



DRAFT

**Semiconductor Policy and Action
Plan**

GOVERNMENT OF PAKISTAN
Ministry of Information Technology

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1. List of Acronyms

ATP	Assembly, Test and Packaging
EDA	Electronic design Automation
FDI	Foreign Direct Investment
GoP	Government of Pakistan
HEC	Higher Education Commission
ICT	Information and Communication Technologies
IP	Intellectual Property
MoITT	Ministry of Information Technology and Telecommunication
OSAT	Outsourced Semiconductor Assembly and Test
PPP	Public-Private Partnerships
PSDP	PUBLIC SECTOR DEVELOPMENT PROGRAMME
ROI	Return on investment
S&T	Science and Technology
SERC	Establish Semiconductor Education& Research Clusters
SIAP	Semiconductor Industry Association of Pakistan
STZ	Special Technology Zone
STZA	Special Technology Zones Authority

2. Executive Summary

Semiconductors form the backbone of modern digital world. To harness the benefits of ICT technologies and 4th Industrial Revolution, Historically, this market has been dominated by few developed countries upon which rest of the world relied for supply of IC chips. It is an established fact that the control of science and technology will be an increasingly important metric of economic, political and military power. As a result, recent geopolitical developments have forced major nations to strive for achieving self-reliance in this critical field.

The three major components of semiconductor devices include design, fabrication and assembly, test & packaging (ATP). While fabrication of ICs gets most media attention, it is not a starting point for developing countries owing to its extremely high CAPEX & OPEX. Design element, on the other hand, involves least cost, and yields high ROI but requires highly skilled human resource. Hence developing nations invariably target design segment first before proceeding to ATP and fabrication elements. Pakistan has not been able to secure its rightful place in any of the three segments and still relies on imported chips for all of its domestic market. With the adoption of Digital Pakistan policy, there is an increasing need to develop an independent semiconductor policy framework for achieving some degree of sovereignty in this critical domain.

Semiconductor supply chain disruptions during COVID-19 pandemic and ongoing tech wars have forced rebalancing of global semiconductor market structure. This coupled with transformative technologies like AI and electric vehicles (EVs) has created an opportunity for many nations to provide skilled workforce and become alternate destination for semiconductor supply chain relocations.

Pakistan's huge youth bulge offers a unique opportunity to develop highly skilled HR for semiconductor industry. To attract global chip giants, key factors such as good size of domestic market, low-cost labor and favorable government policy can be utilized to our advantage.

3. Preamble

The worldwide semiconductor market has surpassed \$600 Billion in 2023 and is poised to cross \$1 Trillion by 2030, of which 70% is driven by rapid growth in computing & data storage, automotive electronics, wireless connectivity and power management. At the same time, the last five years have witnessed major disruption in the semiconductor value chain due to COVID pandemic and evolving geopolitical rivalries. Governments have introduced new strategies and increased investment plans in the semiconductor sector to accrue economic benefits and achieve self-reliance for safeguarding strategic interests. It is envisaged that the role of these electronic chips will become manifold in coming days and semiconductor technology will become a reflection of soft power. Given the dependence of national economy and security on semiconductors, it has become imperative to formulate the Pakistan Semiconductor Policy.

Semiconductor market can be divided into chip design, fabrication and ATP (assembly, test & packaging). Among the three segments, design has the highest ROI with least investment but requires highly skilled HR. Fabrication is the most expensive element but dream of self-reliance will not be fully realized without achieving indigenous fabrication capability for critical ICs. To start with, designing semiconductors for already established firms is a successful model followed by many developing countries and same can be a good starting point. Supporting and growing domestic startups of IC design is a feasible line of action that could be closely followed by ATP to benefit from opportunity afforded by desired of global manufacturers to diversify their supply lines. Hence a phase approach is necessitated that covers all three elements while giving due consideration for economic feasibility of each component.

The semiconductor industry requires a huge pool of skilled manpower to fuel the global expansion and diversification of supply chain. Deloitte estimates that the global semiconductor industry will need more than a million additional skilled workers by 2030. Pakistan, with one of the highest youth bulge in the world, has a chance to leverage this huge opportunity through meaningful, long term and well planned initiatives in the different areas of the semiconductor value chain.

Ministry of IT & Telecom (MoIT) has formulated this policy document based on a multi-stakeholder consultations and takes on a holistic approach to cover all segments of semiconductor market. This policy will also serve as the foundation for the creation of a sustainable semiconductor ecosystem that builds on the potential of our large youth bulge and serves the needs of both local as well as international market. It also affords an opportunity for semiconductor startups and entrepreneurs to employ skilled workforce for expanding their businesses and become internationally competitive. It is envisaged that the policy will provide a much needed boost to Pakistan's economy, national security, critical infrastructure, and ensuring global competitiveness

4. Overview of Global Semiconductor Industry

Semiconductor industry is becoming the modern-day battleground for digital supremacy. The ever increasing dependence on these seemingly benign chips can be gauged from the fact that an electric vehicle (EV) can contain over 1,000 chips to run various functions. The Semiconductor Industry is expected to grow from USD 0.7 trillion in 2024 to USD 1.2 trillion by 2029, at a CAGR of 10.86% (<https://www.mordorintelligence.com/industry-reports/semiconductor-industry>).

The last five years have witnessed major disruption in the semiconductor value chain due to the US-China trade war, famously known as the 'Chip Wars'. It has not only exposed the World's dependence on the USA for advanced technologies and on Taiwan for chip manufacturing but has also triggered a chain reaction in many countries to attain self-reliance in this critical technology. To counter the potential restrictions and export controls, governments have introduced new strategies and increased investments to grow and strengthen semiconductor capabilities, with an eye toward safeguarding their interests. For instance, China is aiming for 70% self-reliance till 2025 by pumping in \$155 Billion in the semiconductor industry, South Korea committing \$450 Billion for chip foundries and the USA is re-focusing on chip manufacturing by investing more than \$52 Billion. Similarly, the EU has committed more than € 11 Billion and India announced a \$10 Billion package to focus on the local semiconductor ecosystem. More recently, Saudi Arabia announced formation of a PIF backed company Alat announcing a \$100 Billion in investments until 2030, semiconductors being one its main thrust areas.

Semiconductor market can be divided into three segments – 1) chip design, 2) fabrication and 3) assembly, test & packaging (ATP) as shown in Figure 1. The EDA tools & chip design market is mostly dominated by USA whereas Taiwan is leading the chip fabrication segment. In ATP (also known as OSAT), major market share is held with China. Different segments of semiconductor industry have varying requirements of investment, HR and ROI as depicted in Figure 2. It is evident that the fabrication and ATP does not guarantee an immediate profit or self-sustenance.

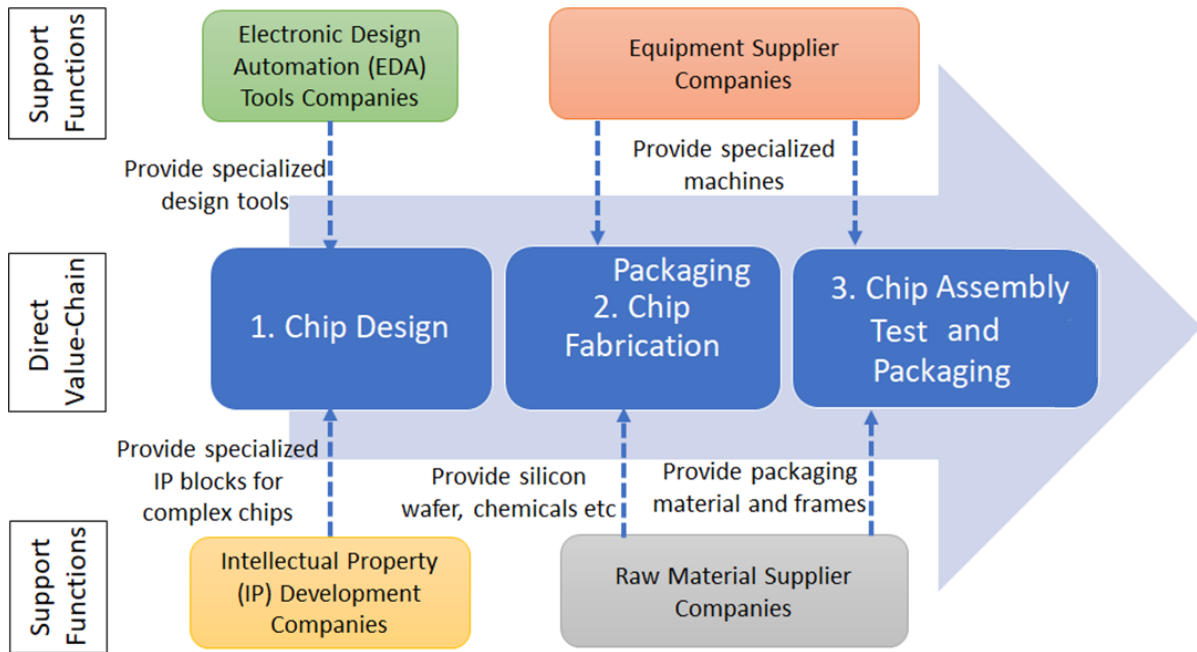


Figure 1: Semiconductor Value Chain

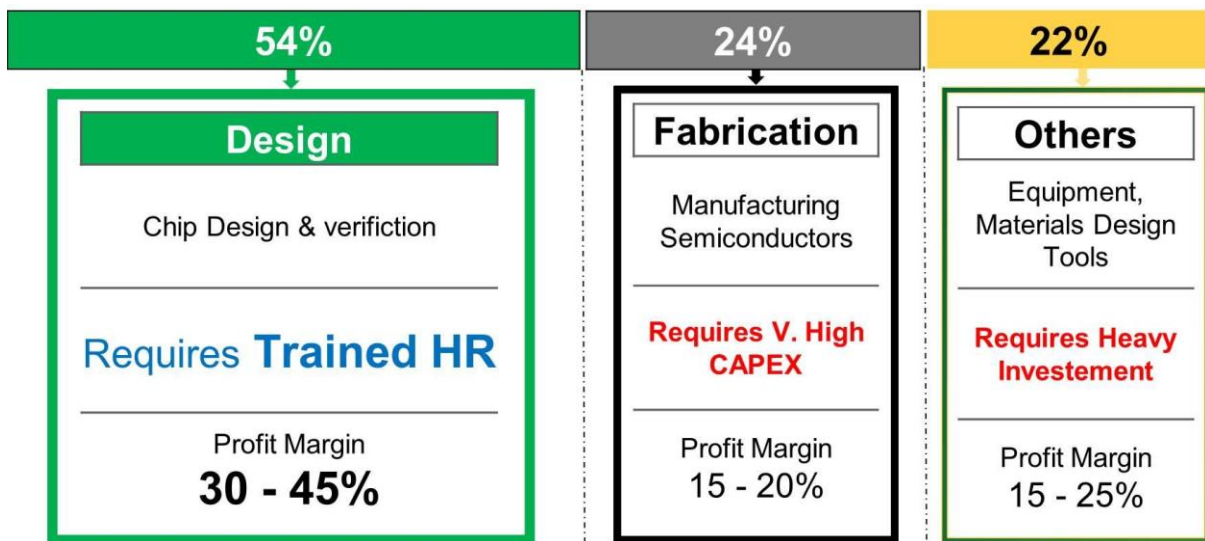


Figure 2: Semiconductor Market Segments

The above mentioned unprecedented investments in the semiconductor domain require a huge pool of skilled manpower to fuel this worldwide phenomenon. Statista's research on the Global Semiconductor Market predicts that the industry will require an additional 1 million skilled personnel by 2030. Hence there is a strong need for Pakistan to grow its domestic semiconductor industry and become part of global supply chain.

5. Vision:

To transform Pakistan into a major hub of semiconductor design, manufacturing and Assembly, Test & Packaging (ATP)

6. Goals:

- 6.1. **Develop Human Resource:** Develop market ready and skilled workforce for local as well as international semiconductor market.
- 6.2. **Establish a Competitive Domestic Ecosystem:** Create an internationally competitive, self-sustaining and conducive ecosystem for IC design, verification, manufacturing, ATP, and R&D.
- 6.3. **Achieve Self Sufficiency:** Achieve indigenous design, testing/ packaging and fabrication capability for critical semiconductor ICs by 2047.

7. Strategy:

The following five main elements of strategy, illustrated in Figure 3, will be utilized to establish semiconductor ecosystem in Pakistan:

- Policy Support and Incentives
- Infrastructure Development
- Human Resource Development
- Industry Ecosystem Building and Collaborations
- Research & Development (R&D) and Innovation

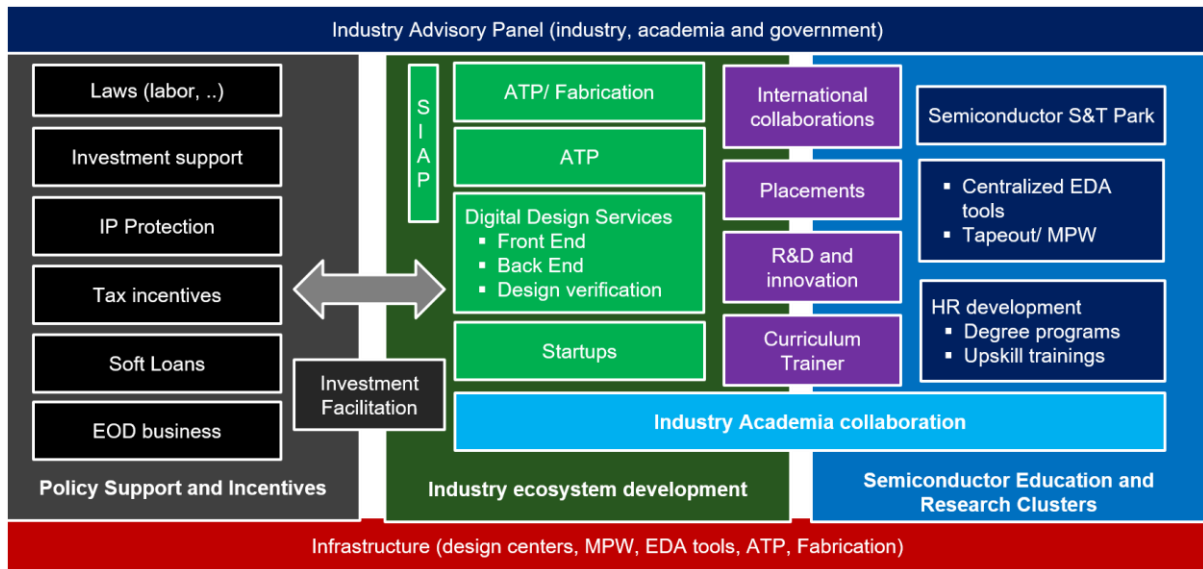


Figure 3: Semiconductor Ecosystem

7.1. Regulatory and Policy Framework

Promulgate necessary policy frameworks, laws and rules to enable creation of a Sustainable semiconductor ecosystem

- 7.1.1. **Incentives:** Offer grants, and subsidies to firms/ organizations investing in semiconductor design, R&D and manufacturing. This will include extending *STZ incentives to semiconductor industry, exemption of import duties on equipment, machinery for semiconductor industry, provisioning of soft loans at 25% rebated interest rates for setting up industry, providing 25% Tax rebates for employees working in industry and R&D organizations.* Also establish national semiconductor fund of PKR 10 billion to provide soft loans, grants, startup support, incentives to retain local talent, attract major international firms & foreign diaspora etc for next decade

- 7.1.2. **Single Window Interface:** Designate one focal ministry and establish a streamlined single window interface for new entrants and existing firms working in semiconductor domain. Simplify funds transfer mechanism for industry.
- 7.1.3. **IP Protection:** Establish national repository of indigenous IPs and provide protection to innovations.
- 7.1.4. **Tax Breaks:** Provide tax incentives, reduced taxes, and import/ custom duty exemptions for semiconductor companies.
- 7.1.5. **Indigenization:** Mandate phased replacement of critical or high volume ICs with indigenous designs.
- 7.1.6. **Labour Laws:** Update and tailor labor laws to serve interests of employees as well as employers.
- 7.1.7. **Foreign Direct Investment (FDI):** Create favorable environment for FDI through regulatory framework that guarantees consistency, stability, predictability and transparency for investors.

7.2. Infrastructure Development

- 7.2.1. **Central EDA tools Infrastructure:** Provide free of cost and rebated Central EDA tools hosting for educational institutes and startups respectively.
- 7.2.2. **Semiconductor Parks:** Establish dedicated thematic areas in existing S&T Parks and Incubating Centers with requisite facilities.
- 7.2.3. **Integrate with Special Economic Zones (SEZs):** Establish infrastructure tailored for semiconductor design, manufacturing and R&D within SEZs.
- 7.2.4. **Sharing of Infrastructure:** Remove barriers to sharing of infrastructure and resources, develop central repository of available capabilities and hold annual/biannual conferences for ideas sharing.
- 7.2.5. **Transfer of Technology:** Facilitate transfer of technology and develop capacity to extend it to same / other relevant fields.

7.3. HR Development

- 7.3.1. **Attract Talent:** Provide merit based fellowships & scholarships and launch awareness campaigns to attract top talent.
- 7.3.2. **Establish Semiconductor Education& Research Clusters (SERCs):** Create consortium of relevant regional universities/ institutions in the form of SERCs, standardize curriculum, launch train the trainer program through international experts, build capacity, provide EDA tools and introduce semiconductor-related courses.
- 7.3.3. **Upskill and Reskill Trainings:** Conduct demand driven training for semiconductor design, ATP and manufacturing utilizing SERCs and industry experts.
- 7.3.4. **Engage Industry:** Foster partnerships between industry and academic institutions for curriculum development, content delivery, internships, placements and joint industrial/ research projects.

7.3.5. **Utilities:** Extend reliable power, water, and high-speed internet connectivity at affordable rates.

7.4. **Semiconductor Ecosystem Building and Collaborations**

7.4.1. **Encourage Startups:** Provide grants and incentives to transform innovative ideas/ research into startups. Promote and strengthen startup eco-system by establishing Semiconductor startup fund to support 40 startups with upto PRR 10 Mil each. MoIT, in consultation with SECP, to simplify registration process and SECT to offer 25% registration fee discount for semiconductor firms.

7.4.2. **Grow Domestic Market:** Encourage entry of new entrants in market, facilitate expansion of existing firms, promote use of indigenously designed/ package/ fabricated chips in products destined for local market.

7.4.3. **Engage Foreign Diaspora:** Encourage and engage foreign diaspora for transfer of technology, projects, setting up of design centres and establishment of competitive ecosystem.

7.4.4. **Public-Private Partnerships (PPP):** Support PPP model to establish design centres, infrastructure. fabrication and ATP facilities.

7.4.5. **Enhance Export:** Facilitate access to global markets through bilateral trade agreements, governmental level engagements and marketing support.

7.4.6. **Establish National IP Repository:** Establish national repository of indigenous IPs with easy sharing mechanism.

7.4.7. **Synergize National R&D Efforts:** Mandate addition of 'Semiconductor Ecosystem' in HEC/ IGNITE funding schemes.

7.4.8. **International Partnerships:** Promote trans-frontier collaboration and form alliances for development of HR, transfer of high tech knowledge, setting up of design centres, ATP and fabrication facilities.

7.4.9. **Industry Conferences and Workshops:** Organize events to facilitate knowledge exchange and networking among industry professionals.

7.4.10. **Tech Destination:** Promote Pakistan as a destination for high-quality semiconductor products and services. Offer subsidies/ incentives to attract global chip firms

7.5. Research, Development and Innovation

7.5.1. **Innovative R&D Grants:** Provide grants and funding to SERCs, industry and relevant institutions for R&D projects focusing on innovative semiconductor technologies and applications.

7.5.2. **Focus on Applied Research:** Promote collaborative research between academia, industry, and international institutions/ organizations.

7.5.3. **Promote Research Collaborations:** Encourage regional and international collaborations for high impact R&D.

7.5.4. **Flagship Projects:** Launch and sponsor flagship projects of national importance like smart chip for CNIC, passports etc.

8. Action Plan

8.1. Phase I - Short Term (2024-2027)

- 8.1.1. Formulate and promulgate the regulatory and policy framework.
- 8.1.2. Set up SERCs for HR development through regular degree programs and up-skill trainings. Provide central EDA tools for SERCs and startups
- 8.1.3. Train the master trainers for IC design by engaging international experts
- 8.1.4. Add 'Semiconductor Ecosystem' as thematic area in HEC/IGNITE funding schemes
- 8.1.5. Establish semiconductor theme areas in incubation centres, S&T parks and link with SEZs
- 8.1.6. Establish Semiconductor Industry Association of Pakistan (SIAP)
- 8.1.7. Set up infrastructure for design and verification services
- 8.1.8. Establish semiconductor fund to provide initial financial support and attract investment
- 8.1.9. Encourage partnerships with global semiconductor companies for offshore outsourcing
- 8.1.10. Begin planning and establishment of ATP facilities
- 8.1.11. Market Pakistan as tech destination and land of opportunities
- 8.1.12. Provide initial financial support and attract investments.

8.2. Phase II - Medium Term (2027-2030)

- 8.2.1. Expand infrastructure and facilities.
- 8.2.2. Enhance skilled workforce and capitalize on experience of HR developed in HR.
- 8.2.3. Scale up public-private partnerships and industry collaboration initiatives.
- 8.2.4. Strengthen the startup ecosystem with incubators and accelerators.
- 8.2.5. Establish feasible ATP facilities
- 8.2.6. Begin planning and development of fabrication facilities for low-end devices

8.2.7. Commercialize IPs and innovations.

8.3. Phase III – Long Term (2030 and beyond)

8.3.1. Achieve global competitiveness in semiconductor design, verification and ATP services.

8.3.2. Capitalize on global semiconductor supply chain diversification to attract foreign investments.

8.3.3. Achieve significant market share in global fabless design and verification services.

8.3.4. Continually upgrade education, R&D, and industry standards to maintain competitive edge

8.3.5. Establish and operationalize domestic fabrication facility for critical or high volume ICs

8.3.6. Continuously upgrade policies and infrastructure to sustain growth and innovation.

9. Governance and Monitoring

9.1. National Semiconductor Industry Panel: Form a National Semiconductor industry panel comprising government officials, industry experts, and academia to oversee policy implementation.

9.2. Regular Reporting and Periodic Reviews: Mandate regular progress reports from key stakeholders to assess progress and make necessary adjustments. Conduct bi-annual reviews to assess the strategy's impact and make necessary adjustments.

9.3. Feedback Mechanism: Implement mechanisms for continuous feedback from industry players, educational institutions, and R&D bodies. Organize annual forums for stakeholders to discuss challenges and opportunities.

9.4. Data Analytics and Monitoring Tools: Use advanced data analytics tools to track KPIs and overall. Establish a centralized dashboard for real-time monitoring of key metrics.

10. Roadmap

