ECOVEM
European Centre of Vocational Excellence in Microelectronics

Financial models for sustainable excellence in VET. Comparative Analysis of Funding Models for VET in Microelectronics
Milestones #4 and #7

Co-funded by the Erasmus+ Programme of the European Union

Version 1.0, 30.10.2024

Project Nr.: 620101-EPP-1-2020-1-BG-EPPKA3-VET-COVE

ECoVEM
European Centre of Vocational Excellence in Microelectronics

The world is undergoing one of the most significant transformations in human history. Challenges in areas such as the economy, health, work, and social relations are inevitable, making the development of relevant skills and competencies essential for individual, corporate, and national growth.

Microelectronics stands at the core of the ongoing global technological revolution. Key future technologies – artificial intelligence, space exploration, bioengineering, computer science, cryptography, security, robotics, and mechanical engineering – all rely on advancements in microelectronics. As such, vocational education and training (VET) in microelectronics is critical for cultivating a highly qualified and skilled workforce.

This analysis explores the funding models of VET in microelectronics in leading countries, including the USA, China, Republic of Korea, Republic of China (Taiwan), India and Japan, comparing them with the funding approaches in the EU and select EU countries. Recognizing that we operate in a globally interconnected environment, this study aims to assess how different nations support this essential sector amid global competition.

The funding models are presented in a format similar to that of McKinsey reports, with visuals and charts allowing the data to speak for itself. The report concludes with recommendations, acknowledging that the sustainability of initiatives like the ECoVEM project depends on high-level political decisions and policy alignment beyond the project's timeframe.

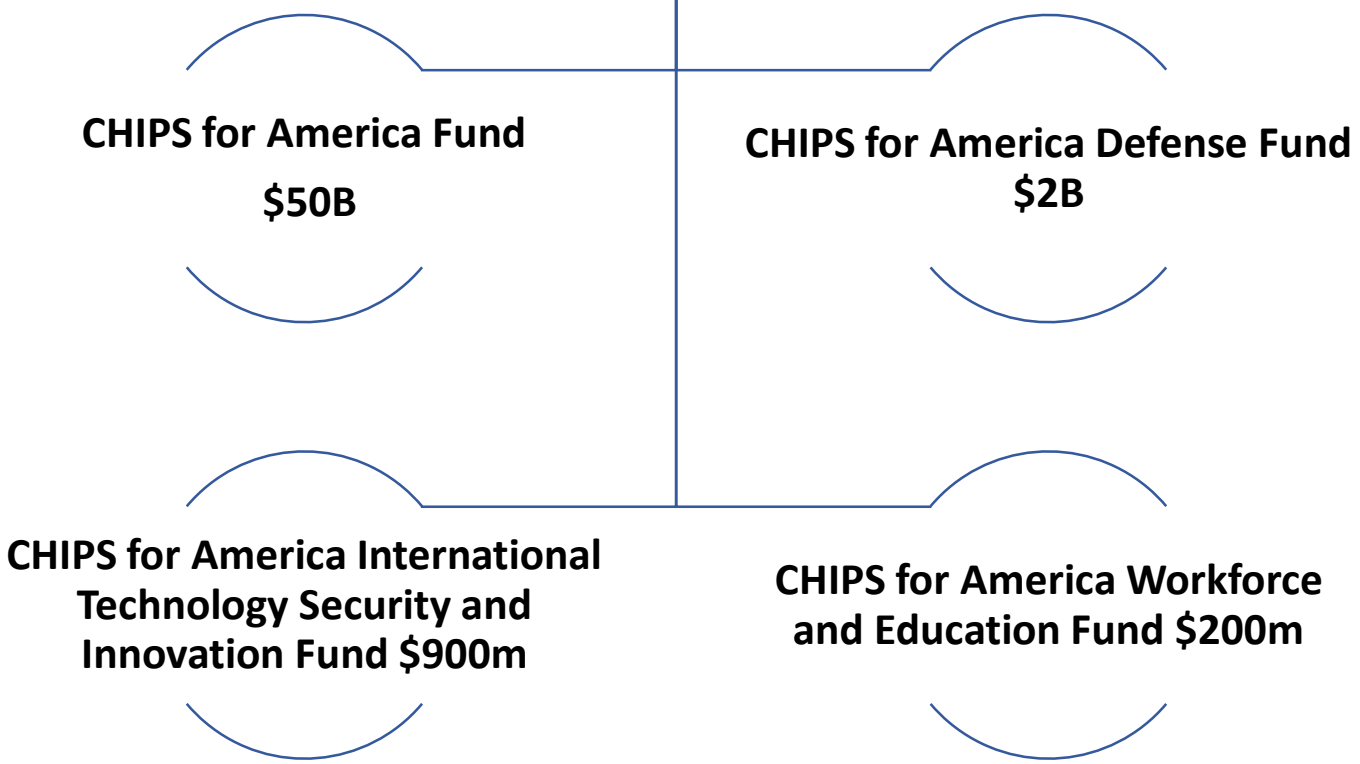
Project partners are committed to advocating for further support of VET in microelectronics, understanding that this commitment aligns with the vision for Europe's long-term prosperity.

ECoVEM partners

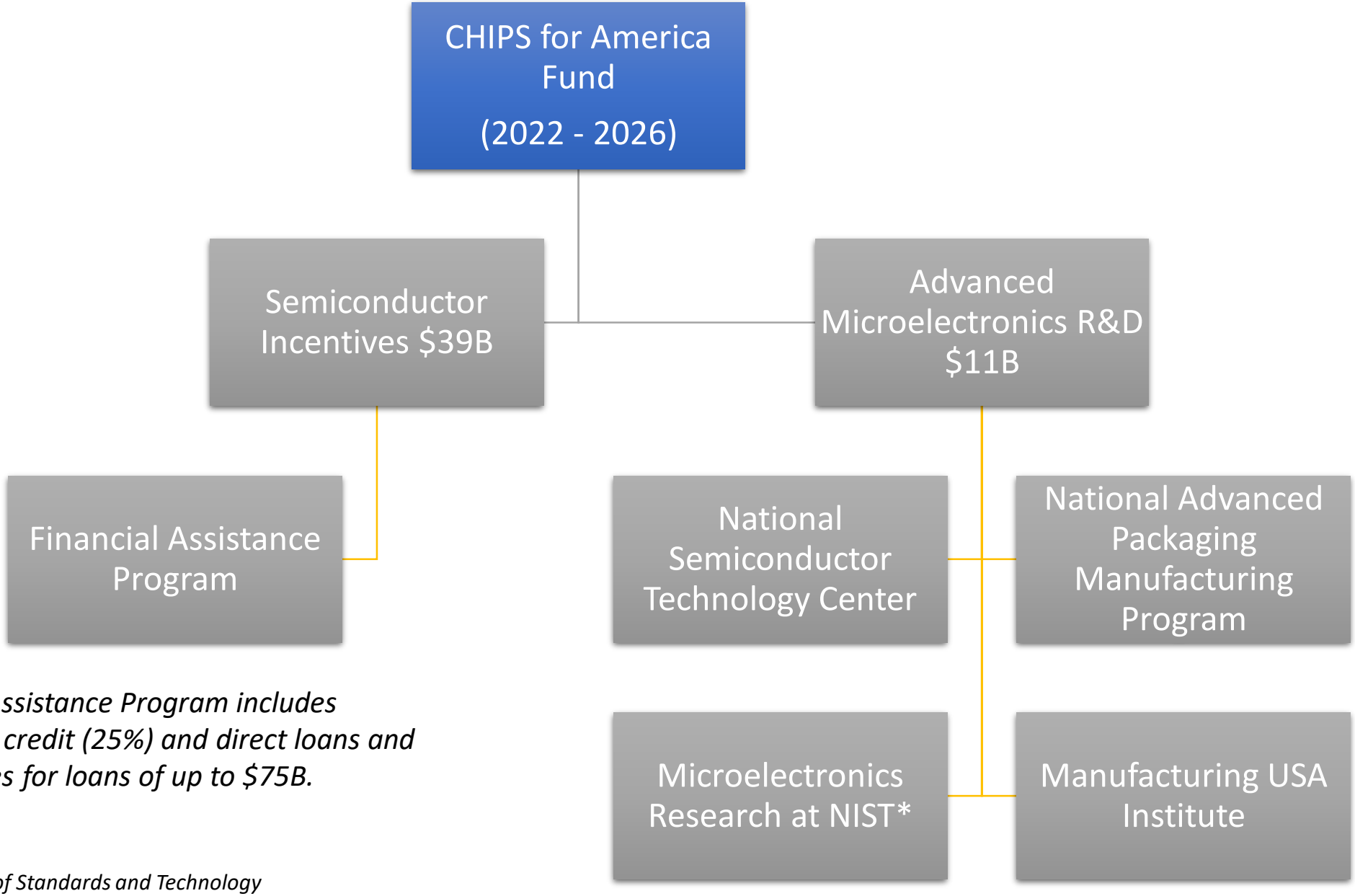
United States of America

The funding for education and training in microelectronics is included across multiple U.S. bills, with the most notable being the CHIPS and Science Act of 2022. This Act allocates various funds that support not only infrastructure, science, and research but also education at all competence levels—from early STEM education to teacher training and business-science-education partnerships. The following charts outline the comprehensive funding framework, highlighting the specific allocations for the development of the microelectronics sector. We have filtered this data to focus solely on the funds directed toward microelectronics, excluding allocations for other sectors where possible to provide a clear view of the financial support dedicated to this field. This analysis covers only Federal funding, excluding State-level contributions, private funding, and public-private partnerships. Consequently, we can assume that the actual financial support for microelectronics is broader than what is represented in the following charts.

CHIPS and Science Act of 2022

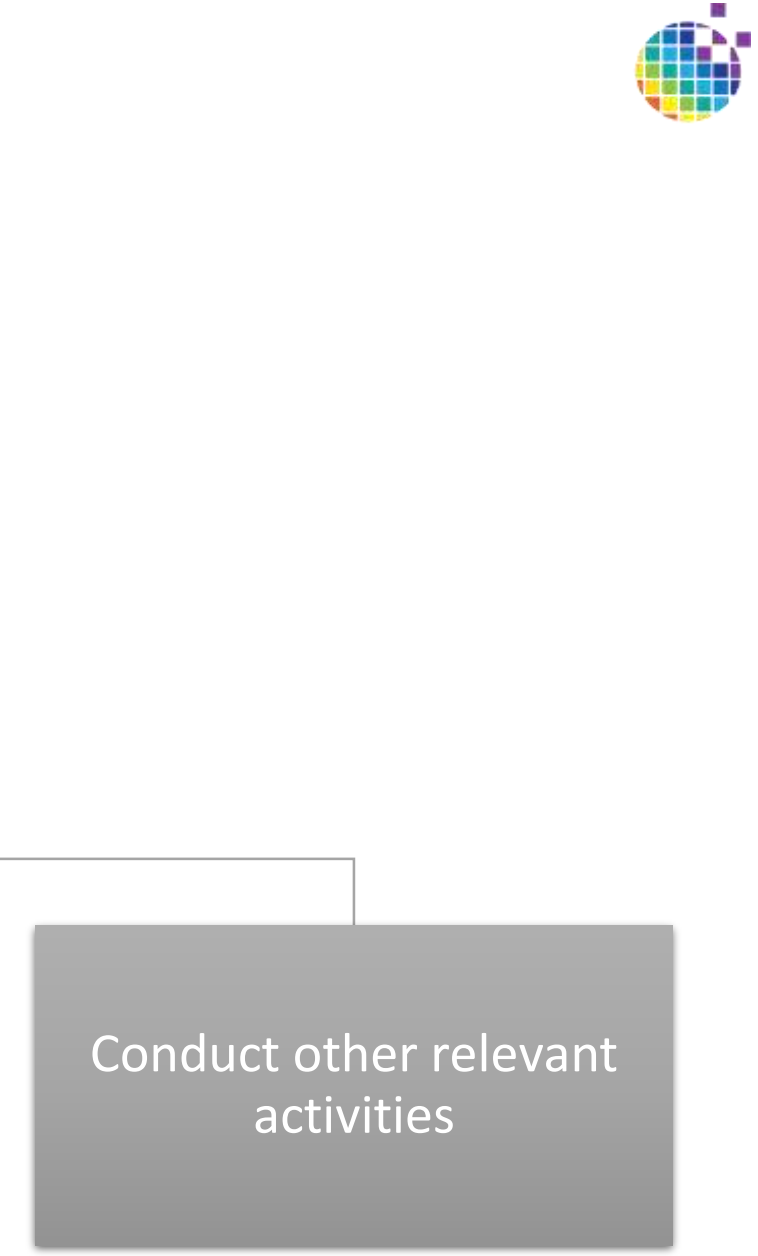


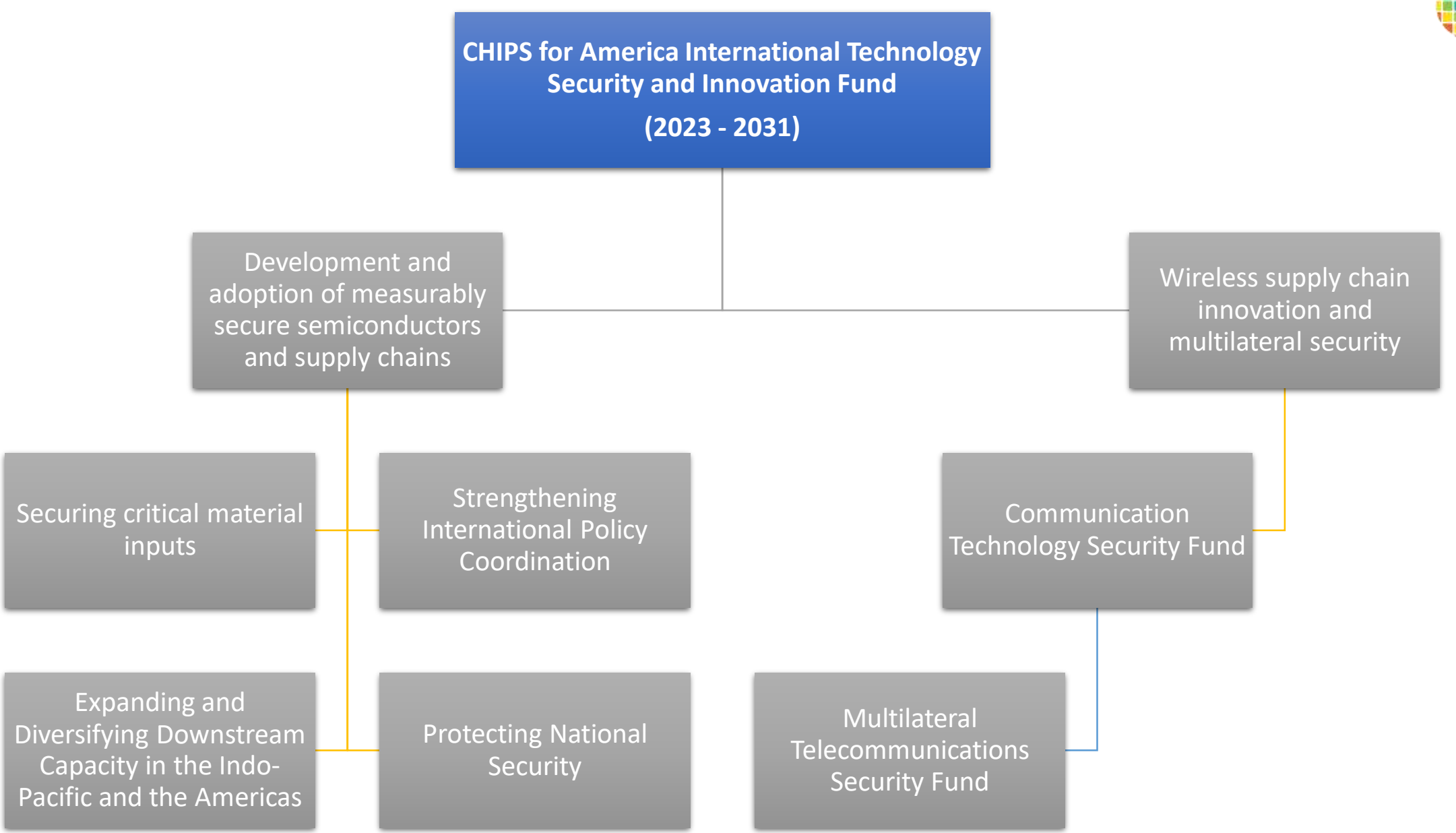
DIVISION A

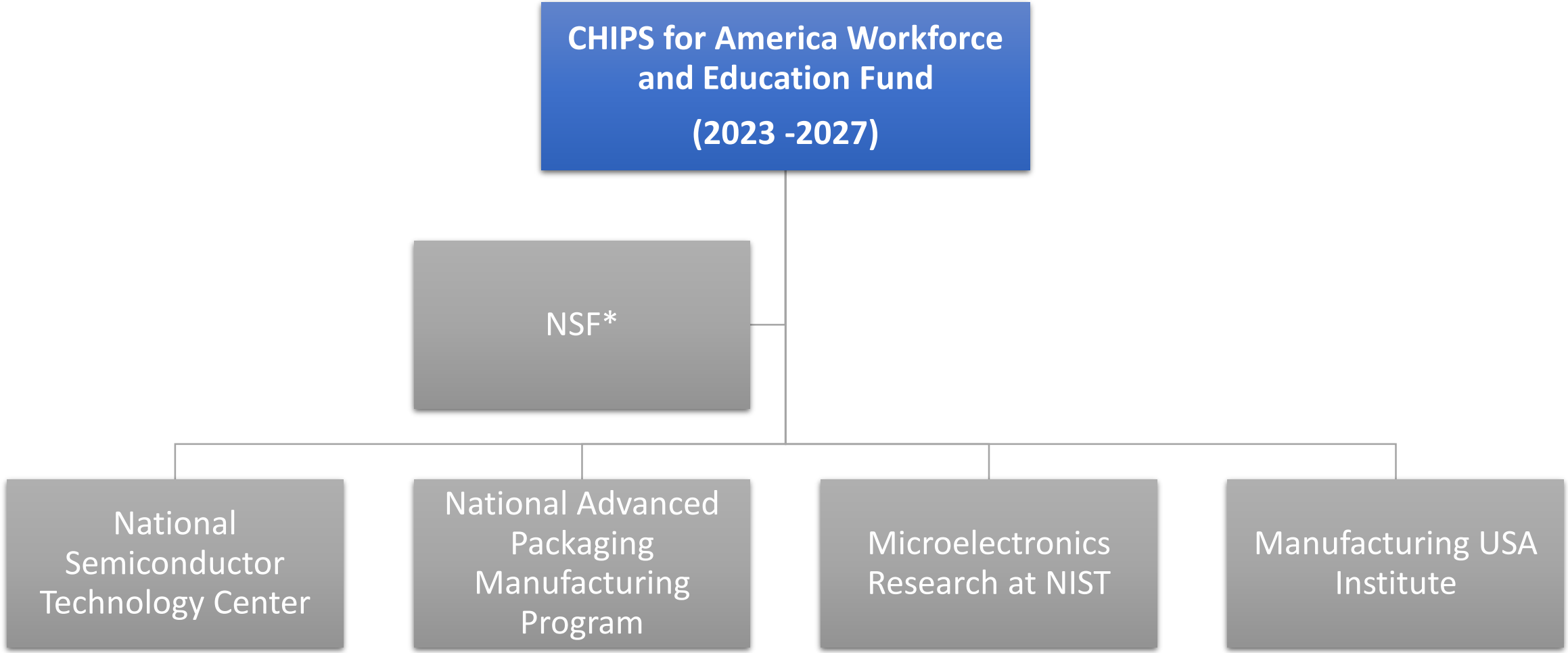


The Financial Assistance Program includes investment tax credit (25%) and direct loans and loan guarantees for loans of up to $75B.

**National Institute of Standards and Technology*

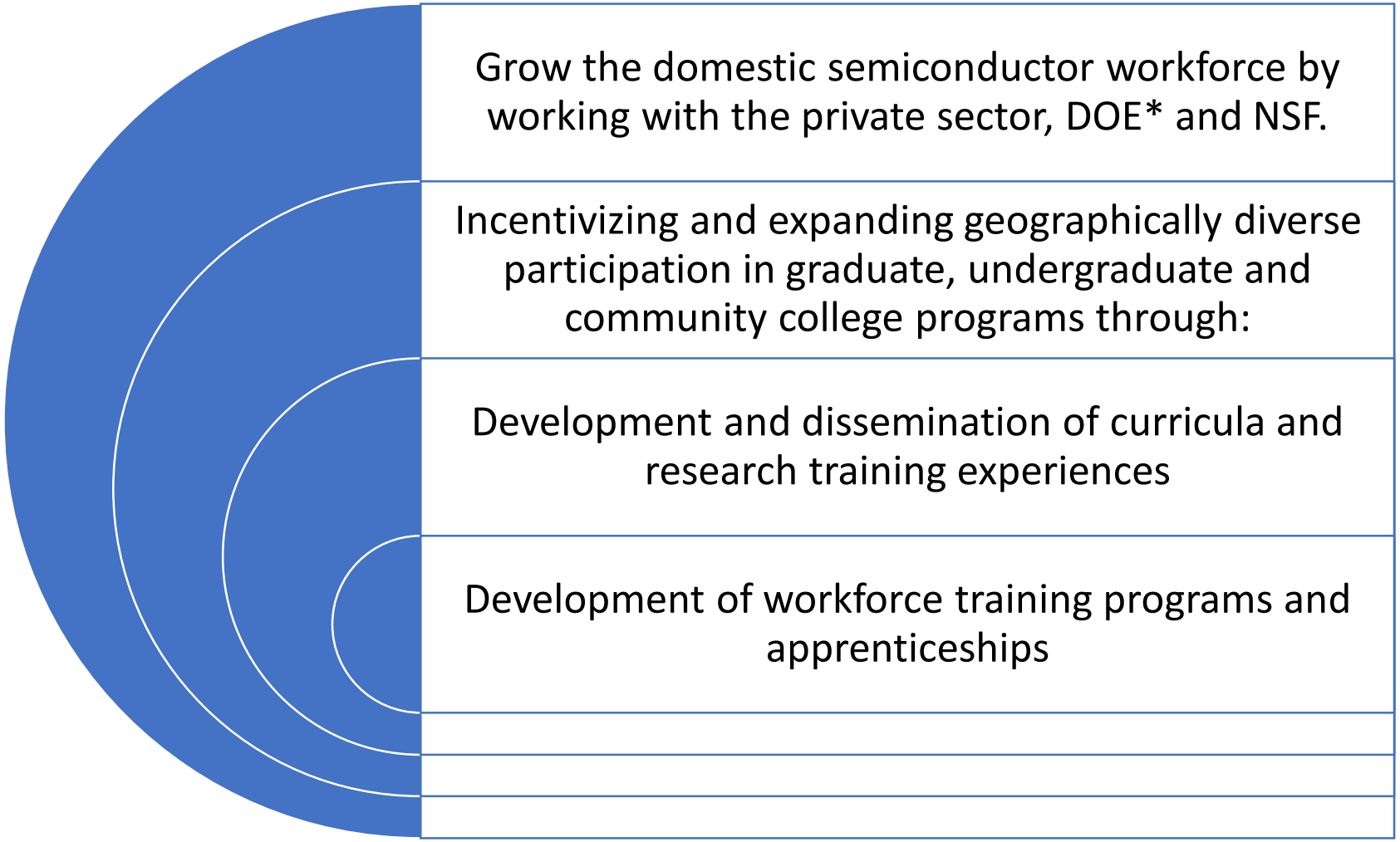

CHIPS for America Defense Fund
(2023 - 2027)
National Network for Microelectronics R&D
Cost effective exploration of new materials, devices, architectures and prototyping in domestic facilities
Accelerate the transition of new technologies to domestic microelectronics manufacturers
Conduct other relevant activities


CHIPS for America International Technology Security and Innovation Fund
(2023 - 2031)
Development and adoption of measurably secure semiconductors and supply chains
Wireless supply chain innovation and multilateral security
Securing critical material inputs
Strengthening International Policy Coordination
Communication Technology Security Fund
Expanding and Diversifying Downstream Capacity in the Indo-Pacific and the Americas
Protecting National Security
Multilateral Telecommunications Security Fund



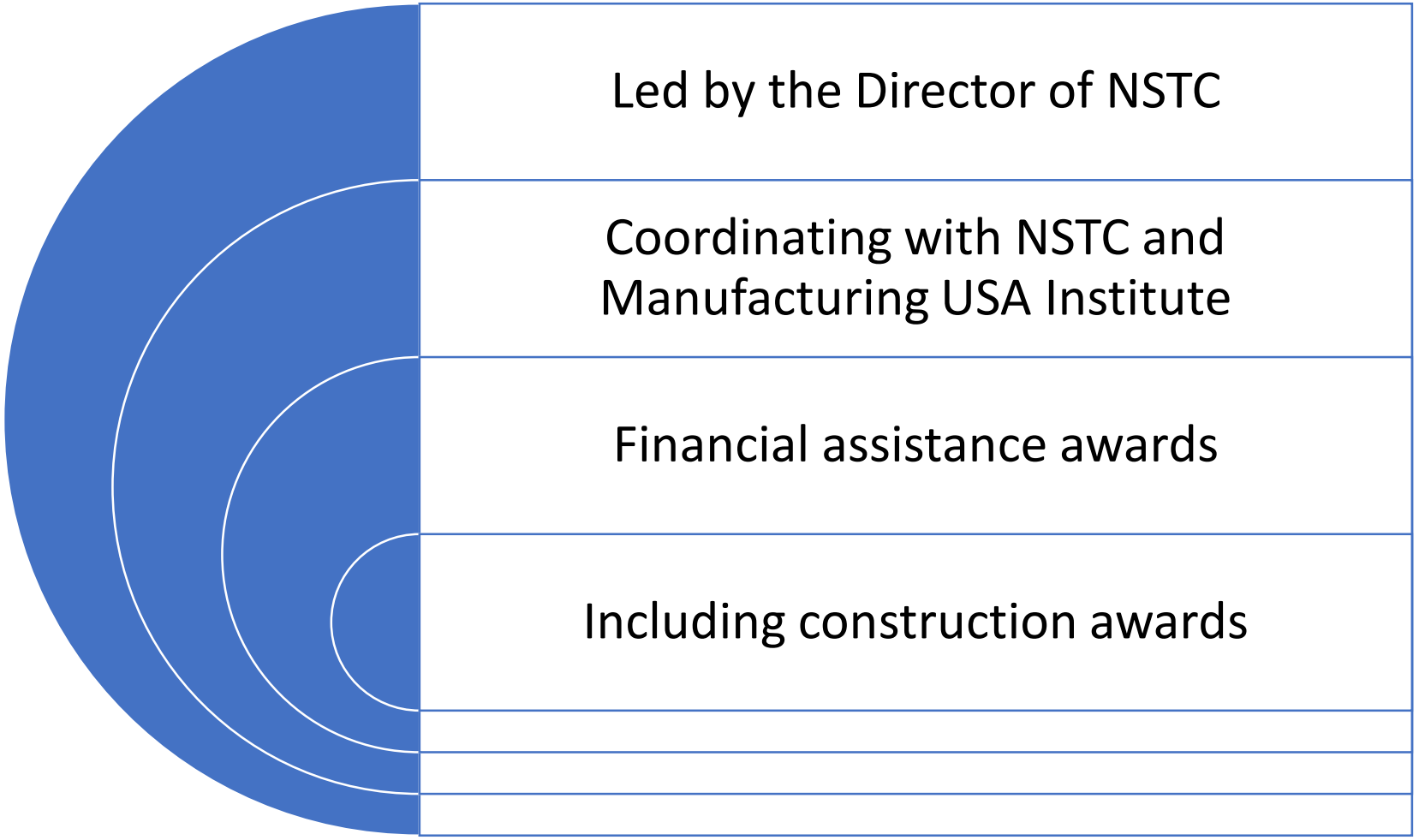
*National Science Foundation

National Semiconductor Technology Center (NSTC)

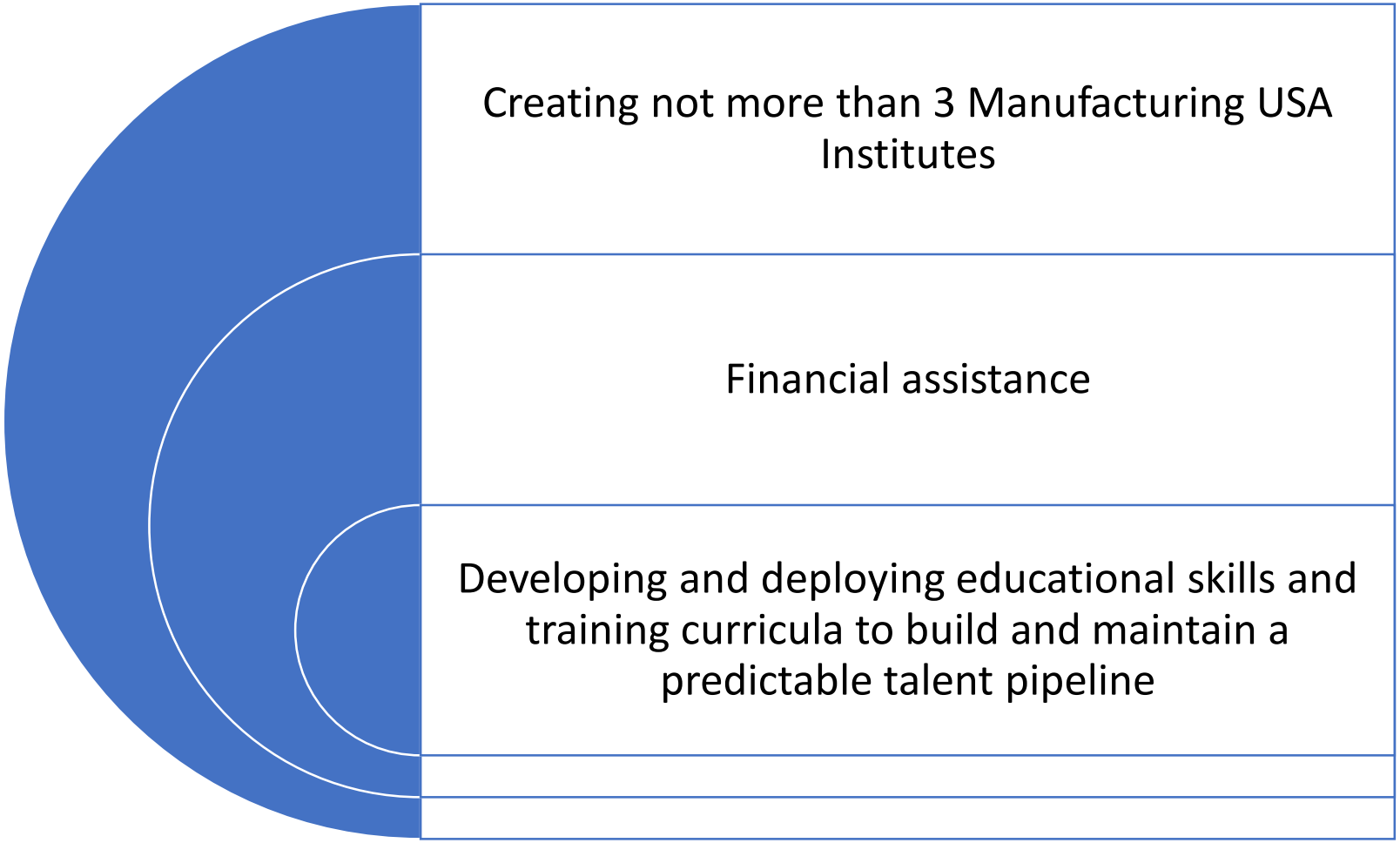


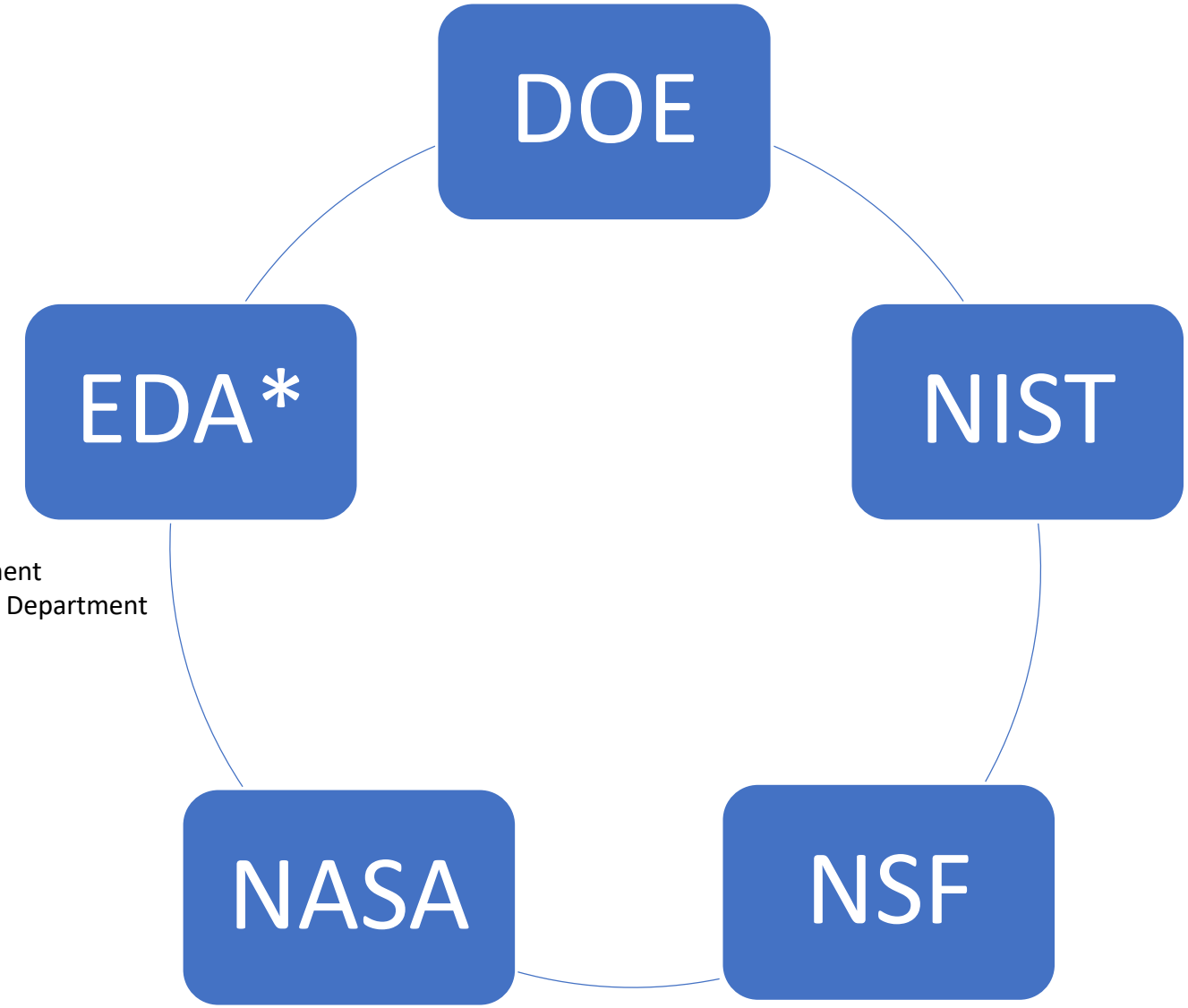
*Department of Energy

National Advanced Packaging Manufacturing Program



Manufacturing USA Institute

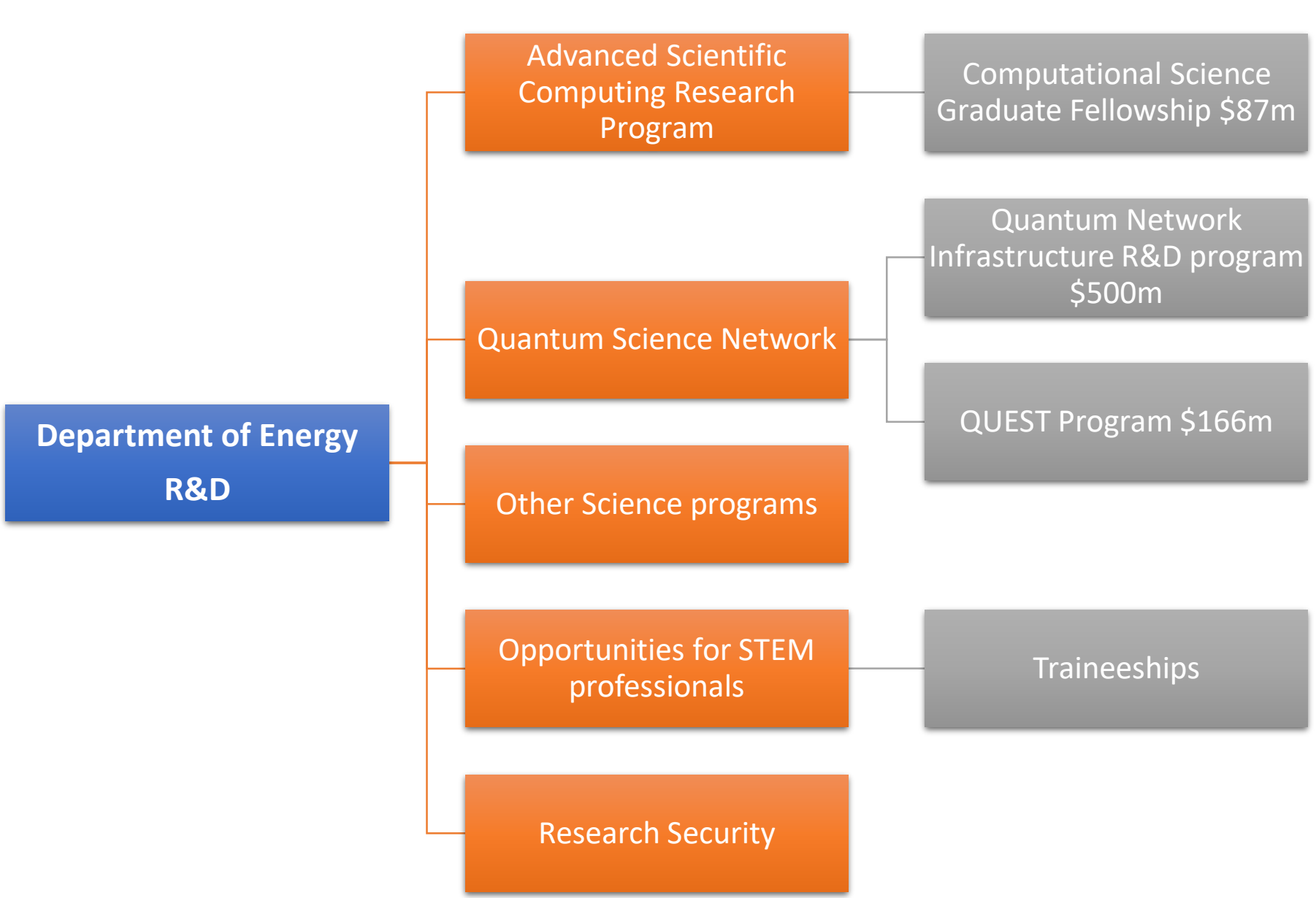


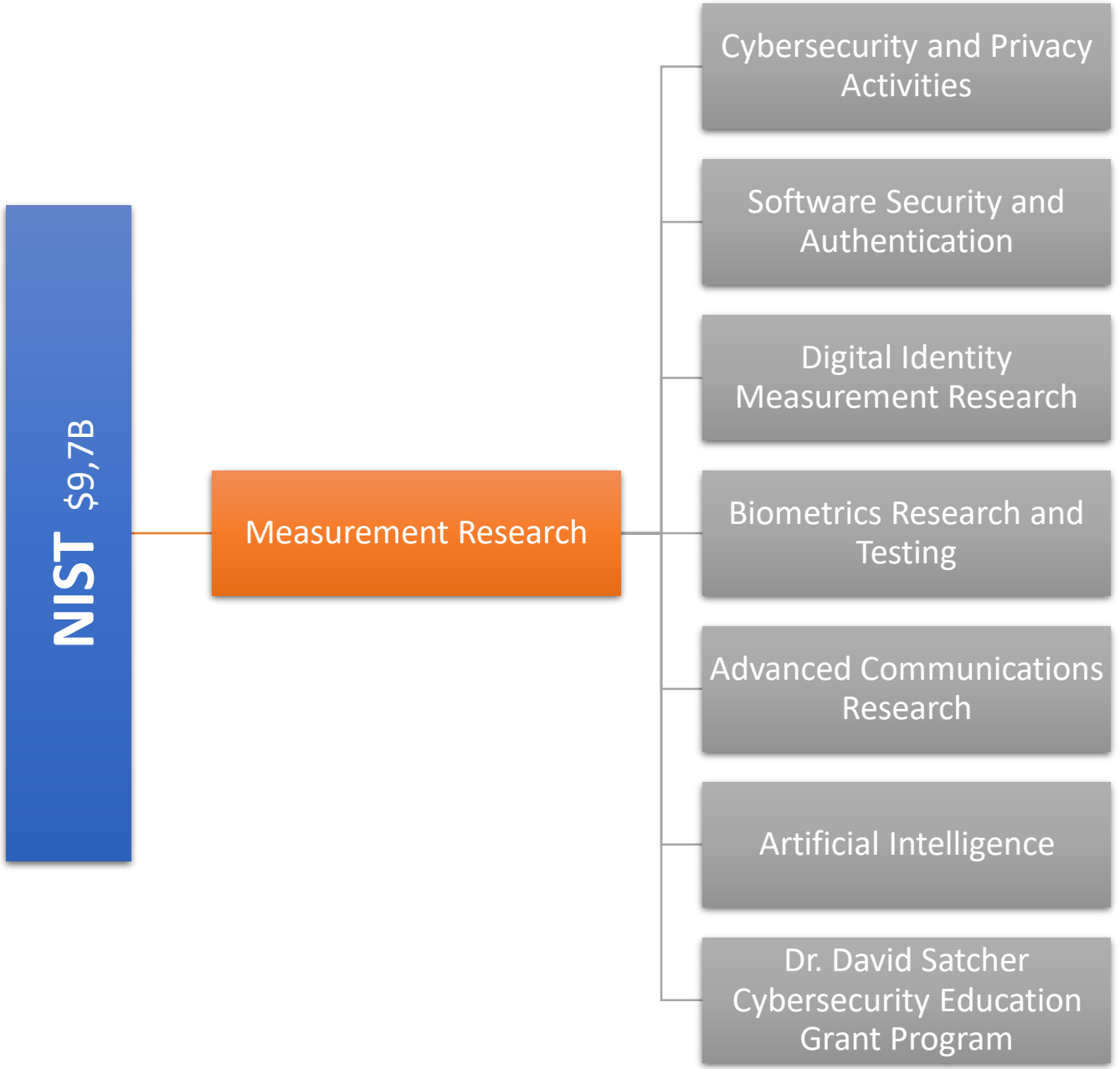


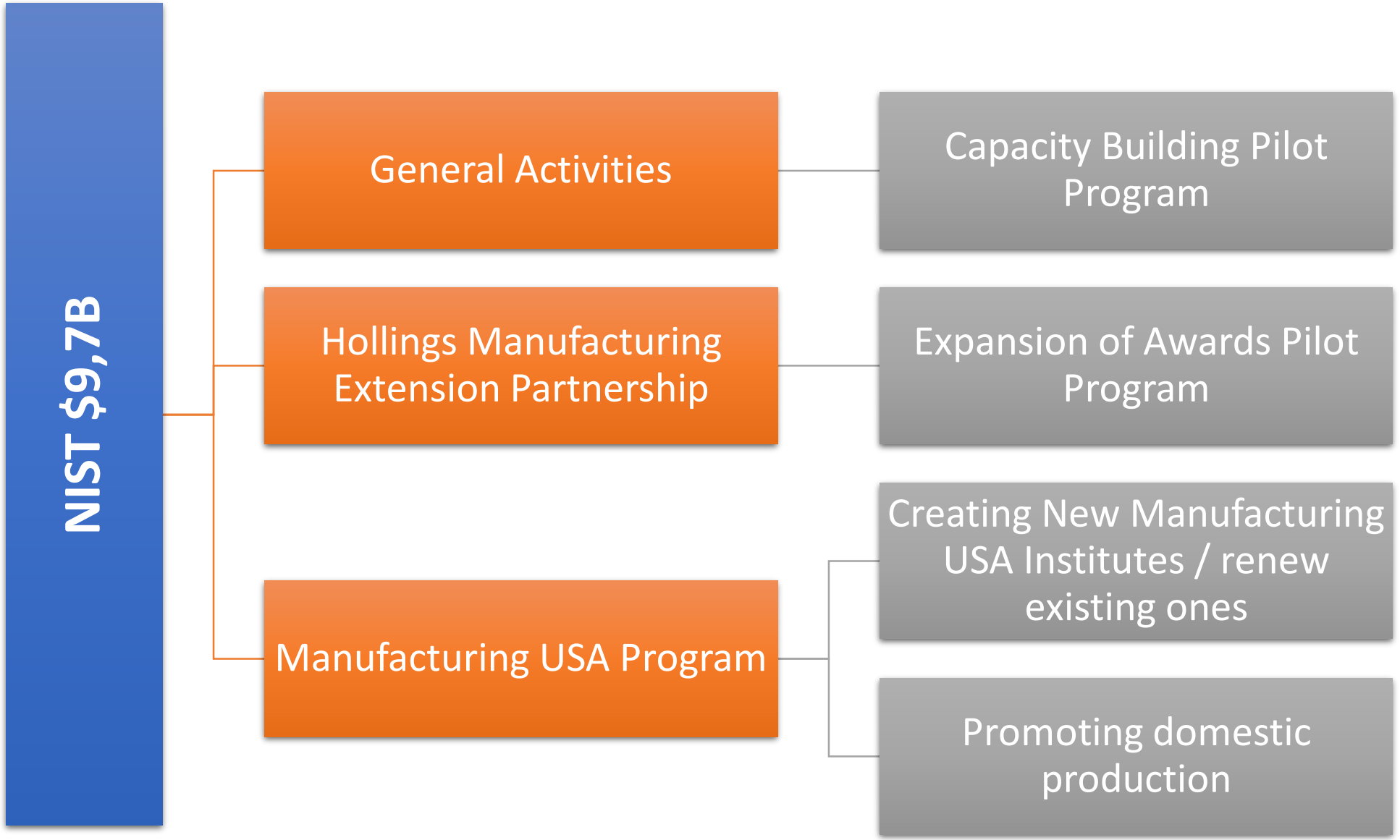
*Economic Development Administration to the Department of Commerce

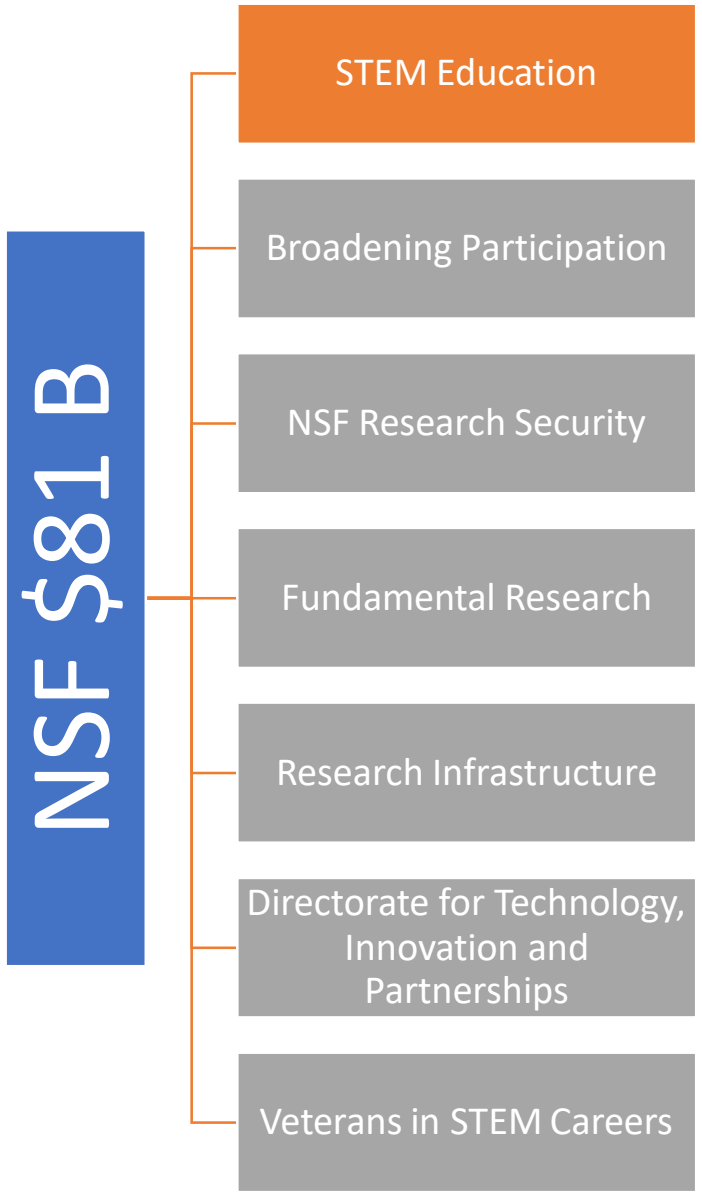
DIVISION B

Additional $174 B invested in the overall ecosystem by the federal government

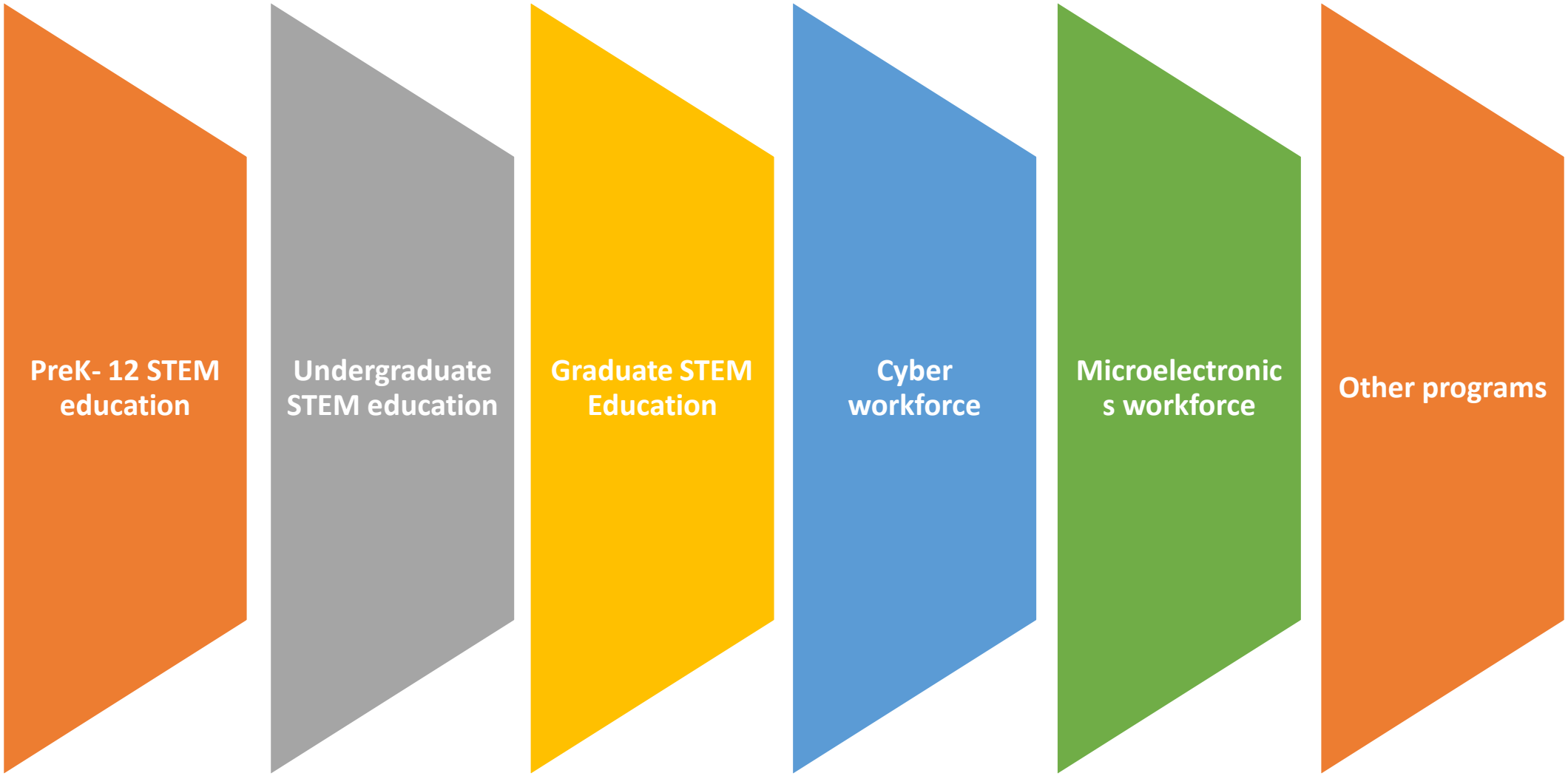

Department of Energy R&D
Advanced Scientific Computing Research Program
Computational Science Graduate Fellowship $87m
Quantum Science Network
Quantum Network Infrastructure R&D program $500m
QUEST Program $166m
Other Science programs
Opportunities for STEM professionals
Traineeships
Research Security


NIST $9,7B
Measurement Research
Cybersecurity and Privacy Activities
Software Security and Authentication
Digital Identity Measurement Research
Biometrics Research and Testing
Advanced Communications Research
Artificial Intelligence
Dr. David Satcher Cybersecurity Education Grant Program


NIST $9,7B
General Activities
Capacity Building Pilot Program
Hollings Manufacturing Extension Partnership
Expansion of Awards Pilot Program
Manufacturing USA Program
Creating New Manufacturing USA Institutes / renew existing ones
Promoting domestic production

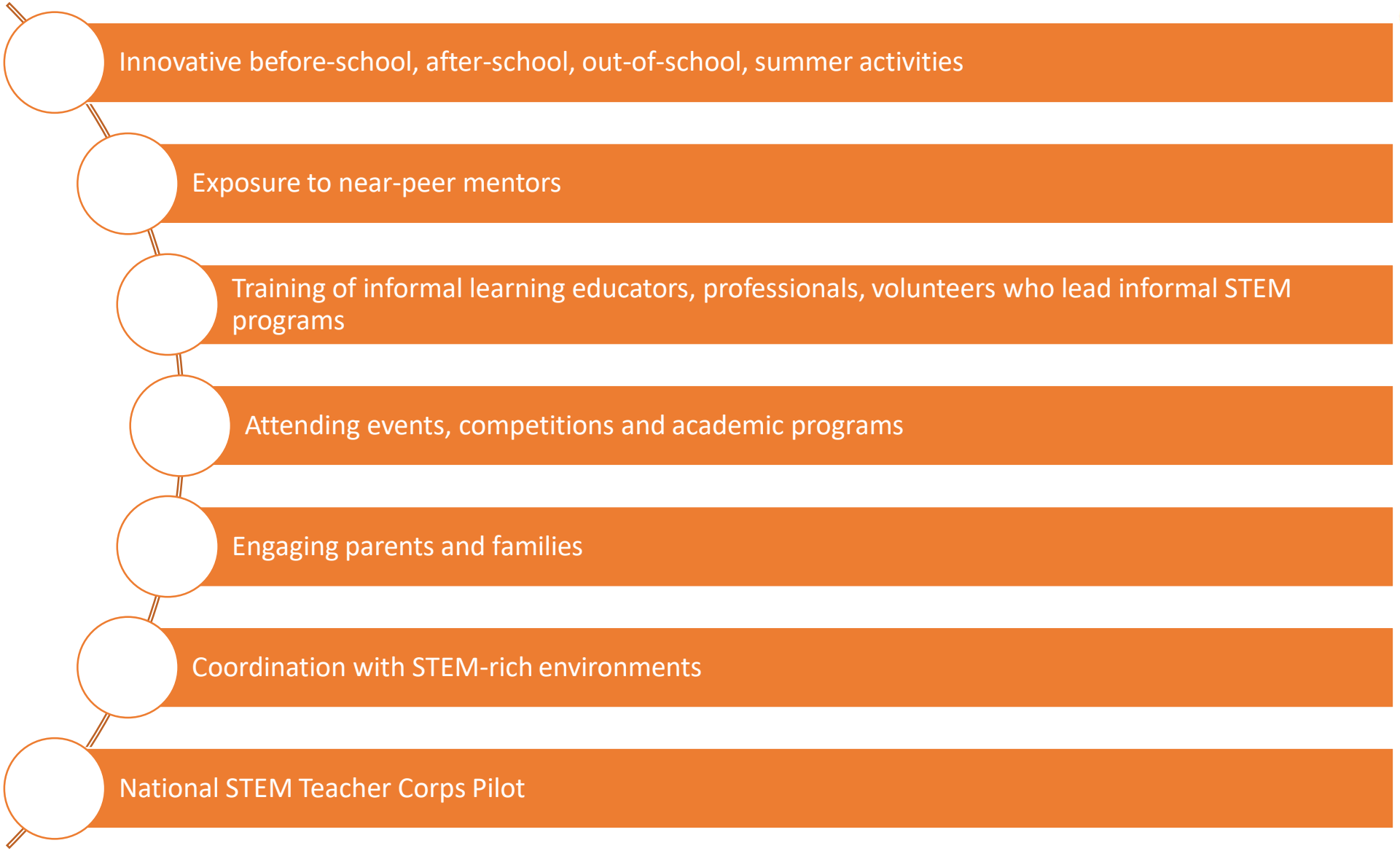

NSF §81 B
STEM Education
Broadening Participation
NSF Research Security
Fundamental Research
Research Infrastructure
Directorate for Technology, Innovation and Partnerships
Veterans in STEM Careers

STEM Education $13 B



STEM + Art and Design – *The U.S. Government has officially incorporated art and design in STEM education as a way to promote creativity and innovation.*

PreK-12* STEM Education



*Pre-kindergarten to 12th grade

Undergraduate STEM Education

Advanced Technological Education Program Update

- Centers of Scientific And Technical Education

Innovations in STEM Education at Community Colleges

- New STEM curricula

Education at Career and Technical Education Institutions

- Including Postsecondary Vocational Institutions

Course-Based Undergraduate Research Experiences

- At least five Centers for developing and scaling up successful models

Graduate STEM Education

Mentoring and Professional Development

- Professional Development Supplement
- Graduate Education Research

Graduate Research Fellowship Program Update

- Cybersecurity Scholarships and Graduate Fellowships
- AI Scholarship-for-Service

Cyber Workforce

Cyber workforce Development R&D

- Build on the National Initiative on Cybersecurity Education (NICE) Cybersecurity Workforce Framework

Federal Cyber Scholarship-For-Service Program

- Preparing and sustaining a national cybersecurity workforce

Cybersecurity Workforce Data Initiative

- Consultations with key stakeholders and the broader community of practice in cybersecurity

Microelectronics Workforce

Creating Helpful Initiatives to Produce Personnel in Needed Growth Industries

- Integrating microelectronics content into STEM curricula at all education levels
- Advanced Microelectronics Traineeships
- Microelectronics Skilled Technical Workforce Programs
- Microelectronics Research Experiences Through Existing Programs
  - *Research Experiences for Undergraduates*
  - *Postdoctoral and Graduate fellowship programs*
  - *Informal STEM Education Programs*
  - *Robert Noyce Teacher Scholarship Program*
  - *Research Instrumentation programs*
  - *Low-Income Scholarship Program*

National Network For Microelectronics Education

- Network Coordination Hub
- Partnerships with HBCUs, TCUs and MSIs

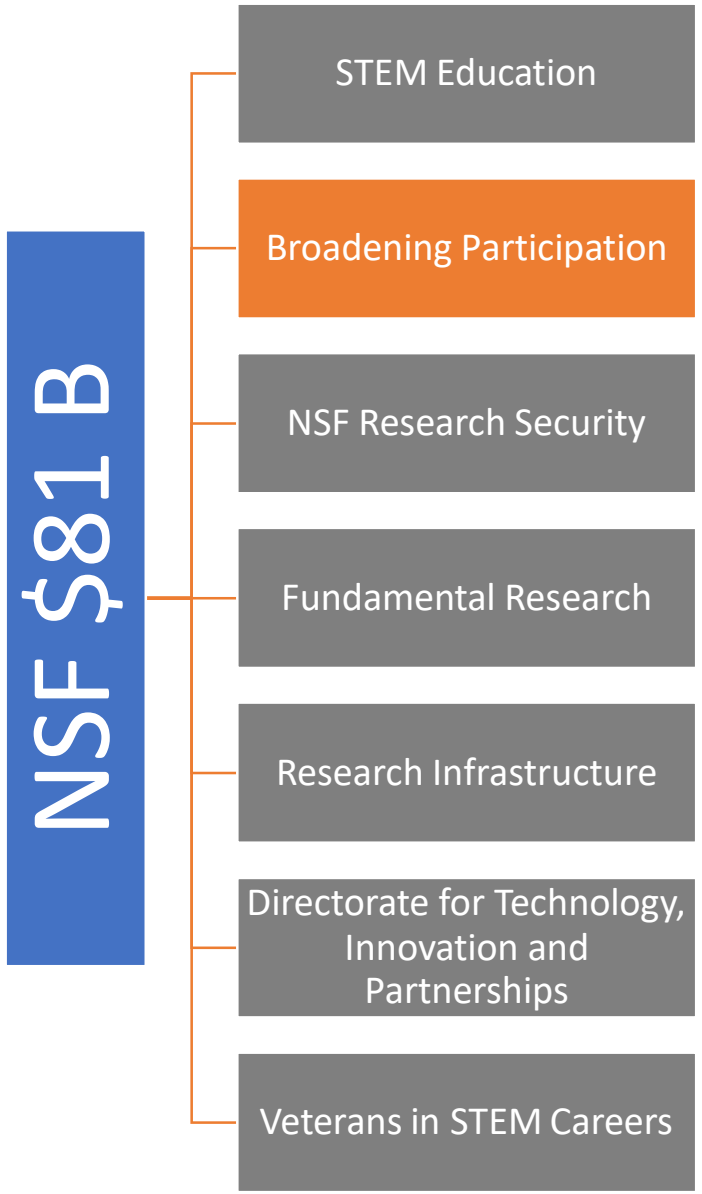
Other Programs

Postdoctoral Professional Development

- Fellowships
- Temporary Rotational Postings

Existing Programs

- Postdoctoral awards
- Graduate fellowships and traineeships
  - *NSF Research Traineeships*
- Scholarships
  - *Scholarships to attend community colleges*
  - *Research Experiences and Internships under America COMPETES Reauthorization Act of 2010*

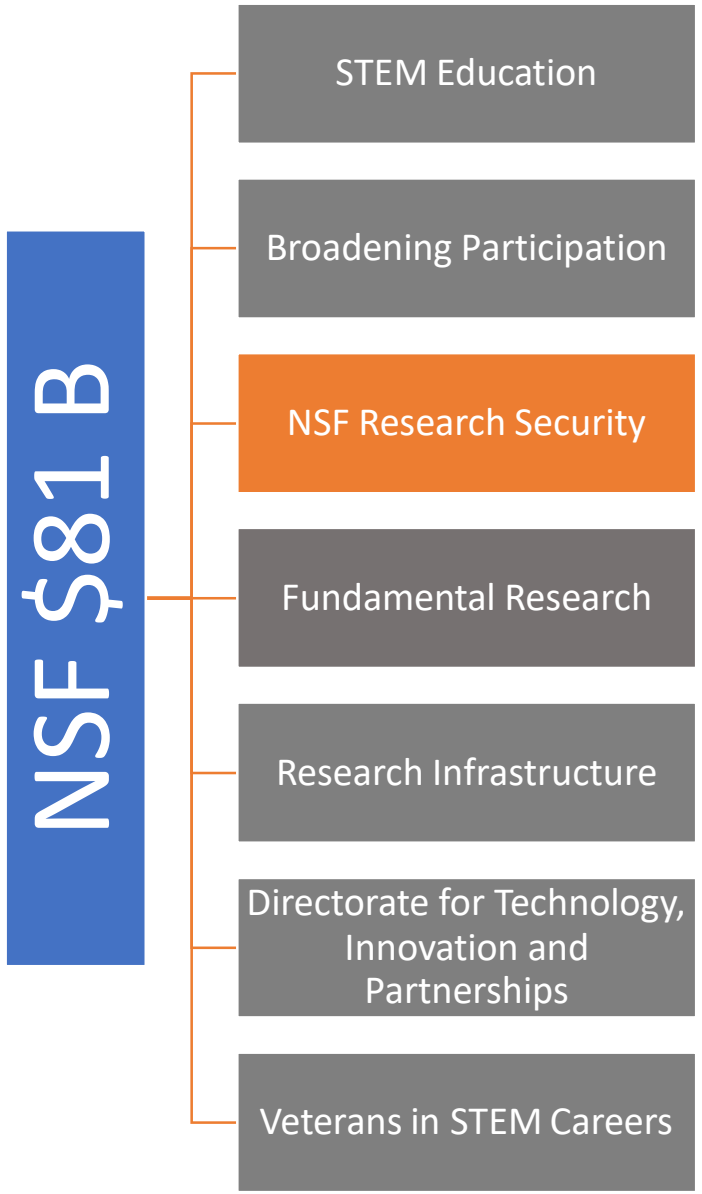

NSF §81 B
STEM Education
Broadening Participation
NSF Research Security
Fundamental Research
Research Infrastructure
Directorate for Technology, Innovation and Partnerships
Veterans in STEM Careers

Broadening Participation

Broadening Participation

- Presidential Awards For Excellence in Mathematics and Science
- Robert Noyce Teacher Scholarship Program Update
- NSF Eddie Bernice Johnson Includes Initiative
- Continuing Support for EPSCoR*
- Women and Underrepresented minorities in STEM
- Intramural Emerging Research Institutions Pilot Program

*The program is part of National Science Foundation – Established program to stimulate competitive research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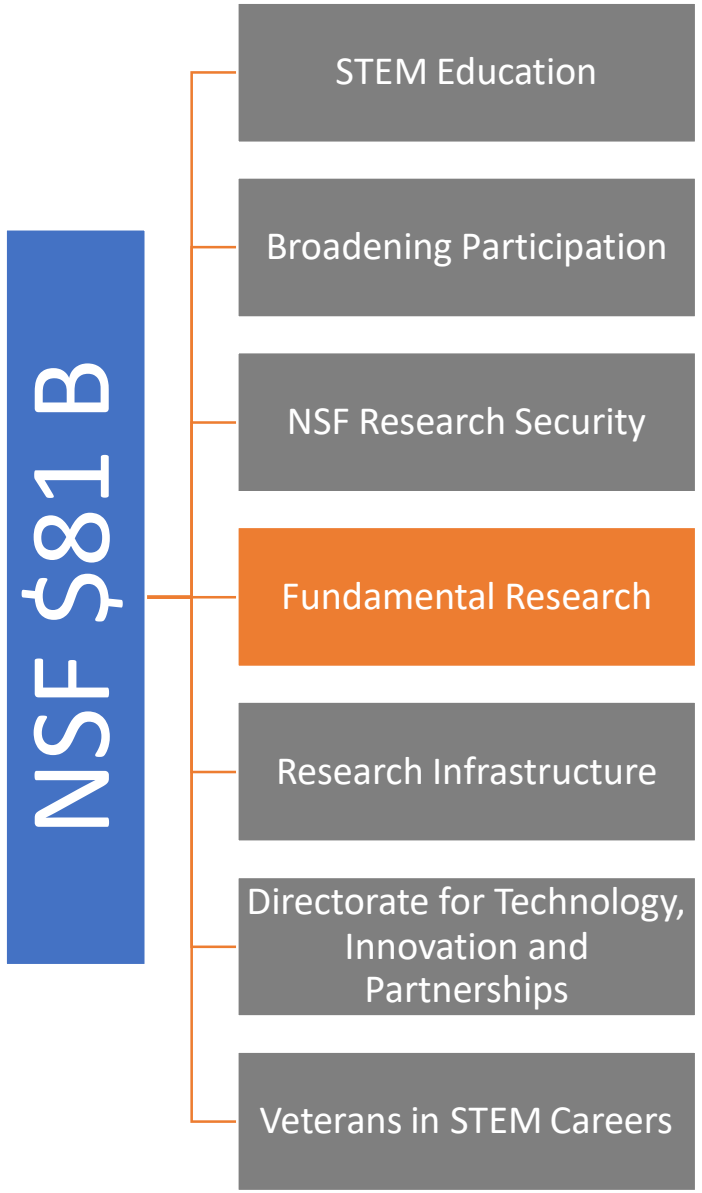
NSF Research Security

NSF Research Security

- Research Security and Policy Office
- Online Resources with up-to-date information and guidance
- Awards for research on research misconduct or breaches of research integrity
- America COMPETES* Updates on Responsible Conduct in Research Training
  - Mentor training and mentorship
- Research Security and Integrity Information Sharing Analysis Organization
- Restrictions on Foundation Funding to Institutions Hosting or Supporting Confucius Institutes

*America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science Act from 2007; Updated in 2022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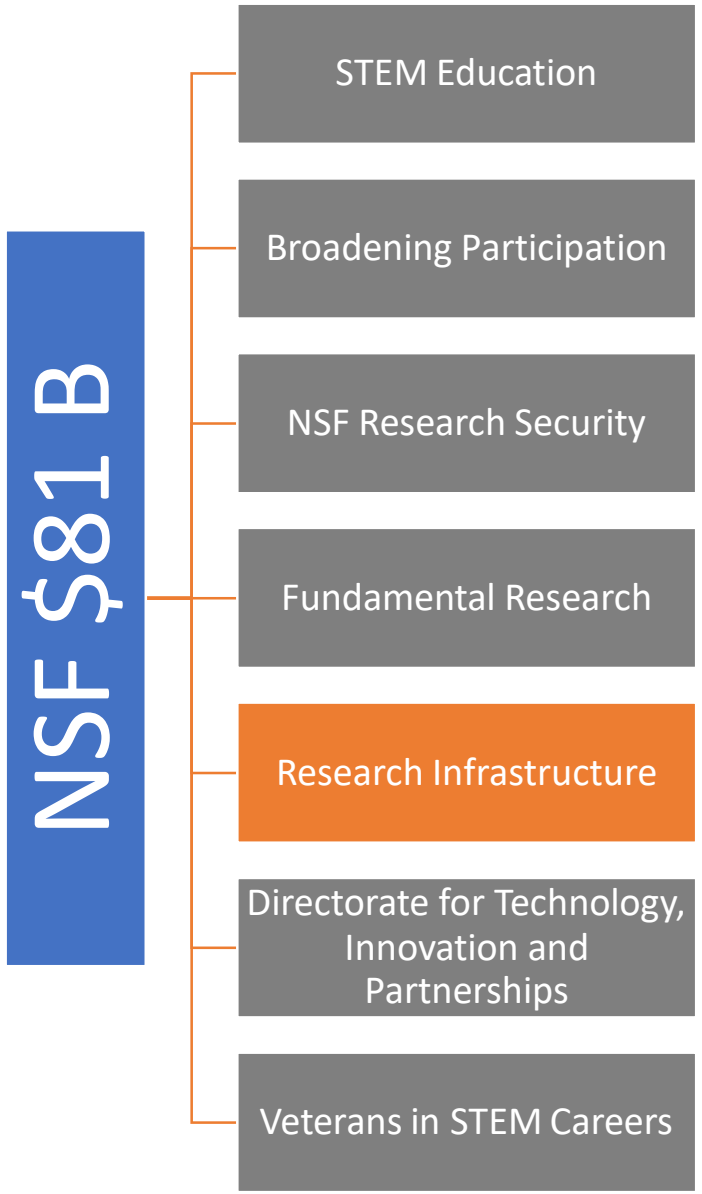
Fundamental Research

Fundamental Research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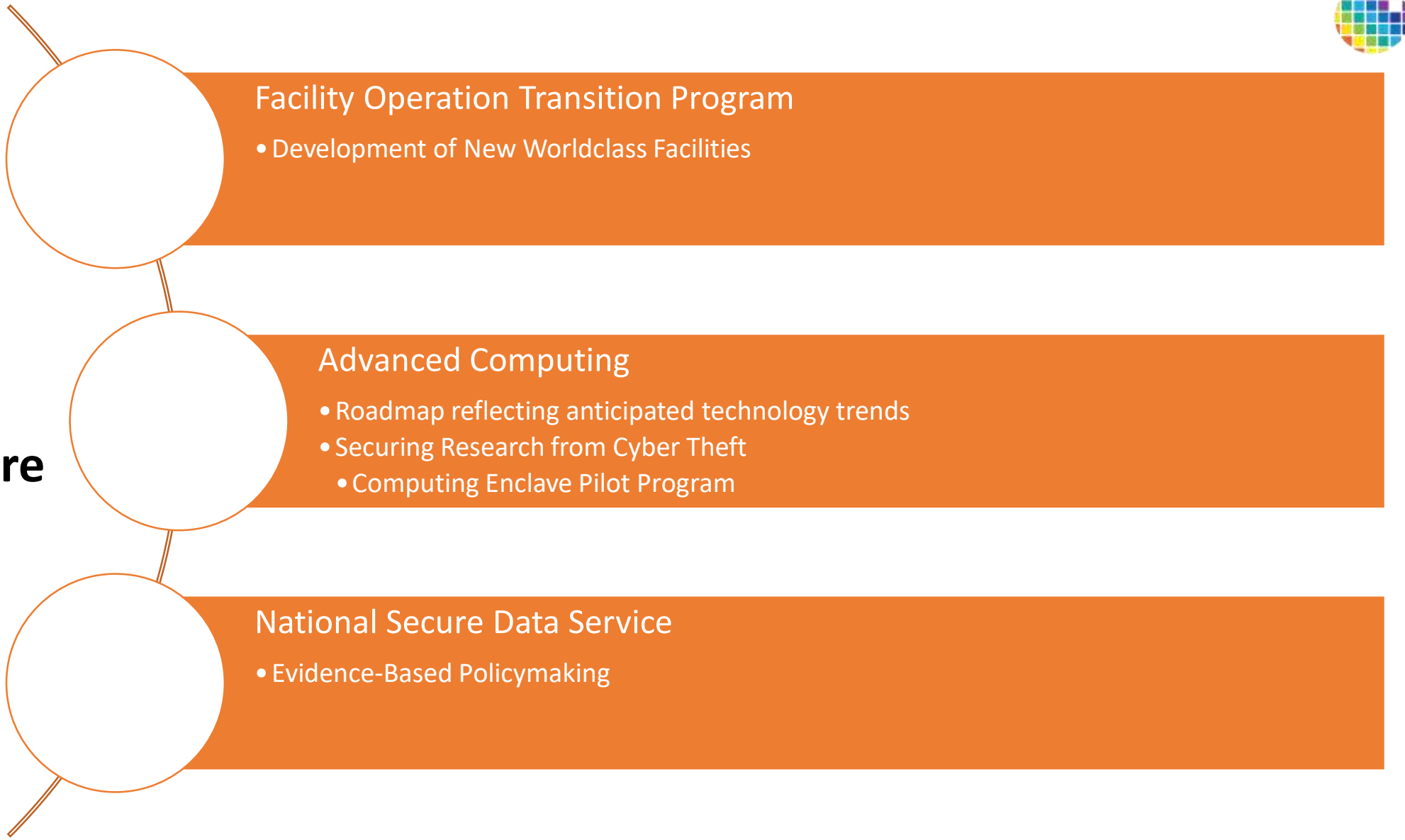
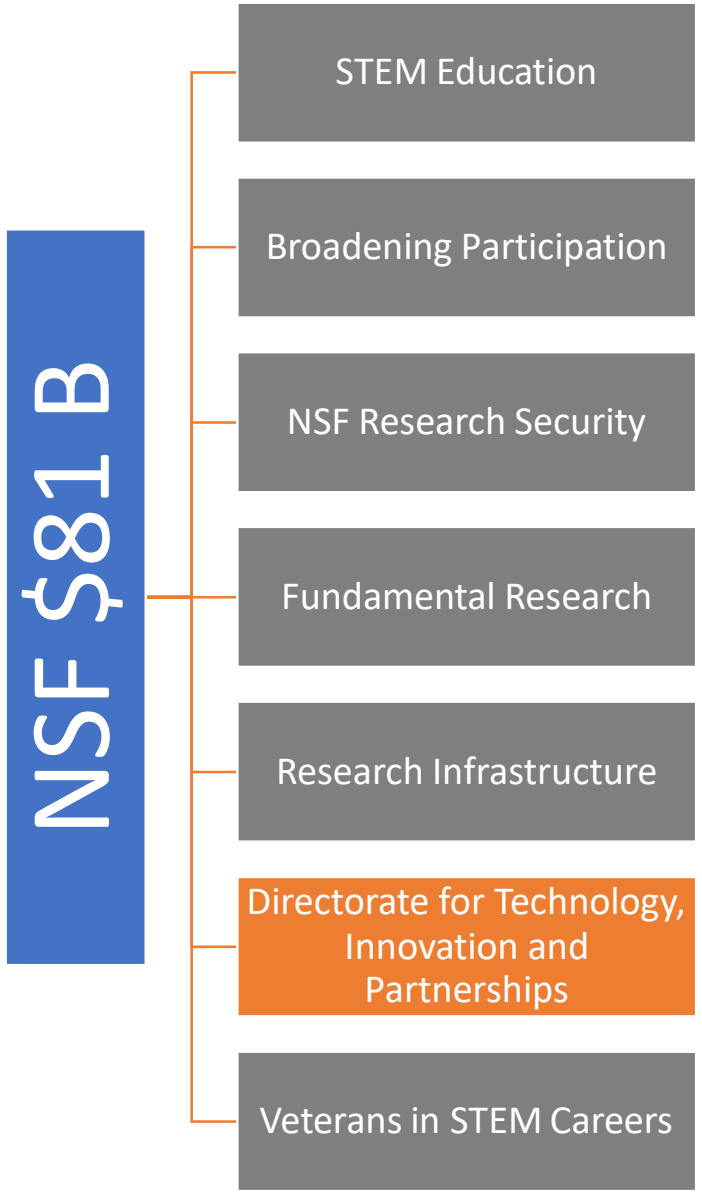
Research Infrastructure

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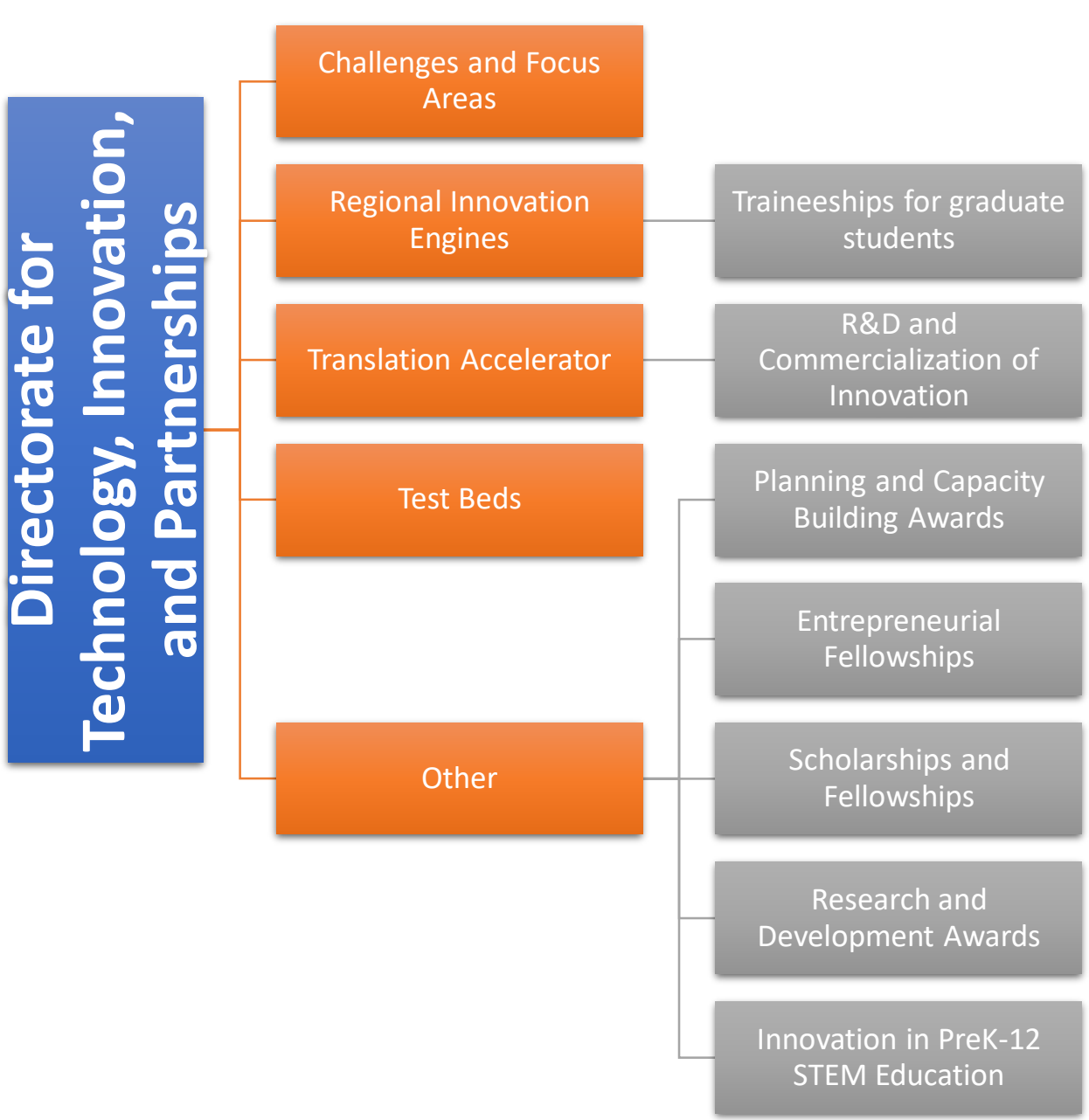
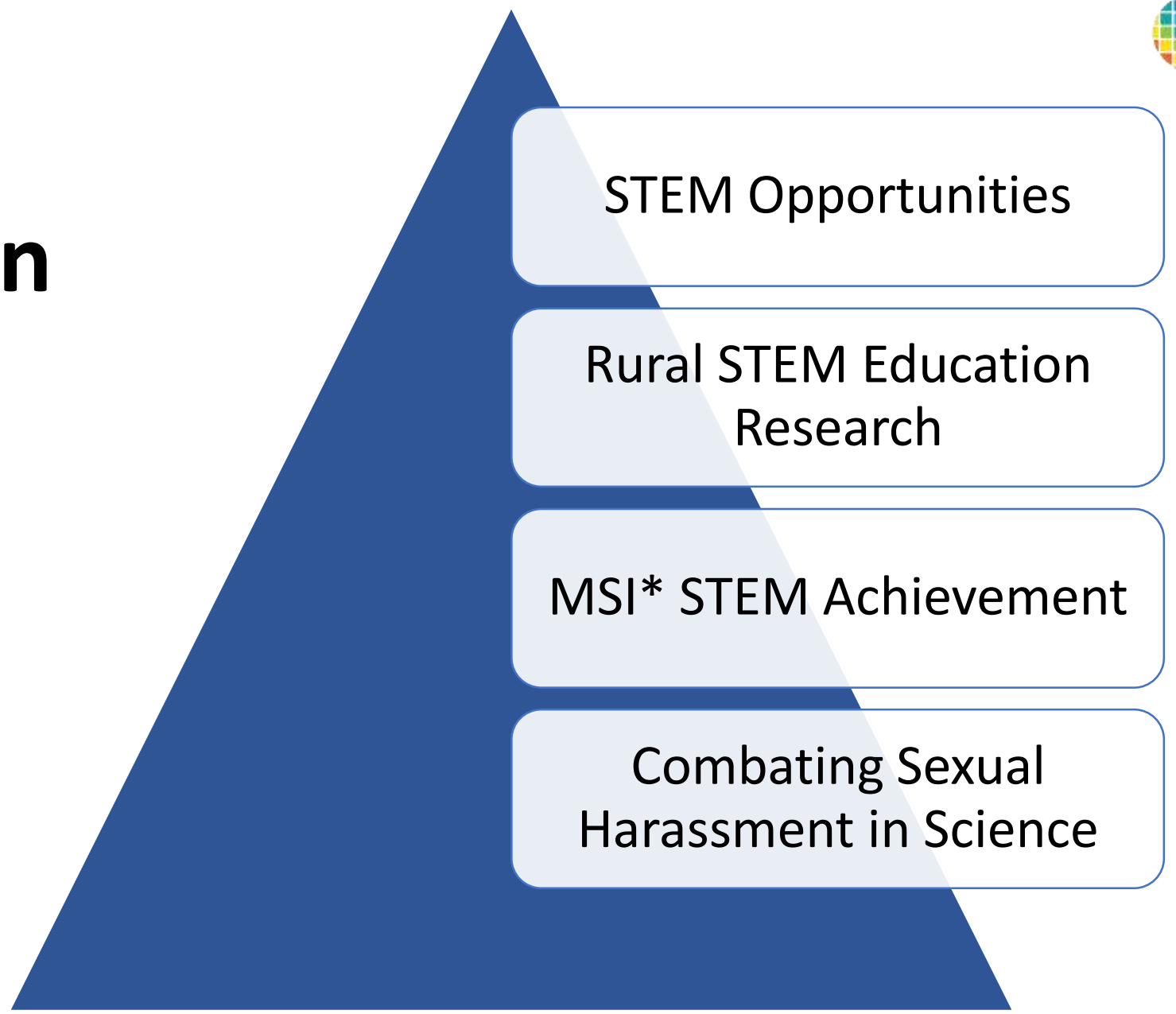
Directorate for Technology, Innovation and Partnerships

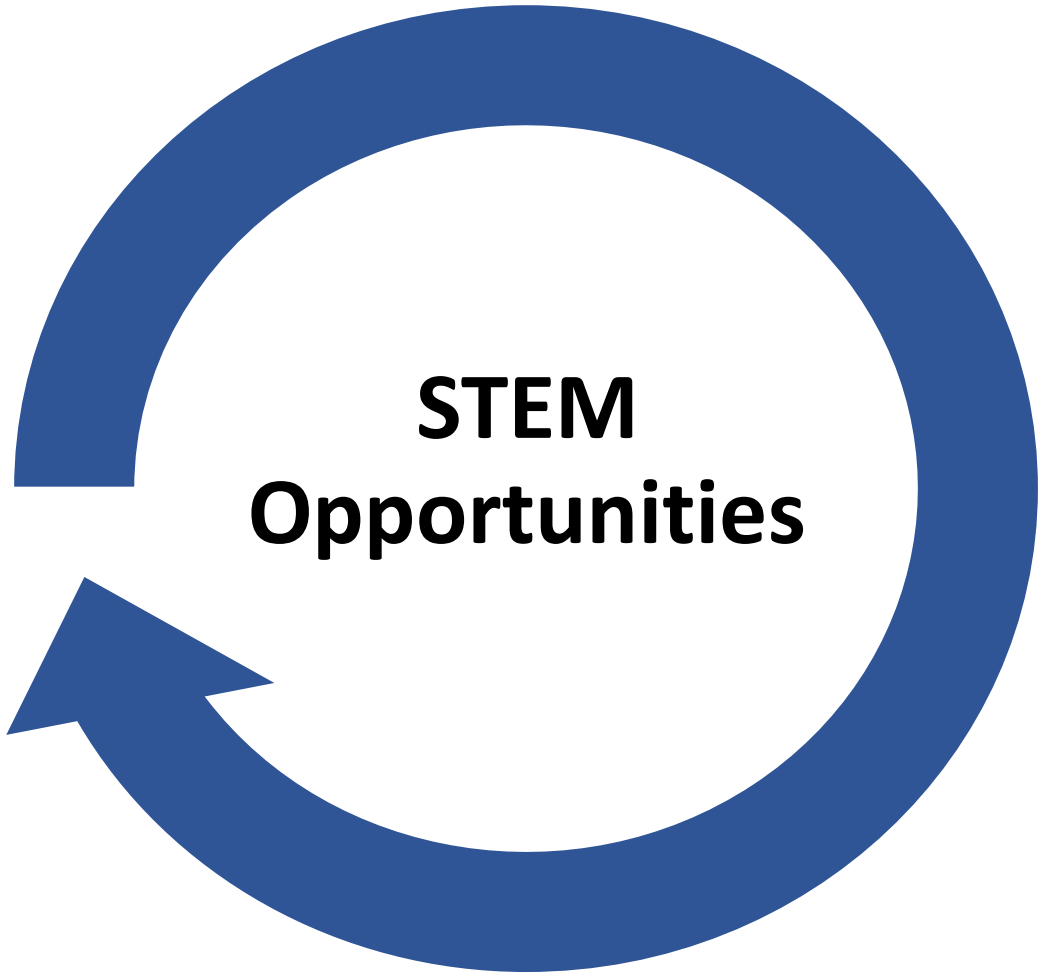

Directorate for Technology, Innovation, and Partnerships
Challenges and Focus Areas
Regional Innovation Engines
Traineeships for graduate students
Translation Accelerator
R&D and Commercialization of Innovation
Test Beds
Other
Planning and Capacity Building Awards
Entrepreneurial Fellowships
Scholarships and Fellowships
Research and Development Awards
Innovation in PreK-12 STEM Education

Broadening Participation in Science



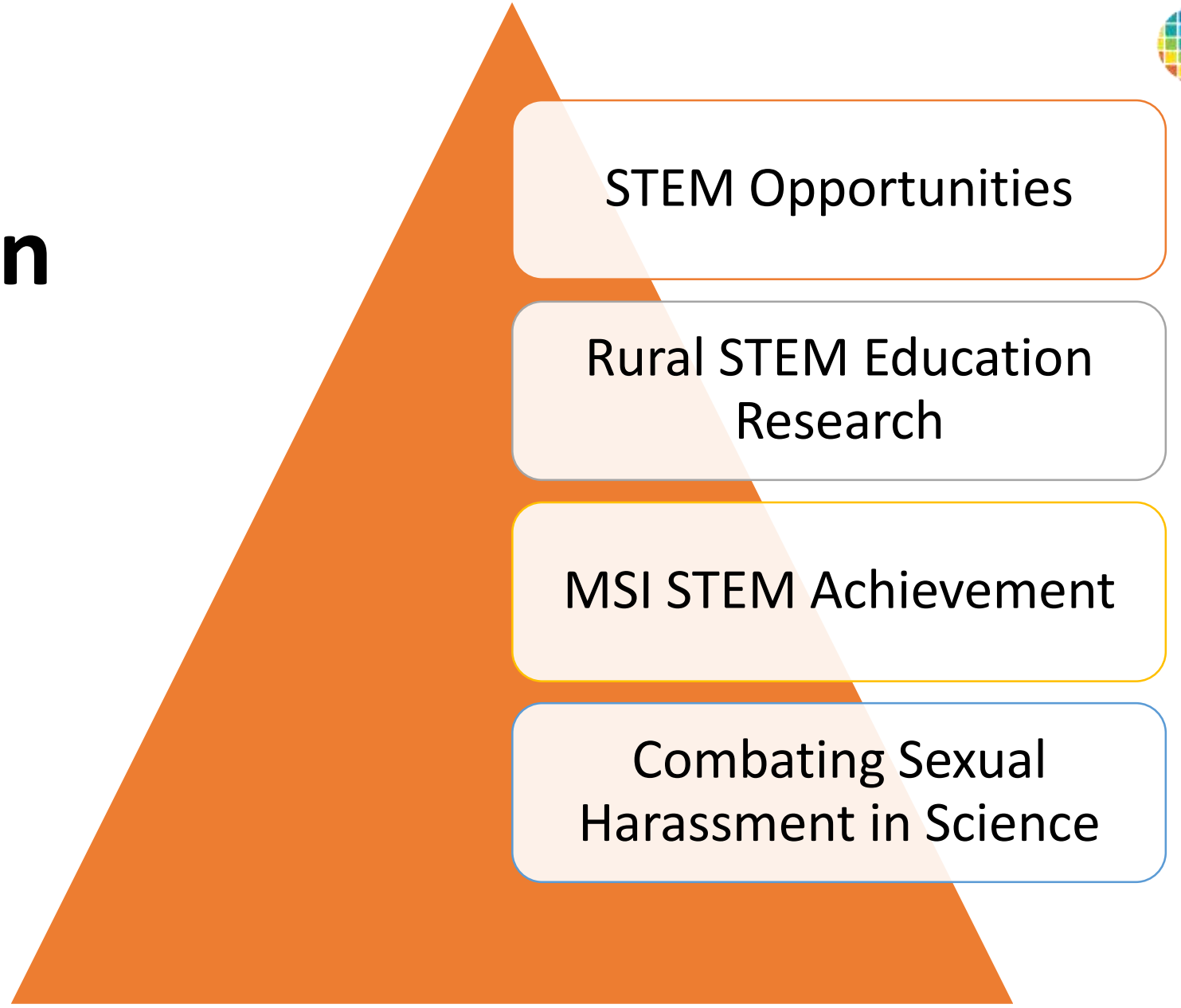
*Minority Serving Institutions

STEM Opportunities



- **Federal research agency policies for caregivers**
  - *Flexibility of initiation of awards*
  - *No-cost extensions of such research awards*
  - *Award supplements*
- **Cultural and Institutional barriers to expanding the academic and Federal STEM workforce**
  - *Best practices for unbiased recruitment*
- **Existing Activities**

Broadening Participation in Science



Rural STEM Education Research

NSF Rural STEM Activities

- Preparing Rural STEM Educators
- Broadening Participation of Rural Students in STEM
- Partnerships

Opportunities for Online Education

- Computer-based and online professional development courses
- Training and mentoring

Rural STEM Education Research

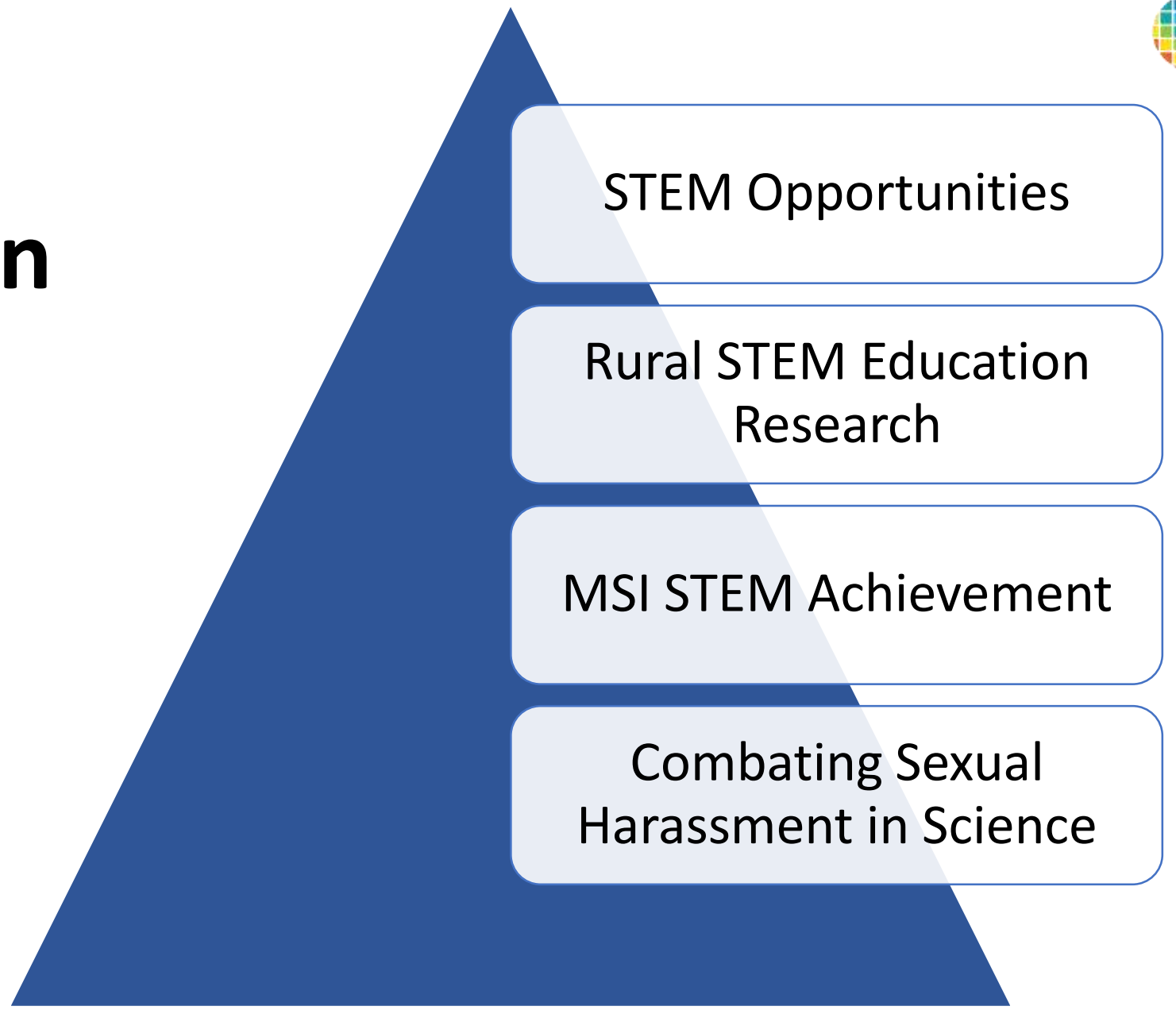
National Academies Evaluation

- Improvement in quality and quantity of Federal programming directed at examining STEM education in PreK-12

NIST Engagement with Rural Communities

- Prize competition for creative technologies to support affordable broadband connectivity

Broadening Participation in Science



MSI STEM Achievement

Funding Programs and Initiatives targeted to HBCUs*, TCUs** and MSIs

- New and Expanding existing funding
- Modifying existing R&D program solicitations
- Planning grants
- Additional Training Programs

Research at the NSF

- Integrating Effective practices in STEM Education
- Access to STEM Infrastructure
- Models of STEM curricula for increasing participation

Capacity- Building Program For Developing Countries

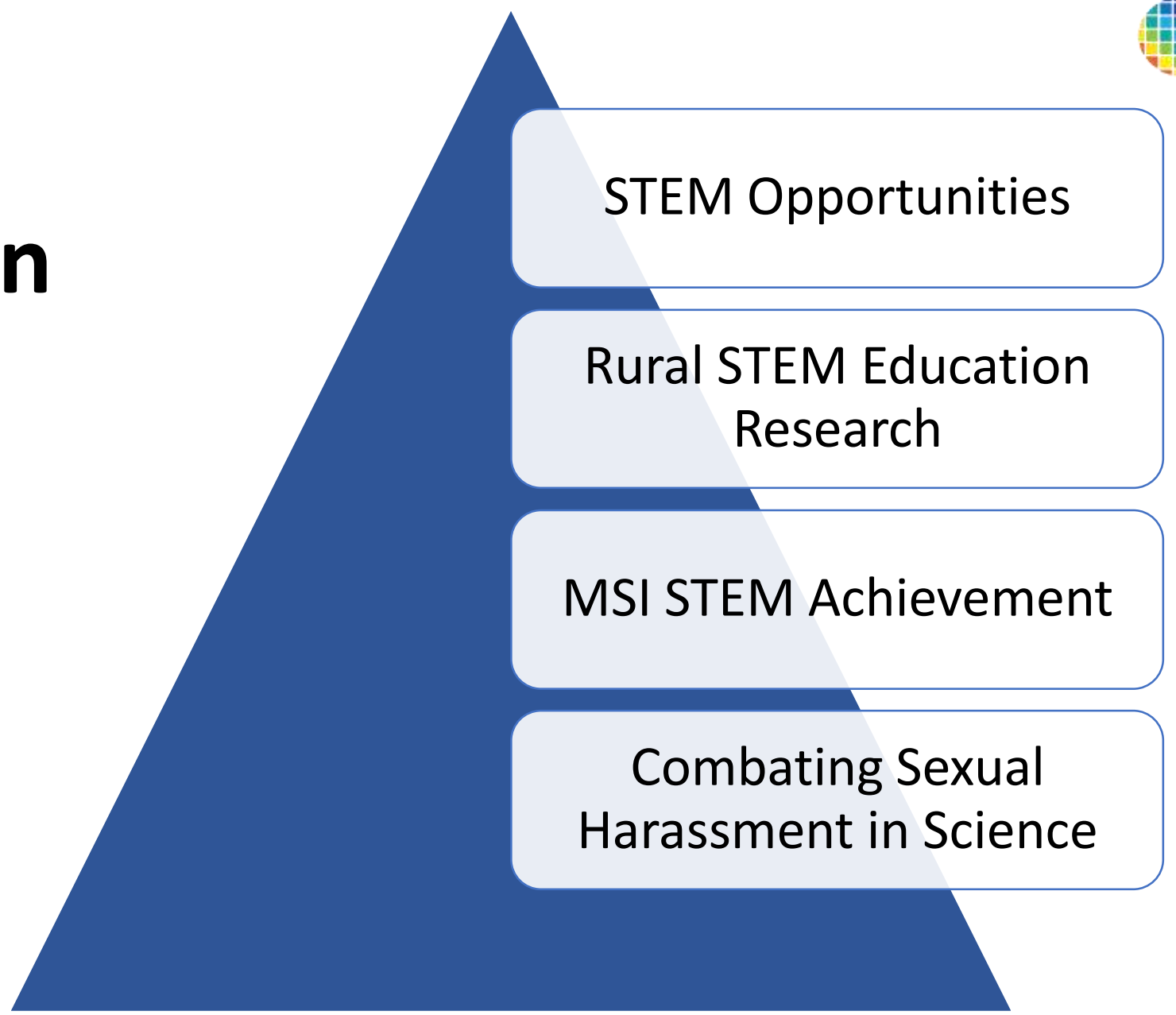
- Awards
- Partnerships
- Very Hight Research Activity Status HBCU Program
- MSI Centers of Innovation

TCU Program

- Awards to Broaden TCU Student Participation in Computer Science

*Historically Black Colleges and Universities
** Tribal Colleges and Universities

Broadening Participation in Science



Combating Sexual Harassment in Science

Research Awards

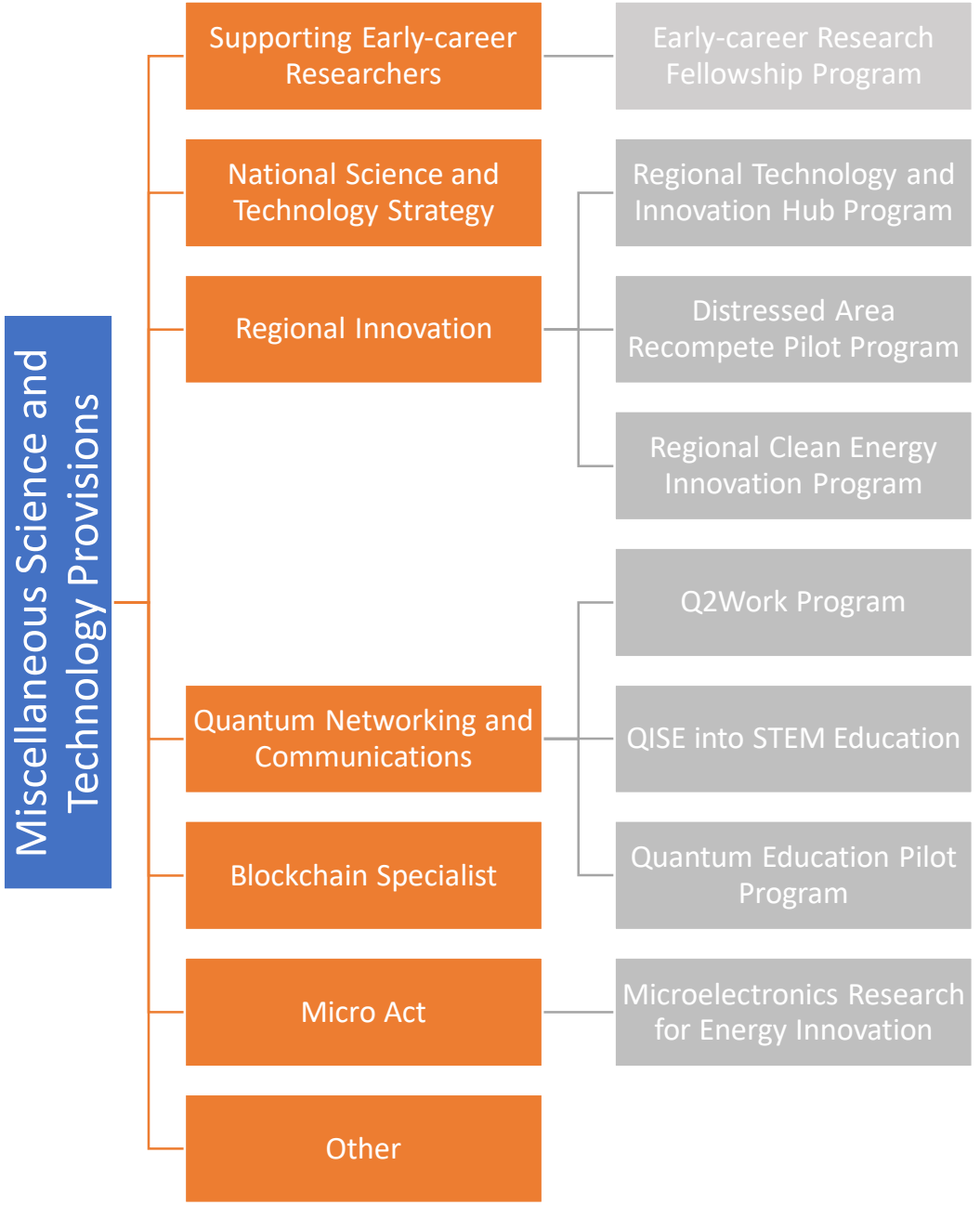
- *Development and assessment of policies, procedures, trainings*
- *Support for institutions to develop and implement prevention policies*

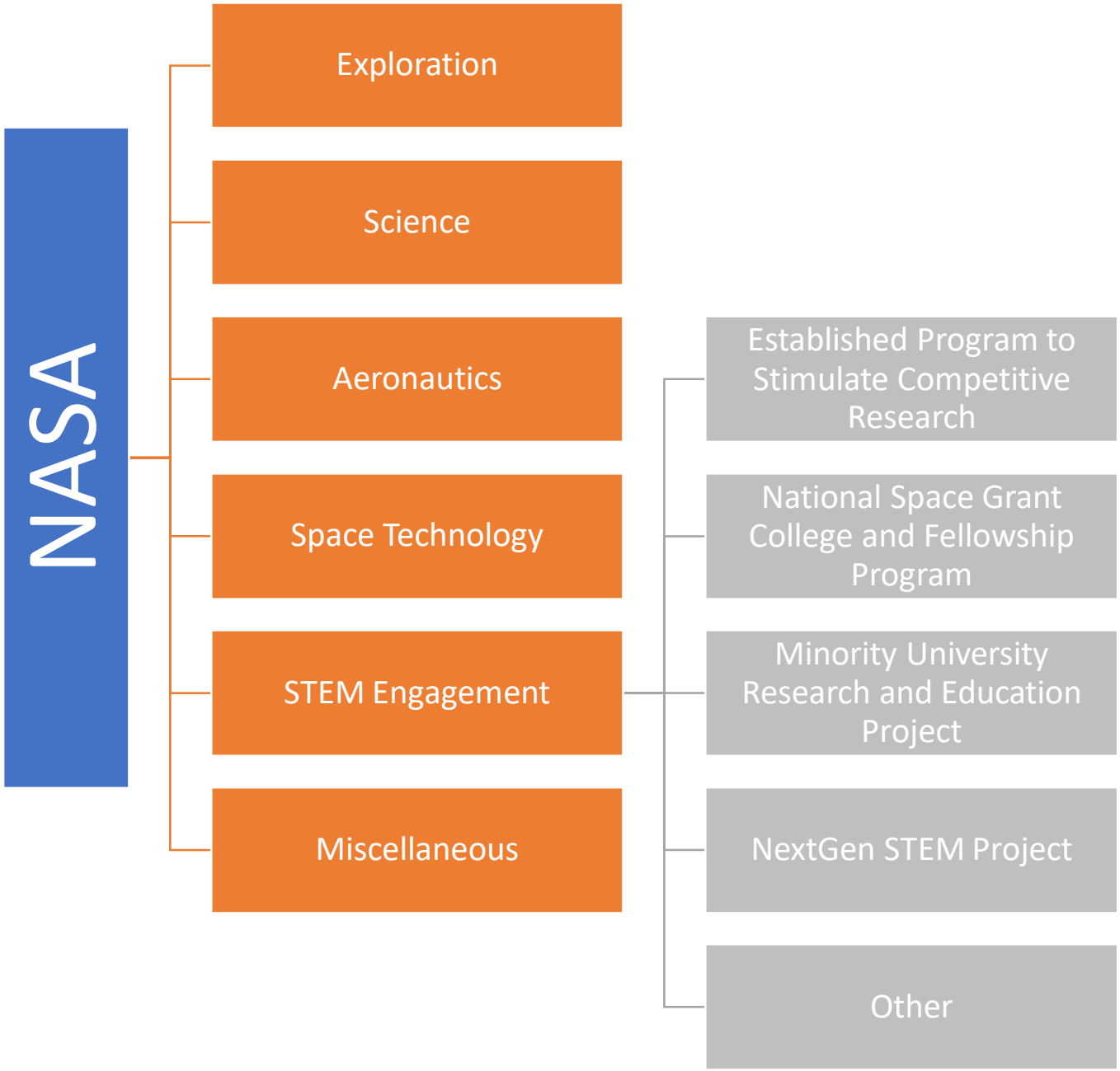
Responsible Conduct Guide

- *Updated Professional Standards of Conduct in Research*
- *Promising Practices for prevention and mitigation*

Interagency Working Group

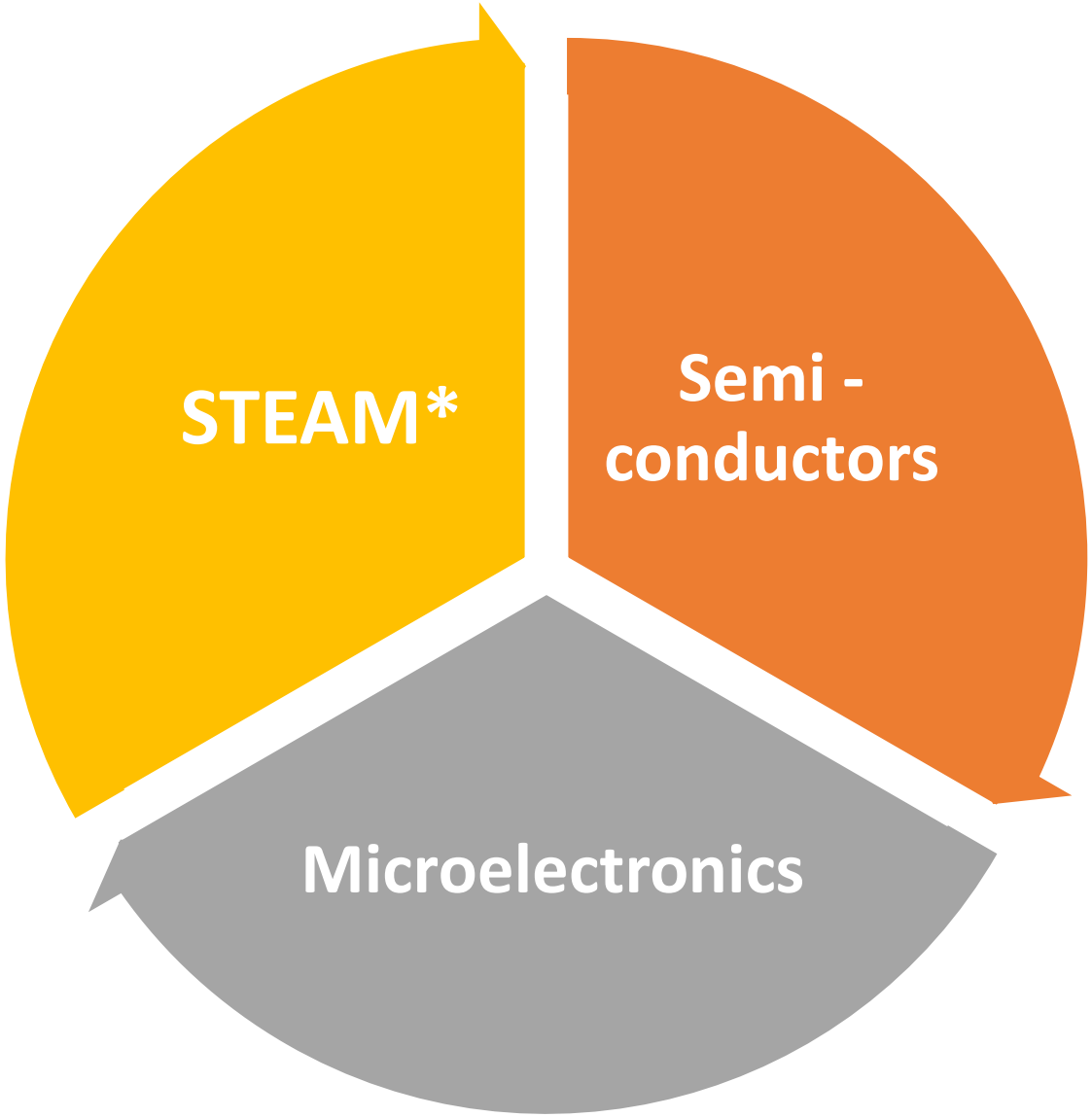
- *Coordinating Federal research agency efforts to reduce the prevalence of sex-based and sexual harassment involving award personnel*


Miscellaneous Science and Technology Provisions
Supporting Early-career Researchers
Early-career Research Fellowship Program
National Science and Technology Strategy
Regional Innovation
Regional Technology and Innovation Hub Program
Distressed Area Recompete Pilot Program
Regional Clean Energy Innovation Program
Quantum Networking and Communications
Q2Work Program
QISE into STEM Education
Blockchain Specialist
Quantum Education Pilot Program
Micro Act
Microelectronics Research for Energy Innovation
Other


NASA
Exploration
Science
Aeronautics
Space Technology
STEM Engagement
Miscellaneous
Established Program to Stimulate Competitive Research
National Space Grant College and Fellowship Program
Minority University Research and Education Project
NextGen STEM Project
Other

Republic of China
TAIWAN

The Republic of China (Taiwan) is the global leader in semiconductor manufacturing, with a workforce development system shaped by three primary streams: STEAM education, microelectronics, and semiconductors. Taiwan's funding model heavily relies on public-private partnerships, particularly within the ecosystem of its largest semiconductor manufacturer, TSMC. This interconnected model sees the educational system producing a skilled workforce to support TSMC and the broader semiconductor sector. Research centers, industry clusters, and government initiatives further sustain this ecosystem through targeted funding. Taiwan also emphasizes the arts as a vital component of STEM education (STEAM), enhancing creativity and promoting scientific excellence.



*STEM + Arts Education

Semiconductors and Microelectronics

Comprehensive Industry Cluster

- Supporting upstream, midstream, downstream sections of supply chain
- Enhancing local production capabilities and technological self-sufficiency
- SEMICON Taiwan

Government Initiatives

- Expansion of the A+ Industrial Innovative R&D Program
- High-end manufacturing center
- Funding for research and training institutions (ex. ITRI)
- Support for high-tech enterprises
- Five-Plus-Two Innovative Industries Plan
- Precision Health Industry
- STEM Education: Digital Learning Improvement Project -$188 m (2022-2025); High-Scope Project

Financial Figures and Goals

- In 2019 the production value of the industry was $91.2 B, with the goal of the government being: $168.9B by 2030
- In 2024 the production value is set rise by 17.7% compared to 2023 and reach $154 B, exceeding expectations

Semiconductors and Microelectronics

Integrated Circuit Development Projects

- Focus on microelectronics and sub-micron technologies

Research

- Industrial Technology Research Institute (ITRI) - $700 m annual budget
- Training programs and research opportunities

Industry – Academia partnerships

- Hands-on training and experience for students and professionals
- TSMC University Collaboration
- Specialized programs and courses
- Research and training

STEAM* Education

***STEM + Arts Education –** *Taiwan's government has deemed Arts in STEM to be crucial for fostering creativity and has incorporated it in the STEM curricula.*

Republic of Korea

South Korea aligns its education and training ecosystem with the needs of its largest producers, Samsung Electronics and SK Hynix. Each region is developed in alignment with its regional industrial value chain. Since 2023, the government has passed multiple bills to address strategic workforce development and educational needs, including six major bills along with additional funding initiatives, strategic allocations, and roadmaps. The funding model also includes various financial incentives and tax breaks aimed at supporting startups.

Workforce Development and Education Programs and Initiatives (2023 -onwards)

- Innovation of Talent in Advanced Industries
- Basic Science and Technology
- Government-funded Research Institutes in Science and Technology Fields
- National Strategic Technologies
- SME Technology Innovation
- Industrial Technology Innovation

Advanced Industry Talent Innovation

The idea of this bill is the innovative talent development in advanced industries.

Overseas Talent Attraction Center

- Supporting the attraction of overseas talent
  - Promotion, Guidance, Research, Administrative tasks

Talent Innovation Council

- Addressing supply and demand for workforce and developing qualifications and competency standards
- Representatives from the private sector, educational and training centers, research institutions and labor unions

Financial and Incentive Support

- Government financial support, economic incentives (incl. tax exemptions), and subsidies to businesses and professionals with excellent achievements in advancing talent in advanced industries
- Human resource development budget up 8.3% year-on-year to 351.3 B KRW (~$261.3 m)

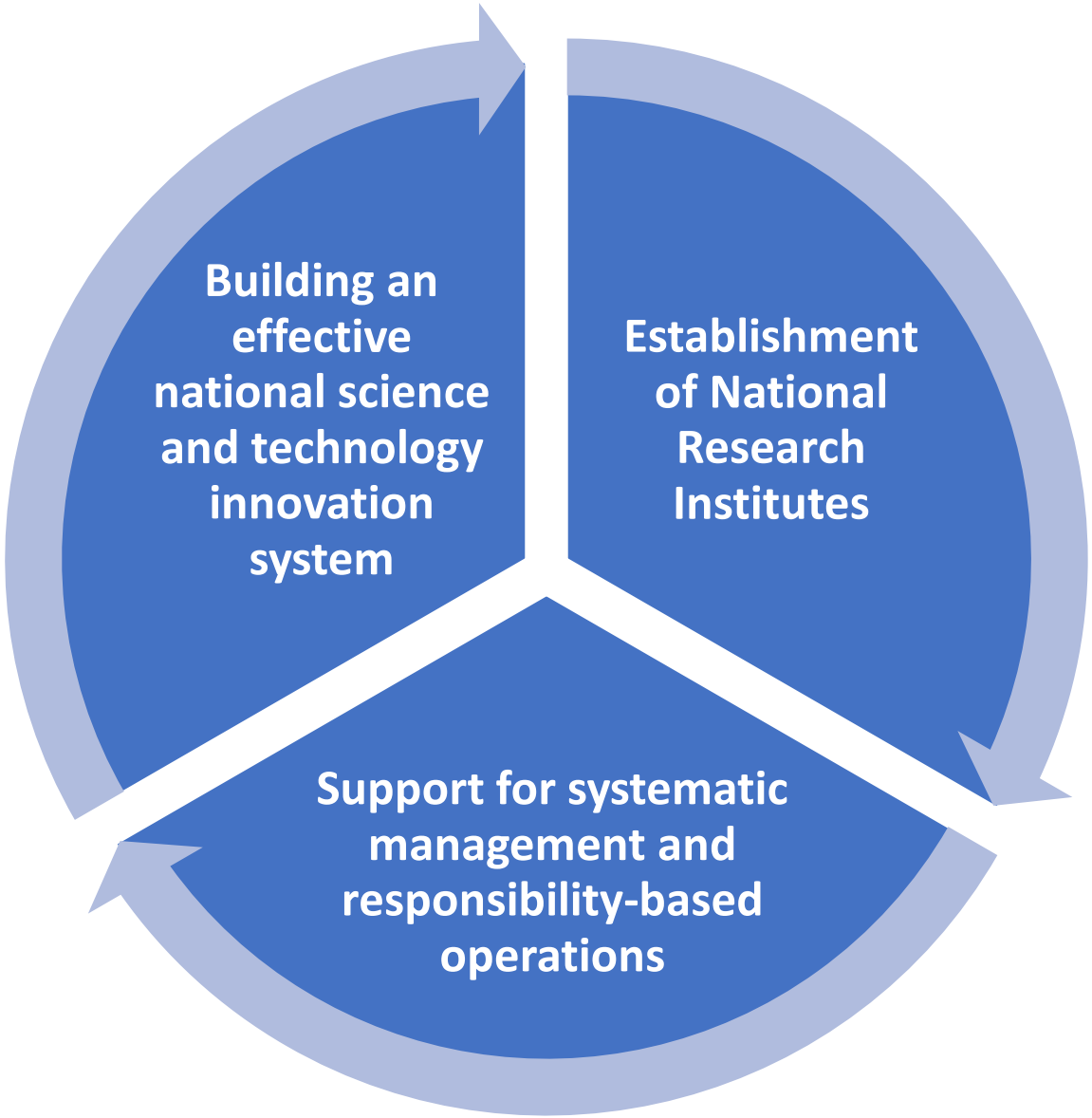
Advanced Industry Talent Innovation Fund

- Managed separately by the association
- Funded by corporate contributions, loans, profits from business activities, and other income sources
- Supports various programs to foster a cooperative ecosystem for advanced industry talent (in-house graduate programs and industry specific academies)

Basic Science and Technology

National Science and Technology Innovation System	• Facilitating exchange of personnel, knowledge and information • Facilitating cooperation between businesses, educational institutions, research institutions and related organizations
Support for Basic Research	• Emphasis on supporting universities and government-funded research institutions • Through stable research funding and promotion of comprehensive measures • **Science and Technology Promotion Fund** • Government subsidies and loans, Contributions from non-governmental entities, Fund management profits, Other income specified by Presidential Decree
Technology Impact and Level Evaluation	• The government conducts evaluations of the impact and level of key national technologies • Implementing strategies for improvement
Training and Utilization of Science and Technology Personnel	• Establishment of mid- to long-term supply and demand outlook and a plan to train and supply personnel • Promotion of technical training and re-education • Establishment of a plan to improve the quality of science and technology education • Expansion of higher education institutions to foster advanced science and technology personnel. • Training of female scientists and engineers • Discovery and Development of Scientific Talents

Government-funded Research Institutes in Science and Technologies Fields


Building an effective national science and technology innovation system
Establishment of National Research Institutes
Support for systematic management and responsibility-based operations

Promotion of National Strategic Technologies

Promotion of National Strategic Technologies (NST)

Development and Implementation of Strategic Technologies Roadmaps

- Five-year plan for the efficient fostering and support of NSTs - management, promotion of R&D, investment and disseminating research outcomes
- Focused on key technologies such as semiconductors, microelectronics, and other advanced industries
- Establishment of specialized research institutes and joint corporate research centers.
- Institutions for training and career development
- International Cooperation and Security

Strategic Technology Projects

- Initiatives designed to support large-scale projects that can have a significant impact on national competitiveness in key technology areas
- Cooperation between industry, academia, and research institutions
- Support for research outcomes to facilitate their application in startups and commercialization; prioritizing innovation products for public procurement

Funding and Grants

- Specific funding programs and grants provided by the government to support the development and commercialization of strategic technologies

Investment Incentives

- Incentives for private sector investment in strategic technology projects
  - Tax benefits and financial support

Promotion of SME Technology Innovation

Promotion of SME Technology Innovation

Support for SME Innovation

- Programs designed to enhance the technological capabilities of SMEs,
  - Funding for R&D, technology transfer, and commercialization support

Collaboration Platforms

- Establishment of platforms for collaboration between SMEs, large enterprises, research institutions, and universities to promote joint innovation and development

Financial Support

- Grants, loans and subsidies provided to SMEs to support technology innovation projects

Tax Benefits

- Various tax incentives to encourage investment in technology innovation by SMEs

Industrial Technology Innovation Promotion

Promotion of Key Technologies

- Focus on developing and promoting key industrial technologies that are critical to national competitiveness

Support for R&D Activities

- Financial and institutional support for R&D activities in key technology areas

Industrial Technology Innovation Promotion

Investment Funds

- Creation of funds to support investment in industrial technology innovation

Tax Incentives

- Provision of tax benefits for investments in R&D of key industrial technologies

Financing and Tax Breaks

This is in addition to the bills frameworks already presented.

Financial Support and Subsidies

- The government provides substantial financial support for R&D in semiconductors and microelectronics, with budgets exceeding 1 trillion KRW annually (~ $745m)

Tax Benefits (Semiconductors and Microelectronics)

- Up to 50% reduction in corporate tax
- Full exemption from acquisition tax for new facilities
- Up to 30% reduction in property tax

Grants and Loans

- SMEs and start-ups in the semiconductors sector can access grants and loans with favorable terms
  - Innovation grants of up to 500m KRW (~ $372k)per project
  - Low-interest loans with interest rates as low as 1.5% per annum

Investment Funds

- The government has established several funds dedicated to technology innovation
  - The Advanced Technology Fund with a capital of 2 trillion KRW (~$1.49B)
  - The SME Innovation Fund with an annual budget of 500 B KRW (~$372m)

Incentives for Talent Development

- Scholarships and stipends for students ,totaling over 100 B KRW annually (~$75m)
- Funding for vocational training programs and industry partnerships, exceeding 200 B KRW annually (~$149m)

Other Education and Workforce Development Programs

Fulbright U.S – Korea Presidential STEM Initiative

- Shared $60m funding commitment
- Opportunities for 2,023 Korean citizens and 2,023 American citizens in the fields of STEM
- The program covers technologies such as biotech, semiconductors, batteries, quantum technology, and AI.
- Scholarships are offered for graduate studies in the U.S (up to 2 years)

Digital Talents Initiative

- Goal – 1 million digital talents by 2026
- Focus on – STEM, AI and Digital Transformation in higher education
- Initiatives:
  - Digital Education Sprout Camps – expansion of the ICT education based
  - Brain Korea 21 (BK21) and other initiatives – supporting universities to nurture talent and strengthen R&D capabilities

Semiconductor Workforce Development

- Expansion of university programs in microelectronics and semiconductors
- Partnerships between industry and academia (R&D hands-on training)

KAIST

- KAIST- Korea Advanced Institute of Science and Technology – national research university
- Institute of Technology Value Creation – collaboration with international partners and SMEs (semiconductors, nanomaterials, robotics etc.)
- KAIST Advisors on Materials and Parts (KAMP)
- Cross-Generation Collaborative Labs – academic legacy and innovative research

Vocational Education and Training

- Integrated with the country's industrial strategy to support high-tech industries
- Hands-on training in vocational schools and technical institutes; specialized programs in microelectronics, automation, and manufacturing technologies
- Glocal* Colleges and Regional Innovation Systems (RISE) – tailored to local (regional) industry needs in technology and manufacturing

Government Research Institutes

- Total funding (2022) – 5.5 T KRW (~$3.1 B) (83% government contribution)
- Electronics and Telecommunications Research Institute (ETRI)
- Korea Atomic Energy Research Institute (KAERI)
- Korea Aerospace Research Institute (KARI)
- Korea Institute of Science and Technology (KIST)
- Korea Institute of Industrial Technology (KITECH)

*Global+local, aiming to develop the regional education systems and innovation ecosystems

Semiconductor-Specialized University Support Project

Fabless Talent Development in Seongnam City

Korea-Netherlands Advanced Semiconductor Academy

Quantum Science and Technology Strategy (2023 - 2035)

- 3 trillion KRW (~$1.7B) investment and training 2500 quantum professionals

Semiconductor Future Technology Roadmap (10 years plan)

- 265 B KRW (~$150.5 m) investment in critical semiconductor technologies

AI Semiconductor Industry Promotion - over 1 trillion KRW (~$568 m) over the next 5 years

In 2023 elementary schools introduced technology and AI-related subjects

- Specialized electives for middle and high schools

Semiconductor Future Technology Roadmap

•10 – year plan to secure future technologies (AI, 6G, power etc.) – technology policies and business directions

Participants

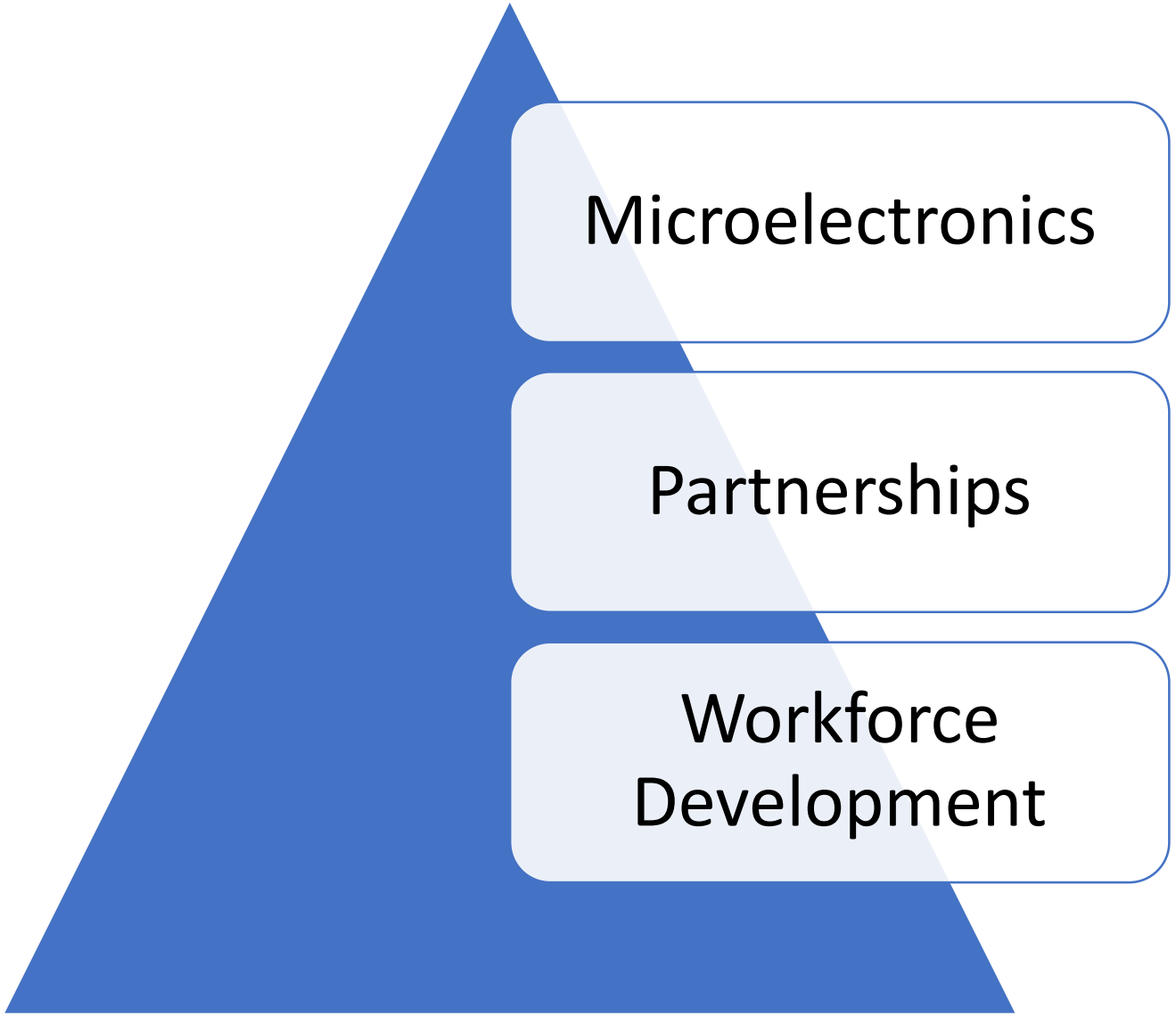
Industry (Samsung Electronics, SK Hynix, Sapion Korea etc.)	Academia	Research Institutes (IEEE)

Semiconductor Future Technology Public-Private collaborative Group

Create an R&D ecosystem in which all major organizations in the government, industry, academia, and research will participate to enable full-time and continuous cooperation

Japan

Japan’s funding model prioritizes the strategic application of microelectronics in biotechnology. With an aging population, the model emphasizes lifelong learning, particularly vocational education and training (VET), to support workforce reskilling. Central to Japan’s approach is the Society 5.0 concept, which seeks to integrate digital and physical spaces to address various societal challenges. Additionally, international collaboration with like-minded partners plays a crucial role in this funding model.


Microelectronics
Partnerships
Workforce Development

Future Semiconductor Strategy

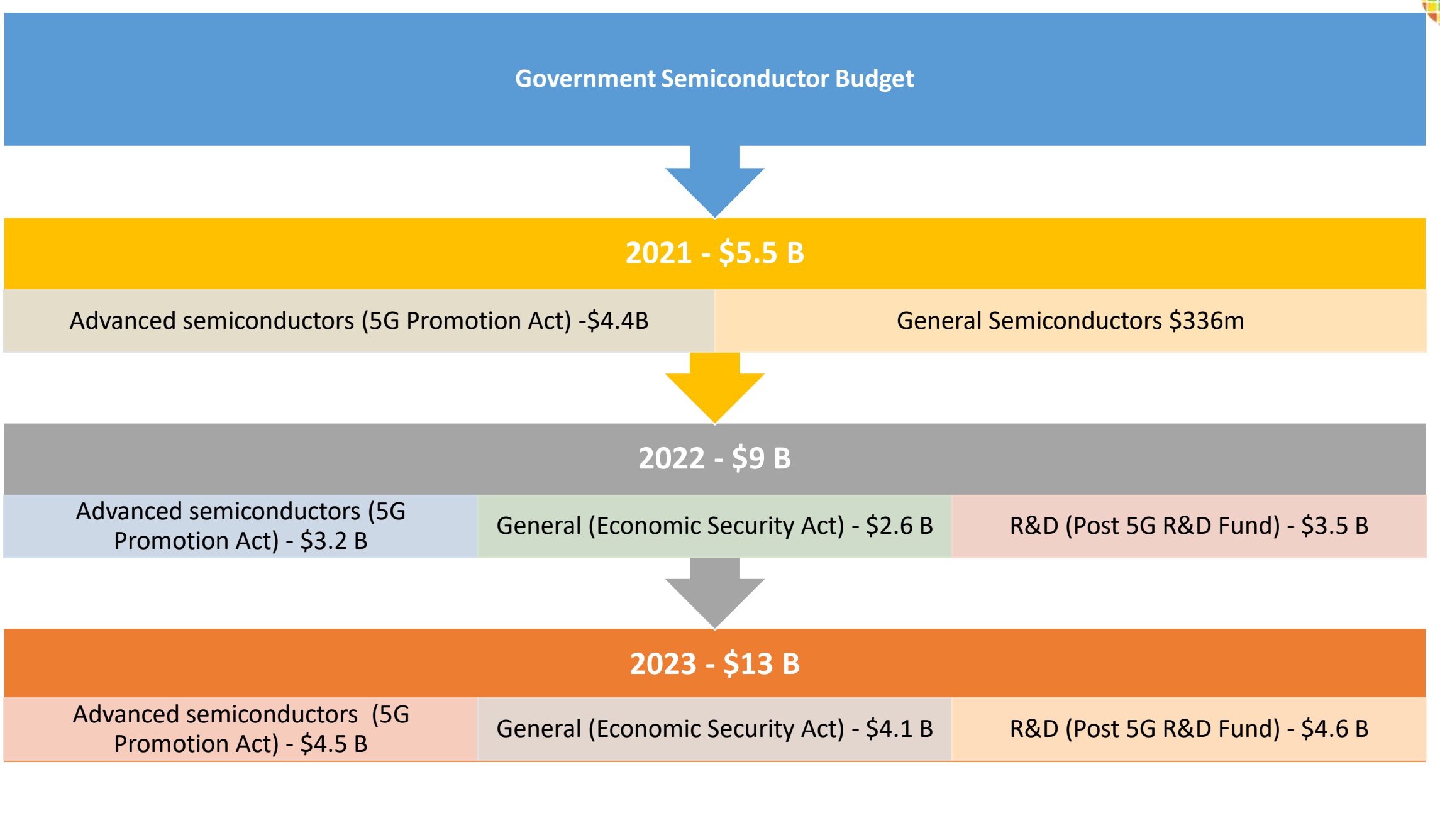
- Securing Manufacturing infrastructures
- Establishing next-gen technologies
- R&D for Future Technologies
  - Photonics – Electronics Convergence
  - Quantum Computing through collaboration
  - Tax Concessions for promoting domestic production in strategic areas

International Partnerships

- Next-Gen Semiconductor Technology through US-JP Collaboration
  - Joint Task Forces
  - Collaborations starting with NSTC and LSTC in the U.S.
  - Tailored collaborations with the EU, Belgium, Netherlands, U.K., ROK, Taiwan, India

Human Resource Development

- Under tailored regional public-industry-academia collaborations (regional consortiums)
- Future projects – new businesses utilizing next-gen semiconductors
- Most prioritized area in skilled HR development – design of semiconductors


Government Semiconductor Budget
2021 - $5.5 B
Advanced semiconductors (5G Promotion Act) -$4.4B
General Semiconductors $336m
2022 - $9 B
Advanced semiconductors (5G Promotion Act) - $3.2 B
General (Economic Security Act) - $2.6 B
R&D (Post 5G R&D Fund) - $3.5 B
2023 - $13 B
Advanced semiconductors (5G Promotion Act) - $4.5 B
General (Economic Security Act) - $4.1 B
R&D (Post 5G R&D Fund) - $4.6 B

Workforce development for realization of Society 5.0

- Regional initiatives (6 regions have already started the initiatives)
- Development of global professional human resources for semiconductor design and manufacturing (NSTC – LSTC)
- “Investment in Human Capital” Policy Package - $7 B over 5 years

Other initiatives

- Industry initiatives – onsite classes, fab tours, contributions to curriculums by JEITA etc.
- Academia initiatives: Curriculums in colleges and R&D in universities etc.
- Government initiatives – holding digital HR development council meetings etc.
  - Open Innovation Tax Incentive Program – 25% tax reduction for innovative technology start-ups

Education

- Significant investments in research programs and advanced technology education (incl. JSTA, AIST)
- Leading universities offer top-tier programs in microelectronics with focus both on research and applied sciences
- Focus on life-long learning and continuous skill improvement through CPD programs supported by both government and industry.

Republic of India

India has launched its Semiconductor Mission to position the country as a global leader in semiconductor design, manufacturing, and innovation. This mission relies on international collaboration to access global expertise and know-how. India has also developed hybrid academic programs for specialized training, offered as noncredit courses and integrated into the curricula of educational institutions. Dual-degree programs are part of the funding model, alongside various additional initiatives that further support this mission.

India Semiconductor Mission

(Development of Semiconductors and Display Manufacturing Ecosystems in India)

- Announced in 2021 with a budget of $9.5 B, updated in 2024 allocation of $15 B more funding (3 new units)
- Aims to establish India as a global hub for semiconductor design, manufacturing, and innovation
- Substantial investments in R&D, infrastructure, and human resource development
- Employment potential of the three newly added units - 20 thousand direct and 60 thousand indirect jobs
- Collaborative Programs with international and domestic institutions : Indian Institutes of Technology (IITs) and National Institutes of Technology (NITs)
- IITs and NITs offer specialized programs in microelectronics
- Financial Incentives and Scholarships

Other Workforce Development Programs

India Semiconductor Workforce Development Program (ISWDP)	• Collaboration between India Institute of Science (IISc) and Synopsys • Specific budget not disclosed • Focuses of trainings is on design, fabrication and advanced packaging • Trainings for students – hands on learning, skills, internships etc. • Trainings for professionals – interactive sessions, workshops, industry practices, custom modules • Trainings for academic institutions – technical offerings, internships etc.
SEMI Workforce Development Program	• In collaboration with government agencies and educational institutions • Integrating semiconductor content into academic curricula and provide tailored training programs • Aim is to help meet the estimated need of 1 m additional workers in semiconductors by 2030
Purdue – India Semiconductor Alliance	• U.S. - India governmental partnership within India Semiconductor Mission • Hybrid academic programs for specialized training both as noncredit offerings and through integration into the curricula of Indian educational institutions • Dual-degree programs in semiconductors and microelectronics • Joint research and innovation programs

Kishore Vaigyanik Protsahan Yojana (KVPY)	• Funded by Department of Science and Technology • Monthly scholarships for undergraduate and post graduate students • Additional contingency grant is provided annually
Prime Minister's Research Fellowship (PMRF)	• Monthly stipends to selected Ph.D scholars in premier Indian institutes • Research grant is provided annually
AICTE PG Scholarship	• Monthly stipends for post-graduate students in technical fields (M.E, M.Tech., and M.Pharma) • Supported by All India Council for Technical Education (AICTE)
PM eVidya and Digital Initiatives	• Setting up 750 virtual science labs • Setting up 75 e-labs for vocational training • One Class- One Channel Tv Channel expanded from 12 to 200 channels to make it available to students in remote areas
Professional and VET Initiatives	• Funding for skilling initiatives includes allocations for setting up virtual and e-labs • Skill India Initiative • National Skills Development Corporation (NSDC)

People’s Republic of China

China invests heavily in achieving semiconductor self-sufficiency, with a funding model focused on developing a skilled workforce for the sector. However, detailed information is scarce, as such data is intentionally kept confidential. In China, vocational education and training (VET) faces challenges due to a cultural stigma surrounding reskilling.

14th Five-Year Plan for National and Economic Development

Development of National High – Tech Industrial Zones

By 2020 – 169 zones (13.3% of GDP generated there), by the end of 2025 – 220 zones

Talent Development Policies

Talent Development

Multilevel Innovative Talent

- Postdoctoral research stations
- Establish innovation driven centers

Talent Cultivation System

- Industry- Education integration
- Dual appointments and cross regional exchanges

Talent Development Mechanisms

- Market-based talent evaluation systems
- Attracting foreign talent

Talent Services and Support

- Housing, childcare, education and healthcare

Other Educational Programs and Initiatives

STEM Education 2029 Action Plan

- Launched in 2017
- Aimed at all levels of education
- Enhancing the quality of STEM education, fostering creativity
- Compulsory STEM and AI courses in primary and secondary schools
- Exact financial details are not publicly available.
- Part of China's broader strategy to increase investment in R&D (over $426 B in 2021)

Semiconductor Talent Development and Training Initiatives

- Partnerships between the government, educational institutions, and private companies
- Creating specialized training curricula for semiconductor manufacturing, chip design and fabrication
- Exact financial details are not publicly available
- China invests heavily in semi –conductor self – sufficiency, with estimates of hundreds of billions (USD) allocated to developing the entire semiconductor value chain

Higher Education and VET Programs

- Various universities, in partnership with the government, offer specialized degree programs in microelectronics and semiconductors
- Programs are supported by government grants
- China's central government expenditure for 2024 (Education $22.9 B (+5%), Science and Technology $51.5 B (+10%), Defense $231.3 B (+7%))
- VET programs exist but are not popular and can't be widely implemented due to cultural idiosyncrasies

Local Initiatives

Shenzhen's Vocational Education Initiatives

- Invested $3.7 B in VET (2015-2020)
- Dedicated $1.54 B by the end of 2022 to support VET
- By 2025 18,000 new vocational school places
- Particular focus on microelectronics
- 15 new specialized majors in 2022

Shanghai Initiatives

- Various programs and facilities which foster STEM education
- E.g. Shanghai Semiconductor Training Facility
  - Training in chip manufacturing and design
- Integrating STEM education at K-12 level
- Professional and technical training focused on semiconductors and AI.

EUROPEAN UNION (Chips Act)

The European Union's funding model for the microelectronics sector is centered around the Chips Act. Framework programs such as Horizon Europe and Erasmus+ include funding for research and vocational education and training (VET), but they are not specifically targeted at microelectronics. Some member states have their own initiatives (graphically presented in a section below), but these funding models generally fall short of matching the scale of investments seen in the other leading countries explored. The Joint Undertaking appears to be the only EU initiative specifically focused on the microelectronics sector, while most funding remains within broader common programs.

EU Chips Act

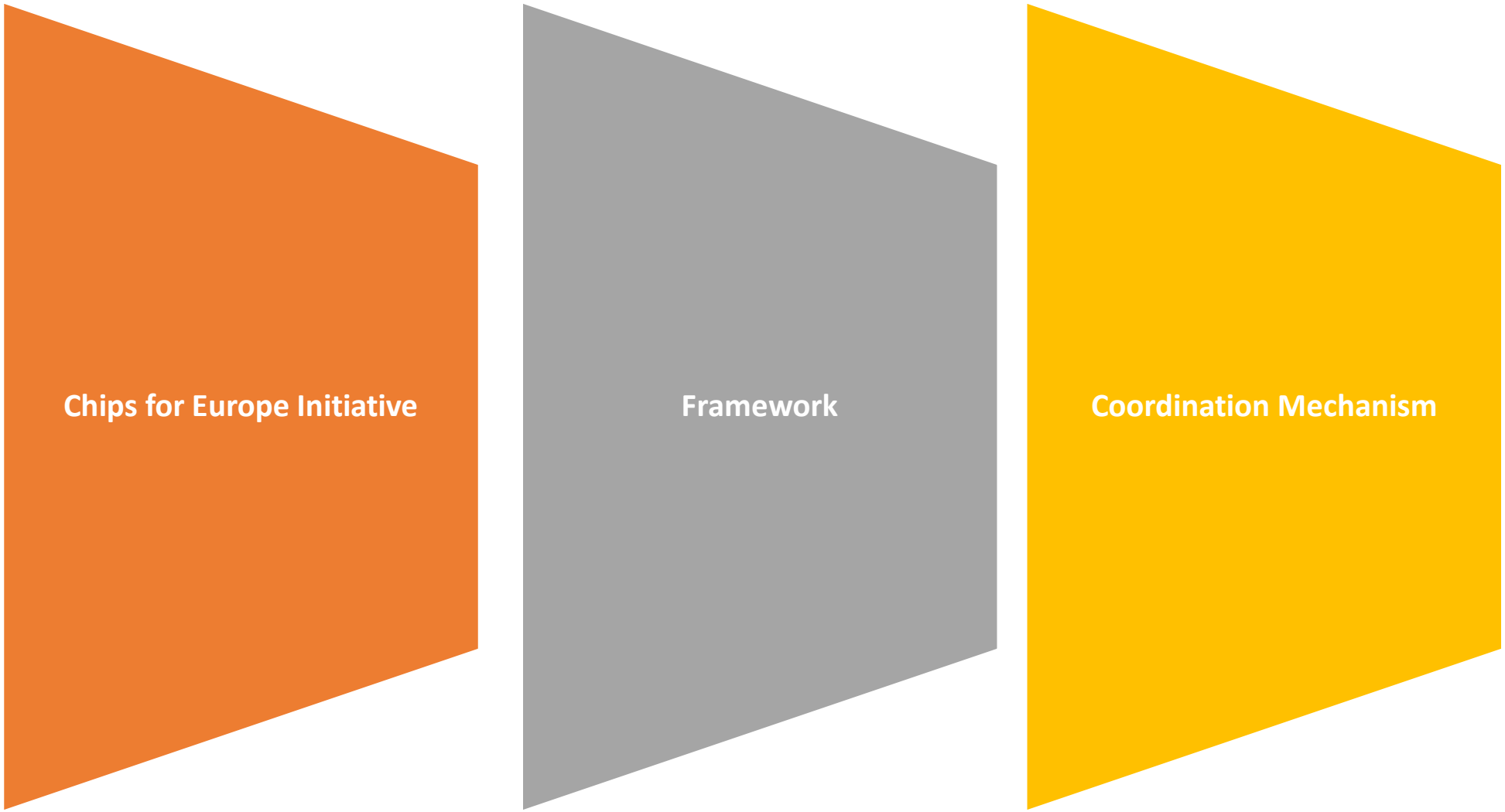
43 B EUR by 2021- 2030	The funding comes from public and private investments

EU Funding

EU Budget 3.3 B EUR	**Horizon Europe – 1.65 B EUR**	**Digital Europe – 1.65 B EUR**	**MSs to use additional funding from the Recovery and Resilience Facility**

Chips Act Goals

- Investments in next-generation technologies
- Access to design tools and pilot lines for the prototyping, testing and experimentation of cutting-edge chips
- Certification procedures for energy-efficient and trusted chips to guarantee security
- Investor-friendly framework for establishing manufacturing facilities
- Support for innovative start-ups, scale-ups and SMEs in accessing equity finance
- Fostering skills, talent and innovation in microelectronics
- Tools for anticipating and responding to semiconductors shortages and crises to ensure security of supply and building international partnerships



Pillars of the Chips Act

Chips for Europe Initiative

- Aims to support large-scale technological capacity building and innovation

Framework

- Incentivizing public and private investments in manufacturing facilities to ensure security of supply and resilience of the sector

Coordination mechanism

- Achieved through the European Semiconductor Board
  - Key platform for coordination between the Commission, MSs and stakeholders

Chips for Europe Initiative

Operational activities

- Setting up a Design Platform
- Enhancing existing and developing new advanced pilot lines
- Building capacities for accelerating the development of Quantum chips and associated semiconductor technologies
- Establishing a network of competence centers across the EU
- Setting up a Chips Fund to facilitate access to debt financing and equity

Funding

- The Chips Fund will be implemented by the EIC and InvestEU
- The Initiative will be implemented through Chips Joint Undertaking (previously known as Key Digital Technologies Joint Undertaking)

Competence Centers

- Access to technical expertise and experimentation
- Services to be provided to semiconductor stakeholders, including start-ups and SMEs

Examples

- Facilitating access to pilot lines and to the design platform
- Providing training and skills development, support to find investors
- Reaching out to the relevant verticals

Competence centers and skills

Connectivity

- Each competence center is to be connected and a part of European network of competence centers in semiconductors
- To act as an access point to other nodes of the network

Reinforcing skills

- Increase the visibility and the attractiveness of the sector
- Support the development of higher education and vocation training networks

Horizon Europe

(95.5 B EUR 2021-2027)

European Institute of Innovation and Technology (EIT) – (2.93 B EUR)

- EIT Digtial, EIT RawMaterials and EIT Manufacturing- training and education

Maria-Skłodowska-Curie Actions (902 EUR 2024)

Key Digital Technologies (KDT) Joint Undertaking – new curricula and training programs/ now Chips JU

Cluster 4: Digital, Industry and Space – training and skill development for workers

Cluster 2: Culture, Creativity and Inclusive Society – STEM education for underrepresented groups

Euratom Research and Training Program (1.38 EUR 2021-2025) – part of the funding is allocated to education and training in the nuclear science and engineering

Skills Agenda for Europe	• Development of specialized training programs
Erasmus + (26.2 B EUR)	• STE(A)M IT Initiative • Alliances for Innovation • Partnerships for Cooperation • Empowering Education: Integrating STEM and STEAM for 21st Century Learning • CoVEs
Digital Europe Program (7.5 B EUR)	• Training and reskilling of workforce • Development of advanced digital skills, including in areas like microelectronics, semiconductors and AI.
European Social Fund + (ESF+)	• Employment, education and social inclusion • STEM and digital skills training

Framework

(Security of Supply and Resilience)

- Status of integrated production facility and open EU foundry
- Label of design center of excellence

Coordination Mechanism

Monitoring	• Strategic mapping • Early-warning indicators • Key market actors • Risk mitigation
Crisis response	• Activation of the crisis stage • Emergency toolbox
Governance	• European Semiconductor Board

EUROPEAN UNION
Examples of Member States

FRANCE

FRANCE 2030
Strategy for electronics

- Launched in 2022
- Supports the development of the electronics industry, focusing on three main areas, one of which is dedicated to initial vocational training, integration & retraining schemes and lifelong learning.
- Supports projects with actions to improve training and access to skills, and to renew and expand initial vocational training.
- Under a specific call for expression of interest called “Skills and professions of the future”
- The programme has a total budget of €5 billion, including €50 million for training.

I-NOVMICRO#2

- The project offers various actions to develop and adapt the training programmes to the new competences & skills needed by companies, to train teachers, to develop relationships between companies and training organisations, to develop the curiosity of young students for STEM, ...
- The project offers various actions to develop and adapt the training programmes to the new competences & skills needed by companies, to train teachers, to develop relationships between companies and training organisations, to develop the curiosity of young students for STEM, ...
- Total project budget : €22.90 million, including €14.95 million from FRANCE 2030

ITALY

IPCEI Microelettronica 2 (ME/CT)

- **Launched** in 2022, as part of the European Important Projects of Common European Interest (IPCEI).
- **Aimed at:** Research institutions and companies in the microelectronics field
- **What it funds:** R+D+I in energy-efficient electronic systems and production methods. It also supports industrial applications of green and digital technologies in microelectronics.
- **How it funds it:** Funding is through grants provided under the National Recovery and Resilience Plan (PNRR) and European funds. The project targets specific technological innovations in microelectronics, with funding managed based on European Commission guidelines.
- **Exact financial details:** €450 million, with potential increases based on further government resources

- **Official website:** www.mimit.gov.it/it/incentivi/ipcei-microelettronica-2

National Fund for Microelectronics

- **Launched** in 2022
- **Aimed at:** Companies and industries within the microelectronics and semiconductor sectors.
- **What it funds:** Development of semiconductor technologies, new industrial applications, and reconversion of existing sites.
- **How it funds it:** Through “Contratti di Sviluppo” (development contracts), supporting investments above €20 million for semiconductor design, manufacturing, and assembly.
- **Exact financial details:** €3.3 billion allocated from 2022 to 2030, with amounts distributed annually, including €487 million in 2023 and similar allocations through 2030.

- **Official Website:** www.investinitaly.gov.it/sectors/microelettronica-semiconduttori

Italian Semiconductor Integrated Circuit Design Center

- The Italian Semiconductor Integrated Circuit Design Center is a public-private partnership supported by the Ministry of Enterprises and Made in Italy.
- It was launched in 2023 with a €225 million investment, aimed at promoting semiconductor design and development. The center focuses on enhancing professional training, fostering innovation, and facilitating technology transfer among universities, research centers, and businesses. It is part of Italy's broader efforts to strengthen the national semiconductor industry, funded through national and EU initiatives
- **OfficialWebsite:** www.investinitaly.gov.it/sectors/microelettronica-semiconduttori

National interprofessional joint funds for continuing education

- **Launched** here are currently 19 authorized and operational Interprofessional Funds and the first ones created date back to the early 2000s with annual calls. Among the most renowned are Fondirifenti and Fondartigianato.
- **Aimed at:** workers of companies that choose to join them by paying 0.30% (after deducting administrative costs) of the supplementary contribution for compulsory insurance against involuntary unemployment paid by employers to INPS (Art. 25 of Law no. 845/1978). INPS returns this percentage to the Fund, to which the company has subscribed, for continuous training aimed at qualifying and retraining the worker, in line with company strategies.
- **What it funds:** continuous training measures with different topics and sometimes specified in calls including digitalization. For example, technical training initiatives on microelectronics can be included in this area.
- **How it funds it**: in order to apply for authorization to finance training activities for their workers, companies that are members of the Funds must submit a Training Plan**.**
- **Exact financial details:** interprofessional funds allow businesses to obtain training and consultancy plans on a non-reimbursable basis, i.e. completely free of charge and at no cost to the business.
- **Official Website:** each Fund has its own website; the complete list is available by accessing the dedicated page of the Ministry of Labor and Social Policy (see link)

Where is the EU falling behind ?

Investments

- The financial scale of EU's investments is smaller.
- The Chips Act doesn't match the commitments seen in American and Chinese initiatives
- This suggest that the Chips Act's goals are difficult to achieve and the EU cannot keep up with the current level of competition , which will increase and the EU is likely to lose more market share

Speed and Coordination

- The pace at which the U.S. and Asian countries implement their strategies is faster
- The U.S has quickly rolled out significant funding and established partnerships to secure supply chains and enhance workforce development
- Asian countries have also rapidly scaled up their educational and industrial initiatives and continue to update their programs.

Collaboration

- The EU needs to enhance its industry- academia collaboration to match the efficiency seen in the U.S and Asia.
- Programs in the U.S., China and South Korea show a higher level of integration between academic research and industry needs.

Hindrance Due to Overregulation

Complexity and Bureaucracy	• The EU's regulatory environment is complex and burdensome, leading to delays in research and innovation • Regulatory procedures are lengthy and navigating through various compliance requirements across MSs slows down project initiation and progress
Inconsistent Regulations across Member States	• The variation in regulatory standards and procedures across MSs adds to the complexity • Companies and educational institutions must adhere to multiple sets of regulations, which can be resource-intensive and discourage innovation
Limited Flexibility	• Strict regulatory frameworks limit the flexibility needed for rapid innovation in fast-evolving fields like microelectronics. • Innovators may find it challenging to adapt quickly to new technological advancements within the constraints of stringent regulations.
Administrative Burden	• The administrative burden associated with compliance can divert resources away from core research and development activities. • It can be particularly challenging for smaller institutions and startups that may lack the resources to manage extensive regulatory requirements.

Improvements and Recommendations

Harmonize Regulations Across MSs	• Standardizing regulations across MSs can reduce complexity and make it easier for institutions to comply. • This can involve creating unified standards for microelectronics research and education, simplifying cross-border collaborations and operations.
Streamline Regulatory processes	• Simplifying and accelerating the approval processes for research projects can help reduce delays. • This could involve setting clear timelines for regulatory approvals and reducing redundant procedural requirements.
Increase Flexibility for Educational Institutions	• Allowing more flexibility in application of regulations for educational and research institutions can foster innovation. • For instance, providing exemptions or simplified procedures for academic research projects can encourage more experimental and cutting-edge research.
Foster Public-Private Partnerships	• Encouraging collaborations between government, industry and academia can help align regulatory frameworks with industry needs. • This can include initiatives like regulatory sandboxes, where new technologies can be tested in a controlled but less restrictive environment.

Invest in Regulatory Support Infrastructure

- Providing resources and support to help institutions navigate regulatory requirements can alleviate administrative burdens.
- This can include setting up dedicated units or providing grants for regulatory compliance.

Focus on Outcome-Based Regulations

- Shifting from prescriptive regulations to outcome-based regulations can provide more flexibility while ensuring safety and efficacy.
- This approach focuses on achieving specific outcomes rather than dictating the exact processes to be followed.

Strategic Recommendations

Policy Alignment

- Align EU policies to provide consistent and substantial funding for microelectronics education and research.
- Streamline regulatory processes to make it easier for institutions to access these funds
- Increase investments in Horizon Europe and Digital Europe, focusing on microelectronics research and education.

Public –Private Partnerships

- Encourage public-private partnerships to leverage industry expertise and resources. Develop joint research programs, internships, and co-ops programs to provide students with practical experience.
- Facilitate collaboration between universities and leading semiconductor companies to align educational programs with industry needs.

International Collaboration

- Establish partnerships with top universities and research institutions worldwide to share knowledge, resources, and talent.
- Promote exchange programs and collaborative research projects.
- Implement scholarship programs to attract international students and research, enhancing the EU's global talent pool.

Infrastructure Development

- Invest in state-of-the-art research facilities and laboratories to provide students and researchers with access to the latest technologies and tools.
- Develop innovation hubs and technology parks that bring together academia, industry, and government to foster collaboration and innovation.

Recommendations for professional education financing initiatives in microelectronics

Funding

- Increase direct funding and grants
- Example: U.S. CHIPS and Science Act. – allocates significant resources to education and workforce development through the CHIPS for America Workforce and Education Fund.
- Through programs like Horizon Europe, with specific grants dedicated to developing microelectronics expertise and infrastructure in universities, research institutions and CoVEs.

Foster Public-Private Partnerships

- Example: Taiwan – leverages close collaboration between academia and industry (TSMC) to create specialized programs and joint research initiatives
- The EU can encourage and facilitate partnerships between universities and semiconductor companies. Create industry-sponsored labs and research centers within academic institutions to provide students with hands-on experience and align educational programs with industry needs.

Develop Specialized Training institutes

- Example: Republic of Korea – established specialized semiconductor colleges and institutes that focus exclusively on training professionals for the microelectronics industry, supported by a $450 billion investment plan.
- The EU can establish specialized microelectronics training institutes and centers of excellence within existing universities. These institutes should focus on advanced training, research, and direct industry collaboration.

Competitive Scholarships and Incentives

- Example: Taiwan Scholarship Program
- The EU can implement competitive scholarships and financial incentives to attract top talent from around the world. This could include tuition waivers, stipends, merit-based scholarships and research and diversity and inclusion grants for students and researchers in microelectronics.

Enhanced Regulatory Support and Flexibility

- Example: U.S.A. – The U.S provides highly supportive regulatory environment for innovation, with streamlined processes and incentives for R&D and educational initiatives in high-tech fields.
- The EU should simplify regulatory processes and provide clear guidance for education institutions and companies engaged in microelectronics research. Create a flexible regulatory framework that supports rapid innovation and adaptation to new technologies.

Interdisciplinary Research and Innovation

- Example: U.S.A. – The Semiconductor Research Corporation (SRC) promotes interdisciplinary research by partnering with universities and industries to address key challenges in semiconductor technology.
- The EU should promote interdisciplinary research initiatives that combine microelectronics with fields such as artificial intelligence, quantum computing, and nanotechnology and encourage collaboration.

Recommendations for career development programs

Current State of Career Development Programs in the EU

- The EU has several initiatives aimed at improving career development, particularly high-tech fields like microelectronics.
- However, compared to leading countries such as the U.S., China, Republic of Korea, and Japan, the EU's programs can be further enhanced in several key areas.

Key Areas for Improvement

- Industry- Academica Collaboration
- Internships and Work-Based Learning
- Continuous Professional Development (CPD)
- Mentorship Programs
- Entrepreneurship and Innovation Support
- Global Exposure and Collaboration

Industry- Academia Collaboration

- **Current Situation:** The EU promotes collaboration between academia and industry through programs like Erasmus+ and Horizon Europe. However, those partnerships are not always as deeply integrated or widespread as those in leading countries.

- **Example from the U.S:** The U.S has robust public-private partnerships facilitated by acts like the CHIPS and Science Act, which encourage joint research, internships, and co-op programs between universities and industry giants.

- **Recommendation:** Establish more structured and long-term partnerships between European universities and microelectronics companies. This could involve creating dedicated industry- sponsored labs, joint- degree programs, and regular industry-driven seminars and workshops.

Internships and Work-Based Learning

- **Current Situation:** While internships are a component of many EU educational programs, there is room for expansion and better integration into curricula.
- **Example from the Republic of Korea:** Republic of Korea’s semiconductor companies like Samsung and SK Hynix offer extensive internship and training programs that are integrated with academic institutions, providing students with hands-on experience and direct industry engagement.
- **Recommendation:** Increase the number and quality of internship programs by mandating internships as part of the degree requirements and creating incentives for companies to offer meaningful internship experiences.

Continuous Professional Development (CPD)

- **Current Situation:** CPD opportunities in the EU are often decentralized and vary significantly across member states.
- **Example from Japan:** Japan emphasizes lifelong learning and continuous skill improvement through structured CPD programs supported by both government and industry.
- **Recommendation:** Develop a unified CPD framework across the EU, providing standardized courses, certifications, and online learning platforms tailored to the needs of the microelectronics sector.

Mentorship Programs

- **Current Situation:** Mentorship programs are less formalized in the EU compared to other leading countries.
- **Example from China**: China has strong mentorship and talent development programs within its major technology companies and universities, fostering direct guidance and knowledge transfer from experienced professionals to younger talent.
- **Recommendation:** Establish formal mentorship programs within universities and companies, pairing students and early-career professionals with experienced mentors in the microelectronics field.

Entrepreneurship and Innovation Support

- **Current Support:** The EU has initiatives like the European Institute of Innovation and Technology (EIT), but support for entrepreneurship varies widely.
- **Example from the U.S.A.:** The U.S. has a vibrant ecosystem for startups, particularly in Silicon Valley, supported by venture capital, incubators, and accelerators.
- **Recommendation:** Create more startup incubators and accelerators focused on microelectronics within the EU. Provide more flexible and business friendly regulatory framework, funding, mentorship, and networking opportunities to young entrepreneurs and researchers looking to commercialize their innovations.

Global Exposure and Collaboration

- **Current Support:** While EU programs like Erasmus+ promote international mobility, there is potential for more focused global collaboration in high-tech fields.
- **Example from Taiwan:** Taiwan attracts global talent through its scholarship programs and collaborative research initiatives, establishing itself as a key player in the semiconductor industry.
- **Recommendation:** Expand exchange programs and international collaborations specifically for microelectronics. Encourage joint research projects, student exchanges, and international conferences to enhance global exposure.

Implementation Steps

- **Policy and Funding**
  - Secure increased funding for career development programs through EU initiatives and national governments.
  - Develop policies that mandate and incentivize industry-academia collaboration and internships.
- **Infrastructure and Resources**
  - Invest in modern labs, research facilities, and online learning platforms.
  - Establish Centers of Excellence in microelectronics across major universities and research institutions.
- **Standardization and Coordination**
  - Create a unified CPD framework and standardized certification programs.
  - Coordinate efforts across member states to ensure consistency and high quality of career development initiatives.
- **Stakeholder Engagement**
  - Engage industry leaders, academic institutions, and government bodies in the design and implementation of career development programs.
  - Foster collaborative ecosystem where all stakeholders contribute to the continuous improvement of educational and professional development initiatives.
  - *By adopting these strategies, the EU can significantly enhance its CPDs in microelectronics, fostering a skilled workforce that can drive innovation and maintain competitiveness in the global semiconductor industry.*

How can the EU become a key player in microelectronics (assembly and design)?

Current Strengths and Initiatives

- **EU Chips Act** – mobilizing 43 B EUR in public and private investments by 2030.
- **R&D**- the EU is home to the world's leading research institutions and universities; Initiatives such as Horizon Europe and European Research Council foster innovation in semiconductors.
- **Existing Industry Base** – Solid foundation with established companies like ASML and Infineon Technologies.
- **Public- Private Partnerships** – several key partnerships such as the one between the EC and Chips JU

Areas for Improvement

- **Funding and Investment**
  - Effective funding allocation that reaches companies and institutions that can drive innovation.
  - The EU must maintain or exceed the levels of investments made to the US Chips Act and China's IC industry Investment Fund (both for shorter time periods than the EU Chips Act) to be competitive.
- **Supply Chain Resilience** – Enhancing its semiconductor supply chain resilience by reducing dependencies on non-EU suppliers and ensuring key materials and components are readily available within Europe.
- **Skilled Workforce** – Focus on developing skilled workforce by investing in education and training programs in microelectronics and related fields to ensure that there is steady pipeline of talent for the industry.
- **Industry Collaboration** – The EU must enhance collaboration between its semiconductor companies and global leaders by fostering partnerships with international tech giants and semiconductor firms, the EU can leverage global expertise and technology.

Recommendations for Vocational Education and Training (VET) in the EU

Enhance Industry Collaboration

- **Current Situation:** Collaboration between VET institutions and industries exists but needs to be more robust and widespread.
- **Recommendations**:
  - **Public Private Partnerships**: Establish and strengthen partnerships between VET institutions and microelectronics companies. These partnerships should focus on developing curricula that are closely aligned with industry needs and providing real-world training opportunities.
  - **Example:** Germany's dual education system, which integrates apprenticeships in companies with vocational schooling, ensuring that students gain practical, on-the-job experience alongside theoretical education.

Update and Standardize Curriculum

- **Current Situation:** VET curricula can be outdated and not fully aligned with current industry standards, particularly in high-tech fields.
- **Recommendations:**
  - **Curriculum Modernization:** Regularly update VET curricula to include the latest advancements in microelectronics and related technologies. Ensure that the curriculum covers practical skills, industry-specific knowledge, and emerging trends.
    - **Example:** Finland's vocational education system frequently updates its curriculum in collaboration with industry partners to keep up with technological advancements.
  - **Standardization Across Member States**: Develop a standardized VET curriculum framework across the EU to ensure consistency in training quality and skills certification.
    - **Example**: The European Credit System for VET facilitates the recognition of learning outcomes and qualifications across the EU, promoting standardization and mobility.

Expand Apprenticeship Programs

- **Current Situation:** Apprenticeship opportunities are available but not uniformly integrated into all VET programs.
- **Recommendations:**
  - **Mandatory Apprenticeships**: Incorporate mandatory apprenticeship periods into VET programs to provide students with hands-on experience and practical skills.
    - **Example**: Switzerland's apprenticeship model is highly successful, with apprentices spending a significant portion of their education working in companies, thus gaining valuable practical experience.

Promote Lifelong Learning and Upskilling

- **Current Situation:** Lifelong learning and continuous professional development opportunities are not uniformly emphasized across VET programs.
- **Recommendations:**
  - **Lifelong Learning Programs:** Establish and promote lifelong learning initiatives that allow professionals to continuously update their skills and knowledge. This is particularly important in fields like microelectronics, where technology evolves rapidly.
    - **Example**: The Lifelong Learning Programme (LLP) in Denmark offers various courses and training sessions to help individuals update their skills throughout their careers.
  - **Online Learning Platforms:** Develop and integrate online learning platforms that provide flexible and accessible upskilling and reskilling opportunities. These platforms should offer courses in microelectronics and other high-tech areas.
    - **Example:** Platforms like Coursera and edX, which offer online courses from leading universities and companies, can serve as models

Enhance Teacher Training and Development

- **Current Situation:** VET educators often need more specialized training to keep up with the latest industry developments and teaching methodologies.
- **Recommendations:**
  - **Continuous Professional Development for Educators**: Provide regular training and development programs for VET teachers to ensure they are equipped with up-to-date knowledge and skills. This includes industry placements, workshops, and courses on new technologies and teaching methods.
    - **Example**: Finland provides ongoing professional development for its VET educators to ensure they stay current with industry advancements and pedagogical best practices.
  - **Industry Experience for Teachers**: Encourage VET teachers to gain industry experience through short-term placements or collaborations with companies. This helps them understand the latest industry trends and practices, which they can then incorporate into their teaching.
    - **Example:** Germany's vocational system includes provisions for educators to spend time working in industry to keep their knowledge and skills relevant

Strengthen International Collaboration and Mobility

- **Current Situation:** There are opportunities for international collaboration and mobility, but these are not fully utilized.
- **Recommendations:**
  - **Erasmus+ Expansion**: Expand the Erasmus+ program to provide more opportunities for VET students and teachers to gain international experience. This can include study exchanges, internships, and collaborative projects with institutions and companies in other EU countries.
    - **Example**: The Erasmus+ program already supports mobility and collaboration, but increasing funding and participation can further enhance its impact.
  - **Cross-Border Partnerships**: Develop cross-border partnerships with leading microelectronics companies and institutions to facilitate the exchange of knowledge, skills, and best practices.
    - **Example:** The European Institute of Innovation and Technology (EIT) fosters cross-border collaborations in various sectors, including microelectronics.

Implement Recognition of Prior Learning (RPL)

- **Current Situation:** Recognition of prior learning (RPL) is not uniformly applied across the EU, limiting the ability of individuals to transition between education and work seamlessly.
- **Recommendations:**
  - **Standardize RPL Processes**: Develop a standardized framework for recognizing prior learning and work experience across the EU. This can help individuals transition more easily between education and employment, and between different countries.
    - **Example**: Australia's RPL framework allows individuals to have their prior learning and experience formally recognized, facilitating career transitions and further education.
  - **Promote RPL Awareness**: Increase awareness and understanding of RPL processes among employers, educators, and students. This can help ensure that more individuals take advantage of these opportunities.
    - **Example:** The UK's National Vocational Qualifications (NVQs) system includes provisions for RPL, helping workers advance their careers based on their existing skills and knowledge.

Develop Sector-Specific VET Programs

- **Current Situation:** VET programs are often general and not tailored to specific industry needs, particularly in high-tech fields like microelectronics.
- **Recommendations:**
  - **Sector-Specific Training**: Create VET programs that are specifically designed to meet the needs of the microelectronics industry. This includes specialized training in semiconductor manufacturing, chip design, and related technologies.
    - **Example**: The Netherlands has sector-specific VET programs that are tailored to the needs of industries such as logistics, healthcare, and technology.
  - **Collaboration with Industry Experts**: Involve industry experts in the development and delivery of sector-specific VET programs to ensure they are relevant and up-to-date.
    - **Example:** The UK's T-Level qualifications are developed in collaboration with employers to ensure they meet industry needs and provide students with relevant skills.

Enhance Data Collection and Analysis

- **Current Situation:** Data on the effectiveness of VET programs and labor market outcomes is often fragmented and inconsistent.
- **Recommendations:**
  - **Comprehensive Data Systems**: Develop comprehensive data collection systems to track the outcomes of VET programs, including employment rates, career progression, and skills gaps. Use this data to continuously improve VET offerings.
    - **Example**: Australia's National Centre for Vocational Education Research (NCVER) collects and analyzes data on VET outcomes, helping to inform policy and practice.
  - **Regular Surveys and Feedback**: Conduct regular surveys of VET graduates and employers to gather feedback on program effectiveness and identify areas for improvement.
    - **Example:** The European Skills and Jobs Survey provides insights into skills mismatches and training needs across the EU, helping to shape VET policies and programs.

Recommendations for raising funds to invest in education and microelectronics

Philanthropic Contributions

Engage with High-Net-Worth Individuals	• Approach philanthropists and donors who have a history of supporting education and technological advancement. Highlight the societal and economic impact of their contributions.
Foundations and Trusts	• Target major foundations that support STEM education and workforce development.
Create Named Funds	• Establish named scholarship and research funds to honor significant donors, providing them with a legacy and recognition.

Crowdfunding and Public Campaigns

Online Crowdfunding Platforms	• Utilize platforms like Kickstarter or GoFundMe to raise awareness and small-scale funding from a broad audience. • Craft compelling stories that emphasize the importance of microelectronics education for future technological advancements.
Community Fundraising Events	• Organize local and regional events, such as tech fairs or hackathons, where participants can learn about the initiative and contribute through entry fees or donations.
Social Media Campaigns	• Launch social media campaigns to reach a wider audience, leveraging influencers and engaging content to drive public interest and support.

SOURCES

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- and international collaboration.
- Ministry of Education Taiwan - Information on Taiwan's educational initiatives and scholarships.
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- NCVER - Australian data on vocational education outcomes.
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- DIGI+ Taiwan - Related to Taiwan's semiconductor industry and initiatives.
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- Ministry of Education Taiwan - Information on various educational initiatives in Taiwan .
- Enterprise Technology News and Analysis - Information on Taiwan’s semiconductor research.
- Nature - Information on the Taiwan Semiconductor Research Institute's programs.
- Shanghai SciTech Commission - Details about China's semiconductor projects.
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- PM India - Information about the India Semiconductor Mission (ISM).
- Press Information Bureau (PIB), India - Additional information on India's semiconductor initiatives.
- MeitY (Ministry of Electronics and Information Technology, India) - Information on India's semiconductor and microelectronics programs.
- I-STEM Portal - India's initiative for mapping public-funded research facilities.
- MSIT (Ministry of Science and ICT, Korea) - Information on Korea's semiconductor roadmap and funding.
- Ministry of Trade, Industry, and Energy (Korea) - Details on Korea's semiconductor academy and investments.
- SMART CITY KOREA - Related to educational initiatives in Korea.
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ECoVEM
European Centre of Vocational Excellence in Microelectronics

Co-funded by the Erasmus+ Programme of the European Union

Project Nr.: 620101-EPP-1-2020-1-BG-EPPKA3-VET-COVE