1. Identification

Call	Date of submission
C1	26/04/2022

1.1. Full name of the project

PE-BSR – Energy efficient and intelligent power electronics solutions from the Baltic Sea Region

96 / 250 characters

1.2. Short name of the project

PE-BSR

6 / 20 characters

1.3. Programme priority

3. Climate-neutral societies

1.4. Programme objective

3.2 Energy transition

1.6. Project duration

Contracting start	22/09/2022	**Contracting end**	31/12/2022
Implementation start	01/01/2023	**Implementation end**	31/12/2025
		Duration of implementation phase (months)	36
Closure start	01/01/2026	**Closure end**	31/03/2026

1.7. Project summary

Power electronics is a key enabling and indispensable technology for an efficient, robust and resilient electrification of the energy systems, which is a megatrend holding an important role in a global green energy transition. It is the overall objective of PE-BSR project to develop internationally leading power electronics solutions with ultra-high energy efficiency and intelligence, and to pilot these with demonstrators on a TRL 5-6 level within HVAC, pump, and electro mobility solutions. Results are through networking and innovation support initiatives transferred to the power electronics business ecosystem as well as to professional user segments with a focus on public applications. Thereby, the PE-BSR project provides solutions assisting in reducing energy consumption in sectors accounting for a relatively high proportion of energy usage in modern societies. Reaching as high a level of energy efficiency as possible, and to intelligently be able to control the energy consuming devices and systems, is an essential high-priority element in successfully reaching an energy transition towards climate neutrality based on scarce and fluctuating renewable energy production mainly from wind and sun. Furthermore, interacting with and making knowledge and results available for regional industrial network partners supports their strong positons in markets for energy efficient power electronics components and systems characterized by user-friendly and intelligent use.

1,483 / 1,500 characters

1.8. Summary of the partnership

The partners of the PE-BSR project are located in four country sites of the Baltic Sea Region – Denmark, Estonia, Finland and Germany – representing geographic North and South clusters. Each site/cluster host strong power electronics business ecosystems operating in selected applications and value chains within heating, ventilation and air conditioning (HVAC), pump systems, and electro mobility. Products and solutions delivered are applied within large-scale public operations like HVAC in public building stocks, water and wastewater treatment services, and scaling of electro mobility with efficient power trains and charging infrastructure.

The PE-BSR project partnership is composed to ensure development and demonstration of power electronics solutions with ultra-high energy efficiency and intelligence in support of green and smart energy transition, which takes place in a dynamic interaction between universities, industrial partners, and public organizations/associations. Within each of the sites/clusters of the PE-BSR project the partnership involves and builds on an interaction between:

• University and education institutions from each site with internationally leading applied research on power electronics solutions. They generate extensive and innovative power electronics knowledge from solution preparation activities focusing on ultra-high energy efficiency and intelligence. Furthermore, they complete piloting experiences with demonstrator solutions for HVAC, pumps, and electro mobility on an experimental technology readiness level (TRL) 5-6. Results of this knowledge and these experiences are made available for innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market.

• Public related organizations comprise business development associations facilitating innovation and networking in their local and regional communities, and interacting on a transnational level. Furthermore, it comprises public authorities who are politically involved in the green energy transition, and responsible for large-scale operation of HVAC, pump, and electro mobility solutions in different services. Financial as well as network partnership is assigned to business development associations, and public authorities are linked in as network partners.

• Industrial companies forming part of the power electronics business ecosystem are involved as network partners with the objective of getting as broad a participation as possible, as their adoption of the generated knowledge and piloting results is crucial for commercial scaling of solutions in the market.

Thus, the partnership contributes to bringing new innovative solutions from idea to market scaling with the purpose of supporting application of renewable energy sources in convenient daily-day power consumption with application of a principle of energy efficiency first: The greenest energy is the energy not consumed.

2,999 / 3,000 characters

1.11. Project Budget Summary

Financial resources [in EUR]		Preparation costs	Planned project budget
ERDF	ERDF co-financing	0.00	2,936,994.24
	Own contribution ERDF	0.00	734,248.56
	ERDF budget	0.00	3,671,242.80
NO	NO co-financing	0.00	0.00
	Own contribution NO	0.00	0.00
	NO budget	0.00	0.00
NDICI	NDICI co-financing	0.00	0.00
	Own contribution NDICI	0.00	0.00
	NDICI budget	0.00	0.00
RU	RU co-financing	0.00	0.00
	Own contribution RU	0.00	0.00
	RU budget	0.00	0.00
TOTAL	**Total Programme co-financing**	0.00	2,936,994.24
	Total own contribution	0.00	734,248.56
	Total budget	0.00	3,671,242.80

2. Partnership

2.1. Overview: Project Partnership

2.1.1 Project Partners

No.	LP/PP	Organisation (English)	Organisation (Original)	Country	Type of partner	Legal status	Partner budget in the project	Active/inactive	
								Status	from
1	LP	University of Southern Denmark	Syddansk Universitet	DK	Higher education and research institution	a)	992,640.00 €	Active	22/09/2022
2	PP	Kiel University	CHRISTIAN-ALBRECHTS-UNIVERSITAET ZU KIEL	DE	Higher education and research institution	a)	354,182.40 €	Active	22/09/2022
3	PP	Lappeenranta-Lahti University of Technology LUT University	Lappeenrannan-Lahden teknillinen yliopisto LUT-yliopisto	FI	Higher education and research institution	a)	987,994.80 €	Active	22/09/2022
4	PP	Tallinn University of Technology	TALLINNA TEHNIKAÜLIKOOL	EE	Higher education and research institution	a)	891,108.00 €	Active	22/09/2022
5	PP	Sønderborg Business Development Association	Sønderborg Vækstråd	DK	Business support organisation	a)	336,741.60 €	Active	22/09/2022
6	PP	Estonian Electronics Industries Association	Eesti Elektroonikatööstuse Liit	EE	Business support organisation	a)	108,576.00 €	Active	22/09/2022

2.1.2 Associated Organisations

No associated organisations found

2.2 Project Partner Details - Partner 1

LP/PP Lead Partner

Partner Status Active

Active from 22/09/2022 **Inactive from**

Partner name:

Organisation in original language Syddansk Universitet

20 / 250 characters

Organisation in English University of Southern Denmark

30 / 250 characters

Department in original language Institut for Mekanik og Elektronik

34 / 250 characters

Department in English Department of Mechanical and Electrical Engineering

51 / 250 characters

Partner location and website:

Address Alsion 2

8 / 250 characters

Country Denmark

Postal Code	DK-6400 (7 / 250 characters)	**NUTS1 code**	Danmark
Town	Sønderborg (10 / 250 characters)	**NUTS2 code**	Syddanmark
Website	www.sdu.dk (10 / 100 characters)	**NUTS3 code**	Sydjylland

Partner ID:

Organisation ID type	Civil registration number (CPR)
Organisation ID	29283958
VAT Number Format	DK + 8 digits
VAT Number	**N/A** ☐ DK29 28 39 58 (13 / 50 characters)
PIC	999904616 (9 / 9 characters)

Partner type:

Legal status	a) Public	
Type of partner	Higher education and research instituti	University faculty, college, research institution, RTD facility, research cluster, etc.
Sector (NACE)	72.19 - Other research and experimental development on natural sciences and engineering	

Partner financial data:

Is your organisation entitled to recover VAT related to the EU funded project activities? Yes

Financial data	**Reference period**	01/01/2021 –	31/12/2021
	Staff headcount [in annual work units (AWU)]		3,941.0
	Employees [in AWU]		3,941.0
	Persons working for the organisation being subordinated to it and considered to be employees under national law [in AWU]		0.0
	Owner-managers [in AWU]		0.0
	Partners engaged in a regular activity in the organisation and benefiting from financial advantages from the organisation [in AWU]		0.0
	Annual turnover [in EUR]		440,185,000.00
	Annual balance sheet total [in EUR]		292,459,000.00
	Operating profit [in EUR]		8,133,000.00

Role of the partner organisation in this project:

The University of Southern Denmark is the lead partner in the project, responsible for project management, day-to-day operations and reporting to the Interreg secretariat. The role of the Centre for Industrial Electronics at SDU is to conduct research in the field of power electronics with special emphasis on integration of electronics into pumps (activity leader) as well as the development of DC powered Heating-Aircondition-ventilation systems (HVAC) and the development of embedded software algorithms integrating artificial intelligence methods into operation and predictive maintenance of pumps and HVAC-systems. SDU will also have significant contributions to the development of power electronics relevant for the e-mobility activity together with Lappeenranta University. SDU further will contribute with its knowledge of electromagnetic compatibility (EMC) and battery technology.

891 / 1,000 characters

Has this organisation ever been a partner in the project(s) implemented in the Interreg Baltic Sea Region Programme?

○ Yes ○ No

State aid relevance

For the partner type selected, the Programme sees a medium to high risk for implementing State aid relevant activities. If the partner is of the opinion that its activities are not State aid relevant, it can ask the MA/JS for a plausibility check on the State aid relevance. Does the partner want to do this?

○ Yes ○ No

2.2 Project Partner Details - Partner 2

LP/PP	Project Partner		
Partner Status	Active		
Active from	22/09/2022	**Inactive from**	

Partner name:

Organisation in original language	CHRISTIAN-ALBRECHTS-UNIVERSITAET ZU KIEL (40 / 250 characters)
Organisation in English	Kiel University (15 / 250 characters)
Department in original language	Technische Fakultät / Lehrstuhl für Leistungselektronik (56 / 250 characters)
Department in English	Faculty of Engineering / Chair of Power Electronics (52 / 250 characters)

Partner location and website:

Address	OLSHAUSENSTRASSE 40 (19 / 250 characters)	**Country**	Germany
Postal Code	24118 (6 / 250 characters)	**NUTS1 code**	Schleswig-Holstein
Town	Kiel (4 / 250 characters)	**NUTS2 code**	Schleswig-Holstein
Website	www.uni-kiel.de (15 / 100 characters)	**NUTS3 code**	Kiel, Kreisfreie Stadt

Partner ID:

Organisation ID type	Other registration number (Sonstige)
Organisation ID	STATUTEN (01/01/1900) / N/A (27 / 50 characters)
VAT Number Format	DE + 9 digits
VAT Number	N/A ☐ DE811317279 (11 / 50 characters)
PIC	999839529 (9 / 9 characters)

Partner type:

Legal status	a) Public	
Type of partner	Higher education and research instituti	University faculty, college, research institution, RTD facility, research cluster, etc.
Sector (NACE)	85.42 - Tertiary education	

Partner financial data:

Is your organisation entitled to recover VAT related to the EU funded project activities? No

Role of the partner organisation in this project:

CAU will contribute to selecting and developing cutting-edge technologies for ultra high efficiency, as well as intelligence. CAU will provide a technical expertise on the development of the demonstrators, based on its experience with the design of ultra high efficiency converters based on new topologies, technologies (e.g. SiC, GaN, planar magnetcs), and control strategies, as well as with DC- and hybrid- grids (converter design, protection, and control). Thereby, CAU will contribute to feeding the open innovation platform.
The main contribution from CAU will however lay in the feasability analysis, technico-economic study, and dissemination activities of the project. CAU will use simulations and, once they are available, results from the pilot projects to estimate the gains (energy and CO2 savings) that could be obtained by deploing the developped technologies on a larger scale. CAU will also contribute to disseminating the project results, using its extensive network.

985 / 1,000 characters

Has this organisation ever been a partner in the project(s) implemented in the Interreg Baltic Sea Region Programme?

○ Yes ○ No

State aid relevance

For the partner type selected, the Programme sees a medium to high risk for implementing State aid relevant activities. If the partner is of the opinion that its activities are not State aid relevant, it can ask the MA/JS for a plausibility check on the State aid relevance. Does the partner want to do this?

○ Yes ○ No

2.2 Project Partner Details - Partner 3

LP/PP Project Partner

Partner Status Active

Active from 22/09/2022 **Inactive from**

Partner name:

Organisation in original language Lappeenrannan-Lahden teknillinen yliopisto LUT-yliopisto

56 / 250 characters

Organisation in English Lappeenranta-Lahti University of Technology LUT University

58 / 250 characters

Department in original language Sähkötekniikan osasto

21 / 250 characters

Department in English Electrical Engineering

22 / 250 characters

Partner location and website:

Address Yliopistonkatu 34

17 / 250 characters

Postal Code FI-53850

8 / 250 characters

Town Lappeenranta

12 / 250 characters

Website www.lut.fi

10 / 100 characters

Country Finland

NUTS1 code Manner-Suomi

NUTS2 code Etelä-Suomi

NUTS3 code Etelä-Karjala

Partner ID:

Organisation ID type	Business Identity Code (Y-tunnus)
Organisation ID	0245904-2
VAT Number Format	FI + 8 digits
VAT Number	N/A ☐ FI02459042 (10 / 50 characters)
PIC	995911209 (9 / 9 characters)

Partner type:

Legal status	a) Public	
Type of partner	Higher education and research instituti	University faculty, college, research institution, RTD facility, research cluster, etc.
Sector (NACE)	72.19 - Other research and experimental development on natural sciences and engineering	

Partner financial data:

Is your organisation entitled to recover VAT related to the EU funded project activities? No

Financial data	**Reference period**	01/01/2020 –	31/12/2021
	Staff headcount [in annual work units (AWU)]		1,042.0
	Employees [in AWU]		1,042.0
	Persons working for the organisation being subordinated to it and considered to be employees under national law [in AWU]		0.0
	Owner-managers [in AWU]		0.0
	Partners engaged in a regular activity in the organisation and benefiting from financial advantages from the organisation [in AWU]		0.0
	Annual turnover [in EUR]		93,401,505.00
	Annual balance sheet total [in EUR]		179,626,540.00
	Operating profit [in EUR]		7,070,037.00

Role of the partner organisation in this project:

LUT University focuses on the e-mobility by creating a demonstrator platform for piloting high-power density PE integrated motors. The platform includes three main components; simulation tool, laboratory emulator as well as an actual test vehicle. The platform will serve as a basis to validate the PE solutions; for dimension of the main components of the vehicle and energy efficiency analysis, analysis of different loading/drive cycle conditions and proof-of-concepts test with actual hybrid vehicle. The test vehicle is a modular hybrid bus vehicle constructed at LUT, where test propulsion motors can be connected to the driveline while the embedded system gives the possibility implement and test intelligent algorithms.

731 / 1,000 characters

Has this organisation ever been a partner in the project(s) implemented in the Interreg Baltic Sea Region Programme?

○ Yes ○ No

State aid relevance

For the partner type selected, the Programme sees a medium to high risk for implementing State aid relevant activities. If the partner is of the opinion that its activities are not State aid relevant, it can ask the MA/JS for a plausibility check on the State aid relevance. Does the partner want to do this?

○ Yes ○ No

Justification why the partner's activities are not State aid relevant

According to section 2.1 of the Finnish Universities Act, the task of universities is to promote free research and scientific and artistic education, to provide research-based higher education and to educate students to serve the homeland and humanity. These tasks can be called basic tasks of universities.

The basic tasks of universities include, for example, free and independent research, when the research results promote a socially significant common good and when the results are public and generally economically exploitable, notwithstanding publicity and secrecy legislation or a contractual term. Carrying out basic duties is not considered to be a business activity of universities within the meaning of section 21 a of the Finnish Income Tax Act.

759 / 3,000 characters

2.2 Project Partner Details - Partner 4

LP/PP Project Partner

Partner Status Active

Active from 22/09/2022 **Inactive from**

Partner name:

Organisation in original language TALLINNA TEHNIKAÜLIKOOL

23 / 250 characters

Organisation in English Tallinn University of Technology

32 / 250 characters

Department in original language Elektroenergeetika ja mehhatroonika instituut

45 / 250 characters

Department in English Department of Electrical Power Engineering and Mechatronics

59 / 250 characters

Partner location and website:

Address Ehitajate tee 5

15 / 250 characters

Postal Code 19086

5 / 250 characters

Town Tallinn

7 / 250 characters

Website www.taltech.ee

14 / 100 characters

Country Estonia

NUTS1 code Eesti

NUTS2 code Eesti

NUTS3 code Põhja-Eesti

Partner ID:

Organisation ID type Registration code (Registrikood)

Organisation ID 74000323

VAT Number Format EE + 9 digits

VAT Number N/A ☐ EE100224841

11 / 50 characters

PIC 999842536

9 / 9 characters

Partner type:

Legal status	a) Public	
Type of partner	Higher education and research instituti	University faculty, college, research institution, RTD facility, research cluster, etc.
Sector (NACE)	72.19 - Other research and experimental development on natural sciences and engineering	

Partner financial data:

Is your organisation entitled to recover VAT related to the EU funded project activities? Yes

Financial data	**Reference period**	01/01/2020 –	31/12/2020
	Staff headcount [in annual work units (AWU)]		1,897.0
	Employees [in AWU]		1,897.0
	Persons working for the organisation being subordinated to it and considered to be employees under national law [in AWU]		0.0
	Owner-managers [in AWU]		0.0
	Partners engaged in a regular activity in the organisation and benefiting from financial advantages from the organisation [in AWU]		0.0
	Annual turnover [in EUR]		117,165,834.00
	Annual balance sheet total [in EUR]		168,263,269.00
	Operating profit [in EUR]		8,873,543.00

Role of the partner organisation in this project:

The main contribution of TalTech lies in the development of energy-efficient direct current technologies, focusing development of proof-of-concept demonstrators thus providing tangible examples of how the research findings of the project could be embedded into innovative power electronic systems for dc.
The expected contributions and results are:
- Assistance in development of cutting-edge knowledge in the applied design and development of high-performance cost-effective power electronic systems
-design of power converter topologies, modulation and control methods as contribution to fundamental power electronics and control theory of power electronic converters and microgrids;
- Market-oriented design and control methods for high-performance power electronic systems;
- Obtainment of practical skillset on deployment, operation and control of high-performance power electronics.

888 / 1,000 characters

Has this organisation ever been a partner in the project(s) implemented in the Interreg Baltic Sea Region Programme?

○ Yes ○ No

State aid relevance

For the partner type selected, the Programme sees a medium to high risk for implementing State aid relevant activities. If the partner is of the opinion that its activities are not State aid relevant, it can ask the MA/JS for a plausibility check on the State aid relevance. Does the partner want to do this?

○ Yes ○ No

2.2 Project Partner Details - Partner 5

LP/PP	Project Partner		
Partner Status	Active		
	Active from 22/09/2022	**Inactive from**	

Partner name:

Organisation in original language	Sønderborg Vækstråd

19 / 250 characters

Organisation in English	Sønderborg Business Development Association (43 / 250 characters)
Department in original language	- (1 / 250 characters)
Department in English	- (1 / 250 characters)

Partner location and website:

Address	Ellegårdvej 36 (14 / 250 characters)	**Country**	Denmark
Postal Code	DK-6400 (7 / 250 characters)	**NUTS1 code**	Danmark
Town	Sønderborg (10 / 250 characters)	**NUTS2 code**	Syddanmark
Website	www.svr.sonderborg.dk (21 / 100 characters)	**NUTS3 code**	Sydjylland

Partner ID:

Organisation ID type	Civil registration number (CPR)
Organisation ID	35433945
VAT Number Format	DK + 8 digits
VAT Number	**N/A** ☐ DK35 43 39 45 (13 / 50 characters)
PIC	(0 / 9 characters)

Partner type:

Legal status	a) Public	
Type of partner	Business support organisation	Chamber of commerce, chamber of trade and crafts, business incubator or innovation centre, business clusters, etc.
Sector (NACE)	94.11 - Activities of business and employers membership organisations	

Partner financial data:

Is your organisation entitled to recover VAT related to the EU funded project activities?	No

Role of the partner organisation in this project:

Sønderborg Business Development Organization is in general working with innovation and networking related aspects of the PE-BSR project, and a particular focus is on involvement of the power electronics business ecosystem and public authority end-users with large-scale operations in the segments of HVAC, pumps, and electro mobility. Emphasis is in relation to WP1 on engagement of stakeholders, needs assessment, inputs for concept vision and design for demonstrator pilot solutions, and not least the establishment of an open innovation platform. In relation to WP3 focus is on a contribution to a broad transferring to the power electronics business ecosystem and end-users of the results from the knowledge generation and piloting of the demonstrator solutions. Furthermore, main responsibility is assumed in relation to innovation initiatives directed towards transferring the demonstrator pilot solutions of the PE-BSR project to market scaling.

953 / 1,000 characters

Has this organisation ever been a partner in the project(s) implemented in the Interreg Baltic Sea Region Programme?

○ Yes ○ No

2.2 Project Partner Details - Partner 6

LP/PP	Project Partner		
Partner Status	Active		
Active from	22/09/2022	**Inactive from**	

Partner name:

Organisation in original language	Eesti Elektroonikatööstuse Liit (31 / 250 characters)
Organisation in English	Estonian Electronics Industries Association (43 / 250 characters)
Department in original language	- (1 / 250 characters)
Department in English	- (1 / 250 characters)

Partner location and website:

Address	Akadeemia tee 23 (16 / 250 characters)	**Country**	Estonia
Postal Code	12618 (6 / 250 characters)	**NUTS1 code**	Eesti
Town	Tallinn (7 / 250 characters)	**NUTS2 code**	Eesti
Website	http://www.estonianelectronics.eu/ (34 / 100 characters)	**NUTS3 code**	Põhja-Eesti

Partner ID:

Organisation ID type	Registration code (Registrikood)
Organisation ID	80312788
VAT Number Format	EE + 9 digits
VAT Number	**N/A** ☐ EE102014680 (11 / 50 characters)
PIC	n/a (3 / 9 characters)

Partner type:

Legal status	a) Public	
Type of partner	Business support organisation	Chamber of commerce, chamber of trade and crafts, business incubator or innovation centre, business clusters, etc.
Sector (NACE)	94.11 - Activities of business and employers membership organisations	

Partner financial data:

Is your organisation entitled to recover VAT related to the EU funded project activities?

No

Role of the partner organisation in this project:

Estonian Electronics Industries Association will bel working with networking-related aspects of the PE-BSR project, and a particular focus is on involvement of the power electronics business ecosystem and public authority end-users with large-scale operations in the segments of HVAC, pumps, and electro mobility. Emphasis is in relation to WP1 on engagement of stakeholders, needs assessment, inputs for concept vision and design for demonstrator pilot solutions, and not least the establishment of an open innovation platform. In relation to WP3 focus is on a contribution to a broad transferring to the power electronics business ecosystem and end-users of the results from the knowledge generation and piloting of the demonstrator solutions. Furthermore, main responsibility is assumed in relation to innovation initiatives directed towards transferring the demonstrator pilot solutions of the PE-BSR project to market scaling.

932 / 1,000 characters

Has this organisation ever been a partner in the project(s) implemented in the Interreg Baltic Sea Region Programme?

○ Yes ◉ No

3. Relevance

3.1 Context and challenge

Power electronics is a key enabling and indispensable technology for an efficient, robust and resilient electrification of the energy systems, which is a megatrend holding an important role in a global green energy transition with reduced greenhouse gas emissions required to combat climate changes. Therefore, the markets for power electronic components and systems are growing rapidly as they are part of renewable energy production systems, and not least used to realize convenient daily-day power consumption in a wide range of applications with the principle of energy efficiency first: The greenest energy is the energy not consumed. With development and implementation of energy efficient and intelligent power electronics, it is possible to substantially reduce the energy consumption, thereby contributing to global energy efficiency goals, including the EU target of 32.5% energy savings in 2030.

The industry of the Northern European region, including the Baltic Sea Region (BSR), has traditionally had strong market positions in several important value chains within power electronics, including heating, ventilation and air conditioning (HVAC) systems, pumps, and electro mobility solutions with a high focus on professional vehicles and vessels. This is based on development, manufacturing and sales of market leading components and systems characterized by user-friendly and intelligent use in specific applications. However, this position is challenged by dominance from other European and overseas regions.

Within this context of strong requirements for energy efficient and intelligent power electronics solutions driven by the need for a green energy transition, and the role of the regional industry in providing such solutions, new and innovative power electronics solutions are required. A regional BSR effort can create critical mass, synergies, and improved competitiveness in interactions between universities, the public sector, and the power electronics industry.

1,994 / 2,000 characters

3.2 Transnational value of the project

The relatively strong power electronics industry of the Baltic Sea Region (BSR) faces a persistent overall challenge of having adequate new knowledge and innovation capabilities at their disposal to maintain and expand their market positions. This includes new insights and innovation within ultra-high energy efficiency made possible by application of new materials and system designs as well as intelligence based on thorough digitalization. Likewise, a stronger and institutionalized transnational innovation platform is required within the BSR power electronics ecosystem on the long term. In this manner, it is possible to maintain a strong and attractive environment for the company activities, including a high level of knowledge and synergies. Otherwise, the threat is that companies can be forced to relocate technology development activities to other geographical centres for power electronics manufacturing.

The PE-BSR project addresses important and common challenges and opportunities of the regional power electronics industry. Firstly, through focused and applied power electronics research resulting in preparation, piloting and transferring of demonstrator technologies in interaction with the industry and selected test-users. Secondly, by development of an open innovation platform supporting the regional ecosystem in the field of power electronics. These challenges and opportunities are most efficiently dealt with and exploited in a common effort, since critical mass and synergies can best be created on an interregional scale.

Therefore, in a common transnational effort comprising geographic areas in the four countries of Denmark, Estonia, Finland and Germany, which have been selected on basis of their relatively high proportion of power electronics related companies and universities, the PE-BSR project addresses a number of regional challenges and opportunities related to the green growth potential connected to power electronics solutions.

1,975 / 2,000 characters

3.3 Target groups

Target group	Sector and geographical coverage	Its role and needs
Small and medium enterprise	The target group comprises small and medium sized companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 493 / 500 characters	Small and medium sized electro-technical companies belonging to the power electronics ecosystem are delivering solutions for electrification of the energy systems, thereby contributing to the green energy transition with reduced greenhouse gas emissions required to ensure energy security and combat climate changes. Their products and solutions are typically power electronics materials, components, devices, and control systems. Furthermore, it may be system integration applying power electronics components. The companies can contribute significantly to electrification and in particular, the realization of the principle of energy efficiency first devoted to optimizing and minimizing energy consumption. However, new power electronics knowledge on ultra-high energy efficiency and intelligence is required together with a stronger transnational innovation platform in order for the companies to maintain development activities and integrate the power electronics ecosystem. 982 / 1,000 characters

Target group	Sector and geographical coverage	Its role and needs
Large enterprise	The target group comprises large companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 476 / 500 characters	Large sized electro-technical companies belonging to the power electronics ecosystem are delivering solutions for electrification of the energy systems, thereby contributing to the green energy transition with reduced greenhouse gas emissions required to ensure energy security and combat climate changes. Their products and solutions are typically power electronics materials, components, devices, and control systems. Furthermore, it may be system integration where power electronics components are applied. The companies can contribute significantly to electrification and in particular, the realization of the principle of energy efficiency first devoted to optimizing and minimizing energy consumption. However, new power electronics knowledge on ultra-high energy efficiency and intelligence is required together with a stronger transnational innovation platform in order for the companies to maintain development activities and integrate the power electronics ecosystem. 980 / 1,000 characters
Regional public authority	Regional public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 446 / 500 characters	The regional public authorities play from a political as well as an operational point of view an important role in realizing the green energy transition that must be undertaken in order to resolve the challenges related to ensuring energy security and combating climate changes. As responsible for large-scale operations applying HVAC, pump, and electro mobility solutions based on power electronics technologies, they are end-users having a high interest and need for applying energy efficient and intelligent solutions. In development of these, they can act as important counterparts and test-users. 601 / 1,000 characters
Local public authority	Local public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 443 / 500 characters	The local public authorities play from a political as well as an operational point of view an important role in realizing the green energy transition that must be undertaken in order to resolve the challenges related to ensuring energy security and combating climate changes. As responsible for large-scale operations applying HVAC, pump, and electro mobility solutions based on power electronics technologies, they are end-users having a high interest and need for applying energy efficient and intelligent solutions. In development of these, they can act as important counterparts and test-users. 598 / 1,000 characters

3.4 Project objective

Your project objective should contribute to:

Energy transition

It is the overall objective of PE-BSR project to develop internationally leading power electronics solutions with ultra-high energy efficiency and intelligence, and to demonstrate these in selected applications and value chains. Results are through networking and innovation support initiatives transferred to the power electronics business ecosystem as well as to professional user segments with a focus on public applications. Thereby, the PE-BSR project provides solutions assisting in reducing energy consumption in sectors accounting for a relatively high proportion of energy usage in modern societies. Reaching as high a level of energy efficiency as possible, and to intelligently be able to control the energy consuming devices and systems, is an essential high-priority element in successfully reaching an energy transition towards climate neutrality based on scarce and fluctuating renewable energy production mainly from wind and sun.

The specific objectives of the PE-BSR project are:

1. Preparation of demonstrator solutions on Technology Readiness Level (TRL) 5-6 with selected elements of ultra-high energy efficiency and intelligence. An open innovation platform being established is supporting the demonstrator work within: (1.) heating, ventilation and air conditioning (HVAC) systems with emphasis on public building stocks, (2.) pumps that can be applied in water and wastewater treatment services, and (3.) electro mobility power trains with focus on professional vehicles and vessels

2. Piloting in iterative processes with manufacturing, test, and evaluation of the demonstrator solutions in collaboration with industrial network partners and end-users, including the public sector

3. Transferring of results for product specific application on TRL 8-9 by power electronics companies through general dissemination, identification of policy measures, networking within the power electronics business ecosystem, and innovation initiatives

1,964 / 2,000 characters

3.5 Project's contribution to the EU Strategy for the Baltic Sea Region

Please indicate whether your project contributes to the implementation of the Action Plan of the EU Strategy for the Baltic Sea Region (EUSBSR).

(•) Yes ( ) No

Please select which Policy Area of the EUSBSR your project contributes to most.

PA Energy

Please list the action of this Policy Area that your project contributes to and explain how.

The PE-BSR project in particular contributes to the PA Energy policy area by contributing to the Action 1 related to streamlining efforts on energy efficiency in the region by deepening the regional cooperation. The project assists in developing ultra-high energy efficient and intelligent power electronics solutions that are central for ensuring and facilitating the application of the "energy efficiency first" principle, and to attain decarbonisation of the national building stocks.

Furthermore, the project contributes to Action 2 and Action 4 through the focus on technologies and solutions enabling electrification with ultra-high energy efficiency that assists in reducing the required size of renewable energy sources. Moreover, intelligent control of large power consuming systems within HVAC, pump and electro mobility solutions may contribute to balancing the supply and demand of fluctuating renewable energy.

926 / 1,500 characters

If applicable, please describe which other Policy Areas of the EUSBSR your project contributes to and how.

The PE-BSR project has a strong focus on innovative power electronics solutions that in accordance with the policy area of innovation (PA Innovation) of the BSR aims at promoting global competitiveness and growth through support for entrepreneurship, business development, science and increased innovation capacity. The BSR industry has strong market positions in several important value chains within power electronics, including heating, ventilation and air conditioning (HVAC) systems, pumps, and electro mobility solutions. This is based on the ability of the region to support internationally leading innovation efforts leading to development, manufacturing and sales of market leading power electronics components and systems characterized by ultra-high energy efficiency as well as user-friendly and intelligent use in specific applications. However, this position is challenged by dominance from other European and overseas regions, and support for power electronics innovation is therefore required.

1,008 / 1,500 characters

3.6 Other political and strategic background of the project

Strategic documents
EU's Green Deal is aiming at making the EU climate neutral in 2050. Key principles include to prioritize energy efficiency and a power sector based largely on renewable resources. The PE-BSR project contributes through its focus on enabling electrification with ultra-high energy efficiency reducing the required power. Moreover, the project focuses on intelligent control of large power consuming systems, which may contribute to balancing the supply and demand of fluctuating renewable energy. 496 / 500 characters
EU's Energy Efficiency Directive mandates energy efficiency improvements. The PE-BSR project is with its focus on power electronics technologies with ultra-high energy efficiency and an intelligent control for applications within heating, ventilation and air conditioning (HVAC), pump and electro mobility at the core of what is required in order to realize the ambitions of the energy efficiency directive. 407 / 500 characters

3.7 Seed money support

Please indicate whether your project is based on a seed money project implemented in the Interreg Baltic Sea Region Programme 2014-2020.

○ Yes ◉ No

3.8 Other projects: use of results and planned cooperation

Full name of the project	Funding Source	Use of the project outcomes and/or planned cooperation
PE-Region Platform – Cross-border platform for energy efficient power electronics 81 / 200 characters	Interreg 5a Deutchland-Danmark 30 / 200 characters	e PE-Region Platform is running over three years in 2020-2022 as a Danish-German collaboration focusing on application oriented power electronics research and development as well as establishment of an innovation platform. The results of the project in relation to energy efficient power conversion and intelligent control as well as optimized components and systems form a solid basis for the preparation and piloting of power electronics demonstrators in the PE-BSR project focussing on HVAC, pumps and electro mobility. Furthermore, the experiences with the cross-border innovation platform established in the PE-Region Platform project will be used. The initiative for the PE-BSR project application is a direct outcome of the PE-Region Platform project, where industrial companies have promoted the idea for a stronger Northern collaboration within power electronics. They see such a collaboration as a strategic necessity in order to maintain technology development activities in the region. 998 / 1,000 characters

3.10 Horizontal principles

Horizontal principles	Projects's direct impact
Sustainable development	positive
Non-discrimination including accessibility	neutral
Equality between men and women	neutral

4. Management

Allocated budget 10%

4.1 Project management

☑ **Please confirm that the lead partner and all project partners will comply with the rules for the project management as described in the Programme Manual.**

If relevant, please indicate any other important aspects of the project management, e.g. external entity supporting the lead partner in the management of the project, advisory board, steering committee, any other relevant working groups, etc.

The lead partner and all project partners will comply with the rules for the project management as described in the Programme Manual

132 / 500 characters

4.2 Project financial management

☑ **Please confirm that the lead partner and all project partners will comply with the rules for the financial management and control as described in the Programme Manual.**

If relevant, please indicate any other important aspects of the financial management, e.g. external entity supporting the lead partner, positions planned for financial management, involvement of special financial experts (e.g. for public procurement), etc.

The lead partner and all project partners will comply with the rules for the financial management and control as described in the Programme Manual

146 / 500 characters

4.3 Input to Programme communication

☑ **Please confirm that you are aware of the obligatory inputs to Programme communication that must be submitted along the pre-defined progress reports, as described in the Programme Manual.**

If relevant, please describe other important aspects of project communication that you plan to introduce, e.g. a communication plan, opening and closing events, social media channel(s) etc.

We are aware of the obligatory inputs to Programme communication that must be submitted along the pre-defined progress reports, as described in the Programme Manual

164 / 500 characters

4.4 Cooperation criteria

Please select the cooperation criteria that apply to your project. In your project you need to apply at least three cooperation criteria. Joint development and joint implementation are the obligatory ones you need to fulfill in your project.

Cooperation criteria	
Joint Development	☑
Joint Implementation	☑
Joint Staffing	☐
Joint Financing	☑

5. Work Plan

Number	Work Package Name
1	WP1 Preparing solutions

Number	Group of Activity Name
1.1	Detailed concept design based on iterative processes in an open innovation platform
1.2	Developing solutions for ultra-high energy efficiency of power conversion chains and motors
1.3	Developing solutions for intelligence in HVAC, pump, and electro mobility applications

Number	Work Package Name
2	WP2 Piloting and evaluating solutions

Number	Group of Activity Name
2.1	HVAC system solution piloting, evaluation and adjustment in iterative process
2.2	Pump system solution piloting, evaluation and adjustment in iterative process
2.3	Electro mobility system solution piloting, evaluation and adjustment in iterative process

Number	Work Package Name
3	WP3 Transferring solutions

Number	Group of Activity Name
3.1	Dissemination of results from demonstrator work and identification of policy measure implications
3.2	Networking activities within the power electronics business ecosystem
3.3	Innovation initiatives for transferring solutions to market scaling

Work plan overview

Period: 1 2 3 4 5 6	Leader
WP.1: WP1 Preparing solutions	**PP1**
A.1.1: Detailed concept design based on iterative processes in an open innovation platform	PP3
D.1.1: Detailed concept design and open innovation platform	
A.1.2: Developing solutions for ultra-high energy efficiency of power conversion chains and motors	PP2
D.1.2: Increased technological knowledge for HVAC, pumps and electro mobility	
A.1.3: Developing solutions for intelligence in HVAC, pump, and electro mobility applications	PP3
D.1.3: Knowledge on intelligence in power electronics solutions as input for demonstrators	
WP.2: WP2 Piloting and evaluating solutions	**PP3**
A.2.1: HVAC system solution piloting, evaluation and adjustment in iterative process	PP4
O.2.1: HVAC demonstrator pilot solution	
A.2.2: Pump system solution piloting, evaluation and adjustment in iterative process	PP1
O.2.2: Pump demonstrator pilot solution	
A.2.3: Electro mobility system solution piloting, evaluation and adjustment in iterative process	PP3
O.2.3: Electro-mobility demonstrator pilot solution	
WP.3: WP3 Transferring solutions	**PP1**
A.3.1: Dissemination of results from demonstrator work and identification of policy measure implications	PP1
D.3.1: Dissemination and policy measure implications	
A.3.2: Networking activities within the power electronics business ecosystem	PP1
D.3.2: Networking	
A.3.3: Innovation initiatives for transferring solutions to market scaling	PP5
D.3.3: Innovation initiatives	

Outputs and deliverables overview

Code	Title	Description	Contribution to the output	Output/ deliverable contains an investment

D 1.1	Detailed concept design and open innovation platform	The deliverable contains the following two elements, which are delivered iteratively as input for connected activities 1.2 and 1.3 in versions of increasing details: 1. Concept design developed: In a concept visioning process, which rests on engagement of relevant stakeholders and a profound needs assessment, a detailed concept vision for the demonstrator pilots is elaborated, including detailed requirements for energy efficiency and intelligence. The detailed requirements link to technical aspects of energy efficiency including: (i.) minimal power conversion losses, (ii.) active and passive components of modern materials, optimal thermal management, (iii.) packaging and application integration design, (iv.) direct current (DC) microgrids. Furthermore, detailed requirements linked to intelligence: (i.) digitalization incorporated, (ii.) grid service contributions, (iii.) microgrid ready operation, (iv.) improved user experience and comfort. 2. Open innovation platform established: On basis of the stakeholder engagement and the comprehensive links of the project partners to industrial collaboration partners, an open innovation platform is established comprising all relevant and interested companies as well as end-users in the power electronics ecosystem. The geographic concentration of the innovation platform is on the four national sites of Denmark, Estonia, Finland, and Germany. However, the platform will reach out to other geographic areas. As part of the establishment, a detailed ecosystem mapping is made, and a strategy and action plan is prepared.	The deliverable contributes to guide knowledge building activities leading to all outputs O2.1-2.3	
D 1.2	Increased technological knowledge for HVAC, pumps and electro mobility	The deliverable for the described group of activities in WP1.2 is primarily knowledge in the form of an increased know-how and technology awareness in the field of electronic packaging, thermal management, modern materials, motor integration and DC-grids aimed at HVAC, pump, and electro mobility applications. All pilots will benefit from the results of this group of activities, as the knowledge generated on all five fields of knowledge touched upon are used as the basis for developing prototypes and pilot units for testing in WP2. The obtained knowledge is expected to include the following: • Software control algorithms for reducing the overall power consumption from motors by several percentages, in addition to a substantial increase in reliability and lifetime of the systems and the applied components • Application of wide-band-gap materials like SiC and GaN for active components and novel magnetic materials for passive components, implying significantly reduced power losses • Thermally and electrically optimized packaging structures for new semiconductors and integration of power modules and control electronics into motor drives and electro mobility applications • System integration optimization for application of ultra-high energy efficiency within HVAC, pumps and electro mobility • Direct current concepts for HVAC units running on direct current (DC) as an alternative to alternating current (AC), giving a substantial increase in overall energy efficiency	The deliverable consists in high performance technologies contributing to all outputs O2.1-2.3	
D 1.3	Knowledge on intelligence in power electronics solutions as input for demonstrators	The deliverable for the described group of activities in WP1.3 is primarily knowledge in the form of an increased know-how and technology awareness in the fields of digitalization and IoT (Internet of Things), sensor networks and Artificial Intelligence and related grid stabilization and power saving solutions. All pilots will benefit from the results of this group of activities, as the knowledge generated in each of primary areas are used to develop the prototypes and pilot units for testing in WP2. The obtained knowledge is expected to include the following: • Establishment of digitalization solutions with connectivity features and data collection structures allowing generation and use of Big Data, which are applied in machine learning algorithms for improvement of control programs for electric power electronic converters and related applications • Digital solutions for controlling devices in a way that they contribute to balancing use of power from the grid and improve the power quality • The micro-grid concept with DC-powered systems will integrate near energy-neutral HVAC system elements like fans, heat pump, solar cells and battery storage using decentralized control	The deliverable consists in intelligence technologies contributing to all outputs O2.1-2.3	

O 2.1	HVAC demonstrator pilot solution	The concerns regarding the use and supply security of traditional energy sources rises the importance of transition to alternative and renewable energy sources as well as more efficient use of energy. At the same time, currently we are still using a 19th century technology to transmit electricity - Alternating Current (AC) meant for a time when all electricity generators were rotating turbines and many power consumers were simple rotating motors that relied on ac. Solar Panels, however, generate Direct Current (DC). Almost all of the final energy consumption can also be supplied with dc - including consumer electronics, modern industrial equipment and batteries. The paradigm shift from centralized to distributed dc generation from renewables opens up possibilities for reconsidering the grid architecture, particularly at the user (prosumer) level. When large part of the energy is being consumed on-site or nearby, the feasibility of interfacing through ac becomes questionable due to need for extra conversion steps (dc to ac and ac to dc), leading to increased losses and cost of the power electronic (PE) interfaces. Therefore, the obvious and remarkable advantage of dc distribution is the elimination of power losses due to extra dc-ac-dc conversions. According to estimations, even by adapting existing devices to dc by removing the ac-dc stage, can provide remarkable energy savings. The additional potential benefits of DC are in simplified communication and controls, power quality, reliability and resilience. The advances in power electronics have made the transition to dc distribution in a building easier than ever before. The fact that future buildings will most likely feature local PV and battery storage, which are natively DC, makes the dc power inherently available in such building. With the extensive use of DC-supplied electronic devices (PCs, cell phones, robotic cleaners, etc.) have made the DC loads to significantly contribute, or even dominate in the residential applications. This dc native consumption is set to explode as by 2030 we will have 0.8 TW of Electric Vehicle chargers installed in the EU. The developed technology related to nearly-energy-neutral HVAC system will be based on dc distribution that includes a heat pump, PV panels and battery storage solutions. PE interfaces together with other system components will be adopted for integration through dc. This will avoid the inverter and power factor correction stages. The additional or modified sensing and protection circuitry together with limitation in inrush current will be developed. In addition, the dc system will feature decentralized control of energy production, storage and consumption using droop control with dc-bus signaling. Intelligent scheduling algorithms aiming towards maximum use of local energy with minimized consumption and purchase costs from the grid will be proposed. The solution will have the option to be extended to include other elements, like EV battery.		
O 2.2	Pump demonstrator pilot solution	The output of the pump pilot demonstrator solution consists of an improved control and precision scheme implemented primarily as software algorithms in embedded hardware, The piloted solutions for pumps controlled by artificial intelligence can easily be implemented existing pump control software platforms/systems as soon as the software algorithms are developed. By the ability of self-learning of the system it will automatically adapt to the specific application over time. By defining the right boundary conditions, it can be ensured that the critical infrastructure is also working in case this new technology fails, the risk is limited since in worst case the system operates for the same high cost as before. The outcome is further characterized by results obtained by testing a highly efficient drive-motor-pump system in a pilot application, where continuous operation is required to keep the output pressure constant. The pump will be fully electrically controlled instead of using inefficient bypass valves in the water system. This increases the energy efficiency of the pump system. The integration of the electronics into the pump structure will increase the EMC (electromagnetic compatibility) performance, as long cables between a motor control unit and its connected motor are eliminated and thus not able to act as receiving or radiating antennas. The active intelligent control of the pump further enables the pump system to supply grid service activities such as balancing and reduction of unwanted currents on the power grid and by that helping to stabilize the power grid, which is suffering from the increasing number of renewable energy plants, both photovoltaic and wind, which by their lack of large rotating generators with high inertia are not able to provide the same stability of the power grid as traditional power generator. This pilot demonstrator output therefore can be described as consisting not only of enhanced knowledge about intelligent algorithms for the energy efficient control of pumps in water systems, but also as a platform to be transferred to industry for the development of more specific applications. The results are expected to be of such a generic nature that they can be applicable in other areas, where motors need to be controlled.		

O 2.3	Electro-mobility demonstrator pilot solution	The ongoing change towards green transportation is in full swing, but there are still many challenges associated with electrification – especially in the case of e-mobility (large hybrid/electric vehicles and mobile equipment) where technology adoption is slow due to several safety restrictions. In order to achieve maximum material and energy savings, selection and optimization of high efficiency components should be tested at system level. The activities in WP2 will lead to a flexible/modular design platform, consisting of combination of I) simulation tool, II) emulator tool and III) actual vehicle, that can be used to step-by-step evaluation of high-power density power electronic (PE) integrated traction motors. This means that new power electronics and/or motor solutions can be piloted and tested in secure environment before scaling them to the market. More importantly, the WP2 will pilot the derived PE and motor solutions with actual test vehicle that is a modular hybrid bus constructed at LUT-University. Often, the testing with prototype e-mobiles on public roads is not an option due to the high safety demands regarding vehicles permitted to drive on public roads, but the demonstrator will provide this possibility (the test vehicle is safety inspected and registered). The bus is equipped with comprehensive data acquisition system (DAQ) that can collect all the necessary information from route, vehicle and drive line (including motor data). The testing under real and harsh operation conditions will provide valuable information about the solutions and serve as an important output for further analysis and development by identified target groups. The demonstration of the solutions with the platform will provide transnational value as a testing ground to deliver transferable knowledge (technology, tools) to be used and up-scaled by power electronic companies.		
D 3.1	Dissemination and policy measure implications	The deliverable relates to dissemination and exploitation of results from the knowledge building and piloting work as well as to the identification of policy measure implications. In line with this, the elements of the deliverable concerns digital activities, publications and conference participation, as well as policy measures. 1. Digital activities: A dedicated project website established and maintained as a common communication platform for active and dynamic dissemination of knowledge generated from WP1 in connection to preparation of demonstrator pilot solutions, results obtained in WP2 from piloting the solutions, and outcomes of networking and innovation activities. A social media project profile on LinkedIn established and maintained with regular postings of all project relevant information relating to preparation and piloting of demonstrator solutions as well as networking and innovation activities. A project brochure and posters are prepared. 2. Publications and conference participation: At least twelve scientific publications are prepared and submitted for peer-review journals and on conferences within the fields of ultra-high energy efficiency and intelligence within HVAC, pump and electro mobility applications. Participation with papers and posters on at least nine internationally recognized conferences forming part of power electronics or energy and climate events such as IEEE or ECPE. 3. Policy measure implications: A catalogue of policy measure implications for creating elements of a facilitating framework for the market scaling of energy efficient and intelligent power electronics solutions is prepared. It contains specific suggestions and recommendations directed towards different policy levels in the local, regional and transnational contexts.	Contributes to transferring all outputs 2.1-2.3 to target groups and to disseminate results.	
D 3.2	Networking	The deliverable relates to networking within the power electronics business ecosystem and among end-users with the aim of making common evaluation of and transferring the knowledge and solutions generated by the PE-BSR project to the target groups. In line with this, the elements of the deliverable concerns establishment of and activities within networking fora as well as planning and execution of events. 1. Networking groups: At least five networking groups are established on a permanent or temporary basis with focus areas covering the two fields of technical emphasis of the PE-BSR project (ultra-high energy efficiency and intelligence), as well as fields of application in focus in the piloting (HVAC, pumps, electro mobility). Networking activities are completed within each group on a regular basis as digital, hybrid or physical events. 2. Planning and execution of events: A catalogue with topics for networking events is created and continuously updated. At least fifteen seminars / workshops are planned and executed as part of the PE-BSR project with the project partners as organizers.	Contributes to transferring all outputs 2.1-2.3 to target groups and to disseminate results.	
D 3.3	Innovation initiatives	The deliverable relates to innovation initiatives evaluating and transferring results from knowledge generation and demonstrator piloting at TRL 5-6 of the PE-BSR project into innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market. Facilitation of innovation development is completed with an open innovation approach reaching out as broad as possible to the power electronics business ecosystem as well as to relevant end-user segments within HVAC, pumps, and electro mobility. In line with this, the elements of the deliverable concerns feasibility and matchmaking in relation to innovation for new products and solutions as well as strategic initiatives, and the maturing of these possibilities. 1. Techno-economic feasibility and matchmaking: At least five techno-economic feasibility studies and matchmaking initiatives are completed and documented to cover at least on study within each of the end-user segments within HVAC, pumps, and electro mobility. 2. Innovation for new products and solutions: At least three cases with innovation for new products and solutions facilitated in the processes of identification, description and clarification of funding opportunities. 3. Strategic initiatives: At least three cases of possible new strategic initiatives identified, described and developed for new common transnational and regional activities of strategic importance for the power electronics business ecosystem and the end-users segments of HVAC, pump and electro mobility solutions.	Contributes to transferring all outputs 2.1-2.3 to target groups and to disseminate results.	

Work package 1

5.1 WP1 Preparing solutions

5.2 Aim of the work package

The aim of this work package is to prepare solutions to help address the identified challenge. You can either develop entirely new solutions or adapt existing solutions to the needs of your target groups. Prepare your solutions in a way that you can pilot them in Work Package 2. Consider how you involve your target groups in preparation of the solutions.
Organise your activities in up to five groups of activities to present the actions you plan to implement. Describe the deliverables and outputs as well as present the timeline.

5.3 Work package leader

Work package leader 1	PP 1 - University of Southern Denmark
Work package leader 2	PP 2 - Kiel University

5.4 Work package budget

Work package budget	35%

5.5 Target groups

	Target group	How do you plan to reach out to and engage the target group?
1	Small and medium enterprise The target group comprises small and medium sized companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 493 / 500 characters	Small and medium sized enterprises within the power electronics business ecosystem are invited to and involved from the very beginning of the PE-BSR project mainly through the iterative process of detailed concept design by taking an open innovation platform approach. Based on already established industrial contacts of the project partners as well as a systematic contact to all relevant companies, they are engaged as stakeholders providing inputs to needs assessment and requirements determination. The objective is to direct the activities of the project in relation to applied research generating new knowledge on ultra-high energy efficiency and intelligence in accordance with their needs for developing their product portfolios. Interaction with the companies is continuously maintained and improved throughout the completion of the applied research activities. 871 / 1,000 characters
2	Large enterprise The target group comprises large companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 476 / 500 characters	Large enterprises within the power electronics business ecosystem are invited to and involved from the very beginning of the PE-BSR project mainly through the iterative process of detailed concept design by taking an open innovation platform approach. Based on already established industrial contacts of the project partners as well as a systematic contact to all relevant companies, they are engaged as stakeholders providing inputs to needs assessment and requirements determination. The objective is to direct the activities of the project in relation to applied research generating new knowledge on ultra-high energy efficiency and intelligence in accordance with their needs for developing their product portfolios. Interaction with the companies is continuously maintained and improved throughout the completion of the applied research activities. 853 / 1,000 characters
3	Regional public authority Regional public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 446 / 500 characters	Regional public authorities are as end-users of energy efficient and intelligent power electronics solutions applied to realize a green energy transition invited to and involved from the very beginning of the PE-BSR project. It will mainly be through the iterative process of detailed concept design by taking an open innovation platform approach. They will as stakeholders be invited to provide inputs to needs assessment and requirements determination from an end-user point of view. The objective is to direct the activities of the project in relation to the customer needs among public authorities responsible for large-scale operation of HVAC, pump, and electro mobility systems. On-going contacts of the project partners as well as a systematic creation of new necessary contacts within the geography covered by the PE-BSR project will be used. 851 / 1,000 characters
4	Local public authority Local public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 443 / 500 characters	Local public authorities are as end-users of energy efficient and intelligent power electronics solutions applied to realize a green energy transition invited to and involved from the very beginning of the PE-BSR project. It will mainly be through the iterative process of detailed concept design by taking an open innovation platform approach. They will as stakeholders be invited to provide inputs to needs assessment and requirements determination from an end-user point of view. The objective is to direct the activities of the project in relation to the customer needs among public authorities responsible for large-scale operation of HVAC, pump, and electro mobility systems. On-going contacts of the project partners as well as a systematic creation of new necessary contacts within the geography covered by the PE-BSR project will be used. 848 / 1,000 characters

5.6 Activities, deliverables, outputs and timeline

No.	Name
1.1	**Detailed concept design based on iterative processes in an open innovation platform**
1.2	**Developing solutions for ultra-high energy efficiency of power conversion chains and motors**
1.3	**Developing solutions for intelligence in HVAC, pump, and electro mobility applications**

WP 1 Group of activities 1.1

5.6.1 Group of activities leader

Group of activities leader PP 3 - Lappeenranta-Lahti University of Technology LUT University

A 1.1

5.6.2 Title of the group of activities

Detailed concept design based on iterative processes in an open innovation platform

83 / 100 characters

5.6.3 Description of the group of activities

Based on an approach of iterative processes carried out with support from an open innovation platform, a detailed solution concept design for the two PE-BSR pilots within HVAC, pump solutions, and electro mobility is determined in sub-activities comprising:
1. Stakeholder engagement and needs assessment
2. Iterative process for detailed concept vision and design
3. Open innovation platform establishment

Re. 1. Stakeholder engagement and needs assessment
The PE-BSR project conducts open innovation processes based on profound stakeholder engagement and needs assessment in order to attain detailed understanding and validation of functional as well as non-functional requirements of the three PE-BSR demonstrator pilots being elaborated within application fields of HVAC, pumps and electro mobility.

Therefore, within each application field activities are carried out to engage relevant stakeholder groups with a special focus on creating strong links to a group of industrial network partners and public end-users. Furthermore, a detailed needs assessment is carried out to precisely understand all relevant aspects of requirements and their balancing in order to deliver optimal demonstrator pilots with ultra-high energy efficiency and intelligence.

Re. 2. Iterative process for detailed concept vision and design
Detailed concept visions and designs are prepared for innovative demonstrator solutions within each of the application fields of HVAC, pumps and electro mobility. In an iterative process, the visions and designs are made on basis of state-of-the-art knowledge, the internationally leading power electronics competencies among the project partners, and not least inputs from the group of associated stakeholders representing industrial network partners and end-users.

Re. 3. Open innovation platform establishment
A transnational open innovation platform for the Northern power electronics ecosystem is established with the aim of sustaining the position of the region as an important power electronics manufacturer, and in order to support power electronics networking and innovation. Through the innovation platform, a number of services are provided that stimulate the development of the regional power electronics ecosystem, and the development of new products and solutions is supported in an innovation-supportive effort.

In the formation of the platform that raises the transnational collaborative structures of the power electronics industry to a higher level, the ecosystem is mapped and contacts are established. Furthermore, a strategy and action plan is prepared and initiated, including aspects of how to complete networking activities, and efforts to support innovation that stimulates the development of new products and solutions in the field of power electronics.

2,809 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ✔

D 1.1

Title of the deliverable

Detailed concept design and open innovation platform

52 / 100 characters

Description of the deliverable

The deliverable contains the following two elements, which are delivered iteratively as input for connected activities 1.2 and 1.3 in versions of increasing details:

1. Concept design developed:
In a concept visioning process, which rests on engagement of relevant stakeholders and a profound needs assessment, a detailed concept vision for the demonstrator pilots is elaborated, including detailed requirements for energy efficiency and intelligence. The detailed requirements link to technical aspects of energy efficiency including: (i.) minimal power conversion losses, (ii.) active and passive components of modern materials, optimal thermal management, (iii.) packaging and application integration design, (iv.) direct current (DC) microgrids. Furthermore, detailed requirements linked to intelligence: (i.) digitalization incorporated, (ii.) grid service contributions, (iii.) microgrid ready operation, (iv.) improved user experience and comfort.

2. Open innovation platform established:
On basis of the stakeholder engagement and the comprehensive links of the project partners to industrial collaboration partners, an open innovation platform is established comprising all relevant and interested companies as well as end-users in the power electronics ecosystem. The geographic concentration of the innovation platform is on the four national sites of Denmark, Estonia, Finland, and Germany. However, the platform will reach out to other geographic areas. As part of the establishment, a detailed ecosystem mapping is made, and a strategy and action plan is prepared.

1,581 / 2,000 characters

Which output does this deliverable contribute to?

The deliverable contributes to guide knowledge building activities leading to all outputs O2.1-2.3

98 / 100 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.1: WP1 Preparing solutions						
A.1.1: Detailed concept design based on iterative processes in an open innovation platform						
D.1.1: Detailed concept design and open innovation platform						

5.6.7 This deliverable/output contains productive or infrastructure investment ☐

WP 1 Group of activities 1.2

5.6.1 Group of activities leader

Group of activities leader PP 2 - Kiel University

A 1.2

5.6.2 Title of the group of activities

Developing solutions for ultra-high energy efficiency of power conversion chains and motors

91 / 100 characters

5.6.3 Description of the group of activities

Ultra-high energy efficiency of power conversion chains and motors used for the two PE-BSR pilots is addressed by sub-activities with focus on:

1. Power conversion losses reduced to very low levels
2. Application of modern materials for active and passive components
3. Thermal management allowing compact and robust construction
4. Packaging and application integration for optimal design, e.g. motor integrated drives
5. Direct current (DC) approaches in microgrids

Re. 1. Power conversion losses.
By applying a drive controlled motor instead of a grid connected motor the power conversion losses can be significantly reduced, since only the power needed in the application will be provided instead of consuming a constant power and burning the exceeding available energy. The combination of new hardware technology and intelligent drive control thus has a significant potential for the reduction of power losses. High efficiency control and modulation strategies furthermore significantly reduces power losses.

Re. 2. Modern materials.
New wide-bandgap (WBG) semiconductors (such as SiC and GaN) will be used to enable a significant reduction of the volume (-30% compared to conventional technologies) as well as the power loss (-30%) -- without compromising the production cost or the reliability. High performance magnetics, such as nano-cristaline core, as well as capacitors, will be considered to fully enable the volume and efficiency gains achievable with WBG semiconductors.

Re. 3. Thermal management.
Thermal management of power electronics is of vital importance, as elevated temperatures have a significant effect of the lifetime of components like capacitors and transistors. The goal to utilize only passive cooling (no active cooling system like fans etc.) requires a holistic design process (electronics, structural mechanics, thermal flow, isolation barriers etc.) and extensive simulations .

Re. 4. Packaging and application integration.
Packaging technology has been a key focus area under previous INTERREG projects by the present project partners and cutting edge packaging technologies and circuit-level integration to co-optimize thermal and electrical performances will be applied. System-level integration, such as direct-motor-drive integration, will also be considered. This will enable a more global optimization of the system, which is required to achieve the target ultra-high efficiency and power density.

Re. 5. Direct current approaches.
The transition of the building with renewable generation and storage to dc leads to simpler PE systems with reduced power losses due to absence of ac-dc conversion stage. It is anticipated that the dc-ac conversion step is responsible for at least 20% and sometimes can exceed 50% of the overall conversion loss in a power electronic system. Therefore the corresponding energy savings can be estimated as a direct result of transition to a dc distribution scheme.

2,960 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ✔

D 1.2

Title of the deliverable

Increased technological knowledge for HVAC, pumps and electro mobility

70 / 100 characters

Description of the deliverable

The deliverable for the described group of activities in WP1.2 is primarily knowledge in the form of an increased know-how and technology awareness in the field of electronic packaging, thermal management, modern materials, motor integration and DC-grids aimed at HVAC, pump, and electro mobility applications. All pilots will benefit from the results of this group of activities, as the knowledge generated on all five fields of knowledge touched upon are used as the basis for developing prototypes and pilot units for testing in WP2.

The obtained knowledge is expected to include the following:
• Software control algorithms for reducing the overall power consumption from motors by several percentages, in addition to a substantial increase in reliability and lifetime of the systems and the applied components
• Application of wide-band-gap materials like SiC and GaN for active components and novel magnetic materials for passive components, implying significantly reduced power losses
• Thermally and electrically optimized packaging structures for new semiconductors and integration of power modules and control electronics into motor drives and electro mobility applications
• System integration optimization for application of ultra-high energy efficiency within HVAC, pumps and electro mobility
• Direct current concepts for HVAC units running on direct current (DC) as an alternative to alternating current (AC), giving a substantial increase in overall energy efficiency

1,484 / 2,000 characters

Which output does this deliverable contribute to?

The deliverable consists in high performance technologies contributing to all outputs O2.1-2.3

94 / 100 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.1: WP1 Preparing solutions						
A.1.2: Developing solutions for ultra-high energy efficiency of power conversion chains and motors						
D.1.2: Increased technological knowledge for HVAC, pumps and electro mobility						

5.6.7 This deliverable/output contains productive or infrastructure investment ☐

WP 1 Group of activities 1.3

5.6.1 Group of activities leader

Group of activities leader PP 3 - Lappeenranta-Lahti University of Technology LUT University

A 1.3

5.6.2 Title of the group of activities

Developing solutions for intelligence in HVAC, pump, and electro mobility applications

86 / 100 characters

5.6.3 Description of the group of activities

Intelligence in HVAC, pump and electro mobility applications is in focus through a number of sub-activities focusing on:
1. Digitalization options incorporated, e.g. connectivity, IoT, cloud/edge computing, AI
2. Grid service contributions, e.g. grid harmonics control, monitoring of grid state, flexible load capability
3. Micro-grid ready for decentralized operations with optimal security of supply

Re. 1. Digitalization options.
The ongoing advances in digitalization and IoT (Internet of Things), combined with sensor networks and Artificial Intelligence / deep learning algorithms enable advance control of power electronics systems from single battery powered units to large systems such as a water treatment plant and HVAC systems. For example can pumping or HVAC-functions, which are not time-critical, be adaptively scheduled to avoid peak-load period in the power grid, saving energy and stabilizing and balancing the power grid. Smaller systems based can periodically run on backup batteries. It further enables self-diagnosis of systems and predictive maintenance, as components can report that they, bases on the measured data, are likely to fail within a specific time period. Digitalization thus enables a holistic approach of power management with focus on energy efficiency, operation and optimization.

Re. 2. Grid service contributions.
The electrical power grid is traditionally considered stable and has historically been dominated by large rotating generators with a considerable inertia, giving a stable power output regarding voltage and frequency. But the rapid application of power electronics devices and renewable energy systems (like solar and wind) connected to the power grid introduce instabilities and noise. Intelligent motor drives for pumps and HVAC-system have the ability to help stabilizing the power grid and minimize the distorted/undesirable waveforms generated by the connected power electronics circuits and supplied to the power grid.

Re. 3. Micro-grid ready concept.
The project will develop, adapt and integrate all of the relevant near energy-neutral HVAC system elements (like fans, heat pump, PV / solar cells and battery storage) through dc and demonstrate its superiority in terms of efficiency to standard solutions. The intelligent decentralized control will provide maximum use of locally generated energy with possibility for its extension of this control toward neighborhood level, The dc/ac grid interface converter will be evaluated for possible grid service contributions.

2,542 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ✔

D 1.3

Title of the deliverable

Knowledge on intelligence in power electronics solutions as input for demonstrators

83 / 100 characters

Description of the deliverable

The deliverable for the described group of activities in WP1.3 is primarily knowledge in the form of an increased know-how and technology awareness in the fields of digitalization and IoT (Internet of Things), sensor networks and Artificial Intelligence and related grid stabilization and power saving solutions. All pilots will benefit from the results of this group of activities, as the knowledge generated in each of primary areas are used to develop the prototypes and pilot units for testing in WP2.

The obtained knowledge is expected to include the following:
• Establishment of digitalization solutions with connectivity features and data collection structures allowing generation and use of Big Data, which are applied in machine learning algorithms for improvement of control programs for electric power electronic converters and related applications
• Digital solutions for controlling devices in a way that they contribute to balancing use of power from the grid and improve the power quality
• The micro-grid concept with DC-powered systems will integrate near energy-neutral HVAC system elements like fans, heat pump, solar cells and battery storage using decentralized control

1,194 / 2,000 characters

Which output does this deliverable contribute to?

The deliverable consists in intelligence technologies contributing to all outputs O2.1-2.3

90 / 100 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.1: WP1 Preparing solutions						
A.1.3: Developing solutions for intelligence in HVAC, pump, and electro mobility applications						
D.1.3: Knowledge on intelligence in power electronics solutions as input for demonstrators						

5.6.7 This deliverable/output contains productive or infrastructure investment

☐

Work package 2

5.1 WP2 Piloting and evaluating solutions

5.2 Aim of the work package

The aim of this work package is to pilot, evaluate and adjust solutions. Plan one or several pilots to validate the usefulness of the solutions prepared in Work Package 1. Start Work Package 2 early enough to have time to pilot, evaluate and adjust solutions, together with your target groups. By the end of this work package implementation the solutions should be ready to be transferred to your target groups in Work Package 3.
The piloted and adjusted solution should be presented in one project output.
Organise your activities in up to five groups of activities. Describe the deliverables and outputs as well as present the timeline.

5.3 Work package leader

Work package leader 1 PP 3 - Lappeenranta-Lahti University of Technology LUT University

Work package leader 2 PP 4 - Tallinn University of Technology

5.4 Work package budget

Work package budget 30%

5.4.1 Number of pilots

Number of pilots 3

5.5 Target groups

	Target group	How do you plan to reach out to and engage the target group?
1	Small and medium enterprise The target group comprises small and medium sized companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 493 / 500 characters	Small and medium sized companies are invited to participate as industrial network partners in the PE-BSR piloting of the three demonstrator solutions. They will be involved in accordance with their interests as providers of solutions for electrification of the energy systems, typically in the form of power electronics materials, components, devices, control systems, and system integration where power electronics components are applied. The project partners are all very experienced in running university-industry interactions, and existing collaboration relations will be mobilized, and additional established through the open innovation platform established as well as through the transferring activities. 711 / 1,000 characters
2	Large enterprise The target group comprises large companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 476 / 500 characters	Large companies are invited to participate as industrial network partners in the PE-BSR piloting of the three demonstrator solutions. They will be involved in accordance with their interests as providers of solutions for electrification of the energy systems, typically in the form of power electronics materials, components, devices, control systems, and system integration where power electronics components are applied. The project partners are all very experienced in running university-industry interactions, and existing collaboration relations will be mobilized, and additional established through the open innovation platform established as well as through the transferring activities. 693 / 1,000 characters
3	Regional public authority Regional public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 446 / 500 characters	Regional public authorities will be involved as end-users testing the developed demonstrator solutions in piloting set-ups in connection to their large-scale operations of HVAC, pumps, and electro mobility solutions. This may for instance cover use-cases within public building stocks, water and wastewater treatment services, and operation of fleets of electric vehicles. Final agreements for piloting will be established during the project. 443 / 1,000 characters
4	Local public authority Local public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 443 / 500 characters	Local public authorities will be involved as end-users testing the developed demonstrator solutions in piloting set-ups in connection to their large-scale operations of HVAC, pumps, and electro mobility solutions. This may for instance cover use-cases within public building stocks, water and wastewater treatment services, and operation of fleets of electric vehicles. Final agreements for piloting will be established during the project. 439 / 1,000 characters

5.6 Activities, deliverables, outputs and timeline

No.	Name
2.1	**HVAC system solution piloting, evaluation and adjustment in iterative process**
2.2	**Pump system solution piloting, evaluation and adjustment in iterative process**
2.3	**Electro mobility system solution piloting, evaluation and adjustment in iterative process**

WP 2 Group of activities 2.1

5.6.1 Group of activities leader

Group of activities leader PP 4 - Tallinn University of Technology

A 2.1

5.6.2 Title of the group of activities

HVAC system solution piloting, evaluation and adjustment in iterative process

77 / 100 characters

5.6.3 Description of the group of activities

After initial verification in the laboratory environment (WP 1), the operational prototypes will undergo necessary adjustments, mainly related to additional protection and safety measures for pilot testing. The pilot will take place in Tallinn, Estonia using a building, specifically modified for dc electric system. The main components of the system include a local solar generation (PV panels), heat pump and battery storage interfaced through dc. Initially, the components will be tested separately in order to confirm their functionality. Afterwards, the joint operation with basic functionality will be verified to obtain real-field parameters and statistics. This will be used for corresponding adjustments in the control algorithm before its implementation. The data from the field tests will be acquired using special logging systems acquired from the project budget. The results will be compared with the initial models of the system previously obtained in the laboratory environment. Required verifications and adjustments will be performed to ensure the validity of results. The improved models will be used for further development of the control and intelligent scheduling algorithms to prioritize such goals as self-consumption or purchase costs.
After testing of the system, an intermediate report will be prepared for the partners. Electronics Industries Association will arrange the dissemination of project activities and a series of consultations with project partners will be arranged in order to assess possible changes in the design, mainly related to functionality, performance and cost optimization as well as comparability with existing supply chains. Certain proposed modifications will be implemented and tested to confirm the expectations.
The proposed technologies will also lay a strong foundation for future associated developments related to smart districts and energy trading, thus representing unique spin-off business opportunities. Development of proof-of-concept demonstrators will provide tangible examples of how the research findings of the project could be embedded into innovative PE systems for dc. Matchmaking events will be organized for industrial companies and start-ups to introduce research findings and opportunities with the aim to initiate applied research and product development projects funded by the private sector. The obtained knowledge will fill the existing gaps, push innovation forward and accelerate the industrial uptake of the highly promising dc technology.

2,523 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ☐

O 2.1

Title of the output

HVAC demonstrator pilot solution

32 / 100 characters

Description of the output

The concerns regarding the use and supply security of traditional energy sources rises the importance of transition to alternative and renewable energy sources as well as more efficient use of energy. At the same time, currently we are still using a 19th century technology to transmit electricity - Alternating Current (AC) meant for a time when all electricity generators were rotating turbines and many power consumers were simple rotating motors that relied on ac. Solar Panels, however, generate Direct Current (DC). Almost all of the final energy consumption can also be supplied with dc - including consumer electronics, modern industrial equipment and batteries.
The paradigm shift from centralized to distributed dc generation from renewables opens up possibilities for reconsidering the grid architecture, particularly at the user (prosumer) level. When large part of the energy is being consumed on-site or nearby, the feasibility of interfacing through ac becomes questionable due to need for extra conversion steps (dc to ac and ac to dc), leading to increased losses and cost of the power electronic (PE) interfaces. Therefore, the obvious and remarkable advantage of dc distribution is the elimination of power losses due to extra dc-ac-dc conversions. According to estimations, even by adapting existing devices to dc by removing the ac-dc stage, can provide remarkable energy savings. The additional potential benefits of DC are in simplified communication and controls, power quality, reliability and resilience.
The advances in power electronics have made the transition to dc distribution in a building easier than ever before. The fact that future buildings will most likely feature local PV and battery storage, which are natively DC, makes the dc power inherently available in such building. With the extensive use of DC-supplied electronic devices (PCs, cell phones, robotic cleaners, etc.) have made the DC loads to significantly contribute, or even dominate in the residential applications. This dc native consumption is set to explode as by 2030 we will have 0.8 TW of Electric Vehicle chargers installed in the EU.
The developed technology related to nearly-energy-neutral HVAC system will be based on dc distribution that includes a heat pump, PV panels and battery storage solutions. PE interfaces together with other system components will be adopted for integration through dc. This will avoid the inverter and power factor correction stages. The additional or modified sensing and protection circuitry together with limitation in inrush current will be developed. In addition, the dc system will feature decentralized control of energy production, storage and consumption using droop control with dc-bus signaling. Intelligent scheduling algorithms aiming towards maximum use of local energy with minimized consumption and purchase costs from the grid will be proposed. The solution will have the option to be extended to include other elements, like EV battery.

2,997 / 3,000 characters

Target groups and uptake of the solution presented in this output

Target groups	How will this target group apply the output in its daily work?
Target group 1 Small and medium enterprise The target group comprises small and medium sized companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR.	The output will enable the SME target group to develop energy efficient solution within the fields of Motor control, HVAC and electro-mobility. SMEs typically do not have the resources available to closely follow the technological development, participating in conferences etc.. The results from this activity therefore directly aims at increasing the knowledge of SMEs for the benefit of their business and job creation potential. The results can be used in the development of new products or extending already existing product series. 536 / 1,000 characters
Target group 2 Large enterprise The target group comprises large companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR.	The output will enable the Large Enterprise target group to develop energy efficient solution within the fields of Motor control, HVAC and electro-mobility. Large Enterprises typically follow the development of new technologies by attending conferences and having own internal proof-of-concept projects. However, projects typically are aimed at specific product ranges and the introduction of new product series , especially with new technologies, are very time consuming. Those companies therefore will benefit from this project, as the results can be transferred to the development and marketing units of those companies. 628 / 1,000 characters
Target group 3 Local public authority Local public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project.	The output will enable the Local public authorities to evaluate the implementation of new technologies in the HVAC, pump and e-mobility sector.Those authorities typically do not follow the technological development closely and wait to evaluate specific solutions until they are introduced into the market. This can delay the uptake of new technologies by several years . Via this project can local public authorities follow the development of relevant new technologies, evaluate the potential for specific application and develop an entrepreneurial spirit and interest in applying new energy saving technologies, products and services. 640 / 1,000 characters

Durability of the output

The durability of the output is long term, meaning several years. New technologies and methods typically take several years from introduction to reaching full market potential, especially in conservative markets. The risk of having to call back products due to generic problems with the applied technology is a nightmare scenario for any manufacturer.The knowledge generated in this project in the form of scientific will always be valid and usable for the development of new products in not only the HVAC market, but also in the pump and e-mobility market.

557 / 1,000 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.2: WP2 Piloting and evaluating solutions						
A.2.1: HVAC system solution piloting, evaluation and adjustment in iterative process						
O.2.1: HVAC demonstrator pilot solution						

5.6.7 This deliverable/output contains productive or infrastructure investment ☐

WP 2 Group of activities 2.2

5.6.1 Group of activities leader

Group of activities leader PP 1 - University of Southern Denmark

A 2.2

5.6.2 Title of the group of activities

Pump system solution piloting, evaluation and adjustment in iterative process

77 / 100 characters

5.6.3 Description of the group of activities

Pumps are widely used in public services e.g. for fresh and waste water. Today they are often running directly connected to the grid without a drive. That means that they are either running full speed or are turned off. Some pumps are even running continuously, independently from the demand and consuming unnecessary energy. If the pumps are not running continuously they are typically controlled by the demand of the application. For some application this is required, e.g. for fresh water pumps that need to provide a constant pressure on the fresh water network. For these applications a speed controlled pump will be introduced that will keep the pressure constant in an efficient way. For the applications where a discontinuous operation is required e.g. refilling a water tower or pumping waste water from a reservoir the pumping today only depends on the need of the application. For a water tower it means that the pump starts if e.g. the gauge is reduced by 5 % in dependent of the actual availability and thereby price of electricity. Here it would be beneficial to wait with the activation of pump until the high amount of energy is available or the price is low typically depending on the energy production of renewables. This leads to two main activities:

1. The integration of inverter/control electronics into the motor housing structure, by e.g. applying new semiconductor technologies, will be evaluated with respect to system volume optimization, energy savings and increased functionality/performance due to reduces electromagnetic interference issues. All these factors contribute to more attractive implementation and operations costs.
2. By analyzing of big data and applying artificial intelligence a prediction of latest point in time to refill the water tower and the development of the electricity price can be predicted and the most cost efficient operation of the pump will be realized. In that way pumps will contribute to the green transition. A pilot pump solution will be tested in an operational environment such as a water treatment plant and the collected data will be analyzed using artificial intelligence / deep learning methods. A virtual plant model will be developed to optimize the development, test and evaluation phases.

2,270 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ☐

O 2.2

Title of the output

Pump demonstrator pilot solution

32 / 100 characters

Description of the output

The output of the pump pilot demonstrator solution consists of an improved control and precision scheme implemented primarily as software algorithms in embedded hardware, The piloted solutions for pumps controlled by artificial intelligence can easily be implemented existing pump control software platforms/systems as soon as the software algorithms are developed. By the ability of self-learning of the system it will automatically adapt to the specific application over time. By defining the right boundary conditions, it can be ensured that the critical infrastructure is also working in case this new technology fails, the risk is limited since in worst case the system operates for the same high cost as before.
The outcome is further characterized by results obtained by testing a highly efficient drive-motor-pump system in a pilot application, where continuous operation is required to keep the output pressure constant. The pump will be fully electrically controlled instead of using inefficient bypass valves in the water system. This increases the energy efficiency of the pump system.
The integration of the electronics into the pump structure will increase the EMC (electromagnetic compatibility) performance, as long cables between a motor control unit and its connected motor are eliminated and thus not able to act as receiving or radiating antennas. The active intelligent control of the pump further enables the pump system to supply grid service activities such as balancing and reduction of unwanted currents on the power grid and by that helping to stabilize the power grid, which is suffering from the increasing number of renewable energy plants, both photovoltaic and wind, which by their lack of large rotating generators with high inertia are not able to provide the same stability of the power grid as traditional power generator.
This pilot demonstrator output therefore can be described as consisting not only of enhanced knowledge about intelligent algorithms for the energy efficient control of pumps in water systems, but also as a platform to be transferred to industry for the development of more specific applications. The results are expected to be of such a generic nature that they can be applicable in other areas, where motors need to be controlled.

2,294 / 3,000 characters

Target groups and uptake of the solution presented in this output

Target groups	How will this target group apply the output in its daily work?
Target group 1 Small and medium enterprise The target group comprises small and medium sized companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR.	The output will enable the SME target group to develop energy efficient solution within the fields of Motor control, HVAC and electro-mobility. SMEs typically do not have the resources available to closely follow the technological development, participating in conferences etc.. The results from this activity therefore directly aims at increasing the knowledge of SMEs for the benefit of their business and job creation potential. The results can be used in the development of new products or extending already existing product series. 536 / 1,000 characters
Target group 2 Large enterprise The target group comprises large companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR.	The output will enable the Large Enterprise target group to develop energy efficient solution within the fields of Motor control, HVAC and electro-mobility. Large Enterprises typically follow the development of new technologies by attending conferences and having own internal proof-of-concept projects. However, projects typically are aimed at specific product ranges and the introduction of new product series , especially with new technologies, are very time consuming. Those companies therefore will benefit from this project, as the results can be transferred to the development and marketing units of those companies. 628 / 1,000 characters

Durability of the output

The durability of the output is long term, meaning several years. New technologies and methods typically take several years from introduction to reaching full market potential, especially in conservative markets. The risk of having to call back products due to generic problems with the applied technology is a nightmare scenario for any manufacturer.The knowledge generated in this project in the form of scientific will always be valid and usable for the development of new products in not only the HVAC market, but also in the pump and e-mobility market.

557 / 1,000 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.2: WP2 Piloting and evaluating solutions						
A.2.2: Pump system solution piloting, evaluation and adjustment in iterative process						
O.2.2: Pump demonstrator pilot solution						

5.6.7 This deliverable/output contains productive or infrastructure investment

WP 2 Group of activities 2.3

5.6.1 Group of activities leader

Group of activities leader PP 3 - Lappeenranta-Lahti University of Technology LUT University

A 2.3

5.6.2 Title of the group of activities

Electro mobility system solution piloting, evaluation and adjustment in iterative process

89 / 100 characters

5.6.3 Description of the group of activities

The transferring of new electrical drive technology (prepared in WP1), before its adoption can be considered to e-mobility applications, requires step-by-step piloting by practical testing and detailed analysis of the overall system. A platform for high power density power electronic integrated propulsion motor testing will be created to LUT University (Lappeenranta, Finland) that has three main elements; I) a simulation tool, II) a laboratory emulator and III) an actual test vehicle. During the first evaluation steps, the solutions are evaluated prior to the laboratory tests by creating a simulation tool for dimensioning of vehicle main components and for energy efficiency calculations (corresponding to WP1 solutions). These results are evaluated in collaboration with partner universities. The next stage will focus on the laboratory emulator that include real e-mobility application components, such as BES, propulsion motor and load emulating drive, that are used to evaluate the derived solutions with emulated (real and measured) load cycles. During the final evaluation stage, the technology derived in WP1 is integrated to the hybrid vehicle technology available at LUT University, that acts as a pilot demonstrator for the developed technology. It is highlighted that the test vehicle is equipped with comprehensive data acquisition system (DAQ) that can collect all the necessary information from route, vehicle and drive line including traction motor data (temperature, currents, etc.). These piloting tests will provide valuable insights and results of the proposed technology solutions – user experience along with validation of the actual performance and efficiency under realistic and harsh operation conditions are obtained. As the tests are planned to be carried out using real operation routes and cycles with the technology delivered from WP1, the tests will provide important knowledge to the target groups to be used in actual product development stage. The identified target groups in Finland (e.g. international companies focusing on electrified mobile equipment such as ABB Drives, Danfoss Editron and AGCO) and companies from Partner Countries are contacted to disseminate the information on the piloting.

2,243 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable

☐

O 2.3

Title of the output

Electro-mobility demonstrator pilot solution

44 / 100 characters

Description of the output

The ongoing change towards green transportation is in full swing, but there are still many challenges associated with electrification – especially in the case of e-mobility (large hybrid/electric vehicles and mobile equipment) where technology adoption is slow due to several safety restrictions. In order to achieve maximum material and energy savings, selection and optimization of high efficiency components should be tested at system level. The activities in WP2 will lead to a flexible/modular design platform, consisting of combination of I) simulation tool, II) emulator tool and III) actual vehicle, that can be used to step-by-step evaluation of high-power density power electronic (PE) integrated traction motors. This means that new power electronics and/or motor solutions can be piloted and tested in secure environment before scaling them to the market. More importantly, the WP2 will pilot the derived PE and motor solutions with actual test vehicle that is a modular hybrid bus constructed at LUT-University. Often, the testing with prototype e-mobiles on public roads is not an option due to the high safety demands regarding vehicles permitted to drive on public roads, but the demonstrator will provide this possibility (the test vehicle is safety inspected and registered). The bus is equipped with comprehensive data acquisition system (DAQ) that can collect all the necessary information from route, vehicle and drive line (including motor data). The testing under real and harsh operation conditions will provide valuable information about the solutions and serve as an important output for further analysis and development by identified target groups. The demonstration of the solutions with the platform will provide transnational value as a testing ground to deliver transferable knowledge (technology, tools) to be used and up-scaled by power electronic companies.

1,894 / 3,000 characters

Target groups and uptake of the solution presented in this output

Target groups	How will this target group apply the output in its daily work?
Target group 1 Small and medium enterprise The target group comprises small and medium sized companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR.	The output will enable the SME target group to develop energy efficient solution within the fields of Motor control, HVAC and electro-mobility. SMEs typically do not have the resources available to closely follow the technological development, participating in conferences etc.. The results from this activity therefore directly aims at increasing the knowledge of SMEs for the benefit of their business and job creation potential. The results can be used in the development of new products or extending already existing product series. 536 / 1,000 characters
Target group 2 Large enterprise The target group comprises large companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR.	The proof-of-concept testing (results from pilot installation and analysis tools) can be used to evaluate the solutions so that they are feasible to be consider in commercialization stage. The results provides valuable insights especially for LEs for technology up-scaling (component dimension to other vehicles or mobile equipment technology). This output cover the implementation and validation activities to guarantee that the proposed technology meets the needs of the identified target groups. 499 / 1,000 characters

Durability of the output

For the PE-BSR partners the durability of the outputs and results are important and that is why several aspects has been considered to ensure that they will have impact/effect after the project. The tests platform and pilot demonstrator will be developed in such manner that they will become part of research infrastructure that support the future needs of the academic ecosystem and its industrial members. The upkeep of e-mobility pilot demonstrator/platform environment and relating costs are financed by LUT University, but the system can be used by the partner organizations and for research services. The project results (platform/pilots) are documented in detailed reports in FAIR enhancing repositories giving the possibility for public authorities/partners to easily access and adapt the tools/results for wider use.

826 / 1,000 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.2: WP2 Piloting and evaluating solutions						
A.2.3: Electro mobility system solution piloting, evaluation and adjustment in iterative process						
O.2.3: Electro-mobility demonstrator pilot solution						

5.6.7 This deliverable/output contains productive or infrastructure investment

Work package 3

5.1 WP3 Transferring solutions

5.2 Aim of the work package

In Work Package 3, communicate and transfer the ready solutions to your target groups. Plan at least one year for this work package to transfer your solutions to the target groups, considering their respective needs. Select suitable activities to encourage your target groups to use the solutions in their daily work.
Organise your activities in up to five groups of activities. Describe the deliverables and outputs as well as present the timeline.

5.3 Work package leader

Work package leader 1 PP 1 - University of Southern Denmark

Work package leader 2 PP 5 - Sønderborg Business Development Association

5.4 Work package budget

Work package budget 25%

5.5 Target groups

	Target group	How do you plan to reach out to and engage the target group?
1	Small and medium enterprise The target group comprises small and medium sized companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 493 / 500 characters	The PE-BSR project generates extensive power electronics knowledge from solution preparation activities in WP1 focusing on ultra-high energy efficiency and intelligence. Furthermore, WP2 creates piloting experiences on an experimental technology readiness level (TRL) 5-6. Results of this knowledge and these experiences are made available for innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market. Dissemination, networking and innovation in WP3 activities reach out to and engage with the small and medium sized enterprises providing products and solutions relying on internationally leading power electronics knowledge. The goal is to reach out as broad as possible, and in this effort, the open innovation platform established in WP1 is mobilized together with the WP3 activities. Existing comprehensive connections of PE-BSR partners to the industry companies provides a solid basis for this. 1,000 / 1,000 characters
2	Large enterprise The target group comprises large companies forming part of the power electronics ecosystem as they are basing their business in part or completely on competencies related to power electronics. They are typically industrial companies operating at different levels of energy consuming value chains related to HVAC, pumps or electro mobility solutions. The PE-BSR project addresses the high number of companies located in the area directly covered, but also those within the BSR. 476 / 500 characters	he PE-BSR project generates extensive power electronics knowledge from solution preparation activities in WP1 focusing on ultra-high energy efficiency and intelligence. Furthermore, WP2 creates piloting experiences on an experimental technology readiness level (TRL) 5-6. Results of this knowledge and these experiences are made available for innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market. Dissemination, networking and innovation in WP3 activities reach out to and engage with the large enterprises providing products and solutions relying on internationally leading power electronics knowledge. The goal is to reach out as broad as possible, and in this effort, the open innovation platform established in WP1 is mobilized together with the WP3 activities. Existing comprehensive connections of PE-BSR partners to the industry companies provides a solid basis for this. 982 / 1,000 characters
3	Regional public authority Regional public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 446 / 500 characters	Regional public authorities are invited into and engaged in the PE-BSR project as they politically are interested in the green energy transition, and because they in many of their operations are end-users of HVAC, pump, and electro mobility solutions based on power electronics technologies. They have a high interest and need for applying energy efficient and intelligent solutions. Therefore, the dissemination, networking and innovation in WP3 activities are designed in a way that they reach out to and engage with the regional public authorities, taking into account the specific needs and interests they have as end-users. Based on strong existing connections of the PE-BSR project partners to the public authorities, involvement of these will be made directly with political as well as operational parts of the organizations at each of the four geographic sites covered by the PE-BSR project – Denmark, Estonia, Finland, Germany. 937 / 1,000 characters

	Target group	How do you plan to reach out to and engage the target group?
4	Local public authority Local public authorities are to a large extent responsible for operating large public building stocks, water and wastewater treatment services, and fleets of vehicles. In doing so, they are important end-users of HVAC, pump and electro mobility solutions applying power electronics technologies. The PE-BSR project addresses primarily the regional public authorities directly located within the geographic area directly covered by the project. 443 / 500 characters	Local public authorities are invited into and engaged in the PE-BSR project as they politically are interested in the green energy transition, and because they in many of their operations are end-users of HVAC, pump, and electro mobility solutions based on power electronics technologies. They have a high interest and need for applying energy efficient and intelligent solutions. Therefore, the dissemination, networking and innovation in WP3 activities are designed in a way that they reach out to and engage with the regional public authorities, taking into account the specific needs and interests they have as end-users. Based on strong existing connections of the PE-BSR project partners to the public authorities, involvement of these will be made directly with political as well as operational parts of the organizations at each of the four geographic sites covered by the PE-BSR project – Denmark, Estonia, Finland, Germany. 934 / 1,000 characters

5.6 Activities, deliverables, outputs and timeline

No.	Name
3.1	**Dissemination of results from demonstrator work and identification of policy measure implications**
3.2	**Networking activities within the power electronics business ecosystem**
3.3	**Innovation initiatives for transferring solutions to market scaling**

WP 3 Group of activities 3.1

5.6.1 Group of activities leader

Group of activities leader PP 1 - University of Southern Denmark

A 3.1

5.6.2 Title of the group of activities

Dissemination of results from demonstrator work and identification of policy measure implications

97 / 100 characters

5.6.3 Description of the group of activities

The PE-BSR project generates extensive innovative, generic and commercially relevant power electronics knowledge from solution preparation activities in WP1 focusing on ultra-high energy efficiency and intelligence. Furthermore, WP2 creates piloting experiences on applying this knowledge in specific solution demonstrators on an experimental technology readiness level (TRL) 5-6. Results of this knowledge and these experiences can serve as a basis for innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market. Meanwhile, a prerequisite is successful dissemination and exploitation of the results, and often the backing from policies on how to ensure a facilitating framework for the market scaling of such solutions. Therefore, dissemination activities and identification of policy measures are crucial for successfully transferring the outputs of the PE-BSR project.

In order to disseminate results and identify policy measures, the sub-activities are:
1. Digital activities: Comprises the establishment of a dedicated website as well as presence on social media platforms. An active and dynamic communication and sharing of information is provided, including continuously updated info on project progress through publishing of a regular newsletter, links to project publications, presentation of outcomes from events, and interviews with stakeholders in the industry and among end-user. A social media profile on LinkedIn will be established and promoted. Brochures and posters for distribution and show at conferences and exhibitions to present the project will be produced.

2. Publications and conference participation: Is a main channel for disseminating results and experiences from WP1 and WP2. Publications are prepared for submission in peer-review journals and on conferences targeting the power electronics ecosystem, and in particular focusing on HVAC, pump, electro mobility applications. Targeted journals include recognized IEEE publications with a high scientific ranking. The project partners will promote the developed demonstrator pilots at conferences and workshops, such as the IEEE European Power Electronics conference series (EPE, CPE-Powereng, and similar) and the ECPE, and will be followed by publication in high-impact peer-reviewed journals. A special effort is directed towards presentation of results from the WP2 demonstrator piloting in publications and conference presentations focusing especially on commercial perspectives. It is targeted the power electronics industry as well as end-users and Key Opinion Leaders (KOL) within HVAC, pumps and electro mobility.

3. Policy measures: Are identified, described and shared with relevant policy makers in order to contribute to a facilitating framework for the market scaling of energy efficient and intelligent power electronics solutions.

The activities involve all PE-BSR project partners.

2,980 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ✔

D 3.1

Title of the deliverable

Dissemination and policy measure implications

45 / 100 characters

Description of the deliverable

The deliverable relates to dissemination and exploitation of results from the knowledge building and piloting work as well as to the identification of policy measure implications. In line with this, the elements of the deliverable concerns digital activities, publications and conference participation, as well as policy measures.

1. Digital activities:
A dedicated project website established and maintained as a common communication platform for active and dynamic dissemination of knowledge generated from WP1 in connection to preparation of demonstrator pilot solutions, results obtained in WP2 from piloting the solutions, and outcomes of networking and innovation activities.

A social media project profile on LinkedIn established and maintained with regular postings of all project relevant information relating to preparation and piloting of demonstrator solutions as well as networking and innovation activities.

A project brochure and posters are prepared.

2. Publications and conference participation:
At least twelve scientific publications are prepared and submitted for peer-review journals and on conferences within the fields of ultra-high energy efficiency and intelligence within HVAC, pump and electro mobility applications.

Participation with papers and posters on at least nine internationally recognized conferences forming part of power electronics or energy and climate events such as IEEE or ECPE.

3. Policy measure implications:
A catalogue of policy measure implications for creating elements of a facilitating framework for the market scaling of energy efficient and intelligent power electronics solutions is prepared. It contains specific suggestions and recommendations directed towards different policy levels in the local, regional and transnational contexts.

1,803 / 2,000 characters

Which output does this deliverable contribute to?

Contributes to transferring all outputs 2.1-2.3 to target groups and to disseminate results.

92 / 100 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.3: WP3 Transferring solutions						
A.3.1: Dissemination of results from demonstrator work and identification of policy measure implications		■	■	■	■	■
D.3.1: Dissemination and policy measure implications						■

5.6.7 This deliverable/output contains productive or infrastructure investment ☐

WP 3 Group of activities 3.2

5.6.1 Group of activities leader

Group of activities leader PP 1 - University of Southern Denmark

A 3.2

5.6.2 Title of the group of activities

Networking activities within the power electronics business ecosystem

69 / 100 characters

5.6.3 Description of the group of activities

Networking within the power electronics business ecosystem and among end-users of HVAC, pump and electro mobility systems is an important element in efficiently making common evaluation of and transferring the knowledge and solutions generated by preparing and piloting the three demonstrators of the PE-BSR project on a technology readiness level (TRL) 5-6. Networking inspires to and assists in making results available for product specific application on TRL 8-9 by power electronics companies and end-users. Focus areas of the networking activities are aligned with the two fields of technical emphasis (ultra-high energy efficiency and intelligence), as well as with the fields of application (HVAC, pumps, electro mobility).

Implementation of networking activities are carried out as a continuation of the open innovation platform established under WP1 in activity 1.1. A strong focus is on creating transnational networking of a general interest for the whole BSR region, but with a high intensity of activities at the four geographic sites covered by the project – Denmark, Estonia, Finland, Germany. Considering the large geographic area covered by the PE-BSR project, and the aim to get a broad participation, the activities are to a large extent completed as digital or hybrid events. However, especially at the beginning of the project there will be a focus on events with possibility of physical presence in order to establish personal contacts.

The networking sub-activities comprise:
1. Networking groups: Establishment of temporary or permanent networking groups in collaboration with relevant existing cluster and networking initiatives operating on transnational, national, regional and local levels. The groups may be structured in relation to technical topics, which can for example be power conversion techniques and topologies, application of new materials for power electronics, thermal management, packaging and application integration, direct current approaches, digitalization solutions, grid services, and micro-grids. Fields of application can also be a topic for networking groups, for example use of pumps in public wastewater treatment, intelligent control of ventilation systems in public building stocks, and electro mobility drive trains for professional vehicles.

2. Topics catalogue: Continuously and on basis of an on-going dialogue with the power electronics ecosystem and end-users monitor a catalogue of relevant topics for seminars / workshops

3. Event planning and execution: Professional planning and completion of events in coordination with other providers, and in accordance with plans

All PE-BSR project partners contribute to the networking activities on basis of their solid and long-lasting experience with carrying out networking activities on different levels within the power electronics ecosystem. This experience will be mobilized and expanded in the PE-BSR project with a high focus on creating transnational synergies.

2,981 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ✔

D 3.2

Title of the deliverable

Networking

10 / 100 characters

Description of the deliverable

The deliverable relates to networking within the power electronics business ecosystem and among end-users with the aim of making common evaluation of and transferring the knowledge and solutions generated by the PE-BSR project to the target groups. In line with this, the elements of the deliverable concerns establishment of and activities within networking fora as well as planning and execution of events.

1. Networking groups:
At least five networking groups are established on a permanent or temporary basis with focus areas covering the two fields of technical emphasis of the PE-BSR project (ultra-high energy efficiency and intelligence), as well as fields of application in focus in the piloting (HVAC, pumps, electro mobility). Networking activities are completed within each group on a regular basis as digital, hybrid or physical events.

2. Planning and execution of events:
A catalogue with topics for networking events is created and continuously updated.

At least fifteen seminars / workshops are planned and executed as part of the PE-BSR project with the project partners as organizers.

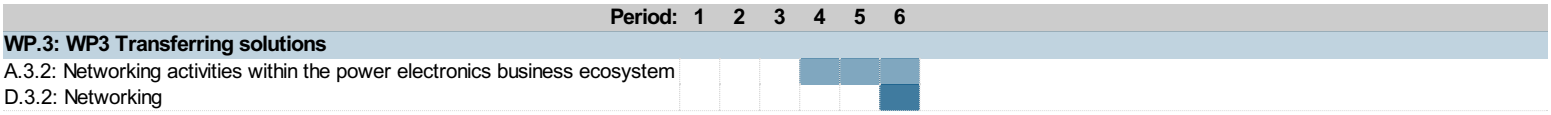
1,107 / 2,000 characters

Which output does this deliverable contribute to?

Contributes to transferring all outputs 2.1-2.3 to target groups and to disseminate results.

92 / 100 characters

5.6.6 Timeline



5.6.7 This deliverable/output contains productive or infrastructure investment

☐

WP 3 Group of activities 3.3

5.6.1 Group of activities leader

Group of activities leader PP 5 - Sønderborg Business Development Association

A 3.3

5.6.2 Title of the group of activities

Innovation initiatives for transferring solutions to market scaling

67 / 100 characters

5.6.3 Description of the group of activities

The knowledge generated and piloting experiences attained on a technology readiness level (TRL) 5-6 through activities in WP1 and WP2 can serve as a basis for innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market. Therefore, in order to sustain this process, innovation initiatives for evaluating and transferring demonstrator pilot solutions of the PE-BSR project are completed. Facilitation of innovation is realized on basis of an approach of open innovation. The goal is to reach out as broad as possible to the power electronics business ecosystem as well as to relevant end-user segments within HVAC, pumps, and electro mobility. In this effort, the open innovation platform established in WP1 under activity 1.1 is mobilized and there is a close interaction with networking activities carried out in activity 3.2.

In order to facilitate innovation development based on knowledge generation and demonstrator piloting in the PE-BSR project, the sub-activities are:
1. Techno-economic feasibility and matchmaking: Analyses are made of a wide range of possible use-cases within HVAC, pump and electro mobility applications where results from the power electronics demonstrator piloting solutions can be applied in calibrated forms in creation of new commercially mature products. The exploration is completed in interaction with companies belonging to the power electronics business ecosystem as well as with end-users, and matchmaking is an intrinsic part of the process.

2. Innovation for new products and solutions: Facilitation of identification, description and funding opportunities for new innovative ideas for creating commercially mature products and solutions on basis of the knowledge generated and piloting experiences attained from the PE-BSR project. On a case-by-case basis, companies and end-users are supported in the planning and implementation of specific innovation projects assisting in market scaling of the outputs from the PE-BSR project.

3. Strategic initiatives: Support the identification, description and development of new common transnational and regional activities of strategic importance for the power electronics business ecosystem and the end-users segments of HVAC, pump and electro mobility solutions. For instance new initiatives in education and competence development, innovation development, and market upscaling.

All PE-BSR project partners contribute to the innovation activities, but the input is from the business development associations.

2,593 / 3,000 characters

5.6.4 This group of activities leads to the development of a deliverable ✔

D 3.3

Title of the deliverable

Innovation initiatives

22 / 100 characters

Description of the deliverable

The deliverable relates to innovation initiatives evaluating and transferring results from knowledge generation and demonstrator piloting at TRL 5-6 of the PE-BSR project into innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market. Facilitation of innovation development is completed with an open innovation approach reaching out as broad as possible to the power electronics business ecosystem as well as to relevant end-user segments within HVAC, pumps, and electro mobility. In line with this, the elements of the deliverable concerns feasibility and matchmaking in relation to innovation for new products and solutions as well as strategic initiatives, and the maturing of these possibilities.

1. Techno-economic feasibility and matchmaking:
At least five techno-economic feasibility studies and matchmaking initiatives are completed and documented to cover at least on study within each of the end-user segments within HVAC, pumps, and electro mobility.

2. Innovation for new products and solutions:
At least three cases with innovation for new products and solutions facilitated in the processes of identification, description and clarification of funding opportunities.

3. Strategic initiatives:
At least three cases of possible new strategic initiatives identified, described and developed for new common transnational and regional activities of strategic importance for the power electronics business ecosystem and the end-users segments of HVAC, pump and electro mobility solutions.

1,597 / 2,000 characters

Which output does this deliverable contribute to?

Contributes to transferring all outputs 2.1-2.3 to target groups and to disseminate results.

92 / 100 characters

5.6.6 Timeline

Period:	1	2	3	4	5	6
WP.3: WP3 Transferring solutions						
A.3.3: Innovation initiatives for transferring solutions to market scaling						
D.3.3: Innovation initiatives						

5.6.7 This deliverable/output contains productive or infrastructure investment ☐

6. Indicators

Indicators

Output indicators				Result indicators		
Output indicators	**Total target value in number**	**Project outputs**	**Please explain how the solution presented in this output serves the target group(s).**	**Result indicator**	**Total target value in number**	**Please explain how organisations in the target groups within or outside the partnership will take up or upscale each solution.**
RCO 84 – Pilot actions developed jointly and implemented in projects	3	N/A	N/A	**RCR 104 - Solutions taken up or up-scaled by organisations**	3	The basic working principle of the PE-BSR project is that university partners in WP1 generate extensive and innovative power electronics knowledge from solution preparation activities focusing on ultra-high energy efficiency and intelligence. In WP2 they complete piloting experiences with outputs of demonstrator solutions for HVAC, pumps, and electro mobility on TRL 5-6. Results are through dissemination, networking and innovation initiatives in WP3 made available for innovation efforts in the product portfolios of power electronics companies, who provide and scale commercial products on a TRL 8-9 to the end-user market. For the three PE-BSR demonstrator solutions the following upscaling is considered: 1. HVAC: The system demonstrator consisting of a heat pump, PV and battery operated through direct current is implemented in a pilot displaying its superiority to standard solutions. Sharing of the results through dissemination, networking and innovation initiatives ensure the uptake of this technology. 2. Pumps: The demonstrator with two elements of an AI controlled pump and a high-efficient drive pump system is implemented in an application demonstrating energy savings and services contributing to the green transition. It is expected to be of high interest for the industry, and by sharing the software and providing design guidelines partner organizations and companies can optimize, adjust and further develop the features of the demonstrator in order to easily adopt it into their business. 3. Electro mobility: The demonstration within a specific e-mobility application is a prerequisite for upscaling the innovative technology. The output and results cover implementation and validation, guaranteeing that the proposed innovative solutions meet the needs of the target groups of power electronics manufacturers for mobile equipment. The platform provides relevant support for product upscaling and thus accelerates the route to market of breakthrough innovations. 1,992 / 2,000 characters

Output indicators	Total target value in number	Project outputs	Please explain how the solution presented in this output serves the target group(s).	Result indicator	Total target value in number	Please explain how organisations in the target groups within or outside the partnership will take up or upscale each solution.
RCO 116 – Jointly developed solutions	3	O.2.1: HVAC demonstrator pilot solution	The main challenges of dc distribution are in lack of awareness, matured technology and market-ready systems. Another specific challenge is the need to ensure competitive safety, lifetime, cost and maintenance expenses. It is highly expected that key competences and knowledge obtained by all partners during this project will help to advance the emerging dc technology by enabling novel cost-effective and highly-versatile solutions as well as efficient ways to adapt existing consumer electronics to dc. The reliability of dc systems is also considered higher due to the use of fewer components in general. Recent discussions with industrial partners have revealed a potential energy saving in the range of several percent on the electronics itself, but also a potential of increasing the overall application efficiency from around 60-80% for HVAC systems, which is a huge improvement. This requires advanced control schemes for optimization of the whole HVAC process. 975 / 1,000 characters			

Output indicators		Result indicators			
Output indicator	**Total target value in number**	**Result indicator**	**Total target value in number**	**Please describe what types of organisations are planned to actively participate in the project. Explain how this participation will increase their institutional capacity. These types of organisations should be in line with the target groups you have defined for your project.**	
RCO 87 - Organisations cooperating across borders	6	**PSR 1 - Organisations with increased institutional capacity due to their participation in cooperation activities across borders**	6	Project partners and associated organisations	The project partners are universities and business development organizations. Through the PE-BSR project both groups of partners significantly strengthen their institutional capacity. The universities improve their capabilities to complete applied research generating new knowledge on power electronics solutions with ultra-high energy efficiency and intelligence, and to conduct piloting on basis of this knowledge in specific fields of application within HVAC, pumps and electro mobility. This is done in close interaction with companies within the power electronics business ecosystem as well as with end-users in the public sector applying such solutions in their operations. The business development organizations strengthen their institutional capacity in working with facilitation of innovation and networking related aspects focusing on involvement of the internationally strong and economically important power electronics business ecosystems located in the geographic sites/clusters covered by the project. Furthermore, they strengthen relations to public authority end-users with large-scale operations in the segments of HVAC, pumps, and electro mobility. Emphasis in improving capabilities is on topics such as engagement of stakeholders, needs assessment, inputs for concept vision and design, open innovation, and facilitation of specific innovation initiatives directed towards transferring new knowledge to market scaling. 1,442 / 1,500 characters
				Other organisations	A number of organizations collaborating with the PE-BSR project also strengthen their capabilities. In particular companies of different sizes within the power electronics business ecosystem who are delivering solutions for electrification of the energy systems, typically in the form of power electronics materials, components, devices, control systems, and system integration where power electronics components are applied. In an open innovation approach, the PE-BSR project partners interact broadly with companies in this group, thereby supporting their capabilities to apply new knowledge and technologies in relation to energy efficient and intelligent power electronics solutions as part of their product portfolio. Furthermore, collaboration is carried out with public authorities who as end-users apply power electronics solutions in their large-scale operations within HVAC, pump, and electro mobility systems. Their capabilities on providing inputs for new solutions and adopting these are strengthened. 1,015 / 1,500 characters

7. Budget

7.0 Preparation costs

Preparation Costs

Would you like to apply for reimbursement of the preparation costs?	No

7.1 Breakdown of planned project expenditure per cost category & per partner

No. & role	Partner name	Partner status	CAT1 - Staff	CAT2 - Office & administration	CAT3 - Travel & accommodation
1 - LP	University of Southern Denmark	Active 22/09/2022	721,261.54	108,189.23	108,189.23
2 - PP	Kiel University	Active 22/09/2022	272,448.00	40,867.20	40,867.20
3 - PP	Lappeenranta-Lahti University of Technology LUT University	Active 22/09/2022	759,996.00	113,999.40	113,999.40
4 - PP	Tallinn University of Technology	Active 22/09/2022	668,160.00	100,224.00	100,224.00
5 - PP	Sønderborg Business Development Association	Active 22/09/2022	259,032.00	38,854.80	38,854.80
6 - PP	Estonian Electronics Industries Association	Active 22/09/2022	83,520.00	12,528.00	12,528.00
Total			2,764,417.54	414,662.63	414,662.63

No. & role	Partner name	CAT4 - External expertise & services	CAT5 - Equipment	Total partner budget
1 - LP	University of Southern Denmark	15,000.00	40,000.00	992,640.00
2 - PP	Kiel University	0.00	0.00	354,182.40
3 - PP	Lappeenranta-Lahti University of Technology LUT	0.00	0.00	987,994.80
4 - PP	Tallinn University of Technology	0.00	22,500.00	891,108.00
5 - PP	Sønderborg Business Development Association	0.00	0.00	336,741.60
6 - PP	Estonian Electronics Industries Association	0.00	0.00	108,576.00
Total		15,000.00	62,500.00	3,671,242.80

7.1.1 External expertise and services

Contracting partner	Group of expenditure	Item no.	Specification	Investment item?	Group of activities no.	Planned contract value
1. University of Sou	Other	CAT4-PP1-G-0	Expenses related to revision 29 / 100 characters	No	N/A	15,000.00
	Total					15,000.00

7.1.2 Equipment

Contracting partner	Group of expenditure	Item no.	Specification	Investment item?	Group of activities no.	Planned contract value
1. University of Sou	Laboratory equipmen	CAT5-PP1-D-0	Lab. equipment, data collection systems etc. 44 / 100 characters	No	1.1 1.2 1.3 2.1 2.2 2.3	25,000.00
1. University of Sou	Tools or devices	CAT5-PP1-F-0	Materials for prototype/pilot construction 42 / 100 characters	No	1.1 1.2 1.3 2.1 2.2 2.3	15,000.00
4. Tallinn University	Tools or devices	CAT5-PP4-F-0	Materials and components for prototypes/pilot construction 58 / 100 characters	No	1.1 1.2 1.3 2.1 2.2 2.3	22,500.00
	Total					62,500.00

7.1.3 Infrastructure and works

Contracting partner	Group of expenditure	Item no.	Specification	Investment item?	Group of activities no.	Planned contract value
Please select	Please select	CAT6-PP--01	 0 / 100 characters	Please select		0.00
	Total					0.00

7.2 Planned project budget per funding source & per partner

No. & role	Partner name	Partner status	Country	Funding source	Co-financing rate [in %]	Total [in EUR]	Programme co-financing [in EUR]	Own contribution [in EUR]	State aid instrument
1-LP	University of Southern Denmark	Active 22/09/2022	DK	ERDF	80.00 %	992,640.00	794,112.00	198,528.00	For each partner, the State aid relevance and applied aid measure are defined in the **State aid section**
2-PP	Kiel University	Active 22/09/2022	DE	ERDF	80.00 %	354,182.40	283,345.92	70,836.48	
3-PP	Lappeenranta-Lahti University of Technology LUT University	Active 22/09/2022	FI	ERDF	80.00 %	987,994.80	790,395.84	197,598.96	
4-PP	Tallinn University of Technology	Active 22/09/2022	EE	ERDF	80.00 %	891,108.00	712,886.40	178,221.60	
5-PP	Sønderborg Business Development Association	Active 22/09/2022	DK	ERDF	80.00 %	336,741.60	269,393.28	67,348.32	
6-PP	Estonian Electronics Industries Association	Active 22/09/2022	EE	ERDF	80.00 %	108,576.00	86,860.80	21,715.20	
Total ERDF						3,671,242.80	2,936,994.24	734,248.56	
Total						3,671,242.80	2,936,994.24	734,248.56	

7.3 Spending plan per reporting period

	EU partners (ERDF)		Total	
	Total	Programme co-financing	Total	Programme co-financing
Period 1	550,686.40	440,549.12	550,686.40	440,549.12
Period 2	624,111.30	499,289.04	624,111.30	499,289.04
Period 3	660,823.70	528,658.96	660,823.70	528,658.96
Period 4	660,823.70	528,658.96	660,823.70	528,658.96
Period 5	624,111.30	499,289.04	624,111.30	499,289.04
Period 6	550,686.40	440,549.12	550,686.40	440,549.12
Total	3,671,242.80	2,936,994.24	3,671,242.80	2,936,994.24