

# Innovation and the Challenge of Legacy Systems



## **Unleashing Innovation & Entrepreneurship in Europe**

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# Themes for Today's Presentation

- A desire for different or better outcomes in the innovation space requires:
  - A recognition of the need for change
  - An emphasis on the importance of learning from others, and from experience
  - Learning is necessary to effectively adopt and adapt new principles & programs
- Change is needed to ensure the continued success of the Transatlantic community

# The Global Innovation Imperative



## 3 Key Points

- **Innovation** is Widely Recognized as Key to Growing and Maintaining a Country's Competitive Position in the Global Economy
- **Collaboration** is Essential for Innovation as Small Businesses and Universities Play a Growing Role in the Innovation Process
- **Institutional and Policy Change** are Necessary to Compete Successfully

# How is the Rest of the World addressing this Innovation Imperative?

- High-level **Policy Focus** on Growth and National Strength
- Greatly Increased **Support** for Universities
- Rapidly Growing **Funding for Research**
- Support for Innovative **Small Businesses**
- Government-Industry **Partnerships** to bring new products and services to market
- Leading nations are investing very substantial resources to create, attract and retain the industries of today and tomorrow.

Global Competition is Increasing  
But...

There is Good News!

Both Europe and the U.S. Have  
Major Innovation Strengths in  
Science, Innovation, and  
Entrepreneurship

# New Tech Based Opportunities for Growth and Jobs

- Advanced Manufacturing
- New Energy Sources & Technologies
- Online Education Systems
- Driverless Cars and Drones
- New Materials
- New Health Technologies for Care and Cure

# Innovation In Legacy sectors

- Need to recognize it is a multi step process—a “new” technology is not enough to generate change
- What are the barriers it will face?
  - Self interest is eternal, change is not cost free
- What are the incentives needed to overcome the barriers?
- What is the nature of the demand for legacy innovation & how can we encourage it?

# Legacy Sectors

- These sectors have drawbacks on innovation, but they also keep the lights on...
- Legacy sectors often have incentives that do not correspond to societal (or planetary) needs...
- Economic, technical, cultural and legal obstacles limit innovation
  - Solar permitting in the US



# The Legacy Challenge

- Perverse Pricing that does not capture the costs of externalities
- Existing infrastructure = existing investments
  - R&D low compared to revenue
- Public expectations favor cheap energy today—storms tomorrow
- Regulations inhibit take up of cost effective green technologies

# Legacy Industry Benefits from Skewed (or Absent) Incentives

- Incumbent Subsidies
  - Oil has depletion & tax incentives
- New Infrastructure: Requirements for Network Build out—“chickens OR eggs”—car charging stations, solar & wind intermittency & the grid
- Lumpiness of investment—next gen nuclear + regulatory hurdles

# Other Sectors to consider for the ECE Innovation Group

- Manufacturing: new models, materials, standards, research
- Buildings: standards, R&D
- Higher Education: career paths, pricing, vested interests, ie, conservative faculty
- Transport: networks, driverless car regulations, infrastructure for e-cars
- Health Delivery: network economies, standards, eg, patient records

# The importance of a self reinforcing suite of Innovation Policies

- R&D Support– both Basic and Applied
- IP Protection for all
- Support to research in Universities and to Graduate education
- Public and Private Risk Capital
- Prizes in Universities & the Market
- Incentives for Innovative Procurement

# Innovation Institutions

- Universities Focused on Education, Research and Commercialization
- Innovative Firms able to enter and exit rapidly and cheaply
- Standards and testing organizations
- Shared research facilities, e.g., Fraunhofer and Carnot, and NNMI
- Legal & other Professional Services

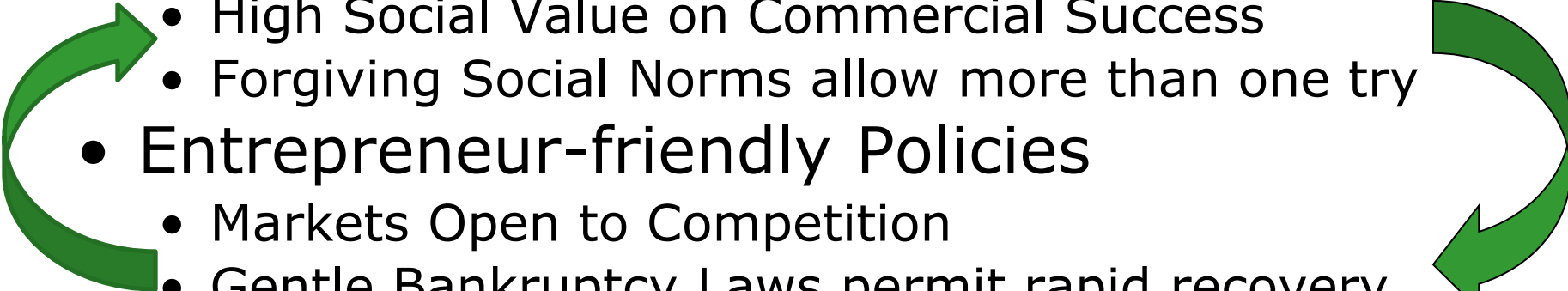
# The Major Risks to the U.S. (and Europe?)

- **Complacency** about our competitive position
  - Focus on **current consumption** rather than investment for the future
- A **lack of investment in R&D, Universities, and Infrastructure**
- Failure to provide enough support for the **commercialization** of research and for new opportunities in manufacturing
- Limited attention to the **composition of the economy**: Can we make what we invent, and create jobs based on new technologies?

# The U.S. Has Substantial Innovation Assets

There may be some lessons...

# Key U.S. Strengths in Innovation

- Openness to science and innovation
    - Trust in Science & Scientific Institutions is key!
  - Positive Social Norms
    - High Social Value on Commercial Success
    - Forgiving Social Norms allow more than one try
  - Entrepreneur-friendly Policies
    - Markets Open to Competition
    - Gentle Bankruptcy Laws permit rapid recovery
    - Taxes give Prospect of Substantial Rewards
  - Flexible Labor Markets:
    - 5.1% unemployment; 250,000 jobs added monthly
  - Outstanding Research Universities
- 



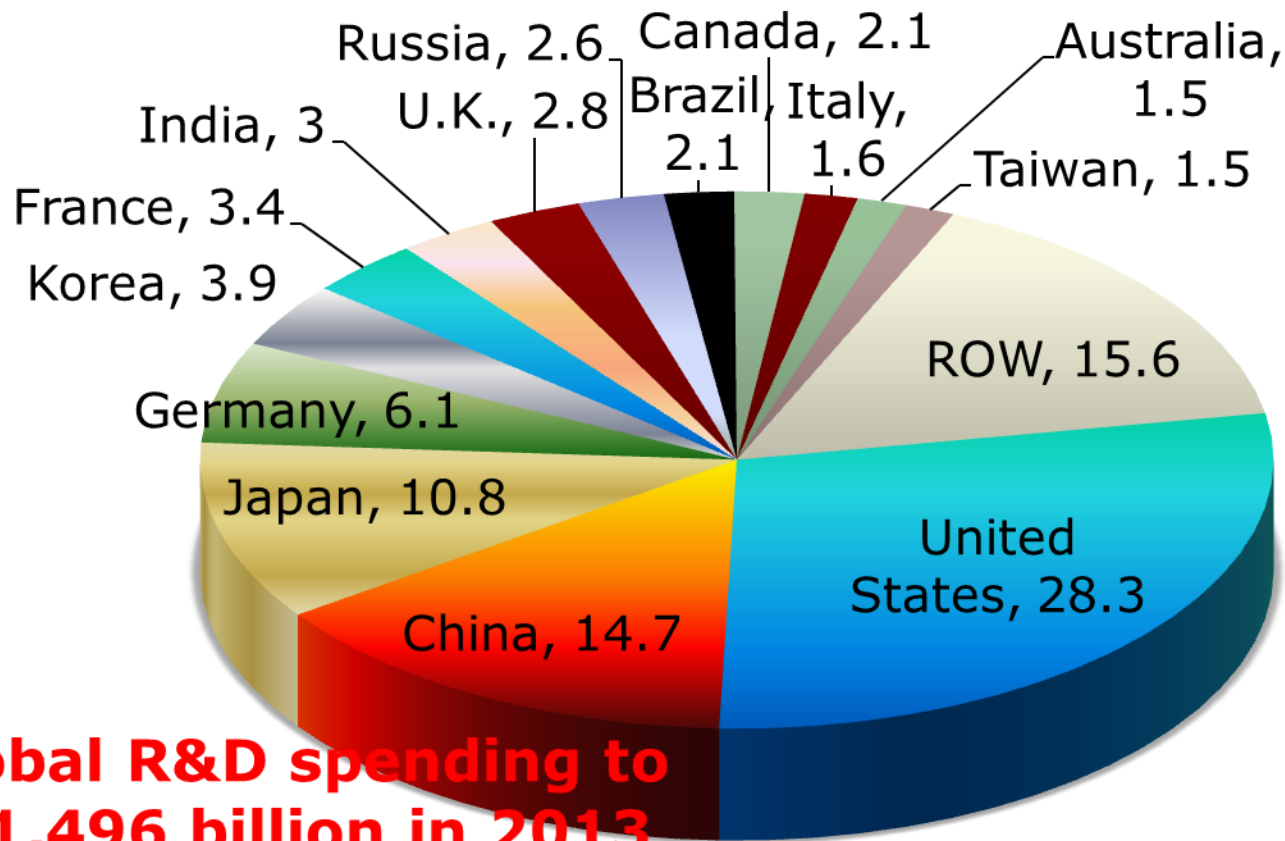
# Traditional Pillars of the U.S. Innovation System

- **Government investments in R&D:** ~\$150B a year
- **Private investments in R&D:** ~\$300B a year
- **Research Universities:** some with a culture of innovation
- **Entrepreneurial spirit** and laws to support it
- **Talent:** from the U.S. and from around the world
- **Capital:** Broad, deep, and efficient capital markets with significant angel (\$22.5 Billion\*) and venture funding (\$28.4 Billion\*\*)

– Sources:

\* Jeff Sohl, UNH Center for Venture Research; \*\* 2012 Money Tree Report

# The U.S. has a Large Share of Global R&D



**Total global R&D spending to reach \$1,496 billion in 2013**

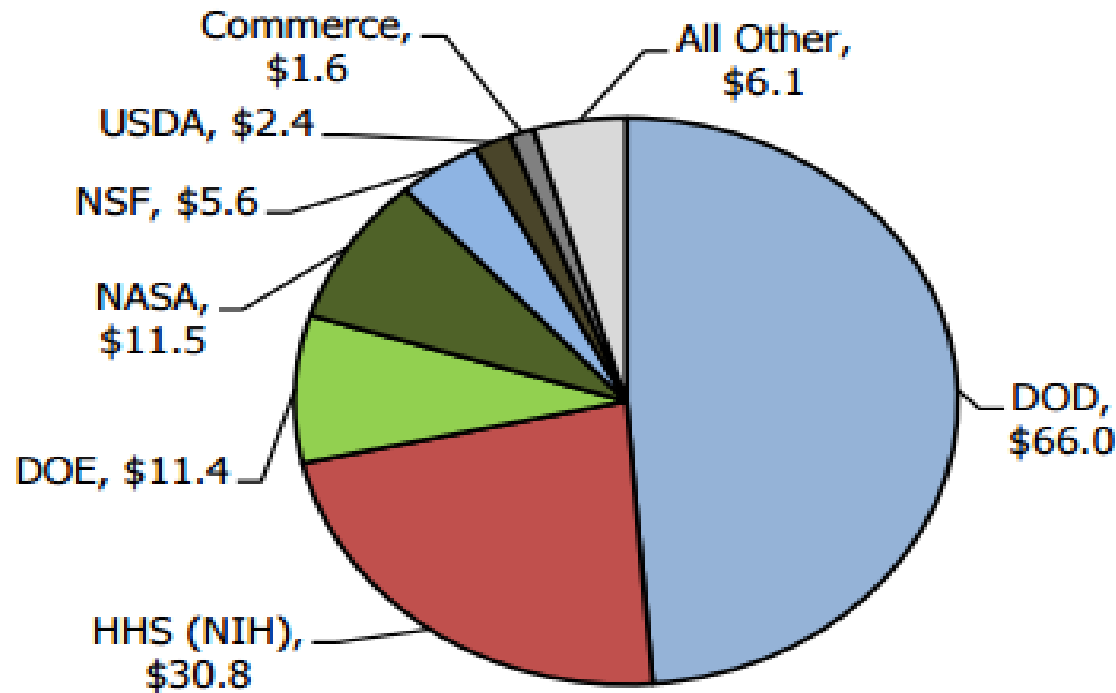
SOURCE: Battelle and R&D Magazine, *2013 Global R&D Funding Forecast* (December 2012).

# A Key Advantage of the U.S. System

Mission-oriented, competitively  
awarded research in well funded,  
competitive universities

# U.S. R&D by Agency

**Figure 2: R&D by Agency, FY 2014**  
budget authority in billions of dollars



Source: OMB R&D data, agency budget justifications, and other agency documents and data. R&D includes conduct of R&D and R&D facilities.  
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# A Broad-based Federal Effort to Support Science and Innovation

- Innovation is driven, in part, by well-developed mission driven institutions:
  - **DARPA:** From the forerunner of the Internet to the I-phone to tomorrow's driverless cars
  - **NSF:** Support for basic research-some led directly to Google
  - **NIH:** Funding for research underpins the modern pharmaceutical and biotechnology industries, basis for start-ups and spin-offs

# The Necessity of Innovating for Innovation

- **Policy innovation** is needed to create the new institutions and new mechanisms in order to generate innovation in products & processes
- **Learning from others:** What's new in Washington is that we are consciously learning from others, notably Germany, in support for manufacturing and renewed emphasis on workforce training

# Learning from Ourselves:

## ARPA-E

- ARPA-E funds “game changing” new energy technologies to reduce emissions & increase energy efficiency
  - \$300 million per year, quick contracting
  - Grants from \$1 million for POC, 2 to 10 million for prototypes
  - 17 PDs & 10 T2M advisors, very flat hierarchy, 3 year terms of employment, good salaries, quick hiring, risk taking is encouraged.

# The Innovation-Corps

## Training for Entrepreneurship

- The I-Corps program provides entrepreneurship training:
  - It pairs federally funded scientists and engineers with business mentors, pushing them to discover a demand-driven path from the lab to the market
  - Heavy interaction with potential buyers before finalizing the product
  - An NSF initiative now adopted by Energy (ARPA-E), NIH, and CDC



# Innovative Universities are a Major U.S. Asset and are Key to addressing Global Challenges

Universities that are able to connect with Industry  
are major Assets for National Competitiveness

We need Innovative Universities to  
Keep and Improve our Standard of Living While  
Protecting the Planet

# Encouraging Universities to Commercialize...

- ...Requires Real Changes in
  - **Culture and Values**: This requires new leadership and new incentives
  - **Status of Professors**: permissive environment to encourage innovations, collaboration with industry, and pursuit of innovation awards and wealth
  - **Institutional Practices**: Parallel research institutes with self-select mechanism
  - **Local Leadership & Local Autonomy**
- Incentives are needed to Effect Change
  - Bayh-Dole created new incentives to commercialize
  - University Entrepreneurship Programs may help
  - Award Programs like SBIR actually shift the culture

# To Conclude

21<sup>st</sup> Century Universities and the  
Innovation Imperative

Our Common Challenge

# The Policy Challenge

- Many officials and advisors in Europe know about these policies and practices
  - But adoption is hard because they are different practices reflecting different policies, which result in different experiences and “cultures”.
- You will recall the observation that “doing the same thing over & over and expecting a different outcome is one form of insanity”
- How do we create the argument and shift incentives to generate different outcomes?

# Thank You



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