Update: Semiconductors

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I will provide an update on the status of various semiconductor activities that could have an impact on the US market and our future federal investments.

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Disclaimer: These views are mine and not of the DOE

Update: Semiconductors

I. Types of challenges include
   - *US-China and semiconductor competitiveness*
   - *Supply chain concerns*
   - *Workforce*
   - *Intellectual Property*
   - *Innovation across the board in today's and tomorrow's technologies*
   - *Future emerging markets*

II. Reports suggesting action

III. Congressional Actions
   - *Bills enacted into Law*
   - *Bills pending*

IV. Initial seed funding

V. Additional thoughts

I. Reports

The problem is well studied and has been recognized for many years. Numerous reports have highlighted the importance of the US semiconductor market and suggested Congressional actions that are needed. Recent examples include:

- From the Legislative branch
  - *National Security Commission on Artificial Intelligence – March 2021*
    - Many recommendations, including "Implement the National Microelectronics Strategy"
- From the Executive branch
  - *Recommendations for strengthening American leadership in industries of the future* – PCAST June 2020
  - *Executive Order 14017: America's Supply Chains. February 24, 2021*
  - *Executive Order 13806: Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States. July 21, 2017*
- From federal agencies including us:
  - *Basic Research Needs for Microelectronics: REPORT OF DEPARTMENT OF ENERGY OFFICE OF SCIENCE WORKSHOP, OCTOBER 23-25, 2018*
- Many additional from outside government including SIA, Hyperion Research, ITIF,…

II. Congressional Actions

There has been recognition on the Hill for some time and numerous bills crafted in various stages. A recent bill that became law: The 2021 NDAA or in its fuller title the "William M. (Mac) Thornberry National Defense Authorization Act for 2021".

- *This provides the authorization for US Defense activities including DoD and DOE(NNSA) but can include broader authorizations for executive branch activities that otherwise are not within defined existing missions.*
- *Provides authorized spending levels, multiyear views on activities, policies, etc, but not funding. That comes from appropriations bills.*
- *This became law by overriding a Presidential veto, on 1/1/2021. It is now Public Law 116–283.*

- **In "Other Matters", starting on page 1456 of 1480:**

  TITLE XCIX—CREATING HELPFUL INCENTIVES TO PRODUCE SEMICONDUCTORS FOR AMERICA

  ("CHIPS for America")

  Section 9901-9908

- **Also other relevant sections, including starting on page 1398:**

  TITLE XCII—COMMUNICATIONS MATTERS

  Sections 9201-9204 including: Reliable emergency alert distribution improvement; Wireless supply chain innovation and multilateral security; Spectrum information technology modernization efforts; Internet of Things.

The 2021 NDAA "CHIPS for America Act" (Section 9900) authorizes new agency missions

Some of the new, relevant authorized activities:

- **9902:** *Department of Commerce lead*. **SEMICONDUCTOR INCENTIVES.**
  - FINANCIAL ASSISTANCE PROGRAM.— For covered entities to incentivize investment in facilities and equipment in the United States for semiconductor fabrication, assembly, testing, advanced packaging, or research and development. 'Covered entity'' means a private entity, a consortium of private entities, or a consortium of public and private entities with a demonstrated ability to substantially finance, construct, expand, or modernize a facility relating to fabrication, assembly, testing, advanced packaging, or research and development of semiconductors.
- **9906(c):** *(DoC lead with DOE and NSF)* **NATIONAL SEMICONDUCTOR TECHNOLOGY CENTER**
  - Research and prototyping of advanced semiconductor technology to strengthen the economic competitiveness and security of the domestic supply chain. A public private-sector consortium with participation from the private sector, DOE and NSF.
    - Advanced semiconductor manufacturing, design and packaging research, and prototyping that strengthens the entire domestic ecosystem
    - Support startups and collaborations between startups, academia, established companies, and new ventures, with the goal of commercializing innovations that contribute to the domestic semiconductor ecosystem, including— (i) advanced metrology and characterization for manufacturing of microchips using 3nm transistor processes or more advanced processes; and (ii) metrology for security and supply chain verification.
    - Graduate and undergraduate programs, workforce training programs and apprenticeships, in advanced microelectronic design, research, fabrication, and packaging capabilities
- **9906(d)** *(DoC/NIST Lead with NSTC, MUSA)* **NATIONAL ADVANCED PACKAGING MANUFACTURING PROGRAM**
  - Strengthen semiconductor advanced test, assembly, and packaging capability in the domestic ecosystem
- **9906(e)** *(DoC/NIST Lead)* **MICROELECTRONICS RESEARCH**
  - Enable advances and breakthroughs in measurement science, standards, material characterization, instrumentation, testing, and manufacturing capabilities that will accelerate the underlying research and development for metrology of next generation microelectronics and ensure the competitiveness and leadership of the United States within this sector.
- **9906(f)** *(DoC/NIST Lead)* **MANUFACTURING USA INSTITUTE**
  - Semiconductor manufacturing. (1) Research to support the virtualization and automation of maintenance of semiconductor machinery. (2) Development of new advanced test, assembly and packaging capabilities. (3) Developing and deploying educational and skills training curricula needed to support the industry sector and ensure the United States can build and maintain a trusted and predictable talent pipeline.

What needs to happen next:

- Authorizations do not provide funding, but frame how much you could spend if you have the funds.
- To support long term authorization language, we require appropriations bills to provide specific annual funding levels for activities.
- The Senate and House typically propose their own approaches that are then reconciled in conference to create final bills that have to pass again through both House and Senate before passing to the President for signature.
- There has been action coming from the House and from the Senate over the past few years, with the most sweeping bill passing the Senate in a strongly bipartisan manner ("USICA"). Bills not passed in a given 2 yr Congressional session expire and must be reintroduced to restart any process.
- The USICA Senate bill was the first step to provide funding to this. It requires House agreement and currently there is no companion bill for USICA, rather a collection of smaller bills that would then have to go to conference.

The USICA Bill (S.1260) is a sweeping Senate Bill encompassing many disparate sections

- The United States Innovation and Competition Act ("USICA")
- 2376 pages
- Includes main divisions:

DIVISION A—CHIPS AND O-RAN 5G EMERGENCY APPROPRIATIONS

includes SEC. 1002. CREATING HELPFUL INCENTIVES TO PRODUCE SEMICONDUCTORS (CHIPS) FOR AMERICA FUND

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

including everything from Sec. 74761. Wood blinds with louvered slats; Sec. 74745. Waterproof waist packs; Sec. 74733. Dog and cat apparel; Sec. 74864. Men's cycling shoes valued over $18 per pair; Sec. 74887. Children's athletic shoes with glitter uppers., …

The USICA Senate Bill proposes to fund the sections of the CHIPS Act in the 2021 NDAA

- The proposed funding levels coming from the Senate in USICA include ($50.2B):

CHIPS section from NDAA	2022	2023	2024	2025	2026
Total	**$24B**	**$7B**	**$6.3B**	**$6.1B**	**$6.8B**
9902	19B	5B	5B	5B	5B
9906(c)	2B	2B	1.3B	1.1B	1.8B
9906(d)	2.5B				
9906(e)	0.5B				
9906(f)					

- This will require companion House bill(s) to propose spending levels and activities in order to move this along. It is bi-partisan and passed Yea-Nay Vote 68 – 32.
- Multi-year funding. If it passes, can keep funds until expended.

USICA also funds: Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America Defense Fund

Supports the stand-up and funding of the NATIONAL NETWORK FOR MICROELECTRONICS RESEARCH AND DEVELOPMENT to be lead by DoD.

Establishes a national network to enable the laboratory to fabrication transition of microelectronics innovations in the US and to expand the global leadership

It is expected to

(A) enable cost effective exploration of new materials, devices, and architectures, and prototyping in domestic facilities to safeguard domestic intellectual property;

(B) accelerate the transition of new technologies to domestic microelectronics manufacturers; and

(C) conduct other relevant activities deemed necessary by DoD

Funding is set at $400M for each year 2022-2026

USICA also funds:

CHIPS for America International Technology Security and Innovation Fund: Supports international information and communications technology security and semiconductor supply chain activities:

- *the development and adoption of secure and trusted telecommunications technologies; secure semiconductors; secure semiconductors supply chains and other emerging technologies*

To be lead by the State Department. Funding is set at $100M/yr for 2022-2026

Public Wireless Supply Chain Innovation Fund – (Section 9202 of 2021 NDAA): Allows Dept of Commerce to support technologies at $1.5B over 2022-2031.

Regional Innovation Hubs: (DoC lead) Support regional economic development in innovation at $10B for 2022-2026. Also $2.4B for The Manufacturing Extension Partnership and $1.2B for the Manufacturing USA Program (2022-2026).

Semiconductor Incentives: (DoC lead) Strengthens the security and resilience of the semiconductor supply chain, including by mitigating gaps and vulnerabilities… $2B

On the House side (mostly):

- In contrast to a single bill, there are many separate (authorization) bills being crafted in this Congress:
  - **National Science Foundation for the Future Act (**H.R.2225) **–** passed House and sent to Senate (7/12/21)
  - **Department of Energy Science for the Future Act (**H.R.3593) –passed House and sent to Senate (7/12/21)
  - NASA and NIST Reauthorization Bills
  - **Endless Frontier Act** – (H.R.2731), includes Department of Commerce Regional Technology Hubs
  - **Regional Innovation Act of 2021 –** (H.R.4588) – includes creating Dept of Commerce Regional Technology and Innovation Hubs
  - **Partnerships for Energy Security and Innovation Act of 2021 –** creates the DOE Foundation (Senate side S.1359)
  - **Bioeconomy Research and Development Act of 2021** – (Senate side S.1418)
  - …
- There were similar bills in the House that expired with new Congress in January and could be reintroduced:
  - S.4629 (9/2020) : America Labor, Economic competitiveness, Alliances, Democracy and Security Act'' or America LEADS Act
  - …
- Still need a separate 'China Innovation' package
- As House bills pass through for House votes then conference can start with Senate to try to achieve draft compromise bills.

Other Bills that passed through House and Senate

Investing in a New Vision for the Environment and Surface Transportation in America Act or the **INVEST in America Act**

- Passed through House and Senate as of 8/10/21
- Related to federal-aid highway, transit, highway safety, motor carrier, research, hazardous materials, and rail programs of the Department of Transportation (DOT)
- Emerging, higher risk technologies are part of the scope.
- With microelectronics becoming such an integral part of transportation, there can be a place here for semiconductors.

IV. Seed Funding

- Some agencies, including DOE, have incorporated microelectronics research into their core programs already.

- For example: DOE Office of Science “Microelectronics Innovation Initiative”

  Starting in FY2021 ASCR, BES, FES, and HEP partner to support multi-disciplinary microelectronics research to accelerate the advancement of microelectronic technologies in a co-design innovation ecosystem in which material, chemistries, devices, systems, architectures, algorithms, and software are developed in a closely integrated fashion. (40M)

V. Additional Thoughts

- We have been working on driving microelectronics from the Obama through the Trump and now into the Biden Administration.
- The problems are complex, disparate, and the role of government different than how competitors like China operate.
- An approach that can unleash innovation by enabling and empowering all the way from discovery to deployment is not just a funding challenge.
- We are in a good place in that there is strong bipartisan support for action, something we had at this scale before. But we can't be complacent.
- We will see what the mood is after the infrastructure bill goes through its process.

We have to look ahead at the rapidly changing world because it is likely that today's perceived needs are anchored to how we have done things and not preparing for what is to come.