European Environment Agency

EEA Scientific Committee Seminar
COPENHAGEN, 15 February 2012

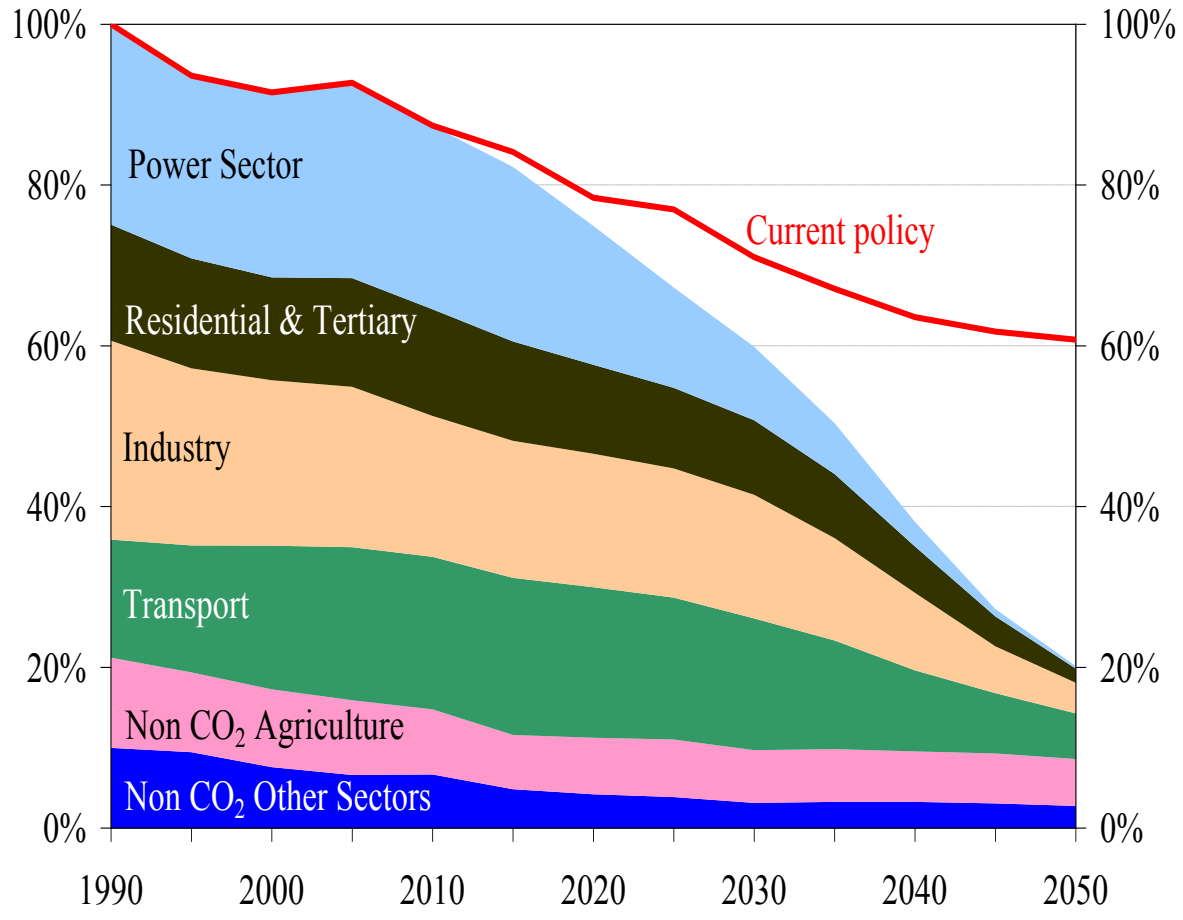
PEAK OIL/GAS AND THE UNCONVENTIONAL FOSSILS ISSUE

Paul McAleavey (EEA) and Pierre Laconte (FFUE)

I. Impact of Peak Oil on the Economy

Paul McAleavey (EEA)

Starting Hypothesis: EU Roadmap Low Carbon Economy in 2050 - A cost-efficient pathway towards 1Gt emissions in 2050



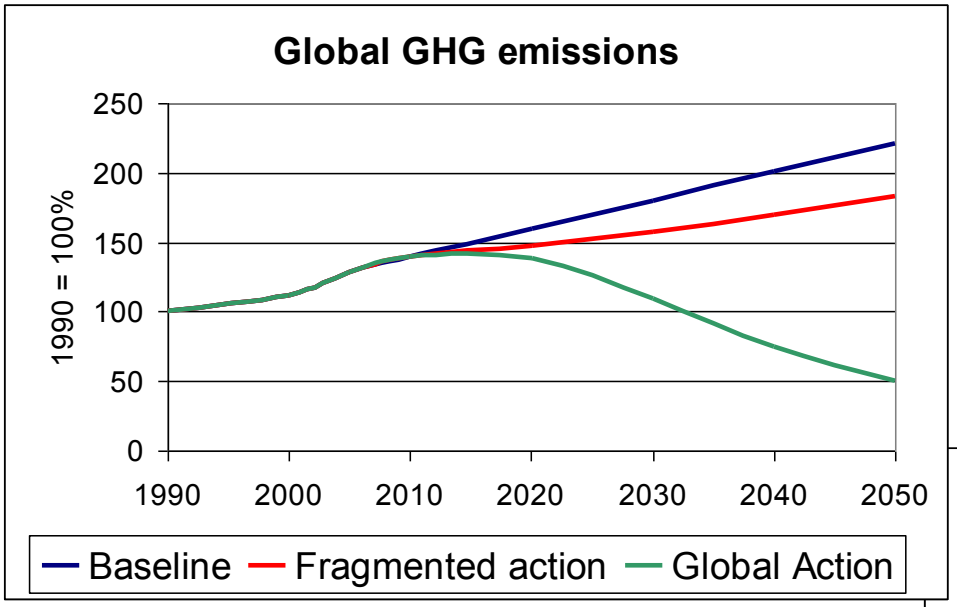
80% domestic reduction in 2050 is feasible

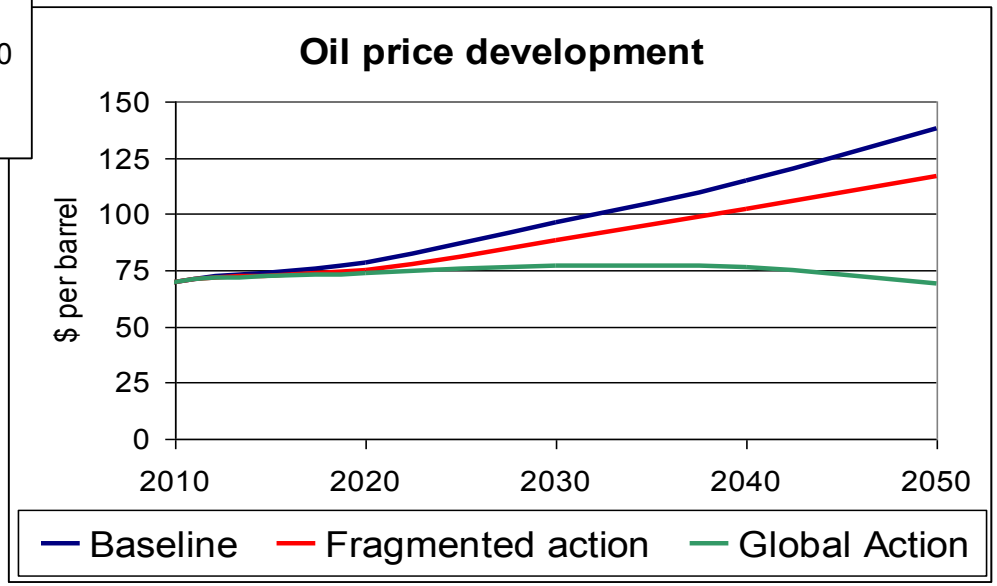
- with currently available technologies,
- with behavioural change only induced through prices
- If all economic sectors contribute to a varying degree & pace.

Efficient pathway:

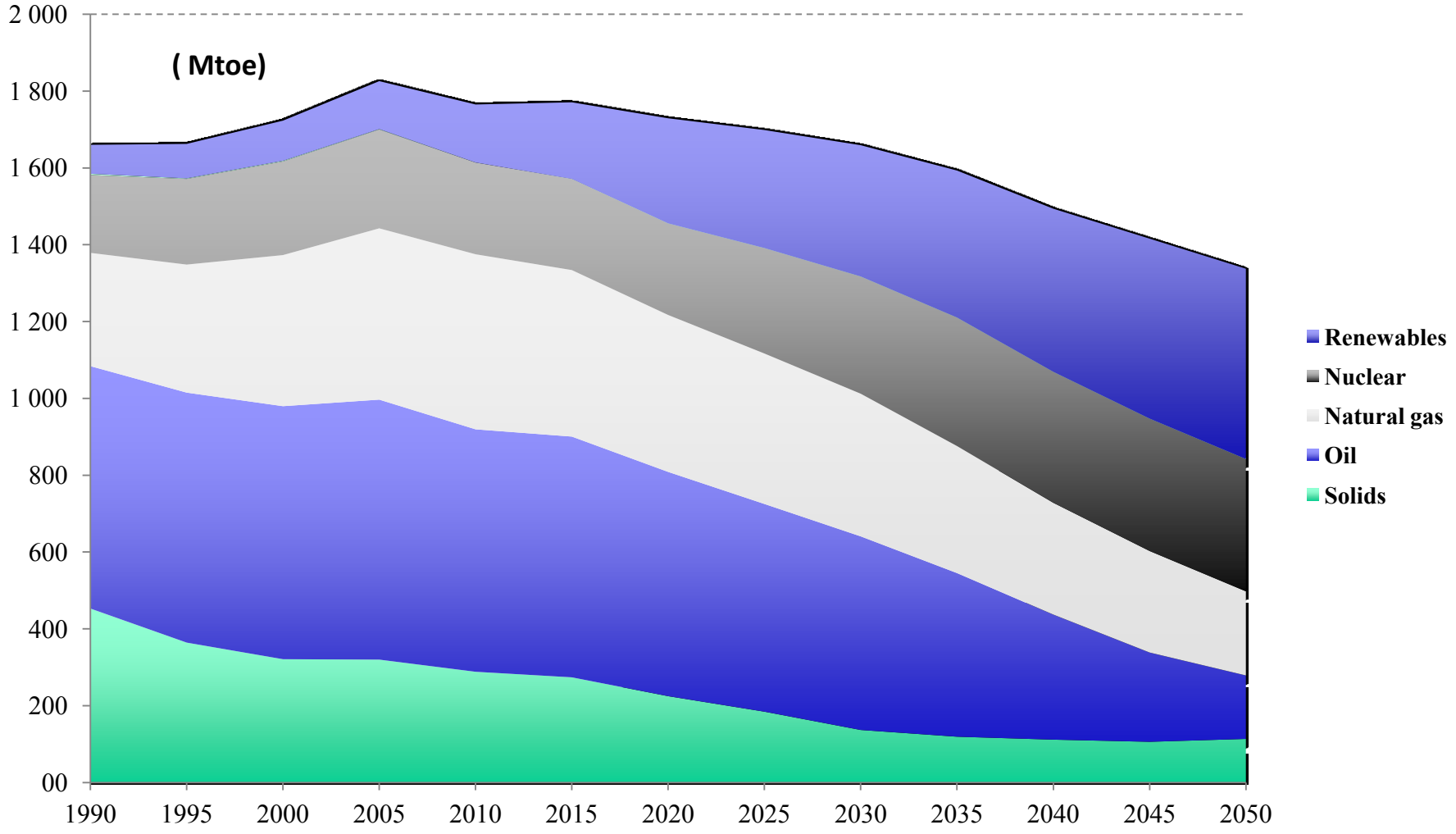
-25% in 2020
-40% in 2030
-60% in 2040

Impact of the EU Road Map on the Economy: Global climate action reduces fossil fuel prices





Impact of the EU Road Map on the Economy: A rapidly changing energy mix



Questions for discussion: Accuracy of the oil price (and oil supply) assumptions in the 2050 Roadmap? Supply-side myopia?

II. Unconventional fossil fuels and the hydraulic fracturing (fracking) issue

Pierre Laconte (FFUE)

1. Oil gas peak/plateau

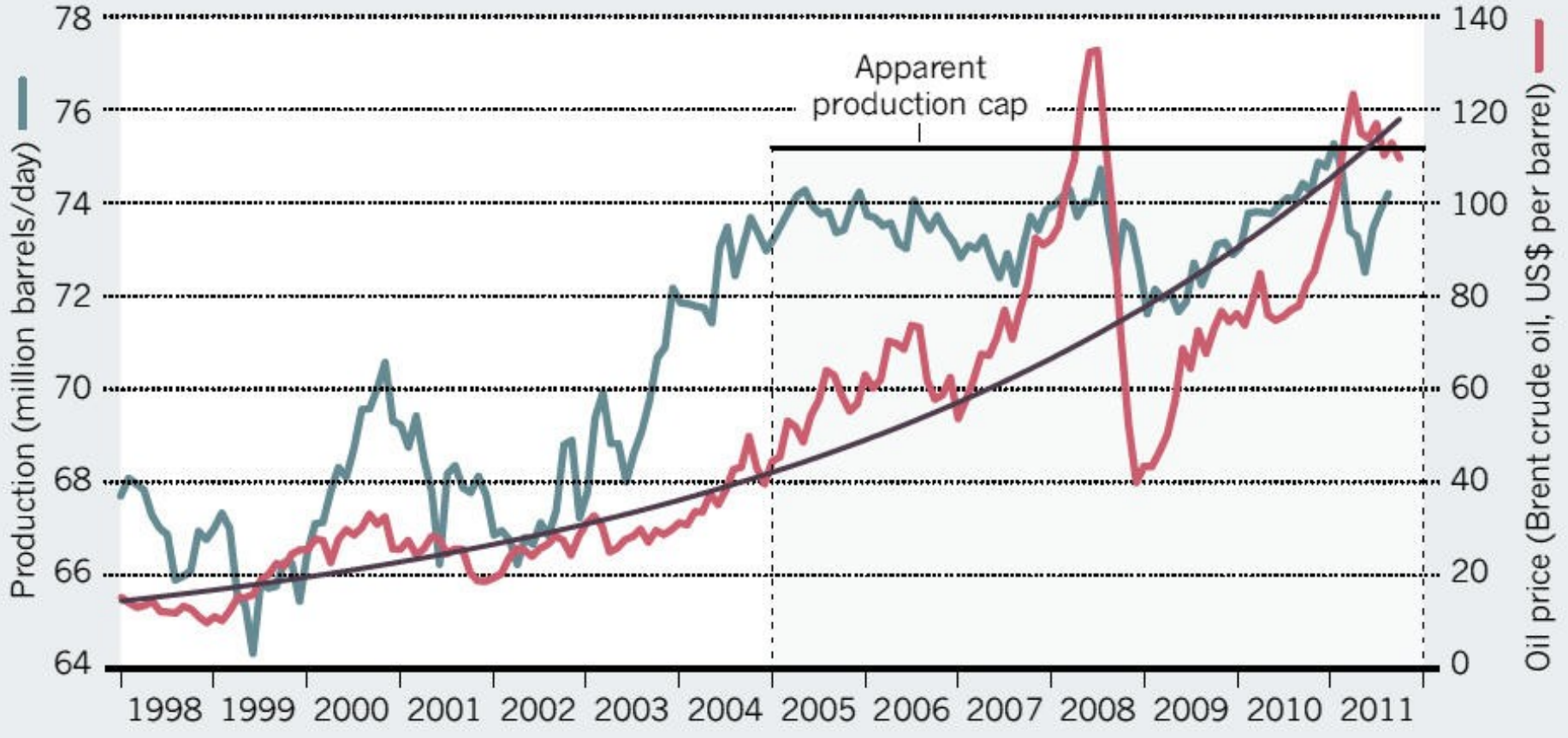
The World Economic Forum "water-food-energy" nexus (Tercek).

A rapidly rising global population and growing GDP are putting unsustainable pressures on resources. Demand for water, food and energy is expected to rise by 30-50% in the next two decades, while short-term responses in production and consumption undermine long-term sustainability, raising the debate and trade-offs between food, feed and energy ("full tanks, empty stomachs"), or between fossil energy and clean water ("more oil/gas, less clean water") .

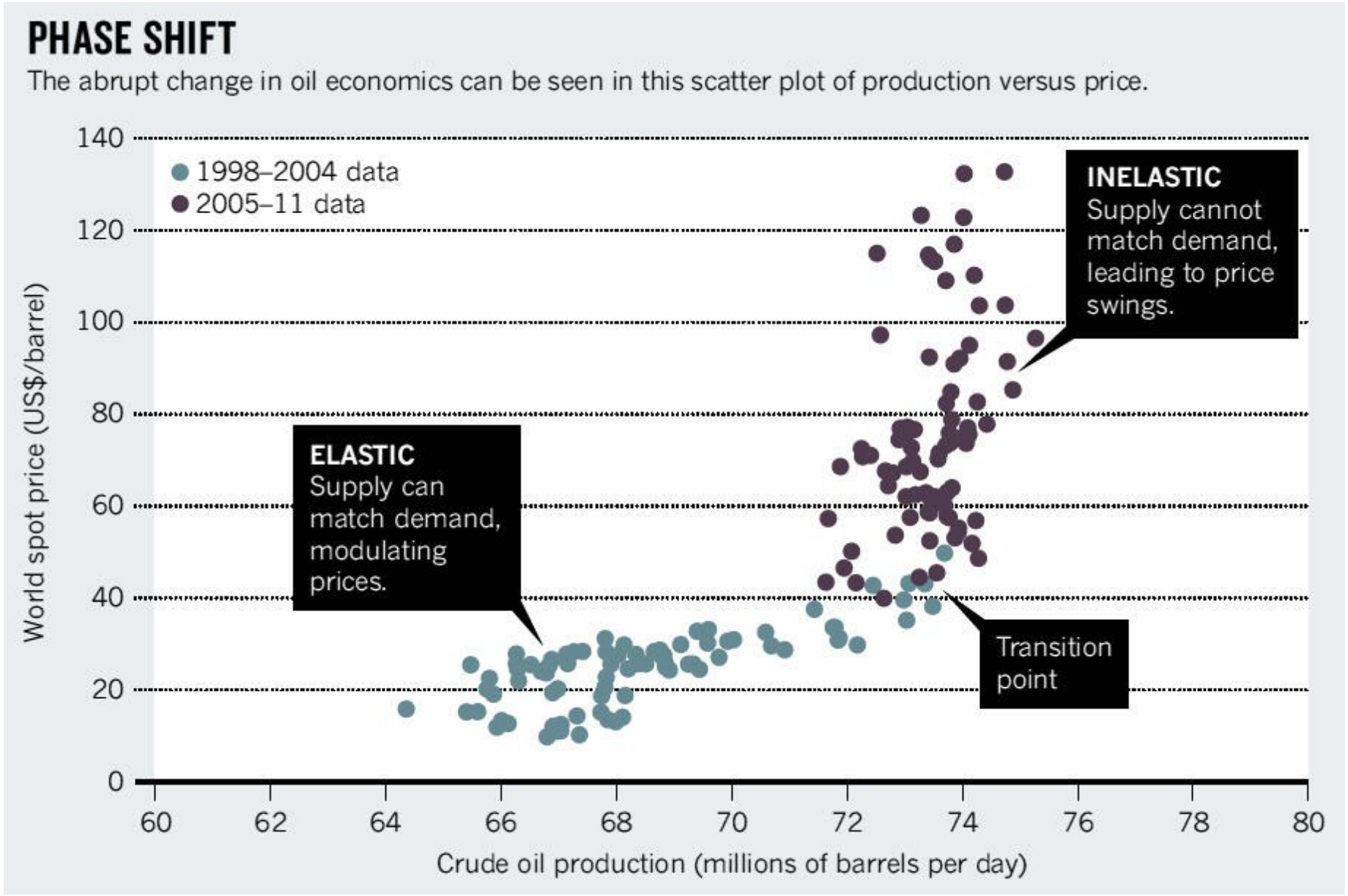
Oil/gas peak does not mean absolute peak but peak of oil/gas that is easy/cheap to produce (UK 2008). The oil and gas industry is today extending production by using more expensive techniques, but trying not to have external costs (environmental damage, risk of accidents) included in their production costs. This means boring in sensitive areas (Arctic) or deeper under the sea (Gulf of Mexico). The tipping point was 2005 (production & elasticity charts from Murray 2012).

OIL PRODUCTION HITS A CEILING

Production followed demand until 2005, when it levelled off despite continued price increases. There seems to be a production 'cap' at about 75 million barrels per day.



US Energy Information Administration *Annual Energy Outlook 2011* (DOE/EIA, 2011).

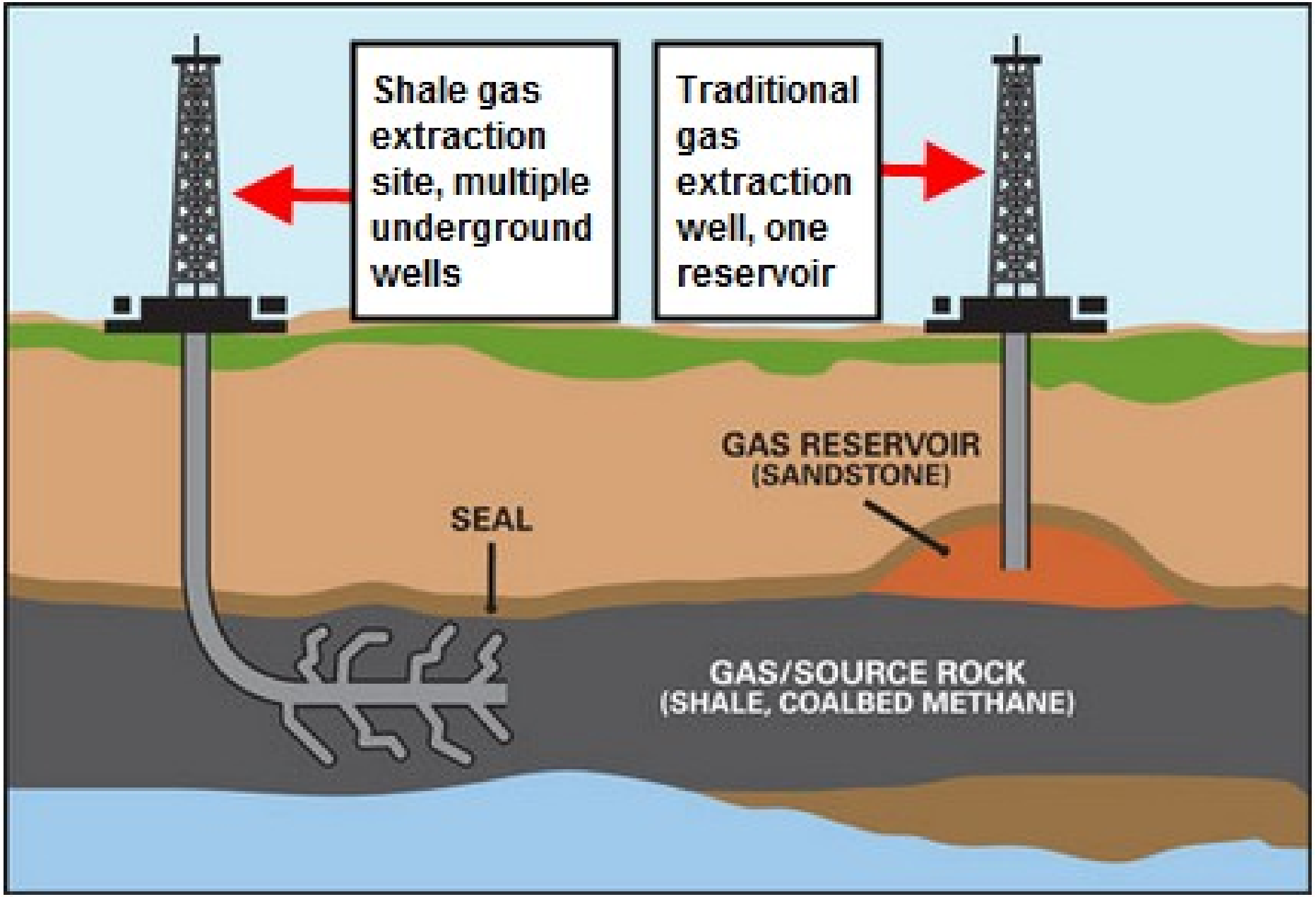


US Energy Information Administration *Annual Energy Outlook 2011* (DOE/EIA, 2011).

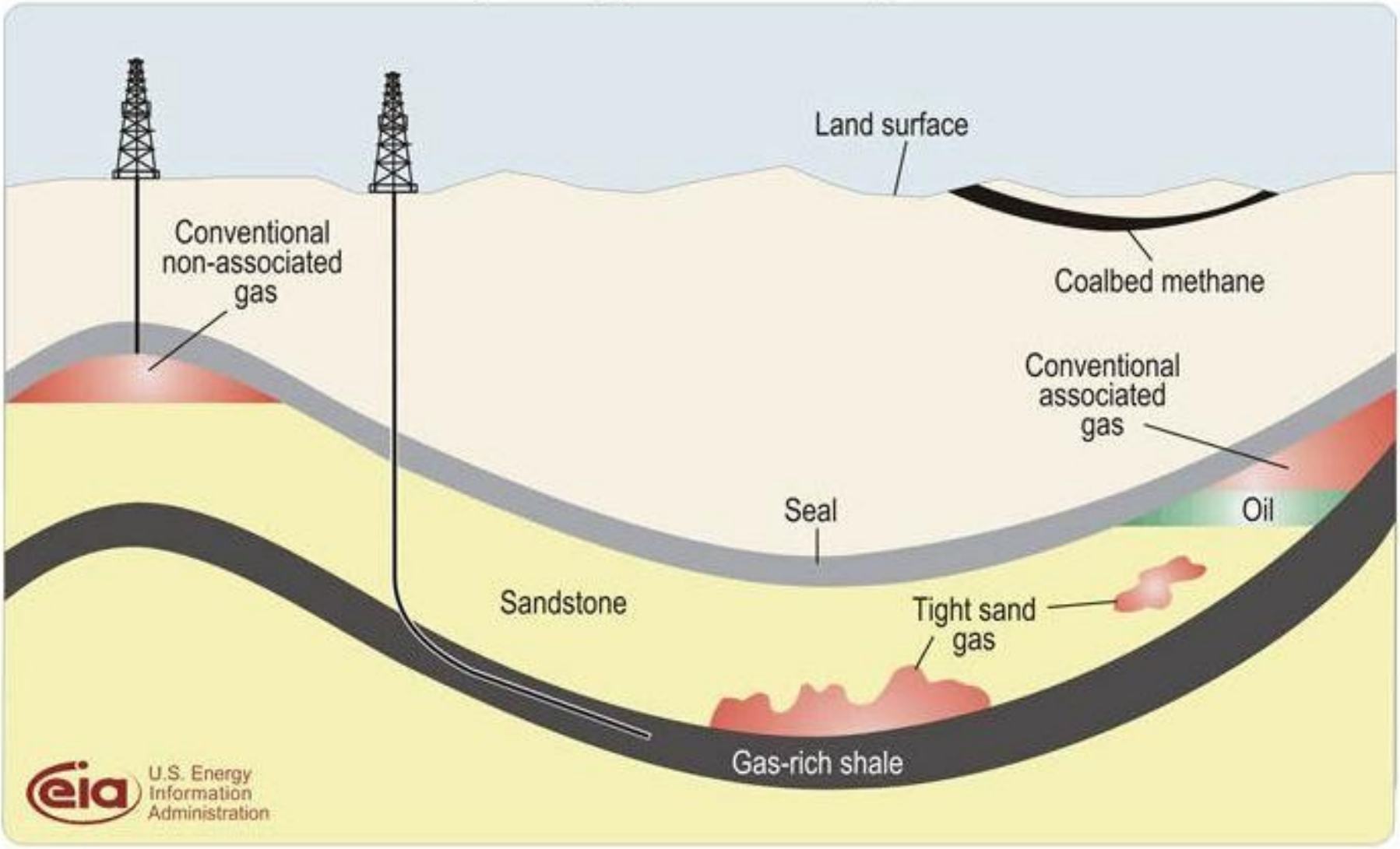
2. The hydraulic gas fracturing issue (fracking).

The short-term most promising technique for boosting production is extracting oil and gas present in tar sands or using other non-conventional sources, raising a water energy debate (more energy/gas but less clean water reserves, less clean air and less landscape quality).

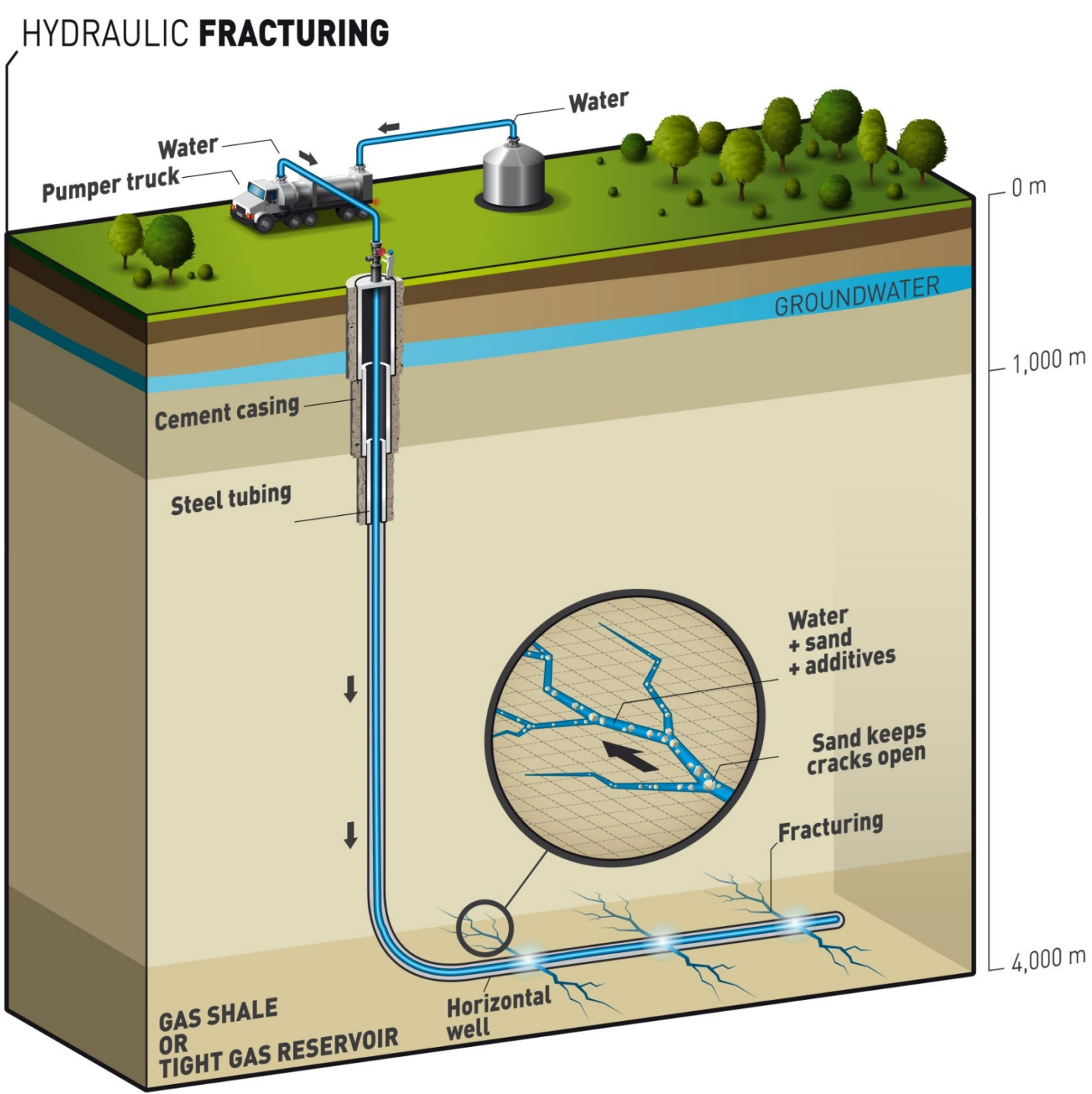
Unconventional fossil fuel resources include:
- Unconventional oil resources. The production process is to extract oil from bituminous rock (mainly in N. America). The potential of only the US Green River is equal to 3 times the Saudi Arabia reserves, but requires heating ("retorting"), costing around 60 $ per barrel.
- Unconventional gas resources (all over the world). The process and issues are complex (Brandt), (Clough), (Huot), (OSTEIS). See illustrations below.

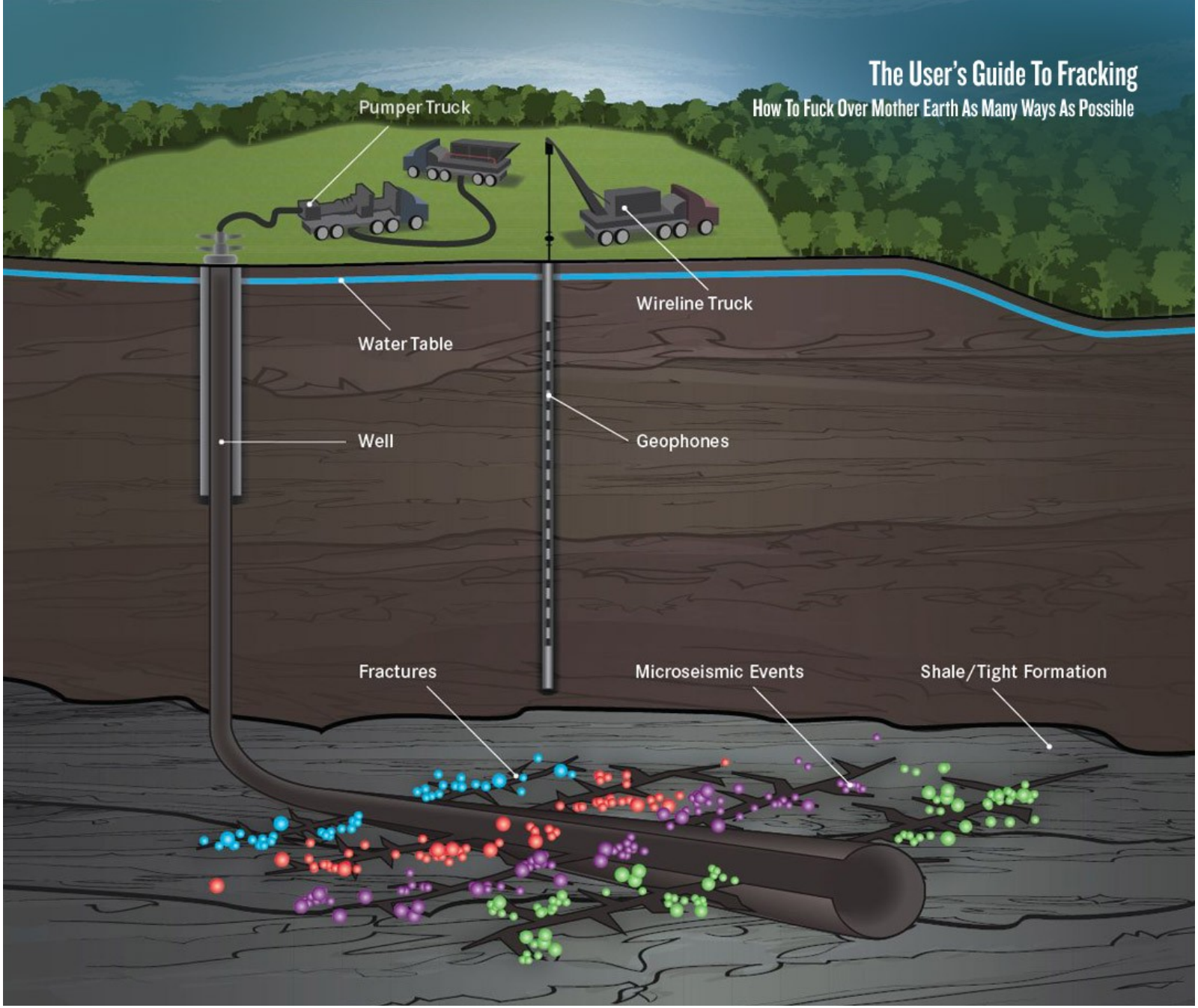


More About Fracking—and Especially Strontium and Bone Health
March 1, 2011 - http://www.anh-usa.org/more-about-fracking/



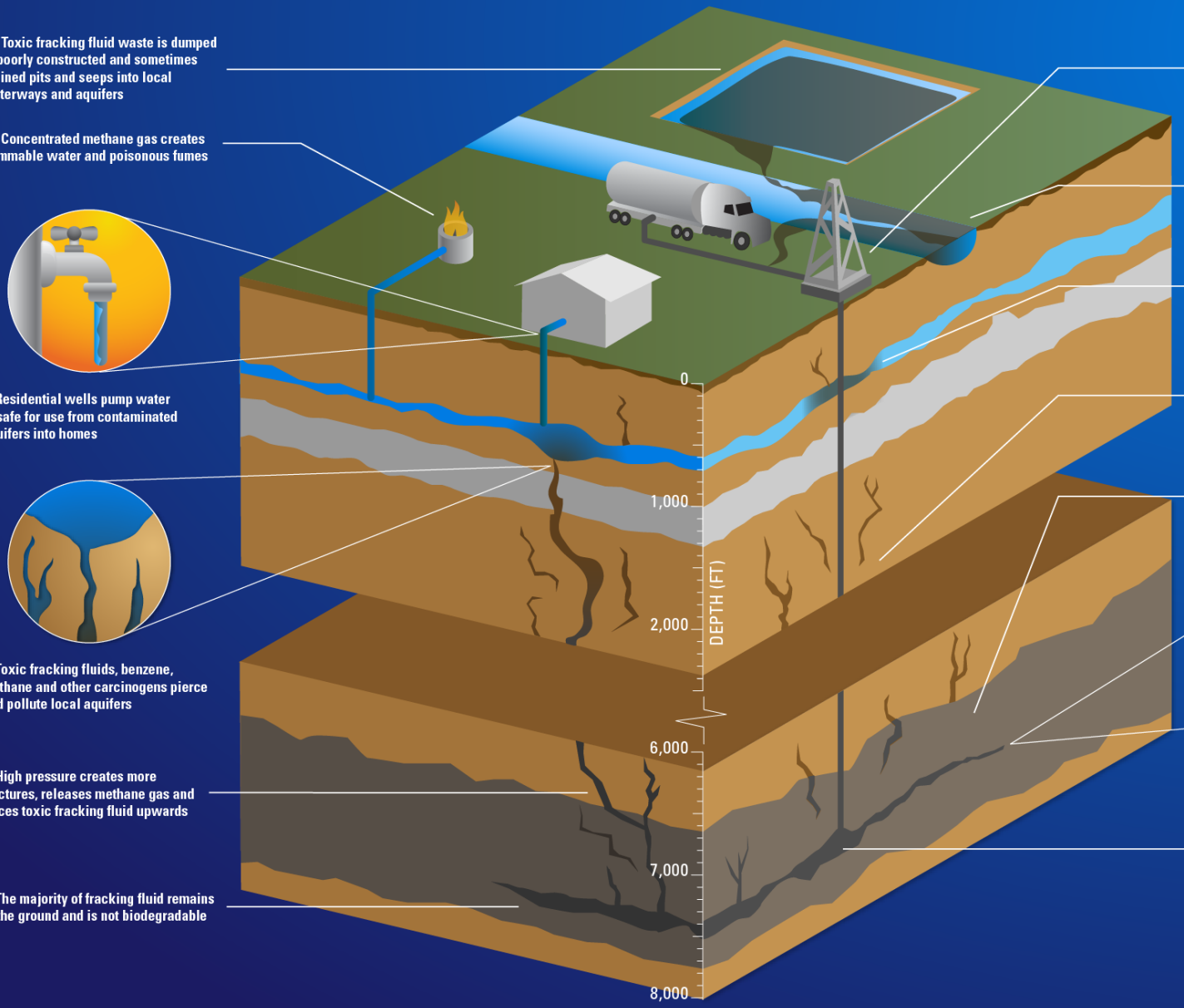
Schematic geology of natural gas resources (source: EIA)


HYDRAULIC FRACTURING
Water
Water
Pumper truck
0 m
GROUNDWATER
1,000 m
Cement casing
Steel tubing
Water
+ sand
+ additives
Sand keeps
cracks open
Fracturing
4,000 m
GAS SHALE
OR
TIGHT GAS RESERVOIR
Horizontal
well



Source: B.C. agency probes possible link between gas 'fracking' and earthquakes, By Gordon Hoekstra, The Montreal Gazette, September 29, 2011

HOW NATURAL GAS DRILLING CONTAMINATES DRINKING WATER SOURCES



11. Toxic fracking fluid waste is dumped in poorly constructed and sometimes unlined pits and seeps into local waterways and aquifers

10. Concentrated methane gas creates flammable water and poisonous fumes

9. Residential wells pump water unsafe for use from contaminated aquifers into homes

8. Toxic fracking fluids, benzene, methane and other carcinogens pierce and pollute local aquifers

7. High pressure creates more fractures, releases methane gas and forces toxic fracking fluid upwards

6. The majority of fracking fluid remains in the ground and is not biodegradable

1. A mixture of millions of gallons of water, chemically treated sand and toxic chemicals is injected under high pressure into drilling well

2. Toxic fracking fluid spills from pipes, open valves and transporting vehicles and contaminates local waterways

3. Fracking fluid leaks though fissures and contaminates aquifer

4. Fracking fluid is pumped 7000 ft or more down and a similar distance horizontally to release natural gas

Gas producing rock formation

Proppants like chemically treated sand and ceramic keep fractures open

5. Fracking fluid injected at high pressure creates fractures and releases natural gas

DIAGRAM NOT TO SCALE

checksandbalancesproject.org

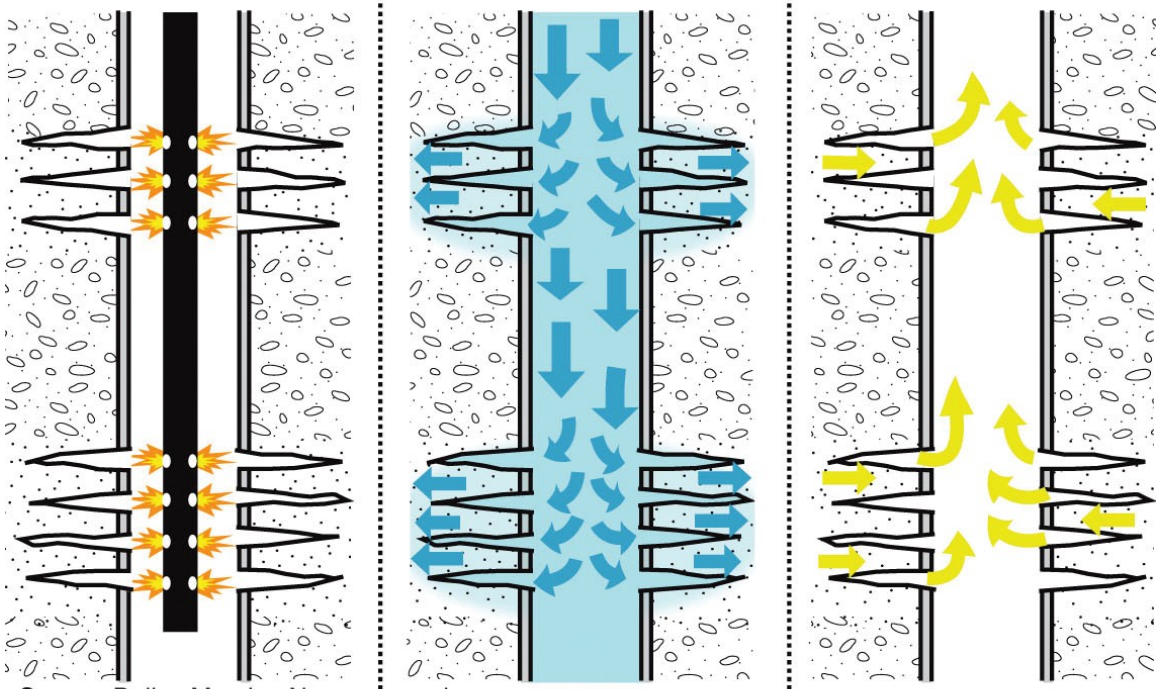
Hydraulic fracturing

Hydraulic fracturing, or fracking, unlocks natural gas from massive reservoir rock formations that otherwise could not be extracted economically. Some people worry hazardous chemicals used in the process pollute air and water.

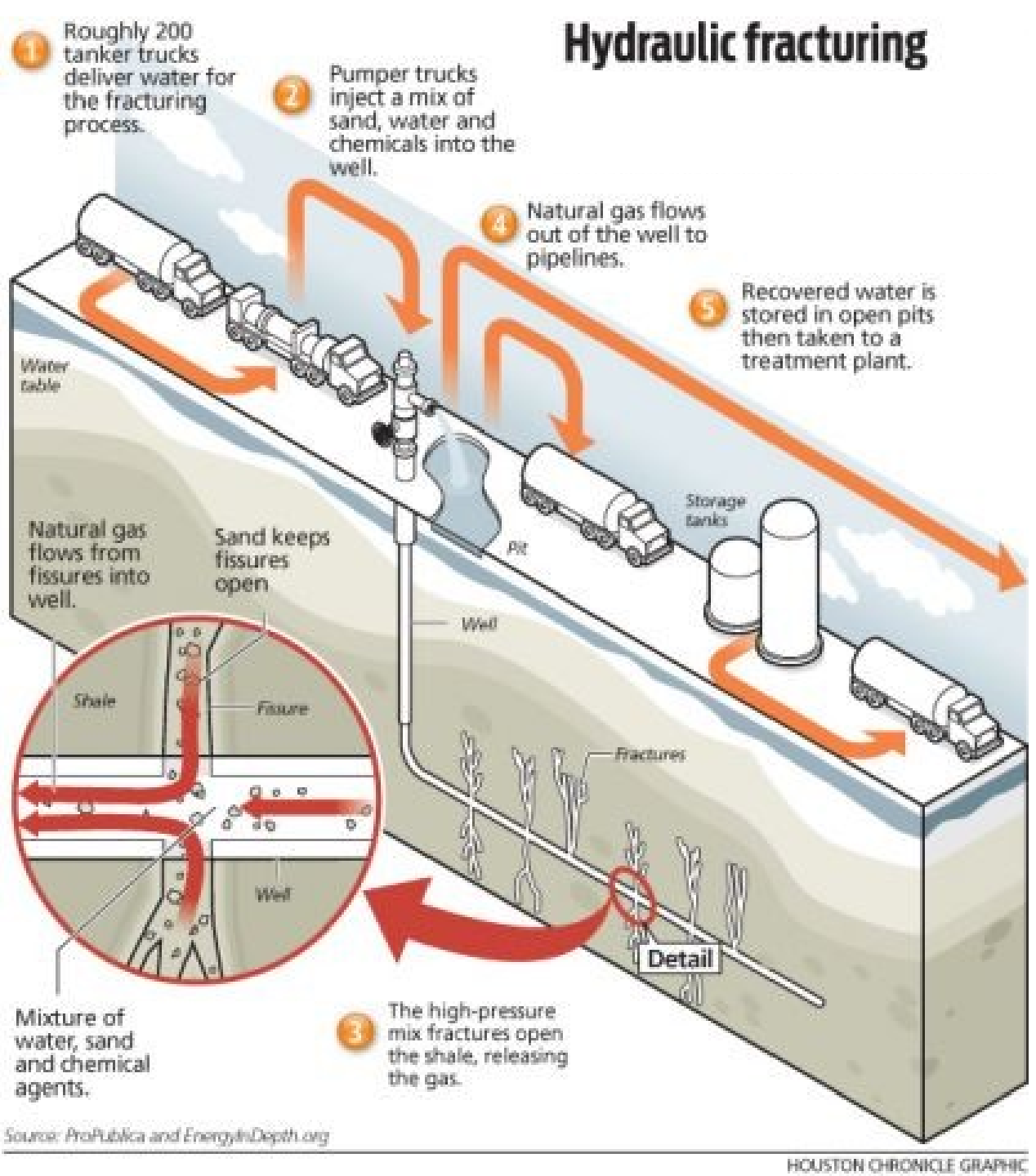
1 Well is drilled and a wire equipped with explosive charges is dropped into the well; the charges perforate the well and cement casing, creating fractures in the underground rock

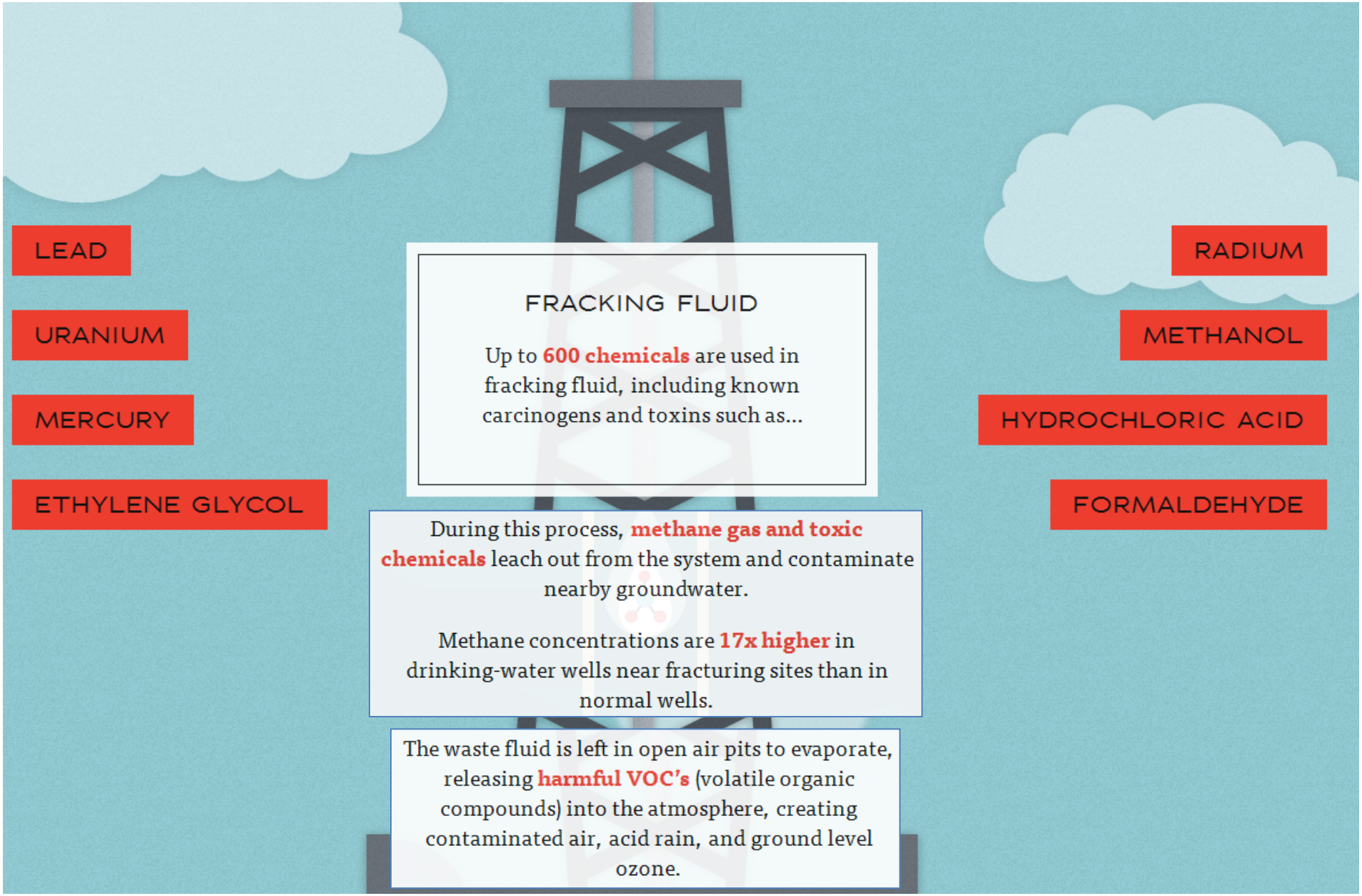
2 Sand, water and chemicals are pumped into the well to pry open the fractures, creating channels for the gas to seep out

3 Fluid is pumped out of the well, allowing the gas to flow



Source: Dallas Morning News research
Graphic: Michael Hogue, Dallas Morning News

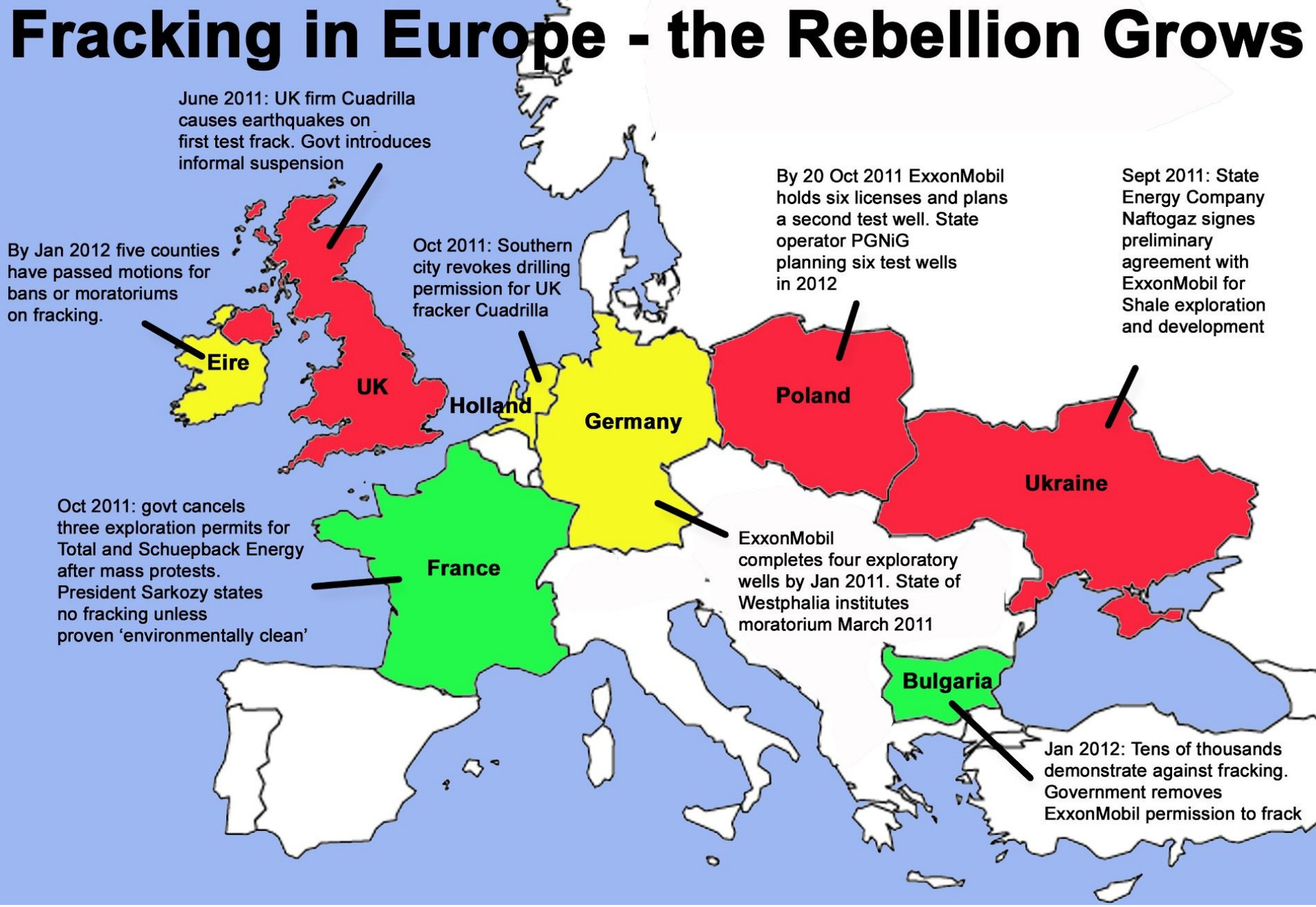

Hydraulic fracturing
1 Roughly 200 tanker trucks deliver water for the fracturing process.
2 Pumper trucks inject a mix of sand, water and chemicals into the well.
3 The high-pressure mix fractures open the shale, releasing the gas.
4 Natural gas flows out of the well to pipelines.
5 Recovered water is stored in open pits then taken to a treatment plant.
Water table
Natural gas flows from fissures into well.
Sand keeps fissures open
Shale
Fissure
Well
Mixture of water, sand and chemical agents.
Pit
Storage tanks
Fractures
Detail
Source: ProPublica and EnergyInDepth.org
HOUSTON CHRONICLE GRAPHIC



Source: http://www.dangersoffracking.com/

The present message of the oil and gas interests can be summarized by the phrase: “All Hail the New Shale King”. The new potentials of fracking and other extraction techniques are being heavily promoted by oil and gas interests in order to dismiss the arguments about peak oil and the need to switch to alternatives and energy savings, but rebellion grows (see map).

Fracking in Europe - the Rebellion Grows



The pending economic issue is that costs associated with shale gas extraction, truck transportation and delivery are not accounted for in terms of their real costs to society.

At the present time, the water, land & air damages by tar sands extraction – and the aftermath - are not valued.

As to the water resources, the main aspects are:

-Water consumption needed for fracking

-Pollution of aquifer by chemical used for fracking

-Pollution by flow-back water treatment (Kerfoot).

Other damages include land subsiding, seismicity (De Pater), land/air pollution. They occur both during extraction and long afterwards (Keferpütz).

The legal issues have been analysed by the European Commission (Energy and Environment).
According to the Energy DG Report (Philippe 2012) there are no major gaps in EU environmental law when it comes to regulating the current level of shale gas activity. However the Report warns for the effects of larger scale operations and suggests centralised and duly informed and trained concession authorities.

Commissioner for the Environment (Potocnic) called among others for a strengthening and stricter implementation of the existing directives (Environmental Impact Assessment, ECHA registration as “downstream users”, compliance of fracturing with Mining waste directive and mandatory disclosure of the substances used (Bloomberg).

One may conclude that a scientific, technical and economic debate on the hydraulic shale gas fracking environmental issues and policies would be justified.

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