



Imec, a research center with flexible **business** opportunities balancing between **fundamental** research, advanced **technology** and innovative **applications**

W.VANDERVORST

vdvorst@imec.be



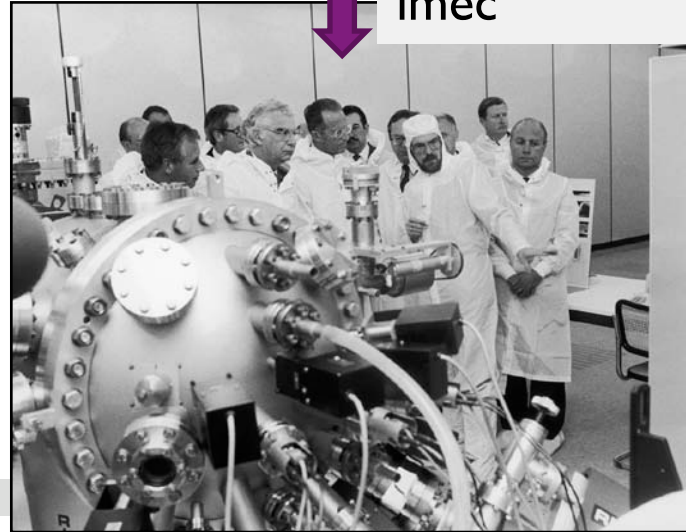
OUTLINE

1. What is imec
2. Critical factors for a successful research – industry interaction
3. Imec's ECO-systems :
 - a. Core CMOS
 - b. Energy
 - c. Human++
4. Formal interaction Research - industry

1984

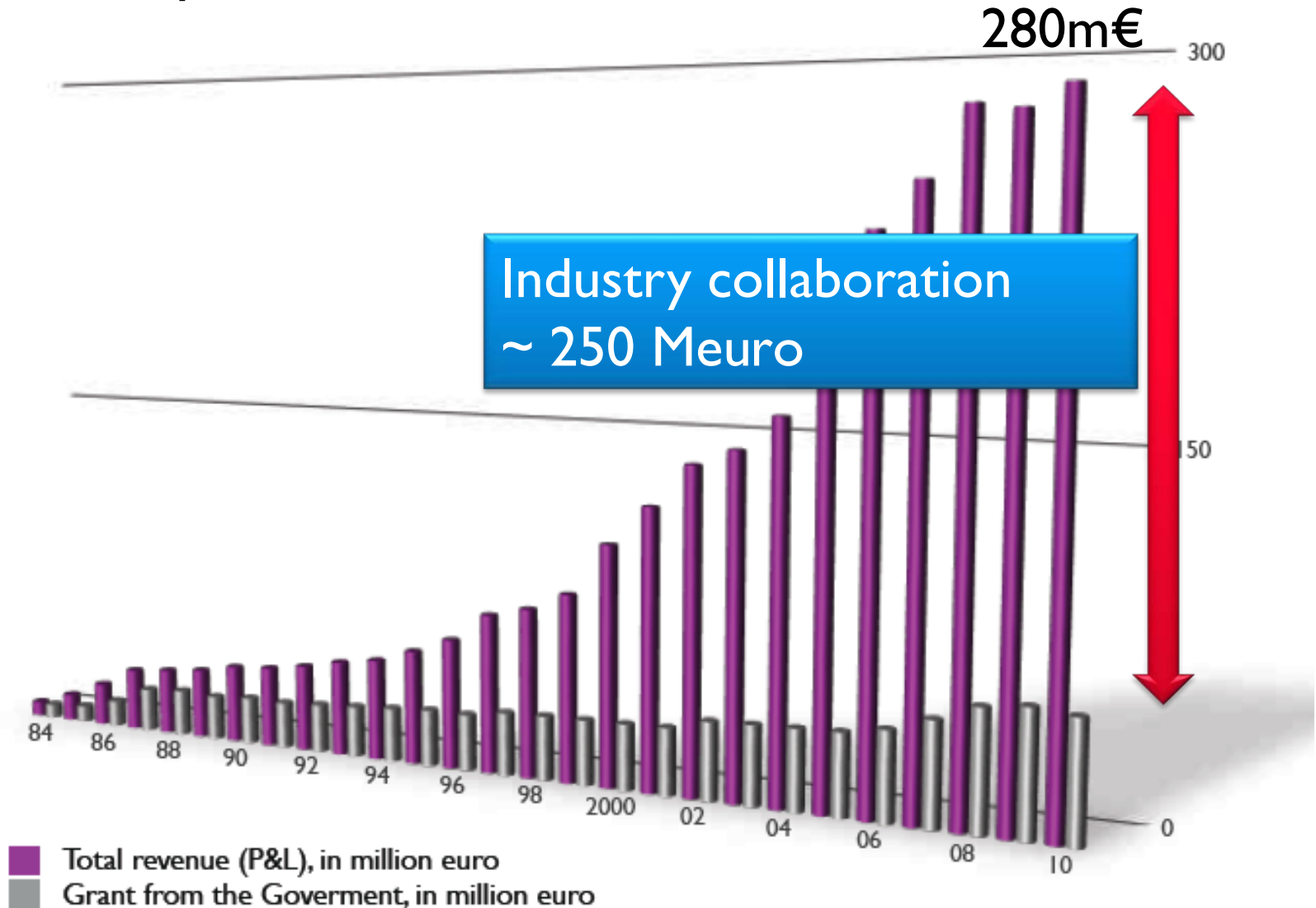
- ▶ Established by state government of Flanders in Belgium (initiative prof.R.Van Overstraeten)
- ▶ Non-profit organization
- ▶ Initial investment: 62M€
- ▶ Initial staff: ~70, annual budget : 30 Meuro
- ▶ Mission : to perform research in nano-electronics 5-10 years ahead of industry

King Boudewijn visiting imec



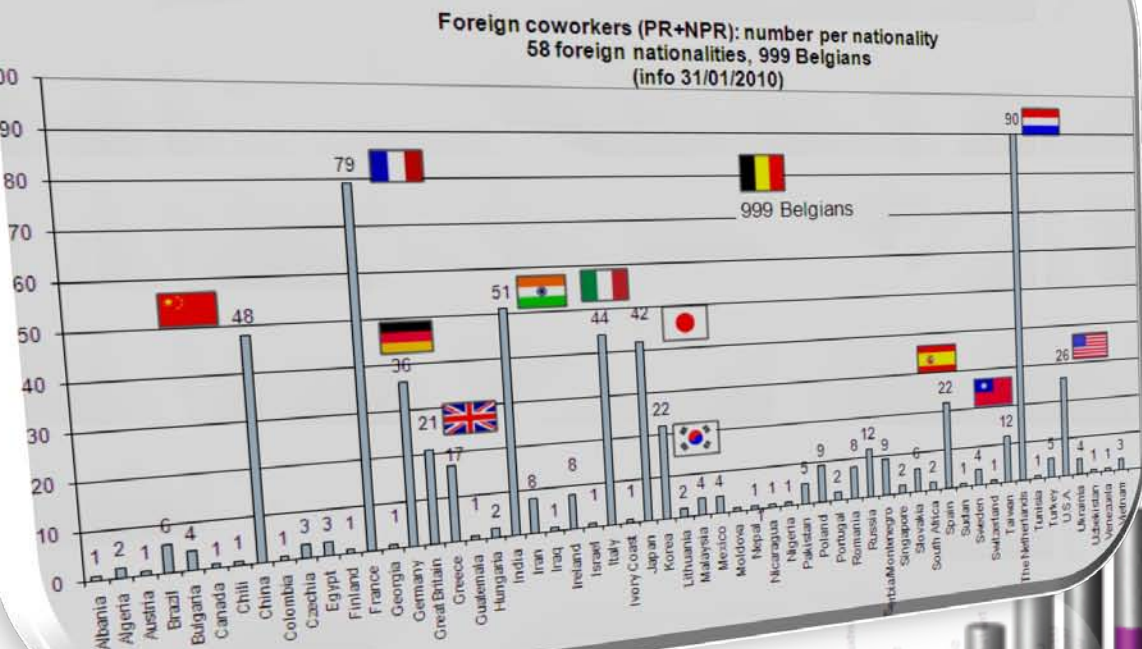
Imec 26 years later

REVENUE

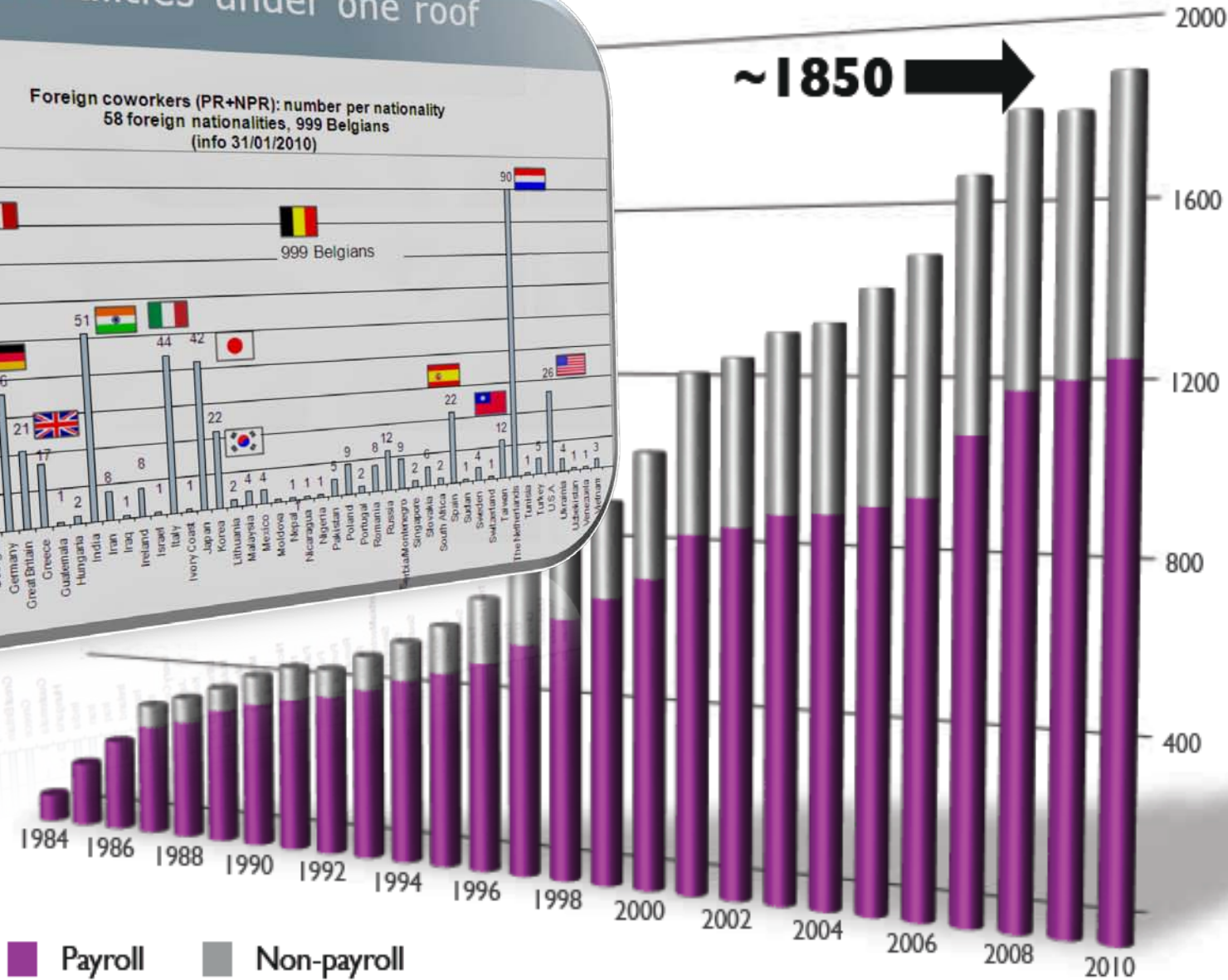


IMEC'S HEADCOUNT

About 60 nationalities under one roof



~1850



IMECAMPUS

FAB 2

3200 m² Clean Room
300 mm pilot line
Ball Room, Clean sub-FAB
Continuous operation:
24hrs / 7 days

1999

1994

1985

1985

2004

FAB 1

4800 m² Clean Room
1750 m² Class 1
200 mm pilot line
Continuous operation:
24hrs / 7 days

Total: **8000 m²** Clean Room



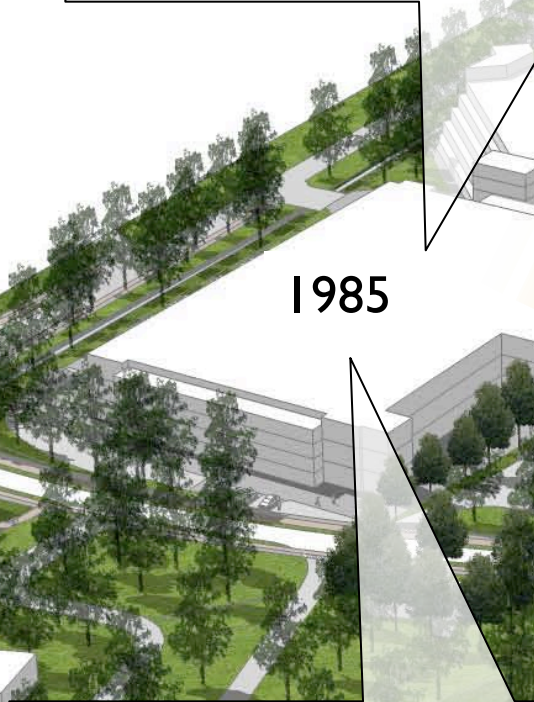


Expansion
CMORE program

Expansion
Bio-electronics Lab



2011 : imec 5
16 floors
450 people
Lab space



1985

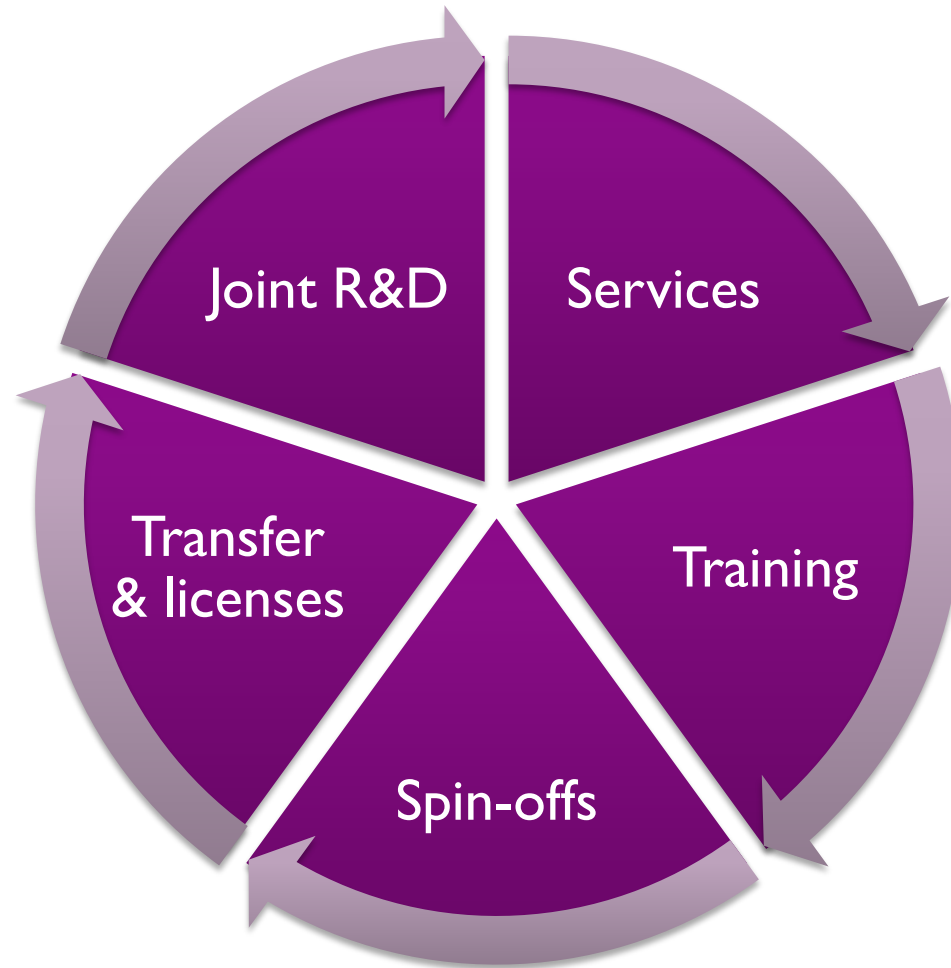
Expansion
Energy (PV) program



imec aims to shape the future.

With our global research partners,
we will lead the development of nano-enabled solutions that
allow people to have a better life in a sustainable society.

IMEC'S BUSINESS MODEL



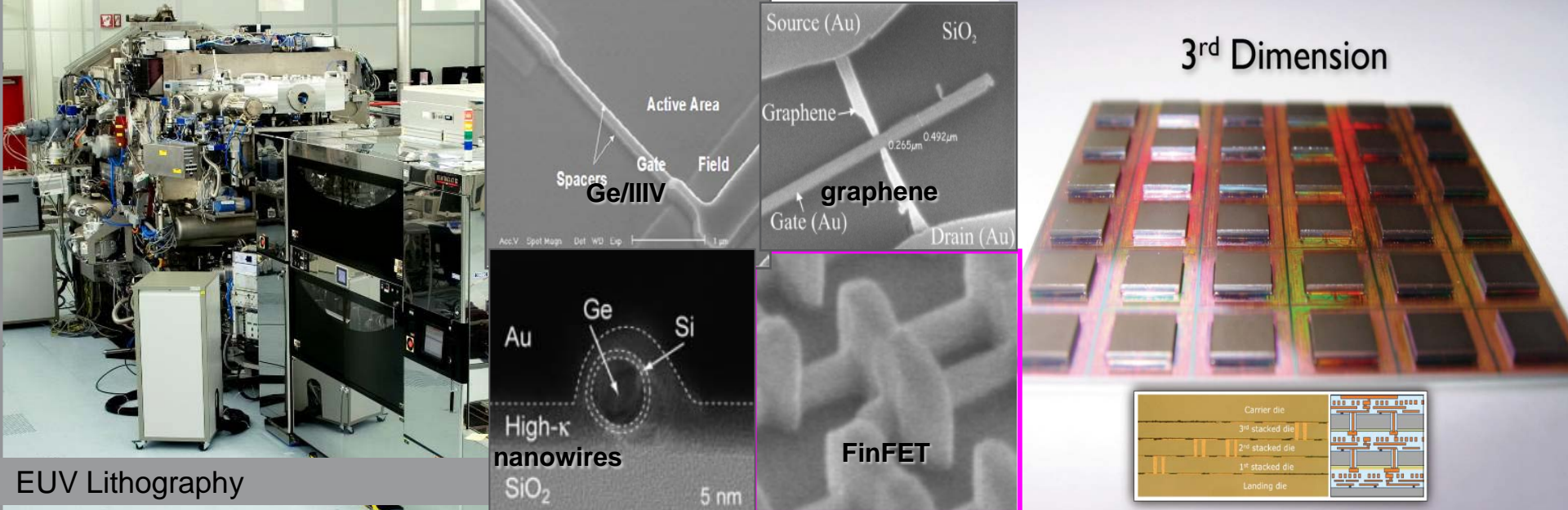
CRITICAL FACTORS FOR A SUCCESSFUL RESEARCH CENTER – INDUSTRY INTERACTION

1. **Mission** : clear, relevant objective
2. **ECO-systems**: focus and strategy process,, from fundamentals to integrated solutions
3. **Implementation** : unique infrastructure operational excellence, shared R&D costs
4. **Connectivity and independence** :
 - customer responsiveness
 - University links
 - Industrial collaboration

An abstract graphic in shades of purple, consisting of overlapping, flowing, and somewhat chaotic shapes that resemble a stylized flame or a complex network of fibers. It is positioned in the upper left corner of the slide.

MISSION

imec performs world-leading research in nano-electronics. We leverage our scientific knowledge with the innovative power of our global partnerships in ICT, healthcare and energy. We deliver industry-relevant technology solutions. In a unique high-tech environment, our international top talent is committed to providing the building blocks for a better life in a sustainable society.



EUV Lithography

TREND ONE

materials

systems

System-driven technology exploration

“following the roadmap”



“exploring the roadmap”

- ▶ Application-driven, technology-enabled opportunities
- ▶ Technology continues to be a key differentiator
- ▶ Equipment and materials enabling factor
- ▶ All guided by a stronger link between SYSTEM and technology: system view on technology offering...



TREND TWO

Economy of scale (*teconomics*)

- ▶ Continued consolidation, pressure on R&D budgets,...
- ▶ Only very few R&D networks will be able to create the right leverage and critical mass to explore cross-technology opportunities in next 10 years
- ▶ Global partnerships: platforms for collaborative R&D where system, IDM, foundry, and equipment and material companies will need to work together

IMEC'S RESPONSE : ECO-SYSTEMS FOR COST-EFFECTIVE R&D

IC manufacturers
system houses

Equipment, material, SW
suppliers

**Collaborative
PROGRAMS & PROJECTS
in a
unique R&D infrastructure**

World-wide
R&D Platforms

***Build critical mass
Share R&D costs***

University
Partnerships

EU, Regional funding



OPEN INNOVATION

Research Center - Industry Collaboration : Implementation



- Shared R&D costs :
cost efficiency, unique infrastructure
- Synergy of resources : **operational excellence, critical mass**
- Customer responsiveness
industrial roadmapping
- Proprietary research on top of shared IP

Enable excellence and diversity

Imec Aims To Shape The Future : For A Better Life In A Sustainable Society



IMEC CORE CMOS

Lithography
Logic devices
Nano Interconnects

3D chip stacking.
Memories Devices

INSITE – connecting
technology and system design



IMEC CMORE

SiGe MEMS
Silicon photonics

Vision systems
Power devices and mixed-
signal technologies

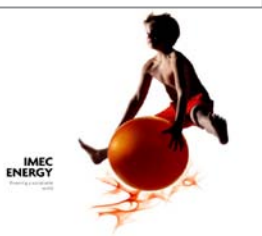
GaN power electronics and
LEDs



HUMAN++

Wearable and implantable
body area networks (with
Holst Centre)

Life sciences



IMEC ENERGY

Photovoltaics

GaN power electronics and
LEDs

Energy Storage.



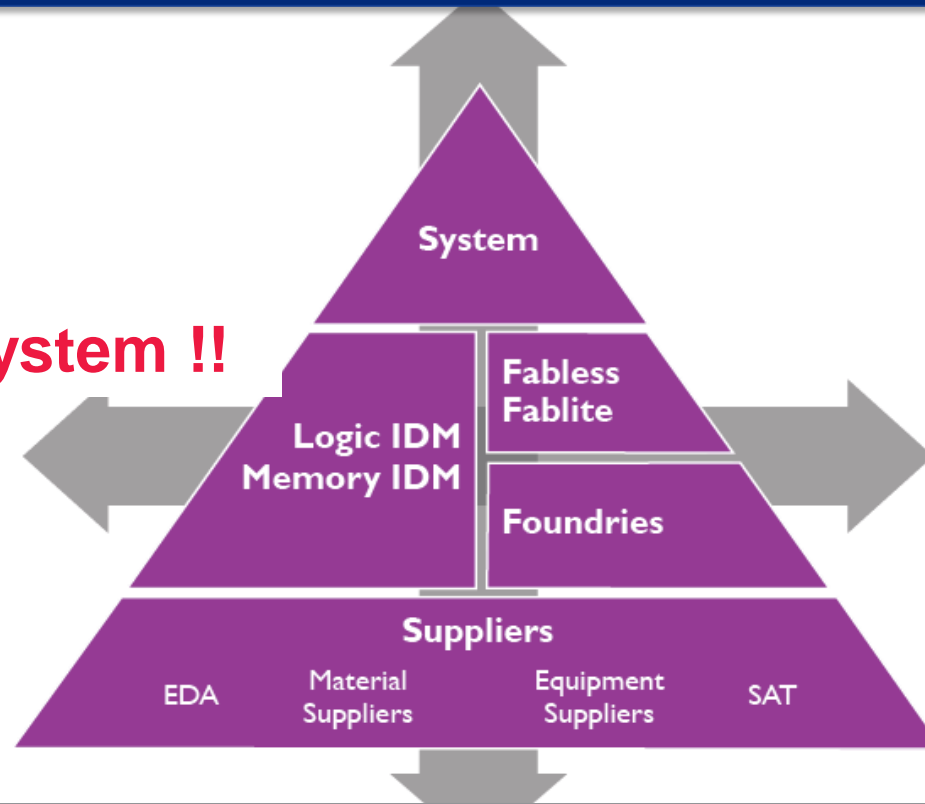
IMEC SMART SYSTEMS

Power-efficient green radios
Vision systems

Large-area electronics and
systems-in-foil (with Holst
Centre)

Wireless autonomous
transducer solutions (with
Holst Centre)

Core Cmos : scaling challenges towards 15/11 nm



Expand the ECO-system !!

2007

2008

2009

2010

2011

2012

2013

32nm

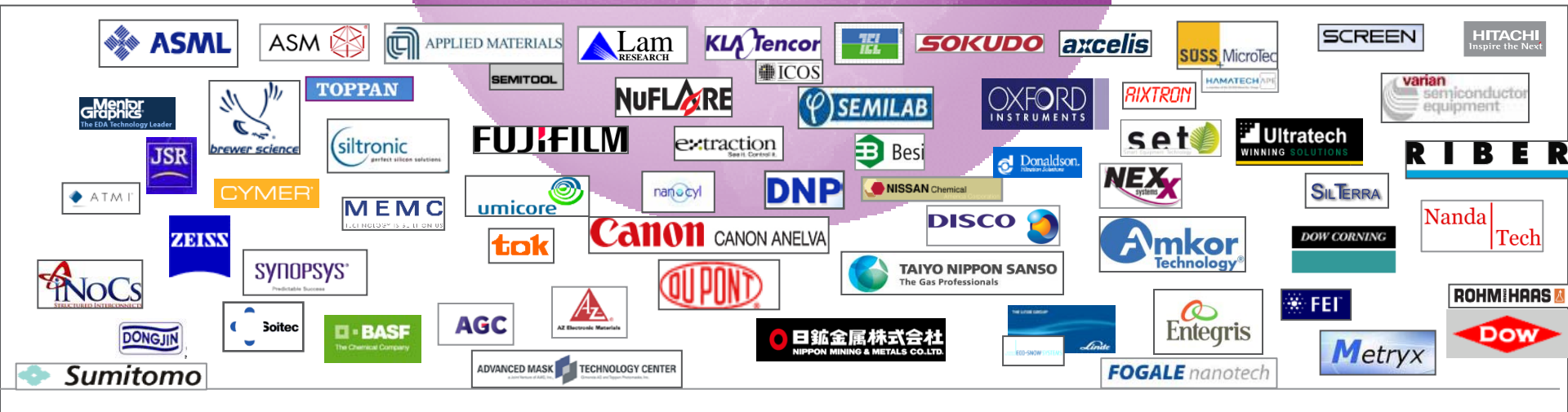
22 nm



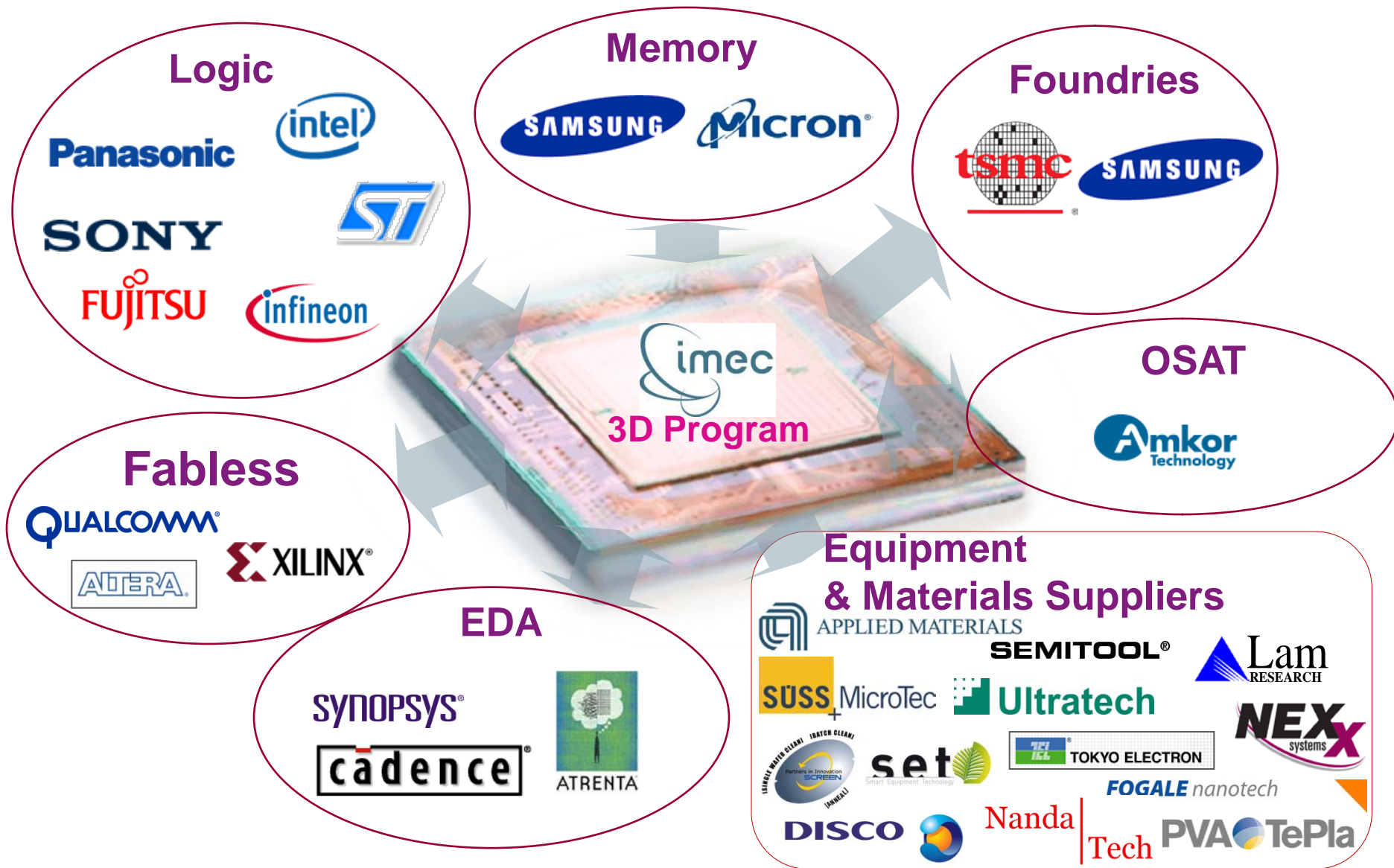
15/11 nm

- Increased focus on new innovative materials & concepts
- Stronger link between Technology and System Design
- Enlarged ECO-system : logic – memory – fablite - fabless

CRITICAL MASS : IMEC CORE CMOS PARTNERS



3D ecosystem at imec



ENABLER : Alignment With Industrial Standards From 4 Inch To 450 mm



ENABLER :

a unique infrastructure build through industry collaboration

2009

2010

2011

2012

2013

2014

Immersion
Extensions

XT:1250 dry, 0.85NA

ASML XT:1900i, 1.35NA



NXT:1950, 1.35 NA

2009

2010

2011

2012

2013

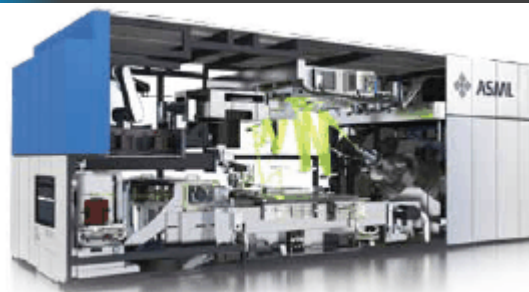
2014

EUVL

EUVL α -tool, 0.25NA



NXE:3100, 0.25NA



NXE:3300, 0.33NA

ENABLER :

UNIQUE World's Most Advanced IC R&D Facilities

- ▶ ULSI design methodology lab
- ▶ Microsystems lab
- ▶ Ultra-clean processing lab
- ▶ Lab for material and device characterization
- ▶ Lab for physico-chemical-analysis
- ▶ Lab for automatic device measurement
- ▶ Organic electronics lab
- ▶ Packaging and testing-equipment lab
- ▶ Reliability lab
- ▶ RF lab
- ▶ Bio-lab
- ▶ Photovoltaics lab

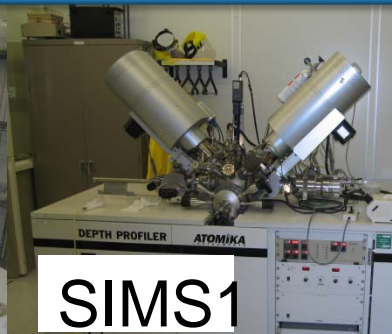
ENABLER : ADVANCED INFRASTRUCTURE FOR CHARACTERIZATION



AES



XPS



SIMS1

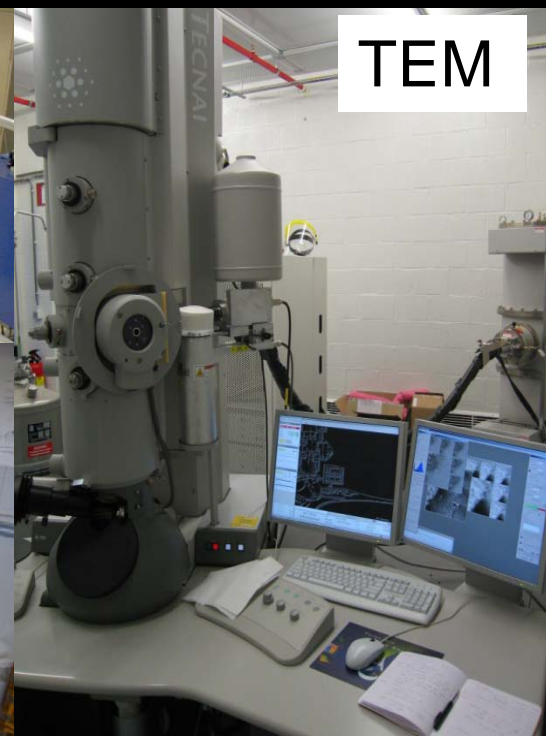


SIMS2



RBS/ERD

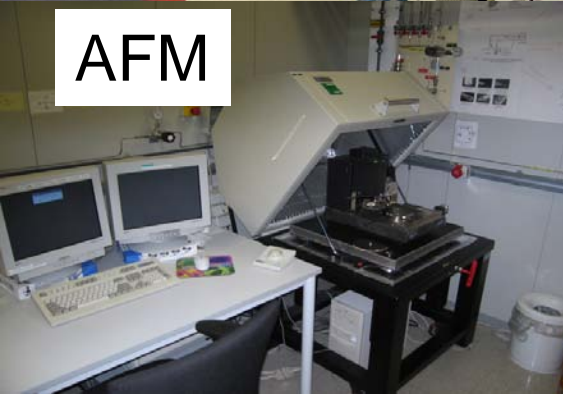
If you can not measure
you can not learn!"



TEM



FIB



AFM

nanoprober

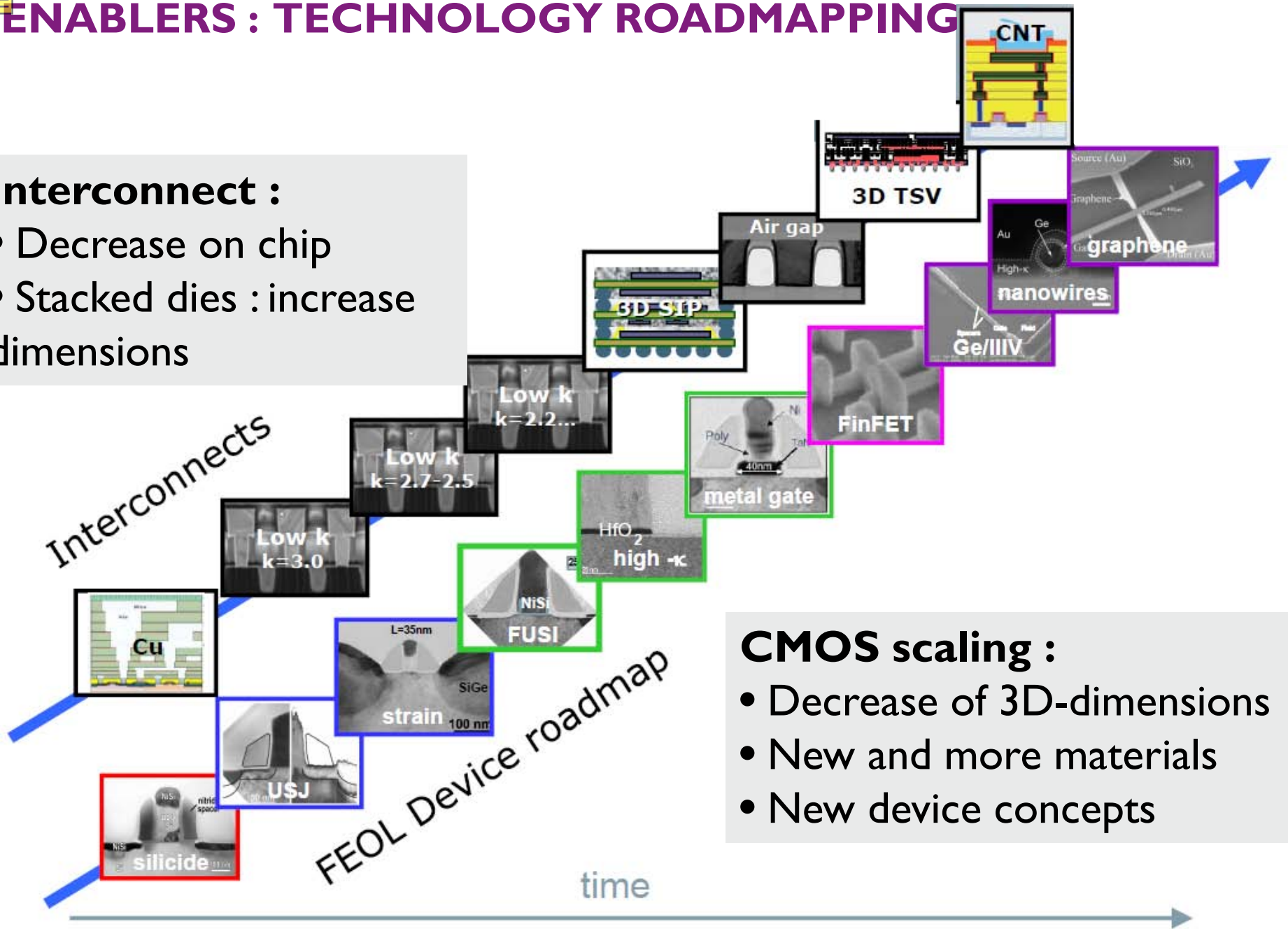


XL 30 S

ENABLERS : TECHNOLOGY ROADMAPMING

Interconnect :

- Decrease on chip
- Stacked dies : increase dimensions

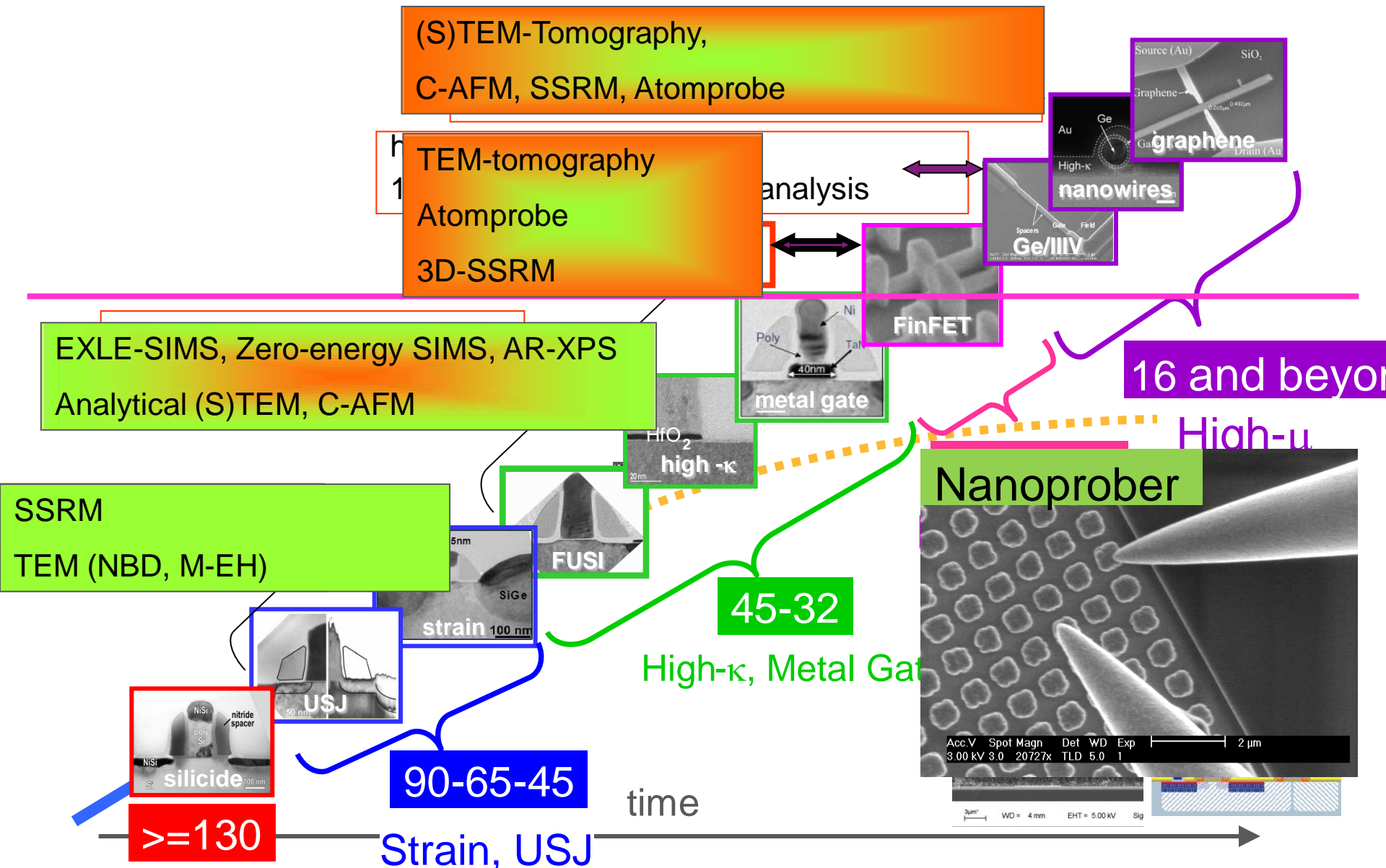


CMOS scaling :

- Decrease of 3D-dimensions
- New and more materials
- New device concepts

ENABLERS : Fundamental Research (matching the Technology Roadmap!)

Implications Of Scaling On Metrology : Mature And Emerging Solutions





IMEC ENERGY



IMEC S⁴ ENERGY STRATEGY

Saving energy

Solar energy

Switching energy

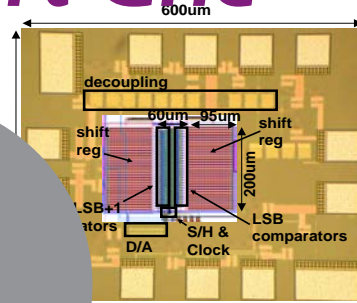
Storing energy



Leveraging Imec's Expertise for a Better Life in a Sustainable Society : *Energy & Smart Grid*



Solar energy
Silicon
Stacks
Organic



Saving
Wireless
ICT systems
LEDs

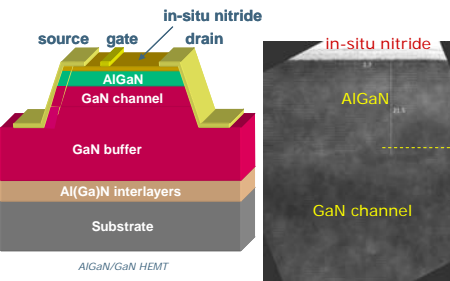


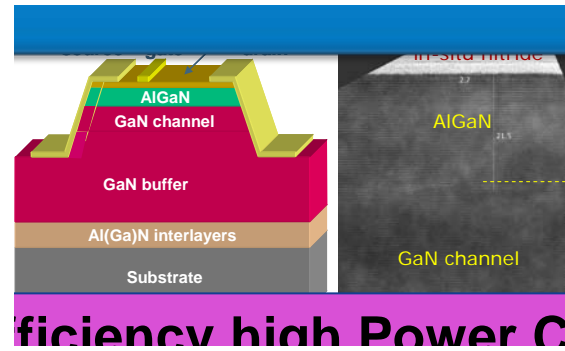
**Sustainable
energy**

generation
consumption
distribution

Switching
GaN power
devices &
convertors

Storage
Fuel cells





efficiency high Power C

Solar energy ECO-system :

Towards

low-cost

high-efficiency

silicon solar cells



Energy companies



Solar cell producers



Tool suppliers



Material suppliers



CONVERGENCE OF TECHNOLOGIES

NEUROELECTRONICS RESEARCH FLANDERS

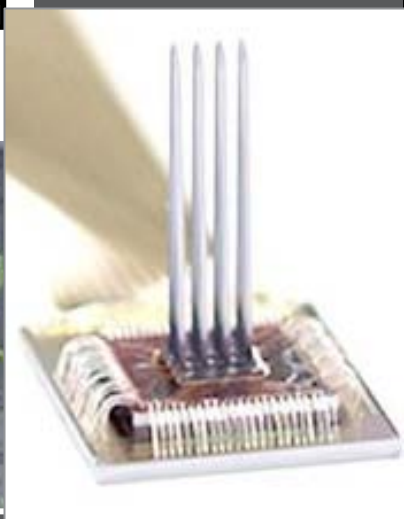
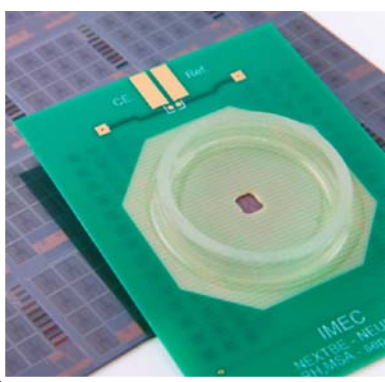


Nano(electronics) technology for biomedical applications

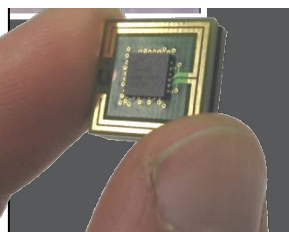

Smart devices
Ultra low power, WiFi,



Brain research : probing and stimulating neurons

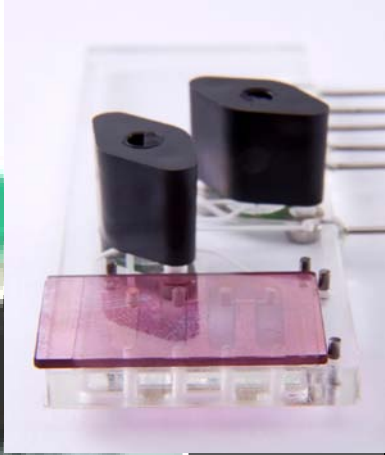
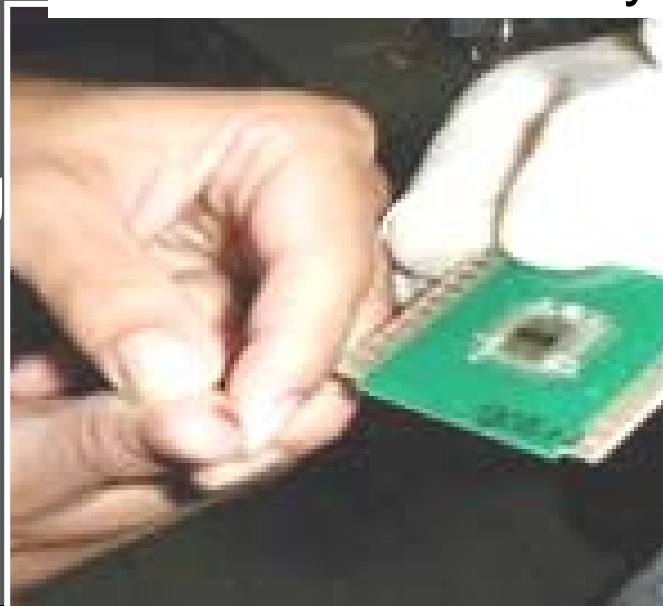


Cochlear implant

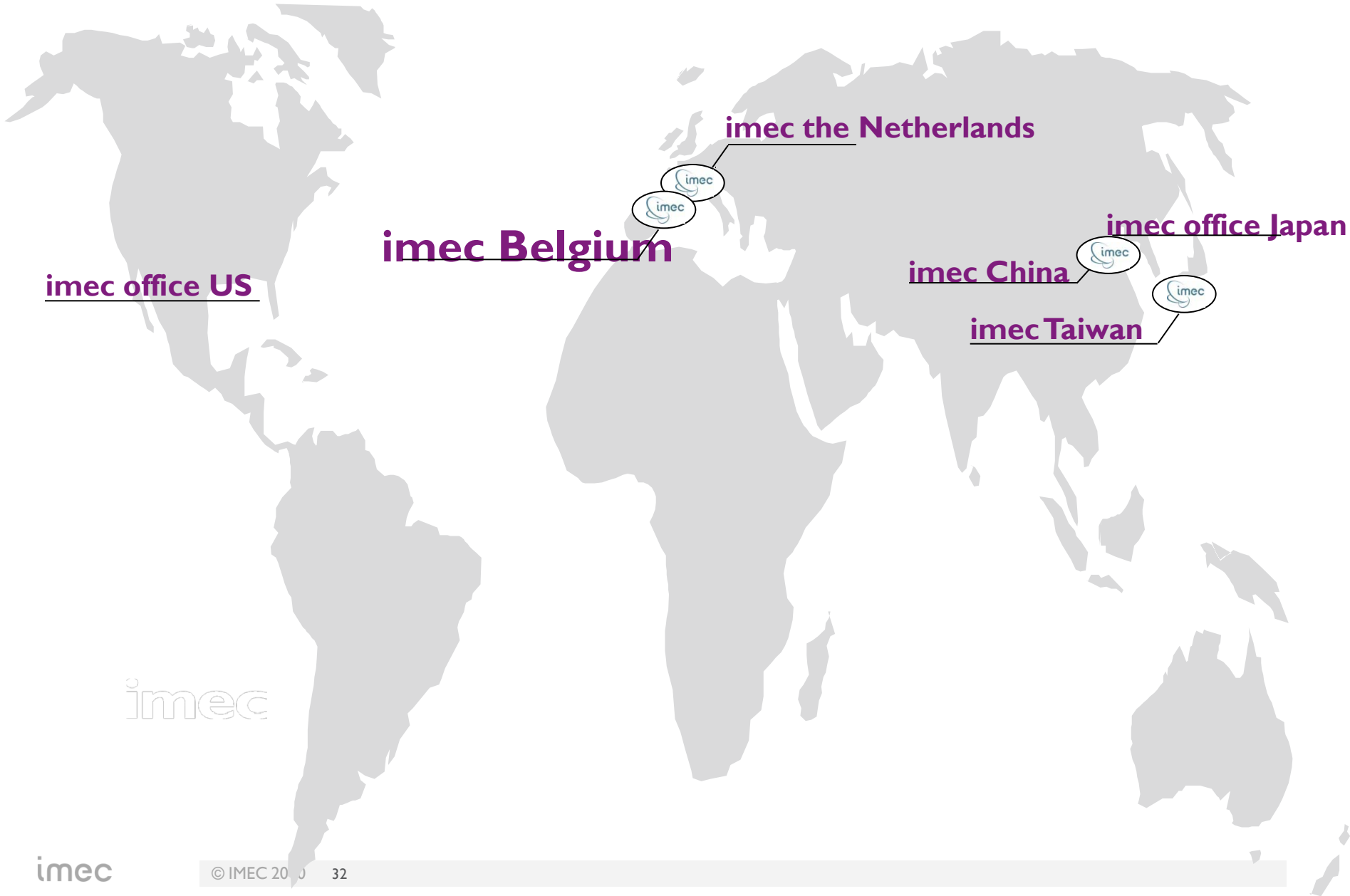


A medical lab of only 1x1 cm²

Ambulatory EEG monitoring

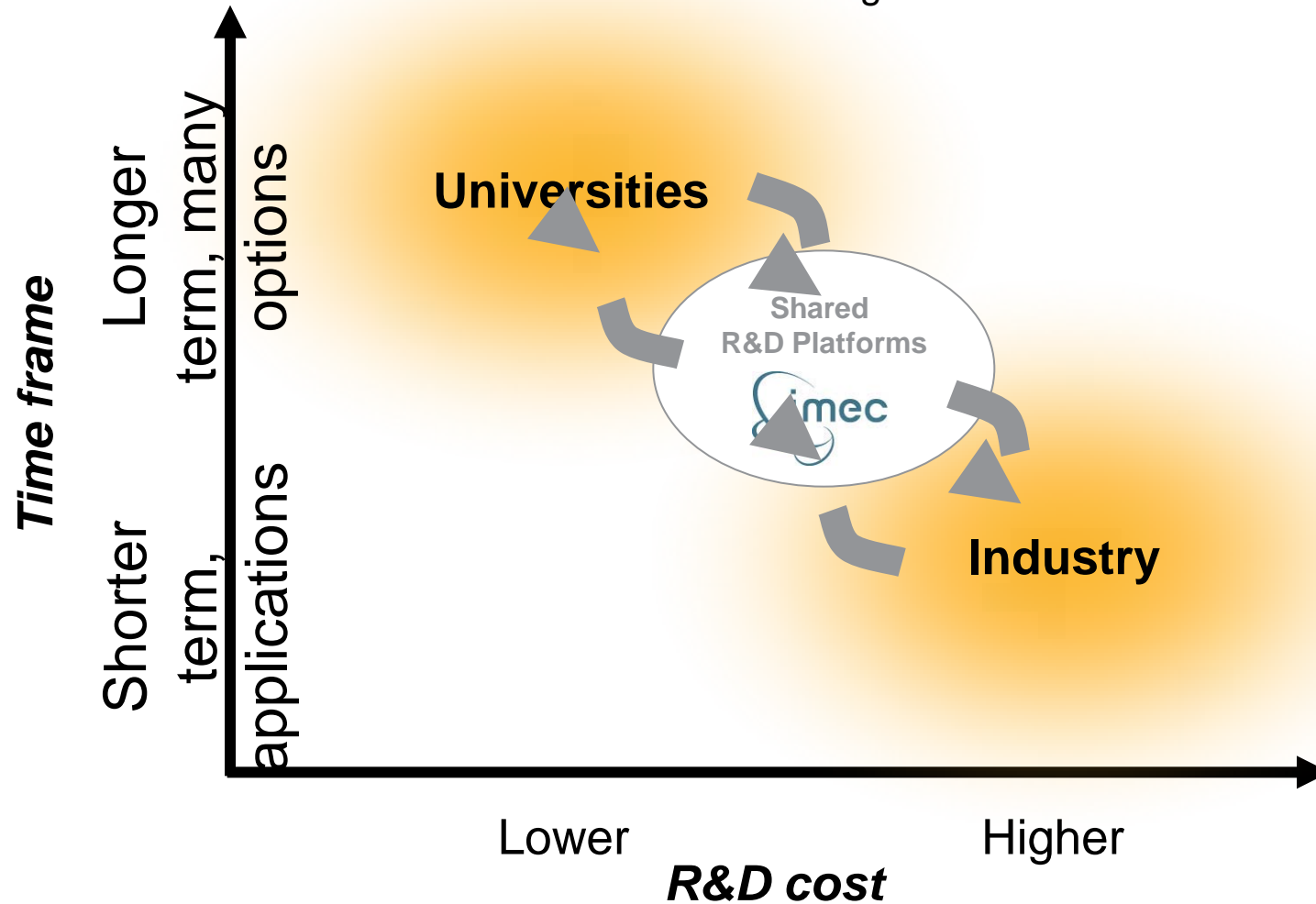


IMEC IN THE WORLD

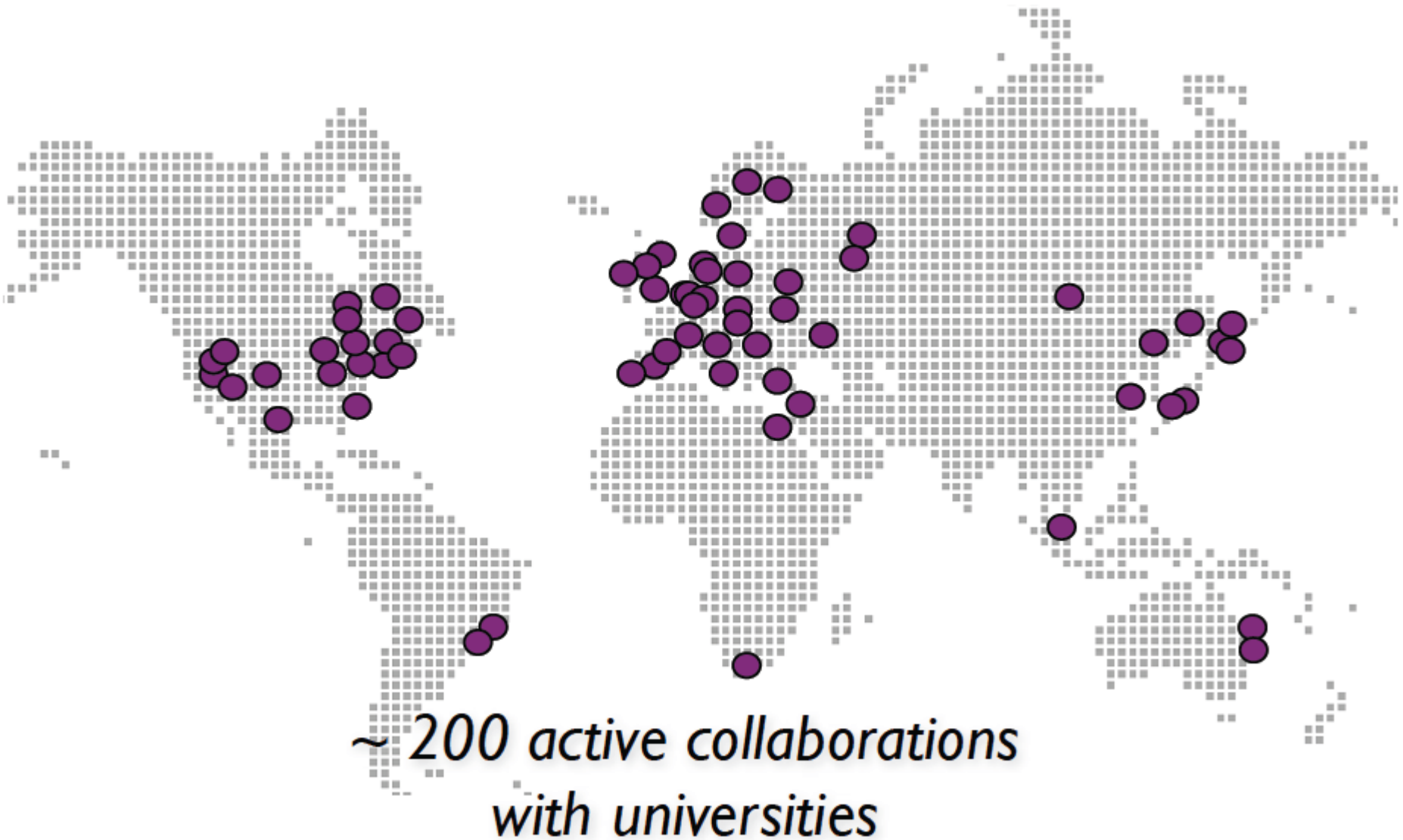


CRUCIAL INTERACTIONS

Providing focus for universities and basic insight and solutions for industrial partners



Leveraging the fundamental expertise of universities



Successful academia industry collaboration

Quality is priority
Nr.



Operational Excellence

Cycle Time

Unique Infrastructure

Top Talent

Global Partnerships

Innovation

1700

publications in 2010

2010 VLSI



TECHNOLOGY SYMPOSIUM
HONOLULU

10



9



19

Responsiveness

Who is your customer?

What does this customer expect from you?

Did you **deliver**?

Academia – Research Center – Industry Collaboration : THE WINNING TEAM

