July 25, 2025

SUBMITTED ELECTRONICALLY

Lou Hrkman
Principal Deputy Assistant Secretary
Office of Energy Efficiency & Renewable Energy
Department of Energy

RE: 2026 Energy Critical Materials Assessment RFI [Docket No. DE-FOA-0003568]

Dear Mr. Hrkman:

The Solar Energy Manufacturers for America (SEMA) Coalition appreciates the Department of Energy's (DOE) leadership in advancing a resilient and secure domestic energy supply chain and welcomes the opportunity to provide input on the forthcoming 2026 Energy Critical Materials Assessment. As detailed in the attached comments, the solar manufacturing industry faces persistent vulnerabilities stemming from concentrated global supply chains, particularly for critical and byproduct materials. These materials are foundational to solar energy technologies and warrant inclusion in the forthcoming assessment. We commend DOE for considering solar technology and its critical materials, including silicon, tellurium, and gallium, in the 2023 Critical Materials Assessment and urge DOE to again consider solar technology and these critical materials in its next assessment, so the U.S. can build out every node of its domestic manufacturing supply chain. We can only achieve lasting resilience by addressing vulnerabilities across the entire supply chain.

The SEMA Coalition is a diverse group of solar manufacturers united to rebuild the domestic solar supply chain. We represent the interests of the major non-Chinese solar manufacturers who are building or looking to build strategic solar components across the value chain in the U.S. Our coalition advocates for a suite of policies to build a secure and competitive U.S. solar supply chain to meet our current and future energy demand while creating good-paying manufacturing jobs and protecting our national security.

We respectfully submit the enclosed comments in response to Docket No. DE-FOA-0003568, and welcome the opportunity to continue engaging with DOE on these important matters. For follow up, please reach out directly to Yogin Kothari, Chief Strategy Officer for the SEMA Coalition. His email is yogin@semacoalition.org, and his phone number is (714) 906–9916.

Sincerely,

Mike Carr
Executive Director

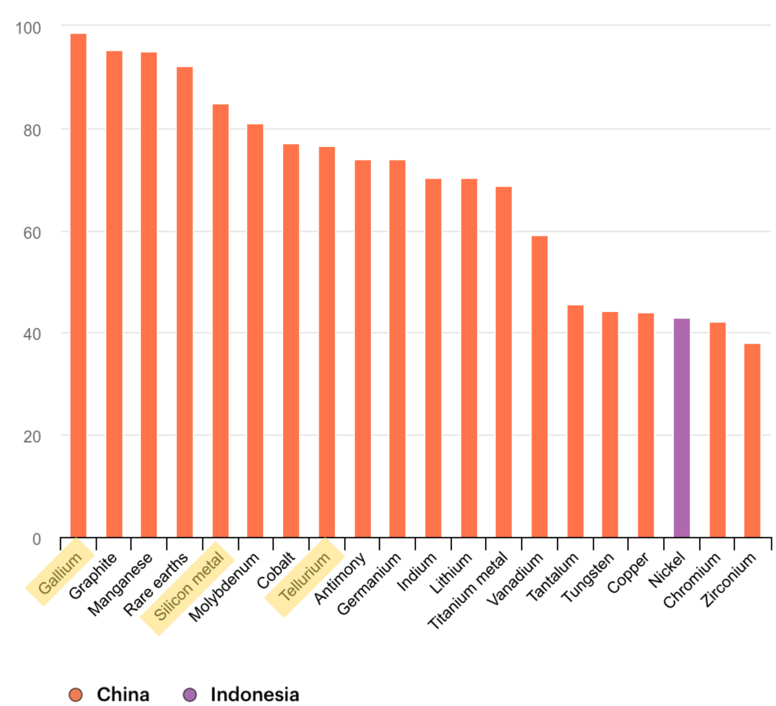
Background

The United States is undergoing a once-in-a-generation effort to reestablish domestic solar manufacturing and reduce dependence on foreign-dominated supply chains. This transformation is supported by strong policy signals to strengthen American energy dominance, including strengthened advanced manufacturing tax credits and executive actions intended to onshore production of critical energy components. There is growing demand for domestically manufactured solar as utility-scale solar is expected to make up 52% of new capacity in 2025. Looking forward, some analysts project the U.S. will add 58-181 GW of solar capacity annually between 2030 and 2035. However, materials essential to solar manufacturing remain exposed to geopolitical risk, concentrated refining capacity, and limited domestic supply. These risks threaten to undermine U.S. advanced manufacturing growth.

Key materials such as silicon, including polysilicon, tellurium, gallium, and others, play indispensable roles in crystalline silicon and thin-film solar technologies. As shown in Figure 1, almost all energy-related critical materials, including those relevant to solar, are refined and processed almost exclusively outside the U.S., primarily in China, and are subject to price and supply volatility that U.S. firms cannot control.

In some cases, there is no viable large-scale substitute. Some of these critical materials are not only critical for solar technologies but also a key input for the semiconductor industry. Growing global demand for semiconductors increases market need for refined silicon feedstock, underscoring the need for strategic domestic supply chain growth. A forward-looking critical materials strategy must reflect not only energy system demand but also the bottlenecks in processing, refining, and recovery, and address unfair and distortive foreign trade practices that may adversely impact domestic manufacturing.

Figure 1: Share of Top Refining Country for 20 Energy-Related Minerals (IEA)



As DOE prepares its 2026 Energy Critical Materials Assessment, the inclusion and accurate evaluation of solar-relevant materials is essential. The SEMA Coalition urges DOE to consider the full range of materials, direct and indirect, that enable solar technology production and to ensure the methodology accounts for the unique vulnerabilities in the solar supply chain. The future of American solar manufacturing depends not only on fair market conditions and a level playing field but also on the strength and security of the materials ecosystem that underpins it.

<u>DOE RFI Question Categories</u>

Category 1: Energy technologies of interest

1.1 What energy technologies should be considered as in-scope for the 2026 Energy Critical Materials Assessment?

To support U.S. energy dominance, national security, and industrial competitiveness, the 2026 Energy Critical Materials Assessment should focus on technologies that are strategically important to domestic energy production and infrastructure resilience. Priority should be given to technologies undergoing rapid deployment and providing a bridge to future innovative baseload technologies, while also strengthening demand for domestic advanced manufacturing and reducing reliance on foreign-controlled supply chains. The 2026 DOE Critical Materials Assessment should include:

- Crystalline silicon (c-Si) photovoltaics
- Thin-film cadmium telluride (CdTe) photovoltaics
- Emerging perovskite and tandem solar technologies

The 2026 Assessment should include both crystalline silicon (c-Si) photovoltaics and thin-film photovoltaic technologies (specifically cadmium telluride, or CdTe) as critical energy generation technologies. Global solar deployment is dominated by c-Si, and maintaining robust, non-Chinese/allied production of polysilicon is essential for strengthening the c-Si supply chain. At the same time, thin-film technologies represent a vital, strategically significant alternative that supports U.S.-based, vertically integrated manufacturing. Emerging solar technologies, particularly perovskite and perovskite-tandem architectures, are also of growing strategic importance. Several SEMA Coalition members are pioneering commercialization efforts in this space, and these technologies depend on critical materials such as gallium and tellurium to enable higher-efficiency solar cells.

SEMA strongly urges the Department to explicitly account for the full range of solar technologies and the materials required to support them. Our members span the U.S. solar manufacturing value chain, from polysilicon and wafers to cells, modules, and advanced perovskite tandem technologies, and rely on a broad set of critical materials, including silicon, tellurium, and gallium. A forward-looking assessment must reflect the material needs of established and emerging solar technologies alike, and prioritize the critical inputs that will determine the success of U.S.-based manufacturing.

Category 2: Materials of Interest

2.1 Given the technologies suggested in the previous section, what materials should be evaluated in the 2026 Energy Critical Materials Assessment?

To support the continued expansion of U.S. clean energy manufacturing and deployment, the 2026 Energy Critical Materials Assessment should evaluate materials that are essential to high-impact technologies like solar photovoltaics. These materials face significant risks related to supply concentration, refining constraints, growing global demand, and strategic market disruptions by foreign adversaries. The following materials are of particular concern and warrant evaluation in the 2026 assessment:

Material 1: Polysilicon (Silicon)

- **Importance in Solar Technologies:** Polysilicon is a foundational input for over 90% of global solar modules (c-Si). Polysilicon is hyperpure silicon; for c-Si solar applications, polysilicon is purified to 9N (99.9999999%).
    - U.S. producers of solar-grade polysilicon also produce semiconductor-grade polysilicon, which is purified to 11N (99.999999999%). Semiconductor-grade polysilicon is used in advanced electronics powered by semiconductors, including inverters used in solar installations. There are effectively no substitutes for polysilicon with respect to semiconductor end-uses.
- **U.S. Industry Status:** The U.S. producers and their global capacities maintain robust polysilicon production capacity through domestic manufacturers.
- **Risk Factors:** China's use of subsidies, massive overproduction, and price depression of solar-grade polysilicon have created significant market challenges. For example, Chinese polysilicon prices have collapsed to an artificially low $4.70/kg, far below the National Renewable Energy Laboratory (NREL) minimum sustainable price of $21/kg. Further, Chinese polysilicon producers rely on forced labor and operate with disregard for environmental considerations that results in a carbon footprint that is roughly double that of U.S. producers. Given China's pervasive and persistent polysilicon market distortions – coupled with its long-standing and unfair support of its solar industry – China's stranglehold on the polysilicon market will continue to create challenges for non-Chinese and allied producers.
- **Justification for Inclusion:** The DOE should incorporate polysilicon as a critical material alongside silicon given the critical importance of polysilicon to the solar and semiconductor industries and U.S. energy production, as well as the serious supply chain threat posed by China.

Material 2: Tellurium

- **Importance in Solar Technologies:** Key component for CdTe semiconductors used to manufacture CdTe PV modules. No commercial-scale substitute.

- **U.S. Industry Status:** Limited solar-grade refining capacity in the U.S., with only two U.S. producers; produced as a copper byproduct.

- **Risk Factors:** The primary constraint on tellurium availability is not geology, but the lack of dedicated refining infrastructure. Tellurium is recovered almost exclusively as a byproduct during the electrolytic refining of copper, meaning its supply is tied to copper refining capacity—not solar demand. According to the 2025 U.S. Geological Survey Mineral Commodity Summary, China accounted for approximately 75% of estimated global refined tellurium output in 2024, and its production has increased significantly over the past decade.

  Despite increasing demand, particularly from cadmium-telluride (CdTe) solar manufacturing, tellurium refining capacity remains geographically concentrated and inflexible. Without targeted investment in domestic recovery and purification infrastructure, U.S. manufacturers could become dependent on Chinese output and vulnerable to supply disruptions, price volatility, and FEOC-related compliance risks. Expanding domestic and allied capacity for tellurium recovery is essential to support projected solar manufacturing and deployment growth and eliminate the risk of future supply chain exposure.

- **Justification for Inclusion:** Tellurium was appropriately designated as a critical material in the 2023 DOE assessment, and its importance has only increased. As a key input for cadmium-telluride (CdTe) thin-film solar technologies, one of the most commercially viable alternatives to crystalline silicon, tellurium is essential to meeting domestic solar deployment goals. Tellurium is also widely used in thermoelectric devices for cooling and energy generation. DOE should reaffirm tellurium's inclusion on the critical materials list and consider elevating its priority level, given its strategic role in domestic manufacturing and limited global availability.

Material 3: Gallium

- **Importance in Solar Technologies:** Used in perovskite tandems and III-V semiconductors. Supports next-generation, high-efficiency cells.

- **U.S. Industry Status:** No significant U.S. production. China accounted for 99% of worldwide primary low-purity gallium production and dominates the supply (byproduct of bauxite/zinc refining).

- **Risk Factors:** Small volume, but critical role in innovation. Supply bottlenecks risk slowing emerging solar tech.

- **Justification for Inclusion:** Gallium remains an essential material for high-performance optoelectronics, semiconductors, and solar technologies, particularly for gallium arsenide (GaAs) and gallium nitride (GaN) devices used in solar cells, LEDs, and defense applications. Despite its widespread use in advanced technologies, the United States currently has no primary gallium production, and 100% of reported consumption is met through imports. In 2024, China accounted for 99% of global primary low-purity gallium production, and in December 2024, China banned all exports of gallium to the United States, significantly escalating the strategic risk to domestic supply. Given the material's geopolitical vulnerability, limited global production base, and critical role in energy-relevant technologies, DOE should reaffirm gallium's inclusion on the critical materials list and consider elevating its prioritization. Investment in domestic recovery, refining, and recycling will be essential to reduce reliance on foreign suppliers, especially those designated as Foreign Entities of Concern.

Category 3: Supply chain information by material

3.1 Who are the major global players at each supply chain stage?

- China dominates solar material refining and processing (e.g. polysilicon), as well as ingot, wafer, and cell production.

- The U.S. polysilicon industry has significant production capacity, but the U.S. has limited tellurium capacity and almost no domestic supply of gallium. U.S. production also lags in large downstream stages (e.g., wafering). Domestic manufacturing has been on the rise due to investments driven by recent tax incentive programs, which will further increase demand for the critical minerals outlined above.

- Solar recycling is not yet a meaningful supply source in the U.S.

China dominates nearly every stage of the solar supply chain. It leads the global market for refining and processing critical materials and manufacturing throughout the supply chain. China's dominant market position stems from decades of strategic industrial policy, state subsidies, and market manipulation that have consolidated global manufacturing capacity within Chinese borders and crowded out competitors.

The U.S. maintains robust polysilicon production capacity but lacks domestic midstream infrastructure and production, particularly around wafers and cell production. SEMA Coalition members represent every stage of the U.S. solar supply chain, including companies involved in polysilicon, ingots, wafers, cells, modules, and emerging technologies like perovskite cells. While polysilicon producers are primarily impacted by Chinese market manipulation and price suppression, the midstream and downstream manufacturers across the coalition depend on access to secure, domestically sourced critical materials to ensure their operations are free from FEOC exposure, aligned with federal standards, and able to scale in response to growing U.S. energy demand. Strengthening each stage of the domestic supply chain is essential for building long-term resilience and advancing national clean energy and industrial goals.

While recent investments have been made in the domestic supply chain through the CHIPS and Science Act and other laws, the U.S. remains reliant on foreign inputs for most upstream and midstream components to meet the energy and production demand of solar technologies. Solar recycling remains in the early stages and is not yet a meaningful source of material recovery.

Without a buildout of the complete domestic supply chain, the U.S. will remain exposed to geopolitical risk and price volatility tied to China's unfair dominance in markets.

3.2 What are the main barriers to production in the U.S. and globally?

- Lack of domestic refining/purification for certain materials that are critical for the solar industry.
- Chinese market manipulation has resulted in artificially low prices for Chinese materials and goods.
- Permitting delays, weak interagency coordination, and policy uncertainty deter investment in the US.

In the U.S., a primary barrier to scaling up domestic manufacturing is the lack of domestic refining and purification infrastructure, as well as secure access to critical materials essential for next-generation solar technologies. These materials, including tellurium and gallium, are byproducts primarily of copper, bauxite, or zinc production and are processed almost exclusively outside the United States. The U.S. must build out its midstream capacity to recover and refine these materials at the scale needed to support a growing solar supply chain to avoid forcing domestic manufacturers to rely on imports, especially of gallium, and exposing them to supply instability and geopolitical risk.

The U.S. retains strong polysilicon production capacity, but widespread Chinese market manipulation, state-backed subsidies, and the prevalence of forced labor used by foreign entities in solar-grade polysilicon supply chains continue to distort global markets. These practices make it difficult for domestic polysilicon producers to compete on price and contribute to bottlenecks throughout the U.S. solar and semiconductor manufacturing ecosystem.

China has built out a dominant position in global critical mineral processing through decades of strategic industrial policy and state-backed investments. As a result, China controls the majority of refining capacity for materials essential to energy technologies, including more than 90% of global gallium and a majority share of tellurium and polysilicon refining. On top of China's share of the critical materials supply chain, they also leverage that dominance in the market to influence prices through various methods, including export restrictions, product dumping, state-controlled industry, and strategic acquisitions across the world. China's influence on these markets creates one of the steepest hurdles to U.S. production. Uneven and unfair global playing fields have led to uncompetitive markets for many U.S. producers.

In the U.S., policy uncertainty and the lack of strategic investment in certain critical technologies and materials further deters private investment in refining, processing, and midstream manufacturing of key energy components. This has complicated the ability of project developers and manufacturers to make major capital expenditures and plan for future investments. While the administration is taking steps to secure America's energy independence, domestic solar manufacturers currently face a constrained supply environment and are competing on an uneven global playing field at the same time that energy demand continues to grow. Consistency and certainty with respect to tax and trade policies will help provide a clearer path forward for domestic producers/manufacturers.

3.3 Is supply a concern for the next 5 to 15 years?

- Yes. The increasing demand for energy will intensify demand for materials that have inelastic supply chains.

- Without an increase in domestic refining capabilities and access to certain critical materials needed throughout the solar supply chain, as well as protection from unfair trade practices from China, the U.S. will remain vulnerable to disruption and volatility of foreign markets and influence.

Supply will be a significant and growing concern over the next 5 to 15 years as solar deployment and energy demand continue to scale rapidly. The accelerated demand for critical materials, particularly those used in next-generation and high-efficiency technologies, will test the limits of the current supply chain. Many of these critical materials are already strained or highly concentrated in foreign markets, which will only continue to drive our reliance on foreign inputs and the volatilities in the market that follow.

In particular, key inputs like tellurium and gallium are byproducts of other mining and refining operations. As a result, their supply is largely inelastic and does not scale with increased solar demand. It is critical that the U.S. recognizes the importance of maintaining mining and refining capacity for elements like copper that indirectly support increased supply for byproduct critical minerals (e.g., tellurium). This will reduce bottlenecks, long lead times, and unpredictable pricing, all of which undermine the ability of U.S. manufacturers to grow sustainably.

There is robust domestic production capacity for polysilicon in the United States (and Europe). However, China's unfair trade practices threaten the health and long-term sustainability of domestic polysilicon production.

3.4 How could global trade policies impact the material supply chain in the short and long term?

- Chinese overcapacity and circumvention suppress global prices and deter U.S. investment.
- Long-term reliance on Chinese imports increases systemic trade/geopolitical risk.
- The SEMA Coalition was founded in response to these risks after tariffs signaled the need for domestic manufacturing support.
- Trade tools alone aren't sufficient - the U.S. needs an industrial strategy with incentives to purchase solar modules made with domestically processed critical minerals.

Global trade policies have both immediate and lasting impacts on the U.S. solar material supply chain. In the short term, Chinese overcapacity, predatory practices, and circumvention strategies continue to distort the global markets by flooding them with underpriced products and inputs. This artificially suppresses prices for critical components like wafers, cells, and modules, discouraging investment in U.S.-based manufacturing even as domestic demand rises each year. These conditions are creating an uneven playing field that undermines the viability of domestic manufacturing and leads to a continued reliance on foreign inputs into the supply chain.

In the long term, a continued reliance on China and other foreign imports introduces a serious systemic risk. China maintains a dominant market position for the upstream production of key materials such as polysilicon, gallium, and tellurium, as well as midstream processing capacity and wafer production. This concentrated market - driven by China's strategic industrial policy agenda and resources – exposes U.S. manufacturers to risks from geopolitical tensions, trade and export restrictions, and supply chain disruptions which threaten U.S. energy and national security, and the U.S. manufacturing base.

While some tariffs and trade enforcement actions signaled a policy shift toward rebuilding our domestic manufacturing capacity, those actions alone have not translated into sufficient industrial development across the supply chain. Trade tools alone cannot overcome decades of offshoring and underinvestment in the U.S. supply chain, as China and our competitors have full and growing support. To achieve lasting resilience and growth, the U.S. must pair bold trade enforcement with a robust industrial strategy that includes direct investment and meaningful incentives, such as the Domestic Content Bonus Credit, and sticks such as the Prohibited Foreign Entity restrictions. The bonus is a key demand driver for U.S.-made components, but its success hinges on the availability of domestically produced inputs at every stage of the supply chain. Without this foundation, global trade dynamics will continue to undercut the competitiveness of American manufacturers and the country's pursuit of energy dominance.

Category 5: Challenges to domestic industry

5.1 What are the largest risks facing businesses related to critical materials?

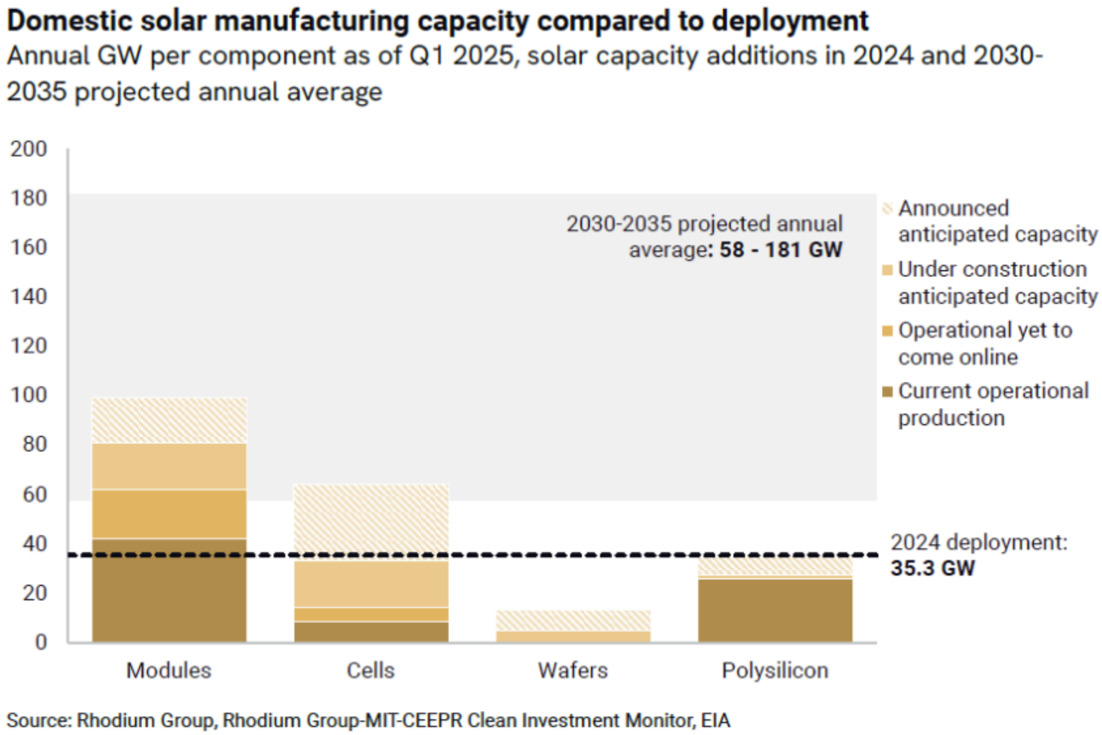
- Foreign dependence on inputs (gallium) and a lack of U.S. capacity in the primary extraction activities that yield certain materials (tellurium).
- A gap between domestic raw material production and domestic midstream manufacturing capacity.
- Trade policies that do not address domestic capacity needs.

U.S. solar manufacturers face substantial and compounding risks stemming from the critical material vulnerabilities that are felt across the supply chain. Chief among these is dependence on foreign sources for essential solar inputs, namely gallium, and a lack of U.S. capacity in the primary extraction applications, namely copper mining and refining, that yield tellurium. The dependencies and lack of domestic capacity expose U.S. manufacturers and firms to sudden price fluctuations, trade disruptions, and strategic export control policies that can destabilize the solar industry and domestic supply chains.

There is also a persistent disconnect between upstream extraction, downstream processing, and midstream utilization in the U.S. For example, while the U.S. maintains robust polysilicon production capacity, led by members of the SEMA Coalition, domestic ingot and wafer production is lacking, creating a substantial domestic supply chain gap. SEMA Coalition members are working to close this gap, driven, in part, by tax incentives and trade measures to protect every aspect of the domestic supply chain. However, with China's continued and aggressive policies designed to maintain dominance throughout the solar supply chain, U.S.

policies will need to focus on maintaining robust domestic investments across the solar industry while also confronting China's trade abuses.

Figure 2: Capacity vs Deployment (Rhodium Group)



While we appreciate the efforts of the administration to level the playing field through comprehensive trade and tariff measures, trade policy alone is not enough to secure a resilient supply chain and domestic manufacturing base. Enforcement actions like AD/CVD, Section 232, Section 301, and FEOC restrictions are important steps, but they must also be paired with bold investments and consideration of all critical materials and resources needed to build out domestic capacity. China poses significant risks to domestic solar production, including producers of strategic materials. An uneven global playing field is not sustainable, which is why DOE should maintain silicon, tellurium, and gallium on the critical materials list and add polysilicon, given the critical roles these materials have on energy production and the serious supply chain risks posed by China.