House Science and National Labs Caucus

March 13, 2014
Universities – A Modified Core Mission

THE NEW INTERFACE

Academic Research ("Pushing back the Frontiers")

Teaching Scholarship ("Human Capital")

Translating Discoveries to Benefit Society ("Reducing to Practice")

[Image of Penn CTT Center for Technology Transfer]
Success of Bayh-Dole

- US Universities reported consolidated licensing income of $1.8B in 2011 and formation of over 600 startup companies in that year alone
- A recent BIO study showed university partnerships have engendered a $187 billion positive impact on economy and a $457 billion addition to GNP
- The number of universities with Technology Transfer offices has risen from 25 in 1980 to over 300 today
- >50% of pharmaceutical drugs derived from discoveries made at academic institutions transferred to industry
- Millions of lives have already been transformed by these activities
Penn Research Enterprise
Economic Impact

- Nearly $1 Billion in total research awards / year
- An estimated $4 billion additional impact*
- ~22,000 research / research support positions
- Nearly 400 new research discoveries annually
- Over 100 new research licenses annually
- Since 1990, >100 new companies & >1500 employees located in Philadelphia

*TrippUmbach
Federal Funding the Lifeblood of R&D at Most Major US Universities

Top 30: How Much R&D Is Federally Funded?

<table>
<thead>
<tr>
<th>Institution</th>
<th>Federally Funded</th>
<th>All R&amp;D Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johns Hopkins University</td>
<td>1161</td>
<td>1870</td>
</tr>
<tr>
<td>University of Michigan, Ann Arbor</td>
<td>1144</td>
<td>1674</td>
</tr>
<tr>
<td>University of Washington, Seattle</td>
<td>1126</td>
<td>1624</td>
</tr>
<tr>
<td>University of Wisconsin, Madison</td>
<td>1101</td>
<td>1593</td>
</tr>
<tr>
<td>Duke University</td>
<td>1094</td>
<td>1593</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>1091</td>
<td>1513</td>
</tr>
<tr>
<td>University of California, San Francisco</td>
<td>1091</td>
<td>1474</td>
</tr>
<tr>
<td>University of California, Los Angeles</td>
<td>1080</td>
<td>1342</td>
</tr>
<tr>
<td>Stanford University</td>
<td>1063</td>
<td>1474</td>
</tr>
<tr>
<td>University of Pittsburgh, main campus</td>
<td>1048</td>
<td>1403</td>
</tr>
<tr>
<td>University of Pennsylvania</td>
<td>1037</td>
<td>1385</td>
</tr>
<tr>
<td>Columbia University in the City of New York</td>
<td>1032</td>
<td>1312</td>
</tr>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>1031</td>
<td>1303</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>1023</td>
<td>1385</td>
</tr>
<tr>
<td>Penn State, University Park, and Hershey Medical Center</td>
<td>1020</td>
<td>1286</td>
</tr>
<tr>
<td>Cornell University</td>
<td>1017</td>
<td>1280</td>
</tr>
<tr>
<td>University of North Carolina, Chapel Hill</td>
<td>1013</td>
<td>1242</td>
</tr>
<tr>
<td>University of Florida</td>
<td>997</td>
<td>1224</td>
</tr>
<tr>
<td>Washington University, Saint Louis</td>
<td>990</td>
<td>1206</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>969</td>
<td>1158</td>
</tr>
<tr>
<td>University of California, Berkeley</td>
<td>968</td>
<td>1136</td>
</tr>
<tr>
<td>University of California, Davis</td>
<td>961</td>
<td>1127</td>
</tr>
<tr>
<td>Texas A&amp;M University</td>
<td>943</td>
<td>1069</td>
</tr>
<tr>
<td>University of Texas Cancer Center</td>
<td>929</td>
<td>1031</td>
</tr>
<tr>
<td>Yale University</td>
<td>921</td>
<td>1005</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>911</td>
<td>982</td>
</tr>
<tr>
<td>Harvard University</td>
<td>910</td>
<td>966</td>
</tr>
<tr>
<td>University of Texas, Austin</td>
<td>902</td>
<td>952</td>
</tr>
<tr>
<td>Northwestern University</td>
<td>890</td>
<td>953</td>
</tr>
<tr>
<td>University of Arizona</td>
<td>853</td>
<td>901</td>
</tr>
</tbody>
</table>

1 Johns Hopkins University includes Applied Physics Laboratory, with $1,161 million in total R&D expenditures in FY 2011.

NOTES: Because of rounding, detail may not add to total. Institutions ranked are geographically separate campuses headed by a campus-level president or chancellor.

Trends in Federal Research Funding

**FEDERAL FUNDS FOR RESEARCH**
US science spending has changed only gradually over the past 25 years, regardless of the party in power.

- National Science Foundation
- Defence department
- Energy department
- National Institutes of Health
- All others
- Agriculture department
- NASA

**Source:** Science

**Figure 1**
NIH Appropriation in Current and Constant Dollars

- With Supplemental Appropriation (APRA)
- Current $ (Millions)
- 1995 Constant $ (Millions)

**Top Spenders on R&D as a Percentage of GDP**

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>4.28%</td>
</tr>
<tr>
<td>Finland</td>
<td>3.96%</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.62%</td>
</tr>
<tr>
<td>South Korea</td>
<td>3.36%</td>
</tr>
<tr>
<td>Japan</td>
<td>3.33%</td>
</tr>
<tr>
<td>Denmark</td>
<td>3.02%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>3.00%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>2.93%</td>
</tr>
<tr>
<td>United States</td>
<td>2.88%</td>
</tr>
<tr>
<td>Germany</td>
<td>2.78%</td>
</tr>
</tbody>
</table>

**Source:** National Science Foundation | Graphic: Hagit Bachrach
Trends in Federal R&D
As a percent of GDP

Source: Up to 1994 - National Science Foundation, Survey of Federal Funds for Research and Development; 1995 to Present - AAAS Research and Development series. GDP figures are from Budget of the U.S. Government FY 2014. FY 2013 and FY 2014 figures are latest estimates.

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Trends in Pharma, FDA and PTO Approvals

Figure 5-37
U.S. university patenting activities: 2002–11
Thousands

Source: Association of University Technology Managers (AUTM), AUTM Licensing Surveys: 2002–11. See appendix table 5-64.

Science and Engineering Indicators 2014
Biopharma R&D Expenditure Trends – 2004 to 2010

Sources: Pharmaceutical R&D Outsourcing Strategies, PhRMA
Trends in Venture Capital

**Healthcare Venture Deals, 1998-2009**
(Dollars Invested and # of Deals)

**Seed and start stage share of venture capital deals**

Source: National Venture Capital Association’s Venture Capital Yearbook, various years

(c) 2011
Adapt to Thrive

• Seek out complementary sources of R&D and new venture funding
• Identify creative new ways to incubate technologies and achieve POC
• Aggressively seek partnerships with industry and foundations
• Reward innovation and embrace it as a critical part of the institutional culture and mission
• Adapt, adapt, adapt
How Can Washington Help Even Further?

- Offer incentives to universities receiving federal funds that encourage them to partner more aggressively with the private sector
- Provide additional grant funds and programs aimed at stimulating development and translation of new products and businesses
- Relax UBIT and private business use thresholds
- Extend unemployment and/or extend low-cost health benefits to workers seeking to shift towards translating early stage research
- Accelerate approval of new drugs and provide facilitated means to perform early proof of principle studies at qualified universities
- Streamline patent processing and restrict obstructive and frivolous challenges
- Support enforcement of federally sponsored patent rights by university title holders
RONALD RUTH, PHD
Professor, SLAC National Accelerator Laboratory
Stanford University
Founder & Chairman of the Board
Lyncean Technologies, Inc.
The Story of Lyncean’s “Compact Light Source” (A SLAC and Stanford Spinoff)
My Connection to National Labs

- PhD Research at Brookhaven National Lab
- First job at Lawrence Berkeley National Lab
- Two years at CERN
- 30 years at SLAC
- 23 years as Professor at SLAC/Stanford
- Founder of Lyncean Technologies, Inc.
The largest synchrotron in the US: billion-dollar scale ‘APS’, a ‘supercomputer’ of X-ray Science
The CLS: The Compact Light Source

- X-RAY SOURCE
- ELECTRON BEAM INJECTOR
- X-RAY OPTICS
- DIFFRACTOMETER ENDSTATION FOR MAD
- DIFFRACTOMETER ENDSTATION FOR HIGH-FLUX SCREENING
- CLS ENCLOSURE
The Compact Light Source today
Compact Light Source Applications

Applications span the broad set available with the large synchrotrons, For example:

- **Biological Imaging**, Medical Research
  - Special high resolution techniques for seeing tiny details in soft tissue.

- **Crystallography**: protein diffraction studies
  - For Drug Discovery

- **Semiconductor metrology for next and future chip production**
  - Measure Critical Dimensions for lithographic production of chips

For illustrations of these applications see: http://www.lynceantech.com/applications.html
Summary and Outlook

• The Synchrotrons have generated many applications which have commercial value in medicine and industry.

• The x-ray science field has been asking for a compact synchrotron for decades to bring these applications to the marketplace.

• Lyncean’s Compact Light Source is that device.

• The Compact Light Source holds the promise of being a driving force for innovation and could increase the breadth of the impact of x-ray science throughout the world.
Acknowledgements-Funding

Concept Development: SLAC/Stanford, US DOE HEP

Grant Funding (Lyncean):

- CLS SBIR Grant Funding NIGMS  
  CLS prototype  
  R44-GM6651

- CXS Grant Funding NIGMS  
  Crystallography development  
  R44-GM074437

- CXS ARRA Grant Funding NIGMS  
  CLS Intensity upgrade  
  R44-GM074437

- ATCG3D Funding Protein Structure Init.  
  CLS Beta/product development  
  U54-GM074961

- CHRSIS SBIR Grant Funding NCRR  
  Imaging development  
  R43-RR025730

- CLS Development SBIR Grant DOE  
  DE-SC0009622
DR. SIVA SIVANANTHAN
Professor of Physics
University of Illinois at Chicago
Founder, EPIR Technologies
EPIR Technologies, Inc.
Founded in 1997 to Commercialize
Infrared Night Vision Technology

- EPIR is built on a passion for **protecting our soldiers** and national security
- EPIR specializes in infrared night vision technology for military and space applications
- Headquartered in Chicago
  - 34,000 sqft facility, 17 years old, 50+ headcount
EPIR Gives Back to the Community

UIC UNIVERSITY OF ILLINOIS AT CHICAGO

EPIR Technologies
Military Systems Supply Chain Risk

**PRIME CONTRACTORS**

**SUB-SYSTEM MANUFACTURERS**

- Specialized Systems
- U.S. Small Companies
- U.S. Universities

**MATERIAL MANUFACTURERS**

- Used to be 7, now down to 2 material manufacturers
PAULA COLLINS
Vice President, Government Relations
Texas Instruments
Key Points

- Research drives innovation, growth and job creation across the country.

- Funding basic research is a fundamental role of the federal government. It won’t get done on the scale it needs to without the federal government’s involvement.

- Research is essential to building a science and engineering workforce, producing our next Nobel Laureates, and ensuring the unparalleled excellence of our universities.

- The stakes are higher than ever. Other countries have the US playbook and are using it. Now is not the time to pull back.
FOR MORE INFORMATION ON COMPANIES CREATED FROM FEDERALLY FUNDED RESEARCH

www.ScienceCoalition.org/SuccessStories