

## **PPOL 5250 Innovation and Sustainability, Fall 2023-2024**

*4 September 2023*

Date & Time: Monday, 13:30-16:20

Venue: Room 2304

Teaching Mode: Lectures and discussions

Instructor: Masaru YARIME, Division of Public Policy

Office: 4616E, PPOL

E-mail: [yarime@ust.hk](mailto:yarime@ust.hk)

Teaching Assistants: Shubham SHARMA

E-mail: [ssharmaad@connect.ust.hk](mailto:ssharmaad@connect.ust.hk)

### **Course Description**

This course examines the role of innovation in achieving sustainability. Among the issues to be discussed include models of technological change, systems approaches to innovation, intellectual property rights, research and development, and case studies in various sectors concerning sustainability. The mechanisms of co-evolution of technology and institutions in facilitating innovation for sustainability are examined from a global perspective.

### **Background**

In moving towards global sustainability, we need to make a balanced approach to achieving environmental protection and economic and social development from a long-term perspective. While new technologies can contribute to producing economic growth and societal benefits, they could also pose potential risks to human health and the environment. It is critical to understand how innovation is created and implemented in our efforts for sustainability. We will then be able to discuss implications for public policy and institutional design in influencing the behavior of relevant stakeholders involved in innovation.

### **Course Objectives**

This course aims to provide students with basic concepts and methodologies for analyzing the mechanisms and processes of creating innovation and examining feasible options for public policy in facilitating sustainability. An integrated approach is explored in designing and implementing science, technology and innovation policy and environmental and sustainability policy. Students learn how to use various types of knowledge from an interdisciplinary perspective and to propose policy and institutional measures for addressing sustainability

challenges.

### **Intended Learning Outcomes**

Upon successful completion of the course, students are expected to be able to:

- Understand basic concepts and methodologies and apply them for analyzing the mechanisms and processes of creating innovation and examining feasible options for public policy in facilitating sustainability.
- Articulate issues and challenges in designing and implementing science, technology and innovation policy and environmental and sustainability policy.
- Evaluate various approaches to policy and institutional measures for addressing sustainability challenges.
- Demonstrate argumentative reasoning and critical thinking in interpersonal dialogues, oral presentations and group reports.

### **Teaching and Learning Activities**

Tasks and activities designed to facilitate students' achievement of the intended learning outcomes:

- Interactive Lectures: Interactive lectures are designed to facilitate application and synthesis of assigned readings (3 hours per week).
- Readings: Readings provide students with the knowledge base necessary to participate effectively in interactive lectures.
- Assignments: Students will be asked to work on assignments to ensure that they understand what is discussed in the class.
- Group project: Students are asked to choose a policy topic by themselves and conduct policy analysis by applying the principles and methods that have learned during the lectures.

### **Course Activities and Grading Criteria:**

Course grades will be based on class participation (10%), assignments (50%), and group project (40%).

- Class Participation (10%): Students are encouraged to actively participate in discussions with the instructor and other students in class.
- Assignments (50%): Students will be asked to work on specific themes by applying the concepts and methodologies developed in the class.
- Group project (40%): Students will be asked in a group to analyze a particular problem concerning innovation and sustainability and to make a policy proposal to tackle the problem. Creating innovation to tackle with sustainability challenges, including environmental, energy, and health issues, has been increasingly regarded as an important

policy agenda. In this group work theme, students will aim to prepare a paper analyzing and proposing science, technology, and innovation policies to address such challenges. Students will first identify the challenges that science and technology can help to solve and analyze the characteristics of such issues. Referring to reviews of existing studies, they will consider what theoretical frameworks can be employed for this purpose. They will then conduct case studies concerning specific themes, which will involve collecting and analyzing relevant data and information. Finally, they will identify and explore possible policy options and make concrete policy proposals. Students will be asked to make a presentation on mid-term progress and a final presentation. Each group member must present. Then students will be asked to submit a final report on problem analysis and policy proposal (3,000 – 5,000 words).

## **Readings**

### Core Reading

- Greenhalgh, Christine, and Mark Rogers, *Innovation, Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

### Additional References

- Bryan, Kevin A., and Heidi L. Williams, “Innovation: Market Failures and Public Policies,” in Kate Ho, Ali Hortaçsu, Alessandro Lizzeri, eds., *Handbook of Industrial Organization, Volume 5*, Amsterdam: Elsevier (2021).
- Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 1 and Volume 2*, Amsterdam: Elsevier (2010).
- Vonortas, Nicholas S., Phoebe C. Rouge, and Anwar Aridi, eds., *Innovation Policy: A Practical Introduction*, New York: Springer (2015).
- World Bank, *Innovation Policy: A Guidebook for Developing Countries*, Washington DC: The World Bank (2010).
- Gault, Fred, *Measuring Innovation Everywhere: The Challenge of Better Policy, Learning, Evaluation and Monitoring*, Cheltenham, UK (2020).
- Borrás, Susana, and Charles Edquist, *Holistic Innovation Policy: Theoretical Foundations, Policy Problems, and Instrument Choices*, Oxford, UK: Oxford University Press (2019).
- Boons, Frank, and Andrew McMeekin, *Handbook of Sustainable Innovation*, Cheltenham, UK: Edward Elgar (2019).

## **Course Schedule**

### ***Class 1 – Monday 4 September 2023***

#### **Introduction to Innovation and Sustainability**

- What Is Innovation?
- The Microeconomic Effects of Innovation
- Interaction between Producers and Users of Innovation
- Innovations and Market Failure
- Restoring Incentives to Invent and Innovate
- Firms Competing through Innovation

#### Required Reading

- Greenhalgh, Christine, and Mark Rogers, “Chapter 1: The Nature and Importance of Innovation,” *Innovation, Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

#### Supplementary Readings

- Geroski, Paul, “Chapter 4: Markets for Technology: Knowledge, Innovation and Appropriability,” in Paul Stoneman, ed., *Handbook of the Economics of Innovation and Technical Change*, Oxford: Blackwell (1995).
- Hall, Bronwyn H., and Nathan Rosenberg, “Chapter 1: Introduction to the Handbook,” in Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 1*, Amsterdam: Elsevier (2010).
- Dodgeson, Mark, and David Gann, *Innovation: A Very Short Introduction*, Oxford, UK: Oxford University Press (2010).

### ***Class 2 – Monday 11 September 2023***

#### **Innovation and the Role of Intellectual Property**

- Why Are Intellectual Property Rights Awarded?
- Patents
- Trademarks
- Designs and Utility Models
- Copyright
- Further Questions about IPRs

#### Required Reading

- Greenhalgh, Christine, and Mark Rogers, “Chapter 2: The Nature and Role of Intellectual Property,” *Innovation, Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

#### Supplementary Readings

- Arora, Ashish, Andrea Fosfuri, and Alfonso Gambardella, *Markets for Technology: The Economics of Innovation and Corporate Strategy*, Cambridge, MA: MIT Press (2001).
- Cohen, Wesley M., and Daniel A. Levinthal, “Innovation and Learning: The Two Faces of R&D,” *Economic Journal*, **99** (397), 569-596 (1989).

### ***Class 3 – Monday 18 September 2023***

#### **Measurement of Innovation**

- How Can Innovation Be Measured?
- Illustrations of Innovation Statistics
- Productivity at the Firm, Industry, and Economy Level
- Comparing Productivity and Growth across Countries

#### Required Reading

- Greenhalgh, Christine, and Mark Rogers, “Chapter 3: The Measurement of Innovation, Productivity, and Growth,” *Innovation, Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

#### Supplementary Readings

- Cohen, Wesley M., “Chapter 4: Fifty Years of Empirical Studies of Innovative Activity and Performance,” in Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 1*, Amsterdam: Elsevier (2010).
- Griliches, Zvi, “Patent Statistics as Economic Indicators: A Survey,” *Journal of Economic Literature*, **28** (4), 1661-1707 (1990).

### ***Class 4 – Monday 25 September 2023***

#### **National Innovation System**

- The National Innovation System
- The Central Role of R&D
- The Government-University Axis
- The University-Business Axis
- The Government-Business Axis
- National Innovation Systems in Emerging Markets

#### Required Reading

- Greenhalgh, Christine, and Mark Rogers, “Chapter 4: The National Innovation System,” *Innovation, Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

#### Supplementary Readings

- Foray, Dominique, and Francesco Lissoni, “Chapter 6: University Research and Public-Private Interaction,” in Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 1*, Amsterdam: Elsevier (2010).
- Soete, Luc, Bart Verspagen, and Bas Ter Weel, “Chapter 27: Systems of Innovation,” in Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 2*, Amsterdam: Elsevier (2010).

- Gu, Shulin, Bengt-Åke Lundvall, Ju Liu, Franco Malerba, and Sylvia Schwaag Serger, “China's System and Vision of Innovation: An Analysis in Relation to the Strategic Adjustment and the Medium- to Long-Term S&T Development Plan (2006-20),” *Industry and Innovation*, **16** (4-5), 369-388 (2009).
- Malerba, Franco, ed., *Sectoral Systems of Innovation: Concepts, Issues and Analyses of Six Major Sectors in Europe*, Cambridge, UK: Cambridge University Press (2004).

### ***Class 5 – Monday 9 October 2023***

#### **Markets and Diffusion of Innovation**

- Entrepreneurship and New Firms
- Innovation and Firms
- Markets and Innovation
- Empirical Evidence on the Returns to Innovation
- Evidence on Interactions between Competition and Innovation
- Modeling the Rate of Adoption of an Innovation
- Statistical Evidence on Rates of Adoption
- Spillovers and Social Returns to Innovation
- Empirical Studies of Social Returns
- Spatial Dimensions of Spillovers

#### Required Reading

- Greenhalgh, Christine, and Mark Rogers, “Chapter 5: Innovative Firms and Markets,” “Chapter 6: Intellectual Property Rights and Firms,” and “Chapter 7: Diffusion and Social Returns, Innovation,” *Innovation, Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

#### Supplementary Readings

- Dosi, Giovanni, and Richard R. Nelson, “Chapter 3: Technical Change and Industrial Dynamics as Evolutionary Processes,” in Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 1*, Amsterdam: Elsevier (2010).
- Teece, David J., “Chapter 16: Technological Innovation and the Theory of the Firm: The Role of Enterprise-Level Knowledge, Complementarities, and (Dynamic) Capabilities,” in Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 1*, Amsterdam: Elsevier (2010).
- Heller, Michael A., and Rebecca S. Eisenberg, “Can patents deter innovation? The anticommons in biomedical research,” *Science*, **280**, 698-701 (1998).
- Stoneman, Paul, and Giuliana Battisti, “The Diffusion of New Technology,” in Hall, Bronwyn H., and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 2*, Amsterdam: Elsevier (2010).

- David, Paul A., “Clio and the Economics of QWERTY,” *American Economic Review*, 75 (2), 332-37 (1985).

### ***Class 6 – Monday 16 October 2023***

#### **Innovation, Work, and Globalization**

- What Is Globalization?
- World Trade in Historical Perspective
- Theories of Trade and Growth
- International Knowledge and Technology Flows: Theory and Evidence
- International Financial Flows
- International Aspects of IPRs
- Microeconomic Models of Innovation and Labor Markets
- Innovation and Labor Markets: Evidence from Firms
- Macroeconomic and Trade Models of Innovation and Labor Markets

#### Required Reading

- Greenhalgh, Christine, and Mark Rogers, “Chapter 9: Innovation and Globalization” and “Chapter 10: Technology, Wages, and Jobs,” *Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

### ***Class 7 – Monday 30 October 2023***

#### **Economic Policies for Innovation**

- Microeconomic Policies to Promote Firm-Level Innovation
- Is the Intellectual Property System Working?
- Incentive Systems for Encouraging Firm-Level R&D
- Other Innovation Policies
- Macroeconomic Issues and Policy
- Macroeconomic Evidence on IPRs and Economic Growth
- Trade-Related Aspects of Intellectual Property (TRIPS)
- Intellectual Property Rights, Exhaustion, and Parallel Imports
- Piracy and Counterfeit
- R&D in the Global Economy
- International Migration of Skilled Labor

#### Required Readings

- Greenhalgh, Christine, and Mark Rogers, “Chapter 11: Microeconomic Policies to Promote Firm-Level Innovation” and “Chapter 12: Macroeconomic Issues and Policy,” *Intellectual Property, and Economic Growth*, Princeton, NJ: Princeton University Press (2010).

#### Supplementary Reading

- Steinmueller, W. Edward, “Chapter 28: Economics of Technology Policy,” in Bronwyn H. Hall and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 2*, Elsevier (2010).

### ***Class 8 – Monday 6 November 2023***

#### **Innovation for Energy and the Environment**

- Fundamentals of Environmental Economics
- Economics of Technological Change
- Innovation: Induced Innovation, Impacts of Technological Change
- Diffusion: Diffusion within Countries, Diffusion across Countries
- Technological Change in Aggregate Energy-Environment Models: Exogenous Technological Change, Endogenous Technological Change
- Implications for Environmental and Technology Policy

#### Required Reading

- Popp, David, Richard G Newell, and Adam B. Jaffe, “Chapter 21: Energy, the Environment, and Technological Change,” Bronwyn H. Hall and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation, Volume 2*, Elsevier (2010).

#### Supplementary Readings

- Porter, Michael, and Claas van der Linde, “Toward a New Conception of the Environment-Competitiveness Relationship,” *Journal of Economic Perspectives*, **9** (4), 97-118 (1995).
- Palmer, Karen, Wallace E. Oates, and Paul R. Portney, “Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?” *Journal of Economic Perspectives*, **9** (4), 119-132 (1995).

### ***Class 9 – Monday 13 November 2023***

#### **Innovation Policies for Sustainability**

- Innovation policy for climate change mitigation and adaptation
- Policy strategies to promote sustainability innovation
- Technological exploration and exploitation
- Evolution of three frames for innovation policy

#### Required Reading

- Mowery, David C., Nelson, Richard R., and Martin, Ben R., “Technology policy and global warming: Why new policy models are needed (or why putting new wine in old bottles won't work),” *Research Policy*, **39**, 1011-1023 (2010).
- Schot, Johan, and W. Edward Steinmueller, “Three frames for innovation policy: R&D, systems of innovation and transformative change,” *Research Policy*, **47** (9), 1554-1567 (2018).



### Supplementary Readings

- del Rio, Pablo, Javier Carrillo-Hermosilla, and Totti Knnola, “Policy Strategies to Promote Eco-Innovation: An Integrated Framework,” *Journal of Industrial Ecology*, **14** (4), 541-557 (2010).
- Hoppmann, Joern, Michael Peters, Malte Schneider, and Volker H. Hoffmann, “The two faces of market support - How deployment policies affect technological exploration and exploitation in the solar photovoltaic industry,” *Research Policy*, **42** (4), 989–1003 (2013).
- Clark, William C., Lorrae van Kerkhoff, Louis Lebel, and Gilberto C. Gallopin, “Crafting usable knowledge for sustainable development,” *Proceedings of the National Academy of Sciences*, **113** (17), 4570-4578 (2016).
- Anadon, Laura Diaz, Gabriel Chan, Alicia G. Harley, Kira Matus, Suerie Moon, Murthy, Sharmila L., and William C. Clark, “Making technological innovation work for sustainable development,” *Proceedings of the National Academy of Sciences*, **113** (35), 9682-9690 (2016).

### ***Class 10 – Monday 20 November 2023***

#### **Final Presentation of Group Projects 1**

- Final presentation for 10 minutes and questions and answers for 10 minutes

### ***Class 11 – Monday 27 November 2023***

#### **Final Presentation of Group Projects 2**

- Final presentation for 10 minutes and questions and answers for 10 minutes