

Hydraulic fracturing: Water and environmental issues related to energy resource development'



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American Ground Water Trust

**Advocate for
Maximizing the Economic
and Environmental
Benefits of
Ground Water**



**Promoting the Science
and Technology of
Accessing, Managing
and Delivering
Ground Water**





An education / information challenge is how to comment on issues where describing the facts accurately can lead to a charge of bias!



Background to US oil & gas development and the current controversies

“Water that Burns” not a new phenomenon!



KEY DATES IN US SHALE-GAS HISTORY

- 1821** Hart Well (first US gas well)
- 1891** First US pipeline
- 1947** First hydraulic fracture
- 1949** Fracture available commercially
- 1974** OPEC Oil embargo
- 1977** DOE formed
- 1978** Fuel Use Act (FUA)
- 1987** FUA repealed
- 2007** Directional drilling and fracking
- 2010** Gasland

1978 FUEL USE ACT (FUA) in the USA

Outlawed building new gas-fired power plants

Between 1978 and 1987 US power stations added 172 GW of capacity (81% coal)

1987 FYU repealed

Between 1989 and 2009 US added 306 GW of generation capacity (88% gas fired and 4% coal)

2010 Josh Fox: “GASLAND” VIDEO/ MOVIE

The video is strongly against fracking

Release had a HUGE worldwide impact on public opinion

Discredited by the O & G industry

Went viral on U-Tube

“Gasland 2” released July **2013**



GASLAND

A FILM BY JOSH FOX

PART II

FOLLOW US:



NOW ON HBO

“Gasland 2 shows even less interest in real science. The thesis of the movie is a categorical denial of the facts”

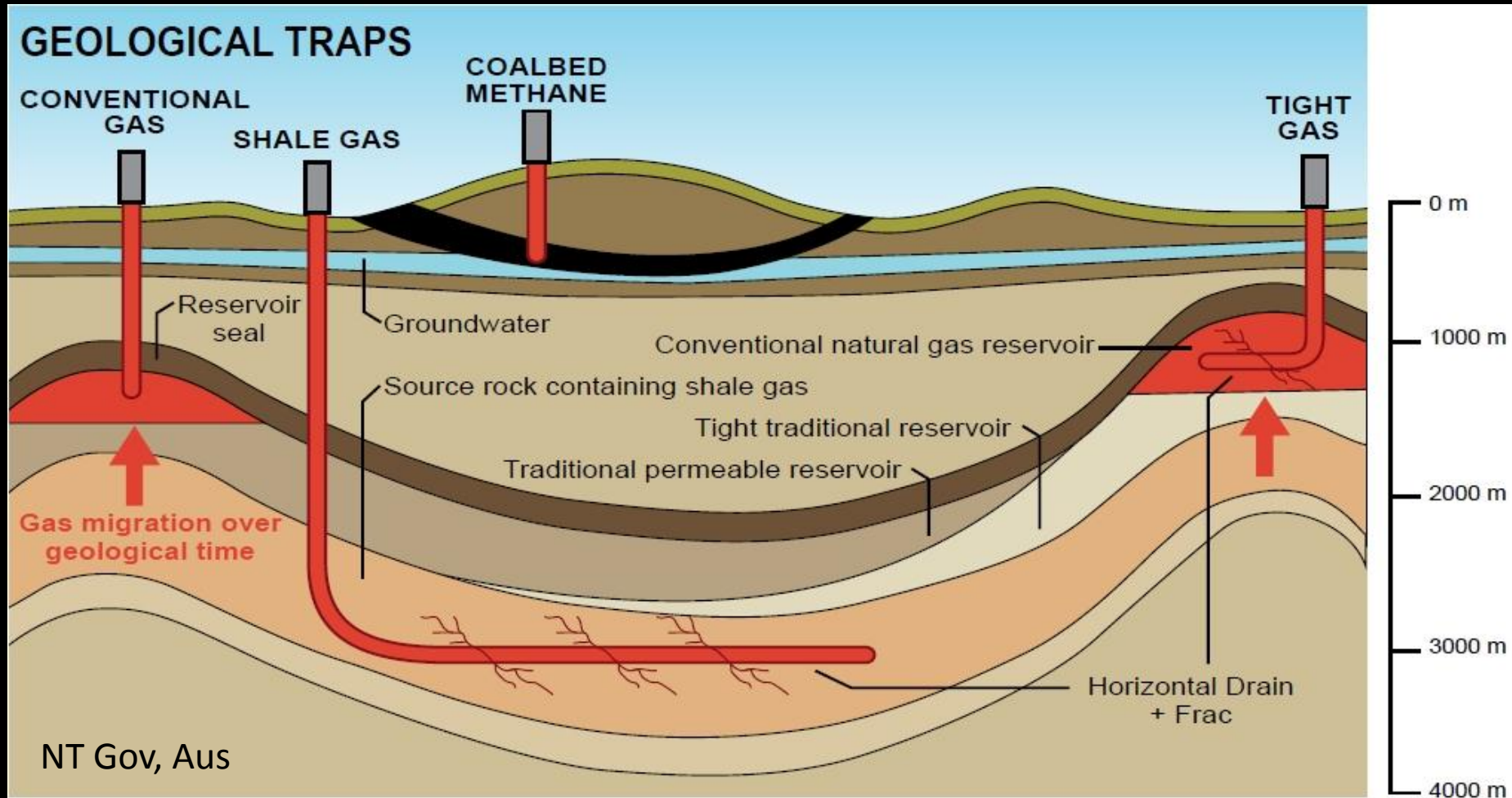
“Everything Josh Fox has said has been debunked, and no one takes him seriously — except for the handful of hardcore ideologues and conspiracy theorists who were never interested in the facts anyway”

Steve Everley of the industry website Energy in Depth



Geological background to shale-gas deposits

Conventional and Unconventional gas



UNCONVENTIONAL

→ Source rock is the → reservoir rock



Sedimentary rocks in layers – not always horizontal!





Shales can have permeability at the near surface, especially if folding has subjected them to tension forces

Shales at depth are not likely to have any permeability unless affected by faults or intrusions

Shale Plays – Lower 48 States



RECOVERABLE SHALE GAS RESERVES

trillion m3 - (top 18 countries)

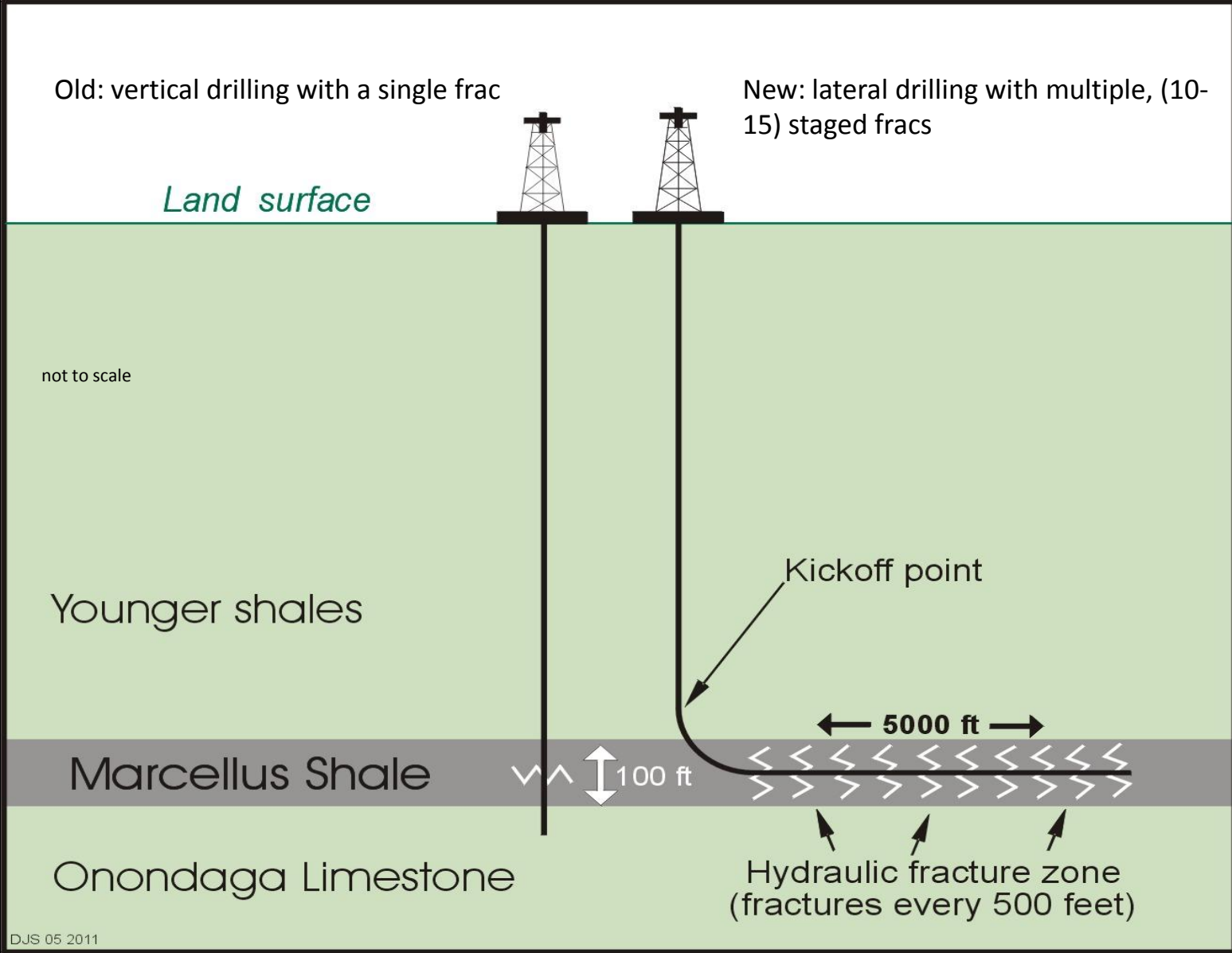


Data source: Royal Society, 2012; cartography by UNEP/GRID-Geneva



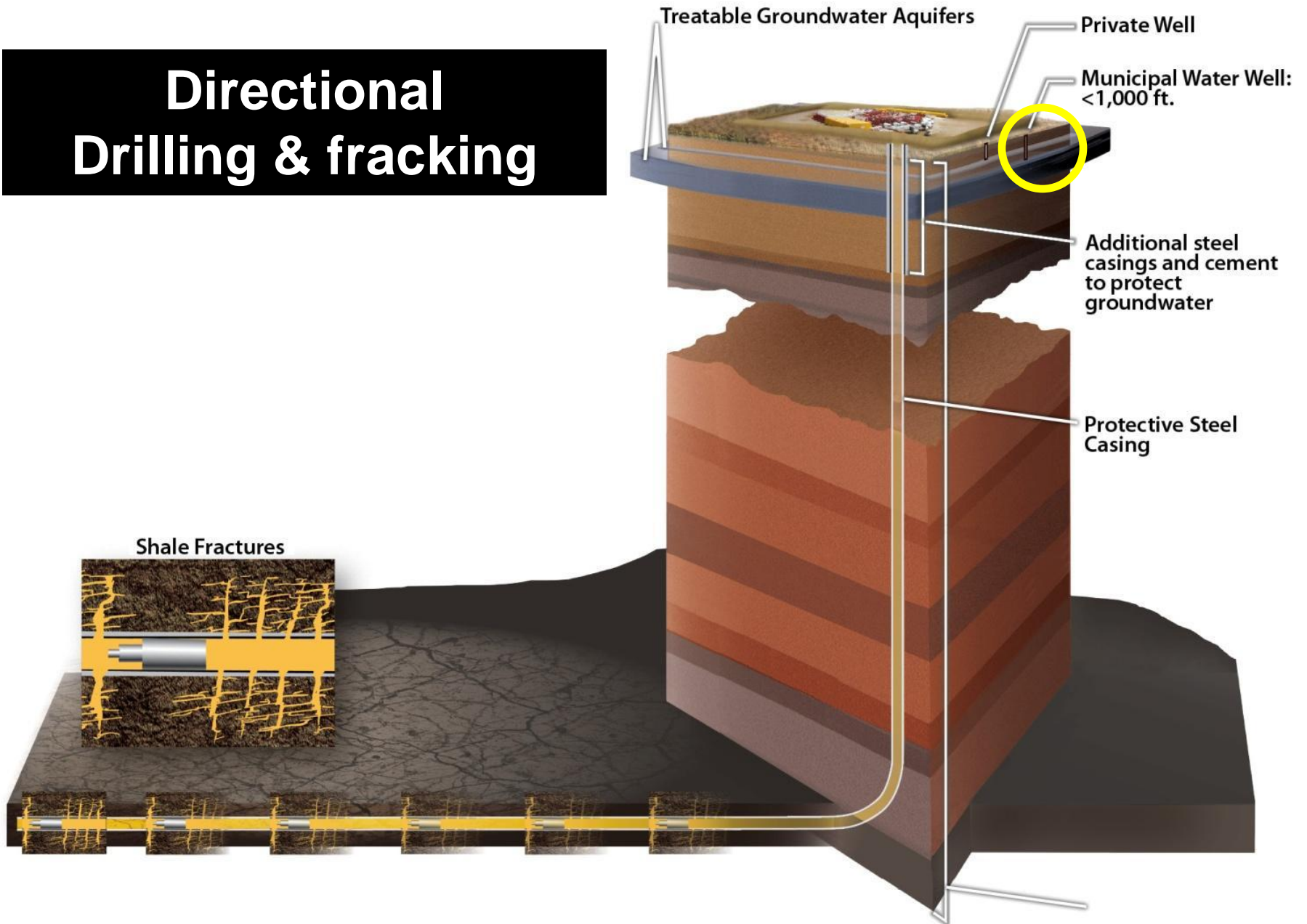
Hydraulic fracture: How it works

Hydraulic Fracturing & directional drilling revolution



DJS 05 2011

Directional Drilling & fracking

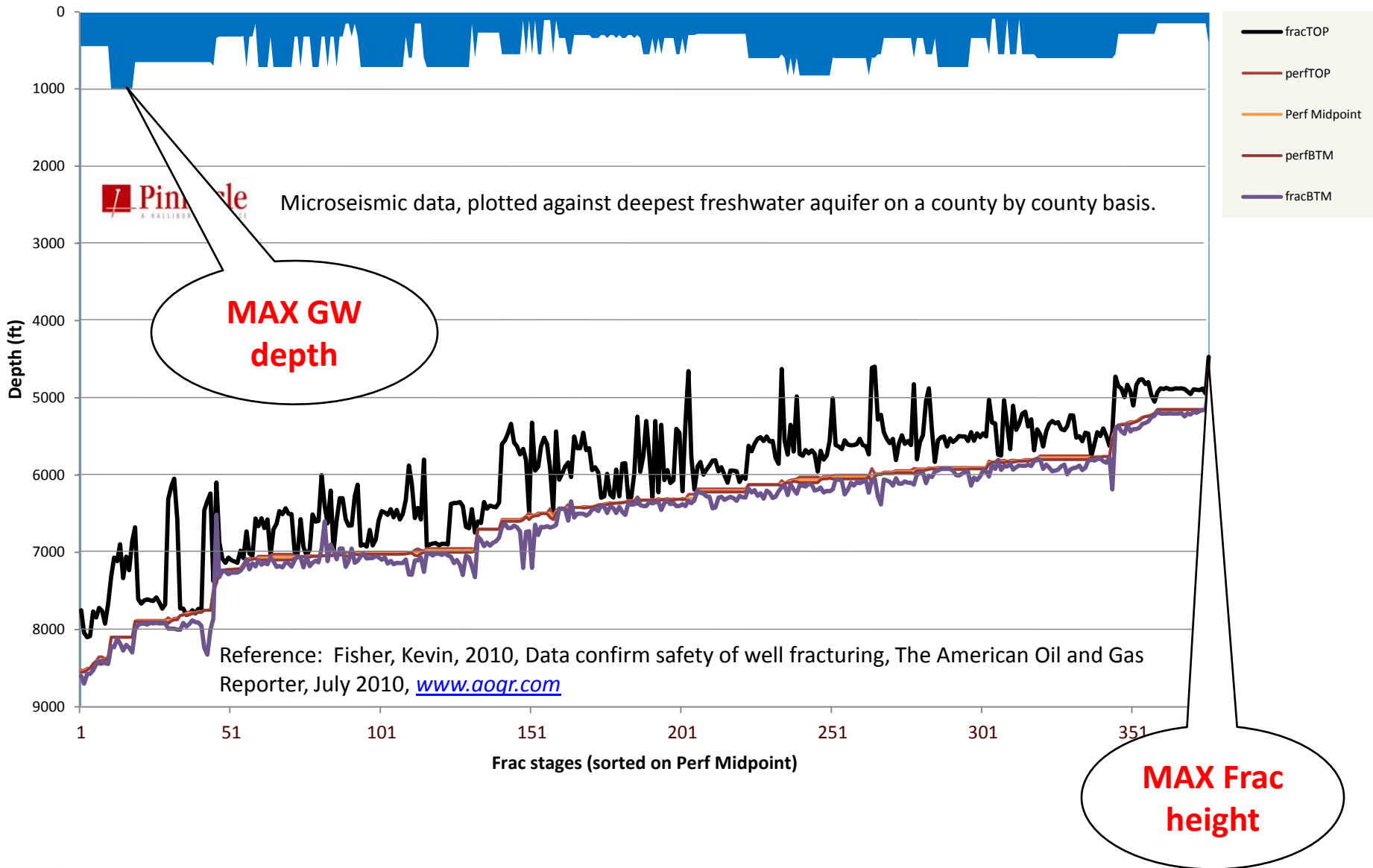


Multiple casings used for shale-gas wells

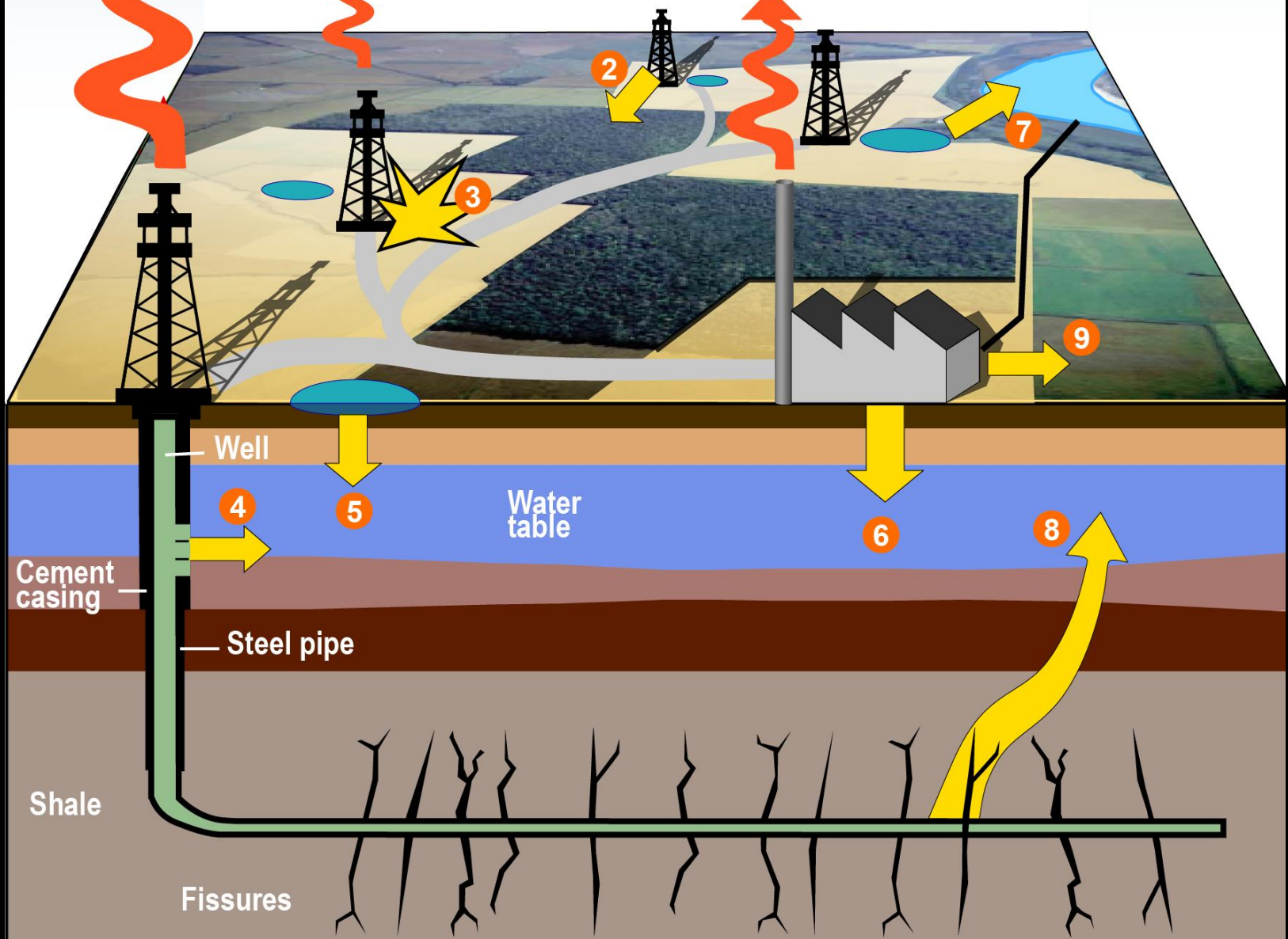


Overstated risks: out of zone fractures

Marcellus Mapped Frac Treatments



Schematic of infrastructure and potential impacts





**What do People
Care About?**



**What do
people
care
about?**



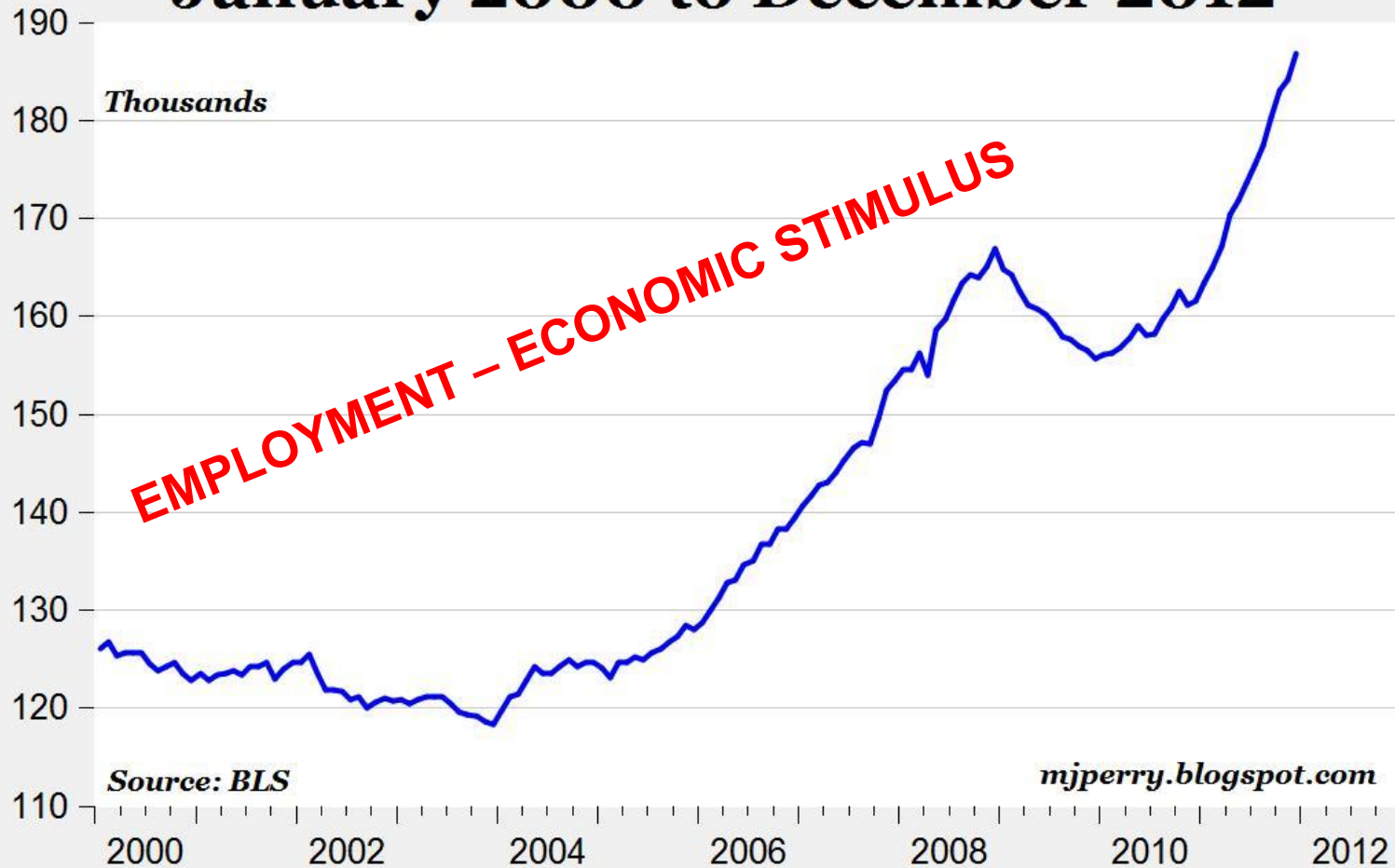
**Drinking water safety
Aquatic habitat & environment
Impacts on climate
Corporate globalization
National energy policy**

Concern about energy independence



(image: AP via sulekha.com Vienna, Austria, on Wednesday, Sept. 9, 2009.)

U.S. Employment: Oil and Gas Extraction January 2000 to December 2012

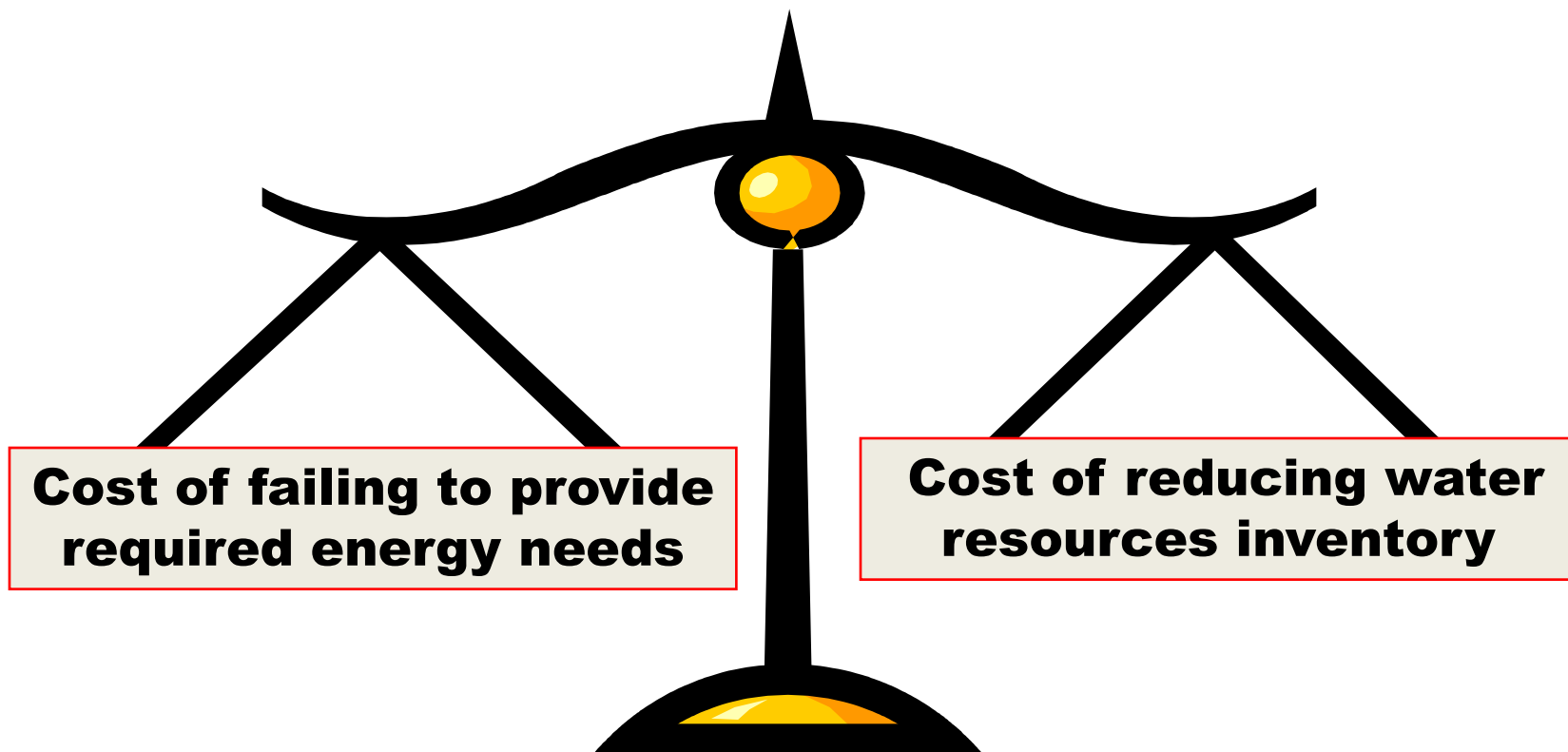




**What are the risks,
benefits, water needs,
new thinking?**

BALANCE

RISK - COST





SIERRA CLUB NATURAL GAS FRACTURING POLICY

Opposes projects:

- if details of fluids are not fully disclosed**
- using fluids that pose toxic risks**
- that do not treat, manage, and account for fluids, muds and produced water**
- endanger water supplies or critical watersheds**
- imperil human health**
- cause violations of air quality standards**



Amy Myers Jaffe, Executive Director, Energy & sustainability, University of California Davis

“Water-treatment technology is going to become more and more critical as the industry moves forward.....the continued use of fracking depends on the industry getting its act together to do it in an environmentally sustainable way.”

NEW TECHNOLOGIES AS “GAME CHANGERS?”

(What if there were no toxic chemicals and little or no water used?)

Company

technology under development

Halliburton

CleanStim (food grade)

Chimera Energy

Dry-fracture (hot gases)

Gas Frac

Liquid petroleum gas gel

CSM Colorado School of Mines

Geothermic (in well)

Water Tectonics

Electric current (binds)

Ecosphere

Advanced oxidation (ozone)

GE

Membrane distillation



Game Changers?

WATER USE PERSPECTIVE

ratio of volume of water used to BTU produced

• Natural gas shale	1
• Coal	3.6 – 14.5
• Nuclear	3.6 – 63
• Oil	3.6 – 9
• Oil shale	10 – 25
• Oil sands	12 – 30
• Bio-fuels	114

Based on data from DOE and GWPC



Changing weather patterns

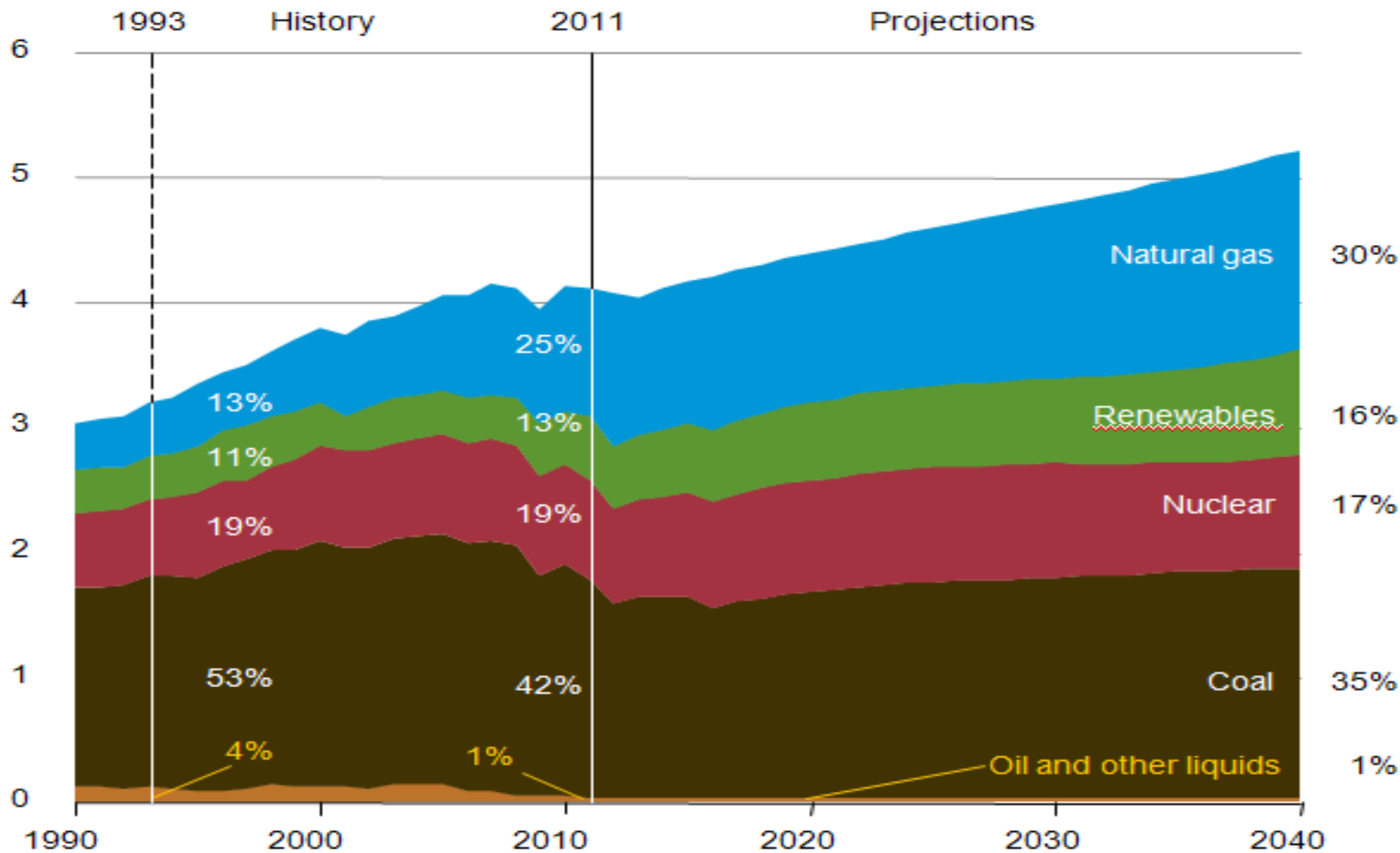
CH₄

CO₂

Emissions – gas & coal

Electricity Generation by fuel source 1990 – 2040

(Trillion kilowatthours per year)

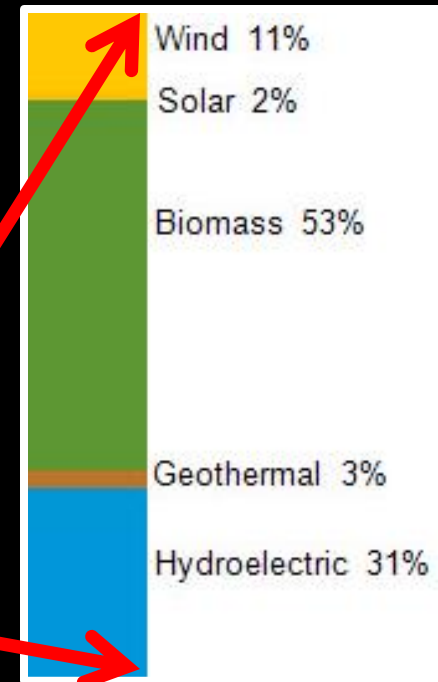
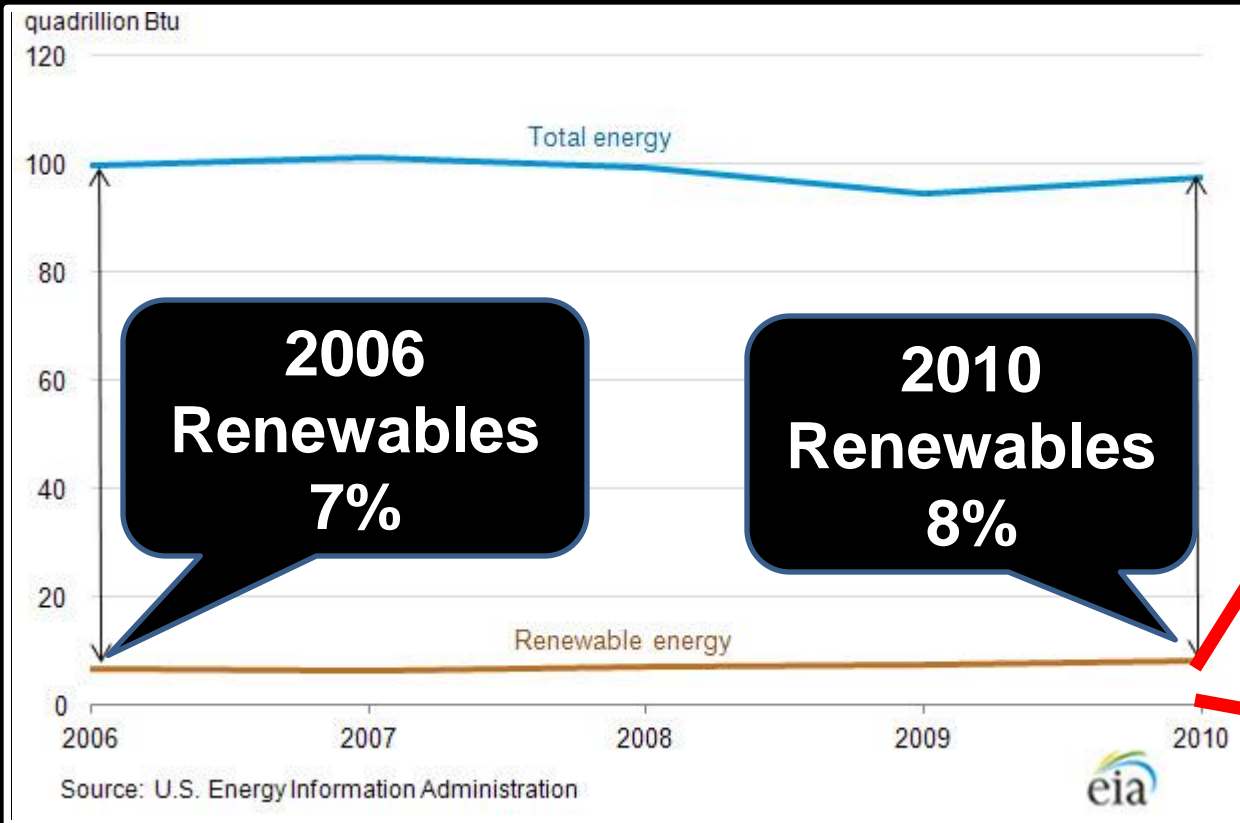


COMBUSTION EMISSIONS

lbs/billion btu of energy input (Energy Information Administration)

	Nat gas	Oil	Coal
CO₂ Carbon dioxide	117,000	164,000	208,000
CO Carbon monoxide	40	33	208
NO_x Nitrogen oxides	92	448	457
SO₂ Sulfur dioxide	0.6	1,122	2,591
PM Particulates	7	84	2,744

US Energy Consumption and renewable energy consumption 2006 - 2010



INTERGOVERNMENTAL PANEL - CLIMATE CHANGE

(Friday September 27th) United Nations Secretary-General

World leaders must now respond to an "unequivocal" message from climate scientists and act with policies to cut greenhouse gas emissions.





Conclusions Challenges

Hydraulic fracturing can be “safe” when done in the right place, on the right scale, with the right safeguards, and as part of a “drill, maybe drill” philosophy.



**Ben Grumbles, President
Clean Water America Alliance**

The Washington Post

**Washington Post Editorial
March 2013**

Environmental groups should push for sound regulation instead of unrealistically insisting that all natural gas should stay in the ground

THANK YOU!



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