

Strengthening Modern Electronics Through National Program in Taiwan

Bhuvi M¹, Dhanyatha K², Chandana K Naik³, Amna Khan⁴, Niveditha V K⁵
Atria Institute of Technology

Abstract—Taiwan's semiconductor sector is essential to both the country's economic expansion and the advancement of global information technology. The National Program for Intelligent Electronics (NPIE), which supports developments in medical, eco, automotive and 3C electronics, was established by the Taiwanese government in 2011 to boost competitiveness. The initiative, which has a \$430 million budget, fosters talent development, international alliances, academic-industry collaboration, and technological innovation. The semiconductor industry in Taiwan, the NPIE's structure and tactics, significant technical advancements, and the program's long-term contribution to the development of intelligent electronics are all covered in this essay. The program's comprehensive strategy fosters the development of creative and sustainable systems, strengthens the skills of the IC sector, and increases Taiwan's worldwide footprint.

I. INTRODUCTION

Taiwan is a significant worldwide hub in the supply chain for integrated circuits (ICs) and semiconductors. Taiwan's IC sector made US\$52 billion in sales in 2012, despite the global semiconductor market growing slowly due to a decline in PC shipments. Founded in the 1970s, Taiwan's IC ecosystem has developed into a highly effective organization with expertise in IC design, manufacture, packaging, and testing.

Not with standing these advancements, Taiwan still has to contend with changes in the world economy, the growing demand for software hardware integration, and growing rivalry from nations like China and Japan. Although Taiwan's hardware manufacturing industry is still robust, more innovation is needed to improve system-level integration and service-oriented technologies. With nations making significant investments in reliable electronics, low-power

gadgets, and sophisticated manufacturing, Taiwan needs to boost its semiconductor ecosystem and drive technical advancement.

Taiwan established the National Program for Intelligent Electronics (NPIE) to solve these issues, with the goal of promoting innovation in the MGC4C sectors medical, green, vehicular and 3C electronics.

The National Program for Intelligent Electronics (NPIE)

The NPIE is a national initiative that was started in 2011 and ran until 2015 with the goal of bolstering Taiwan's IC sector. It focuses on new application areas such as consumer electronics, automotive, green, medical, and communication. Through a top-down approach, the initiative brings together academic institutions, research institutes and commercial companies with government agencies including the NSC, MOEA and MOE.

The NPIE consists of seven major subprograms:

Medical Electronics Subprogram

Created competitive medical electronics supply chain with an emphasis on biosignal platforms and affordable Optical Coherence Tomography (OCT).

Green Electronics Subprogram

Focuses on power devices, photovoltaic components, and automotive electronics, including high-voltage semiconductors and battery management systems.

4C Electronics Subprogram

Develops ultra-low-power designs, intelligent power management, mixed-signal circuits and 3D-IC technologies.

Advanced Research Subprogram

Promotes commercialization through the NPIE Bridge Program and encourages scholarly research on SoC technology.

Talent Cultivation Subprogram

Encourages multidisciplinary education to produce professionals with the ability to innovate in intelligent electronics.

Industry Promotion Subprogram

Enhances industrial conditions by forming consortiums, improving investment environments, and promoting standardization.

MGC4C Vertical Integration Project

Enhances supply-chain efficiency, unifies design-production flows and fosters cross-company cooperation.

These programs have produced breakthroughs such as solar-powered artificial retinas, 3D X-ray imaging systems, advanced 3D stacked memory, and 60-GHz life detection systems.

Executive Framework

Governmental organizations, academic institutions, businesses, and research centers collaborate to run the NPIE. ITRI, CIC/NARL, III and significant Taiwanese universities are important participating organizations.

Medical Electronics

This subprogram focuses on advanced medical imaging, biosignal processing, and clinically relevant devices. Major developments include low-cost OCT modules and platform-level biosignal solutions.

Green Electronics

High-value green electronic technologies are developed under the program, especially for solar systems and next-generation automobile power devices. Establishing a high-voltage semiconductor sector in Taiwan is one of the main objectives.

4C Electronics

4C Electronics combines consumer, computer, automotive, and communication technology. Ultra-low-power integrated circuits, intelligent power management, and TSV-based 3D ICs are all being researched.

Advanced Research

The advanced research component supports academic SoC designs, design automation, and interdisciplinary innovation to accelerate MGC4C applications.

Talent Cultivation

Multidisciplinary talent that can work in software, biomedical engineering, electronics, and product creation is trained by educational institutions.

Industry Promotion

In order to facilitate commercialization, this initiative fosters cooperative R&D, fortifies international partnerships, and creates industrial alliances.

MGC4C Vertical Integration

By creating CMOS-MEMS standards, hybrid product designs, and economical co-manufacturing techniques, this initiative improves integration across the supply chain.

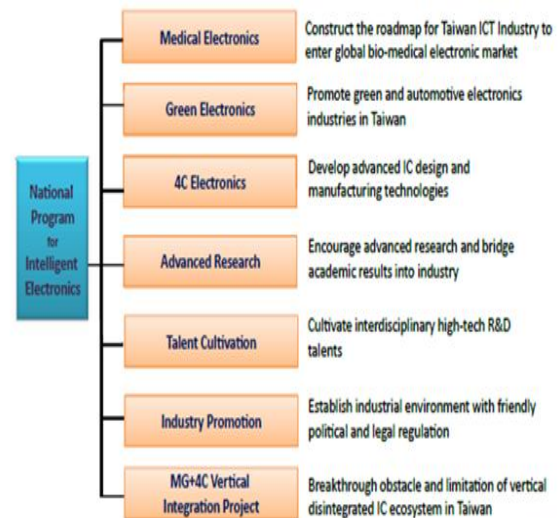


Fig.1 NPIE 7 Subprograms

II. NPIE STRATEGIES

Upstream-NSE and MOE

Universities emphasize multidisciplinary education, including computer science, biomedical applications, electronics, and practical instruction. Long-term human resources for MGC4C industries are supported at this level.

Midstream (Government and Research Institute)

R&D in IC design and production is the main emphasis of this tier. By connecting academic findings with business, the Bridge Program facilitates commercialization and generates income for more investment.

Downstream (Industry)

The downstream level places a strong emphasis on commercialization through government-backed technological projects, industrial use, international collaborations, and standardization activities. Additionally, international cooperation is emphasized through conferences, internships, and collaborative research. The global availability of Taiwan's MPW shuttle services promotes cooperation in IC design and production.

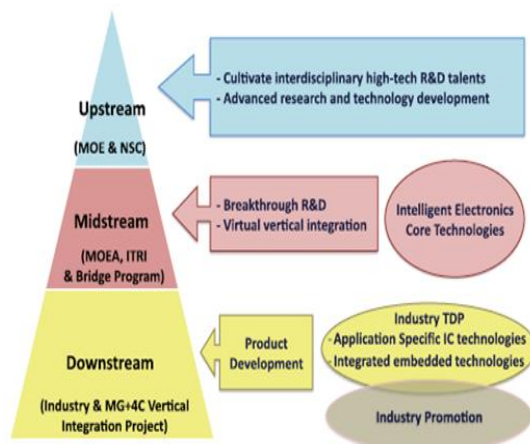


Fig 2. NPEI 3-tier Strategy

III. CONCLUSION

The NPIE has greatly improved Taiwan's standing in the international electronics industry since its inception. With more than \$21 billion invested in industry-driven R&D, the program has made significant advancements in 3D IC systems, green technology, and medical devices. Additionally, it has improved academic-industry cooperation, fostered the development of startups, and increased international ties.

Taiwan's competitiveness in intelligent electronics is strengthened by the NPIE's integrated strategy, which promotes innovation in several fields.

IV. FUTURE SCOPE

The NPIE continues to support emerging technologies and market demands through a rolling-plan strategy. It prioritizes:

- Next-generation medical diagnostics
- Sustainable and low-carbon electronic systems

- High-performance smart handheld technologies
- Intelligent sensing and miniaturized IC designs
- Stronger international standards and collaborations

Future developments aim to create a sustainable, innovative, and globally competitive ecosystem for intelligent electronics.

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