



## INTRODUCTION

The Information Technology and Innovation Foundation (ITIF) is an independent, nonpartisan research and educational institute focusing on the intersection of technological innovation and public policy. As the world's leading science and technology policy think tank, ITIF's mission is to formulate and promote policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress.

The Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act of 2022 represents a tremendous step forward toward renewed U.S. industrial competitiveness, science and technology leadership, and restoring the United States as a world-leading location for semiconductor fabrication.<sup>1</sup> While U.S. innovators created the integrated circuit and U.S. industry long-dominated global semiconductor production, the U.S. share of global semiconductor production has fallen from 37 percent in 1990 to 12 percent today, a 70 percent decline.<sup>2</sup> U.S. enterprises have also fallen off the leading-edge in logic semiconductor fabrication.<sup>3</sup> As of May 2021, the United States commanded only 4.7 of the global market share for manufacturing semiconductor memory chips and just 15.9 percent for logic chips.<sup>4</sup>

The CHIPS Act commits a roughly \$50 billion investment designed to catalyze long-term growth in the domestic semiconductor industry in support of America's national and economic security.<sup>5</sup> Implemented effectively, the CHIPS Act represents a once-in-a-generation opportunity to restore U.S. leadership in all phases of semiconductor production—from tooling and semiconductor manufacturing equipment (SME) to the design; fabrication; and assembly, testing, and packaging (ATP) of the semiconductor chips themselves. ITIF herewith responds to selected questions on DoC NIST's request for information on Implementation of the CHIPS Incentives Program.

## ITIF RFI RESPONSES

### Use of Grants, Loans, and Loan Guarantees

1. *The Department may allocate up to \$6 billion out of the \$39 billion of total incentives to support loans and loan guarantees to covered entities. This \$6 billion has a significant multiplier effect: the principal amount of financing available through loans and loan guarantees could be leveraged to support up to \$75 billion in loans and loan guarantees. This leverage will help the CPO achieve the needed scale of investment by facilitating additional private capital and providing access to debt for companies with reasonable prospects for repayment.*
2. *How should CHIPS financial assistance (grants, loans and/or loan guarantees) be designed to be additive to, rather than a substitute for, private sector equity or debt capital?*

The Department of Commerce should tie CHIPS investment incentives in part to state government incentive grants. In making decisions on applications, DoC should identify to what extent the company has opportunities to build capacity outside of the United States, and consider the cost differentials semiconductor manufacturers face when making globally mobile investment decisions.

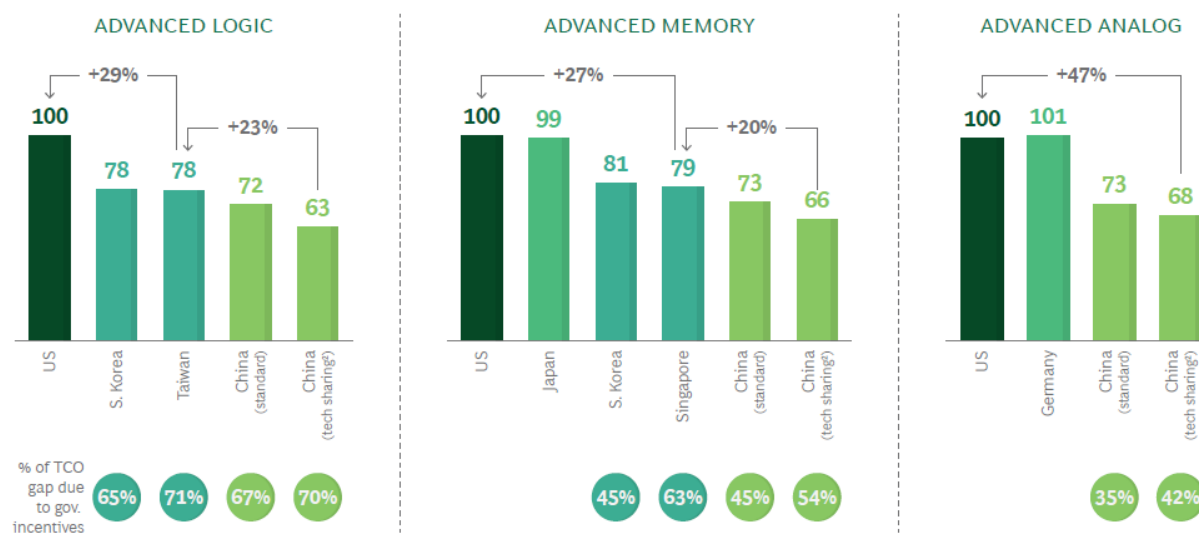
3. *What information is available on how foreign and domestic companies engaged in semiconductor manufacturing or suppliers to that industry evaluate whether to invest in a discrete project—for example, through internal rates of return (IRR)? Do evaluations and IRRs differ by producer, project, technology, or segment of industry?*
4. *What debt/equity ratios have semiconductor manufacturers or suppliers used in previous projects that are individually financed?*
5. *Does the industry, including foreign and domestic firms, finance semiconductor manufacturing or supplier investments on a limited recourse or nonrecourse project finance basis? What proportion of investments are financed this way?*

6. How does access to debt and capital markets differ for companies across the semiconductor sector? Which parts of the sector struggle to access debt and equity capital?

Questions 1-6 generally appear to misread the central challenge facing the U.S. semiconductor sector, which is the significant cost differential that exists in launching and operating fabs in the United States as compared to in competitor nations. The central focus of the CHIPS Incentive Program should be to address this significant cost differential that exists between building and operating a semiconductor fabrication facility in the United States vs. other competitor nations around the world. In other words, semiconductor companies don't face a financing challenge (they can generally attract the financing they need, so access to capital is not the challenge); rather the challenge regards the cost differential: when launching a fab in the United States costs so much more than it does in other countries, it can be difficult for executives to justify citing a fab in the United States as opposed to locating it elsewhere. Government-provided loans or loan guarantees would do virtually nothing to reduce the cost-gap challenge; only grants will do that. Thus, the core issue is whether semiconductor fab investments make sense given the cost structure of the United States.

And, frankly, other countries have been and remain willing to subsidize the building of semiconductor fabs, whereas the United States has largely not, and this explains a large share of the U.S. decline. Indeed, many countries help companies defray the high costs of building a fab, with incentives that reduce up-front capital expenditures on land, construction, and equipment and that can also extend to recurrent operating expenses such as utilities and labor. Foreign government incentives may offset from 15 to 40 percent of the gross total cost of ownership (pre-incentives) of a new fab, depending on the country.<sup>6</sup> In fact, the 10-year total cost of ownership (TCO) of U.S.-based semiconductor fabs is 25 to 50 percent higher than in other locations, with government incentives accounting for 40 to 70 percent of the U.S. TCO gap.<sup>7</sup> (See **Error! Reference source not found.**)

Figure 1: Estimated 10-year TCO of reference fabs by location (U.S. indexed to 100)<sup>8</sup>



For instance, from 2000 to 2020, Korea provided roughly \$7 to \$10 billion in government subsidies for semiconductors, including for infrastructure support, equipment incentives, and workforce training. Going forward over the next decade, Korea's K-belt strategy calls for \$450 billion in semiconductor-sector investments, supported by tax benefits and credits, low-rate loans, and manufacturing incentive investments.<sup>9</sup> Key elements of Korea's strategy include a program of 40 to 50 percent tax credits for chip R&D and 10 to

20 percent tax credits for facility investments.<sup>10</sup> Japan’s Ministry of Economy, Trade, and Industry will provide 70 billion yen (\$500 million) in subsidies as part of its semiconductor strategy compiled last year.<sup>11</sup> Japan’s manufacturers (including of semiconductors) will also benefit from the multiple billions of dollars the Japanese government will provide in manufacturing technology incentives and decarbonization subsidies over the course of this decade. Also over the course of this decade, Taiwan will be on course to provide some \$27 billion in R&D and foundry expansion subsidies to the sector. In September 2022, India announced a \$25 billion semiconductor investment scheme.<sup>12</sup> The European Chips Act promises €43 billion (\$44.5 billion) in “policy-driven investment” up to 2030.<sup>13</sup> The R&D and innovation ‘pillar’ of the European Chips Act will amount to roughly €11 billion (\$11.4 billion), with most of the rest going to subsidies to attract chip manufacturers. Individual European countries are launching their own semiconductor sector investment strategies as well; for instance, reported German government subsidies for a new Intel foundry in Magdeburg alone are €6.8 billion (\$7 billion).<sup>14</sup>

Of course, all this is dwarfed by China, whose semiconductor industry has been the recipient of over \$170 billion worth of government subsidies from the National IC Plan, which China has used both to stand up entirely new companies from scratch (such as semiconductor memory manufacturer Yangtze Memory Technology Corporation (YMTC)) and to finance the acquisition of foreign competitors.<sup>15</sup> An Organization for Economic Cooperation and Development (OECD) study of 21 international semiconductor companies from 2014 to 2018 found that Chinese companies received 86 percent of the below-market equity provided by all governments assessed.<sup>16</sup> State subsidies accounted for slightly over 40 percent of Semiconductor Manufacturing International Corporation’s (SMIC) revenues over this period, 30 percent for Tsinghua Unigroup, and 22 percent for Hua Hong.

The bottom line is this: because of this intense competition, if a nation wants to maintain or expand its semiconductor production it must pay for it.<sup>17</sup> To date, the United States has not been willing to do that, and it has paid the price, with the U.S. share of global semiconductor manufacturing falling by 70 percent, as noted.

Thus, loans or loan guarantees won’t solve the challenge, which is not financial in nature (and so the concern isn’t about federal dollars being a substitute for private capital) but rather about addressing the significant cost differential, and so it requires actual grants/incentives to address. As such, the Chips Program Office (CPO) should consider applications for CHIPS Incentive packages almost like a reverse auction, examining all the applicants and selecting the projects willing to make the biggest capital investment in the United States with the lowest request for federal grants. But it must realize that to ensure that the United States wins the global race for semiconductor investment—especially fabs—subsidies, not financing, are the key.

#### *Financial Assistance for Upstream Suppliers and Materials Used To Manufacture Semiconductors*

7. *For purposes of this set of questions, the upstream supply chain refers to companies that provide materials (including minerals, chemicals, slurries, gases, photomasks, photoresists), equipment, or other inputs (including specialized services) for the semiconductor manufacturing process. Which elements of the upstream supply chain could constrain the ability to expand domestic semiconductor production? For example, if U.S. semiconductor production were to increase by 30%, would suppliers be able to keep pace? Please specify in terms of categories like industrial gases, raw materials, specialty chemicals, wafers, photoresists, and/or photomasks.*

In general, the CHIPS Incentive program should be concerned with stimulating greater investment in more and larger-scale semiconductor fabs in the United States, in logic, memory, and analog alike. In fact, U.S. semiconductor fabs on average are only about one-half the scale of an Asian fab.<sup>18</sup> Attracting large-scale semiconductor fabs should be viewed as “the tip of the spear” in recapturing greater U.S. share of global semiconductor manufacturing, because if America can attract the fab, then not only will a wide variety of

downstream suppliers be more likely to follow, they'll be financially healthier from the economic opportunity that flows therefrom. That's why the vast majority of CHIPS funds should be targeted at the highest level to attracting the largest-scale semiconductor fabs.

Now, to be sure, one of the strengths of the Asian semiconductor manufacturers broadly (e.g., Samsung in Korea or TSMC in Taiwan) is that key suppliers often have their production facilities located geographically close to major fabs, bringing cost efficiencies and innovation and learning advantages that help drive some of the lower-cost manufacturing advantages they've enjoyed. The United States will need to develop such a deep networks of localized semiconductor suppliers. Indeed, one of the challenges of restoring U.S. leadership in semiconductor manufacturing will be revitalizing a deep network of Tier 2 and Tier 3 suppliers making needed tools, chemicals/substrates, photoresists, lithography equipment, etc., and so this is where some firms in the supply chain may face genuine financial/capital constraints, and so this is where it would be more prudent to consider the use of loans/loan guarantees where the financial structure of supplier firms may be more tenuous. But the focus should be not to dilute scarce funding on a wide array of projects along the supply chain, but to focus on Tier 1 fabs that will form the nucleus of a revitalized American semiconductor ecosystem.

### Expansion Clawbacks

*15. The Secretary has authority, in consultation with the Secretary of Defense and the Director of National Intelligence, to define the terms "semiconductor manufacturing" and "semiconductor manufacturing capacity." To ensure effective limits on manufacturing in foreign countries of concern—while balancing the interests of potential eligible CHIPS applicants that may have existing legacy facilities—what types of activities would need to be included under the scope of these terms? How do industry members define the terms in trade usage?*

*16. What considerations are relevant in determining what memory, analog, packaging, and other technologies should be considered equivalent to 28 nm logic chips?*

*17. Given the complexities in chipmakers determining where their product might eventually reach its enduse, how can the CPO best enforce the requirement that a proposed investment "predominately serve[s] the market" of the foreign country?*

Most of the questions 16-18 again miss the broader point. There is limited opportunity for semiconductor capital expenditure (CapEx) investment to be made globally. Companies will expand to meet expected demand. The only real question is where that investment will be. The United States does not have the leverage it once had. U.S. policymakers must recognize that the United States has gone from being a "price maker" to a "price taker" in the competition for globally mobile investment in advanced-technology industries (whether semiconductors, aircraft, biopharmaceuticals, or clean energy technologies). In other words, corporations now shop the globe to find the countries with the most attractive markets—based on direct subsidies, corporate tax rates, R&D tax credit generosity, workforce talent, availability of digital infrastructure, and the presence of technology clusters, among other factors—in which to locate their R&D, design, production, and management activities and establishments.<sup>19</sup> Countries have to get all these aspects of their business, regulatory, and innovation policy environment right to attract investment. And in many sectors, it is subsidies that play the key deciding factors.

Put simply, competition among governments has become a critical factor in determining global market share amongst nations. As former NIST chief economist Greg Tassej argues, "The potential exists for competing nations to create comparative advantage through technology and thereby shift relative prices and ultimately incomes in their favor. Purely private-sector reallocations based on relative prices (the neoclassical approach) will result in a relentless decline in an economy's share of global income, as other economies with public-private investment strategies more rapidly and efficiently innovate and acquire dominant market shares."<sup>20</sup>

For the U.S. economy, the implication is that the United States has become a large state—in the sense that a large share of the economy is now traded—and it competes against other nations, the way U.S. states have had to compete for investment since the end of WWII. In other words, the United States as a nation has to compete vigorously to attract globally mobile investments, delivering incentive packages where it must and broadly implementing a wide range of factors to offer fertile innovation ecosystems.

The point is: semiconductor companies don't have to invest in the United States, and if the United States makes it extremely difficult to also invest in China with overly broad restrictions, there will be less demand for investment here. Enterprises will instead invest in other nations with better incentives and fewer restrictions. Many policymakers may argue that this is not fair or that the United States should not engage in such a “race to the bottom.” This is frankly naive. Absent a global and binding agreement limiting industrial subsidies, including on China, this competition is robust and here to stay. As such, if the U.S. government wants to win this competition, it's limited on the kinds of restrictions and requirements it can place on semiconductor companies. It is not a “monopsony buyer” any more.

### Taxpayer Protections

*18. The CPO has committed to prioritizing companies that are dedicated to making investments in manufacturing, innovation, and workers. Are there types of investments and/or pre-commitments that data suggest have been most effective in promoting inclusive economic growth for workers and communities?*

With regard to the previous point, while inclusive growth is certainly an important concern for the United States, with regard to determining the allocation of CHIPS Act incentives, this is far from the most-important factor to be considered. The United States is locked in a fierce competition for global semiconductor leadership, and the focus first and foremost should be on attracting more activity in the semiconductor value chain, and especially semiconductor production, to the United States. The entire focus should be on narrowing the cost gap between the United States and foreign competitors, full stop, not on attaching a host of social policy goals to this one-time opportunity to restore critical U.S. semiconductor capabilities. There are a host of other programs and tools (such as the recently enacted regional innovation hubs, an ITIF proposal) that are better positioned to help achieve these social policy goals.<sup>21</sup>

*19. The CPO intends to preference companies which commit not to engage in stock buybacks with non-CHIPS funds. What terms and length should the CPO seek in such a commitment and should the commitment extend to any forms of capital distribution beyond buybacks? What types of existing buyback programs or programs tailored to prevent dilution from the award of employee stock compensation exist within the industry?*

Certainly, it would be unacceptable for recipients to use CHIPS Incentive funds for buyback purposes, but of course none of them would do this. However, the CPO should not make whether companies elect to engage in stock buybacks or not a consideration whatsoever in making allocation decisions on CHIPS Incentive funds. How semiconductor enterprises elect to dispense profits should not be a material consideration in making CHIPS fund allocations. The premise of the question implies that the CHIPS incentives are substitutes for other financial income from semiconductor makers. They are not. CHIPS incentives will not, nor should they, cover 100 percent of capital costs of a new fab. Therefore, absent the subsidy, the fab will not likely be built in the United States, or if it is it will likely be smaller than optimal from national interest perspective. In this sense the issue of stock buybacks is irrelevant.

Moreover, far from stock buybacks only benefitting the well-to-do, when corporate profits are returned to shareholders, it can benefit a great many Americans. For instance, a survey conducted at the start of 2022 by Gallup found that approximately 58 percent of Americans own stock.<sup>22</sup> This includes individual stocks, stocks

owned through a mutual fund, and stocks owned through a retirement savings account. Similarly, a 2020 national survey conducted by the Investment Company Institute found that 45.7 percent of U.S. households own share in a mutual fund.<sup>23</sup> Stock buybacks that return profits to shareholders can and do benefit U.S. citizens of all income levels. But the final point here goes back to previous ones ITIF has made herein: loading up CHIPS Incentive fund allocations with so many non-competitiveness focused covenants, restrictions, requirements, etc. will only dilute the potential effectiveness of the program.

Further, the CHIPS for America Strategy noted that, “The plan {i.e., application submission} should not result in an outsized rate of return relative to commercially reasonable expectations.”<sup>24</sup> This too is misguided. Companies should certainly put forward credible and realistic proposals and for how they’ll apply the incentives in their business applications and how these incentives are needed to ensure a decision to build or expand in the United States, but at the same time companies are entirely justified in trying to seek the most-profitable investments possible. And if a company develops a very successful business model that earns a high rate of return, this should be viewed as a success for U.S. industry, for the workers the business employees, and for the business’s potential to generate tax revenues that benefit U.S. society. Further to the point made above, it is unlikely that any of these investments will make outsized rates of return. If they would, there would be no need for a federal subsidy to close the cost gap with foreign countries. Indeed, the opposite is more likely. Even with generous CHIPS subsidies, it is likely that many companies’ new U.S. operations will be higher costs than some overseas locations. Rather than praise companies for accepting lower rates of return for investing domestically, the guidance wants to punish companies for success.

Moreover, America’s semiconductor industry supports good-paying jobs, with jobs in the U.S. semiconductor industry paying \$80,000 on average, almost 40 percent more than the average U.S. job, at \$51,000. The sector already supports 277,000 U.S. jobs directly, and another 1.6 million jobs indirectly.<sup>25</sup> Moreover, analysts predict the CHIPS/FABS Act would create an annual average of 185,000 temporary American jobs and add to \$24.6 billion to the U.S. economy as new semiconductor manufacturing facilities are constructed from 2021 to 2026.<sup>26</sup>

### Opportunity and Inclusion

*22. What policies have been successful in ensuring that job opportunities are good quality and available to and filled by a diverse pool of workers? Does industry currently offer wrap-around services to employees: childcare, paid leave, transportation, etc.? Why or why not?*

A 2017 report by MxD (one of America’s 16 Institutes of Manufacturing Innovation) and Manpower Group, “The Digital Workforce Succession in Manufacturing,” identified 165 completely new job roles pertinent to digital manufacturing and design.<sup>27</sup> The report includes descriptions for jobs such as collaborative robotics specialist, manufacturing cybersecurity strategist and enterprise digital ethicist give a window into the advanced skills and knowledge needed to put new technology into practice and remain globally competitive. Crucially the report not only identified and described these new roles, but also specified what types of skills and certifications the positions required and where to acquire such skills and certifications.

Section 9906 of the FY 2021 National Defense Authorization Act (NDAA) authorized NIST to establish up to three Manufacturing USA institutes to advance research and commercialization of semiconductor manufacturing technologies, and to carry out an R&D program to advance measurement science, standards, material characterization, instrumentation, testing, and manufacturing capabilities. Certainly all three authorized Institutes should be stood up. A key objective of any Manufacturing USA Institutes set up as part of the CHIPS Act should be to produce a similar report that comprehensively describes the wide variety of

job roles that exist across the semiconductor industry, what skills and certifications those jobs require, and at what community colleges or universities, and with what curricula/degrees, those skills can be acquired. Further, an analysis should be made of whether historically black colleges and universities (HBCUs) or related minority-serving institutions are offering such relevant courses and/or degree programs to enable graduates to acquire in-demand skills of the U.S. semiconductor industry.

*25. What actions can the CPO take to ensure that the implementation of the CHIPS incentive programs is equitable and inclusive?*

As this RFI has contended, while goals such as social justice and inclusiveness are certainly laudable and important, these cannot be goals that drive CHIPS Incentive decisions. Those decisions need to be driven by one major goal: reducing the cost differential to launch and operate at scale semiconductor fabs in the United States. If the program's funding mechanisms become knotted up with considerations tied to ancillary, non-competitiveness-related objectives, the overall effectiveness of the program will suffer. In other words, ITIF believes it would be a mistake to impose social goals on an initiative that is so fundamental to U.S. national and economic security. However, should the United States get this program right, and recapture a much-greater share of high-value-added semiconductor manufacturing and the high-value-added employment that flows from it, then many of the desired social goals will indeed be met.

#### Other

*26. What other information should inform the CPO's implementation of the CHIPS incentive programs?*

*27. What data will be important for the agency to collect to build evidence on the effectiveness of the CHIPS program? What are potential data sources?*

The acid test of CHIPS Act incentives will be whether companies invest in establishing fabs and other facilities in the United States, full stop. However, for purposes of assessing the effectiveness of CHIPS Act implementation, DoC should also examine over ensuing three-, five-, and ten year periods, metrics such as: changes in U.S. semiconductor industry value added (output), global market share, and exports and trade balances.

The CHIPS Act includes an investment tax credit (ITC) equal to 25 percent of the value of qualified investments in buildings and other eligible depreciable tangible property for advanced manufacturing facilities that have a primary purpose of manufacturing semiconductors or semiconductor manufacturing equipment. As ITIF has argued, the United States should implement such an ITC to attract greater levels of globally mobile investment in other high-tech industries, such as in the biopharmaceutical sector.<sup>28</sup> DoC should closely monitor the effectiveness of the ITC in the semiconductor case in order to assess its merits for use in other sectors of the economy, such as to support biopharmaceutical manufacturing.

The final point is that the United States must get the CHIPS Incentives program right, because if it fails to do so, the United States is seriously at risk of losing long-term competitiveness in the semiconductor industry. One study predicted that, absent policy intervention, the U.S. share of global semiconductor fabrication would continue to shrink throughout the 2020s, to even below 10 percent.<sup>29</sup> The United States should not let semiconductors get added to a long list to tech industries—including machine tools, telecommunications equipment, displays, solar panels, and many others—where the United States once held a leading global market share, only to see it slip away. Such erosion was bad enough in the past when our competitors were



mostly democratic and allied nations. Further erosion would be frankly catastrophic and permanently debilitating given the accelerating competition from China.

It should also be noted that America's current global market share in semiconductor manufacturing, 10-12 percent, is far below the share the U.S. holds in other strategic industries, including aerospace (where 49 percent of global manufacturing is performed in the United States), biopharmaceuticals and medical equipment (at least 25 percent), and petrochemicals (around 20 percent).<sup>30</sup> In other words, the United States can do much better than the 10 to 12 percent of global semiconductor manufacturing it commands today. But if the United States misses this opportunity that Congress has provided, it will almost surely never get another one to restore U.S. semiconductor competitiveness and globally leading innovation and manufacturing prowess. It's now or never time for the U.S. semiconductor industry. As such, Commerce should focus laser-like on one goal: providing generous-enough, cost-differential-reducing subsidies to significantly expand U.S. semiconductor market share across the board (e.g., memory and logic, digital and analog).

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## Endnotes

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