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Does Science Diplomacy Work in Highly Competitive Technology Areas? An Analysis of the EU’s S&T Cooperation with China in the Field of Solar Photovoltaics

Daniel Gehrt

In recent years, the European Commission (EC) and particularly its Directorate-General for Research and Innovation (DG RTD) have increasingly promoted the concept of science diplomacy as a means to wield soft power in the European Union’s relations with other countries and regions. One publication in which this idea is prominently mentioned is the vision paper Open Innovation, Open Science, Open to the World (2016).[1] While the EC’s use of the term science diplomacy is somewhat vague, the concept tends to refer to support for research and innovation (R&I) collaboration with other countries and world regions, including through government-to-government science and technology (S&T) agreements and dialogues and a variety of other tools.[2]

The expected benefits of science diplomacy are manifold. First of all is the potential of working with the world’s best minds and most experienced researchers, which in turn can enhance a country’s economic competitiveness. Second is the

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argument that “global challenges require global solutions,” a reference to issues such as climate change, infectious diseases, and food as well as energy security. Third is the idea that good relations between the R&I communities of two countries will also benefit the countries’ overall relations.

The understanding of science diplomacy just described relies on an (implicit) assumption that collaboration in R&I is generally beneficial for both sides. While this may be true for fundamental science-related collaboration relatively distant from actual applications or market-ready products, the question is to what extent this also applies to research and development closer to market, where commercial interests, and therefore competitive thinking, will likely come into play. Or, to put it differently: Can the idea of science diplomacy be transferred to the realm of innovation, and can we usefully speak of something like innovation diplomacy?

The Decline of European Solar PV and China’s Role

A highly interesting example in this context relates to solar photovoltaics (PV) and the associated competition between Europe and China. In fact, the decline of the European solar PV industry and the role of China makes for quite a dramatic episode in recent economic history. Europe was in a leading position up until the late 2000s, when China suddenly managed to not only overtake Europe as the global leader but to effectively destroy large parts of the European industry with an overabundance of PV products sold at prices with which European producers simply could not compete. All this happened roughly between 2008 and 2012—that is, within a span of less than five years. Anti-dumping measures put in place by the EU have only resulted in countermeasures by China and overall have not helped in saving the European solar PV industry against Chinese competition. (Figure 1 shows a 1997–2014 timeline encompassing key events that prompted changes in solar PV market share.[3])

In the eyes of many EU policy makers, the key to rebuilding at least some of the European PV industry lies in technological innovation. Because European producers cannot compete on price, they must compensate in innovation, developing technologies that are more efficient and can serve new application areas. With this specific goal in mind, strong efforts have been made by the EC and others to review their PV-related R&I policy instruments.[4]

Clearly, a difference at least in spirit exists between (1) the very competition-oriented view on innovation as a tool to strengthen one’s own industry and gain advantage over others; and (2) the philosophy espoused in Open Innovation, Open Science, Open to the World. An additional motivator for the international
collaboration angle, according to the EC, is the supportive role solar PV can play in addressing two global challenges: energy security and climate change.

**Figure 1**

Timeline of events affecting market share of leading countries in the solar PV industry.

The question, therefore, emerges of how EU R&I policy has been responding to the tension between these different rationales. An in-depth study that we conducted sought to answer this question, and this paper presents a summary of its conclusions.

**Opportunities and Threats from EU-China Collaboration in Solar PV**

Against the background just established, an EU policy maker would likely perceive support for R&I collaboration with China in solar PV as linked to various opportunities and threats. These will be outlined briefly in the following sections, leading to an analysis of how EU R&I policy has responded to this situation.
Opportunity 1: Generally Assumed Benefits of International S&T Cooperation

As already described, fostering international cooperation in R&I has become quite prominent in recent EC communications, notably the 2012 publication *Enhancing and Focusing EU International Cooperation in Research and Innovation: A Strategic Approach.*[5] This document lists as one of the overall objectives of international cooperation “strengthening the Union’s excellence and attractiveness in research and innovation as well as its economic and industrial competitiveness.” Relatedly, it specifies the following objectives:

- Creating win-win situations and cooperating on the basis of mutual benefit
- Accessing external sources of knowledge
- Attracting talent and investment to the Union
- Facilitating access to new and emerging markets
- Agreeing on common practices for conducting research and exploiting the results

All these specific objectives can safely be applied to the solar PV field. As shown in figure 2, solar energy is a field in which both China and the EU are at the forefront of technological development. This provides a strong argument for the two sides to work together to maintain and advance this technological leadership. From this point of view, each of the five preceding bullet points can be seen as “opportunities” for collaboration.

The previously noted *Open Innovation, Open Science, Open to the World,*[6] published four years later, continues along a similar trajectory. In explicating the title, the authors suggest that “to maximise their potential, the main components of the ‘Open Innovation’ and ‘Open Science’ policies should also be ‘Open to the World.’”[7] This interesting perspective expands the idea of open innovation from an inter-company to an inter-country level.

Opportunity 2: Climate Action and Energy Security as Global Challenges Calling for a Collaborative Approach

The 2012 and 2016 publications just discussed both make strong reference to the need to tackle global challenges through collaboration. This idea is highly relevant to solar PV, together with other renewable energy sources, specifically in addressing climate change and energy security. Solar PV is emission-free, leaves no carbon footprint, and thus does not contribute to global warming. Further, as a power source that can be tapped at virtually any location, it is available more or less irrespective of economic or geopolitical factors.
### Threat 1: Solar PV as a Mature Technology in an Extremely Competitive Market

Solar PV can today be seen as a fully mature technology, with products sold at mass scale, almost similar to mobile phones, televisions, and so forth. The competition in this sector has been fierce, claiming most of the European industry, which had flourished until a decade ago, as a casualty. As explained before, prospects for the European industry to regain lost ground could include increasing the efficiency of solar panels and a greater focus on developing tailored products, such as building- or product-integrated solar panels. Yet that is exactly where the risk dwells. If the only means for European producers to compete is by developing more efficient or more specialized technologies and applications, then there is a strong rationale for doing this alone, rather than together with the already dominating competitor. Otherwise, the investments simply might not pay off, given that Chinese companies might innovate as fast as or even faster than
their European counterparts, in turn limiting the chances for European producers to regain market share. Overall, the risk of European money, both public and private, being wasted is therefore quite substantial.

**Threat 2: Specific Issues Relating to R&I Collaboration with China**

Yet another specific, accentuating risk applies to China, with two interrelated components: (1) serious problems about intellectual property rights (IPR) protection and other legal issues; and (2) an industrial policy carried out by the Chinese government that would be impossible in the EU and is frequently judged as “unfair.”

The first of these two concerns, insufficient IPR protection, is shared by a large number of companies doing business with Chinese partners and is likewise acknowledged in various official documents concerning EU-China S&T relations. [8] The case for collaboration diminishes when one contestant in a neck-and-neck race is known for lax IPR enforcement. The risk of losing therefore appears much greater.

The second point regarding China’s industrial policy is possibly somewhat less well known but certainly not less problematic. A report on the “Made in China 2025” strategy by Jost Wübbeke and his coauthors from the Berlin-based Mercator Institute for China Studies points very clearly to various interrelated issues in this area.[9] First of all, it states that “China’s leadership systematically intervenes in domestic markets so as to benefit and facilitate the economic dominance of Chinese enterprises and to disadvantage foreign competitors.”[10] Second, the Chinese strategy has a strong outward-looking aspect, rooted in the heavily state-backed acquisition of international high-tech companies by Chinese investors, benefiting from the open-market economies in Europe and the United States. The report argues that “Chinese high-tech investments need to be interpreted as building blocks of an overarching political program. If successful, *Made in China 2025* could accelerate the erosion of industrial countries’ current technological leadership across industrial sectors.” There is not much to be added to this passage, which explains quite well the seriousness of the “threats” of collaborating with China in any high-tech sector.

**Analysis of the EU Position on Solar PV**

This section will examine how European R&I policy has responded to both the opportunities and threats outlined in the previous section. In other words, the
underlying analytical question is: In a sector as competitive as solar PV, does the EU stick with its proclaimed principles of “open innovation, open science, open to the world” and of “global challenges needing global solutions,” or do other forces, in conflict with these principles, prevail?

For this purpose, we have analyzed the following three types of sources:

1. Official documents released by the EC as well as agreements and joint statements concerning S&T collaboration between the EU and China. This part of the analysis thus relates to the strategic or policy level of S&T cooperation.
2. Quantitative data concerning concrete topics of calls for proposals and other actions encouraging collaboration with China. This part of the analysis looks at the implementation or program level of S&T cooperation.
3. Interviews conducted with relevant EC officials. This part of the analysis relates to both the strategic and implementation level of S&T cooperation.

Analysis of Official EU Policy Documents and Agreements

In analyzing whether the fierce competition in solar PV is reflected at the strategic level of the EU’s S&T cooperation policy toward China, I have, as noted, studied all relevant official EU policy documents as well as agreements and joint statements concerning S&T cooperation between the EU and China. At the time of this writing, these included the following:

Based on these documents, overall S&T relations between the EU and China appear very good. This is manifested, for instance, in upgrades of their shared government-to-government S&T exchanges to something called an Innovation Cooperation Dialogue (ICD), a governmental forum that has “the ambition of raising the level and intensity of research and innovation relations”[20] and has been held four times since 2013. One of the important decisions the dialogue has yielded is reciprocal access to respective R&I funding programs as well as new co-funding mechanisms. In 2017, both sides agreed on a package of flagship cooperation initiatives in the following categories: (1) Food, Agriculture, and Bioeconomy; (2) Environment, Climate, and Sustainable Urbanization; (3) Aviation; (4) Biotechnologies and Biomaterials; and (5) Surface Transport.

Yet they say nothing specifically about the field of solar PV. Given how important solar PV technology is for (1) the European industry, (2) the Chinese industry, and (3) solving global challenges associated with climate change and energy security, the presence of such content would be of interest. Yet a comprehensive comb-through of the relevant documents reveals not a single reference to solar PV as a (potential) field of collaboration. This is quite remarkable given the discussions in this paper and the prominence of clean energy as an identified field of collaboration. The 2017 “Roadmap for EU-China S&T Cooperation,” for example, says the following: “China is a strategic partner for the EU in energy research and innovation (R&I) considering the size of its market, its commitment to increase R&D spending for clean energy as well as its commitment to the Paris Agreement,” the 2016 transnational compact on climate change. Nor does this omission appear to reflect a generally low level of specificity in the documents, with references appearing to several other renewable or clean energies, such as concentrated solar power, carbon capture and storage technologies, as well as hydrogen safety.

To be sure, the EC’s Directorate-General for Trade (DG TRADE) has produced a number of documents concerning the trade conflict between the sides in solar PV. But they do not, as such, refer to S&T cooperation on the matter.

Analysis of Horizon 2020 Topics

Having analyzed the documents relating to strategic-level S&T cooperation between the EU and China, we will now move toward the implementation level. For this, we have analyzed all funding opportunities in the EU framework known as Horizon 2020[21] (hereafter: H2020) explicitly encouraging collaboration with China, over the entire programming period. The findings are quite clear and speak for themselves.

Out of a total seventy topics on which collaboration with China was explicitly encouraged, not one referred directly to solar PV. Furthermore, it should be added, the entire field of renewable energy technologies seems underrepresented among the H2020 topics on which collaboration with China was urged. Overall, for the full duration of H2020 (2014-2020), only four topics related to “Societal Challenge 3—Secure, Clean, and
Efficient Energy” (hereafter: SC3) drew such encouragement (see table 1 at the end). And even these four were either very generic or related to carbon capture utilization and storage, which may be a “clean” energy technology but is not renewable.[22]

This underrepresentation of renewable energy technologies overall, while suggesting that solar PV has not been singled out, still leaves the impression of a conscious decision against specific support for R&I collaboration in the field. Of course, the reasons for excluding other renewables such as wind might be similar and directly related. Indeed, this hypothesis has been confirmed by interviews with EC officials, as synthesized in the next section.

The near absence of renewable energy topics encouraged for collaboration grows even more remarkable when one notes that forty-eight of the seventy China-related topics fall within the “Societal Challenges” category. In other words, the EC clearly prioritizes societal challenges, but appears to have relegated some in favor of others.

Analysis of Interviews Conducted with Relevant EC Officials

To complement our analyses of the strategic and implementation levels, we conducted interviews with five officials from the DG RTD as well as the European External Action Service whose work is connected to that of this study.[23] The interviews were semistructured and focused on the following four key aspects: (1) views on the tension between the concepts of science diplomacy and innovation (policy); (2) general views on S&T relations with China; (3) statements concerning the R&I collaboration with China specifically in solar PV; (4) the role of the Mission Innovation initiative.[24]

Views on the Tension between the Concepts of Science Diplomacy and Innovation

All interviewees who were asked about the tension between the competition-oriented dimension of innovation policies and the cooperation-oriented dimension of science diplomacy confirmed that this potential conflict exists, although views diverged on its prevalence within the DG RTD. The strong perception also holds that cooperation in fields where both sides are advanced is a sine qua non for competitive success. One interviewee stressed that the answer to this question depends on the specific partner country. But assuming a level playing field, cooperation was seen as less problematic even in highly competitive fields. The same interviewee explained that “the case of China, however, is a bit trickier. Here, the state enters into the game with very clearly and strategically selected priorities. R&I policy actually becomes an instrument of industrial policy.”
Another interviewee argued that the whole concept of science diplomacy was outdated, even if the growing use of the term itself is relatively new. The original idea of science diplomacy was to create openings in difficult contexts, such as the Cold War. The situation today is very different, wherein most countries share established links and exchanges of people, economies, and so on. This interviewee elaborated, “What we are working on today is new cutting-edge, disruptive technologies, and what we are dealing with issues regarding market access and competitiveness; in this context, the concept is not particularly useful.” Other interviewees expressed overall agreement with such points, even if stating them less explicitly.

Views on S&T Relations with China in General

The views on S&T relations with China were diverse. One interviewee was quite positive, pointing out that advancement in this area was one of the bright spots of the EU-China summit in June 2017. Others did not directly disagree with this perspective, but stressed that the field of energy research, for example—in which both sides strongly compete—was de facto excluded from any agreements on further enhanced cooperation made at this summit. This is of high relevance to this case study.

Several of the interviewees referred to difficulties in R&I collaboration with China, such as IPR infringements or lack of enforcement as well as a lack of “reciprocity” in access to research programs. This latter point is interesting given that such reciprocity in access has in fact been agreed at policy level (as described earlier in the section “Analysis of Official EU Documents and Agreements”).

Statements concerning S&T Cooperation in Solar PV with China

Essentially all interviewees confirmed that enhanced S&T cooperation with China in solar PV ended because of the European industry’s decline and China’s role therein, as explained earlier. One interviewee even stated repeatedly that the solar PV case has been a “turning point” that “has influenced a lot what we do with China in energy research in general today.” The same interviewee cited a “fear” that a similar development may take place in wind energy.

We also learned that the last solar-PV-related project with a Chinese partner was funded under the predecessor program to H2020, based on a call for proposals launched in 2008. At that time, the European solar PV industry was still at its height, with the dramatic Chinese-industry takeover not yet in effect.

Several interviewees stressed that EC policy does not explicitly exclude cooperation with China in this area, but rather seeks to focus on other areas. If a proposal is submitted that includes Chinese partners, it must always be evaluated based on its excellence. As far as co-funding, this decision ultimately rests with the Chinese Ministry of Science and Technology.
The Role of “Mission Innovation”

Several DG RTD representatives stated that R&I collaboration with China in clean and renewable energy technologies was supported specifically through Mission Innovation (MI), an initiative of twenty-four countries and the EC. According to the MI website, participants have committed to “taking action to double their public clean energy R&D investment over five years. In addition, MI members encourage collaboration among partner countries, share information, and coordinate with businesses and investors.”[26]

Overall, the EC officials admitted that success in encouraging concrete collaboration projects was limited. The MI initiative served more as a means to exchange experiences and best practices. This worked reasonably well with partners such as the United States and Canada, but much less so with others like China, which was regarded as insufficiently transparent, resistant to sharing experiences and interests. Such sharing is considered a necessary component for building trust.

Discussion and Conclusions

We now return to the question posed at the outset: How has EU R&I policy responded to the tension between (1) gaining competitive advantage by supporting the development of technologies not yet possessed by others; and (2) the collaborative philosophy embraced in Open Innovation, Open Science, Open to the World?

The evidence, both qualitative and quantitative, suggests strongly that the first rationale has prevailed. Collaboration with China in solar PV no longer receives support, and strong hints indicate this is a direct result of tough competition. Among the quantitative facts: the most recent funding opportunity explicitly encouraging collaboration with China in solar PV preceded the fall of the European solar industry. Since that moment, more than a decade ago, R&I collaboration with China has garnered no encouragement. Moreover, our interviewees were unequivocal on this issue. With only minor nuances separating them, all said that there is no intention to specifically promote collaboration with China in solar PV. They also stated repeatedly that this was a direct consequence of the experience of China coming to dominate the industry. In view of generally positive S&T relations between the EU and China, all this must be seen as highly remarkable.

These findings relate not only to solar PV but also to S&T cooperation in the wider renewable energy domain. Reiterating here the statement of one interviewee: “The solar PV case has been a turning point, which has influenced a lot what we do with China in energy research in general today.” This interviewee, as recorded earlier, also gave voice to the fear that this development might spread to wind energy. Indeed, renewables such as wind energy have, like solar PV, been the subject of zero explicit encouragement for collaboration with China. Hence, while strong competition in one technology still leaves
room for overall good and intensive relations between the two sides, the solar PV case cannot be seen in isolation but instead as part of a likely trend in S&T cooperation in renewable energy at large.

What lessons can be drawn from all this? I argue for one main conclusion: that a strong tension does appear to exist between science diplomacy, with its cooperation-oriented, win-win philosophy, and innovation, with its competition-oriented, close-to-market emphasis. The case study informing this paper shows that where commercial interests interfere with the ideal of “open innovation, open science, open to the world,” the former appears to triumph. Interestingly, this is even the case for a technology that has a strong potential to help address global challenges—which would provide another rationale for international collaboration.

One may of course argue that the case chosen for this analysis is an extreme one, with a sector experiencing particularly intense competition and a country known to be not the fairest competitor. While both statements are true, the case study analyzed for this paper was premised on just such an approach, because it was deemed the best way to produce clear results. Most other cases are less extreme and the situation therefore is less clear-cut, but we would argue that the underlying dynamics would remain the same. As has been shown, the EC has itself drawn lessons from the solar PV issue, and is reconsidering its cooperation in other highly competitive technology domains based on this experience.

Does this mean that the ideas constituting science diplomacy simply cannot be reimagined as something along the lines of “innovation diplomacy”? Innovation diplomacy may still make sense in at least two contexts. One such context is quite obvious: areas with far lower commercial implications, such as an industry not dependent on thousands of jobs. Societal challenges present an opportunity here, with one possible example being climate adaptation—that is, the steps necessary to avert the worst outcomes of climate change. The second context in which innovation diplomacy could offer interesting new approaches is that of development cooperation. As opposed to classical development cooperation, wherein money or ideas are transferred to the target country, innovation diplomacy could entail the shared development of solutions, drawing on and modifying existing models, tailored to a development partner country. In this situation, a conflict between a cooperative approach and commercial interest would be much less likely, given that the solutions to be developed would be specific to the partner country and thus less suitable to be sold at a global scale.
Endnotes


[2] The terms *science and technology (S&T)* and *research and innovation (R&I)* are often used interchangeably. In this paper, we use S&T primarily in the context of S&T *cooperation* at the policy level between countries and R&I primarily in the context of actual R&I *collaboration* on the ground between specific research organizations.


[4] The author was involved in a large-scale study to support the European Commission precisely in these efforts.


[7] A brief explanation of the open innovation paradigm may help in following this reasoning. To be sure, the concept is constantly evolving, but some key elements are especially important. First and foremost is the idea that the innovation process benefits from product development in an open creative marketplace of ideas, rather than behind a company’s closed doors. Such a creative process would involve the users but also other stakeholders along and across industry and sector-specific value chains. While this open pursuit of innovation carries known risks, the argument in favor holds that the opportunities outweigh these risks, and that an individual company, if it plays the situation right, will see primarily positive rather than negative effects. Closely linked to the concept of open innovation is that of open science, which refers essentially to involving citizens and all kinds of stakeholders as much as possible in the research process and sharing research results as early as possible.


[10] More specifically, it explains that the Chinese government massively supports domestic high-tech companies while systematically erecting barriers to market access and obstacles to business activities for foreign companies.


[22] A number of areas in fundamental research are indirectly linked to solar PV technologies, such as the development of more-advanced materials. The analysis here has only considered funding opportunities that explicitly and directly focus on solar PV.

[23] I conducted interviews with five officials from the Directorate-General for Research and Innovation (DG RTD) and the European External Action Service (EEAS), specifically: (1) DG RTD, Directorate C—International Cooperation, Unit C.1—Strategy, EFTA and enlargement countries, Russia, Asia, and Pacific; (2) DG RTD, Directorate G—Energy, Unit G.1—Strategy (hosting also the
Mission Innovation secretariat; (3) DG RTD, Directorate G—Energy, Unit G.3—Renewable energy sources; (4) EEAS, Directorate ASIAPAC—Asia and Pacific, Unit 4—China, Hong Kong, Macao, Taiwan, and Mongolia; (5) EEAS, Delegation to the People’s Republic of China, Science, Technology, and Environment Section.

[24] Mission Innovation is an initiative of twenty-four countries and the European Union that have committed to double their public clean energy R&D investment over five years and to increase collaboration in this field; see http://mission-innovation.net.


Table 1

European Union funding program “Horizon 2020” topics on which collaboration with Chinese partners was explicitly encouraged.

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of topics</th>
<th>Subtotal</th>
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<tr>
<td><strong>Excellent Science</strong></td>
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<td>European Research Infrastructures</td>
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<td>Future and Emerging Technologies</td>
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<td>Biotechnology</td>
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<td><strong>Societal Challenges</strong></td>
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<td>SC1—Health, demographic change, and well-being</td>
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<tr>
<td>SC2—Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy</td>
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<tr>
<td><strong>SC3—Secure, clean, and efficient energy</strong></td>
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<tr>
<td><strong>Thereof relating to solar PV</strong></td>
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<tr>
<td>SC4—Smart, green, and integrated transport</td>
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<td>SC5—Climate action, environment, resource efficiency, and raw materials</td>
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<tr>
<td>SC6—Europe in a changing world: inclusive, innovative, and reflective societies</td>
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<td>SC7—Secure societies: protecting freedom and security of Europe and its citizens Crosscutting (mostly sustainable urbanization)</td>
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