Energy Policy ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Managing intellectual property rights in cross-border clean energy collaboration: The case of the U.S.–China Clean Energy Research Center

Joanna I. Lewis *

Georgetown University, Edmund A. Walsh School of Foreign Service, Science, Technology and International Affairs Program, 37th & O Street NW, ICC 512, Washington, DC 20057, USA

HIGHLIGHTS

- The CERC has been able to generate new IP through collaborative RD&D activities.
- Minimal IP has come from cross-national collaborative activities.
- The TMP has mitigated IP concerns, though few have tested its enforceability.
- The CERC provides a unique model for collaborative clean energy RD&D.
- The TMP may ultimately help to build trust among the consortia participants.

ARTICLE INFO

Article history:
Received 10 October 2013
Received in revised form
22 December 2013
Accepted 23 December 2013

Keywords:
U.S.–China cooperation
Energy research
development and demonstration (RD&D)
Intellectual property rights

ABSTRACT

This paper examines how the United States and China are implementing the most ambitious model of bilateral clean energy technology cooperation to date: The U.S.–China Clean Energy Research Center (CERC). It finds that the CERC has been able to generate new IP through RD&D activities, though minimal IP has come from collaborative activities involving both U.S. and Chinese participants. Many participants reported that the CERC′s Technology Management Plan (TMP) mitigated their IP concerns, though few have tested its efficacy or enforceability. While it is too early to comprehensively assess the efforts of the CERC, it is increasingly evident that the CERC provides a model for collaborative clean energy RD&D that is unique in the history of U.S.–China collaborations in this area. The TMP may ultimately play an important role in building trust among the consortia participants, which could lead to even more constructive collaborations in the future, and serve as a model for future bilateral cooperation agreements. Without sustained support, and continued attention to IP concerns, it will be even harder for China and the United States to make progress towards true cross-national research collaborations which ultimately could produce considerable global benefits, particularly in the clean energy field.

1. Introduction

As global interest in technologies that can either replace or improve the efficiency of fossil fuels increases, we are seeing increasing calls for international clean energy research and development (R&D) partnerships, both to harness the unique technical capacities and market characteristics of partner countries, and to promote high-level political cooperation. International technology partnerships vary widely in scope, targeting different stages of the technology development process, posing different intellectual property (IP) concerns and encompassing different actors across the public and private sectors. This paper examines how the United States and China, the two largest energy consuming and greenhouse gas emitting nations, are designing international clean energy partnerships contribute to the development, deployment and dissemination of clean energy technologies.

This paper examines the origins and structure of the most ambitious model of U.S.–China clean energy technology cooperation to date: The U.S.–China Clean Energy Research Center (CERC). It presents the first investigation of the CERC′s IP framework analyzed in the context of the existing literature on clean energy R&D, China′s innovation system and international technology partnerships. Based on this analysis, the study presents broader conclusions about how IP can be better managed to promote cross-national technology cooperation in the clean energy sector, and how specific IP concerns in U.S.–China collaborations can be effectively navigated.

1.1. International partnerships in clean energy RD&D

While international partnerships occur in a variety of technology sectors, technologies that result in or are aimed at improving

* Tel.: +1 202 687 7284.
E-mail address: jil9@georgetown.edu

0301-4215/$ - see front matter
http://dx.doi.org/10.1016/j.enpol.2013.12.053

environmental protection, including clean energy technologies, have some unique characteristics. In order to establish what models of international technology cooperation might work for clean energy technology, it is important to both understand what we can learn from technological innovation models in other sectors, and what distinguishes the clean energy case.

First, clean energy technologies are in fact comprised of a diverse range of technological sectors. While energy-supply technologies bring energy forms to a point of final use, energy end-use technologies are applied at this point of use to covert an energy form to a service. In addition, an energy technology is not just hardware but also the software, practices and knowledge relating to its use (Gallagher et al., 2006). Clean energy technologies also span a range of stages of technological development, from the research and development stage (e.g. next generation biofuels or high efficiency solar photovoltaics), to the demonstration stage (e.g. Integrated Gasification Combined Cycle (IGCC) coal fired power stations), to the commercial stage (e.g. wind turbines and crystalline photovoltaic solar modules). Clean energy technologies also come from dissimilar origins. For example, while solar cell innovation stemmed from R&D in the satellite and semiconductor industries, innovation in modern wind turbines was linked to R&D in the aerospace, shipbuilding and agriculture industries (Colatat et al., 2009; Lewis, 2012c). Given the diversity of sectors, markets and technologies involved, policies designed to promote the innovation and utilization of clean energy need to be flexible and consider the specific characteristics of the technology or technologies in question.

Second, because the social benefit of reducing greenhouse gas emissions is not yet generally reflected in cost structures, the deployment of socially desirable technologies is generally not economically profitable (Chao and Peck, 2000; Feiveson and Rabl, 1982). Like many other types of technologies, clean energy technologies can require significant R&D investments and pose a high risk to investors while still in the early stages of development. Unlike many other technologies; however, the benefits of investment in R&D are not readily appropriable to the firm making the investment due to the current pricing system of fossil fuels which may suppress the demand for low-carbon energy technologies. As a result, there is in fact a powerful disincentive against investing in clean energy technologies. For pre-commercial technologies that lack a market rationale, policymakers must also consider the role of demonstration projects and creating early adopters (Huang and Liu, 2008; Consortium for Science, Policy and Outcomes and Clean Air Task Force, 2009).

The factors discussed above suggest a different paradigm for technological innovation and deployment is required for the clean energy sector than what was employed in other industrial sectors. These political, economic and technical factors must inform the way in which clean energy partnerships are structured and financed.

1.2. Benefits and challenges to technology cooperation with China

China has emerged as a key center of innovation as China's government research laboratories, universities, and domestic and multinational corporations have increased their innovative activity in recent years (Li and Yue, 2005). High-level government economic plans now regularly call for increased attention to both indigenous innovation and the promotion of foreign investments in fields of strategic importance for the country such as clean energy (Zhi et al., 2013; OECD, 2008). Having recently become a global leader in the manufacturing of many core clean energy technologies, China has seen increases in both public and private R&D spending across clean energy fields, with concrete examples of innovative activity regularly reported (Huang et al., 2012). In 2010 it was the leader in new clean energy investments, surpassing the United States and the European Union (Fig. 1). China has also been increasing its annual number of patent applications in renewable energy generation, and by 2009 ranked fifth globally after the United States, Japan, Germany and South Korea (Fig. 1). Technology partnerships with overseas firms further expand the access of Chinese firms to global learning networks of knowledge and innovation, which are likely a crucial determinant in a firm's ability to obtain success with a new technology (Karnoe, 1990; Van Est, 1999; Kamp, 2002). But as China attempts to move away from its historical reliance on foreign firms and foreign technology, the environment for international technology cooperation is increasingly complex.

As a location for innovation, China is simultaneously desired and feared by overseas firms. The technology development strategies of transnational firms are becoming increasingly global in

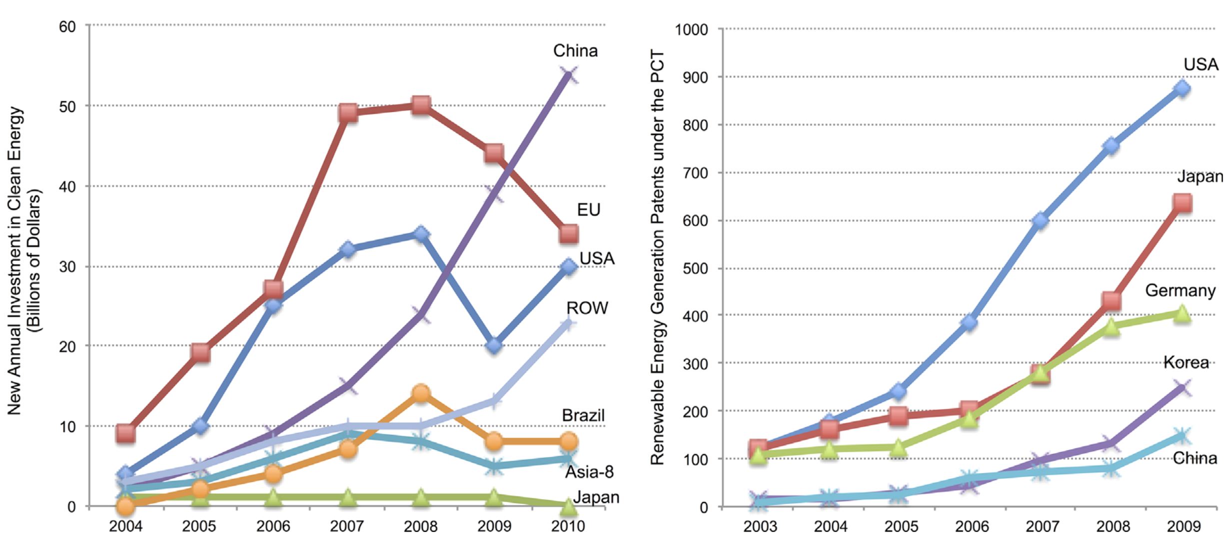

Fig. 1. Clean energy investment and patenting: China and the USA in an international context. *Notes*: Clean energy and technologies include biomass, geothermal, wind, solar, biofuels, and energy smart and efficiency. New investment includes private and public R&D, venture capital, private equity, and public markets (mergers and acquisitions are excluded). Asia-8 includes India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, and Thailand. ROW = Rest of World; EU = European Union; USA = United States of America; UK = United Kingdom; PCT = Patent Cooperation Treaty.
Sources: Investment data from Science and Engineering Indicators 2012 (National Science Board, 2012); patent data from OECD Patent Database (OECD, 2013).