Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Power Electronic Conversion Technology Annex PECTA

Power Electronic Conversion Technology Annex (PECTA)

Factsheet and general Overview

(Version of May 1, 2019)

Power Electronic Conversion Technology

The field of Power Electronic Conversion Technology deals with the use of solid state electronic devices for the conversion, control and processing of electric power. Traditionally, silicon-based (Si) semiconductors have been used. However, new wide-band-gap (WBG) semiconductors based on materials like silicon carbide (SiC), gallium nitride (GaN) and diamond, have the capability to process electric power with much higher efficiency compared to their aforementioned Si counterparts. An US-DOE analysis estimated a saving potential of over 7'000 GWh/y for laptops, tablets and mobile phones (based on the global stock of 2014). Many other applications such as converters for renewables (PV, wind), train traction, uninterruptable power supplies, variable speed drives, etc. have the potential to become substantially more efficient if enhanced by this new technology.

WBG-based semiconductors allow higher blocking voltages, faster switching speeds and increased operating temperatures, which enable smaller and lighter systems by a reduction of the size of active and passive components and cooling equipment. Moreover, WBG integrated power electronic *systems* come with an improved efficiency (due to their outstanding switching loss characteristics) if operated with the same switching frequency as Si-based devices. It has been estimated that a wide-spread adaptation in excess of 90 % of such new power electronic systems utilizing WBG semiconductor devices would lead to an annual decrease in energy use of 25 % world-wide.

Thus, WBG power devices have a potential to provide a paradigm shift in performance and energy efficiency over the well-established and mature Si power devices. Silicon carbide (SiC) and gallium nitride (GaN) are the most mature WBG materials so far. Furthermore, power devices using these materials are commercially available now for a few years and either of them is suited to different power electronics applications.

PECTA's goal as base for policy makers

In general, policy makers are hardly aware of the benefits WBG semiconductor devices come with and governments do normally not have access to an independent and well-founded expertise source in this field. Therefore, it is challenging for policy makers to foresee and judge the future impact of this technology. Only based on profound knowledge it will be possible for them to apply appropriate policy measures. The Power Electronic Conversion Technology Annex (PECTA) has therefore been initiated as a new Annex to the IEA 4E TCP[1]. PECTA shall assess the efficiency benefit utilizing the emerging WBG technology. International collaboration under 4E will provide the ability to monitor and engage the worldwide research and industry efforts in this area and lay the base for suitable policy measures. PECTA shall ensure that policy makers are not only aware of the efficiency potential of the new WBG technologies but also have access to an independent source of knowledge to build their own capacity. This technical knowledge will provide a foundation for the consideration of appropriate policy measures. For this reason, individuals who are involved in PECTA activities should have no direct commercial interests. Therefore, the task leaders and the operating agent of PECTA shall come from a university, an independent laboratory, a governmental research organization or a similar independent organization. Nevertheless, the involvement of the industry is, however, highly relevant and established as part of the industrial information exchange and in the discussion platform (industrial liaison).

[1] IEA: International Energy Agency; TCP: Technology Collaboration Program; 4E: Energy Efficient End Use Equipment

PECTA will intentionally link different sectors, i.e. the research and development community and the respective industry. By targeting the interfaces between R&D, industry, and potential customers with specific policy measures, the market penetration of energy-efficient WBG technology will be supported and expedited, in order to be able to enhance the benefits for the customers and the overall society.

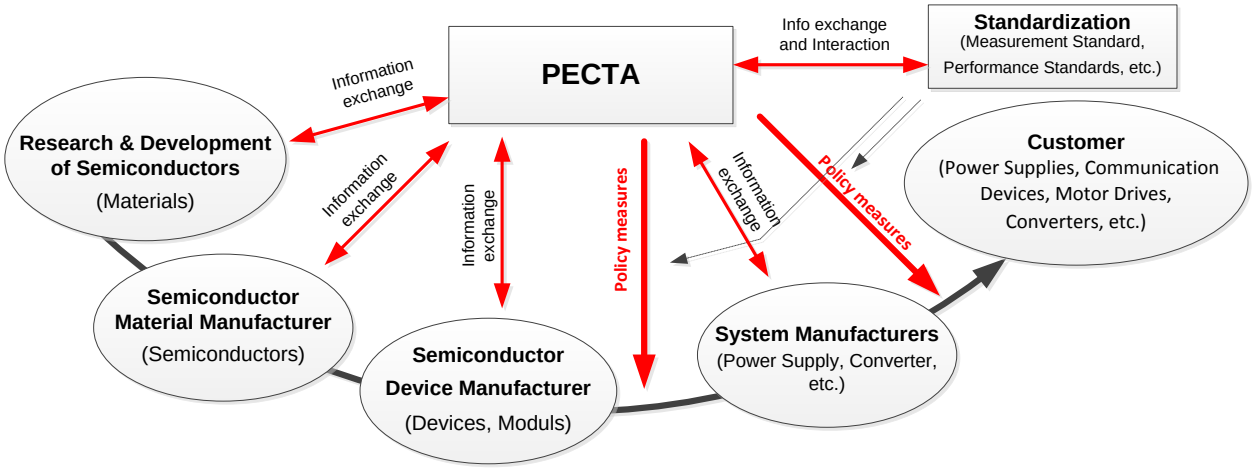

Fig 1: PECTA's role and interaction within the industrial value chain

PECTAs' organizational structure

Technical competence and the knowledge of the corresponding market are essential for the policy making process. During the preparation of PECTA, a "pre scoping study" has been undertaken, including mainly the identification of existing and potential applications of power electronics which might be influenced by the WBG technology (https://www.aramis.admin.ch/Texte/?ProjectID=40173).

During the first phase of PECTA (introduction phase), the development of a short and long-term roadmap for power devices as well as the efficiency potential of promising applications will be elaborated. With this focus, specifically the short-term potential benefits can be identified for WGB. PECTA will then focus on these applications.

In parallel, it is foreseen that a special industry linkage is established, which includes both, manufacturers of semiconductor materials and devices and system manufacturers which are anticipated to integrate these new semiconductor devices into their customer-oriented applications and solutions.

The next stage will focus more on outreach-oriented activities, including "Education" and "Dissemination". As energy efficiency policies need accepted standards for measurements as well as for the definition of efficiency levels, the "Standardization" task in this phase intends to engage in international standardization activities (eg. IEC). Furthermore, any further areas for investigation are identified during the introduction phase and these activities will be as well incorporated into PECTA.

PECTA's timetable and introduction phase

After having PECTA approved by the 4E EXCO in November 2018, a scoping study is foreseen in the starting phase to identify the existing and potential applications of power electronics which might be influenced by the WBG technology, and to develop a short and long-term roadmap. The different tasks of PECTA will be formed afterwards leading to the following tentative timetable:

- Start of PECTA: March 2019
- Introduction phase: Scoping study and structure finalization: March 2019 – March 2020
- Decision / approval of final structure: May 2020 (4E EXCO)
- Established phase: PECTA with established structure: May 2020 – February 2024