

Purdue Research Landscape & Opportunities

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Outline

- **Purdue Moves 2.0**
 - National Security and Defense Research
 - Purdue Applied Research Institute (PARI)
- **New Trends in Federal Funding**
 - US Innovation and Competition Act (~\$250B)
 - CHIPS Act (\$50B)
 - NSF Directorate of Technology, Innovation and Partnerships (TIPs)
 - NIH ARPA-H
 - DOC (NIST) Regional Technology Hubs
 - DOE Priorities
 - Basic Science
 - ARPA-e
- **Winning Strategies**

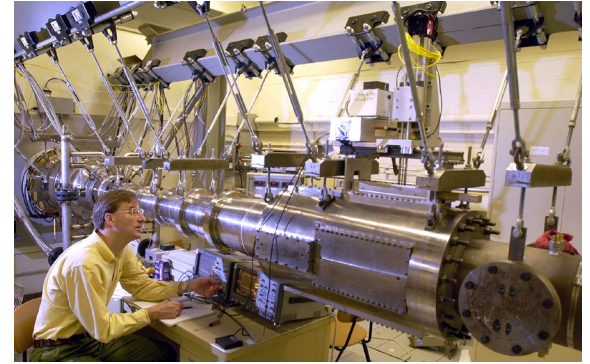
Purdue Moves 2.0

- Five new distinct strategic initiatives
 - Plant Sciences 2.0
 - National Security and Technology Initiative
 - Hypersonic and space vehicles
 - Energetic materials and systems
 - Cybersecurity
 - Secure microelectronics
 - Purdue Applied Research Institute (PARI)
 - Digital Innovation in Agri-Food System
 - National Security and Technology
 - Global Development and Innovation
 - Transformative Education 2.0
 - Equity Task Force

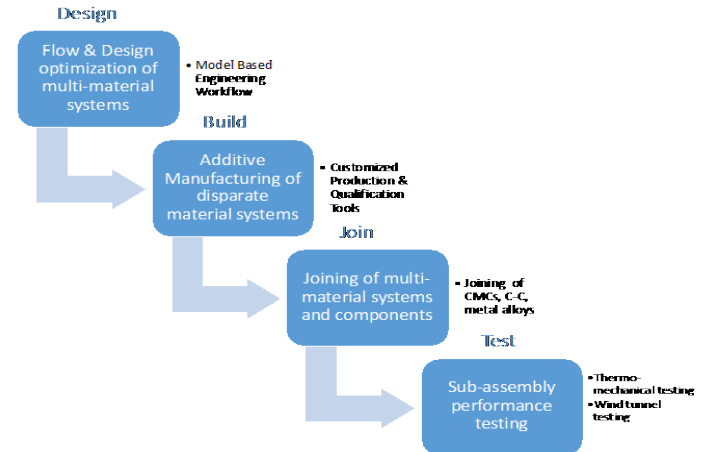


Hypersonic and space vehicles

- \$41M Hypersonics and Applied Research Building (HARB) housing:
 - World's first Mach 8 Quiet Tunnel
 - HYPULSE reflected shock/expansion tunnel
 - Advanced hypersonic manufacturing facilities
- Already secured large programs
- Over 40 faculty members involved



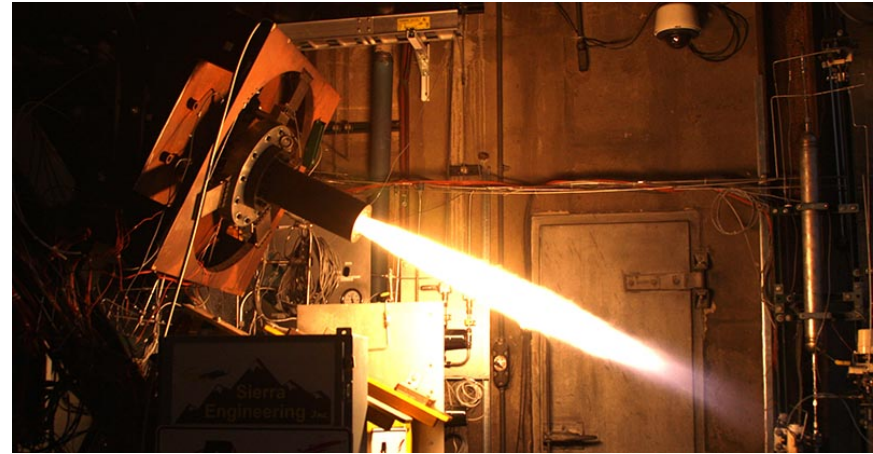
Steve Schneider



Courtesy of Mike Sangid

Energetic Materials and Systems

- The Purdue Energetics Research Center (PERC) is the premier academic research institute focused on the RDT&E of explosives, propellants, and pyrotechnics.
- The Center encompasses approximately 25 faculty/staff affiliates and 150 graduate/ undergraduate research assistants.
- Annual research expenditures in excess of \$20M.



Zucrow Laboratory

Harrick Laboratory



AAMP-EM

Cybersecurity

- No. 6 Cybersecurity program in the nation (US News, 2021)
- CERIAS: one of original seven NSA-designated centers of excellence
- Robust partnerships with defense/national security industry and labs
- Embedding cybersecurity in other top-ranked areas (e.g., aerospace, autonomy, energy, manufacturing, and supply chain systems)
- Breadth and depth of expertise, from foundations to applied R&D
- Integrating research, education, and workforce development



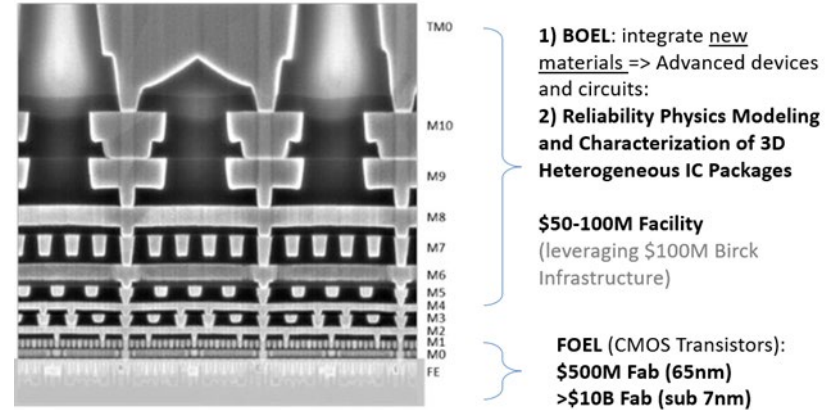
*The Center for Education and Research in
Information Assurance and Security*



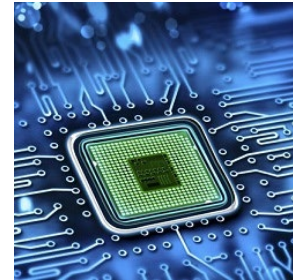
Secured Microelectronics



- 25,000 sf Cleanroom (45% class 1, 10% biopharma)
- Home to SCALE (Secure Microelectronics Workforce)
- Home to Microsoft Station Q
- Home to LyoHUB (23 Pharma companies)
- Home to SMART consortium (low-cost IoT)
- Advanced Chips for Quantum, Photonics, Spintronics, AI & Trusted Microelectronics



Courtesy of Mark Lundstrom



CSME

New Trends in Federal Funding

- Economic Development is the creation of wealth from which community benefits are realized.
- It is more than a jobs program, it's an investment in growing your economy and enhancing the prosperity and quality of life for all residents.



U.S. Innovation and Competition Act

- Senate Schumer called the \$250 billion bill a “once-in-a-generation investment in American science and American technology.”
- >\$200 billion investment into U.S. scientific and technological innovation over the next five years.
- \$52 billion allotment to spur the domestic production of semiconductors.
- \$80 billion on research into artificial intelligence, robotics, and biotechnology.
- \$23 billion on the advancement of space exploration.
- \$10 billion in new technology hubs throughout the country.
- \$1.5 billion to boost innovation in wireless technologies (5G and 6G).

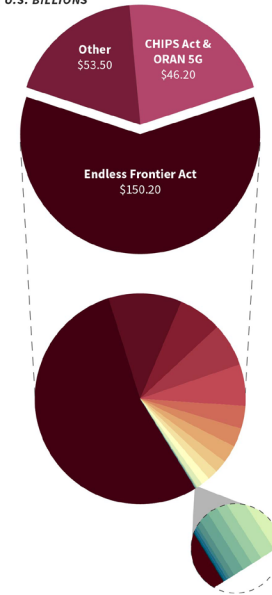


Seven Divisions of USICA

- Division A – CHIPS Act and ORAN 5G Emergency Appropriations
- Division B – Endless Frontier Act
- Division C – Strategic Competition Act of 2021
- Division D – Homeland Security and Governmental Affairs Committee Provisions
- Division E – Meeting the China Challenge Act of 2021
- Division F – Other Matters
- Division G – Trade Act of 2021: Forced Labor, Censorship, Consumer Protection, Supply Chain Resiliency, and Tariffs

U.S. Innovation and Competition Act Breakdown

\$ IN U.S. BILLIONS



ENDLESS FRONTIER ACT PROVISIONS

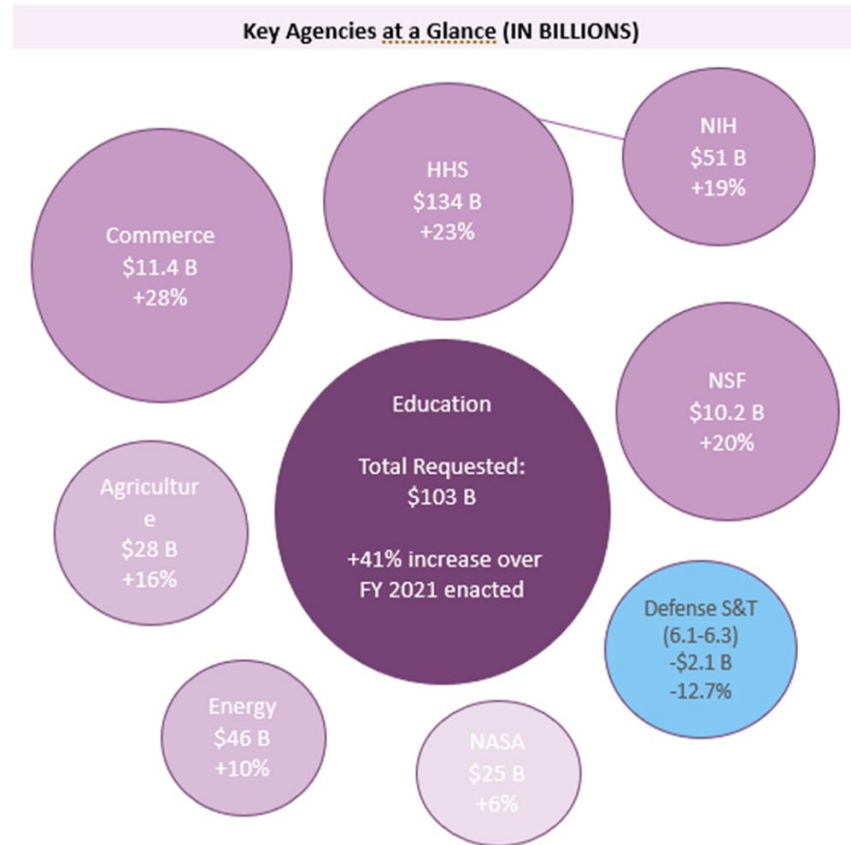
\$81	Authorization of Appropriations for NSF Research
\$16.90	Authorization of Appropriations for the DOE
\$10.03	Competitiveness within the Human Landing System Program
\$10	Regional Technology Hubs
\$9.57	Innovation Centers
\$5.22	Providing Scholarships, Fellowships, and Other Student Support
\$4.35	Research and Development
\$4.06	Academic Technology Transfer
\$2.90	Test Beds
\$2.40	Manufacturing Extension Partnership
\$2	Semiconductor Incentives
\$1.20	Manufacturing USA Program
\$0.15	Capacity-Building Program for Developing Universities
\$0.10	Critical Minerals Mining Research
\$0.10	Telecommunications Workforce Training Grant Program
\$0.10	National Science Corp
\$0.05	Office of Manufacturing and Industrial Innovation Policy
\$0.03	Hands-on Learning Program
\$0.02	Centers of Excellence for Space Situational Awareness
\$0.02	Space Situational Awareness Data, Information, and Service
\$0.005	Chief Diversity Officer at NSF
\$0.005	NSF Research Security

Source: CSIS analysis of the United States Innovation and Competition Act of 2021, S. 1260, 117th Cong. (2021).

President's Budget Request & FY22 Appropriations

FY 2022 Appropriations Highlights

- \$3B to establish an ARPA-H within NIH (\$9B total increase for NIH)
- \$7.4B for a new Prepare Americans for Future Pandemics Initiative to fund R&D and manufacturing programs in bio-preparedness / biosecurity at HHS, DOD, and DOE
- \$865M to establish a new NSF Directorate for Technology, Innovation, and Partnership; funding for Regional Innovation Accelerators
- \$500-\$700M for a new ARPA-C (not funded by House Energy appropriators)
- \$9B (\$5.8B increase) for DOE applied energy
- \$48M to launch 4 new Manufacturing Innovation Institutes: 2 at NIST and 2 at DOE



Biden Policy Priorities

- **Promote:**
 - Public health
 - Climate and clean energy
 - Innovation
 - Education
 - Racial equity
- **Cut:**
 - DOD's Science and Technology accounts
 - NNSA's academic research and development programs

Unit	Budget requested	Change
Agriculture	\$28B	+16%
Commerce	\$11.4B	+28%
---NIST	\$1.5B	+44.7%
---NOAA	\$6.97B	+28.2%
Education	\$103B	+41%
Energy	\$46B	+10%
HHS	\$134B	+23%
---NIH	\$51B	+19%
NASA	\$25B	+6%
NSF	\$10.2B	+20%
DoD S&T (6.1-6.3)	-\$2.1B	-12.7%

New Initiatives

- \$865M to establish a **New NSF Directorate: Technology, Innovation and Partnerships (TIPs)**
- \$6.5 billion to establish a **new Advanced Research Projects Agency for Health (APRA H)** within NIH
- \$7.4 billion for a **new Prepare Americans for Future Pandemics Initiative** to fund research, development, and manufacturing programs related to biopreparedness and biosecurity at HHS, DOD, and DOE
- \$500 million for a **new Advanced Research Projects Agency for Climate (ARPA C)** managed by DOE, but funded in collaboration with other agencies
- \$500 million, a **\$100 million increase**, for the Advanced Research Projects Agency for Energy (ARPA E) within DOE
- \$9 billion, a **\$5.8 billion increase**, for DOE applied energy programs
- \$48 million to launch **four new Manufacturing Innovation Institutes**, with two at NIST and two at DOE
- \$275 million, a **\$125 million increase**, for NIST's Manufacturing Extension Partnership

NSF Directorate for Technology, Innovation, and Partnerships (TIPs)

- Serve as a cross-cutting platform that leverages, energizes, and **rapidly brings to the market and to society** the innovations that result from all of NSF's investments.
- \$865M out of NSF's \$10.2B for FY22.
- Focus areas:
 - Artificial intelligence, machine learning, and other software advances
 - High-performance computing, semiconductors, and advanced computer hardware
 - Quantum computing and information systems
 - Robotics, automation, and advanced manufacturing
 - Natural and anthropogenic disaster prevention or mitigation
 - Advanced communications technology
 - Biotechnology, medical technology, genomics, and synthetic biology
 - Cybersecurity, data storage, and data management technologies
 - Advanced energy, batteries, and industrial efficiency
 - Advanced materials science, engineering, and exploration relevant to the other focus areas

ARPA-H

- Advanced Research Projects Agency for Health.
- Biden requested **\$6.5 billion for ARPA-H** in his fiscal year 2022 budget.
- Niche: **accelerates biomedical innovation and adoption of technologies and approaches**, to help the US capitalize on life-saving discoveries and advancements in healthcare and medicine.
- Supported projects would focus on **solving practical problems** that foster breakthroughs, serve patients equitably, and drive solutions to the point of widespread adoption.
- Time-limited projects with **goals, benchmarks, and accountability** to revolutionize how we prevent, treat, or cure a range of diseases.

DOE New Initiatives

- **\$422 million for Climate Research:** for earth and environmental systems sciences. DOE would launch a National Virtual Climate Laboratory (NVCL) as a one stop portal to access climate science at the DOE national laboratories and user facilities.
- **\$55 million in new funding for Clean Energy Research:** for materials, chemical, and biosciences in support of new clean energy research. Priority research areas include direct air capture of carbon dioxide, hydrogen production including the use of solar energy, and new materials and chemistries for next-generation electrical and thermal energy storage.
- DOE plans to release a **\$100 million** funding call in **Fall 2021** to compete **Energy Frontier Research Centers (EFRCs)** and expects to make between 40 and 50 center-level awards. EFRC topics will likely focus on clean energy, advanced manufacturing, and microelectronics.
- **\$25 million for a new Fundamental Science to Transform Advanced Manufacturing Initiative:** focusing on fundamental science that drives advanced manufacturing.
- **\$28 million for a new Reaching a New Energy Sciences Workforce (RENEW) Initiative**

DOE Priorities

- **\$298 million for Quantum Information Science**
- **\$130 million for Artificial Intelligence (AI)**
- **\$48 million for Microelectronics**
- **\$445 million for Exascale Computing**
- **\$200 million for a new ARPA-C**
- **\$500 million for ARPA-E**
- **\$400 million for a new Office of Clean Energy Demonstrations (OCED)**
- **\$4.7 billion for Renewable Energy and Energy Efficiency programs**
- **\$890 million for Fossil Energy and Carbon Management**
- **\$25 million for a new Nuclear Forensics R&D University Consortium**

Regional Tech Hubs (DoC/NIST)

- **\$10 Billion to create ~18 Regional Tech Hubs**
- **~3 Hubs will be in the region of IL/IN/MI/MN/OH/WI**
- **Each Hub is at ~\$100M/year (can be at ~\$200M/year) for 5 years (FY22-26)**
- **Focus on job creation and economic development**
- **Headquarter cannot be in urban areas**
- **Will need support from State and industry**
- **Indiana's strength in job creation is manufacturing**
 - **Pharmaceutical?**
 - **Biomedical?**

DoD Priorities

- DOD's budget request accelerates 6.4 and up RDT&E investment for modernization areas like AI, hypersonics, 5G, and cyber. These increases come at the cost of a **\$2.1 billion cut to 6.1-6.3 S&T**.
- **Hypersonics**: \$6.6 billion to develop long range fires and field hypersonic weapons on air, land, and sea.
- **Microelectronics**: \$2.3 billion to improve assurance, availability, and access to advanced semiconductors and components.
- **5G**: \$398 million to leverage 5G technologies and networks for military applications.
- **AI**: \$874 million to invest in AI as a top priority, funding over 600 AI-related efforts.
- Pacific Deterrence Initiative (PDI): DOD plans to spend over \$66 billion in direct efforts to address the China threat in the Indo-Pacific through a mix of RDT&E, procurement, and operational funding.
- \$1.6 billion is requested specifically in Air Force, Navy, and Defense-wide RDT&E.

Trends in Research Funding

- **Large size** – Significant increase in federal funding (largest since Apollo time), but relatively same sizes of funding agencies.
- **Use inspired** – Focus has been placed on enhance US industry competitiveness, which requires fast translation of technologies to products.
- **PI as CEO** – PIs will be managing large teams with demanding customers. Attention to financial, team dynamics, IP transition, milestones, in addition to scientific discoveries. Likely need professional program managers.
- **Workforce Development** – Talent is critical to enhance competitiveness.

Winning Strategies

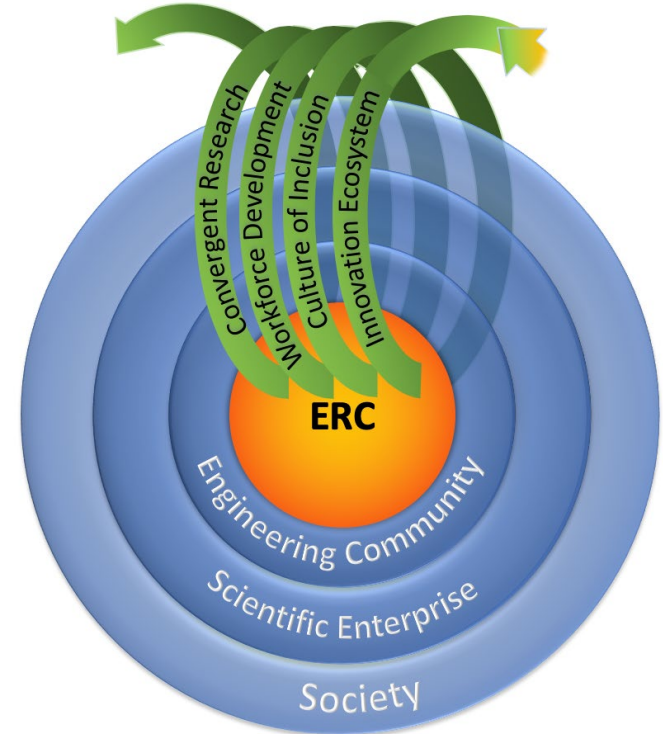
- **PI** acts more like a **CEO**. Manages team professionally.
- Include **STEM** and **workforce development** solutions in every proposal.
- Include **DEI considerations** in every aspect of your work:
 - Partnered with an MSI, HBCU, or community organization?
 - How does your research help underserved communities?
- Focus on the practical applications of your research: **What does the end user get?**
- Engage agency **policy heads and PMs** to drive future funding priorities.
- **Partner** with manufacturing institutes, think tanks, U.S. companies, regional leadership.
- Quantifiably demonstrate how your research will lead to **new jobs**.
- **Shoot for the moon**: propose leap-ahead research that no one else is doing.

The best strategy: build relationships

- **Invite** USG PMs/policy reps for research areas to campus seminars/events
- **Participate** in formal events, e.g. DARPA proposers days or Air Force's programmatic reviews
- **Attend** conferences & webinars for issue areas, government and think tank sponsored
- **Publish** and publicize press: tons of great science newsletters, podcasts, websites
- Where possible, **meet end users of your work**: who benefits?

Winning strategy: build your team early

- Workshops/seminars/visits
- Joint papers/joint student supervising
- Joint proposals
- Establish centers with clear themes
- Involve industry
- Diversity
- Establish paths from lab to market



NSF ERC Model

Questions?

