

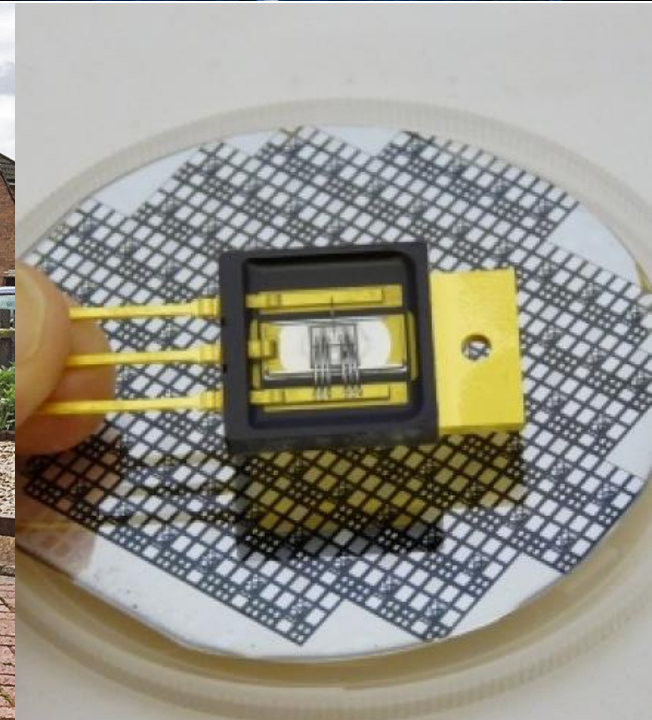
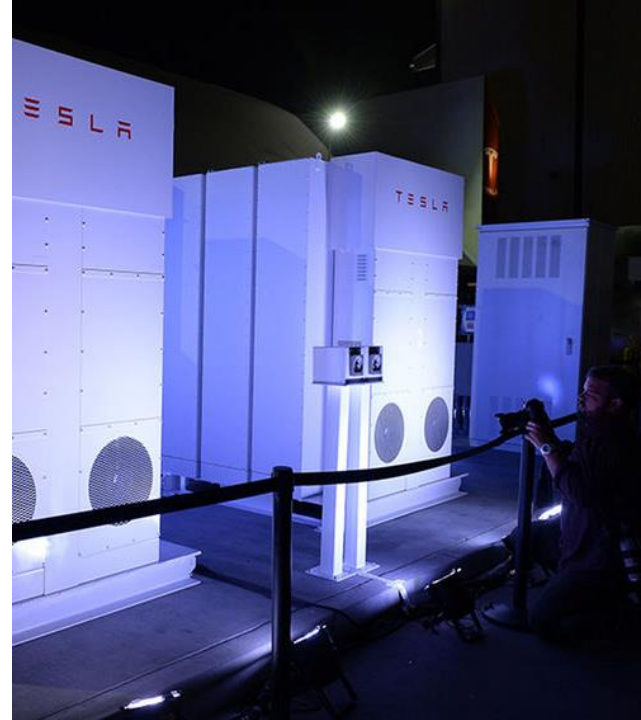
CLOSER TO CLIMATE NEUTRALITY WITH POWER ELECTRONIC SOLUTIONS

Teresita Qvarnström

5 October 2017

100% Climate Neutrality, Sønderborg, Denmark

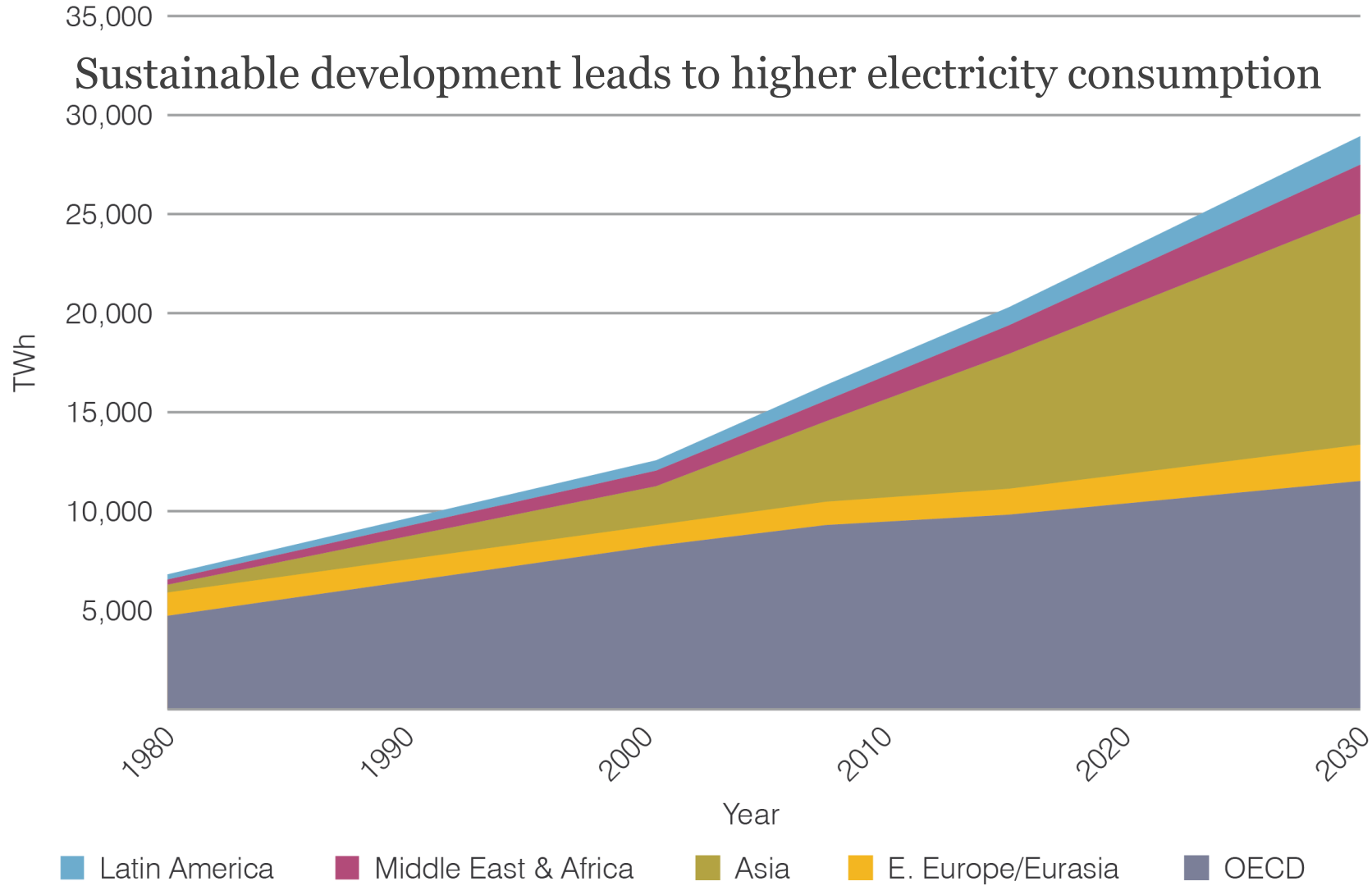
Research Institutes of Sweden
ICT DIVISION



To discuss today

- What can we do to support companies in our regions working for climate neutrality?
- Which are the technological demands for energy efficiency?
- Which technologies are keys for an effective energy management?
- Time effective technology transfer systems
- Efforts in the Baltic Sea Region

World Electricity Consumption by Region

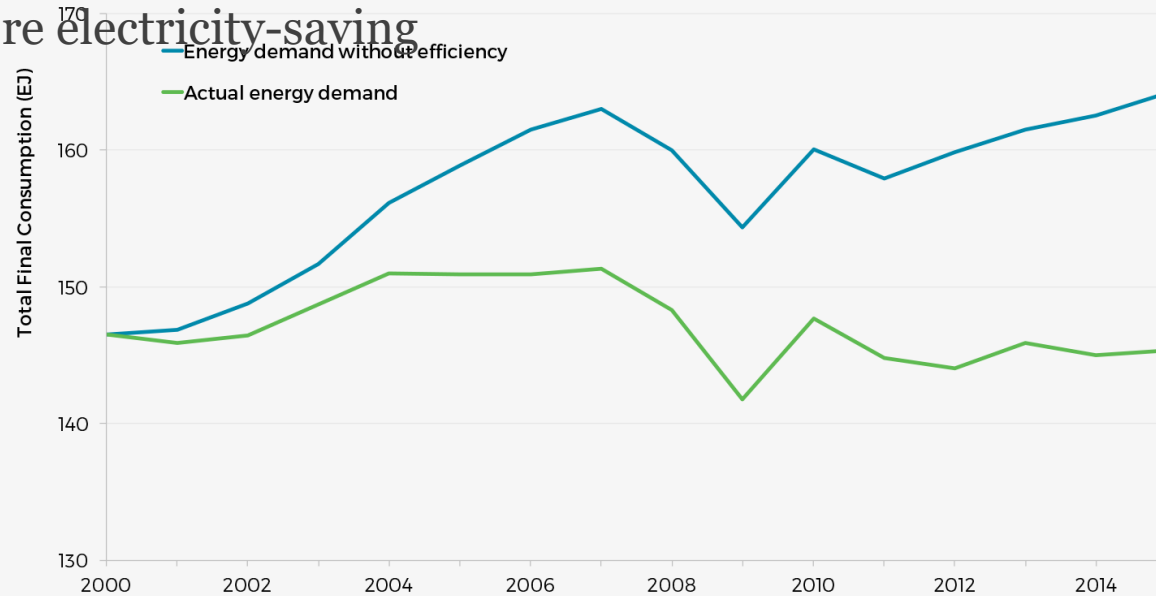


Global trends in energy efficiency

Larger use of electricity demands

■ - more efficient use of electricity

■ - more electricity-saving



International Energy Agency

Without efficiency gains the energy demand in 2015 in IEA countries would have grown by 1% annually surpassing the 2007 peak. Instead, the energy demand is 1% below 2000 levels

The need of highly efficient energy systems

Increases the need of power electronic systems and highly efficient energy converters

POWER ELECTRONICS
is a key technology
for Sustainable Development



Energy

e-mobility

Transport

Industry

ICT

The use of Power Electronics for energy effectivization Extends to more and more applications

- Transport
 - cars, busses, trains, airplanes, forklifts
- Industrial
 - pumps, fans, compressors, conveyor belts, roller mills
- Elevators and escalators
- Heat pumps and air conditioning
- Electrodomestics
- High-frequency industrial applications
 - Resonant converter
- Transmission Applications
 - HVDC and Flexible AC Transmission Systems (FACTS)



A revolutionary development is enabled by new materials (WBG) Silicon carbide (SiC) and Gallium Nitride (GaN)

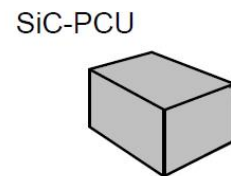
Electronic components based on the new materials achieve

Lower losses -- higher frequencies -- more compact systems -- higher effectivity



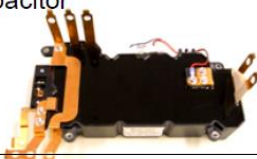

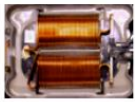

ISiCPEAW2014

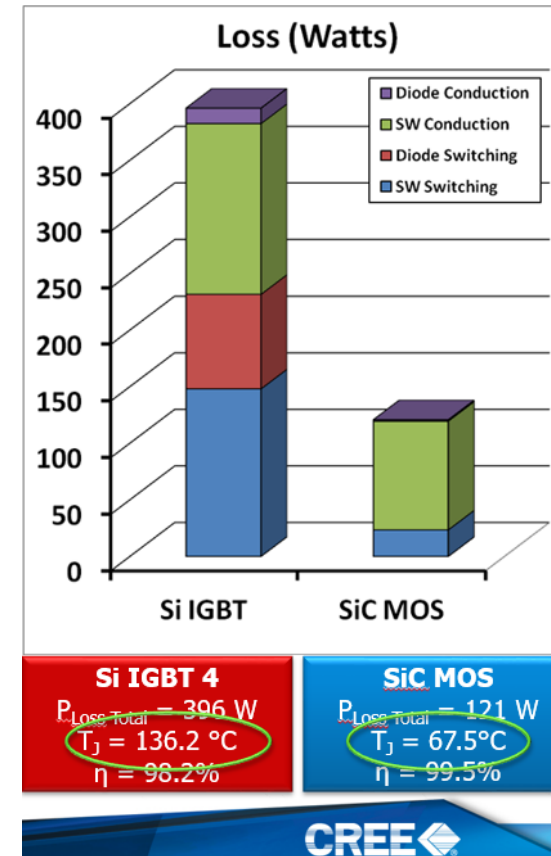
Merits of SiC : Size Reduction

Power Control Unit



Size : ~1/5

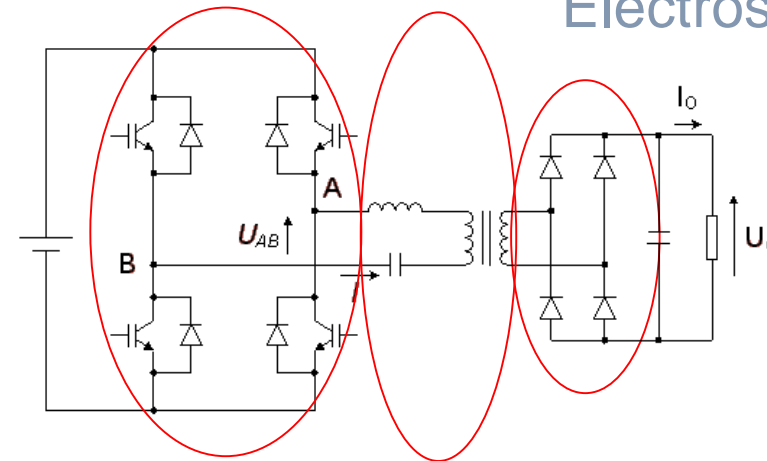
	Si-PCU	SiC-PCU
Power Module		Volume reduced to between 1/2 and 1/3 by reducing loss. 
Capacitor		Volume reduced to between 1/3 and 1/5 by use of higher frequencies. 
Reactor		Volume reduced to between 1/3 and 1/5 by use of higher frequencies. 



With WBG materials can losses be reduced with at least 50% for almost all applications



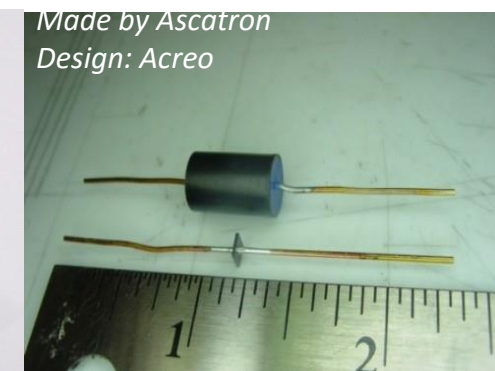
Electrostatic particle filter



ALSTOM



- **Improved energy efficiency (> 98%)**
 - Reduced power density → Cheaper cooling system
 - **Reduced operational cost**
- **Reduced switching losses**
 - Higher switching frequency $f_s > 100 \text{ kHz}$
 - Improved power density
 - Reduced cost of reactive elements
- **High junction temperature operation**
Allows higher ambient temp $T_{\text{amb}} > 60 \text{ }^\circ\text{C}$



Cost benefits vs Si if:

- SiC < 3 x Si
- $f_s > 2 \text{ x Si}$
- $P_L < 50\% \text{ x Si}$

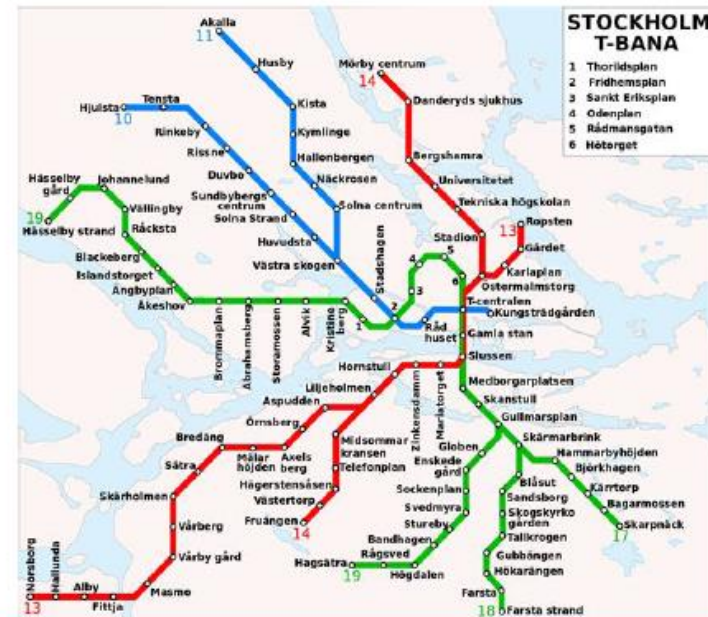
> 75% loss reduction was measured

Green SiCtracdemo

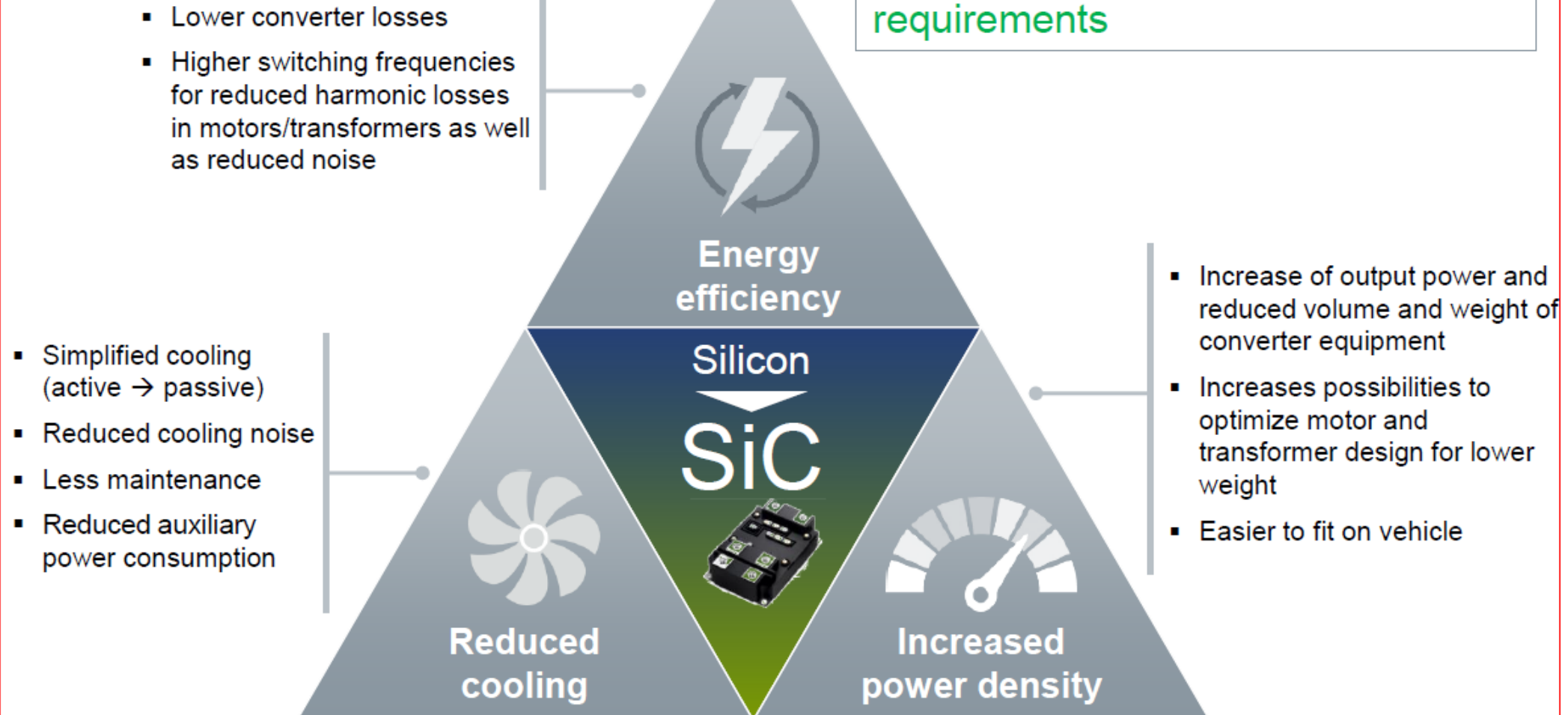
Field test of SiC propulsion equipment in Stockholm Metro



- Bombardier and the Stockholm Metro operator (MTR) intend to demonstrate SiC propulsion equipment on a **C20 MOVIA** vehicle
- The **Swedish Energy Agency** very recently (May 2017) granted co-funding support for the field test in Stockholm Metro
- Field test planned to 2017 Q4 – 2018 Q1 on the **Green** line
- The prestudy shows significant customer values with SiC technology:
 - *Lower losses*
 - *Reduced volume and weight*
 - *Reduced noise*



Best use of SiC benefits depends on specific market and customer requirements



SICPC

Read more at
www.acreo.se/projects/sic-power-center



The technology is available

We need efforts to promote
the market uptake
of sustainable solutions

We aim to speed up the market uptake of power electronic solutions based on WBG materials



Boosting efficiency in conversion, transmission and consumption of energy

We address

- **Companies**

Element and component producers, system providers, consulting and financing companies

- **Public Research Institutions**

Universities, R&D institutions, technology and science parks

- **Public Authorities**

Policy administration, regulatory bodies, business incubators, business development agencies

Support business development

Increase the competitiveness of BSR companies

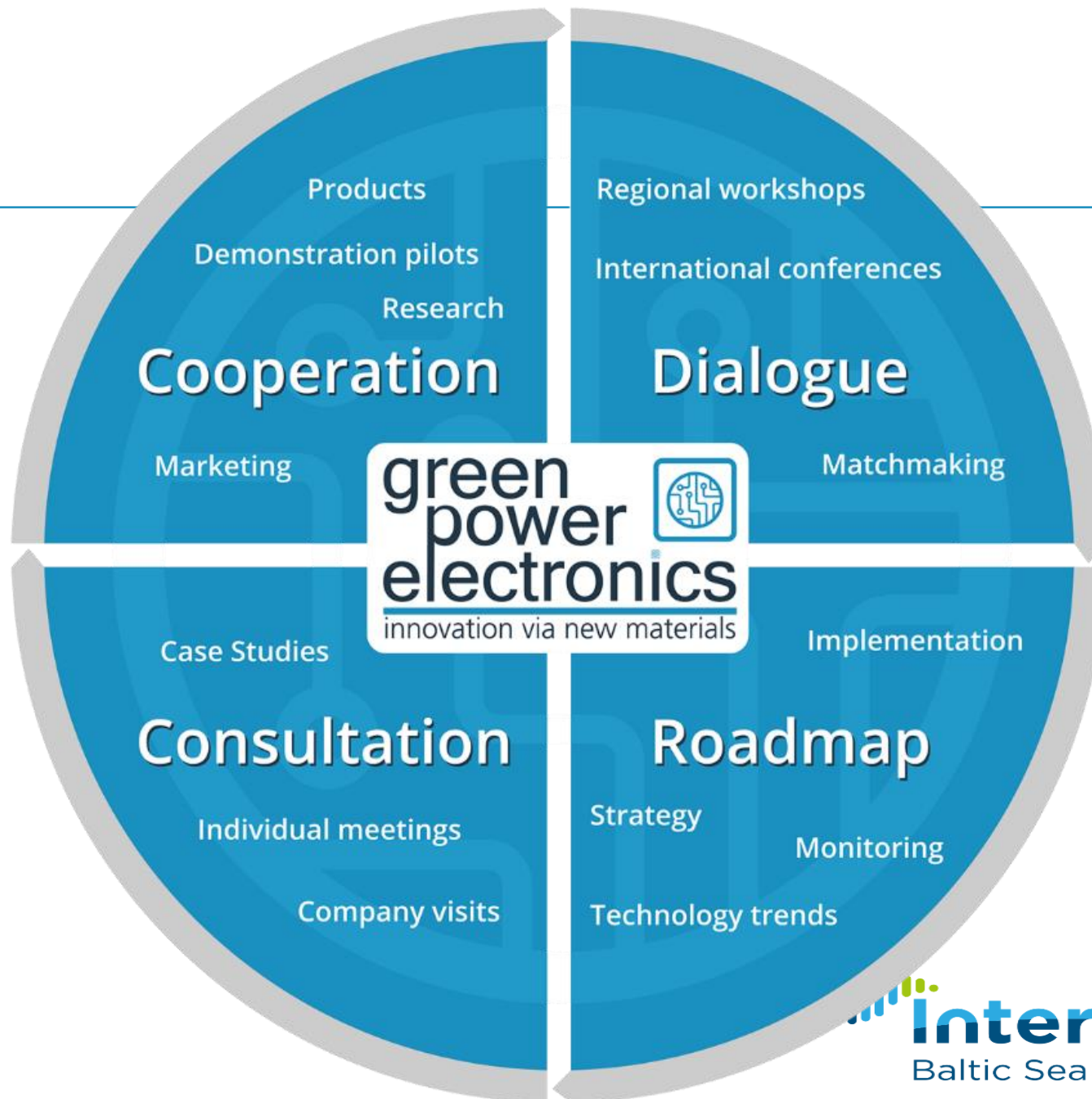
Provide state-of-the-art competences

Identify barriers and drivers for an effective market uptake of the new technologies

What we are doing

1. We demonstrate and market the technical and economic opportunities of advanced power electronics to the Baltic Sea Region research and development ecosystem.
2. We support companies in developing their individual technology roadmap to take up advanced power electronics.
3. Thus we help Baltic Sea Region companies to implement advanced power electronics into their R&D strategies and investment planning.

Green PE Activities



Five demonstration pilots

R&I pilots between companies and research institutions within

- Renewable energy,
- e-mobility and
- Smart houses



demonstrating the technical maturity, reliability and economic feasibility of integrating advanced power electronics



Project partners

Estonia

- University of Tartu
- Ubik Solutions OÜ

Germany

- Renewable Energy Hamburg
- Kiel University

Latvia

- University of Latvia
- Latvian Technological Center

Lithuania

- Kaunas University of Technology
- Kaunas Science and Technology Park
- Applied Research Institute for Prospective Technologies

Denmark

- University of Southern Denmark (Lead)
- CLEAN
- Converdan

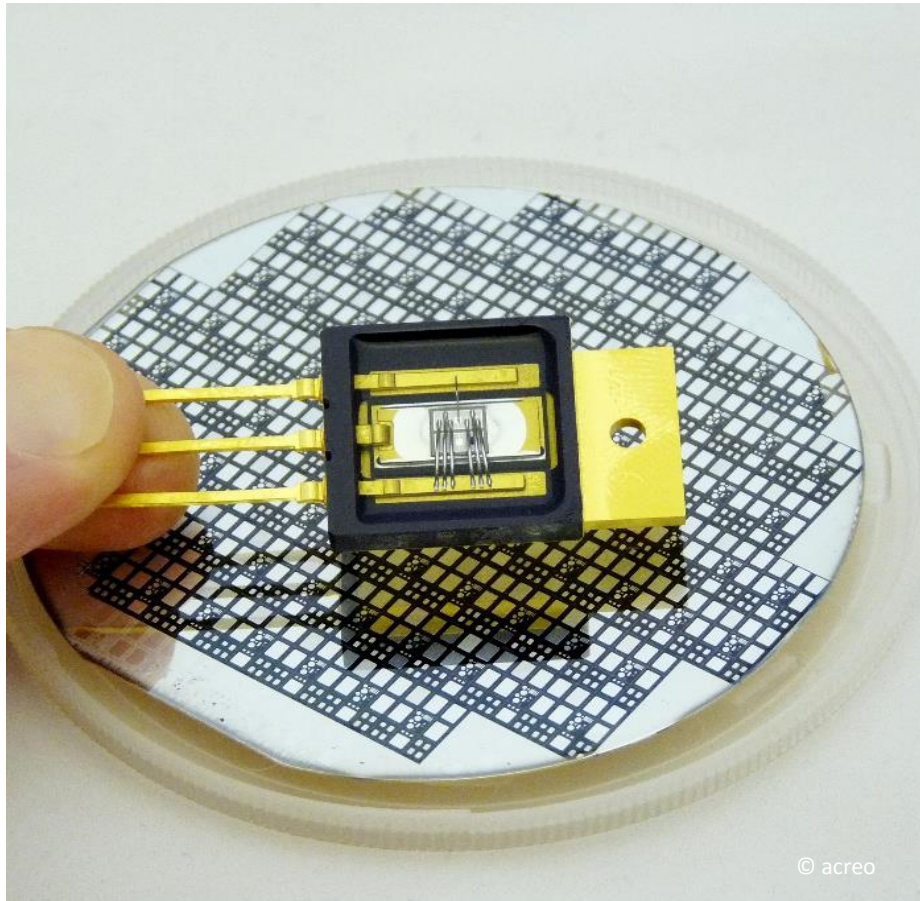
Poland

- Warsaw University of Technology
- Polish Chamber of Commerce for Electronics and Telecommunications

Sweden

- RISE Acreo
- Sustainable Smart Houses in Småland
- NATEK Power Systems AB

Project in a nutshell



- 17 Partners
Research institutions, companies and technology transfer partners from the Baltic Sea Region
- Duration: 36 months (2016 – 2019)
- Budget: EUR 3.1 million
- European Regional Development Fund: Interreg Baltic Sea Region Programme
- Led by University of Southern Denmark

Impact on the Baltic Sea Region

- Technology developers and market actors benefit from the creation of a critical mass of knowledge, expertise and demonstration activities across borders in the Baltic Sea Region.
- The project provides a collaboration platform for research institutions and companies.
- The transnational approach enables critical mass of expertise, applied knowledge and collaboration which is a key driver to address market needs.

Contact

Lead Partner

Horst-Günter Rubahn
University of Southern Denmark
Mads Clausen Institute
Sønderborg, Denmark
e-mail: rubahn@mci.sdu.dk

In Sweden

Teresita Qvarnström
RISE Acreo
e-mail: teresita.qvarsntrom@ri.se

Project Management

DSN - Connecting Knowledge

www.balticgreenpower.eu