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The INFRACHIP European Research Infrastructure for Emerging and Responsible Electronics

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In September 2023 the European Chips Act was enacted by the European Union. The Act comprises a comprehensive set of measures worth of more than €43bn for strengthening the EU's semiconductor ecosystem.¹ The proposals target among others: *'investment in next-generation technologies; access across Europe to design tools and pilot lines for the prototyping, testing and experimentation of cutting-edge chips; and fostering skills, talent and innovation in microelectronics'*. All these provisions are indispensable as, for Europe, the most important step to become a globally competitive player in the development of semiconductor technologies will be to structure its R&D and training activities in this direction.

In the meantime, the Chips Joint Undertaking (Chips JU) was established as the main implementation body of the ‘Chips for Europe Initiative’, the first of the three pillars of the Act. One of the key actions has been to establish ‘Chips JU Pilot Lines’. These are projects that bring together the tools and expertise necessary to test, demonstrate, validate, and calibrate advanced semiconductor technologies. Negotiations with four consortia have been recently announced on the areas of leading-edge nodes, fully depleted silicon on insulator (FD-SOI), heterogeneous system integration and wide bandgap semiconductors.²

In this comment we would like to take away the spotlight from these multi-billion projects (approx. €3.3bn co-financed by the EU and participating Member States) and highlight another – relatively more modest – investment of €15mn made by the EU in the INFRACHIP project under the Horizon Europe programme.³ INFRACHIP goes beyond the current provision of infrastructure

¹ European Chips Act - European Commission ([europa.eu](#))

² [Chips JU Press Release](#)

³ INFRACHIP - European Infrastructure for Semiconductor Chips

services to bridge gaps in science and technology and to amplify Europe's capacity to innovate as well as talent development and skills training towards the development of green and responsible electronics.



Under INFRACHIP, a consortium of fourteen partners led by Tyndall National Institute in Ireland has been brought together to implement the first integrated, distributed Research Infrastructure (RI) as a wider European research platform for the sustainable development of next-generation and future semiconductor chips. Running for a planned period of 4 years, INFRACHIP will offer access – free-of-charge for transnational users - to state-of-the-art infrastructure and technology blocks. Guidance will also be provided through leading experts.

Scientific & Technological Gap – The INFRACHIP concept emerged as a new, enlarged and strengthened RI based both on recent foresight studies^{4,5,6,7} and primary knowledge deriving from analysing technical enquiries of users during the implementation of the ASCENT+ (<https://www.ascent.network/>), EMERGE (<https://emerge-infrastructure.eu/>) and EnABLES (<https://www.enables-project.eu/>) RI initiatives. ASCENT+ targets: (i) solid-state quantum platforms; (ii) disruptive devices for low-power, energy-efficient, high-performance computing; and (iii) increased functionality through advanced integration of a diverse range of materials and innovative technologies. ASCENT+ builds primarily around using silicon as a substrate. EMERGE aims at providing access to users working with materials such as paper, textiles, or biocompatible polymers and to enable integration of these technologies in flexible, printed, smart electronic and photonic products with small carbon footprint towards establishing new market sectors vertical to silicon technology. EnABLES provided fully funded access to key European RIs in powering the Internet of Things.

INFRACHIP will offer complementary and expanded RI services to enhance the EU's R&I capacity for the sustainable development of sustainable semiconductor technologies challenged by the

⁴ [EPoSS White Paper Green Electronic Components and Systems \(2023\)](#)

⁵ [‘NanoElectronics Roadmap for Europe: From Nanodevices and Innovative Materials to System Integration’, J. Ahopelto *et al.*, Solid State Electronics \(2019\)](#)

⁶ [Electronic Components and Systems Strategic Research and Innovation Agenda 2024 | ECS SRIA](#)

⁷ [International Roadmap for Devices and Systems \(IRDS™\) 2023 Edition - IEEE IRDS™](#)

emerging data-driven ICT of the secure edge and the linked need for new computing paradigms. Future research for the development of semiconductors is anticipated to include:

- the design, development and production of heterogeneous autonomous systems that are able to sense and compute at the same node with ultra-low operating and standby power
- new energy-efficient information processing paradigms such as in-memory-computing, neuromorphic and quantum computing
- and the design, architecture, and processing of new functional system-in-a-package (SiP) (e.g., energy source in Package) and system-on-a-chip (SoC), built using heterogeneous/hybrid integration on conformable or stretchable substrates for wearables and beyond.

There is currently no direct access to a comprehensive offer of equipment, technology blocks, proof-of-concept prototyping and expert knowledge enabling smaller research groups and innovative SMEs to address effectively these diverse interdisciplinary challenges.

Innovation Capacity Gap – The action plan of the EU Chips Act is predominantly concerned with strengthening the semiconductor ecosystem and regaining market share in the short to medium term, aiming at achieving 20% global chip production by 2030. However, the innovation cycle of a new material, a new manufacturing process or a disruptive technology paradigm may take up to 20 years from early-stage research to commercialisation. In the USA, the Microelectronics Commons⁸ and the National Semiconductor Technology Center⁹ are envisaged for sustaining the innovation pipeline in the US Chips Act. At present, there is no research infrastructure in Europe to play this role. The INFRACHIP vision is to fill in this gap.

INFRACHIP will open access to medium- and large- scale research facilities to empower users seeking proof-of-principle demonstration, technological feasibility and prototyping for the integration of new materials and novel devices and architectures in green semiconductor technologies. This activity is important to feed new innovations with research at the early to medium readiness levels and ensure the sustainability of Europe's innovation capacity. By linking its user community with other initiatives, including the Pilot Lines, INFRACHIP will catalyse the lab-to-fab translation.

Talent and Skills Shortage – INFRACHIP activity will also address the current gap between supply and demand of engineers with technical skills in semiconductors. A common challenge for semiconductor development and manufacturing is skills development on processing and manufacturing, digital and analog design, heterogeneous integration, and formulation of innovative materials. The future workforce of a sustainable high-value semiconductor industry relies heavily on the availability of people with imagination, ingenuity, and innovative instincts. However, the talent gap keeps increasing according to a report coordinated by SEMI Europe¹⁰ – the European branch of the global semiconductor industry association comprising companies involved in the electronics design and manufacturing supply chain – and the pressure for talent acquisition will only intensify in the next years.

INFRACHIP will complement the current national and international attempts to address the huge demand. INFRACHIP anticipates adding value to the forming educational resource ecosystem of Europe through its 'Research Acceleration Programme' to educate new users, hands-on training in the cleanroom and on specialised equipment (i.e., glove boxes and pilot lines for printed

⁸ [Microelectronic Commons – DoD Research & Engineering, OUSD\(R&E\) \(cto.mil\)](#)

⁹ [The National Semiconductor Technology Center Update to the Community | NIST](#)

¹⁰ [Europe's Semiconductor Talent Gap Widens \(eetimes.eu; Jan. 2023\)](#)

devices), integrated training courses for researchers and semiconductor professionals, and leveraged training services from the consortium's linked activities and network.

In summary, INFRACHIP is to implement the first integrated, distributed RI mobilising a critical mass of expert knowledge, technology blocks, and state-of-the-art equipment to ensure Europe's capacity to innovate at the early to medium readiness levels for the twin digital and green transition. The INFRACHIP initiative will support comprehensive user projects for multi- and trans-disciplinary path-finding research on sustainable ICT driven by the secure edge. These challenge-driven projects will target the introduction of new materials, proof-of-concept and feasibility studies of new manufacturing processes or disruptive technologies for emerging and responsible electronics. INFRACHIP will significantly contribute to research and innovation capacity within the objectives of the European Chips Act.

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