Global Trends in Microelectronics and how Europe can address them

Joel HARTMANN
Executive Vice President
Digital & Smart Power Technology and Digital Front-End Manufacturing
STMicroelectronics
joel.hartmann@st.com

Outline

- What is the IPCEI on microelectronics?
  - Global objective and partnership
  - The 5 Technology Fields
  - Application domains
- Mega trends
  - Smart Mobility
  - Power & Energy
  - Internet of Things and Future Networks
- Microelectronics in Europe: strengths and opportunities
  - Edge AI
  - Sustainable solutions
- Take aways

We are creators and makers of technology

- One of the world's largest semiconductor companies
- 2019 revenues of **$9.56B**
- **46,000** employees of which **7,800** in R&D
- Over **80** Sales & marketing offices serving over **100,000** customers across the globe
- **11** Manufacturing sites
- Signatory of the United Nations Global Compact (UNGC), Member of the Responsible Business Alliance (RBA)

As of December 31, 2019


Global presence
Research & Development
Main Sales & Marketing
Front-End
Back-End
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The Context

Sovereignty

Sustainability

Competitiveness

Security

IPCEI ID Card

Important Project of Common European Interest

Countries involved

Duration

France: 2018~2022

Germany: 2017~2020

Italy: 2018~2024

UK: 2019~2025

Supports RDI + FID

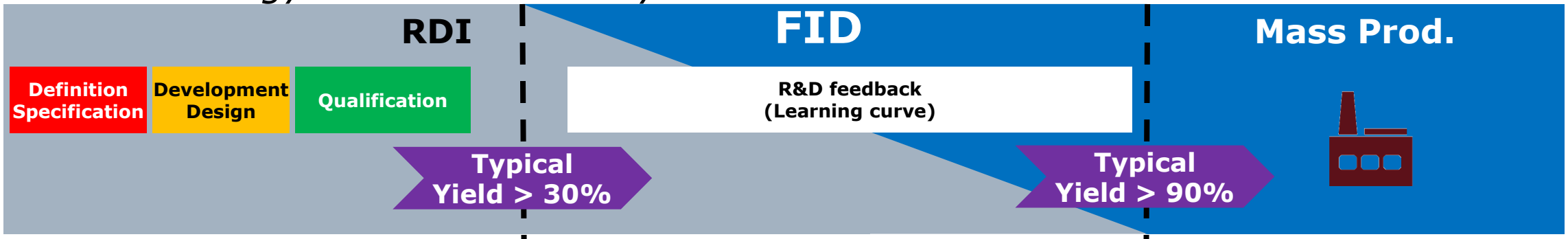
"Usual" R&D effort (RDI)

"From R&D to pre-production" effort

(FID = First Industrial Deployment)

IPCEI ID Card: FID at a glance!

New Technology & Product usual cycle



Public support usually stops here:
Techno/Product is qualified as prototype…
missing real production capability…

But… a long and costly path is still needed to reach mass production criteria → This is FID phase

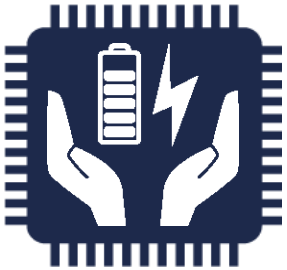
- Involving **multiple processes** at the cross-road of interacting sciences
  (Optical, Material, Chemistry, Electrochemistry, Vacuum, Non-linear processes)
- Involving costly experiments on **hundreds of wafers** and often specific **CAPEX**

→ Supporting FID is a way to secure new manufacturing capability in Europe

IPCEI Structure

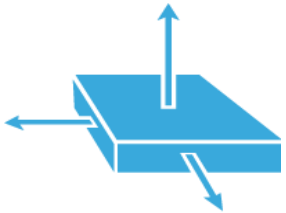
Automotive	IoT	Space & Avionics	Security
			

5 Technology Fields



Energy efficient Chips (TF1)

Power semiconductors (TF2)



Smart sensors (TF3)

Optical equipment (TF4)

Compound materials (TF5)

The Actors

Project management

1 Energy efficient chips	2 Power semiconductors	3 Sensors	4 Advanced optical equipment	5 Compound materials
CEA-Leti	3-D Micromac	CEA-Leti	AMTC	AZUR Space Solar Power
Cologne Chip	AP&S International	*CorTec*	Carl Zeiss	CEA-Leti
Globalfoundries	CEA-Leti	Elmos Semiconductors		Integrated Compound Semiconductors
RacyICs	Elmos Semiconductors	Fondazione Bruno Kessler		IQE
Soitec	Infineon	Infineon		Newport Wafer Fab
ST Micro-electronics	MURATA	Robert Bosch		SPTS Technologies
X-FAB	Robert Bosch	ST Micro-electronics		OSRAM
	SEMIKRON	TDK-Micronas		Sofradir
	ST Micro-electronics	ULIS		Soitec
	X-FAB	X-FAB		ST Micro-electronics

Name in *"italic"* = SME

R&D and Industrial Results examples

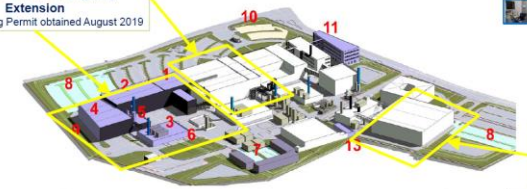
IPCEI 2019 Outcomes and Perspectives

soitec

« Bernin 2 conversion »
300mm SOI substrates «new generation»

« Substrate Innovation Center »
R&D SOI fabrication line in Leti

« 5G » 300mm SOI Capacity Extension
2000m² Building Permit obtained August 2019



« Bernin 3 production line »
Creation of a new production line for Piezo On Insulator substrates (RF filters)

New infrastructures in purple
Up to 700 new employees in European R&D and Production

2019-11-19

STMicroelectronics

New Investments supported by the IPCEI initiative in France and Italy:

- 300mm Crolles Gateway extension and
- R3 300mm construction in Agrate

and

- ❑ RDI and First Industrial Deployment in French ST's sites and labs
- ❑ Technology development and new circuits on FD-SOI, embedded NVM, Imaging Sensors, Power GaN, etc.
- ❑ RDI and First Industrial Deployment in Italian ST's sites and labs
- ❑ Technology development and new circuits on BCD, MEMS, SiC, RF GaN, Digital microprocessors, etc.

Semiconductor Fab in Dresden

R&D and First Industrial Deployment Power

Start of Pilot Production end of 2021

Up to 500 new employees in European R&D and Production

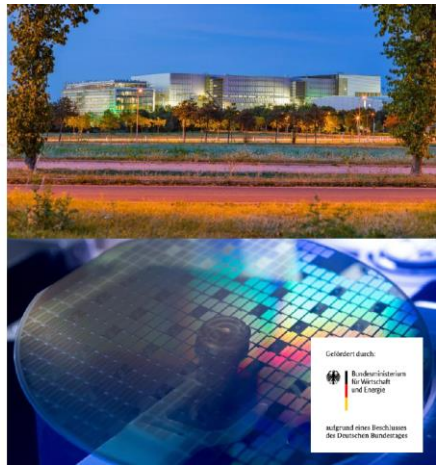
Börsen-Zeitung
Bosch wertet Silicon Saxony auf

SiC Line in Reutlingen

Differentiating new tech for electric mobility and renewables
Opportunity for European Leadership

Automotive News
Bosch to produce range-boosting microchips for EVs

The New York Times
Bosch to Make Silicon Carbide Chips in Electric Vehicle Range-Anxiety Play



New EUV Optics Fab in Oberkochen

- R&D and First Industrial Deployment for next generation High NA EUV Optics
- First high NA EUV optics system manufacturing has started
- About 1000 new employees for R&D and production in Europe since project start

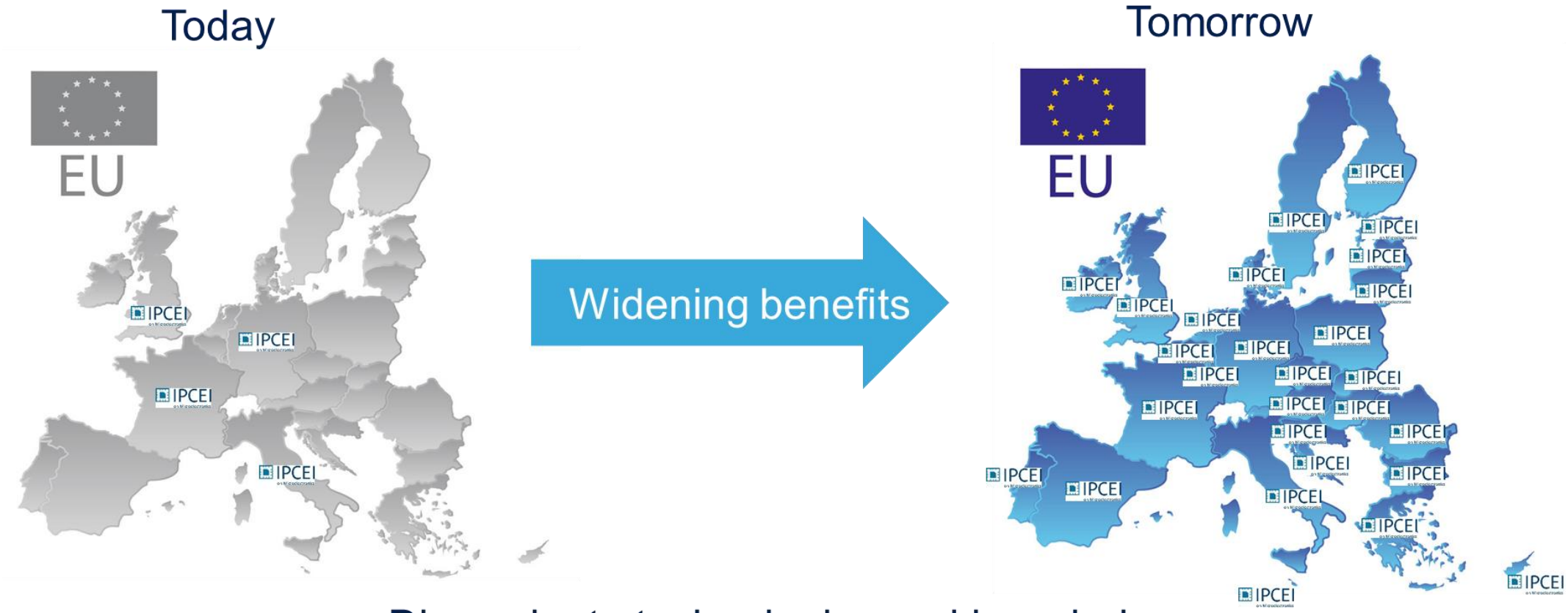
Handelsblatt
Carl Zeiss macht der Chipbranche Mut
EUV lithography revisited
„Es gibt keine Alternative zu EUV"

Puces: une alliance européenne se dessine

Les défis de la lithographie extrême ultraviolet
Zeiss SMT – schon bereit für die nächste Generation

Extracts from the 2019 EFECS presentation of J Fabrowsky (Bosch)

What are Spillovers?



Disseminate technologies and knowledge

Create opportunities to develop more microelectronic activities

Spillover main areas

Knowledge creation & sharing

Education

Access to IPCEI technologies

Spillover actions at IPCEI consortium level (cumulative to e/o 2019)

Type of Spillover actions	Count
Dissemination and spill-over events	75
Dissemination to the European collaborative R&D&I ecosystem	150
Dissemination of IP unprotected and protected results	68
Dissemination by exploiting the use of the IPCEI results outside the targeted sector	66
Dissemination through standardization activities	5
Dissemination via major European clusters in microelectronics	37
Spillover effects in first industrial deployment	29
Spillover effects in downstream markets	33
Sum	463

Source: internal IPCEI report

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Smart Mobility

ST provides innovative solutions to help our customers make driving safer, greener and more connected for everyone

Increase safety for road users & driver comfort and convenience	Road crashes carry a high human toll and cost > **$500** Billion every year
Affordable, desirable electric vehicles	Electric vehicles* from **9%** in 2019 to **19%** in 2025 of global car production
Cleaner, greener Internal Combustion Engines (ICE)	ICEs in > **90%** of new vehicles produced 2020-2025

Sources: www.asirt.org, Strategy Analytics
* Excluding Mild Hybrid EV

A few examples of Smart City projects

Toyota Woven City:

Ambitious Smart City project
around Mount Fujiwhere R&D
will be dedicated to autonomous vehicles,
robotics and AI

Future Living Berlin:

Panasonic project with real estate companies
To develop green energy and smart homes

Smart City Evolution

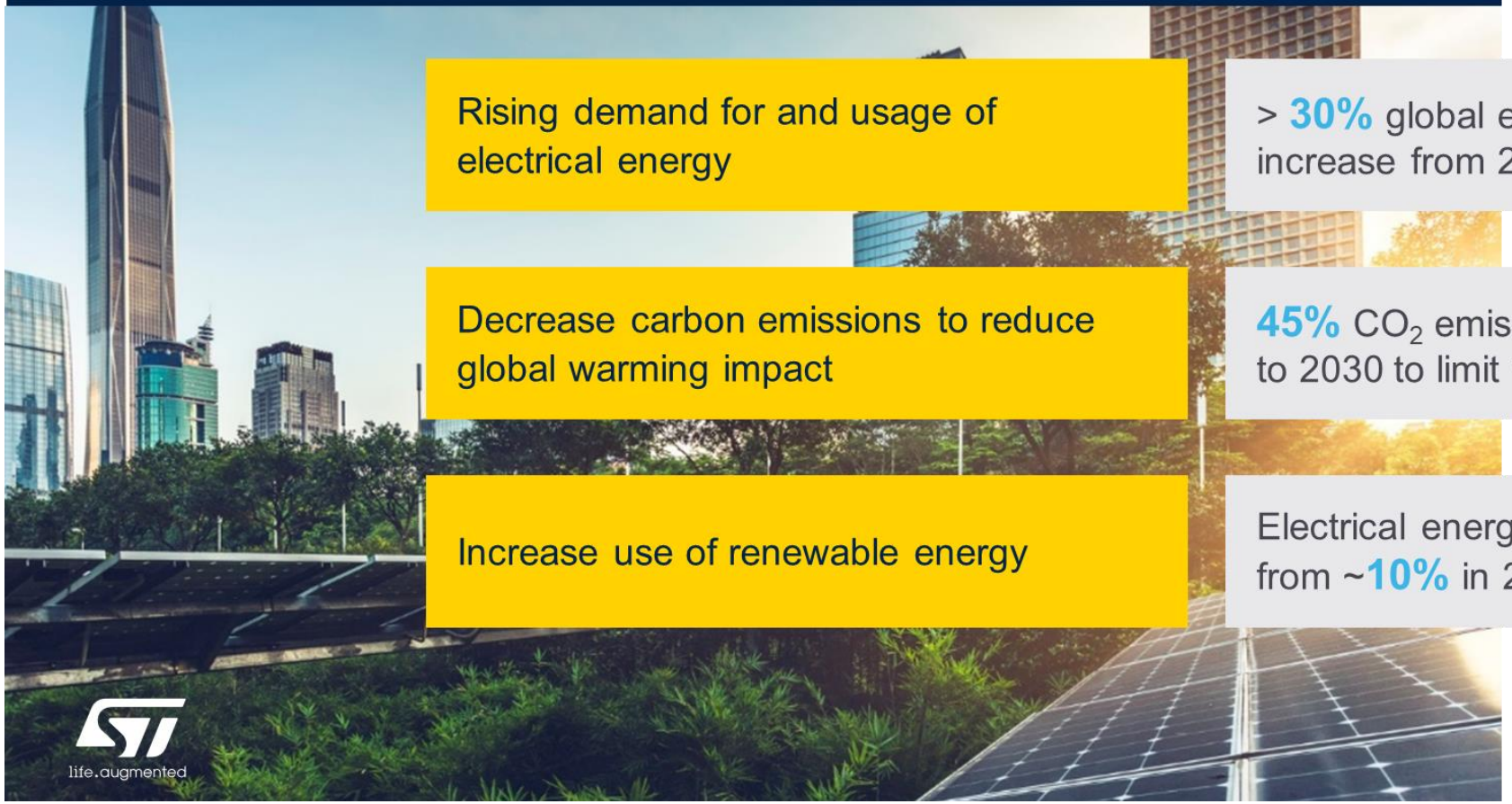
Today, cities represent:
- 2% of globe surface
- 80% of WW CO2 emission
- consumption of 75% of energy produced

We can expect these indicators to double by 2050

Smart city expectations from residents:
- Green energy
- Smart mobility
- Safety, Resilience
- Harmonious environment

Power & Energy

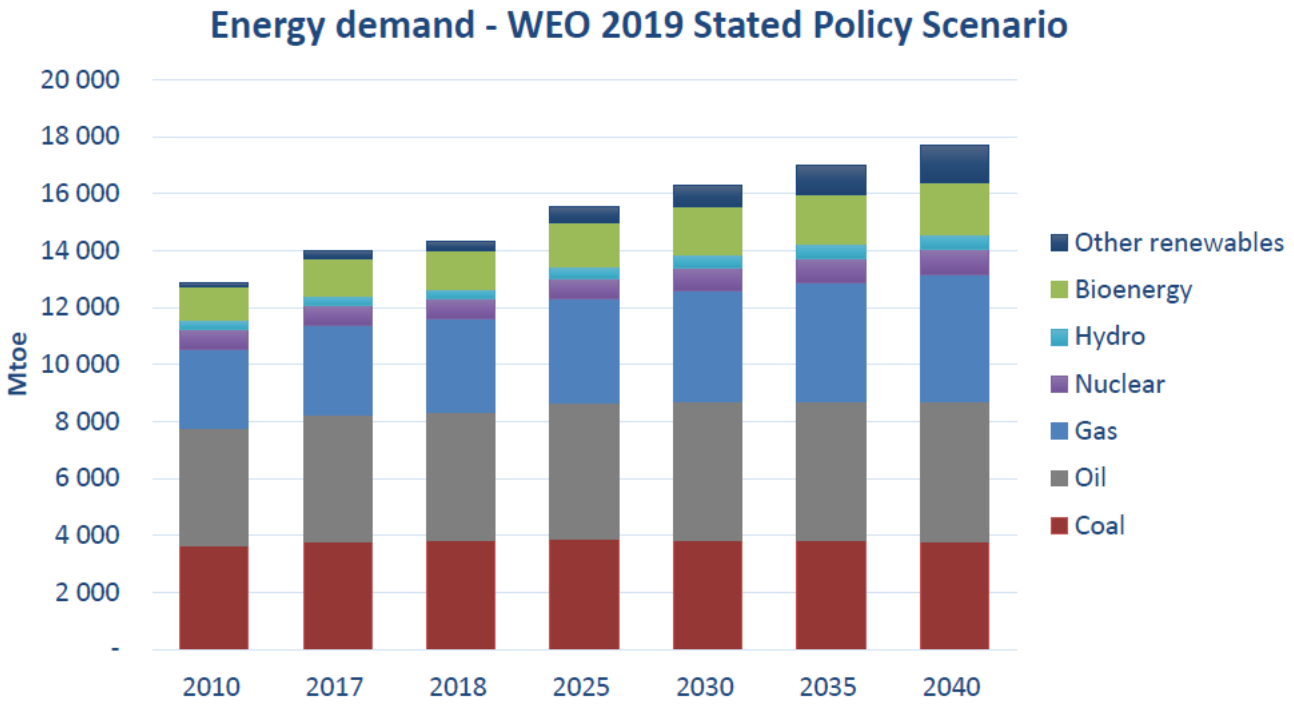
ST technology and solutions enable customers to increase energy efficiency everywhere & support the use of renewable energy sources



Rising demand for and usage of electrical energy	> **30%** global electricity demand increase from 2020 to 2030
Decrease carbon emissions to reduce global warming impact	**45%** CO_2 emission reduction from 2010 to 2030 to limit warming to 1.5oC
Increase use of renewable energy	Electrical energy from renewal sources from ~**10%** in 2020 to ~**20%** in 2030

Sources: IEA, IPCC, BP

Power and Energy Trends



Conversion towards Green Energy

Social acceptance versus increased Energy needs dilemma

Internet of Things & 5G

ST provides sensors, embedded processing, connectivity, security and power management, as well tools and ecosystems

Cloud connected and data-enabled services	**Two** billion industrial IoT & utility connected devices by 2022
Digital security for all data	IoT security services market > **$10** billion in 2021
5G accelerating the connection of objects to the IoT	> **90** million new 5G IoT connections in 2026

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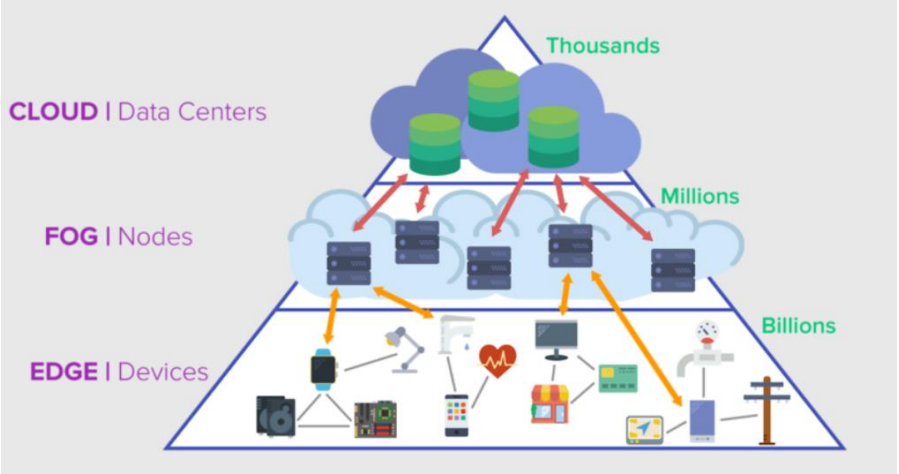
Source: ABI

Edge AI: a Challenge/Opportunity for Europe

Edge Computing:
- Treat the data as close as possible to the sensor
- Increase speed of treatment
- Reduce Internet traffic



2018

RANK	COMPANY	FOUNDED	USBn
1.	Apple *	1976	890
2.	Google *	1998	768
3.	Microsoft *	1975	680
4.	amazon *	1994	592
5.	f *	2004	545
6.	Tencent 腾讯 *	1998	526
7.	BERKSHIRE HATHAWAY	1955	496
8.	Alibaba.com *	1999	488
9.	Johnson & Johnson	1886	380
10.	J.P.Morgan	1871	375

2008

RANK	COMPANY	FOUNDED	USBn
1.	PetroChina	1999	728
2.	EXXON	1870	492
3.	GE	1892	358
4.	中国移动 China Mobile	1997	344
5.	ICBC	1984	336
6.	GAZPROM	1989	332
7.	Microsoft	1975	313
8.	Shell	1907	266
9.	SINOPEC	2000	257
10.	AT&T	1885	238

* Companies based on the platform model

Sources: Bloomberg, Google

Hyperscale Platform based companies EvolutionFrom 2008 to 2018

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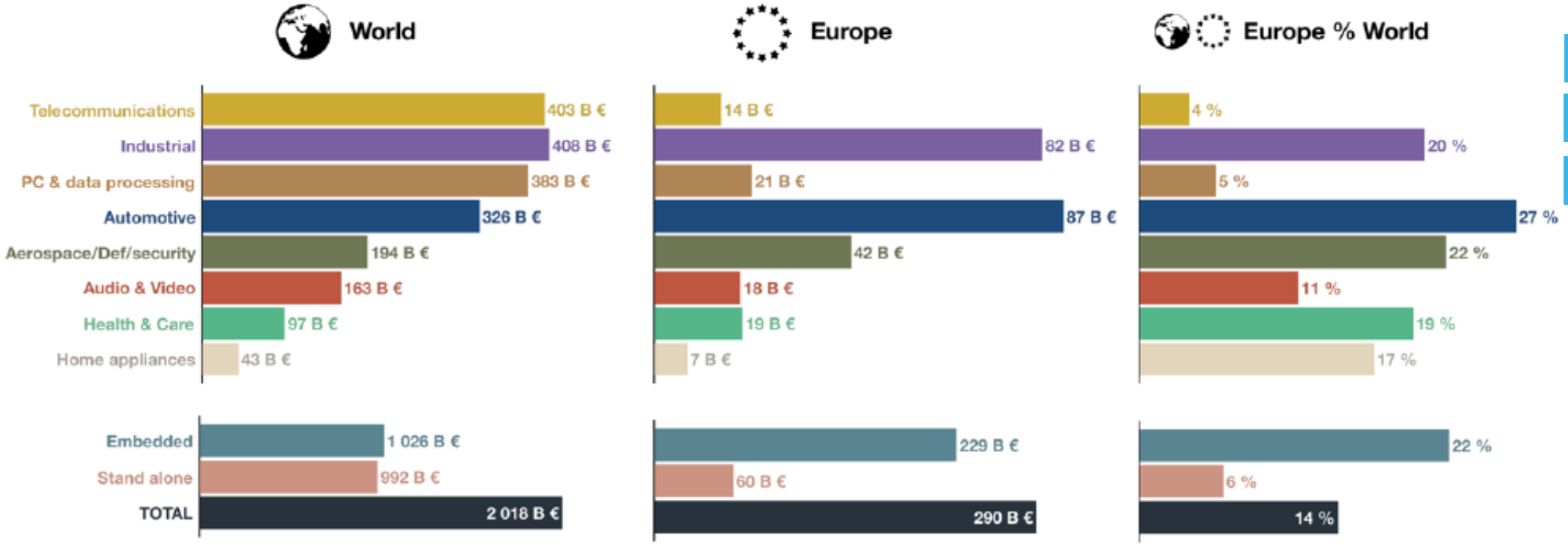
Europe Positioning electronic systems



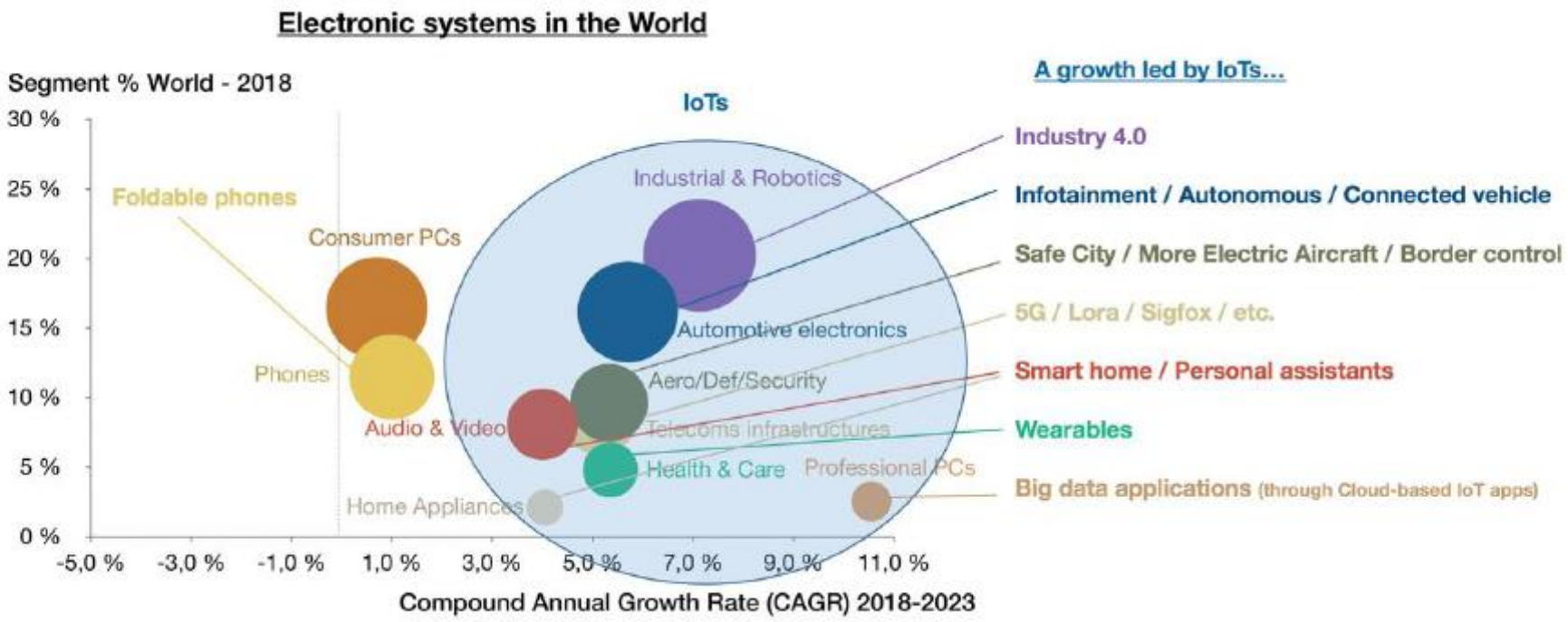
Industrial

Automotive

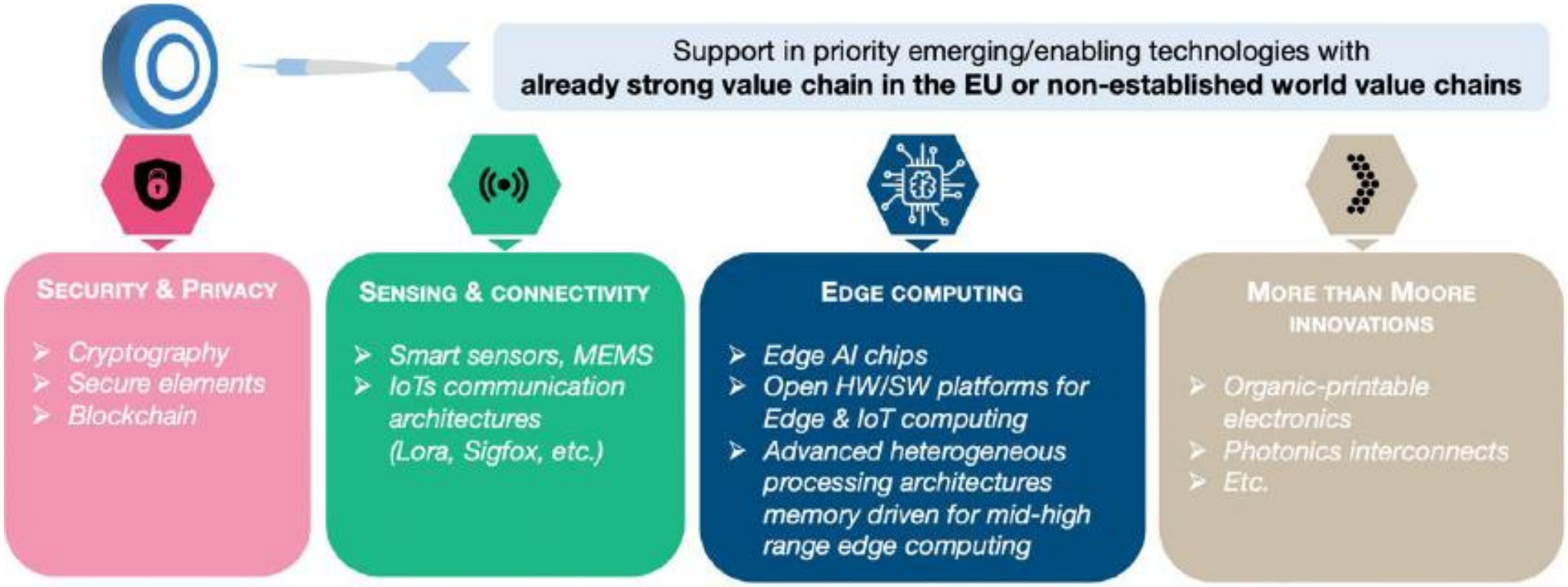
Security

Source: DECISION Études & Conseil

Areas of High growth

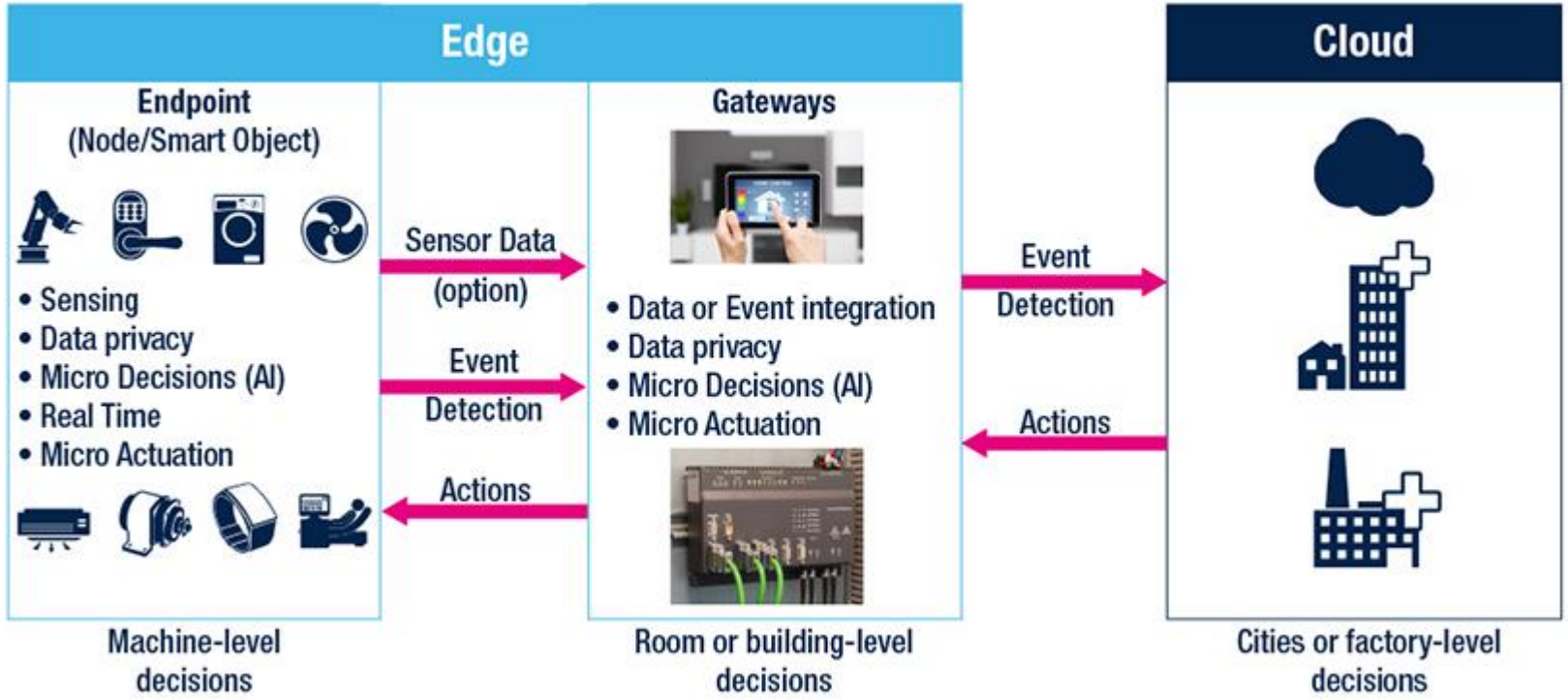


Promising Technologies for Europe



Source: DECISION Études & Conseil

From centralized to distributed intelligence system



Opportunities for Europe

Take aways

- IPCEI on microelectronics gathers important actors, for R&D as well as first industrial deployment. This is the first Important Project of Common European Interest on industrial topics. Others have followed on Batteries, Hydrogen..
- Important results have already been shown, both in R&D&I and First Industrial Deployment
- This IPCEI on microelectronics helps Europe address the important trends of our digital society
  - Smart Mobility
  - Power & Energy
  - IoT and 5G
- Moving forward Europe must continue invest to exploit opportunities and preserve sovereignty and achieve sustainibility
  - Security and Privacy, Sensing & Connectivity, Edge computing including AI on the Edge

Acknowledgement (French example)

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