Testimony of the
SEMICONDUCTOR INDUSTRY ASSOCIATION
On the
Critical Minerals Policy Act of 2013 (S. 1600)

January 28, 2014

The Semiconductor Industry Association (SIA), the voice of the U.S. semiconductor industry,[1] appreciates the opportunity to testify in support of the Critical Minerals Policy Act (S.1600). We commend Ranking Member Murkowski and Chairman Wyden, as well as the large group of bipartisan co-sponsors, for introducing this important legislation and for convening this hearing. We look forward to continuing to work with this Committee to ensure that the U.S. has a secure supply of the materials that are critical to the manufacture of semiconductors and by extension the health of the U.S. semiconductor industry and the U.S. economy as a whole.

Semiconductors are the micro-circuits (sometimes referred to as "chips" or "computer chips") that are the enabling technology for all modern electronics found in computers and cell phones, transportation and health care devices, information and communications systems, and numerous aspects of our national defense. Because semiconductors are a foundational technology for virtually all areas of our economy, continued U.S. leadership in semiconductor technology is essential to America's continued global economic leadership and our national security. Semiconductors are one of the nation's top exports[2] and the industry directly employs about 250,000 employees and supports approximately 1 million indirect jobs.[3]

I. Semiconductor Manufacturing and Critical Materials

Contrary to the popular perception that most high-tech manufacturing has been offshored to Asia, advanced semiconductor manufacturing remains strong and growing in the U.S.[4] The process of manufacturing semiconductors is incredibly complex,

[1] SIA seeks to strengthen U.S. leadership of semiconductor design and manufacturing by working with Congress, the Administration and other key stakeholders. SIA works to encourage policies and regulations that fuel innovation, propel business and drive international competition in order to maintain a thriving semiconductor industry in the United States. Additional information on SIA is available at www.semiconductors.org.

[2] During the period 2008-12, semiconductors were the second largest export from the U.S., after aircraft. *Source: U.S. International Trade Commission. Industry Defined By: NAIC Codes 336411 (Aircraft); 334413 (Semiconductors); 336111 (Automobiles); 324110 (Petroleum Refinery Products), Based from total exports revenue.*

[3] http://www.semiconductors.org/clientuploads/Jobs%20Rollout/Jobs%20Issue%20Paper_April_2013.pdf.

[4] The majority of production (56 percent) from U.S. semiconductor firms is located in the United States, and the U.S. is home to more leading-edge process technology manufacturing facilities (i.e., 22 nanometer process technology or less) than any other country in the world. Source: IC Insights, Global Fab Database. SIA member companies continue to invest and expand in the U.S., with the construction of new and expanded state-of-the-art fabrication facilities across the country. Overall, U.S.-based semiconductor companies retain over 50 percent of global market share in a highly competitive market. Source: SIA/iSuppli/WSTS.

employing sophisticated equipment and techniques developed by the world's leading scientists and engineers[5] and the precise and controlled use of specific materials, chemicals, and gases that possess unique chemical and physical attributes. The semiconductor industry is innovating at the atomic level and each material used in our manufacturing is carefully selected to meet our technology needs and integrated together with high precision manufacturing tools to produce high performance semiconductors. As circuit features reach the nanoscale level,[6] the semiconductor industry's use of materials with unique properties becomes even more critical.

The building blocks of advanced semiconductors include a range of elements, including arsenic, cerium, cobalt, copper, fluorine, gallium, germanium, indium, phosphorus, silicon tantalum, tungsten, tin, titanium, and others. Our industry also relies on a number of specific chemicals and industrial gases in our production process. The materials utilized in the semiconductor manufacturing process are selected because they possess unique chemical and physical properties. In many instances, there are no known alternatives to these materials that satisfy our functional needs.

The semiconductor industry relies on a complex global supply chain that consists of numerous suppliers of materials, chemicals, and gases. Many of these materials are subject to multiple processing steps and pass through multiple hands prior to shipment to a semiconductor manufacturing facility (a "fab") for use in our manufacturing process. As a downstream user of these materials, SIA member companies are typically several steps removed from the extraction of the basic material, and therefore we believe it is important to adopt a holistic approach and look at the entire supply chain when assessing potential vulnerabilities in supply of these critical materials.

Because of our reliance on key materials – and the potential vulnerabilities in the supply of these materials – we believe that the Critical Minerals Policy Act is an important bill that warrants prompt consideration. We support the goal of the bill, which is to identify minerals that are critical to the American economy and may be subject to potential supply disruptions, and to develop a framework for policies to prevent potential disruptions to the supply of these minerals. Our industry has experienced shortages, price spikes, or other disruptions of key materials in the past, and we believe that it should be a national priority to take reasonable steps to improve the security of supply of critical materials. The implications of a supply disruption in the semiconductor industry reach far beyond our industry because so many sectors of our economy are

[5] The industry invests on average 22 percent of revenue in R&D, amounting to approximately $32 billion in 2012. Source: World Semiconductor Trade Statistics (WSTS) and IC Insights. Semiconductor companies receive a large number of patents each year and possess extensive patent portfolios. Six of top 15 US companies receiving patens in the U.S. were semiconductor companies. Source: US Patent and Trademark Office, compiled by IFI CLAIMS Patent Services (January 2013).

[6] Nanotechnology is the science, engineering, and technology conducted at the nanoscale, a range from 1 to 100 nanometers (nm). One nanometer is a billionth of a meter, or 10^{-9} of a meter.) See http://www.nano.gov/nanotech-101. Current leading edge chips have over a billion transistors on a single chip and features of 22 nanometers (nm), and the industry is engaged in ongoing development at the scale of 10 nm (i.e., 22 billionths of a meter, or roughly a 4,000th the width of a human hair). See "Moore's Law: The rule that really matters in tech (Oct. 15, 2012) (available at http://news.cnet.com/8301-11386_3-57526581-76/moores-law-the-rule-that-really-matters-in-tech/).

dependent on the electronics that are enabled by semiconductors. Consequently, the ripple effects of a supply disruption can adversely impact major elements of the U.S. and global economy.

Our industry's recent experience with supply shortages in the supply of helium illustrates the potential adverse implications that may result in the disruption in the supply of critical materials for the semiconductor industry. Helium is an essential gas in the semiconductor manufacturing process, and because helium has unique functional attributes, there are no known alternatives to this gas for many of processes in our manufacturing processes. Last year our industry faced significant shortages in the supply of helium, as well as substantial price increases, as a result of several factors, including the pending closure of the Federal Helium Reserve. Our suppliers were shipping a reduced allocation at dramatically increased cost to semiconductor fabs, and despite efforts to conserve and recycle this gas or find alternatives in some processes, our industry was facing the risk of having insufficient quantities to operate. This created a very significant risk for our industry and the economy as a whole.

Fortunately, this Committee recognized the need to resolve this problem and Chairman Wyden and Ranking Member Murkowski led the successful efforts in enactment into law of the Helium Stewardship Act (PL 113-40). We greatly appreciate the leadership of this Committee in enacting this essential legislation in a timely manner. But this experience demonstrates the need to work proactively to develop the appropriate policies to avoid future disruptions to the supply of critical materials.

Our industry has also faced other disruptions in the supply of processed materials that are essential to semiconductor production. To cite one prominent example, in July 1993, an explosion at a Sumitomo Chemical plant in Japan shut down a factory that supplied over half of the world supply of a high purity resin used in semiconductor packages. The value of the resin was estimated to be only 0.26 of a penny per integrated circuit, but without the resin semiconductor production would come to a halt, a disruption that the U.S. government recognized would soon be felt in the computer, automobile, telecommunications equipment, and other manufacturing industries. Spot prices for one type of chip, dynamic random-access memory ("DRAM") memory chip nearly doubled, and DRAM buyers who did not have long term contracts were paying in excess of $300 million a week for several weeks after the explosion. Since 95% of world production of the high purity resin was located in Japan, there was a concerted effort by the U.S. industry and government to press Sumitomo Chemical and other Japanese suppliers to allocate remaining inventory and production transparently and fairly. In part due to long supply chains using sea freight, there was sufficient inventory to overcome the crisis until the Sumitomo Chemical resumed operations in November of 1993. This example illustrates the need for policies that adopt a holistic approach to assessing the supply chain of critical materials.

These are just a sampling of instances that illustrate the potential vulnerability of the supply chain.[7] In order to avoid future supply disruptions, SIA is pleased that this Committee is taking action to secure the supply of critical materials for the future.

II. Actions by the Semiconductor Industry to Secure Supply of Key Materials

In light of our recent experience with the shortage of helium, SIA looks forward to working with the Congress and the Administration to identify critical materials and develop the appropriate policies to secure the supply of key materials. Our industry is engaged in ongoing efforts to identify critical materials used in our processes and avoid harmful disruptions to the supply of these materials.

1. An industry consortium, SEMATECH,[8] has a Critical Materials Council that works to analyze risks to the critical materials supply chain and develop contingency plans for dealing with possible disruptions.

2. The industry's technology roadmap, the International Technology Roadmap for Semiconductors (ITRS),[9] includes a chapter on emerging materials that will be needed for future innovations in our industry.

SIA is leveraging these ongoing efforts, as well as studies and reports from government and other experts,[10] to evaluate the materials critical to the semiconductor manufacturing process. Our assessment will consider of a broad range of factors, including the following:

- The nature, type, and amount of usage in the semiconductor industry
- The availability of alternatives to the material to satisfy the industry's functional requirements
- The degree of reliance on imports of the material
- The geographic concentration and location of sources of the material
- The nature of the supply chain and potential vulnerabilities in supply
- Known worldwide reserves and anticipated future supplies
- Current consumption and expected future demand

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[7] Another example was the result of Hurricane Katrina, which caused extensive damage to a major liquid hydrogen facility in New Orleans. Coupled with a previously planned closure of another plant in Canada, the damage to this plant caused a shortage of supplies of liquid hydrogen. More recently, the industry is concerned by actions such as the recent announcement by China to reduce the export quota for rare earth minerals. See http://www.bloomberg.com/news/2013-12-13/china-cuts-first-batch-rare-earth-export-quota-for-second-year.html.

[8] See http://www.sematech.org/.

[9] See http://www.itrs.net/.

[10] See, e.g., U.S. Department of Energy, Critical Materials Strategy (December 2011) (available at http://energy.gov/sites/prod/files/DOE_CMS2011_FINAL_Full.pdf); U.S. Geological Survey Minerals Information (available at http://minerals.usgs.gov/minerals/).

- Percentage of U.S. consumption of the material, and the usage in the semiconductor industry as compared with other uses
- Price and price trends
- Past incidents of supply disruptions or price spikes

As we continue with this process and identify critical materials and potential vulnerabilities in the supply of these materials, we hope that our recommendations will be considered for inclusion in the lists compiled by the Secretary under this bill.

III. SIA Suggestions on the Critical Minerals Policy Act

SIA offers the following suggestions for the consideration of the Committee as you continue work on S. 1600.

1. Definition of "critical mineral"

The bill defines a "critical mineral" as "any mineral or element" designated as critical, with exclusions for materials that are fuels or water. While this definition is broad, we believe that it is important to ensure that this definition is sufficiently broad to encompass the full range of materials that are critical to the semiconductor industry. The semiconductor industry relies on a range of chemicals, gases, and other materials that may fall outside the definition of a "mineral" or "element." For example, drawing on the recent experience with helium, it is possible that this gas might fall outside the definition of "mineral." Alternatively, even if it was captured by the term "element," it is possible that it may be excluded as a "fuel," since it is typically co-located with natural gas and extracted as a byproduct of the natural gas extraction process. There may be other materials or compounds that are essential to the semiconductor manufacturing process that might inadvertently fall outside the definition of this term. Accordingly, we request that the definition of "critical mineral" (or "critical material") is broad enough to capture the full range of materials that are critical to semiconductor manufacturing and the U.S. economy as a whole.

2. Definition of "critical mineral manufacturing"

Section 101(a)(2) defines "critical mineral manufacturing" specifically cites a number of important sectors of the economy, including "consumer electronics." Semiconductors play a pivotal role in all the listed sectors, including consumer electronics. Nonetheless, we believe that this term should be broadened to encompass the full range of electronics that are critical to our economy, not only consumer electronics. For example, the bill omits transportation and information technology, two important sectors that are reliant on innovations enabled by semiconductors. Some of these sectors may not be consumer focused but still have semiconductors as an essential component.

We further note that Section 101(a)(2), regarding the draft methodology for designating critical minerals, employs the same reference to "consumer electronics" regarding "important uses" of these minerals. This list should also be expanded to include a broader range of sectors that rely on semiconductors, information technology, and electronics.

3. Criteria for Designation as "Critical"

Section 101(a) sets forth the factors to be considered in the methodology for designation as "critical," with a focus on minerals that may be subject to supply restrictions and are used in important economic sectors. SIA agrees with this general approach, and suggests that these criteria should be made more detailed to encompass a broader range of factors that could warrant a designation as a critical mineral. Pages 3-4 of our testimony lists a number of factors that we believe should be considered. We also urge the Committee to take a holistic approach to evaluating the supply chain that supplies critical materials to the semiconductor industry and other sectors, because vulnerabilities in the supply may occur far beyond the extraction of the material.

4. Policy Changes to Address Critical Minerals

Section 102 enumerates certain policy changes in response to the designation of a mineral as critical, such as changes to the National Materials and Minerals Policy, Research and Development Act of 1980. Similarly, Section 106 calls for a study by the National Academies of Science to update its report on "Hardrock Mining on Federal Lands." We agree that these measures may be appropriate, but the bill should address the full range of policies that could impact critical materials, whether or not they pertain to minerals and minerals extraction. Once again, drawing on the helium example, we suggest that the bill should be broad enough and flexible enough to trigger appropriate revisions to policies relating to helium, such as the Helium Stewardship Act.

5. Recycling, Efficiency, and Supply

Section 106 calls for the Secretary of Energy to conduct a research and development program "to promote the efficient production, use, and recycling of critical minerals throughout the supply chain." We agree that such a study could be beneficial to improving the efficiency in the use of critical materials. Among other things, reforming the rules governing the import and export of used electronics for recycling could facilitate the recovery of valuable materials contained in these products. We should exercise caution, however, before imposing new or ill-advised mandates on the use, labeling, reuse, or recycling of these materials.

6. Alternatives

Section 107 calls for the Department of Energy to conduct a study on potential alternatives to critical minerals. We strongly support research to evaluate alternatives to certain critical materials. Because our industry selects materials because of their unique physical and chemical properties, there may not be suitable alternatives in the semiconductor industry. Nonetheless, we support additional research in this area.

We note that the study called for in Section 107 appears to be limited solely to critical minerals in energy technologies. This is certainly one essential area for study, but the bill should call for an assessment of potential alternatives in the full range of critical mineral manufacturing.

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Thank you for the opportunity to offer this testimony on behalf of the U.S. semiconductor industry, and we look forward to working with the Committee as it works on this important bill.