4E Power Electronic Conversion Technology Annex (PECTA) Factsheet for Term 2020 – 2024 (established phase)

Introduction and Objectives

Power electronics condition and control the conversion and flow of electricity, using solid-state electrical devices to handle a wide range of power levels, from milliwatts to gigawatts. Wide Band Gap (WBG) is an emerging power electronics technology that is maturing rapidly and offer enormous opportunities for increasing energy efficiency.

New wide-band-gap (WBG) semiconductors based on materials like Silicon carbide (SiC) and Gallium nitride (GaN) show higher efficiency potential compared to the currently dominant semiconductor material, Silicon (Si), due to their outstanding switching loss characteristics, and the possibility to operate at higher blocking voltages and increased operating temperatures.

The Power Electronic Conversion Technology Annex "PECTA" is one of four Annexes of the IEA - 4E Technology Collaboration Program of Energy Efficient End-Use Equipment. PECTA engages with relevant research, government and industry stakeholders worldwide to monitor the development, assess the benefit and impacts of utilizing WBG technology, provide information to policy makers, and build the foundation for suitable policies for the adoption of WBG as an energy efficient technology.

PECTA is a collaboration of the governments of Austria, Denmark, Sweden and Switzerland, with representatives of these member countries actively engaged in the strategic and decision-making work through their roles in PECTA´s management committee. The Academic Advisory Group (AAC) and the Industrial Advisory Group (AIG) in PECTA will support, with their knowledge and expertise, the coming work of the Annex. PECTA engages along the whole value chain of the Semiconductor Industry according to Figure 1.

A preliminary estimate of the worldwide energy savings potential from adopting WBG technology is very promising, as shown in Figure 2, even without having fully explored it for all application areas.

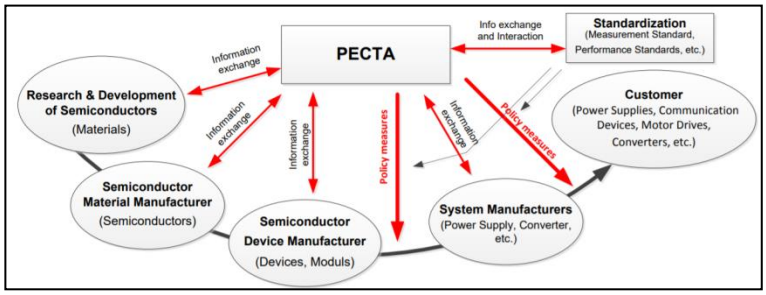

Figure 1: PECTAs role and interaction within the industrial value chain

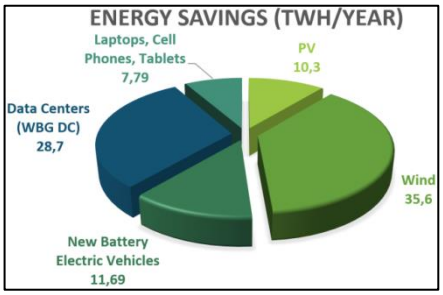

Figure 2: Energy savings with WBG-Technology

Six Tasks

PECTA developed an ambitious work plan for the actual term, to investigate, together with independent experts from research and academia, selected topics of importance for policy-makers. Six new tasks of PECTA have the following concrete scopes.

Task A: Completion and updating available efficiency figures will assess the energy efficiency potential from using WBG semiconductors in different applications, with a focus on those applications with higher potential. This will mainly include mobile phones, laptops, desktops, data centers, residential battery storage and PV energy generators, drive inverters for small and medium motors and for servo-drives, electric vehicle chargers and HVACR-Appliances with variable speed drives. This task is led by the Austrian Institute of Technology (AIT) and is planned from 2020 until 2024.

Task B: Energy and environmental related Life Cycle Assessment (LCA) investigates the environmental aspects and impacts of WBG technology over its life cycle, and compared to existing Silicon based technologies for selected applications. An in-depth analysis of impacts and benefits looks into the specific environmental and energy aspects and impacts of SiC and GaN, under plausible production, adoption, and use scenarios. This task is led by Austria, with experts from the Vienna University of Technology, and is planned from 2020 until 2023.

Task C: Revision of elaborated Application Readiness Map (ARM) is a follow up to update the recent Application Readiness Map (ARM) developed and published by PECTA. The ARM visualizes the development of WBG technologies for several applications and voltage levels until 2035. This task is led by the Austrian Institute of Technology (AIT), and revised ARMs shall be available in 2022 and in 2024.

Task D: Policy measures and mapping with applications over a timeline tackles the policy landscape of WBG technology. The scope of this task is identifying and assessing possible policy measures in relation to the development of WBG technology presented in the Application Readiness Map. To realize the energy efficiency potential from WBG technology, policy makers need to consider the timing and the suitable policy measures that could ease the market entrance and the adoption of WBG for particular applications and devices. The feasibility of horizontal and/or vertical regulatory approaches will be assessed, as well as the benefits of possible policy and other support measures. This task is jointly led by Denmark and Sweden, is planned from 2020 to 2022, and will engage experts from Aalborg University, Denmark (Section Power Electronic Systems).

Task E: Standards to support WBG adoption aims at developing global accepted efficiency standards for WBG semiconductors, to promote their adoption in end-user equipment and appliances. Standardised energy efficiency measurements and declarations are currently lacking, making it difficult for users to accurately compare the efficiency of devices based on different technologies. With these initial steps the basic guidelines for a proper and elaborated method of efficiency measurements as base for standardization will be established. This task is led by the Swiss Federal Office of Energy, will engage experts from industry and the IAG, and is planned from 2020 to 2024.

Task F: Measurement of power supply efficiency shall concretely measure the energy efficiency of WBG-based and Si-based power supplies for mobile and non-mobile ICT-appliances, to compare and better understand their performance, as well as associated features and advantages. This highly technical and truly collaborative task is led by the Swiss Federal Office of Energy, and engages laboratories from Switzerland (Power and Wideband Gap Electronic Research Lab of the Ecole Polytechnique Fédérale de Lausanne, EPFL), and Austria (Austrian Institute of Technology) as well as skilled experts and researchers from Sweden and Denmark. It will last from 2020 until 2024; with interim results published as soon as they become available.

Further information is available from https://pecta.iea-4e.org/ and by contacting the operating agent of PECTA: Mr. Markus Makoschitz (markus.makoschitz@ait.ac.at), or PECTA´s Chair: Mr. Roland Brueniger (roland.brueniger@brueniger.swiss).