54] Robert D. Atkinson, "Assessing National Performance in the Competition for Advanced Industries," Information Technology and Innovation Foundation, June 8, 2022. ITIF calls this an "Advanced Industries Technology Innovation Fund" but it has the same meaning as a CTIF. https://itif.org/publications/2022/06/08/the-hamilton-index-assessing-national-performance-in-the-competition-for-advanced-industries/

U.S. by requiring Chinese companies participating in U.S. markets to place assets here which can be attached by court order[55]

13. Reform the 1930 Tariff Act, Section 337 to enable the U.S. Trade Representative to enable stronger use of the U.S. International Trade Commission's (USITC) Section 337 statute to exclude goods and services from China supported by systemically unfair trade practices. "Section 337 needs several critical updates to be an effective tool for addressing unfair Chinese trade practices. For example, Section 337 does not discuss forced technology transfers, closed domestic markets, subsidies, or other unfair practices. It should. Ideally, Congress would make it clear that these and related unfair trade practices are eligible for Section 337 investigations, but only against companies from non-market, non-rule-of-law economies. In addition, exclusion orders should be able to be issued not against a particular product (e.g., 12-inch steel pipe) but instead on all products or services from a firm in a non-market, non-rule-of-law economy found to have benefited from unfair trade practices. Section 337's critical "injury" standard should also be removed. It should be irrelevant if the domestic company is harmed in the here and now. The point is that unfair practices should not be rewarded, period."[56]
14. Direct the Commerce Department's Bureau of Industry & Security (BIS) to be more aggressive using the authorities of the Export Control Reform Act of 2018 related to critical and emerging technologies as we have already done with semiconductors; export controls should be harmonized with allied policies to avoid loss to the U.S. economy without achieving their objective of preventing exports to China. To effectively execute this mission, BIS would need to recruit talent with more technology expertise (likely from industry) and Congress would need to fund an expansion of this office.
15. Provide the Defense Department more flexibility in budgeting such as colorless, multi-year funding for adopting critical and emerging technologies; eliminate the need for requirements prior to acquisition of commercial items and encourage the use of Other Transaction Authority to emphasize speed and flexibility for these purchases just as Congress created in 1958 to respond to the Sputnik launch
16. Given the complexity of developing and maintaining an articulated industrial strategy, create accountability for this efforts through a new Assistant to the President position reporting to the NSC Director and the NEC Director.

[55] For a complete listing of recommendations to reduce obstacles to successful litigation and to incentivize U.S. companies to bring meritorious suits, see United States Air Force Office of Commercial Economic Analysis Summer Studies, "Study I - Great Power Competition in the 21st Century: Understanding the Critical Elements," September 2017.

[56] Nigel Cory and Robert D. Atkinson, "A Reformed Section 337 Is the Tool for USTR to Mitigate China's Unfair Trade Practices," Information Technology and Innovation Foundation, March 8, 2023. https://itif.org/publications/2023/03/08/a-reformed-section-337-is-the-tool-for-ustr-to-mitigate-chinas-unfair-trade-practices/

Long-term Incentives for Capital Markets

17. Provide larger (up to 50%) and permanent tax credits for R&D in our critical and emerging technologies compared to those throughout the economy; we should differentiate this tax credit for those developing quantum computing relative to those developing advertising targeting systems or dating apps
18. Provide a better capital gains tax benefit for truly long-term investments, say more investments held more than 5 years and a higher benefit for 10 years
19. Require the SEC to establish long-term company performance metrics which correspond to capability development rather than simply focusing on earnings per share (EPS) on a quarterly basis; one example might be the percentage of sales from products introduced in the most recent 3 years to highlight the velocity of new product introductions. To change CEOs behavior, we cannot simply call for increased patriotism, we have to change the incentives and metrics by which they are measured.
20. Create tax penalties for short-term actors in our capital markets
    a. Owners of assets sold within one year; this type of tax was recommended by the economist James Tobin to slow transactional trading in currencies but could easily be applied to short-term sales of stocks[57]
    b. Prohibition of private equity firms from distributing dividends to themselves in <3 years after acquiring a company which often leave companies with too much debt and not enough cash to service interest on loans
    c. Activist investors who buy and sell company equity within a single year and ask management to make structural changes for short-term gains

Productivity Investment

21. Develop a national productivity strategy to stimulate economic growth through "incentives, including tax policies, to encourage organizations to adopt new tools to drive productivity; policies to spur the advance and take-up of systemic, platform technologies that accelerate productivity across industries; a research and development strategy focused on spurring the development of productivity-enabling technologies such as robotics; and sectoral productivity policies that reflect the unique differences between industries." [58]
22. Create incentives to increase labor rate participation (especially among aging baby boomers, women with children and men without college degrees) and upgrade skill levels; subsidize reskilling to move workers into new industries
23. Create incentives for private sector investment in capital equipment and implementing new technologies, especially those in lagging sectors. For example, we could restore the

[57] Matthew Watson, *Encyclopedia Britannica*. https://www.britannica.com/topic/Tobin-tax

[58] Robert D. Atkinson, "Think Like an Enterprise: Why Nations Need Comprehensive Productivity Strategies," Information Technology and Innovation Foundation, May 2016. https://www2.itif.org/2016-think-like-an-enterprise.pdf

ability to deduct capital equipment in the first year which most affects three industries: information, manufacturing and professional, scientific and technical services which, together, account for 90% of private R&D investment in the U.S.[59] We should reduce the regulatory and permitting burdens on high tech and capital-intensive industries to ensure they can support new R&D and manufacturing plant investments to enable speed and reduce costs to companies.

24. To complement the recent investment in broadband access across the U.S., consider additional investments in U.S. infrastructure especially transportation, ports and enablers of digital transformation such as smart cities, smart manufacturing and smart agriculture.

Asymmetric Strength of Allies and Partners

25. Create a new Pan-Pacific Alliance that builds on AUKUS but creates a stronger and more formal treaty alliance (with a NATO Article 5 provision for mutual defense) that includes Canada and Japan; this will serve as a deterrent to Chinese military action against our allies. This alliance should aim to develop interoperable capabilities across the partners and remove current constraints to sharing investment dollars, resources, IP, talent and manufacturing for joint projects.
26. Create a forum for our most important allies and partners to coordinate in a plan for technology dominance and measure our position relative to China (as the Australian Strategic Policy Institute has done)
27. Coordinate investment among allies to avoid duplication and amplify efforts so that our allies share the investment and also the economic benefits of technology leadership
28. Strengthen allied participation in international standards setting bodies to counter the *China Standards 2035* initiative
29. Re-build supply chains in the U.S. and with allies to reduce or eliminate dependencies on China for choke points in raw materials as well as manufactured goods; this requires financial incentives for companies consistent with what the CHIPS Act does for semiconductors
30. With allies, offer stronger alternatives to China's Belt and Road initiatives that do not overly burden development countries with debt they cannot repay as the U.S. has done with the G7 in the Partnership for Global Infrastructure and Investment

[59] Ian Clay, "Key Industries Most Affected by Elimination of Full Expensing of R&D Activity," Information Technology and Innovation Foundation, January 17, 2023
https://itif.org/publications/2023/01/17/key-industries-most-affected-by-elimination-of-full-expensing-of-rd-activity/

## Appendix D:

### The Need for Strategic Industrial Policy[60]

By Robert D. Atkinson, President, Information Technology and Innovation Foundation

In today's new realpolitik world, no advanced nation can do without a strategic-industry policy, unless it wants to put its national and economic security in the hands of foreign powers. As such, the most important economic question for the U.S. government is whether and to what degree it should seek domestic strength in key advanced industries. If policymakers answer that in the negative, then there is no need for a revised industrial strategy, or perhaps not even for a broader competitiveness policy.

This gets to a key point: There is a difference between economic policy writ large, competitiveness policy, and strategic-industry policy. (See table 1 below.) At the broadest level, economic policy is about ensuring steady growth of the U.S. economy. This can involve a wide array of policy tools, including education, a well-functioning intellectual property system, fiscal and monetary policy for full employment, a sensible tax system, and others. While some on the left appear to have rejected growth as a goal in favor of redistribution, most policymakers still embrace economic growth and the broad policies required to facilitate it. Overall, growth policy does not concern itself with particular industries, technologies, or capabilities. In fact, most economists see any sectoral-focused policies as downright harmful.

The most important economic question for the U.S. government is whether and to what degree it should seek domestic strength in key advanced industries.

At the next level is competitiveness policy, which focuses on ensuring the strength of U.S. traded sectors (industries that compete in global markets), but beyond that is industry- and technology-agnostic. Competitiveness policy is focused on maintaining strong terms of trade, even if the exporting industries are natural-resource-based or services and not complex and technology driven. In this framing, the United States should, relative to its imports, export enough to prevent its trade deficit from getting too large. If the way to do that is through pork bellies, tourism, and wastepaper exports, then that's fine (exports are exports).

While some neoclassical economists, such as Paul Krugman, still deny that nations compete economically with each other, increasingly, the center of gravity of elite opinion acknowledges that the United States is in serious economic competition with the rest of the world, especially China, and endorses some kind of competitiveness policy. But many stop short of embracing a strategic-industry policy, instead favoring policies such as better and more trade agreements, a more globally competitive tax code, and broad investments in skills and research, all steps that are needed.

**Table 1: Typology of growth and competitiveness policies**

| Type of Policy | | Focus of Policy |
|---|---|---|
| Economic Growth | → | All Sectors |
| Competitiveness | → | Traded Sectors |
| Strategic Industries | → | Critically Important Traded Sectors |

[60] Robert D. Atkinson, "Computer Chips vs. Potato Chips: The Case for a U.S. Strategic Industrial Policy," Information Technology and Innovation Foundation (ITIF) paper, January 3, 2022. https://itif.org/publications/2022/01/03/computer-chips-vs-potato-chips-case-us-strategic-industry-policy/

Unfortunately, in the world the United States finds itself in, competitiveness is not enough. The United States could eliminate its trade deficit by increasing wastepaper, agricultural, and oil exports. But that would do nothing to reduce key dependencies, especially in critical advanced technology sectors.

Even many who understand that competitiveness policy must have some focus on advanced industries remain committed to industry and technology agnosticism out of fear of committing the cardinal sin of "picking winners." Note how the globalists at the Peterson Institute described industrial policy: "We define industrial policy as government intervention against market forces to promote a favored firm or industry." Heaven forbid! Going against market forces? This is clearly a step too far! According to this view, as long as the economy is relatively competitive and has some advanced industries that do well globally, the competitiveness challenge has been addressed.

Unfortunately, in the world the United States finds itself in, competitiveness is not enough.

In a world of technologically strong allies, perhaps that generic competitiveness policy could be acceptable. As long as China does not invade Taiwan, the United States can remain dependent on Taiwan for much of its semiconductor production. (And, while it's clearly worrying to contemplate, it does not appear that the U.S. government is seriously evaluating the former scenario, envisioning the consequences it would have for the U.S. economy and national security, or beginning to imagine needed contingency plans.) And as long as our European and Asian allies don't cave in to Chinese pressures—which we see regularly through the practice of "wolf-warrior" diplomacy—they presumably will continue to sell to America whatever it needs.

But if we believe we don't live in that world, but rather in a world where economic and national security depend on the United States having adequate capacity in particular industries and technologies, then a generic competitiveness policy will not suffice.

For example, a world in which the United States is dependent on foreign nations for semiconductors is a world in which the United States has significantly reduced degrees of freedom. Clearly, if China were to dominate global semiconductors, it could withhold key exports from the United States as a foreign policy tool, or in the case of armed conflict between the two nations, China would be able to cripple the U.S. economy and significantly limit our ability to produce weapons for war. Moreover, if China were ever to lead in semiconductors, then any Chinese technology company using semiconductors, which is to say all of them, since semiconductors are the brains of every device from vehicles and airplanes to appliances and solar panels, would be positioned to enjoy first-mover advantage in such technologies.

There are a wide array of critical industries beyond such narrow weapons-based industries as armaments in which the United States must be able to maintain innovation and production leads. As the Department of Defense's (DOD's) Office of Industrial Policy points out, these include, among others, advanced materials, drones, autonomous systems, artificial intelligence (AI), quantum computing, biotechnology, energy storage systems, lasers, optical equipment, space technology, machine tools, shipbuilding, and advanced wireless systems. Overall, strategic industries are in traded sectors where the ability to restore lost production would be time-consuming and technically difficult.

Only a strategic-industry policy can ensure that the "right boats" are lifted. Therefore, while a generic, non-industry-focused competitiveness policy might very well help many of these industries regain or maintain domestic competitiveness—assuming the competitiveness policy is adequately funded and effectively implemented—it would not necessarily help all, or even the majority, of the most-critical industries for American strength. Competitiveness policy raises the tide to lift boats, but it doesn't raise them all adequately. And the most important boats might still be at the bottom of the ocean. Only with a strategic-industry policy that identifies key industries and technologies required for U.S. security, continually monitors U.S. and foreign capabilities for

innovation and production, and implements specific policies to ensure these sectors' domestic health can the federal government ensure that the "right boats" are lifted.

To be clear—and to respond to complaints from free-market globalists—this does not mean embracing autarky. Today's advanced economy is simply too complex for any nation, even one as big and technologically sophisticated as the United States, to be self-sufficient. Moreover, allies are still allies that can mostly be counted on in crunch time to support each other. And global trade, even with China, cannot and should not be stopped.

But it does mean that the United States cannot be indifferent to its industrial and technology mix, and that the magic of the invisible hand will not automatically produce an adequate outcome. In other words: Computer chips, potato chips—there is a huge difference.

To understand what "strategic-industry policy" entails, it's important to first note what it doesn't entail. It doesn't mean favoring U.S. firms exclusively over allied nations' firms that produce or perform research in the United States. It almost never means picking industries in which the United States has almost no capabilities and then trying to create those capabilities from scratch. And it doesn't mean picking some individual firms over others in the same sector or technology as "winners."

First and foremost, it entails identifying industries in which the United States must have adequate capabilities to be globally secure. Second, it means analyzing the strengths and weaknesses of both each industry in the United States and U.S. policies affecting those industries. Finally, it means identifying the correct policy interventions to spur competitive strengths, such as direct funding for production (as the CHIPS Act proposes), targeted incentives to attract investment to the United States, support for industry-led research and development (R&D), streamlining regulatory systems (including considering the effect of antitrust actions on the industry), developing focused education and skills programs, and other sectoral interventions.

It is time for a fundamentally new approach to U.S. economic policy, one that recognizes the need for two separate and distinct economic policy approaches—one for the non-strategic sector and one for the strategic sector.

This bifurcation between the broader national economy and the narrow military economy meant that economic policy was also bifurcated, with virtually all of the economy governed by free-market principles (albeit, supplemented by business cycle policies and a growing welfare state), while the narrow defense sector was to be government-led with much of the work performed by private defense contractors. The wellbeing of the broader industrial base, even the dual-use base, was seen as something that would take care of itself through market forces, capitalist incentives, and America's inherent entrepreneurial spirit. It could and should thrive on its own without specific policies. The fact that the only competitors to the U.S. advanced-industry commercial base were allies, such as Europe and Japan, helped blunt any calls for strategic-industry policy.

But the world is now fundamentally different. Indeed, it is almost impossible to overstate the implications of this new development—the U.S. defense sector's dependence on the broader commercial advanced-industry sector and the challenge to that sector from China—on how policymakers and scholars should conceptualize the role of government and markets. It is time for a fundamentally new approach to U.S. economic policy, one that recognizes the need for two separate and distinct economic approaches; one for the non-strategic sector and one for the strategic sector.

## Appendix E:

## Criticisms of Strategic Industrial Policy[61]

By Robert D. Atkinson, President, Information Technology and Innovation Foundation

There are several criticisms that are usually made of the assertion that the United States needs a strategic-industry policy.

**Criticism 1: Yes, there are strategic industries, especially for defense, but DOD can manage the defense industrial base.** To be sure, while some products that go into U.S. weapons systems are designed and built solely by specialized defense contractors, many others are derived from a strong advanced dual-use technology production system. As DOD's Office of Industrial Policy wrote with respect to China, military-civilian fusion "means there is not a clear line between the PRC's civilian and military economies."

This is also true in America, where most weapons systems rely at least somewhat on dual-use U.S. commercial providers. For example, DOD's trusted foundries produce only a fraction of the semiconductors needed for weapons systems (largely those that are designed by DOD itself or their contractors). But the vast majority of computer chips are bought straight from the commercial market. As the Office of Industrial Policy writes: "Support for a vibrant domestic manufacturing sector, a solid defense industrial base, and resilient supply chains is a national priority." A strong commercial sector is critical to getting the scale economies needed to support innovation and low costs. Moreover, emerging technologies, including advanced materials, AI, clean energy, biotechnology, hypersonic and directed-energy technologies, metamaterials, quantum technologies, robotics, semiconductors (including beyond Complementary Metal Oxide Semiconductor [CMOS] technology), and advanced computing are needed for the third offset, and will rely to a significant extent on commercial sector capabilities.

**Criticism 2: Strategic-industry policy means picking winners and losers.** This criticism never really says why this is bad, implying that everyone knows government should not do this kind of thing. But let's be clear: Even the most heavy-handed industrial policy proposals never involve picking losers—they usually don't even involve picking winners, if that is defined as trying to identify and help the firm(s) that will best succeed. Given that just 4 percent of venture deals end up earning 10 or more times the cost of the original investments, and 65 percent lose money, it's clear that picking winning firms is difficult.

The goal is not to identify and support the firms that will see the biggest equity appreciation, it's to identify and support the industries and technologies that are critical to the nation's military and economic functioning. Moreover, good strategic-industry policy does not involve picking specific firms as national champions (unless those firms are the only players in their respective critical industries) or narrow technologies to support (e.g., lithium-ion batteries) in large part because of the risk of picking the wrong firms or specific technologies. Rather, it focuses on key industries and technologies (e.g., semiconductors and AI).

**Critique 3: Industrial policy has largely failed in the past, so it will fail in the future.** Painting the history of industrial policy as a failure clearly undercuts support for it. But virtually all critiques of past industrial policy come from organizations or scholars committed to finding that industrial policy has not worked, as opposed to neutral scholars. As such, they make a number of methodological and logical errors.

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[61] Robert D. Atkinson, "Computer Chips vs. Potato Chips: The Case for a U.S. Strategic Industrial Policy," Information Technology and Innovation Foundation (ITIF) paper, January 3, 2022.
https://itif.org/publications/2022/01/03/computer-chips-vs-potato-chips-case-us-strategic-industry-policy/

One iconic study often referred to is Linda Cohen and Roger G. Noll's 1991 book The Technology Pork Barrel. It and related studies make several errors. First, they see almost any rate of project failure as an indictment of industrial policy. Yet, the whole point of government involvement is to take risks the private sector won't. If government projects never fail, then they are being too cautious.

Second, many of the critiques, such as the "Pork Barrel," base their assertion that all government projects fail on an analysis of certain failed projects, not a random selection of all projects.

Third, the critics imply that policy and organizational learning is zero. Yet, as innovation economists Richard Lipsey and Ken Carlaw have documented, not only is there a long history of industrial policy success, particularly tech-related policies, but lessons from success and failures have been distilled and many governments incorporate them into program design and execution.

Fourth, some studies use dubious measures of success, such as jobs saved. In many cases, the result should actually be fewer, not more, jobs if the industry being helped is boosting labor productivity.

Fifth, some dismiss the concept of essential industries, arguing that it can be abused, such as when one study suggested that brown cows in Switzerland could be identified as an essential industry.

Sixth, critics assert that measures such as countervailing duties against unfair foreign subsidies for certain industries (e.g., steel) did not make U.S. industry more competitive. But that lack of increase could very well be because the duties imposed were not high enough or in place early enough to effectively counter unfair subsidies. And in some cases, such as with solar companies devastated by massive Chinese subsidies in the 2000s, countervailing duties arrived too late to save most of the industry. Or they criticize measures that were not really industrial policies at all, such as when a Peterson institute report claims that solar tax credits failed to advance the international competitiveness of the solar panel manufacturing industry. In reality, the reason they didn't advance is, unlike in China, U.S. credits applied to both imported and domestic panels.

Finally, the critiques often employ selective methodologies to identify the failures. A recent Peterson Institute study rightly notes the Department of Energy's (DOE's) funding of the Solyndra Corporation as a failure. But it also notes that the overall loss rate of the DOE Loan Program Office (which funded Solyndra) is under 3 percent (a very good rate), noting the goal is for the government to take some higher risks. Nonetheless, Solyndra is emblematic of pervasive failure.

**Critique 4: A strategic-industry policy will be politicized.** According to this critique, the whole enterprise is so politicized that most funding will be wasted. At one level, this is a strange critique because all government policy is politicized; it comes from our democratic political process. But what it really means is that, somehow, narrow political interests will distort policy and it will not be effective. But again, this fails to account for the fact that many strategic-industry programs, such as the former Advanced Technology Program operated by the National Institute of Standards and Technology or the current Manufacturing USA program, are not politicized and are run by professionals.

Perhaps a more relevant critique is that, once it becomes legitimate to identify industries as strategic, every industry will lobby for that status—e.g., "the beer industry is strategic!" If these neoclassical critics of strategic-industry policy really want to make a contribution, then they should focus on identifying the right and wrong aspects of policy and program design and push Congress and the administration to implement policy the right way.

Many strategic-industry programs, such as the former Advanced Technology Program operated by the NIST or the current Manufacturing USA program, are not politicized and are run by professionals.

## APPENDIX F: About the Author

### Michael Brown

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Michael Brown is a visiting scholar at the Hoover Institution of Stanford University and a partner at the dual-use venture capital firm, Shield Capital.

Michael previously served four years (2018-2022) as the Director of the Defense Innovation Unit (DIU), U.S. Department of Defense. DIU fields leading-edge commercial capabilities to the military faster and more cost-effectively than traditional defense acquisition methods. During his tenure, DIU introduced 100 new vendors to DoD, fielded 50 new capabilities to the military, and increased the transition rate of fielded capabilities to 50%. He also led the initiative for a new Defense Department-sponsored investment vehicle, National Security Innovation Capital (NSIC) to fund dual-use hardware technology companies.

From 2016 to 2018, Michael served as a White House Presidential Innovation Fellow. There, he co-authored a Pentagon study on China's participation in the U.S. venture ecosystem, a catalyst for the Foreign Investment Risk Review Modernization Act (FIRRMA). FIRRMA was signed into law in August 2018 and provided expanded jurisdiction to the Committee on Foreign Investment in the United States (CFIUS).

Prior to civil service, Michael was the CEO of Symantec Corporation (2014-2016), the global leader in cybersecurity and the world's 10th largest software company. He is also the former Chairman and CEO of Quantum Corporation (1995-2003) and Chairman of EqualLogic (2003-2008).

Michael received his BA degree in economics from Harvard University and his MBA degree from Stanford University.