Syndex

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The world of semiconductors: between geopolitics and tech race

The Covid crisis has heightened awareness of the dependence that can exist when it comes to chips, which are now everywhere.

The European Union has been slow to react but has now introduced the Chip Act. Is there still time? Is it enough? Is it the right answer? IndustriAll Europe wanted to find out more about this crucial issue and commissioned a study from Syndex to try and shed some light on it.

industriAll
EUROPEAN TRADE UNION

Main features of the semiconductor industry

The semiconductor market has been worth almost $600 billion in recent years. It is experiencing a high rate of growth, which could see it reach $1,000 billion by the end of the decade. All segments should see strong growth (7% CAGR), but the automotive (13%) and industrial (9%) sectors should enjoy even more spectacular momentum.

Key facts

High-growth industry
- 7.5% CAGR 1990-2010
- 7% CAGR 2021-2030

CAPEX intensive industry
- Rising costs of fabs
- Fewer and fewer players able to invest

High R&D investment
- High R&D expenditures as a percentage of sales
- US companies are investing more

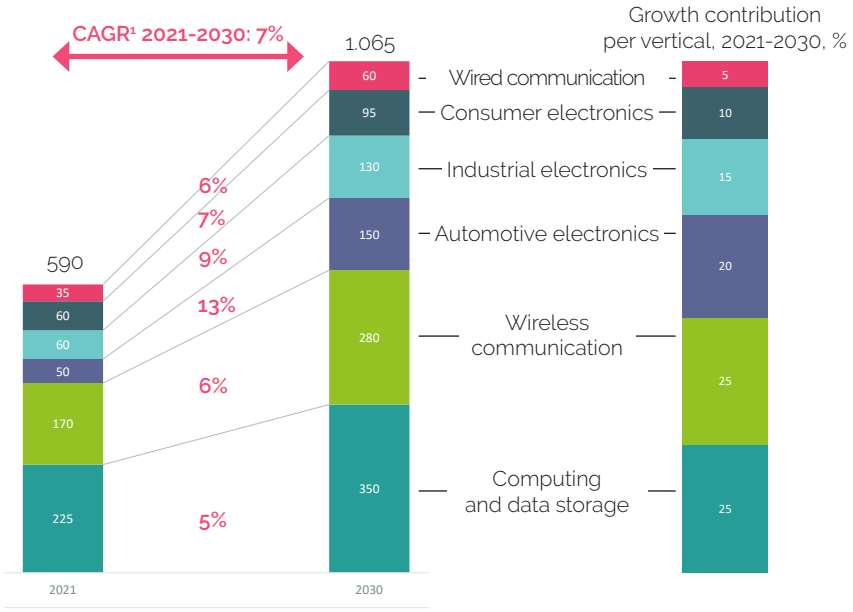
Highly cyclical industry
- Strong correlation with GDP
- Overreaction with GDP evolution

Concentration and oligopolistic industry
- ASML quasi-monopoly (lithographic tools)
- ARM quasi-monopoly (architecture)
- TSMC quasi-monopoly (foundry)
- Samsung/Hynix/Micron oligopoly (DRAM memory)
- Samsung/Hynix/Kioxia/Western Digital/Micron (Nand flash memory)

> THE SEMICONDUCTOR INDUSTRY MIGHT GROW TO 1 TRILLION BY 2030

Growth is driven by wireless, automotive and data storage and even industrial electronics. It favours European players.

Global semiconductor market value by vertical, indicative $ billion

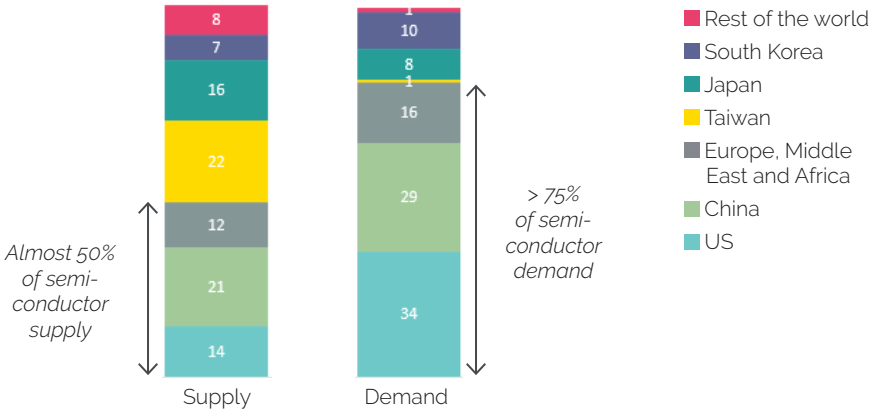


1. CAGR: Compound annual growth rate.
Source: The semiconductor decade a trillion-dollar industry. McKinsey. April 2022.

> SEMICONDUCTOR SUPPLY AND DEMAND IS NOT REGIONALLY BALANCED

In recent years, Europe and the United States have become much less important in terms of production. European production fell from 30% in 1990 to 12% in 2019. US production fell from 37% to 14% in the meantime. China has become a major player in production, but it still needs to import a lot of chips due to its major role in the assembly of electronic devices. On the other hand, Taiwan and Japan export a lot.

Semiconductor supply and demand, by region in 2021, % share



Source: Semiconductor fabs: Construction challenges in the US. McKinsey & Company. January 2023.

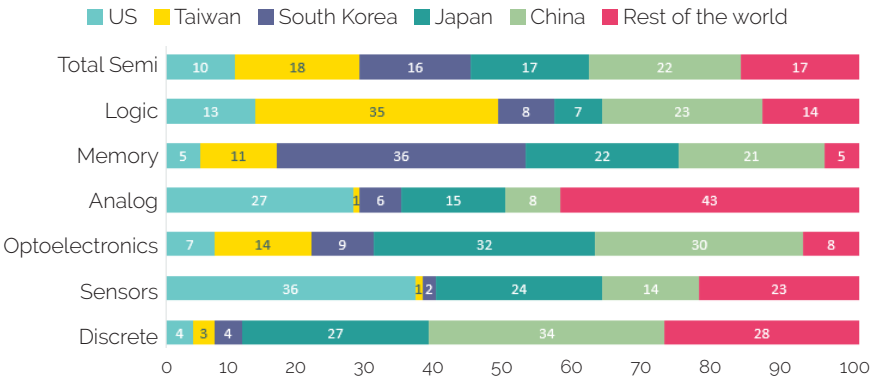
1. PRODUCTION IS MOSTLY DONE IN ASIA: TAIWAN, SOUTH KOREA, JAPAN AND CHINA. The most advanced technology is in Taiwan and South Korea. They represent 73% of the world's total production. In certain high-volume areas, such as memory, Asia's share is even greater.

2. ASIA'S DOMINANCE IN INDUSTRY IS EVEN MORE SPECTACULAR WHEN IT COMES TO TECHNOLOGICAL COMPLEXITY. The more advanced the technology, the more dominant Asia is, and in particular South Korea and especially Taiwan. In the most advanced fabs, these two countries are the only ones to master them.

The US is trying to re-enter the race by attracting investment in the most advanced technologies to their shore. In the case of Europe, no investment in the most advanced technologies is being planned.

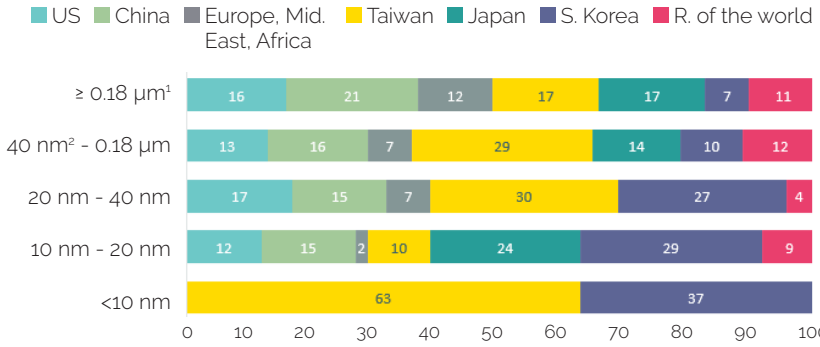
3. VALUE ADDED (DESIGN) REMAINS LARGELY AMERICAN. Valued added (VA) angle doesn't give a more favourable view of Europe's situation. The US keeps a strong share of the VA albeit deindustrialisation. Wafer fabrication and PAT are predominently in Asia. The distribution of added value adds another perspective. But the picture remains as bleak as ever in the case of Europe, which only captures around 10% of value added, equivalent to its weight in production. The situation is quite different for the United States, which accounts for around 35% of value added. This is due to their major role in R&D (as well as the fact that several major fabless players are American).

1. Wafer manufacturing capacity by fab location and chip type, 2020



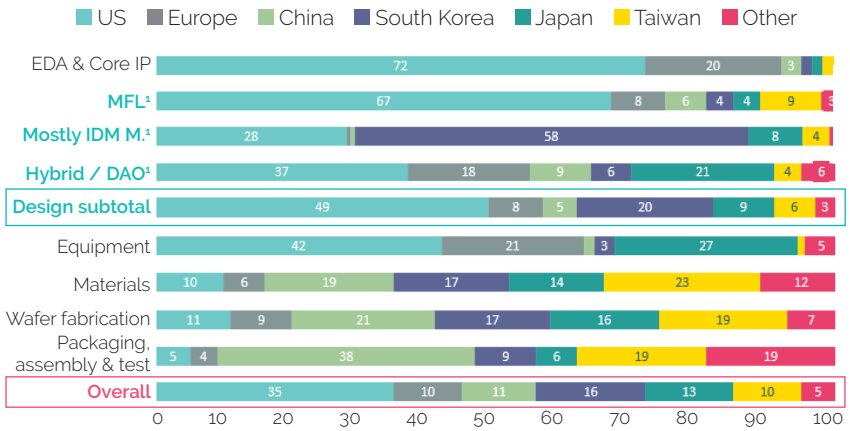
Source: CRS, adapted from SEMI, World Fab Forecast, November 2020.

2. Regional semiconductor chip production varies by node size.
Installed worldwide capacity, by node size, December 2020, %



1. Micrometer. 2. Nanometer. *Sources: IC Insights; IHS Markit; SEMI World Fab Forecast database. Semiconductor fabs: Construction challenges in the US., McKinsey & Company, January 2023.*

3. Semiconductor industry value added by activity and region 2021 (%)



1. Design : Mostly fabless / Logic (MFL), Mostly IDM Memory, Hybrid (fab-lite) / DAO.
Source: 2022 State of the U.S. semiconductor industry. SIA.

> THE WORLD'S TOP PLAYERS ARE ASIAN AND AMERICAN. The weakness of the European industry is borne out by an examination of the main companies in the sector. Very few companies feature in the top 10 (just one and it is a provider of semiconductor equipment rather than a semiconductor player per se) or even the top 100.

The first Chinese company is ranked 29. Europe has only 14 companies in the top 100. The ranking is dominated by US companies.

Top 10 publicly listed semiconductor companies by revenues

Rank	Company	Country	Revenues (M$)
1	Samsung	South Korea	218 047
2	TSMC	Taiwan	72 005
3	Intel	United States	54 044
4	Qualcomm	United States	38 584
5	Broadcom	United States	35 042
6	SK Hynix	South Korea	28 298
7	ASML	Netherlands	27 424
8	Applied Materials	United States	26 638
9	NVIDIA	United States	25 878
10	AMD	United States	21 876

Source: companiesmarketcap.com

Public policies all over the world

The European Union is not the only country or region of the world to have chosen to react to its heavy dependence on a handful of countries. Plans to attract or repatriate production and/or R&D have been announced on every continent. A lot of public money is being poured everywhere to attract investments. Which can be highly questionable when there are no conditionalities.

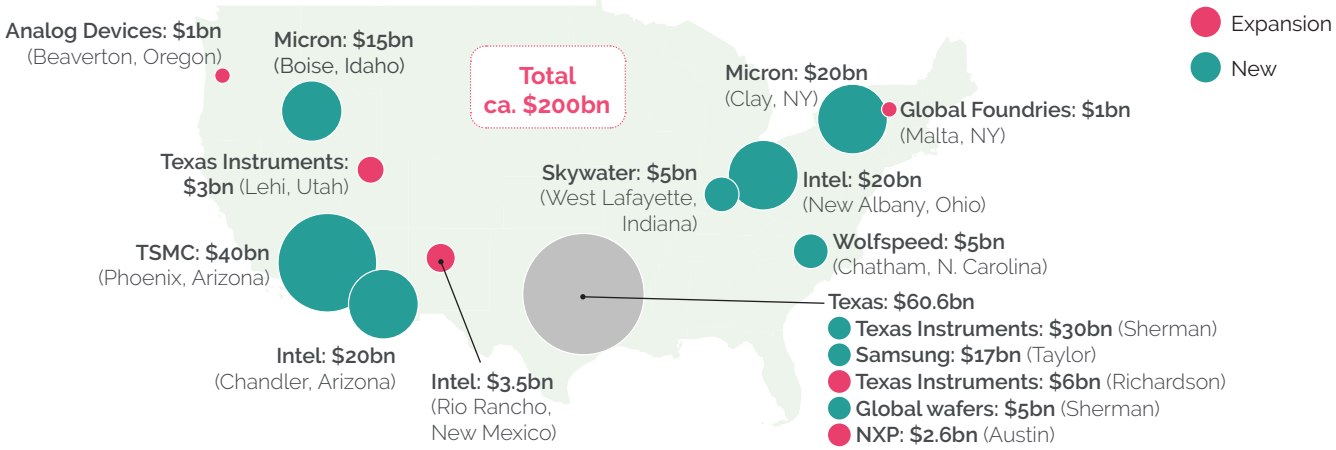
> BLOSSOMING PUBLIC PLANS ALL OVER THE WORLD

- EU Chips Act €43bn
- S. Korea K-semiconductor Belt strategy
- US Chips and Science Act: $52.7bn
- 2021 Japanese $6.8bn funding
- Taiwan additional tax incentives
- Thailand preferential tax policy for semiconductor investments
- Vietnam tax incentive policy for chip firms
- India $10bn incentive package for semiconductor investments
- Mexico incentive package for semiconductor investments
- Canada incentives for semiconductor investments

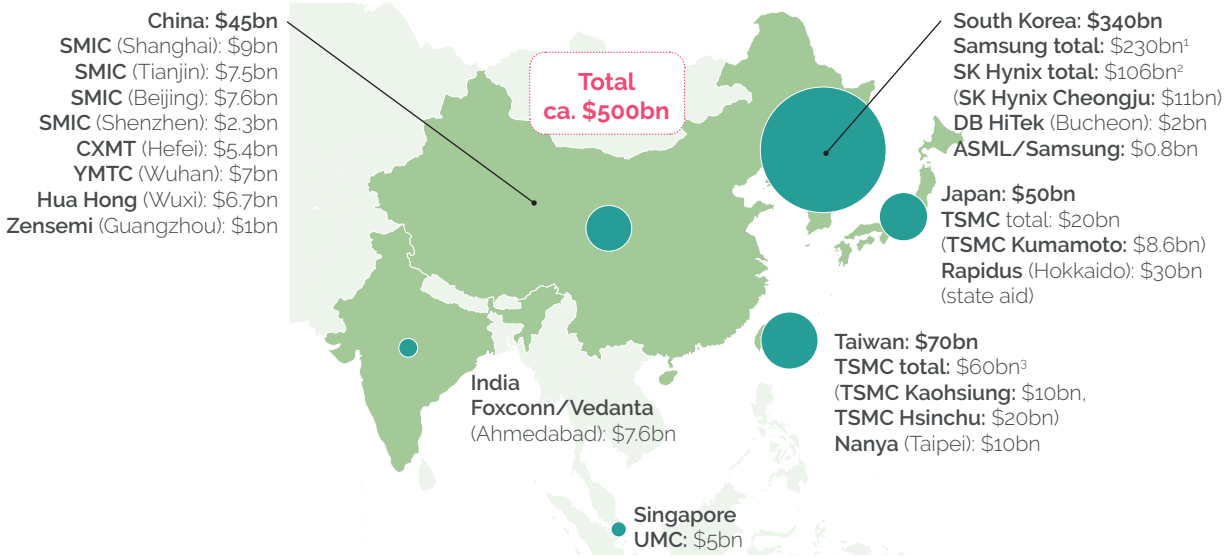
> THE SCALE OF INVESTMENTS PLANNED IN EUROPE IS MODEST WHEN COMPARED TO THE US AND ASIA

The European **20% objective** by 2030 could prove difficult to reach considering the scale of investments planned in **South Korea** and **Taiwan**, but also the **United States**.

Major investments planned in the United States

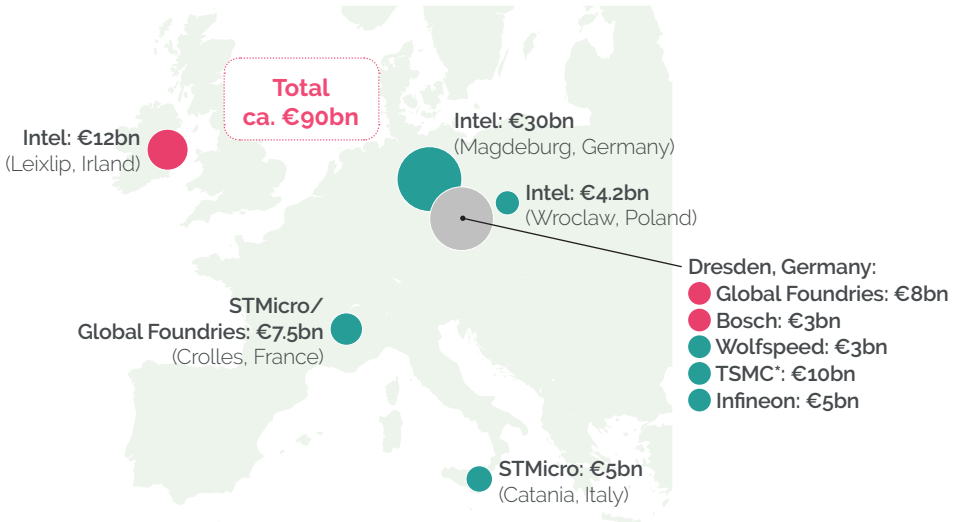


Major investments planned in Asia



1. Five new plants by 2042. 2. Four new plants. 3. Over five years.

Major investments planned in Europe

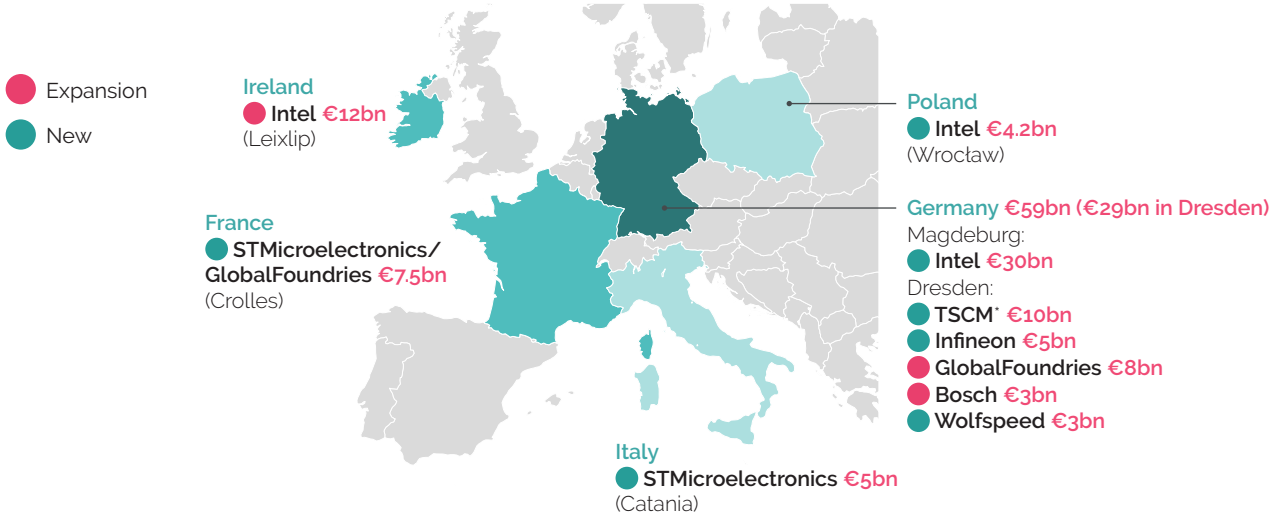


* TSMC, Bosch, NXP and Infineon joint project.

> THE SPLIT OF INVESTMENTS IN EUROPE SHOWS A SIGNIFICANT REGIONAL IMBALANCE

The comparison between the EU, the United States and China is brutal. The United States has succeeded in attracting $200 - 300 billion in investment. Asia, on the other hand, is likely to generate even more colossal investment, given the announcements made by South Korea (albeit over a longer timescale). Europe, meanwhile, is likely to see investment of just under $100 billion.

The bulk of planned investments in Europe remains so far concentrated in a handful of markets, led by **Germany**. The remaining major projects are located in **Ireland**, **France**, **Poland** and **Italy**.



* TSMC, Bosch, NXP and Infineon joint project. Source: Syndex.

> CONDITIONALITY OF PUBLIC AID: WHAT POTENTIAL FOR WHAT RISKS?

Conditionality of public aid appears to be limited in general within the EU, or more specifically for schemes dedicated to semiconductors. Most of the time, there are no financial, tax or employment conditions attached to these grants. The question of introducing **quantified conditions** in the granting of such aid arises in the context of forecasts of massive aid on an EU scale.

In this respect, Europe should draw inspiration from the US Chips and Science Act, which requires beneficiaries to include clauses covering repayment in the event of exempt earnings, payments to shareholders or employee health cover.

Interesting avenues to explore in terms of aid conditionality...

... which could ultimately align the interests of all stakeholders. It is important to provide for total or partial reimbursement of public aid in the event of non-compliance with the conditions initially set out.

Employment conditions

- A stability or growth term for the workforce, with a duration to be set according to the duration of the investment.
- Obligation to devote part of the aid (5%?) to training programmes for employees in the European Union (a job in which a company has invested in training is potentially less risky).

Conditions for profit-sharing

- Better sharing of added value: obligation to set up or improve profit-sharing mechanisms.
- Clause requiring profits to be reinvested in R&D within Europe.

Environmental conditions

- Emissions reduction clause
- Water use commitments
- ...

A European strategy beginning to take shape, but still efforts to be made on skills, working conditions and environmental issues

Investment in the semiconductor industry will lead to a sharp rise in employment in the sector, which according to Deloitte will increase from €2 million today to €3 million by 2030. This will increase pressure on recruitment, with direct competition for many skills with the GAFAMs and the automotive sector, but above all between geographical regions. Like all geographic regions, Europe is already facing a skills shortage in the microelectronics sector, which is bound to increase over the coming years.

The need to focus on training and attracting talent has obviously been identified at European level, but not necessarily quantified at this stage.

The European Union's strategy under the **Chips Act** presupposes a strong interweaving of skills centres, universities and private players.

It will require a high level of coordination in the distribution of resources and specialties. The establishment of the European Chips Skills 2030 Academy is intended to meet this objective by :

- setting up an industry university network and resources to support training and reskilling in the industry
- managing coordination with competence centres
- launching initiatives to raise the industry's profile

As we can see, the creation of competence centres and the distribution of roles will be of crucial importance.

Two risks may arise at this stage:

- a risk of resources being spread too thinly across a number of micro-competence centre
- a lengthy coordination phase, which could slow down Europe's ability to turn new investments into accounts

The responsibility of companies also appears to be strongly engaged. As we saw earlier, the attractiveness of semiconductor companies is a major issue on which a great deal of effort needs to be focused in the short/medium term, particularly in three areas (see chart on next page).

SEVERAL ACTIONS COULD HELP LIMIT RISKS in this crucial field for Europe:

- **on the corporate side:** make efforts to improve remuneration and working conditions, including H&S, build common values based on a shared corporate project, invest massively in employee training
- **from the public sector:** set up training courses and communicate on the subject, clarify the question of the distribution of skills centres (heart of the EU's strategy), support fair mobility
- **joint actions:** set up public/private funding schemes to finance studies and rapidly define a clear public/private organisation plan (EU, countries, regions, universities)

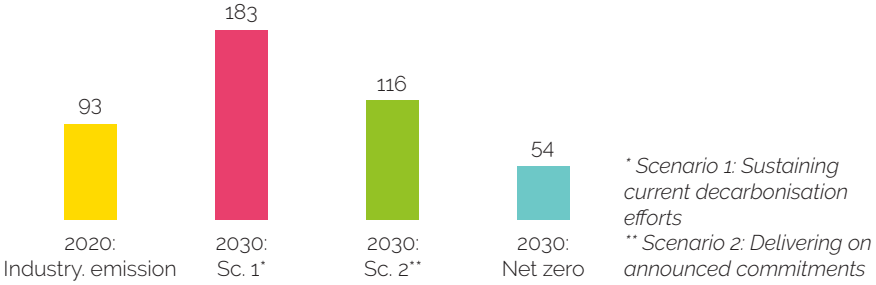
A joint effort coupled with strong public demands will be needed to make the European plan work.

To be sustainable, fabs need to minimise GHG, waste and water usage.

IT IS UNLIKELY FOR THE SEMICONDUCTOR INDUSTRY TO COMPLY WITH THE 1.5° TRAJECTORY

In a conservative scenario, CO_2e would almost double from 2020 - 2030. This has lot to do with the forecasted dynamic increase in production. This is based on the current announcements of the semiconductor players. In a more ambitious scenario that would limit the rise of CO_2e, some of the players would need to strengthen their plan. But only drastic change would permit compliance with the net-zero target.

Scope 1 & 2 (million CO_2e)



Source: "Keeping the semiconductor industry on the path to net zero». Mc Kinsey. November 2022.

> THE RESPONSIBILITY OF COMPANIES MUST BE ENGAGED IN THREE AREAS

>> Working conditions

It is imperative that companies in the sector take a proactive approach to the issue of working conditions and communicate on the subject **in order to counterbalance an unattractive image** in this area (e.g. working hours, work from home, paid family leave…).

>> Competitive salary conditions

Semiconductor companies are facing **increasingly head-on competition from sectors offering significantly higher levels of remuneration** for the same level of qualification.
In this context, firms need to think about the **packages** they offer.
The introduction or improvement of **value-sharing mechanisms** for the benefit of employees is a factor in attracting and retaining employees and lends credibility to the "joint project" often put forward by top management.

>> Values issues (diversity / ESG)

Companies in the sector need to pay particular attention to a number of aspects, as employees' expectations have changed significantly:

- the question of **shared values** is essential to give meaning to work and joint effort;
- the issue of **diversity**, which is also a weak point in the sector. For example, according to GSA (*Women in the semiconductor industry*, 2020), women represented only 1% of leadership positions in 2020;
- **environmental issues**, which need to be taken seriously in view of the sector's impact, particularly in terms of water use.

> TOO LITTLE TOO LATE?

- Europe is lagging behind
- Tech giants are not European

→

- EU support is not important compared to other countries that try to attract investments

→

- European top players are only targeting 30% of the market

↓

- More than $200bn investments announced in the US
- Around €100bn in Europe

←

- **The EU will not reach its target in 2030**
- **The industry is not on the right track regarding climate change**

>> On the positive side, the EU has become aware of its deindustrialisation and its backwardness. The EU has also realised that many countries around the world have introduced industrial policies. Change has also begun within the EU. The future is not written.

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