

# 6" AND BELOW: SMALL-DIMENSION WAFER MARKET TRENDS 2020

Market & Technology Report - September 2020

*Wafer fabs never die: small-dimension wafer is still a growing market.*

## KEY FEATURES

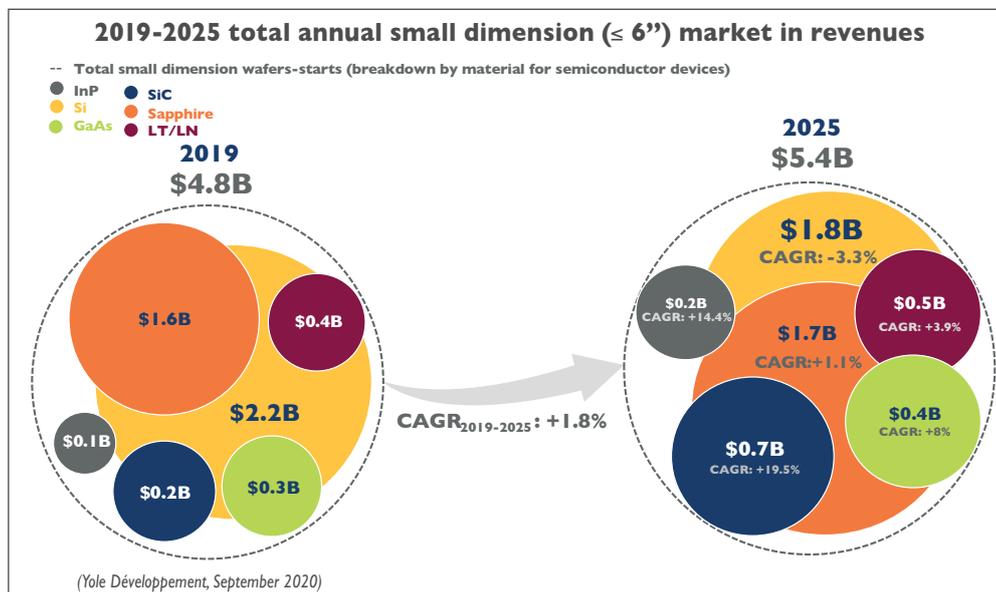
- Comprehensive analysis of the small-dimension wafer market by material, application, and diameter
- Description of the key benefits, added value, and drivers for using small-dimension wafers in the semiconductor industry
- The emerging wafer reclaim industry
- 2019 - 2025 small-wafer market forecasts: breakdown by material, application, and wafer diameter
- Summary of key players by wafer material, and discussion of the global supply chain
- Focus on China and Russia

## MATERIALS, APPLICATIONS, AND MARKET SIZE

The small-wafer (1" - 6") market is anything but "dead", with a 2019 - 2025 CAGR of + 1.8% and estimated revenues of \$5.4B in 2025. More than Moore (MtM) applications represent the overwhelming part of this market, and as such it is still very dynamic. In fact, non-Si wafer markets (sapphire) exhibit moderate to strong (eg. 19.5% for SiC, with revenues estimated at \$712M in 2025) CAGRs over the 2019 - 2025 period. Only Si exhibits a moderate negative CAGR (-3.3%) over the same period for sub-6" Si wafers, due mostly to power and RF applications increasingly transitioning to 8" and even 12".

This sub-6" market strength can be linked to 1) a "good enough" device performance/fabrication cost-per-die ratio so that large CAPEX and risky process changes cannot always be fully justified. This "good enough"

concept is important and is a strong driver in the use of small-dimension wafers. 2) There are strong drivers for materials such as power for SiC and datacom for InP. The case of sapphire is particularly interesting, and the competitive landscape has changed tremendously after a price collapse, with only a handful of players serving a high-volume yet saturated LED market. However, the microLED market could significantly increase demand by 2023, especially in the 6" range. MicroLEDs could also propel the GaAs wafer market, particularly for red pixels – but unlike sapphire, GaAs does not solely rely on the LED market. Indeed, there is a strong forecasted demand for 3D sensing applications, causing GaAs to grow with a CAGR of no less than 8% 2019 - 2025. Overall, new applications and needs are driving evolutions in wafer diameters, by material and by application.



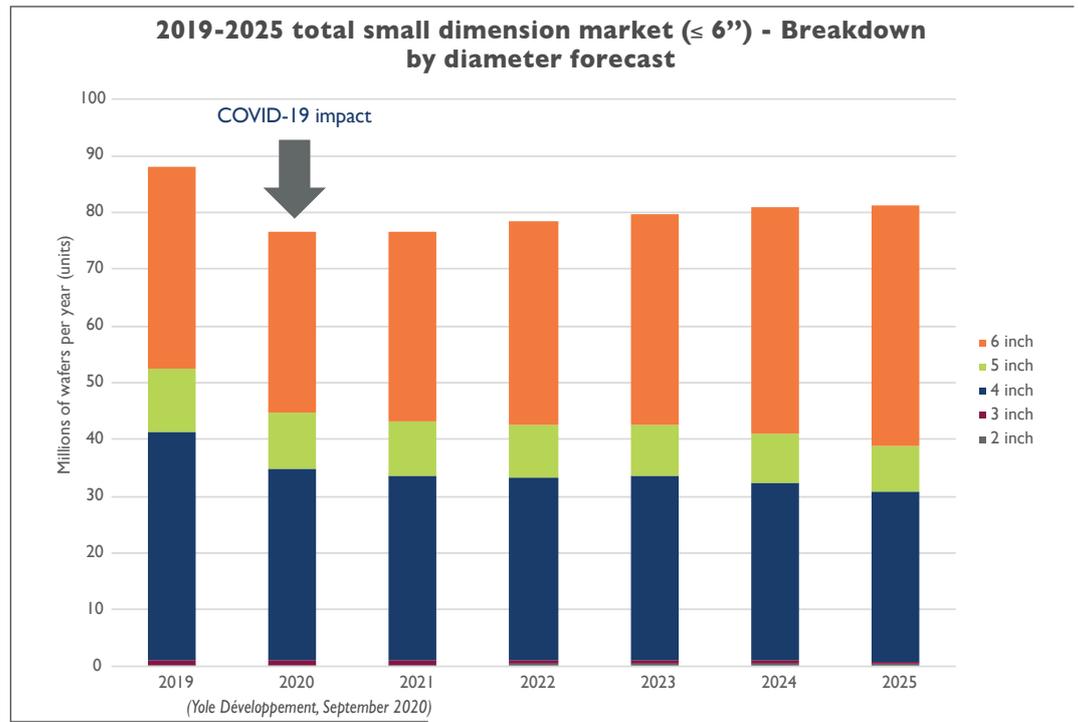
## MATERIAL SUPPLIERS AND MARKET DYNAMICS

Wafer material (ingots and/or wafers) market players tend to be specialized and concentrated on one or two material types. This is especially the case for SiC, sapphire, GaAs, and InP. Interestingly, large Si players (by volume) such as SK siltron have started moving to the SiC market, and we could soon see more such moves. SiC is strongly emerging in the small wafer-size markets – indeed, large financial investments (especially from the power electronics industry) are driving SiC to the

6" and even 8" diameter range, with new dedicated 8" SiC fabs being built. This scaling-up is driven mostly by the need to further reduce wafer cost per square inch, which is still substantially higher for SiC than "traditional" Si wafers. Similarly, GaAs and InP are also limited by the material cost itself. Even though the transitions from 2" to 3" (InP) and 4" to 6" (GaAs) are already underway, strong volumes remain on 2" (InP) and 4" (GaAs) for datacom and 3D sensing applications, respectively.

LT/LN wafers remain firmly anchored to the 5" - 6" wafer diameter for RF applications, with significant volumes attached. However, the GaN/Si combined with the Piezoelectric on Insulators (POI) approach often requires the use of 5" and 6" Si wafers in large volumes, and they have started gaining market share in the RF segment. In parallel, some wafer suppliers are increasingly proposing reclaim service in the well-established 8" and 12" Si wafer segments. Reclaim service is also growing in the 4"- 6" range with the wider use of non-Si

wafers (excluding sapphire), which are in general much more expensive than traditional Si wafers. Interestingly, in a saturated sapphire wafer market, some players are looking for other business opportunities. For example, Hansel Technics (Korea) has started offering 8" and 12" Si reclaim wafers. However, there is no financial incentive to reclaim sub-8" Si and sapphire wafers. Incidentally, the sapphire market has become significantly concentrated around a few players such as Monocrystal (Russia).



## REFURBISHED EQUIPMENT MARKET: "NEW" VERSUS "DEPRECIATED" FABS

In parallel to mainstream semiconductor equipment there exists a vibrant refurbished equipment & maintenance market. This is significant and connected to the "fabs never die" trend. Less known is the existence of a market for depreciated fabs, which also represent tremendous opportunities to produce devices at low cost for any volume. For

example, there is still significant demand for 6" Si wafers in standard power IGBT and MOSFET devices. Higher-end devices can then be fabricated in brand-new fabs (e.g. Bosch and Infineon in the power electronics industry, in the Si 300 mm range) which is also a way to secure future supplies and assert one's dominance in the market.



A similar trend is at play in the SiC wafer manufacturing industry, with some major players moving quickly to 8" wafer diameter and securing their supply chain while leaving behind 6" (and even more so 4") wafer processing capacities. With the increased use of non-Si substrates, more and more players are offering specific processing equipment for a

given material and/or are proposing equipment which can adapt to different materials and diameters, including 4" and 6". This equipment can be astutely used in fully depreciated sub-6" Si wafer fabs, creating opportunities for players small and large to offer a highly competitive device fabrication cost. Therefore, wafer fabs never die.

**REPORT OBJECTIVES**

- Assess the wafer market (up to 6-inch) for More than Moore (MtM) devices
- Submit a wafer-starts analysis and metrics by MtM application segment and split by wafer size and material (2019 - 2025)
- Define the key drivers for using small wafer sizes
- Describe the ecosystem and positioning of key players in the sub-6" wafer diameter market

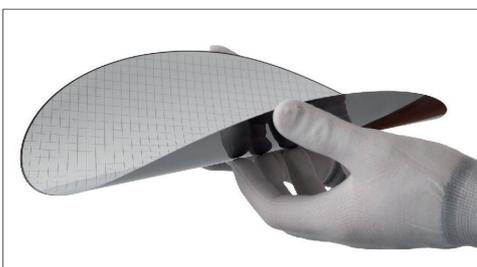
**COMPANIES CITED IN THE REPORT (non exhaustive list)**

II-VI Advanced Materials, Applied Materials, Atecom Technology, ATREG, Ceramic Forum, CMK, Cree-Wolfspeed, Crystaland, Cyberstar, ELMA, Freiburger, Global Wafers, Harbin Aurora, III-V Reclaim, Iljin Display, Infineon, InPact, Monocrystal, Okmetic, Optim Wafer Services, Power Advanced Materials, PSI, Pure Wafer, ROHM - SiCrystal, Saint-Gobain LUMILOG, Shin-Etsu, Showa Denko, Siltronic, Sil'Tronix ST, Si-Mat, SK siltron, SOITEC, STMicroelectronics, SUMCO, Sumitomo, TDG, University Wafer, Vital Materials, Wafer Export, Wafer World and more...

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- Thinning Equipment Technology and Market Trends for Semiconductor Devices
- Epitaxy Growth Equipment for More Than Moore Devices Technology and Market Trends 2020
- Status of the MEMS Industry 2020
- Compound Semiconductor Quarterly Market Monitor
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 Branch code: 00170  
 Account n°: 0170 200 1565 87  
 BIC or SWIFT code: CCFRFRPP  
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6.7 It is further acknowledged and agreed by the Buyer that any investor in the Buyer Company, any external consultant of the Buyer Company or any joint venture done with a third party in which the Buyer Company is involved , is not entitled to use a Product, without paying to the Seller the full price for a license to the required Product..

## 7. TERMINATION

If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be incurred by the Seller, pursuant to such cancellation or postponement.

## 8. MISCELLANEOUS

8.1 All the provisions of these General Terms and Conditions of Sale are for the benefit of the Seller, but also for that of its licensors, resellers and agents. Each of them is entitled to assert and enforce these provisions against the Buyer.

Any notices under these Terms and Conditions shall be given in writing and shall be effective upon receipt by the other Party.

8.2 The Seller may, from time to time, update these General Terms and Conditions of Sale, and the Buyer, shall be deemed to have accepted the latest version of such General Terms and Conditions of Sale, once they have been duly communicated to the Buyer by the Seller.

## 9. GOVERNING LAW AND JURISDICTION

- 9.1 Any dispute arising out or linked to these General Terms and Conditions of Sale or to any Licenses or Products purchased in application thereof shall be submitted to the French Commercial Court of Lyon, which shall have exclusive jurisdiction upon such issues.
- 9.2 French law (without reference to any applicable conflict of law provisions) shall apply to these General Terms and Conditions of sale and any agreement between the Buyer and the Seller made pursuant thereto.