



1. WATER CONTAMINATION

Shale gas development has been linked to **surface and groundwater contamination on numerous occasions**; this is extensively documented in the peer-reviewed literature¹ and in government investigations.² There are numerous mechanisms and pathways by which this can occur, but **well failure and improper wastewater treatment and disposal** remain the most frequently cited and difficult to control.³



3. HEALTH RISKS

There are few quantitative epidemiological investigations that have assessed the associations between risk factors and human health outcomes, although there have been **numerous and consistent health-related complaints among distinct populations**. Evidence suggests that those living in closer geographical proximity to active shale gas development are at an increased risk of acute and sub-chronic **respiratory, neurological, and reproductive health effects** from exposure to air emissions as well as **slightly elevated cancer risks**.⁶ One study showed a greater prevalence of some adverse birth outcomes for neonates born to mothers living in higher densities of natural gas development;⁷ another study using survey data found higher reported health symptoms per person among residents living closer to gas wells.⁸ **Hydraulic fracturing fluids contain endocrine disrupting chemicals** (EDCs), which may have effects on organisms that manifest themselves years or decades after exposure.⁹ One study found an **increase in estrogenic, anti-estrogenic, and anti-androgenic activity** in areas of natural gas development compared with reference sites.¹⁰



5. ECOLOGICAL IMPACTS

Shale gas development is spatially intense and requires large well pads and extensive ancillary infrastructure that leads to **habitat degradation as well as damage to vegetation and fauna**.¹⁴



7. COMMUNITY AND SOCIAL ISSUES

The introduction of a short-lived, intensive industrial activity can **profoundly alter the social fabric of a community** with heavy truck traffic, noise and light pollution, accidents, perceived declines in livability, decreases in property value, stress, and anxiety.¹⁷



9. ECONOMICS

The natural gas industry can create jobs, increase tax revenues, and lower energy costs, but many of these **short-term gains impact other industries** (e.g., tourism, agriculture, renewable energy) **as well as long-term economic sustainability** (e.g., boom-bust cycles are common among many energy extraction communities).¹⁸ Major direct and indirect costs associated with healthcare, environmental remediation, and climate change are ignored in economic discussions.

2. AIR QUALITY



Air pollutants such as hydrogen sulfide, nitrogen oxides, volatile organic compounds (e.g., benzene, formaldehyde), particulate matter, and ground level ozone are emitted or produced during the full life cycle of development and have been shown to **impact both local⁴ and regional⁵ air quality**.



4. CLIMATE CHANGE

Natural gas is comprised principally of methane – a potent greenhouse gas that is leaked and vented into the atmosphere at many stages of production and transmission –which is ~ 86 times as potent as carbon dioxide over a 20-year time frame and ~ 34 times as potent over a 100-year time frame.¹¹ Most research indicates that **a direct switch from coal to natural gas would not achieve the emission reductions needed to slow climate change**,¹² while some research indicates that shale gas production and use may actually be worse for the climate than coal from a lifecycle perspective.¹³



6. EARTHQUAKES

The UK has already experienced **seismic activity triggered by hydraulic fracturing** activities near the town of Blackpool¹⁵ and seismic events have been associated with well stimulation and underground injection of wastewater in the U.S. on numerous occasions.¹⁶



8. AESTHETICS AND WELLBEING

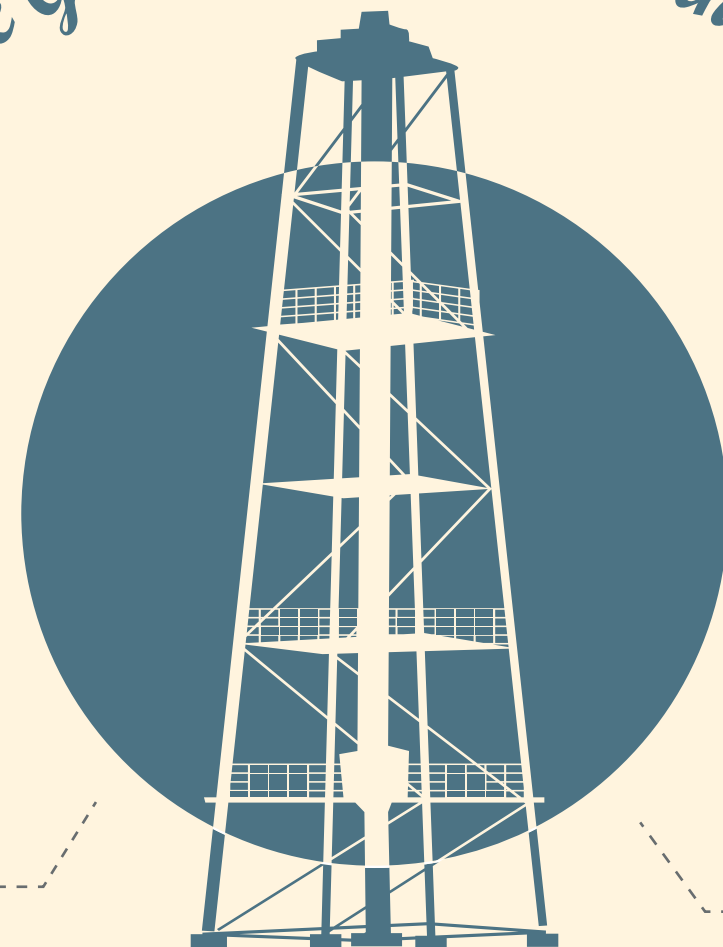
The industrial infrastructure required to produce, process, and transmit natural gas **alters the character of the land**, which contains an instrumental value with economic implications as well as its own inherent, “non-use” value. In the UK, licenses for shale gas development can be issued for “beauty spots” and national parks if it is demonstrated to be in the public’s interest.



10. REGULATORY BODIES

There is **no independent regulatory body capable of effectively regulating the shale gas industry in the UK** and existing bodies have been downsized (e.g., Environment Agency). There is no evidence that any regulatory body in the U.S. has been able to adequately minimize environmental impacts and some evidence shows that even with tighter emission standards air pollution from shale gas development actually increased.¹⁹

Shale Gas Development in the UK



10 CONSIDERATIONS FROM THE U.S. EXPERIENCE

BASED ON: Hays et al. 2015. Considerations for the development of shale gas in the United Kingdom. Science of the Total Environment. 512-513, 36-42.

SOURCES: 1. Osborn et al. 2011; Fontenot et al. 2013; Gross et al. 2013; Jackson et al. 2013.; Kassotis et al. 2013; Darrah et al. 2014. 2. PA DEP 2014. 3. Davies et al. 2014; Dusseault et al. 2014; Ingraffea et al. 2014. 4. Macey et al. 2014; Brown et al. 2014; Colborn et al. 2014. 5. Kembball-Cook et al. 2010; Edwards et al. 2014; Thompson et al. 2014. 6. McKenzie et al. 2012. 7. McKenzie et al. 2014. 8. Rabinowitz et al. 2014. 9. Colborn et al. 2011. 10. Kassotis et al. 2013. 11. IPCC 2013. 12. Brandt et al. 2014; McJeon et al. 2014. 13. Howarth et al. 2011; Pétron et al. 2012; Pétron et al. 2014; Caulton et al. 2014; Karion et al. 2013; Peischl et al. 2013. 14. Jones et al. 2014; Souther et al. 2014; Hamilton et al. 2011; Papoulias and Velasco 2013; Weltman-Fahs and Taylor 2013; Adams 2011; Brittingham et al. 2014; Racicot et al. 2014; Kiviat 2013. 15. de Pater and Baisch 2011; Green et al. 2012. 16. Davies et al. 2013; Ellsworth 2013; Elst et al. 2013; Keranen et al. 2013; Keranen et al. 2014; Kim 2013. 17. Witter et al. 2013. Economics. 18. Jacquet 2009; Jacquet 2014; Christopherson and Rightor 2011; Finkel et al. 2013. 19. Thompson et al. 2014. To access the referenced studies please visit the PSE Healthy Energy citation database: <<http://psehealthyenergy.org/site/view/1180>>. Infographic by Yoonseo Cha. Some graphic components are based on free vector images available at www.freepik.com and www.vecteezy.com