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Opaque transparency: How material affordances shape intermediary work

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Abstract

How do the material aspects of intermediary work affect regulators, targets, and beneficiaries? To shed light on this question, we studied an information intermediary in the form of a website and the organizations who founded it. Specifically, we analyzed FracFocus, a self-regulatory initiative with strong industry ties, charged with disclosing data pertaining to the chemicals used in oil and gas wells completed using hydraulic fracturing technology (fracking) in the United States and Canada. We found that between 2010 and mid-2017, the vast majority of legislation in states and provinces where fracking actively occurred was updated to mandate or encourage disclosure via FracFocus, meaning that it had a considerable effect on the trajectory of official regulation on fracking disclosure. We also found that FracFocus disclosed important data but did so in a manner that limited accessibility and reduced the comprehensibility of environmental and public health risks to beneficiaries. Our analysis suggests that the public's experience of such a device is one of opaque transparency, in which the line between official and non-official regulation is blurred. We traced these outcomes to the material affordances created by FracFocus.

Keywords: FracFocus, fracking, information disclosure, material affordances, regulatory intermediary.

1. Introduction

Over the past several years, the Regulator–Intermediary–Target (R–I–T) framework has garnered significant scholarly interest because of its utility in analyzing the dynamics that can ensue between these disparate actors (Abbott *et al.* 2017). In their introduction to this special issue, Ména *et al.* (2018) suggest analyzing intermediary work along two dimensions. The first dimension distinguishes an intermediary as "official" to the extent that its enactment and potency stem from undisputed authority. The second dimension involves the "cognitive and material aspects of intermediation" (Ména *et al.* 2018, p. 11), that distinguish between tools, procedures, codes, and similar artifacts on the one hand, and human and organizational actors on the other. Drawing directly on this typology, in this paper we study the intermediary work involved in transforming an initially voluntary industry initiative into a widely adopted field level practice. Our analysis foregrounds the role of material affordances in shaping the emergence and trajectory of subsequent regulation and associated practices, as well as shaping the outcomes for intended beneficiaries (typically denoted as B in the extended R-I-T-B model; Koenig-Archibugi & Macdonald 2017).

We analyzed intermediary work in the context of information disclosure (Fung & O'Rourke 2000; Gupta 2008; Delmas & Lessem 2017), a practice that has become increasingly commonplace in transnational multistakeholder regulation over the past several decades. Notable examples include the Global Reporting Initiative (GRI) and the Responsible Care Program (King & Lenox 2000; Abbott & Snidal 2009; Brès & Gond 2014). While subject to alternative interpretations, in each of these examples an authoritative actor (R) devised a formalized set of directives (I) that was meant to modify industry practices and performance (T) for the benefit of the public at large (B). In prior research, scholars have interpreted intermediaries as either self-interested entities driven by

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institutional pressures (van der Heijden 2017) or collectives of human actors operating in a conflicted environment (Pegram 2017; Paiement 2018). We complement these theoretical advances by exploring the mechanisms through which the material affordances of information disclosure influence regulators, targets, and beneficiaries.

Specifically, our investigation focuses on the work of an information intermediary in the oil and gas industry. We chose to study FracFocus, an online chemical registry purporting to inform affected communities and the wider public in the United States (US) and Canada about the environmental and health risks associated with hydraulic fracturing ("fracking"), a suite of practices that have dominated unconventional shale oil and gas extraction over the last decade. FracFocus was launched in the US in 2011 in response to concerns about environmental hazards presumed to be by-products of fracking, such as water consumption and contamination, air pollution, and induced seismicity (Vengosh *et al.* 2014; Environmental Protection Agency 2016; Etzion *et al.* 2016; Gehman *et al.* 2016). FracFocus was established by two quasi-regulatory bodies with strong industry ties and is maintained by a private technology consultancy. In 2012, an equivalent website was established in Canada by the same organizations, with cooperation from the British Columbia Oil and Gas Commission (BCOGC). Applying Koenig-Archibugi and Macdonald's (2017) extension to the original R–I–T model, we interpreted FracFocus as a regulatory intermediary (I), situated between regulators (R), fracking operators (T), and the public (B) in the US and Canada, and analyzed the dynamics surrounding its relationships with each of these constituents.

First, we explored the adoption of FracFocus as an official disclosure channel among regulators in the various states and provinces in the US and Canada where fracking occurred. Our analysis revealed that 22 of 24 US states and two of four Canadian provinces with fracking activity required, permitted, or encouraged disclosure through FracFocus, either solely or in tandem with disclosure through a website operated by the relevant state or provincial regulator. Our analysis also revealed that FracFocus launched just before the first big wave of statutory legislation on fracking disclosure. Although FracFocus was initially conceived as a voluntary tool, it evolved into a de facto statutory disclosure mechanism throughout the US and Canada. Second, we found that even in states and provinces where FracFocus was not mandated, fracking operators regularly used this website to voluntarily disclose details of their fracking operations, attesting to its overall successful diffusion within the industry.

Third, we explored the effectiveness of FracFocus in providing meaningful information to the public regarding environmental and health risks posed by fracking. To this end, we expanded Weil *et al.*'s (2006) notion of "user embeddedness" of disclosure policies into a model comprised of four criteria for assessing information quality: accessibility, granularity, comprehensibility, and timeliness. Using this model, we analyzed the effectiveness of disclosure provided via FracFocus and compared it to the effectiveness of the regulator-operated websites used as the alternative mandatory channel in some jurisdictions. Our overall conclusion was that the information disclosed by FracFocus remained largely unhelpful to citizens, manifesting problems with respect to each of our criteria. In many cases, the information disclosed via regulator-operated websites was more accessible than information disclosed via FracFocus, and was presented at a level of granularity and comprehensibility that better supported public decision-making.

We interpret these findings as showing how a non-official yet formalized intermediary (Ména *et al.* 2018) can precede, catalyze, and funnel official regulation in a way that favors industry rather than the public, and we relate this outcome to its material affordances (Orlikowski & Scott 2008; Treem & Leonardi 2013). Our findings also suggest that unlike other information intermediaries such as GRI and Responsible Care, FracFocus operates essentially as a regulator-in-disguise, blurring the boundaries between the supposedly distinct realms of official regulation and self-regulation, while providing what amounts to "opaque transparency" for its intended beneficiaries.

2. Theoretical background

The R–I–T model provides the conceptual building blocks for analyzing intermediary-based regulation, a form of control that can provide tangible benefits when regulators have limited capacity and expertise (Abbott *et al.* 2017). In particular, competent intermediaries can: translate or interpret regulations for targets, making it easier for them to follow the letter of the law; monitor compliance; and serve as a conduit from targets to regulators, providing advice on improving institutional designs (Bothello & Mehrpouya 2018; Kourula *et al.* 2018).

In an important extension to the original model, Koenig-Archibugi and Macdonald (2017) added another actor, the intended beneficiaries of intermediary work (B). Often relationships with beneficiaries are notable for being less intimate and immediate than those found in the basic R–I–T triad. For example, in the case of labor practices, governments and multinational non-governmental organizations (NGOs), such as Fairtrade, engage directly and repeatedly with one another, each pursuing their own direct interests, while the beneficiaries – the actual workers in far flung locations who ostensibly benefit from this engagement – are only indirectly (re)present(ed) (Koenig-Archibugi & Macdonald 2017).

Consequently, a key focus of research in the R–I–T–B framework has been to examine whose interests are served by governance structures involving intermediaries – those of the regulators (Paiement 2018), targets (Maggetti *et al.* 2017), or intended beneficiaries (Monciardini & Conaldi 2018), or even the interests of the intermediaries themselves (Auld & Renckens 2017; Galland 2017; Kruck 2017). These studies suggest not only that intermediaries strive to extend their power and influence, but more fundamentally recognize that intermediaries are agentic, acting in the world in a deliberate and strategic manner. Scholars have typically described such phenomena in the intermediary literature using a regulatory capture framework (Abbott *et al.* 2017; van der Heijden 2017), emphasizing an intermediary's actions, tussles, and maneuvering as it pursues its self-interest vis-à-vis targets, regulators, and beneficiaries (De Silva 2017; Kruck 2017).

In contrast, few researchers have examined how an intermediary's indirect actions – its influence from a distance (Latour 1987) – can shape these dynamics. Such actions often manifest through symbolic systems like standards, certifications, and other instantiations of calculability that transmit information to the rest of the constituents (Callon 1998; Etzion & Ferraro 2010; Giamporcaro & Gond 2016; Ména *et al.* 2018). For example, an organic food label is the visible manifestation of an intermediary's efforts to promote sustainable agriculture (Lee 2009; Lee *et al.* 2017). The certifying intermediary exerts its influence in this context not only directly through engagement with regulators and farmers (Loconto 2017), but also indirectly through the presence or absence of its logo on products (Thøgersen 2011; Delmas & Lessem 2017; Gehman & Grimes 2017).

In "signaling" contexts such as these, the overall influence that an intermediary will exert is potentially a function of the material form through which it displays its engagement. The public-facing presentation of an intermediary, that is, "the ways that its physical and/or digital materials are arranged into particular forms" (Leonardi 2012, p. 29), is crucial for the assessment of its credibility and independence – attributes of utmost importance for a successful intermediary (Leonardi & Barley 2010; Abbott *et al.* 2017). The effects of materiality are presumably particularly pronounced when the intermediary serves as a conduit for certifying compliance or conferring legitimacy. Typically in these contexts, the intermediary serves as a regulator-sanctioned discloser of information: assessing, distilling, and presenting data from targets on behalf of the other constituents.

2.1. Information disclosure via intermediaries

As part of the shift toward neoliberal policies (Levi-Faur 2005; Djelic 2006; Mehrpouya & Djelic 2014), regulators have embraced a governance approach based on providing information to the public to drive collective action, also known as regulation-by-information (Stephan 2002; Gupta 2008; Delmas *et al.* 2010; Haufler 2010; Florini & Saleem 2011). A pioneering example of this regulatory approach is the US 1986 Emergency Planning and Community Right-to-Know Act (EPCRA). The Act requires facilities that exceed mandated thresholds to report their emissions to the US Environmental Protection Agency (EPA) through the Toxic Release Inventory (TRI) program, which then makes these reports publicly available (Fung & O'Rourke 2000; Bae *et al.* 2010; Doshi *et al.* 2013). Other early examples include the Nutrition Labeling and Education Act of 1990 (Weil *et al.* 2006) and the 1996 amendment to the Safe Drinking Water Act, which requires suppliers to provide users with annual reports of regulatory violations and contaminant levels (Bennear & Olmstead 2008).

The rationale underlying this regulatory approach is that an information-rich environment will contribute to the dynamic interplay between various stakeholders, under the assumption that sunlight is the best disinfectant (Stephan 2002). From an economic perspective, knowledge about corporations' objective performance can reduce information asymmetry, thus improving signal reliability and overall market efficiency (Konar & Cohen 1997). Via an institutional lens, information disclosure is supposed to unleash a set of forces and pressures that will motivate corporations to adjust their conduct (DiMaggio & Powell 1983; Raufflet *et al.* 2014). For example,

information about a competitor's performance might drive good performers to excel, whereas a desire to avoid embarrassment might drive poor performers toward the average (Gunningham *et al.* 2003; Campbell 2007; Chatterji & Toffel 2010). Finally, from an ethical standpoint that acknowledges the wider social context in which corporate activity is embedded, information disclosure aligns with the idea that the public has a basic right to know about issues that concern its general interest (Tietenberg & Wheeler 2001; Florini 2007; Fisk 2013).

Initial efforts to mandate information disclosure, such as the TRI, were devised and implemented by the regulators themselves (Bae *et al.* 2010). Other disclosure regimes have been spearheaded by industry (Levi-Faur 2005), such as Responsible Care, a set of 10 general principles for managing chemicals developed in the aftermath of the Bhopal disaster, that promote the communication of product, service, and process risks to stakeholders (King & Lenox 2000). In other settings, third party intermediaries have taken on prominent roles in a variety of information disclosure regimes. For example, the GRI is an NGO that began promoting corporate responsibility reporting in the late 1990s, aiming to better inform the public about the environmental and social performance of corporations (Abbott & Snidal 2009; Etzion & Ferraro 2010; Brès & Gond 2014).

Building on this prior literature, we propose that depending on the identity of the actor leading an information disclosure initiative, such arrangements can be conceptualized using the R–I–T–B model. For example, Abbott *et al.* (2017) examined the industry association behind Responsible Care as though it were a regulator, having its own members as targets and independent monitors as intermediaries. Similarly, GRI can be interpreted as a regulator of a new form of disclosure, or alternatively as an intermediary situated between traditional regulators and targets. For the most part, such "information intermediaries" have enjoyed wide support by industry, but have also been critiqued by researchers regarding the extent to which they truly benefit intended beneficiaries (B) in terms of reducing environmental and public health risks. For example, the GRI guidelines, which prescribe how organizations should disclose information, have been criticized for fostering a "check-box mentality" and decoupling reporting from performance (Milne & Gray 2013; Cho *et al.* 2015). More broadly, environmental disclosure has been criticized as little more than greenwashing (Delmas & Burbano 2011; Lyon & Maxwell 2011; Marquis *et al.* 2016).

Such concerns further highlight the importance of the material dimensions of intermediary work, or their "material agency" (Leonardi 2012, p. 27; Cecez-Kecmanovic *et al.* 2014). Information disclosures are particularly "loaded," carrying with them not only scripts and affordances, but also norms, values, and politics (Cloatre & Dingwall 2013; Gehman *et al.* 2013). Their presentation is not decontextualized: "inscription" (Latour 1987; Akrich 1992) matters too. Structure, appearance, format, specificity, and location all matter for stakeholders attempting to gauge the credibility and legitimacy of information (Robson 1992), and by extension, that of the intermediary providing it. In particular, materiality can be mobilized to encourage certain interpretations of information (Gond & Nyberg 2017). Thus, understanding information intermediaries and the technologies they employ for knowledge production and regulation (Mehrpouya & Samiolo 2018) can potentially enrich debate regarding their "effectiveness, legitimacy, accountability and transparency" (Abbott *et al.* 2017, p. 4).

Notably, Weil *et al.* (2006) suggested that a public disclosure mechanism could be deemed successful to the extent that its products can be incorporated within the decision-making routines of its recipients, (beneficiaries in Koenig-Archibugi & Macdonald's 2017 terms). In this study, we expand the typology of information disclosure policies suggested by Weil *et al.* (2006) into a model comprised of four criteria for assessing information quality: accessibility, granularity, comprehensibility, and timeliness. We then utilize this expanded model to examine how the material affordances of an intermediary-based information disclosure initiative played out in the context of fracking in the US and Canada.

3. Research setting

Fracking is a general term for a set of technologies employed in the production of oil and gas from unconventional shale formations, including high volume, multistage slickwater hydraulic fracturing, and horizontal drilling (Gold 2014; Gond *et al.* 2016). In fracking, shale rock formations are drilled horizontally and a chemical cocktail is injected into the rocks at high pressure, creating fractures that unlock oil and gas, releasing it into the drilling pipe. Although the first fracking experiment was performed in 1947 (Fig. 1, based on Cahoy *et al.* 2013), the current high-volume slick water fracking boom only began in earnest during the past decade (Sernovitz 2016), with

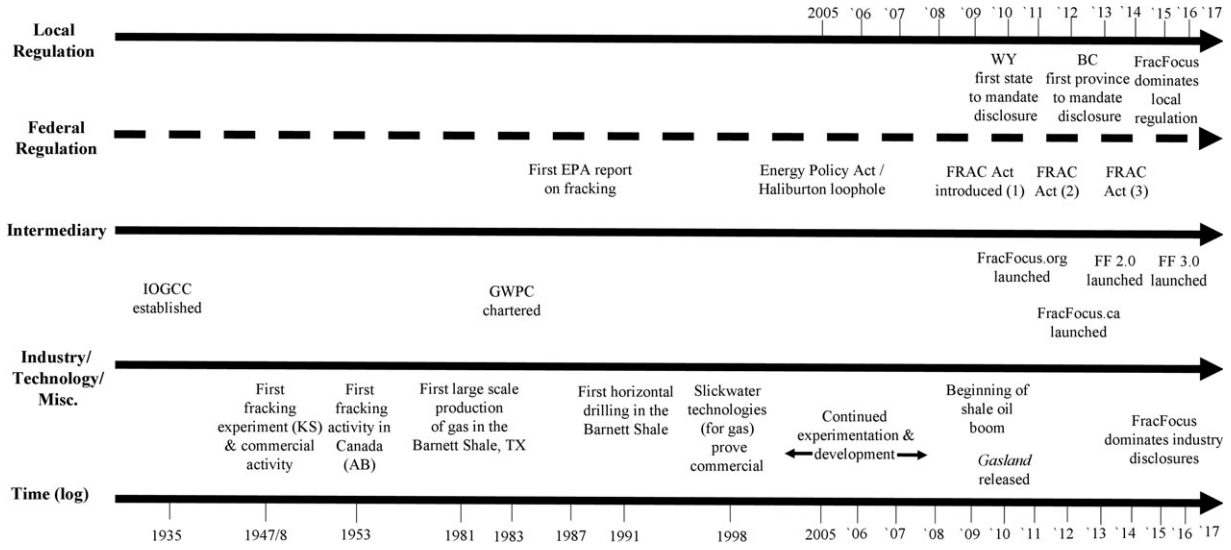

Figure 1 Timeline of fracking related events in Canada and the United States. AB, Alberta; BC, British Columbia; EPA, Environmental Protection Agency; GWPC, Ground Water Protection Council; IOGCC, Interstate Oil and Gas Compact Commission; KS, Kansas; TX, Texas; WY, Wyoming.

tens of thousands of new wells drilled in North America. What follows is a short review of this boom and its potential effects on the environment and public health. Figure 1 depicts the key events discussed in this section.

In the US, fracking accounted for less than 2 percent of oil and gas production in 2000, but as of January 2018, it accounted for 64.4 percent of oil and 66.2 percent of natural gas production, and is expected to continue expanding (Egan 2016).[1] Among the roughly 900,000 active oil and gas wells in the US, about a third are fracking wells, a more than 10-fold increase compared to 2000 (Egan 2016; Meko & Karklis 2017). In Canada, unconventional oil production has doubled since the early 2010s, recently surpassing 400,000 barrels per day (Ewart 2014). However, this only represents approximately 10 percent of Canada's total production, which continues to be dominated by sources such as Alberta's oil sands (CBC 2017).

At the same time, ever since the EPA's (1987) report on the subject (see Fig. 1), fracking has been associated with an array of potentially detrimental impacts to the environment and public health, especially regarding water consumption and contamination. By composition, water is the primary component in fracking fluids used both during the initial drilling and subsequent pumping of wells. Although fracking operations consume little water relative to total annual water flows in many regions, this consumption often occurs over a short period (generally weeks or months), thus potentially impacting water supplies, particularly in "low-flow" areas during peak times of the year (Vengosh *et al.* 2014). Fracking operations might also contaminate ground and surface water sources in the process of fracturing the shale rock using fluid that contains hazardous chemicals, especially through improperly cased (i.e. sealed) wells (Alessi *et al.* 2017). Methane contamination can also occur, as exemplified most vividly in the 2010 documentary, *Gasland.* In one scene, a resident of Dimock, Pennsylvania, dramatically lit his tap water on fire, apparently a result of the presence of methane. In addition to water withdrawal and contamination, other risks include air pollution, noise pollution, and induced seismic activity (Adgate *et al.* 2014; Gehman *et al.* 2016; Weber 2016). Because fracking technology has only been widely employed for a decade, the extent of many of these environmental impacts is still unknown or uncertain (EPA 2016).

In the US, where fracking originated, the oil and gas industry has traditionally been exempt from federal environmental regulation. In fact, the 1986 EPCRA explicitly exempted this industry from reporting under the TRI. In addition, the 2005 Energy and Policy Act formally exempted the oil and gas industry from the Safe Drinking Water Act, in what has since become known as the "Halliburton loophole," named after a prominent fracking services provider (Urbina 2011). In 2009, attempts were made to repeal the exemption and to define hydraulic fracturing as a federally regulated activity under the EPCRA (i.e. the FRAC Act), but were unsuccessful.[2] Consequently, most regulation and oversight occurs at the state level.

3.1. FracFocus

FracFocus.org was launched in April 2011 as a voluntary well registry within the US as a joint venture of the Ground Water Protection Council (GWPC) and the Interstate Oil and Gas Compact Commission (IOGCC). According to its website, the GWPC is a private, non-profit corporation chartered in 1983 that employs nine professionals, including an information technology and network specialist who provides website support to FracFocus; its 21 board members are representatives from state ground water agencies. According to the website, the GWPC's purpose is to "promote and ensure the use of best practices and fair but effective laws regarding comprehensive ground water protection." The IOGCC, according to its website, is an interstate compact originally founded in 1935 by six US states, whose mission is to promote "the conservation and efficient recovery of domestic oil and natural gas resources while protecting health, safety and the environment." Although it lacks official regulatory authority, as of 2018, its members included the governors of 38 oil and gas producing states, plus eight Canadian provinces, as well as appointed representatives from related agencies. Hundreds of additional members take part in standing committees (IOGCC 2015). Overall, at least a third of IOGCC members are lobbyists and industry executives (Baca 2010; Song 2016; see Fig. 2).

Prior to the launch of FracFocus.org, the GWPC and the IOGCC signed a Memorandum of Understanding (MOU; available at FracFocusData.org). The MOU contained four main clauses, stipulating that the two organizations agree on: (i) "the value, importance and jurisdiction of state regulatory authorities in matters concerning oil and gas exploration;" (ii) "the need for public access to current information and data;" (iii) their "common interest in providing readily accessible and meaningful information;" and (iv) the public benefits of harnessing "the unique and common strengths and assets of both organizations." Accordingly, FracFocus aims to provide "a central location for [the] public and industry to communicate and relay information on the chemicals used during the process of hydraulic fracturing of oil or gas wells" as well as "impartial and balanced education tools to the public on the topic of hydraulic fracturing" (FracFocusData.org).

According to FracFocus.org, the GWPC and the IOGCC contracted with ALL Consulting, a private technology consultancy that works primarily with oil and gas companies, to develop and manage the US website and database. All three organizations (GWPC, IOGCC, and ALL) are headquartered in Oklahoma, one of the largest oil and gas states in America (U.S. Department of Energy 2017). According to the 2014 Secretary of Energy Advisory Board Task Force Report on FracFocus.org the budget for the project increased from US$527,000 in 2011 to US$1,406,000 in 2013: "these funds come from the Department of Energy, the American Petroleum Institute, American Natural Gas Alliance, Environmental Defense Fund and other organizations" (U.S. Department of

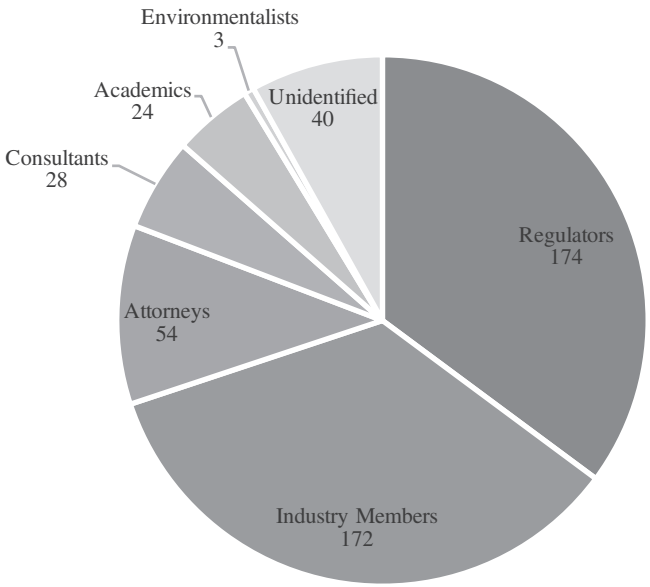

Figure 2 Interstate Oil and Gas Compact Commission membership breakdown (IOGCC 2015).

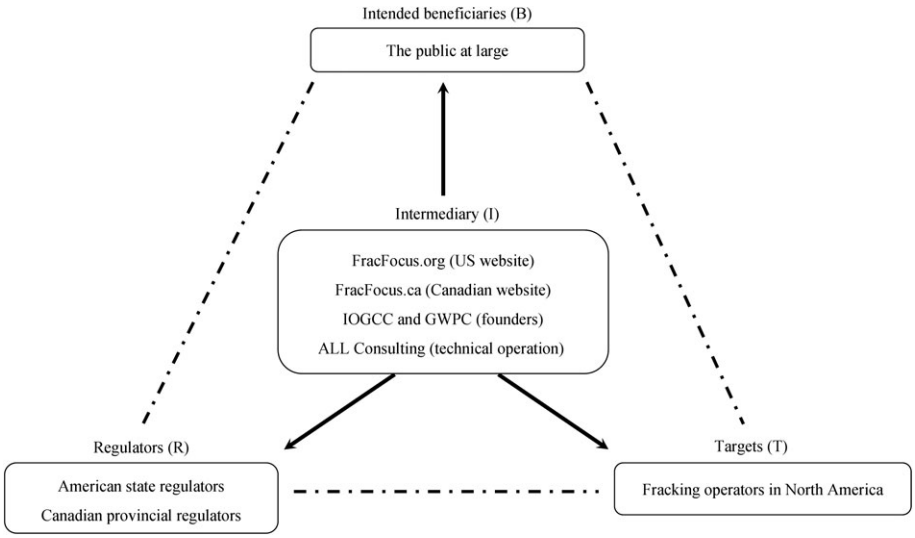

Figure 3 The Regulator–Intermediary–Target–Beneficiaries (R–I–T–B) model applied to the context of fracking disclosure. GWPC, Ground Water Protection Council; IOGCC, Interstate Oil and Gas Compact Commission.

Energy 2014, p. 6). The report also suggested charging a modest user fee on each well registered; however, this recommendation was never implemented.

FracFocus.ca, the Canadian website, was launched in January 2012, shortly after its American counterpart, and is additionally sponsored by the BCOGC, the province's legislated regulatory agency (Fig. 1). However, according to the website, its ongoing operation and maintenance has been officially handed over to the GWPC and IOGCC.

We henceforth refer to this entire collective – the two websites, the two quasi-regulatory entities behind them (i.e. the IOGCC and GWPC), as well as the consulting firm in charge of maintenance (i.e. ALL Consulting) – as "FracFocus" (Fig. 3). Consistent with the R-I-T-B framework (Abbott *et al.* 2017), we conceptualize FracFocus as an *intermediary* positioned between traditional regulators (R) and oil and gas operators (T). We interpret the excerpts from the MOU and the website as suggesting that the intended beneficiaries (B) of this initiative include (but are not limited to) the communities living near fracking sites and members of the general public who are interested in these issues, even if they are not located in the immediate vicinity (Florini 2007).

While recognizing the validity of alternative interpretations of our context that fit the R-I-T-B model (e.g. FracFocus as a regulator of disclosure, see Havinga & Verbruggen 2017), our conceptualization (Fig. 3) uniquely allows us to explore FracFocus's connections with the rest of the constituents in the model: local regulators (R), fracking operators (T), and the public at large (B). In the following sections, we examine the dynamics surrounding each of these three dyads in detail.

4. Findings

4.1. Intermediary–regulator (I–R) dynamics

In this section we provide a formal analysis of the fracking disclosure policies in each of the American and Canadian jurisdictions with active fracking operations as of June 2017. For this stage of the analysis, we first determined which US states and Canadian provinces had active fracking operations. We obtained this information from regulator-operated websites, as well as other publicly available sources, such as the U.S. Energy Information Administration (EIA). We excluded from the analysis states and provinces that had no oil and gas wells or only conventional wells, as well as states and provinces in which unconventional oil and gas extraction had not been undertaken commercially or was subject to a ban or moratorium. As of June 2017, a total of 24 states and four provinces met these criteria. We then determined the current disclosure policy in each jurisdiction. State and provincial regulators decide whether to mandate fracking disclosure or not, and if so, whether to use the chemical registry database offered by FracFocus or a custom solution (e.g. a regulator-operated reporting website). We also

Table 1 Fracking disclosure policies and channels in the United States[†]

Jurisdiction	Fracking disclosure policy[‡]	Earliest enactment date[§]	Actual disclosure channel
Alabama	FF and RW	09/2013[4]	FF and RW[5]
Alaska	FF and RW	01/2015[6]	FF and RW (possibly)[7]
Arkansas	RW[8]; FF voluntary	01/2011	FF and RW[9]
California	FF and RW	07/2015[10]	FF and RW[11]
Colorado	FF	04/2012[12]	FF
Illinois	RW[13]	07/2014	FF and RW
Indiana	RW[14]	07/2012	FF and RW[15]
Kansas	FF or RW	12/2013[16]	FF and RW[17]
Kentucky	FF	06/2015[18]	FF
Louisiana	FF or RW	10/2011[19]	FF and RW[20]
Michigan	RW; FF voluntary	06/2011[21]	FF and RW[22]
Mississippi	FF or RW	03/2013[23]	FF and RW
Montana	FF or RW	08/2011[24]	FF and RW
Nebraska	FF	03/2016[25]	FF and RW[26]
New Mexico	RW; FF voluntary	02/2012[27]	FF and RW[28]
North Dakota	FF	04/2012[29]	FF
Ohio	FF or RW	09/2012[30]	FF and RW[31]
Oklahoma	FF	01/2013[32]	FF
Pennsylvania	FF and RW[33]	02/2011	FF and RW
Texas	FF and RW	09/2011[34]	FF and RW
Utah	FF	11/2012[35]	FF
Virginia	FF	12/2016[36]	FF
West Virginia	FF and RW[37]	12/2011	FF and RW (possibly)[38]
Wyoming	RW; FF voluntary	08/2010[39]	FF and RW[40]

[†]Excludes states where there are no oil and gas wells, states where there are only conventional wells and states that ban fracking. [‡]Reporting requirements vary in form (some are regulations, others legislation), timing for submissions, content of submissions, justifications for withholding information, and method of disclosure. [§]In cases where the regulation allows both alternatives (FracFocus and a regulator-operated website), we noted the earlier of the two. FF, FracFocus; RW, Regulator-operated website.

collected data on when relevant policy legislation was enacted in each jurisdiction relative to the launch of FracFocus. We focused specifically on regulation related to consumption and potential contamination of water sources.

We present the main findings from this stage of the analysis in Tables 1–4. Table 1 presents fracking disclosure policies in the US. Wyoming was the first state to impose a fracking disclosure mandate in August 2010. In 2011, seven states followed suit (Arkansas, Louisiana, Michigan, Montana, Pennsylvania, Texas, and West Virginia), followed by six states in 2012 (Colorado, Indiana, New Mexico, North Dakota, Ohio, and Utah), four states in 2013 (Alabama, Kansas, Mississippi, and Oklahoma), one state in 2014 (Illinois), three states in 2015 (Alaska, California, and Kentucky), and two states in 2016 (Nebraska and Virginia). Of note, only three states enacted any mandatory fracking disclosure laws prior to FracFocus's launch in April 2011: Arkansas, Pennsylvania, and Wyoming.

Table 2 summarizes these data. Among the 24 states with mandatory fracking disclosure laws: seven states mandated fracking disclosure exclusively via FracFocus; six states mandated disclosure exclusively via a regulator-operated website (of these, four encouraged the use of FracFocus as an additional voluntary disclosure mechanism); six states mandated disclosure via both FracFocus and a regulator-operated website; and five states mandated disclosure via either FracFocus or a regulator-operated website. In short, 18 out of 24 states either mandated disclosure via FracFocus or permitted its use, and an additional four states encouraged its use.

Tables 3 and 4 summarize fracking disclosure policies in Canada. We found that in two of the four provinces with fracking activity (Manitoba and Saskatchewan), no regulation had been enacted as of June 2017, whereas the BCOGC mandated the use of FracFocus.ca in tandem with the Canadian site's launch in early 2012. Alberta

Table 2 Summary: Fracking disclosure policies and channels in the United States

Metric	Number of jurisdictions (n = 24)
Fracking disclosure policy	
FF only	7
RW only (FF encouraged)	6 (4)
FF and RW	6
FF or RW	5
Earliest enactment date	
Pre-FF launch	3
Post-FF launch	21
Actual disclosure channel	
FF	24
FF and RW	11

FF, FracFocus; RW, Regulator-operated website.

Table 3 Fracking disclosure policies and channels in Canada[†]

Jurisdiction	Fracking disclosure policy	Earliest enactment date	Actual disclosure channel
Alberta	RW[41]	06/2013	FF and RW
British Columbia	FF and RW[42]	12/2011[43]	FF and RW
Manitoba	Not finalized	N/A	None
Saskatchewan	Not finalized	N/A	None

[†]Excludes provinces where fracking is in an exploratory phase and provinces that ban fracking. FF, FracFocus; RW, Regulator-operated website.

Table 4 Summary: fracking disclosure policies and channels in Canada

Metric	Number of jurisdictions (n = 4)
Fracking disclosure policy	
RW	1
FF and RW	1
Not finalized	2
Earliest enactment date	
Pre-FF launch	1
Post-FF launch	1
N/A	2
Actual disclosure channel	
FF and RW	2
None	2

FF, FracFocus; RW, Regulator-operated website.

enacted its disclosure requirements about a year and a half later. Overall, these findings are consistent with previous analyses of fracking disclosure legislation status in the US and Canada (Gosman 2013; Etzion *et al.* 2016; Konschnik & Dayalu 2016; Notte *et al.* 2017).

Figure 4 depicts the cumulative production of tight oil in the US and, starting with the passage of the disclosure mandate in Wyoming, indicates the share of production that became subject to disclosure under FracFocus. A majority of the output became regulated under FracFocus disclosure as early as September 2011 when Texas, the largest producing oil and gas state in America (U.S. Department of Energy 2017), mandated its use. By April 2012, a mere year after its launch, the disclosure of more than 90 percent of unconventional oil production was already stipulated under FracFocus, as additional states hosting significant production volumes, such as Colorado and North Dakota, mandated its use.

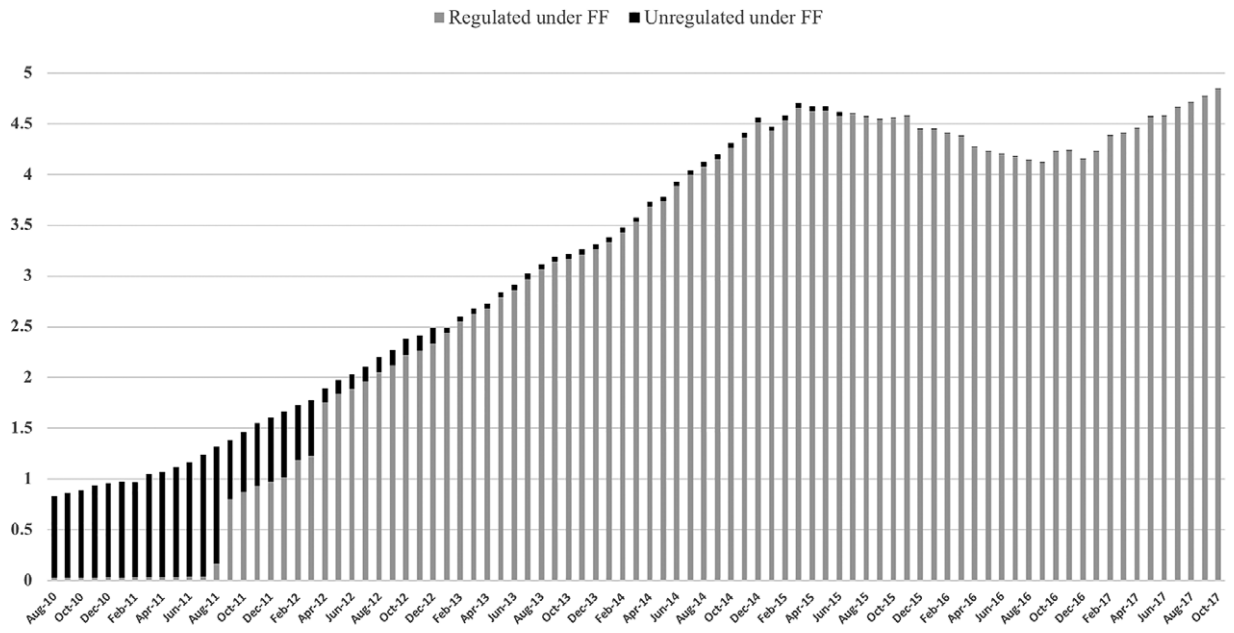

Figure 4 Total tight oil production regulated under FracFocus disclosure (million barrels per day).

4.2. Intermediary–target (I–T) dynamics

We next examined the extent of FracFocus's diffusion within the oil and gas industry. Our findings point to rapid adoption. As of January 2018, the website contained reports from oil and gas operating companies in all 24 states, including states whose regulations did not specifically mandate FracFocus as a disclosure mechanism, and two (out of four) provinces we studied. In other words, the impact of FracFocus extended beyond the states where its use was mandated or optionally permitted. To further explore this diffusion process, we used the Wayback Machine (http://www.archive.org) to track the number of wells registered on FracFocus on a biannual basis since 2012. As depicted in Figure 5, there was a consistent increase in well-level fracking disclosures, totaling nearly 130,000 wells operated by more than 1,000 participating companies by January 2018.

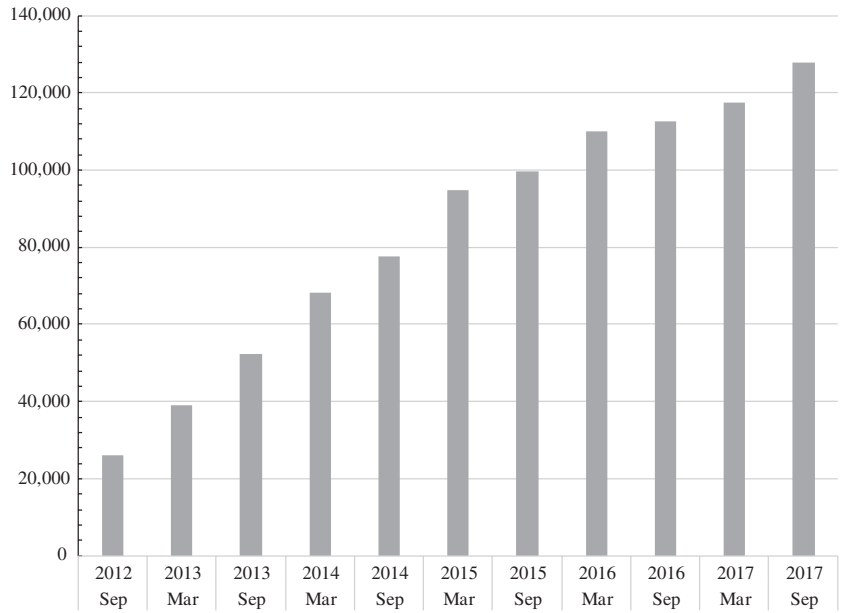

Figure 5 Total number of well sites registered on FracFocus.

Secondary evidence implies a tight alliance between the website and the fracking industry, notwithstanding some initial reluctance of firms to reveal sensitive information via this platform. Already by the afternoon of the first day of FracFocus's launch, 24 gas producers, mostly large firms such as ExxonMobil, BP, and Chesapeake, but also some smaller ones such as Chief Oil & Gas, had pledged to disclose their fracking cocktails on a voluntary basis (DowJones Newswires 2011; EPA 2011).

4.3. Intermediary–beneficiary (I–B) dynamics

Finally, we analyzed the quality of data available through the website from the perspective of FracFocus's putative beneficiary, the general public. Basically, we sought to ascertain to what extent FracFocus succeeded in its stated goal of providing "a central location for [the] public and industry to communicate and relay information on the chemicals used during the process of hydraulic fracturing of oil or gas wells" as well as "impartial and balanced education tools to the public on the topic of hydraulic fracturing" (FracFocusData.org). Similarly, as a point of comparison, we also evaluated regulator-operated websites, where available, to assess these websites' effectiveness in allowing members of the public to access and understand information about the potential environmental and health risks associated with fracking.

4.3.1. Early debates regarding the quality of data provided by FracFocus

The first version of FracFocus.org (commonly known as FF 1.0) launched on 11 April 2011, and included 444 voluntary chemical disclosure reports (GWPC 2018, personal communication). Initially, the website listed the ingredients of each well's fracking compound solely by registry number and identified wells by location (using latitude and longitude coordinates) and American Petroleum Institute (API) number (a 10-digit well-level identifier). These limitations inspired early critique regarding the quality of information provided by FracFocus (e.g. EPA 2011; Platts Commodity News 2011). Regulators, academics, and environmental activists pointed to: the non-disclosure of chemical compounds labeled as proprietary; the fact that there was no way to determine if companies were accurately reporting information for all of the wells in which hydraulic fracturing was used; and the fact that this form of disclosure did not provide advance notice to landowners (EPA 2015).

In 2013, Harvard Law School researchers issued a report concluding that FracFocus "fails as an acceptable regulatory compliance tool" (Konschnik *et al.* 2013, p. 3). In addition to previous claims, they noted that FracFocus did not notify a state when it received a disclosure from a company operating in that state, and that as a result, states could not enforce timely disclosure requirements, thereby diminishing the quality of service to the public. They also argued that by failing to provide state-specific forms and review submissions, FracFocus encouraged companies to undervalue careful reporting. Responding to these claims, Dundon *et al.* (2015) argued that states were using the website to augment their regulatory program capabilities and that FracFocus could be used to monitor and increase compliance with state regulations.

Against this backdrop, FracFocus 2.0 (FF 2.0) was released in January 2013 (Fig. 1). The update provided features such as search of a specific well by additional identifiers and drop-down menus, by ingredient list, and through use of a Geographic Information System (GIS) map. In May 2015, FracFocus began making disclosure data available for download in machine-readable database format (GWPC 2018, personal communication). As of June 2016, FracFocus 3.0 (FF 3.0) went live. Upgrades included "improved data accuracy… and a decrease in the use of trade secrets" (GWPC 2018, personal communication). Despite these claims, however, recent analyses indicate that rates of withheld chemical information have only increased (Konschnik & Dayalu 2016). In the following sections we provide a systematic evaluation of FracFocus's current effectiveness in informing its beneficiaries.[3]

4.3.2. A theoretical model for the assessment of a disclosure website's effectiveness

For this stage of the analysis, we developed a four-criterion model of information disclosure policies (Etzion *et al.* 2016). Weil *et al.* (2006) originally suggested that a public disclosure mechanism could be deemed successful to the extent that its products can be incorporated within the decision-making routines of its beneficiaries. Essentially, this means that beneficiaries often prioritize clear-cut, processed, and accessible information over scientifically oriented data, even at the cost of richness and reliability. For example, the subtleties of financial reports are only comprehensible to professional audiences, such as accountants, bankers, and investors. Those who do not

possess a professional understanding can better relate to public disclosure systems based on much simpler schemes, such as a letter grade ranking for restaurant hygiene (Ho 2012; Lehman *et al.* 2014) or a color-grading scheme for pollution standards (Lee 2010). We therefore see four main criteria as determining the outcome for beneficiaries of such publicly oriented endeavors.

Accessibility. How easy it is to obtain the data? Are data disseminated in ways that are compatible with users' decision routines? In our case, optimal accessibility would mean that users should invest minimal effort to obtain information on the safety of their drinking water and waterways.

Granularity. What is the level of analysis of disclosed information? For example, the safety of drinking water may be reported for a specific well location (highly granular), or for a neighborhood, city, region, or even a province (less granular). Unlike accessibility, where greater availability is better, optimal granularity generally requires striking a balance between precision and relevance.

Comprehensibility. What is the relative ease with which one can understand the impact represented by the disclosed information? For example, risk from drinking water can be disclosed in terms of the concentrations of hazardous chemicals that comprise the fracking fluids in the region, which is probably only intelligible to professionals. Alternatively, it can be disclosed in terms of a single word (e.g. "safe" vs. "unhealthy").

Timeliness. How promptly is information released to the public relative to the occurrence of an event? In our case, timeliness is critical. Ideally, available information should correspond to any immediate concern regarding the safety of drinking water. Timeliness in our context can be determined by the frequency and lag with which data are uploaded to the website.

Using the four-criterion model, we analyzed FracFocus' effectiveness in generating data relevant to community-level awareness and decision-making regarding the safety of drinking water. For comparative purposes, we also analyzed regulator-operated websites dedicated to fracking information disclosure and provided qualitative descriptions of notable exemplars.

4.3.3. Applying the assessment model to FracFocus

Accessibility. We evaluated accessibility in terms of website compatibility, user friendliness, search options, and ease of downloading information. First, in terms of compatibility, the FracFocus website is robust. However, the FracFocus 2.0 GIS-based search only works properly in certain browsers. In terms of user-friendliness and search options, the FracFocus 2.0 interface provides an intuitive search menu. In addition to search by well identifiers and ingredient list, it allows a GIS-based search. However, it is not possible to search by user location (e.g. based on a home address). Finally, accessing and downloading data involves a series of obstacles. For instance, well-level information can only be downloaded as PDF files. The aggregated data on FracFocus.org was created using Microsoft SQL Server 2012, so only users who are familiar with this format can read it. Although links on the website lead to Word documents explaining how to convert the SQL database to Access and Excel, both documents are titled "Converting the FracFocus SQL Database to Access," a format less familiar and intuitive than Excel. This information must be downloaded using a separate link that is unavailable on the main website. After finding this link, the user is asked to read and accept the terms of use, and to enter personal details (optional) and a CAPTCHA code.

Granularity. By default, FracFocus provides well-level information. Arguably this granularity does not fit public needs in the context of drinking water safety, where the average user is likely seeking information for a city, neighborhood, or street, rather than on a disaggregated well-by-well basis.

Comprehensibility. The well-level PDF reports available on the website typically include lists of the chemical ingredients in fracking fluids (with or without actual concentrations) that are not meaningful to non-professional users. The downloadable aggregated data provide information about other fracking impacts, such as the volume of water involved, but is not contextualized in terms of environmental or public health impacts.

Timeliness. Operators in both the US and Canada are typically required to disclose well-level information to regulators through FracFocus within 30 to 60 days of well completion (Etzion *et al.* 2016). The aggregated data are

Table 5 Comparison of the effectiveness of fracking disclosure channels

Criterion	FracFocus	Regulator-operated websites
Accessibility		
Compatibility	GIS-based search on FF.org does not work in certain browsers	Compatible, including GIS-based search (most), some features do not work in certain browsers (few), recurring errors (few)
User-friendliness	Simple interface; aggregate data on FF.org highly inaccessible	Varied from very poor (few) to moderate (some) to excellent (few). Aggregate data usually highly accessible
Search options	By well identifiers (FF.org and FF.ca), ingredient list or GIS-based (FF.org)	By well identifiers (all), GIS-based (many), by user location (few)
Download options	PDF (FF.org and FF.ca) or SQL format (FF.org)	PDF (almost all), Excel/CSV (most), TXT/HTML/others (few)
Granularity	Well level (FF.org and FF.ca), partial aggregate data (FF.org)	Well-level (all), aggregate data (most)
Comprehensibility	Technical data	Technical data, some provide cumulative reports, charts and graphs
Timeliness	Periodic reports	Periodic reports

FF, FracFocus; GIS, Geographic Information System.

updated by FracFocus on a monthly basis to include the latest information uploaded. There is no mechanism for providing real time information about water quality.

4.3.4. Applying the assessment model to regulator-operated websites

Accessibility. The majority of websites are compatible with multiple browsers, although several show poorer performance than FracFocus (Table 5). User interface quality varies. Some websites offer relatively clear, intuitive, and user-friendly interfaces (e.g. California, Indiana, Ohio). Many others, however, exhibit non-intuitive menus and non-friendly interfaces (e.g. Alaska, Mississippi, Pennsylvania, Texas, Wyoming, and others). For example, some websites (e.g. Montana, Texas, Wyoming) require the user to type text in the search fields, offering no drop-down menus. All websites offer an identifier-based well search, but several do not feature some of the options provided by FracFocus. Many allow a GIS-based search. A small number offer a search based on user location (e.g. California, Indiana, Pennsylvania). Finally, in terms of downloadable data, the majority allow easy access to well-level information, as well as to aggregated information, although in some cases (e.g. Louisiana, Michigan, Pennsylvania) aggregated data are difficult or impossible to find. Most allow well-level information and aggregated data to be downloaded in Excel or CSV format. Only a few websites make use of other, less friendly formats, such as TXT (e.g. Alaska, Kansas). Several websites provide easily printable charts and graphs (e.g. California, West Virginia). Information regarding chemical ingredients is harder to find unless explicitly referred to by the website's navigation (e.g. California).

Granularity. The majority of websites provide both well-level and aggregated information. In most cases, the aggregated information enables a user to produce cumulative production and injection reports by resource (e.g. water, energy), operator, lease, and location-based fields over time.

Comprehensibility. Only a few websites make a clear distinction between conventional and unconventional wells (e.g. Indiana, Pennsylvania, West Virginia). The well-level information provided by the vast majority of websites includes basic operational parameters, such as the name of the extracting company, lease dates, and permit certificates. Typically, neither well-level nor aggregate data are contextualized in terms of environmental or public health impacts; however, the cumulative reports and charts provided by some websites are somewhat more comprehensible than the typical well-level information.

Timeliness. All of the websites provide periodic data corresponding to how frequently regulators monitor operators' activities. Such data may prove to be untimely in terms of informing citizens' immediate decisions.

4.3.5. Comparison: FracFocus versus regulator-operated websites

In Table 5 we compare the relative performance of FracFocus and regulator-operated websites in terms of their effectiveness in informing their intended beneficiaries. We found notable differences in accessibility, granularity, and comprehensibility, but not in timeliness.

Accessibility. FracFocus underperforms compared to the majority of regulator-operated websites in terms of the functionality and availability of its GIS-based search (limited on FracFocus.org and not available on FracFcous.ca) and the accessibility of its aggregated information (which is not available from the main website). FracFocus does not offer a user location search, whereas this feature is available on some of the regulator-operated websites. In addition, FracFocus underperforms in terms of the formats it offers for downloading data. Whereas FracFocus offers Adobe Acrobat PDF files that are not machine readable and Microsoft SQL files suitable for technically proficient users, the majority of regulator-operated websites offer spreadsheet formats. On the other hand, FracFocus's interface is simpler and more user-friendly than many of the regulator-provided websites.

Granularity. FracFocus underperforms compared to the majority of regulator-operated websites in terms of its aggregated data functionality. Whereas many websites offer user-generated aggregation by various parameters, FracFocus offers a single ready-made downloadable file of aggregated data that cannot be manipulated online by the user.

Comprehensibility. FracFocus is more effective than most of the other websites in providing information that relates solely to fracking. FracFocus also has an advantage compared to other websites on the issue of chemical ingredients. In terms of providing information that is more intuitive to non-professional users, such as reports, charts, and graphs of cumulative data, the majority of regulator-operated websites are more effective than FracFocus.

5. Discussion

The findings from all three dyads we analyzed (I–R, I–T, I–B) support the general notion that between its launch in 2011 and the conclusion of our analysis in mid-2017, FracFocus effectively swayed fracking disclosure regulation and practice in North America in favor of industry over the public. FracFocus managed to catalyze, funnel, and eventually shape not only the letter of the law, but also industry practice in this field to the point where its use had become essentially taken for granted. In the next section, we elaborate on how the material affordances (Hutchins 1995; Gond & Nyberg 2017) created by FracFocus vis-à-vis each of the other constituents contributed to this outcome. At the same time, we realize that the complexity of our context limits our ability to unequivocally associate our findings with specific cause-and-effect mechanisms. Therefore, we are cautious about attributing an explicit intention or use of deliberate strategy to FracFocus as an information intermediary. Nonetheless, counterfactually, our case study is notable for what is not present. Namely, compared with extant research, we do not see evidence of any particular "capturing mechanism." In our case, this may be a result of the fact that FracFocus was intricately involved in the Regulator–Target nexus from the very start (i.e. the regulator was "pre-captured" by design; see also Fig. 2).

5.1. Material affordances: An augmented R–I–T–B model

While aligned with previous research on intermediary self-interest (De Silva 2017) and the consequential disservice to beneficiaries (Monciardini & Conaldi 2018), our focus on the role of material affordances in intermediary work sets our contribution apart from the current body of literature in the field. For example, although Mehrpouya and Samiolo (2018) also discussed knowledge production in an intermediary setting, they focused on the roles and conflicts of human analysts in the process. Kruck used "principal-agent, private authority and historical-institutional perspectives" (2017, p. 135) to explain when and why intermediaries become entrenched and jeopardize regulators' goals and public interest. Similarly, van der Heijden (2017) used macro theories of private and public self-interest to the same end. Situated alongside these contributions, we propose a materially augmented R–I–T–B model emphasizing that once the calculative device at the base of its operation is set (Callon

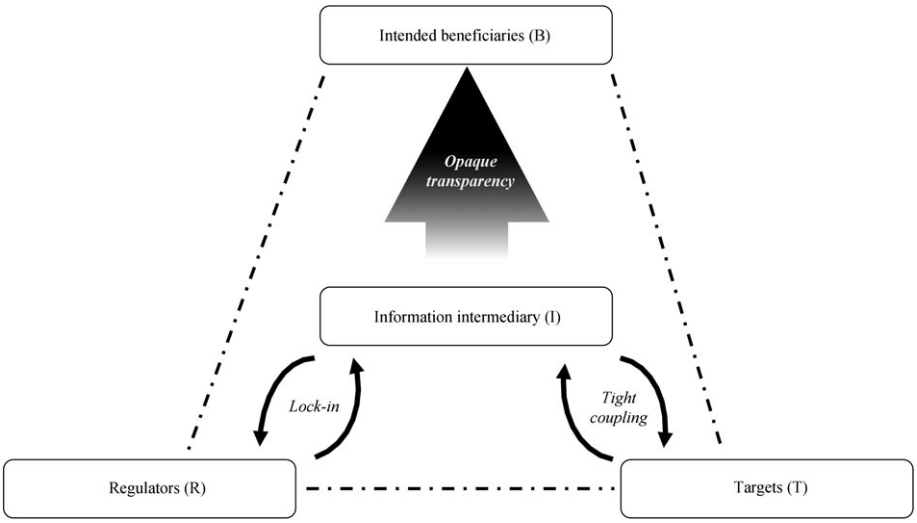

Figure 6 Augmented Regulator-Intermediary-Target-Beneficiaries (R–I–T–B) model highlighting the role of material affordances.

1998), an intermediary's configuration of the field can proceed with little deliberate human involvement (see Fig. 6).

5.2. Lock-in: Material affordances in the I–R dyad

A plausible explanation for the rapid and widespread diffusion of FracFocus is its function as a de facto calculative space that affords regulators a satisfying solution to the complex challenge of informing the public about fracking related issues (Simon 1972). First, FracFocus manages to frame this challenge around corporate information disclosure, thereby following a paradigm that has already proven successful in distancing regulators' concerns from actual industry practice (e.g. TRI, GRI, and Responsible Care). Second, it provides a simple technique with which to calculate what information needs to be disclosed and how. The first is resolved by focusing solely on chemical listings, thereby allowing an indirect response to the issue of water pollution and excluding other issues, whereas the second is resolved by allowing companies to upload ready-made PDF files to a main registry.

As supported by our analysis (e.g. Fig. 4), and further attesting to the intrinsically dynamic aspects of intermediary work (Bothello & Mehrpouya 2018; Ména *et al.* 2018; Paiement 2018), the material affordances provided by FracFocus were particularly timely, occurring a few months after Wyoming became the first state to mandate disclosure. This was at the very beginning of the fracking boom (Meko & Karklis 2017) and at the height of public debate following field configuring events (Hardy & Maguire 2010), such as the attempted enactment of the "FRAC Act" in 2009, the release of *Gasland* in 2010 (Cahoy *et al.* 2013; Vasi *et al.* 2015; see also Fig. 1), and the publication of *Chemicals Used in Hydraulic Fracturing* (Waxman *et al.* 2011). FracFocus's emergence at this critical point in time presumably enabled regulators to demonstrate timely responsiveness to these concerns, supplemented by promises for ongoing improvements.

Moreover, the calculative "solutions" proposed by FracFocus aligned well with extant industry practices. For instance, in Pennsylvania, operators were required to report comparable information to the regulator, although it did not actively assure the completeness of fracking-related information (e.g. Pennsylvania's Well Completion Report). Thus, the responsibility for publicly disclosing this information was offloaded from the regulator to the operator via FracFocus. As more and more regulators adopted FracFocus as an exclusive or acceptable channel, a kind of lock-in occurred (refer to Fig. 6). Ultimately, the launch of the website marked the transformation of these potentially useful yet hypothetical calculations into a tangible reality. In the process, FracFocus was able to further lock-in and "format" regulators into the roles and calculations it inscribed (Akrich 1992; Garcia-Parpet 2007; Leonardi & Barley 2010).

5.3. Tight coupling: Material affordances in the I–T dyad

For their part, a visible group of operators were willing to become "early adopters," voluntarily disclosing their fracking chemical recipes on FracFocus. Indeed, as shown in the analysis, two dozen companies, including some of the largest operators in the industry, uploaded their reports to the registry within a day after its launch. At least one of these, Range Resources, had been voluntarily disclosing such information on its own website, presumably as a way of allaying public concerns.

These dynamics can be interpreted as another form of tight coupling, that is, a quick endorsement by the industry of the structure imposed by a third party, previously depicted in the socio-management literature in contexts such as higher education (Lutz 1982). For example, Sauder and Espeland (2009) explored the effects of rankings (e.g. *U.S. News & World Report*) on law schools. They argued that the deep institutionalization of rankings in this arena was the result of not only their coercive attributes (e.g. threat of reputation loss) but also their seductive features (e.g. being amenable to gaming strategies).

In a similar vein, FracFocus appears to have made itself seductive to oil and gas companies by providing them with a ready-made, almost effortless tool for alleviating external pressures. In addition, some secondary evidence (e.g. Blackmon 2013), suggests that FracFocus has been effectively serving operators as a central repository and data pool for commercial interests such as benchmarking, business intelligence, performance tracking, and quality assurance. The high volume of voluntary disclosures to FracFocus is thus presumably related not only to its a priori affinity with industry interests, but also to emergent opportunities.

5.4. Opaque transparency: Material affordances in the I–B dyad

The FracFocus website's limitations in enabling observers to truly grasp the impacts of fracking activity seem to mirror its affordances to regulators and industry operators (Miller & Power 2013; Koenig-Archibugi & Macdonald 2017). Even after being upgraded to version 3.0, aggregated information remains difficult to obtain and challenging to manipulate and analyze. The public's experience of using the FracFocus website is thus marked by an overall sense of "opaque transparency." As with Briscoe and Murphy's (2012) research on the diffusion of opaque practices among publicly traded companies, the process we observed is facilitated by the involvement of third parties and "design features" of the disclosures. However, unlike the practices studied by Briscoe and Murphy, the fracking practices being disclosed are not opaque. Quite the opposite, what is being done and who is performing these actions are readily observable. The opacity in our case is because the *meaning* of the information is unclear to the average user (Delmas & Lessem 2017). This is evident, for instance, in our analysis of the accessibility, granularity, comprehensibility, and timeliness of the FracFocus website (Table 5). Our focus on material affordances highlights the extent to which merely providing information is not the same as conveying meaning (Ho 2012; Lehman *et al.* 2014).

In addition to partial information that is misaligned with users' capacities, another aspect of opaque transparency is the blur between self-regulation and official regulation. Whereas regulatory intermediaries are often celebrated by stakeholders as distinct and innovative organizations, at least upon their launch (Abbott *et al.* 2017), FracFocus seems to go to great lengths to mask its non-authoritative status and to mirror the function of a regulator. The website makes ample use of the neutral-sounding acronyms of its founders (GWPC and IOGCC) and mentions their supposed independent and impartial status several times, while not mentioning their lack of official authority and close industry ties. For example, according to FracFocusData.org: "The GWPC and IOGCC are uniquely suited to host these websites due to their impartial nature and ties to the regulated and regulatory community." In doing so, FracFocus seems to have mimicked the technical functionality of compulsory information disclosure programs, such as the TRI. FracFocus also defines which elements to "highlight" and which to "shade" and how the totality of these disclosures is "rendered" online (Johnson *et al.* 2011).

While it is beyond the scope of our analysis to say whether this "disguise-as-regulator" practice is intentional, our analysis does suggest that such practices are marshaled by FracFocus for deflecting criticism regarding its pro-industry origins and justifying its adoption among regulators and targets. Drawing on the typology suggested by Ména *et al.* (2018), FracFocus seems to have established a material façade (Cho *et al.* 2015) that shapes and re-shapes common understandings regarding its authoritative status.

5.5. Scope conditions and opportunities for future research

The calculative mechanisms that have enabled FracFocus's diffusion are obviously inseparable from the surrounding political context (Giamporcaro & Gond 2016). The oil and gas industry in the US and Canada wields immense power, as evinced by the pattern of pro-industry regulation of the past 150 years (Wiseman 2009; Cahoy *et al.* 2013; Gond *et al.* 2016). The industry has lobbied for – and benefited thoroughly from – exemptions from environmental regulation long before the beginning of the fracking boom, such as an exemption from information disclosure requirements via the federally run TRI program. Given this history, it is perhaps unsurprising that FracFocus has not provided the public with accessible, comprehensive, and timely data about fracking.

Nonetheless, our findings highlight the importance of understanding the intentionality behind the establishment of intermediaries, and the political opportunity structure (Briscoe & Gupta 2016; Schneiberg & Lounsbury 2017) that shapes their mission, governance, and modi operandi before the enactment of official regulation. Additional work is needed to more fully integrate an intermediary-based view with power related theories, such as firm political action and calculability as politics (Fleming & Spicer 2014).

6. Conclusion

Intermediaries and their work are a critical aspect of governance (Abbott *et al.* 2017; Koenig-Archibugi & Macdonald 2017). In this paper, we have analyzed how chemical disclosure via FracFocus, an initially voluntary industry initiative, has transformed into a widely adopted field-level practice. Our analysis foregrounds the role of material affordances in shaping the emergence and trajectory of subsequent regulation and associated practices, and shows how this in turn has affected intended beneficiaries.

Our findings imply that a possible way to mitigate the effects of such powerful intermediaries is to eliminate their involvement altogether. In our context, this would have translated to reliance on regulator-operated websites, many of which performed better than FracFocus in our analysis, particularly in terms of accessibility, granularity, and comprehensibility. However, currently only a handful of state regulators appear to share this view (Environmental Working Group [EWG] 2015). In California, for example, authorities have expressed an explicit desire to diverge from the method of disclosure used by FracFocus in favor of a tool that would allow the public to easily search and aggregate each type of information disclosed (EWG 2015); likewise, Pennsylvania's oil and gas regulator has signaled its interest in establishing an independent repository (Soraghan 2015). More radically, the oil and gas industry's exemption from the TRI could simply be rescinded, at which point oil and gas wells would be subject to the same disclose requirements as other industries subject to EPCRA. Meanwhile, stakeholders in other places should be mindful of the precursors and implications of the unique organizational dynamics we have uncovered.

Acknowledgments

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Notes

1 In January 2018, unconventional oil production totaled 6.438 million barrels per day (mbpd) and unconventional gas production totaled 63.181 billion cubic feet per day (bcfpd) (https://www.eia.gov/petroleum/drilling/archive/2018/01/#tabs-summary-2). In January 2018, total US oil production was 9.995 mbpd (https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbblpd_m.htm) and total US natural gas production was 95.418 bcfpd (https://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_FGW_mmcfpd_m.htm).

2 According to Gosman, "the FRAC act would have repealed the exemption for hydraulic fracturing in the… state laws governing oil and gas wells [and] would also have required 'any person using hydraulic fracturing' to report the chemical constituents in the fluid to the state or the EPA. In turn, the state or the EPA would post the constituents on '*an appropriate Internet website*'" (2013, p. 124; emphasis added).

3 As of this writing, Phase 2 of FF 3.0 was in development and was expected to include a relaunch of the public website (GWPC 2018, personal communication).

4 Alabama: Ala. Admin. Code Rule 400-3-8-.03. See: https://www.gsa.state.al.us/Scripts/OGB/rules/goldbook.pdf. According to Konschik and Daylu (2016) this requirement was introduced in 2013.

5 Alabama state website: http://www.gsa.state.al.us/ogb/. (Well completion forms marked "OGB-6").

6 Alaska Admin. Code tit. 20, § 25.005 et seq. See: http://www.legis.state.ak.us/basis/aac.asp#20.25.283

7 Alaska state website: http://doa.alaska.gov/ogc/publicdb.html.

8 Arkansas: Ark. Code R. § 178.00.1-B-19. See: http://www.aogc.state.ar.us/Rules/RulesRegs.pdf#page=82.

9 Arkansas state website: http://www.aogc.state.ar.us/pages/Default.aspx. (Well files available under "Document Image System").

10 California: Cal. Code Regs, tit. 14, §1780 et seq. See: http://www.conservation.ca.gov/index/Documents/Text%20of%20Proposed%20Regulations%20-%20SB%204%20Well%20Stimulation%20Treatment%20Regulations.pdf [Last accessed 26 Aug 2018.]

11 California state website: http://www.conservation.ca.gov/dog/.

12 Colorado: 2 Code Colo. Regs. § 404-1:205A. See: https://cogcc.state.co.us/Announcements/Hot_Topics/Hydraulic_Fracturing/Rule205A.pdf

13 Illinois: 225 Il State Ann. 732/1-70; 1-75. See: http://www.ilga.gov/legislation/ilcs/ilcs4.asp?DocName=022507320HArt%2E+1&ActID=3493&ChapterID=24&SeqStart=100000&SeqEnd=3950000. (Required to make information public. Unable to find website)

14 Indiana: 312 Ind. Admin. Code Emergency Rule, Section 3. See: https://law.justia.com/codes/indiana/2016/title-14/article-37/. [Last accessed 26 Aug 2018.]

15 Indiana state website: http://www.in.gov/dnr/dnroil/6599.htm (required to make information public).

16 Kansas: Kan. Admin. Regs. § 82-3-1400 et seq. See: http://www.kcc.state.ks.us/conservation/cons_rr_091615.pdf.

17 Kansas state website: http://www.kgs.ku.edu/Magellan/Qualified/.

18 Kentucky: 28 Ky. Rev. Stat. § 353.6003. See: http://www.lrc.ky.gov/statutes/statute.aspx?id=44246.

19 Louisiana. Admin. Code tit, 2011. 43 XIX, 118. See: http://www.doa.la.gov/Pages/osr/lac/LAC-43.aspx.

20 Louisiana state website: http://sonris.com.

21 Michigan. Supervisor of Wells Instruction. 1-2011. See: http://www.michigan.gov/documents/deq/SI_1-2011_353936_7.pdf.

22 Michigan state website: http://www.deq.state.mi.us/GeoWebFace/.

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