



The U.S.-India Initiative on Critical and Emerging Technology (iCET) from 2022 to 2025: Assessment, Learnings, and the Way Forward

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Introduction

“The mood was great,” is how a senior official described interactions in June 2024 between U.S. and Indian counterparts during the second round of review meetings of the U.S.–India initiative on Critical and Emerging Technology (iCET).¹ The U.S. National Security Advisor (NSA) Jake Sullivan traveled to New Delhi with a notable delegation of officials.

The strategic directive from the White House was clear: India, as a U.S. official put it to us, “is a critical part of the growing complexities in a substantively different geopolitical world.”² There is an unmistakable imperative on the part of the White House to further deepen strategic ties with India, as also underlined to us by U.S. officials over the last two years. As far as officials are concerned, this is a “good bet.”³ This line of thinking is not new—it can be traced back to the early part of this century when both India and the United States decided to reshape strategic relations.⁴

Yet, two decades ago, India did not have the wide range of strategic capabilities it does now—in space, defense, opportunities in manufacturing critical technologies, assembling and testing emerging technologies, some aspects of artificial intelligence (AI), low-cost and scalable solutions in biotechnologies, and a lot else. These varied competencies, if they can be called that, provide a new basis to further forge ties between these two outsized democracies. From securing supply chains to breaking export control barriers, from re-energizing legacy “deals” to fostering new ones, this impulse for change and investments in deliberate mechanisms to elevate trust has been in the works for two years—ever since the iCET first found a brief mention in a readout following a meeting between President Joe Biden and Prime Minister Narendra Modi in the summer of 2022.⁵ To be sure, this process for change is built upon deep investments made in this critical relationship for at least the last two-and-a-half decades.⁶

The iCET is a unique framework to deepen technological and economic cooperation between the United States and India. It is shepherded by the National Security Council Secretariat (NSCS) in India and the National Security Council (NSC) in the United States, as well as supported by the Indian Ministry of External Affairs (MEA) and the U.S. State Department. Such uncommon stewardship provides this elastic arrangement for cooperation with doses of agility. To be sure, a set of countries are knocking on India's doors for similar arrangements. For example, the India–United Kingdom Technology and Security Initiative (TSI) is arguably the only other similarly designed arrangement which was announced in July 2024.⁷ A trilateral technology dialogue between India, the U.S. and the Republic of Korea was announced under the iCET.⁸ The first meeting in Seoul took place in March 2024.⁹

The second iCET review meeting between Jake Sullivan and Indian NSA Ajit Doval in June 2024 was striking.¹⁰ The readout is impressive.¹¹ New initiatives in biotechnology were highlighted. Critical partnerships in semiconductors for defense were emphasized, a lot of which is being driven by the private sector between U.S. primes and Indian mid-sized firms. The carefully worded and negotiated factsheet published on the eve of the Sullivan-Doval meeting was peppered with mentions of fellowships, joint defense challenges, new funding for exchanges, crucial agreements on space cooperation, an architecture for doing more with O-RAN and 6G technologies, joint investments in critical technologies, and new lines of collaboration in quantum technologies and AI.¹²

Despite the thickening lines of cooperation highlighted in two successive iCET factsheets—the first published in February 2023, following the first official iCET meeting, and the second in June 2024—“what's next?” is a common refrain for those who have invested in what might be called the iCET ecosystem. Apart from officials and political leaders in the governments of India and the U.S., a network of professionals, academics, industrialists, think tankers, lawyers, industry representatives, and several others have both energized and even delivered for the iCET in different ways. Modi's last official meeting with Biden in Wilmington on September 21, 2024, on the sidelines of the Quad Leader's Summit has helped inject greater doses of enthusiasm in realizing new investments and agreements.¹³ This is discussed in different sections of this paper, below.

Equally, there is still much skepticism in both the United States and India on the future of the iCET. The broad scope of the initiative, enunciated in a lengthy joint statement following Modi's state visit to Washington in June 2023, is often seen to be both a boon—for expanding the contours of the partnership—and a hindrance—because of limited capabilities to deliver on the goals announced. “iCET fatigue” is a term that does the rounds in some conversations on the future of the initiative.¹⁴

In the United States, increasingly, senior staffers in Congress ask piercing questions on what more India can do for the iCET. While some on the Hill invested in de-risking from China remain equally committed to the wide strategic partnership with India, their counterparts in different committees probe the virtues of the same.¹⁵ For some in the United States, the question, as one analyst puts it, is: “Can India help the U.S. win its race against China

for technological dominance?”¹⁶ In India, the primary motivation for the iCET is seemingly designed around supporting India’s economic development, jumpstarting manufacturing in strategic technologies, and fusing tech talent and capabilities between two unique innovation ecosystems. To be sure, “bridging our [India and the United States’] innovation ecosystems” is a strategic priority for the iCET architects.¹⁷

From the outside, apart from the fundamental impetus of the iCET to support India’s strategic development through collaboration between the private sectors and the governments of both countries, the initiative’s architecture can help India with the following:

- further diversify its military dependencies over the next few decades;
- strengthen lines of strategic cooperation to deal with the challenge of economic overproduction in China;
- coproduce and co-innovate technologies to build geo-economic resilience;
- and potentially cocreate new language in the complicated world of standards ,thereby offering technology solutions to large parts of the globe that thirst for greater transparency.¹⁸

So, what has the iCET delivered? What is next? What is needed to strengthen and potentially refine this innovative framework for cooperation? This paper is divided into two parts. It begins by assessing deliverables and actions against the intentions inked in the June 2023 joint statement, following a state visit by Modi to Washington. The June 2023 joint statement provides the most detailed expression of intent and official reflections on progress till the publication of this working paper.

This notable visit and the subsequent official publications provide details on what is expected from the iCET. The paper uses other official documents, especially a set of factsheets published between 2023 and 2024 that set benchmarks for progress along different lines of effort.¹⁹ It uses these templates only for measuring progress and relies on a mixed set of sources—as highlighted below—to assess the extent of delivery.

As far as we see it, there are at least three sets of methodological problems in writing a paper focused on assessing a process for change in a relatively short period of time.

We have closely considered whether or not using joint statements and factsheets is a methodologically sound approach to test and assess progress. We have spoken to a set of officials, including those involved in negotiating such statements, over the last many years. There is clearly a political exigency to highlight deliverables and even “pad” texts of this nature. In joint statements, more is good. At the same time, and to the best of our understanding, there is no falsity in the texts. Hence, we use the June 2023 joint statement as the template for assessments with caution. As highlighted above, we also refer to two iCET factsheets published

separately (January 31 and February 1, 2023) with differing language by the White House and the Indian MEA, one joint iCET factsheet (June 17, 2024), and a U.S.–India joint factsheet that is not specifically about the iCET (September 21, 2024). We would not want to lose the reader in these details, but from a methodological perspective, we wanted to highlight upfront the process we have adopted in analyzing the iCET deliverables and also earmark the limitations embedded in this approach.

Another methodological issue that has been highlighted to us, especially in the deep reviews done for this paper, is that of what should be included as a factor for an iCET outcome. After all, a range of big-ticket agreements—analyzed below—include those that predate both the iCET and the Biden administration. Should they, then, be even considered in our assessment? This is a valid question, yet we do not see a contradiction. The question pushed us to return to our notes taken between June and December 2022, when we held several meetings with both Indian and U.S. officials. This was what might be called the canvas-building time for the iCET. It was made clear to us that this new structure was designed as much to cocreate new arrangements as it was to impel changes in those that had not gotten off the ground for whatever set of reasons. This was as much about the old as it was and is about the new.

To be sure, this is as true in the complex world of export controls discussed in detail in this working paper. A lot of the effort over the past two decades was important and has helped shape channels for clearer communication between firms and controllers. Decisively segregating how much of the current impact is because of the past and how much of it is the result of the iCET activities is hard, if not impossible, to determine.

There is some merit, perhaps, in counterfactually assessing whether or not outcomes and agreements that predate the formal announcement of the iCET in the summer of 2022 would have generated momentum had the iCET not existed. An exercise such as this, if possible, would test the structural muscle of the iCET. But, as policy aficionados interested and invested in the current process of change and increasingly cognizant of the various caveats in assessing impact on a process with several moving targets, it is impossible for us to make such judgments.

The first section of this paper highlights and analyzes how specific iCET deliverables have served as a forcing function within India for deregulation, administrative pivots, and decisionmaking less common in India's past. Equally, it assesses how iCET outcomes have reshaped the way political leadership and U.S. bureaucracy deal with questions on export controls and critical technology partnerships. It outlines new areas of cooperation that could define the iCET calendar over the next twelve months as a new administration will be sworn in to the White House.

Lastly, the iCET is a process. Though a fuller assessment of clear outcomes will require a longitudinal study over a five-year or even a ten-year time frame, there is merit in laying out progress and hurdles and highlighting areas for refinement and growth in the sectors we

closely track. To this end, the second part of the paper details lessons that we have gathered on what has helped generate and maintain momentum for the iCET, which has played a part in shaping outcomes thus far. It also highlights concerns regarding the future of this framework and offers strategies for the mitigation of the same.

This paper is based on our own engagements with the iCET ecosystem, including its expansions, since the summer of 2022. For the past two years, we have been involved in numerous interactions, publications, interviews, and agenda-setting meetings with principals invested in the iCET, and others.²⁰ Broadly, and if we had to categorize these interactions into research and policy clusters, they include interrelated, emerging, and critical sectors such as space, defense, semiconductors, export controls, biotechnology, and AI. We have been actively working on and closely monitoring the progress and challenges in these sectors as part of the initiative. We provide a limited assessment on defense. Our colleagues at Carnegie India recently authored a detailed analysis of various defense initiatives under the iCET.²¹ They also attended the third India–U.S. Defence Acceleration Ecosystem (INDUS-X) Summit in Palo Alto in September 2024. There is little point in being repetitive.

As a final note, this paper only delves into certain iCET priority areas such as space, defense, semiconductors, export controls, biotechnology, and AI and not others such as quantum computing, critical minerals, clean energy, O-RAN adoption, and other associated sectors.

Regarding sources, we have referenced assertions, developments, and initiatives to the best of our ability.²² Since it is a relatively new initiative, there is limited analysis of the iCET in the public domain. We have referenced several of our conversations with policymakers over the last two years. In some cases, we have cited notes taken following closed-door meetings that were also shared with participants. Yet, a lot of our analysis is based on being a participant of sorts in what might be called the wider iCET ethnography. In the world of social anthropology, our approach would be called “participant observation.” Our analysis is based on the progress of the iCET we have observed from the outside.

Part I: Is the iCET Delivering?

The short answer, for us, is yes, the iCET is delivering.

The first question is this—what does delivery look like? We categorize this into two segments. The first is an assessment of observable outcomes based strictly on the intentions highlighted in the June 2023 joint statement and the factsheets mentioned above. These observations are falsifiable—the reader can easily compare the difference between intent, progress, and delivery. The second is an analysis of momentum in areas where clear outcomes are not observable. These assessments, at this time, cannot be quantified and are not falsifiable. It is, of course, up to the reader to decide whether they are convinced by our conclusions or not. For both of these segments, we propose new ideas to be considered for the future.

On Semiconductors

Prime Minister Modi and President Biden hailed the signing of an MoU on Semiconductor Supply Chain and Innovation Partnership as a significant step in the coordination of our countries' semiconductor incentive programs. This will promote commercial opportunities, research, talent, and skill development. The leaders welcomed an announcement by Micron Technology, Inc., to invest up to \$825 million to build a new semiconductor assembly and test facility in India with support from the Indian government. The combined investment valued at \$2.75 billion would create up to 5,000 new direct and 15,000 community jobs opportunities in next five years. The leaders also welcomed Lam Research's proposal to train 60,000 Indian engineers through its Semiverse Solution virtual fabrication platform to accelerate India's semiconductor education and workforce development goals, and an announcement by Applied Materials, Inc., to invest \$400 million to establish a collaborative engineering center in India. ²³

In September 2023, U.S. chipmaker Micron Technology Inc. started constructing a semiconductor assembly and testing facility in Gujarat, India.²⁴ The project, as stated in the joint statement, cost \$2.75 billion.²⁵ Micron has declared that it will invest \$825 million. The balance has been provided as an incentive between the state government of Gujarat (the first in India with a semiconductor incentive scheme) and that facilitated by the Indian Semiconductor Mission (ISM).²⁶ The ISM is administratively located within the Indian Ministry of Electronics and Information Technology (MeitY).²⁷

Started in 1978, Micron has offices and investments in seventeen countries.²⁸ In May 2023, the Cyberspace Administration of China claimed that there were “serious network security risks” in the memory chips produced by Micron within China.²⁹ News reports suggest that China was retaliating against U.S. industrial policies, which were partially designed to

encourage leading-edge chip manufacturing away from China and into the United States.³⁰ Micron seemed to have become a proxy in the deepening geo-technological competition between the United States and China. In November, reports suggested that a “*détente*” had been reached between the Chinese Ministry of Commerce and Micron.³¹

However, insiders argue that the damage had been done.³² Micron clearly saw the need to diversify and India provided an alternative at the right time. India’s incentive schemes helped mitigate the risks associated with investing in a country with only a strategic vision to build a semiconductor ecosystem. Coordination between the NSCS and the NSC was crucial, as were the long hours invested by the ISM. To be sure, the Micron deal serves as something of an anomaly given the speed of execution in India. “No one thought this could happen that fast,” is a sentiment voiced in a series of closed-door iCET meetings.³³

Clearly, this was a strategic priority for India. Further, while the world’s focus has been on the future of fabrication, what is sometimes less understood is that assembly, testing, and packaging (ATP) facilities “are exposed to the same wide variety of shocks, any one of which could interfere with the global supply of semiconductors.”³⁴ This is also what India has doubled down on and also what Micron was interested in, from what we can discern from the outside.

Many moving parts worked in favor of the Micron deal in India, apart from constant iteration by the ISM and monitoring by the Prime Minister’s Office and the NSC. First, the decision to extend subsidies to assembly and testing facilities and not only to those invested in fabrication was key. Second, something called an Advanced Pricing Agreement (APA) was negotiated with Micron in record time—less than six months.³⁵ The APA provisions were introduced in 2012. They are designed to increase “certainty with respect to tax outcome of the taxpayer’s international transactions,” remove “an audit threat,” and deliver “a particular tax outcome based on the terms of the agreement.”³⁶ An APA usually specifies how the tax treatment of certain corporate transactions will be considered. Comparable transactions typically take up to six years to complete.³⁷

Lastly, the Indian government provided an exemption to “the import of inputs and capital goods” for units “engaged in manufacturing electronic goods, semiconductor chips/devices (including assembly, testing, marking, and packaging) and all types of displays.”³⁸ The exemptions provide the sector as a whole a degree of confidence in the otherwise ambiguous universe of taxation.

It is clear that the Micron investment has benefitted from deregulation from the bottom-up and top-down. The approach to this iCET deliverable combines geopolitical needs (to arrest this time in substantive diversifications away from any one jurisdiction of economic overproduction) and economic imperatives (deepening the base of India’s nascent high-tech sector). The campus in Gujarat, as we have been informed, is in the process of constructing two facilities and will likely be ready by 2025. It is worth keeping in mind that this is India’s first major investment in a still-nascent semiconductor ecosystem.

Further, as mentioned in the joint statement, announcements were made by LAM Research and Applied Materials. In May 2024, it was announced that LAM Research would expand its global semiconductor fabrication equipment supply chain to India as well.³⁹ This would largely focus on precision components, custom parts, and high-purity gas delivery systems. In October 2023, it was revealed that LAM Research had plans to set up units for engineering, R&D, testing, and tool prototyping in Karnataka, with an investment of INR 236 crores (\$28 million).⁴⁰ Also, as part of the iCET factsheet from June 2023, LAM Research announced plans to train 60,000 Indian engineers with respect to its Semiverse Solution—a virtual fabrication software that would help engineers operate in a virtual environment to run parallel experiments regarding chipmaking, as making integrated circuits becomes more complex.

LAM Research signed an MoU for this training program with the Centre for Nano Science and Engineering (CeNSE) at the Indian Institute of Science (IISc), Bengaluru. The first phase was a pilot started at IISc. However, there are plans to roll out this program in other Indian universities at the undergraduate level as well. From our interviews conducted for this paper, it is clear that approximately 2,800 students are expected to avail the benefits of this training program in 2024 alone, with the coming years likely to see a ramping-up of enrollment figures.⁴¹ The overall engagement with the Indian semiconductor ecosystem has also been consistent. LAM Research saw three visits of its top-level executives in 2024 to identify Indian partners that can help build their supply chain in India. Here, suppliers that “have the capability” but may not have the scale due to inadequate access to funding—something that could be rectified through the availability of more loans—have been identified.⁴²

Regarding the announcement made by Applied Materials—a global firm focused on engineering solutions for materials—in the iCET factsheet on the engineering center in India, there was an update in February 2024 regarding the creation of a collaborative engineering center. This is estimated to create 500 new advanced engineering jobs and 2,500 other employment opportunities in the manufacturing ecosystem.⁴³ To this end, Applied Materials commissioned the India Validation Centre in March 2024.⁴⁴ This center, which is “already up and running,” is intended to be the first phase of the collaborative engineering center proposed in the iCET factsheet.⁴⁵

Being a company that looks at providing semiconductor manufacturing equipment, Applied Materials’ long-term view with the India Validation Centre is to significantly compress the “time to market” for the semiconductor manufacturing equipment it creates. Those we interviewed suggested that “typically time cycles for such equipment are long due to the precision required in making semiconductors, unlike software updates; and by the time a new semiconductor manufacturing equipment is tested, it takes 1.5–2 years.”⁴⁶ The India Validation Centre will aim to bring this down to six months. This will, according to those we interviewed, enable early pilots and collaboration with engineers and academia.⁴⁷

In sum, the Micron investment has had multiplying effects on India's budding semiconductor ecosystem. It has given some degree of confidence to leading market players to invest in India. In February 2024, the Indian cabinet approved three sets of semiconductor investments—a fabrication facility to be built between the Powerchip Semiconductor Manufacturing Corporation (PSMC) in Taiwan and TATA Electronics Private Limited (TEPL) as well as an Outsourced Semiconductor Assembly and Test (OSAT) and ATMP in Gujarat and Assam.⁴⁸ The OSAT in Gujarat is to be built by CG Power and Industrial Solutions Limited.⁴⁹ The ATMP in Gujarat will be operated by TEPL.⁵⁰

Ground broke in the TATA–PSMC facility (Dholera, Gujarat) in March 2024. TEPL has signed an agreement with the PSMC. Accordingly, the PSMC will provide design and construction support to the fab in Gujarat.⁵¹ The new fab will also reportedly manufacture chips for applications in markets such as AI, automotive, and data storage. While this agreement is between TEPL and a major Taiwanese semiconductor company, it shows how certain Indian companies such as TEPL are now expanding their presence at all stages of the semiconductor supply chain, which may open up more touch points for collaborating with potential partner firms from the United States as well.⁵² Moving up the semiconductor value chain is a slow-going process, which is why the possibility of Indian conglomerates entering into the fray across various parts of the value chain is encouraging for building a more holistic Indian semiconductor ecosystem.

This is not to argue that the iCET itself has opened the pathway for industrial cooperation and co-investments in India's nascent-but-growing semiconductor ecosystem, but as officials and industry representatives make clear, it has provided a degree of confidence in the market to make bets and forge alliances that many thought were impossible only a year earlier. We are equally clear about the fact that investments like in the case of Micron are not a direct result of the iCET.

There are several experts who would argue that the Micron agreement had little to do with the iCET. Rather, it was an investment made possible because of forces apart from those driven by the iCET umbrella. This might well be true. “Whose win is it?” is a question that is almost impossible to answer with fact and evidence alike. Yet, our own assessment is that the ecological change in India–U.S. technology relations that followed the birth of the iCET has been instrumental in reviving legacy projects. It's quite clear that instruments like the APA were a direct result of the spirit-moving new and old agreements alike.

Further, the September 2024 factsheet also states that GlobalFoundries—a semiconductor manufacturing firm—would create a center in Kolkata that aims to create linkages in R&D in chip manufacturing, advances for low-emission as well as connected vehicles, and IoT devices.⁵³ This could well be GlobalFoundries feeling out the Indian market prior to committing to a fab in India—press reports suggest that the firm was interested in entering into a joint venture with Indian partners to set up a fab unit in the country.⁵⁴ The firm's CEO also met with Modi at a roundtable in New York in September 2024.⁵⁵

To be clear, parts of the U.S. system are keen to continue to support securing the semiconductor supply chain in India. In the June 2024 factsheet, a new partnership was announced between General Atomics—a U.S. defense technology company—and 3rdiTech—a mid-sized Indian company—to “co-develop semiconductor design and manufacturing for precision-guided ammunition and other national security-focused electronics platforms.”⁵⁶ In September 2024, Modi and Biden announced the creation of a national security fab in India “enabled by the support from the India Semiconductor Mission as well as a strategic technology partnership” between two Indian firms and the U.S. Space Force.⁵⁷

While the fab will take time to realize, what’s clear is the signal for the Biden administration: do more with India, including in sensitive areas that would have been off limits only a few years ago. According to those involved in this particular “arrangement,” as the September 2024 factsheet puts it, the chips designed and made in this facility will be for the Indian and U.S. militaries. They will also be used in the deployment of 6G technologies and in high-speed trains, along with other wider applications.⁵⁸ All eyes will be on realizing these goals in the not-too-distant future. The agreement has been in the works for over a year.⁵⁹

Significantly, with the view to align announcements such as the one above with the required financial support to conceptualize other such initiatives, the September factsheet highlighted a “new strategic partnership” between the Indian MeitY and the U.S. State Department “in connection with the International Technology Security and Innovation (ITSI) Fund.”⁶⁰ This is a welcome step and has also been in the works for over a year. Yet, disappointingly, the State Department announcement highlights the need to conduct a “comprehensive assessment of India’s existing semiconductor ecosystem,” before those in the United States or India could make use of this fund.⁶¹

An initial assessment has already been done by industry bodies in both India and the United States. This was an outcome of decisions taken at the first iCET review meeting on January 31, 2023.⁶² Our understanding is that the U.S. State Department has commissioned an international organization to do the new assessment.⁶³ The same practice is followed in other countries too. Yet, in the case of India, it begs the question: why are two assessments required? It will only delay the stated objective in the ITSI–MeitY partnership to “create a more resilient, secure, and sustainable global semiconductor value chain” in a timely manner.⁶⁴ The iCET negotiators would do well to revisit the need for a second assessment. There is a clear desire to do more together. One assessment has been done. Micron has invested. The U.S. Space Force is partnering with Indian firms to produce chips in India. Surely, it is time to move beyond more typical bureaucratic processes that the iCET was designed to overcome.

Out to 2025: What Could Be Next?

We propose three sets of ideas that require immediate attention.

Secure chips

Ensuring cyber-resiliency and the ability to create a trusted corridor—making sure that there is zero opportunity for backdoors and leakages—for the production of chips and associated materials with other countries and their suppliers will be key for India as it seeks to build its own semiconductor ecosystem.⁶⁵ To be sure, this is critical for any country that positions itself as a viable location for semiconductor operations, especially those investing in trusted global supply chains. Indian companies, as has been mentioned above, have announced that they will enter agreements with the U.S. military to produce chips for defense and commercial purposes.⁶⁶ This is a novel development, at least in so far as intentions are concerned.⁶⁷

Our sense is that these partnerships, between different parts of the U.S. government and Indian industry, and even between the U.S. industry—contracted by the U.S. government—and Indian firms, designed to lead to manufacturing semiconductor-related products for national security, will increase. To be sure, there is an opportunity for India in cornering a part of the market—however small that might be—to coproduce secure chips. The 2022 U.S. CHIPS and Science Act carved out funding for the Secure Enclave project.⁶⁸ This project is intended to create specialized facilities to make chips for the defense establishment in the United States. The firms contracted to do so, in time, may well look to expand their base of production at some level in other geographies, like in India. United States officials have actively explored extending the Secure Enclave to India.⁶⁹ These collaborations could be expanded by starting academic-to-industry partnerships between the two countries.

In May 2023, the ISM signed an agreement with Purdue University to advance workforce development, R&D, and industry partnership in semiconductors.⁷⁰ These kinds of arrangements could be expanded. For instance, Purdue University in the United States has the Center for Secure Microelectronics Ecosystem (CSME), which is funded by the U.S. Department of Defense (DoD) as well as by the TSMC. The Semi-Conductor Laboratory in Mohali, India, which has in the past been entrusted with making secure and reliable chips for the Indian space program, could partner with CSME to explore synergies when it comes to ensuring that the security architecture of chips remains reliable.

However, these arrangements need to be carefully considered for them to be viable in the long run. In the mid 2000s, the U.S. government announced the creation of the Trusted Foundries Program (TFP). The DoD was to “acquire custom microelectronics” from a “trusted foundry.” In 2020, DoD officials claimed that this process had failed to deliver results. The DoD moved to a different system to acquire state-of-the-art microelectronics from the market.⁷¹ For Indian and U.S. planners considering a TFP-like advance between firms and governments in both countries, the reasons for the failure of the TFP to deliver might be kept in mind. Interviews with industry representatives and officials engaged in the TFP suggest the following.

- **The issue of scale:** The volume of products required by the government was smaller than that required in the commercial market. The government typically also procured not just a singular product but a comprehensive range of systems such as aircraft, electronic warfare, and radar. It was found that there was not much in common in terms of platform architecture between these systems. The resultant fragmentation of production led to an outcome where military sales did not exceed 2 percent of the total sales made by any trusted foundry operator.
- **High cost of servicing:** Due to various accreditation criteria required by the U.S. government under the TFP, it was challenging for firms to satisfy them without considerable paperwork. In the end, many top firms such as Intel, Samsung, and the TSMC did not end up being a part of the TFP.
- **No long-term contracts:** While some firms in the mid 2000s were handed a long-term contract, other suppliers in the value chain were not even given “a yearly contract with guaranteed business.”⁷² This led to a low level of uptake from commercial firms that otherwise could have been engaged in the TFP.
- **High cost of upgrading:** Most defense technology relies on mature nodes or less advanced nodes.⁷³ Periodically, they require products based on advanced nodes. Our sense, also ascertained in interviews, is that TFP partners were unable to invest larger sums required to upgrade their facilities based on the orders from the government alone. This made the “business case” for the TFP weaker.⁷⁴

From the outset, the media reports during Modi’s visit to the United States in September 2024 on the so-called national security fab to be built in India and that will supply to the U.S. Space Force appear to have got this balance right—to make products for both military and commercial use and applications.⁷⁵ Yet, on the whole, the above takeaways might be considered for bets made on secure chips within the context of the iCET and beyond.

Compound semiconductors

The domain of compound semiconductors remains a low-hanging fruit for both countries. Compound semiconductors—semiconductors made from two or more elements from the periodic table—show a great potential for growth. Compound semiconductors like silicon carbide or gallium nitride are particularly well-suited for applications requiring high-power electronics. These are increasingly being used in the renewable energy industry, among others, and are excellent in providing efficiency by ensuring that the inputs in the form of input voltage levels are regulated in such a way that they are able to provide the highest level of output, with minimum energy losses during the conversion of the source electrical power. The compound annual growth rate for this sub-segment is also forecasted to outpace the growth of the broader semiconductor market.⁷⁶ However, most commercial fabs are reluctant to use advanced materials such as compound semiconductors for fear of contaminating their production lines.⁷⁷ This affects startups that work on compound semiconductors—their lack of early adoption by mainstream commercial players effectively leads to the lack of a sound advanced materials ecosystem.

The recent agreement announced in the September 2024 factsheet between the U.S. Space Force and two Indian firms to create a compound semiconductor fabrication plant focusing on advanced sensing, communication, and power electronics for national security applications is a welcome step and speaks to the ability to pick up on emerging trends in the semiconductor sector.⁷⁸ This fabrication unit will look at manufacturing not just gallium nitride and silicon carbide semiconductors but also infrared ones, which can have applications in making infrared detectors.

It should be noted that even if there are concerns regarding toxic substances in such advanced materials, the answer should be to pursue joint research on alternatives to hazardous materials. Here, a partnership could be considered between the University of Arizona Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, and the Gallium Nitride Ecosystem Enabling Centre and Incubator facility at the IISc, Bengaluru.

Advanced packaging

The process of shrinking chips is reaching the limits of what was known for decades in the semiconductor industry as Moore's Law—essentially, every eighteen months, semiconductor companies would be able to pack twice as many transistors and wires in the same silicon area. This is getting harder to execute over time. As per industry views, even the speed of processors is no longer getting faster with each successive generation. What has happened, however, is higher transistor density, as a result of packing more cores (essentially, an individual processing unit on a chip) onto chips, has allowed chipmakers to outwit the limits of Moore's Law. But investments are already underway by leading chipmakers to work on advanced packaging techniques.

These could involve wafer-level processing, where a full wafer of silicon is used to make chips—a larger base allows more space for packing more cores and more room for efficient communication between these cores.⁷⁹ These techniques could also utilize 2.5D packaging, where essentially chips are stacked on top of each other to squeeze out maximum performance. This trend is likely to continue since advances in artificial neural networks have meant that the compute power required to train them is huge. While compute demand is doubling every three-and-a-half months, the improvements to chipmaking technology have not kept up.⁸⁰

There is an opportunity for investments in the future of packaging techniques. Here, a possible collaboration between the newly announced Bharat Semiconductor Research Centre and the U.S. National Semiconductor Technology Center could be considered. Both are institutions entrusted with leading the charge on moonshot projects, which advanced packaging techniques fall squarely under. As it is, currently, advanced packaging also requires collaboration between multiple stakeholders due to the high level of industry specialization required in different areas on the part of various industry players.⁸¹

The Future of Semiconductors

Why India? is a point made by different sets of experts when it comes to the potential for the country's budding semiconductor ecosystem. For some economists, the prospect of India investing in a "race" for chips with other nations could be "ruinous."⁸² India has few obvious advantages. And according to these assessments, chip subsidies for a country like India do little to generate large employment opportunities. India is simply hypnotized by "prestige projects," which include chips, according to this line of thinking.⁸³ For those who have long worked in the electronics segment, Malaysia and Vietnam are far more attractive jurisdictions for the semiconductor supply chain. Semiconductor market movers like Intel have large investments in both these Southeast Asian states.⁸⁴

Intel opened a plant in Malaysia on a paddy field in 1972. In 2024, Malaysia announced a \$5.3 billion semiconductor incentive scheme.⁸⁵ Vietnam hosts Intel's largest test and assembly factory globally. It introduced tax breaks in the burgeoning semiconductor sector in February 2024.⁸⁶ The communist country aims to train 50,000 engineers by 2050.⁸⁷ These are only two examples of market leaders in Asia. The Philippines and Thailand are well in this race too.⁸⁸ Given the deep investments in these states, some experts have opined, why would India matter?

The counterarguments, if they can be called that, are important to consider as architects of the iCET continue to centralize the importance of "securing semiconductor supply chains."⁸⁹ This is a critical moment for India, and investing in a semiconductor ecosystem is not only prudent but also the right geopolitical move. Our views are based on what might only be called early observations.

First, many economists do not like industrial policies, which makes sense.⁹⁰ Industrial policies reshape global trade, create tariff barriers, and do not necessarily create the kind of employment opportunities that alternative investments could. The opportunity cost, say in the case of India's semiconductor subsidies, might well be considered to be out of sync with its economic realities. Yet, the key to incentives for semiconductors is that this has as much to do with geopolitics and resilience as with pure mathematics. These are geo-economic bets. If, as we predict, India is able to attract eight to ten ATMP units by 2026, this would give it a more-than-respectable place in the global semiconductor supply chain. Indeed, as highlighted above, if the logic underlying Moore's Law breaks and advance packaging is the future of the global semiconductor industry, India could double-click on these prospects.

For India, ATMP units do provide jobs, although clearly, these are not labor-intensive sectors. We suspect that eight to ten ATMP units could provide up to 60,000 direct jobs and three times that indirectly.⁹¹ This is also why LAM Research is training thousands of engineers in India, with an eye on this growing market. Further, much like in the automobile manufacturing ecosystem in India since liberalization in 1991, we expect that a vendor and materials ecosystem will grow side-by-side.⁹² Based on our conversations with chemical company owners in Gujarat and those in Europe and the United States already

investing in these sectors, these are opportunities waiting to materialize. The chips are falling in pace, as it were. We only hope that the momentum behind these initiatives and constant revision to regulatory approaches continue unimpeded.

Lastly, while the gains in countries in Southeast Asia are nothing short of impressive, India still manages to compare favorably despite the perceived advantages. First, a lot of the companies that have relocated to Southeast Asia in the wake of the U.S.–China trade war are Chinese firms that do packaging and are contract manufacturers for other global semiconductor manufacturing equipment firms.⁹³ There is an unspoken risk involved with using such Chinese firms, related primarily to cybersecurity issues—the reason being that the chip packaging process is often seen as being susceptible to entry points for the manipulation of chips—ranging from modifying the testing software used during their packaging to the introduction of compromised components. Given that the ATMP supply chain is fairly fragmented with multiple contractors, these entry points may become even more leaky in such circumstances.

Several firms in Southeast Asia have also shown reluctance to remove sanctioned Chinese firms like Huawei from their local 5G networks.⁹⁴ This could impact the view of them as being a “secure” place to package, design, and manufacture chips. Further, despite being an OSAT destination for decades, many firms in Southeast Asia have not migrated to the higher parts of the semiconductor value chain. It does not have a skilled workforce to service a chip design ecosystem or advanced packaging.

India compares favorably as home to approximately 25 percent of the global chip design workforce.⁹⁵ Lastly, Asian states in the Regional Comprehensive Economic Partnership (RCEP) could produce risks that are not always clear at first glance. These jurisdictions could be used as a conduit to route Chinese goods to other countries that have a free trade agreement (FTA) with them. Most FTAs have rules of origin that ascertain the source of a product, thereby having implications on the duties applicable to the same. However, under the RCEP, the concept of “cumulative rules of origin” has been adopted.⁹⁶ Under this concept, goods procured from one member state of the RCEP and used as material in the production of a new product in another member state will be regarded as originating in the latter. Therefore, material originating from China with minimal value added in a particular Southeast Asian state could possibly be treated as originating from that state.

In sum, despite India’s late arrival in different stages of the semiconductor supply chain, the strides made over the last year have been impressive. The iCET has delivered and played an important part in propelling the aforementioned arrangements and investments to build out the Indian government’s semiconductor ambitions. What is needed globally is greater coordination on incentive schemes and streamlining a workable and safe supply chain amongst like-minded partners.⁹⁷ A trilateral arrangement for coordination between South Korea, the United States, and India under the iCET should be utilized more forcefully to this end.

On Space

Prime Minister Modi and President Biden set a course to reach new frontiers across all sectors of space cooperation. The leaders applauded our growing cooperation on earth and space science, and space technologies. They welcomed the decision of NASA and ISRO to develop a strategic framework for human spaceflight cooperation by the end of 2023. The leaders hailed the announcement by NASA to provide advanced training to Indian astronauts at the Johnson Space Center in Houston, Texas, with a goal of mounting a joint effort to the International Space Station in 2024. The leaders celebrated the delivery of the NASA-ISRO Synthetic Aperture Radar (NISAR) satellite to ISRO's U.R. Rao Satellite Centre in Bengaluru, India, and looked forward to NISAR's 2024 launch from India. Welcoming India's Space Policy – 2023, the leaders called for enhanced commercial collaboration between the U.S. and Indian private sectors in the entire value chain of the space economy and to address export controls and facilitate technology transfer. President Biden deeply appreciated India's signing of the Artemis Accords, which advance a common vision of space exploration for the benefit of all humankind.⁹⁸

“India would not have signed the Artemis Accords had it not been for the iCET,” a senior official told us in July 2023, soon after India became the twenty-seventh country to join the accords. These discussions had been in the works since 2022, a year before India entered into an implementation agreement with NASA: “a legal instrument related to the Artemis Accords.”⁹⁹

A push from the top helped cross the hurdle to full membership. This in itself is good news for India's state-owned Indian Space and Research Organization (ISRO) and the burgeoning private-sector space market in India. What the accords will actually do for India is less than clear, but at the very least, they provide the basis for sharing scientific space data.¹⁰⁰ The efforts to join the Artemis Accords were moved by the relevant divisions in the Indian MEA and the Indian Mission in Geneva that focuses on disarmament. Much of this was coordinated by the NSCS, as we understand.

In a sense, joining the accords is equally important to several interrelated conversations about the future of space, including its militarization, in other multilateral fora. Increasingly, because of these imperatives, the Indian private sector has been wired into bilateral and multilateral discussions. This is key. As product builders—companies launching rockets at low cost, printing 3D rocket engines, producing hyperspectral imagery, focusing on space situational awareness, and designing and building satellites—an insight into global norm-building formulations is key. The landing of the Chandrayaan-3 lander near the south pole of the moon is nothing short of astounding and moved all global eyeballs to India. That the mission cost only \$75 million still shocks U.S. interlocutors and deepens their interest in India's space sector.¹⁰¹

The iCET has energized a link between the private sectors in India and the United States dedicated to space. A number of these initiatives are jettisoned by industry representation bodies, vying for deeper space in the iCET ecosystem.¹⁰² The timing works well too. In 2020, the Indian government took the striking and necessary call to “open up the space sector and enable the participation of the Indian private sector in the entire gamut of space activities.”¹⁰³ It created the Indian National Space Promotion and Authorisation Centre (IN-SPACe) under the Department of Space. The deregulation of the space market in India has led to the mushrooming of startups across Bengaluru, Hyderabad, Gurugram, and other tech-first cities in India.¹⁰⁴

For the last two years, we have worked with about a dozen such space companies and seen them plug into the iCET ecosystem. This could simply mean getting clarity on export controls (detailed in the next section) and licenses or finding a pathway by which these companies in India can access technologies available in the United States. The combination of deregulation in India and space as an iCET priority area has had tangible benefits to the sector as a whole.

As one venture capitalist (VC) in California told us recently, “India’s space market is the next frontier for investments.”¹⁰⁵ There is no other place, this VC made certain, where rockets can be launched at a tenth of the price. In time, and with both capital and technology support from Silicon Valley, some Indian companies could be on their way to do hundreds of launches a year at a cost that is unthinkable in the United States.¹⁰⁶ This, as U.S. officials have mentioned to us, could potentially help de-risk their own dependencies within their own country.

In our assessment, both countries and their private sectors are genuinely invested in “reach[ing] new frontiers” in space cooperation, as underlined in the June 2023 joint statement.¹⁰⁷ The primary hurdles—such as export controls—are equally important to consider. The joint statement welcomed the Indian Space Policy 2023.¹⁰⁸ This has provided a degree of predictability to the growing Indian private space industry. From an Indian perspective, what is needed is a space law that will help startups with a higher degree of regulatory comfort.

Since the joint statement of June 2023, both countries have also secured a “carrier for the first-ever joint effort between NASA and ISRO astronauts at the International Space Station.”¹⁰⁹ We are less clear about the status of the advanced training of Indian astronauts at NASA. According to the June 2024 factsheet, the Strategic Framework for Human Spaceflight Cooperation has been concluded. This framework is designed to “deepen interoperability in space” and support the “training for ISRO astronauts” at the NASA Johnson Space Center.¹¹⁰ This framework, in the works since 2023, has been delivered. On the other hand, according to interviewees, the launch of the NASA-ISRO Synthetic Aperture Radar (NISAR) satellite has been delayed due to longer-than-expected work on a radar antenna on the satellite.¹¹¹ Currently, the NISAR is in the United States, undergoing work to deal with temperature changes, which it will encounter once it is in orbit. It will subsequently be transferred from the United States to an ISRO facility in India toward the end of 2024. The launch of the NISAR may be delayed until early 2025.

In sum, based on our observations, much work has been invested by both the United States and India on space cooperation. Moreover, the private space market in India has benefitted greatly following the launch of the iCET, which happened to coincide with the liberalization of the space market in India. However, as highlighted, there is still much to be done as far as export controls and licensing regimes are concerned.

Out to 2025: What Could Be Next?

Looking to the third round of iCET meetings, potentially in 2025, we propose three sets of ideas that will require attention.

Opportunities under the Commercial Lunar Payload Services program

In January 2023, India and the United States agreed to identify commercial actors from the two countries to work on NASA's Commercial Lunar Payload Services (CLPS) program, which aims to deliver science and technology payloads to the lunar surface by engaging with companies that will help NASA perform science experiments and test technologies. It also offers contracts to vendors that have a cumulative maximum value of \$2.6 billion through 2028. However, under the CLPS program, vendors have to be from the United States. This is because of an apparent "domestic source limitation," which prevents the procurement of foreign launchers and landers.¹¹² This being said, domestic vendors do work with foreign ones—for instance, a few companies from the United Kingdom—under this program.¹¹³ More recently, in 2023, iSPACE (a CLPS vendor) signed an MoU with India's Skyroot Aerospace.¹¹⁴ However, it remains to be seen whether more opportunities will emerge for Indian companies in the CLPS program. ISRO and NASA could potentially set a timeline by which to identify potential Indian companies that can work under the CLPS program.

Interoperability under the Artemis Accords

Under the Artemis Accords, both India and the United States can work to promote their commercial space sectors regarding the interoperability of common exploration infrastructure and standards. Furthermore, considering that all Quad members are signatories to the Artemis Accords, this agenda can also be taken forward under the Quad space working group. This ought to be utilized by the Quad grouping to conduct focused discussions on common standards for exploration infrastructure.

Further joint involvement in lunar economy projects

The Artemis missions are essentially about returning humans to the Moon and attempting to build a sustainable lunar presence. In this regard, the focus has largely been on the big-ticket missions of vendors contracted by NASA under the Artemis program. For instance, the per-launch cost of NASA's Artemis missions is expected to be around \$4 billion.¹¹⁵ However, everything in the program does not have to be "big-ticket," and other smaller contracts can be looked at as well. For instance, the recent success of U.S. private space

company Intuitive Machines shows that there is a more niche market segment for the lunar economy as well. The company has, for instance, become an end-to-end operator in the critical infrastructure needed to operate on the Moon.¹¹⁶

This includes lunar terrain vehicles, communication data services, as well as a navigation system for the Moon. Recent talks between the United States and India have discussed jointly building a navigation system for the Moon, either in orbit or on the Moon itself.¹¹⁷ More such projects focusing on the lunar and cis-lunar economy should be pursued. Here, the Artemis Accords could possibly be leveraged, too. As per the interviews we conducted, a workshop focused on the Artemis Accords signatories was held in Montreal, Canada in May 2024. The workshop focused on discussions regarding the key principles of the Artemis Accords—non-interference and sharing scientific data. Going ahead, according to an Indian government official we interviewed, in future editions of discussions regarding the Artemis Accords, India will also be looking at how a larger role for its private space sector could be accommodated.

On Export Controls

Prime Minister Modi and President Biden committed their administrations to promoting policies and adapting regulations that facilitate greater technology sharing, co-development, and co-production opportunities between U.S. and Indian industry, government, and academic institutions. The leaders welcomed the launch of the interagency-led Strategic Trade Dialogue in June 2023 and directed both sides to undertake regular efforts to address export controls, explore ways of enhancing high technology commerce, and facilitate technology transfer between the two countries.¹¹⁸

In May 2022, on the day the iCET was first announced, one of the authors of this paper happened to be in Washington, speaking to U.S. officials, who, at the time, were only beginning to jot down ideas on a blank canvas and were clear about the need to do more in semiconductors, quantum computing, and telecom in general (such as O-RAN and 5G standards).¹¹⁹ The need to address export control issues with the view to deepen technological partnerships was tangentially mentioned. In India, it was clear that this was one of the primary motivations behind the conceptualization of the iCET. “Getting exemptions and easing regulatory burdens” from the United States was a major objective, as senior Indian officials made clear to us.¹²⁰ This was also the outcome of a study that the NSCS had done with stakeholders in India between 2021 and 2022 before the iCET was announced. As various conversations in the United States and India on the iCET grew in both scale and depth, the emphasis on export controls was unmistakable.

The first large, less-official, agenda-setting iCET roundtable, with representatives from the NSC, NSCS, other government departments from the United States and India, industry and industry bodies, and think tanks, was hosted at the Carnegie India–Ministry of External

Affairs Global Technology Summit in December 2022. The focus areas were semiconductors, AI (with a focus on compute), and quantum computing. Interestingly, defense was not a central focus of the iCET discussion at the time. In each of the interventions, made primarily by industry leaders in India, it was clear that the iCET could only succeed in its vision to cement strategic technology ties if export control and the frictions on licensing were resolved, or at least addressed, at the highest levels of the U.S. government.

In January 2023, by the time Doval and Sullivan held the first set of official iCET meetings in Washington and launched the iCET, export controls and defense were placed at the heart of the iCET agenda. The iCET imperatives on defense are discussed in the next section. On export controls, the key question that arose was: “what is to be done?” Many in India argued that the country ought to be given a blanket waiver from the State Department’s International Traffic in Arms Regulations (ITAR).¹²¹ “This is the main obstacle to our growth,” was the refrain amongst Indian business leaders and officials.

However, as we learned in a series of interactions with various agencies in the United States, this was not going to happen. The ITAR was last reformed in 2013.¹²² In early 2023, if anything, the U.S. government was looking at ways to provide exceptions to Australia and the United Kingdom for the AUKUS submarine deal with the United States.¹²³ There was no chance of India being considered for a blanket waiver. This was made clear to us across the U.S. system. In May 2024, changes in the ITAR were announced to “create a license exemption supporting billions of dollars in license-free defense trade between Australia, the United Kingdom, and the United States.”¹²⁴ In addition, it allows for “deeper security cooperation and innovation among AUKUS partners.” This may reshape Indian imperatives, which we discuss below.

At the time, in the first half of 2023, the more Indian industry engaged with U.S. export controllers—facilitated by and through the iCET—they realized that a lot could be done by way of getting clearances under the ITAR threshold. The large Indian primes could afford top lawyers in Washington, to unpack this for them. Those who needed to be more directly supported and guided were India’s startups and mid-sized firms, like the aforementioned space companies, that did not have adequate means or access.

It took some time for the U.S. system and export controllers in the Department of State’s Export Control and Border Security and the Department of Commerce’s Bureau of Industry and Security (BIS) to fully grasp this need. The NSC, as we understand, played a key role in nudging these departments to do more with and in India. This was not easy. For most administrators in these bureaus, the main efforts of action were directed against China and Russia. The need to bridge ties with India and do more with Indian companies invested in strategic technologies became a major objective partly because of the many iCET discussions that highlighted the glaring gap.

The need to exchange knowledge on export controls—a mind-numbingly dense landscape in any country, especially the United States—was given attention later in the first quarter of 2023. To be clear, in the first factsheet following the January 2023 Doval–Sullivan meetings, there was no mention of export controls in the five-page readout.¹²⁵ The only mention of cooperating on regulation was with reference to telecommunications: the future of 5G, 6G, and O-RAN. Factsheets are important since anything on them automatically becomes a point of policy. “These are hard-won words,” explained one negotiator to us early in 2023.¹²⁶

However, the need to address export control queries from companies in India was soon clear to U.S. administrators. In March 2023, U.S. Secretary of Commerce Gina Raimondo and Indian External Affairs Minister S. Jaishankar announced the creation of the Strategic Trade Dialogue, to be anchored by the U.S. Commerce Ministry and the Indian MEA.¹²⁷ In our view, this is one of the most consequential outcomes of the iCET process. It is also noteworthy that this dialogue was and is housed by the respective ministries in the United States and India. This does a lot for institutionalizing a process that requires dedicated divisions (in India) and bureaus (in the United States) that in turn have dedicated capacities for export controls.

In keeping with this momentum, in April 2023, U.S. Assistant Secretary of Commerce Thea Kendler and her team at the BIS, along with counterparts from the State Department, ran a workshop in Bengaluru.¹²⁸ Around fifty Indian companies and those from government and think tanks like ours took part in the workshop. Our assessment upon speaking to many of the company representatives in the room was that this was a successful process. There was a perceivable knowledge gap between those wanting licenses and exemptions (Indian companies) and those authorizing the same (controllers). This is especially important for technology companies (like in space and defense) that by nature produce dual-use products.

On June 6, 2023, a fortnight before Modi’s state visit to Washington, the Strategic Trade Dialogue was launched.¹²⁹ Foreign Secretary Vinay Kwatra led the Indian delegation. Discussions were held in Washington with a U.S. team led by Alan Estevez, the undersecretary for industry in the Department of Commerce, and Victoria Nuland in the State Department. That this process was led by the Indian foreign secretary (the U.S. equivalent to the undersecretary of state) is vital. It reflects the importance given to this dialogue by both sides. The MEA also has the capabilities to deal with export control issues alongside the division that is dedicated to working with the United States—the Americas Division. Moreover, it institutionalizes a crucial channel to unblock regulatory barriers to deepening strategic technology ties.

Among the objectives of the first Strategic Trade Dialogue, there was the need to enhance awareness among stakeholders regarding the export control regime through workshops. Over the last one year, there have been a series of workshops convened by either industry bodies or think tanks. In December 2023, over a hundred Indian companies and officials attended a set of workshops led by export controllers from the U.S. DoD, BIS, and State Department. The Fifth Annual India–U.S. 2+2 Ministerial Dialogue held in December

2023 also acknowledged the need to facilitate technology transfer through the Strategic Trade Dialogue and its affiliated working groups.¹³⁰ This was followed by the INDUS-X Summit held in India in February 2024, where a session was organized on both the U.S. and Indian export control regimes. We discuss the INDUS-X in more detail in the next section.

From the outset, these exchanges have been decisive. In some cases, Indian entrepreneurs have gotten licenses in a record three to four months, a process that would ordinarily take a year or more. An ecosystem has been created between technologists, firms, and export controllers. Access has become much easier. The MEA is on the front foot, engaging directly with those in need of assistance. From our perspective, and as far as the June 2023 joint statement is concerned, this part of the iCET is gradually delivering outcomes.

There is still a long way to go. Following the exemptions given to Australia and the United Kingdom for AUKUS, there is also merit in revisiting the question of large-scale exemptions for Indian firms and ITAR reform. This may not be realized anytime soon, especially with the United States currently in election mode, but it is something that need not necessarily seem impossible, as we had assumed in early 2023.

There is a “Russia problem,” as some U.S. officials put it, that at times sits squarely at the center of arguments for and against deepening ties in particular areas.¹³¹ But, as Indian interlocutors have made clear to us, specifics need to be discussed.¹³² Whether it is on quantum computing or the potential of an agreement on nuclear submarines down the line, dealing with definite apprehensions provides some space for maneuver. Generalities do little for change.

In the meantime, other nations such as France have moved to supply India to build a nuclear submarine.¹³³ Press reports highlighted that the Macron government was open to discussing and supporting the construction of nuclear submarines with a promise of 100 percent transfer of technology (ToT). Clearly, France is keen to build on its defense industrial roadmap with India, which was launched earlier this year in January.¹³⁴

Overall, the primary takeaway from the various workshops has been that India has come a long way when it comes to the overall scheme of export control regime in the United States. Despite the over 40,000 applications received by the BIS every year regarding all of the export control review applications, their denials tend to be in the range of 500–800 per year. The BIS denies approximately only 1 percent of the total applications made to it.¹³⁵ The trend with respect to India is similar. At the same time, there is also a view amongst Indian officials that the extent of paperwork required to apply for licenses is cumbersome, deterring firms from even doing so. Indian firms that attended the third INDUS-X Summit in Palo Alto in September 2024 also underlined the need to fix delays and further clarify processes.¹³⁶

Further, in terms of clarity and progress, as per the BIS workshop conducted in April 2023 in Bengaluru, it was stated that earlier, there were 300 companies from India on the Entity List. First published by the BIS in 1997, the list was introduced to inform the general public of entities that engaged in conduct suggestive of an increased risk of diversion of exported items to countries that may use them in weapons of mass destruction programs or carry out activity contrary to U.S. foreign policy interests.¹³⁷

The Entity List subjects companies in it to additional and specific requirements for the export of specific items, in addition to their obligations under the Export Administration Regulations (EAR). The number of companies from India on this Entity List in 2024 was in single digits, compared to the 300 companies on it in the late 1990s. The change in dynamics has much to do with the deep investments that have been made by successive administrations and governments in India and the United States in the last two decades. The attention on export controls since the creation of the iCET has jettisoned these efforts and also opened new pathways for interaction between multiple actors in both countries—including in the governments—fixated on deepening strategic and business ties.

Lastly, it is worth keeping in mind that presently, less than 0.5 percent of exports from the United States to India require an EAR license. The EAR largely governs the export of commercial items and, to a limited extent, that of “specially designed or modified for military items.”¹³⁸ Also, India enjoys an Strategic Trade Authorization-1 (STA-1) exemption issued by the U.S. Department of Commerce in 2018, which is relevant when it comes to allowing the unlicensed export, reexport, and in-country transfer of products to thirty-six U.S. allies. India, despite not being an official “ally,” was provided with the STA-1 exemption in 2018.¹³⁹ However, the overall STA exemption is used to the tune of \$1.3 billion by other countries.¹⁴⁰ For India, the figure is around only \$7.7 million for 2022. This needs to be understood better.¹⁴¹

Out to 2025: What Could Be Next?

To build on the momentum on export control discussions and workshops over 2023, we suggest the following actions.

Expanding the Validated End-User exemption for India

“Validated End-User (VEU) reduces the licensing burden on the industry by allowing U.S. exporters to ship designated items to pre-approved entities under a general authorization instead of under multiple individual export licenses.”¹⁴² Being approved for VEU status enables entities in VEU-approved countries to receive U.S.-controlled products and technologies more easily, quickly, and reliably. Currently, only GE India enjoys a VEU status in India, whereas a country like China enjoys VEU status being given to ten entities.¹⁴³ This list with respect to India can be expanded to include other Indian entities that are increasingly involved in the coproduction of defense items with U.S. firms.

Investing in a Legal Cell to Support MSME's with Export Controls

The larger firms that deal with the United States have the capacity to deal with 800-page ITAR applications and other paperwork. Mid-sized firms and startups do not have such capacities or resources. The Government of India, through existing institutions such as Invest India or Start-up India, could consider investing in a legal cell to support Indian firms engaging with the complicated world of controls in the United States.¹⁴⁴ Together, the Indian and the U.S. governments could support these relatively low cost, but potentially highly effective, legal aid channels through the Indo-U.S. Science and Technology Forum.¹⁴⁵ Among those that we have engaged with in the startup ecosystem, there is a clear need and demand for such assistance being made available to them.

Liberalizing the trade in spacecraft technology

Under the U.S. Department of Commerce Country Chart of the Code of Federal Regulations, entities in India still require a license for sensors and lasers as well as on-board systems or equipment specially designed for spacecraft and having any of the following functions: command and telemetry data handling, payload data handling, or altitude and orbit control. These can be traced back to Regulation ECCN 9A515e.¹⁴⁶ The purported rationale for requiring a license here is “regional stability”—a ground that India may wish to seek more clarifying details on. Furthermore, India, through its successive generations of special launch vehicles, has demonstrated the know-how and capability with respect to spacecraft technology anyway. The purpose served by maintaining this license requirement that was last revised in 2015 remains unclear.¹⁴⁷

Allowing a more permissive export regime for focal plane arrays

Furthermore, under Regulation ECCNs 6A003.b.4.b., imaging cameras incorporating “focal plane arrays” also require a license when exported to India.¹⁴⁸ This specific regulation, in turn, refers to Regulation ECCN 6A002.a.3.f, which details that a license would be required for a “non-space qualified” infrared focal plane array. Here, it may be noted that India’s indigenous development of infrared focal plane arrays started as far back as October 2011 under the earlier Twelfth Five-Year Plan of the Department of Space.¹⁴⁹ More recently, the Indian Institute of Astrophysics, Bengaluru, a premier research institute in astronomy and astrophysics, has already partnered with the Canadian Space Agency (CSA) to develop focal plane arrays and other sub-systems for use in the INSIST-CASTOR collaboration project.¹⁵⁰

Indian Spectroscopic and Imaging Space Telescope (INSIST) is a dedicated ultraviolet (UV) mission to observe the skies. Similarly, the Cosmological Advanced Survey Telescope for Optical and UV Research (CASTOR) is a proposed CSA mission that would image the skies at UV and blue-optical wavelengths. Since India has already developed the technological wherewithal to deploy focal plane arrays and is partnering on cutting-edge missions in this domain, it is suggested that the concerned license requirement for focal plane arrays be done away with.

Export control rules are usually devised and enforced by a team of scientists and engineers, in addition to the various export control bureaucracies. It is a highly technical endeavor, where inputs are sought from industry, academia, and intelligence officials. However, in the past, it has been seen in the United States that in technological fields with a high innovation rate, export control limits were revised “on a regular basis to reflect the shift of the cutting-edge of development, the ‘diffusion’ of technology to other countries, and the change in global technology markets.”¹⁵¹ It is perhaps time to do the same with respect to the changes suggested above as well.

The GE-F414 jet engine deal detailed below was an exemplar of what it signaled to the highly influential and tightly enmeshed U.S. export control bureaucracies. Export controls have now become tools in the economic arsenal of the United States where their trade element is becoming subsidiary to the national security prerogatives. This is also taking place at a time when globalization, with its connotation of free flows of trade and technology, is undergoing a significant recalibration.

The fact that India has been able to secure the relevant congressional waivers for the GE-F414 jet engine in such circumstances is a huge confidence-building measure when it comes to prospects regarding future tech transfer—a fact that should guide any future discussion on the topic.¹⁵² Indeed, it should also be remembered that these waivers and the entire effort in the United States to process the same within the DoD, and shepherded by the NSC, “broke a lot of eggs” in the system, as one negotiator put it to us. The imperative to do so was shaped by the direction that the iCET has taken. The jet deal predated the iCET. Much like the case of Micron, it is debatable whether or not this is an iCET win or a legacy agreement that was repackaged under the iCET.

What is clearer to us is that the creation of the iCET structure, which in turn is partially designed to reorient the administrative energy in bureaucracies toward outcomes, continues to shape the ongoing negotiations on this age-old arrangement. This includes making a hard push for export control releases in the United States and making sure that technology transfers for the coproduction facility in India are clearly protected against leakages and misuse. The September 2024 factsheet does acknowledge this and goes on to “redouble efforts to address export controls, enhance high technology commerce.”¹⁵³

On Defense

President Biden and Prime Minister Modi hailed the landmark signing of an MoU between General Electric and Hindustan Aeronautics Limited for the manufacture of GE F414 jet engines in India, for the Hindustan Aeronautics Limited Light Combat Aircraft Mk 2. This trailblazing initiative to manufacture F-414 engines in India will enable greater transfer of U.S. jet engine technology than ever before. The leaders committed their governments to working collaboratively and expeditiously to support the advancement of this unprecedented co-production and technology transfer proposal.

The leaders welcomed the setting up and launch of the U.S.-India Defense Acceleration Ecosystem (INDUS-X). As a network of universities, startups, industry and think tanks, INDUS-X will facilitate joint defense technology innovation, and co-production of advanced defense technology between the respective industries of the two countries. The U.S. Department of Defense's Space Force has signed its first International Cooperative Research and Development Agreement with Indian start-up 114 AI and 3rdiTech. Both companies will work with General Atomics to co-develop components using cutting edge technologies in AI and semiconductors respectively.

President Biden and Prime Minister Modi welcomed India's plans to procure General Atomics MQ-9B HALE UAVs. The MQ-9Bs, which will be assembled in India, will enhance the ISR capabilities of India's armed forces across domains. As part of this plan, General Atomics will also establish a Comprehensive Global MRO facility in India to support of India's long-term goals to boost indigenous defense capabilities.¹⁵⁴

In April 2023, in a small room in Central Delhi, a group of officials and experts got together to brainstorm a new initiative—the India–United States Defence Accelerator Ecosystem (INDUS-X).¹⁵⁵ At the time, the term had only recently started doing the rounds between the U.S. Department of Defense (DoD), the Indian Ministry of Defence (MoD), the two respective embassies in New Delhi and Washington, and a few others.

This was to be a part and parcel of the broader iCET agenda. It soon found an institutional home in both countries. In India, INDUS-X is anchored by the Innovation for Defence Excellence (iDEX), a special purpose vehicle (bureaucratic speak for a subsidiary) under the MoD.¹⁵⁶ The Defense Innovation Unit (DIU) in the United States serves as a counterpart to the iDEX.¹⁵⁷ Based in California, the DIU is “the only DoD organization focused exclusively on fielding and scaling commercial technology across the U.S. military at commercial speeds.”¹⁵⁸ A memorandum of intent (MoI) was signed between the iDEX and the DIU in 2017 during Modi's visit to Washington.¹⁵⁹ This was the first time Modi met with the newly

elected president, Donald Trump. The MoI provided a necessary formal architecture for the new set of collaborations under the INDUS-X. The existence and need for this formal structure should not be undervalued. The first major military agreement signed between the two countries was in 2002.¹⁶⁰

Modi's June 2023 state visit to Washington served as a forcing function for everyone involved. The INDUS-X needed to be delivered. Within days of the small-room meeting in April, weekly calls were set up. Officials, experts, industry representatives, and industry representation bodies were called in every week. The INDUS-X was fleshed out. This was quintessentially a set of brainstorming sessions designed to avoid traps and missteps of such initiatives in the past and to make sure that the private sector was a stakeholder from day one. This loose and unstructured approach may have initially riled officials who are more used to typeset agendas. But the value of this process was soon clear to all. Big online meetings would be preceded and succeeded by several small gatherings. The NSCS, MEA, MoD, and NSC filled gaps and made sure that the INDUS-X approach was squarely tied to the larger iCET imperative of cross-leveraging partnerships where possible.

The advance worked.

A day before Modi traveled to Washington, INDUS-X was launched at the U.S. Chambers of Commerce.¹⁶¹ An exhibition of defense-related products was put on by Indian startups. Panel discussions on everything from the need for patient capital to export control waivers dotted the thick agenda.¹⁶² Business cards were exchanged. U.S. investors got a clear sense of what is available in India. Indian primes, micro, small and medium enterprises (MSMEs), startups, and officials understood what it would take to attract capital and access niche technologies. It is our understanding that these exchanges have led to a set of investments and coproduction opportunities. Some agreements have been inked, as underlined in the June 2023 joint statement. Mostly, as a VC in Silicon Valley told us a year later, the INDUS-X ecosystem offered "discoverability" to both sides.¹⁶³ "We had no idea that India had serious space capabilities in the private sector," was the refrain amongst those in the United States who interacted with India's budding entrepreneurs.¹⁶⁴

Eight months later, in February 2024, the second INDUS-X Summit took place.¹⁶⁵ Senior officials from the United States traveled to New Delhi. Over two days, startups and MSMEs exhibited their advancements. This time, the quality of the conversation had changed. These meetings were more about getting deals done. Export controllers spent a lot more time on specific queries on licenses and processes. The questions were sharper. The answers provided a little more space for experimentation, as opposed to the usual approach taken by administrators wedded to controls. At private events hosted by competing industry bodies, the discourse had a focused direction.¹⁶⁶ U.S. officials came with clearer asks, and Indian industry leaders responded with their own demands. The results of the two summits, in a period of less than a year, were more than noteworthy.¹⁶⁷

As our Carnegie India colleagues Ajay Kumar and Tejas Bharadwaj surmise, in possibly the most detailed essay on INDUS-X and the way forward inked to date, the defense innovation bridge is off to a promising start.¹⁶⁸ The initiative builds upon layers of past efforts going back to 2002.¹⁶⁹ As mentioned above, this agreement facilitated the sharing of military intelligence. In 2018, India was given what is called the STA-1 status.¹⁷⁰ This is a license exception that allows Indian firms access to controlled technologies.¹⁷¹ In 2012, government officials in both countries embarked on the Defense Trade and Technology Initiative (DTTI).¹⁷² Over time, for those in India, it was clear that DTTI “faced challenges such as technology transfer restrictions.”¹⁷³ It was also clear at the time that there was a “mismatch of expectations between the two sides.”¹⁷⁴ Yet, by 2023, when the iCET was officially launched, the Indian startup ecosystem had matured. The iDEX had played an important role in supporting the creation of this ecosystem. Space and defense companies now dotted the landscape. Within India, there was a need for an initiative that opened doors in the United States and allowed entrepreneurs and financial backers to access export controllers, technologies, and capital.

The INDUS-X could not have been better-timed. Since its launch in June 2023, a wider ecosystem of officials (export controllers, those from the DoD, Indian MoD, DIU, and iDEX, and others), private sector players, VCs, academics, industry body representatives, and think tankers have invested time and capital in this new approach. It is important to note that the INDUS-X is not a replacement for the DTTI.¹⁷⁵ The former is largely led by the private sector. Although anchored by DIU in the United States and iDEX in India, it is about creating a new marketplace for deals, competition, and innovation. The wide spectrum of deliverables includes joint challenges—the second round of which was announced in February 2024—on space-based intelligence, surveillance, and reconnaissance (ISR) workshops at universities, a knowledge exchange education series, exhibitions, and much else. The aforementioned Kumar-Bharadwaj essay has all the details.¹⁷⁶

The third INDUS-X Summit was convened in Silicon Valley in September 2024. Much “business” was conducted—another MoU between IDEX and DIU, further issuing of new challenges, and the release of a new INDUS-X Impact Report.¹⁷⁷ Going ahead, what may be needed is a focused discussion on the need for a joint fund and patient capital for strategic technologies, a framework for a testing consortium that is essential for companies from both countries to use each other’s facilities for a testing kit, and a lot else.¹⁷⁸ Furthermore, while both governments have thus far driven the INDUS-X, what will be needed in the future is for organic B2B collaboration and the possibility of winners from the two countries to collaborate and split the development process. Every year, the INDUS-X ecosystem grows. Tapping into the intelligence, innovation, and capital available in Silicon Valley is a creative and excellent way to electrify the fusions between Indian and U.S. entities. It would be equally moot to host the fourth INDUS-X Summit in Bengaluru, Pune, or Hyderabad—the tech innovation capitals in India.

As per the June 2023 joint statement, INDUS-X is doing exactly what is on the tin, as it were. There is much that can be done, as we outline below. As for the two defense agreements mentioned in the joint statement—the GE F414 jet engine agreement to manufacture in India with the Hindustan Aeronautics Limited (HAL) and the sale of General Atomics MQ-9B HALE unmanned aerial vehicles (UAVs) to India (to be assembled in India)—our understanding is as follows.

On the General Electric (GE) deal, the joint statement stated that “the leaders committed their governments to working collaboratively and expeditiously to support the advancement of this unprecedented co-production and technology transfer proposal.”¹⁷⁹ On June 22, 2023, during Modi’s visit to Washington, an MoU was signed between GE Aerospace and the HAL.¹⁸⁰ This was for the joint production of engines for India’s light combat aircraft.¹⁸¹ The press release at the time made clear that this was subject to receiving the necessary export authorization[s].¹⁸² On July 28, as per the established processes, the U.S. State Department formally notified the U.S. Congress about the potential deal.¹⁸³

At the end of August, insiders in the Biden administration confirmed that the agreement could go ahead, as there were no objections raised in the thirty-day period since the U.S. Congress had been notified.¹⁸⁴ The Congress had essentially given its nod. On August 19, the HAL gave an order for ninety-nine F404-GE-IN20 engines.¹⁸⁵ These are to be jointly produced with the HAL, reportedly with 80 percent ToT, including areas that were considered “off limits more than a decade ago,” according to defense journalists following this beat.¹⁸⁶ Again, reportedly, 75 percent of the engines are to be manufactured indigenously in India. The threshold of 80 percent is a sea change from the earlier 58 percent technology transfer that was agreed upon by both governments a decade ago. The higher percentage of technology transfer is a result of the United States providing technology in eleven critical areas that were seen as “off-limits” earlier. A press report details these areas.¹⁸⁷

As we understand it, negotiations are underway for the GE–HAL joint production agreement. The end result will come down to commercial arrangements and other specifics between the two sides. We can only assume that HAL’s long-term and established relationship with Russian firms is a matter that is part and parcel of the current negotiations. As per the June 2023 statement, the governments have done their part. It is now up to GE Aerospace—a private sector company—and HAL, a public sector unit in India to complete the agreement. The conclusion of this agreement will serve as a milestone in the long and complicated history of U.S.–India relations. This will potentially open other commercial and manufacturing opportunities in India. While insiders who we have spoken to complain of the delays in the process, as yet, there is nothing to suggest—to us, at least—that this agreement is off-track.

Also, in the September 2024 factsheet, India’s decision to set a uniform Goods and Services Tax (GST) of 5 percent on the maintenance, repair, and overhaul (MRO) sector, including on all aircraft and aircraft engine parts was welcomed by the U.S. administration.¹⁸⁸ This may be helpful for General Atomics in setting up the Comprehensive Global MRO facility, which was announced earlier in June 2023, to help assemble the MQ-9B HALE UAVs in India.

Lastly, the 2023 joint statement underscored “India’s plans to procure General Atomics MQ-9B HALE UAVs.”¹⁸⁹ Accordingly, thirty-one such drones—the maritime-focused SeaGuardian and the all-weather SkyGuardian—are to be given to the three services of the Indian military.¹⁹⁰ On June 15, the Indian Defence Acquisition Council, chaired by the Indian defense minister, provided an Acceptance of Necessity (AoN) for the potential procurement of the drones.¹⁹¹ An AoN is usually provided when there is either an “imminent” need to be addressed or a particular capability is categorized as “operationally critical equipment,” as per the Indian MoD’s procedures. In late August or early September, the Indian government sent a letter of request to the Biden administration.¹⁹²

This was just before the U.S. president was expected in India for the G20 Leaders’ Summit on September 9–10. Subsequently, the U.S. State Department “made a determination” approving the sale to India.¹⁹³ On February 1, 2024, the U.S. Defense Security Cooperation Agency “delivered the required certification notifying Congress” of the sale.¹⁹⁴ This is a formal notification following what is known as an “informal notification” process: giving members of the Senate Foreign Relations Committee and House Foreign Relations Committee time to “ask questions or raise concerns prior to the Department of State initiating formal notification.”¹⁹⁵

As has also been widely reported in the press, during this time, tough questions were asked of the administration. Uncannily, the procedural track for the drone deal was in parallel to difficult discussions within the U.S. administration as well as between the Biden administration and the U.S. Congress on an alleged assassination plot sanctioned purportedly by someone in Indian security forces on U.S. soil.¹⁹⁶ What mattered, from an iCET perspective, was that an arms deal was caught in the middle of a controversy. Tough deliberations went on between August 2023 and early February 2024.¹⁹⁷ Finally, on February 2, 2024, Senator Ben Cardin, the chair of the U.S. Senate Foreign Relations Committee, approved the sale of MQ-9B drones to India. In a press statement that caught many by surprise, he did not fail to mention that his approval “was the result of months of painstaking discussions with the Biden administration.”¹⁹⁸ As per procedure, a draft letter of acceptance (LoA) was kept open for objections by legislators on the Hill. On March 15, 2024, with no objections, the LoA was sent to India.

On 15 October 2024, the two governments finally signed an agreement for India to procure the drones.¹⁹⁹ This came down to the wire. Pricing, levels of ToT, the exact role of indigenous production, and other commercial arrangements led to several delays. The conclusion of this agreement will no doubt deepen the technology ecosystem that India would like to shape and even produce. It provides a fillip to domestic firms invested in strategic technologies and potentially opens pathways for genuine co-development of such technologies. We spent some time to understand what helped in getting this agreement thus far. Three points stand out.

First, while the genesis of this agreement can be traced back to at least 2016, we are convinced that the iCET structure (being anchored by the NSC and the NSCS) was critical in the revitalization of this particular arrangement. Indeed, as officials in both Indian and

the United States have openly made clear to us on several occasions since 2022, the iCET is designed as much for new arrangements as it is for “springboarding”—as an Indian official put it to us in December 2023—ideas and potential deals (like GE and the General Atomics sale) that have “not moved” for whatever set of reasons.²⁰⁰

Second, the ability of the system as a whole, especially in the United States, to negotiate complicated procedures at a time when the “India conversation”—as Congressional staffers put it to us—was overshadowed by “other” factors. The larger imperatives of the iCET—led by the top and designed to reenergize legacy agreements and forge new ones—helped steer an outcome that both the U.S. and Indian governments wanted. Getting the agreement signed is a clear expression of strategic clarity.

Third, and most importantly, the broader role of the MEA and the State Department was and is essential. These are, after all, entities that have far deeper engagements. This of course alludes to a broader question about a sustainable institutional structure for the iCET, which we discuss in the last section of this paper.

In sum, and as per the June 2023 joint statement, it is clear to us that the needle is moving on key lines of effort. There is a need to conclude another landmark agreement in this vertical (GE–HAL). There is also an opportunity at this time to consider pushing the boundaries on the defense side of the iCET as follows.

Out to 2025: What Could Be Next?

The INDUS-X Fund

Since the summer of 2023, there have been several rounds of discussions with regard to an INDUS-X fund. This is still to be created. The third INDUS-X Summit in September 2024 in Silicon Valley was partially designed to address this, bring VCs on board, and perhaps create a structure for a fund that is effective. There is no doubt a need for such funds. Patient capital is hard to come by. Rather than trying to create this from scratch with government buy-in, it might be worth asking professional fund managers from established institutions to create and manage this on a purely professional basis. Our conversations with VCs in the Valley suggest the same. The two governments can contribute to this. The Indian MeitY has similar funding arrangements in the startup space. The structure could be replicated for an INDUS-X fund. Indeed, the iDEX team could consider adapting tried-and-trusted pathways created by the MeitY.

Further, we recommend that those setting up the INDUS-X fund discuss the same with officials from NATO who have created an innovation fund with a capital of \$1 billion—Defence Innovation Accelerator for the North Atlantic (DIANA).²⁰¹ As NATO officials have explained to us, it is essentially a “multi-sovereign venture fund” dedicated to supporting dual-use technologies. Twenty-four NATO allies support DIANA. Importantly, funds like this are also designed to support key firms and technologies that produce cutting-edge

strategic technology but do not always have access to patient capital. They are vulnerable to capture by foreign firms with unclear ties to governments that are less friendly. We make these suggestions of engaging with this team at NATO for the simple reason that there are lessons that can be adopted immediately for the INDUS-X. Also, the priority areas for DIANA are very similar to those of interest to the INDUS-X process. This is by no means a suggestion to do something functional with NATO but only to exchange knowledge about what has worked and what has not in the business of augmenting strategic technologies.

Security of Supply Arrangement

Other bilateral agreements could be negotiated with the United States that may enable companies from both countries to work with each other in a far more accessible manner. Most recently, in August 2024, the United States and India signed a Security of Supply Arrangement (SOSA) after being in negotiations for over a year.²⁰² The United States has signed SOSA agreements with only seventeen other countries so far. The purpose of a SOSA is to ensure mutual and timely provision of defense-related goods and services. It would allow the U.S. DoD as well as the Indian MoD to request prioritized performance of contracts from companies from each other's countries. The SOSA may offer both countries advantages, such as possible follow-on orders for the Indian defense industry, once they prove their credentials as reliable suppliers under a procurement contract arising from a SOSA request, as well as provide U.S. firms familiarity with the procurement practices of the Indian government and its defense bureaucracy.²⁰³

Reciprocal Defense Procurement agreement

Talks are also progressing on a Reciprocal Defense Procurement (RDP) agreement between the United States and India.²⁰⁴ An RDP is essentially an MoU that relates to the reciprocal procurement of defense items. Each RDP MoU is individually negotiated and may contain varying levels of detail. In effect, the RDP ensures that the signatory nation will not discriminate against the suppliers from its counterpart signatory when it comes to defense procurement. These suppliers are also exempted from the applicability of the Buy American Act.²⁰⁵

Lastly, Kumar and Bharadwaj have detailed a set of clear recommendations to expand the INDUS-X.²⁰⁶ These include expanding joint challenges and providing greater clarity on “procurement of technologies developed under the joint challenges,” doing more for “facilitating access to testing centers” under INDUSWERX—a new initiative for reciprocal access to testing sites and the evaluation of new technologies—and initiating an INDUS-X fellowship akin to the Quad Fellowship started in 2020, supported by the private sector.²⁰⁷

On AI and Biotechnology

The leaders welcomed the launch of a \$2 million grant program under the India-U.S. Science and Technology Endowment fund for the joint development and commercialization of Artificial Intelligence (AI) and quantum technologies, and encouraged public-private collaborations to develop high performance computing (HPC) facilities in India. President Biden also reiterated his government's commitment to work with U.S. Congress to lower barriers to U.S. exports to India of HPC technology and source code. The U.S. side pledged to make its best efforts in support of India's Center for Development of Advanced Computing (C-DAC) joining the U.S. Accelerated Data Analytics and Computing (ADAC) Institute.

Both Prime Minister Modi and President Biden acknowledge the profound opportunities and significant risks associated with AI. Accordingly, they committed to develop joint and international collaboration on trustworthy and responsible AI, including generative AI, to advance AI education and workforce initiatives, promote commercial opportunities, and mitigate against discrimination and bias. The United States also supports India's leadership as Chair of the Global Partnership on AI.

The leaders called on their administrations to extend these partnerships to advanced biotechnology and biomanufacturing, and enhance biosafety and biosecurity innovation, practices, and norms.²⁰⁸

There is an ongoing conversation between the two sides on high-performing computing (HPC). An AI cluster is in the process of being shifted to India to create “a hub for innovation.”²⁰⁹ There are other such initiatives being considered with the support of state governments within India. We have no visibility on the support that the joint statement mentions have been provided to C-DAC. This might well be underway. Yet, our impression is that AI is a line of effort that needs a fillip. We have not seen much happen apart from Track 1.5 meetings thus far. We anchored one of these meetings in December 2023 with key officials from the United States and India as well as industry leads and experts from both countries. These meetings are crucial. The December meeting took place soon after the U.S. Executive Order on Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence was published in October 2023.²¹⁰ A set of U.S. companies had also signed up to “voluntary commitments” that underscore “safety, security and trust” in July 2023.²¹¹ Eight more companies signed in September 2023.²¹²

The Track 1.5 provided an ideal opportunity for key decisionmakers to explain these initiatives and allow Indian interlocutors to get the clarity they wanted. Equally, it provided U.S. interlocutors to get a sense of how the Government of India is beginning to think about the future of AI and the declared need to build compute capacity. These intentions were also articulated in the December 2023 declaration of the Global Partnership on Artificial Intelligence (GPAI) under India's Presidency.²¹³

What also came through in the GPAI meetings was that India was and is seen as a genuine voice of the Global South. Participants from the United States kept returning to this point and emphasized its importance in subsequent meetings with us. To be clear, GPAI ministerial meetings in 2024 have also emphasized the importance of the Global South and how important it is to better understand the AI needs of countries in Africa, Asia, and Latin America.²¹⁴ More could be done on the sidelines of large meetings such as this to leverage iCET imperatives, push the boundaries, and help take actions to improve access to compute and full-stack solutions (including clean hardware). Such meetings could open up potential economic benefits of AI to countries that have such a demand, and more importantly, where the competition providing less transparent alternatives is starkly clear.

Currently, the existing U.S.–India working groups on AI focus on operational ways in which both sides can cooperate and exchange notes on new initiatives (like the international conferences in Bletchley and the Republic of Korea).²¹⁵ There is a strategic element to AI cooperation, which not only focuses on impending regulations but also on ways in which both India and the United States can augment opportunities around the world, especially in the Global South. Further, on the Indian side, it would be beneficial if the relevant divisions in the NSCS, MeitY, and MEA coordinated these efforts—if this is not happening already.

Lastly, it has become increasingly clear that countries’ declarations to build and actually create respective AI safety institutes are strategically important. In May 2024, the United Kingdom and the Republic of Korea cohosted the AI Seoul Summit. Leaders agreed to create an “international network of AI Safety Institutes.”²¹⁶ India, alongside the European Union and twenty-six other countries, was a signatory to the ministerial statement at the end of discussions and negotiations.²¹⁷ Importantly, the statement highlighted “the unique role of AI Safety Institutes” to “enhance international cooperation.” The aim is to “share best practices” and “collaborate in establishing safety testing guidelines.”²¹⁸ It is noteworthy that India was a signatory to this statement. As our colleagues Amlan Mohanty and Tejas Bharadwaj state: “Now is the right time for the Indian government to bring together key stakeholders and convene a strategic dialogue on the need for a national AI safety institute.”²¹⁹ Our sense is that India will, perhaps by the end of 2024, announce the creation of its own version of an AI safety institute.

To this end, there is an urgent need for a Track 1.5-like dialogue where those in India can constantly brainstorm structures, imperatives, and institutional designs with those who have set up such institutes recently or are in the process of doing so. Further, it will be key to arrive at similar approaches to assess and quantify different risk categories and thresholds. We started this process through a detailed workshop held in Bengaluru in October 2024 with officials, market players, AI Safety Institute representatives from the United Kingdom, United States, and Singapore, as well as other experts. This exchange of knowledge was important with key takeaways to consider from an Indian perspective on risk and safety. The United States recently set up such an institute led by Elizabeth Kelly, who has previously served in the Biden White House.²²⁰ Her office meets with counterparts from different parts of the world, such as the European Union, to “deepen bilateral cooperation on AI and foster scientific information exchange[s].”²²¹ Continuing to engage with this outfit will be crucial for India.

We recently met with EU officials and those who had insight on these exploratory sessions with their U.S. counterparts in Brussels. Knowledge exchange sessions such as these can go a long way in helping shape what might potentially be a new institution designed for collaboration but which, of course, must be informed by national imperatives. As Mohanty and Bharadwaj underline, these institutes could be designed in different ways: within national standard-setting bodies (the United States), universities (Singapore), within regulatory authorities (the EU), or without any enforcement authority (the United Kingdom).²²²

Further, there is an equally urgent need to discuss threadbare the implications of export control barriers on AI models and technologies. The June 2023 joint statement mentions that the Biden administration will work with the U.S. Congress “to lower barriers to U.S. export to India of HPC technology and source code.”²²³ In our interactions with officials and those in large technology firms in India, it is clear that the issue of export controls is of primary importance. In May 2024, reportedly, there were discussions of placing controls on “advanced AI models” on both China and Russia. According to news reports, the U.S. Department of Commerce was considering “a new regulatory push to restrict the export of propriety or closed source AI models.”²²⁴ In October 2024, in a workshop hosted by the authors between Indian and American interlocutors, it was made clear to us that the issue of export controls is not going away.²²⁵

Calls such as these, although targeted, have reverberations in India. “Could this happen to us?” is the common refrain amongst insiders who understand both technology and geopolitics.²²⁶ In sum, the iCET framework is the ideal one, at this time, to prioritize these discussions. Too many industry-led iCET meetings focus on defense, semiconductors, space, and other aforementioned lines of effort. Very few thus far have focused on the lines of argument highlighted above. This should change. There is an urgent need to keep open a clear channel for dialogue on such controls and how they impact open-source solutions that are critical to India’s own AI-driven future.

On biotechnology, there is still much to be done. This has come through in our discussions with officials and industry leads in both India and the United States. Our understanding is that Track 1.5 meetings have been held. There is a faint line of effort on fairer practices for Indian and U.S. biotechnology companies invested in each other’s jurisdictions. In early June 2024, workshops were held at the University of California San Diego. The list of participants was impressive.²²⁷

In August and September 2024, U.S. National Academies with partners in India hosted two virtual workshops and an in-person meeting designed to find a pathway for deeper collaborations in genomics, synthetic biology, effective regulatory approaches, and associated areas of interest.²²⁸ Separately, outside of the iCET architecture, the Stanford Mussallem Centre for Biodesign—an incubation hub of sorts—is currently developing low-cost and scalable technology solutions in the broader areas of healthcare. There are several other lines of association between U.S. and Indian entities invested in the future of biotechnologies and cutting-edge research.

The difficulty is that there is no way, at the moment, to connect these different dots of action. There is no one umbrella or structure under which researchers, investors, officials, designers, innovators, regulators, scientists, entrepreneurs, and others can meet. To this end, following the meeting between Sullivan and Doval in New Delhi, a new initiative called Bio-X was highlighted. The aim, according to the factsheet, is to “promote biotechnology cooperation by leveraging the synergies between domestic programs and enhancing the competitiveness of the biotechnology industries in both countries.”²²⁹

Bio-X could be loosely modeled around INDUS-X. The aim would be to create an “innovation bridge” that could “leverage the synergies between the domestic programs of two countries.”²³⁰ With our colleague Shruti Sharma, we have detailed this advance separately in an essay just before Bio-X was formally announced in June 2024.²³¹ A Bio-X summit could connect the dots for Indian and U.S. bio-economies, including parallel tracks of work (such as the efforts at Stanford). It could be anchored by the National Science Foundation (NSF) in the United States and the Department of Biotechnology (DBT) in India. The NSF and DBT already have an agreed-upon implementation agreement.²³² Much like the INDUS-X process, both the DBT and NSF could involve industry representation bodies that are already actively involved in iCET-related efforts.

There are three reasons why a summit could be beneficial. First, it serves as a forcing function for those anchoring these efforts to channel collective energies into one program. Second, the anchors would be accountable for outcomes. Third, it could potentially be the right format for organizing joint challenges in the bio-economy, creating regulatory sandboxes that can benefit the industries of both countries, and even considering a joint fund that coalesces around but goes beyond existing and signed commitments between the NSF and DBT. The summit would be an instrumental step to the leaders’ vision to extend “partnerships to advance biotechnology and biomanufacturing.”²³³ The first one could be hosted in the first half of 2025, following the elections in the United States and timed around a major state visit.

Part II: What Have We Learned in the Past Two Years?

Constant Engagement Helps

The United States and India inked several agreements over the last year, accompanied by a steady flow of commercial announcements between their enterprises. Whether it was the convening of the INDUS-X Senior Advisory Group or the regular visits of delegations from the U.S. Semiconductor Industry Association (SIA), each visit served to generate momentum toward further engagement.²³⁴ At the same time, it is also important to note that this engagement has been worthwhile and translated into tangible outcomes. The INDUS-X meetings led to the announcement of joint challenges in the domain of ISR surveillance as well as undersea communication.²³⁵ The SIA delegation visits were followed by the announcement of the consequential Micron investment, which, as we underline above, has had a significant signaling effect on the Indian semiconductor ecosystem. The Bio-X initiative, if put into practice, could have an equally important impact on the bio-economies of both countries.

The Government Has a Steering Role

The governments of both India and the United States have been adept at promoting the iCET as a problem-solving mechanism. Stakeholders have used the regular iCET Track 1.5 dialogues to bring their problems to the attention of the leadership in their respective countries. This has sensitized both governments to regulatory obstacles as well as facilitated an awareness of what more is required to bring other stakeholders together. The fact that the iCET was led by the national security councils of both countries likely played a critical role in quicker resolutions of any bottlenecks to further deals.

Senior government meetings, whether at the level of the NSAs or otherwise, have been instrumental as a force-functioning mechanism. The 2023 joint statements and the factsheets published thus far do well for transparency. It allows the iCET to be audited by researchers and those in industry, as we have attempted to do in this essay. This momentum ought to continue, making sure that the iCET is focused on deliverables and that gaps, where visible and as also outlined above, are bridged.

Yet, the other side of the framework approach is that it tends to be personality driven. There is a delicate balance that needs to be reached between committed personalities working in a purposefully non-institutional structure. This allows for agility, speed of action, and the space to address a problem through less conventional means as far as diplomacy goes. This also means that when personalities move on, on either side, there is a risk. Given the framework-led design of this unique tract in technology-diplomacy, the iCET needs the

highest levels of personal commitment amongst officials and technocrats alike. The system, perhaps in both countries, is not always incentivized for this kind of advance. We leave these observations here for consideration by policymakers as they think of the future of the iCET. It is something that has a direct causal effect on the outcomes generated.

Positioning the iCET as a Framework

Positioning the iCET as a framework from its inception as opposed to a “deal” allowed a more open appreciation of what the iCET could do.²³⁶ This allowed it the flexibility required to pursue outcomes in whichever direction the stakeholders decided to take. By not limiting the iCET to results that may usually flow from a one-time deal, the framework structure also encouraged regular interaction among its key players. We have seen this ecosystem grow. The iCET discussions in 2022 started with a focus on strategic technologies minus defense, AI, and biotechnologies. Yet, as iCET imperatives continue to grow, it ought not to become a bucket for all that is possible in the wide range of subject areas but rather a process that prioritizes efforts of action with the view to deliver results in critical and emerging technologies.

Showcasing of India’s Deep Technology Capabilities

The iCET has led to high-tech deals being struck. However, this has also served as a reminder that the iCET is not merely about offshoring to India due to its lower labor costs or for India to benefit from supply chain arbitrage as global value chains undergo recalibration. In many ways, the iCET has shown both an appetite among Indian enterprises for receiving high technology as well as the ability of Indian companies to partner and provide cutting-edge tech in their own right.

Discovering Potential on Both Sides

The iCET is designed for both sides to discover the potential for collaboration between varied ecosystems in India and the United States. The steer provided by the governments on both sides is meant to engineer different pathways for discovery. Post January 2023, when the iCET was launched, U.S. export controllers interacting with different elements of the Indian private sector are no longer strangers. For VCs in the Valley and policymakers in Washington, the potential of Indian startups and MSMEs invested in dual-use technologies has been made clear. Indian companies applying for licenses in the United States reveal that processes are faster.

The GE deal, if it goes through, will expand the numbers of vendors in India that are more than capable of becoming part of a global supply chain that is friendly. The INDUS-X has created an orbit of actors that are organically creating commercial opportunities that will no doubt benefit the larger strategic relationship between India and the United States. Bio-X

might well do the same. This verve for discovery must not stop. Even if there is a lacuna in “big deals,” governments and industry actors on both sides must not give up on the need to create opportunities. This is also where top-level leadership is key.

The China Question

Will the iCET survive if U.S.–China relations change? Will it be as important for India if there is some form of rapprochement between India and China? Will the iCET matter if President Xi Jinping were replaced by a Chinese leader who is more open to engagement with the West, especially in light of the current economic troubles inside of China?

There is little doubt in our minds that China’s self-designed aggression on the contested boundary with India and the sharp deterioration in its relations with the United States—over trade, technology, the potential of kinetic action in the Taiwan Strait, dealings with U.S. allies like the Philippines, and other factors—has provided an impetus to bridge and cement strategic technology ties between India and the United States. We see an appetite for those running industrial policies in India and the United States coordinate with each other, however informally. It is unlikely that Micron would have set up in India had it not been for difficulties in the U.S.–China relationship.

There is a clear realization in the United States that supply chains need to be divested from China. As one senior U.S. military official told us, there is a congressional mandate to “diversify all military supplies from China by 2028.” There is, in this official’s words, “an opportunity for both the American military and Indian defense firms.”²³⁷ There is a clear signal that the U.S. military would like to see a portion of its supplies come from India. India provides opportunities and can arrest diverted traffic. Whether or not it is able to do so is dependent upon making it easier for investments to materialize into profits and attracting the right kind of manufacturing into India.

This is only one element that drives the iCET. There is a natural progression and evolution of the U.S.–India relationship that has been boosted by the iCET, especially in niche areas. This is not all about China. This is about a long list of connections between two outsized democracies—the role of the diaspora, familiarity of human resources, and the potential India offers that has been fired by the evolution of new capabilities in and through the development of strategic technologies. This is why large U.S. firms are investing hugely in India. From cloud infrastructure to applications, massive R&D centers to the codesign of future technologies, there is a natural spirit for outcomes that are more than visible in Bengaluru, Gurugram, Pune, Palo Alto, Menlo Park, Hyderabad, and other tech-led hubs in both countries.

This is not to say that the China question is not moot, that the timelines for iCET deliverables are not driven by current elite interpretations and apprehensions about China’s forceful rise. We are not China experts by a wide margin, but even we can see that there is a structural shift in both the United States’ approach to China as well as India’s advance. This will not

alter. In a year from now, the situation along the boundary between India and China may or may not stabilize. Ministerial-level meetings are ongoing. There might even be a bilateral between Prime Minister Narendra Modi and President Xi Jinping if ground realities return to a pre-Galwan or pre-April 2020 status quo.

On the other hand, the current U.S. administration or the incoming win following the November 2024 elections may just decide to change tact and engage more directly with China and look for cooperation where it can. Nonetheless, and following the many conversations we have had with officials, experts, and industry leaders, our sense is that none of the above will significantly change the dynamic of a China that is widely considered to be anything but challenging. This will not mean immediate disinvestments—we are not seeing too much of this, but it will mean that companies and governments will constantly look to hedge the overproduction of strategic tools and supplies from one jurisdiction. It's safe to say that this will remain the age of industrial policy for the near future.

A Trump or Harris Presidency?

“Will the iCET survive Donald Trump? Will it continue with the same fervor under Kamala Harris?” are questions that are, for good reason, constantly posed. We have had some albeit limited interactions with those who are considered—rightly or wrongly—to be close to the Trump campaign. We have also consulted personalities who were a part of the first Trump administration. What is clear is that the imperatives that drive the iCET—in doing more in AI, quantum, defense, and so on—will not necessarily serve as a problem. There is a clear interest in diversifying away from China to create clean supply chains. After all, three of the four foundational defense agreements (Basic Exchange and Cooperation Agreement, Industrial Security Agreement, and Communications Compatibility and Security Agreement) between the United States and India were completed under Trump. The Trump team's focus on tariffs and economic pressures may be challenging in the short term, but this is unlikely to have a long-term effect on strategic technology cooperation.²³⁸ The iCET might be rebranded or redesigned under the Trump administration since it is closely associated with the Biden administration.

None of this seems like a dealbreaker.

As far as Harris is concerned, our own assessment is that the risk to the momentum that shapes the iCET will have more to do with changes in personalities than structure. The potential loss of spirit channeled through personalities in the United States that have championed iCET imperatives in the DoD, DoE, DoC, NSC, and other parts of the U.S. government could be temporarily costly for a process that also depends on individual agency. In the Biden administration, key personalities broke a lot of china, if we may be forgiven for the pun, to get major agreements like GE–HAL and General Atomics across the regulatory wire within the United States. Whether it is President Donald Trump or President Kamala Harris, there is a high probability that new actors will share less of this spirit for

change. Under Harris, some actors will remain. Under Trump, all will change. There is an opportunity for a reboot in the case of Harris and the potential for a redesign in the case of Trump. This will require effort and tact that are certainly not insurmountable.

For Indian policymakers, continuous engagement of lightning rods in the U.S. Congress, labor unions (concerned about off-shoring), and industry partners will be key. Doubling down on institutional mechanisms like the Strategic Trade Dialogue, led by the Indian foreign secretary (equivalent to the U.S. deputy secretary of state), will be important. This tract is designed to unpack export control issues that can deter or end bilateral cooperation. That this process was shepherded in India by the current Indian ambassador to the United States—previously the Indian foreign secretary—promises to be beneficial in the near-term. Equally, it will be important to tighten the extent of collaboration in other institutional arrangements under the broad iCET umbrella, such as between the DIU and iDEX and potentially between new actors leading Bio-X.

The Russia Question

There is a deep understanding between Indian and U.S. interlocutors at the highest levels of government about India's dependence on Russia for arms. The question of buying oil from Russia, while once all the rage in the press in both countries, is hardly a matter of disagreement. In fact, senior U.S. officials have clearly told us that India maintains prices. Their concerns have more to do with the potential of Indian companies crossing the threshold into sanctions territory. To avoid these situations, discussions between export controllers and more face time between Indian banks and the U.S. Treasury Department are key. The iCET framework provides an umbrella for these discussions, workshops, and knowledge exchange sessions. We have first-hand seen Indian companies clear fundamental doubts in such dialogues that could otherwise find them across the tripwire of sanctions.

However, there are clear challenges to India's well-rehearsed balancing act between deepening ties with the United States—through the iCET and otherwise—and maintaining relations with Russia. First, as more U.S. firms codevelop strategic technologies with India (like in the case of GE engines, if the agreement goes through), there will be a need for skillful separation of talent and facilities. The public sector units that are likely to partner with U.S. firms have long invested in the coproduction of Russian technologies. Second, optics matter. We initially misunderstood this, but over the last two years, and following several conversations with those in the U.S. administration, we have realized how important this is. Indian leaders' engagements with Russian counterparts will have a counterreaction. The key is managing the same, and where possible, coordinating actions to lower the blow, as it were. There will be similar counterreactions in India when U.S. leaders engage with Chinese counterparts. Communication is key. Third, what will get tricky is that as India's need for different technologies—such as hypersonic missiles—grows, there will be a national security prerogative to attain these. Here, both the United States and France (in the West) and Russia can serve as partners. India's decisions might tilt depending on at least two factors.

First is the extent to which U.S. firms will be provided licenses and waivers to sell or even coproduce such technologies to and in India. Frictions in doing so could well tilt India toward alternative suppliers, including France, or Russian firms who have long codeveloped strategic missiles with Indian companies.

Second, whilst the focus of many Indian experts and observers has been on the transfer of strategic technologies from China to Russia, there is an emerging sense among international policymakers that the Sino–Russian dependency dynamic may force Russia to transfer its crown jewels to China. So far, we have not seen any evidence of this in public sources. Officials who bring this up have not provided any evidence of the same either. Yet, if this were to be the case, it would have major strategic implications for India.

Lastly, for those in the United States who constantly question India’s dependencies on Russia, what is clear is that India has been diversifying away from Russia for at least a decade, if not more. The point about dependency ought not to dissuade furthering military ties but to augment the same. This is why the iCET is an important vehicle for change. In the same vein, for those invested in augmenting ties, it needs to be clear that this will not lead to a major shift in emphasis in Indian foreign policy away from Russia. Russia is important to India—this is not going to change. There will be friction, even disappointment, but those invested in the strategic futures of both countries will need to see beyond the immediate.

India’s deep relationship with Russia is a global advantage, especially during this time of war in Europe, and not a liability for the United States. There is a trusted channel in India to share messages and communicate high concerns to Russian counterparts—even if India does not join a formal process for dialogue and peacemaking—that has been used by U.S. interlocutors. It is one of the few channels of trust that remain—the other channel runs through Beijing. Overall, the advantages seem quite clear.

Managing Expectations

The iCET has to an extent led to a shift in mindset among various stakeholders as well as onlookers—India is not just a passive receiver of technology but also a mutually beneficial partner of choice. The high level of bilateral technology cooperation has showcased that the country is ready to engage at a higher level of technology readiness than before. However, more may be needed to dispel the notion that India has been an overall recipient of largesse from the United States.²³⁹ In the past, the latter has granted waivers or made exceptions for India in the form of the U.S.-India civilian nuclear deal, the STA-1 authorization (that put India at par with NATO allies when it comes to receiving dual-use technology), granting the CAATSA waiver when it comes to India’s purchase of Russian S-400 anti-aircraft systems, as well as the recent Congressional approval of the transfer of unprecedented GE jet engine technology to India.²⁴⁰

But at the same time, there is an overall acknowledgment in the United States of India's challenging geostrategic neighborhood and a recognition that India is gradually increasing its acquisitions of U.S. defense equipment.²⁴¹ Concurrently, from an Indian point of view, the success of the iCET may raise expectations among domestic stakeholders about elevating the partnership to the ranks of other high-profile technology partnerships that the United States has, such as the AUKUS, which enjoys a far more preferential environment when it comes to the integration of technology ecosystems and industrial base.

Trilateral Dialogue Between the United States, India, and South Korea

An agreement was announced in December 2023 between India, South Korea, and the United States for a trilateral technology dialogue in the first quarter of 2024.²⁴² Since most of the areas announced for discussion under this dialogue overlap with those under the iCET, it will be keenly watched by stakeholders to understand how it will complement the initiative as well as other partnerships like the Quad and I2U2.

Is This Really the Right Framework?

There has been an ongoing discussion in many quarters about the need to institutionalize the iCET. From calls for an iCET secretariat to thinking about the iCET through leadership at the ministerial level—such as the EU–India and the EU–U.S. Trade and Technology Council (TTC)—several formulas have been discussed. We have also written about the need for deeper institutionalization in the past.²⁴³

Yet, it is now unclear whether or not the question of institutionalizing the iCET is moot. No matter which formula is followed, overengineering the administrative structure of the iCET would take away from the nimbleness that has produced results. On the other hand, not doing so could leave the iCET in the hands of those that are less inspired by its imperatives, as discussed above. There is then a question of a new administration in the United States.

As observers from the outside, we have no definite answers. All we have is a set of approaches that might serve to steer a more focused discussion within both India and the United States on the future of the iCET.

First, given the increasing bandwidth that is offered by both the MEA in India and the State Department in the United States on iCET imperatives, might there be a way in which the NSC–NSCS–led structure is reframed to formally bring in the MEA and the State Department? We are certain that as much as the iCET in India is driven by the NSCS, its success in delivering outcomes has been made possible because of the leadership and the administrative setup in the MEA. Both these bodies, in many ways, complement the iCET. The NSC–NSCS structure incubated the iCET, but at a slightly more mature state,

it perhaps cannot do without the leadership and timeless bureaucratic structures available in the MEA and the State Department. This is as much a matter of capacity as it is about a shared vision to collectively capture all the potential in this time of geopolitical change.

Second, could the iCET be remodeled to look a bit like the EU's TTC structure, whereby leaders in key ministries co-run the initiative? This arrangement could include the NSC and the NSCS. In India, this would include the MEA, MeitY, Ministry of Commerce (MoC), and NSCS. The upside is that more players have a stake; the downside is that drivers for change may get drowned out by over-bureaucratizing the iCET. Again, there are no easy answers.

Third, and the most radical of all approaches, could be to consider rewiring the iCET completely. It is a framework that is delivering, as we have argued in this paper. Of course, more needs to be done in some sectors, but the iCET has succeeded in electrifying old deals and created enough and more space for new ones. At the end of January 2025, the iCET would have formally been in existence for three years. Perhaps it has largely done what it has set out to do: build bridges across a wide range of strategic technology ecosystems that will likely outlast both builders and architects alike. As a new president takes office in the United States, would it be worth thinking of the iCET as a three-year incubator that has prepared the groundwork for the next stage of U.S.–India strategic ties, either bilaterally or perhaps with other like-minded partners and alignments?

Conclusion

“Everyone wants their own version of the iCET,” is the chorus that chimes across many different quarters in the diplomatic space in New Delhi and several capitals across the world.²⁴⁴ That this structure is effective is what invites greater interest. Moreover, the many exhibitions, discussions, media reports, and summits organized by American and Indian counterparts under the iCET umbrella have done well to showcase the Indian private sector's deepening capabilities in various strategic technologies. The United Kingdom has entered into its own technology partnership with India, anchored by the respective NSAs in the two countries. The United States, Republic of Korea, and India have a trilateral arrangement to strengthen technology ties carved into the iCET agenda. Our sense is that there are at least three other countries that have approached the Government of India for a similar arrangement, reflecting their needs and competencies.

The impetus behind these administrative initiatives is partly shaped by and because of the ongoing geo-technological competition with China. There is an urgent need to de-risk supply chains from any one jurisdiction. They are in part informed by the need to strengthen bilateral relationships in new areas of cooperation—such space, semiconductors, advance materials, and digital infrastructure—led by the private sector but gently nudged by public enterprises and the respective governments.

Had Eric Hobsbawm the right of a pen today, he may well have termed the present era of geopolitics as one of industrial policy. Whether it is India, Japan, Australia, the United States, or the United Kingdom, the verve behind the need to rewire global supply chains through new partnerships is unlikely to fizzle anytime soon—no matter how each of these states' approach to China might change in the near future. Moreover, for India, the key lies in making the best of the opportunities at hand to support its own economic development, widening its manufacturing base, and placing itself as an important hub for different technologies serving several different areas of military and industrial advancement. There is of course much that India needs to do internally to capitalize on the promise of these partnerships, which will require a concentrated, whole-of-society effort in a relatively short period of time. This is a separate question for a separate paper.

Lastly, this paper has recounted the story, as it were, of one such initiative that has delivered results for India and continues to do so. There is still, of course, a long way to go. Although the iCET story is not necessarily a template for other advances, there are lessons that might be worth drawing out as practitioners, technologists, experts, and policy architects around the world consider innovative and niche strategic technology advances with India. We hope that this paper serves as something of a light guide in this endeavor, and in doing so, further refines the architecture for innovation, coproduction, and diplomatic practice in shaping the future of the geopolitics of technology.

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Acknowledgments

The authors would like to thank Ashley Tellis, Joshua White, and Arun Singh for their deep and rigorous reviews of this paper. They would also like to thank a range of individuals in both the U.S. and the Indian governments as well as the private sector, along with experts who offered insights and reviews on different parts of this paper at different points in time during the last six months.

Notes

- 1 Authors' conversations with a senior official following the June 2024 NSA-level meetings, June 2024.
- 2 Authors' conversation with a senior U.S. official, June 2024.
- 3 For an alternative view, see Ashley J. Tellis, "America's Bad Bet on India: New Delhi Won't Side With Washington Against Beijing," *Foreign Affairs*, May 1, 2023, <https://www.foreignaffairs.com/india/americas-bad-bet-india-modi>.
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- 5 "Readout of President Biden's Meeting with Prime Minister Modi of India," U.S. Embassy and Consulates in India, May 24, 2022, <https://in.usembassy.gov/readout-of-president-bidens-meeting-with-prime-minister-modi-of-india/>.
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- 12 Both the Indian and the U.S. versions of the joint factsheet are available here: <https://www.mea.gov.in/Images/jfactsheet.pdf> and <https://www.whitehouse.gov/briefing-room/statements-releases/2024/06/17/joint-fact-sheet-the-united-states-and-india-continue-to-chart-an-ambitious-course-for-the-initiative-on-critical-and-emerging-technology/#:~:text=Since%20the%20launch%20of%20iCET,%2C%20biotechnology%2C%20and%20clean%20energy.>
- 13 “Joint Fact Sheet: The United States and India Continue to Expand Comprehensive and Global Strategic Partnership,” The White House, September 21, 2024, <https://www.whitehouse.gov/briefing-room/statements-releases/2024/09/21/joint-fact-sheet-the-united-states-and-india-continue-to-expand-comprehensive-and-global-strategic-partnership/>.
- 14 Note: This is the language that has been used by experts, industry representatives and even officials to describe what they see as the loss in momentum on the iCET. These observations are based on the author’s conversations with these actors between January and September 2024 in Delhi, Bengaluru, and Washington D.C.
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- 18 Note: In this paper, “we” and “us” refer to either or both authors who may have participated in meetings and interactions individually or collectively. Though implicative of a joint perspective, “we” and “us” do not necessarily indicate the presence of both authors at every interaction.
- 19 The three fact sheets can be found here: (1) January 31, 2023: <https://www.whitehouse.gov/briefing-room/statements-releases/2023/01/31/fact-sheet-united-states-and-india-elevate-strategic-partnership-with-the-initiative-on-critical-and-emerging-technology-icet/>. Also see https://www.mea.gov.in/press-releases.htm?dtl/36153/Visit_of_National_Security_Advisor_to_Washington_DC_January_30February_01_2023. (2) June 17, 2023: <https://www.whitehouse.gov/briefing-room/statements-releases/2024/06/17/joint-fact-sheet-the-united-states-and-india-continue-to-chart-an-ambitious-course-for-the-initiative-on-critical-and-emerging-technology/#:~:text=Since%2520the%2520launch%2520of%2520iCET,%252C%2520biotechnology%252C%2520and%2520clean%2520energy.> (3) September 21, 2024: <https://www.whitehouse.gov/briefing-room/statements-releases/2024/09/21/joint-fact-sheet-the-united-states-and-india-continue-to-expand-comprehensive-and-global-strategic-partnership/>. Note: Following the inaugural meeting of the iCET on January 31, 2023, the White House and the Indian MEA published two respective factsheets, which have been linked above. These were specifically iCET factsheets. Following the second iCET review meeting in New Delhi in June 2024, the United States and India published a joint factsheet. Another joint factsheet was published subsequent to a meeting between Modi and Biden in September 2024. This was not specific to iCET, but included significant sections connected to the initiative.
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