ASML

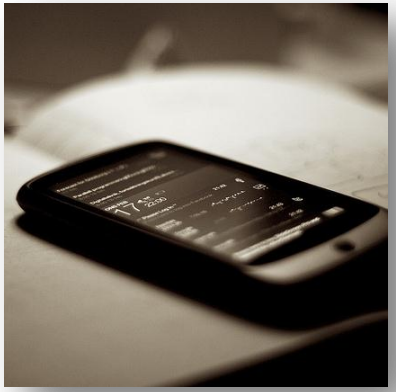
Faster, smaller, greener

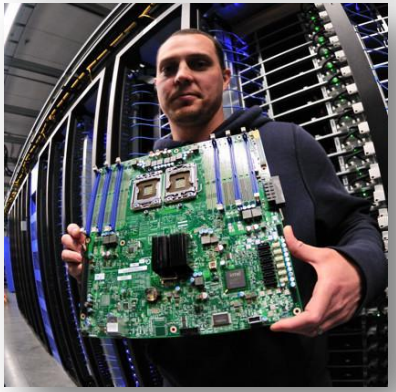
Vadim Banine

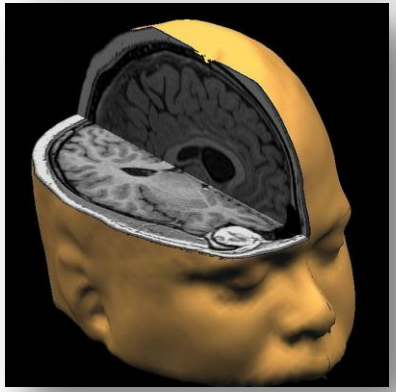
La3net 18 November 2014

Chips are everywhere

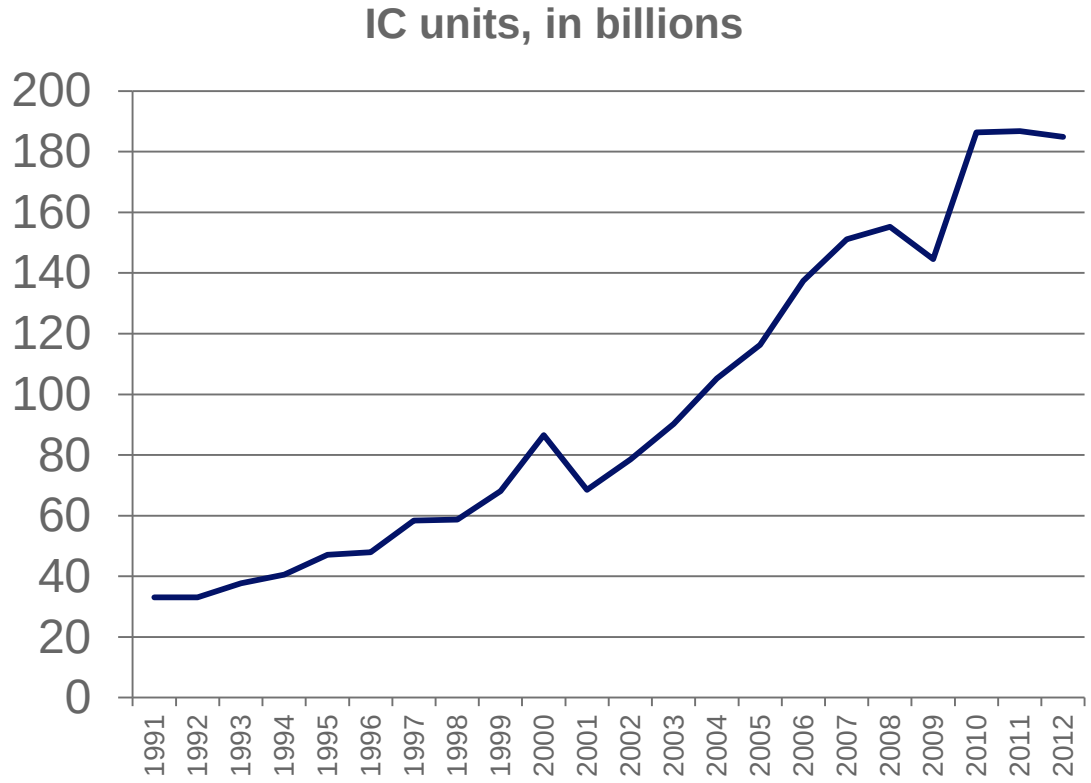
It’s hard to imagine a world without chips







More than 180 billion chips are made every year

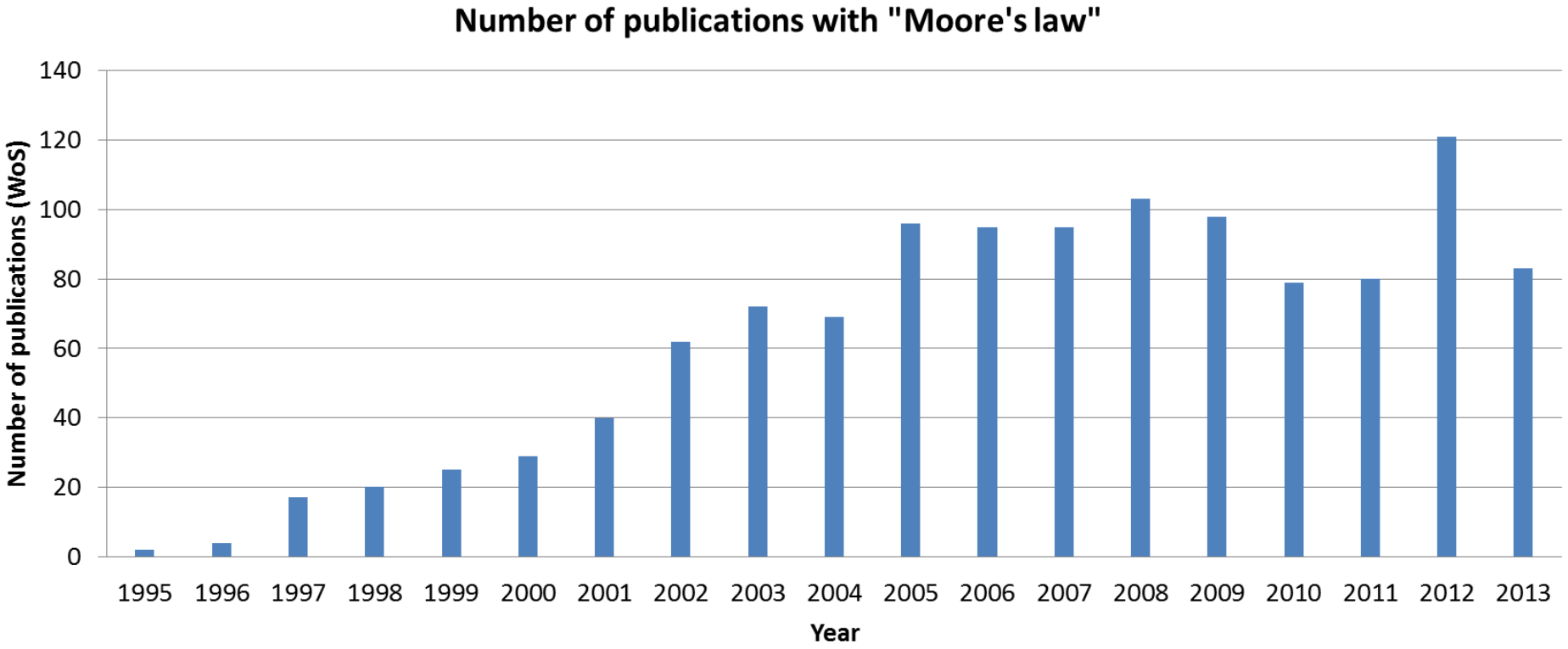


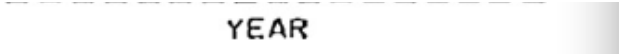
In 2012, 185 billion chips were produced — 27 for every man, woman and child on the planet.

Global semiconductor industry sales were about $300 billion.

Data: WSTS

Vision of Moore … and further replication





The demise of Moore's law?

explaining it for the first time, Moore made one familiar prediction. "Over the longer

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Incredible Shrinking Transistor Nears Its Ultimate Limit: The Laws of Physics

By W... Publis...

IT v...

Is There Life A...

By JOHN MARKOFF
Published: April 9, 2003

PALO ALTO, Calif., Ap...

If there is a religion he... long been Moore's Lav... number of transistors...

TECHNOLOGY | INNOVATION, THE INTERNET, GADGETS, AND MORE. | DEC. 20 2005 3:15 PM

The End of Moore's Law

Industry Expert Blogs

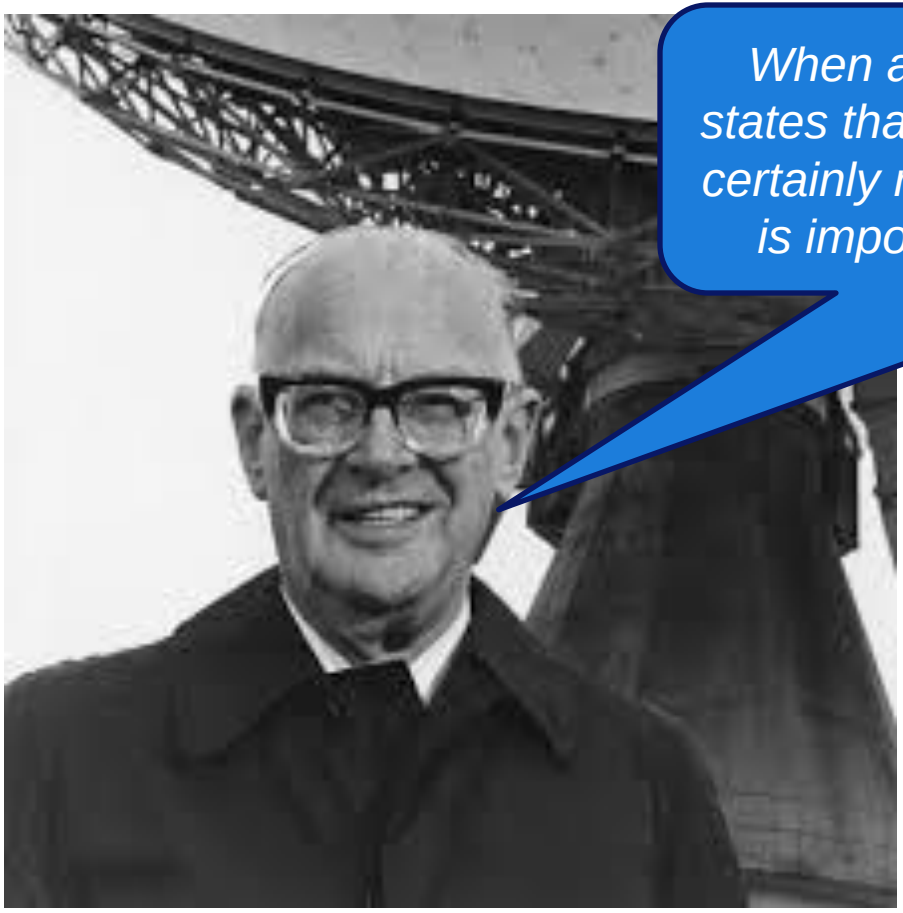
"Moore's Law Dead by 2022" - Then, Before or .... ?

MonolithIC 3D Blog - Zvi Or-Bach, MonolithIC 3D Inc.
Sep. 04, 2013

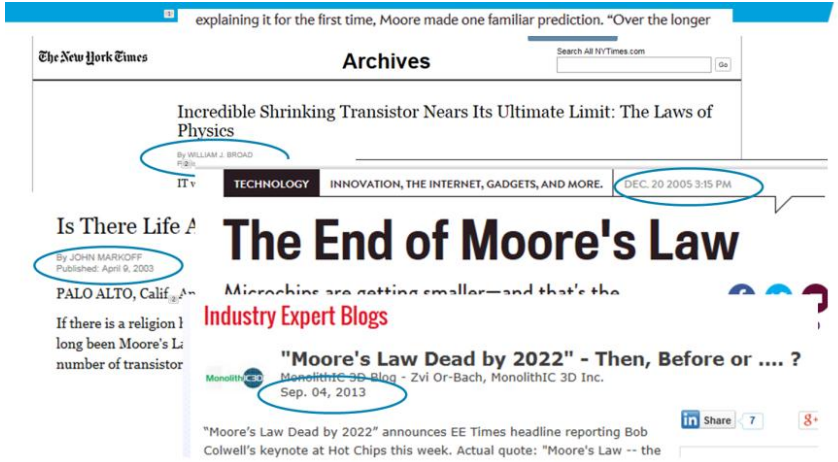
Share 7

"Moore's Law Dead by 2022" announces EE Times headline reporting Bob Colwell's keynote at Hot Chips this week. Actual quote: "Moore's Law -- the

First law of Arthur C. Clarke



When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.



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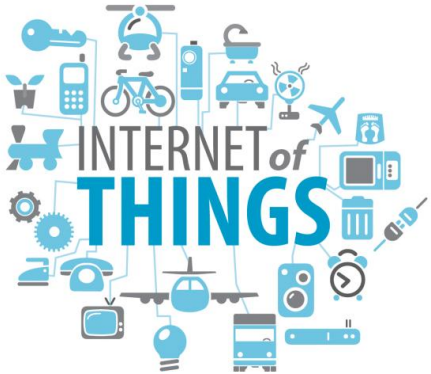
From connecting cities to connecting smart things

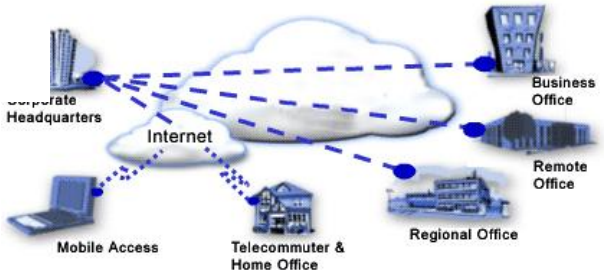
"One day there will be a telephone in every major city in the USA"
A.G. Bell



~ 50 Billion things (2020)

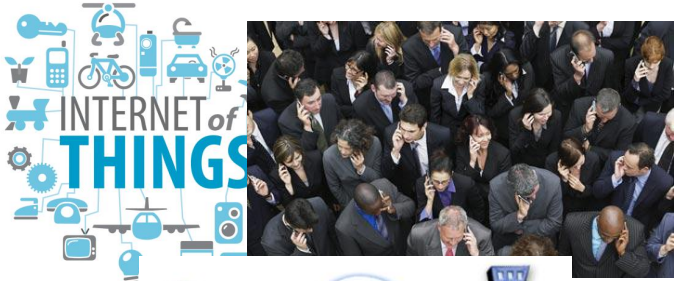
~ 6 Billion People

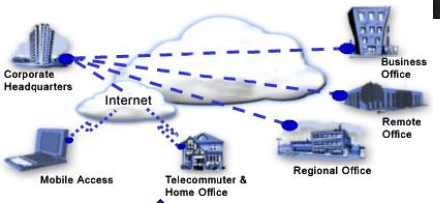
~1 Billion households

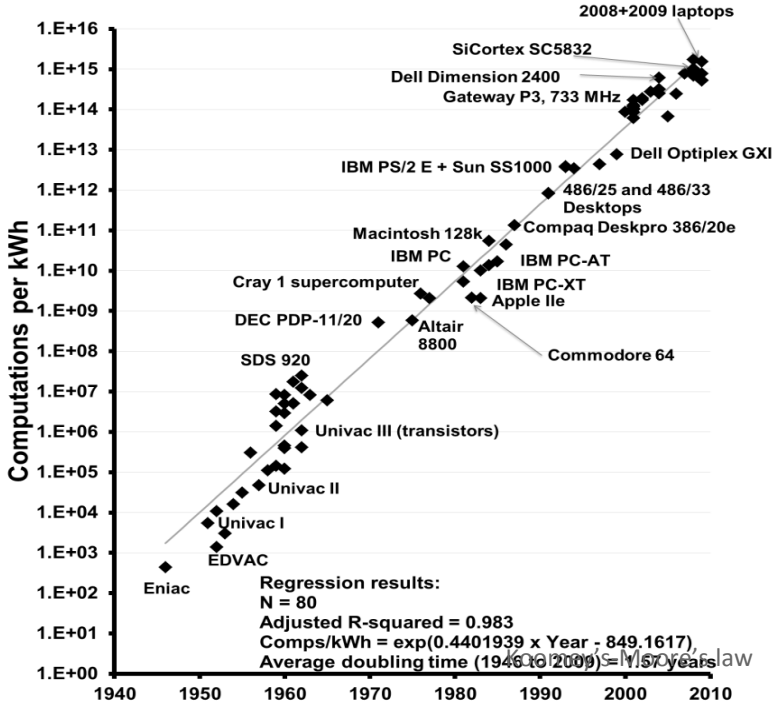


~ 40000 cities WW

Power efficiency: additional driver to Moore's law





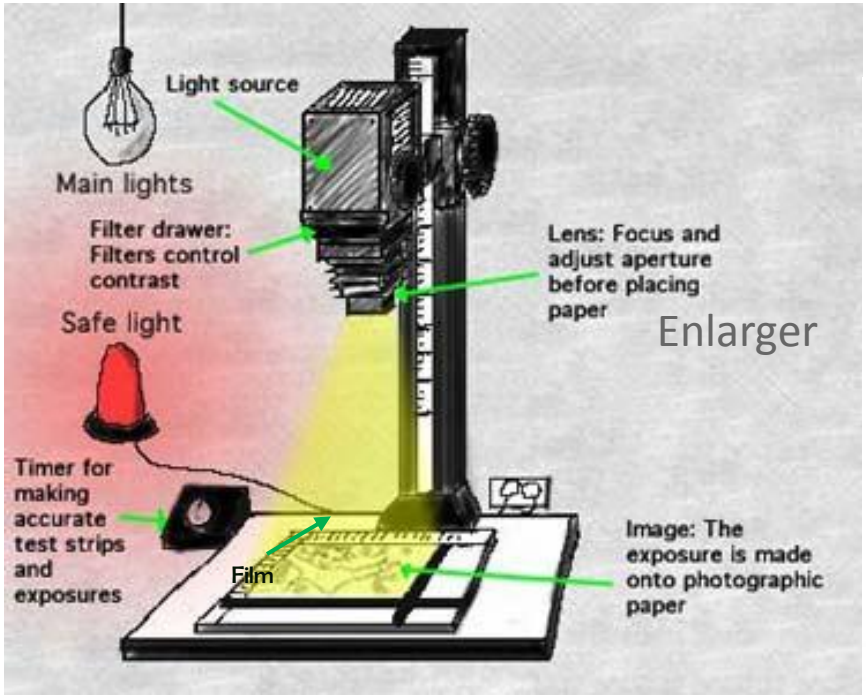


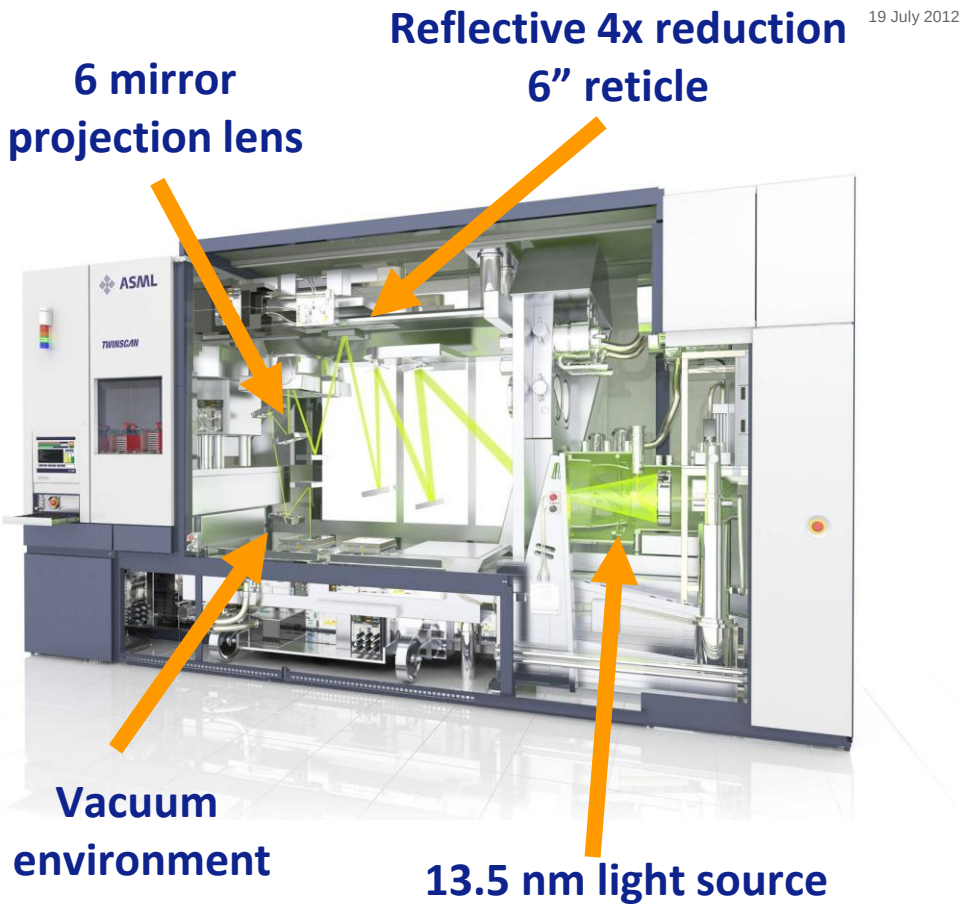
Introducing lithography

ASML makes the machines for making those chips

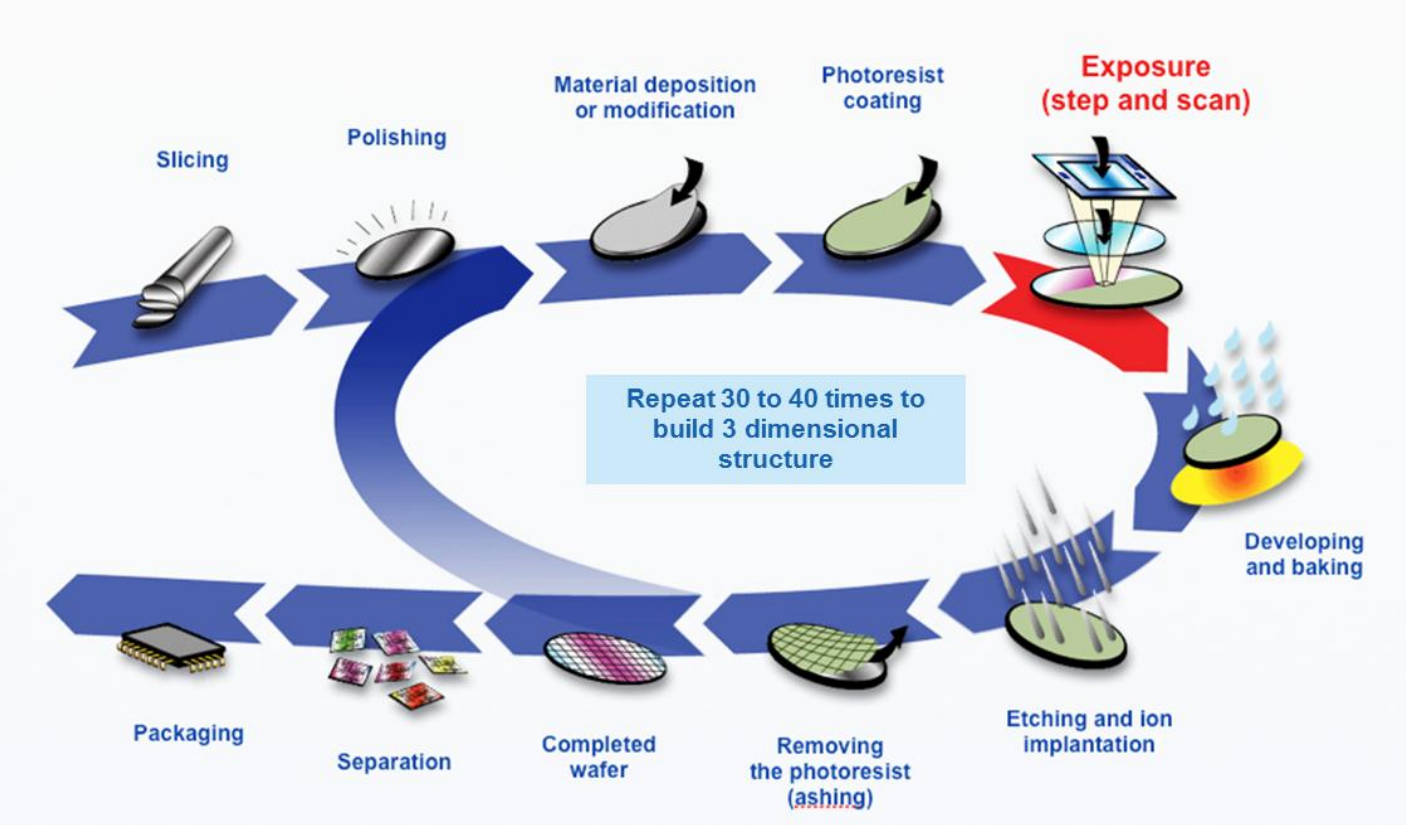
- Lithography is the critical tool for producing chips
- All of the world's top chip makers are our customers
- 2013 sales: €5.2 bln
- Payroll: about 10,400 FTEs

Lithography machine

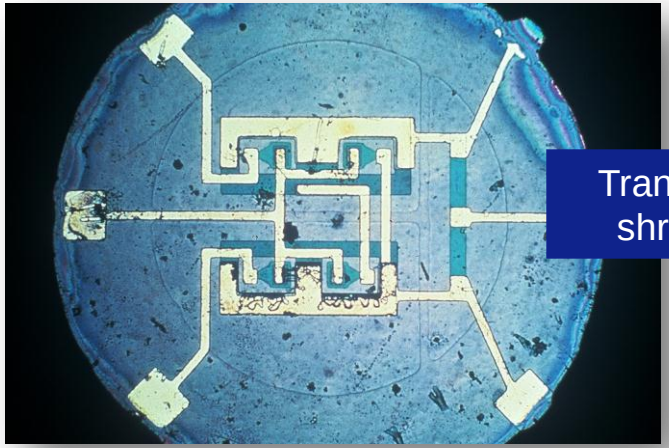




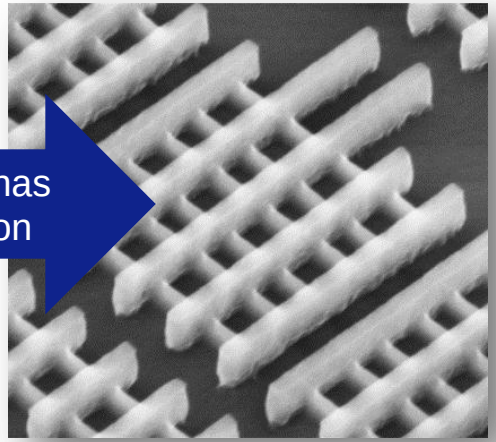
The place of lithography in semiconductor process



Key to Moore's Law: Making smaller transistors



Transistor length has shrunk by a million



The first integrated circuit on silicon, on a **wafer the size of a fingernail**
(Fairchild Semiconductor, 1959)

Today: **More than a billion transistors on the same area**
(Intel, 2012)

How do we do it?

Defining equation of the optical lithography

$$R = k_1 \lambda / NA$$

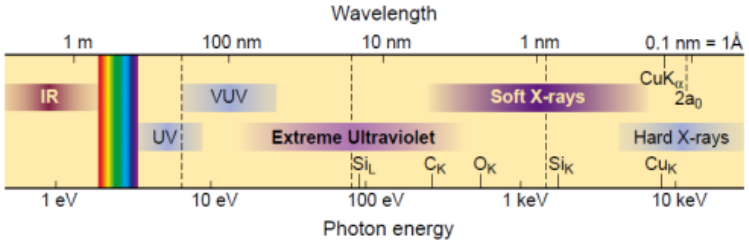
Rayleigh

436 nm (aka g-line)

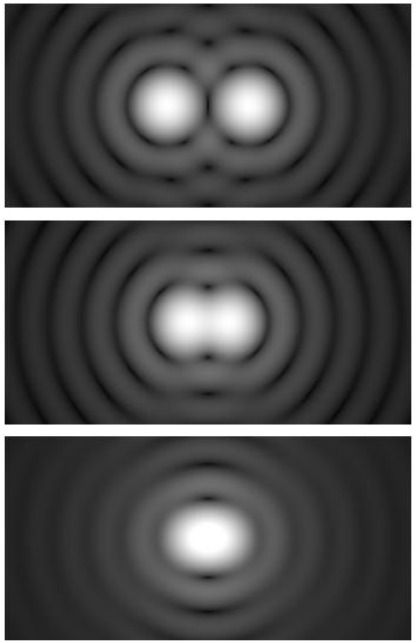
365 nm(aka i-line)

248 nm(aka KrF)

193 nm (aka ArF)



13.5 nm (aka EUV)



High R&D spending to sustain technology leadership

1980s:
PAS 2000/5000

R&D: 50 mln €

1990s:
PAS 5500

R&D: 400 mln €

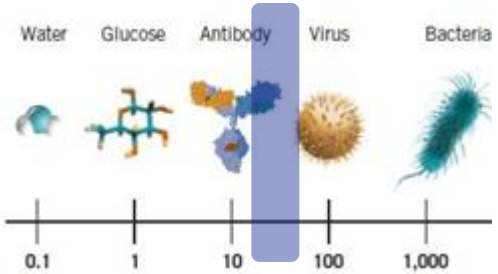
2000s:
TWINSCAN

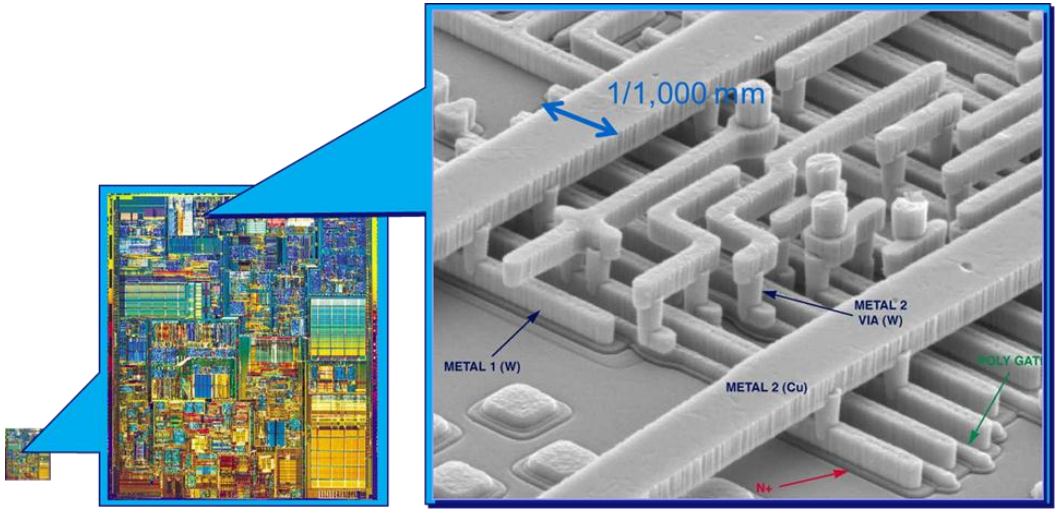
R&D: 1500 mln €

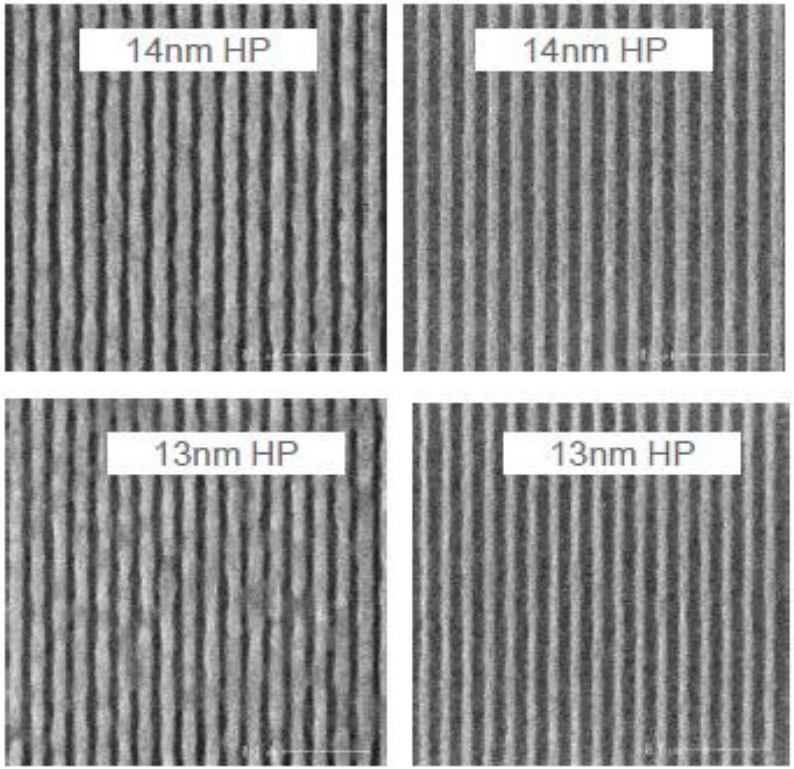
2010s:
NXE EUV

R&D: 2000 mln €

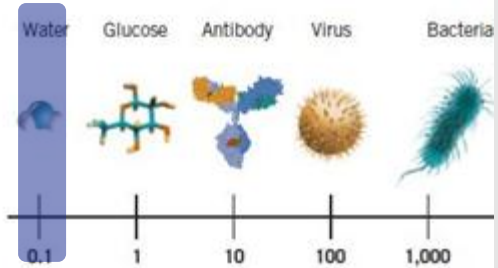
EUVL Imaging: magic inside

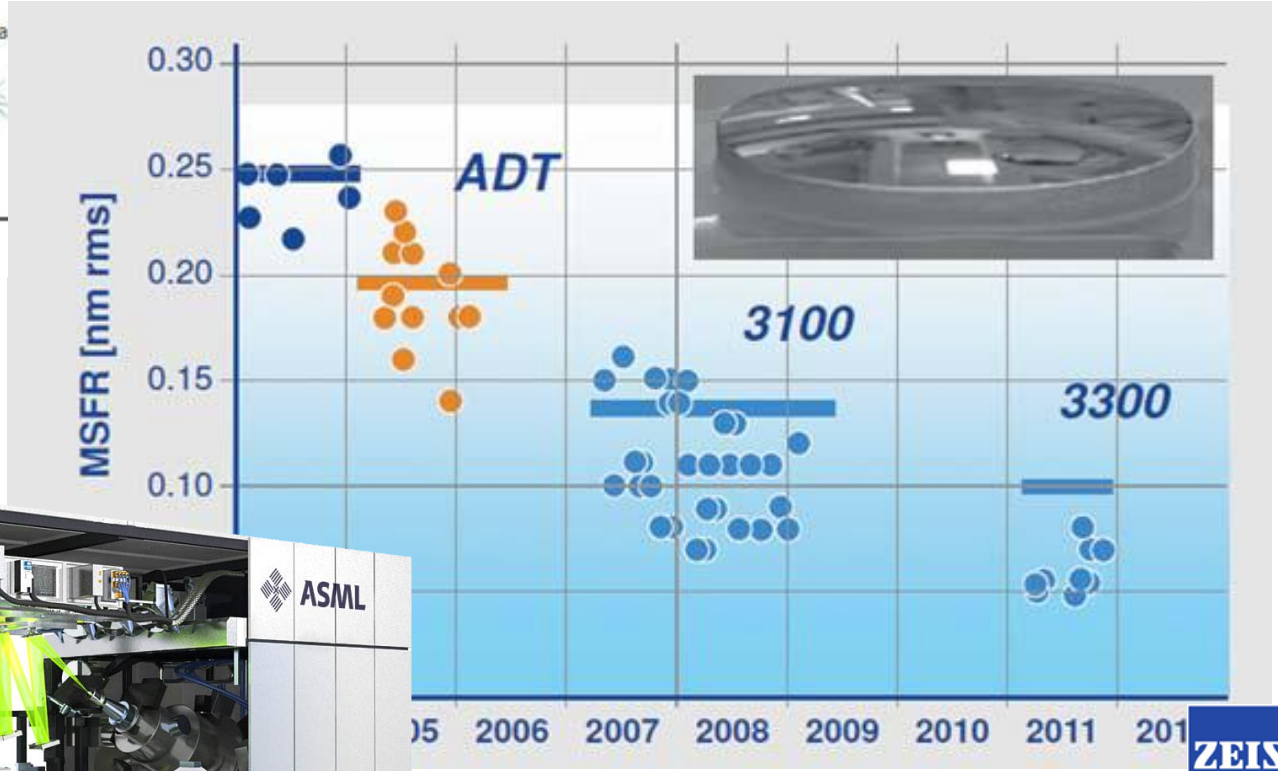


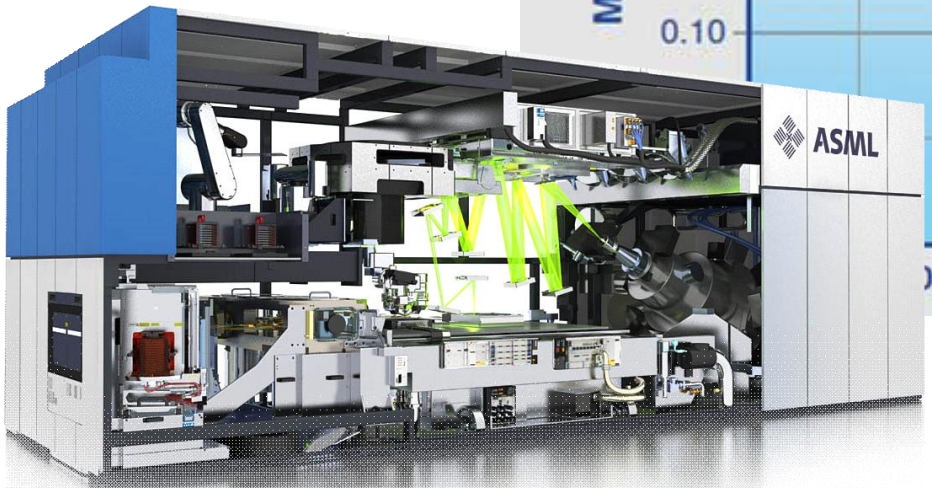




Optical elements: pushing atoms

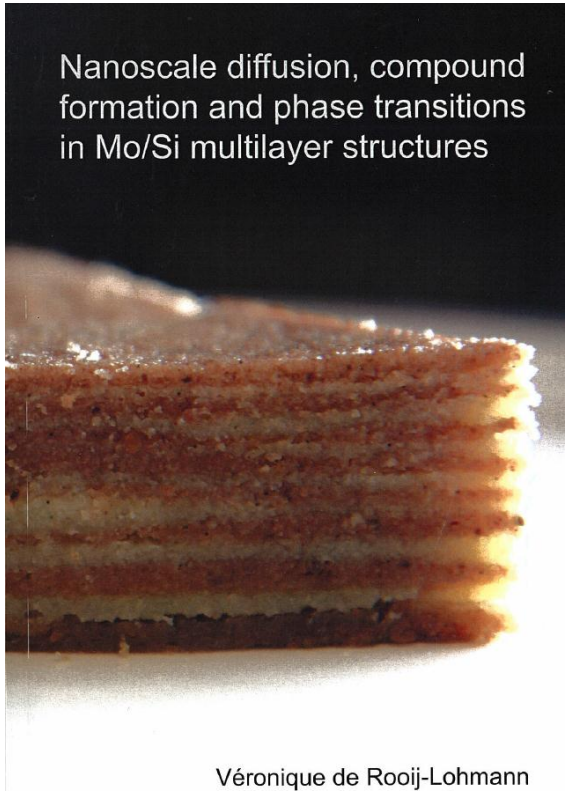


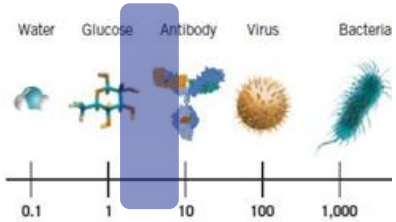


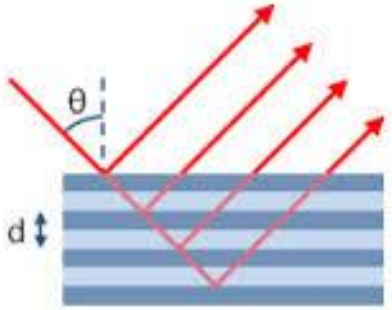


ZEISS

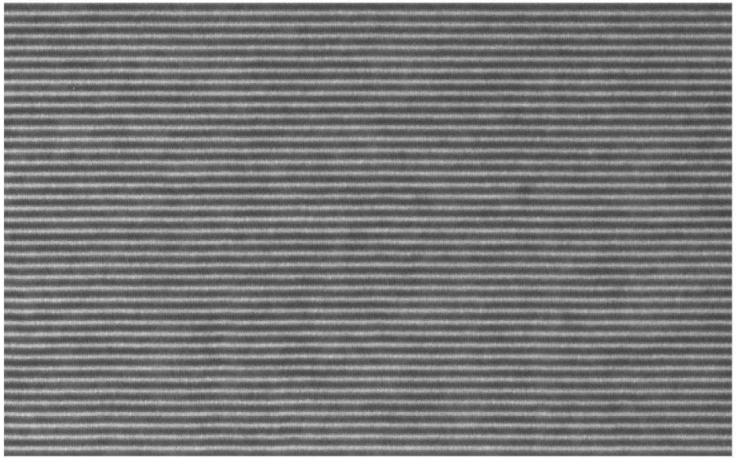
Multi-layer magic







N = 40
d = 6.7 nm

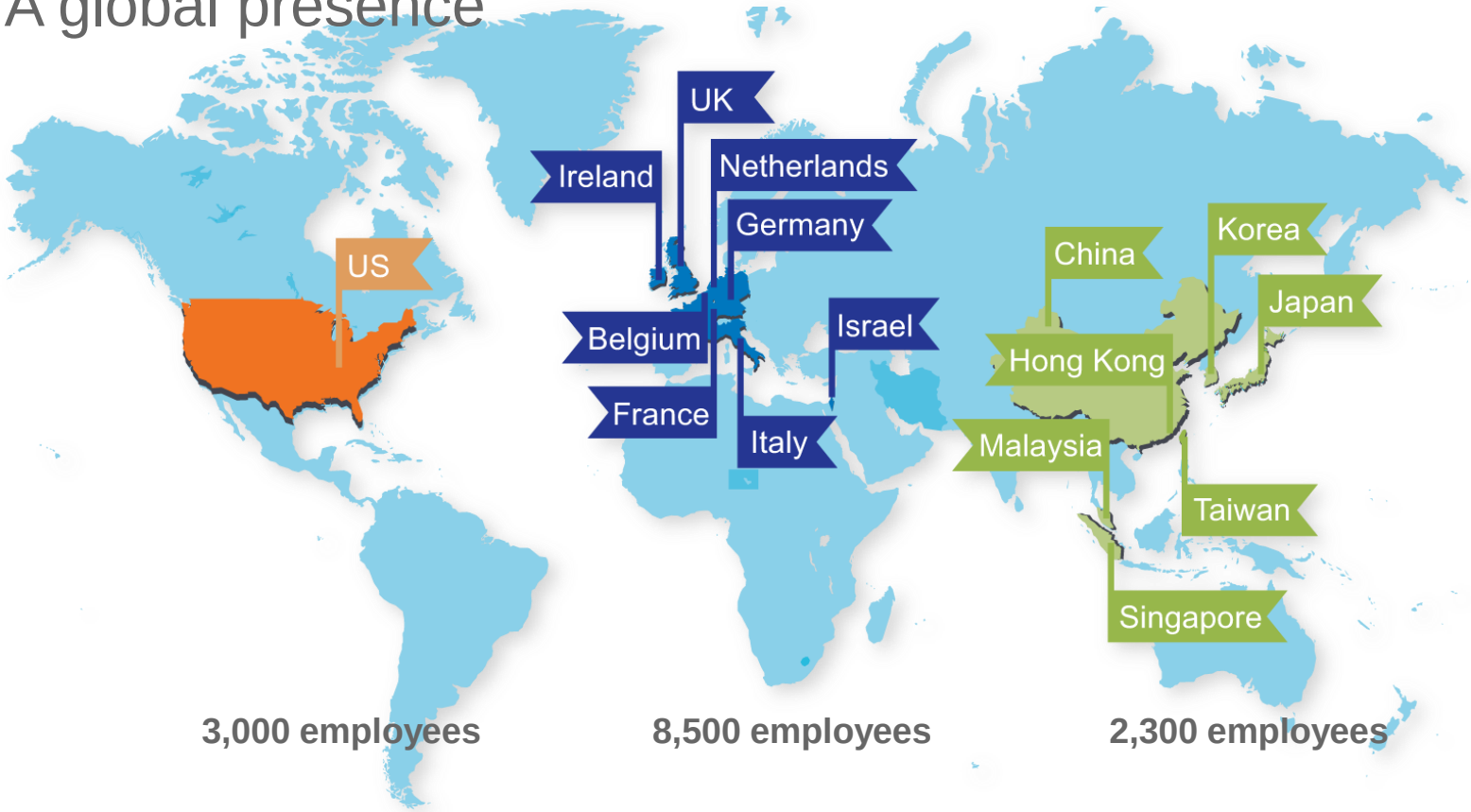


Courtesy of Saša Bajt (LLNL)

Introducing ASML

Founded in 1984 as a spin-off from Philips

A global presence



Over 70 sales and service offices located worldwide

Source: ASML Q2 2014

A global presence

San Diego(CA)

Wilton (CT)

Korea

Veldhoven

Chandler (AZ)

Taiwan

A market of 12 large ASML customers

Technology Collaboration Award

Preferred Quality Supplier Award

'Good Partner' Award

For the 10th consecutive year, top five of VLSI's "Best Wafer Processing" suppliers

Company	2013 semi capex (estimate, $M)
Intel	10,500
TSMC Group	9,750
Samsung	9,500
GlobalFoundries	4,000
SK Hynix	2,730
Toshiba (incl. SanDisk)	2,580
Micron Technology	1,800
United Microelectronics Group	1,500
SMIC	805
Infineon	640
Sony	617
STMicroelectronics	500

Source: Gartner, Q4 2013

1
2
3

Vision, Mission, Strategy

Vision:

ASML makes possible affordable microelectronics that improve the quality of life.

Mission:

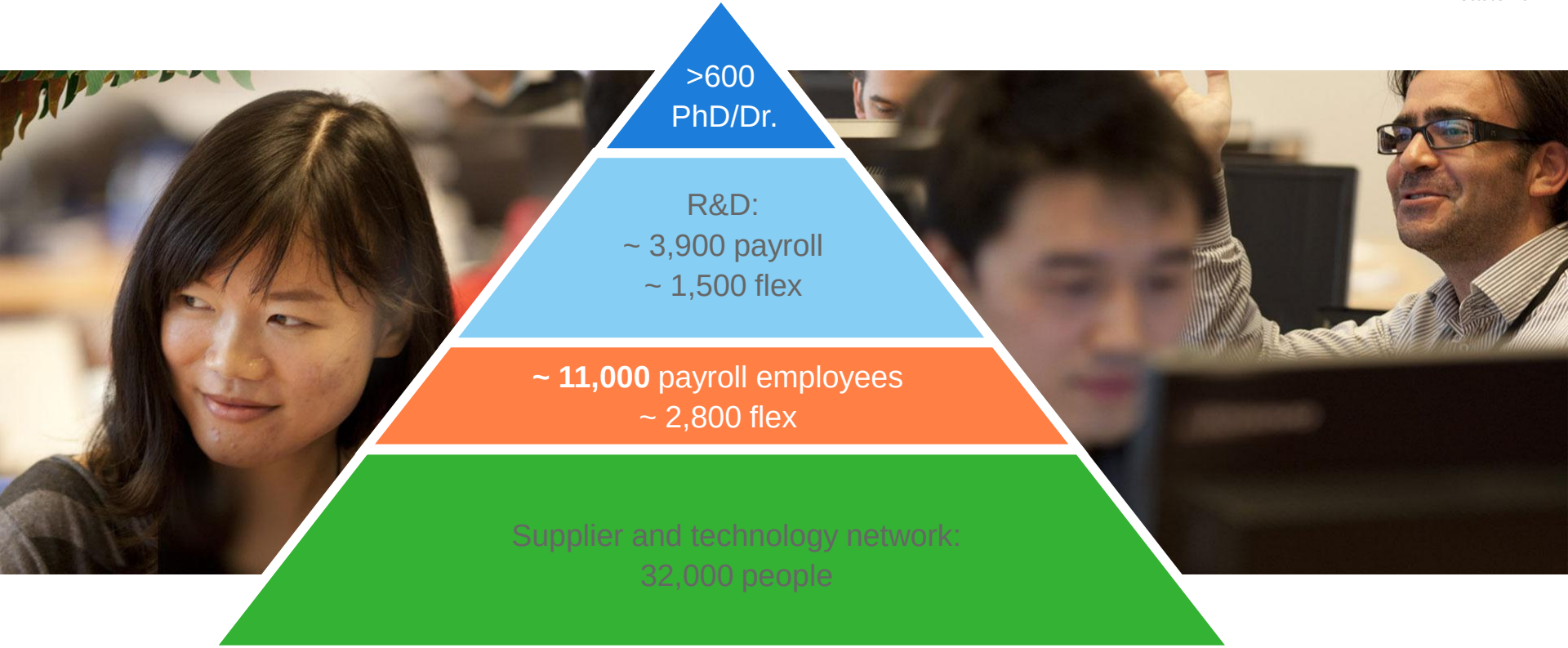
1. **ASML invents and develops complex technology for high-tech lithography machines for the semiconductor industry.**
2. **ASML's guiding principle is continuing Moore's Law towards ever smaller, cheaper, more powerful and energy-efficient semiconductors that drive our customers' competitiveness.**

Strategy:

1. **Our success is based on three pillars: technology leadership, combined with Customer and Supplier intimacy, high efficient processes and Entrepreneurial people.**
2. **We operate in a safe environment where we care for people, planet and our local communities.**
3. **Our company is an inspiring place where employees work, meet, learn and share.**

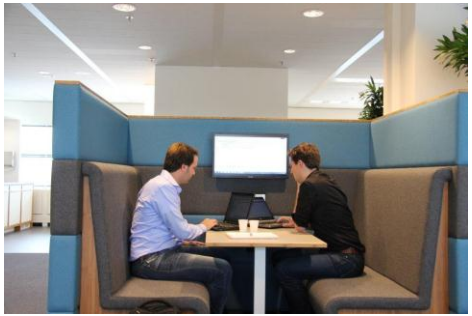
ASML and employees

Great people in an integrated supply chain



Our people are the key to our success

Their workspace



ASML nominated as Best Employer in NL

GENOMINEERD
BESTEWERKGEVERS2013
Intermediair | Effectory

ASML's first entry in Top 100 employers resulted in Top 25* position

Good result and a lot to gain!

* based on high me@asml scores

Strong team with active social agenda

Public

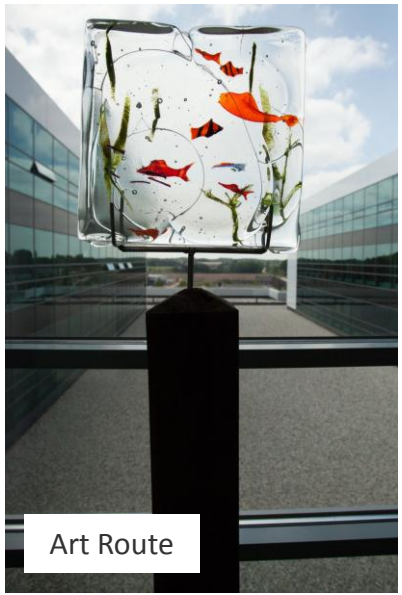
EUV transport

Volunteer Day

ASML Vitality

Family event

Hockey Clinic


Art Route

Extra information

- Job application: www.asml.com/careers
- This also concerns Internships & Traineeships
- ASML offers PhD positions via Universities
- Master class
- Vadim.banine@asml.com

ASML