# SEMICONDUCTORS: ENABLING SUSTAINABLE LIVING IN 21ST CENTURY EUROPE

EECA ESIA

European Semiconductor Industry Association

European Semiconductor Industry Association
Sustainability Brochure 2009

# INTRODUCTION

## SUSTAINABILITY AND SEMICONDUCTORS

More than 50 years after the Physics Nobel Prize winner Jack Kilby invented the first integrated circuit at Texas Instruments, the semiconductor device today is a key facilitator of sustainable development throughout the modern world. Semiconductor devices[1] provide solutions that help people and the planet reduce energy and power consumption by increasing energy efficiency and improving functionality in many end-user applications. This sustainability brochure of the European Semiconductor Industry Association (ESIA) for 2009 presents the overall commitment of the industry to reduce greenhouse gas emissions continually and to contribute to this through global climate projection efforts both in their manufacturing facilities and in the industry's products.

*"Semiconductor devices provide solutions that help people and the planet reduce energy and power consumption by increasing energy efficiency and improving functionality in many end-user applications."*

The brochure's main focus area is environmental. It highlights what the companies' products enable in terms of sustainable living, particularly in terms of energy saving. It also profiles how companies implement sustainability policies with resource conservation projects in their manufacturing operations.

Climate change is the most important challenge facing global society in 2009. The semiconductor device continues to play an important part in combating climate change by achieving a more efficient use of the world's energy resources. The increasing global demand for energy now and in the future requires innovative solutions. Traditional forms of energy and renewable energy sources will not be sufficient alone to meet the world's future energy needs. Using energy more efficiently is therefore of paramount importance, and semiconductor devices help achieve this goal. Semiconductor devices can facilitate a more sustainable model of development for the world through more effective energy use in society. The industry produces products that enable a more efficient use of energy in all aspects of our daily lives: in the home, office or on the road; in industrial manufacturing; in public infrastructure; and in public transport.

This brochure reviews the impact that the semiconductor device has, as well as the benefits it provides, in terms of facilitating sustainable living in the 21st century. It is divided into three chapters. The first outlines the broad-based forums in which the European semiconductor companies' environmental and sustainability personnel cooperate on a pre-competitive basis to address common challenges. This long-standing cooperation, through associations such as ESIA, has enabled pioneering achievements in the industry's protection of the environment. The industry was the first to come together globally on environmental issues in the 1990s and to set reduction targets stricter than the Kyoto protocol goals for the reduction of greenhouse gas emissions resulting from the manufacturing process.

The second chapter describes companies' semiconductor device products that promote more sustainable living in modern society and serve a crucial function in enabling technologies for the information technology revolution.

The third chapter outlines some of the many projects the industry implements in manufacturing semiconductor devices. Each company that is a member of the ESIA is committed to minimising at every possible stage in their production process the environmental footprint of their resource use, namely: water and energy use; waste disposal; and the minimisation of the use of perfluorinated compounds (PFCs).

1 More commonly known as a microchip, silicon chip or integrated circuit (IC). An IC is a miniaturized electronic circuit (consisting mainly of semiconductor devices, as well as passive components) that has been manufactured on the surface of a thin substrate of semiconductor material. Integrated circuits figure in almost all electronic equipment in use today and have revolutionized the world of electronics.

## ENABLING SUSTAINABILITY - End user applications and the benefits facilitated by semiconductors


**Figure 1**

# BROCHURE CONTENTS 2009

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# CHAPTER 1

## SUSTAINABILITY THROUGH COOPERATION:
## EUROPEAN SEMICONDUCTOR INDUSTRY – PROACTIVE APPROACHES TO COMMON RESPONSIBILITIES

### Cooperation at the European and global levels

The European semiconductor industry has for many years co-operated on common environmental challenges that the industry faces. The industry is proud to have been amongst the early sectors that embraced environmental sustainability as a core part of manufacturing operations and strategy. The industry has continuously taken a proactive approach to environmental responsibilities as corporate citizens in the communities in which it operates. It has long since rejected the philosophy of leading economist Milton Friedman that corporations are only responsible to their shareholders and not to society as a whole.[2] Semiconductor companies have clearly recognized in their actions that sustainability practices are not to be seen as a burden. This is demonstrated by company activities in the fields of: social projects (in education, in the local community), protecting the environment (by reducing environment footprints) and incorporating life cycle thinking in product design. Companies operate robust environmental management systems and focus on reducing, reusing or recycling natural resources used in production where it is possible and practical to do so. In the field of environmental protection, the industry has been heralded by regulatory authorities in Europe, US and Asia over the past two decades for its pioneering efforts in achieving concrete global agreements to reduce environmental footprints.

*"The industry signed a voluntary agreement to reduce, by 2010, absolute PFC emissions of the overall European industry by 10% below the 1995 baseline year for emissions."*

2 *The Social Responsibility of Business is to Increase its Profits* Milton Friedman, The New York Times Magazine, September 13, 1970

3 'PFCs' refers to perfluorcompounds and not just perfluoirinated carbon compounds. As Nitrogen trifluoride and sulfur heaxaflouride are included in the basket of gases collected

4 2006 EU 27 emissions- 5,143 Megatonnes in $CO_2$ equivalents/ $10^{12}$ ; 2006 ESIA 1.4 Million Tonnes in CO2 equivalents/ $10^6$- Annual European Community Greenhouse Gas Inventory 1990-2006- Submission to UNFCCC Secretariat (27 May 2008)

5 Full ESIA PFC intermediate report can be found at http://www.eeca.eu/index.php/esh_pfc/en/

6 http://www.st.com/stonline/company/cr/2007/environmental/nobel_peace_prize.htm

### The European greenhouse gas emissions reduction agreement

The European semiconductor industry's agreement to reduce the emissions of perfluorocompounds (PFCs)[3] from manufacturing operations is one such voluntary effort that has been recognized by authorities. Semiconductor manufacturing is not considered a significant contributor to global warming, yet the industry does emit some greenhouse gases in the course of its production processes. The total European semiconductor emissions accounted for several orders of magnitude less than even .001% of the total European Union (27) emissions of $CO_2$ equivalents in 2006.[4] ESIA companies worked in the 1990s with our gas suppliers and the industry signed a voluntary agreement to reduce, by 2010, absolute PFC emissions of the overall European industry by 10% below the 1995 baseline year for emissions. This regional European goal forms part of the global semiconductor industry's overall proactive effort to reduce PFC emissions on a worldwide basis by a similar percentage. The European industry is on its way to meet this target (as illustrated in figure 2). Another very positive outcome achieved by the European companies is the continued decrease in normalized emissions reduction (NER) (MTCE/square metre of wafer demand - Metric Tonnes of Carbon Equivalent). This reduction means that the industry has consistently reduced PFC emissions per square meter of silicon since 2001. If no progressive action and investments had been undertaken by the industry to reduce emissions, these would have increased significantly beyond the 1995 levels under a 'business-as-usual' scenario.

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**Picture 1** — In 1998 the World Semiconductor Council received the U.S. Environmental Protection Agency's Climate Protection Award. The award was for setting a PFC reduction goal and for laying out a strategy on how to achieve it.

ESIA published an intermediate technical status report on the industry's progress towards meeting the reduction goal in 2006.[5] PFCs are used in semiconductor fabrication plants because they provide uniquely effective process performance in etching and are a safer, more reliable source of fluorine, which is required for cleaning certain deposition process chambers. Manufacturers of semiconductor devices have been able to reduce PFC emissions by taking a number of actions including process optimization, use of alternative chemicals, employment of alternative manufacturing processes where possible and improved abatement systems. However, the use of PFC gases in these processes is crucial to the production of semiconductor devices, as there are no effective substitutes that can be used.

The global PFC reduction goal is coordinated through an organization called the World Semiconductor Council (WSC), with each regional semiconductor trade association in China, Europe, Japan, Korea, United States and Taiwan having individual goals for contributing to the worldwide reduction efforts. It is important to outline that – through the WSC - the semiconductor industry was the first industry to come together globally to establish a worldwide greenhouse gas emission goal that goes beyond the targets established by the Kyoto protocol for Annex 1 countries. Several representatives of the WSC PFC working group were involved with the Intergovernmental Panel on Climate Change's (IPCC) Nobel Peace Prize Award in 2007. Dr Francesca Illuzzi, who is the ESIA's PFC group chairperson, attended the peace prize ceremony because of her collaborative expert work since 2000 on the guidelines of the IPCC.[6]

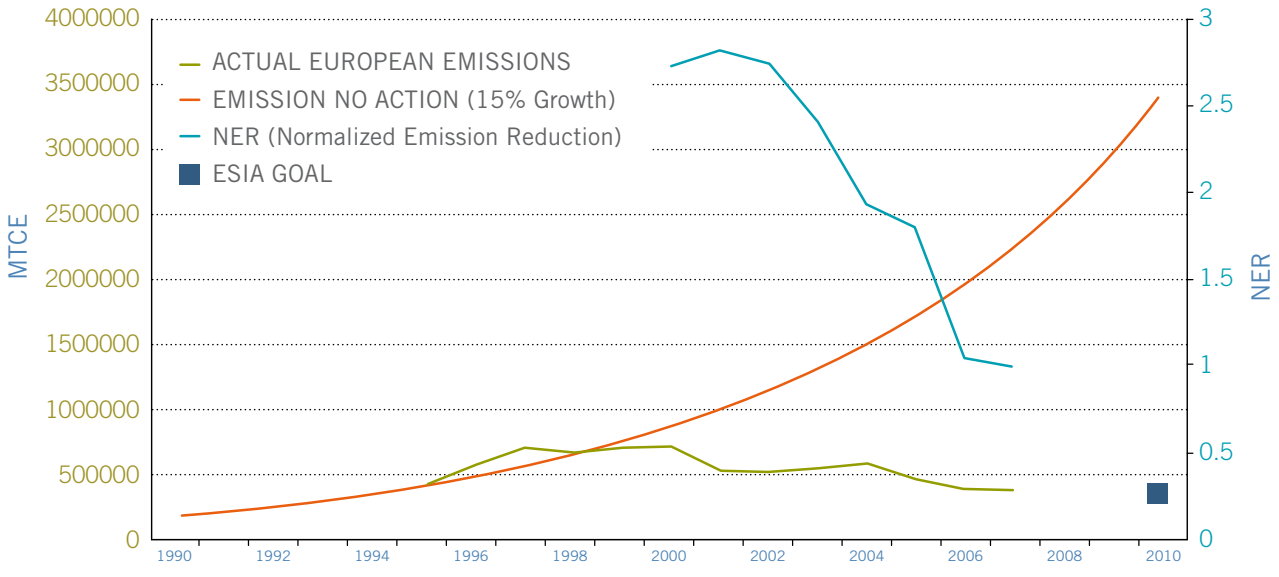


**Figure 2** — European emissions reduction programme. Absolute emissions have continued to decrease. A comparison between actual emissions and projected emissions if no reduction options had been implemented

## Reducing energy consumption

The semiconductor industry has a small proportionate share of energy consumption in its production processes when compared with other global manufacturing industries. The industry is nevertheless very focused on continually innovating in order to achieve energy reductions at its production factories (fabs). Through ESIA as well as through partnerships with its equipment suppliers and international research consortia, the European industry develops, shares and implements best practice energy performance in its facilities. This is an area where win-wins are created by sharing relevant pre- competitive information on reducing energy consumption at the fab level.

*"The European industry develops, shares and implements best practice energy performance in its facilities."*

Most metric programmes in the industry focus on the normalised energy consumption, which gives a relative value compared to production output per wafer or on a per product basis. Figure 3 identifies the electricity consumption reductions that the industry has achieved worldwide. In accordance with the WSC's Guiding Principles for Environment, Safety and Health, the industry in Europe is focused on energy reduction through the efficient use of energy, efficient cooling systems, process and facility optimization, seeking high-efficiency energy sources such as co-generation, as well as utilizing cost-effective renewable and alternative energy sources where possible and appropriate. Chapter 3 of this brochure will outline examples of energy reduction efforts.

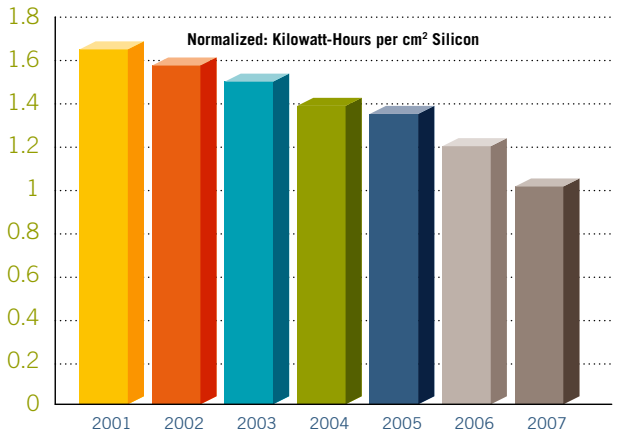


**Figure 3** — World semiconductor council normalised electricity consumption data

## ESIA — environmental, safety & health committee

The ESIA coordinates its common sustainability and cooperation projects through the work of the ESIA ESH committee. This committee is responsible for coordinating the activities and setting the goals of the association in these areas. The committee, together with specific working groups, is active directly in technical cooperative projects and on regulatory issues of relevance to ESIA members. The ESIA has working groups dealing with chemical management and reach implementation, energy savings, PFC, health and safety, resource conservation and EU legislation.[7] **(Picture 2)**

## International semiconductor environmental, safety and health (ISESH) conference

In addition, the associations of the WSC hold annual public international semiconductor ESH conferences. The ESIA initiated the 1st conference in Brussels in 1994 and since then, the conference has been hosted by ESIA in Milan (1997), Dresden (2000), Noordwijk (Netherlands, 2003) and Malta (2006). The ISESH conference is now in its 16th year and is the leading global forum facilitating sharing of innovative ideas on new ESH technology practices and best practice exchange amongst ESH professionals, suppliers, research institutes, regulators and other stakeholders. The conference rotates amongst the various member associations of the WSC cooperating on ESH and sustainability policy, with the 2009 conference to be hosted by the Taiwanese semiconductor association in Taichung, Taiwan.

## Global ESH task force

The ESIA is also proud to play a role as a member of the ESH task force of the World Semiconductor Council.[8] This unique forum brings together expert representatives from six major semiconductor associations from China, Europe, Japan, Korea, the United States and Taiwan to work together on collaborative approaches to resource conservation, emission reduction and many other common environmental safety and health issues. This cooperation operates in the pre-competitive arena and is a knowledge-sharing process. The semiconductor industry's PFC global reduction programme, along with the PFOS reduction agreement and the joint energy white paper with suppliers worldwide, are some of this body's worthy achievements and highlight the commitment to sustainability globally. **(Picture 3)**

**Picture 2** — ESIA ESH Committee meeting at Intel, Ireland 2008; Backrow Standing from L to R; Michael Cullen,Intel ; Martin Gernert, Infineon; Philippe Levavasseur, STMicroelectronics; Bodo Eilken, Infineon; Julian Lageard, Intel; Christian Pophal, Infineon; Konrad Schützenmeier, Renesas; Eric-Paul Schat, Committee Chair, NXP; Robert Wright, Intel; Jacques Mohr, NXP; Shane Harte, ESIA; Harry Thewissen, NXP; Front Row Seated: Fiona Lyons, Intel; Silke Hermanns, AMD; Beatrix Pichl, TI; Francesca Illuzzi, Numonyx

**Picture 3** — Members of the Environment, Safety & Health Task Force of the World Semiconductor Council at their meeting in Lisbon September 2008
Delegation Chairpersons Front Row Seated L to R; Mr SangSun Ha, Samsung Electronics, KSIA; Mr Reed Content, AMD, SIA; Mr Masahiro Hashimoto, Sanyo Semiconductor, JSIA; Mr Eric-Paul Schat, NXP, ESIA; Mr Joseph K C Mou, Powerchip Semiconductor, TSIA; Mr Shoumian Chen, Shanghai IC R&D Center ,CSIA.

## Managing substances of concern – investing to reduce lead and pfos usage

Semiconductor manufacturing is a complex process which utilities selective chemicals and materials. ESIA member companies have many company risk management programmes in place to manage and regulate the use of these hazardous materials where they are necessary. Risk management measures (RMM) are focused on employee and environmental protection. RMM such as chemical assessment, selection and control procedures, hazardous gas management systems, segregated exhaust systems, safety interlocks, are commonplace in semiconductor facilities (fabs). New fabs use totally enclosed processes, automation, and chemical delivery systems to create a barrier between workers and the process. The European semiconductor industry proactively since 2001 through the companies of the E3 and E4 programmes has been leading the global efforts towards 'lead free' packages and technologies.[9] Significant reductions and progress has been achieved by the whole industry in terms of the movement towards lead free and the industry meets all its legal obligations under the various EU and international legislation (RoHS). However, currently there are no identified substance solutions for some remaining exempted critical applications where the use of lead and other hazardous materials are needed in tiny amounts. The industry is continuing its investigative efforts in these remaining areas with technical industry research programmes looking for appropriate solutions.

PFOS (Perfluorooctane/ octyl Sulfonates) is a substance used in very small quantities in the manufacture of semiconductor devices.

The manufacture of advanced semiconductor devices is not currently possible without the use of PFOS in 'critical applications' such as photo resistant and antireflective coatings. PFOS is a process chemical; it does not remain in the final product, i.e., the semiconductor device. The industry carefully manages and uses PFOS in tightly contained systems in the semiconductor manufacturing process to yield minimal emissions. Since the first environmental concerns about PFOS were noted in 1990s, the European semiconductor industry together with its chemical suppliers has been working to reduce PFOS use in applications and to try and find alternatives wherever technologically possible.

The global semiconductor industry, through the World Semiconductor Council (WSC), agreed in May 2006 to end the use of PFOS-based chemicals where they are not technologically critical to the manufacturing process. Under the agreement, members of the WSC and SEMI (material suppliers) have committed themselves to phase out non-critical uses of PFOS by specific dates. In addition, the industry will work to identify substitutes for PFOS in critical uses for which no other materials are presently available and to remove solvent wastes from critical uses.

This global agreement is a good example of how industry-wide sustainability is valued not only in Europe but worldwide as well. Although emissions from European manufacturing are extremely low, the industry remains focused on finding less harmful alternatives that can perform the same function.

7 More information on the work of the ESIA ESH Committee can be found at http://www.eeca.eu/index.php/esh_intro/en/
8 http://www.semiconductorcouncil.org/
9 E3 Programme: http://www.nxp.com/acrobat_download/other/green_roadmap/pb_free_pressrelease.pdf


# CHAPTER 2

## HOW DO SEMICONDUCTORS ENABLE MORE SUSTAINABLE LIVING IN THE MODERN WORLD?

***"Semiconductors are for the Information Society what grain was for the agrarian society and iron and steel were for the industrial society."***
... Museum of Urban Development, Shanghai, China

This statement is an accurate assessment of the critical importance of semiconductors to life in the modern world. This chapter describes some of the semiconductor products that enable a more sustainable approach to life. Innovations in semiconductor devices enable positive and sustainable developments in the areas of increasing automotive fuel efficiency; automotive safety; more secure communications and banking payment systems; improving medical devices; and more efficient use of energy in the home, in public transport,in lighting, in personal computers and in data storage centres.

### NXP — Semiconductors enabling fuel and resource efficiencies in the automotive industry

While the basic design of an internal combustion engine has not changed much since its invention in the late 1800s, there is a lot that can be said for the electronics in today's automobiles. Beyond the more obvious features such as GPS for navigation, onboard DVD players and "smart" features like automatic headlights and windshield wipers, today's cars are an army of semiconductor-powered electronics that make them more responsive, safer, more immune to theft and, in particular, more energy efficient.

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NXP is a leading provider of semiconductors for automotive applications, with a special emphasis on sensors and in-automobile networking. Using these technologies, the company is helping cars make better use of fuel and replacing heavy mechanical components with lightweight alternatives that improve overall efficiency. Here are some examples:

- **In vehicle networks**
  A typical car today has up to 100 electronic-control modules (such as ABS, (Anti lock Braking System) ESP (Electronic Stability Programme), automatic windows, and rear-seat entertainment) that communicate with each other increasingly via a network bus rather than heavy point-to-point copper wires. All those wires add weight – as much as 200 pounds in some cases – and make the car less fuel-efficient. NXP's CAN-, LIN- and FlexRay-networking technologies operate via a single bus system and does away with all the point-to-point copper wires, thus eliminating

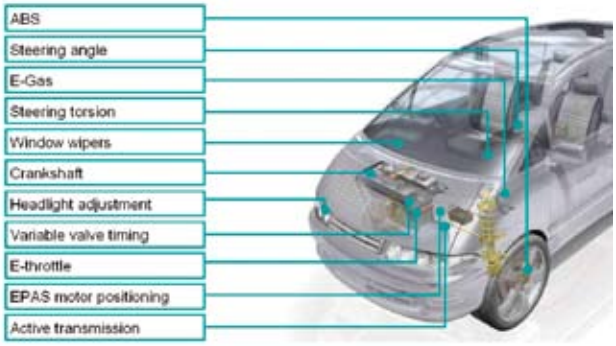



**Figure 4** — Automotive sensors (courtesy of NXP Semiconductors)

the extra weight. On average, replacing point-to-point with CAN/LIN/FlexRay buses can stretch a tank of petrol by an extra five miles. Applied to all cars globally for a year, that extra mileage would mean 15 megatons of $CO_2$ were prevented from entering the atmosphere.

- **Engine-control sensors**
  Studies have shown that as much as 75% of the energy in a fuel tank is lost to engine and driveline inefficiencies and idling. The engine is a rugged environment, but precision measurement systems that can withstand high temperatures can dramatically improve efficiency. The engine's computer unit can read NXP sensors located at the crank and cam shafts and use real-time sensor information to regulate fuel flow, match air intake or even adjust the spark timing for various RPMs and engine loads. The result is better engine performance and optimized emissions.

- **Tire-pressure sensors**
  According to the National Highway Traffic Safety Administration (NHTSA) in the US, four million gallons of fuel a day (over 1.3 billion gallons per year) are wasted due to low tire pressure. Inflating tires to the proper pressure can raise fuel efficiency, extend the life of the tires and boost fuel savings. Tire pressure monitoring systems, built using NXP silicon, alert drivers when it is time to add air to the tires.

- **Telematics: intelligent traffic management systems**
  On a daily basis 30 million liters of fuel (or 70 kilotons of $CO_2$) are being wasted in traffic jams. Intelligent traffic management systems can help to improve traffic flow. NXP has been working hard to develop telematic-systems that may help to reduce unnecessary $CO_2$ emissions.

## Infineon — Car safety systems - reducing road fatalities

Safety electronics is one of the key solutions for reducing road fatalities. In areas such as electric power steering the safety aspect can ideally be combined with reduction of fuel consumption, emissions reduction and improved overall car energy efficiency.

*"Safety electronics is one of the key solutions for reducing road fatalities."*

Infineon is one of the few broadband suppliers with products that include intelligent sensors and microcontrollers along with automotive power standard products, application-specific standard products (ASSPs) and highly integrated, customized, application-specific ICs (ASICs). This flexibility, combined with the company's systems expertise and with almost four decades of experience in the automotive segment, allows the company to support its customers by meeting their key challenges.

**Picture 4** (courtesy of Infineon)

## Freescale Semiconductor — Making cars more efficient - from copper to silicon

Weight has a major influence on fuel consumption, so reducing the weight of the car is a key priority. The use of semiconductors are central to this weight reduction. The usual intent of the driver when using his vehicle is to transport people or loads from one point to another. Transporting the weight of the car itself is useless for that purpose. The main elements of weight are: the engine and the wiring harnesses, along with mechanical and hydraulic equipment.
For the past 30 years, Freescale Semiconductors has enabled an increase of fuel efficiency and of the power obtained from a given engine regardless of the fuel used. This is accomplished by optimizing injection. For equivalent performance, small, electronically-controlled engines today are much lighter compared with engines of a few years ago.
The second heaviest component in the automobile is the wiring harness. This is where the semiconductor brings most of its value, reducing the car's weight in a two ways: length and width. Multiplexing is a major step that has begun to reduce the length and thus the weight of wiring. Thanks to semiconductor technologies that use techniques developed by European automotive industry consortiums, much information needed to make a car function are transported by a single wire, replacing the dozens that were necessary just a few years ago.

Freescale is accelerating the convergence of wireless technologies that will allow carmakers to remove physical wires for the car that are currently used for entertainment functions, allowing passengers to have the multimedia equipment they enjoy at home or at the office with them in their car. Even though a fair share of the energy consumed by the engine is used to move the car, another significant amount is used to power all the electrical and hydraulic systems that make the car user-friendly and safer: electric power steering, lighting and wiping systems; radio, CD player, navigation and other entertainment systems; air conditioning and remote keyless entry and start systems. With these types electronic equipments becoming more common, it is clear that the proportion of total energy they use will change rapidly. Most of these functions have to be powered on and off when it is useful, very often without any action on the driver's part. To help the system decide when to make a function available, the car needs to become "ambient and intent aware". Only semiconductor devices are able to capture events or detect modifications in the environment, then compute and decide upon the action to take before actually powering up and activating the door locking system or switching off the lights according to the presence or absence of sunlight or passengers.

## Freescale Semiconductor — Reducing pollution emissions from cars

A car today generates about 150g of $CO_2$/km. Most of us are driving about 30000 km per annum, so every user is causing 4.5 tons of $CO_2$ per year to be released into the atmosphere, taking one year for a hectare of forest to absorb.

It is clear that the semiconductor industry has a continued responsibility to facilitate ever greater changes to: reduce pollution emissions; increase the energy efficiency of car systems and to track and eliminate useless power consumption.

Semiconductor technologies being developed are focusing on making cars manage and optimize their own energy efficiency, salvaging energy from braking, as well as developing hybrid systems that increase fuel economy and reduce emissions. Freescale technology is in being used in five of the top automotive manufacturers' HEV (hybrid electric vehicles) architectures – from small to large passenger vehicles. Fuel cells are still years away, and semiconductor technology will be needed to drive the electric power train systems of the future. Freescale is a leading global supplier of semiconductors for the automotive industry and is at the forefront of development of standards in advanced automotive control that will be critical for improving efficiency and sustainable development. The company is proactively driving and enabling technology advancement toward greater efficiency and lower costs.

In future vehicles, individual systems will become so efficient, powerful and high-performing that vehicles will begin to act autonomously. This development, in line with progressive European Union emission controls will have a major impact on automotive systems.

To enable new engines to meet the European vehicle emission regulations, from Euro 2 to Euro 4, semiconductor designers had to improve technology performances by a factor of 20 over the past 10 years, faster than the computer industry (factor of seven). Innovations in semiconductors allowed average energy consumption and automobile emissions in Europe to decrease by 15% in 10 years in spite of an almost 20% weight increase because of more material being used for passenger protection.

## NXP — Saving energy in LCD panels through solid state lighting solutions

The bulky CRTs (cathode ray tubes) used in yesterday's TVs and computer monitors are quickly being replaced by slim LCD (liquid crystal display) screens. The new LCD panels offer clear, colourful pictures, and save a lot of space, but there's still room for improvement in their power consumption.

*"In the end, the use of NXP's 2D dimming solution can reduce the LCD TV's overall energy consumption by more than 60%."*

In the average 40-inch LCD panel, roughly 75% of the energy is used for screen illumination. NXP's Solid State Lighting (SSL) solutions can help lower that number. By replacing the conventional light source typically used in backlight applications with SSL, which uses LEDs (light emitting diodes) for its light source, manufacturers can save energy, improve colour performance, reduce heat generation and extend the life of the display.

NXP technologies also help improve the operation of the backlight itself. In standard LCD panels, the backlight unit lights every pixel at 100% brightness at all times. When the video content requires that a pixel should be dark or grey, the pixel is still lit at 100% while the LCD cell modulates the pixel brightness.

By using white LEDs with 2D dimming, the luminance of each LED segment can be controlled individually. The light output of each LED is controlled, according to time and location, as required by the video content, thereby saving about 60% of the power needed for the backlight. In colour displays that use RGB LEDs with 2D colour dimming, the savings can be even greater. Colours are only produced when and where they are needed, for a savings of up to 75%. In the end, the use of NXP's 2D dimming solution can reduce the LCD TV's overall energy consumption by more than 60%.

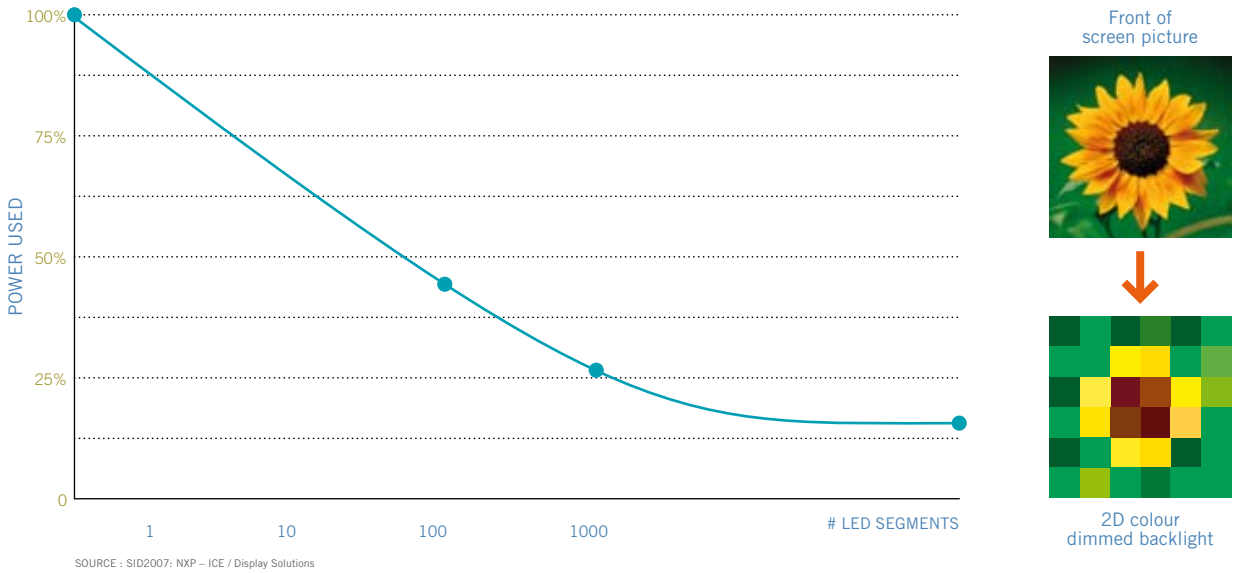



**Figure 5** — Energy savings in LCD TV panels through use of LEDs with 2D Colour Dimming; the LEDs optimise light output thereby saving backlight power. (courtesy of NXP)

## NXP — Power supply chipsets – saving electricity in computing

The power supply of a desktop or laptop computer takes power from a wall socket and converts it into a voltage the PC (personal computer) can use. This process, which converts mains voltages into all the voltages needed by the PC leads to inefficiencies, with as much as 40% of the applied electricity being lost. Given the millions and millions of computers in use today, these losses can really add up.

NXP has developed a power-supply chipset, called GreenChip PC, which has been designed as the world's most efficient PC power supply (silverbox) solution. The design uses innovative techniques to increase efficiency, lower noise and reduce the materials bill. It also cuts power losses by up to 50% and reduces or even eliminates the need for a cooling fan.

Beyond PC power supplies, other high-power applications such as flat-screen TVs can benefit from GreenChip as well, gaining lower standby power and improved efficiency, with advanced safety features.

GreenChip is now in its third generation and is expected to produce its 400-millionth IC in 200w. Every appliance that has a GreenChip power-supply controller saves about 60 kilowatt hours per year. For a consumer, that means an average savings of around EUR 10 per year per appliance. Worldwide, GreenChip is saving more than EUR 1 billion on energy costs.

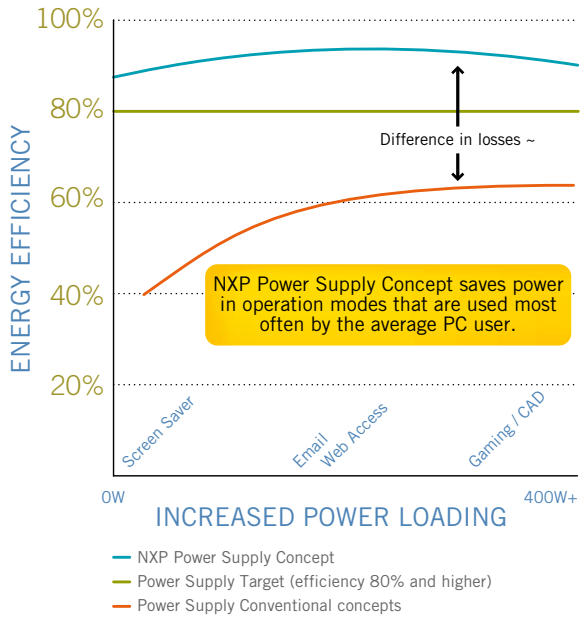



**Figure 6** — Green Chip power supply controller (courtesy of NXP)

## Texas Instruments — Revolutionizing improvements in medical devices

Texas Instruments (TI) believes that smart machines buried inside us will someday keep a constant eye on our health, administer care as needed and alert doctors to problems they cannot fix. Today, diabetics must constantly prick themselves to measure their blood sugar. Tomorrow, tiny machines could monitor the sugar and eliminate the need for insulin shots by telling the body to make more naturally. Does this sound far-fetched? Pacemakers already monitor and regulate the heart, while many lesser-known implants combat other afflictions.

Advanced Neuromodulation Systems, a US-based division of St. Jude Medical Co., uses TI chips to build a pain-management device that doctors implant in people with certain types of chronic back pain. The device, which is used in patients who get little benefit from medication, reduces pain by emitting small electrical charges. As chips grow more efficient, ANS devices will last longer and will thus reduce the number of times they must be replaced during a patient's lifetime.

Medical devices hold so much promise for TI because medical-device makers demand much the same thing as mobile phone companies. They want chips to make their products smaller, cheaper and more energy-efficient, while also making them more powerful. New products powered by TI chips illustrate the benefits of smarter processors:

Automatic blood pressure monitors let patients get quick and accurate measurements at home. Imaging machines deliver clear pictures rather than fuzzy outlines. Portable ultrasound devices let health workers bring care to ailing patients. That word portable looms large in TI's medical efforts.

The company believes it can greatly improve health care by shrinking existing products and making them cheaper. Imagine how much more use you'd get from a CT scanner if a machine that currently occupies an entire room could fit inside a doctor's closet. Now imagine that visiting nurses could fit a hospital's worth of diagnostic tools into their car trunks.

TI believes that these applications will have a huge impact in the West but it would be truly revolutionary in places like India, where most people live nowhere near a hospital.

## Texas Instruments — a semiconductor technology platform combining low power consumption and wireless functionality

TI recently announced a solution that combines its ultra-low power technology with the ability to send information wirelessly with a low power TI radio frequency (RF) transceiver all on one tiny chip. The new CC430 technology platform will bring intelligence to a range of applications in which low power, small size and wireless connectivity are crucial.

▪ Medical - Applications that benefit from the CC430 platform's high integration and "smarts" may include intelligent hospital tracking systems that communicate patient or medical equipment information to a central location, as well as personal area networking between watches, pedometers, chest strap heart rate monitors and PC-based health and fitness analysis programmes.

▪ Energy harvesting - The CC430 platform's incredibly low power consumption make battery-free sensors that run off solar power, human body temperature or vibrations for a power source a reality.

▪ Remote data collection - The CC430 platform can also power RF sensor networks that report data to a central collection point to analyze information such as smoke in the atmosphere to detect forest fires, moisture or pesticide information in crop fields or even humidity levels in a winery.

*"The new technology platform will bring intelligence to a range of applications in which low power, small size and wireless connectivity are crucial."*

▪ Smart metering - The CC430 platform offers low power consumption to extend the battery life for years for the remote meter (great for metering companies to avoid digging underground or remote sites to replace meter batteries) while the RF component enables the wireless link between the meter and the collector. Automatic meter reading enables more responsive service to help reduce electric, gas and utility costs.

## INTEL — Enabling the management of remote computers and more efficient servers

Management technologies like Intel® vPro™ technology help to reduce energy usage further by enabling IT managers to utilize power management controls and thus allow them to manage remote computers centrally. Energy savings can then be optimized while business continuity is maintained and all critical security patch requirements are met.

Energy savings of mobile vs. desktop systems are considerable, especially if paired with management technologies. If one compares the annual power consumption of an average unmanaged desktop system based on a Pentium® Dual Processor 945 with a Centrino® Pro™ processor technology based notebook (based on C2D T7700) up to 17 times less energy is required while getting even better performance.

*"Energy savings can then be optimized while business continuity is maintained and all critical security patch requirements are met."*

Microprocessors also play a significant role in the Data Centre, where efficient usage of floor space and energy are imperative to meet growing demand. In three years, the processing power of 6 racks of servers have shrunk to 1/6th the physical size, and 1/8th of the energy consumed which equals a floor space reduction of 83% and an annual energy cost reduction by 87%. The adoption of virtualization technology in the Data Centre enables a more efficient use of server resources. The opportunity to consolidate multiple applications on one server utilizing virtualized resource management helps to reduce energy utilization and to create a more cost-effective alternative for data centre deployments.

## Infineon — Semiconductors enabling secure communications, payment and identification systems

Infineon provides the technology basis for increased user comfort, privacy and protection of personal information as well as company data. State-of-the-art secure microcontroller solutions pave the way for secure communication, banking and commerce.

*"Infineon's high security smart card and ePassport controllers have reached the highest international security level achieved today"*

The Infineon "Security Initiative" was launched at the beginning of 2008 with the aim of combining the existing know-how in security applications with other issues, for instance those in the automotive, industrial or communications sectors. Infineon's security microcontrollers comprise a complete microcomputer in a space of only a few square millimeters. Security controllers, if not properly protected, are a target for criminals. Adequate security protection measures must be included in the concept, design, production and logistics phases of such products.

The central processing unit (CPU) cores utilized in Infineon security controllers are, at the "heart" of each smart card or ePassport chip, designed by Infineon from scratch under strict design rules of integral security.

In 2008, Infineon revealed a new integral security concept for the next decade, which combines full on-chip encryption, full error detection and intelligent shielding to counteract not only past, recent and current known threats, but even advanced attack methods that are anticipated in the future.

Infineon's high security smart card and ePassport controllers have reached the highest international security level achieved today: the international "Common Criteria EAL5+ (high)". This security level has been confirmed by the Federal Office for Security in Information Technology (BSI) in the form of an international certificate, awarded after the technology passed intensive attack tests.

## Infineon — Enabling improved hardware security - *Trusted Computing Group*

The communications world is still confronted by tens of thousands of viruses, "trojans", or "worms" that attack information and communications technologies. The protection of personal computer hardware platforms against such attacks on its integrity or against modification of its software is still a major problem. Approaches to solving this problem purely at the software level typically yield only limited efficiency whilst implementing pure software-driven security usually drastically limits functionality. Major companies in the PC sector have therefore joined forces to solve this problem with the aid of a new hardware approach and the creation of an associated industry standard. The Trusted Computing Group (TCG), with its promoters AMD, Fujitsu, HP, IBM, Infineon, Intel, Lenovo, Microsoft, Seagate, Sun and Wave, strives for more secure support for vital computing platform processes.[10]

One example of the Trusted Computing Group's standards for PC platforms is a secure hardware structure whose main component, the Trusted Platform Module (TPM), is specified as a security chip. This standard is largely based on recent years' experience with high-security smart cards and their applications, important parts of whose architecture and security characteristics have been consistently adopted. Infineon's expertise in high-security, Common Criteria EAL5+(high)-certified smart card security controllers was utilized in the design of the Trusted Platform Module (TPM) IC that made its way not only into a large number of personal computers, both desktop and notebook versions, but also into new applications such as gaming, industrial and mobile computing.

10 https://www.trustedcomputinggroup.org/home

**Picture 5** — Smart Card Banking (courtesy of Infineon)

**Picture 6** (courtesy of Infineon)

**Picture 7** (courtesy of Infineon)

## Infineon — Improving energy savings in the home

Private houses are particularly large energy consumers. Along with the promotion of environmentally conscious consumer behaviour, making household appliances use energy more efficiently poses a special challenge. Infineon's power management devices concentrate on reducing power loss in electronic equipment and on the efficient use of energy. Consumers benefit directly from Infineon's efforts by saving money on energy. Some of the most inefficient energy consumers in European households are lighting, air conditioning systems and electrical appliances or devices operating in standby mode. The unproductive standby mode accounts for about 1.5 % of the entire power consumption in the USA. A 90% reduction in power loss is already technically possible and could save some 3-4 billion US dollars in the USA alone. In 2001 the International Energy Agency (IEA) conducted a study of the energy consumption resulting from the standby mode of various household appliances in the 30 member states of the OECD. The study found that the capacity of all the wind power stations in the world falls far short of that required to cover the energy demand from the standby mode of household appliances.

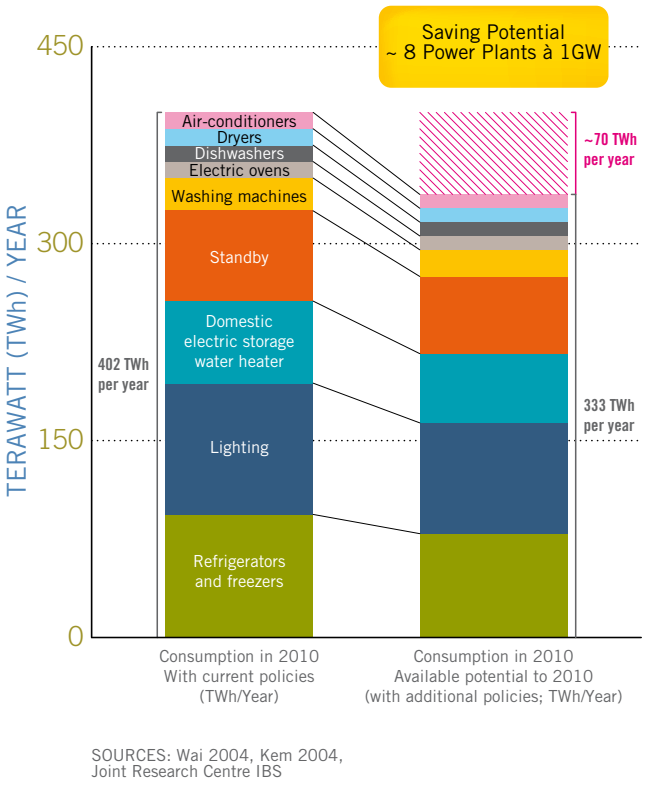



**Figure 7** — Potential energy savings in the home (courtesy of Infineon)

## Infineon — Energy savings in the kitchen

The TrenchStop®, in combination with a tailor-made Emitter Controlled Diode, offers the lowest losses and the highest energy efficiency for 600V/900V and 1000V induction cooking applications (stove, rice cookers, microwave ovens). Efficiency improvement by using induction cookers with Infineon products is for example 25% per year in Germany compared with electric cookers (only heating the pot, not the air, stove, etc., surrounding it). This also results in better cooking (faster heating, better safety).

## AMD — Microprocessors as key enablers for energy-efficient digital inclusion

AMD provides low-power embedded processors, including the AMD Geode ™ processor. These processors power innovative designs such as the XO Laptop developed by the One Laptop per Child (OLPC) organisation. AMD's participation in OLPC is a key component of the 50X15 Initiative, a global initiative founded by AMD that seeks to bring Internet access and computing capabilities to 50% of the world's population by the year 2015.[11]

In March 2008, Internet World Statistics released the figure of 1.4 billion as the estimated global number of Internet users. This corresponds to a global Internet penetration rate of 21% based on estimated world population as of mid-2008. Low power embedded processor designs are critical to the future sustainable growth of worldwide IT.

In 2008, One Laptop per Child earned top honours at the March 2008 Design Museum's Brit Insurance Design Award. From a shortlist of 100 designs, OLPC's XO laptop was found to be the most pioneering and progressive international design produced in the last twelve months. This inexpensive and energy-efficient computer can be charged by hand-cranked power, making it ideal for use in rural villages. The AMD Geode™ LX 700@0.8W[12] processor powers the OLPC.
According to OLPC, the laptop nominally consumes less than two watts (source: http://wiki.laptop.org/go/XO; website monitored by the OLPC team).

## AMD — Making data centres more energy efficient: internet service provider - *Strato*

What does the future hold for Internet service providers (ISPs)? The direction is already set: greater computing power, increased security and load balancing, and at the same time a need to control energy use. STRATO[13], one of the largest webhosting providers in Europe, transitioned to servers based on the Dual-Core AMD Opteron™ processor because of the processor's overall value proposition as well as its energy efficiency features. In a highly-commoditized and competitive sector, Internet service providers must maintain a state-of-the-art infrastructure that delivers leading-edge performance or else see their customer base erode.

With their large server farms, ISPs are challenged by operational issues of energy consumption and environmental factors such as ambient temperature and physical space. Dual-Core AMD Opteron processors provide substantial performance advantages over single-core AMD Opteron processors within the same power and cooling envelopes. In addition, 64-bit processing is the wave of the future. AMD's 64-bit products are preparing ISPs for the emergence of 64-bit applications now, ahead of the curve. While a webhost's servers are always switched on, they do not work around the clock — many are in idle mode. Dual-Core AMD Opteron processors are designed to be energy efficient in idle mode, thus controlling power usage and costs. By using these processors as well as deploying virtualization (consolidation of some virtual servers on one physical server), the service provider is able to offer enhanced capacity to its growing customer base while at the same time managing its server power consumption.

**Picture 8** — Server Room at Strato Data Centre (courtesy of Strato)

11 (visit http://www.50X15.org for more information about this initiative).
12 This processor operates at 433 MHz. Model numbers reflect performance as described here: http://www.amd.com/connectivitysolutions/geodegxbenchmark
13 Article courtesy of Strato- http://www.strato.de/press/download.html
14 http://www.thegreengrid.org/home
15 VLSI Research INC – Chip Insider on Qimonda and the strategic advantage of burried Wordline; May 2008 page 6-8

## *The Green Grid*

In 2006, AMD, along with other technology leaders, many of whom compete in the marketplace, began the journey to form The Green Grid[SM] [14] consortium. This non-profit initiative gathers together all parties interested in lowering consumption of power in data centres around the globe. Since its inception in February 2007, the organization has grown to well over 200 members, including companies from the Americas, EMEA (Europe, Middle East and Africa) and Asia-Pacific regions. The consortium has released a series of white papers that address various aspects of data centre energy consumption, including promoting industry best practices to help IT managers start to reduce energy consumption.

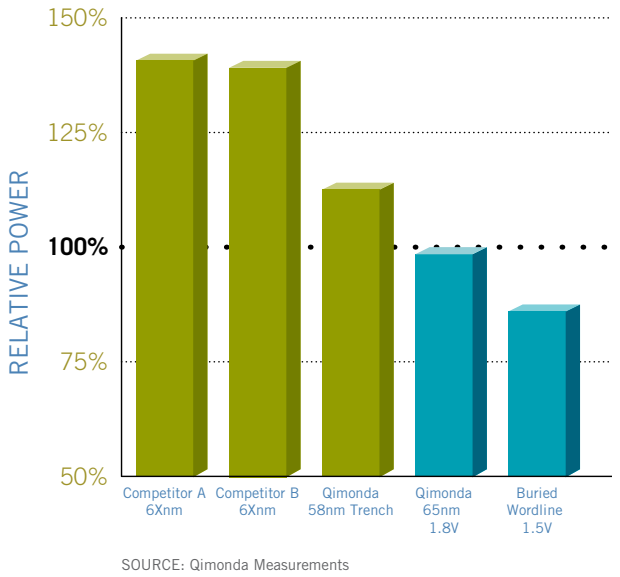
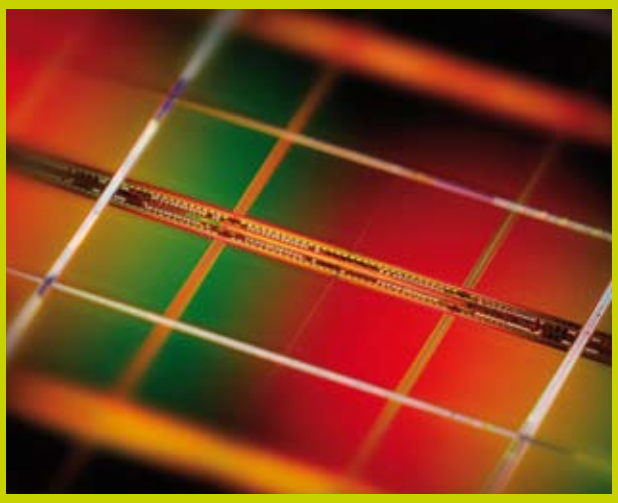



**Figure 8** — Power savings through the use of Buried Wordline (courtesy Qimonda)



**Picture 9** — Buried Wordline DRAM technology that combines high performance, low power consumption and small chip sizes (courtesy Qimonda)

## Qimonda — Enabling reduced power consumption through innovative memory development

At Qimonda, energy efficiency is a prime focus of development. With the introduction of its innovative buried wordline memory technology Qimonda is addressing energy consumption per device both in the manufacturing process as well as in the field operation. Due to the inherent leaner process complexity of the buried wordline technology and the efficient nature of the buried wordline 6F2 cell structure more perfect devices per wafer can be produced, thus the energy consumption per device manufactured is reduced considerably.

An other critical advantage of this innovative process architecture is the significantly reduced electrical parasitic compared to other state of the art memory process technologies causing Qimonda's memory devices to consume considerably less power in operation.[15] Lower power consumption results in less heat loss on the one hand side and thus reduced energy usage related forced cooling in server and data centre type applications. One the other hand lower power consumptions enables longer battery life for portable applications. Independent of the innovative buried wordline process technology it is our development goal to reduce the power consumption of our products from generation to generation by more than ten percent, for example, by minimizing geometrics, supply voltages and standby consumption. With the introduction the buried wordline technology Qimonda has set the foundation for a sustainable roadmap in energy efficient product offerings tailored for data centres, home computing and graphic applications. To make an effective contribution to energy conservation, our products are optimized for minimum power consumption in end-applications right from the development phase. Qimonda is known as a key memory enabler for the introduction of leading edge products such as DDR3 as well as GDDR5. These state-of-the-art memory products significantly reduce power consumption while offering higher data bandwidth within the memory subsystem. Their use in IT infrastructures and in consumer electronics heralds a long-term reduction in energy requirements for all electronic applications which employ memory products.

*"Qimonda has set the foundation for a sustainable roadmap in energy efficient product offerings tailored for data centres, home computing and graphic applications."*

# CHAPTER 3

## SUSTAINABILITY IN THE EUROPEAN SEMICONDUCTOR MANUFACTURING PROCESS

The following examples demonstrate the commitment of the European semiconductor industry to resource conservation and to the reduction of environmental footprints attributable to the production process of microchips in Europe. Technological progress brings many positive things to society but is not without challenges for the environment. Absolute consumption of materials used for production continues to increase in the information technologies sector and unfortunately $CO_2$ emissions and waste generation remain a part of the manufacturing process. The industry is focusing on reducing, reusing or recycling natural resources used in production where possible and practical to do so.

### AMD — Dresden, Germany

- **Low-carbon energy from tri-generation for fabrication facilities (Fab)**

Energy Centre I (EVC I) and Energy Centre II (EVC II) are specially designed tri-generation facilities that supply the electrical, heating, and cooling demands of AMD Fab 30 (now being converted into Fab 38) and AMD Fab 36 respectively. EVC I began supplying energy to Fab 30 in 1998. During its initial ten years of operation, the tri-generation system has achieved a total average energy efficiency of more than 72%.

Waste heat from electricity production in the co-generation system is used to generate heating and cooling. As a result, tri-generation system efficiency is much higher than that of a conventional energy supply system where electricity and heat as well as cooling are generated separately. EVC II began operating in 2005, supplying all of the energy needed for AMD Fab 36. To date, the EVC II has achieved a total average efficiency of almost 84%, 12% more than that of EVC I due to better heat extraction from the natural gas combustion engines and better utilization of the respective heating and cooling energies within the AMD Fab 36 facilities. Annual avoided emissions compared to a conventional electricity generation solution are estimated to surpass those avoided by EVC I.

Over the last ten years, the combined operations of the EVC I and EVC II facilities have avoided more than 222,000 MTCE (metric tonnes carbon equivalent) of greenhouse gas emissions when compared to emissions from a conventional energy supply. This calculation assumes that the local utility company would buy electricity from a base load power plant fuelled with brown coal, while heating and cooling would be supplied on-site and fuelled by natural gas. This would have been the most likely conventional scenario considering the amount of energy needed, existing capacity at the local utility company and the unique nature of the site's electricity demand profile, which shows minimal daily variation. In 2007 alone, avoided greenhouse gas emissions from the combined operations of both co-generation plants were estimated at 48,600 MTCE. This equals 3.6 % of the City of Dresden's total $CO_2$ and Methane emissions[16] and is also more than the total of annual per capita MTCE emissions of 16,500 average Germans.[17] In 2007 the EVC II was elected "Cogeneration plant of the year 2007" in Germany by the Bundesverband Kraft-Wärme-Kopplung (Federal Combined Heat and Power Association).

16 Reference Year: 2004, http://www.dresden.de/de/08/03/c_0225.php?PHPSESSID=ea8225o3m158oop867ka4t99p6

17 Calculation according to http://uba.klima-aktiv.de, with 10.88 t $CO_2$ being the annual $CO_2$ per capita emission in Germany.

**Picture 10** — tri-generation facilities AMD Dresden (courtesy of AMD)

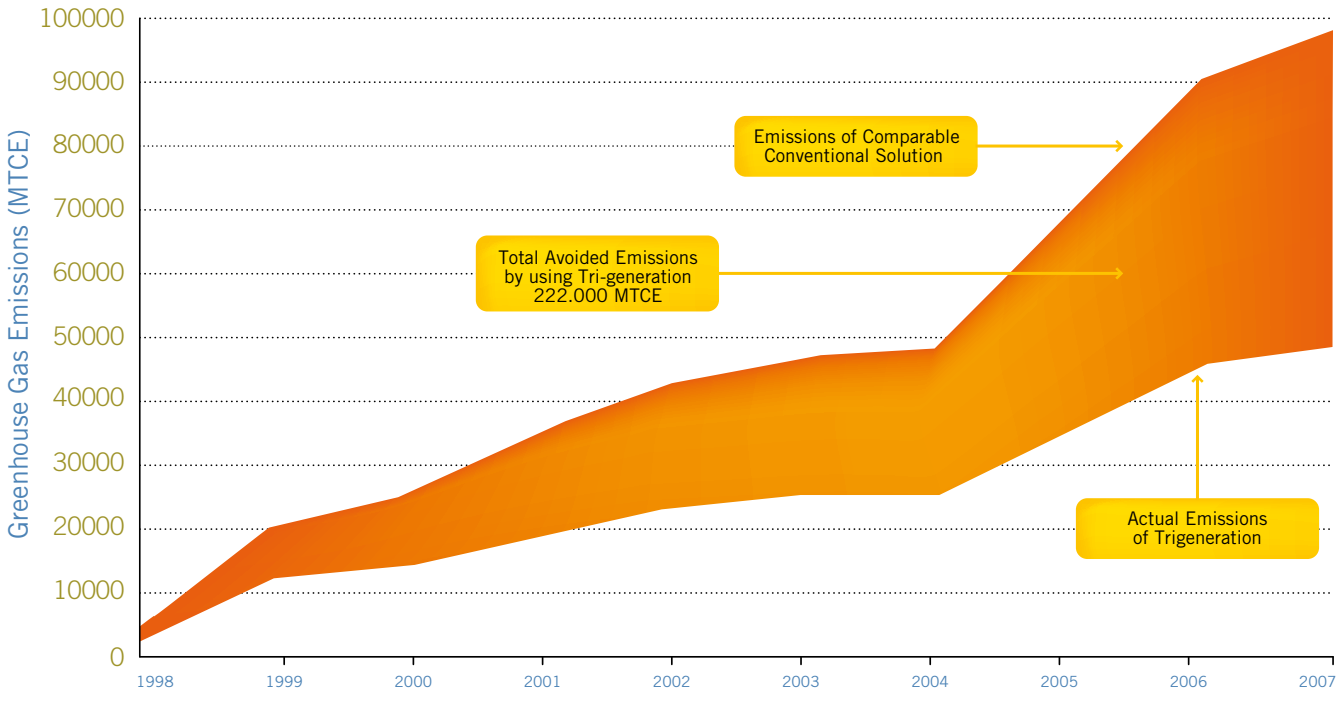



**Figure 9** — Avoided greenhouse gas emissions through use of tri-generation facility (courtesy of AMD)

## Qimonda — Dresden, Germany

### Energy reduction in the production process

Qimonda is highly aware of its ecological responsibility. We are committed to minimizing the effects of our activities and products on the environment. Besides reducing for example our water consumption, waste production and emissions we also continuously search for best practice solutions in implementing energy-saving measures such as efficient use of conditioned air within the cleanrooms and utilization of waste process heat to produce hot process water.

At the 300mm facility in Dresden, Qimonda has implemented many such measures which help reduce energy consumption at this site.

- Cooling of process cooling water through raw water: process cooling water is partially cooled through raw water, at the same time deionized water (DI) is heated. This results in less energy needed for heating (880.000kWh/a) (kilowatt hour per annum) and cooling (880.000kWh/a equal to approx. 175.000kWh/a in electricity).

- Usage of heat from neutral exhaust air: pre-heating of conditioned fresh air (air-air heat exchange) results in less energy needed for heating (gas) and cooling (chillers), which equates to 6.150.000 kWh/a less heating energy.

- Even more efficient than air-air heat exchange is the pre-heating of incoming air through heat of returned process cooling water. The heat of the returned process cooling water is used to pre-heat conditioned fresh air, especially in winter. This results in 11.380.000 kWh/a less heating energy (gas) and energy for chillers 11.380.000 kWh/a, which equates to approx. 1.625.000 kWh/a electrical energy.

- Free cooling effect: during winter the cold temperature is used for the production of process cooling water through cooling towers. This results in less electrical energy needed for chillers, which is on average 760.000 kWh/a.

- Cooling of compressors - usage of heat exchange: the returned flow from heating water is used to cool down the heat generated by compressors. This heat is than used to pre-heat DI water, which results in less heating energy (8.550.000 kWh/a) and less energy needed for chillers (8.550.000 kWh/a equal to approx. 1.425.000 kWh/a electrical energy)

## NXP — Nijmegen, The Netherlands

### Environmentally-friendly packaging concept thanks to cooperation between NXP and Hakapak High Tech Packaging

NXP Semiconductors and Hakapak High Tech Packaging have together developed a completely new environmentally-friendly packaging concept for the transport of chips from Europe to Asia. Thanks to this new packaging method, NXP no longer has to use non-recyclable and environment-polluting polyether foam. Additionally, by saving 6,000 kgs of wood and 30,000 kgs of cardboard, a reduction in volume of 60% for air cargo can be achieved.

Every year NXP ships millions of wafers from Europe to Asia. A wafer is a silicon disk on which chips are placed. Wafers are exceptionally vulnerable. The requirements for the strength of packaging materials necessary for safe transport are therefore very demanding.

NXP is continuously improving its business processes and is actively looking for environmentally-friendly solutions. The company is party to the covenant for sustainable business. Thanks to its cooperation with Hakapak, supplier of industrial packaging, NXP has succeeded in developing new packaging methods that not only meet the highest standards but at the same time are far less of a burden on the environment. The new packaging is made of (partly) recycled cardboard and, because of its shape, is much more compact and therefore space-saving.

Due to this unique teamwork, the bulk wafer transport team, comprised of employees from NXP Nijmegen and Hakapak Eindhoven, won the public prize (Vox Populi Award) in the NXP Business Improvement Competition (BIC).


**Picture 11** — NXP's environmentally-friendly packaging concept

## NXP — Nijmegen, The Netherlands

- ***Dark Green Programme***
  **Caring for the waste stage of the life cycle through material management and eco-design thinking**

NXP Nijmegen has initiated an aggressive strategy to ensure the end-of-life stage of their products is managed well. This is called Dark Green, which means that the products are RoHS compliant, halogen free and free of antimony oxides. By the end of 2009 NXP estimates that this conversion to 'Dark Green' sustainability policy will have reached 75% of all their products.

## NXP — Hamburg, Germany

- **Bio-filter technology: an innovative and highly cost-effective system for removing VOCs**

The Bio-filter system is a highly cost-effective system with excellent efficiency for VOC (Volatile Organic Compounds) treatment. For the company's site, this abatement concept is the best technology for environmental protection and meets all the requirements of German and European law. The application of this new technique in the semiconductor industry was an interesting challenge for the project team at NXP Semiconductors Hamburg.

New legal limits for VOC emissions in Europe and Germany and NXP environmental policy make it necessary to treat the exhaust air from different production processes at the NXP Semiconductor site in Hamburg. The new German legal limit for VOC concentration in exhausts is 50 mg/m3.(Carbon Equivalent) Because various systems are available on the market, the task of the local project team was to find a cost-effective and applicable technology for NXP Hamburg. After conducting comprehensive investigations into all available abatement tools adapted to the VOC data in our semiconductor fab, it became obvious that there were only two technologies suitable for NXP: the regenerative thermal oxidation and the bio- filter system.

Regenerative Thermal Oxidation (RTO) is the standard system in the semiconductor industry. In RTO, the VOCs are converted by a burning process using natural gas into carbon dioxide ($CO_2$) and water ($H_2O$) along with the by-products nitrogen dioxide ($NO_x$) and carbon monoxide (CO).

In the Bio-filter system, VOCs are absorbed into a natural filter material and are completely biodegraded by microbes to $CO_2$ and H2O. No harmful by-products are created.

The team in Hamburg fully evaluated the two options. The running costs for the Bio filter system are about ten times less and in contrast to thermal oxidation, the natural oxidation process in a Bio filter produces no surplus $CO_2$ and no critical burning by-products such as CO and NOx. In addition, the contribution to $CO_2$ air pollution is significantly lower than that of the RTO. Although used in many industries such as food and automotive, this biological abatement process is relatively new to the semiconductor industry so the team performed a 3-month pilot to ensure that they made the right decision. By the end of 2007 Hamburg was running two Bio-filter systems; one for each of the two fabs on the location. Because of these two systems the VOC emissions for NXP Hamburg was reduced by more than 90%.

The Hamburg Bio-filter project was presented to the German Electronic Industry Association (ZVEI) at a number of environmental conferences as a best practice and since then the site has hosted visits from several different companies/ industries (e.g. Daimler, Reemtsma, European food industry) wanting to see the company's Bio-filter systems in operation and to learn from its experiences with this technology.

## Texas Instruments — Freising, Germany

### Energy savings in manufacturing

Texas Instruments established a special task force at its manufacturing site in Freising, Bavaria that focuses on efficient energy use. From 2003 to 2007 the Freising wafer fab capacity has been doubled but not so the energy demand. The site reduced by 34% the energy attained from a community heating network during the same time period with the associated cost savings of approximately Euro 1.5 million. In 2008 alone 11 energy savings projects including electricity, heating and natural gas have been realized which have lead to important energy savings. The environmental benefit has resulted in a reduction of 5.500 t $CO_2$ being released and a savings of 10 giga watts. Amongst the simple yet innovative projects undertaken was to minimize the chemical storage area used to store the temperature sensitive photoresist. This action saved on using cooling energy for the temperature controlled storage room.

## STMicroelectronics — Rousset, Grenoble in France and Agrate, Catania in Italy

### Climate change: a key driver for environmental actions and achievements

Like every company, ST functions as an open eco-system. It needs external inputs such as energy and raw materials to operate its manufacturing processes, but its production of components, which are used in a wide variety of electronic applications, also generates less-desirable outputs such as waste, $CO_2$ and other emissions. These inputs and outputs have environmental impacts, one of them being a contribution to climate change, which we consider a major global challenge requiring the focused, consistent efforts of all social actors to alleviate its alarming impact on our planet. ST integrated a formal, structured approach to climate change into its environmental policy in the early 1990s. Working with the World Business Council for Sustainable Development (WBCSD) at that time helped us to define the areas for action and improvement relating to $CO_2$ emissions and other greenhouse gases (GHG). ST has been measuring these impacts with its own indicators since 1995, when it published its first Environmental Decalogue. Its reporting on perforance has also consistently evolved since 2002 in line with Global Reporting Initiative (GRI) guidelines.

*"ST has been measuring these impacts with its own indicators since 1995, when it published its first Environmental Decalogue."*

### Actions in the supply chain

Since 1999 the company has strongly encouraged its suppliers to become ISO 14001-certified and EMAS-validated, and it has supported them with training courses on environmental awareness. In 2007, 80% of its suppliers and 93.5 % of its subcontractors were ISO 14001-certified. More recently it has adopted the EICC Code of Conduct, which includes a focus on air emissions, as its official supplier code of conduct and it is progressively deploying this code to its suppliers and subcontractors. The company's participation in the EICC and its routine engagement with its customers allows it to monitor and understand the environmental needs of its business partners, who are increasingly concerned about climate change issues. The company's Environmental Decalogue includes as an objective the progressive increase of its purchase of green or $CO_2$-free energy and increased use of renewable and alternative energy. In 2007, 28.6% of the

company's purchased energy was $CO_2$-free, including nuclear energy, and 3% was green (nuclear energy excluded). The company's wind farm in the South of France and photovoltaic and solar thermic panels at several of its sites contribute to helping it achieve this objective.

### ▪ Actions in the company's manufacturing operations

Approximately 70.3% of the company's global energy consumption comes from primary energy (fossil fuels), so the reduction of energy consumption plays an important role in limiting manufacturing impact on climate change. To meet its Decalogue target and annual roadmaps, the company has been consistently reducing its energy consumption per production unit. Today, thanks to clear targets, strong efforts and the spreading of good practices among its sites around the world, the company has decreased consumption by 47.7% since 1994, on average more than 5% per year.

### ▪ Actions in logistics and transportation

The semiconductor market is highly dynamic and requires fast delivery to market, which often means using airplanes to get the company's components to their destination. However, the company's products are quite light, so overall $CO_2$ emissions linked to transportation remain rather low. It has been estimated that all transportation linked to its activities (including employees on business trips and travelling from home to work) represents only 6.4% of the company's total $CO_2$ emissions. As part of the culture of sustainable excellence in everything the company does, several local initiatives have been launched over the years to reduce the impact of employee travel to work (for example, through car sharing, bicycle services and innovative public transport schemes), notably in Grenoble and Rousset, France, as well as in Agrate and Catania, Italy.

## Infineon — Regensburg, Germany

### ▪ Energy recovery from factory air conditioning systems

In addition to Infineon technologies' resource and energy management concepts, the company's individual sites also implement individual economy measures. For example, semiconductors are manufactured in cleanrooms with complex air conditioning systems. Various heat and cold recovery systems are deployed to reduce heating and cooling inputs. These systems use heat from a re-circulating cooling system, for instance, to preheat the cold outdoor air in the winter. All the buildings for frontend production in Regensburg/Germany have been equipped with these systems since 2002. In 2005, the energy recovered from the air conditioning system was approximately 9,000 megawatt-hours, equivalent to around 902,000 cubic meters of natural gas or the heating energy needed for 300 average 4-person households. This allowed carbon dioxide emissions to be reduced by 1,782 tons per annum.

## Intel — Leixlip, Ireland

### ▪ Dedicated funding for energy efficiency and resource conservation projects

Intel has implemented a dedicated capital funding programme that allocates funds solely for the purpose of conservation and efficiency projects. This programme preserves the importance of these improvements and keeps funds from being re-allocated for other purposes. Many energy-efficiency and conservation improvements have been implemented across Intel, including additional efficient lighting; "smart" system controls; boiler efficiency; chilled water improvements; cleanroom heating, ventilation, and air-conditioning improvements; and improved operating processes and procedures. As a result, Intel's energy use in 2006 was reduced by more than 160 million kilowatt-hours (kWh).

# USEFUL WEB LINKS

## ESIA MEMBERS SUSTAINABILITY, ENVIRONMENTAL AND CORPORATE SOCIAL RESPONSIBILITY WEB PAGES

**Altis Semiconductor:**
http://www.altissemiconductor.com/en/politiqueEnvironnement.php

**AMD:**
http://www.amd.com/us-en/0,,3715_14217_14202,00.html

**Bosch:**
http://www.bosch-umwelt.com/up/en/html/index.htm

**Freescale Semiconductor:**
http://www.freescale.com/webapp/sps/site/homepage.jsp?nodeId=065612

**Infineon Technologies:**
http://www.infineon.com/cms/en/corporate/company/csr/

**INTEL:**
http://www.intel.com/intel/environment/index.htm?iid=about_intel+cm_environ

**Micron:**
http://www.micron.com/quality/environment/pbfree

**Micronas:**
http://www.micronas.com/company/environmentalpolicy/index.html?backurl=%2Fcompany%2Fenvironmentalstatement%2Findex.html&l=71586

**Numonyx:**
http://www.numonyx.com/en-US/About/EHS/Pages/EHS.aspx

**NXP:**
http://www.nxp.com/profile/corporate/index.html

**Qimonda:**
http://www.qimonda.com/about/corporate_responsibility/index.html

**Renesas:**
http://eu.renesas.com/fmwk.jsp?cnt=/env_category_landing.jsp&fp=/support/environmental_activity&site=i

**STMicroelectronics:**
http://eu.st.com/stonline/company/cr/environment/index.htm

**Texas Instruments:**
http://www.ti.com/corp/docs/csr/index.shtml

# ABOUT ESIA

The European Semiconductor Industry Association (ESIA), part of the European Electronic Component manufacturer's Association (EECA), represents the European-based manufacturers of semiconductor devices. The semiconductor industry provides the key enabling technologies at the forefront of the development of the digital economy. This sector supports around 115 000 jobs in Europe.

## EECA-ESIA MEMBERS

*Companies*

Altis Semiconductor
AMD
ATMEL
Robert Bosch
Freescale Semiconductor
Infineon Technologies
Intel Corporation
Micron Technology
Micronas
Numonyx
NXP Semiconductors
Qimonda
Renesas Technology Corp.
STMicroelectronics
Texas Instruments

*National Associations*

AGORIA (BE)
ANIE (IT)
ANIEL (ES)
FEEI (AT)
HSIA (GR)
NMI (UK)
SITELESC (FR)
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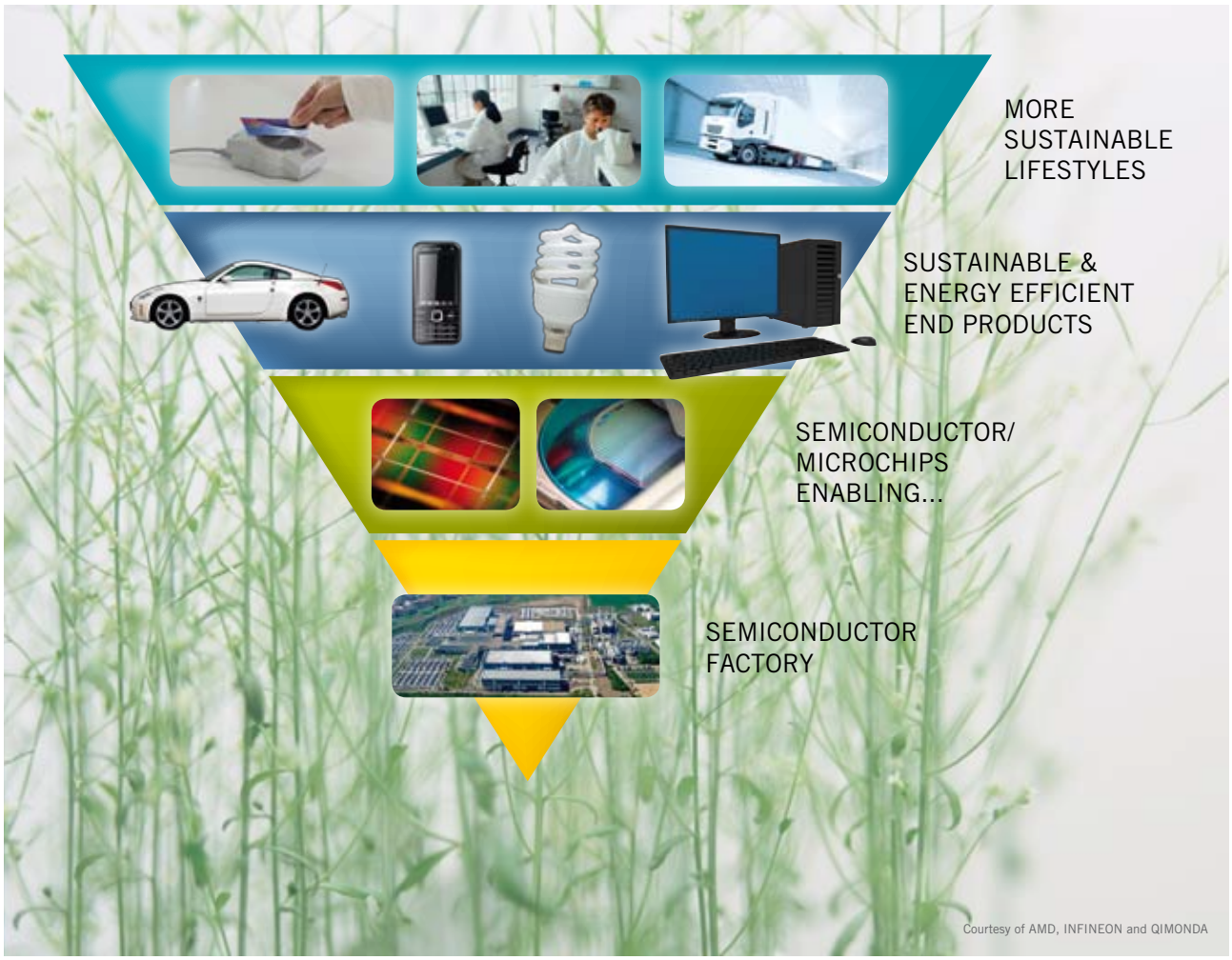
## SEMICONDUCTORS - At the origin of sustainable lifestyles

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