

The Impact of the Semiconductor Shortage on Electronic Specialty Gases

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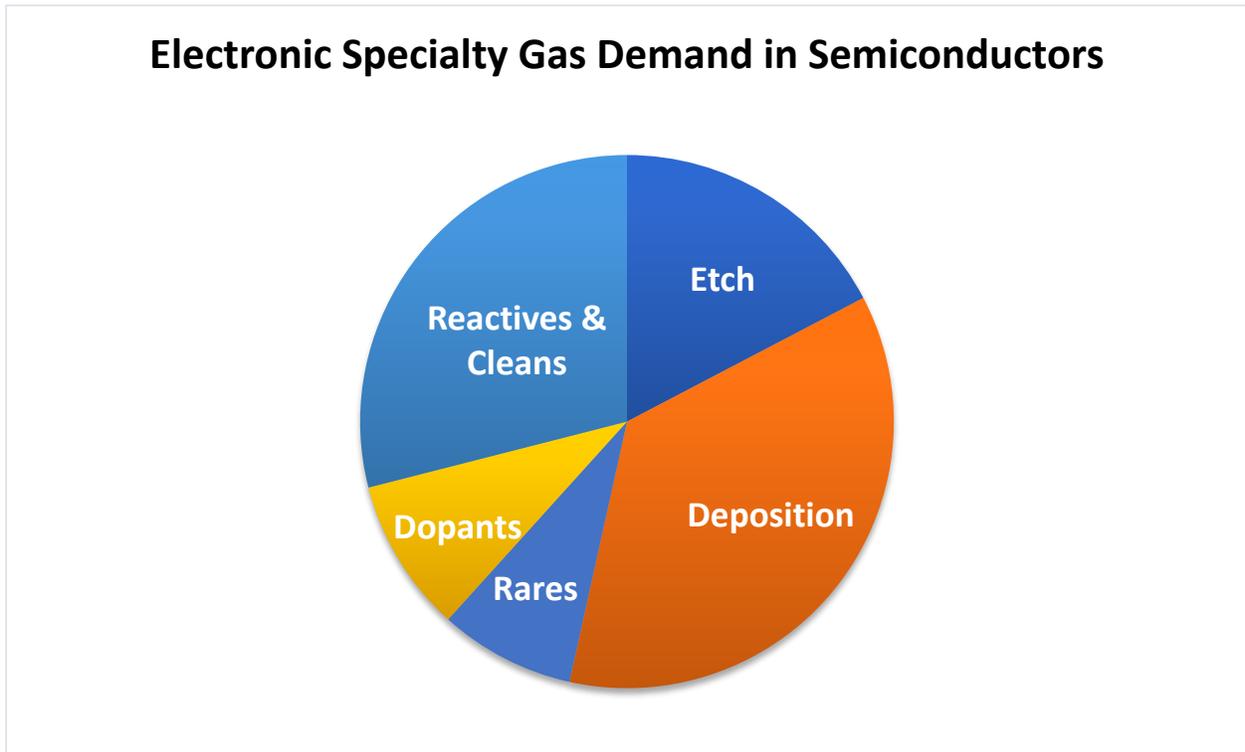
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The Chip Shortage

When COVID first started shutting down the global economy last year, there was an unexpected impact on the semiconductor industry and the demand for electronic specialty gases. Historically, consumer and industrial investment on technology goods has reduced as a recession hits. However, in this recession, there was robust growth both technology investment, and in the global semiconductor industry and, as such, electronic specialty gases. The growth was driven by high technology spending supporting virtual connectivity. Virtual connectivity has been essential in the era of COVID-19 as it is facilitating continuity for our everyday existence during this pandemic.

The semiconductor industry consumed \$3 billion of electronic specialty gases in 2020 vs. \$2.5 billion in 2019. Key categories of electronic specialty gases used in the semiconductor industry include deposition gases, etch gases, rare gases, dopants, and reactive and clean gases, illustrated below:



The growth in technology spending was the culprit that led to a semiconductor shortage. The semiconductor shortage gained headlines earlier this year when its impact on the automotive industry led

to multiple automotive plants having to shut down due to a limited supply of the chips that are used in automobiles. Ford recently announced that it now expects to lose about half of its planned second-quarter 2021 production due to the chip shortage. However, the semiconductor shortage impacts all varieties of devices that use chips, from refrigerators to high-end smart phones.

There are several key reasons why the chip shortage had such an early impact on the auto industry. The auto industry was one of the first industries to shut down at the onset of the pandemic and when the auto industry reduced output, the auto producers cancelled a multitude of orders for semiconductors. The auto industry typically relies on very tight supply chains which do not hold too much inventory. The industry also has some of the most stringent quality and qualification procedures and processes in place, which means that it is not easy for auto companies to shift production from one chip supplier to another in a timely manner. With increased demand from other sectors, the chip suppliers were able to find alternative outlets for their products.

The other reasons for a chip shortage across multiple end-use industries have to do with the complexities of building semiconductors and the semiconductor industry structure. Many complex semiconductor devices have extremely long build cycles. An advanced microprocessor can require almost 1,000 individual steps to complete the wafer and a wafer manufacturing process can take a semiconductor fab 3 to 4 months. The nature of the semiconductor industry structure has also contributed to the shortage. Many semiconductors used in the auto industry, as well as less technology driven applications, come from older semiconductor plants. In many cases these plants are running 200mm wafers, which were state of the art 20 years ago. There has been limited technology investment in 200mm capacity since the emergence of 300mm wafers in the late '90s. Almost all technology investment is focused on the "latest node" 300mm semiconductor devices produced by advanced logic and memory producers, such as TSMC, Samsung and Intel.

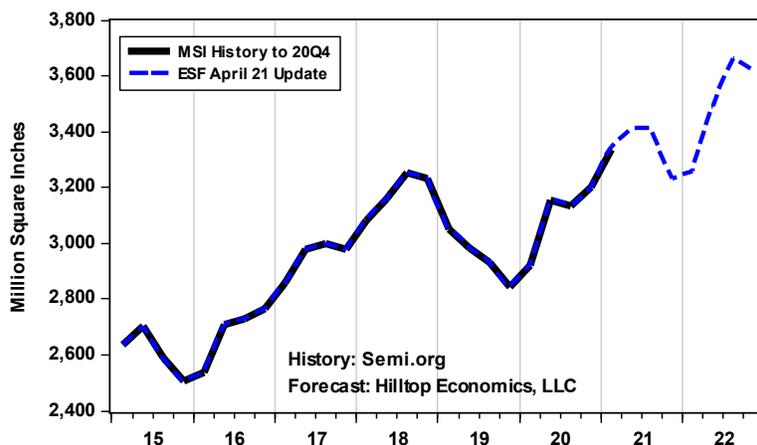
Impact on Regional Semiconductor Industry Structure

Due to the highly visible nature of the global auto industry and the emerging strategic competition between the USA and China, the current semiconductor shortage is driving the US Government to place renewed emphasis and funding on the domestic semiconductor industry and its underlying technology. Multiple government sponsored initiatives have been proposed which can impact the entire industry supply chain from basic R&D to materials development to semiconductor device fabrication and packaging. Examples of such proposed initiatives include The Chips for America Act, The American Foundries Act, The Endless Frontiers Act, as well as other in the National Defense Authorization Act. Many of these initiatives are still being developed and there is some momentum to include most of these in a broader Infrastructure Bill. Likewise, the industry is witnessing parallel developments in Europe with a push to build out the semiconductor capacity in the EU.

These factors will have major implications for the producers and users of electronic specialty gases over the next decade. Not only is the semiconductor industry experiencing significant amounts of capacity ramping up in China, Korea, and Taiwan, but now there are also multiple announcements of substantial capacity additions in Asia and the USA. Recent announcements by Intel, Samsung and TSMC amount to capital expenditures of roughly \$75 billion for new semiconductor fab projects in the USA. Intel also discussed investment in Ireland and Israel, and the intention to add another fab somewhere in Europe.

Industry Outlook

The demand for semiconductors as measured by Silicon area demand in millions of square inches (MSI) for processing into chips, remains strong over the next several years. This outlook is based on the **Econometric Semiconductor Forecast**, published by Linx Consulting and Hilltop Economics each month. MSI is a key indicator for electronic materials and electronic specialty gas demand. MSI is anticipated to grow by 8% in 2021 with have strong growth in 2022, as illustrated below:



The above-mentioned capacity expansions and organic industry growth will tax current electronic specialty gases supply chains. Multiple electronic specialty gas supply chains will need investment to meet quality requirements and increased volumes, associated with new fab builds. Electronic specialty gas suppliers will need to invest across Asia to meet increasing demands for locally produced materials and specialty gases as well as USA and Europe to meet new capacity requirements. Several supply chains have had limited investment over the past few years as regional capacity has been closed, and upgrades have been focused on manufacturing in Asia. In addition, the increased demand in the USA will draw a greater degree of competition in the USA from the many suppliers that do not currently participate in the market. Hopefully, there will be government support for increased supply chain capability and capacity. However, there will remain a significant requirement for continued investment in the supply chain in the USA and Europe over the next few years.

More information on Electronic Specialty Gases

For more information on specialty gases used in electronics industry, please plan on attending the Electronic Specialty Gas Conference 2021, hosted by Linx Consulting. The Conference will spotlight issues pertaining to the manufacture, storage, delivery, use and abatement of specialty gases and materials that are essential to the microelectronics industry. Please go to the conference website link: <https://www.linx-consulting.com/electronic-specialty-gas-conference/> for more information about the agenda and how to register for Electronics Gases 2021.

About Linx Consulting

Linx Consulting is the leading specialist consulting firm focused on the needs of chemical suppliers, device producers, equipment manufacturers, service providers and technology and financials sources in the global microelectronics industry. The company offers strategic intelligence and consulting services and publishes several dedicated reports each year, focused on electronic materials, including one on electronic specialty gases. Linx also publishes the ***Econometric Semiconductor Forecast*** each month. For more information, please visit www.linx-consulting.com