

## Social Networks and Policy Entrepreneurship: How Relationships Shape Municipal Decision Making about High-Volume Hydraulic Fracturing

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*Well-resourced and well-connected individuals, or “policy entrepreneurs,” often play an important role in advocating and securing the adoption of policies. There is a striking lack of inquiry into the ways that social networks shape the ability of these actors to achieve their aims, including the ways in which network ties may channel policy conflict. To address these gaps, we analyze data from an original survey and an original database of policies to assess the success of policy entrepreneurs (PEs) active in a highly contentious arena: municipal policymaking concerning high-volume hydraulic fracturing (HVHF) in New York. We use text-mining to collect social network data from local newspaper archives, then use those data to construct municipal HVHF policy networks. Municipal anti-HVHF PEs appear more successful when they operate in less cohesive networks, act as bridges to relative newcomers to the governance network, and have a larger number of network connections. Pro-HVHF PEs appear more successful when they can forge high-value connections to key decision makers. Policy entrepreneurs on both sides of the issue are more successful when they have a greater number of sympathetic coalition partners.*

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**KEY WORDS:** social networks, fracking, policy entrepreneurship

拥有良好资源和关系的人，又或被称为“政策企业家”的那些人，在推动政策倡议和守护现有政策中发挥着重要的作用。然而，鲜有研究分析社会网络如何塑造这些政策行动者的能力以实现其目标，其中包括网络关系纽带如何导致政策冲突。针对这一研究空白，我们利用一手问卷数据和一手政策数据库来分析政策企业家在纽约市使用高容量水力压裂技术这一有着高争议的政策平台上是如何取得成功的。我们使用文本挖掘从地方报纸存档中获取社会网络数据。随后，我们利用这些数据构建与纽约市高容量水力压裂相关的政策网络。该市反对使用高容量水力压裂技术的政策企业家在以下情况更易成功：运行低凝聚力的社会网络，充当新人与治理网络之间的桥梁，有大量的社会网络连接。那些支持使用高容量水力压裂技术的政策企业家在与核心政策制定者形成大量联系时更易成功。当拥有大量同心的联盟伙伴时，该政策正反两面的政策企业家都更易成功。

### Introduction

In 2008, when New York’s Governor Paterson imposed a moratorium on a new oil and gas production technique called high-volume hydraulic fracturing (HVHF),

or “fracking,” few could have predicted that seven years later the moratorium would still be in place and that Paterson’s successor, Governor Cuomo, would impose a state-wide ban on the practice. Just as surprising was the intensity, diversity, and level of organization of interests that mobilized in response to HVHF in many New York municipalities. Local HVHF advocacy is increasingly attracting the attention of scholars and policymakers. This paper explores how social network features affect local HVHF policy entrepreneurs’ ability to secure the policies they champion.

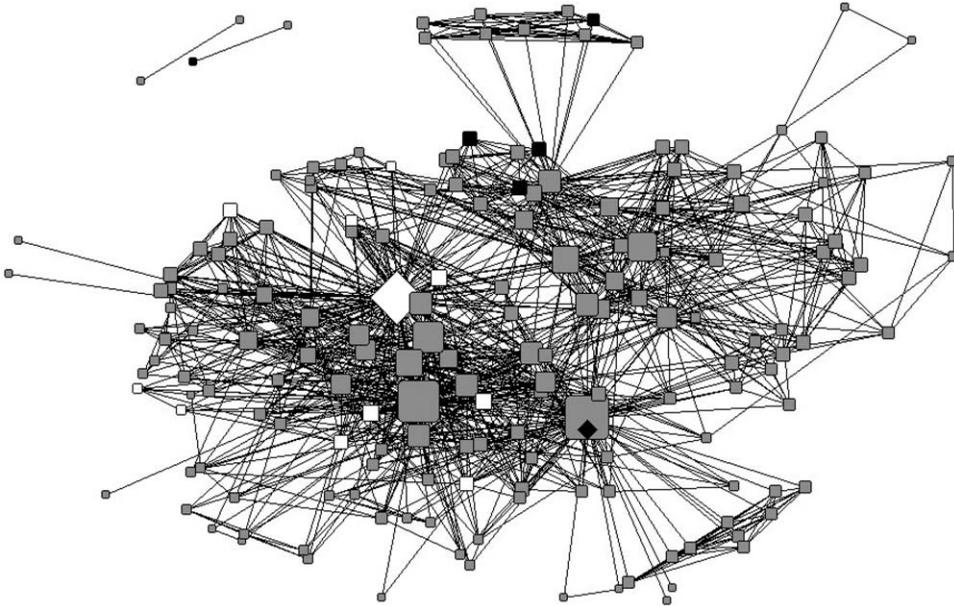
HVHF is a technique for hydrocarbon extraction that has recently boomed in the United States. It targets shale plays, expansive underground rock formations that contain pockets of natural gas and oil. The United States possesses roughly 750 trillion cubic feet of shale gas and oil (U.S. EIA, 2011). Over 2010–13, oil yields from U.S. shale resources tripled, largely because of HVHF (Dimick, 2014). Today, production from shales is responsible for nearly 40 percent of the nation’s natural gas production; this figure is expected to exceed 50 percent soon (U.S. EIA 2012, 2013).

HVHF is controversial, largely because of its potential adverse environmental consequences. Drilling is water intensive, requiring 4–9 million gallons per well (Dillon, 2012). The drilling process involves injecting pressurized liquid underground; a small percentage of the liquid may contain toxins, such as benzene, which could threaten water resources and public health. Spills have been linked to deaths of fish, amphibians, and farm animals (Rahm, 2011). HVHF also generates heavy vehicle traffic and air and noise pollution. Equipping one well requires roughly 77 tractor trailer loads; operating it may require 1,340 delivery truck loads (Gottlieb, 2010).

New York is one of six states that has installed a moratorium on HVHF or related practices, and one of two to ban HVHF. Some argue that Cuomo’s decision was effectively made for him by a proliferation of municipal anti-HVHF policies that collectively made about 63 percent of the state’s land area overtop the Marcellus Shale, the world’s largest unconventional natural gas reserve (Pierce, Coleman, & Demas, 2011), off limits to drilling (Casler, 2014). Between 2008 and 2012, cities, towns, and villages in New York passed at least 357 local policies or resolutions concerning HVHF and related land uses (see Walsh, Bird, & Heintzleman, 2015; Ziogiannis, Alcorn, Piepenburg, & Rupp, 2014).

Opposition to HVHF was neither uniform nor uncontested. Municipalities passed nearly 50 pro-HVHF resolutions and policies, and many experienced bitter conflicts between anti- and pro-HVHF interests. Some municipalities in New York’s Southern Tier, where pro-HVHF sentiment is strong and economic malaise is widespread, responded to the recent ban with threats of secession (Susman, 2015). Polls in New York suggest an electorate evenly divided on HVHF’s desirability (Quinnipiac University, 2012; Trotta, 2011). Nationwide, the trends of municipalities attempting to regulate HVHF and residents battling over this activity are becoming more common (Spence, 2014). Since New York has experienced more local HVHF policymaking than any other state, we use its experience to explore dynamics of municipal-level policy entrepreneurship.

An original survey of New York municipal officials, social network analyses of data from 931 local newspaper articles, and an original database of HVHF municipal



**Figure 1.** HVHF Governance Network in the Town of Ullyses, NY.

*Notes:* Nodes are scaled by degree centrality. The white diamond is the anti-HVHF policy entrepreneur and the black diamond is the pro-HVHF policy entrepreneur. Nodes with the same shading as the entrepreneur (e.g., also white or also black) are actors whose affiliations suggest they are likely to support the policy entrepreneur's advocacy.

policies allow us to investigate the influence of a local policy entrepreneur's network on her efficacy in securing desired policy outcomes. We analyze networks of individuals involved in municipal HVHF policymaking in New York, tracing relationships among town supervisors, city planners, citizen activists, oil and gas company lobbyists, and many others. As an example, Figure 1 maps one of the 56 governance networks we study, depicting the array of actors (nodes) involved in HVHF governance in the town of Ullyses. The size of each node is scaled proportional to the number of ties the node has to others (degree centrality). Policy entrepreneurs (PEs) favoring and opposing HVHF are indicated by a black diamond and white diamond, respectively. Other nodes with the same shading are individuals who, based on their affiliations, are likely to be supportive of the PE's advocacy.

Actors in the Ullyses HVHF governance network seem to be clustered roughly into four connected subgroups. In the center-left of the map there is a large cluster of actors. Both the anti-HVHF PE (white diamond) and pro-HVHF PE (black diamond) is located within this cluster. Node size, which scales with degree centrality, suggests that the pro-HVHF PE has few connections to others in the network. Additionally, the pro-HVHF PE is located far from the black squares (at the center-top of the map), which represent actors who may be supportive of pro-HVHF efforts. (Node location is based on the average number of relationships that separate actors.) In contrast, it appears that the anti-HVHF PE is a central, highly connected actor who is situated near potential allies. It may thus be no coincidence that Ullyses passed an anti-HVHF policy but did not adopt any pro-HVHF measures. In this article, we explore

whether and how network attributes like centrality and connectivity impact a PE's advocacy efficacy.

Overall, our analysis finds that municipal-level anti-HVHF PEs appear more successful when they operate in less cohesive networks, can loop new actors into policy debates, and have a larger number of network connections, while pro-HVHF PEs are more successful when they can forge high-value connections to key decision makers. Policy entrepreneurs on both sides of the issue are advantaged by larger coalitions of sympathetic allies, though this finding is stronger for pro-HVHF PEs.

## Background

Policy entrepreneurship is the phenomenon wherein certain actors expend large amounts of time, energy, and resources trying to secure a preferred policy outcome and often have a significant influence on policy processes (Kingdon, 1984; Mintrom & Norman, 2009). Policy entrepreneurs appear to have played a critical role in local HVHF policymaking in New York. Media accounts highlight how actors like Ithaca-based lawyers Helen and David Slottje traveled from town to town, advising officials on how to use land use authorities to prevent HVHF (Mufson, 2014). Local elites commented on the countervailing influence of pro-HVHF groups that encouraged municipalities to pass HVHF-supportive resolutions.<sup>1</sup> The New York case thus offers a unique opportunity to tackle unanswered questions about policy entrepreneurship amidst contention.

The Marcellus Shale contains 84 trillion cubic feet of undiscovered, technically recoverable natural gas and spans 20,569 square miles beneath New York, mostly in an area near the Pennsylvania border called the Southern Tier (Esch, 2012; Pierce et al., 2011). Some projections suggest that HVHF could create more than 54,000 jobs over the next 30 years in New York and annually increase state and local revenues by \$32–126 million (Rugh, 2012). Around 2005, Southern Tier landowners began signing oil and gas leases; roughly 40–60 percent of land in the region was at one point leased for HVHF (Jacquet & Stedman, 2011).

Most of those leases never yielded profits. In 2008, the governor imposed a moratorium on HVHF, with the aim of giving state regulators an opportunity to tailor oil and gas regulations to HVHF (Executive Order 41, 2010). The moratorium was extended multiple times by gubernatorial or legislative order, and in December 2014, Governor Cuomo announced the ban (Sadasivan, 2014).

New York's protracted regulatory process created a policy space in which advocates and opponents of HVHF proliferated. More than 200 anti-HVHF groups formed (NYAF, 2013). Pro-HVHF groups also formed, often founded by landowners who had signed or wanted to sign leases (Esch, 2013; Jacquet & Stedman, 2011). Initially, advocates sought to influence the state review process. However, its sluggishness led them to redirect their efforts toward the state's cities, villages, and towns, enabled by New York's status as a strong home rule state (Kenneally & Mathes, 2010).

A groundswell of local policymaking began. Jurisdictions passed moratoriums of varying lengths, bans, zoning revisions, and resolutions supporting and opposing HVHF. Across New York, conflict over whether localities should prohibit versus

encourage HVHF created “divisions between residents, residents and farmers, [and] farmers and other landowners . . . [that] threaten[ed] to tear apart the communit[ies]” (Crean, 2013).

HVHF became and remains a highly politicized activity in New York. Advocates who viewed the industry as a source of economic revitalization clashed with those concerned with HVHF’s environmental and public health costs. Their battles played out against a backdrop of pervasive uncertainty about HVHF’s consequences. This context, combined with a vacuum of state regulation, engendered advantageous conditions for municipal-level policy entrepreneurship.

### Theory

The literature offers numerous descriptions of PEs and entrepreneurship (e.g., Mintrom & Vergari, 1998; Roberts & King, 1991; Weissert, 1991), many of which contain similar themes, such as advancement of innovative policy proposals, use of expertise and persuasion to sway decision makers, and development of supportive coalitions. We follow Kingdon’s (1984) seminal conceptualization, which describes a PE as constantly alert for opportunities to convince the public that the PE’s pet issue is a societal concern, that this concern can be best addressed via the policy solution the PE favors, and that political decision makers should address the issue immediately. The main features that distinguish PEs from other policy advocates is dogged persistence in pursuit of their cause (Guldbrandsson & Fossum, 2009; Oborn, Barrett, & Exworthy, 2010; Sink, 1991; Weissert, 1991) and active intervention at multiple junctures of the policy process where they perceive an opportunity for influence (Bardach, 1977).

Intuitively, a PE’s efficacy would seem greater if the PE is well-connected within the relevant policy community. A PE’s success appears linked to her ability to gather, centralize, and shape information, and disseminate that information to policy participants (Braun, 2009; Christopoulos, 2006; Skok, 1995). PEs develop policy innovations (Font & Subirats, 2010; Huitema & Meijerink, 2010; Roberts, 1992) by creatively recombining policies from different jurisdictions or knowledge realms (Garud, Hardy, & Maguire, 2007; Weissert, 1991). Indeed, there is a relatively ubiquitous argument that successful PEs draw resources from peer and/or professional networks, or create such networks to advance policies (e.g., Christopoulos, 2006; Mintrom, 1997; Mintrom & Norman, 2009; Oliver, 2006). Some scholars have evaluated these claims empirically, exploring whether PEs who gain resources from networks are more successful (where success is the adoption of preferred policies, or consideration of such policies by governing bodies) than those who do not. For example, Mintrom and Vergari (1998) found that when PEs are more deeply embedded in state-level policy networks, they are more successful at convincing state legislatures to adopt school choice reform. Balla’s (2001) work revealed that when state insurance commissioners participate in interstate professional organizations, they are more likely to convince state lawmakers to adopt model HMO legislation.

While valuable, this research has minimally tapped into burgeoning theory and increasingly sophisticated methods used to study social networks (e.g., Lubell, Scholz, Berardo, & Robbins, 2012). The ways existing studies operationalize network connectivity, such as membership in organizations that facilitate peer communication, are often rudimentary. They ignore potentially relevant aspects of the networks themselves and minimally explore the mechanisms by which network membership matters.

A handful of scholars have explored these mechanisms. Braun (2009) inferred from an analysis of a carbon trading program that networks of colleagues and experts best serve PEs when they allow entrepreneurs to access key information before their peers. A study of health services in London found that a successful PE acted as a bridge and linking agent among multiple issue-specific policy networks, and, by encouraging multiple communities of practice to attend to the need for a more coordinated health strategy, was able to open a window for policy change (Oborn et al., 2010).

These investigations are often case-based and qualitative, although there are notable exceptions. Ingold and Varone (2011) used social network measures of structural equivalence and density to identify members of the Swiss climate policy subsystem and its coalitions, and employed betweenness centrality and reputational power to identify inter-coalition brokers. Christopoulos (2006) analyzed political entrepreneurship in a debate over European Union rules, mapping networks and quantitatively testing hypotheses about PE strategies. Ingold and Christopoulos (2015) differentiate between PEs and policy brokers by re-analyzing the Swiss and EU data and identifying actors scoring highly on social network metrics linked to these roles. While valuable, these studies focus on just a few cases and thus may have limited generalizability. Policy scholarship lacks cross-sectional analyses that use social network analytics to understand how networks affect PE behaviors and advocacy outcomes. This research addresses that gap.

We theorize that a PE's advocacy efficacy is mediated by a governance network's structure and the relative position of actors in the network. Network structure, or the overall distribution of relationships within a community of connected individuals, influences behavioral patterns of embedded agents (Burt, 2000; Granovetter, 1985; Jackson, 2008; Knoke & Yang, 2008; Moreno, 1934). Network position affects the capacity of actors to form advantageous relationships (Gargiulo & Benassi, 2000; Kenis & Knoke, 2002), pursue entrepreneurial opportunities (Hoang & Antonic, 2003), and organize collective endeavors (Nguyen Long, 2015; Strang & Soule, 1998). Drawing on policy entrepreneurship and network science theorizing, we test four hypotheses:

1. PEs with more direct connections to others in municipal HVHF governance networks will be more likely to secure adoption of the HVHF policies they support.
2. Anti-HVHF PEs will be advantaged by the ability to draw new actors into the policy process, but this capacity will disadvantage pro-HVHF PEs.

3. Anti-HVHF PEs will be more successful in securing preferred policies when embedded in less cohesive HVHF governance networks, but pro-HVHF PEs will be more successful when embedded in more cohesive networks.
4. PEs who leverage larger sympathetic coalitions will be more likely to secure adoption of the HVHF policies they support.

*Hypothesis 1: Degree Centrality Facilitates Policy Entrepreneurship*

Hypothesis 1 links network position with theorizing about PEs' engagement in strategic information dissemination (Braun, 2009; Skok, 1995). A crucial function of PEs is to deliver information to decision makers who need guidance in making sense of ambiguous policy problems (Kingdon, 1984; Zahariadis, 2014). This task necessitates connections to decision makers, policy experts, and other actors with critical insight.

We hypothesize that PEs with more direct connections to other members of local HVHF governance networks are better able to connect policymakers with actors possessing policy-relevant information. The number of direct connections that a PE has within a network speaks to her ability to mobilize public concern and increases the likelihood that she has access to decision makers. Well-connected PEs have better information about the receptivity of different economic and societal sectors to HVHF policymaking and can shape their campaigns to maximize support. This hypothesis evaluates empirically an assumption made in many applications of social network analysis to policy entrepreneurship: that PEs possess high network centrality (Christopoulos, 2006; Christopoulos & Ingold, 2014; Ingold & Christopoulos, 2015).

*Hypothesis 2: High Power Centrality Benefits Anti-HVHF Advocates, but Disadvantages Pro-HVHF Advocates*

We propose that anti-HVHF PEs will be advantaged by drawing new actors into the policy process, since these new actors bring information, strategies, and resources necessary to disrupt the status quo. PEs structurally positioned to loop in these actors will have high power centrality (Bonacich, 1987); that is, they will have many connections to actors who themselves have poor network connectivity.

The contrasting argument about pro-HVHF advocates operationalizes a notable feature of New York's pro-HVHF movement. Observers in New York have argued that many pro-HVHF resolutions were passed by municipalities quickly, with minimal public input (e.g., Campbell, 2015). We hypothesize that pro-HVHF PEs are best served by connections to status quo power brokers in municipalities who could use their positions of power (e.g., as town supervisors or village trustees) to stifle anti-HVHF efforts, and who could agree among themselves to pass HVHF-supportive measures. We expect that successful pro-HVHF PEs will have many ties to well-connected municipal actors, meaning that the PE's own power centrality should be relatively low.

*Hypothesis 3: HVHF Opponents Are Advantaged by Weak Network Cohesion; Proponents Benefit from Cohesion*

The cohesiveness of networks is a critical determinant of the opportunity structures that network members face (Burt, 2001; Cook, Emerson, Gillmore, & Yamagishi, 1983; Ibarra, 1995). The expectation that a less cohesive network will advantage an anti-HVHF PE but a pro-HVHF PE will be better served by a more cohesive one flows from observed differences in the policy actions that they pursue.

Anti-HVHF PEs tried to convince municipalities to limit or prohibit HVHF. This action constituted a significant change in the status quo in most cases. While land use regulation is traditionally a municipal responsibility, using this power to affect drilling was novel; oil and gas regulation was normally the state's provenance. Some municipalities did not have zoning regulations and had to establish them to prohibit HVHF. The status quo of deference to state decision making not only had inertia, but also aligned with the pro-business, pro-growth interests that tend to dominate local government (Schneider & Teske, 1993a, 1993b).

To disrupt the status quo, anti-HVHF PEs needed new ideas (e.g., the notion of using zoning to regulate HVHF) and new resources (e.g., expertise to construct a zoning law), and required new sources of support for this tack or new strategies to build support in the community. They may have sought or been motivated by outside experts who could provide information about the dangers of HVHF. PEs may have purposefully formed ties to anti-HVHF advocates in other communities to learn how they were addressing HVHF. In both cases, these individuals would represent new, relatively unconnected elements in the local HVHF governance network. The structural signature of this flux in preferences, people, and ideas is a lack of network cohesion.

In contrast, the media frequently portrayed HVHF supporters as long-time residents trying to save their municipality from economic decline (e.g., Richards, 2014). In championing this cause and in defending the status quo pro-growth orientation of local government, we anticipate that pro-HVHF PEs would find most facilitative a community structure that offers solidarity, supportive relationships, and a sense of shared identity. A cohesive network offers those benefits (Alguezaui & Filieri, 2010; Coleman, 1988; White, Owens-Smith, Moody, & Powell, 2004). Additionally, highly cohesive networks tend to be difficult to penetrate and resistant to outside interventions (Sandefur & Laumann, 1998), potentially making them more difficult for anti-HVHF PEs to maneuver.

*Hypothesis 4: Larger Sympathetic Coalitions Facilitate Entrepreneurial Success*

Social networks may shape and channel conflict between opposing interests (Stevenson & Greenberg, 2000; Uzzi, 1997). The extent to which conflict impacts policy advocacy may be mediated by a governance network's composition. Here, we argue that PEs who leverage larger sympathetic coalitions will be more likely to secure adoption of the HVHF policies they support.

Policy entrepreneurship scholarship almost universally emphasizes the importance of garnering support and obtaining resources from stakeholders and constituents (e.g., Christopoulos, 2006; Font & Subirats, 2010; Mintrom & Norman, 2009; Mintrom, Salisbury, & Luetjens, 2014). Coalitions allow advocates to share information and pool resources and give a PE access to these assets (Font & Subirats, 2010). They expose the PE to different perspectives and help her learn how to tailor her proposals and strategies to actors with diverse interests (Mintrom et al., 2014). Supportive norms develop among members as they interact (Burke, Fournier, & Kislaya, 2006; Gradstein & Schiff, 2006).

Not only do allies offer resources, but teaming up with allies allows PEs to redistribute risk (Christopoulos, 2006; Hoang & Antonic, 2003), build prestige (Wellman, 1983), and access key decision makers (Botterill, 2013). Thus, we expect that more successful anti-HVHF PEs operate in networks with a larger proportion of anti-HVHF activists, while pro-HVHF PEs should be advantaged by networks with more of oil and gas interests and members of landowner groups.

## Methods

We next describe our survey that identified local HVHF PEs, our use of local newspaper articles to construct municipal HVHF governance networks, the original dataset of HVHF policies that provides our outcome variable, and the social network metrics used to test the hypotheses.

### *Survey Administration*

In 2014, we administered a 40-item postal survey to clerks in all New York municipalities ( $n = 1539$ ) except New York City.<sup>2</sup> The survey investigated local policymaking on and perceptions about HVHF and elicited names and other information about PEs in local HVHF policymaking.

We surveyed municipal clerks because they take minutes at public meetings and are involved in many aspects of local government, and thus are positioned to know about local political affairs (Schneider & Teske, 1992, 1993a, 1993b; Teske & Schneider, 1994). Survey administration followed Dillman's Tailored Design Method (Dillman, Smyth, & Christian, 2014) and yielded a 31 percent response rate.

*Non-Response Bias.* Supporting Information Table A1 reports *t*-tests evaluating the differences in means of potential covariates of survey response between responding and nonresponding municipalities. Response was more likely among towns (31 percent of responsive jurisdictions) and villages (32 percent) than cities (21 percent); municipalities with a larger proportion of citizens with a high school diploma or equivalent and owning rather than renting; and municipalities with lower population densities, smaller populations, and less electoral support for President Obama.

*Policy Entrepreneur Identification*

The survey asked respondents whether, since 2008, anyone in the jurisdiction had pursued at least one of 10 activities drawn from the PE literature, including asking local leaders to learn, gather information, or make other government officials aware of local sentiment about HVHF; or doing things to get local leaders' attention, like contacting the media. The specific text is in the Supporting Information Appendix.

A respondent could name one individual most active in trying to get the municipality to pass resolutions or policies limiting HVHF and one most active in trying to get the municipality to pass resolutions or policies facilitating HVHF. Entrepreneurs who opposed HVHF were reported in 108 municipalities, while entrepreneurs supporting HVHF were reported in 57. Not all respondents named the entrepreneurs they described. Seventy anti-HVHF and 37 pro-HVHF PEs were clearly identified (65 percent of each group) in 76 municipalities, though ultimately a smaller number was analyzed due to data constraints (see below).

Respondents nominated individuals active as PEs during 2008–14, but the policy passage outcome variable described below spans 2008–12. This discrepancy does not pose a major problem. Survey respondents indicated the years in which PEs they identified were active. Of the 56 anti-HVHF PEs in the dataset, only seven were exclusively active in 2013–14 (about 12 percent). Of the 35 pro-HVHF PEs, only four were exclusive to that period (about 11 percent). When the *t*-tests in Table 1 are run on a dataset that drops the municipalities with these PEs, the results are substantively equivalent. The regression results in Table 2 are similar, though not identical.<sup>3</sup>

*Policy Dataset*

The outcome variable is a binary indicator of whether a municipality passed at least one anti-HVHF or pro-HVHF policy, 2008–12. The passage of such policies is the assumed goal of PEs and offers a measure of success independent of survey respondents' assessments.<sup>4</sup>

In 2013, we began documenting and collecting full texts of HVHF policies passed by New York municipalities since the start of the state's moratorium. We compiled policy data from the nonprofits Frac Tracker and Food and Water Watch (FWW), the pro-HVHF Joint Landowners Coalition of New York (JLCNY), and the grassroots Keuka Citizens Against Hydrofracking. Every 3–6 months, the team checked for updates to these sources and supplemented them by performing internet searches for local news articles documenting HVHF policy passage.

When at least two sources documented passage of a policy, we considered it verified. If only one source indicated passage, we submitted a public information request to the municipality to verify its existence. FWW and JLCNY often listed municipalities without their type (e.g., town vs. village), and many towns in New York share names with villages. Thus, we queried all same-name towns and villages identified by those sources to determine which had passed policies.

**Table 1.** Differences in Mean Values of Degree and Power Centrality for (Un)Successful Anti- and Pro-HVHF Policy Entrepreneurs

	Anti-HVHF policy entrepreneurs			Pro-HVHF policy entrepreneurs			<i>p</i>
	Success	No success	Z	Success	No success	Z	
Degree (size-adjusted)	22.41 (5.80)	1.96 (1.89)	-2.03	1.24 (9.36)	7.46 (3.18)	0.63	0.69
Power	3447.57 (1268.15)	970.51 (385.04)	-1.87	124.61 (122.38)	2107.65 (611.29)	3.18	0.00***

*Notes:* \*\*\*  $p \leq 0.01$ , \*\*  $p \leq 0.05$ . The size-adjusted degree is the network's degree minus in its average degree. *N* is 27 for anti-HVHF PEs and 15 for pro-HVHF PEs.

Table 2. Logistic Regression Models Predicting Likelihood of Municipal Adoption of Anti-HVHF and Pro-HVHF Policies

	Anti-HVHF policy adoption (champion: anti-HVHF PEs)			Pro-HVHF policy adoption (champion: pro-HVHF PEs)		
	Coefficient (standard error)	Z	p	Coefficient (standard error)	Z	p
Contestation by an opposing PE	-0.85 (0.78)	-1.08	0.28	—	—	—
Democrat: Republican voting ratio	0.57 (0.86)	0.67	0.50	-4.90 (3.66)	-1.34	0.18
High school education	0.17 (0.09)	1.85	0.06*	-0.08 (0.12)	-0.69	0.49
Population density	-0.00 (0.00)	-1.87	0.06*	-0.00 (0.00)	-0.22	0.82
Population size (1000s)	-0.18 (0.11)	-1.68	0.09*	0.07 (0.13)	0.55	0.59
Unemployment rate	13.43 (11.30)	1.19	0.23	15.87 (16.06)	0.99	0.32
Network coalition support: Anti-HVHF activists	9.34 (5.66)	1.65	0.10*	—	—	—
Network coalition support: Gas industry representatives and landowners	—	—	—	8.26 (3.70)	2.23	0.03**
Network closure	-4.01 (2.13)	-1.88	0.06*	-5.74 (5.51)	-1.04	0.30
	LR $\chi^2(8)$	19.48***		LR $\chi^2(7)$	13.03*	
	McFadden's $R^2$	0.26		McFadden's $R^2$	0.34	
	Percent correctly classified	72.73		Percent correctly classified	90.91	

Notes: \*\*\*  $p \leq 0.01$ , \*\*  $p \leq 0.05$ , \*  $p \leq 0.10$ .  $N = 55$ . Contestation is not evaluated in the pro-HVHF regression because all pro-HVHF PEs faced opposition from an anti-HVHF PE. The constant is omitted.

For 2008–12, we identified approximately 287 anti-HVHF policies, 47 pro-HVHF policies, and 13 neutral policies passed by 218 different New York municipalities.<sup>5</sup> Anti-HVHF policies include laws and ordinances that sought to limit or ban HVHF, including policies seeking to mitigate or prevent damage to roads from HVHF-associated heavy truck traffic and resolutions expressing concern about HVHF's negative consequences. Pro policies included resolutions of support for HVHF, resolutions requesting that municipalities defer to state regulation, and resolutions calling for the state to issue HVHF permits. Neutral policies were miscellaneous other actions without discernable valence. Among the municipalities analyzed here, 27 passed at least one anti-HVHF policy and 6 passed at least one pro-HVHF policy.

### *HVHF Governance Network Overview*

To construct HVHF governance networks for the municipalities with named PEs, we extracted the names of actors who participated in HVHF-related events reported on by local newspapers. Online newspaper archives were queried for 13 HVHF search terms, and the resulting articles collected.<sup>6</sup> Local newspaper accounts are good sources for governance network data because they tend to focus on public meetings, hearings, and debates.

### *Newspaper Selection*

We collected data from 64 local newspapers<sup>7</sup> identified via a three-part search protocol. In Part 1, we obtained from the media database Cision listings of print newspapers based in each New York county. We excluded newspapers that lacked URLs and special interest newspapers, then eliminated community and weekly (rather than daily) papers unless they were the only outlets remaining for a county. We eliminated papers obviously lacking online archives through 2008. If a county had more than one eligible newspaper at this point, we selected the one without subscription fees; if both had fees, we selected the newspaper with a higher Cision "influencer" score.

Residents may read papers from neighboring areas and the prominence of a municipality likely affects its coverage in a county-wide paper, with smaller municipalities underrepresented. Thus, in Part 2, we contacted the municipalities to find out their newspapers of record. We retained for analysis newspapers with URLs and archives going back to 2008. Finally, since media markets overlap, in Part 3 we performed internet searches for each municipality's name, state, and the term "newspaper," and added any new non-national newspaper with an online archive (2008 forward) identified in the first 20 search engine hits. The total number of newspapers per municipality ranged from one to five; the mode was three.

### *Inferring Network Ties and Building Networks*

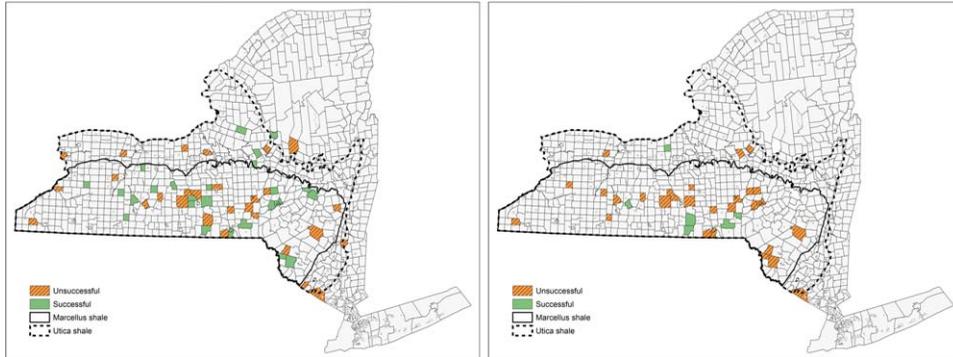
To identify the HVHF governance networks in each municipality, we used the qualitative analysis program NVivo to filter the articles by the municipality with

which each paper was associated. Next, we filtered the articles manually to isolate articles providing accounts of HVHF-related events (e.g., hearings, public meetings, rallies) occurring in the municipality or involving people from the municipality. We excluded articles that predominantly featured general reporting on HVHF, national-level HVHF events, and elections and electoral candidates. We also excluded opinion pieces, letters to the editor, and editorials, as well as articles that reported on multiple events (e.g., event calendars). We took excerpts from articles wherein details about a local HVHF event were embedded in a larger text. Each article was inspected by at least two researchers. The average number of usable articles per municipality was roughly 17 (standard deviation: 24); the average number of nodes per network was approximately 59 (standard deviation: 62).

We employ an event-based strategy for eliciting networks (Danowski, 2010; Davis, Gardner, & Gardner, 1941). This strategy identifies relationships between network members via their joint participation in an event and is common in network analysis of archival texts (Freeman & Romney, 1987; Knoke & Yang, 2008). The appearance of an actor in an article signals the individual's engagement in the HVHF policy process. The actor's concurrent participation in an event with another individual mentioned in the article is counted as a connection, or tie, to that person.

Network statistics are calculated differently on the basis of the directionality—the relationships that we document are undirected—and weights can be assigned to relationships (Knoke & Yang, 2008). Relationships may be weighted in terms of content, for example, based on whether they are collaborative or antagonistic, or by form. Relationship content is likely to influence whether two actors work together. A PE embedded in a network with more contentious ties should generally face more opposition and thus may struggle to achieve her policy goals; this is the premise of hypothesis 4. However, antagonism between actors is not absolutely determinant of behavioral outcomes. For example, under certain conditions, actors on opposing sides of an issue may work together, as per structural balance theory; the enemy of one's enemy may be a friend.

In this study, there are practical reasons not to weight ties by content. The articles sometimes did not provide detail sufficient to characterize relationships. In some cases, the nature of an actor's ties to others in the HVHF policy arena appeared to vary across events. For example, landowners pursuing oil and gas leases often appeared to have harmonious ties with representatives of the oil and gas industry when testifying about the opportunities offered by HVHF at state hearings, but opposed them at local public meetings where mineral rights and lease terms were discussed. Moreover, categorizing actors as opposing or supporting HVHF would have been an oversimplification in some cases. Actors sometimes espoused nuanced views on HVHF, such as tentative interest in its local economic benefits tempered by concerns over potential damage to infrastructure. Other actors purposively remained neutral while still others experienced shifts in opinion. With these issues in mind, we weighted ties not by content, but by frequency (the number of times two actors co-occur in an article). Presumably, the more frequently two actors interacted, the greater the opportunity of information transfer and for negotiating positions and preferences.



**Figure 2.** Successful and Unsuccessful Anti-HVHF Policy Entrepreneurs (Left) and Pro-HVHF Policy Entrepreneurs (Right).

We used Stanford's Name Entity Recognizer (NER) to identify the names, organizational affiliations, and occupations of network participants (nodes). In addition to the 3,332 nodes identified by the NER, the program identified 132 organizations represented by unnamed individuals. We used a two-step process to match organizations to nodes. We first surveyed the entire set of networks. When an unaffiliated organization in Network A appearing in year X was featured in a different Network B for the same year, the B node was assigned to the unaffiliated organization in A. Second, we searched webpages and electronic records to identify best guesses of the identities of individuals representing remaining unaffiliated organizations.<sup>8</sup>

### *Case Selection*

Seventy-six municipalities were considered for analysis because survey respondents clearly named at least one PE. Ultimately 56 municipalities were analyzed; all contained anti-HVHF PEs and 35 contained pro-HVHF PEs. Nine municipalities were excluded because fewer than three news articles documented local discussion of or activities associated with HVHF, and the articles discussed HVHF events primarily occurring nonlocally and/or substantially involving nonlocal actors. Nine municipalities were excluded because their newspaper texts yielded fewer than 10 nodes, suggesting a potentially significant missing data problem. One municipality was excluded because a subscription to an associated newspaper was prohibitively costly.

All but one municipality overlays the Marcellus and/or Utica Shale and they range over 28 counties; see Figure 2 and Supporting Information Table A2. Moran's I was used to evaluate whether the spatial distribution of successful PEs appears non-random, thus potentially warranting spatial controls in statistical analysis. For anti-HVHF PEs, the test statistic was  $-0.02$  ( $p \leq 0.49$ ), indicating that we cannot reject the null hypothesis of no spatial autocorrelation. For pro-HVHF PEs, the statistic was  $0.21$  ( $p \leq 0.07$ ),<sup>9</sup> suggesting that there may be a nonrandom pattern in the distribution of outcomes. However, the statistic is below 0.3, a commonly accepted threshold

above which statistical corrections for spatial autocorrelation are warranted (O'Sullivan & Unwin, 2010). Also, this value is produced by just six cases of pro-HVHF success, and correlations using small numbers are inherently unreliable. Thus, we do not apply statistical corrections.

We found anti-HVHF PEs in approximately 48 percent ( $n = 27$ ) of the municipal HVHF governance networks, and pro-HVHF advocates in about 43 percent ( $n = 15$ ). These rates may suggest that the networks are incomplete. We justify including networks in our sample that do not feature named PEs, from municipalities where survey respondents did name PEs, because we assume that the PEs there are either unconnected to the network or connected in low-profile ways.

The question of why not all PEs appeared in the media-based networks is important. All network elicitation strategies are susceptible to some form of bias. As Yi and Scholtz (2015) observe, media reports tend to focus on relatively "high profile" or established actors. This implies that media-based networks are likely to capture actors traditionally linked to politics and governance, such as politicians, bureaucrats, and industry leaders, and may be less likely to cite individuals new to political circles. However, when policy issues cross a certain threshold of public attention, media coverage tends to become more inclusive, also documenting the participation of lesser-known actors (see Yi & Scholz, 2015). Since HVHF is a contested issue with many different aspects that concern many different stakeholders, we suspect that the local news coverage from which we infer network participants may tend toward greater inclusivity—but still only captures individuals who engaged in HVHF advocacy in public venues. It is possible that, where named PEs did not appear in the texts, PEs engaged in more low-profile advocacy in more private forums. Thus, the networks we analyze may be relatively complete for advocacy that rises above a particular threshold of publicness.

## Analysis

We analyze anti- and pro-HVHF PEs separately because we assume that they are best served by different resources and strategies, and that there may be systematic socioeconomic or political differences between municipalities that offer fertile ground for anti versus pro advocates. Supporting Information Table A3 indeed suggests that there are many statistically significant differences between municipalities that only contain an anti-HVHF PE versus those with both a pro- and an anti-HVHF PE.

We use *t*-tests and multivariate regression to evaluate the hypotheses. *t*-tests enable us to assess whether network variables have significantly different values in municipalities where PEs experienced more or less success, but do not allow evaluation of the impact of other covariates. We use *t*-tests rather than regression to evaluate hypotheses 1 and 2 because positional network data (degree and power statistics) are available only for the subset of governance networks wherein PEs were found ( $n = 27$  for anti-HVHF PEs and  $n = 15$  for pro-HVHF PEs).<sup>10</sup> Applying maximum likelihood estimation to such small samples can be problematic; Long (1997) suggests including at least 10 cases per parameter. Moreover, we would be unable to include both degree and power centrality in the same regression because they are highly correlated.<sup>11</sup>

We have more extensive data on network structure. Thus, to test hypotheses 3 and 4, we use logistic regression and include additional variables alongside network terms as we evaluate the latter's influence on municipal adoption of anti- and pro-HVHF policies; see Table 2. This analysis explores whether network-driven aspects of policy entrepreneurship significantly help predict policy adoption while controlling for other factors whose influence on adoption are fairly well established.

Certain socioeconomic, political, and demographic variables frequently help explain which jurisdictions adopt policy innovations (see Berry & Berry, 1990). A few studies have specifically investigated the covariates of HVHF policy adoption by New York municipalities (Barnes, 2013; Walsh et al., 2015; Ziogiannis et al., 2015). The variables in Supporting Information Tables A1 and A3 have precedent in the policy adoption literature generally and the New York studies specifically. We evaluated the statistical significance of these variables in bivariate regression, then selected for inclusion in multivariate modeling those with high *p*-values and/or a strong theoretical justification. Data are from the 2000 Census unless otherwise noted.

*Contestation* is a variable indicating whether a PE encountered opposition in a municipality from another PE with opposing preferences regarding HVHF. There are no municipalities with pro-HVHF PEs that do not also contain anti-HVHF PEs. In 21 municipalities, the anti-HVHF PE did not face a named opponent, and in 35 there were opposing entrepreneurs.

The *Democrat to Republican voting ratio* is the ratio of the percentage of voters who supported the Democratic presidential candidate in 2008 and 2012 (averaged) to the percentage of voters who supported the Republican candidate (Naigles, 2014). The vote share for villages was assumed identical to the vote share of the surrounding town.<sup>12</sup> Extent of Democratic partisanship has been used as a proxy for extent of environmental concern (Krause, 2011; Lubell, Feoick, & de la Cruz, 2009; Sharp, Daley, & Lynch, 2011). We expect that larger ratios will be associated with greater likelihood of a jurisdiction adopting an anti-HVHF policy, consistent with findings from previous studies of HVHF policy adoption in New York, and with a lower likelihood of adopting a pro-HVHF policy.

*High school* is the percentage of citizens with a high school diploma or equivalent by 25. A more educated citizenry is consistently associated with adoption of policy innovations generally (Berry & Berry, 1990) and environmental policies specifically (Opp, Osgood, & Rugeley, 2014). We expect that municipalities with more educated citizens will be more likely to adopt an anti-HVHF policy and less likely to adopt a pro-HVHF policy, as found in all three New York studies.

*Population* is the number of citizens in the municipality. Larger jurisdictions tend to be more likely to adopt policy innovations because they have greater resources and capacity (Shipan & Volden, 2008; Walker, 1969). We expect that larger jurisdictions will be more likely to adopt pro- and anti-HVHF policies. *Population density* measures an area's rurality (rural areas have lower population densities; see Lane, 1994) and, relatedly, its amenability to oil and gas drilling. Extractive operations are easier to site in open land, unhampered by constraints posed by infrastructure.<sup>13</sup> More rural areas should be more likely to pass pro-HVHF policies because they

stand to reap the greatest economic benefits from drilling. Walsh and coauthors (2015) do not find a relationship between population density and anti-HVHF policy adoption, but Barnes (2013) and the Ziropiannis team (2015) (in some specifications) find that less densely populated municipalities are slightly less likely to adopt HVHF prohibitions.

*Unemployment rate* is a measure of the jurisdiction's economic health. We focus on unemployment because the job opportunities offered by HVHF are one of the industry's selling points. Consistent with findings by Barnes and Ziropiannis and coauthors, we expect municipalities with higher unemployment to be more likely to adopt pro-HVHF measures.

*Hypothesis 1: Degree Centrality Facilitates Policy Entrepreneurship*

We operationalize the connectivity of a PE using degree centrality, a measure which accounts for the number of connections held by a member of a network (a node). Degree centrality captures a node's popularity based on her number of contacts in the network (Freeman, Roeder, & Mulholland, 1979). These direct connections facilitate the transfer of complex information (Hansen 1999; Reagans & McEvily, 2003) and cultivate trust that helps smooth out misunderstandings that otherwise might impede collective action (Coleman, 1988; Strang & Soule, 1998). We adjust degree centrality for network size by subtracting average degree, the ratio of the total number of relationships in a network to its total number of nodes.

Anti-HVHF PEs with higher size-adjusted degree centrality in their HVHF governance networks are significantly more likely to secure the passage of an anti-HVHF policy than those with lower size-adjusted degree centrality, supporting hypothesis 1. However, there is no significant difference in size-adjusted degree centrality for successful versus unsuccessful pro-HVHF PEs.

*Hypothesis 2: High Power Centrality Benefits Anti-HVHF Advocates,  
but Disadvantages Pro-HVHF Advocates*

A PE's level of influence depends in part on how connected the nodes in her neighborhood are to others. We capture this connectivity using Bonacich's power centrality, or power. This measure weights degree centrality for the degree of all the nodes in the target node's neighborhood (Bonacich, 1987). A neighborhood is the set of nodes to which an individual is directly connected. More power means that a PE has a larger number of connections to less-connected nodes, and less power means that a PE has a larger number of connections to more well-connected nodes.

This hypothesis is supported for anti-HVHF PEs, who are more successful when they have significantly higher power, that is, they loop otherwise unconnected actors into the network. The expectation that pro-HVHF PEs would be disadvantaged by high power centrality, and better served by being well-connected to "insider" political actors, is also supported; pro-HVHF PEs were significantly more successful when they had low power.

*Hypothesis 3: HVHF Opponents Are Advantaged by Weak Network Cohesion; Proponents Benefit from Cohesion*

Network cohesiveness can be measured using closure (see Burt, 2001). Networks with greater closure have more highly connected nodes, that is, nodes that are directly connected or can be connected through a path (a series of relationships that link nodes to one another). Closure is measured by the proportion of triads present in the network (Simmel, 1923). A triad is a network substructure wherein three nodes are all connected to one another. Higher levels of closure indicate higher levels of cohesion (Knoke & Yang, 2008).

This hypothesis is supported for anti-HVHF PEs. When closure is at its minimum and all other variables are at their means, an anti-HVHF PE has a roughly 79 percent chance of securing the passage of an anti-HVHF policy. At the average value for closure, this chance declines to 40 percent; at maximum closure, likelihood of anti-HVHF PE success falls to 24 percent. For pro-HVHF PEs, the coefficient on closure is not signed as expected but also is not statistically significant.

*Hypothesis 4: Larger Sympathetic Coalitions Facilitate Entrepreneurial Success*

For anti-HVHF PEs, sympathetic supporters are other anti-HVHF activists, while for pro-HVHF PEs, sympathetic supporters are actors affiliated with oil and gas companies and members of landowner coalitions. The prevalence of these interests was evaluated by designating nodes to occupational or social group affiliations (as reported in newspaper texts<sup>14</sup>), then calculating their proportions in the networks.

This hypothesis is supported for both types of PEs, although for anti-HVHF PEs the  $p$ -value is marginal (0.099) and when the dataset excludes municipalities where PEs were exclusively active in 2013–14, it becomes nonsignificant ( $p \leq 0.30$ ). Thus, the anti-HVHF PE results should be interpreted with some caution. The estimates in Table 2 suggest that having a larger proportion of the network composed of anti-HVHF activists makes it more likely that the municipality will adopt an anti-HVHF policy. Adoption likelihood is approximately 25 percent when the proportion of activists is at its minimum (zero) and all other variable are held at their means. This likelihood increases to 40 percent at the mean proportion of activists and 84 percent when the variable is at its maximum. For pro-HVHF PEs, the likelihood of securing a preferred (pro-HVHF) policy climbs from 0 percent when there are no oil and gas interests in the network to 66 percent when this value is at its maximum.

*Alternative Explanations*

The results in Table 2 indicate that the non-network covariates do not efficaciously explain pro-HVHF policy adoption. In contrast, in the regression modeling anti-HVHF policy adoption, education and population density are signed as expected and statistically significant. Population size is also significant, though

unexpectedly negative. Political partisanship, unemployment, and contestation are not significant in either model.

### Discussion

The analysis generally supports the hypotheses and provides insight into how networks can enable or constrain PEs advocating for local HVHF policies. We posited that degree centrality facilitates PE advocacy and found support for this argument among anti-HVHF PEs. We found support for the hypothesis that higher power advantages anti-HVHF PEs, who should be more successful when they can connect to new sources of information and support. We also found support for the proposition that lower power should advantage pro-HVHF PEs, whose advocacy often seeks to entrench the municipal policy status quo. We expected that anti-HVHF PEs would be most successful in minimally cohesive networks; this proposition was supported. Conversely, we expected that pro-HVHF PEs would find highly cohesive networks facilitative; this hypothesis was not supported. Finally, for PEs on both sides of the HVHF debate, having a larger coalition of allied interests in the relevant municipal governance network appears to increase the likelihood that a policy consistent with her views on HVHF will be adopted by the municipality, though this result should be interpreted with some caution for anti-HVHF PEs.

The advantages that degree centrality brings anti-HVHF PEs affirms the intuition that possessing numerous supportive relationships is helpful for policy advocacy. The results also suggest that the ability to access and deploy novel, policy-relevant information and resources is particularly important when PEs are seeking to disrupt a policy equilibrium, encouraging a jurisdiction to take anti-HVHF action that is largely unprecedented and which challenges the pro-economic development interests that often dominate local government.

Power, the ability to loop weakly connected or unconnected nodes into the HVHF governance network, is key for anti-HVHF PEs. Successful anti-HVHF PEs appear to play a key role bridging between actors in the network and brokering the exchange of information and organizational resources. In contrast, pro-HVHF PEs seem most successful when they have lower power, which signals their association with (and direct access to) well-connected nodes who hold sway in local decision-making circles.

The argument that anti-HVHF PEs are best served by an influx of new ideas, perspectives, and actors that can disrupt the status quo enough to pass path-breaking policies also is supported by our finding that less network closure is significantly associated with the adoption of anti-HVHF policies. However, network cohesion does not seem to affect outcomes for pro-HVHF PEs. This may be because their advocacy depends less on penetrating governance networks to bring new messages about HVHF than on exerting direct influence on key decision makers.

Finally, we found support for the proposition that the size of the coalition of sympathetic supporters is important for PE success, though this finding is stronger for pro-HVHF PEs. Overall, this result is consistent with the finding of numerous

policy studies, particularly those connected to the Advocacy Coalition Framework (Sabatier & Weible, 2007), that coalitions can be key in perpetuating policy stasis or prompting policy change. It also is broadly consistent with an argument, associated with narrative policy theories, that coalitions help shape discourse about contentious issues such as HVHF, and that this discourse can meaningfully affect policy outcomes (see McBeth, Jones, & Shanahan, 2014, generally, and Dodge & Lee, 2015, for a discussion specific to HVHF in New York).

Since this analysis considers one slice of time, it cannot speak to the direction of causality. Anti-HVHF PEs may have been drawn to municipalities that already had more fluid, diverse HVHF governance regimes, or their advocacy may actually have created these conditions. Similarly, pro-HVHF PEs may have strategically picked targets where they already had preferential access to decision makers and a consensus supporting HVHF was already established, or they may have fostered that consensus and forged high-value ties. Entrepreneurship scholarship has forwarded both arguments (e.g., Mintrom, 1997; Mintrom & Norman, 2009; Schneider & Teske, 1992, 1993a, 1993b; Sheingate, 2003; Teske & Schneider, 1994).

## Conclusions

Policy entrepreneurship is unique in public policy scholarship in its focus on individuals. Policy studies typically focuses on outside constraints and events that act on participants in the policy process, or on the influence of societal-level groups such as institutions and agencies. In contrast, policy entrepreneurship views specific actors as agents for potentially game-changing outcomes. This focus makes policy entrepreneurship scholarship particularly complementary to network research, which investigates how individual-level behavior shapes the group, and vice versa.

Methods for eliciting networks from media reports are gaining in sophistication. Herein, we used a novel text-mining approach to construct 56 networks for cross-sectional analysis. We developed this approach because, while networks are widely recognized as critical in many policy processes, the application of network analysis to policy studies is often frustrated by data deficits. By the time scholars recognize that events are consequential for policy, it is often too late to gather data to reconstruct social networks. Even if data can be collected contemporaneously, common approaches such as surveys and interviews face biases from recall error, non-response and selection, and instrumentation. Data constraints often lead scholars to focus on focal individuals (egos) and their connections rather than on entire networks, but ego-based analyses likely miss important interplays that influence policy outcomes (Knoke & Yang, 2008; Yi & Scholtz, 2015). Using local newspaper accounts published concurrently with policy entrepreneurship, mining the texts for all actors, and inferring network ties using principled inclusion criteria, we side-step many of these challenges. The approach is replicable and can be relatively cheap. While journalism is not a precise mirror of society, the professional norms that guide journalists arguably make news accounts more objective than some other potential sources of

network data, and also make these accounts relatively comparable across newspapers. However, this approach also brings challenges.

Some municipalities are exposed to and covered in fewer news outlets than others. Our approach captures most newspapers that are available to residents and host online archives. To the extent that community events are covered in print-only or nonarchived papers, we miss those data. The larger issue is that when there are few or no newspaper articles documenting HVHF policy discussions in a municipality, it is not clear whether this is due to limited coverage or actual lack of discussion. We assume that there is some threshold of salience above which HVHF discussion would merit coverage even in the smallest of municipalities. We plan to probe this assumption using our full-text archive of HVHF policies passed by New York municipalities to identify and explore cases wherein HVHF policies passed but we find minimal newspaper coverage.

Another challenge lies in the variation in size of the networks under study. Metrics for extremely small networks are not comparable to those same metrics for networks with numerous nodes, since the likelihood of tie formation scales negatively with size. The reality may be that the HVHF governance network in a municipality is small. However, the constraints of our analytical tools mean that we must exclude municipalities with very small networks from analysis.

The extent to which the social networks revealed by local news coverage map onto the “real” networks involved in HVHF policy remains an open question. Our network mapping strategy likely misses back-channel political maneuverings, as well as negotiation and discussion occurring at other levels of government or in non-public locales. No method for constructing networks is perfect; the more typically used surveys and interviews certainly have disadvantages. Our challenge is to identify the strengths and weaknesses of this new approach so that other scholars can deploy it intelligently.

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## Notes

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1. Authors' interview with a leader of a landowner coalition in Broome County, March 29, 2013.
2. We excluded villages that were dissolved, or a decision was made to dissolve them, before or during the study period. New York City was omitted because it is a major international city and its characteristics arguably are not comparable with those of lower-profile municipalities. A handful of other towns and villages were treated as one unit because they are administered jointly.
3. Anti-HVHF activism is no longer statistically significant in the model predicting anti-HVHF policy adoption ( $p \leq 0.30$ ), nor is population or population density. Education and unemployment remain statistically significant (the latter marginally), as does network closure. The dropped cases do not meaningfully affect the model predicting pro-HVHF policy adoption.
4. Respondents rated PE success on a 1–3 scale. These success assessments and passage of municipal policies are statistically significantly positively correlated: Spearman's rho is 0.66 ( $p \leq 0.00$ ,  $n=51$ ) for the anti-HVHF side, and 0.72 ( $p \leq 0.00$ ,  $n=28$ ) for pro-HVHF.
5. We are still trying to verify details of approximately five policies. Also, several municipalities did not respond to public information requests, despite appeals.
6. The search terms: hydrofracking, hydraulic fracturing, hydraulic fracking, fracking, fracing, shale gas drilling, shale drilling, shale gas, shale, natural gas drilling, Marcellus Shale, gas drilling, and Utica Shale (see Arnold & Holahan, 2014).
7. The newspapers are listed in the Supporting Information Appendix.
8. We were unable to assign individuals to three organizations, or 0.2 percent of network nodes.
9. The statistics were based on 99 simulations;  $n=56$ .
10. Municipalities where survey-reported PEs were not identified in the networks were considered to have missing values for degree and power centrality. An alternate approach is to assume that their absence indicates a total lack of degree or power centrality, and assign them a zero. When the data are coded in this manner, the same variables are statistically (non)significant in *t*-tests.
11. Anti-HVHF power and degree centrality are correlated at 0.65 and pro-HVHF power and degree centrality at 0.74 (both  $p \leq 0.00$ ).
12. Villages are located inside towns in New York and voting tallies for nonlocal offices are only reported at the town level.
13. Population size and density are not highly correlated;  $\text{rho}=0.16$  ( $p \leq 0.23$ ).
14. When those data were not provided, an internet search on the individual's name and any other identifying details was used to make a best-guess approximation.

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### Supporting Information

Additional Supporting Information may be found online in the supporting information tab for this article.

**Table A1.** Differences in Means of Covariates of Response Between Respondent and Nonrespondent Municipalities

**Table A2.** Basic Data on Sampled Municipalities, PEs, and HVHF Governance Networks

**Table A3.** Differences in Means of Covariates Between Municipalities with Anti-HVHF and Pro-HVHF Policy Entrepreneurs