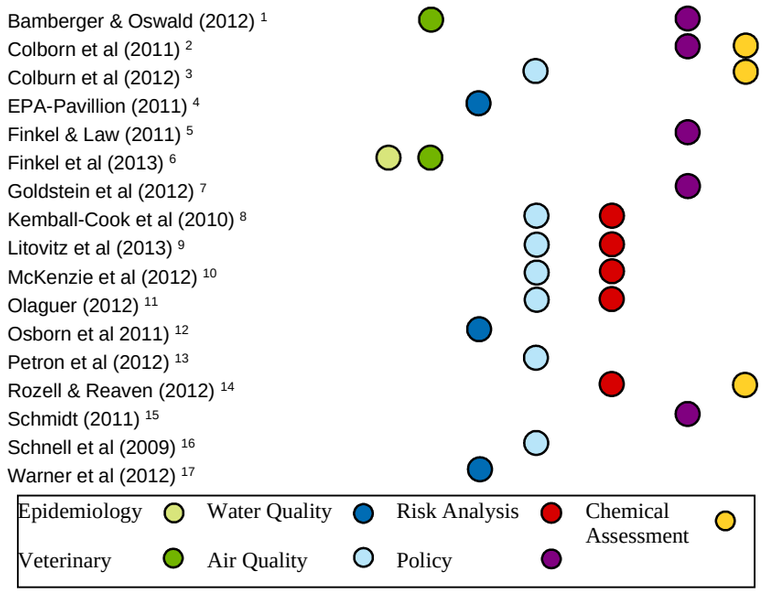
Recent years have seen a surge of scientific studies on the public health dimensions of shale gas development. However, data gaps continue to persist and efforts to fill these gaps are hampered by a variety of regulatory, governmental, and research obstacles.



Obstacles in Governance

Lack of Health Expertise

There is a lack of environmental health expertise in the National Advisory Committees. While public health concerns related to shale gas and tight oil development are certainly recognized, the state and national advisory committees designed to respond to and investigate these concerns lack personnel with environmental public health expertise (7). This lack of expertise functions as a barrier to adequate scientific investigations and to subsequent science-based health policies.

Lack of Capacity and Resources

Governmental departments are understaffed and funding shortages are exacerbated by the economic recession. Thus, governmental monitoring of public health and environmental dimensions of shale (tight) oil and gas production has been limited. For instance, in 2011 the Pennsylvania Department of Environmental Protection (PA DEP) failed to inspect 66,000 of its active oil and gas wells (18). A lack of monitoring inhibits data collection, data analysis, and the growth of scientific understanding of public health concerns.

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Impediments to Public Health Research on Shale (Tight) Oil and Gas Development

Over the past several years there has been a surge of scientific studies on the public health dimensions of unconventional gas development. However, data gaps continue to persist and efforts to fill these gaps are hampered by a variety of regulatory, governmental, and research obstacles.

- A full understanding of the risks to human health from shale gas and tight oil development is not yet known due to a dearth of environmental science and epidemiologic research, yet l**ack of data is not an indication of an absence of harm.**
- Despite considerable known risks to human health, the burden of proof regarding health and safety of shale gas and tight oil development currently falls on scientists and the public as opposed to industry. This creates a **bias towards the increased development of shale gas and tight oil with limited public health and environmental protections.**
- Industrial, legislative, and regulatory development have historically outpaced scientific consensus on these types of topics, resulting in human harm. Examples where health-damaging industrial activities were scaled much more rapidly than the science of its health effects and subsequent evidence-based policy development include, tobacco, PCBs, asbestos, and leaded gasoline. **The science should be put before risky industrial processes are allowed to be scaled.**

Methodological Obstacles & Exposure Assessment

Exposure Considerations

Even with full disclosure of chemicals added to frac fluid, the ability to link chemicals to specific health outcomes remains difficult:

- Frac fluid mixes with compounds found underground including heavy metals, salts, associated hydrocarbons, and, sometimes, naturally occurring radioactive materials (NORMs). **Flowback and produced fluids are a complex soup of chemicals with individual, cumulative, and synergistic properties that are often difficult to predict and safely dispose of.**
- **Many health outcomes are not specific to chemicals associated with the shale gas and tight oil development process** (e.g., headaches can be caused by a number of factors), complicating the ability for researchers to link exposures to health outcomes.

Temporal Considerations and Causal Inference

Shale gas and tight oil development is a relatively recent development and **the most rigorous epidemiologic study designs can take several years to complete**.

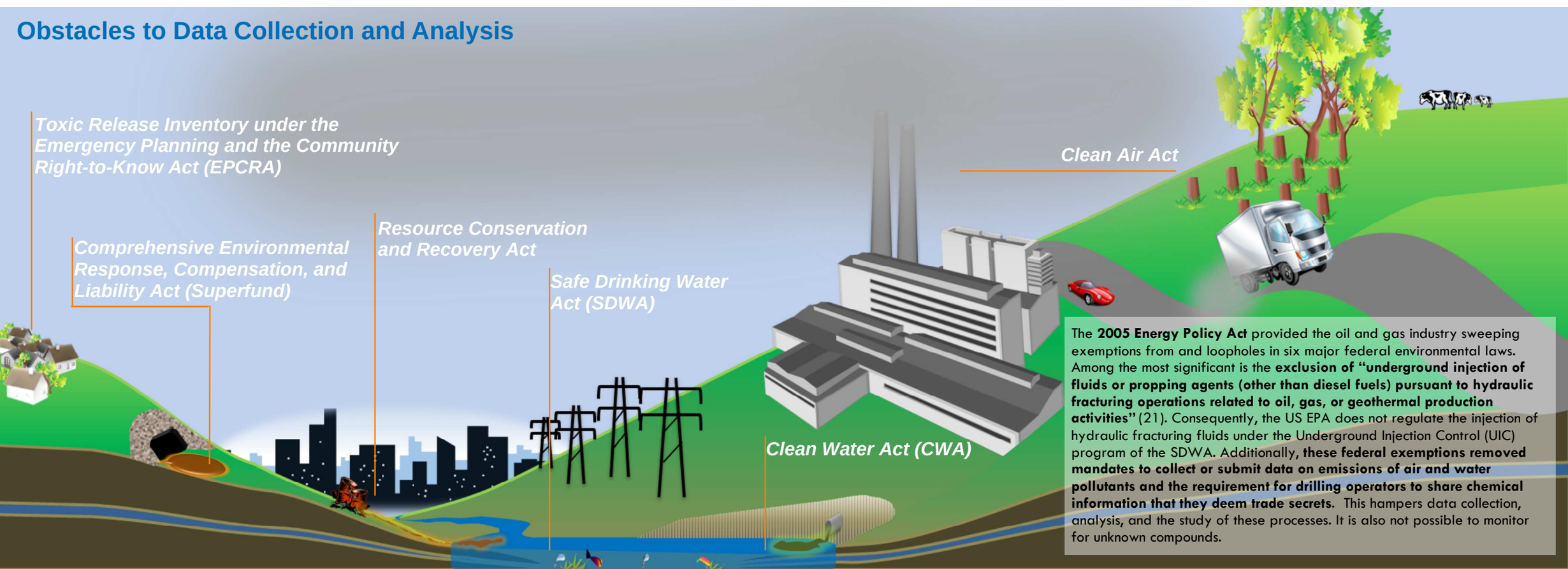
- For instance, prospective cohort studies, that follow groups to measure their exposures and their health outcomes, can take 15-20 years to generate quality data.
- Other studies that focus on diseases, such as cancers and cardiovascular illnesses, associated with long latency periods and chronic low-level exposures to environmental pollutants may not produce results for many years.

Non-Disclosure Agreements

Anecdotally, the **acquisition of environmental and health data is made difficult due to obscured data sources and hidden evidence of health outcomes and damages due to non-disclosure agreements** signed by impacted landowners in exchange for payments aimed to recoup economic losses associated with water contamination, soil degradation, illness, and/or death of livestock.

Several states have legislated **"physician gag orders"**, e.g., § 3222.1 (b)(10) of Act 13 in Pennsylvania (20). Under these policies, health professionals are required to sign confidentiality agreements in exchange for information on chemicals a patient may have been exposed to but are deemed proprietary by a drilling operator. These non-disclosure laws interfere with data sharing among health professionals, public health researchers, public health departments, and communities at large. They also hinder the abilities of researchers to conduct studies.

Obstacles to Data Collection and Analysis



The **2005 Energy Policy Act** provided the oil and gas industry sweeping exemptions from and loopholes in six major federal environmental laws. Among the most significant is the **exclusion of "underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities"** (21). Consequently, the US EPA does not regulate the injection of hydraulic fracturing fluids under the Underground Injection Control (UIC) program of the SDWA. Additionally, **these federal exemptions removed mandates to collect or submit data on emissions of air and water pollutants and the requirement for drilling operators to share chemical information that they deem trade secrets.** This hampers data collection, analysis, and the study of these processes. It is also not possible to monitor for unknown compounds.