# High Level Group on Key Enabling Technologies

# Interim Thematic Report

# by

# the Micro/Nanoelectronics Sherpa Team

**November 2010**

## Table of Contents

## 1. INTRODUCTION

"*Semiconductors are for the digital society what grain was for the agrarian society and iron & steel were for the Industrial society*." Shanghai Museum for Urban Development 2004

In all aspects of our connected lives, from the digital world to the green economy, micro and nanoelectronics act as the building blocks of products and services, which perform breakthrough functions in the home, in the office and in society in general**.** The complex technology behind micro and nanoelectronics and its incredible pace of innovation and development represents a key factor in the evolution of industrial competitiveness worldwide. Studies have shown the direct correlation between the rate of technological innovations and economic or GDP growth in nations (Zalewski and Skawinska, OECD and others). In Europe and at a worldwide level, micro/nanoelectronics provide the knowledge and technologies that generate some 10% of GDP. Through the R&D efforts of this industry, these tiny but incredibly powerful components have achieved a steady rate of innovation for decades, pushing the boundaries of what computing power can achieve at ever decreasing costs to the end user. Today, these components are integrated into virtually all domestic devices, such as cars, home appliances, smart-phones, computers, televisions, cameras. They have transformed virtually every sector of industry, be it automotive, ICT, medical or banking sectors. As a result, the micro/nanoelectronics industry is not just a strategically important growth and jobs engine in itself, with the European-based industry operating in a global market expected to reach the record $300bn mark in 2010, and employing a largely high-skilled workforce of over 110,000 directly and 500,000 indirectly ('induced') in Europe. In Europe the growth rate for 2010 is expected to reach 30% in 2010 in a European market valued at €21bn ($30bn). In addition it represents an enabling engine which facilitates innovation in almost every other type of industry.

Due to the ubiquitous nature of micro/nanoelectronics products and the industries role as an enabling engine for other industries, it plays a unique role in bridging the gap between what is currently technically feasible and what is needed to create the products and solutions that will address society grand challenges now and into the future. It is therefore fair to say that strong progress in the micro and nanoelectronics industry is essential in order to make these vital new products and services accessible, affordable, manageable, simple, relevant, applicable and feasible for society in general.

In terms of manufacturing these products we are fortunate within Europe to have developed four main micro/nanoelectronics clusters. They are in Dresden, Grenoble, Eindhoven/Nij/Leuven, and Ireland (Dublin). In addition several further smaller locations with micro/ nanoelectronics expertise exist such as Villach, Catania, Agrate, Regensburg, Erlangen, and Munich. In these geographic regions there is still a widespread existence of front-end, some back-end and numerous R&D locations but many of these locations are not yet producing at the current industry standard level of 300 mm for More Moore and 200mm for More than Moore companies.

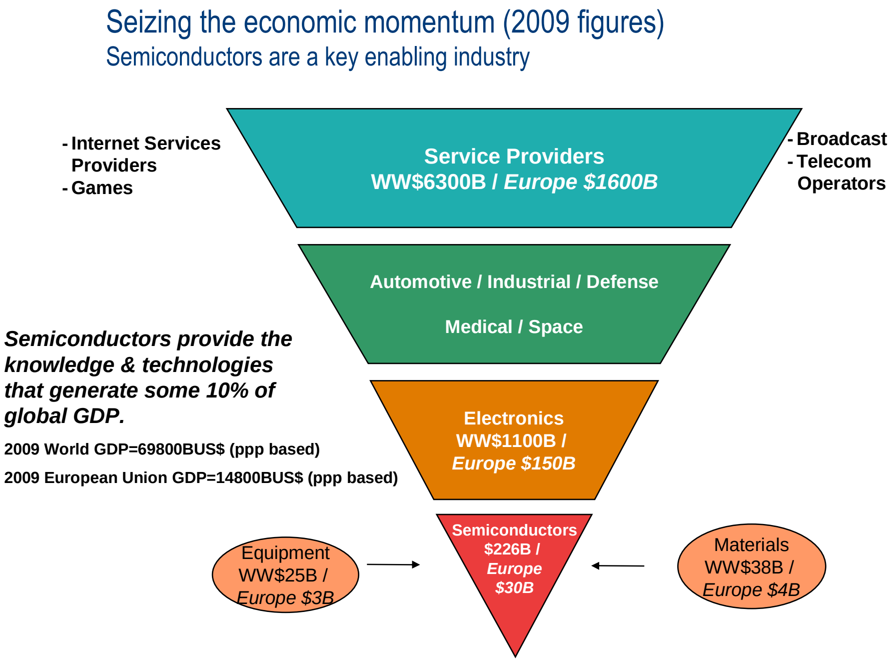
Total Front End Locations in Europe by number of companies, status 2005.
(Total = 52 company manufacturing sites.[5])

SOURCE: ESIA MEMBERS; PUBLICLY AVAILABLE INFORMATION

## 2. SCOPE OF THE THEMATIC AREA

The primary focus of this report is on the semiconductor value chain as a networked model from material, through process & product design and research to end product.

This includes applications-oriented research (research centres), design (design houses & IP providers), equipment and materials, Electronic Design Automation (EDA), manufacturing (IDMs, Fabless, foundries, back-end packaging, mask and testing houses). Widening the focus a bit further we find the broader semiconductor ecosystem including Education (promoting sciences), academia, and scientific institutions focused more on fundamental research. In total from the inverted pyramid model below we see that the semiconductor industry is a driver of massive economic activity in Europe and the world.




## 2.1 Scope (Borders and Complementarities)

### 2.1.1 Borders

For the purposes of this report we excluded from this analysis areas such as electronic systems, service providers and end consumer.

### 2.1.2 Complementarities

Several complementarities or overlaps existed with other KETs. Generally, the interaction between micro/ nanoelectronics and the other KETs can be seen from various aspects from a demand or a supply perspective. Several KETs working in close coordination will often be required to meet some societal needs. We see the following overlapping areas:

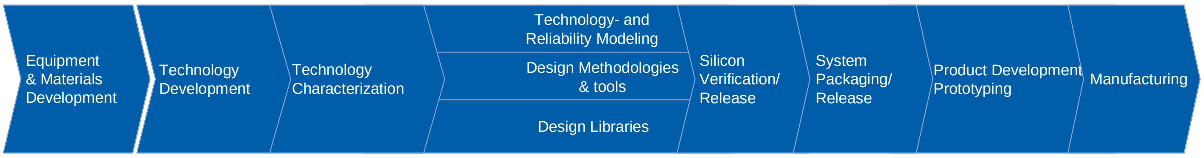
- Photonics: technology overlap. Same physics with different technical pre-requisites and different technical challenges (e.g. no miniaturisation issue in photovoltaics but they do exist in some other photonics e.g. modules for fibre-optics). Both deal with transformation of energy. Equipment and materials provide an overlap. Photovoltaics would not work without power electronics.
- Nanotechnology: Apart from dimension, there is no significant overlap. In contrast to nanotechnology, which uses the phenomena of materials at the nanometric scale, where properties differ significantly from those at a larger scale, semiconductor manufacturing does not create nano-materials, but fixed patterns at the nanometric level on silicon wafers (ESIA Jan. 2010)
- Advanced materials: Some overlap exists in terms of supply side access to advanced materials. There is a dependency on advanced materials with common development and advanced materials are a driving force of innovation for micro/nanoelectronics through miniaturisation.
- Advanced manufacturing systems: Micro/nanoelectronics KETs require the presence

of advanced manufacturing systems to be effective. There is an overlap in terms of supply-side access to manufacturing processes. Materials and equipment are the suppliers of micro/nanoelectronics in the industry value chain. Advanced manufacturing is involved in the specific development of semiconductor manufacturing processes (e.g. thin-wafer and/or bigger wafers at 450mm level). Advanced manufacturing systems and equipment foster innovation and disruptive new processes; e. g EUV. Manufacturing science & automation are important for quality, cost and cycle time.

- Biotech: We did identify an overlap, but electronics uses some devices containing biological material such as the concept of a ‘Lab-on-chip’. As such it is part of the supply side. The biotech and micro/ nanoelectronics industry do have a trait in common though as they are both industries with perhaps the two highest levels of R&D intensity.

## 2.2 Micro/Nanoelectronics Industry Value Chain

In this section we will outline the generic elements of the micro/nanoelectronics’ industry value chain and give some examples of the value chain in reality.



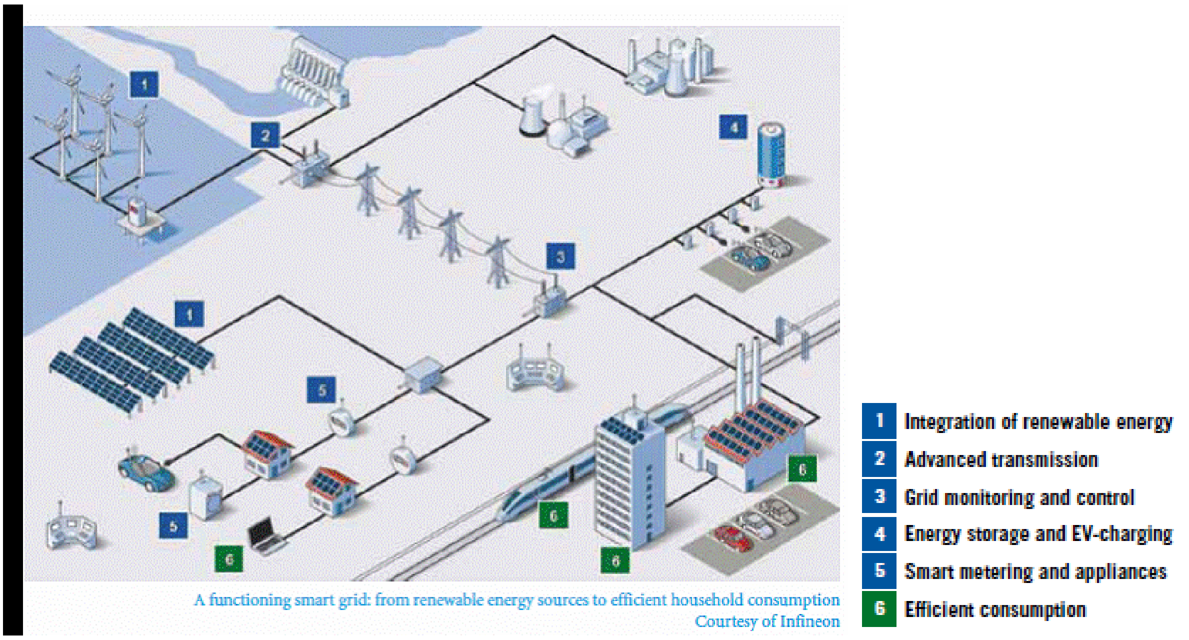

Micro/nanoelectronics will be of crucial importance in addressing the societal challenges which face modern society. We will discuss these in greater depth in a following section. The industry is a key enabler in the overall value chain of innovative solutions to answer these challenges and also to deliver the economic growth related to these challenges. These emerging solutions will foster the competiveness of the industrial sectors where Europe already has a leading position, such as automotive, telecommunication, and renewable energy. The semiconductor industry has always been a driving force for innovation in Europe’s key industries such as telecommunications, medicine, aerospace and the automotive sector. Nowadays, the percentage of microelectronics components in services and usages systems is growing but its ability to enhance innovative solutions is also growing exponentially.

Let s look at some examples.

A current area of high focus is the **energy sector**. Following the Copenhagen scenario adopted by European Commission, and as explained by the International Energy Agency (World Energy Outlook 2009), in the next decades our energy needs will double but the climate requirement is to half our level of consumption. At the same time most energy usages are switching to electricity (such as transportation, heating, cooling). This scenario cannot be achieved without energy efficient electronics and semiconductor based renewable energy.

*For example, consumers typically know very little about their own consumption patterns, while suppliers know little about the status of the electricity grids. This is because that information doesn’t become available until after electricity has been consumed. Through the* *application of smart grids and smart meter technology, consumption patterns in a near to real time can be identified, allowing consumers to make real time power saving decisions.*

The energy sector will require innovation in renewable energy sources and in more efficient energy management, through intelligent renewable energy sources, smart grids, smart buildings, empowered energy consumers and progressive thinking in utilities (e.g. lighting will require low consumption lamps and LEDs devices can drive up to 70% energy efficiencies).



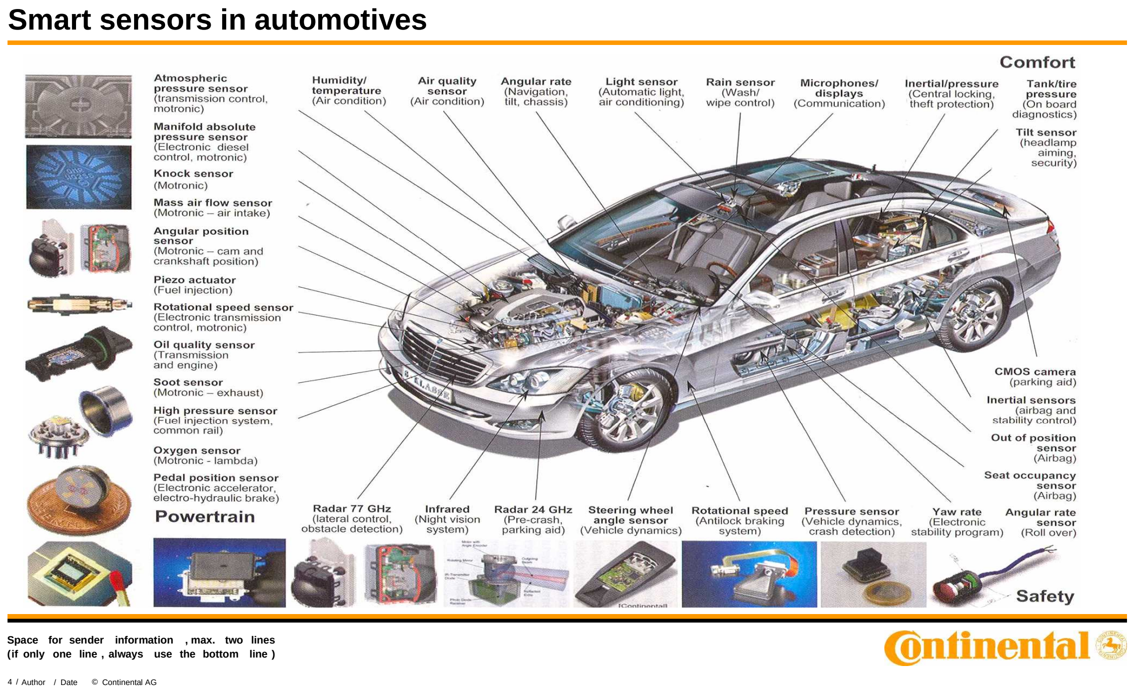

A functioning smart grid: from renewable energy sources to efficient household consumption
Courtesy of Infineon

Let s look in a little more detail at the example of the Smart Grid. The Smart Grid application will require power electronics, smart sensors and data communication for energy management. Many semiconductor products will play key roles in the current evolution of smart grid technology, such as power management, wireless, microcontrollers, digital signal, multimedia and embedded processors and sensors. They are essential in 'connecting the dots' of the smart grids. The movement from traditional passive electricity networks into smart grids marks a fundamental shift in how Europe and the world supplies and manages its electrical energy resources. The first step in making an intelligent /smart grid system to bring real benefits and choice to the consumer is typically through the installation of smart electricity meters. Smart meters function in a two way flow unlike the traditional one way direction flow, allowing a consumer to manage energy more efficiently and to make informed choices about how much energy to use. One study looking at 15 EU countries showed that if smart meters were installed on a voluntary basis they would save some 200 terawatt hours per month by 2020 – the residential consumption of Spain and Germany – and approximately 100m tons of $CO_2$ emissions. Semiconductors will enable society to use alternative energy sources more effectively, distribute them more efficiently and consume them in the most efficient and user friendly way - they are a key enabling part of the smart grid programmes that many countries in Europe are launching.

Another example is the **transportation sector** which is a key sector for energy challenges. Europe already has a leading position in this sector and can have great ambitions to be a home to world class equipment and system manufacturers. Europe can leverage its automotive micro and nanoelectronics sector to increase its competitiveness. This sector is currently in a period of rapid evolution and technological advancement with initiatives such as electrical or hybrid cars, smart roads where cars interact with their surroundings., and in-vehicle entertainment, Electronics are contributing significantly to bringing innovative solutions to these applications. In the automotive component and power module market alone, demand is expected to increase twenty-fold over the next decade, giving the market a value of over $5 billion in 2020.

By way of example, the figure shown below illustrates the variety and preponderance of electronic components now present in a modern car. This diagram shows only the sensors found in a modern vehicle; but the sensors themselves need a number of additional microprocessors to control them, turning a modern car into a mobile computer network. These components cover various applications, linked to transmission**,** safety and comfort. With the arising generation of hybrid and electric cars, the demand for components will grow in a critical way as they will be at the heart of the functional and operational driving system. Indeed, while the electronic content of today's car already reaches some 20% it is estimated that that figure will rise to 35% in the near future, especially in the context of developments towards the electric car. Europe can rely on its micro/nanoelectronics sector to strengthen competitiveness… and provide solutions which will need needed to overcome the barriers to allow the electric car to rule this century.

Power converters and controller devices help to supply and manage energy in a very effective way, through higher supply voltage to drive more electrical power with less ohmic losses, efficient power converters, advanced power devices on semiconductor compounds (GaN, SiC, etc). Sensors, MEMS, RF devices and microprocessors will contribute to the availability of more information and communication for safety control in a 'smart road' concept.




Another example is the European telecom sector. Again Europe has a leading position in this sector consolidated by the GSM revolution. Moreover, this sector is going through a period of rapid evolution to an always connected ‘broadband society’. Change today is driven by usage thanks to the opportunities offered by an endless innovative technology and product cost reduction. In our modern connected world, society is demanding more digital products, services and utilities and ubiquitous access to all types of media, data, audio or video is becoming a reality. In the pursuit of ideal communication and multimedia services, the key evolution which may dominate is the continuation path towards convergence between fixed and mobile networks. The applications and advances required to deliver these services are increasing in areas such data input, storage, cloud computing, e-health, consumer communication, control and management, decision making, safety, and security to name but a few. The emergence of broadband services is made possible by the digitalization of all aspects of communication combined with new technologies of transmission. The universal access to high-speed broadband will be totally enabled by the development and use of more complex and better performing semiconductor components and again this sector is going through a period of rapid evolution. New semiconductor devices such as high bandwidth RF devices, displays, CMOS imagers, enable technical breakthrough in the development of these new services.

Moreover to these general trends, semiconductor-based products are linked in different ways to this increasing integration of transistors and the growing complexity of components. On the one hand, market forces demand fast-paced improvements in integration for use in computer memory, processors (for computers, graphics cards, servers or mobile data terminals) and most of the specific integrated circuits, and therefore economically justify the pursuit of Moore's Law to avoid the creation of a digital divide.

On the other hand, analogue components, and even sensors have crucial applications in electronic products, enabling price reductions for the corresponding final products. For example, microsystems have led to the integration of sensors in electronics - the same sensors are found in car airbags and the Nintendo Wii and Radiofrequency components or imagers have revolutionised photography and mobile phone usage.

Two other societal challenges will benefit from the semiconductor industry's evolution and the emergence of a digitally connected society:

- the health and aging society : The **medical sector** will benefit from the emergence of digital services. For example, remote health care monitoring allows citizens to age longer at home and avoid hospital overcrowding. In addition, semiconductor technology will be a nest for biotechnology and innovative solutions, for example Biochips have allowed medical diagnostics to be re-thought, to allow for things like early detection of bird flu. ICT based therapy for mental health management improves healthcare productivity and access to care as it provides therapy with 80% savings in therapist time compared to conventional therapy
- **Safety and security** : for example : Security Chips, as used in electronic (travel) documents, ensure that data cannot be manipulated and that privacy is guaranteed

We understand our role in the European economic value chain much in the same way as the European Commission expressed in its Communication of September 2009; i.e.
"*A significant part of the goods and services that will be available in the market in 2020 are as yet unknown, but the main driving force behind their development will be the deployment of key enabling technologies (KETs). Those nations and regions mastering these technologies will be at the forefront of managing the shift to a low carbon, knowledge-based economy, which is a precondition for ensuring welfare, prosperity and security of its citizens. Hence the deployment of KETs in the EU is not only of strategic importance but is indispensable" (EU Commission Kets Communication Sept. 2009)*

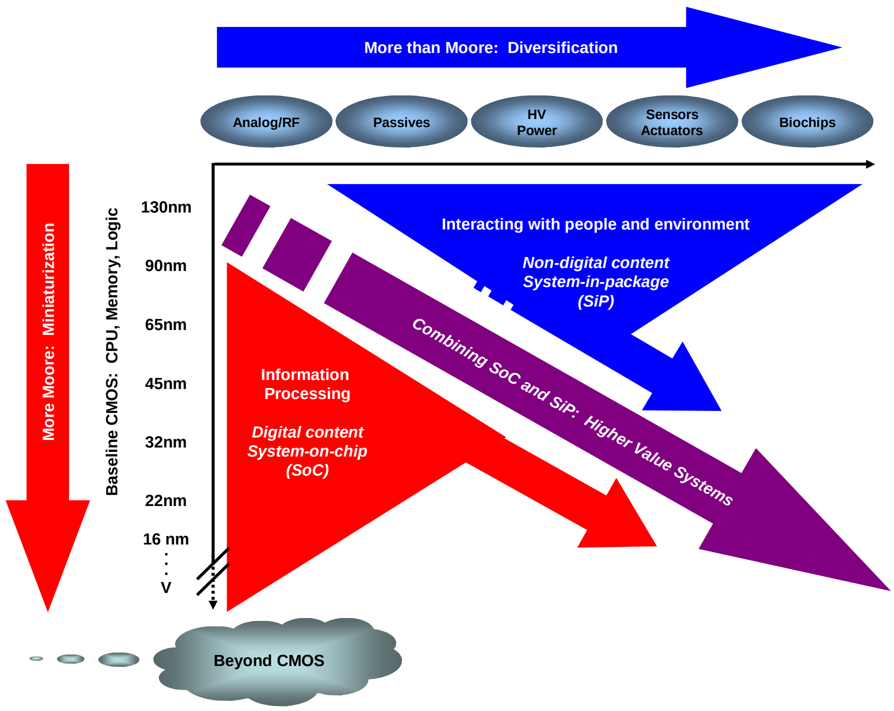
It is crucial to European industry that the ability to innovate and manufacture semiconductors remains located in Europe, in order to guarantee independent access to this vital source of innovation and be able to best address Europe's societal challenges in and for Europe. This was the conclusion recently declared by former Commission Vice President Guenther Verheugen, who described the semiconductor industry as a priority, and as critical to **keeping European industry strong and competitive**

## 3. DESCRIPTION OF MICRO/NANOELECTRONICS INDUSTRY

### 3.1 Definition of Micro/Nanoelectronics industry

So what types of activities are we referring to when we talk of the micro/ nanoelectronics industry? Well, the nature of the micro/nanoelectronics industry is such that everyone reading these words has probably benefited from the service of a broad range of semiconductors with in the last hour. Whether you have used a laptop or tablet computer at home or in the office, made a mobile phone call, taken a digital photo, watched TV, used any form of transport, been treated in hospital or engaged in just about any other modern societal activity – you can be sure that semiconductors have been involved. The semiconductor and the products and services that they enable have become a vital cog in the modern connected world.

The micro/nanoelectronics industry can be defined as having two distinct sub-categories. These are broken down as ‘More Moore’ and ‘More than Moore’. This naming convention comes from the work of Intel co-founder Gordon E. Moore, who in 1965 described a trend that noted that number of components in integrated circuits had doubled every year from the invention of the integrated circuit in 1958 until 1965 and predicted the number of transistors on a chip would double every 18 to 24 months. This observation became known as ‘Moore’s law’.This forecast of the pace of silicon technology was more than just a prediction. Essentially, it described the basic business model for the semiconductor industry.




The industry segment referred to as ‘More Moore’ is defined by its focus on the continued shrinking of physical feature sizes of the digital functionalities (logic and memory storage) in order to improve density (cost per function reduction) and performance (speed, power) and decreasing costs (increased yields, bigger wafers). This more-Moore technology accounts for a large share of the global semiconductor market. Today's most advanced semiconductor in mass production are based on 32 nm technology process and this allows the integration in few square centimeters of several hundred millions of transistors which facilitate millions of different functions to meet the needs of modern computing power. In certain companies advanced development are already in progress at diameters of 22nm width.

The industry segment known as 'More-than-Moore' refers to the incorporation into devices of functionalities that do not necessarily scale according to 'Moore Law', but provide additional value in different ways. The 'more-than-Moore' approach allows a greater variety of semiconductor devices to be combined on the same chip in so-called SoCs (System-on-chip) or in the same package using so-called SiPs (System-in-Package). This concept, involves a lot of other devices on top of the pure miniaturisation (CMOS) process, such as analog/radio frequency, passives, high voltage power, sensors, biochips and MEMS (Micro-Electro-Mechanical systems) components. These devices are processed and embedded in the chip/package instead of being added at systems level. This improves system integration and opens new applications fields. Interacting with people and the environment and powering the system are a main element of more-than-Moore.

Advances in both industry segments do not come cheaply, and cooperation and consolidations will be required to offset the exponentially increasing costs of the design, technology development and manufacturing. Further changes will also happen as businesses increasingly focus on their core capabilities and their product and services portfolio in response to international need. In view of this evolution, the electronics systems value chain has changed and diversified substantially. The traditional Integrated Device Manufacturers (IDM) keeps the whole Integrated Circuit (IC) value chain 'in-house'. This model is now complemented by the growing importance of foundry services (specialized manufacturing services mainly for standard CMOS) on one side, and of so-called fabless companies on the other, with different degrees of so-called fablite strategies in between; and by the availability of sophisticated Intellectual Property (IP) and know-how providers throughout the design cycle itself.

### 3.2 Description of the Semiconductor Industry

Whether in Europe or elsewhere in the world, the following characteristics are shared by actors in the semiconductor industry, and many are common among the KETs:

- Key enabling function for other industries
- Very high, continuous R&D intensity (up to 20% of annual revenues)
- Very high capital intensity (up to 25% of annual revenues)
- Strong creation and diffusion of innovation

- Truly global footprint from product creation to commerce competing in an ITA tariff-free global environment
- Vital role of Government support
- Cyclical market evolution with high volatility
- More than proportional need for highly skilled personnel
- Production with very high environmental sensitivity and diligence
- Significantly strong market presence for local applications development
- High value added for leading global end-user OEM manufacturers.

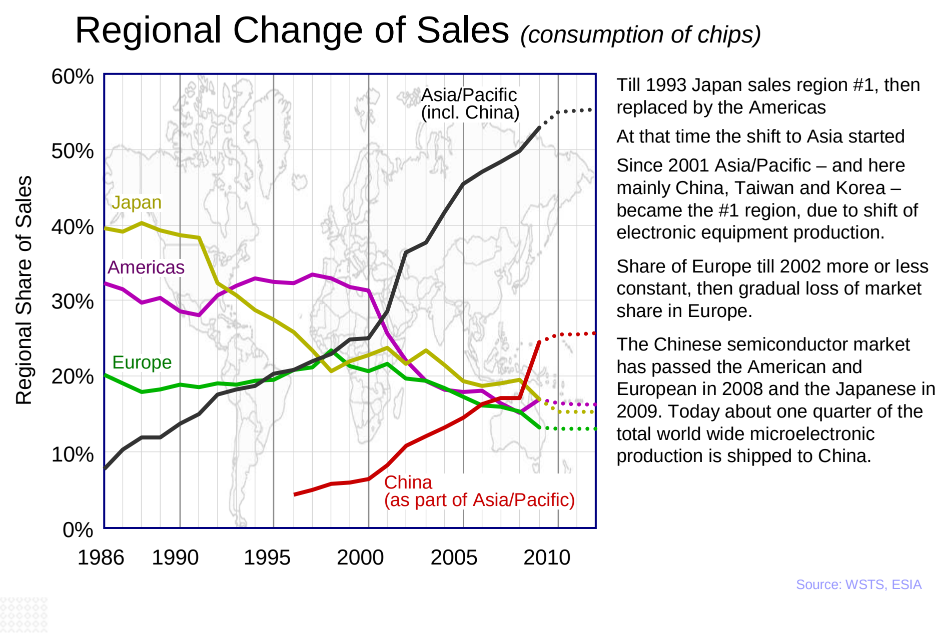
Semiconductors are the second most R&D intensive industry sector in Europe (with on average 18% of turnover being reinvested in R&D) and 3rd worldwide. Value-add based on R&D continues to be one of Europe's major assets. Systems architecture & design, software, testing & simulation, multichip solutions and some IP blocks are all research & technology domains where Europe is in a strong position. As a final note, regarding commercialisation, Europe is particularly strong in analogue, strong in telecom design, eroding in advanced CMOS.

## 3.3 Analysis of the situation world-wide and in the EU

At a research and applied research level, Europe is well represented along all main technology developments through institutes such as LETI, Fraunhofer, and IMEC and with PPPs becoming more widely used. In both the industry segments described above Europe has a leadership position. In 'More-than-Moore' (SiP) and heterogeneous integration, Europe is leading, and in 'More Moore' (SoC), Europe still at a state of the art level. As previously stated four main clusters and a few other smaller clusters exist in Europe. These clusters have organically developed a good working ecosystem around them and are therefore in a good position to foster cooperation between industry, research and academia that can lead to positive spill-over effects.

### 3.3.1 Worldwide Ranking

**In terms of market development, i.e. consumption of semiconductors, the European market is growing at an increasingly slower pace than the rest of the world. Europe is also a net importer of semiconductors.**

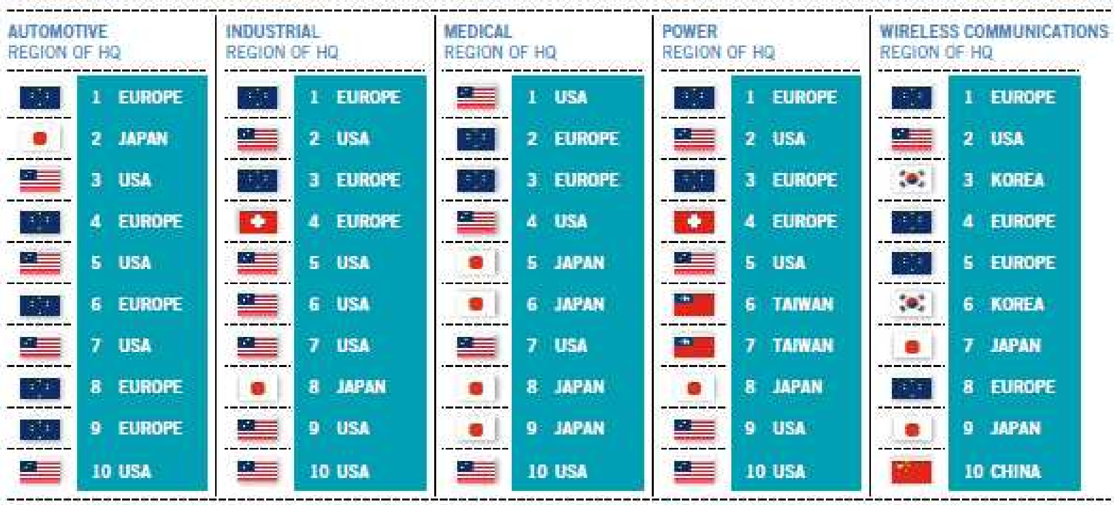



The 2009 global top 20 semiconductor companies contained 3 EU companies. In some specific domains Europe is leading such as:

- Automotive - 3 in top 6,
- Industrial - 3 in top 5,
- Medical -2 in the top 5,
- Smart cards 3 in top 5

As you can see from the chart below, there is a strong correlation between the strengths of the semiconductor industry in Europe and those of their customers in the various application areas:

Fig. 10 - Electronics system OEM rankings



| | AUTOMOTIVE REGION OF HQ | INDUSTRIAL REGION OF HQ | MEDICAL REGION OF HQ | POWER REGION OF HQ | WIRELESS COMMUNICATIONS REGION OF HQ |
|---|---|---|---|---|---|
| 1 | EUROPE | EUROPE | USA | EUROPE | EUROPE |
| 2 | JAPAN | USA | EUROPE | USA | USA |
| 3 | USA | EUROPE | EUROPE | EUROPE | KOREA |
| 4 | EUROPE | EUROPE | USA | EUROPE | EUROPE |
| 5 | USA | USA | JAPAN | USA | EUROPE |
| 6 | EUROPE | USA | JAPAN | TAIWAN | KOREA |
| 7 | USA | USA | USA | TAIWAN | JAPAN |
| 8 | EUROPE | JAPAN | JAPAN | JAPAN | EUROPE |
| 9 | EUROPE | USA | JAPAN | USA | JAPAN |
| 10 | USA | USA | USA | USA | CHINA |

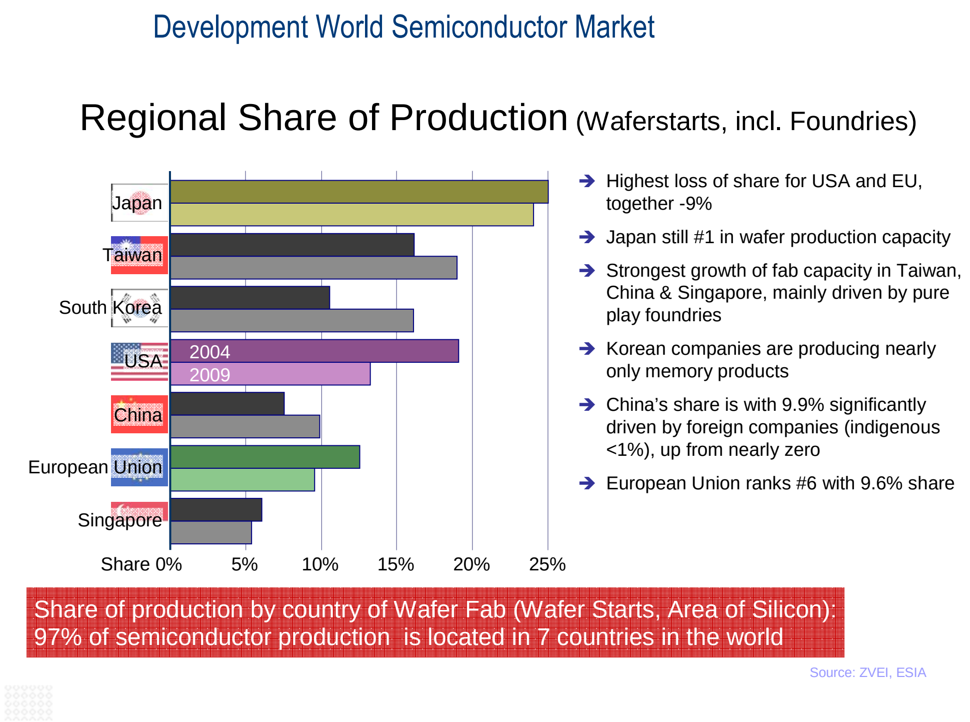
SOURCE: ISUPPLI 2008

In addition Europe has a market leadership in lithography and user market strengths and leadership in Automotive (Bosch, Conti), medical (Siemens, Philips), smart cards (Gemalto, G&D, Oberthur), wireless (Nokia) in terms of ranking

However amongst the 1300 fabless companies worldwide, only 12% are in Europe, 4% in Israel, 46% in US, 38% in Asia. Within this subset, the top 10 fabless companies represent 57% of total revenue (2007 figures).

### 3.2.2 Other factors

- **Ability to attract FDI for investment in Europe.** Until the major changes to the EU state aid framework in 2004, there was some significant global investment in Europe. However since then investment levels have declined drastically and existing manufacturing investments are being pulled back, with a few exceptions.
- **Market consumption/size/forecasts** (10 year time frame): In relative terms European semiconductor market consumption shows decline, showing OEM weakness and lack of new market development.
- **System design**: (10 year time frame) is more resilience and relatively stable (some 25%). ‘Designed in Europe – made in Asia.’
- **Fab/ production capacity**: Current analysis of worldwide production capacity shows Europe fluctuating at around 10% of global fab capacity, down from some 14% some years ago and losing ground on deployment of 300mm technology and future technologies. In terms of capital investment there has been a 5% decline in the past few years.




- **Extent of supporting sustainable industrial structure:** Capital investment in European semiconductor manufacturing at risk as framework conditions not as attractive as other competing regions

## 3.3 Current global & EU economic importance

### 3.3.1 Economic importance (including employment)

We have seen from the inverted pyramid model in the introduction that the micro/nanoelectronics industry is calculated to enable approximately 10% of European and global GDP. This is due to the widespread application of its products in key markets. The industry is acknowledged as an innovation engine and as being central for innovation for downstream industry. In many ways it is a bellwether for the global economy. Over the last 40 years it has been a high growth sector and continuing to rise with a net worth of $226bn worldwide.

## The semiconductor market in 2009

- Total worldwide market value 2009: $ 226bn (€ 162bn). Total European market value 2009: $ 30bn (€ 21bn)
- Percentage of worldwide market in 2009: Europe 13% / Americas 17% / Japan 17% / Asia Pacific 52%

The different semiconductor market mix in Europe, 2009
SOURCE WSTS

| EUROPE | | WORLD |
|---|---|---|
| 1% | **GOVERNMENT** and military purchases | 1% |
| 8.5% | **CONSUMER** entertainment, radio, TV, VCR, personal or home appliance, camera, games, etc. | 19% |
| 20% | **AUTOMOTIVE** powertrain, safety management, body and convenience, engine controls, entertainment | 7% |
| 33% | **COMPUTER & OFFICE** mainframe, peripheral office equipment and personal computers | 42% |
| 16.5% | **INDUSTRIAL & INSTRUMENT** lab, test, control and measurement | 9% |
| 21% | **COMMUNICATIONS** wired and wireless, mobile, RF connctivity solution (Bluetooth, GPRS...), telecommunications, traditional telecom equipment, home networking equipment | 22% |

The different semiconductor market mix in the world, 2009
SOURCE WSTS

The industries employment levels are relatively stable in Europe with over 200,000 directly employed between IC producers and equipment and material suppliers. Generally, the semiconductor industry is a medium sized industry for employment and is characterized by a highly skilled workforce mainly from an engineering background. There is a high knock-effect in terms of 'induced' employment and a strong emphasis on STEM (Science Technology, Engineering, Maths) skills background of employees.

3.3.2 Inter-linkages and spill-overs with other sectors

- To customers. As enabling industry the applications-base for semiconductors is naturally broad, and divided into 6 applications segments. In terms of market, Europe has shares in all segments either below or above worldwide average; e.g. the European market for chips is particularly strong in communications, automotive and industrial, while remaining weak in consumer and computer & office.
- Increasingly, part of the changing s/c landscape is the 'blurring boundaries between s/c players & OEMs' in the research area.
- Pervasiveness of s/c in new applications and new domains continues to increase.
- Micro/Nanoelectronics is part of the electronic components group

### 3.4 Obstacles & drivers in Europe at MS level (financing, regulatory issues, public perception of security & safety concerns, incentives etc

#### 3.4.1 Obstacles

- Weak pan-European approach to R&D. Also the delay in the approval mechanisms from idea to financing for R&D projects restricts innovation. State aid R&D eligibility criteria are laid out differently in Europe, placing global industries with high levels of application-R&D and short product cycles in Europe at a disadvantage.
- State aid regime laws which are intended to ensure a level playing field only within Europe but not compared to other regions are placing restrictions on large production investments. This places global industries in Europe at a disadvantage because of our inability to compete in terms of incentives. For larger investments the decal age mechanism - meaning that the more is invested the less intensive is the support - acts as an incentive to invest outside Europe.
- Market development. The main customer base for emerging markets is not in Europe. No common EU priorities exist for market pull public initiatives, and lack of initiative to implement and effectively use European scale in areas such as public transport, smart grid, and public lighting.
- Lack of coherent industrial innovation policy (R&D, Market push, production, education)
- Financing of SMEs through venture capital; e.g. in capital-intensive activities.
- Talent. There is a need for more electro-technical engineer pool in Europe for chip designing, as well as a lack of female engineers and not sufficient focus on microelectronics at education levels.

#### 3.4.2 Drivers:

- Some strong application areas (e.g. automotive, security)
- Some strong and broad ecosystems & research capacities
- Strong tradition of cooperation with downstream industry, especially in R&D

## 4. CONTRIBUTION OF MICRO/NANOELECTRONICS IN TACKLING GRAND SOCIETAL CHALLENGES

### 4.1 Grand challenges

Semiconductors can bridge help the gap between what is currently technically feasible and aspirational needs and challenges of modern society. To make new products and services to solve these challenges, and to do so at a price that is affordable for the population at large, strong progress in nanoelectronics in terms of costs and integration is necessary. The Micro and nanoelectronics industry has risen to this challenge and contributes to the various grand challenges by making digital products and services accessible, affordable, manageable, simple, relevant, applicable, and feasible.

Industry and academia have defined how to address major challenges in several fields and there is a consensus on the grand challenges that micro/nanoelectronics can address. It now turns to the public authorities (EU and Member States) to decide on priorities, and implement these through effective and appropriate measures & tools in the areas of R&D, market pull, production and education under the umbrella of a European industrial innovation policy. Here are some examples of the grand societal challenges and how micro/nanoelectronics products can help address them:

1. **Health & aging society** (for example, devices that facilitate home health care thereby allowing citizens to age with dignity in their homes, avoiding hospital overcrowding by managing chronic health conditions remotely)

2. E**nergy security and efficiency** (for example, sustainable, clean and efficient energy generation; distribution and management through the implementation of a technology enabled smart electric grid and smart metering for more efficient energy management in the home). Microelectronics devices as ‘green electronics’, low power devices, power controller, control microprocessors, communication devices will bring key solutions to automate, monitor and control operations and accelerate the integration of and synergy between renewable energy sources and utilities. Semiconductors will enable society to use alternative energy sources more effectively, distribute them more efficiently and consume them in the most efficient and user friendly way - they are a key enabling part of the smart grid programmes that many countries in Europe are launching.

3. **Sustainable Transport** (for example, intelligent electric vehicle, cooperative traffic management, digitally enabled smart cars, improved efficiency in public transport provision through deployment of ICT).

4. **Safety and security** The shortage of raw materials has not become a general major problem yet, but as the list of basic elements rises and alternative materials are introduced, so also does the risk of scarcity; not only of the products themselves, but also through the banning of certain key products. As a region we need to ensure access to the raw materials for this vital supply chain by protecting against risks for instance of for rare earth materials. Example of how micro and nano-electronics help solve safety and security challenges are:, improved consumer and citizen security through secure digital standards and infrastructure; from hyper-encryption for secure communications, bio-metric screening, and other enabling trusted technologies to protect against identify theft, fraud and terrorist and cybercrime threats). *It should also be noted that as a vital strategic resource, Europe should protect its political and economic independence and retain security of semiconductor supply by ensuring that leading edge semiconductor production remains strong within its borders.*

5. **Climate Change.** The micro and nanoelectronics industry supports and drives climate change solutions either through their devices and services themselves or by providing a means to use and control other devices. While most other industries can only focus on reducing their own carbon footprint, the micro and nano industry has the ability to help. Within its on processes the industry itself has reduced our PFC emissions by 10% from the 1995 baseline, overshooting the Kyoto goal of 8% and reducing Electricity consumption by 37% in 2008. European industry can be central in ensuring that this goal is a global one through leadership in areas such as electric car development, solid state lighting and LEDs, CO2 reduction. *It should also be noted that while many other industries can only focus on reducing their own carbon footprint (and micro/nanoelectronics constantly works on this), the solutions provided by the micro/nanoelectronics industry can help other industries achieve reduction in their carbon footprint by means such as a substitution of some airline business travel with videoconferencing.*

6. **Employment/ Competitiveness/ Prosperity** *(*Studies have shown the direct correlation between the rate of technology deployment and economic or GDP growth. In addition the micro and nano electronics industry drives Europe employment and competitiveness by 1. enhancing productivity across multiple industries through its products, 2. directly employing over 200,000 people between IC companies and their supply chain in the equipment and material suppliers and and far more linked to the industries' presence in Europe, 3. fueling economic growth due to the capital intensive nature of the industry, 4. acting as a anchor tenant for clusters and fueling a leading edge research ecosystem in Europe and thereby, 5. sustaining leading edge advanced manufacturing in Europe because of the symbiotic relationship between leading edge research and advanced manufacturing.

7. **Globalisation.** Finding paths to a sustainable development is a global challenge. Innovation & knowledge are the pivotal requirements of the next decades. The Micro and nano-electronic industry is one of the most globalized industries worldwide. The challenge is to set a framework to achieve a global level playing field. While for market we enjoy and support open and fair market conditions (tariff & duty free); for research & innovation is in some domains already a key asset and is key to regain competitiveness; for manufacturing & investment framework conditions are better outside Europe. Since the semi-conductor industry is global, European companies strive for global leadership not national championship (leadership in the case in application sectors like automotive, industry, security and on the equipment side in areas such as lithography and materials & substrate). For computing, analogue consumer weak, partly communication difficult trend

### 4.3 Market Pull Measures

4.3.1

Microelectronics plays a unique role up-stream to stimulate a Europe-led market pull for new applications and solutions paving the way to emerging markets. Innovative semiconductor systems provide the know-how for these new applications. There remains a need to bring the applications and the enabling technology industries together. The respective agendas risk being disconnected. Market pull is an essential means to bring them together. Without a clear market pull the semiconductor industry alone can push the market; however this is like pushing a rope. It also needs a market pull. This can be achieved through regulation and pre-commercial procurement, and the KET initiative offers an opening for this. Areas include sustainable energy, energy efficiency, smart grids & e-metering, health care, electro mobility, e-cars etc – aiming to creat a similar effect as the GSM in the past. Semiconductors can bridge the rift between the technically feasible and the needs of the modern society.

4.3.2 Public procurement, including pre-commercial public procurement.

Public procurement to be used as means to promote industrial innovation in Europe. Lighting projects, traffic monitoring systems, health products, ambient living, high quality smartcards, buildings.

4.3.3 Standards-related issues

Helps promote scale and reduce waste and promote interoperability and compatibility. These are regulatory framework conditions that secrure an EU wide single market. Also includes e.g. phase-in / phase-out periods for broadband, safety requirements (e.g. tire pressure monitoring), security (e.g. data, banking cards), phase-out regulation of inefficient products. Market-driven standards, but also needing norms to stimulate innovation.

Norms: Security standards for Smart Grids/Metering, standardization of electrical systems supporting evolution of market, energy efficiency indicators e.g fridges energy star for white goods, 4G LTE,

4.3.4 Identification of scope for closer collaboration between different EU policies and programmes, as well as MS tech. strategies.

- -Comparisons between MS priorities in Germany, France and UK all include micro/nano-electronics. Probably similar in Ireland, Austria, Portugal, Netherlands
- WTO related
- Existing market pull policies, including a comparison of EU and third country policies (as far as possible) and industry diffusion. Commission to provide. E.g ‘Abwrackprämie’, power prices for photovoltaic also benefiting s/c

4.3.5 Global benchmarking (international policy concerning trade, regulatory, development, security issues, etc). Markets should be global, trade should be open, free and fair. ITA and improvement of in terms of tariff-free trade and removal of NTBs. Any policy benefiting our customers would also benefit us provided it is open, free and fair.

## 5. SWOT ANALYSIS FOR THE MICRO AND NANO-ELECTRONICS INDUSTRY IN THE EU

### 5.1 Strengths:

1. Industrial Base. The **presence** in the EU of leaders in the top ten of most major semiconductor sectors: automotive, industry, security, power and wireless communication, medical (Auberton, Malier, SEMI, ESIA). Europe can build on its still **strong existing industrial base**, world leading equipment suppliers, some world class advanced manufacturing facilities with highly skilled and experienced employees. Complementary smaller, non-advanced CMOS manufacturing already exists for dedicated products (ESIA 2008 54)
2. Clusters. The EU still has a number of successful **clusters** (e.g. Dresden, Grenoble, Dublin, Eindhoven, and other EU locations) which have developed an efficient ecosystem resulting in cooperation, synergies, joint education programmes, and centres of excellence in Research and Advanced Manufacturing (Auberton OpD). These clusters positively impact the full European value chain driving GDP growth, employment, inward investment and reinvestment, innovation (strong IP portfolio), and raising standards of living.
3. Industry Leadership. Global leadership in **More than Moore** technologies and applications (VMS), with the presence in Europe of the complete value chain up to the system (Lakner OpD). Leading competence in analogue and mixed signal technologies, systems and IP. Market leaders in equipment and material, such as lithography, SOI and deposition technologies (VMS). Existence of strong semi-conductor manufacturing capability in France, Germany, Ireland, Austria, Netherlands and Italy.
4. R&D Network. Existing strong and efficient **network of R&D** capability and capacity in industry, institutes and academia (VMS)
5. Education and Innovation. Strong **innovative expertise** with over 135,000 patents filed in 2009. More than 10 European universities in the global top-50 and a high number of PhD’s in process development & design.
6. Adaptability. **Flexibility and agility** of semiconductor sector to adapt to fast-moving environment. For example the microelectronic actors moved quickly to provide solutions in the energy market (Auberton OpD)

### 5.2 Weaknesses:

1. Lack of Strategy. Insufficient alignment of member states on a European semiconductor strategy (VMS). **Limited strategic approach** to deployment of semiconductor solutions for societal challenges (VMS) Consumer electronics is the biggest share of the SC market, but almost completely in Asia.(S/C Sherpa) & low European presence (10%) (Auberton OpD) Lacking of European level clear prioritisation of grand challenges and lead markets (ESIA)
2. Lack of European industry policy. Europe is a net importer of semi-conductor chips (a vital strategic resource), with decreasing share of global semiconductor market. **Inadequate economical framework** conditions (VMS). Missing industrial innovation policy (ESIA 2008). No Cluster Policy at European level in comparison to other regions in the world. Result is many small Clusters without critical mass. Stringent labour policies,

limited flexibility in employment conditions. Lack of single authority responsible for incentive packages in Europe.

3. Weak R&D supports. Semi-conductor industry spends 20% of annual revenue on R&D (€5bn pa in Europe) yet 60-70% of that **R&D is not eligible for funding** due to interpretation of the eligibility criteria. **40 % less patent** applications than USA or Japan (VMS). Lack of strong and efficient, harmonized IP laws.
4. Incentives policy: Incentives for European Union (EU) are limited by EU Structural Fund requirements which limit support based on economic need for a geographic region (Deloitte), leading to limited incentive possibilities in more developed and semi-conductor relevant areas of Western Europe. Issues with cross-border R&D funding.
5. Financial Eco-system: Lack of financial ecosystem and dedicated stock markets for high tech industries to enable SME’s to grow. **Inadequate venture capital** and spirit for commercialisation of inventions and R&D results. Lack of homogeneous tax credit system across Europe for R&D activities. Europe's ability to exploit opportunities to engage in advanced CMOS R&D hampered by complexity of different funding schemes & limited amounts of funding in comparison to required R&D effort (ESIA 2008 47)
6. Low Investment in Manufacturing Capability. Manufacturing capacity dropped by 25% from 2007-2005. 75% of global investments in semi-conductor manufacturing now taking place in Asia and USA. (Singapore, Malaysia, Taiwan, China incentivise investment using corporate tax exemptions i.e. pioneer status for 5-10 years). Insufficient focus on high-tech products within European manufacturing industry (VMS). An ecosystem of large-scale foundry & large scale assembly & testing service providers is absent in Europe (ESIA 2008 54).
7. Lack of Dedicated Educational facilities. Weak education in Manufacturing Sciences and Industrial Engineering Only few ICT dedicated faculties; technology hostile European public; shortage on well educated new talents (VMS).

### 5.3 Opportunities:

1. Develop New Markets. New markets can be created from the need to **focus on developing proprietary leading solutions** for European industry particularly in areas related to the grand societal challenges (e.g. in automotive, industry, security, healthcare) (VMS). For example the energy challenge on CO2 reduction cannot be achieved without energy efficient microelectronics and semiconductor based renewable energy and solutions such as lighting with LED, energy management with smart grids, transportation conversion, energy management with solar PV etc. (Auberton OpD). Build a rich ecosystem around software which controls product know-how. Exploit experiences in heterogeneous integration in the design & manufacturing of multi-chip solutions. Increased Industrial exploitation of new materials and corresponding equipment (VMS). Huge opportunity exists for EU components in tomorrow’s products (Brown OpD).
2. Clusters. Strengthen competitiveness by gathering the intelligence of the European industrial value chain to enable competitive final products. However we will need new European instruments to promote/stimulate European cross border (and cross cluster) collaboration (IMEC OpD). Fostering strategic semi-conductor innovation in application-focused clusters or centres of excellence supported by strategic R&D programmes (ESIA 2008 45). Clusters can act as source of Spin-off companies and an opportunity for SME's to grow (Auberton OpD)
3. R&D. Focus R&D on differentiation of devices with new proprietary features & incremental performance (ESIA 2008 43). Lab-Fab: common lines between R&D and

Industry to minimize innovation and prototype costs. Opportunity to remain at leading edge of advanced semi-conductor manufacturing by investing in 450mm process and equipment research.

4. Policy. Increased public procurement for stimulation of new markets (VMS). Creation and steering of Lead Markets by setting standards and regulations (e.g. GSM, PV FIT). Opportunity for European IP suppliers to be a part of ecosystem for specific application areas (ESIA 2008 56)
5. New Business Models. Emergence of new opportunities through powerful foundry sector (Global Foundries, Altis, LFoundry, XFab, Telefunken Semiconductors, etc)(Vatel OpD). These add new strength to EU semi-conductor manufacturing and associated R&D and allows a reversal of a multi-year trend of leading-edge semiconductor manufacturing moving off-shore. Opportunity for development of various models : IDMs, Fabless and Fablite, Foundries (both large and more specialised local foundries). Development of local testing capabilities.
6. Cross-Border Opportunities. European cross border funding to be made available to fund projects which bring together development/prototyping ventures with multiple companies would provide an advantage in particular for smaller nations who would not benefit from the critical mass of the larger member states.
7. Exploit Leadership Position. Europe's leadership position in some industries offers significant opportunities in specialised application areas such as Analog/mixed signal space, modular design approaches, system architectures & integration capabilities (ESIA 2008 39). Continue to leverage More than Moore world class leading position (VMS). Exploit the strong presence of chip manufacturing plants, system integrators, design centres, supply chain, equipment and material suppliers, metrology and test.(Auberton OdP). Exploit opportunities to engage in advanced CMOS R&D. Exploit experiences in heterogeneous integration in the design & manufacturing of multi-chip / multi-layer solutions which are in growing demand (ESIA 2008 42)
8. Innovation Targets. Implement a European 'man on the moon' type programme involving all KETs. Suggest leveraging European strength in Automotive and Security. Big goals to be set e.g. By 2020 achieve zero road fatalities across Europe, reduce congestion by 50%, CO2-neutral housing/buildings (Penning)

### 5.4 Threats:

1. Lack of a Global Level Playing Field. Persistence of the unfavourable European Framework conditions means that the semiconductor industry is less supported in Europe than in Asia and USA resulting in unfair competition for European semiconductor ecosystem (Auberton). With strong public support the most successful semiconductor companies have developed around strong Clusters (e.g. Albany in US, Singapore Asia) while there continues to be the lack of cluster policy in EU (Cluster OdP). European policy, anxious to guarantee internal non-competition, has discouraged organisations that wish to invest in Europe (Malier pp 21). Limits to funding allowed to manufacturing in EU, except by use of structural funds by smaller companies in poorer regions, has lead to gaps versus RoW. These need to be closed to keep up with state of the art technology (Auberton). Europe does not offer the variety of measures which are offered to companies which install production facilities in US or Asian or Middle East countries include fiscal measures, such as tax exemptions for companies and their workers, tax credits in R&D, and accelerated amortisation of investments, provision of land, regular financial aid for

equipment (including for production), fixed price guaranteed energy provision, attractive finance plans and aid in staff training (Malier pp21-24, Deloitte OpD, etc).

2. Lack of Policy Alignment. Fragmented regulatory framework prevents economy of scale exploitation (VMS). Examples: traffic toll; health care cards, tire pressure monitoring. EU regulation not aligned with the international practices from Competition : this legally constraint environment drives to low flexibility and low reactivity for a real competitiveness within a very volatile and competitive environment (clusters OpD) Only large Clusters, with critical mass and international competitiveness, can drive the overall European Semiconductor Ecosystem and the complete value chain
3. Prohibitive costs of IP Protection. A strong European R&D investment should be supported by a European-wide IP policy (Penning). Currently filing a patent is more expensive in Europe than in other regions. Also because there is no 'one' EU patent – need a common IP jurisdiction in Europe, currently very fragmented. Cost to move from the time that you file, 4-5 years – have to fees every year. Costly litigation fees – in each country in Europe.
4. Falling behind in R&D. Currently no EU 450mm programme while other regions around the world are already planning their next steps to move their research and advanced manufacturing capabilities to the larger wafer size (Intel OpD). Where R&D goes, manufacturing will follow. No durable innovation without Industry Manufacturing close to R&D (Auberton). Loss of major parts of technology and production expertise and as a consequence, risk of degradation in leading edge R&D (VMS). Today, some R&D domains, where a significant European added value is created and which guarantee the competitiveness of European semiconductor industry, are not eligible for adequate funding.
5. Lack of integrated Strategy. We will stay in a More than Moore top position only if we don't forget about the knowledge and access on/to MM technologies (Lakner OpD) In the long-term, no strong region without design and manufacturing. It is necessary to focus, but not blind selection into the value chain (Vatel OpD). In view of changing landscape, high dependence of IC foundries located in Asia can lead to strategic risk (ESIA 2008 50)
6. Loss of Competitiveness. Loss of competitiveness in production cost (labour, energy, imposed environmental conditions) (VMS).
7. Missing some Value Chain components. Lack of advanced CMOS wafer processing or full foundry assembly & testing ecosystem has negative impact on s/c suppliers (ESIA 2008 55). Semiconductor manufacturing leaving Europe will jeopardize the entire industrial ecosystem (SEMI) Excessive external equipment maintenance (contracts and spare parts) if no more suppliers in EU (SEMI)
8. Education Deficit. There is a threat of a loss of major parts of technology and production expertise and as a consequence, risk of degradation in leading edge R&D (VMS). Brain drain to other regions (VMS). Need for talent: sustainable provision of qualified personnel is key for competitiveness and innovation leadership (Ploss OpD). It is crucial that Europe undertake actions to prevent a shortage of electronics engineers & further decrease in numbers of Analog & systems design engineer graduates (ESIA 2008 39)

## 6. INPUTS FROM THE KET OPEN DAY

A very successful Micro/nanoelectronics open day was held on Oct 18, 2010 in the Breydel Building in Brussels. It was attended by over 150 people from various European companies, academic institutions and European and Member State policy makers.

### 6.1 Summary of the Open day Key statements.

The over-arching theme of the Open Day was of the importance of micro/nanoelectronics as a key enabler, especially in large and key industry sectors where Europe has leading positions: Automotive, Industrial, Medical, Energy, Power & Wireless Communication

There was a broad sense that research and manufacturing and design should all be present in the EU, for the European economy to be competitive and healthy. Another key theme was that a knowledge-based society should also have manufacturing as Europe cannot live on services alone.

Another key theme was that critical mass is a key factor of success. Europe must target growth and have focused lines of action: 'If you are not leader you die'; 'small is not beautiful'.

Three other key topics emerged throughout the day:

6.1.1. Clusters:

- They enable efficient ecosystems for developing cutting-edge industry and value (leaders, cooperation & synergies, joint education programs, shared know-how, excellent infrastructures). There is no innovation without Industry and advanced manufacturing col-located with R&D
- They mix all the industrial actors of the value chain in order to enable competitive final products,
- Clusters provide opportunities for SME's to grow.
- They balance the continuous disaggregation of micro/nanolectronics industry in last decades, which is an irreversible trend due to increased complexity, with some players now very specialist companies.
- Four world-class clusters exist in Europe for micro/nanoelectronics. Three on advanced micro/nanoelectronic devices with manufacturing on 300mm (Dresden, Grenoble, Dublin), and one on equipments for advanced micro/nanoelectronics (Belgium-Netherlands)

6.1.2. Areas of high potential for growth currently exist:

- "More than Moore", with strong leverage on sectors such as Power, Automotive, Security, Medical, provided there exist in Europe some competitive, reactive and open prototyping capabilities for serving on a global base the European Industry needs ("Lab Fabs" where smart system technologies are developed and smart systems are manufactured and brought to market in a short loop). We will stay leaders in “More than Moore” only if we don’t forget about the knowledge and access on/to advanced “More Moore” technologies, in the long-term. “More than Moore” is not just an option for Europe, but a must.

- Fabless business, with a strong potential for SMEs and start-ups. Wealth creation is potentially stronger in design than in manufacturing. Long-term leading positions need secure access to manufacturing.

- Innovative system solutions, where Europe can excel through its strong related R&D and technologies.

- For these areas, specific clusters exist in Europe, of smaller size than the previous, but not lesser importance. Clusters are the most-efficient support for innovation and growth for whole ecosystems. Better cooperation between clusters in Europe is to be promoted.

6.1.3. Declaration of Strategic Importance of Micro/Nanoelectronics Industry:

- Semiconductor industry is at risk in micro/nanoelectronics, with European share of global market dropping, despite having access to first-class R&D. There is an urgent need to follow up on the declarations also from the EU that the semiconductor industry is considered as “strategic” and as a “key enabling” industry. This type of declaration exists from governments in Asia and the USA. There is a need for a shared compelling vision. Europe needs a specific strategy for 200mm, 300mm and 450mm.

- R&D regulation is strongly competitive in Europe, but manufacturing conditions are disadvantaging, compared to other areas, resulting in unfair competition for European semiconductor ecosystem. Incentive for industries investing in manufacturing seem appropriate, provided a return “for the society”.

## 6.2. Recommendations derived from the Open Day.

Central recommendation: To declare and support an ambitious vision for developing wealth at European level through supporting and leveraging a strong European position in micro/nanoelectronics.

6.2.1. Education

Education and skills are an asset for Europe, but the attraction of technical education is decreasing. Specific initiatives can help cultivate the skills Europe will require in the future:

- Support initiatives for stimulating awareness and appeal for maths, engineering, technology and science, at 10-18 years age,

- Launch specific ERASMUS calls, focused on KET areas,

- Through student grants, support international cooperation between Masters in Electronics and nanotechnologies, as well as the residence of students from such masters within European RTOs (Research and Technology Organizations),
- Support European trans-national initiatives for specific training of workers in the field

### 6.2.2. Clusters, R&D and Proto-typing:

- Support the development of leading-edge clusters, and the cooperation between them.
- Leverage these leading-clusters through supporting cooperation between the clusters and global European Industry (possible specific calls in FP8).
- Develop European instruments to promote and stimulate European cross-border (and cross-cluster) collaboration.
- Ensure early prototyping capabilities, especially for devices and applications based on "More than Moore" technologies. Suggestion was to fund 5 to 10 EU "LabFabs", based on existing centres of excellence, where smart system technologies are developed and smart systems are prototyped, manufactured and brought to market in a short loop. This network of "LabFabs" could constitute the key European Infrastructure for heterogeneous integration, where System OEM, Semiconductors, Research labs, SME's, will cooperate to define and produced the best in class smart systems;
- Promote the access of SMEs to leading edge technologies, through specific funding support
- Strengthen 300mm positions: develop a strategy and a large program for granting long-term production in Europe of advanced nanoelectronic chips (processors, ASICs, System-on-chip (SoC)) and strategic equipments/material (lithography, epitaxy, smart substrates), by leveraging the strengths of existing clusters;
- Support the link between European designers and technology clusters, in order to accelerate the rate of application of those technologies into products for the benefit of industry globally through Europe. Consider specific calls ; consider a premium for usage of Europe-based manufacturing, in funded programs;
- For "More than Moore", develop and secure the key technologies: power devices, sensors.
- Explore 450mm: currently limited to equipment/material European suppliers needs, unless a serious perspective and commitment is made by the EU to 450mm manufacturing in Europe.

### 6.2.3. Manufacturing

All participants at the Open Day acknowledged the strategic importance of keeping manufacturing capabilities in Europe for some key areas, due to the wealth creation, and to the leverage effect on other sectors. Other areas (Asia, US) have endorsed that strategic interest in their strategy, and strongly support manufacturing as well as R&D.

A generic recommendation is to consider and promote actions that enhance competitive advantage for Europe. Most recommendations are developed in 'Regulations' sector.

### 6.2.4. Regulations

- <u>Funding for R&D and Manufacturing</u>
    - Ensure a global competitive playing field in Europe vs. the rest of the world for research, development and manufacturing, through a competitive environment about regulations, incentives and industrial policies, aligned with the international practices from competition;
    - Alleviate access for SMEs : activate the European Small Business Act;
    - Reduce limitations against regional/national policies. Competition is no more within Europe, but essentially between Europe and the rest-of-the-world;
    - Allows sectorial policy for existing clusters. Authorize member states to provide funding support for "Clusters of Expertise," that strengthen the full value chain in Europe;
    - Adapt the EC direct financing mechanisms to the specific challenge of maintaining "More Moore" R&D and manufacturing capabilities in Europe, competitive with US and Asia;
    - Create a financial ecosystem and dedicated stock markets for high tech industries enabling SME's to grow.
- <u>Standardization/Normalization</u>
    - Create attractive and sustainable lead, early setting of standards (e.g. for the green society) and of regulations, keeping or even increasing the level of R&D ,keeping high reliability and quality level, own the "Solution", safeguarding the close link between semiconductor companies and system houses and continuation of the consequent differentiation strategy;
    - Accelerate the adoption of Smart Systems through policies and pilot infrastructure programs.

## 6.3. Selected quotes that represent the position of the Open Day presenters:

- “The open day seeks to address how to make Europe more competitive, to discuss demand and supply-side measures and how to create incentives for KETs deployment.” ( E. Villa)
- “EU promote and support industrial development of KETs . Ultimate goal exploit and nurture this industry for global competitiveness of EU but also for growth and jobs in Europe. “( G. Lalis – DG Enterprise)
- “Incentive programs include cash grants, project financing or equity investment tax abatement and rebates. In Counties like China, Singapore , Malaysia, Taiwan very aggressive use of Corporate Income tax abatement to encourage investment” ( O. Babinet – Deloitte Consulting)
- “Not possible to have R&D for future advance production if you don’t have a minimum of manufacturing. Ensure a global competitive playing field in Europe versus the rest of the world for research, development and manufacturing R&D on advanced CMOS has to be tied up to leading edge manufacturing infrastructure.” ( O. Bellezza ST Microelectronics)
- “Microelectronics clusters have generated high levels of investments and high level education, system solid regional ecosystems which are innovative, dense, integrated, powerful, resilient, and prosperous.” ( D.Hilbert and G. Fioraso – Deputy Mayor of Dresden and Grenoble)
- “Technology development roadmaps confirm Moore‘s Law will continue for at least 10 years plus. Strategically 3 elements are key: scaling, increase in wafer size and increase in volume to drive the business output”. ( J.O’Hara – Intel Ireland)
- “New opportunity for Europe through emergence of a powerful foundry sector”.( O. Vatel – Global Foundries)
- “The innovation inherent in Europe must be capitalised. Wealth creation is in design more than in manufacturing. Mixed-signal expertise of Europe is still probably the best in world .Complex global supply chain is irreversible”. ( T. Brown – ARM )
- “What are the reasons for current European ‘More than Moore’ leadership? Awareness of societal needs, presence of system houses, broad knowledge base, excellent competence and executing a differentiation strategy”. ( R. Ploss- Infineon)
- “Implement a European ‘man on the moon’ programme involving all KETs. Specific suggestions leveraging European strength in Automotive and Security that we would like to make is to by 2020 such as Achieve zero road fatalities across Europe, Reduce congestion by 50% , CO2- neutral housing/building”. (R. P. De Vries- NXP ).
- “If you are not leader you die. Small is not beautiful” (A.J. Auberton-Hervé)

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- **ESIA** Statement done on the Open Day on Micro/nanoelectronics, Oct. 18, 2010
- **Free State of Saxony** List of Demands concerning Key Enabling Technologies (KET), Nov. 2, 2010
- **IMEC** contribution to the KETs open day on Nanoelectronics, Oct. 18, 2010
- **NXP** letter to the Chairman of the KET Sherpa Group, 26 November, 2010
- **Telefunken 2010** Proposal to KET Sherpa's for use in future documents, TELEFUNKEN Semiconductors GmbH & Co. KG