PREFACE

Unconventional oil and natural gas extraction in the early twenty-first century has transformed social, physical, economic, legal, and biological landscapes in the United States. From 2000 to 2014, shale gas production increased from near zero to approximately 40 billion cubic feet per day, making the United States the world's largest natural gas and oil producer (Smith 2014; EIA 2015). The dramatic growth of U.S. oil and gas prices produced record low prices for oil and gas in 2015, leading to declines in production, job losses, and bankruptcies (Frazier 2016; Hunn 2016; Scheyder 2016). Hydraulic fracturing (fracking) that entails high-pressure injection of synthetic chemical mixtures into subsurface formations made drawing oil and natural gas from previously unreachable reserves possible. Thirty-two states now produce unconventional fossil fuels (EIA 2013b) at an unprecedented scale (EIA 2013a). Extraction from the Brakken Shale in North Dakota produced new human settlements visible from space (J. Amos 2012; Swanson 2014).

Industry and regulators promote unconventional gas and oil production as the key to U.S. energy independence and as a bridge to a low-carbon economy (MITEI 2011; Graves 2012; G. Zuckerman 2013). But there is another side to the story. In 2014, New York State became the first state rich in unconventional natural gas to ban fracking due to human health and environmental concerns (Lustgarten 2014). Debates over fracking are being fought state by state everywhere that the practice spreads; the 8,696 unconventional shale wells drilled in Pennsylvania from 2000 to 2014 incurred 5,983 violations from the Department of Environmental Protection (Kelso 2014). Earthquakes in Alabama, Ohio, Oklahoma, and Texas are linked to the injection of fracking wastewater—3.5 billion barrels in Texas alone in 2011 (up from 46 million in 2005) (Hargrove 2014). Research in Pennsylvania, Texas, and

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Colorado shows fracking-contaminated ground and surface water is destroying the lives and livelihoods of landowners (Jackson et al. 2013; Warner et al. 2013; Darrah et al. 2014; Kassotis et al. 2014). Furthermore, natural gas may be no more "green" than coal. Life-cycle analyses of its production reveal that tons of methane are released into the atmosphere when natural gas is processed and transported (Howarth, Santoro, and Ingraffea 2011; Karion et al. 2013; S. Miller et al. 2013; Pétron et al. 2014). Methane is a far more potent greenhouse gas than carbon dioxide (Myhre et al. 2013).

This book explores the emergence of both the gas boom and its controversies, offering innovative scientific approaches to studying gas extraction's harmful impacts on human health and the environment. Via participant observation within a small scientific advocacy organization, The Endocrine Disruption Exchange (TEDX), I follow the development of the first database of chemicals used in natural gas extraction, a database that documents not only the (often proprietary) constituents of fracking chemicals but also their bodily and ecological effects. My ethnographic analyses of TEDX's database demonstrate how it transformed an information vacuum around fracturing into fierce regional and national debates about the public health effects of this activity.

Expanding on TEDX's databasing methodology, the book describes the research, development, and impacts of a set of online, user-generated databasing and mapping tools designed to interconnect communities encountering the corporate forces and chemical processes animating gas development. Fracking is an intensive, technological practice that requires the delicate calibration of corporate, governmental, and legal apparatuses in order to proceed. The industry operates at county, state, federal, and international levels, and it has successfully organized regulatory environments suited to rapid and lucrative gas extraction. Amid such multiscalar forces, communities have little legal or technical recourse if they have been subjected to chemical and corporate influences that undermine their financial, bodily, and social security. ExtrAct, a research group I cofounded and directed with the artist and technologist Chris Csikszentmihályi, sought to empower isolated local communities by developing a suite of online mapping and databasing tools through which gas-patch communities exposed to fracking could share information, network, study, and respond to industry activity across states. Using ExtrAct as an example, I explore how social sciences and the academy at large can invest in developing research tools, methods, and programs designed for noncorporate ends to help redress the informational and technical imbalances faced by communities dealing with large-scale multinational industries.

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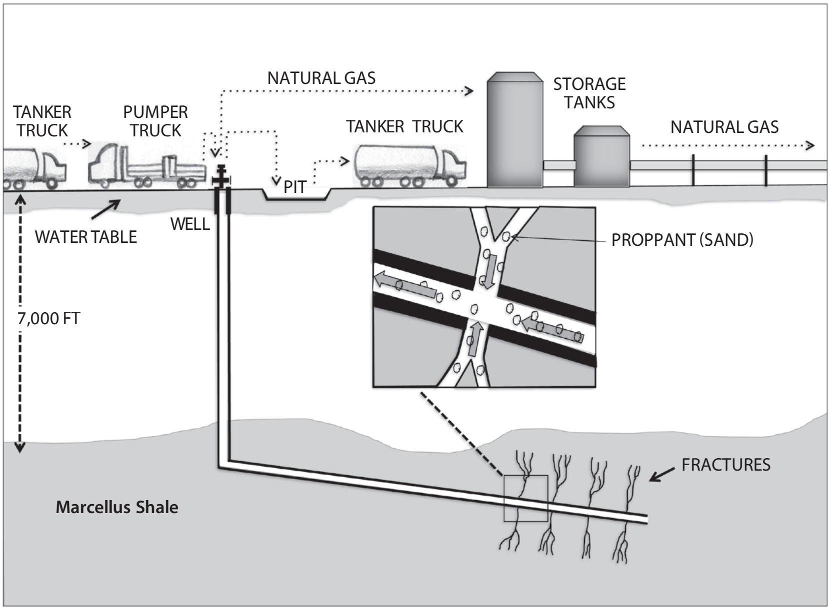

FIGURE P.1. The process of hydraulic fracking.

In unconventional gas reserves, gas is distributed throughout a porous matrix like coal or sandstone. Fracking creates a route through which this gas can be brought to the surface (EPA 2004) by injecting a mixture of synthetic chemicals under extremely high pressure into the porous matrix. A high-volume hydraulic frack is a large-scale industrial operation. A cavalcade of 18-wheeler trucks bearing containers filled with the thousands of gallons of fluid and associated machinery necessary for the procedure draws up to a frack site (see figure P.1). These containers are arranged around the "head" of the well to be fracked and then connect to the wellhead to form what looks like an octopus of piping.

Within the containers, blending machinery mixes fracturing fluids composed of dry or nondiluted stores of chemicals and other materials such as proppants, sand, or other grainy materials used to prop the fractures open (Montgomery and Smith 2010: 30).[1] This mixture is forced into the well by powerful diesel engines capable of producing 15,000 hhp (hydraulic horsepower), which is roughly equivalent to about twenty-three 650 hp 18-wheel truck engines roaring to life as a frack operation begins (Montgomery and Smith 2010: 30). A frack operation can continue for many hours as the mixture is pumped underground at a high-enough pressure to break pathways

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in the subsurface gas-bearing layer thousands of meters below the surface. The force of these fluids generates a mini-seismic event. A single frack can require one million gallons of fluid, and a well might be fracked from three to 40 times during its life cycle. On average, each horizontally drilled well in the United States undergoes 10 fracking cycles (Montgomery and Smith 2010: 27, 28, 35). Most horizontally drilled wells in the Marcellus Shale region, the largest natural gas-producing region in the United States in 2013, extend two kilometers below the surface and over a kilometer into shale beds (Kemp 2014).

The combination of horizontal drilling and fracking has transformed oil and gas resource extraction. Rather than sinking individual wells into pockets of gas or oil, the oil and gas industry can now collect fossil-fuel resources from across a formation, drawing gas and oil from kilometers of pipe drilled laterally through a shale bed.

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