erVa | NSF Engineering Research Visioning Alliance

NORDP Presentation
November 2, 2023

Conducting Research Intelligence for NSF's Engineering Research Visioning Alliance

OUR MISSION

To identify and develop bold and transformative new engineering research directions and to catalyze the engineering community's pursuit of innovative, high-impact research that benefits society.

Principal Investigators

Tony Boccanfuso
ERVA Co-Principal Investigator
UIDP

Strengthening University-Industry Partnerships

Charles Johnson-Bey
ERVA Co-Principal Investigator
Booz Allen Hamilton

Dorota A. Grejner-Brzezinska
ERVA Principal Investigator
The Ohio State University

BIG ACADEMIC ALLIANCE

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ERVA Co-Principal Investigator
University of New Mexico

EPSCoR/IDeA FOUNDATION

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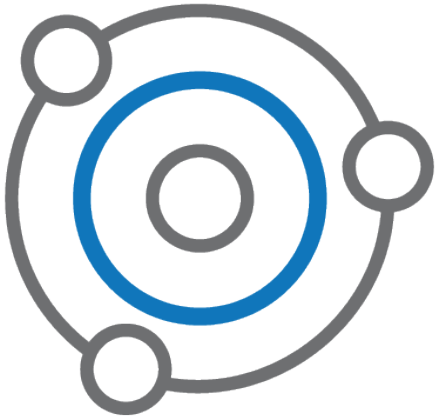
Visioning Events: ERVA's core activity

ERVA Outcomes



Identify lines of research ripe for engineering community pursuit with potential for the greatest benefits to society.

Actionable recommendations for academia, industry, nonprofits, and government.

Raise awareness of the role of engineering to advance the nation's pursuit of high-value, high-return research.

With success: *Increase support for and understanding of engineering research.*

ERVA Activities & Aspirations

Obtain and integrate input from an inclusive and diverse body of engineering stakeholders into one coordinated voice.

Communicate nascent opportunities and priorities in engineering research to stakeholders to increase the pace and American leadership in technological innovation.

Strengthen connectivity across diverse stakeholders, increase cross-fertilization among engineering disciplinary communities, and enhance awareness that engineering contributes to our society.

Research Intelligence Working Group

Mark Schmidt
North Carolina State University, Chair

Emily Devereux
University of South Carolina, Contractor

Carrier Berger
Purdue University Online

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Elsevier Inc

Jian Cao
Northwestern University

Roman Caudillo
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Rutgers University

Mridul Gautam
University of Nevada, Reno

Daniel Noneaker
Clemson University

Connie Stovall
Virginia Tech

RIWG – Charter

- Provide landscape information to the Thematic Task Force with the assistance of the research intelligence contractor
  - Inform and define topics for visioning events
  - Ensure clear communication of data and information needs related to rapid response queries

- Help Thematic Task Force (TTF) with event scope to ensure underserved areas are addressed within each visioning event theme

Our Premise

- A successful visioning event starts with a theme that has a clear role for engineering research that could have transformative societal impact if appropriately resourced

RIWG Evolutions in the Process

- RIWG formed in 2021 –third iteration of process (refinement)
- Considerations
  - Stage in process – feeding, checking or validating
  - Integrity of input (representations)

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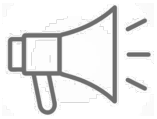
Visioning Process

Research Intelligence

Idea Identification

External Community Listening Sessions



Open Call for Ideas

NSF Input

Due Diligence

Standing Council prioritizes ERVA PI team executes

Theme Development

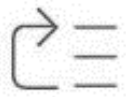
Open Call for Diverse Subject Matter Experts

Research Fellow

Visioning Process

Launch Thematic Task Force

Visioning Event



Nascent Engineering Research Directions Identified

Impact

Catalyze Action

High-Impact Report

Disseminate Broadly

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Current Focus – Landscape Analysis

- Goal
  - Identify trends over the last five years
- Tenets
  - Guided by visioning event themes and subthemes to scan the landscape
- Objectives/uses
  - Identify whether the subtheme is resourced appropriately
  - Create talking points for opening comments
  - Foster discussion using a common language and scope among TTF
  - Show trends in keyword emergence – check TTF knowledge
  - Identify participants
  - Provide keywords for a bibliography of terms for participants

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Current Focus – Landscape Analysis

Process

Identify – meet with taskforce chairs – identify initial keywords

Refine – present and refine individually with subtopic leads

Iterate – revise as needed throughout process

Summarize – final meeting with subtopic leads and TFF – takeaways

Landscape analysis – tools

Funding – federal

Publications – conference proceedings – news articles

Intellectual property – patents

Employment – workforce trends

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Current Focus – Landscape Analysis

- Process
  - Identify – meet with taskforce chairs – identify initial keywords
  - Refine – present and refine individually with subtopic leads
  - Iterate – revise as needed throughout process
  - Summarize – final meeting with subtopic leads and TFF – takeaways

- Landscape analysis – tools
  - Funding – federal
  - Publications – conference proceedings – news articles
  - Intellectual property – patents
  - Employment – workforce trends

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Funding – Landscape Analysis

Two Levels

- Thematic Summaries
- Vertical Summaries

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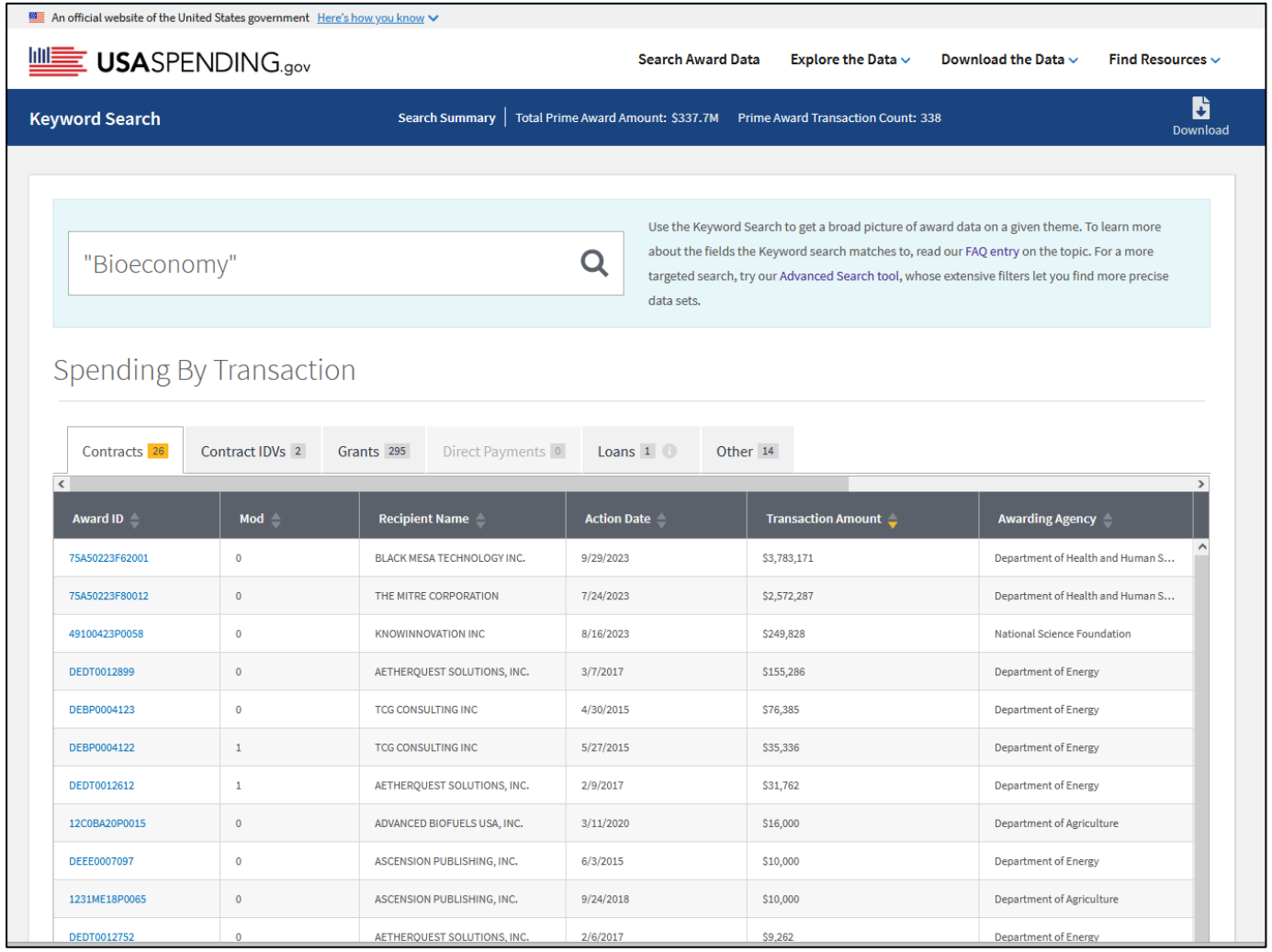
Federal Funding Landscape – Data Sources



Award ID	Mod	Recipient Name	Action Date	Transaction Amount	Awarding Agency
75A50223F62001	0	BLACK MESA TECHNOLOGY INC.	9/29/2023	$3,783,171	Department of Health and Human S...
75A50223F80012	0	THE MITRE CORPORATION	7/24/2023	$2,572,287	Department of Health and Human S...
49100423P0058	0	KNOWINNOVATION INC	8/16/2023	$249,828	National Science Foundation
DEDT0012899	0	AETHERQUEST SOLUTIONS, INC.	3/7/2017	$155,286	Department of Energy
DEBP0004123	0	TCG CONSULTING INC	4/30/2015	$76,385	Department of Energy
DEBP0004122	1	TCG CONSULTING INC	5/27/2015	$35,336	Department of Energy
DEDT0012612	1	AETHERQUEST SOLUTIONS, INC.	2/9/2017	$31,762	Department of Energy
12C0BA20P0015	0	ADVANCED BIOFUELS USA, INC.	3/11/2020	$16,000	Department of Agriculture
DEEE0007097	0	ASCENSION PUBLISHING, INC.	6/3/2015	$10,000	Department of Energy
1231ME18P0065	0	ASCENSION PUBLISHING, INC.	9/24/2018	$10,000	Department of Agriculture
DEDT0012752	0	AETHERQUEST SOLUTIONS, INC.	2/6/2017	$9,262	Department of Energy

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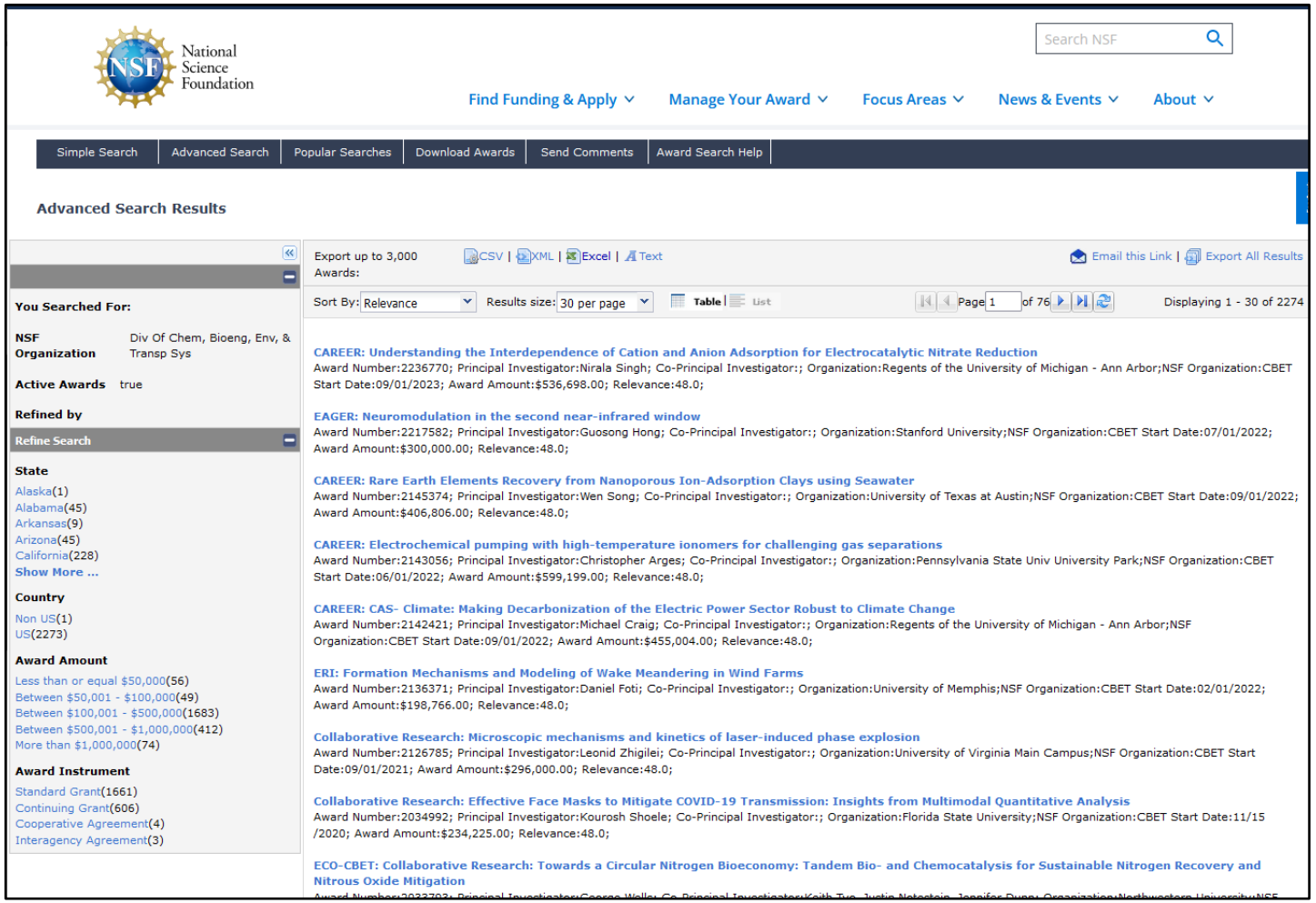
Federal Funding Landscape – Data Sources



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Federal Funding Landscape

total_obligated_amount	Start Date	End Date	Awarding Agency	Awarding Sub Agency	Awarding Office	object_classes_funding_this_award	Program Activity	Recipient	Country	CFDA #	CFDA Title	Prime Award Description
$ 489,911	2/15/2018	2/14/2022	Department of Agriculture	National Institute of Food and Agriculture	INSTITUTE OF BIOENERGY, CLIMATE, AND ENVIRONMENT (IBCE)	41.0: Grants, subsidies, and contributions	0005: AGRICULTURE FOOD AND RESEARCH INITIATIVE	AUBURN UNIVERSITY	USA	10.31	AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI)	[illegible] COSMETICS, AND PHARMACEUTICAL INDUSTRIES. SHORT-CHAIN ESTERS CAN ALSO BE USED FOR SOLVENTS, COATINGS, PAINTS, AND FUEL COMPONENTS. IT IS PROJECTED THAT THE US MARKET DEMAND FOR FATTY ACID ESTERS WILL REACH $4.34 BILLION BY 2022. WHILE THE TRADITIONAL APPROACHES FOR ESTER PRODUCTION THROUGH PETROLEUM CHEMICAL ROUTES ARE HIGHLY ENERGY-CONSUMING AND GENERATE A LARGE AMOUNT OF ENVIRONMENTAL POLLUTANTS, MORE AND MORE INTERESTS HAVE BEEN EVOKED RECENTLY FOR ESTER PRODUCTION THROUGH BIOLOGICAL ROUTES. THERE ARE GENERALLY TWO MICROBIAL PATHWAYS FOR ESTER PRODUCTION, EITHER BY ALCOHOL ACYL TRANSFERASES (AATS) WITH ACYL-COA AND ALCOHOLS AS FEEDING COMPOUNDS, OR BY LIPASE WITH FATTY ACID AND ALCOHOL AS REACTING MATERIALS. NON-PATHOGENIC CLOSTRIDIUM HAS TREMENDOUS SIGNIFICANCE FOR INDUSTRIAL BIOCHEMICAL PRODUCTION. WITH THE ANAEROBIC FERMENTATION PATHWAY, IT CAN GENERATE ACYL-COAS (ACETYL-COA AND BUTYL-COA), ACIDS (ACETIC ACID AND BUTYRIC ACID), AND ALCOHOLS (ETHANOL AND BUTANOL). THEREFORE, IN THIS PROJECT, WE PROPOSE TO USE CLOSTRIDIUM AS A PLATFORM TO BE METABOLICALLY ENGINEERED FOR ESTER PRODUCTION, PARTICULARLY FOR BUTYL BUTYRATE (BB) PRODUCTION. FIRST, BASED ON THE CRISPR-CAS SYSTEM THAT WE RECENTLY DEVELOPED FOR GENOME ENGINEERING, WE WILL ENGINEER THE CLOSTRIDIUM STRAIN FOR ENHANCED BUTYRYL-COA/BUTYRATE AND BUTANOL CO-PRODUCTION, PROVIDING FEEDING COMPOUNDS FOR BB PRODUCTION. FURTHER, WE WILL ENGINEER THE MODIFIED STRAIN FOR BB PRODUCTION, BY INTRODUCING LIPASE GENES (PRODUCING BB FROM BUTYRIC ACID AND BUTANOL) AND AAT GENES (PRODUCING BB FROM BUTYRYL-COA AND BUTANOL). MEANWHILE, WE WILL DEVELOP A GENOME-SCALE METABOLIC MODEL, TO GUIDE OUR FURTHER METABOLIC OPTIMIZATION FOR ENHANCED BB PRODUCTION. ULTIMATELY, WE WILL ESTABLISH A BIOPROCESS BASED ON THE METABOLICALLY STABLE CLOSTRIDIUM STRAINS FOR RENEWABLE ESTER PRODUCTION FROM LOW-VALUE CARBON SOURCES.THIS PROJECT AIMS TO TACKLE A KEY ISSUE RELATED TO BIOFUEL/BIOCHEMICAL PRODUCTION BY PRODUCING A HIGH VALUE BIOPRODUCT THAT IS EASILY RECOVERABLE, THUS DECREASING ENDPRODUCTS TOXICITY AND IMPROVING FEEDSTOCK CONVERSION EFFICIENCY AND PRODUCT PRODUCTION RATE. THIS RESEARCH ALIGNS WELL WITH THE PRIORITY AREA OF "BIOPROCESSING AND BIOENGINEERING". VALUE-ADDED BB WILL BE PRODUCED FROM LOW-VALUE MATERIALS THROUGH OPTIMIZED BIOPROCESS USING ENGINEERED MICROORGANISM. THIS REPRESENTS A POTENTIALLY TRANSFORMATIVE RESEARCH WHICH CAN LEAD TO AN ENABLING BIOPROCESS IN SUPPORT OF THE US BIOECONOMY. IT ALIGNS WELL WITH THE US ENDEAVORS TO FOSTER THE [illegible]
1000000	4/1/2018	3/31/2022	Department of Agriculture	National Institute of Food and Agriculture	INSTITUTE OF BIOENERGY, CLIMATE, AND ENVIRONMENT (IBCE)	41.0: Grants, subsidies, and contributions	0005: AGRICULTURE FOOD AND RESEARCH INITIATIVE	REGENTS OF THE UNIVERSITY OF MINNESOTA	USA	10.31	AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI)	WITH SIGNIFICANT POTENTIAL FOR IMPROVING RURAL ECONOMIES OF THE MIDWESTERN UNITED STATES. POPLARS ARE AMONG THE MOST TESTED AND PROMISING WOODY ENERGY CROP FOR THE MIDWEST. THE POTENTIAL FOR ACHIEVING ONE BILLION DRY TONS OF CELLULOSIC BIOMASS PER YEAR NATIONALLY BY 2030 AS DOCUMENTED IN THE DOE 2016 BILLION TON REPORT WILL REQUIRE THE PRODUCTION OF MORE THAN 239 MILLION DRY TONS FROM ENERGY CROPS GROWN ON AGRICULTURAL SOILS. POPLAR CULTURE HAS SIGNIFICANT CAPACITY TO HELP MEET THIS TARGET, AND THE MIDWEST HAS THE ATTRIBUTES TO BE A MAJOR PART OF THE ACREAGE REQUIRED DUE TO ADEQUATE RAINFALL AND A LARGE CROP AND PASTURELAND RESOURCE. THE CURRENT CELLULOSIC ENERGY CROP OUTPUT IN THE UNITED STATES IS VIRTUALLY ZERO, INDICATING THAT AN INTENSIVE RESEARCH, DEVELOPMENT, AND OUTREACH EFFORT WILL BE NEEDED TO MEET THE NATIONAL BIOMASS FEEDSTOCK GOAL WITHIN THE NEXT 13 YEARS.ESTABLISHMENT OF SUCCESSFUL POPLAR PLANTATIONS REQUIRES GENETIC IMPROVEMENTS FOR INCREASED AND CONSISTENT YIELD, DISEASE RESISTANCE, AND BROADENED ADAPTABILITY ACROSS A RANGE OF CLIMATE AND SOIL TYPES. THESE GENETIC PARAMETERS ARE THE BIOLOGICAL LIMITATIONS TO THE EXPANSION OF HYBRID POPLARS ACROSS THE MIDWEST THAT ARE GERMANE TO THE SUSTAINABLE BIOENERGY AND BIOPRODUCTS CHALLENGE AREA RFA. THERE HAVE BEEN SUCCESSFUL LARGE-SCALE COMMERCIAL POPLAR PLANTATIONS IN MINNESOTA, THE PACIFIC NORTHWEST, AND THE MID-SOUTH. IN ALL CASES SUCCESS WAS DUE TO RESEARCH THAT DEVELOPED LOCALLY ADAPTED AND TESTED POPULUS GENOTYPES. THE ECONOMIC VIABILITY OF HYBRID POPLAR IS LIMITED, HOWEVER, BY THE CURRENT SCALE OF BREEDING, SELECTION, AND TESTING, AND VARIES WITH SHIFTS IN COMMODITY AND PETROLEUM PRICES, REGIONAL BIOMASS SOURCES, AND NATIONAL ENERGY POLICIES. GENETIC ADVANCES NEED TO BE COUPLED WITH AN ASSESSMENT OF TRADE-OFFS BETWEEN POPLARS VERSUS COMMODITY CROPS THAT WILL INDICATE IF AND WHEN GROWERS SHOULD MAKE THE DECISION TO PLANT POPLARS. OTHER LIMITATIONS INCLUDE THE SOCIAL ACCEPTANCE OF A MULTI-YEAR CROP BY FARMERS. ALL OF THESE FACTORS HAVE PREVENTED THE WIDESPREAD PLANTING OF HYBRID POPLARS ACROSS THE MIDWEST.DEPENDABLE YIELD IMPROVEMENT WILL DECREASE INVESTMENT RISK AND PRODUCTION COSTS FOR GROWERS AND INDUSTRIAL WOOD USERS BY REDUCING THE AMOUNT OF LAND AND MINIMIZING THE ROTATION LENGTH (YEARS OF GROWING TIME) REQUIRED PER UNIT OF BIOMASS. ADOPTION OF POPLARS AS AN AGRICULTURAL CROP ALSO DEPENDS ON AN EFFECTIVE OUTREACH PROGRAM TO FARMERS, INDUSTRIAL GROWERS, AND FEEDSTOCK PROCESSORS THAT ARE CLOSELY INTEGRATED WITH NEW RESEARCH RESULTS. BIO-REFINERIES AND OTHER PROCESSORS NEED GOOD ESTIMATES OF DEDICATED PLANTATION ACREAGES REQUIRED TO SUPPLY THEIR PLANTS, WHICH IN TURN DEPEND ON PROVEN YIELD VALUES FOR GENETICALLY IMPROVED POPLAR GENOTYPES. NEW BIOECONOMY INDUSTRIES WILL HAVE A PARTICULAR NEED FOR A GUARANTEED BIOMASS SUPPLY IN THE FACE OF COMPETITION FOR WOOD FROM NATURAL FORESTS BY ESTABLISHED FOREST PRODUCTS COMPANIES. FURTHERMORE, POPLAR CULTURE CAN SUPPLY A HIGHER QUALITY BIOMASS (I.E., WOOD) THAN AGRICULTURAL RESIDUES IN NON-FORESTED REGIONS.THE IMMEDIATE GOAL OF THE PROPOSED PROJECT IS TO MAKE MAJOR ADVANCES IN THE YIELD AND FUTURE COMMERCIALIZATION OF POPLAR PLANTATIONS IN THE MIDWESTERN UNITED STATES THROUGH GENETIC DEVELOPMENT, ECONOMIC ANALYSIS, AND ASSOCIATED EXTENSION INNOVATION PROGRAMMING THAT WILL MINIMIZE THE TIME TO ADOPTION OF COMMERCIAL POPLAR CULTURE. THIS WILL BE ACHIEVED BY DEVELOPING UNIQUE AND VALUABLE GENETIC RESOURCES TO SUPPORT CONTINUING AND FUTURE BREEDING EFFORTS, EVALUATING THE ECONOMICS OF POPLARS VERSUS MAJOR AGRICULTURAL CROPS, AND IMPLEMENTING AN EXTENSION PROGRAM CLOSELY

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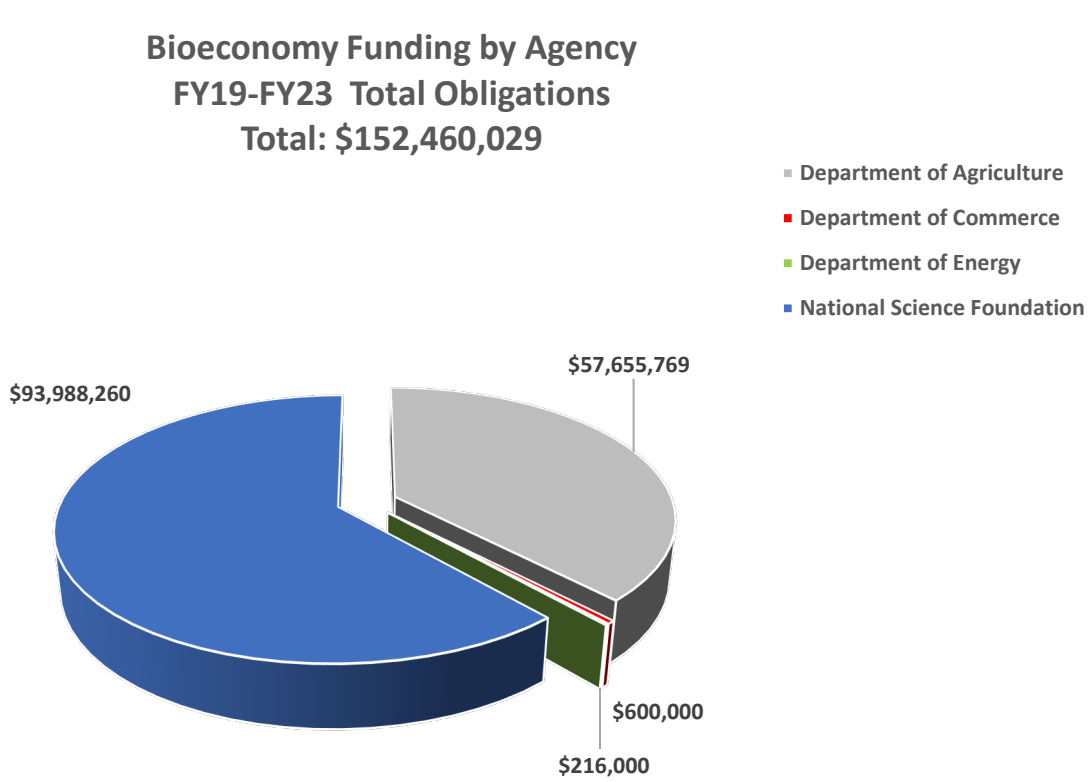
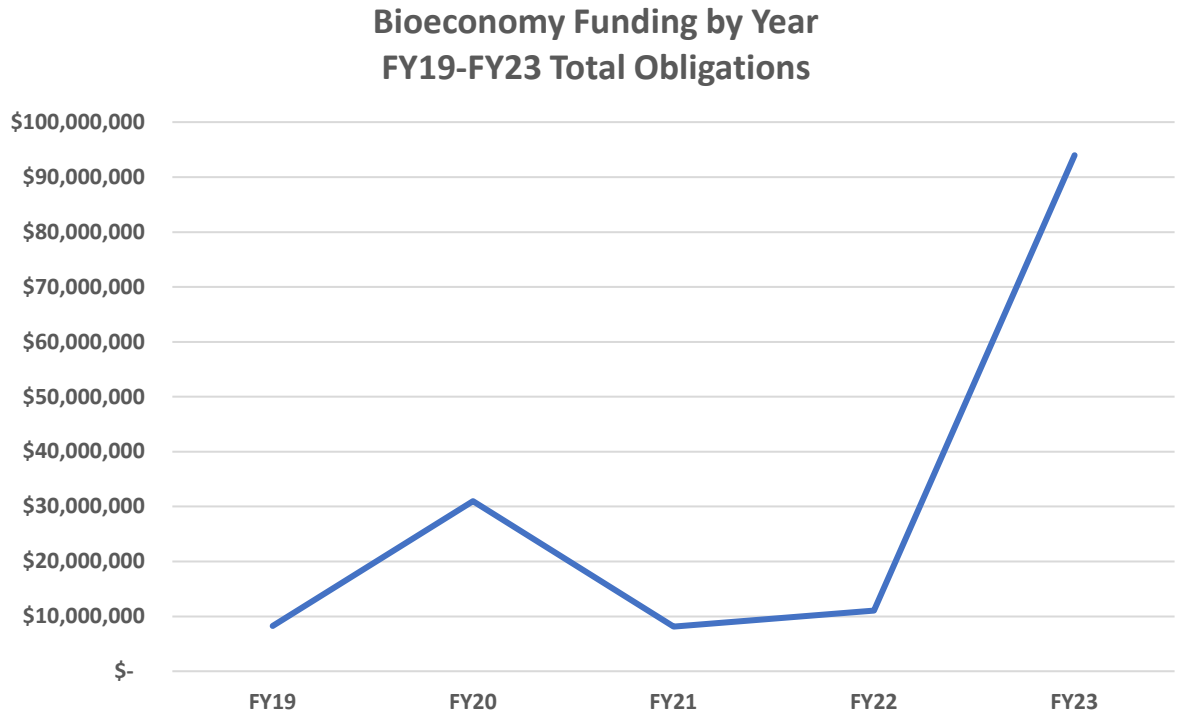
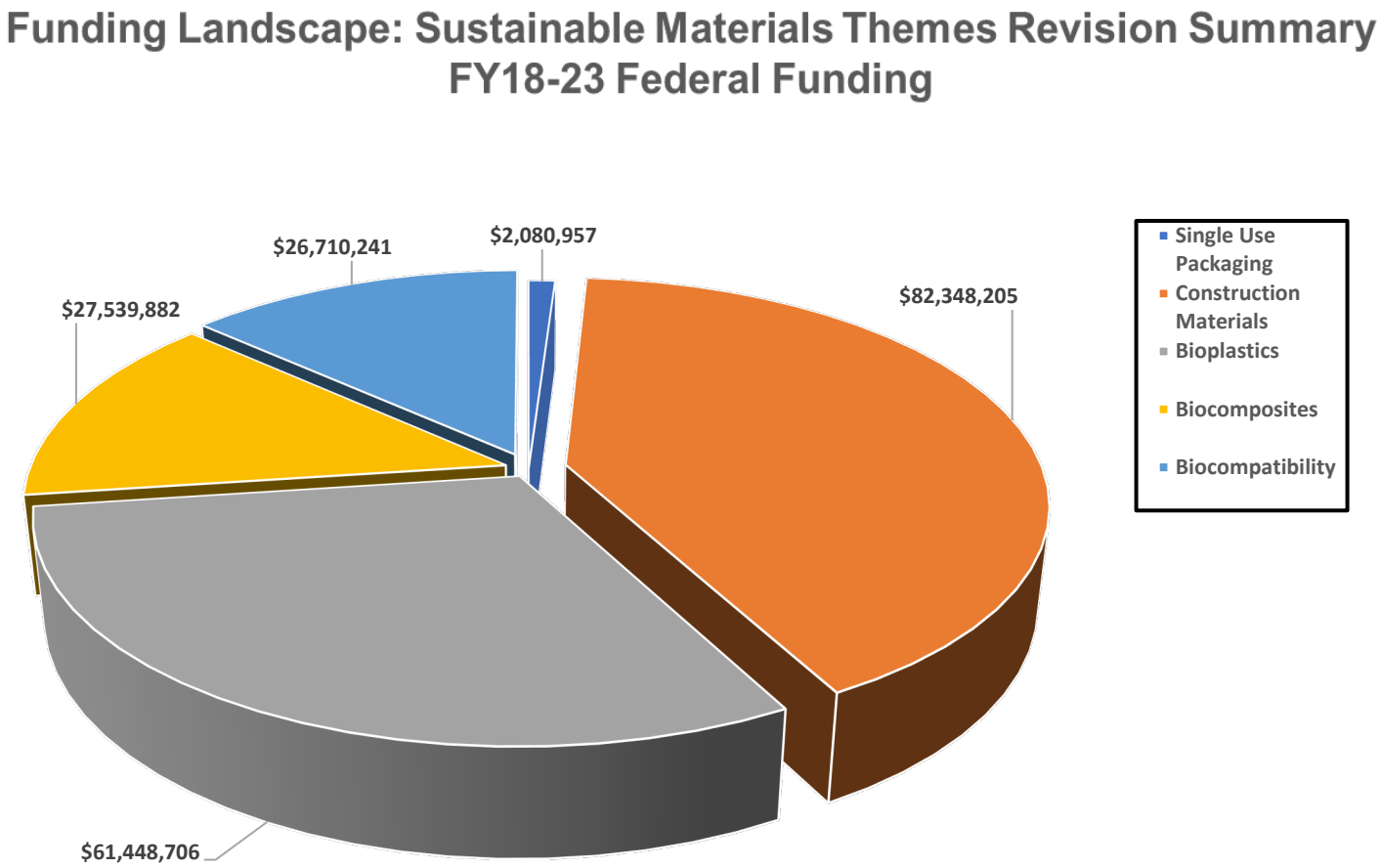
Federal Funding Landscape (Verticals)





Vertical Example:
Sustainable Materials: Chemical: Bioeconomy
Keywords: Abiotic Biotic Interface, Biomaterials, Biomanufacturing, Bioeconomy, Carbon Intensity

Federal Funding Landscape (Thematic Summaries)



Thematic Summary	
Theme	**Total Funding**
Single Use Packaging	$ 2,080,957
Construction Materials	$ 82,348,205
Bioplastics	$ 61,448,706
Biocomposites	$ 27,539,882
Biocompatibility	$ 26,710,241

**Pie Chart excludes DHHS (NIH) in biocomposites.

Publications Landscape Analysis

- Develop keyword search string and apply parameters: time frame, publication type
- Search and save in Scopus for conference proceedings and articles
- Export findings into Bibliometrix and view in Biblioshiny
- Modify findings by combing terms and remove select terms from visualizations
- Topic trends best for this scenario

Scopus

Dimensions

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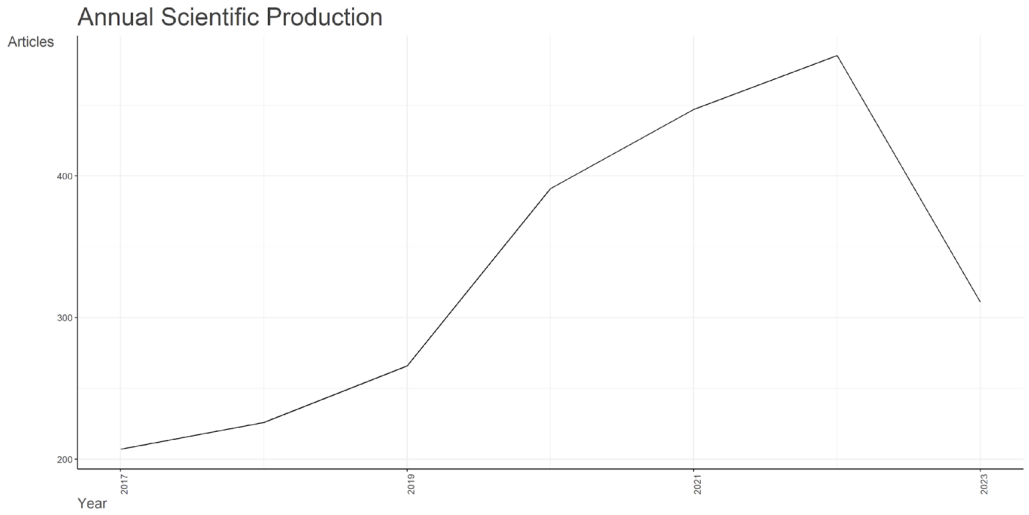
Overview– Alternative Microbials Landscape Analysis

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2017:2023
Sources (Journals, Books, etc)	786
Documents	2333
Annual Growth Rate %	7.02
Document Average Age	2.57
Average citations per doc	19.28
References	152746
DOCUMENT CONTENTS	
Keywords Plus (ID)	15515
Author's Keywords (DE)	5291
AUTHORS	
Authors	10243
Authors of single-authored docs	46
AUTHORS COLLABORATION	
Single-authored docs	47
Co-Authors per Doc	6.09
International co-authorships %	26.45
DOCUMENT TYPES	
article	1633
conference paper	27
review	673



Search string in Scopus: (alternative AND antimicrobial*)
AND
("alternative biotics" OR "machine learning" OR "artificial intelligence" OR bacteriophage OR "repurposed drugs" OR "antimicrobial peptide*" OR "antimicrobial polymer*" OR "drug target*")

Editorials, books, book chapters, datasets excluded

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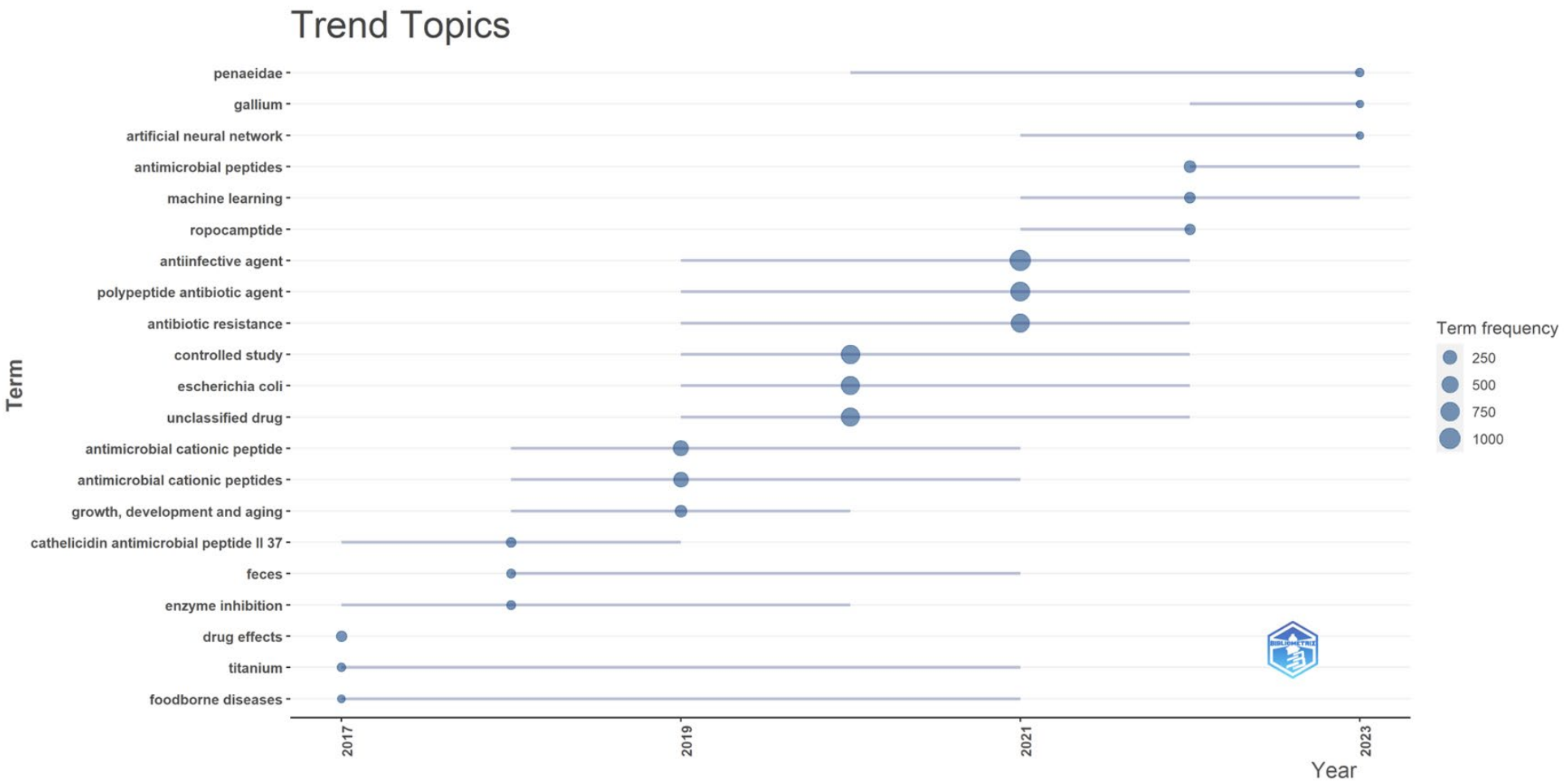
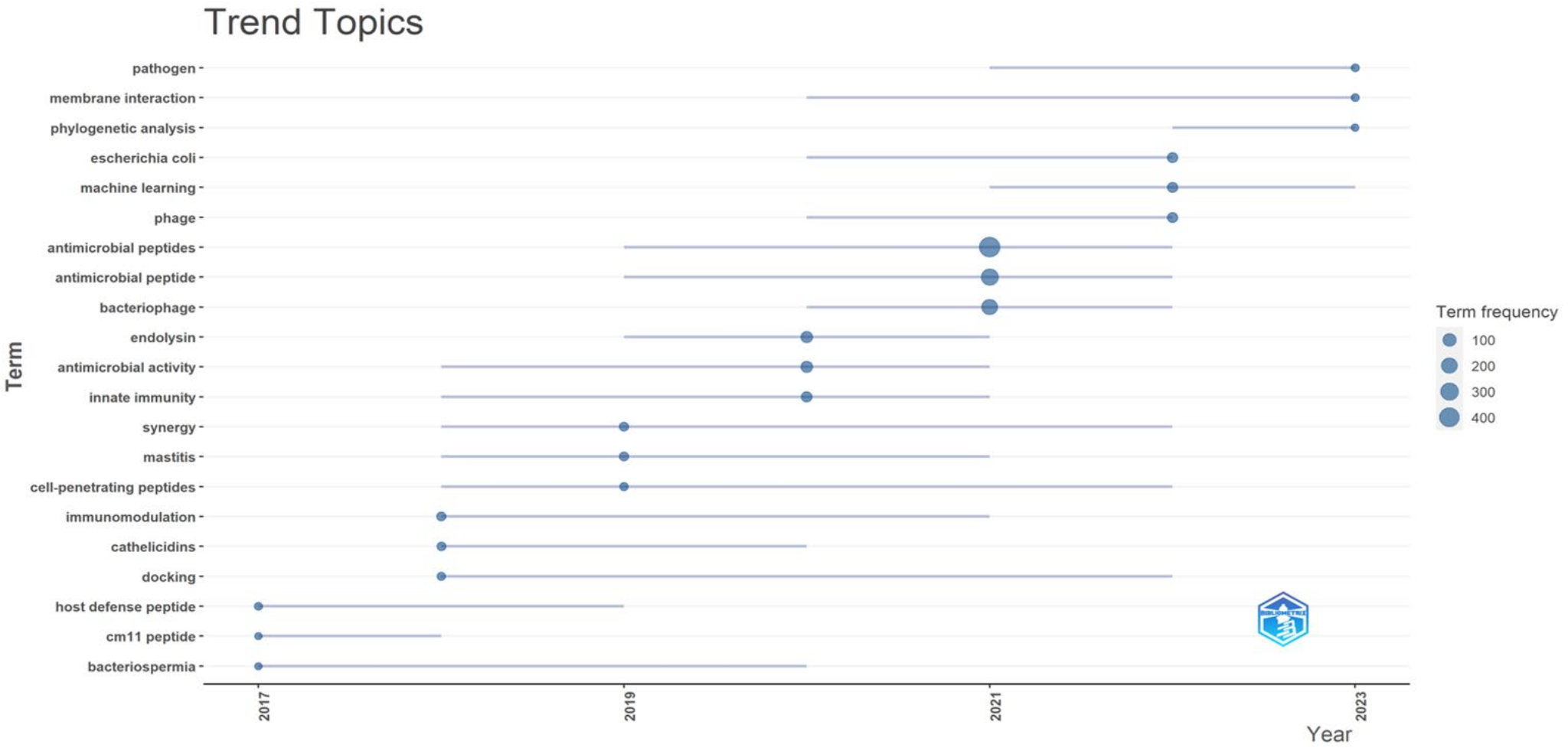
Topic Trends Over Time Based on Keywords Plus



Topic Trends Over Time Based on Researcher Keywords



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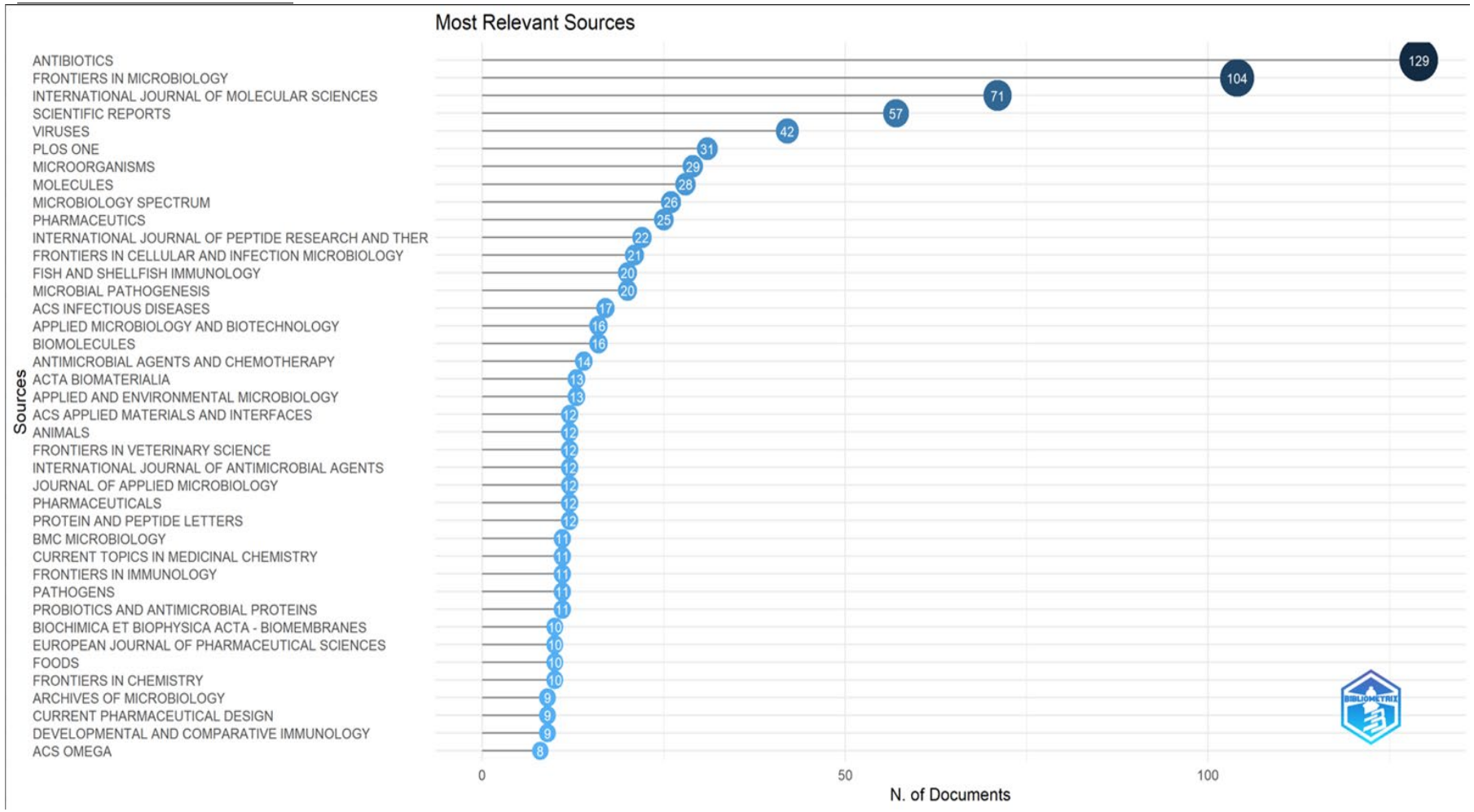
Top 25 Journal Sources



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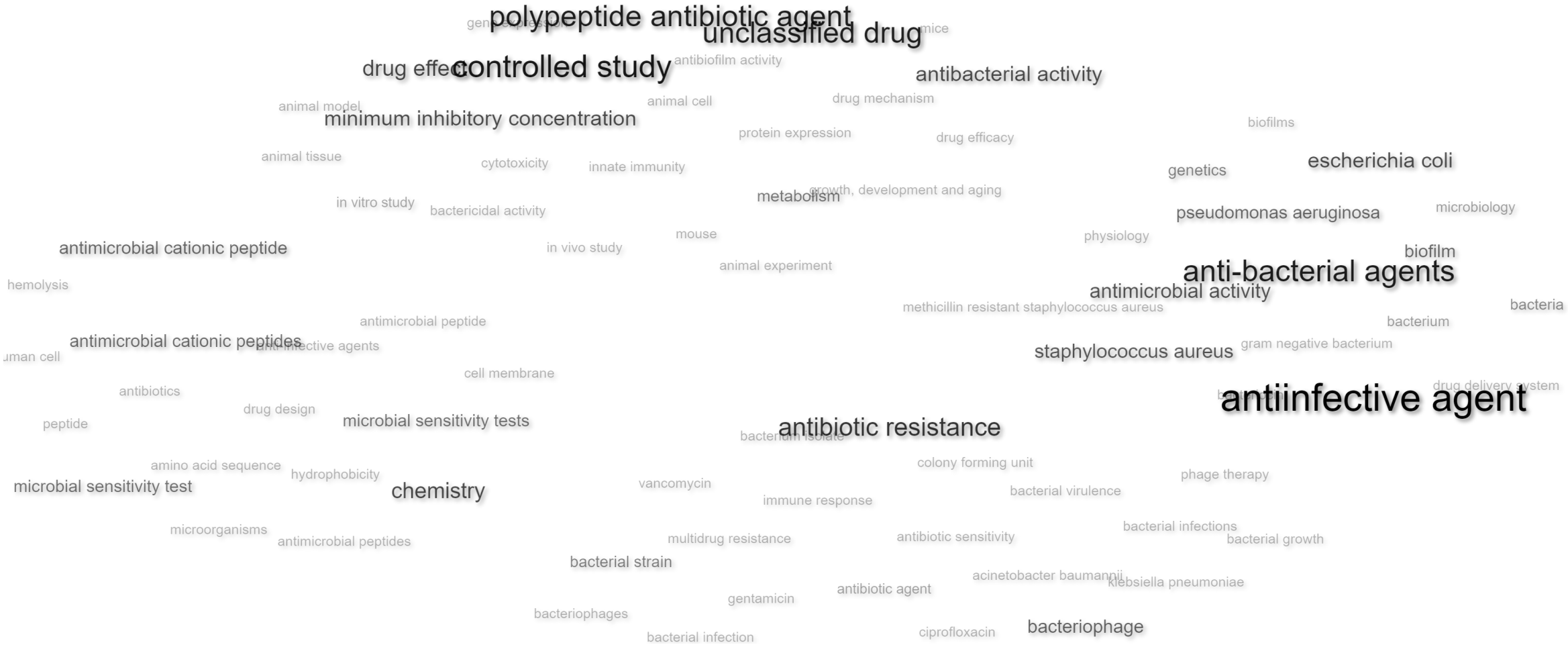
Term Co-Occurrence 2017 – 2023: Keywords Plus, terms only



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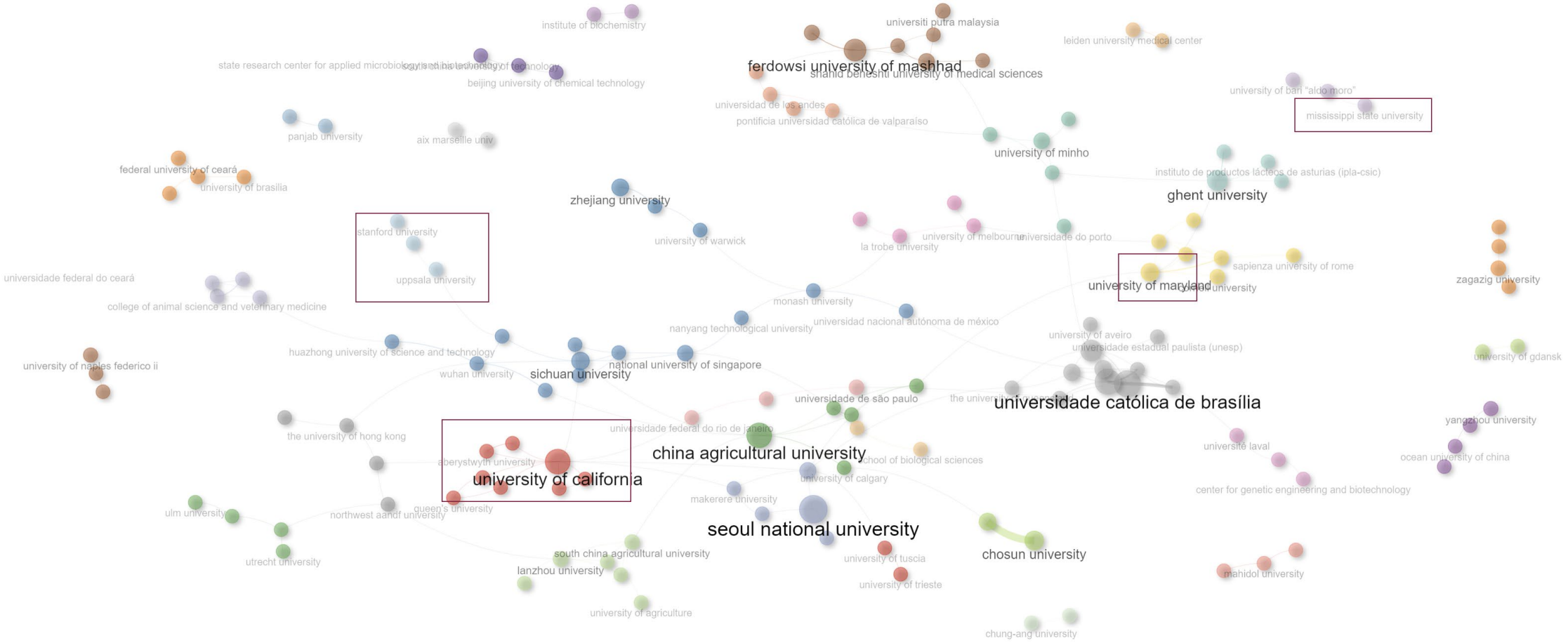
Institutional Collaboration Network 2017 - 2023



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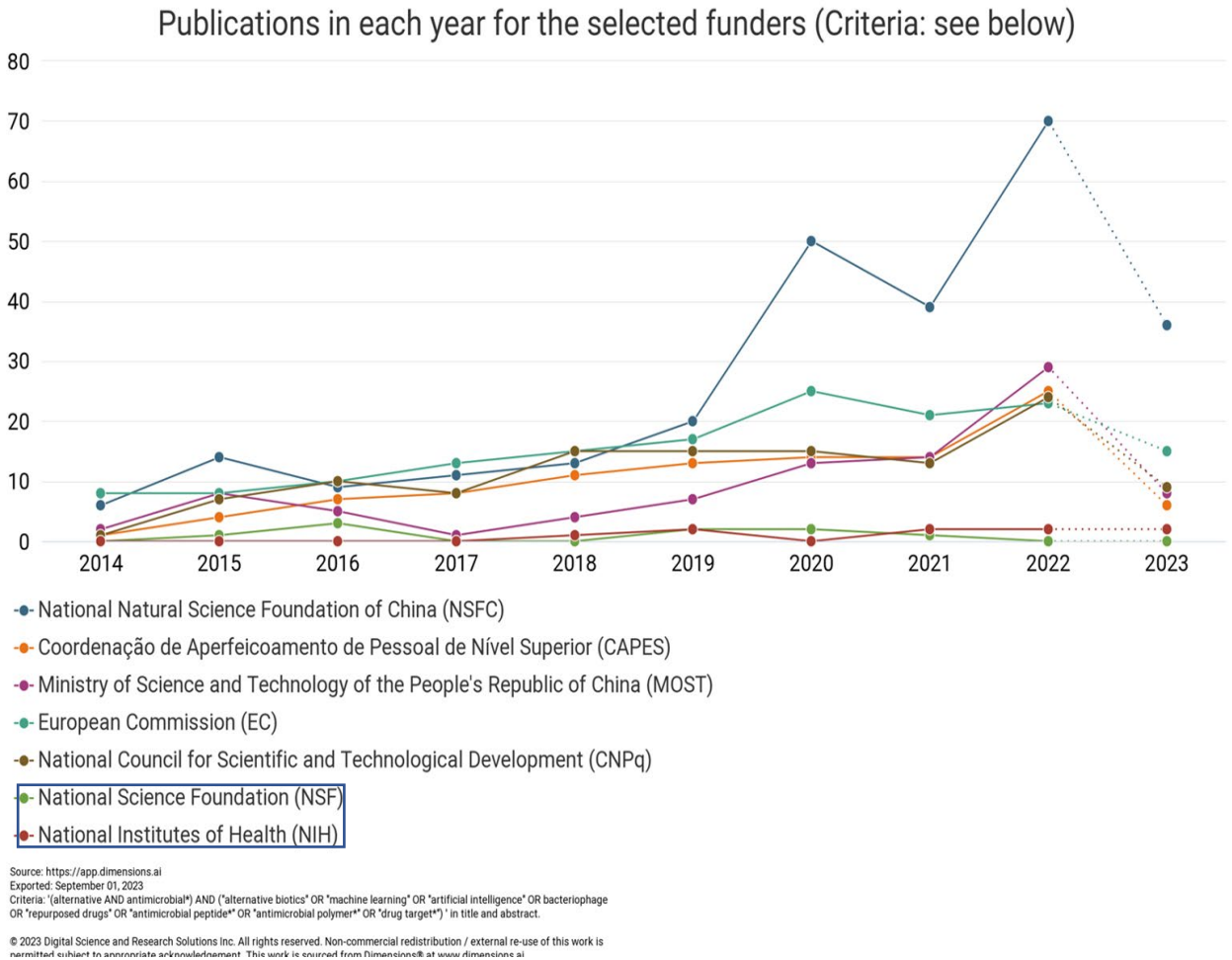
Publication Funding Source Acknowledgements



All publications are rather flat until 2019, when again NSFC demonstrates a sharp increase. NIH and NSF associated publications are the lowest among these funders, although this is not necessarily negative.

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Patents Grouped By Patent Families

Name Organization, Country	↓Patents
Jens-Michael M Schröder University Hospital Schleswig-Holstein, Germany	5
Johnna K Garrish Agricultural Research Service - Southeast Area, United States	4
David Matthew Donovan Beltsville Agricultural Research Center, United States	4
Gregory R Siragusa Agricultural Research Service - Southeast Area, United States	4
Bruce S Seal Oregon State University Cascades, United States	4
Kwang-Min Choi Gyeongsang National University, South Korea	2
Hui-Yun Chen Xiamen University, China	2
Seong Don Hwang National Fisheries Research and Development Institute, South Korea	2
Ke-Jian Wang Xiamen University, China	2
Hui Peng Xiamen University, China	2
Yan-Chao Chen Xiamen University, China	2
Fang-Yi Chen Xiamen University, China	2

ASSIGNEES

United States Department of Agriculture (USDA) United States	5
Kiel University (CAU) Germany	5
Buckman Laboratories (United States) United States	3
Xiamen University (XMU) China	2
Gyeongsang National University (GNU) South Korea	2

PLACES

United States	12
China	8
South Korea	6
Germany	5
Italy	2

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Get Involved!

Please sign up to be an ERVA Champion!

Use your mobile device to scan this QR code and take a brief questionnaire.

Have a great idea?
Send your idea to ERVA!

Use your mobile device to scan this QR code and take a brief questionnaire.

Q&A