Government Interest Patents: When Public Investment Feeds Innovation

Dr. Andrew Toole, USPTO Acting Chief Economist

Spring Meeting, DOE Technology Transfer Working Group, May 14-15, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

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Office of the Chief Economist

Advises the USPTO Chief Policy Officer and USPTO Director on economic aspects of domestic and international IP policy to enhance decision making

Three broad approaches:

1. Appling economic frameworks and tools
2. Bridging the USPTO with scholarly communities
3. Performing research and anaylses

Objectives

1. Patents in technology transfer
2. Government interest patents
3. www.patentsview.org – a resource created through a public-private partnership
4. Trends in government interest patents (results are preliminary)

Patents in Technology Transfer (TT)

- **Economists view TT as taking place within "markets for technology"**
- **The characteristics and behaviors of buyers and sellers help identify strengths and weaknesses in these markets**
  - E.g. information differences between buyers and sellers lead to too few transactions (called "market failure").
- **Patents play an important role:**
  - They allow sellers to enter the market with well-defined and protected property right that describes the technology
  - Help to overcome information problems that lead to market failure
- **But – markets for technology are hard to analyze because information on market participants and transactions are notoriously difficult to obtain**

Two Main Sources of Information on Government Interest Patents

1. USPTO patent documents

2. USPTO patent assignments database

Bayh-Dole Act of 1980

1. **Permits nonprofit organizations, small business firms, and large businesses (under Executive Order 12591) to retain title to a subject invention, 35 U.S.C. 202(a).**
   - These entities can patent inventions partially or wholly funded by the Federal government

2. **Bayh-Dole imposes several requirements, one of these creates a record in the text of the patent document.**

3. **The patent specification must include:**

"This invention was made with government support under (identify the *contract*) awarded by (identify the Federal agency)."

Bayh-Dole and Other Tech Transfer Legislation

1. Inventions under the Bayh-Dole Act, CRADAs and other mechanisms (typically) require recording a “government use license” or “confirmatory license”

2. These licenses usually say the federal government has:

A nonexclusive, nontransferable, irrevocable, paid-up, world-wide license in this subject invention, patent application, and any resulting patent to practice or to have practiced for or on behalf of the United States throughout the world

3. When submitted by various patent holders and agencies, the USPTO records this information in its “assignment database”

Patent Text vs Assignments (1981-2017)

Government Interest in Patent Text
124,418 patents
(89% unique)

Assignment of Confirmatory License
65,900 patents
(11% unique)

Public-Private Partnership

PatentsView

A unique visualization and analysis platform with over 40 years of USPTO patent data

https://www.patentsview.org

PatentsView USPTO

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RELATIONSHIPS

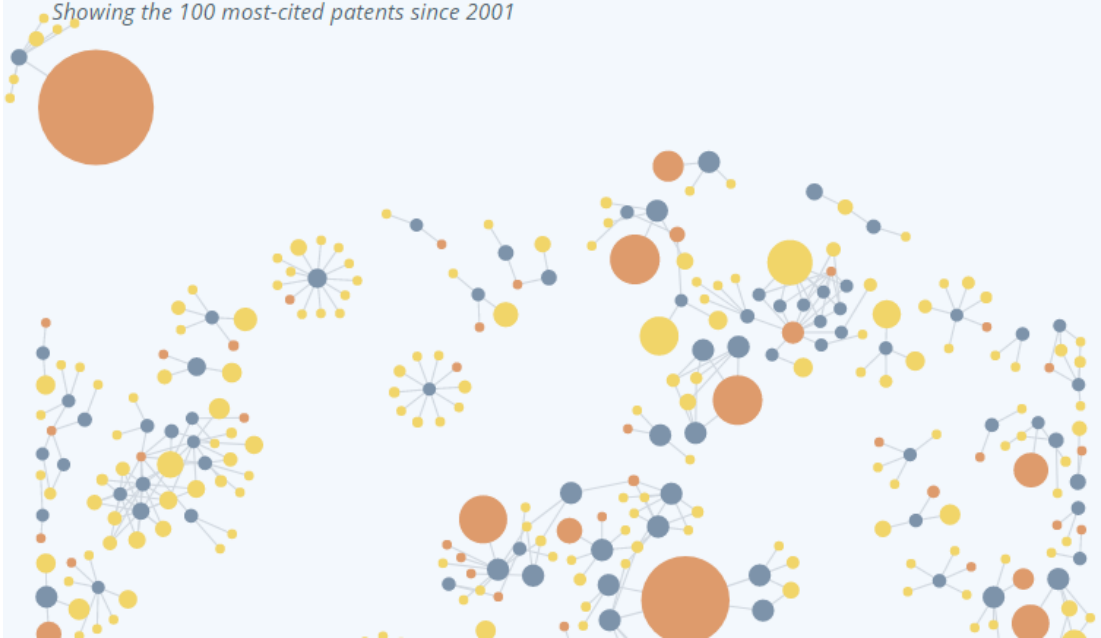
EXPORT

Inventions that Propel Innovation

A patent's influence can be gauged by the number of times it is cited by later patents building on its innovation. Every patent starts with an inventor or a team of inventors and typically a company, university, research lab, or other patent-owning entity – called an *assignee* – that employs them and invests in their innovation. Take a look at the inventors and assignees behind the top 100 most-cited patents granted since 2001.

● Patents ● Inventors ● Assignees

Showing the 100 most-cited patents since 2001

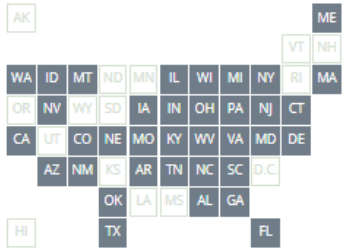


SHOW PATENTS FOR:

select a location or tech area

RELATED LOCATIONS

U.S. STATE

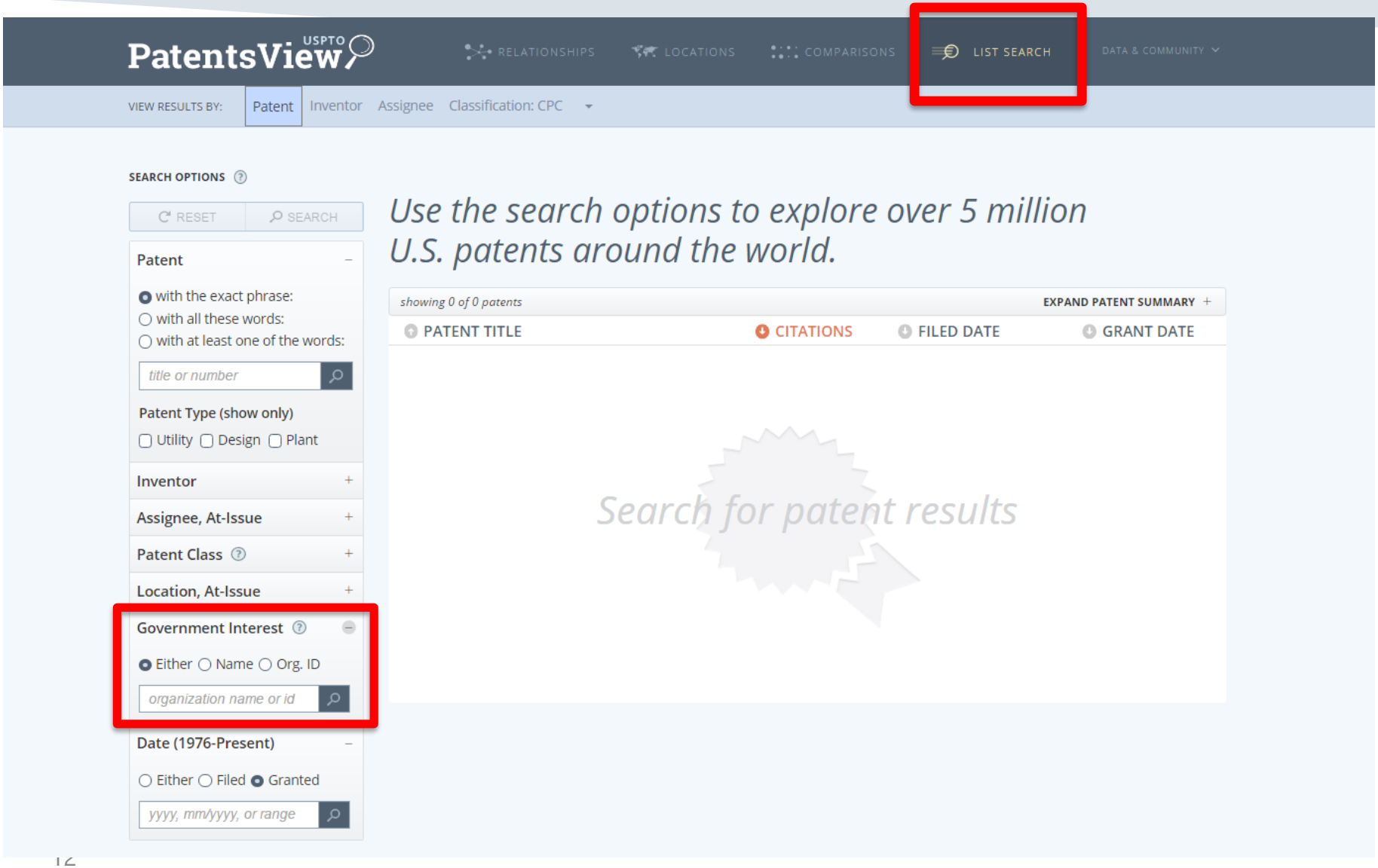


COUNTRY

Brazil

Canada

China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title or number
Patent Type (show only)
Utility
Design
Plant
Inventor
Assignee, At-Issue
Patent Class
Location, At-Issue
Government Interest
Either
Name
Org. ID
organization name or id
Date (1976-Present)
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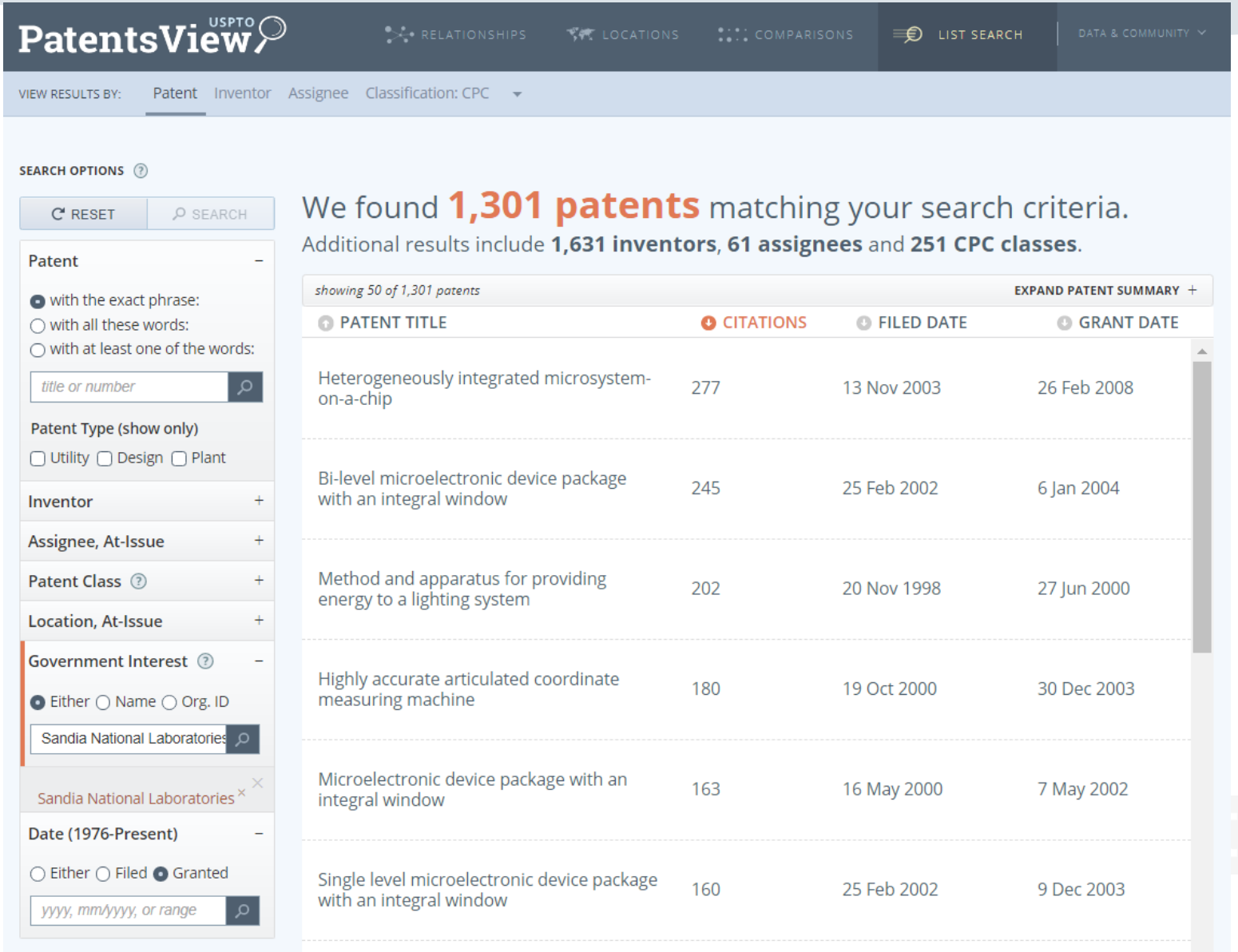
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title or number
Patent Type (show only)
Utility Design Plant
Inventor
Assignee, At-Issue
Patent Class
Location, At-Issue
Government Interest
Either Name Org. ID
Sandia National Laboratories
Sandia National Laboratories
Date (1976-Present)
Either Filed Granted
yyyy, mm/yyyy, or range
We found 1,301 patents matching your search criteria.
Additional results include 1,631 inventors, 61 assignees and 251 CPC classes.
showing 50 of 1,301 patents
EXPAND PATENT SUMMARY
PATENT TITLE
CITATIONS
FILED DATE
GRANT DATE
Heterogeneously integrated microsystem-on-a-chip 277 13 Nov 2003 26 Feb 2008
Bi-level microelectronic device package with an integral window 245 25 Feb 2002 6 Jan 2004
Method and apparatus for providing energy to a lighting system 202 20 Nov 1998 27 Jun 2000
Highly accurate articulated coordinate measuring machine 180 19 Oct 2000 30 Dec 2003
Microelectronic device package with an integral window 163 16 May 2000 7 May 2002
Single level microelectronic device package with an integral window 160 25 Feb 2002 9 Dec 2003

PATENT DETAILS

Heterogeneously integrated microsystem-on-a-chip

A microsystem-on-a-chip comprises a bottom wafer of normal thickness and a series of thinned wafers can be stacked on the bottom wafer, glued and electrically interconnected. The interconnection layer comprises a compliant dielectric material, an interconnect structure, and can include embedded passives. The stacked wafer technology provides a heterogeneously integrated,... *more*

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PATENT INFORMATION

PROCESSING TIME

CPC Filing Year Avg: 959 days **This Patent:** 1566 days

FILED
Nov 13, 2003

GRANTED
Feb 26, 2008

PUBLICATION NUMBER
US7335972

PATENT TYPE
Utility

CLASS TYPE

CPC: H01L - Semiconductor devices; electric solid state devices not otherwise provided for

B81C - Processes or apparatus specially adapted for the manufacture or treatment of microstructural devices or systems

NBER: 46 - Semiconductor Devices

USPC: 257 - Active solid-state devices (e.g., transistors, solid-state diodes)

INVENTORS

1. **Rajen Chanchani**
   Mayo, SC, US

ASSIGNEES AT-ISSUE

1. **Sandia Corporation**
   Albuquerque, NM, US

GOVERNMENT ORGANIZATION(S)

ID	NAME
10	Department of Energy (DOE)
47	Sandia National Laboratories (SNL)

GOVERNMENT INTEREST STATEMENT

This invention was made with Government support under contract no. DE-AC04-94AL85000 awarded by the U.S. Department of Energy to Sandia Corporation. The Government has certain rights in the invention.

Example Patent

(12) **United States Patent**
Caimi et al.

(10) **Patent No.: US 7,897,396 B2**
(45) **Date of Patent: *Mar. 1, 2011**

(54) ***ZYMOMONAS* WITH IMPROVED ETHANOL PRODUCTION IN MEDIUM CONTAINING CONCENTRATED SUGARS AND ACETATE**

(75) Inventors: **Perry G. Caimi**, Kennett Square, PA (US); **Yat-Chen Chou**, Lakewood, CO (US); **Mary Ann Franden**, Centennial, CO (US); **Kyle Knoke**, Newark, DE (US); **Luan Tao**, Havertown, PA (US); **Paul V. Viitanen**, West Chester, PA (US); **Min Zhang**, Lakewood, CO (US); **Yuying Zhang**, New Hope, PA (US)

(73) Assignees: **E.I. du Pont de Nemours and Company**, Wilmington, DE (US); **Alliance for Sustainable Energy LLC**

Zhang et al., Metabolic Engineering of a Pentose Metabolism Pathway in Ethanologenic *Zymomonas mobilis*, Science, 1995, vol. 267:240-243.
Lawford et al.,Comparative Energetics of Glucose and Xylose Metabolism in Recombinant *Zymomonas mobilis*, Applied Biochemistry and Biotechnology, 2000, vol. 84-86:277-293.
Kim et al., Kinetic and Nuclear Magnetic Resonance Studies of Xylose Metabolism by Recombinant *Zymomonas mobilis* ZM4(pZB5), Applied and Environmental Microbiology, 2000, vol. 66:186-193.
Joachimsthal et al., Characterization of a High-Productivity Recombinant Strain of *Zymomonas mobilis* for Ethanol Production From Glucose/Xylose Mixtures, Applied Biochemistry and Biotechnology, 2000, vol. 84-86:343-356.
Kim et al., Nuclear Magnetic Resonance Studies of Acetic Acid Inhibition of Rec *Zymomonas mobilis* ZM4)pZB5), Applied Biochemistry and Biotechnology, 2000, vol. 84-86:357-370.
Joachimsthal et al., A Mutant of *Zymomonas mobilis* ZM4 Capable of Ethanol Production From Glucose in the Presence of High Acetate

ZYMOMONAS WITH IMPROVED ETHANOL PRODUCTION IN MEDIUM CONTAINING CONCENTRATED SUGARS AND ACETATE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 60/983,761, filed on Oct. 30, 2007, which application is incorporated herein by reference.

STATEMENT OF GOVERNMENT RIGHTS

This invention was made with United States Government support under Contract No. 04-03-CA-70224 awarded by the Department of Energy and Contract No. DE-AC36-08GO28308 between the United States Department of Energy and the Alliance for Sustainable Energy, LLC, the Manager and Operator of the National Renewable Energy Laboratory. The U.S. Government has certain rights in this invention.

FIELD OF INVENTION

The invention relates to the fields of microbiology and genetic engineering. More specifically, the himA gene, encoding the alpha subunit of the integration host factor, was found to be involved in acetate tolerance of *Zymomonas*. A strain of xylose-utilizing *Zymomonas* with a genetic modification of the himA gene was developed, which exhibits improved ethanol production in the presence of acetate.

BACKGROUND OF INVENTION

ference becomes much greater under adverse conditions. Because of the slow carbon flux, the steady-state level of ATP is also lower with growth on xylose (Kim et al. (2000) Applied and Environmental Microbiology 66(1):186-193), and as a result *Z. mobilis* is far more susceptible to stress and inhibitors when it is grown on this sugar (Joachimsthal et al. (2000) Applied Biochemistry and Biotechnology 84-86:343-356; Kim et al. (2000) Applied Biochemistry and Biotechnology 84-6:357-370). A particular stress encountered in using hydrolyzed lignocellulosic biomass for fermentation is the presence of acetate (Kim et al. (2000) Applied Biochemistry and Biotechnology 84-86:357-370), which is released from the acetylated xylose residues in hemicellulose during pre-treatment and saccharification processes.

Mechanisms for *Z. mobilis* to cope with stress related to acetate and other organic acids remain to be elucidated, and there are no reports in the literature about the genes that play a role in this process. Using rational design to genetically engineer a strain that has higher resistance to acetate is therefore currently not an option. On the other hand, *Z. mobilis* mutants that have greater tolerance for acetate have been described (Joachimsthal et al. (1998) Biotechnol. Lett. 20(2): 137-142; Jeon et al. (2002) Biotechnol. Lett. 24:819-824; US Patent Application 20030162271). Selection after random chemical mutagenesis with nitrosoguanidine (NTG) was used to generate these mutants, but the modified genes that were responsible for the acetate-resistant phenotype were not identified in any of these cases. It was also not determined whether one mutation or multiple mutations were required for better fermentation performance in the presence of acetate. Thus it is currently not known from the studies cited above how to impart acetate tolerance to other strains of *Z. mobilis*

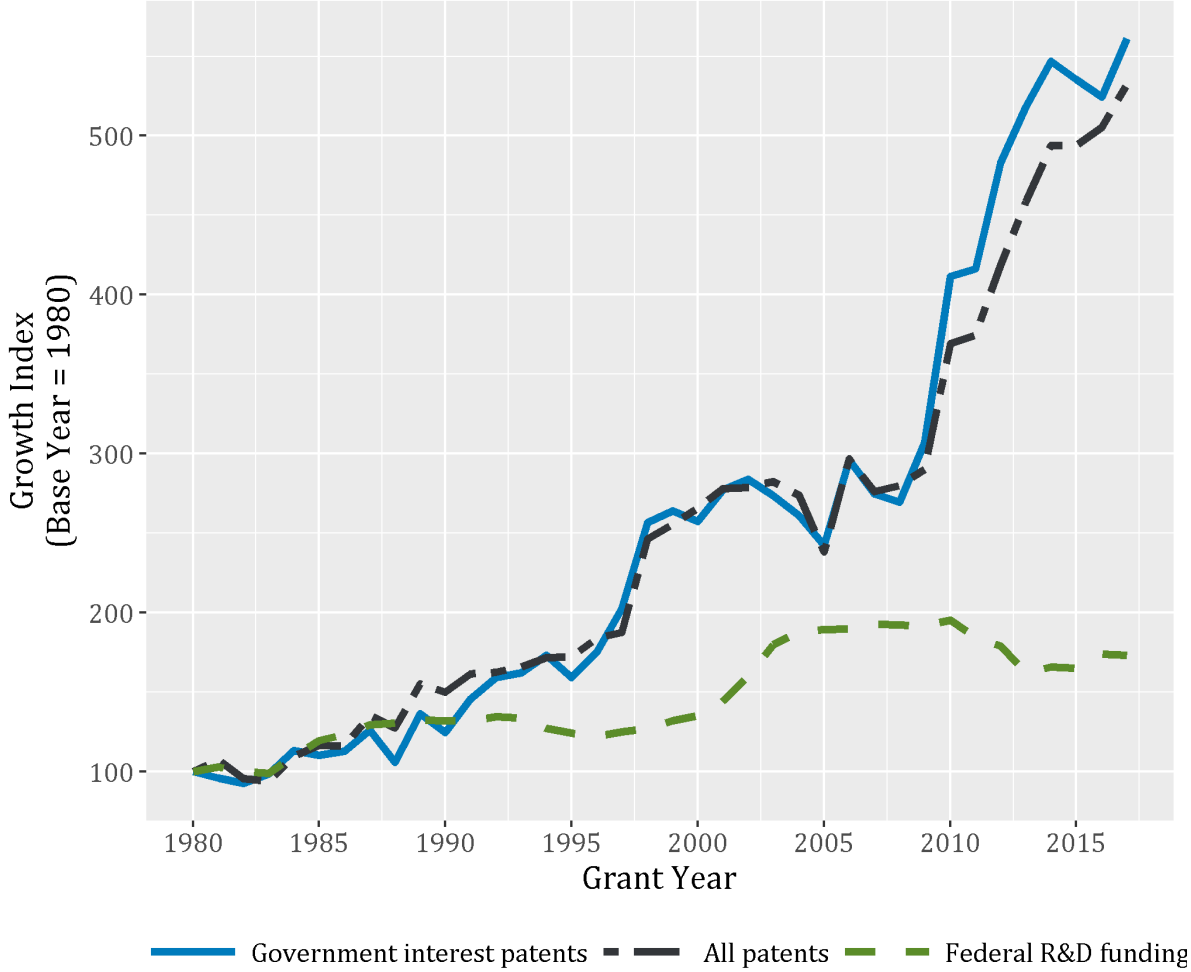
Parsed Government Interest Statement

The invention was made with <ORGANIZATION>United States Government</ORGANIZATION> support under Contract No. 04-03-CA-70224 awarded by the <ORGANIZATION>Department of Energy</ORGANIZATION> and Contract No. DE-AC36-08GO28308 between the <ORGANIZATION>United States Department of Energy</ORGANIZATION> and the <ORGANIZATION>Alliance for Sustainable Energy</ORGANIZATION>, <ORGANIZATION>LLC</ORGANIZATION>, the Manager and Operator of the <ORGANIZATION>National Renewable Energy Laboratory</ORGANIZATION>. The <ORGANIZATION>U.S. Government</ORGANIZATION> has certain rights in this invention.

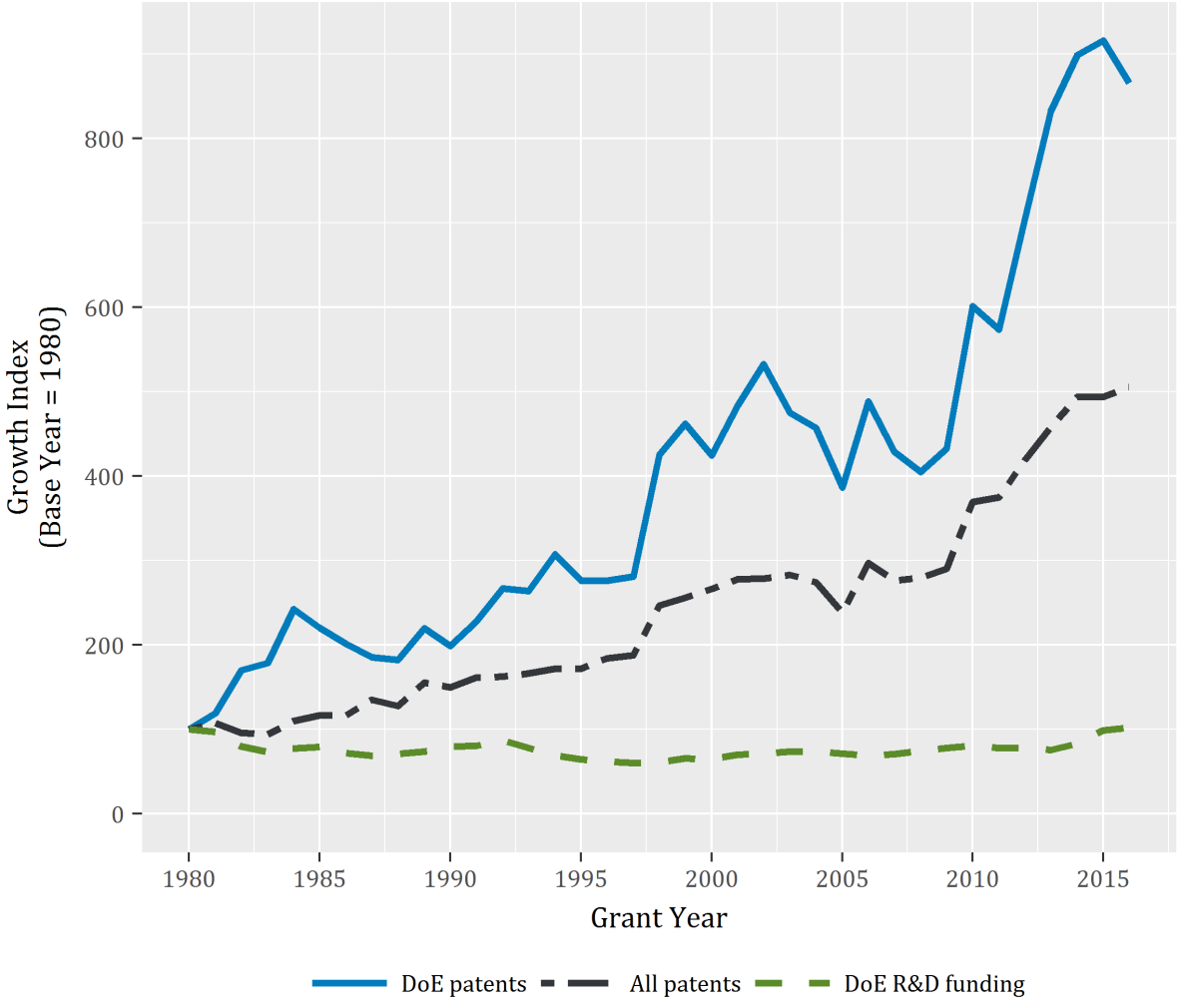
Government Organization(s)	Grant/Contract Award Number(s)
Department of Energy (DOE)	04-03-CA-70224
National Renewable Energy Laboratory (NREL)	DE-AC36-08GO28308

Growth in Government Interest (GI) Patents Since 1980

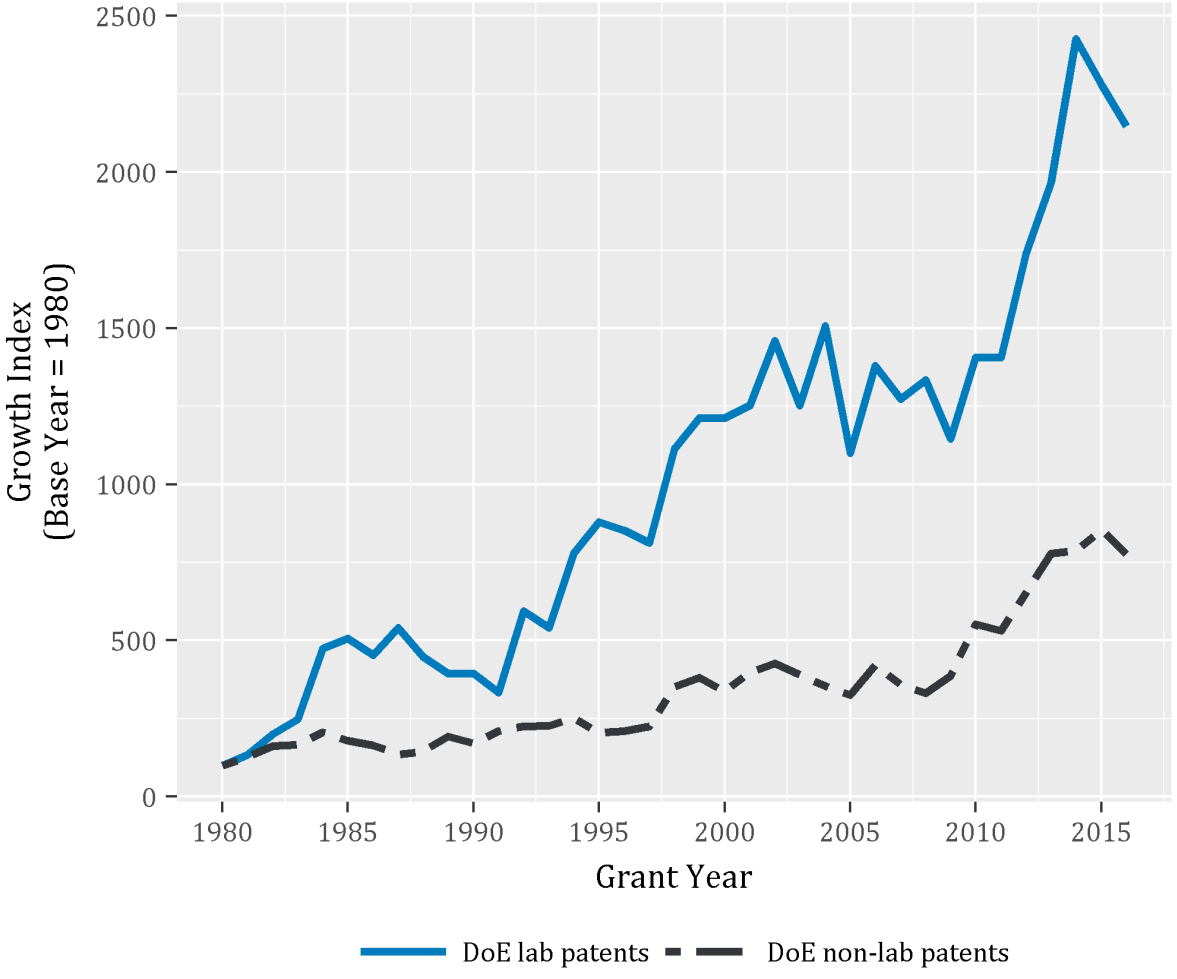
USG GI Patents Show Faster Growth



DOE GI Patents Show Faster Growth

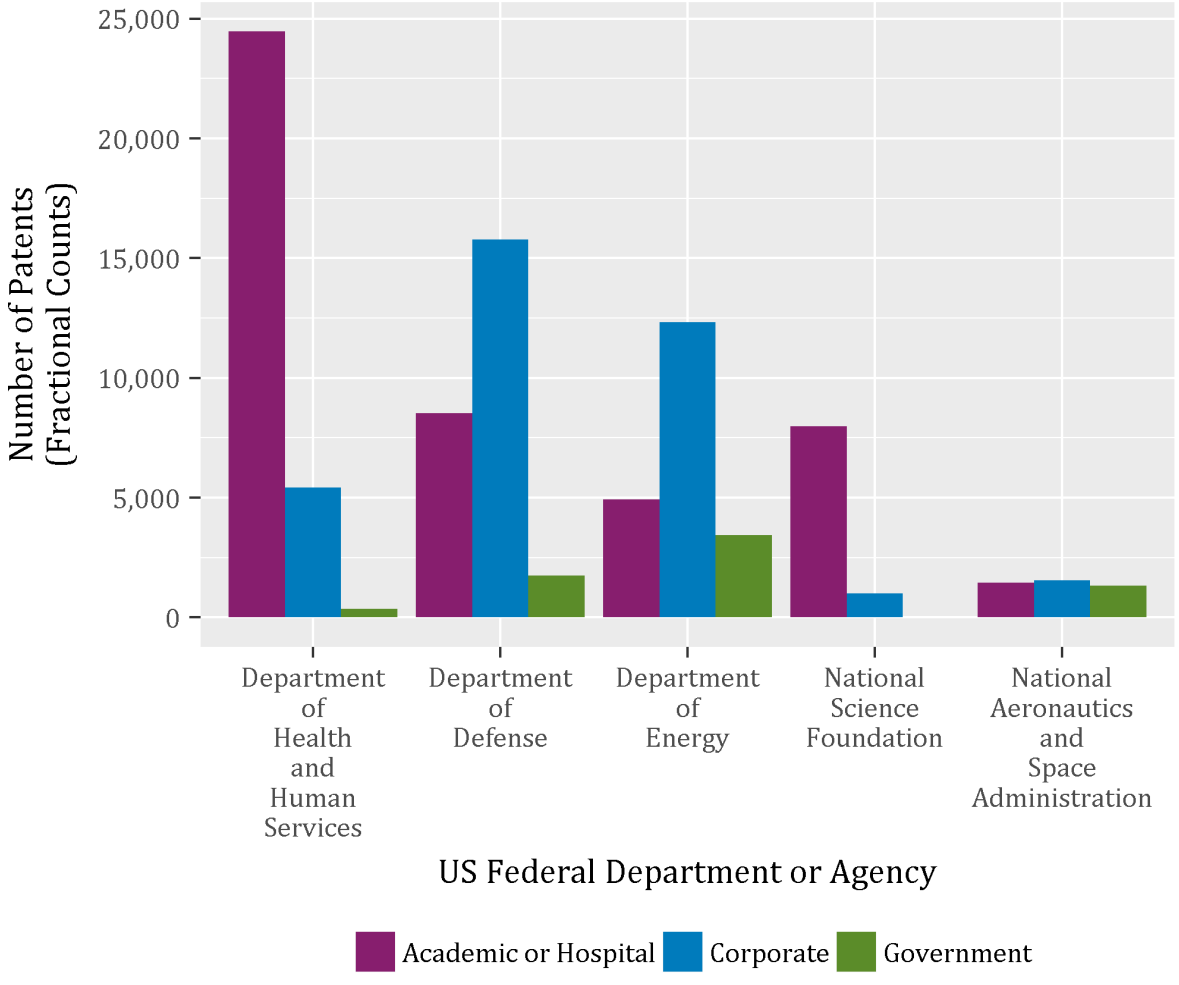


DOE Labs Show Stronger Growth

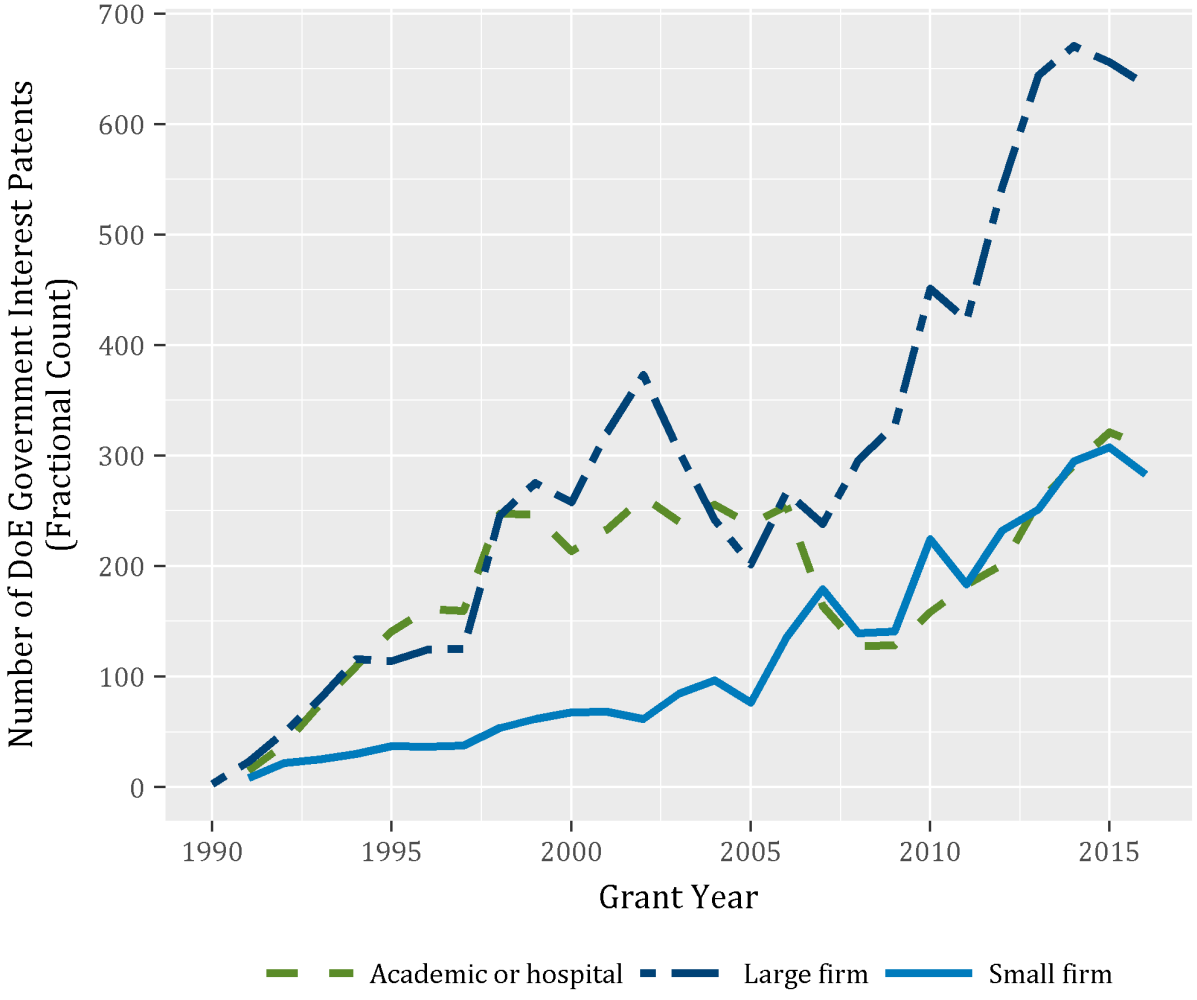


Agencies and Owners of GI Patents

DOE Ranks High Among US Agencies

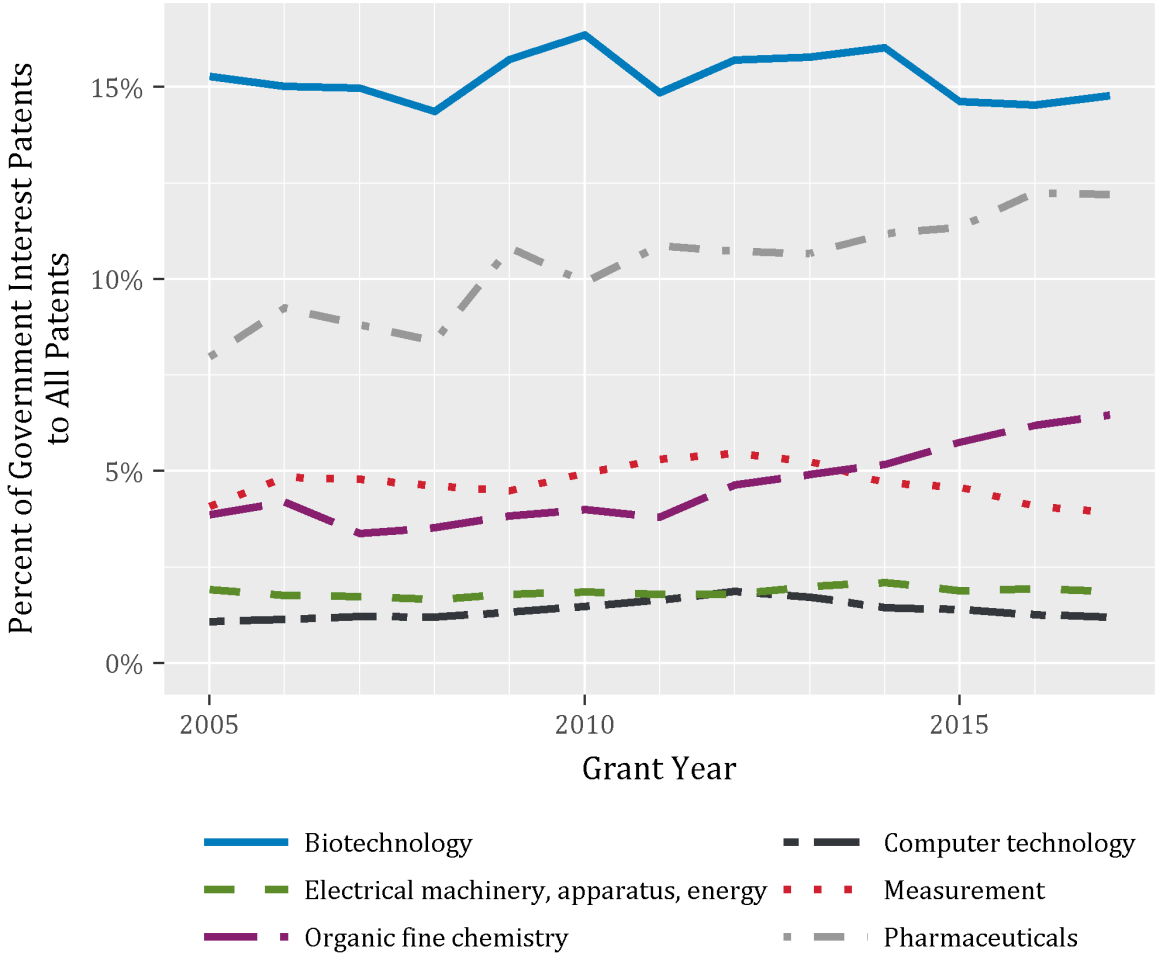


Large Firms Own Most DOE GI Patents

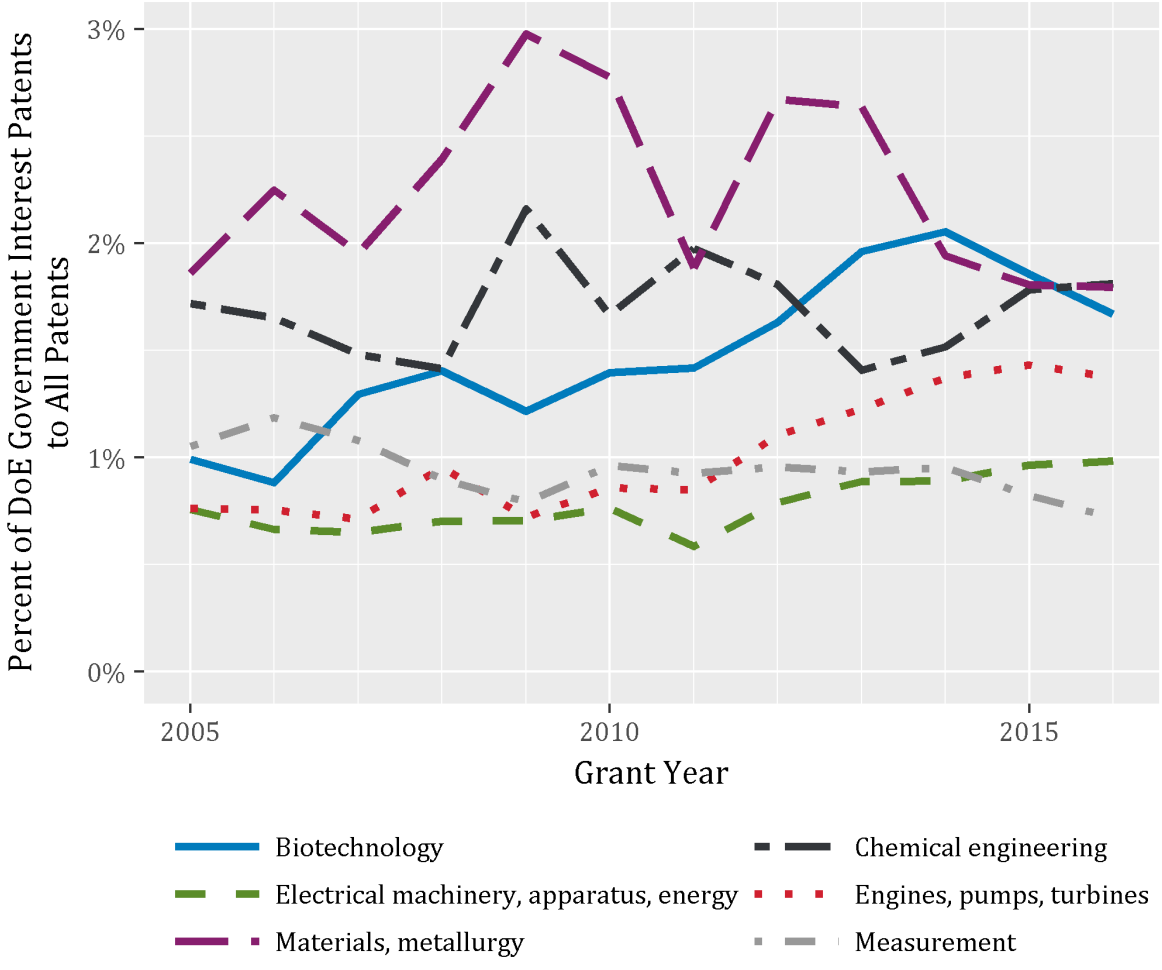


Technology Fields of GI Patents

USG: Biotech/Pharma Have Largest Shares

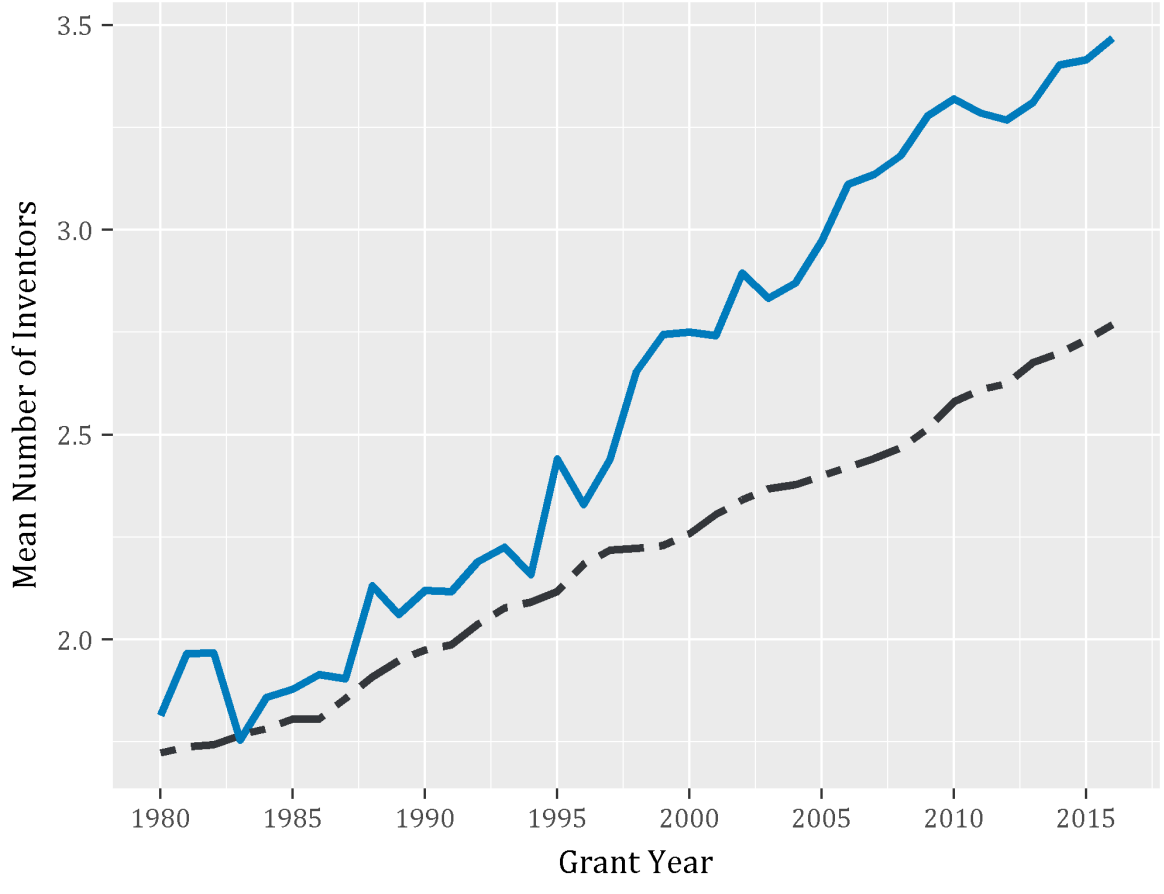


DOE: Materials and Chem Engineering

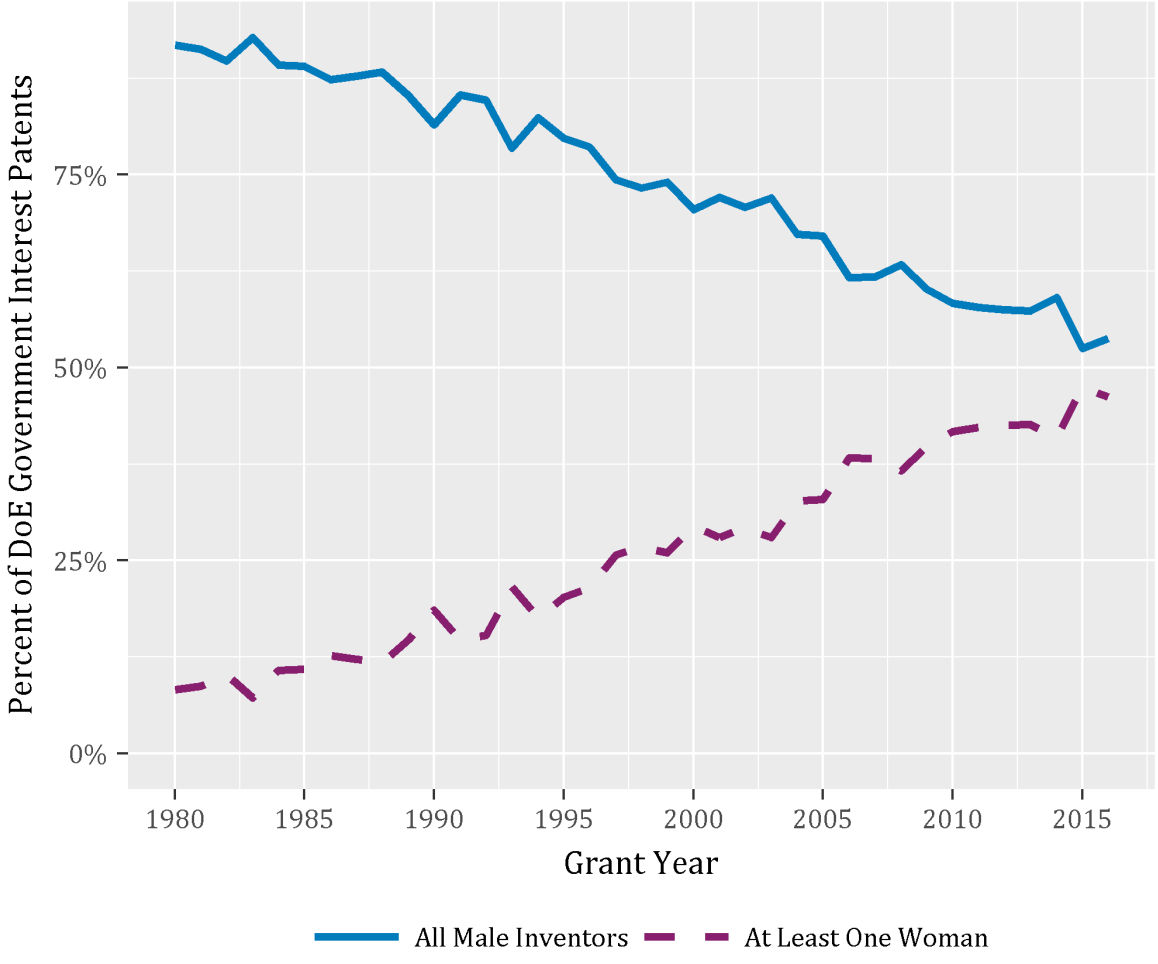


Inventor Teams on GI Patents

DOE Invention Involves Larger Teams



DOE Women Inventorship Trending Up



Concluding Thoughts

- **The paper trail between funding and invention (innovation) created by the Bayh-Dole Act can help agencies such as DOE:**
  - To track technology transfer outcomes
  - To understand trends in inventor teams
  - To see differences across technology areas

- **The USPTO public-private partnership, www.patentsiew.org, is a valuable resource for:**
  - Accessing patent data
  - Visualizing relationships (e.g. between agencies, inventors, and firms)
  - Creating custom datasets and exporting visualizations that help communicate relationships between funding and invention

Thank you

Contact Information

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www.uspto.gov/economics