

Institute for International Science and Technology Policy
The George Washington University

Cornerstone

INTERNATIONAL SCIENCE AND TECHNOLOGY POLICY

IAFF 6141.10
ROME 204
T 17:10-19:00
Fall 2023

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Note: This course will be delivered in-person with online accommodations (permission required)

Overview

This course provides a comprehensive overview of the policy issues related to the support, use, management, and regulation of science and technology. It addresses US domestic as well as international issues, is concerned with governmental policies as well as non-governmental decisions, and it is focused on both the economics and politics of science and technology issues.

In today's world, scientific discoveries and technological innovations influence almost every aspect of human existence. Many changes induced by these innovations have been extremely positive, bringing advances in health, communications, material wealth, and quality of life. At the same time, Science and Technology have helped create apparently intractable problems, including new risks to human health, pollution of the natural environment, and the existence of weapons capable of mass destruction. Given all of these impacts, making effective and fair choices regarding technologically complex issues is one of the most challenging tasks of modern governance.

Especially demanding is policy-making for international economic competition, which is increasingly defined in terms of technological competence. The diffusion of centers of technological excellence around the world and the progressive convergence of local markets in terms of consumer tastes and preferences have obliged actors to adopt a more global outlook: not only do firms compete internationally, but they also depend on each other's technological, organizational, financial, and marketing strengths to stay afloat. In this course we examine a number of important characteristics of the new international context that are currently related to the technological competence of firms and nations.

Goals

This course is intended to impart: knowledge of the institutions that shape international science and technology policy, with a focus on the U.S. institutions surrounding the George Washington University; familiarity with policy research and key indicators that shape science and technology policy; an overview of historical and current science and technology policy issues, with a focus on issues under consideration by policymakers in institutions surrounding GW; the skill of policy analysis – the ability to dissect a problem in science and technology and connect the elements of that problem to the relevant institutions; and the skill of policy formulation – the ability to craft a science or technology policy in a way that might promise success, drawing on historical and/or international experience.

These goals are assessed in the two major exams and the policy exercise. Each exam will have questions that are intended to assess mastery of the categories of knowledge, described above, that are developed in the class. The exams are cumulative, in the sense that they make use of the lectures, reading material, and class discussions. They may also introduce new material as well. In general, they consist of a series of short essay questions with short essay answers. They are take-home exams.

Learning Outcomes

Students will be able to critically analyze science and technology policy proposals and supporting data with reference to historical trends and key policy institutions.

Students will be able to formulate science and technology policy proposals, support proposals with relevant data or indicators, and critically evaluate their potential effectiveness.

Students will be able to evaluate the economic, political, and social contexts of actual or proposed science and technology policy actions in terms of historical and contemporary settings.

Out of Class and Independent Learning Expected per Week

For this 3-credit graduate class students are expected to spend at least 350 minutes per week outside the classroom on preparation and class assignments.

Grades

The final grade will be computed in the following way:

- Class participation: 25%
- This portion of the grade is based on students' attendance, frequency and quality of participation in class discussion. Active engagement in class discussions during lectures is recommended, bringing new issues to the floor outside the assigned readings is encouraged.
- Policy memorandum: 25%
- This portion of the grade is based on student performance on a short policy exercise. A policy-related question will be distributed on **October 3**. Students will work individually to prepare a 1-2 pages memo to a policy decision-maker in a couple of days.
- Final Examination: 50%
- Students work individually. The examination will be a collection of short essays based on class discussions and readings during the course. A set of three questions will be distributed on **December 5** (last class). Answers will be due a week later.
 - Grades will be based upon the full set of attributes that are important to good policy papers, including accuracy, clarity, logic, and relevance. Referencing sources of information sources is highly desirable.

Class Policies

Class attendance is expected. There will be no allowance for late work, except by prior arrangement with the instructor. Arrangements for make-up work must be made with the instructor. The instructor has the discretion to grant or refuse requests for late work or make-up work. Students are always welcome to discuss grades with the Professor. However, students wishing to formally contest a grade are required to write a memo outlining their case, along with supporting examples from the submitted assignment.

University Policies & Services

Academic Integrity Code. Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information. For details and complete code, see: studentconduct.gwu.edu/code-academic-integrity

Sharing of Course Content. Unauthorized downloading, distributing, or sharing of any part of a recorded lecture or course materials, as well as using provided information for purposes other than the student's own learning may be deemed a violation of GW's Student Conduct Code.

Use of Student Work (FERPA). The professor will use academic work that you complete during this semester for educational purposes in this course during this semester. Your registration and continued enrollment constitute your consent.

Accommodations for Students with Disabilities. Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information see: disabilitysupport.gwu.edu/

Religious Observances. In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. For details and policy, see: students.gwu.edu/accommodations-religious-holidays.

Mental Health Services 202-994-5300. The University's Mental Health Services offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include: crisis and emergency mental health consultations confidential assessment, counseling services (individual and small group), and referrals. For additional information see: counselingcenter.gwu.edu/

GW Security and Safety Policy. In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location.

Readings

You are requested to purchase the book:

Homer A. Neal, Tobin L. Smith, and Jennifer B. McCormick (2008) *Beyond Sputnik: U.S. Science Policy in the 21st Century*, University of Michigan Press, Ann Arbor.

An extensive report by UNESCO (737 pages) provides excellent background material on various countries/regions around the world, difficult to find elsewhere in such a comparative manner:

United Nations Educational, Scientific and Cultural Organization *UNESCO Science Report 2021: The Race Against Time for Smarter Development*, UNESCO Printing.
[open source] [<https://www.unesco.org/reports/science/2021/en/download-the-report>]

All other readings will be posted on Blackboard, except for selective large reports that you can locate on the internet.

Summary Schedule of Class Meetings

INTRODUCTION

8/29 Course Introduction

I. SCIENCE, TECHNOLOGY AND INNOVATION (STI) POLICY

9/5 U.S. STI System I

9/12 U.S. STI System II

9/19 U.S. STI System III

9/26 STI Policy in Europe

10/3 STI Policy in Other Countries

Policy Exercise (Memorandum) posted

II. CORE AREAS (selectively)

10/10 Digital Economy I

10/17 Digital Economy II

10/24 Energy, Environment, Climate

10/31 Pharmaceuticals, Public Health

III. SYSTEM MANAGEMENT AND THE FUTURE

11/7 STI Policy in Times of Global Crises

11/14 STI Policy in Times of Strategic Competition

11/28 STI Policy for Sustainability Transitions

12/5 STI Policy Tools and Challenges

Final Exam posted

Analytical Schedule of Meetings and Readings

Core readings are unmarked. Readings marked with an asterisk (*) are recommended.

8/29

COURSE INTRODUCTION

(i) *Course Introduction*

Piper, Kelsey (2018) “Human History in One Chart”, *Vox*, Nov.8.

(ii) *Megatrends / Technology Trends in Context of Future Research Policy*

Organization for Economic Cooperation and Development *Science, Technology and Innovation Outlook 2016*, OECD, Paris. [Chs 1, 2]
[Ch 1] “Megatrends Affecting Science, Technology and Innovation”
[Ch 2] “Future Technology Trends”

- * McKinsey “Technology Trends Outlook 2023”
<https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-top-trends-in-tech#new-and-notable>

(iii) *Pandemics in Human History*

Alfani, Guido and Murphy, Tommy E. (2017) “Plague and Lethal Epidemics in Pre-Industrial World”, *Journal of Economic History*, 77(1): 314-343.

I. SCIENCE, TECHNOLOGY AND INNOVATION (STI) POLICY

9/5

U.S. STI SYSTEM I

(i) *Foundations of STI Policy – Historical Overview of STI Development*

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008) *Beyond Sputnik: U.S. Science Policy in the 21st Century*, University of Michigan Press, Ann Arbor. [Chs 1, 2]
[Ch 1] “Science Policy Defined.”
[Ch 2] “U.S. Science Policy before and after *Sputnik*.”

- * Bush, Vannevar, “Science the Endless Frontier,” Washington, Government Printing Office 1945.
<http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm>

(ii) Actors, Processes

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008),
op.cit. [Chs 3-4]
[Ch 3] “The Players in Science Policy”
[Ch 4] “The Process of Making Science Policy”

9/12

U.S. STI SYSTEM II

(i) Institutions – R&D Funding

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008),
op.cit. [Chs 6-9]
[Ch 6] “Universities”
[Ch 7] “Federal Laboratories”
[Ch 8] “Industry”
[Ch 9] “The States”

National Science Board (2022) *The State of U.S. Science and Engineering 2022*, National Science Foundation.

(1) “The State of U.S. Science and Engineering 2022”

<https://ncses.nsf.gov/pubs/nsb20221/u-s-and-global-science-and-technology-capabilities>

(2) “R&D: National Trends and International Comparisons”

<https://ncses.nsf.gov/pubs/nsb20225>

United Nations Educational, Scientific and Cultural Organization (2021) *UNESCO Science Report 2021*, UNESCO Printing. [Ch 5]

[Ch 5] Vonortas, Nicholas S. with Brennan Hoban and Connor Rabb
“United States of America”

[\[https://www.unesco.org/reports/science/2021/en/download-the-report\]](https://www.unesco.org/reports/science/2021/en/download-the-report)

- * Executive Office of the President of the United States, Office of Management and Budget (OMB) & Office for Science and Technology Policy (OSTP), “Multi-Agency R&D Priorities for the FY 2025 Budget”, 8/17/2023.

9/19

U.S. STI SYSTEM III

(i) National Defense – Security

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008),
op.cit. [Chs 11, 13, 18]

[Ch 11] “Science for National Defense”
[Ch 13] “Scientific Infrastructure”
[Ch 18] “Science and Homeland Security”

- * “Cloning DARPA”, *The Economist*, June 5, 2021.
- * Bonvillian, William B., Richard Van Atta, and Patrick Windham (eds) *The DARPA Model for Transformative Technologies*, Open Book Publishers, 2019.

(ii) Space

Organization for Economic Cooperation and Development (2023)
“Harnessing ‘New Space’ for Sustainable Growth of the Space Economy”,
OECD Publishing, Paris.

Pace, Scott “U.S. National Security Interests in Space”, in Kai-Uwe Schrogl
(ed) *The Oxford Handbook of Space Security*, Oxford University Press,
forthcoming 2023.

9/26

STI POLICY IN EUROPE

UNESCO (2021) *op. cit.* [Ch. 9]
[Ch 9] Soete, Luc, Sylvia Schwaag Serger, Johan Stierna, and Hugo
Hollanders “European Union”

European Commission (2022) “A New European Innovation Agenda”,
Communication from the Commission to the European Parliament, the
Council, the European Economic and Social Committee, and the Committee
of the Regions (SWD(2022) 187 final).

- * European Commission *European Innovation Scoreboard 2023*, European
Commission, Luxembourg: Publications Office of the European Union.
[ES, Chs 2, 3, 8]
[ES] “Executive Summary”
[Ch 2] “Innovation Performance and Trends”
[Ch 3] “Performance by Innovation Dimension”
[Ch 8] “Country Profiles”
- * European Commission *Horizon Europe - the Framework Programme for
Research and Innovation*.
[https://ec.europa.eu/info/research-and-innovation/funding/funding-
opportunities/funding-programmes-and-open-calls/horizon-europe_en](https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en)

10/3

STI POLICY IN OTHER COUNTRIES

UNESCO (2021), *op.cit.* [Chs 7, 16, 22, 23]
[Ch 7] Latin America
[Ch 16] Israel
[Ch 22] India
[Ch 23] China

Policy Exercise (Memorandum) posted

II. CORE AREAS (selectively)

10/10

DIGITAL ECONOMY I

(i) The New Knowledge-Driven Paradigm; 4th Industrial Revolution

Schwab, Klaus (2016) “The Fourth Industrial Revolution: What it means, How to Respond”, World Economic Forum.

<https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>

(ii) Advanced Manufacturing

Adler, David and William Bonvillian (2023) “America’s Advanced Manufacturing Problem – And How to Fix It”, *American Affairs*, VII(3), Fall.

- * “Virtual Realities”, Technology Quarterly, *The Economist*, October 3, 2020
 - [1] Reaching into other worlds
 - [2] Reality bytes
 - [3] The promise and the reality
 - [4] Getting better
 - [5] What is real, anyway

10/17

DIGITAL ECONOMY II

(i) Artificial Intelligence; The Data Economy;

World Intellectual Property Organization (2019) *WIPO Technology Trends 2019: Artificial Intelligence*, Geneva: WIPO. [ES, Chs 1-2]

[ES] “Executive Summary”

[Ch 1] “Introduction”

[Ch 2] “Trends in Artificial Intelligence”

Andersen, Ross (2023) “Does Sam Altman Know what he’s Creating? The OpenAI CEO’s Ambitious, Ingenious, Terrifying Quest to Create a New Form of Intelligence”, *The Atlantic*, July 14 (online).

Bjoerkegren, Daniel (2023) “Artificial Intelligence for the Poor: How to Harness the Power of AI in the Developing World”, *Foreign Affairs*, August 9.

- * Organization for Economic Cooperation and Development (2023) *Employment Outlook 2023*, OECD, Paris. [Chs 2, 3]
[Ch 2] “AI and the Labor Market: Introduction”
[Ch 3] “AI and Jobs: Ni Signs of Slowing Labor Demand (Yet)”

10/24 ENERGY, ENVIRONMENT, CLIMATE

(i) Energy

International Energy Agency (2023) “World Energy Investment 2023”, IEA
“Overview and Key Findings”
“R&D and Technology Innovation”

- * International Energy Agency (2023) “Energy Technology Perspectives”, IEA “Executive Summary”
<https://www.iea.org/reports/energy-technology-perspectives-2023/executive-summary>

(ii) Environment, Climate Change

“The Climate Issue”, *The Economist*, September 21, 2019.

“Climate Brief”, *The Economist*, 2020 (various)

- [1] “Politics of climate action”, April 25
- [2] “Modelling the greenhouse effect”, May 2
- [3] “Carbon cycle”, May 9
- [4] “Bad times”, May 16
- [5] “Burn”, May 23
- [6] “Softening the blow”, May 30

- * Intergovernmental Panel on Climate Change (2023) *AR6 Synthesis Report: Climate Change 2023*, IPCC, Geneva Switzerland.
<https://www.ipcc.ch/report/ar6/syr/>

10/31

PHARMACEUTICALS, PUBLIC HEALTH

Kliff, Sarah (2016) “The True Story of America’s Sky-High Prescription Drug Prices”, *Vox*, November 30.

Congressional Research Service (2019) “Drug Pricing and the Law: Pharmaceutical Panel Disputes”, *In Focus*, Washington: CRS, May 17.

“Personalized Medicine”, *The Economist*, March 14, 2020.

- * DiMasi, Joseph A., Henry G. Grabowski, and Ronald W. Hansen (2016) “Innovation in the Pharmaceutical Industry: New Estimates of the R&D Costs”, *Journal of Health Economics*, 47: 20-33.

III. SYSTEM MANAGEMENT AND THE FUTURE

11/7

STI POLICY IN TIMES OF GLOBAL CRISES

Organization for Economic Cooperation and Development (2023) *OECD Science, Technology and Innovation Outlook 2023: Enabling Transitions in Times of Disruption*, OECD Publishing, Paris. [Ch 1]
[Ch 1] “STI Policy in Times of Global Crises”

11/14

STI POLICY IN TIMES OF STRATEGIC COMPETITION

OECD (2023) *ibid.* [Ch 2]
[Ch 2] “STI Policy in Times of Strategic Competition”

Vogel, Stephen K. (2021) “Level Up America: The Case for Industrial Policy and How to Do It Right”, Report, Niskanen Center: Washington DC.

Edler, Jakob et al. (2020) “Technology Sovereignty: From Demand to Concept”, Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany.

11/28

STI POLICY FOR SUSTAINABILITY TRANSITIONS

OECD (2023) *ibid.* [Ch 3]
[Ch 3] “STI Policy for Sustainability Transitions”

- * Mathews, John A. (2023) *A Solar-Hydrogen Economy: Driving the Green Hydrogen Industrial Revolution*, Anthem Press.

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008),
op.cit. [Ch 19]
[19] “Grand Challenges for Science and Society”

Edler, Jakob and Jan Fagerberg (2017) “Innovation Policy: What, Why, and How”, *Oxford Review of Economic Policy*, 33(1): 2-23.

Bremmer, Ian and Mustafa Suleyman (2023) “The AI Power Paradox: Can States Learn to Govern Artificial Intelligence – Before It’s Too Late?”, *Foreign Affairs*, September/October.

- * UNhappy Birthday”, Special Report, *The Economist*, June 20, 2020.
Antonio Guterres’ 4 horsemen
<https://www.un.org/sg/en/content/sg/speeches/2020-01-22/remarks-general-assembly-priorities-for-2020>

Final Exam posted

Useful Resources

I. Organizations (selectively)

AAAS R&D Budget and Policy Program

<http://www.aaas.org/spp/rd/>

White House Office of Science and Technology Policy (?????)

<http://www.ostp.gov>

The National Academies (NAS, NAE, IOM, NRC)

<http://nas.edu/>

National Science Foundation (NSF)

<http://www.nsf.gov>

National Science Board

<http://www.nsf.gov/nsb/>

NSF Science and Engineering Statistics

<http://www.nsf.gov/statistics/>

Organization for Economic Cooperation and Development (OECD)

<http://www.oecd.org/>

United Nations Conference on Trade and Development (UNCTAD)

<http://unctad.org/en/Pages/Publications.aspx>

United Nations Industrial Development Organization (UNIDO)

<http://www.unido.org/>

The World Bank

<http://www.worldbank.org/>

The European Union (EU)

Directorate-General (DG) Research and Innovation

<http://ec.europa.eu/research/index.cfm?pg=dg>

DG Connect

<http://ec.europa.eu/dgs/connect/en/content/dg-connect>

DG Enterprise and Industry

http://ec.europa.eu/enterprise/index_en.htm

European Space Agency

<http://www.esa.int/ESA>

Core Academic Journals (selectively)

Science and Public Policy

<http://spp.oxfordjournals.org/>

Research Policy

<http://www.journals.elsevier.com/research-policy/>

Journal of Technology Transfer

<http://link.springer.com/journal/10961>

Technovation

<http://www.journals.elsevier.com/technovation/>

Economics of Innovation and New Technology

<http://www.tandfonline.com/toc/gein20/current#.Uhgjqd9Y0M>

Industrial and Corporate Change

<http://icc.oxfordjournals.org/>

Research Evaluation

<http://rev.oxfordjournals.org/>

Issues in Science and Technology (National Academy of Sciences)

<http://www.issues.org/>

IEEE Transactions on Engineering Management

<http://www.andromeda.rutgers.edu/~ieeetem/>

R&D Management

[http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1467-9310](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1467-9310)

Technology Analysis and Strategic Management

<http://www.tandfonline.com/toc/ctas20/current#.UhhMTOD9Y0M>

Technological Forecasting and Social Change

<https://www.journals.elsevier.com/technological-forecasting-and-social-change>

GW's Gelman Library online system typically offers remote access to such organizations and journals and extensive download privileges to publications. It also provides free of charge the vast collections of international organizations such as the OECD, the World Bank, and the United Nations.