

GREEN PE: POWER ELECTRONICS FOR GREEN ENERGY EFFICIENCY – EXTENDED PROJECT SUMMARY –



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Project Summary

The project accelerates the market uptake of Advanced Power Electronics (Advanced PE) by companies, especially SMEs, in the Baltic Sea Region (BSR) for the efficient conversion, transmission and consumption of energy from renewable sources.

The novel technologies behind Advanced PE allow more than 50 % of energy savings by enabling the efficient control and conversion of electrical power and the reduction of energy losses in all stages of the energy supply chain. The corresponding market, which is expected to grow annually by 7.4 % from 2014 - 2020, is driven by the demand for an increase in energy efficiency to enable renewable energy production, efficient energy transmission and intelligent consumption (e. g. within e-mobility and smart houses). Thus, the novel technologies foster the transition towards green growth and green society.

The market uptake of Advanced PE is challenged by technical and economic barriers as well as knowledge gaps which are difficult to be overcome by companies from the energy supply chain in the BSR. As a result these companies tend to choose conservative technology management and R&I strategies with regard to Advanced PE. At the same time, innovative start-ups and SMEs - from component and element level to system integrators - need to accelerate the innovation cycle and market acceptance of the energy efficient novel technology.

The project aims to demonstrate solutions to overcome these barriers faster and to increase the capacity of companies to adopt their business and R&I strategies to the potentials of Advanced PE. The project provides a transnational collaboration platform for research institutions and companies - especially innovative start-ups and SMEs - to transfer knowledge and build up R&I alliances across borders. The partners demonstrate the technical feasibility, reliability and cost-efficiency of the novel technology and strengthen the industry's confidence in Advanced PE. The transnational approach creates a critical mass of expertise and collaboration for the still pre-mature market for Advanced PE.

The project involves widely BSR companies in the development of a technology and product roadmap enabling them to define their technology and business strategies (e. g. adequate technology, and timing of investments). The project carries out three demonstration pilots in the market sectors renewable energies, e-mobility and smart houses with 8 companies and 7 research institutions. In addition, the research partners consult 14 BSR companies supporting their R&I strategy development. All project results are spread across the BSR via dedicated technology marketing measures, thus advancing the BSR capacities in the enabling technology.

Project Facts

- 17 research institutions, companies and technology transfer partners from the Baltic Sea Region
- 36 months (2016 – 2019)
- EUR 3.1 million budget
- European Regional Development Fund - Interreg Baltic Sea Region programme

Summary of Partnerships

The project sets up a cross-sector consortium consisting of 7 research institutions with expertise in Advanced PE, 18 companies from the energy supply chain (4 project partners, 14 associated partners) as well as 6 partners from business development associations, technology transfer institutions

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and cluster organisations. The consortium establishes an effective collaboration in the BSR which accelerates the market uptake of energy efficient Advanced PE.

The **research institutions** provide state-of-the art knowledge about new materials (such as SiC, GaN) and technologies (packaging, cooling, failure monitoring) in Advanced PE. They contribute with their research expertise to the roadmapping (WP2), the demonstration pilots (WP3) run together with the companies and the technology consulting of companies in the BSR (WP5) providing also the necessary laboratory infrastructure for reliability tests of the novel technology.

The **companies'** main focus is the participation in one of the three demonstration pilots in renewable energies, e-mobility and smart houses. They take the role of technology suppliers and system integrators in the demonstration pilots collaborating together with the research partners (WP3). Moreover, the industry partners contribute to roadmapping (WP2) and to the dissemination of the pilot results (WP4).

The partners from **business development, technology transfer and cluster organisations** support the involvement of regional companies and stakeholders from their networks in the roadmapping process through the organisation of workshops (WP2). They communicate and market the project findings and the opportunities of Advanced PE to the relevant companies in the BSR (i. e. roadmapping results, case studies from the demonstration pilots and technology consulting). Each partner organises local stakeholder meetings and individual company visits to disseminate and market the potentials of Advanced PE (WP4). In addition, they support the recruitment of companies which are interested to carry out technology consulting together with the research partners within their specific technological scope (WP5).

The project collaborates with **14 associated partners** consisting of companies and institutions from the BSR. Among the associated partners is the STRING partnership supporting the project, which contributes to the STRING green growth strategy. KIC InnoEnergy as Europe's largest public-private innovation partnership focused on climate change states strong interest to collaborate with the project.

Partners

University of Southern Denmark, DK (Lead partner)

Applied Research Institute for Prospective Technologies, LT

Christian Albrechts Universitaet Kiel, DE

CLEAN, DK

CONVERDAN A/S, DK

Kaunas Science and Technology Park, LT

Kaunas University of Technology, LT

Latvian Technological Center, LV

NATEK Power Systems AB, SE

Polish Chamber of Commerce for Electronics and Telecommunications, PL

Renewable Energy Hamburg, DE

RISE Acreo AB, SE

Sustainable Smart Houses in Småland Miljösmarta Hus i Småland, SE

Ubik Solutions OÜ, EE

University of Latvia, LV

University of Tartu, EE

Warsaw University of Technology, PL

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Associated Partners

Reese + Thies Industrieelektronik GmbH, DE
VTT Technical Research Centre of Finland / Human-Driven Design and System Dynamics, FI
Park&Charge I Sverige AB, SE
STRING, DK
Energy Conservation Foundation, PL
National Innovation and Entrepreneurship Centre, LT
JSC "Saules Energija", LT
JSC "Sinktoteksas", LT
Technitel Polska S.A., PL
IPP Sp. z o.o., PL
National Institute of Telecommunication of Poland, PL
Infratel-Operator Infrastrukturalny Sp. z o.o., PL
Globema Sp. z o.o., PL
"Commener" Sp. z o.o., PL
State Research Institute of Physical Energetics , LV
Company ENERGOŁUKSS, Ltd, LV
KIC InnoEnergy Germany GmbH, DE
Ferroamp Elektronik AB, SE
Danfoss Silicon Power GmbH, DE
Vishay Siliconix Itzehoe GmbH, DE
Business Development and Technology Transfer Corporation of Schleswig Holstein, DE

WP2: Transnational Technology and Product Roadmap of Advanced PE

The overall aim of the work package is to enable companies from the energy supply chain in the BSR to integrate disruptive energy efficient Advanced PE in their business strategy and technology management through a transnational technology and product roadmap.

The key performance measurement of this WP is a broad participation of relevant companies in the roadmapping process and the level of influence of the technology and product roadmap on the companies' R&D investment planning related to Advanced PE. The participatory roadmapping process involves companies around the BSR from power electronics element and component suppliers to system integrators along the value chain. Together with research institutions, they identify technical and economic opportunities and barriers for the market uptake of Advanced PE.

The transnational roadmap focuses on the application markets renewable energies, e-mobility and smart houses covering efficient energy generation from renewable sources, energy transmission and consumption. Hence, it enables especially firms to substantially improve their technology management and take informed decision regarding the R&D and market entrance investments and timing. The transnational roadmap covers the market conditions in the BSR partners' countries and facilitates the market access across borders.

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Transnational Technology and Product Roadmap

Leader: RISE Acreo AB
Timeframe: March 2016 – August 2017

A technology and product roadmap for the whole BSR and on a broader level on a global scale providing information such as market size and requirements is of high transnational relevance. The consolidation of requirements, drives and barriers allows stakeholders to see the overall roadmap instead of being limited to their separate regions. This is especially important for the capacity building in terms of technology management at SMEs because they usually lack business intelligence tools and management routines to adequately assess technology and market trends.

Taken as a whole, a roadmap is an adequate instrument for both strategic planning and controlling for firms, research institutes, and public authorities. For all these stakeholders, development and market risks are reduced by the information provided in the roadmap. Hence, the roadmap serves as a basis for capacity building in the following:

Companies: Improved capacity of technology and product development and commercialisation of Advanced PE by companies (component producers, system providers, consulting and financing etc). The transnational roadmap enables to understand market sizes, requirements and risks as well as technology and market trends in order to choose the right innovation strategy including timing and investments.

Public authorities: Capacity to consider Advanced PE within energy efficiency policy, research policy, legislation, public procurement and regional energy supply. The transnational roadmap supports informed decisions about investments, funding, procurement and necessary regulations in order leverage on synergies of the individual regions.

Research institutions: Capacity to respond to the needs of companies and public authorities regarding research and innovation. The transnational roadmap informs about gaps and bottle necks, which are higher risk developments and will be less likely addressed by companies.

Transnational Roadmap Implementation and Monitoring

Leader: RISE Acreo AB
Timeframe: September 2017 – February 2019

The implementation strategy for the transnational technology and product roadmap defines the requirements, procedures and partners' roles to monitor and update the information for the roadmap. The key assumptions about the technological fields, barriers and options as well as market demands in the roadmap need to be monitored and verified both during the project and beyond the project completion. Thus, the legacy and function of the roadmap as important instrument to support the market uptake of Advanced PE is ensured also beyond the project.

Industry (firms from the energy supply chain) and policy (public authorities, policy makers, and regulatory bodies) increase their capacity to introduce Advanced PE in the BSR also in the future. The results are widely distributed on a nonexclusive and nondiscriminatory basis to ensure the most transparent and the widest possible access to all interested stakeholders including potential competitors of the participating firms.

This is achieved through web publication of the transnational roadmap as well as through proactive dissemination of the transnational roadmap within WP4 (e. g. local stakeholder meetings, individual company visits, and international conferences). All meetings and events are widely announced and distributed and are open to any interested stakeholder.

Consequently, additional interested firms are reached, which have not been part of the project and also their capacity of professional technology management is improved.

WP3: Transnational Industrial Demonstration Pilots

The overall aim of this WP is to carry out three R&I pilots between 8 companies and 7 research institutions within renewable energies, e-mobility and smart houses demonstrating the technical maturity, reliability and economic feasibility of integrating Advanced PE into the energy supply chain at element, component and system level for increased energy efficiency. The findings from the demonstration pilots are widely published among companies and further stakeholders in the BSR.

The key performance measurement of this work package is that the participating and additional companies outside the consortium in the BSR have specific knowledge to make better informed decisions about future R&D strategies and investments for the uptake of Advanced PE.

The WP demonstrates the potential, feasibility and relevance of PE-based solutions for the development of sustainable infrastructure. The work is to be performed in close cooperation between industrial and research partners. The goal is to identify knowledge gaps, find efficient communication strategies and propose feasible and sustainable solutions for the green society. A key focus is on establishing strategic transnational cooperation between research partners, companies and public actors in the BSR.

The following three model pilot areas were chosen:

- A. Renewable energies: Use of new sources for renewable energies (large scale photovoltaics, offshore wind, and large scale bioenergy) requiring radical changes in the power electronics modules on the element (e.g. transistor) level.
- B. E-mobility: Introduction of e-mobility as an alternative to conventional car technology requires a radical new concept of car electronics, electrics and control, requiring power train integrated Advanced PE components.
- C. Smart houses: Acceptance of new energy efficiency solutions in smart houses requiring user participation, active feedback control and sophisticated (e.g. window or wall integrated) power modules.

Overall Strategy of the Demonstration Pilots

Leader: RISE Acreo AB
Timeframe: March 2016 – August 2016

The integrated strategy of the pilot demonstrators aims to organise the transnational efforts during the WP3 to maximise the impact on the industrial competitiveness in the BSR. The strategy is to be based on the industrial needs and the existing public policies in the BSR. The three selected areas renewable energies, e-mobility and smart houses address different markets.

The integrated strategy includes a description of target groups for each pilot demonstrator, a compilation of existing public policies, and description of the regional coverage of the participating and associated partners, as well as a communication strategy for the pilots' results.

A - Demonstration Pilot on Renewable Energies

Leader: Christian-Albrechts-Universität Kiel
Timeframe: March 2016 – February 2018

In order to implement new architectures for wind power converters for increasing the market share of power stack manufacturers and realisation of Advanced PE topologies for renewable energy applications, a demonstrator is realised, which is in detail a power converter with highest light load efficiency for renewable energy application.

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Major output is a document covering issues such as system specification, design and simulation of such a converter, development and realization of this AC/DC converter, demonstrator test and performance evaluation under lab conditions, result assessment and converter re-design, as well as marketing and activities for distribution of a concept to the market.

The output is applied at power device and system manufacturing companies supported by research and development institutes. It increases the strategic capacity for technology management of BSR companies in this sector.

B - Demonstration Pilot on E-Mobility

Leader: University of Southern Denmark

Timeframe: March 2016 – February 2018

The pilot project addresses a number of barriers (e.g. high cost of new components and their implementation, reliability and high requirements for device materials and their packaging), and is aimed at demonstrating to the industry, research and education institutions, and to innovation transfer organisations in the BSR the capabilities, benefits and peculiarities of the Advanced PE in application to the e-mobility. Target groups are industrial companies, especially SMEs, research centres within value chain for PE, and technology transfer organisations.

The pilot increases the capacity of the companies/SMEs to uptake and implement Advanced PE based on wide bandgap semiconductors. The results of the construction are to be used as demonstrators to disseminate the potential of PE for e-mobility.

The results are presented in different forms: The main document is an extended test report containing technical information on the demonstrator electronic modules, test parameters, conditions and results of the performed tests. The document concludes on functionality parameters, efficiency and reliability of the modules in the automotive environment. Moreover, there shall be information material that contain all the major results and conclusions but less technical details. These documents are tailored to the management boards of the companies which have less technical background.

C - Demonstration Pilots on Smart Houses

Leader: RISE Acreo AB

Timeframe: March 2016 – February 2018

Smart houses aim to maximise energy savings and cost reductions by utilising intelligent automation systems to control power consumption and optimize lighting, climate control and security systems. For these purposes, efficient power conversion systems are essential prerequisite for smart houses.

A demonstration system is set up at a house in Sweden which is equipped with 20 solar panels with a capacity of about 5000 kWh per year and 14 solar collectors.

The pilot presents the advantages of PE-based solutions for the energy management in smart houses and analyse the impact in the BSR industry and is used as input information for the dissemination actions (WP4). Target groups are companies in the BSR working on energy optimisation for housing and small industrial plants. The output increases the strategic capacity for technology management of BSR companies in this sector.

Evaluation and Pilot Case Studies

Leader: RISE Acreo AB
Timeframe: September 2016 – August 2018

The activities comprise the analysis of the achievements in the demonstration pilots, the evaluation of the potential impact of the results in the business capability of the regional industry and the compilation of information to give to technology transfer partners for dissemination work (WP4). They especially focus on the industrial technical requirements and market opportunities deriving from the pilot findings. Within the case studies, the results of the demonstration pilots are published.

Target groups are companies working on electronic design and manufacturing, energy optimisation and applications on energy efficiency within renewable energies, e-mobility and smart houses in the BSR. They use the output as informational basis for informed decisions about the integration of Advanced PE into their business and R&I strategies.

WP4: Technology Marketing

The overall aim of this work package is to disseminate the short and mid-term technical and economic opportunities of Advanced PE for increased energy efficiency within renewable energies, e-mobility and smart houses to companies in the BSR. The targeted companies include element and component suppliers of power electronics as well as system integrations from the energy supply chain. Although companies are the main target group, this work package also addresses further stakeholders from public institutions such as technology transfer institutions and business development agencies such as ministries or government agencies dealing with development or implementation of regional policy related to the aims of Green PE.

The key performance measurement of this work package is the broad involvement of the relevant companies from the BSR and an increased awareness for the technical and economic opportunities of this novel technology. Furthermore, the work package aims to changing the attitude positively of the stakeholders which participated in the marketing events regarding their strategic opportunities promoting the market uptake of Advanced PE for increased energy efficiency.

The work package supports WP2 in organising regional workshops with the industry to provide input to the roadmapping process. Furthermore, the work package uses as input for the marketing activities expertise from the research and industry partners from the consortium, the technology and product roadmap (WP2) as well as the approaches and findings from the pilot demonstrations (WP3).

The key activities of this work package are regional and transnational events and workshops with companies and public stakeholders for the regional knowledge transfer. The partners carry out international PE applications workshops with matchmaking events aiming to reach SMEs in the BSR.

Concept for Technology Marketing of Advanced PE

Leader: RISE Acreo AB
Timeframe: March 2016 – August 2016

This activity determines the approach to be used for technology marketing. The aim is to communicate the technology from a business perspective so that SMEs in the BSR are motivated to integrate the new power electronic technologies systems into their products.

The output is a technology marketing concept that is used by the project partners in communication with companies and public stakeholders. The output shall attract the SMEs in the different regions for using the technology for green power terms and thereby find new business opportunities.

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Communication and Marketing Material

Leader: University of Latvia
Timeframe: March 2016 – February 2019

Information and marketing material is developed on the basis of technology marketing concept and strategy. Materials include both printed and web based material and are tailored to fit the target groups. Web based materials include a webpage, newsletters, activities via social media accounts. . Printed materials e.g. leaflets, brochures etc. are developed for distribution at workshops organised during the project and other events.

Industry and Stakeholder Network

Leader: University of Latvia
Timeframe: March 2016 – February 2019

Establishing a network of regional stakeholders allows an intensified personal dialogue with companies and individual company visits throughout the project's lifetime. These companies are the key actors in the market uptake of Advanced PE for energy efficiency. The direct contact is necessary to involve the companies in the identification of technical and economic barriers and opportunities from the industrial perspective and to maximise the outreach of the project results.

Target group are the companies that use the Green PE network to establish R&I collaboration with research institutions and other companies across the BSR promoting the market uptake of Advanced PE.

International Advanced PE Conferences & Matchmaking

Leader: RISE Acreo AB
Timeframe: March 2017 – February 2019

The activity aims to organise two matchmaking events between technology developers and industry in connection with the internationally recognised International Wide Bandgap Power Electronics Applications Workshop, IWBGPEAW 2017 and 2018 (former ISiCPEAW). These workshops are traditionally organised in Stockholm, Sweden and have become an international meeting point for the power electronic community. These workshops gather around 150 participants from about 20 countries around the world, key actors in the technology developers and industry. The workshops include an exhibition area, a poster session and networking opportunities with business to business (B2B).

The matchmaking events shall each year attract the participation of at least 20 new SMEs to hold 50 meetings with conference delegates. The use of the output involves transferring the set of knowledge developed through the events among the target groups and also supporting WP2 by providing input to the roadmapping process.

The target groups of this output is companies /SMEs in the BSR that have a great potential for adapting the new PE technology for green power purposes, including element and component suppliers of PE as well as system integrations from the energy supply chain.

SMEs working on renewable energies, e-mobility and smart buildings in the BSR use the conferences to get first-hand information and inspiration about opportunities from Advanced PE for their technology management and R&I strategies. Furthermore, they benefit from the matchmaking events to find complementary partners for their R&I alliances.

WP5: Technology Consulting enabling SMEs Strategy Competence

The overall aim of this work package is to provide technology consulting to 14 companies from the energy supply chain in the BSR in order to support their capacities to consider Advanced PE in their R&D strategies and investments. SMEs are the target group of this work package as the capacities for technology absorption and for responding to mid- and long-term technological developments are more limited compared to larger enterprises.

The key performance measurement of this work package is a positive impact on the R&D strategies and planned investments of the consulted SMEs with regard to promote the market uptake of Advanced PE in the BSR. The work package validates the consulting potential and regional demand and promotes the use of Advanced PE based on new materials and new technologies such as packaging, cooling, failure monitoring.

The SMEs gain access to research capacities from the project consortium enabling them to address specific technological questions within their technological field and position in the energy supply chain.

As a result of the consulting activities, strategic transnational cooperation between research partners and companies will be established also beyond the project. The results of the technology consulting should be open access and widely published to companies in the BSR (WP4) as they reveal general solutions for a specific technology field. Thus, this work package maximizes the outreach benefits potentially all companies in the BSR in the same technological area.

Technology Consulting Portfolio for BSR Companies

Leader: Kaunas University of Technology

Timeframe: March 2016 – August 2016

Regional demands of companies working in the field of renewable energies, e-mobility and smart houses shall be validated for the clear understanding of needs for technology consulting activities in the frame of Green PE. A pre-survey shows novel technologies in PE in the BSR are challenged due to pre-maturity of some technologies, low volume and high production costs compared to existing technologies as well as weak understanding of market developments in public and private sector. Thus, the main task of this work package is to provide technical research capacities to BSR industry and SMEs and to support the companies' individual R&D strategy development.

The first step in development of technology consulting portfolio is the identification and comparison of detailed technological specialisations, research competencies and education offers of the research institutions involved into the project. Based on this information and identification of the industrial needs in the BSR, a technology consulting portfolio is developed. This portfolio is for companies interested in Green PE: Each company from a BSR country has a possibility to find appropriate support and consulting services by Green PE research institution. Joint efforts of project partners ensure the optimum collaboration and transnational spread of knowledge. That also allows in turn transferring regional offers onto a transnational landscape. The necessity of such joint offers is again given by the complexity of the R&D activities of the SMEs.

Individual Technology Consulting for SMEs

Leader: Kaunas University of Technology

Timeframe: September 2016 – February 2019

This group of activities include 14 individual technology consulting projects run by research partners of Green PE to provide technology competence with companies from the BSR within efficient energy generation, transmission and consumption and Advanced PE. Accordingly, each research partners carries out at least two technology consulting projects with SMEs from the BSR.

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Companies from BSR are not only focusing on minor improvements of existing product series, but are also actively following a research and development strategy towards significantly better product performance. Companies also realise that such an increase in performance in a global competitive market can only be achieved by remaining up to date within product relevant key technologies. Thus, the implemented technology consulting projects will serve to intensify the knowledge exchange on technological state of the art in Advanced PE and energy efficiency.

Outputs of these activities shall be used for optimisation of the collaboration between companies and research institutions and transnational spread of knowledge. It is used by companies/SMEs in BSR related to PE and renewable energetics to receive in depth input within their technology scope to further develop their strategic technology management and adopt their R&I strategies and investments.

The project activities benefits third parties/organisations outside the project partnership. The consulting focuses on the general R&D strategy of the companies with regards to opportunities deriving from Advanced PE. Accordingly, the activity has a strategic focus mainly on R&D potentials with no direct commercial character.

Case Studies from Technology Consulting

Leader: Kaunas University of Technology

Timeframe: September 2016 – February 2019

Each technology consulting project is published as case study covering issues such as up-scaling and proof-of-concept, test-beds to pilot production for the companies (i. e. 14 individual technology consulting projects with 14 case studies in total). Key results of the projects are made public for demonstration of the high technology potential that is available at current level of innovations.

In order to intensify the knowledge exchange on technological state of the art, main outcomes of the consulting projects are analysed by Green PE partners and used to intensify the knowledge exchange on technological state of the art in Advanced PE and alternative energetics.

A feedback loop of key topics and indicators from the technology consulting is arranged into the technology and product roadmap.

The consulting focuses on the general R&D strategy of the companies with regards to opportunities deriving from Advanced PE. Accordingly the activity has a strategic focus mainly on R&D potentials with no direct commercial character.

The output is used by research institutions and companies/SMEs related to PE and renewable energies, e-mobility and smart houses to optimise their technology management and to get inspired to engage in the collaboration within the Green PE network.

Green Power Electronics: Project Activity Map

