

1. What is the current and future anticipated demand for common products built with semiconductor materials (e.g. computer chips) both in the UK and globally?

1. Semiconductor technology covers a wide range of different sectors That cover a diverse range of applications from Opto-electronics, Information processing, Radio Frequency communications and military applications, and Power electronics.
2. Power Electronics is about 10% of the global semiconductor market (approximately \$450b total market and so \$45b for power alone). Power components (mainly power transistors and diodes) support a whole industrial sector which is at least a factor of 10 bigger than the underpinning component themselves. It is a sector the UK still is competitive in and is mass production supporting many jobs. The main growth area is in the automotive sector, as it is the core technology that allows the development of advanced clean electric vehicles. It is essential in the electrification of everything – all forms of transport to advance grid infrastructure and renewable energy.
3. Unfortunately, the manufacture of advanced information processing chips is very capital insensitive and there is no practical way the UK can compete in this market sector as the costs are too prohibitive. On the other hand, RF and optoelectronics manufacture can be carried out in the UK, but is relatively small scale (measured in the number of wafers processed) compared to the power sector.

2. What is the UK's semiconductor supply chain and is this secure? If not, how can this be improved? What specific strengths does the UK have to contribute to regional or global semiconductor supply chains? How competitive is the UK within the global context of the semiconductor industry?

4. In the power sector the UK has a very strong OEM manufacturing base, however, the underpinning power electronics components are manufactured overseas mainly in Japan, USA, Europe and increasingly in China (which has a massive internal consumption of semiconductor chips). We Do successfully manufacture in the UK, but the supply chain is not integrated and joined up. So that many end users use components made in the UK but are not aware of their point of origin as they are owned by multinational companies. The main issue is the lack of an indigenous industry owned by UK firms. This means that such an important industry is left to pure market forces and can easily be off shored at any time. This has been happening for over 30 years and has been seen as a commodity and not a building block of a modern economy. This must change if the country is to prosper in the manufacturing sector (in any area) going forward. In the 1990's the UK was set to be the 3rd largest supplier of silicon chips globally – at that time LG planned to manufacture state-of-the art CMOS components in Newport in south Wales, and Siemens had built a similar factory in Newcastle. This was in addition to a number of other international companies (particularly in Scotland). Most of these have now ceased to be and we are on the margins of not being part of the 4th largest industrial sector in the world.
5. The development of new materials for power, in particular silicon carbide, have been a growth area where high efficiency electrical conversion is needed – In particular in the automotive industry. Every major OEM is building this technology into to the majority of their EV offering – particularly in the high-end vehicles. The volumes to support our own industry alone need at least 8 wafer fabs the size of the largest in the UK to stay at our current number of vehicles manufactured in the UK.
6. We have an exciting opportunity to develop and expand this sector in the UK right now. However, to make this viable we need to have the **LONG-TERM** strategic support of the UK government. And in particular we need support in developing the manufacture of the raw starting material – the starting SiC wafers. I strongly believe we need to take a strategic decision to develop this in the UK, as the Chinese are doing. This is so important and cannot simply be left to the whims of market forces in an advanced manufacturing economy such as ours.

3. Are there opportunities for strengthening different parts of the current UK semiconductor industry? What are the potential weaknesses and strengths of the UK semiconductor industry to meet future requirements of electronic device manufacturing?

7. As mentioned above, the UK has the skills and ability to support a large-scale manufacturing effort in advance power semiconductors for the electric revolution that is taking place around us at an ever faster rate. If we rely on importing this underpinning technology, we run the risk of not being able to control our destiny in this vital market sector. There are two main areas we need to invest in: 1) skills training 2) longer-term support of the industry by taking a proactive stance and gently guiding the developing support of these manufacturers. This need not cost vast amounts of money but does need to be made a strategic priority to ensure economic success for the future.

4. In which industries does the UK not have an end-to-end semiconductor supply chain? Are there any opportunities for these supply chain gaps to be filled within the UK?

8. It depends on the definition of the supply chain. We do not have any UK companies providing the starting materials for the semiconductor industry which is the starting point. Without high quality starting materials we can only participate in part of the supply chain; this really does need serious consideration and action to take place.

5. How can the Government strengthen semiconductor research and innovation? Are there any current areas of weakness in the present Government strategy to semiconductor innovation? Is there effective communication between the various stakeholders within the UK's semiconductor ecosystem?

9. We need to make it clear to the wider community that this is a core capability of any advanced manufacturing economy. We need to be deeply involved as a country in ensuring that the benefits of the technology are seen and understood. If we do this, it will raise salaries, attract the best talent, and it will become a virtuous circle. If the career path is seen as rewarding both financially and intellectually, we will have no problem with the innovation pipeline going forward. There is no doubt we have the technical know-how we need to create a framework where long-term stability is taken care of and successful careers can be built around working in the industry. Typically, the demand for power semiconductors is much less cyclical than other forms of semiconductor technology, and so the continuous circle of boom and bust is far less common in this sector. Rounds of endless hiring and firing in the semiconductor industry are not so prevalent in other countries, which has been a major contributing factor to the UK's demise in the semiconductor sector. It needs stability and clear direction, the latter of which can be provided by the government strategy.

6. Does the UK have the required skills, talent and diversity to be able to boost its current semiconductor industry and to respond to future disruption?

10. At present there is a major skills shortage in power electronics in general. This does need addressing, but it is the long-term vision and stability that creates and maintains a healthy industry. As mentioned above, clear long-term vision can have a major impact here. Stable jobs will attract the best of the talent both nationally and internationally. I believe the skills shortage is a result of long-term prospects rather than a lack of training per se.

7. What are the potential national security concerns or vulnerabilities in our semiconductor industry? How should the UK collaborate with the United States and European Union? What are the ramifications on other industries and the wider economy within the UK?

11. This is very sector specific. Power electronics does not really have traditional national security concerns other than, foreign takeover of indigenous manufacturing, quite often leads to acquisition and transfer of know-how and knowledge out of the economy, which makes us much more vulnerable to the impact of supply chains we have little or no control over – this is a major security issue. If for example we can no longer procure advanced power electronic

components for the automotive supply chain – then we no longer have an automotive industry – we are very close to this as has been observed in the last few months.

8. Is the Government currently providing the clarity and direction required to enable growth and security in the semiconductor industry? Are the right governmental organisations involved with ensuring effective development of our current semiconductor industry to thrive in the future?

12. NO! This should be clearly part of the remit of BEIS. It is a vital and vibrant sector in its own right – the 4th largest manufacturing sector in the world and is not strictly part of the “digital economy” which really refers to the internet and film industries rather than hard manufacturing. It is not recognised by government as the valuable strong underpinning sector that it is. It is equivalent to the brick supply in the house building industry, where without brick you can’t build anything. The main issue is that it is hidden away and not on view – not sexy like the visual appearance of a high performance car which is stuffed with this technology.