

Power Electronics Value Chain (Automotive)

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ADVANCED
PROPULSION
CENTRE UK

Accelerating
Progress

This document is aimed at supporting industry, academia and government in the following ways:



Industry

- Identify strategic strengths within the UK for market growth opportunities
- Understand how each company's technology fits in and its contribution to the supply chain
- Identify gaps within the local supply chain and opportunities for foreign direct investment or local scale-up



Academia

- Guide R&D into next-generation technologies to build a strong UK supply chain
- Promote undergraduate and postgraduate uptake in electronics and electrical engineering to feed the skills gap
- Develop up-skilling and re-skilling programmes to support UK industrial companies train their staff



Government

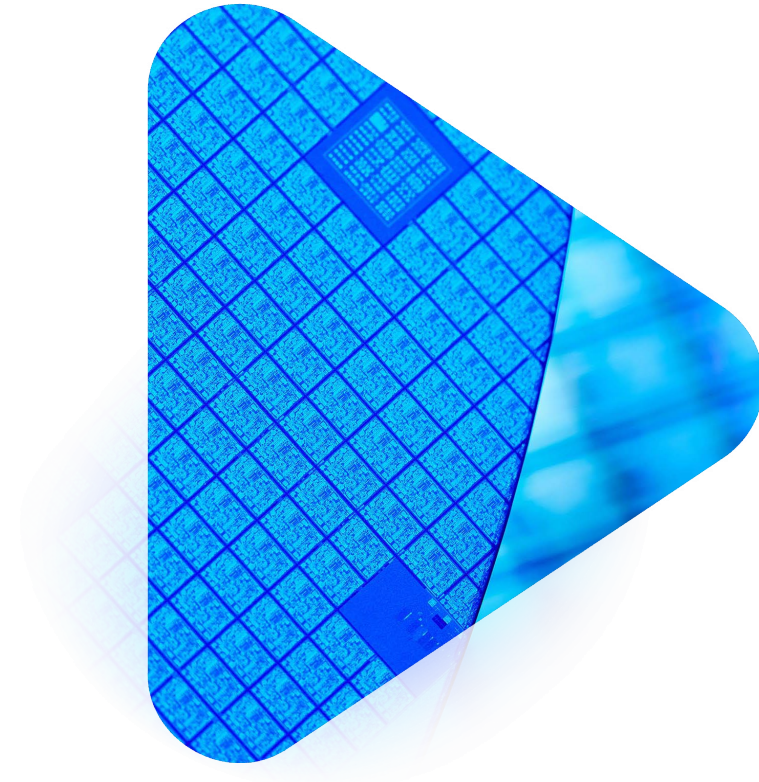
- Understand where the UK's strengths and gaps lie in the automotive semiconductor supply chain
- Develop policy, strategy and funding to accelerate scale-up in critical parts of the supply chain
- Support foreign direct investment decisions that complement UK strengths and incentivise local production

An introduction to the power electronics value chain

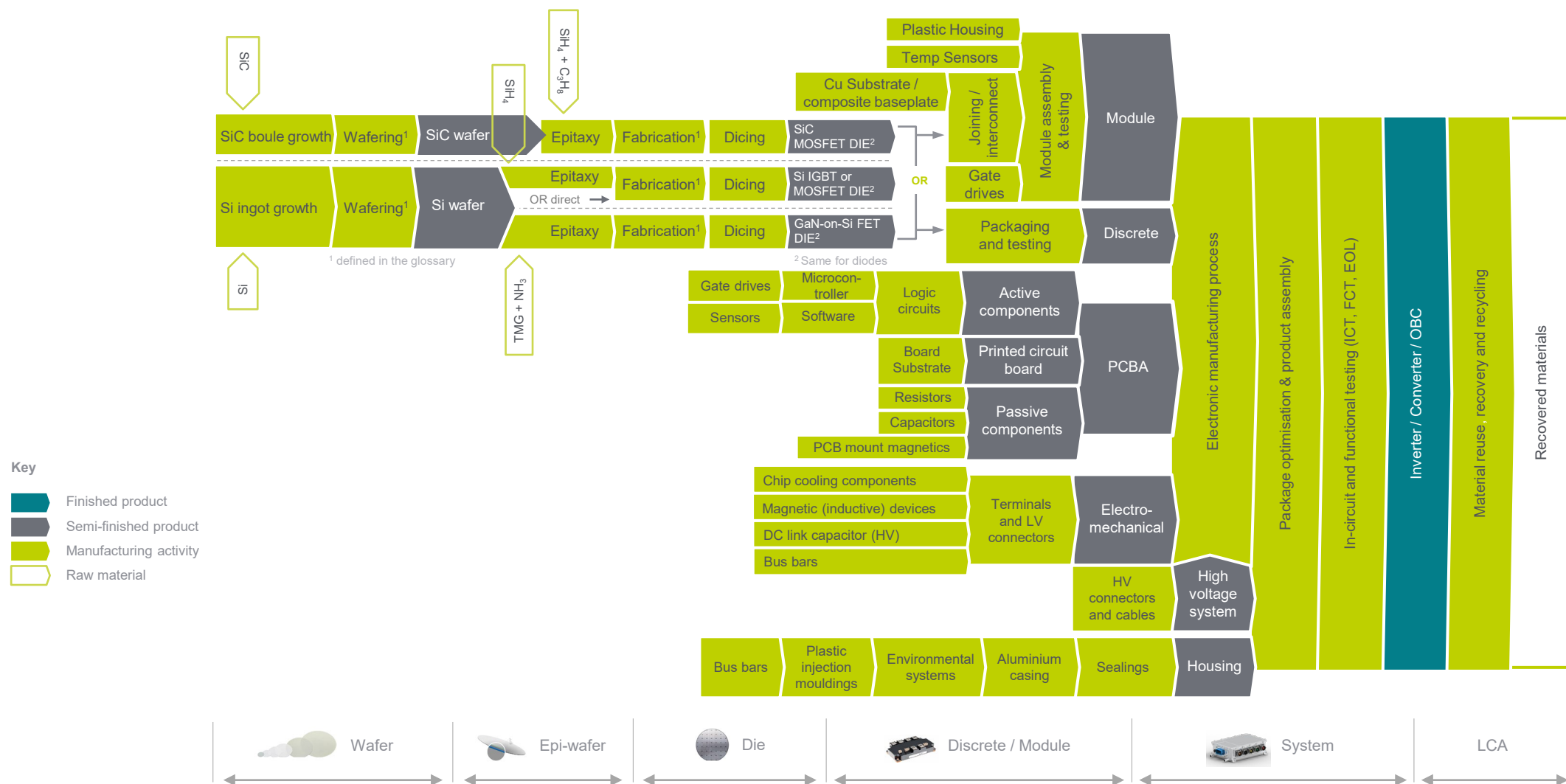
With the UK government's targets for net zero and decarbonising road transport, the UK's well-established automotive industry is transitioning rapidly to new electrified powertrain technologies.

This value chain map provides a framework for growing the UK's semiconductor manufacturing industry, whilst highlighting dependencies of contribution through the supply chain.

Developed by the Advanced Propulsion Centre (APC), with experts from industry and academia, the updated power electronics value chain shows an end-to-end view of materials and components required for volume manufacturing of automotive inverters, DC-DC converters and onboard chargers (OBC).



Power electronics value chain for automotive powertrains



Semiconductor types: Si = Silicon, SiC = Silicon carbide, GaN = Gallium nitride

Glossary and definitions

Boule	A boule is a single-crystal ingot produced by synthetic means, mostly commonly used for silicon carbide. Boules are sliced to create thin substrates or wafers.
Die	An electronic die is a small block of semiconducting material upon which integrated circuit parts and functions are fabricated.
Discrete	A discrete device (or discrete component) is an electronic component with just one circuit element, either passive (resistor, capacitor, inductor, diode) or active (transistor or vacuum tube), other than an integrated circuit.
Epi-wafer	An epitaxial wafer (commonly called epi-wafer) is a wafer of semiconducting material made by epitaxial growth (epitaxy) for use in photonics, microelectronics, spintronics, or photovoltaics. Layers can be of different materials, suited to its intended function.
EoL	End-of-line tests, are carried out on a final product to ensure current functioning in its use case.
Fabrication	Involves a large number of process steps by which electronic devices are fabricated onto semiconductor wafers. While different semiconductor materials (Si, SiC, GaN) have unique processing requirements, some commonality does exist.
FCT	Functional tests, are used to validate correct functioning of a complete electronic assembly.
FET	Field Effect Transistor is an active semiconductor device, where the output current is controlled by an electric field generated by the input voltage.
GaN	Gallium nitride is a wide bandgap compound semiconductor material providing high frequency and high power capability.

ICT	In-circuit tests, are used to check individual components on an electronic assembly.
IGBT	An insulated-gate bipolar transistor is an efficient and fast power electronic switch.
Module	A power module is an assembly containing several power components, mostly power semiconductor devices, internally interconnected to perform a power conversion function.
MOSFET	A metal-oxide semiconductor field-effect transistor is a device which can amplify and switch electronic signals.
PCBA	A printed circuit board assembly (PCBA) refers to a circuit board that contains all the necessary electronic components for the function required. A PCB refers to a blank circuitry board.
SiC	Silicon carbide is a wide bandgap compound semiconductor material and a potential replacement for silicon, particularly suited to high voltage circuits.
TMG	Trimethylgallium, often abbreviated to TMG or TMGa, is the organogallium compound with the formula $Ga(CH_3)_3$
Wafer	A wafer (also called a slice or substrate) is a thin slice of semiconductor, used for the fabrication of integrated circuits and, in photovoltaics, to manufacture solar cells.
Wafering	The process by which semiconductor ingots, or boules, are made into thin wafers. The process involves; slicing, lapping, etching and polishing to achieve a high-quality finish for epitaxy layering.

Contact APC for further information

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Technology Trends

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