SUPPORTING ELECTRONIC ASSEMBLIES AND PCBS FOR A RESILIENT AND COMPETITIVE EEE COMPONENTS SUPPLY CHAIN IN EUROPE

FINAL FOR Distribution - March 2023

- *Subject: white paper on Space Electronic Assemblies & PCBs in the EU Chips Act*
- *Contributors: Eurospace, Components Technology Board and its PCB/SMT working group*
- *Addressees: European Commission DG DEFIS, DG CONNECT, European Defence Agency*
  - *to: T. Pesonen (D/DEFIS), R. Viola (D/CONNECT), J.F. Ripoche (EDA), cc: T. Henriksen (ESA)*
  - *fwd: EC: E. Kavvada, G. de la Brosse, F. Vitobello, E. Papantoniou, I. Poldrugo; EDA: P. Langlois; ESA: B. Schade, T. Ghidini, E. Williams; DLR: B. Gökgöz; CNES: A. Mallet, F. Malou; ASI: G. D'Amore.*

Summary

This white paper provides a review of the Printed Circuit Board (PCB) and Advanced Packaging supply chains in Europe, from the point of view of critical applications, such as for space (and defence) programmes, and also from the point of view of the main leading industry organisations such as the IPC and the EIPC. **It notes that against the key trends identified in electronics technologies the European PCB supply chain exhibits a few weak spots**, which affect a broad range of industrial sectors, from consumer electronics to high-performance/high-reliability sectors like automotive, aerospace and defence.

This situation is critical for Europe, also because it impacts the space (and defence) industries. There is a direct impact, because space systems and equipment integrators often procure their PCBs outside Europe, especially when triggered by cost and timeline constraints, and an indirect one, as the European PCB ecosystem is losing ground to its competitors, the workforce landscape is shrinking, capabilities are less readily available, and basic supplies, including equipment and raw materials, are growingly difficult to source in Europe.

This paper includes a call for the more comprehensive development of PCB technology and for the strengthening of the PCB supply chain benefiting all user sectors.

The EU Chips Act is seen as a major opportunity to consistently address the issues identified.

This white paper was authored by a representative group of experts from the space PCB and space electronics stakeholder community, involving customers, integrators and manufacturers. It was endorsed and released by Eurospace. See details in the annexes.

Introduction

The goal of the European Chips Act is to strengthen the European semiconductor supply chain and the wider electronics manufacturing ecosystem. European sovereignty, and national and economic security are dependent upon the ecosystem's ability to design and produce semiconductor chips for cutting edge applications.

Today, semiconductor designers are leveraging advanced packaging as a means to achieve greater functionality and economic efficiencies previously realized through silicon scaling. Advanced packaging, at component and system level, is considered within the chip functional and supply chains, as it plays a central role in the context of the European chips development roadmap.

The enabling aspect of these technologies is widely recognized and the European Union already funded several activities for specific development in space and defence applications. However, the PCB supply chain in Europe is not able to meet European demand, as industry generally sources 60% of its PCB technology overseas[1] for reasons of cost, lead-time and capability.

European stakeholders should seize the opportunity of the European Chips Act to strengthen the European PCB (and electronic assembly) ecosystem.

Indeed, the Chips Act describes clear objectives for building European non-dependence, not only for the chips development and production, but also for the packaging ecosystem upon which it depends. However, in its current formulation the Act is not inclusive of PCB technology, as it includes back-end packaging for EEE components (Electronic, Electric and Electromechanical components), but not system level packaging, PCBs and electronic assemblies.

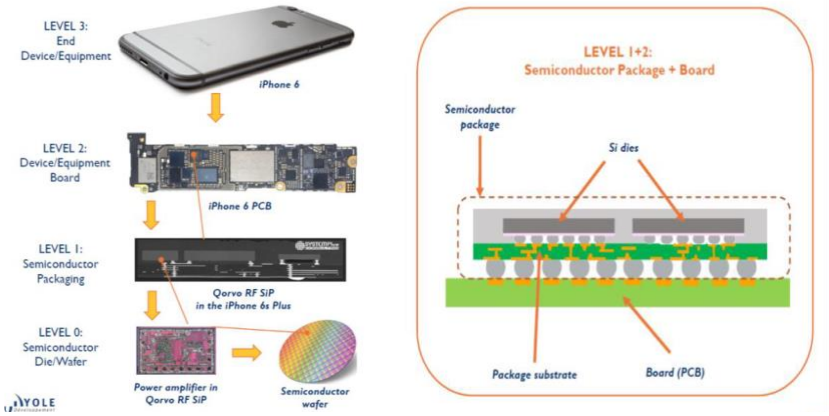
The Chips Act should provide robust support for PCBs, given their increasingly important role in chip performance and supply chain resiliency. This support should extend to both IC (Integrated Circuit) substrate fabrication and final package and system assembly and test. This support shall apply to the whole of the supply chain involved, to enable a robust ecosystem where the niche strategic application segments, such as space and defence applications, will be able to thrive.

European stakeholders understand that the implementation phase of the Chips Act may foresee development activities for PCB technology. This is a welcome opportunity, and the authors of the present white paper would like to collaborate with other industry associations and the Commission on charting the way forward.

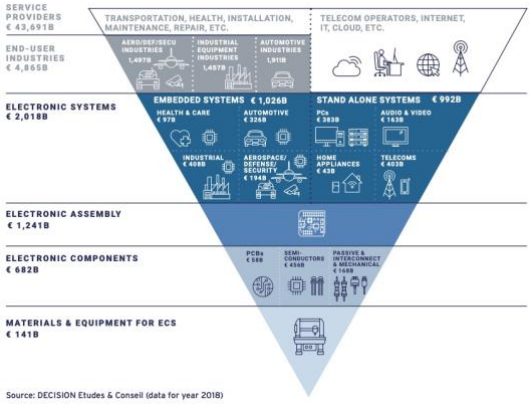
[1] *From https://emails.ipc.org/links/IPCStudyEMED.pdf*

Scope: PCBs in the Electronics manufacture value chain

Components Packaging, Electronic Assembly and Printed Circuit Board (PCB) are key constituents of the global electronics value chain. After semiconductor production, electronic packaging provides the first layer of value added in the electronics manufacturing ecosystem.



System integration and packaging levels[2]



Global electronic components and systems value chain[3]

Increasingly, PCBs play a key role in the value chain, they provide the boards that mechanically support and electrically connect electronic components, with growing levels of sophistication to accommodate ever smaller, more powerful electronics.

The PCB is no longer a passive base where components are placed, but rather an integral part of the final product. Advanced packaging of EEE components (i.e. IC substrates) is closely related to PCB technology due to the similarity of manufacturing processes and materials. The lines are further blurred when integrated circuits are embedded in PCBs and with the growing levels of integration driven by the most demanding applications, such as for space and defence.

Advanced packaging enables the continuation of technology development for chips, as the limits of photolithography have been reached. Similar to the PCB supply chain, the substrate manufacturers are scarce in Europe and their technology needs to be developed.

Supply chain overview[4]

The European PCB manufacturers, like their US competitors, have gradually specialized in high-mix/low-volume market segments for embedded systems (aerospace/defence/security, industrial & robotics, transport, energy and health & care industries) characterised by high added value (performance, complexity, reliability, quality, speed of delivery and services), high customisation and small series (from one unit to around 10,000 pieces). In the meanwhile, the Asian PCB ecosystem has developed on the low-mix/high-volume segment, serving mostly mass market products (consumer electronics, smartphones, PCs, home appliances...).

The great majority of European manufacturers are small and medium-sized enterprises (ACB, Cimulec, Finmasi...), but the European ecosystem also includes one large company (AT&S), a few midcaps (Wuerth Elektronik CBT, Schweizer Electronic, KSG, Elvia...) and many start-ups. Most production capacities are in

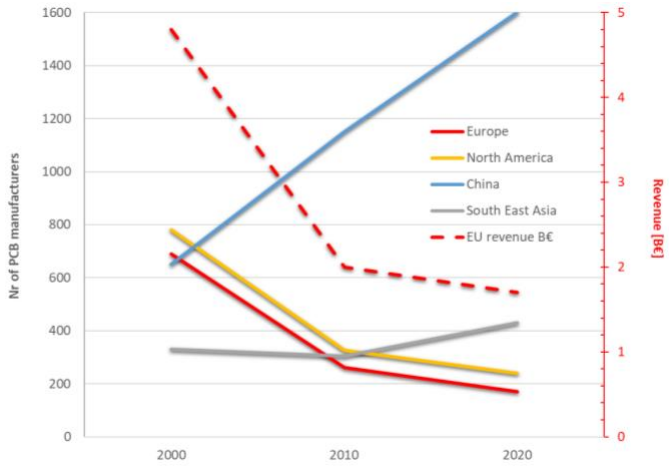
[2] *From https://cset.georgetown.edu/wp-content/uploads/CSET-Re-Shoring-Advanced-Semiconductor-Packaging.pdf*

[3] *From https://emails.ipc.org/links/IPCStudyEMED.pdf*

[4] *See more details in the relevant annex*

Germany (43%) followed by Austria and Switzerland. According to a recent Eurospace survey of critical vendors for space applications the main space capabilities are located in France, Belgium, Germany, Italy and the UK (ACB, Systronic, Elvia, Cistelaier, Invotec, TESAT).

The PCB supply chain in Europe generates a business of about €1,6 Billion, with a marked receding trend further enhanced by the reduction and consolidation of European suppliers.



Evolution of PCB manufacturers by region[5]

This leads to a reduction of European capabilities at the expected quality level, as well as increasing lead-times and higher costs for European products.

Key issues of European PCB supply chain:

- **The low volume disadvantage**: European PCB suppliers focus on highly embedded systems for high mix, low volume markets. They cannot compete on price with overseas volume manufacturers.
- **The high reliability challenge**: State-of-the-art HDI PCB technology is enabling the complex routing of advanced packaged integrated circuits. However, the lack of systematic reliability of microvias and difficulty to screen are subject of a global IPC industry alert named “the hidden reliability threat”, which is subject of a European IPC working group.
- Ultimately, **European independence is at stake** considering that 60% of European demand for PCBs is satisfied by non-European sources[6]. The situation is further aggravated by the fact that most of the supply chain for PCB raw materials and process equipment is mostly non-European.

[5] *The chart is generated from data of a yearly survey by Data4PCB named “The European PCB industry 2020”, which indicates that the number of PCB manufacturers in Europe declined from 690 in 2000, to 260 in 2010, and 170 in 2020, and their revenue declined from 4.8 M€ in 2000, to 2.0 M€ in 2020, and 1.7 M€ in 2019 (2020 is not representative due to the pandemic) - https://www.emsnow.com/the-european-pcb-industry-a-trip-down-memory-lane-data4pcb-custer-consulting-group/ https://files.constantcontact.com/81bb99bd001/9241a0e6-d73f-4f75-8419-c4685b2b3540.pdf*

[6] *Digital Directions, Greener Connections: An Industrial Policy Report on European Electronics Manufacturing - IPC/Decision April 2021 - https://emails.ipc.org/links/IPCStudyEMED.pdf*

What can the Chips Act do? Recommendations and way forward

PCBs, electronic assembly and component packaging constitute the nerves and the veins of an electronic system, providing interconnection of power and signal. They are also its backbone and armour, protecting sensitive components from thermal and mechanical stress.

The enabling aspect of these technologies is widely recognized and the European Commission already funded several activities for specific development for space and defence applications. However, the foundation layer of the PCB supply chain is insufficient, as volume industry sources 60% of its PCB technology overseas[7] for reasons of cost, lead-time and capability.

The two major representative trade associations of the electronics sector have assessed the EU Chips Act, and have expressed generally positive opinions. These views are fully shared by space stakeholders involved in the preparation of this white paper.

The IPC[8] provided a comprehensive position paper[9] on the EU Chips Act, from which we wish to highlight the following recommendations:

> *"Lay the foundations for a resilient electronics manufacturing ecosystem silicon-to-system"*
>
> *"Support investments in high-end chips as crucial for European leadership in innovation and manufacturing, so too should we support long-neglected segments of the industry including PCB and EMS that will need to innovate to meet the requirements of more sophisticated packages. Printed circuit board continue to form the base for electronics connection, including for packaged chips and embedded components, while new chip design and packaging technologies mean that demand for certain kinds of PCBs (HD Boards) and embedded PCBs will also rise in the future."*

The EIPC[10] described the risk[11] of losing further PCB facilities due to the increased cost of energy that affect Europe more than other regions and because of disadvantageous import tariffs on raw materials. Indeed, most of the supply chain for materials and equipment used for the manufacture of PCBs is not present in Europe.

While in its current formulation the Chips Act appears not inclusive of PCB technology, **it does provide the appropriate framework for the broad strengthening of the PCB supply chain.** The stakeholders of the space community **welcome the opportunity to work with the Commission and industry associations to elaborate:**

[7] *Ibid*

[8] *IPC is the global association that helps OEMs, EMS, PCB manufacturers, cable and wire harness manufacturers and electronics industry suppliers build electronics better. IPC aim is to standardize the assembly and production requirements of electronic equipment and assemblies. It was founded in 1957 as the Institute of Printed Circuits. Its name was later changed to the Institute for Interconnecting and Packaging Electronic Circuits to highlight the expansion from bare boards to packaging and electronic assemblies. In 1999, the organization formally changed its name to IPC - ipc.org*

[9] *IPC Position on the European Commission's proposal for a European Chips Act - May 2022 - https://emails.ipc.org/links/IPCFeedbackEUChipsAct.pdf*

[10] *EIPC: The EIPC is a network of Professionals of the Electronics Industry providing platforms to exchange business & technology information for the success of the European electronics industry. - eipc.org*

[11] *Europe's energy disadvantage - December 2022 - http://pcb.iconnect007.com/index.php/article/134459/eipc-europes-energy-disadvantage/*

- a holistic roadmap and technology development for advanced PCBs in all market segments,
- incentives to attract the raw material and process equipment supply chains,
- a wide-spread introduction of state-of-the-art process equipment,
- education of personnel for front-end engineering, process control and servicing of equipment,
- corrective measures for legislation, trade tariffs and increased energy cost.

Annex A – Problem statement: a weakening European supply chain, from raw materials to workforce and skills

The lower end of the supply chain into the PCB manufacturer is largely absent in Europe. Examples of this are laminates and prepreg (Arlon /USA, Ventec/China), flex laminate (Dupont/USA) e-glass yarns, woven glass (Japan), copper foil (OAK Mitsui/Japan) and some of the chemistry (Dupont/USA).

Moreover, the key manufacturing equipment for vertical plating, imaging and automated optical inspection are mostly sourced in Asia and Israel. **As a result, it is difficult to find service engineers in Europe, especially at a senior competence level**. PCB manufacturers also struggle to find competent personnel to run the processes, as the education landscape does not produce the required skillset in Europe.

Quote from: "The European PCB industry 2020", survey by Data4PCB

> *"The necessary raw material, such as copper foil, the glass filament, the woven glass, the resin, the additives: they are all are made exclusively in Asia; if not, the facilities in Europe are either owned by Asian principals or the quantities are not large enough to supply the whole market. Because of these facts, manufacturers of PCBs in Europe have a hard life."*

European PCB capabilities are decreasing as several incidents have occurred in the past, leading to definitive closures (accidental and financial causes alike). New production sites are hardly ever proposed, even in cases where insurance companies could cover the loss of facilities.

Quote from "An Industrial Policy Report on European Electronics Manufacturing", IPC, Apr, 2021[12]

> *"The production of PCB in the EU is ten times smaller than the production of semiconductors, while globally, PCB production represents 16% of semiconductor production. As a consequence, 60% of the consumption of PCB in the EU is imported."*

This trend can also be observed in the space industry as some OEMs are (partly) sourcing complex High Density Interconnect (HDI) PCBs for their NewSpace projects overseas, motivated by reduced cost and lead-times and in some cases a more capable production lines, instead of developing the required technology in a sustainable European partnership.

The low volume disadvantage of niche applications

European PCB suppliers focus on highly embedded systems for high mix, low volume markets, which is matching well with the space electronics manufacturing ecosystem. Space industry develops new designs frequently, and procures in low volume. Besides capability, reliability, cost and lead-time, OEMs seek significant support from front-end engineering teams at the PCB manufacturer to review and optimize their new designs.

The high mix, low volume market is a critical constraint in substrate manufacturing, because the main non-European suppliers do not support low volumes orders.

The high reliability challenge

State-of-the-art HDI PCB technology is enabling the complex routing of advanced packaged integrated circuits. The lack of systematic reliability of microvias and difficulty to screen are subject of a global IPC industry alert[13]

[12] https://emails.ipc.org/links/IPCStudyEMED.pdf

[13] *"IPC-WP-023, IPC Technology Solutions White Paper on Performance-Based Printed Board OEM Acceptance: The Hidden Reliability Threat, May 2018"*

named “the hidden reliability threat”. This had dramatic impact in several space projects as generic weaknesses were discovered after failures were detected by testing at module level. The microprocessors assembled on these circuit boards performed adequately. But these component packages drove the need for microvias, which had not been subject of in-depth technology development, not covered by generic qualification and they subsequently failed. It is widely recognized that horizontal processing equipment can provide state-of-the-art microvia plating capability. But PCB manufacturers struggle to justify this high required investment.

Despite these challenges, European high-reliability/high-performance industry has a leading role in the investigation to microvia reliability, as this is the subject of a European IPC working group that includes space, defence, aeronautics and oil industry, as well as a wide representation of PCB manufacturers, test labs and research institutes.

Dependence situations for space PCBs

The PCB supply chain dependencies for space technology, including the raw laminate supply chain, were highlighted in the recent European Space Technology Harmonisation Dossier for PCB and Electronic Assemblies[14]. Several activities have been specified under AIM C for “strengthening the end-to-end supply chain” that are strongly supported by stakeholders throughout the European space community. Yet, the necessary investments need to be identified and committed. This shows a remarkable consideration for the supply chain deficiencies in the space sector, but it is insufficient in driving the overall trends.

The European energetic disadvantage

PCB manufacturers in the Far East are less constrained by environmental legislation. The growing cost of energy in Europe has also impacted the PCB supply chain[15], which further contributes to the imbalance towards overseas manufacturing facilities. Meeting Europe’s green aspirations requires substantial development and investment in production facilities.

Quotes from “EIPC: Europe’s Energy Disadvantage”, Dec 2022, PCB007[16]

> *“Compare the average with that of the USA or China in 2021, and Europe was significantly higher in energy costs than those regions. […] Energy costs have risen by a factor of three from where they were. This is a uniquely European burden, and it is actually a very difficult burden to carry.”*
>
> *“Our tariff structure is set up completely wrong. We are encouraging the importation of final PCBs, but we are penalizing the importation of materials to make those PCBs.”*

[14] *Source available to registered entities only:*
https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Technology_Harmonisation

[15] *Costs of energy, before the Ukrainian crisis represented about 11% of PCB production costs according to this study*
https://pdfs.semanticscholar.org/6360/3510e438cd54a86581f1349f9051f593ad0d.pdf

[16] *http://pcb.iconnect007.com/index.php/article/134459/eipc-europes-energy-disadvantage/*

Annex B – Review of EU Chips Act with regards to PCB and assemblies

The following documents of the EU Chips Act have been reviewed:

- Reference: European Chips Survey Report
  https://digital-strategy.ec.europa.eu/en/library/european-chips-survey
- Reference: COM/2022/45 final
  https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022DC0045
- Reference: COM/2022/46 final
  https://eur-lex.europa.eu/legal-content/EN/PIN/?uri=COM:2022:46:FIN
- Reference: SWD(2022) 147 final
  https://digital-strategy.ec.europa.eu/en/library/european-chips-act-staff-working-document
- Reference: COM/2022/47 final
  https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022PC0047

The absence of measures for PCBs and system packaging is observed in the following:

- The term 'PCB' is mentioned only once (p125 of SWD), but only to describe context, not as a development aim.
- Packaging is considered in the chips act. However, pillar 2 describes a development aim for back-end packaging, which is the packaging at component level, not including PCB and its module/system level assembly (see fig1 and p9 of SWD). Moreover, pillar 2 applies a condition for a 'first-of-a-kind' production facility (p4 of COM/2022/46), which would be difficult to fulfil for PCBs manufacture.
- Pillar 3 addresses the generic semiconductor supply chain dependencies. But the market assessment does not mention PCBs, and neither does pillar 3.

It is therefore perceived that the Chips Act in its current formulation is not inclusive of PCB technology. The cause for this apparent omission may be found in the initial survey (of the Chips Act, as referenced above) that did not include questions about PCB technology and the electronics manufacturing supply chain.

IPC position on the EU Chips Act - Highlights

IPC is the global electronics industry association (ipc.org). Their position on the EU Chips Act can be found here:

https://www.ipc.org/news-release/ipc-welcomes-european-chips-act

Main Quotes

> *"Chips don't function in isolation; they require interconnection with other components via printed circuit boards and PCB assemblies, which are mostly built outside of Europe. To meet the goals of the Chips Act, Europe needs to take a comprehensive approach to bolstering the region's electronics manufacturing ecosystem."*

> *"The Chips Act perpetuates a far too narrow, triage-like approach to technological innovation focused almost singularly on one segment of the electronics manufacturing ecosystem to the exclusion of the ecosystem upon which it depends. A viable, long-term strategy for innovation and economic growth requires a strong foundation of European electronics manufacturing which largely remains marginalized in the region's industrial policies."*

IPC Overview of Advanced Packaging

https://emails.ipc.org/links/IPCFeedbackEUChipsAct.pdf

Semiconductor chips are fragile and must be protected from thermal and mechanical stresses during operation. Semiconductor advanced packaging principally comprises two industry segments:

- **Integrated Circuit Substrate Fabrication:** IC substrate manufacturers produce the base layers used in the packaging of integrated circuit chips. The substrate connects the chips with each other and with the printed circuit board (PCB), in addition to protecting, reinforcing, and supporting the IC chip.
- **Final Package Assembly and Test (e.g., OSAT):** These companies assemble bare semiconductors onto IC substrates and into protective packaging. After packaging, they conduct final testing to ensure that the packaged semiconductors meet performance specifications. In addition, it is important to note that traditional packaging of semiconductors is meanwhile supplemented by Embedding Technologies, where the packaging takes place by integration (embedding) into Printed Circuit Boards

The following technologies need to be included in a definition of advanced packaging which spans semiconductor technologies, IC-substrates, and final package assembly and test:

- **Microelectronic Semiconductor Components** – including active logic components (compute, memory, analogue, mixed signal). Generally, silicon-based semiconductors.
- **Power Semiconductor Components** – powering many different electronic systems, but also play an important role in the conversion of energy (EV automotive, renewable energy sources like solar cells, wind and fuel cells)
- **Embedded Technologies** – embedded passives, as well as die/bridge/component technologies should be encouraged to develop and expand IC-substrate capabilities and capacity.

IPC Recommendations

- Clarify financial aspects and ensure value chain resiliency
- For a competitive Europe, enhance production investment & address skills
- Involve electronics industrial players in the Chips Act Governance
- Work with international partners
- Lay the foundations for a resilient electronics manufacturing ecosystem silicon-to-system

Annex C – Review of US advocacy and support for Advanced Packaging and PCB

The research data shows that North America (USA) exhibits a similar trend as Europe in the number of PCB manufacturers. This concern is fully recognized and amendments to the US Chips Act have been and continue to be introduced to clearly include system level packaging[17].

A US Congress report[18] confirms an allocation of $2.5 Billion for Fiscal Year 2022 for the National Advanced Packaging Manufacturing Program that includes advanced component and system level packaging. Another $6.2 Billion are allocated in 2023-2026, a significant part of which is attributed to packaging.

The National Advanced Packaging Manufacturing Program is further elaborated in the NIST report[19] "A Strategy for the CHIPS for America Fund", as well as the policy brief[20] on "Re-Shoring Advanced Semiconductor Packaging" from CEST, both of which state unambiguous objectives for developing US domestic packaging capabilities at semiconductor and at system level.

The Printed Circuit Board Association of America (PCBAA) has initiated a strong advocacy campaign under hashtag *#chipsdontfloat*, which is analogous to IPC's call for a *"silicon-to-systems"* approach. Additional to the Chips Act, there are several other industrial policy incentives to establish PCB technology development and PCB supply chain resilience, such as the National Defense Authorization Act (NDAA) and the Defense Production Act (DPA). The latter is quoted to *"allowing the government to buy chips—and microelectronics, generally—but PCBs specifically…"* Notably, there is also a self-standing PCB support framework being prepared, referenced as the Supporting American Printed Circuit Boards Act. Although this act did not previously pass through Congress, it will be reintroduced. The tax credit envisaged herein for American made PCBs is an example of compensation for import from low wage economies.[21]

Furthermore, the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) are already in place and provide evidence of successful reshoring manufacturing industry. Incentives, both on the demand and supply side, are effective in offsetting the labour cost differentials for tradeable products, such as PCBs, in offshore manufacturing[22].

Educated by recent years of industry-wide advocacy efforts, US politicians do recognise the need to implement system level packaging in their holistic supply chain resilience. Most notably, in a recent interview Ms Gina Raimondo, Secretary of Commerce in the Biden Administration, referred to PCB manufacturers as eligible to receive support under the various industrial policy incentives: *"There are other monies, though, that will go to smaller companies: chemical companies, circuit-board companies. I hope they do apply. And if they show us they can get the job done, they will get money."*[23]

[17] See: https://www.ipc.org/news-release/electronics-industry-welcomes-bipartisan-proposal-congress-boost-us-printed-circuit

[18] https://crsreports.congress.gov/product/pdf/IF/IF12016

[19] https://www.nist.gov/document/chips-america-strategy

[20] https://cset.georgetown.edu/wp-content/uploads/CSET-Re-Shoring-Advanced-Semiconductor-Packaging.pdf

[21] https://pcb.iconnect007.com/index.php/article/135406/time-to-finish-the-job-on-pcb-funding/

[22] https://www.forbes.com/sites/willyshih/2023/02/22/the-inflation-reduction-act-will-bring-some-manufacturing-back-to-the-us/?sh=cec1c80b5441

[23] https://freakonomics.com/podcast/will-the-democrats-make-america-great-again/

Annex D - Authors and signatories

This white paper was elaborated with the active contribution of the members of the **Components Technology Board (CTB) of the European Space Components Coordination (ESCC)**, and in particular the PCB/SMT Working Group.

- Industry representatives: ACB, Cistelaier, Elvia, Invotec, Systronic, Hytek, IMEC, Airbus Defence & Space, Beyond Gravity, Kongsberg Defence & Aerospace, OHB, SENER Aeroespacial, TESAT, and Thales Alenia Space.
- Institutions representatives: European Space Agency (ESA), and national space agencies Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), the Centre National d'Etudes Spatiales (CNES), and Agenzia Spaziale Italiana (ASI).

The CTB is the technical body of the ESCC. It gathers technical experts from all space agencies and institutions (ESA, CNES, DLR, ASI, UKSA, European Commission and EDA as observers), all space manufacturers and component users gathered in Eurospace (Thales Alenia Space, Airbus Defence & Space, OHB, ALTER, Beyond Gravity), main components manufacturers (ST, Microchip, Teledyne e2V, 3D Plus, Radiall, Isabellenhütte, Infineon, UMS) and IMEC representing the RTOs. The CTB relies on thematic Working Group, one of them being the PCB/SMT WG.

The ESCC is a system for the specification, qualification and procurement of EEE parts for use in Space programmes. It is an organisation managed jointly by European space agencies and private industry. It promotes standards, certification and strategic development and innovation roadmaps to ensure the robust implementation of electronic solutions in European space programmes today and in the future.

- more at spacecomponents.org

The paper was endorsed and issued by Eurospace, the representative association of space manufacturing industries in Europe. Eurospace members represent >60% of total European space systems development and manufacturing capabilities, and >90% of space systems final sales in Europe.

Eurospace is a registered entity in the EU transparency register. Eurospace is the Space Group of ASD-Europe.

- more at eurospace.org and ASD-Europe.org

Table of contents