Power semiconductors are key enablers for modern, smart products. Setting up a pan-European pilot line dedicated to power semiconductor manufacturing, the EPPL project enables a wealth of innovation of direct impact on our everyday life.
“The only way to do great work is to love what you do.”

**Focus on EPPL project – faster together**

We at CTR use the CTRtimes magazine to provide regular information on the research centre’s projects, results and current research questions. In this issue however we have dedicated all 16 pages to one topic: the Enhanced Power Pilot Line (EPPL) project. It not only has a remarkable geographical reach with 31 partners from six nations in the consortium, but will also be of great significance for Europe in the future.

The EPPL project focuses on developing next-generation power semiconductors and forward-looking fabrication methods in Europe. In addition to improving the technology involved, another of its main objectives was to make energy-efficient applications more commercially viable in the spirit of “innovation meets manufacturing and the market”. We will give you details of the work performed and the results of the EPPL project on the following pages. They are proof of how science and industry can collaborate effectively to shape Europe’s future and enhance its competitiveness.

The good network of partners consisting of application-oriented research centres, universities, colleges, centres of excellence and partners in business and industry gave rise to a vital dynamic that drives innovations faster. This results in gains for both the project partners and the general public alike: science and application-oriented research centres – like us – promote the exchange of expertise and tackle challenges with practical implications. Industry benefits from the expert knowledge, special facilities and technological findings in working towards future business success. And the general public – that is to say all of us – benefit from new, energy-efficient products and applications in energy generation, the automotive industry and medical devices. You will find further information on the following pages.

We are proud of having been part of the consortium and hope you find reading this issue informative.

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**Collaborative research to maintain leadership**

Electronic components are a key enabler for smart systems to address the Grand Challenges in society. In fact, innovative technologies and smart manufacturing act as a source of innovation in many areas of our daily lives. Innovative cars, smart production equipment, efficient use of energy, assisted living and modern communication, to name just a few, are enabled by power electronics components.

In its Europe 2020 initiative, the European Commission set ambitious targets to reduce greenhouse gas emissions, improve energy efficiency and establish electric vehicles in Europe. Power semiconductors designed and manufactured at competitive cost and in sufficient quantities in Europe are key enablers here, and the EPPL project was launched to play a major role in achieving these targets.

Collaborative innovation at a European level is vital to speeding up time to market. It was the strong focus on practical application that made the EPPL results and achievements attractive for industry. The financial contributions by the ENIAC JU and the member states involved also supported the partners significantly in meeting their challenging project targets. Manufacturing was another area fostered in the EPPL project, as 300mm wafer-based technologies pave the way to competitive cost structures for power solutions made in Europe.

A project volume of €74 million and the commitment on the part of 31 partner organisations underlines the importance of EPPL for the semiconductor industry in Europe. The project objectives are fully in line with Infineon’s strategy and we are therefore proud and honoured to have led this powerful partner network, thus contributing our experience in this area to the EPPL project and to Europe’s technology advancement.

Many thanks to all the stakeholders for making these great achievements happen.

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Werner Scherf  Simon Grasser  Sabine Herlitschka  Thomas Reisinger
Chief Executive Officer  Chief Financial Officer  Chief Executive Officer  Board Member Operations
CTR Carinthian Tech Research AG  Infineon Technologies Austria AG

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Photos © Helge Bauer, Martin Steinthaler, Henry Welisch (2), Alun Foster (2)
EPPL innovation meets power semiconductors

When people think of the future, they tend to assume that the current rate of progress will continue for long periods to come. However, experience shows that the rate of progress is not constant and depends largely on investments and strategies. For this reason Infineon Technologies was proud to lead the collaborative project – Enhanced Power Pilot Line (EPPL). The main purpose of the project is to expand European capabilities and competitiveness in developing and producing power electronics for semiconductor components.

A total of 31 European partners from industry and research collaborated to advance production technology for power semiconductors, an industry segment where Europe still holds the leading position. Europe is home to the first power semiconductor facilities fabricating devices using 300mm wafer technology, i.e. on silicon wafers that are extremely thin – hardly thicker than a sheet of paper. With EPPL, Europe further expanded this production advantage.

The partner organisations cover the entire industry and research value chain in 300mm power semiconductor manufacture, comprising material research with a focus on silicon, semiconductor development that includes 3D integration and packaging, and related developments in logistics and automation technologies. After three years of collaborative research in the previous ETP300 project (2012–2015) and three years in EPPL (2013–2016), we reached our primary objective of expanding the wafer size limit for power semiconductors made in Europe to 300mm wafer diameters. The first products now qualify for release on the international market, and exciting new products will be created using advanced power semiconductor technologies. This magazine summarises some of the results of the EPPL activities and accomplishments during the project.

Three years passed quickly and it is now time to look at the very exiting results and say thank you to the stakeholders involved. This applies to the ENIAC JU and the public authorities in the contributing member states for their financial support to the EPPL project. We are also indebted to the project officer at the ENIAC JU for the professional guidance given during the project. But most of all we are grateful to the consortium members for their outstanding spirit of collaboration and goal-oriented approach, which enabled the EPPL project to achieve these outstanding results. Together, we strengthened European industry and research by innovating advanced semiconductor products made in Europe. Enjoy reading.

Cristina De Luca
Project Manager
Infineon Technologies Austria AG

Johann Massoner
Project Coordinator

Systemic & strategic impact

A pilot line project, EPPL was co-funded within the framework of the ENIAC Joint Undertaking (ENIAC JU) by the European Union, the ENIAC member states and their national funding authorities. One of the key achievements of ENIAC JU, if not its most important accomplishment, was the successful implementation of the pioneering pilot line concept. Having allocated around €1.8 billion to 14 pilot line projects over two years, ENIAC JU funded a mechanism to take European R&D electronics from lab scale towards production readiness with unparalleled systemic and strategic impact. This strategic implementation – a first in Europe – was only made possible by the resolute and well-timed cooperation between the respective national authorities and ENIAC JU.

In 2014, a new generation of public-private partnerships was established under the H2020 programme and the Electronic Components and Systems for European Leadership Joint Undertaking (ECSEL JU) took over the ENIAC JU projects, continuing to further and strengthen its impact. Through new calls for proposals and new initiatives e.g. Lighthouses, ECSEL JU strives – together with all its stakeholders – to create more opportunities and leverage investments on levels ranging from the local and regional to the pan-European.

EPPL belongs to a strong and continuous series of investment commitments (ETP300, eRAMP, PowerBase, SemI40 projects) supported by ENIAC JU/ECSEL JU and the countries’ national or regional funding authorities, with the ambitious aim of reinforcing and advancing one of the core strengths of European electronics: power semiconductors and the industries that rely on them, resulting in growth and jobs. EPPL is a step forward in reaching the ultimate goal of excellent electronics made in Europe.

As a programme officer, it was a rewarding experience for me to see how EPPL successfully developed from ideas to real life implementation. It was a long and challenging path but the participants’ motivation and the coordinator’s driven leadership resulted in everyone going the “extra mile” to make it happen.

Simona Rucareanu
Programme Officer
ECSEL Joint Undertaking

Bert De Colvenaer
Executive Director
ECSEL Joint Undertaking
Next Generation Technologies

- SFET
- Cool MOS™
- IGBT
- ACD

Key Applications

- Renewable Energies
- Automotive Energy Systems
- Automotive LED Illumination
- Healthcare

31 partners

- 20 industrial partners
- 6 research & technology organisations
- 5 universities

€72m total project volume

€23m public funding

€10.8m EC / €1.2m national

€49m industry investment in Europe

3.5 years of joint research

6 European countries
~ 239 experienced researchers
~ 30 Phd students
21% female
79% male

124 scientific publications
7 PhD theses
11 MSc theses

EPPL PROJECT

Key Facts

Addressing technological challenges together with commercial competitiveness and energy efficiency, EPPL aimed at securing Europe’s leading position in power semiconductors. The achievements are groundbreaking:

- 27 Process Innovations
- 16 Product Innovations
- 14 Original Patents
- 15% size reduction compared to previous technology generation
- 15% up to -50% size reduction

4 technology work packages
3 application work packages

Advanced Power Semiconductor Pilot Line
Technology & Demonstrator Research
Semiconductor Assembly & 3D Integration
Advanced Logistics and Automation

Renewable Energies
Automotive Applications
Healthcare

Application I: Renewable Solar Energy WP5
Application II: Automotive WP6
Application III: Automotive LED (replaces former WP7) WP6
Application IV: Healthcare WP8
Application V: Automotive WP9

WP1 Advanced Power Semiconductor Pilot Line
WP2 Technology & Demonstrator Research
WP3 Semiconductor Assembly & 3D Integration
WP4 Advanced Logistics & Automation

WP9 Dissemination, Exploitation & Standardisation
WP10 Project Management
The EPPL project's prime objective is to build a fully functional, yield-proven pan-European pilot line for fabricating next generation power semiconductors. The unique opportunities offered by 300mm manufacturing technology, combining higher energy and cost efficiency with better production yield and improved device reliability, are demonstrated on four next-generation technologies - ACD7, SFET6, CoolMOS™ and IGBT4.

A wide range of technologies, materials, processes and equipment is needed to manufacture the different power semiconductors, making high-volume fabrication on one pilot line extremely challenging. Processes and equipment had to be specifically defined and adapted for the manufacture of the next generation demonstrator technologies using the 300mm wafer platform. To ensure efficient production, special attention was given to new methods and tools for the various production steps and processes. Examples range from a new gas cabinet design (partner ALES) for efficient (pilot) line operation to novel plasma doping solutions developed by IBS that facilitate highly cost-efficient implantation.

NEW MATERIALS & TOOLS
Increasing miniaturisation of semiconductor devices leads to higher power densities and thus stronger thermo-mechanical loading of the semiconductors and metallisation layers. Improved materials are required to withstand these increasing temperatures and thus guarantee full device functionality. With special emphasis put on further improved device reliability, metallisation development became one main project focus. Related R&D activities hence aimed at new materials, but also on the analytical tools

Novel products using new generation power semiconductors and a pilot line for high-volume fabrication based on 300mm technology are the EPPL project’s main goals. To enable that, a wide range of new methods and tools had to be developed.

[Work Package 1 & Work Package 2]
needed for successfully producing next generation devices and on characterising the devices throughout the development phase. Research partner CEST, together with Infineon, developed a new copper-based metallisation process designed to meet these demands. At CTR Carinthian Tech Research the deposition of metallisation layers onto 300mm silicon wafers was modelled to understand the effect of residual stresses on manufacturability, e.g. the influence of wafer bow on automated wafer handling or high precision lithography.

METHOD DEVELOPMENT
The Montanuniversität Leoben, KAI and the Max-Planck-Institut für Eisenforschung jointly investigated the degradation of metal layers caused by repetitive heating during device application. One aspect in this research dealt with method development to allow faster evaluation of newly developed metallisations as to their resistance to degradation. In parallel, material behaviour during application was investigated in detail to identify the underlying mechanisms that dominate metal degradation. Graz University of Technology for instance examined microscopic defects in silicon that could originate either from production, e.g. by proton implantation, or application, with the goal of gaining a better understanding of such defects’ influence on product performance and reliability.

PROVEN ENERGY EFFICIENCY
In several development cycles, manufacturability and performance of the next generation power devices were optimised and their functionality and reliability proven in final qualification tests. The results of the validation and qualification tests show that the initial goals have been reached. The functionality of the 300mm technology-based power pilot line was shown, and significantly improved energy efficiency proven for all device types.

The project complemented Infineon’s design and product development competence with the expertise of various industrial and academic, Austrian and European partners. The ensuing research activities contributed significantly to the success of product development of both the next-generation power technologies and the new and emerging applications relying on them. Furthermore, scientific key results were published in numerous conference proceedings and peer-reviewed papers.

INTERVIEW WITH PETER IRSIGLER AND JOSEF FUGGER
Three questions to the work package leaders

1. **What was the greatest challenge in these work packages?**
   “As many processes and base materials in power technologies are very specific, the greatest challenge was adopting these steps for the 300mm manufacturing platform. The material had to satisfy the demands of each technology. Ultra-thin wafer and high-temperature processing for example had to be developed from the very beginning. In some cases the standard equipment available on the market did not meet the requirements and had to be modified to our needs.”

2. **What were the highlights?**
   “All four demonstrators were developed and qualified successfully to schedule. They have created the basis for silicon-based power technologies at Infineon and all such future products will be developed and produced on 300mm wafers. The next generation based on 300mm manufacturing capabilities shows a great improvement in productivity (e.g. CoolMOS™, ACD7). Close interaction and collaboration between all the partners proved to be a key success factor. The academic partners’ latest results in material research were quickly incorporated in technology development and production.”

3. **What will be the sustainable impact for the semiconductor industry?**
   “The 300mm platform developed is setting a new productivity benchmark in this sector. Such advanced manufacturing capabilities will drive further innovation, unlock potential and enable new features in technologies and related products. New materials and characterisation methods will support engineers in designing more powerful and at the same time more robust semiconductor products.”
3D Integration & Chip Interfaces

Semiconductor assembly and 3D integration directly impact performance, lifetimes and costs of power devices. In particular research into materials was of critical importance for improving electrical properties, heat dissipation and stress management.

Miniaturisation and integration of greater functionality are major trends in power electronics, which require possibly low parasitic effects for optimal signal transmission alongside the ability to work under increasing temperature demands. Assembly and packaging thus become key objectives calling for innovative technologies and components. A main aspect in miniaturisation is using the third dimension, which is highly challenging in particular with power devices. The best technology is thus needed, requiring a thorough in-depth understanding of processes and materials.

The work package pooled experts along the full value chain, involving suppliers of materials like Plansee alongside equipment providers SPTS and EVG, semiconductor manufacturers Infineon and ams, and packaging foundry Nanium. Their work was supported by leading European research and technology organisations, such as the Fraunhofer IISB, CEA-LETI, INL and CTR contributing:

- research on technologies for the chip/package interface, including pre-assembly
- research on 3D integration technologies with an interposer applicable for power devices, including a first pilot line
- research on a 3D test vehicle demonstrating the technologies, and on reliability of chips from 300mm devices for power modules

**Processes & Materials**

Investigating the processes affecting the chip/package interfaces included liner sputtering, galvanic copper (Cu) deposition and Cu structuring to deposit Cu backside metallisation on power chips. A dedicated thermal laser separation technology was developed for bonded wafer stacks with silicon dioxide interfaces and interposer wafers with through-silicon vias (TSV) and redistribution layers (RDL). This led to significantly reduced in-die stresses and chip edge defects. Another team investigated extending Advanced Process Control methods to assembly and packaging of semiconductor devices. Initial results on wedge wire bonding showed encouraging process improvements. Infineon meanwhile successfully applied a highly conductive die attach adhesive for assembling 125μm thin dice and collaborated with Plansee on improved heat dissipation interfaces of molybdenum composites with mould compounds and silicon. Molybdenum is particularly attractive since it has a coefficient of thermal expansion close to that of silicon, thus introducing less thermal stress than the normally used copper.

**3D System Integration**

Led by ams, seamless 3D system integration for power applications was intensively researched. The processes on the ams interposer pilot line were refined and a tungsten (W) TSV module developed. Research addressed industrial high etch rate recipes and metal and dielectric layer deposition for TSV technology with an aspect ratio 5:1 (TSV depth to diameter). Apart from the W-TSV, a TSV module with Cu metallisation and a Cu RDL were developed, thus achieving...
considerably improved TSV and line resistances: first interposer samples have TSV resistances as low as 3mOhmTSV. Die-to-wafer stacking (D2W) complemented the 3D technology modules.

As 3D devices are sensitive to defects on both sides, smooth sidewalls with minimum chip out are required. Thermal laser separation (TLS) again was studied and optimised for such 3D applications. A final main 3D topic was fan-out wafer-level packaging (FOWLP) with through-mould vias. Following investigation of various concepts, temporary wafer bonding technology for FOWLP was brought to volume production readiness.

TEST VEHICLE & RELIABILITY
To demonstrate 3D system integration viability, a dedicated technology test vehicle for power applications was designed and realised. Incorporating an Infineon power device, an ams/CEA-LETI interposer and Cu pillar D2W, the co-design was supported by extensive thermal and thermo-mechanical simulation.

In parallel, the reliability of chips from the 300mm wafer line in power applications was studied under the lead of Infineon Warstein. Module reliability investigations focused on high temperature reverse bias, high temperature gate stress and high humidity/high temperature reverse bias, all of which were concluded successfully. Correlations of the chips’ static electrical parameters using 300mm wafer technology were found to be within the limits, and no differences found between qualification and reference modules, illustrating the maturity of the technology solutions developed in EPPL.

“Innovation has become a collaborative process, linking firms and research institutions. Our results constitute scientific and technical knowledge produced, acquired, pooled and systematised by the whole work package team.”

Franz Schrank, Group Manager 3D and Wafer Level Integration, ams AG (Unterpremstätten/Austria)
Advanced Logistics & Automation

The combination of intelligent logistics with a high level of manufacturing automation is one cornerstone in implementing the world’s first 300mm pilot line for power microelectronics, and directly reflects Infineon’s strategy for achieving manufacturing excellence.

The optimal utilisation of advanced automation and intelligent logistics nowadays is a necessity for establishing a high-mix, high-volume 300mm wafer manufacturing pilot line. Other than with 300mm CMOS fabs, several of the specific processing tools for power electronics are not automated, and established mass production standard logistics are barely applicable. Moreover, many next-generation power devices involve special thin wafers, requiring singular processes, excellent cross-functional know-how and creating unique challenges for system automation in a front-end wafer facility.

**ADVANCED WAFER HANDLING**

Defining new transportation and handling procedures required combining theoretical and practical approaches. For instance, a finite element method (FEM) simulation model was created in cooperation with CTR to identify suitable handling and storage solutions for the different (thin) wafer substrates. The Technische Universität Dresden meanwhile studied e.g. the actual susceptibility of the wafers to vibrations, providing the very first reliable figures on vibration damage thresholds. Meanwhile, different thin-wafer handling concepts, from edge grippers to Bernoulli end effectors and magnetic handling systems, were compared and ranked. The experts at the Stralsund University of Applied Sciences then devised and built a demonstrator based on a contactless end effector that is now being validated by Infineon Technologies Dresden against standard end effectors already in use in the fab.

“Logistics and automation are an emerging key factor in power semiconductor fabrication. They are nowadays indispensable in establishing high-performance, high-volume manufacturing facilities for innovative products that meet the customer demands and are seamlessly integrated into the supply chains.”
Refined Fab Logistics

Exploiting the advances in process automation to full potential and assuring maximum efficiency of the pilot line, the second key objective dealt with dedicated logistics. A comprehensive top-layer fab simulation model was created for the 300mm wafer start scenario to quantify e.g. the influence of the product mix on key performance parameters like utilisation, flow factor and cycle times. One level deeper, dedicated simulation models e.g. for the 300mm wafer transportation system were developed in cooperation with the Technische Universität Dresden to study the material flow of the handling systems. Enabling a convenient variation of key parameters, like the number of vehicles, automation strategies and other factors, these unique models proved invaluable for strategic decision-making and selecting the best concepts for the pilot line and future ramp phases.

The research into advanced logistics also created operation curves for the special equipment used in the thin wafer flow. Some of the new tools have a special tool loading behaviour that requires specific automation concepts for wafer transportation and storage close to those tools to integrate them most efficiently. Finally, the factors that influence the complexity of power manufacturing were quantified, visualised and critically assessed. Based on this work, strategies are now being defined to reduce (superfluous) complexity.

Enhanced Line Stability

In addition to achieving best manufacturing performance, yield improvement is needed for high stability and high efficiency. Power semiconductors introduce a number of essential but critical new materials, from noble elements to organic components that can cause corrosion. The control of the cleanroom as well as the conditions in mini-environments, e.g. wafer containers, are hence of key importance. adixien Vacuum provided demonstrators that were used to analyse particles and organic components that occur e.g. in the air within the container at different process steps. Analyses for metals and organic components were performed at Infineon Technologies Dresden and the Fraunhofer Institute for Integrated Systems and Device Technology (IISB) in Erlangen. The results provided the basis for special container cleaning procedures and tool dedications that efficiently avoid yield loss related to critical contaminants.

The results of the R&D activities in the work package were continuously used alongside the qualification of the different technologies and products in the pilot lines, thus achieving a highly automated fab with best-in-class key parameters.

Statement

Trending topics in logistics & automation

“Implementing highly automated tools and processes for 300mm power pilot lines was a very challenging task that involved closely coordinated collaboration across disciplines and teams. Many processes for new semiconductor technologies and products had to be automated without reverting to classic fab automation standards. Additionally, the manufacturing floor had to be converted from a low-mix/high-volume to a high-mix/high-volume fab producing a range of different products with individual customer due dates in the same area.

Intelligent logistics had to be defined to meet the demands according to development speed and cycle times. Since every lot creates huge amounts of information that has to be managed and used for controlling the different processes, vast databases are needed to store and process all the pertinent data. Based on the high automation level of the pilot lines, a manufacturing area was established that uses the latest trends from the Internet of Things. Virtual fab simulation and big data handling will thus play an important role also in the future in increasing manufacturing productivity and competitiveness through digitalisation.”
Innovation for Industry and Applications

[ Application 1 ]

Solar Power/Photovoltaics (PV)

Our aim was a holistic design approach to reduce PV inverters’ volume, weight and bill of materials. The technical key was increasing the switching frequency by a factor of three; as this normally decreases efficiency, we opted for a soft-switching topology. Together, these two factors allowed saving around 50% in weight and volume of the inverter’s inductive components, and achieving slightly better efficiency. Regarding the semiconductor devices, we focused on efficiency and reliability, and thus chose Infineon’s silicon-based next-generation semiconductors (CoolMOS™). Measurements, including EMI, validated our approach.

As the quality leader in the global solar energy market, Fronius has been researching innovative technologies for the PV industry for more than 20 years. This application is another step towards 24 hours of sun, Fronius’ vision of a future where 100% of the world’s energy needs are met by renewable sources. With 24 hours of sun, we provide a vital, sustainable vision for the energy revolution and concentrate on solutions to generate, store, distribute and consume solar energy smartly, efficiently and economically. This vision will provide a reliable, clean, independent and sustainable supply for both individual consumers and whole countries.

"Taking a holistic design approach, we managed to reduce the volume, weight and costs of the photovoltaic inverters, which also resulted in improved electrical efficiency."

Günter Ritzberger, R&D Manager Power Electronics, FRONIUS International (Wels/Austria)

[ Application 2 ]

Automotive Body Control Module

Many automotive applications rely on semiconductor devices, such as smart high-side switches or power MOSFETs, for tasks like power switching and monitoring output loads. Semiconductors for such automotive applications have to meet very special requirements, like driving within a wide range of loads and temperatures at possibly small power losses, and must support safety mechanisms and diagnostic features. A key example of such an application is a Body Control Module, i.e. the central control unit for low- and medium-rated electrical power loads, ranging from interior/exterior lighting to heaters and door locks. A fully functional Body Control Module demonstrator has been developed and qualified according to the latest automotive standards. This prototype validated the features and advantages of the new power devices in an improved high-performance application and proved the quality and functionality of EPPL’s next-generation semiconductor devices.

The following improvements were achieved:
- reduced package size and weight compared to current, equivalent components
- expansion of the portfolio towards higher load current-capable power semiconductors by introducing lower resistance models
- improved control performance to reduce overhead losses
- improved electromagnetic compatibility

“Our new Body Control Module demonstrates the applicability of the new power semiconductor technology in a high-performance automotive system. It supports enhanced current controlling capability, full diagnosis and enhanced reliability.”

Gregor Bugla, Advanced Engineering, Lear Corporation (Kronach/Germany)
Creating a range of unique manufacturing processes and technologies, EPPL paved the way from research to manufacturing and the market. This enabled a multitude of product innovations of direct impact on our everyday high-tech life.

[ Application 3 ]

Automotive LED

Modern, innovative and efficient: LED-based headlights for cars capture buyers’ hearts at first sight. LED lighting is thus now being adopted quickly in the volume car market, where it is already used in a variety of different functions – from turn signals to low beam, daytime running, cornering and matrix lights. This demands innovative, reliable and cost-efficient power conversion solutions.

The automotive LED demonstrator system developed by Infineon involved a combination of next-generation “EPPL” power MOSFETs with an efficient DC/DC power conversion controller. Designed and developed in a compact package, the DC/DC unit meets the most stringent automotive quality and reliability standards, including EMC (epoxy moulding compound), ESD (electrostatic discharge) and safety requirements. Full validation of the DC/DC confirmed it satisfies all relevant requirements. Its single coil architecture provides the flexibility to address different lighting functions with one setup, and enables high energy conversion efficiency and a significant reduction in components and board space. This, in turn, results in significantly reduced overall system costs for applications that combine different lighting functions.

“LED lighting is spreading to the volume car market. The DC/DC demonstrator shows the advantages of high conversion efficiency and flexible architecture: reduced board space and weight with multiple functions at reduced cost.”

Christian Gurschler, Product Manager, Infineon Technologies (Padua/Italy)

[ Application 4 ]

Healthcare

Driven by the company’s comprehensive sustainability strategy, the EPPL project came at the right time for Philips Healthcare. The innovation activities focusing on energy-efficient medical power converters were split into two parts - the power converter itself, aimed at improving performance and reducing size and costs, and a Healthcare Platform Demonstrator for two different medical application domains:

• Interventional vascular imaging, and
• Computer tomography imaging

During the project we cooperated closely with scientific and industrial partners. Eindhoven University of Technology focused their research on a kW power AC/DC converter, creating converter topologies that significantly increase overall system efficiency. Combining new modelling and control techniques with improved EPPL devices, they managed to go far beyond the state-of-the-art. HELIOX worked on interleaving four boost converter modules to operate as a power factor converter, which is equally attractive as it provides efficiencies of around 97%.

All the work package’s main objectives were met, creating significant innovation that will be reused in future medical products. The project enabled a shorter time to market, and we expect to achieve commercial exploitation with a significantly shortened lead time.

“Sharing ideas and making use of each partner’s strength helped us to generate innovative power semiconductor solutions and a platform to take the next step into sustainable solutions and lower the cost for healthcare.”

Harry Marinus, Group Leader Power Management Design Group, Philips Innovation Services - Electronics (Eindhoven/The Netherlands)
Consortium

The EPPL consortium brought together large industry with small and medium enterprises, high-tech research institutes and leading universities throughout Europe. Financially supported by national grants from Austria, Germany, The Netherlands, France, Italy, Portugal and the European Commission within the ENIAC Joint Undertaking the project strengthened Europe’s leading position in power semiconductors.
**Austria**

**Consortium members:**
- Infineon Technologies Austria AG (project leader)
- CTR Carinthian Tech Research AG
- Technische Universität Graz
- Montanuniversität Leoben
- CEST Kompetenzzentrum für elektrochemische Oberflächentechnologie GmbH
- Fronius International GmbH
- ams AG
- Plansee SE
- KAI Kompetenzzentrum Automobil- und Industrieelektronik GmbH
- EV Group E. Thallner GmbH

**Funding institutions:**
- Austrian Research Promotion Agency (FFG) on behalf of the Austrian Ministry for Transport, Innovation and Technology

**The Netherlands**

**Consortium members:**
- Philips Medical Systems Nederland B.V
- Technische Universiteit Eindhoven
- Heliox B.V.
- EMOSS B.V

**Funding institutions:**
- NL Agency (Agentschap NL) by the Dutch Ministry of Economic Affairs (Ministerie van Economische Zaken)

**France**

**Consortium members:**
- CEA-LETI (CEA - Commissariat à l’Energie Atomique et aux Energies Alternatives; LETI - Laboratory for Electronics & Information Technology)
- Ion Beam Services
- adixien Vacuum Products
- Air Liquide Electronics Systems
- Entegris Cleaning Process
- SPTS Technologies SAS

**Funding institutions:**
- Dgcis (Direction générale de la compétitivité, de l’industrie et des services) by the French Ministry of Craft, Commerce and Tourism

**Germany**

**Consortium members:**
- Infineon Technologies AG / Neubiberg
- Infineon Technologies Dresden GmbH
- Fraunhofer Gesellschaft E.V., Institute for Integrated Systems and Device Technology (IISB)
- Philips Medical Systems DMC GmbH
- Technische Universität Dresden
- Fachhochschule Stralsund
- Max-Planck-Institut für Eisenforschung (MPI-E)
- Lear Corporation GmbH

**Funding institutions:**
- Federal Ministry of Education and Research of Germany

**Italy**

**Consortium members:**
- Infineon Technologies Italia S.r.l.

**Funding institutions:**
- Italian Ministry of Education, University and Research

**Portugal**

**Consortium members:**
- Laboratorio Iberico Internacional de Nanotecnologia (INL)
- Nanium S.A

**Funding institutions:**
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supported by grants from [flag images] and the ENIAC Joint Undertaking
The EPPL timeline

April 2013
EPPL project kick off at Infineon Technologies (Villach/Austria)

July 2013
EPPL website is online
www.eppl-project.eu

January 2014
Online launch of the EPPL video
www.eppl-project.at

October 2013
First semester meeting at INL – International Iberian Nanotechnology Laboratory (Braga/Portugal)

September 2014
Multi Key Enabling Pilot Line Demonstration of EPT300 and EPPL Project at Infineon Technologies (Villach/Austria)

March 2014
EPPL first year meeting at Infineon Technologies (Villach/Austria)

April 2014
EPPL was selected as a Multi-KETs Pilot Lines Project (Delft/The Netherlands)

2015

May 2015
“Open Innovation Day” – InnoDay 2015 (Villach/Austria)

June 2015
Year 2 review (Brussels/Belgium)

March 2016
Year 3 meeting (Erlangen/Germany)

April 2016
Milestone: >100 scientific publications

June 2016
EPPL review meeting at Infineon Technologies (Dresden/Germany)

2016

March 2016
EPPL scientific work wins Semikron Award (Nuremberg/Germany)

September 2016
EPPL final general review (Villach/Austria)

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