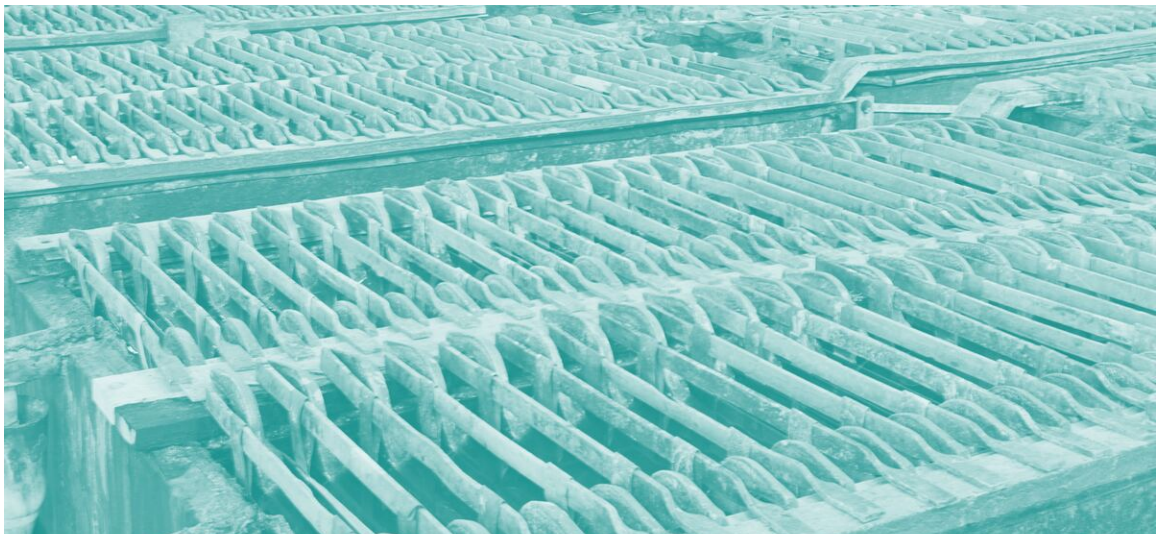
03

PART I · THE ATOMIC WORLD

Material Preconditions of the AGI Buildout

Edwin Farrell Gregory



Electrolytic copper refining at the Anaconda Copper Mining Company, Great Falls, Montana, 1942. Transforming the physical world has always been dependent on the industrial systems that turn raw materials into useful inputs.
Photograph by Russell Lee / Library of Congress.

SUMMARY

For all the forecasts that see an imminent AGI future and a radically advanced physical world, too few have examined the material barriers to that transformed future. In recent years, supply shocks and political interference have brought renewed attention to the physical dimension of industrial supply chains. But both the current AI buildout of data centers, power, and transmission, and the AGI buildout, which encompasses the transformation of the material world enabled by general intelligence, will likely be constrained by speed and scale. Materials have never been able to scale like digital units. But there are several ways that in an AGI future, artificial intelligence could enable a much faster and abundant physical world, including novel material science, improved efficiencies, and newly possible recycling. In this world, nations will need to remember the importance of maintaining control over their industrial space.

WHAT HAPPENS WHEN AGI HAS ARRIVED DIGITALLY, BUT FACES BARRIERS TO EX-erting itself in the material world? How can we make the physical world scale like the digital world? Historically, it has not, to the frustration of many. Even when the cost of hyper-capable intelligence collapses to zero, the physical world will still contain friction and constraints. America will likely be capable of overcoming these seeming barriers, but how we do so matters.

There are two buildouts. Right now, we are living through the conventional AI buildout: the scramble to bring data centers online, extend transmission, increase power generation, and overcome supply constraints for semiconductors, all with the purpose of achieving AGI digitally. Capex for this is set to hit $700 billion this year and reach up to $8 trillion in the coming few years.[1] Additionally, the rapidly growing robotics industry will require a new scale of production for sensors, actuators, and other components.[2]

The second buildout will be far larger. The AGI buildout is what begins once AGI exists digitally and moves on to transforming the physical world. It will encompass more than scaling the infrastructure necessary to grow and embody AGI throughout the material world. AGI-enabled infrastructure includes mass orbital compute, autonomous research labs, and self-expanding robotics factories.

The details of the AGI buildout remain speculative, but get clearer by the day. In this period, where AGI exists digitally and is working to exert itself physically, national security and supply chain reliance principles will remain relevant. The AGI buildout will require a tremendously larger and more complex ecosystem of raw material, processing, and intermediate product supply chains. If the goal is scaling physical materials to meet the needs of the post-digital AGI buildout, there are several verticals that would allow digital AGI to scale its own infrastructure while creating new America-centric supply chains and managing overreliance on our only peer competitor: China.

The first vertical is autonomous novel material science research. The recent White House Office of Science and Technology plan for a new golden age of science recognizes that greater domestic production is a highly desirable political end which, if protected, results in an enduring technological lead.[3] AGI-enabled autonomous labs pursuing novel material research could find new materials at scale, allowing for old materials from unstable or exterior supply chains to be replaced by new domestic synthetic materials. But if automated neomaterial discovery is proving dozens of viable and needed potential materials a day, the state will need to reform the material qualification process. Qualification, which standardizes and provides assurance for the widespread use of these materials, can take between five and twenty years.[4] If neomaterial science will

1 George Lee and Lucas Greenbaum, "Tracking Trillions: The Assumptions Shaping the Scale of the AI Build-Out," Goldman Sachs, May 1, 2026.

2 Ani Kelkar et al., "Turning Humanoid Supply Chain Constraints into Billion-Dollar Wins," McKinsey & Company, April 17, 2026.

3 Michael Kratsios, *Science: A New Golden Age* (White House Office of Science and Technology Policy, *2026)*.

4 National Institute of Standards and Technology, "Qualification for Additive Manufacturing Materials, Processes, and Parts," last modified March 26, 2025.

play a role in the AGI buildout, the state will need to drastically accelerate both the speed and scale of qualification. Digital AGI could perhaps enable both automated material discovery and qualification.

Additionally, digital AGI could help industry make better use of existing resources. Too many materials currently wind up in landfills because of insufficient recycling technology, or production dynamics that make available recycling technology uneconomic. This could be especially helpful in the short term as depreciating physical assets increase in volume. The state could increase the viability of AGI-enabled recycling technology by providing accelerated permitting for the use of dormant feedstocks.

The material research categories above will be extremely fast-moving and complex, rapidly going from autonomous labs to remote geographies like the roots of a plant. The state should be especially careful to ensure that a rapidly growing and naturally autonomous AGI industrial ecosystem does not create extremely concerning dependencies on China. Right now, digital AGI does not exist, and many of the features that will define the Sino-American relationship in five years are likely not yet visible. When America has AGI, China likely will, too. This creates a tension that does not resolve easily: we do not want to create a reliance on China in the next few years that threatens our AGI buildout.

As many would recognize today, developing ex-China and secure supply chains is time-consuming, and often not very price-efficient in the short term. Additionally, it is neither desirable nor feasible to entirely detach American supply chains from China. Already, American data centers rely on a broad range of Chinese hardware and intermediate goods.[5] It could very well be that to initiate the AGI buildout and maintain our rate of progress, America will need to source raw materials and components from China. In this case, the policymakers overseeing American material science policy should use their authorities to ensure that novel AGI buildout supply chains are resilient, reflecting the expectation that exposure to China is a risk not priced in by markets. Just as the wave of globalization and free trade enthusiasm swept the world after the Cold War and left in its wake a tangle of risky supply chains, an AGI supply ecosystem that grows without regard for national interest could do the same. Now is the time to put in place forward-looking policies to support the AGI buildout. These could include investment and purchase restrictions for the five layers of the machine intelligence stack, precluding increased reliance. A phased and publicized item-by-item set of purchasing restrictions for data centers and other supporting infrastructure could follow the Federal Communications Commission's regulation in drones, robotics, and intermediate parts.[6]

Perhaps more than anything else, industrial and science policy after digital AGI must be adaptive. We should expect the relative scarcity of materials, the tenor of our relationship with China, and the global politics of the post-AGI world to change. In de-

5 Kai Nicol-Schwarz and Evelyn Cheng, "Hidden China Risks Are Emerging in America's Multibillion-Dollar AI Data Center Boom," *CNBC*, September 3, 2026.

6 Federal Communications Commission, "National Security Determination on the Threat Posed by Foreign-Produced Advanced Robotic Devices," July 27, 2026.

scribing the supply and access constraints that America will need to overcome to go from digital to physical AGI, I do so with the full expectation that these barriers will be overcome. History is full of examples of overcoming material constraints at times when intelligence was far more scarce. In the early 20th century, nitrogen was a vital agricultural and industrial input that was locked into certain biological and mineral supply chains. In 1909, the German scientist Fritz Haber was able to synthesize ammonia from atmospheric nitrogen, a chemical process which was subsequently industrialized, commodifying what had previously been a scarce and geography-constrained resource.[7] Digital AGI will make such transformative science commonplace as it grows across the physical world. With resilience-minded and adaptive governance, it can do so in a way that strengthens America.

ABOUT THE AUTHOR

Edwin Farrell Gregory is the special projects manager and research fellow at the Foundation for American Innovation. In addition to a portfolio of special projects, his research focuses on Chinese technological development, startup and industrial policy, and super intelligence strategy.



From *Futurecraft: The Day After AGI*, Foundation for American Innovation, 2026.
Read or listen online at futurecraft.thefai.org/essays/material-preconditions-of-the-agi-buildout.

© 2026 by the Foundation for American Innovation. All rights reserved.

7 Jason Crawford, "The Alchemy of Air," *The Roots of Progress*, August 10, 2017.