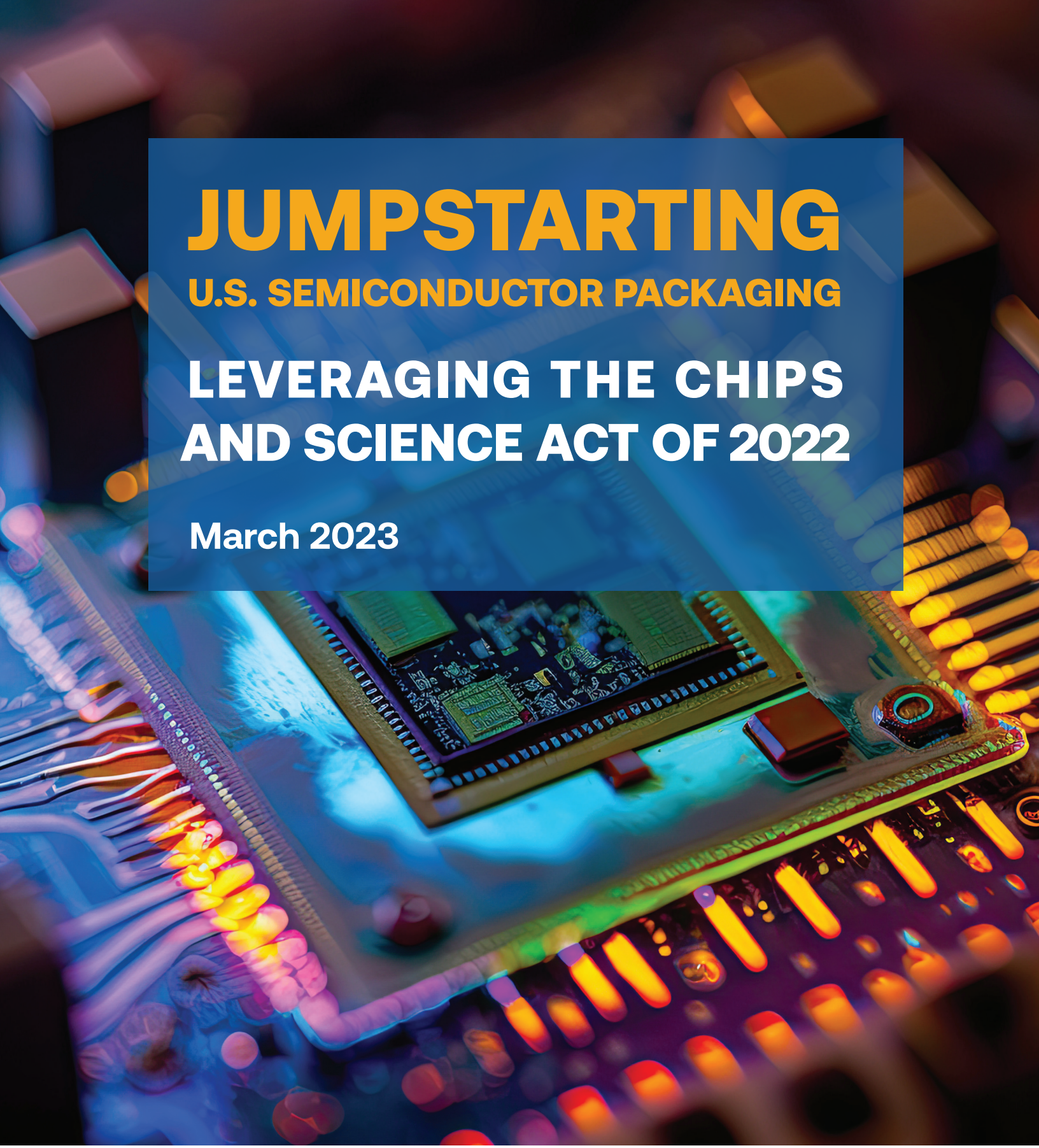


JUMPSTARTING
U.S. SEMICONDUCTOR PACKAGING
LEVERAGING THE CHIPS AND SCIENCE ACT OF 2022

March 2023

IPC INDUSTRY INTELLIGENCE

A White Paper from IPC's Chief Technologist Council

INTRODUCTION

The CHIPS and Science Act of 2022 provides a once-in-a-generation opportunity to redirect the dynamics of the integrated circuit (IC) substrate supply chain, to establish much-needed IC substrate fabrication, assembly and test capabilities, and over the longer term to leapfrog into state-of-the-art capabilities in the United States. Spending more time planning, talking and debating will not get us to the desired competitiveness position more quickly. Only by starting the process, using our collective intellect to make on-the-fly adjustments will we reconcile the technology shortfall in a timely fashion. Do something. Sooner is better than perfect.

Problem Definition

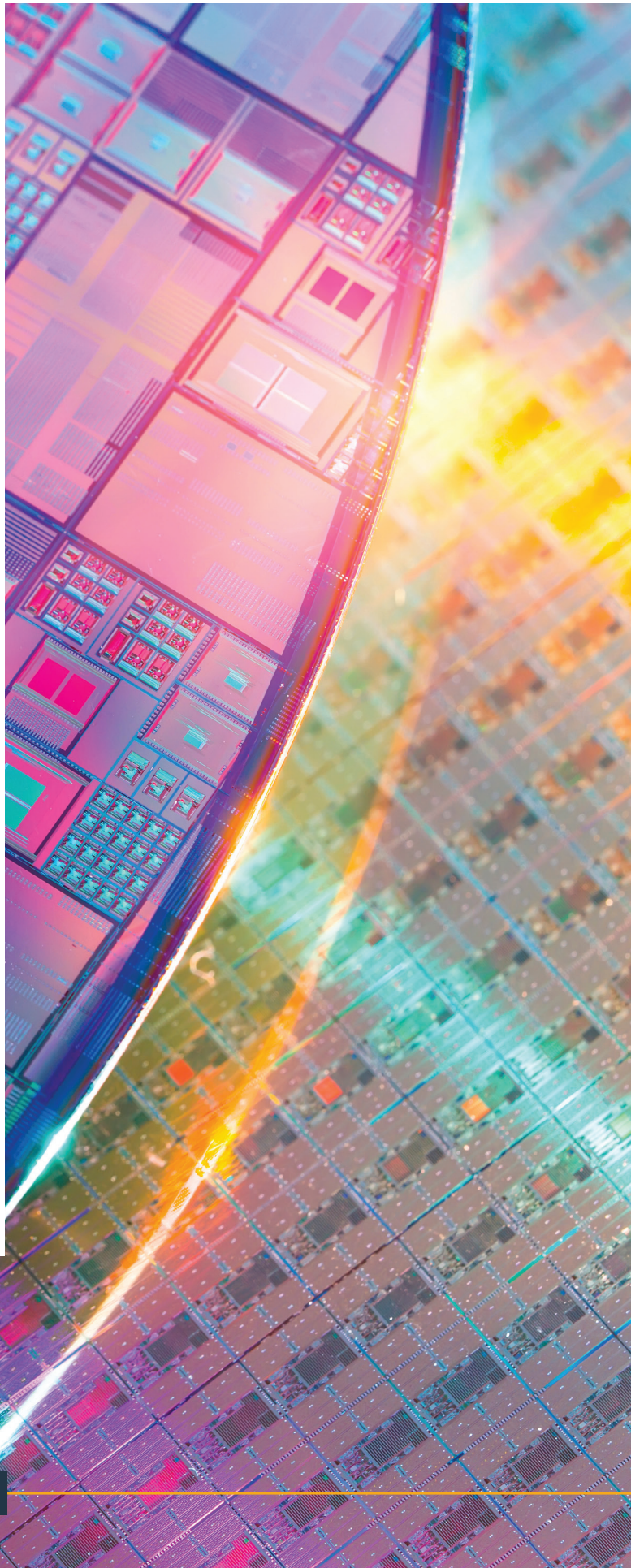
After decades of consistent and relentless offshoring for the printed circuit board (PCB) and IC substrate industry, the experience base in implementing and executing the operational management of an IC substrate fabrication facility is nearly non-existent in North America. This applies to both the leadership skills required as well as the process engineering expertise which provides the backbone of these operations.

Additionally, there is no real "surplus" of PCB manufacturing expertise available to seed an IC substrate fabrication facility. This is amplified by the fact that PCB companies are generally risk averse, given the uncertainty of the business model through the facility life, including the market definition, the market dynamics, razor thin profit margins and regular geopolitical oscillation. This isn't a criticism, just a simple fact. From where the North American capability is in 2022, it is appropriate to ask where the technology intercept point should be if a company was to embark on a new IC substrate fab.

With very little experience, implementing a leading- or bleeding-edge fabrication facility, without the requisite manufacturing scars, is an absolute recipe for disaster. The CHIPS and Science Act of 2022 is specifically intended to jump start the effort.

The U.S. Government has established processes to determine how CHIPS Act funding will be allocated. The result to date has not necessarily been constructive. A "feeding frenzy" has emerged. The competition for funding has led to the proposed creation of complicated, highly centralized mechanisms that are likely to eat up funding while failing to address the underlying needs.

Perhaps most importantly, the desire to create mechanisms to deploy federal funding betrays the well-established reality of electronics manufacturing innovation: "We learn by doing."



DO SOMETHING: Build a Pilot Facility

The cycle of inaction needs to be broken somehow, but for all the right reasons it is uncertain who should initiate action and where the starting point should be. We, as an industry, can intercept this cycle of inaction and disrupt the conversation. We are advocating that the industry "do something," even if we know that it can never be 100% correct. The premise is simple: It is better to make accelerated incremental progress and the associated learning rather than waiting for an epiphany that will likely never come.

The recommendation is very basic in its content. Start simple; build an IC substrate fabrication pilot line. The pilot line neither has to be, nor should be, state-of-the-art as its initial technology point. Rather, it should be set up to allow for capabilities to grow quickly, targeting state-of-the-art in the future without being held hostage to these eventual requirements in the short term. This facility will be implemented as a U.S. asset, following a consortia model like the High Density Packaging User Group (HDPUG), for example, allowing any company to join, participate, contribute and realize the benefits of the effort.

The facility should not be "squeezed" into a surplus building that is donated. Instead, begin with the end in mind. Plan for the next iteration/generation of equipment, acknowledging that more is required, and that more is both possible and required. The expansion space must be available at time zero, so that as version 1 is implemented, version 2 already being planned and has available space. When version 2 is implemented, version 3 is planned for the space that the newly obsolete version 1 currently occupies. The model would be to continue to swap out the equipment, incrementing capability at a sustainable pace.

Establish a U.S. IC Substrate Manufacturing Center of Excellence

This facility would not only start to resolve the IC substrate manufacturing shortfall, but would also be geographically located to facilitate the other weaknesses that have been identified in the semiconductor packaging ecosystem. The line should be located in a facility that has PCB and/or substrate manufacturing precedence, so as to potentially leverage the facility infrastructure required, like wastewater treatment capability. Such placement should also provide experienced professional expertise that can be quickly brought to bear.

To help address the intellectual capacity crisis, there should be a university presence nearby with an outstanding and recognized electronics curriculum, ideally staffed with highly experienced industry subject matter and operations experts. The curriculum can utilize this pilot facility as a sort of "Unit Ops Lab" specific to PCB or IC substrate fabrication.

Additionally, it should have easy access to semiconductor and outsourced semiconductor assembly and test (OSAT) facilities. After all, this is an ecosystem we are trying to build, and other facets of this ecosystem need to be taken into account. An example of this type of model is the Center for Advanced Microelectronics Manufacturing (CAMM) advocated and administered by Binghamton University in New York state.

SUMMARY AND CONCLUSION

Establishing a pilot facility in the U.S. for manufacturing IC substrates is a first step towards re-establishing semiconductor packaging within the United States, by utilizing opportunities provided by the CHIPS and Science Act of 2022. Further steps in other fields need to follow, because the supply chain for this pilot facility can be expected to be far from being localized entirely within the United States. Yet, following the impetus “do something” and “sooner is better than perfect,” such an approach already addresses an essential element within the supply chain of semiconductor packaging.

Once also geographically and organizationally closer relationships between research, industrialization of technology and manufacturing have been re-established, direct feedback loops between these three disciplines will be enabled, and knowledge rebuilding will be fostered. This should result in reduction of defect costs as well as facilitation of innovation and finally new developments.

Competition has been and always will be a driving force for excellence and creativity. It can thus be anticipated that such an endeavor initially localized in the U.S. will spur the attention of other stakeholders in the Western World, e.g., Europe, thus breathing new life into IC packaging efforts globally, thereby moving the field on to pastures new.

ABOUT THE IPC CHIEF TECHNOLOGIST COUNCIL

The **IPC Chief Technologist Council (CTC)** is an active working group with some of the electronics industry's top technology leadership spanning OEM, EMS, component packaging, materials, and PCB companies. Members consist of CTOs, Engineering VPs, Directors, Fellows, Distinguished Engineers, Senior Technical Staff Members, and Chief Engineers. The intent of the Council is to obtain VOC (voice of customer) input, keep a pulse on the industry, and to continuously monitor IPC member key plans regarding electronics manufacturing technology needs. Council contributions are intended to help shape strategic direction of the industry moving forward.

To learn more about the CTC including Council mission, objectives and members, visit www.ipc.org/chief-technologist-council-vision.

For more information:

IPC offers many resources to assist and guide the electronics manufacturing industry through the next industrial revolution. For more information, visit: www.ipc.org/solutions/ipc-factory-future.

For information on IPC industry intelligence programs, visit: www.ipc.org/advocacy/industry-intelligence.