LEGAL ASPECTS OF HYDRAULIC FRACTURING
An Idaho Law Review Symposium

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What if we stop increasing emissions?
Even at the current emissions rate, CO2 is released into the atmosphere nearly twice as fast as it is removed—so the bathtub will continue to fill.

How do we cause CO2 emissions?
Four-fifths is from burning fossil fuels. Nearly all the rest is from deforestation and other changes in land use.

How much is too much?
No one is sure. Some scientists think we need to reduce the CO2 level back down to 350 parts per million (ppm)—equivalent to 745 billion metric tons of carbon—to avoid serious climate impacts. But if current emissions trends continue, 450 ppm will be passed well before mid-century.

How does CO2 cause warming?
It absorbs some of the heat radiation coming off Earth’s sunbaked surface and reradiates it back downward.

Where does our CO2 go?
 Plants and soil absorb about a third each year, and ocean surface waters about a quarter. The rest stays airborne for a long time.

OUT
5 billion metric tons a year

45% REMAINS IN ATMOSPHERE
30% ABSORBED BY PLANTS & SOILS
25% ABSORBED BY OCEANS
<1% ABSORBED BY SEDIMENTS & ROCKS

Hasn’t CO2 been this high before?
Not for at least 800,000 years, say the oldest air bubbles found in Antarctic ice cores—and probably not for millions of years.

PERCENTAGES DO NOT ADD UP TO 100 BECAUSE OF ROUNGING.
It will take centuries for plants and the ocean to soak up most of the human-made CO₂. It will take hundreds of millennia for the rest to be removed by rock weathering, which converts CO₂ to carbonate sediments and rocks.

Plants and soil absorb CO₂ quickly, but that reservoir fills up fast.

The deep ocean is bigger, but access is slow; CO₂-laden surface water sinks at only two places near the Poles.

Carbonate sediments and rocks are far bigger and slower still; they form at sea from elements weathered off rocks on land.

**What if we stop emissions completely?**

**Why would the level stay high for so long?**
http://www.informationisbeautiful.net/visualizations/how-many-gigatons-of-co2/
Climate change models

Likely effects of four emission reduction models

**132% increase in emissions by 2050**

5.5-7.1°C rise in global temperature by 2100

**76% increase in emissions by 2050**

4-5.2°C rise in global temperature by 2100

**2.9-3.8°C rise in global temperature by 2100**

Emissions return to 1990 levels by 2050

**47% decrease in emissions**

2.1-2.8°C rise in global temperature by 2100

*Source: Met Office*

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*from 1990 levels

**Temperature rise is relative to pre-industrial levels and ranges from the most likely (50% chance of occurring) to the worst case (10% chance of occurring).
In such a 4°C world, the limits for human adaptation are likely to be exceeded in many parts of the world, while the limits for adaptation for natural systems would largely be exceeded throughout the world. Transactions of the Royal Society January 13, 2011; 369
Preliminary Significant U.S. Weather and Climate Events for 2012

**SNOW PACK**
3rd smallest winter snow cover extent. Below-average snow pack was observed for much of the West.

**WARM**
Warmest year on record for the nation. 19 states record warm. The 4th warmest winter, warmest spring, and second warmest summer contributed to 2012 having an average temperature 3.3°F above average and 1.0°F above the previous record warm year of 1998.

**WILDFIRES**
Over 9.2 million acres burned nationwide during 2012. CO experienced its most costly fire on record in June. The Whitewater-Baldy fire was the largest on record for NM.

**FLOOD**
Storms caused record flooding in and around Duluth, MN on June 20th with over 8 inches of rainfall observed in 24 hours. Rivers in the area reached their highest levels on record.

**TORNADOES**
An early season tornado outbreak on March 2-3 in IN, OH, WV, and KY resulted in 42 fatalities. This was the deadliest tornado outbreak of 2012.

**POST-TROPICAL CYCLONE SANDY**
Made landfall near Atlantic City, NJ with sustained winds of 80 mph in late October. Record storm surge along NJ and NY coasts along with heavy rain and snow. Over 8 million people lost power, 131 fatalities.

**STORMS**
A straight-line wind storm called a derecho caused significant damage from IN to MD. Over 250,000 customers lost power, including the densely populated Washington, D.C. area.

**DROUGHT**
The 2012 drought peaked in July with over 60% (PDSI) of the nation experiencing drought conditions, comparable to the drought episodes of the 1950s. Corn and soybean crops failed across a large portion of the Great Plains and Midwest. Water levels along the Mississippi approached record lows and slowed commercial shipping.

**HURRICANE ISAAC**
Made landfall near the mouth of the Mississippi River in late August with winds of 80 mph. Significant storm surge and flooding rains along the Gulf Coast. 9 fatalities.

**WET**
Florida had its wettest summer on record, partially due to Hurricane Isaac and Tropical Storm Debby. Seasonal precipitation was 140 percent of average.

**STORMS**
On March 9th a storm system brought severe weather to HI. A rare tornado hit Oahu. Largest hailstone on record for the state in Oahu.
Business As Usual vs. Smart Policy

Potential to reduce annual emissions by 17 Gt in 2020; 35 Gt in 2030

Global greenhouse gas emissions
GtCO₂e per year

Source: McKinsey Global GHG Abatement Cost Curve v2.0; Houghton; IEA; US EPA; den Elzen, van Vuuren; Project Catalyst analysis

Note: As a reference, 1990 total emissions were 36 Gt CO₂e
Delay In Action
Forces drastic economic dislocation

<table>
<thead>
<tr>
<th>Year of peak emissions</th>
<th>Required decline</th>
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<tbody>
<tr>
<td>2010</td>
<td>1.3 percent</td>
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<tr>
<td>2020</td>
<td>3.3 percent</td>
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<tr>
<td>2030</td>
<td>6.1 percent</td>
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<tr>
<td>2040</td>
<td>16.6 percent</td>
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Annual global CO₂e emissions
Billion metric tons (Gt)

Business as usual
Carbon Prices alone will deliver only a part of the abatement needed.
American Council for an Energy Efficient Economy
Overcoming Market Barriers and Using Market Forces to Advance Energy Efficiency
March 2013
Provides a roadmap for how the US can save 30 quads of electricity and up to a trillion dollars by 2030
http://aceee.org/research-report/e136
National Renewable Energy Laboratory, 
*Renewable Electricity Futures 2012*

Conclusion: Existing renewable technologies can supply 80% of US electricity demand by 2050

http://rpm.nrel.gov/refhighre/expansion/expansion.html
Off Ramps on The Shale Gas Superhighway
See Brookings and MIT Studies
Boxer Sanders Climate Protection Act of 2013
Reduce CO2 by 80% by 2050
Upstream tax of $20/ton on emissions rising 5.6 percent annually over a 10-year period
Rebate 60 percent of revenues to consumers
Invest balance in energy efficiency and clean technologies
Revenue: $1.2 trillion
Minimize methane leakage

✓ Implement Green Completions

✓ Initiate rulemaking to set NSPS for methane

✓ Establish strict MRV protocols

✓ Tighten controls as needed
Level the Playing Field

Close statutory loopholes: SDWA, CWA, RCRA, CERCLA
Eliminate subsidies for fossils
Extend PTC for wind for five years
Increase R&D for renewables
Invest in smart grid and transmission infrastructure (e.g. trunk line for east coast offshore wind)
Increase Energy Efficiency by 50% by 2025

NATIONAL ACTION PLAN FOR ENERGY EFFICIENCY
VISION FOR 2025: A FRAMEWORK FOR CHANGE
Integrate Gas and Renewables as Complementary Strategies

USE WIND AND SOLAR AS HEDGES AGAINST VOLATILE GAS PROCESS.

Gas Price Projections 1986-2005
Figure: U.S. Energy Information Administration forecasts of U.S. wellhead natural gas prices, adjusted for inflation, in various years (blue lines) compared with actual prices (orange line).
We will respond to the threat of climate change, knowing that the failure to do so would betray our children and future generations.
Thanks For Your Attention