Global Environmental Change 41 (2016) 124–141

Contents lists available at ScienceDirect

Global Environmental Change

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

Hype among low-carbon technologies: Carbon capture and storage in comparison

Alfonso Martínez Arranz

School of Social Sciences, Monash University, 900 Dandenong Rd., Caulfield East, VIC 3145, Australia

ARTICLE INFO

Article history:
Received 17 February 2016
Received in revised form 30 August 2016
Accepted 3 September 2016
Available online xxx

Keywords:
Carbon capture and storage
Hype
R&D
Climate policy
Technology policy
Solar thermal power

ABSTRACT

Carbon dioxide capture and storage (CCS) technology has become a crucial part of climate change mitigation strategies around the world; yet its progress has been slow. Some have criticised CCS as a distracting hype, even as mainstream support continues. This article adapts the literature on technological hypes to develop a framework suitable for technologies with limited media/public exposure, such as CCS. It provides a qualitative context and analyses seven quantitative indicators of hype that are largely internal to the CCS technology regime. Throughout, the article contrasts results for CCS with those of comparable technologies. The main findings, are as follows. “Expectations” in the form of mounted rapidly project announcements for electricity applications of CCS and deployment forecasts in influential reports. However, announcements soon plummeted. “Commitments” remained high, nonetheless, judging by allocations in public budgets and number of peer-reviewed publications. Meanwhile, “outcomes”—in terms of patents, prototypes and estimated costs— reveal few if any improvements for CCS. Considering these findings and the characteristics of CCS, its development is likely to be more difficult than initially expected. Accordingly, this article calls for decisively prioritising CCS for industrial and, potentially, bioenergy uses. Coal- and gas-fired power plants may be replaced by non-CCS technologies, so power CCS development is far less pressing.

1. Introduction

Carbon dioxide capture and storage (CCS) is often considered an essential technology for climate change mitigation; yet it faces fundamental technical, economic and social uncertainties (Markusson et al., 2012a). Nonetheless, some insist on the transient nature of its problems or on the necessity of building from the small progress in essentially the same direction (Shackley and Evar, 2012; IEA, 2015b). Another view is that CCS has been a harmful technological “hype” drawing resources away from other technologies (Stephens, 2015).

Several studies have remarked on the biased or conflicting beliefs in CCS discussions and policymaking (Hansson and Bryngelsson, 2009; Meadowcroft and Langhelle, 2011; Hansson, 2012; Martínez Arranz, 2015). This suggests a significant potential for hype. This article firstly builds a conceptual framework based on existing studies of technological hypes. It adapts some elements for the analysis of a low-carbon energy technology such as CCS. Then, the article uses this framework to test for a CCS hype. Finally, it derives some implications for CCS policy and directions for further hype research.

2. Conceptual framework

Hype is often defined as a cycle of high-rising expectations and subsequent disappointment about a technology. Despite tendencies in the literature to dissociate hype from outcomes and to emphasize its positive effects (Borup et al., 2006; Bakker, 2010; Van Lente et al., 2013), the use of the term “hype” is implicitly (Jarvenpaa and Makinen, 2008; Jun, 2012) or explicitly (Brown, 2003; Borup et al., 2006; Van Lente, 2012; Van Lente et al., 2013) associated with poor outcomes at the system level. Uncovering a hype is only possible retrospectively (Jarvenpaa and Makinen, 2008; Bakker, 2010; Van Lente et al., 2013), but once this happens it can and should lead to a rethink of assumptions and directions for technological development.

Hype results from the embeddedness of technology in society (Rip and Kemp, 1998). Interests and institutions can be powerful barriers to technological change, e.g. through higher financing requirements or commercialisation disadvantages for new technologies (Unruh, 2000). Thus, during early phases of

E-mail addresses: alfonso.martinez-arranz@monash.edu, gmig25@gmail.com (A. Martínez Arranz).

http://dx.doi.org/10.1016/j.gloenvcha.2016.09.001
0959-3780/

development—in which CCS and most low-carbon technologies find themselves—the unavoidable risks and uncertainty are countered with claims about future reductions in social costs or future synergistic linkages with existing technologies, which are in turn backed by existing interest groups. Crucially, thanks to the "interpretive flexibility" of project results (Konrad, 2006), framing of early results as a step on the road to success is often difficult to disprove. It is only in more advanced phases that more objective techno-economic competition can play an important role (Geels, 2005; Bakker et al., 2011).

A certain "desire for a miracle" in clean energy technology makes it particularly prone to hypes—not only among an ignorant public and politicians (Banholzer, 2012), swayed by sweet-talking marketers and narratives (Audin, 2002; Vel, 2014), but also among experts in their earnest pursuit of the results they wish for. Indeed, framing, as the socio-cognitive mechanism by which hypes become possible, is naturally applicable to the energy sector (Dosi, 1982; Scrase and Ockwell, 2010).

Due to space constraints, the focus below is on the differences between existing studies of hype and the framework presented in this article. Section 5 draws on observations from this same literature to derive lessons for the case of CCS.

2.1. Existing studies of hype

2.1.1. Context, relevant indicators and their relationships

Studies of hype often use interviews with experts and close textual analysis of media articles to provide a qualitative context within which to interpret fluctuations in attention or other quantitative indicators of hype. However, the selection of indicators is quite varied and inconsistent:

- Qualitative analysis of roadmaps and expert interviews (Bakker et al., 2011).
- Qualitative analysis of peer-reviewed publications (Van Lente and Bakker, 2010).
- Counts of articles in prestigious newspapers (Konrad, 2006) combined with analyses of their content (Van Lente et al., 2013).
- Counts of prototypes and (a) company statements on time remaining until market launch (Bakker, 2010) or (b) specialised magazine articles (Bakker et al., 2012).
- Counts of items in science, engineering, and patent databases, as well as in the popular and business press (Jarvenpaa and Makinen, 2008).
- Analysis of Internet search traffic, patent analysis, counts of news items, and market share (Jun, 2012).
- Media attention and expert interviews (Konrad et al., 2012).
- Media attention, expert interviews, conferences and R&D fairs, peer-reviewed publications and patents (Ruef and Markard, 2010).

In general, the literature analyses both discursive indicators (such as media attention or stakeholder statements) and innovative indicators (such as patents or the building of prototypes). However, although both types are deemed to affect expectations (Konrad, 2006; Konrad et al., 2012), hype is also frequently noted to be the result of discursive activities only (Borup et al., 2006; Ruef and Markard, 2010; Van Lente et al., 2013). The hype cycle is therefore most often depicted by plotting the level of media activities as a proxy for expectations (Fig. 1).

Nonetheless, the media have been rather passive regarding CCS (Boyd and Paveglio, 2014), and public opinion remains overwhelmingly ignorant about what CCS is and what it does (Riesch et al., 2013; Ashworth et al., 2015). In addition, media attention may well have little impact on actual innovation activities (Ruef and Markard, 2010). Thus, attention from mass media is likely to be a secondary aspect of hype for CCS, and probably many other technologies. Moreover, not all activities involved in hype yield a rising-falling plot as different activities play different roles in technology development (Konrad et al., 2012; Jun, 2012; Jarvenpaa and Makinen, 2008).

Accordingly, the framework outlined in Section 2.2 defines hype as the result of rapid changes across both discursive and innovative quantitative indicators, which correspond with a plausible narrative drawn from contextual information.

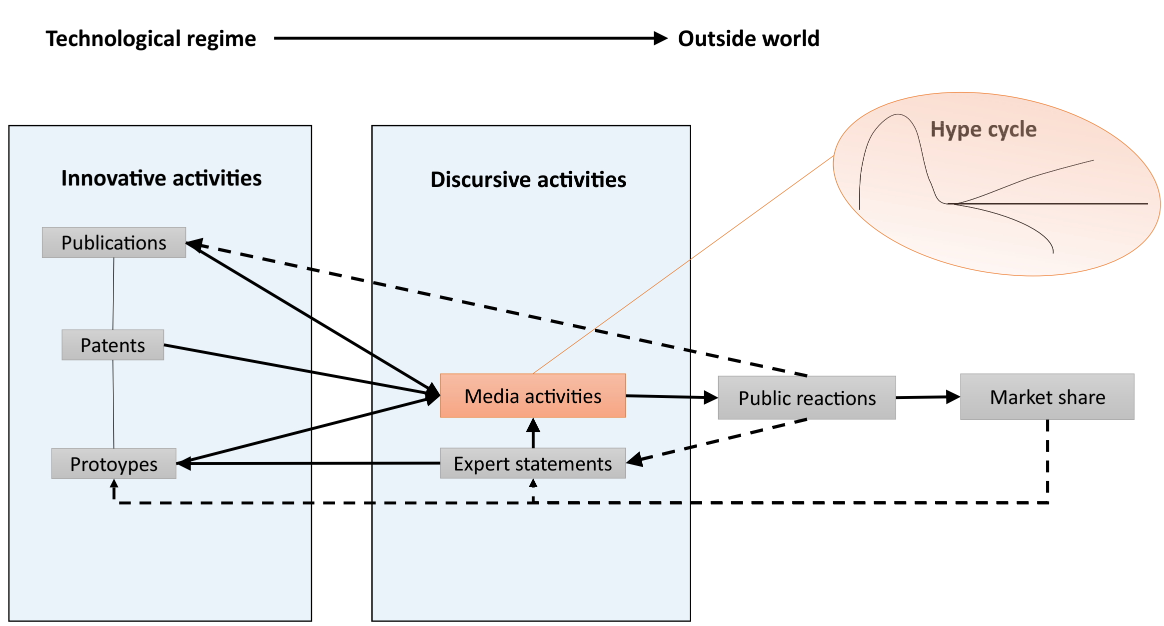

Fig. 1. Schematic of indicators of hype analysed in the literature, with media activities acting as the measure of technological expectations. Solid lines indicate direct influence, dashed lines indicate delayed influence.