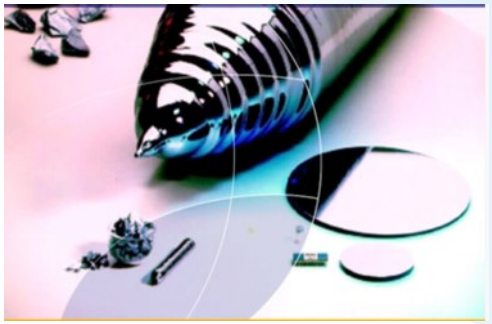
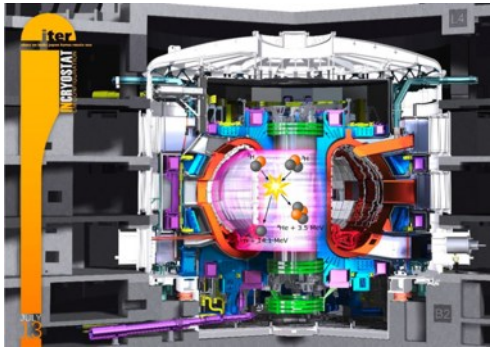
Brief Introduction to the Market & Applicable Field of Superconducting Technology

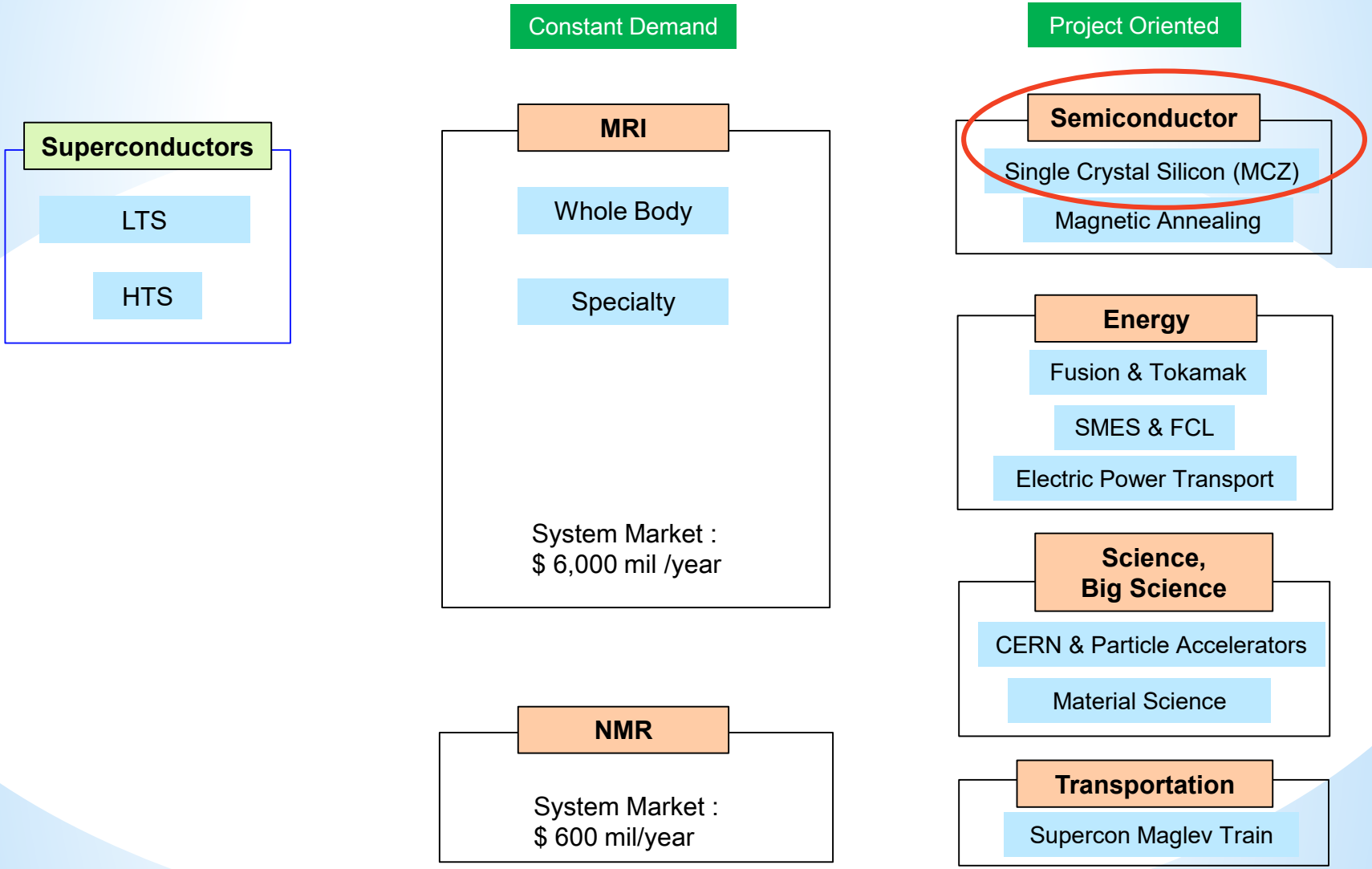


Semiconductor Application



30th of March, 2022
Yasunao Yokota
yokota.yasunao@icloud.com

Market & Applicable Field of Superconducting Technology



Brief Introduction to the Market & Applicable Field of Superconducting Technology

Semiconductor Application

- Contents –

Wafer Suppliers
&
Each Market Share

1.1 Growth rate of silicon wafer market

SUMCO's Business

From SUMCO Annual report 2020

Silicon wafers are a growth industry

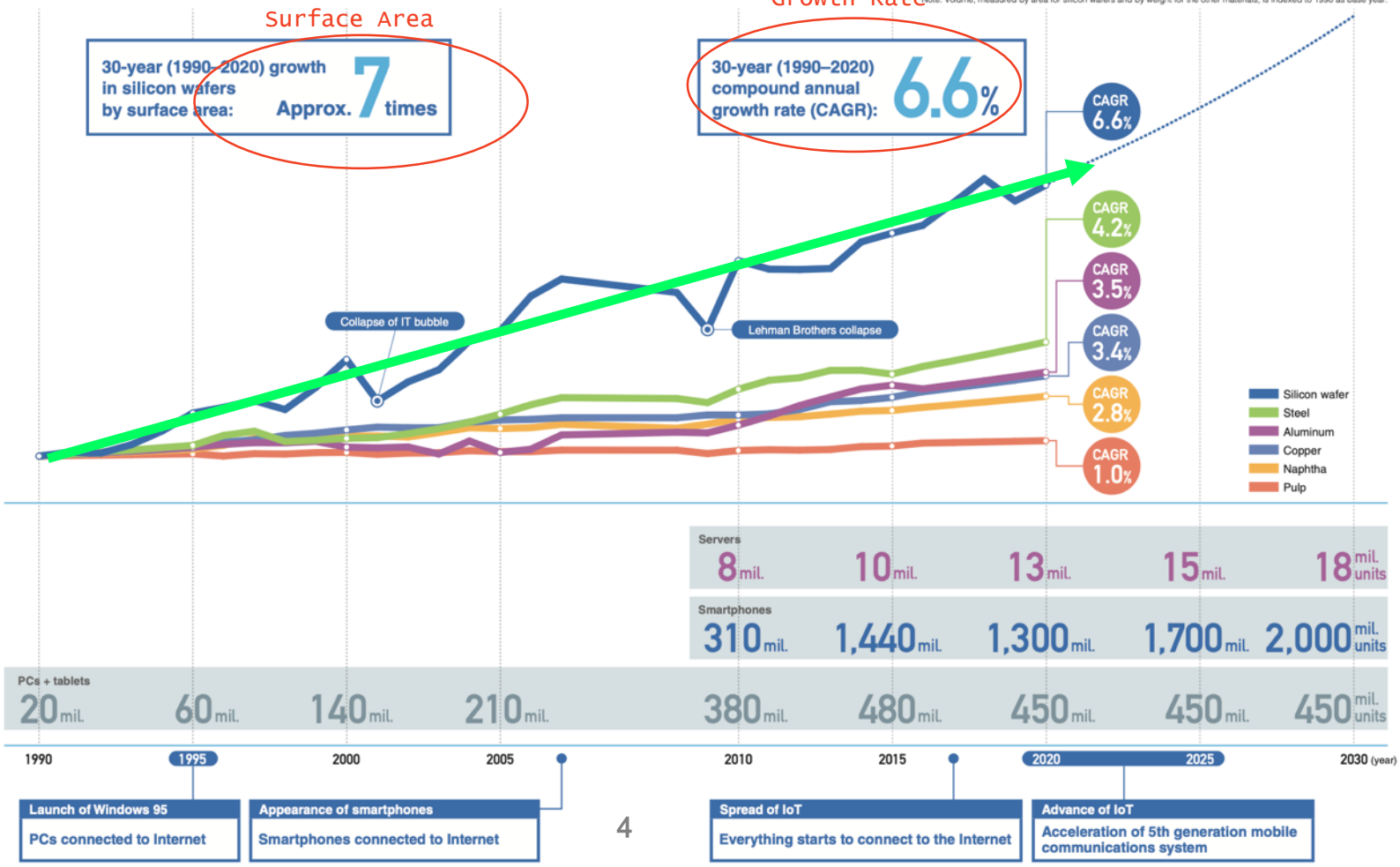
Surface Area

30-year (1990–2020) growth in silicon wafers by surface area: Approx. 7 times

Growth Rate

30-year (1990–2020) compound annual growth rate (CAGR): 6.6%

Note: Volume, measured by area for silicon wafers and by weight for the other materials, is indexed to 1990 as base year.

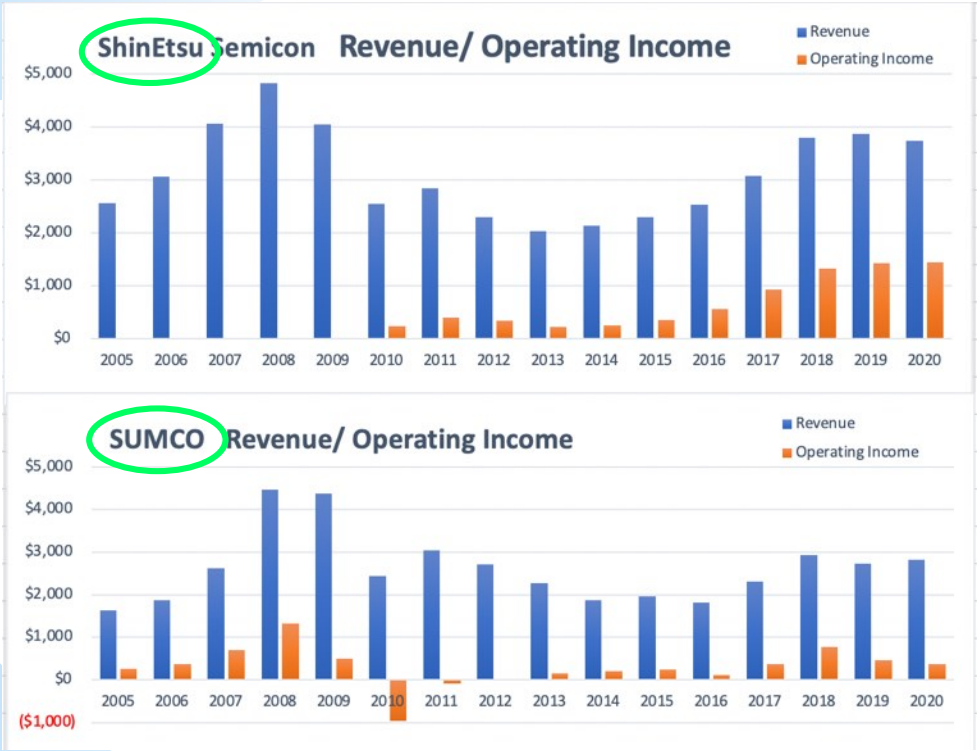


Silicon Wafer Market
CAGR 6.6% 1990-2020

1.2 Silicon wafer market (by SUMCO)

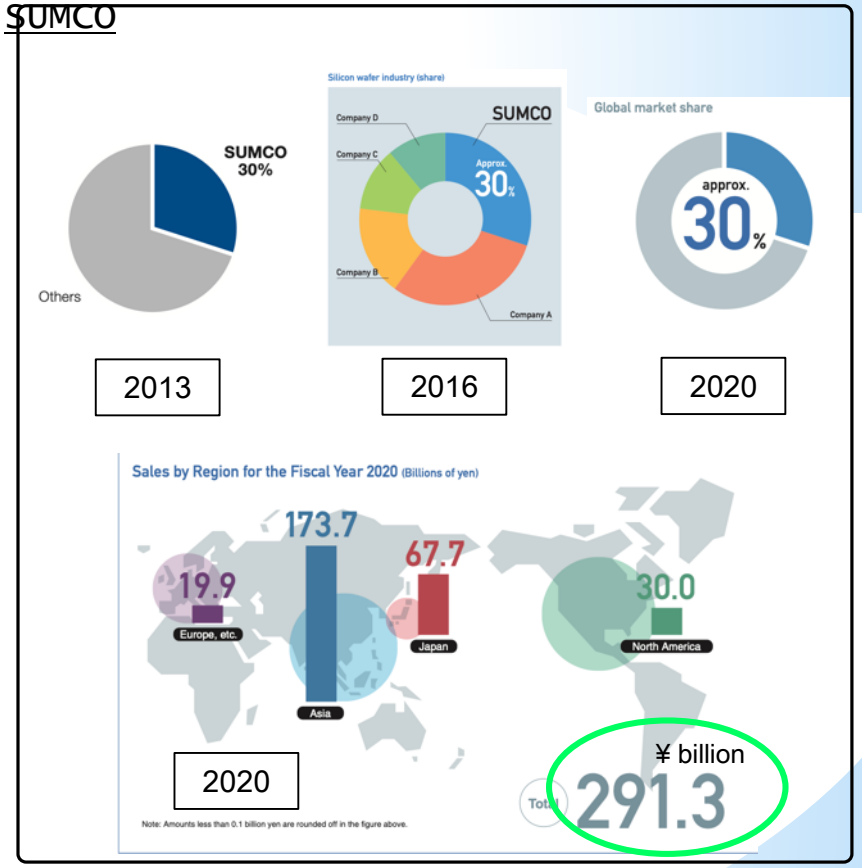
Appreciate insider's instruction

$ million



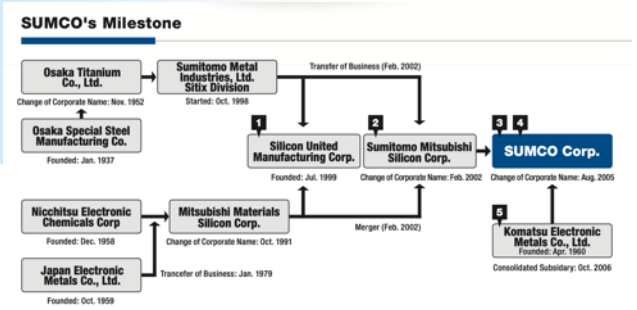
Figures above from each Annual Report

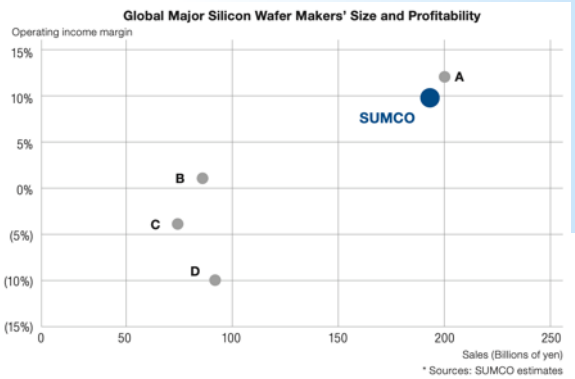
Wafer supply share by SUMCO

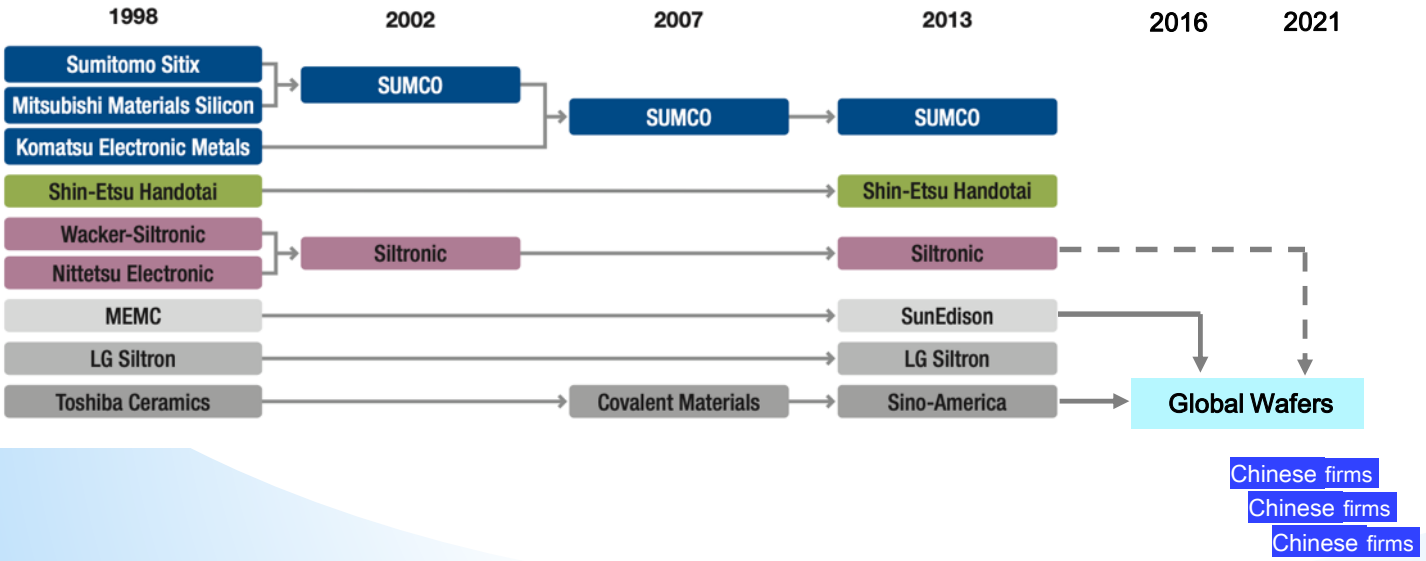


Source of information, SUMCO Annual Report

1.3 Wafer supplier profitability, M&A historyc



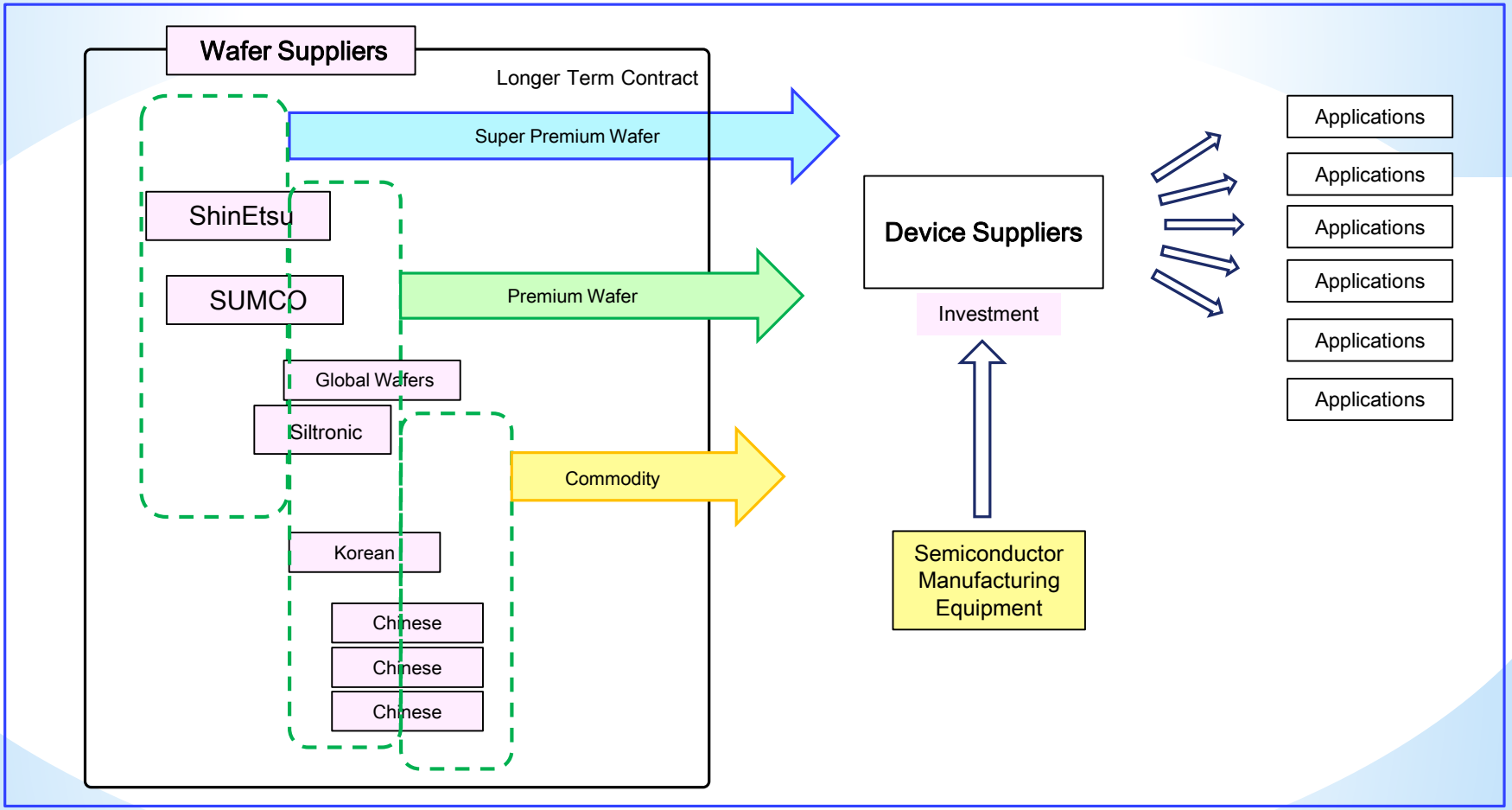




1.4 Wafer Quality Matters

How?

Appreciate insider's instruction



MCZ process
&
Supply Chain
around the Crystal Growth Process

2.1 Process Concept of MCZ

Semiconductor

Single Crystal Silicon (MCZ)

Magnetic Annealing

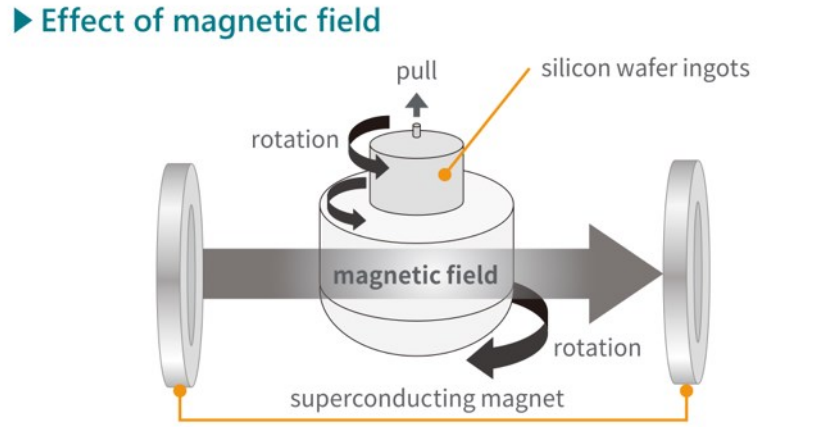
M-RAM (Magnetic RAM)

HDD Head Magnetisation

Process Concept of MCZ :
Magnetic-field applied Czochralski process
(from Toshiba brochure)

SC28 Czochralski system

Puller, PVA TePla brochure

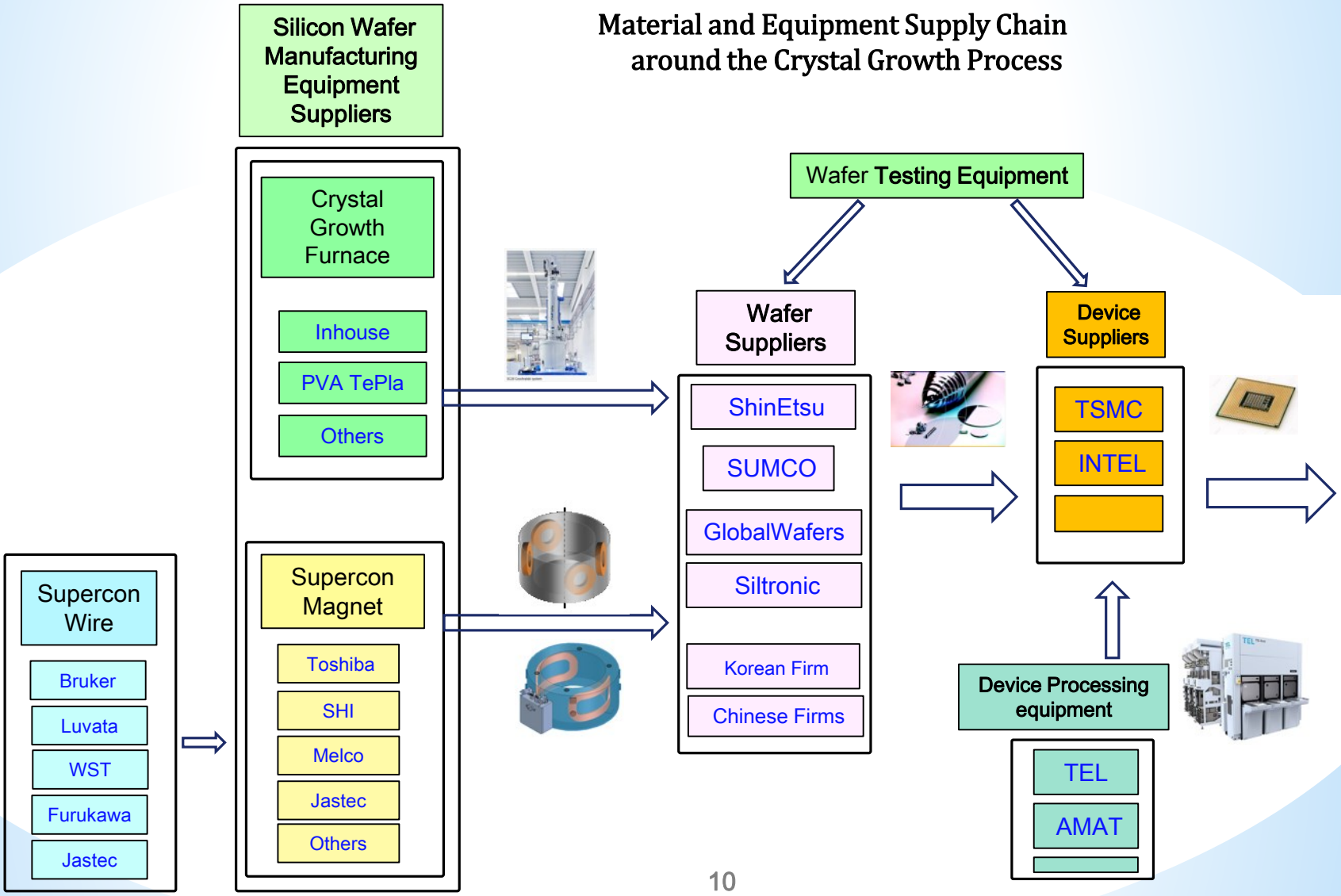


Effect of high magnetic field ▸▸▸ Improvement of productivity

Suppression of convection and temperature gradient.. → Good quality of silicon ingot.

Extend life of crucible. → Increasing yield.

Material and Equipment Supply Chain around the Crystal Growth Process



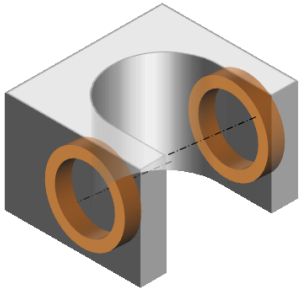
Superconducting Magnet for MCZ Process

3. Superconducting Magnet for MCZ Process-1

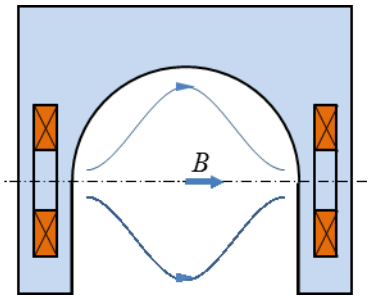
Jastec

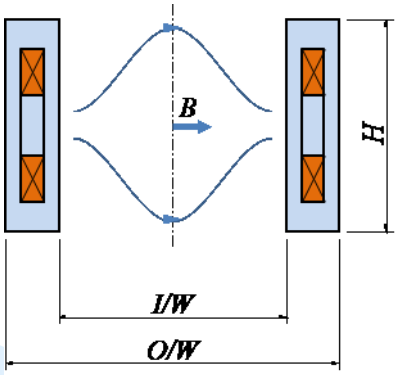
Toshiba

simple solenoid
Located in parallel



- Simple design
- Suitable for "retro-fit"
- Rather bigger footprint





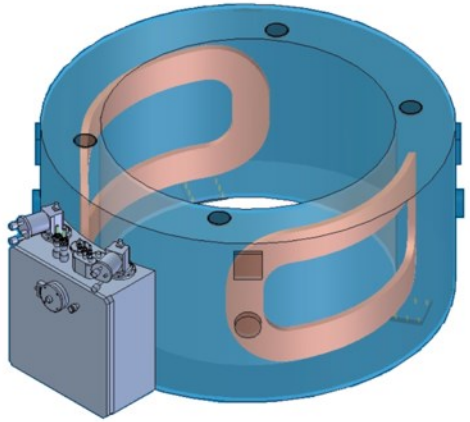
3. Superconducting Magnet for MCZ

Process-2

Toshiba

Melco

Saddle type

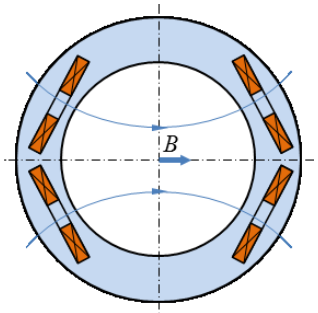


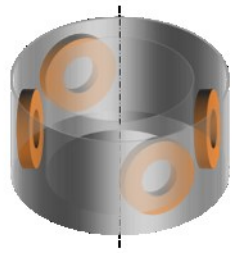
- Most sophisticated design
- Thinnest and most compact
- Cost friendly option

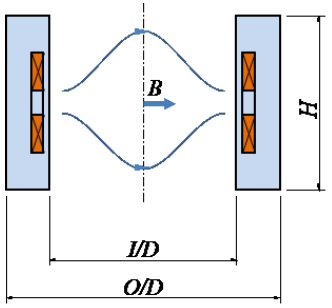
- Requires winding know-how

SHI

4-Coil-type







- Higher stress design
- Costly option

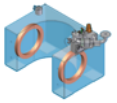
3. Superconducting Magnet for MCZ Process

-3

1988 2008 2015 2022

Shin-Etsu

Wet (zero-boil off)

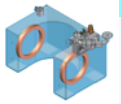


simple solenoid
Located in parallel

Toshiba

Dry

simple solenoid
Located in parallel



Jastec

Saddle type

Toshiba

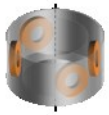
SUMCO

Wet (zero-boil off)

Saddle type

Melco

Dry



4-Coil-type

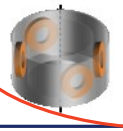
SHI

Wet (zero-boil off)

Saddle type

Melco

?? Dry



4-Coil-type

SHI

Siltronic Global Wafers

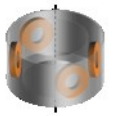
Dry

4-Coil-type

SHI

and various types

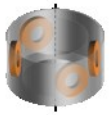
Dry



4-Coil-type

SHI

China



4-Coil-type

SHI

Dry

Toshiba

Saddle type

Melco

Wet (zero-boil off)

Analysis and expectation for the investment of wafer suppliers

4.1 SUMCO Interview (Jan 2022)

- Order backlog filled till 2026
  (all customer accepted price increase)

- New factories planned in Saga & Taiwan.
  Saga : Operation to start in II half of 2023

  T
  2024

5

——ウエハー不足が長期化する要因は需要急増だけですか。

「ウエハー各社は10年ほど前に大増産し、供給過剰となった。そのためしばらくは需要拡大には余剰能力

——今回も供給過剰となる懸念はありませんか。

「半導体の需給は周期的に動いているわけではなく、市場が年々拡大してい

< SAMCO Chairman interviewed
13 of Jan, 2022
Nikkei >

2022年(令和4年)1月13日(木曜日) 12版 ビジネス1 14

半導体ウエハー不足、どう解消?

SUMCO会長
橋本 真幸氏

日台に新工場、来年から改善

聞き手から一言

競争力の向上へ上流まで育成を

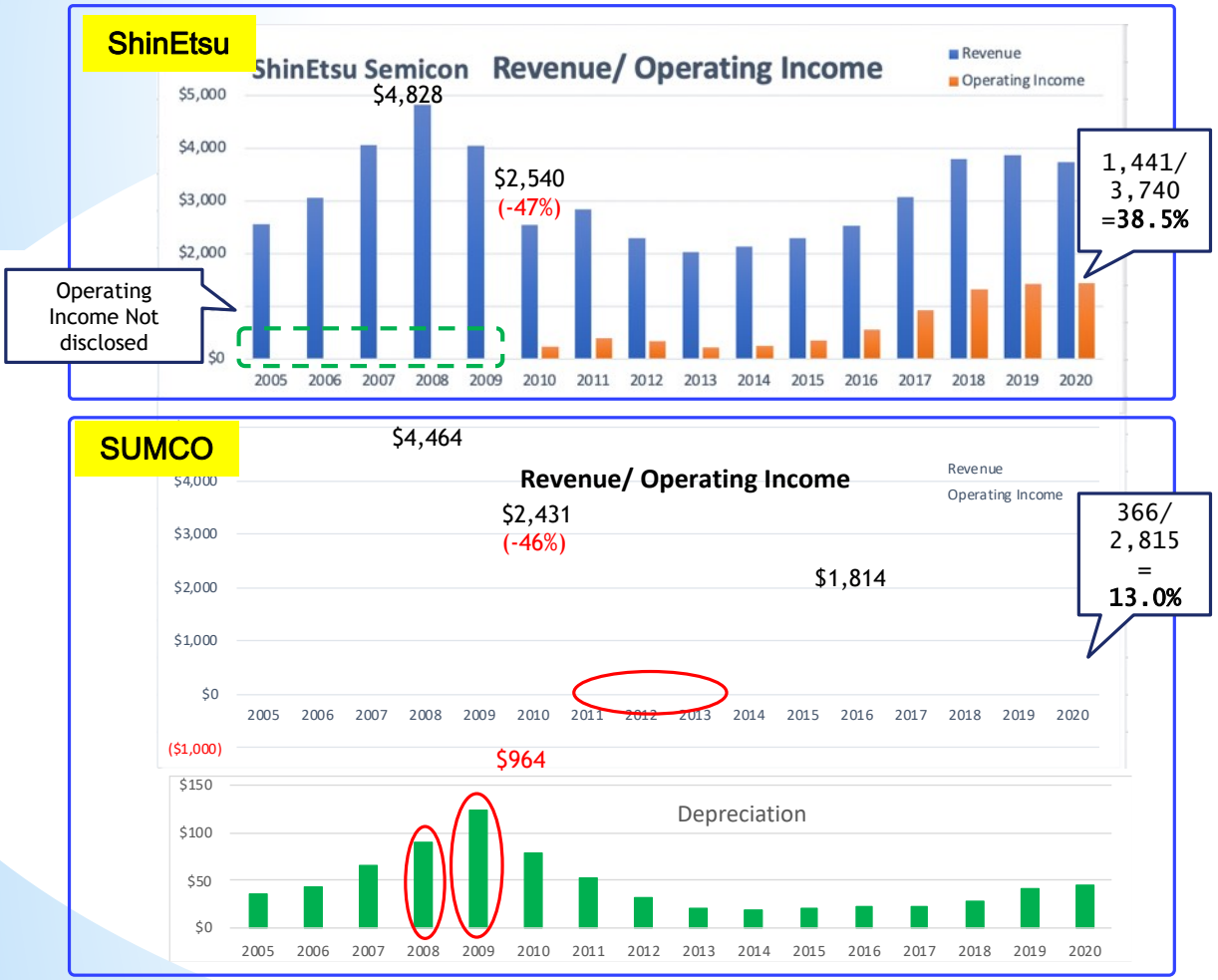
——ウエハー不足が長期化する要因は需要急増だけですか。

「ウエハー各社は10年ほど前に大増産し、供給過剰となった。そのためしばらくは需要拡大には余剰能力

4.2 Performance analysis of ShinEtsu & SUMCO

Silicon Wafer Market
Performance of ShinEtsu & SUMCO

$ million

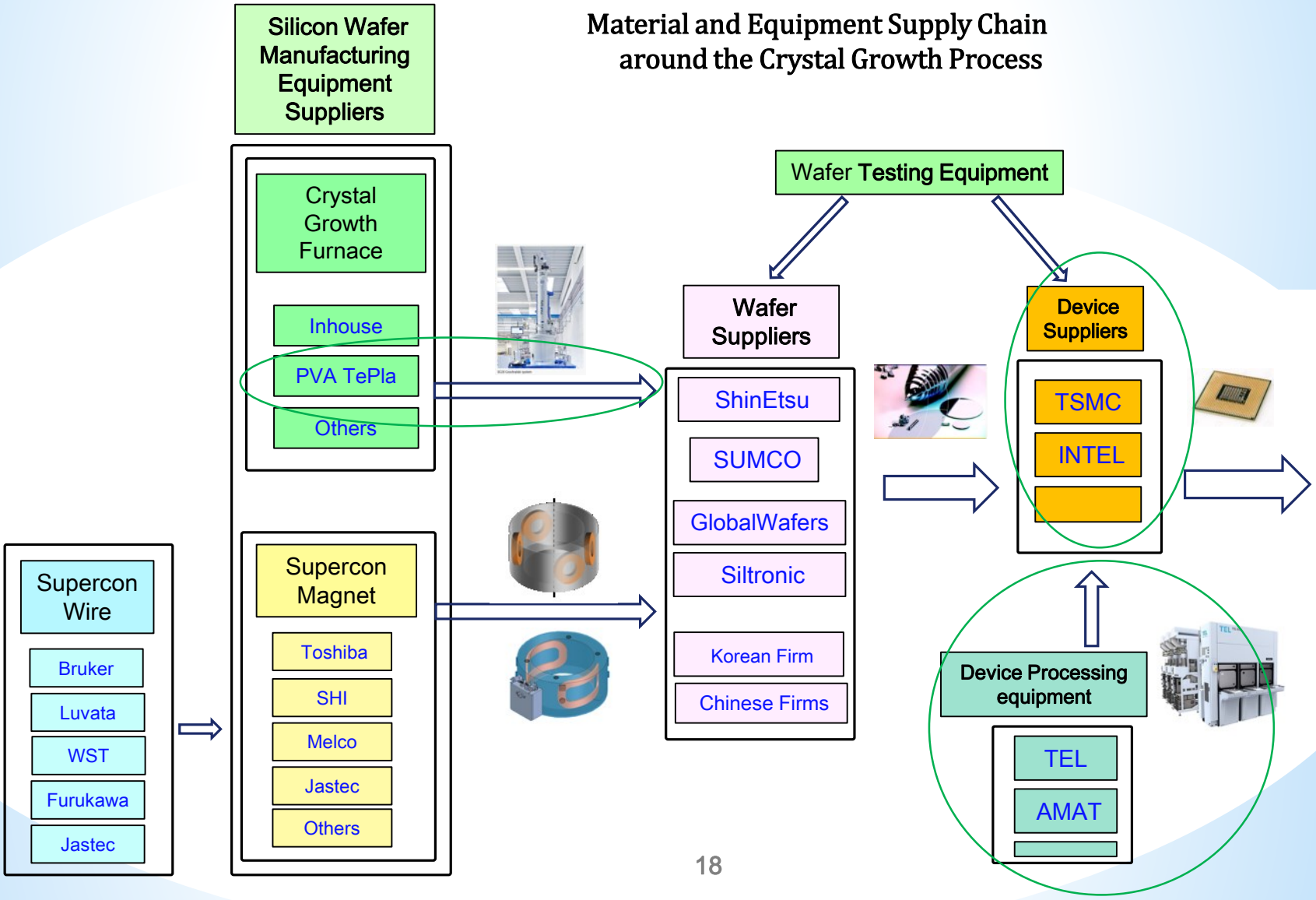


Figures above from each Annual Report

2.2 Supply Chain around the Crystal Growth Process

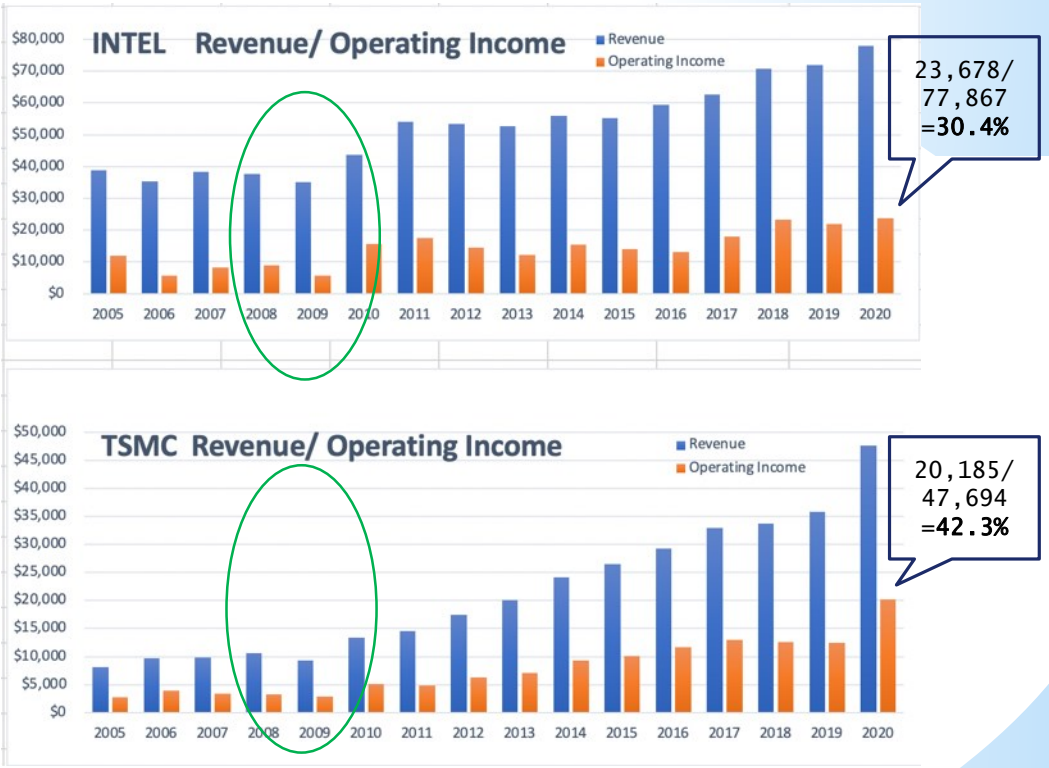
Wafer Business

Material and Equipment Supply Chain around the Crystal Growth Process



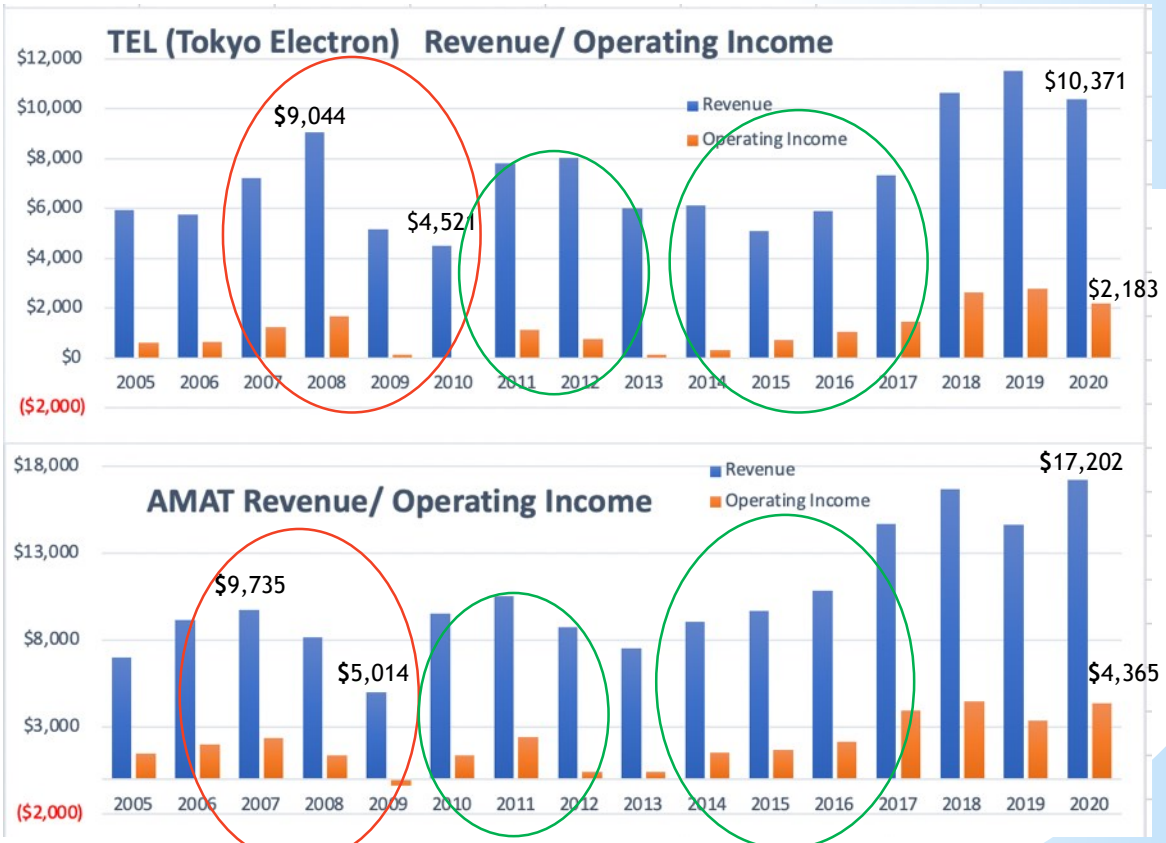
4.3 Performance analysis of INTEL & TSMC

Performance of Device Suppliers



4.4 Performance analysis of TEL & AMAT

Performance of Device Manufacturing Equipment Suppliers



4.5 Performance analysis of PVA TePla

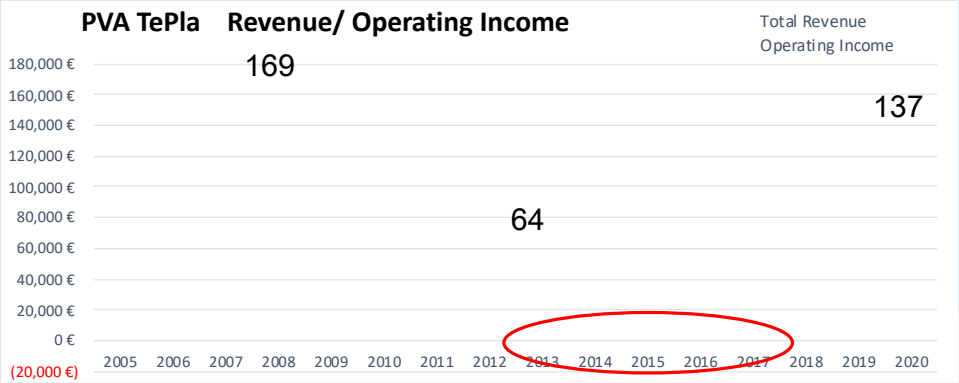
Investment of Semiconductor Wafer Supplier
Performance of PVA TePla

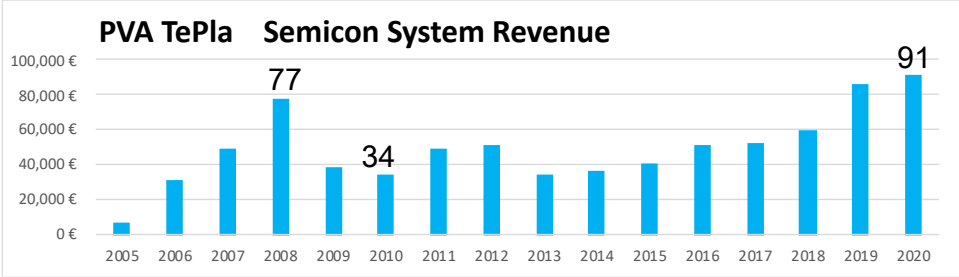
SC28 Czochralski system

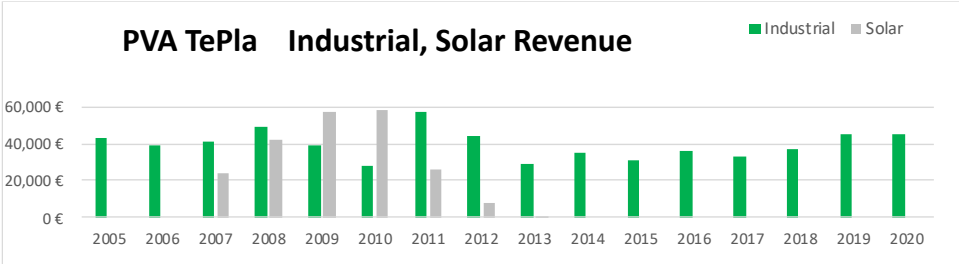
Industrial System

Semicon System

Solar System







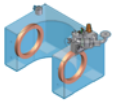
4.6 How long will current investment continue?

Appreciate insider's instruction

1988 | 2008 | 2015 | 2022

Shin-Etsu

Wet (zero-boil off)

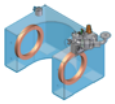


simple solenoid
Located in parallel

Toshiba

Dry

simple solenoid
Located in parallel



Saddle type

Toshiba

Jastec

?

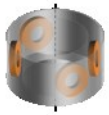
SUMCO

Wet (zero-boil off)

Saddle type

Melco

Dry



4-Coil-type

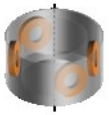
SHI

Wet (zero-boil off)

Saddle type

Melco

Dry



4-Coil-type

SHI

?

Siltronic Global Wafers

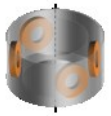
Dry

4-Coil-type

SHI

and various types

Dry

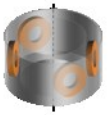


4-Coil-type

SHI

?

China



4-Coil-type

SHI

Dry

Toshiba

Saddle type

Melco

Wet (zero-boil off)

?

End of Presentation