

QUARTERLY UPDATE: SILICON WAFERS

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OUTLINE

- Wafer Market Assessment
- Semiconductor Market Trends
- Silicon Shipment and Revenue Forecasts
- Silicon Market Trends
- Supplier Activity
- Polysilicon
- SiC
- Supply-Chain Issues / Concerns

WAFER MARKET ASSESSMENT / ANALYSIS

- The very strong demand in 2021 across the global semiconductor industry will result in a record high total for annual silicon shipments:
 - 2021 Forecast: 10% wafer shipment growth estimated, and a 2020 to 2025 CAGR of 3.5%
 - 300 mm wafer shipments to grow over 11% this year; Strong shipment growth is playing out for 200 mm wafers as well.
- As noted previously, the successful acquisition of Siltronic AG by GlobalWafers will result in the second largest supplier by revenue share
 - Acquisition still waiting approval by several nation's regulatory agencies. Rulings are expected in the second half of this year.
- 300 mm wafer capacity has tightened and may suffer shortages in the coming years unless greenfield capacity is brought online:
 - Based on current forecasts 300 mm prime wafer demand will be at >99% of utilization of production capacity 2022.
- Siltronic has announced a new greenfield wafer manufacturing plant investment in Singapore.
 - Project investment is needed by Siltronic even if the acquisition by GlobalWafers does not go through.
 - Plant will begin producing wafers in 2024.
- Reports earlier in the summer stated both SEH and Sumco are in consideration of new greenfield investment planning, though wafer price increases will be needed to make such an investment.
 - In its last quarterly report, SEH indicated it was already discussing such plans with customers.

SEMICONDUCTOR MARKET TRENDS

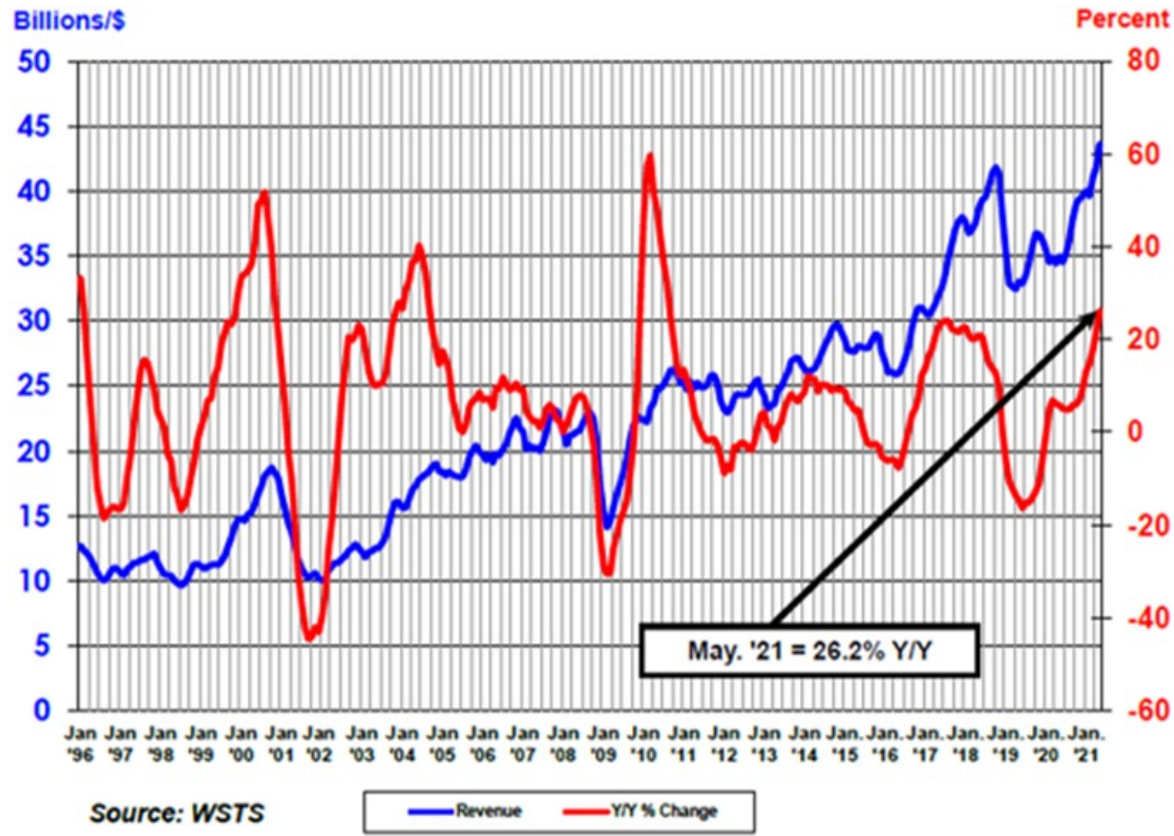
- GDP recovers for all advanced economies
- Semiconductor market is forecasted experience 20% or more revenue growth for the year/
- Top challenges to growth include economics, geopolitics, length and severity of pandemic – including the effectiveness of the vaccine roll out globally and the impact of corona virus variants.
- Trade and IP concerns remain, especially between China and the U.S. Strong economic recovery is straining supply chains across the economy.
 - Impacts delivery of manufacturing equipment needed by companies to ramp production.
- Highest materials growth areas include metals/ precursors, cleans followed by CMP and Photoresists
 - Driven by 3DNAND and advanced Logic

SEMICONDUCTOR SALES GROWTH

Worldwide Semiconductor Sales

Worldwide Semiconductor Revenues

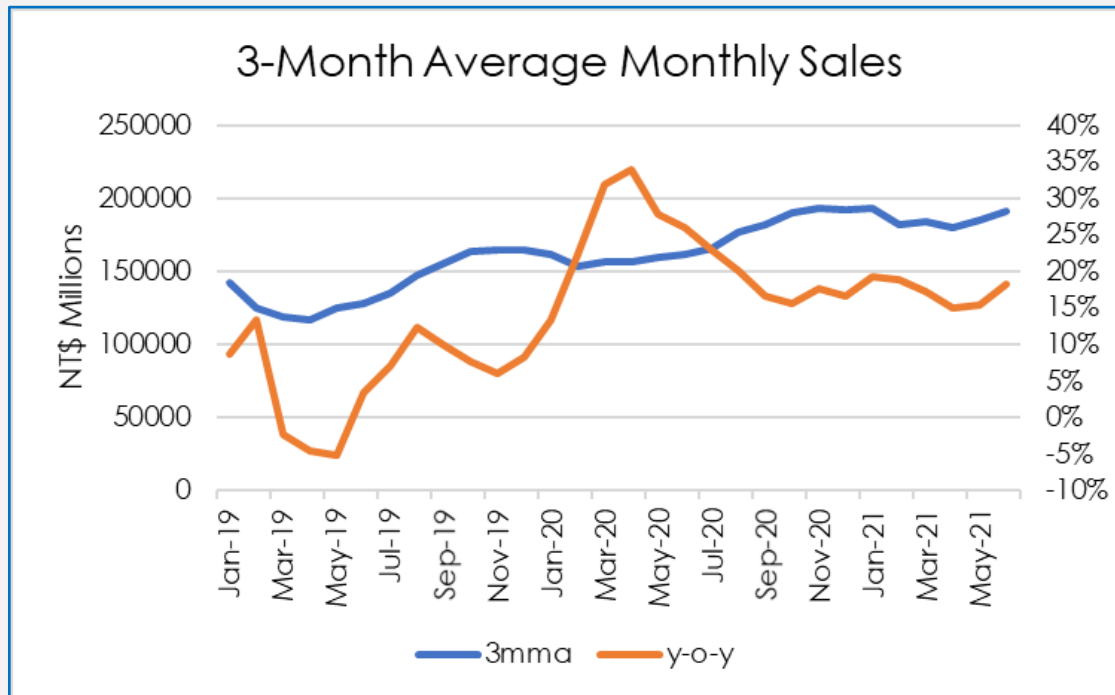
Year-to-Year Percent Change



- Strong momentum continues in the first half of 2021
 - Sales in May Up 26.2% Year-to-Year, 4.1% Month-to-Month
 - On a regional basis, year-to-date sales are up double-digits across all markets compared to the same period of 2020.

TAIWAN MONTHLY SALES TRENDS

**Worldwide Semiconductor Sales
(TSMC, UMC, VIS, ASE, ChipMOS, KYEC)**



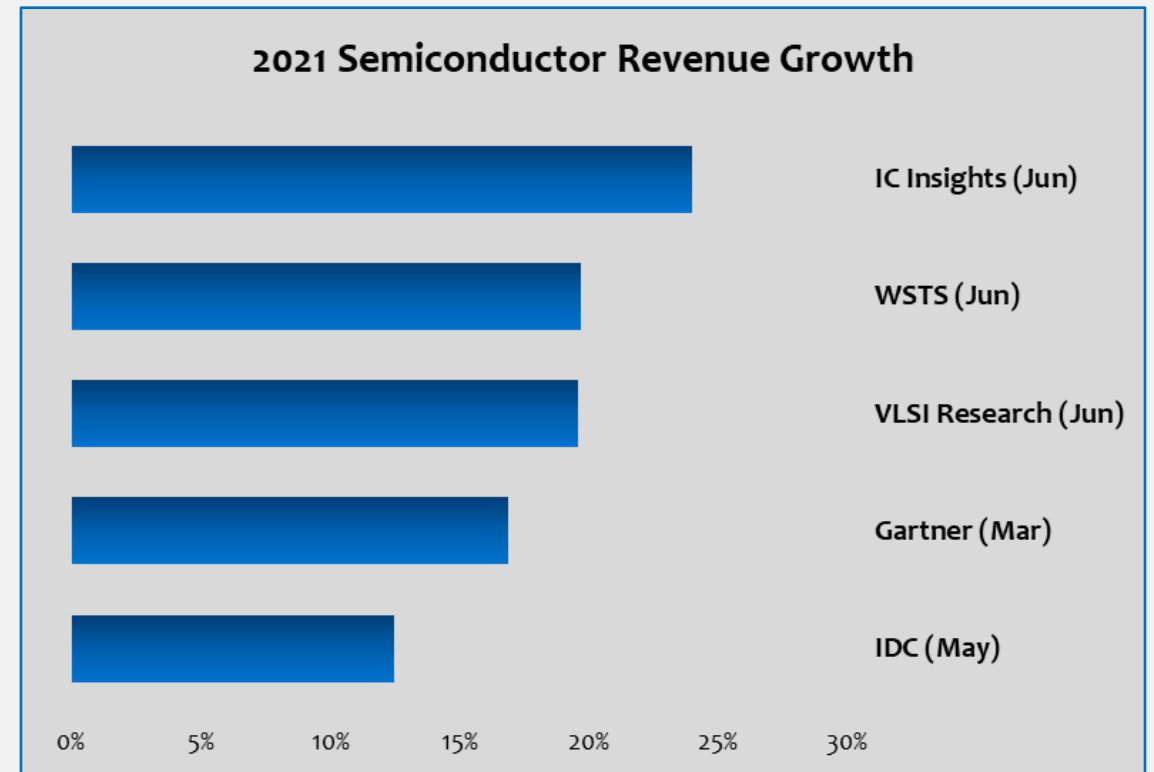
Source: Company Monthly Reports

- Combined monthly sales of six outsource manufacturers in Taiwan increased throughout much of 2020.
- Through June 2021, sales are up +17% compared to the same period one year ago.
- 2Q 2021 sales improved over 4.1% from 1Q 2021 sales.
 - Appears June sales for some companies may have dampened due to the COVID19 outbreak in Taiwan
- Reports out of Taiwan state capacity utilization is strong at Taiwan's foundries (150 mm, 200 mm and 300 mm lines) and backend assembly & test houses
- The Taiwan data trends and company reports point to a strong semiconductor industry growth year for 2021 and into 2022.

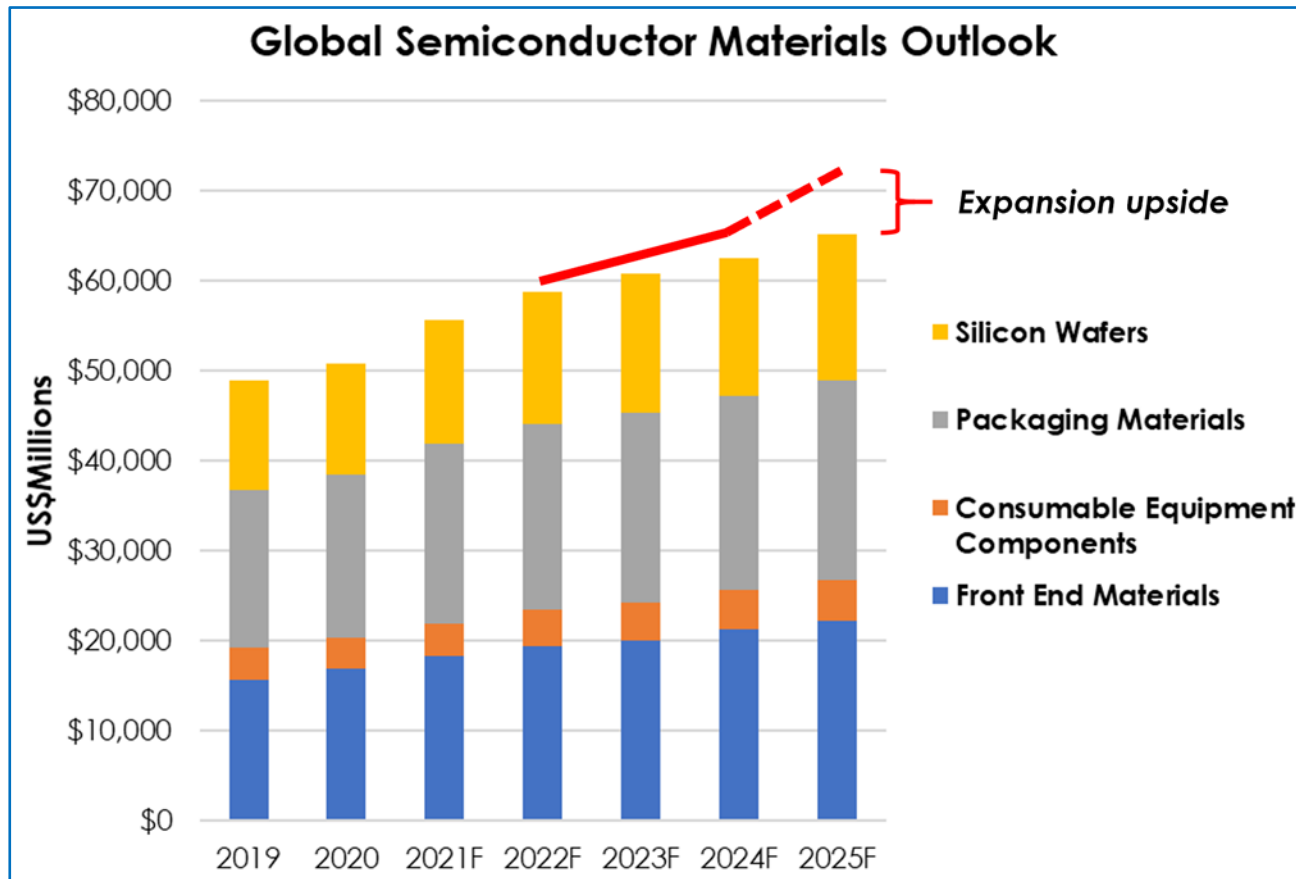
SEMICONDUCTOR INDUSTRY OUTLOOK

- Semiconductor market is forecasted experience very healthy growth in 2021
 - Many analysts forecasting double-digit revenue growth for the year, as high as and even topping 20% revenue growth
- Increase in smartphone shipments, continued rollout of 5G, demand growth in data centers and the recovery and growth for automotive electronics
- Possible negatives to the forecast remain stagnant economic recovery from the pandemic, vaccination roll out, and trade issues.

Semiconductor Revenues 2021



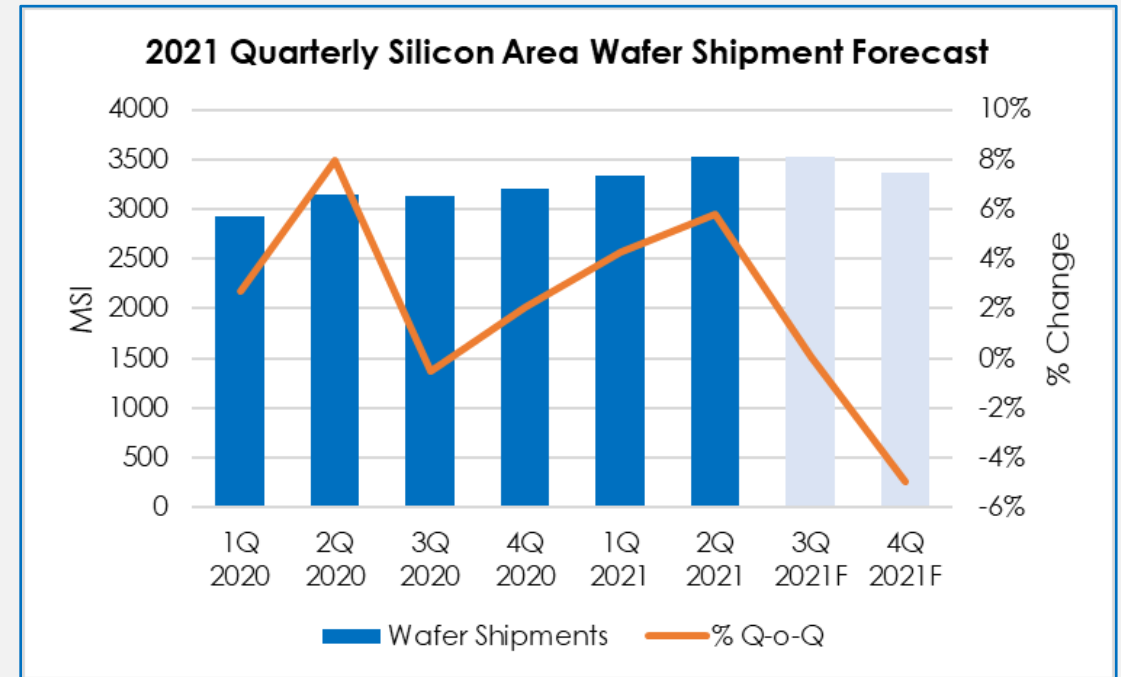
SEMICONDUCTOR MATERIALS FORECAST



- Total materials revenues will top \$55B this year growing by 10%
- With growth projected for 2021 through 2025
 - 5% CAGR
 - Upside potential in latter years of forecasts given fab announcements
- Highest materials growth areas include metals/precursors, cleans, CMP, SOI wafers, and Photoresists

QUARTERLY SILICON WAFER SHIPMENT TRENDS

- 2Q 2021 wafer shipments grew over 5% from 1Q 2021 shipments
 - All time record high quarterly shipments
- 1H 2021 shipments reached 13% above 1H 2020 shipments
- Assuming 10% shipment annual growth in 2021, a seasonally expected slowdown in wafer shipments will payout in 4Q 2021.

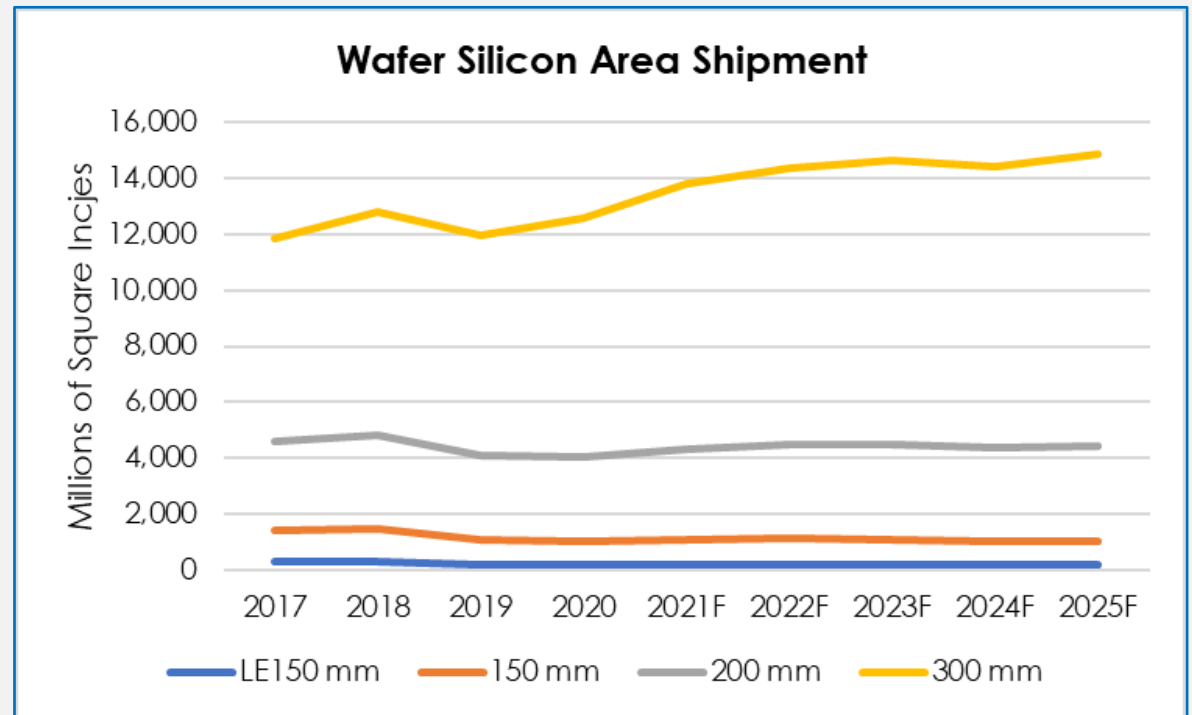


Source: TECHCET/SEMI SMG

SILICON WAFER SHIPMENT FORECAST

- 2021 wafer shipments forecasted increase +10.0% to reach a record level of 13.8 billion square inches
 - 300 mm to grow by +11.3%
 - 200 mm by 7.2%
- 2020-2025 CAGR for total shipments is +3.5%, and by diameter:
 - 150 mm = 0.1%
 - 200 mm = +2.4%
 - 300 mm = +4.2%

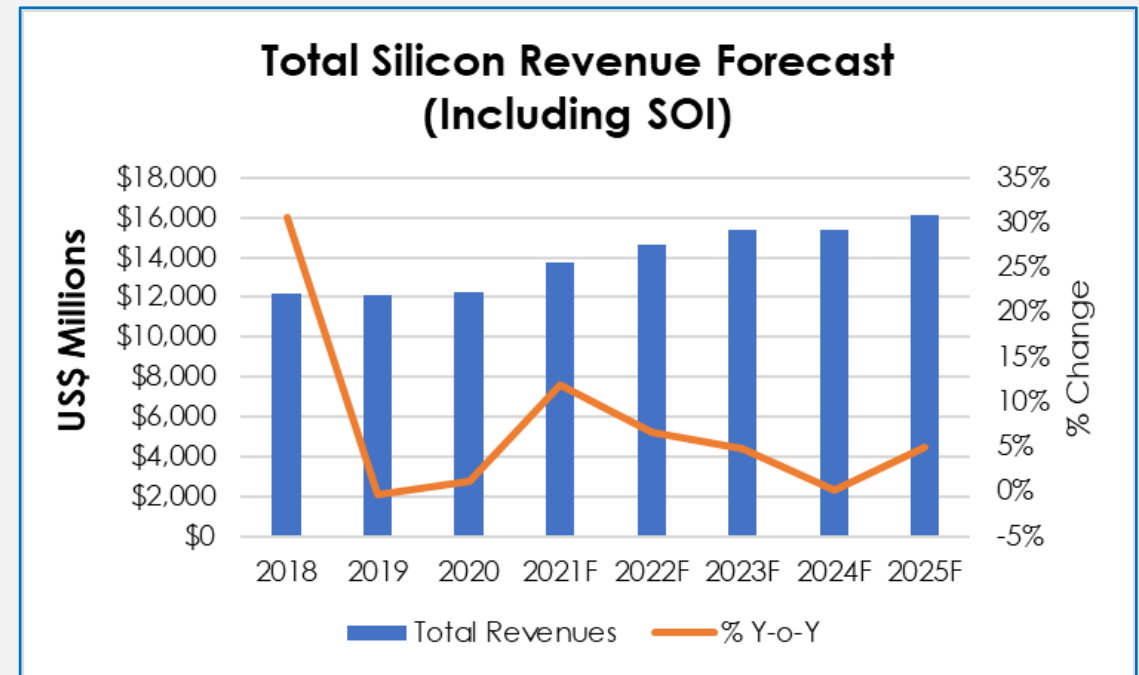
Silicon Wafer Shipment Forecast (Updated July 2021)



SILICON WAFER REVENUE FORECAST

- 2021 silicon wafer revenues now forecasted to increase by almost 12%
- Excluding SOI wafers, revenues will increase 11.7%
- SOI wafer revenues will grow >14%
- 2020-2025 CAGR for Total Wafer Revenues is +5.6%
- Supply tightness is expected to boost aggregated ASPs higher in the forecast years.
- Including expected higher LTAs to pay for new greenfield expansions

Silicon Wafer Revenue Forecast (Updated July 2021)



WAFER SUPPLIER UPDATE- SHIN-ETSU

Electronics Materials

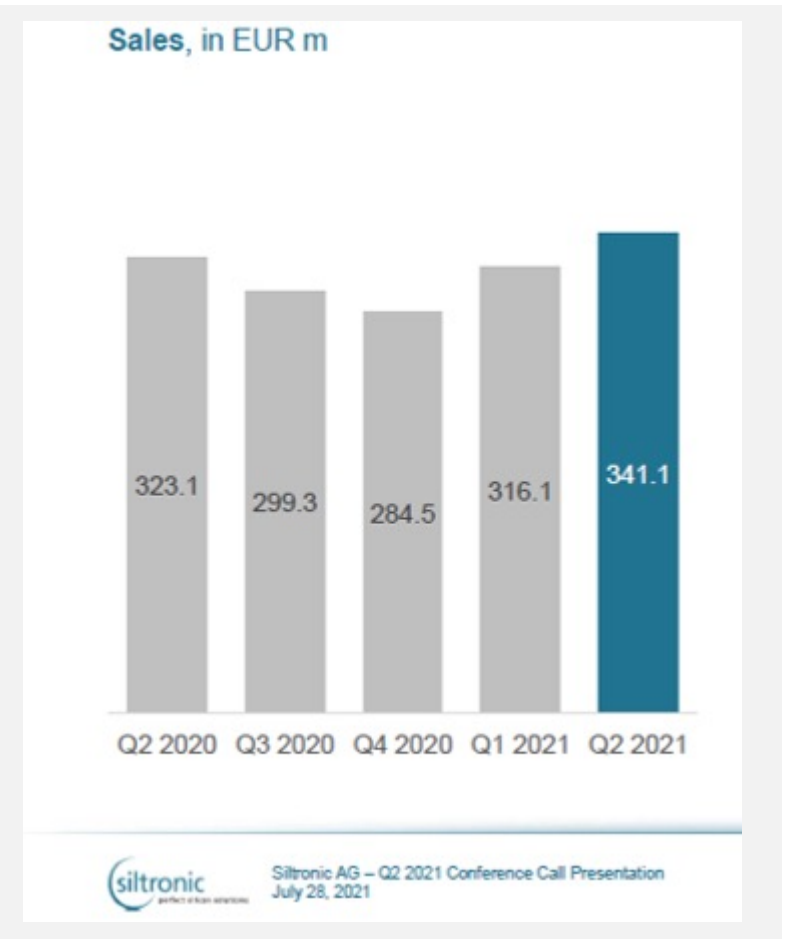
	Apr - Jun 2020 (Billions of yen)	Apr - Jun 2021 (Billions of yen)	Increase / (Decrease)
Net sales	144.4	161.1	11.5%
Operating income	51.8	56.7	9.4%

SEH reports:

- Electronic Materials revenues increased 11.5% in FYQ1 2021 vs. FYQ1 2020.
- (Did not report Silicon Wafer revenues separately in its FY1Q 21)
- *“Strong demand across range of Electronic Materials products”*
- Based on the trend TECHCET believes:
 - CY 2Q 2021 revenues increased at least 10% vs. CY 1Q.
 - 1H 2021 revenues are estimated to be about 6% above 1H 2020.

WAFER SUPPLIER UPDATE- SILTRONIC

- Siltronic reports 1H2020sal ending 6/30:
 - 1H 2021 sales up 5.5% (15% in USD) vs. 1H 2020
 - 2Q 2021 sales up 8% vs. 1Q 2021
 - 300 mm epitaxial is on allocation; while 300 mm polished, 200 mm, and smaller diameters are “fully loaded”.
 - ASP was “flatish”
- Announced new greenfield plant in Singapore for leading-edge 300 mm (includes ingot growing, polishing, and epitaxial)
 - Investment needed whether acquisition by GlobalWafers goes through or not.
 - Construction will begin this year and production should commence in early 2024.
 - Project is part of the JV with Samsung
- 2021 capex increased to about €459 million:
 - Upgrade ingot growing capabilities and increase epitaxial production at Freiberg Germany location



WAFER SUPPLIER UPDATE- SOITEC

- Soitec reports:
- Q1 '22 revenue reached €180m, up 69% at constant exchange rates versus Q1 '21
- FY'22 revenue guidance confirmed at around \$950m (up around 40% at constant exchange rates)
- In the first quarter of FY'22, 150/200-mm wafer revenue reached 79.1 million Euros, a 24% increase at constant exchange rates compared to the first quarter of FY'21 and an 8% increase at constant exchange rates compared to the fourth quarter of FY'21.
- In the first quarter of FY'22, 300-mm wafer sales reached 95.9 million Euros, a 149% increase at constant exchange rates, compared with the first quarter of FY'21.

NEWS

- In June 2021, Globalfoundries and GlobalWafers have struck a US\$800 million agreement to add 300mm silicon-on-insulator (SOI) wafer manufacturing and expand existing 200mm SOI wafer production at GlobalWafers' MEMC facility in O'Fallon, Missouri
 - Expansion includes funding support from the state of Missouri.
- There was a report out of South Korea that SK Siltron announced an invest to expand capacity
 - The investment is believed to be epitaxial wafers. The capacity addition will be in the range of 20,000 to 30,000 wpm.
 - It is unclear if the investment is for expansion into an existing facility or will involve the construction of a new one. SK Siltron to Expand Wafer Production Lines
- There are report that both SEH and Sumco are in consideration of new greenfield investment planning, though wafer price increases will be needed to make such an investment.
 - In its last quarterly report, SEH indicated it was already discussing such plans with customers.
 - A Yahoo News Japan article mentioned that Sumco would consider Japan or Taiwan as a greenfield plant location.
 - The article states a sizeable 50% to 60% price increase is part of the discussions.

POLYSILICON

- Pricing for solar-grade polysilicon began to rise in 2020 given a series of factors. Now it is reported that semiconductor grade polysilicon pricing on the spot market is on the rise. Long-term Agreements are in place in this sector, so immediate price rises due to higher starting material prices should be limited in 2021. However, as the LTAs end and new ones need to be discussed, higher polysilicon prices could impact the semiconductor wafer market in 2022 and forward.
- REC Silicon considering investment to boost Float Zone polysilicon capacity
 - Silicon anodes for batteries to drive consumption of silane gas.

SiC

- SK Siltron CSS Announces \$300 Million Michigan Expansion to Support Electric Vehicle Growth:
 - eng.sk.com/news/sk-siltron-css-announces-300-million-michigan-expansion-to-support-electric-vehicle-growth
 - This is a sizeable investment by SK Siltron CSS to boost SiC wafer production capacity.
 - Given the SiC device market is forecasted to be US\$3B to US\$4B by 2025, business conditions will affect the timing of the ramp in the investment.

M&A – GLOBAL WAFERS ACQUIRES SILTRONIC

- GlobalWafers announced plans to acquire Siltronic AG back on November 29, 2020
 - This acquisition will result in the second largest semiconductor wafer supplier in the industry.
 - Acquisition still awaiting approval from US FTC and similar national authorities in Japan, China, and Germany
 - Current expectation is that all approvals will close in 2H2021.

SUPPLY-CHAIN ISSUES, PROBLEMS, CONCERNS

- No major supply chain issues, although as demand increases the supply/demand balance tightens
 - 300 mm epitaxial wafers are on allocation for some customers
 - Supply for other 300 mm has tighten this year and will remain so into 2022 through 2024.
- Global 300 mm wafer production capacity will need to expand by 6% or more over the next two years to avoid a shortage in meeting current 300 mm wafer shipment forecast.
- Logistic challenges and costs remains
- Potential for higher electricity prices to impact prices for polysilicon and wafers.

THANK YOU!

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