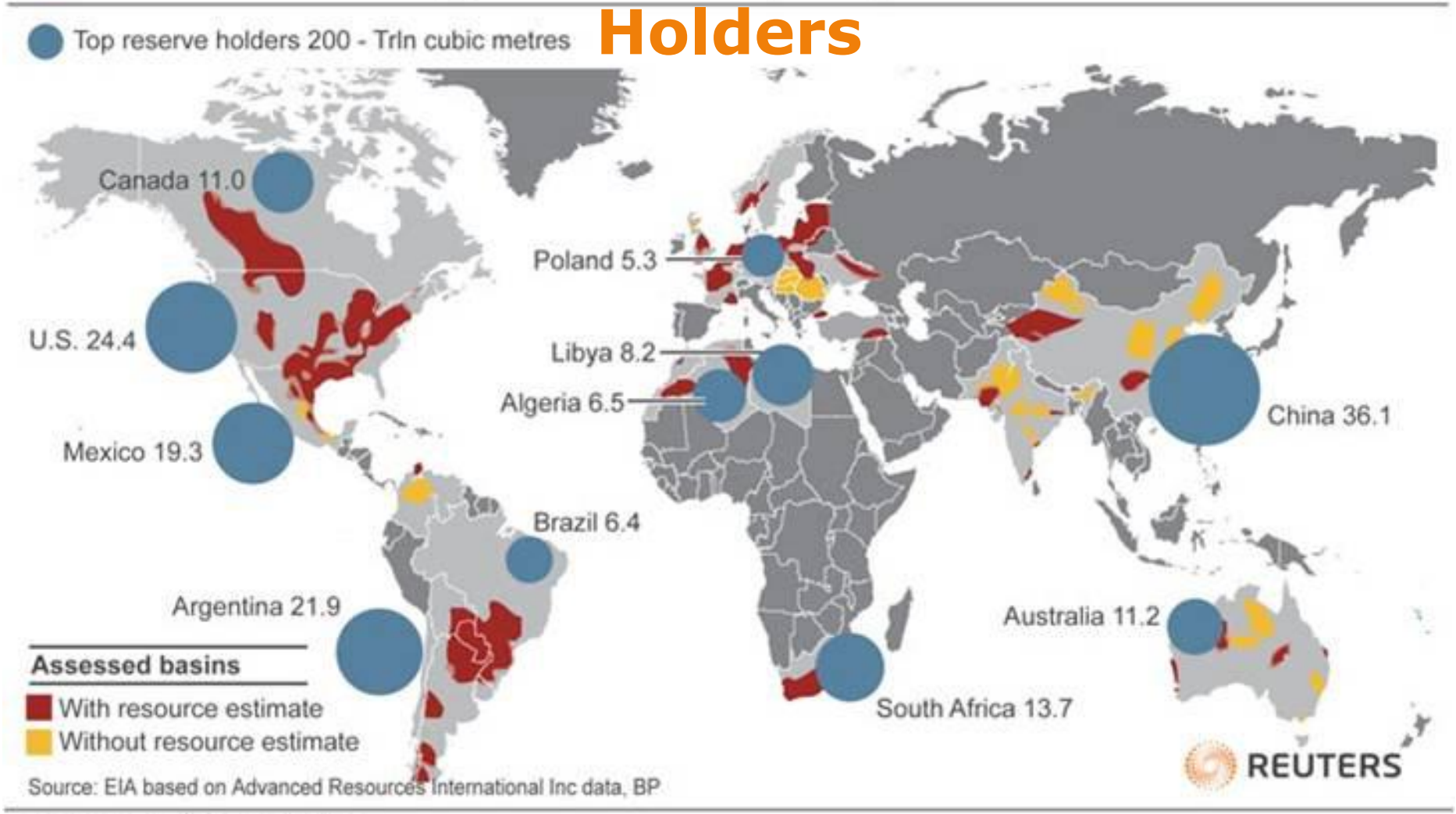
Does "fracking" change the energy world?

Prospects & Impacts of Unconventional Gas in the U.S. & Globally

Samantha Malone, MPH, CPH
Manager of Science and Communications
FracTracker Alliance

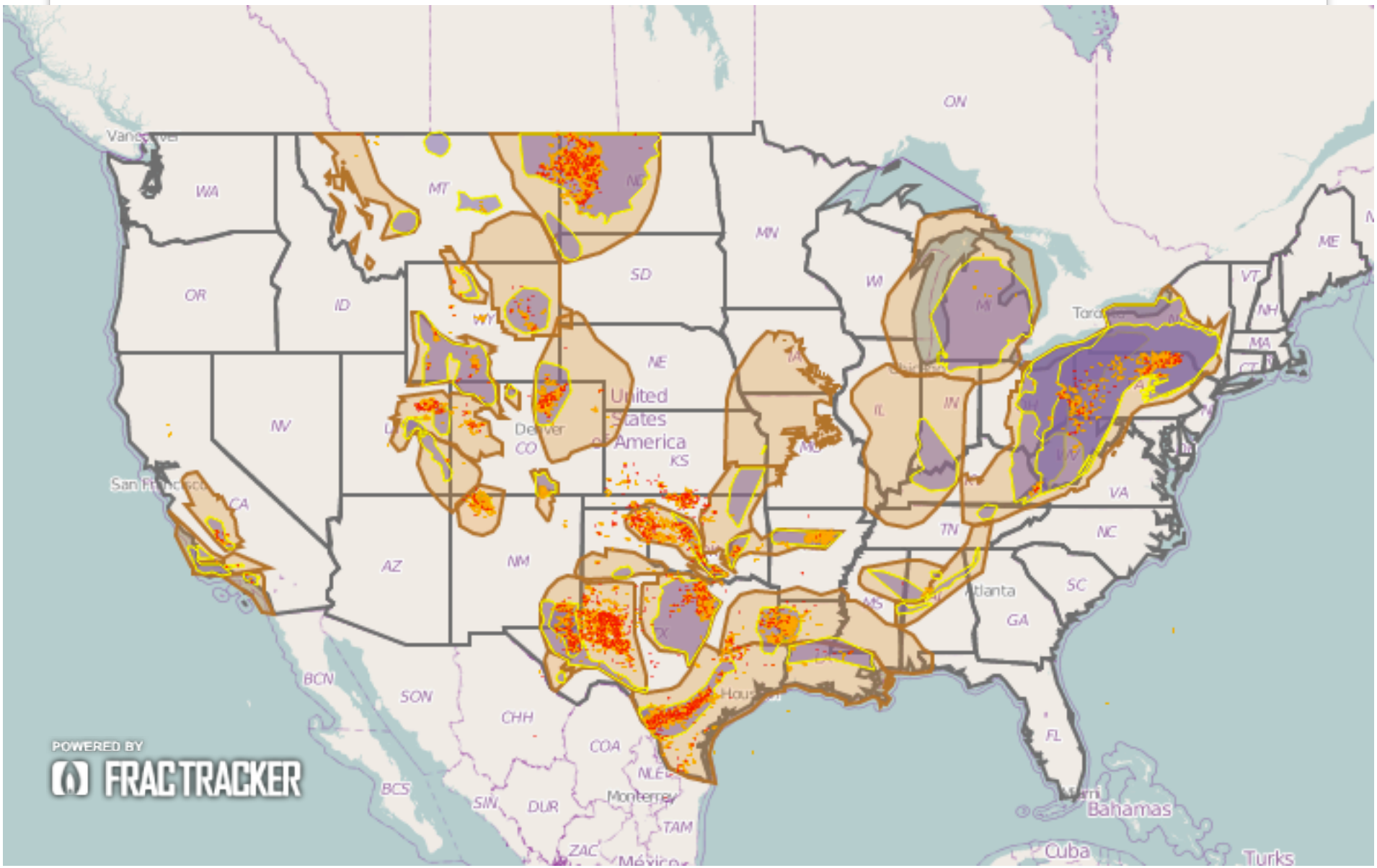
Agora Energiewende
Berlin, Germany
August 20, 2013

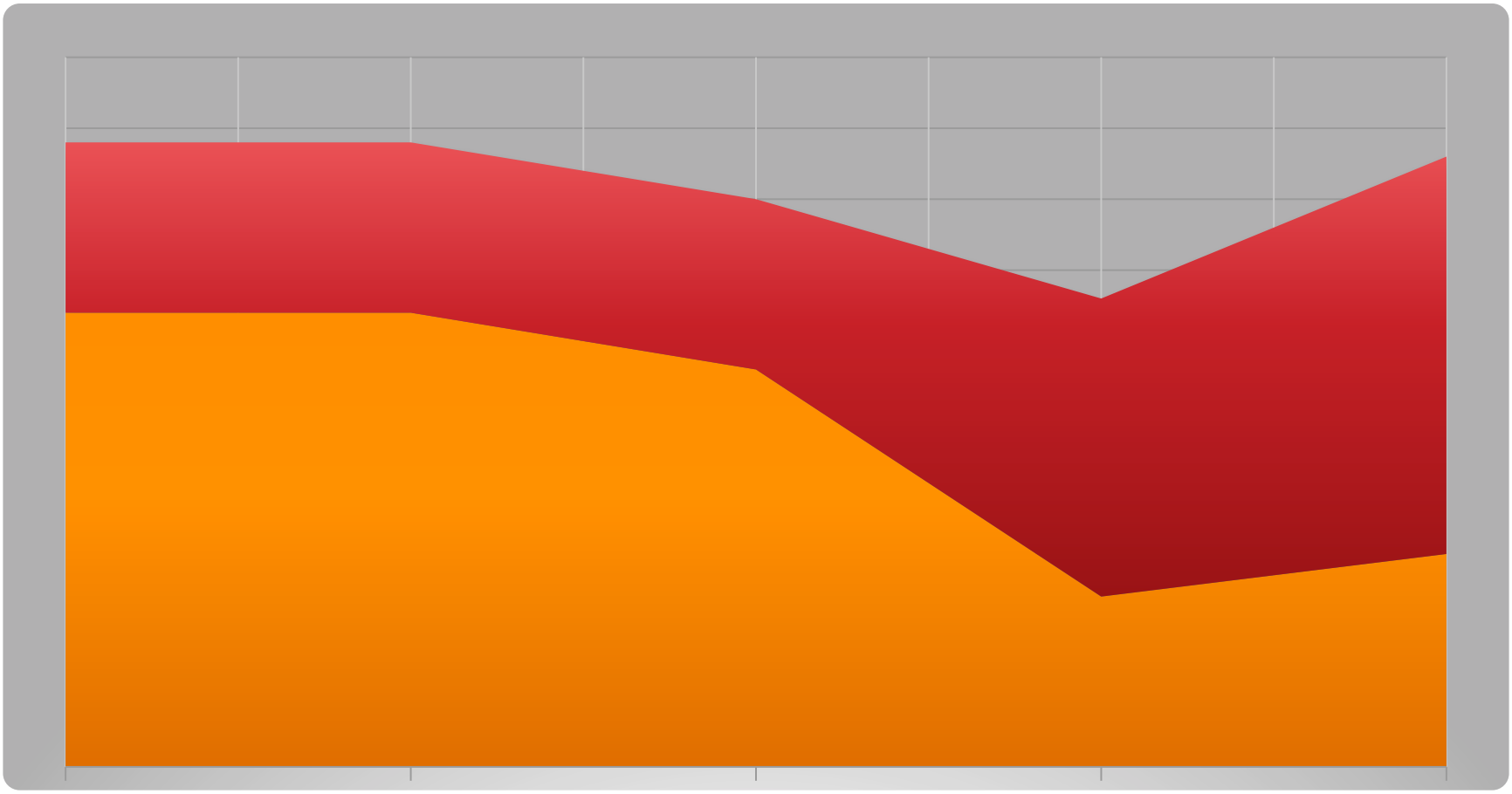
Global Shale Gas Basins, Top Reserve Holders



Reuters graphic/Catherine Trevethan

Shale Gas Plays in the Continental United States





Energy Trends

How U.S. gas extraction affects the global energy market

Table 1. Technically recoverable shale oil and shale gas unproved resources in the context of total world resources

	Crude oil (billion barrels)	Wet natural gas (trillion cubic feet)
Outside the United States		
Shale oil and shale gas unproved resources	287	6,634
Other proved reserves [1]	1,617	6,521
Other unproved resources [2]	1,230	7,296
Total	**3,134**	**20,451**
Increase in total resources due to inclusion of shale oil and shale gas	**10%**	**48%**
Shale as a percent of total	**9%**	**32%**
United States		
EIA shale / tight oil and shale gas proved reserves [3, 4]	n/a	97
EIA shale / tight oil and shale gas unproved resources [5]	58	567
EIA other proved reserves [6]	25	220
EIA other unproved resources [5]	139	1,546
Total	**223**	**2,431**
Increase in total resources due to inclusion of shale oil and shale gas	**35%**	**38%**
Shale as a percent of total	**26%**	**27%**
Total World		
Shale / tight oil and shale gas proved reserves	n/a	97
Shale / tight oil and shale gas unproved resources	345	7,201
Other proved reserves	1,642	6,741
Other unproved resources	1,370	8,842
Total	**3,357**	**22,882**
Increase in total resources due to inclusion of shale oil and shale gas	**11%**	**47%**
Shale as a percent of total	**10%**	**32%**

Source: Data compiled by the U.S. Energy Information Administration

Table 2. Wet natural gas production and resources (trillion cubic feet) Via EIA

Region totals and selected countries[1]	2011 natural gas production[2]	January 1, 2013 estimated proved natural gas reserves[3]	2013 EIA/ARI unproved wet shale gas technically recoverable resources (TRR)	2012 USGS conventional unproved wet natural gas TRR, including reserve growth[4]	Total technically recoverable wet natural gas resources
Europe	**10**	**145**	**470**	**184**	**799**
Bulgaria	0	0	17		
Denmark	0	2	32		
France	0	0	137		
Germany	0	4	17		
Netherlands	3	43	26		
Norway	4	73	0		
Poland	0	3	148		
Romania	0	4	51		
Spain	0	0	8		
Sweden	-	-	10		
United Kingdom	2	9	26		
Former Soviet Union	**30**	**2,178**	**415**	**2,145**	**4,738**
Lithuania	-	-	0		
Russia[5]	24	1,688	287		
Ukraine	1	39	128		
North America	**32**	**403**	**1,685**	**2,223**	**4,312**
Canada	6	68	573		
Mexico	2	17	545		
United States[6]	24	318	567	1,546	2,431
Asia and Pacific	**13**	**418**	**1,607**	**858**	**2,883**
Australia	2	43	437		
China	4	124	1,115		
Indonesia	3	108	46		
Mongolia	-	-	4		
Thailand	1	10	5		

Table 2 Continued...

South Asia	**4**	**86**	**201**	**183**	**470**
India	2	44	96		
Pakistan	1	24	105		
Middle East and North Africa	**26**	**3,117**	**1,003**	**1,651**	**5,772**
Algeria	3	159	707		
Egypt	2	77	100		
Jordan	0	0	7		
Libya	0	55	122		
Morocco	0	0	12		
Tunisia	0	2	23		
Turkey	0	0	24		
Western Sahara	-	-	8		
Sub-Saharan Africa	**2**	**222**	**390**	**831**	**1,443**
Mauritania	-	1	0		
South Africa	0	-	390		
South America & Caribbean	**6**	**269**	**1,430**	**766**	**2,465**
Argentina	2	12	802		
Bolivia	1	10	36		
Brazil	1	14	245		
Chile	0	3	48		
Colombia	0	6	55		
Paraguay	-	-	75		
Uruguay	-	-	2		
Venezuela	1	195	167		
Subtotal of above countries[7]	**89**	**3,157**	**7,201**	**NA**	**NA**
Subtotal, excluding the United States[7]	**65**	**2,840**	**6,634**	**NA**	**NA**
Total World[7, 8]	**124**	**6,839**	**7,201**	**8,842**	**22,882**

Increase in U.S. export of gas:

Chart 1. U.S. net imports of natural gas (all types), 2003-12
Via EIA

billion cubic feet (Bcf)

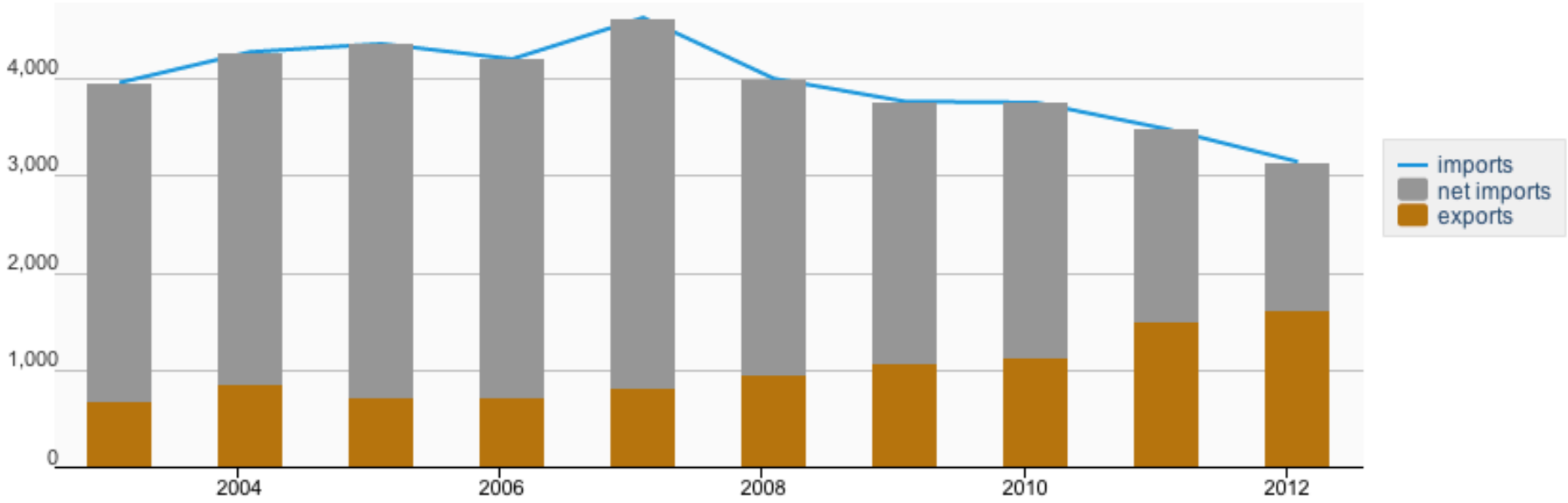
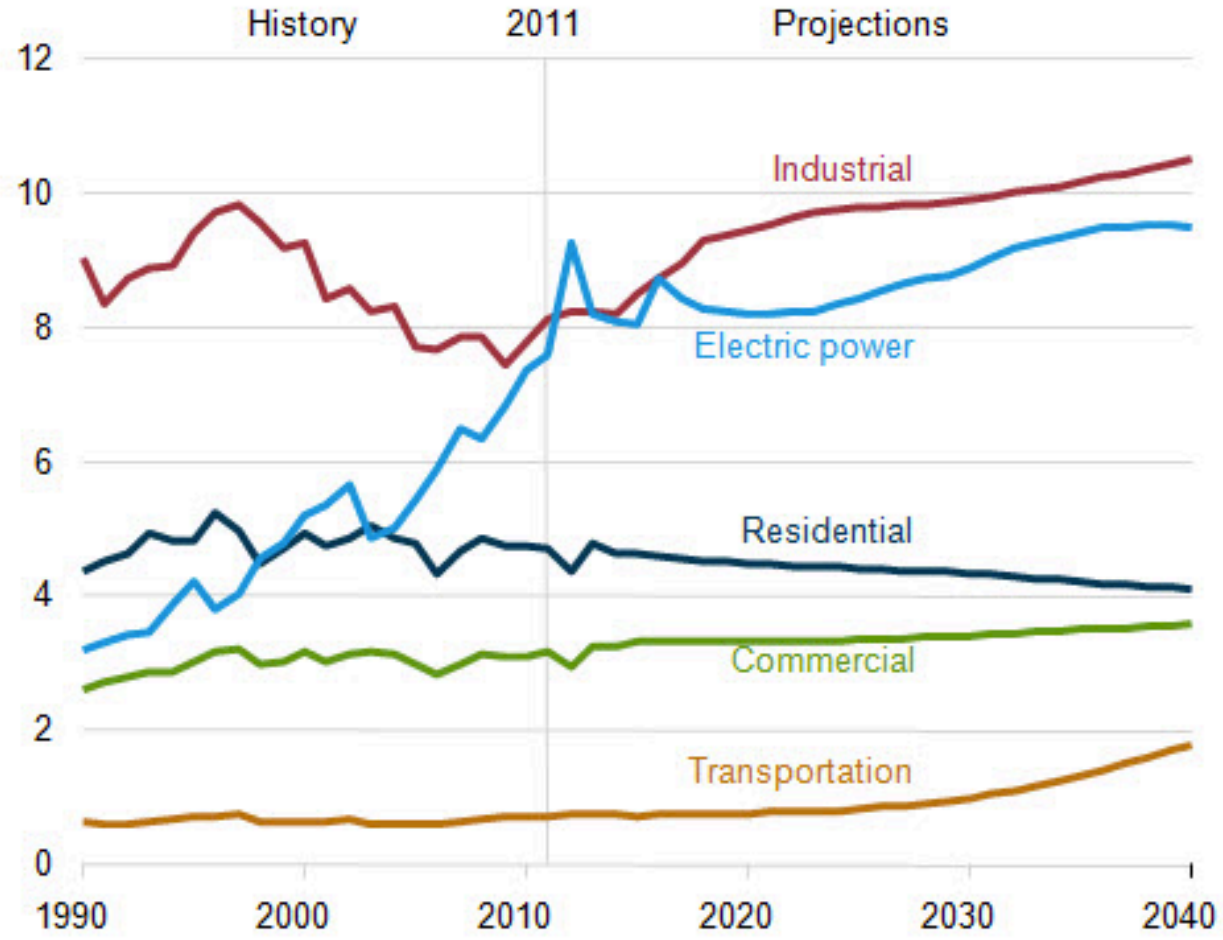


Chart 2. Natural gas consumption by sector in U.S., 1990-2040

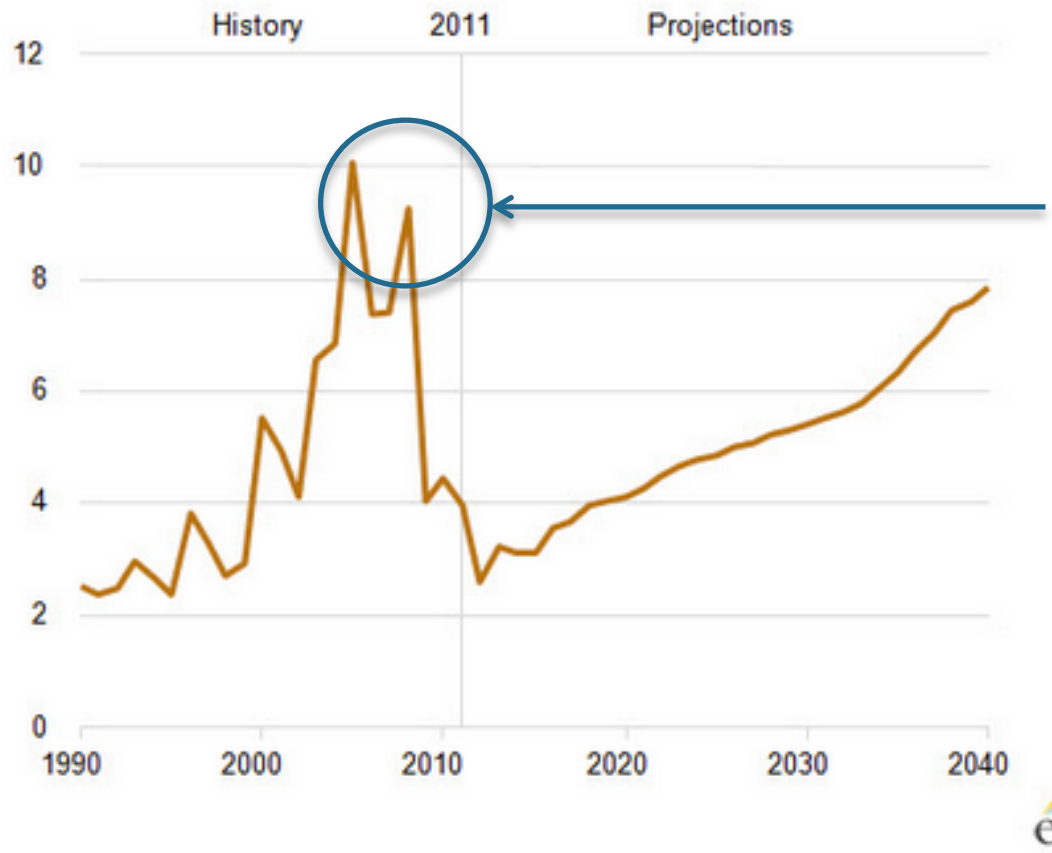
trillion cubic feet (Tcf)



Residential is only sector expected to decrease in consumption (due to improved efficiency and population shifts to warmer regions)

eia

Chart 3. Annual average Henry Hub spot natural gas prices in U.S., 1990-2040 (2011 dollars per million Btu)



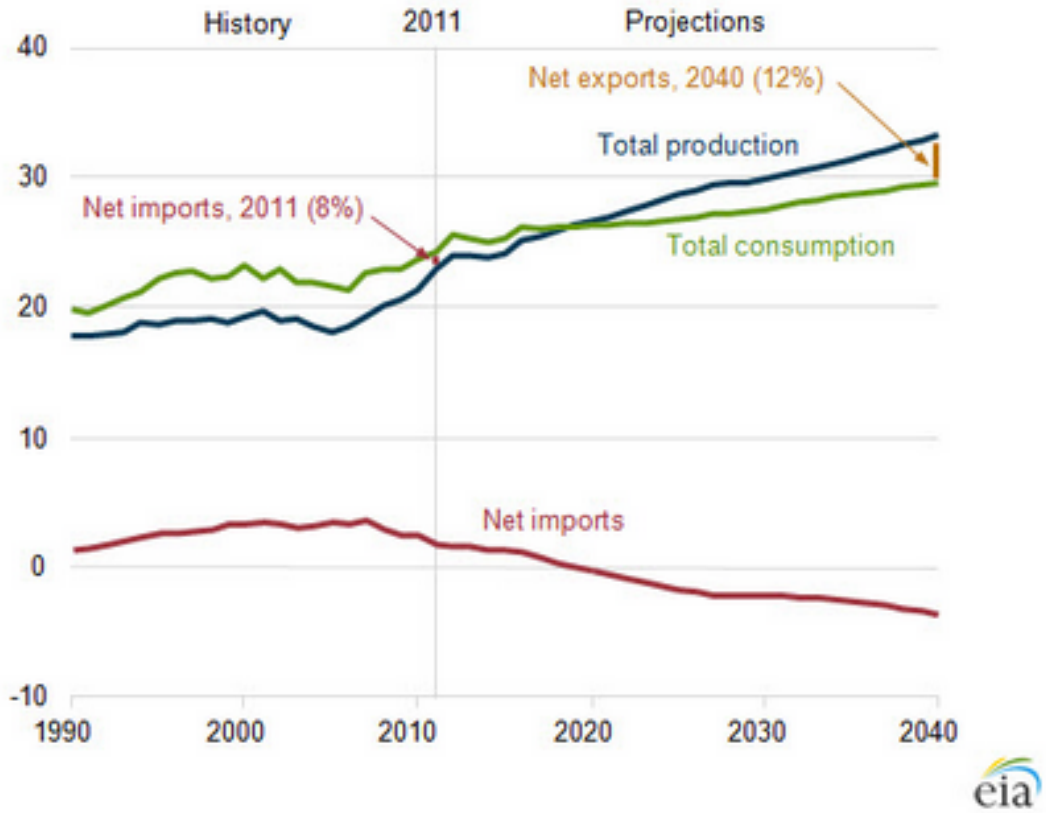
2007-08: When shale gas began hitting market, but also when U.S. stock market crashed. Hard to tease effects apart.

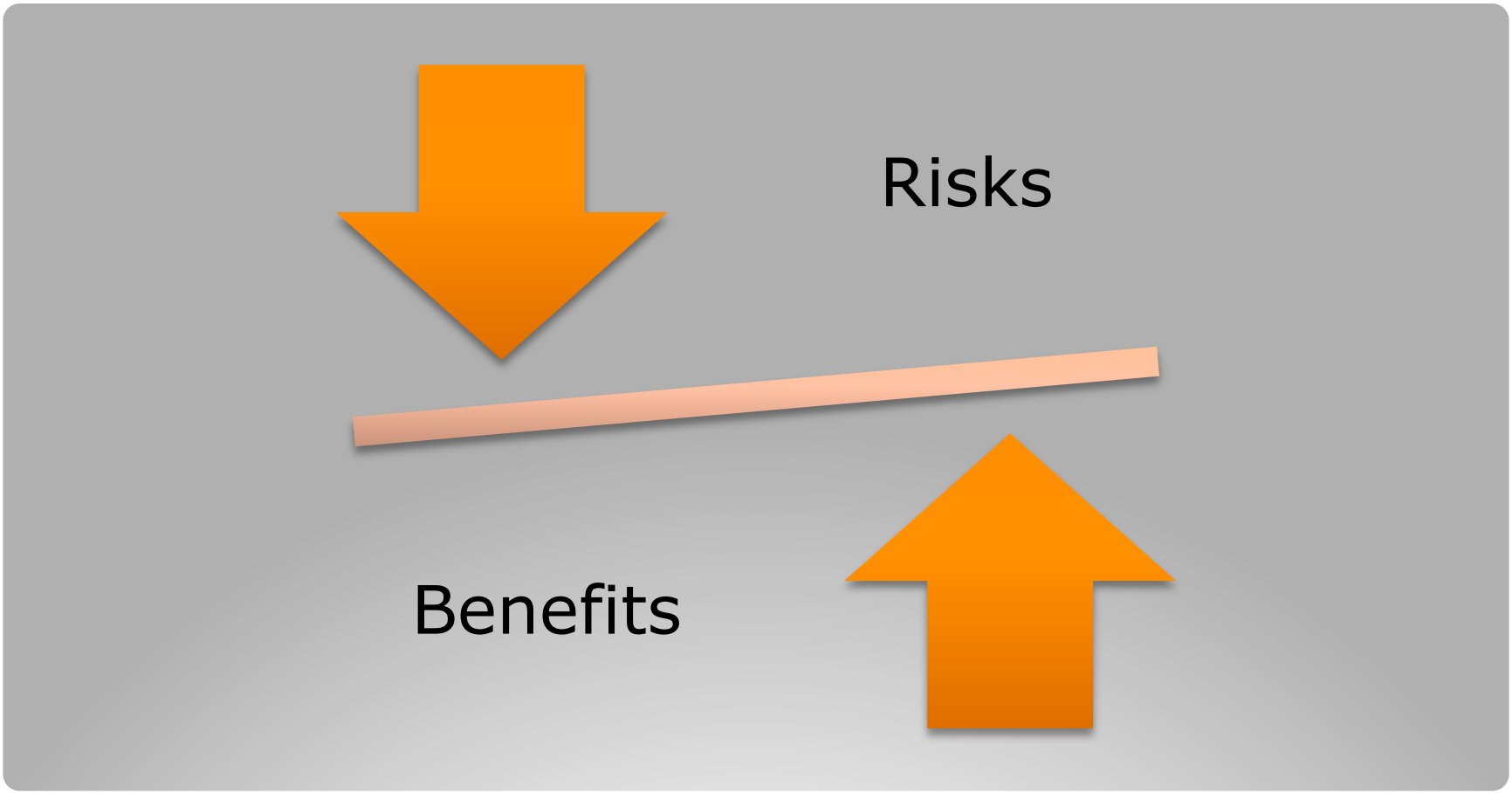
Energy from natural gas will remain less expensive than energy from oil in U.S. through 2040, although difference will narrow over time.

With production outpacing consumption, U.S. exports of natural gas will likely exceed imports over time:

Chart 4. Total U.S. natural gas production, consumption, and net imports, 1990-2040

trillion cubic feet (Tcf)

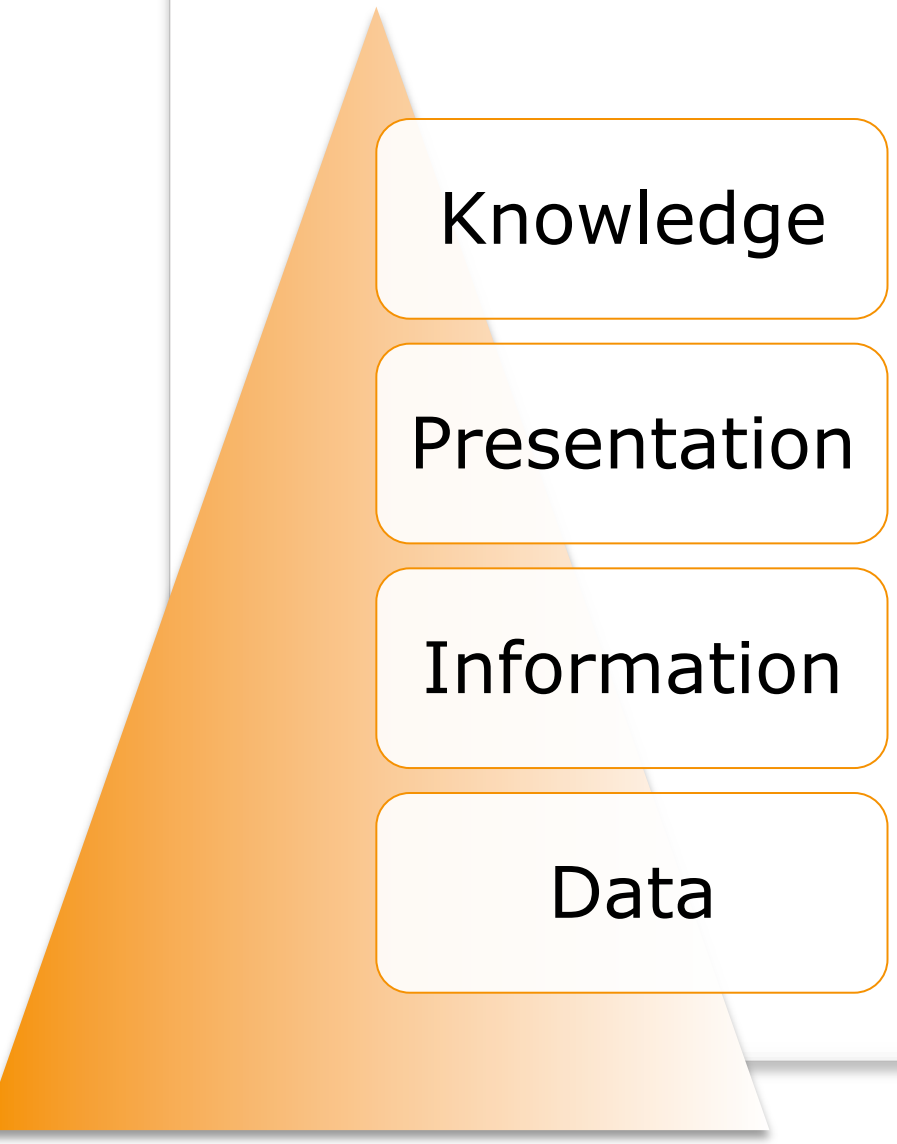




Shortfalls Experienced in the U.S.

Learning from our mistakes

Problem 1: Data Transparency



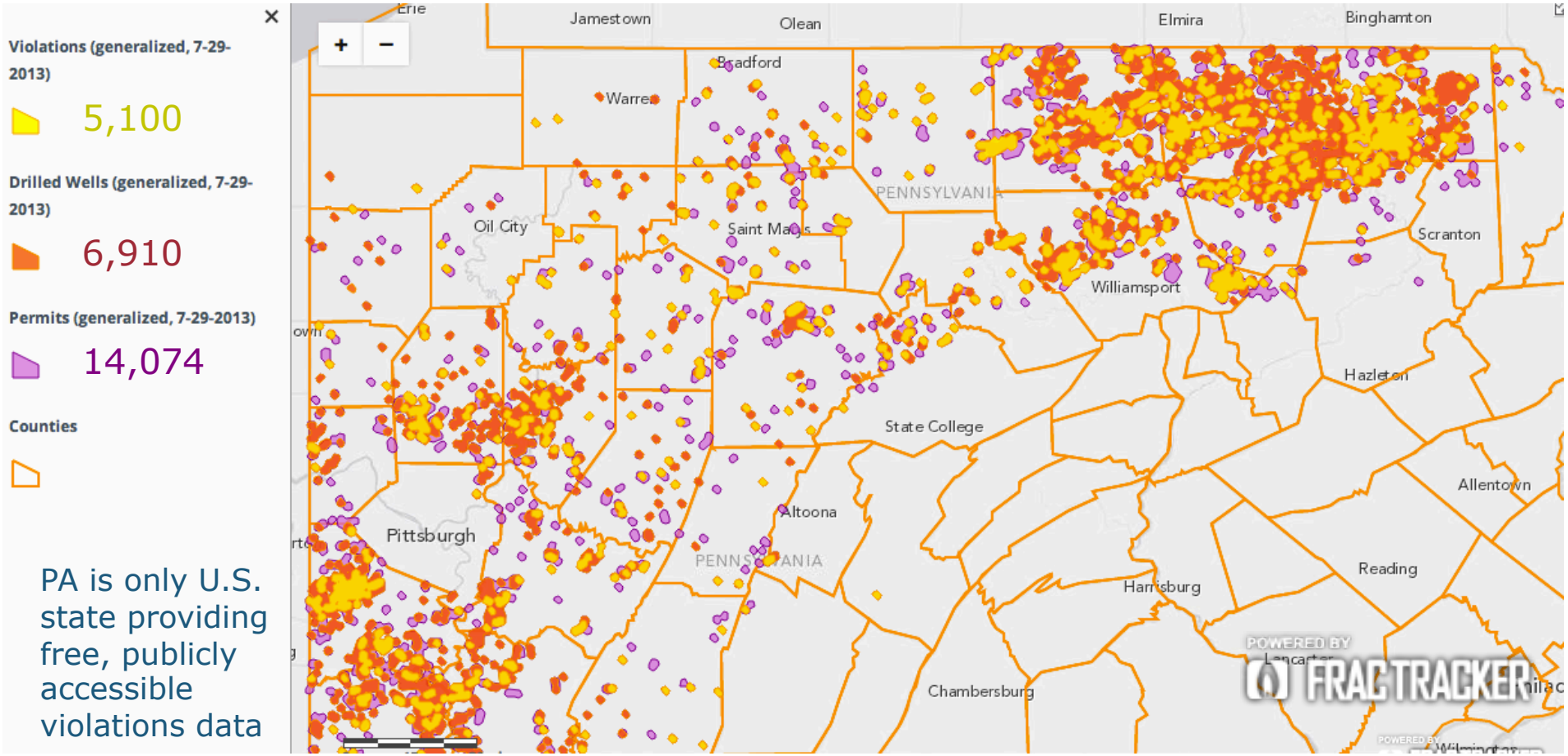
- "Publicly available data" should be in electronic format and shared online
- The lack thereof hinders regulatory trust and transparency
- Shale gas extraction is a controversial subject, so data transparency needed improvement
- Drove the development of FracTracker.org and FracTracker Alliance

What FracTracker Alliance does with data (all types):

- Collect
- Analyze
- Manipulate, where necessary
- Map or chart, and then
- Share it

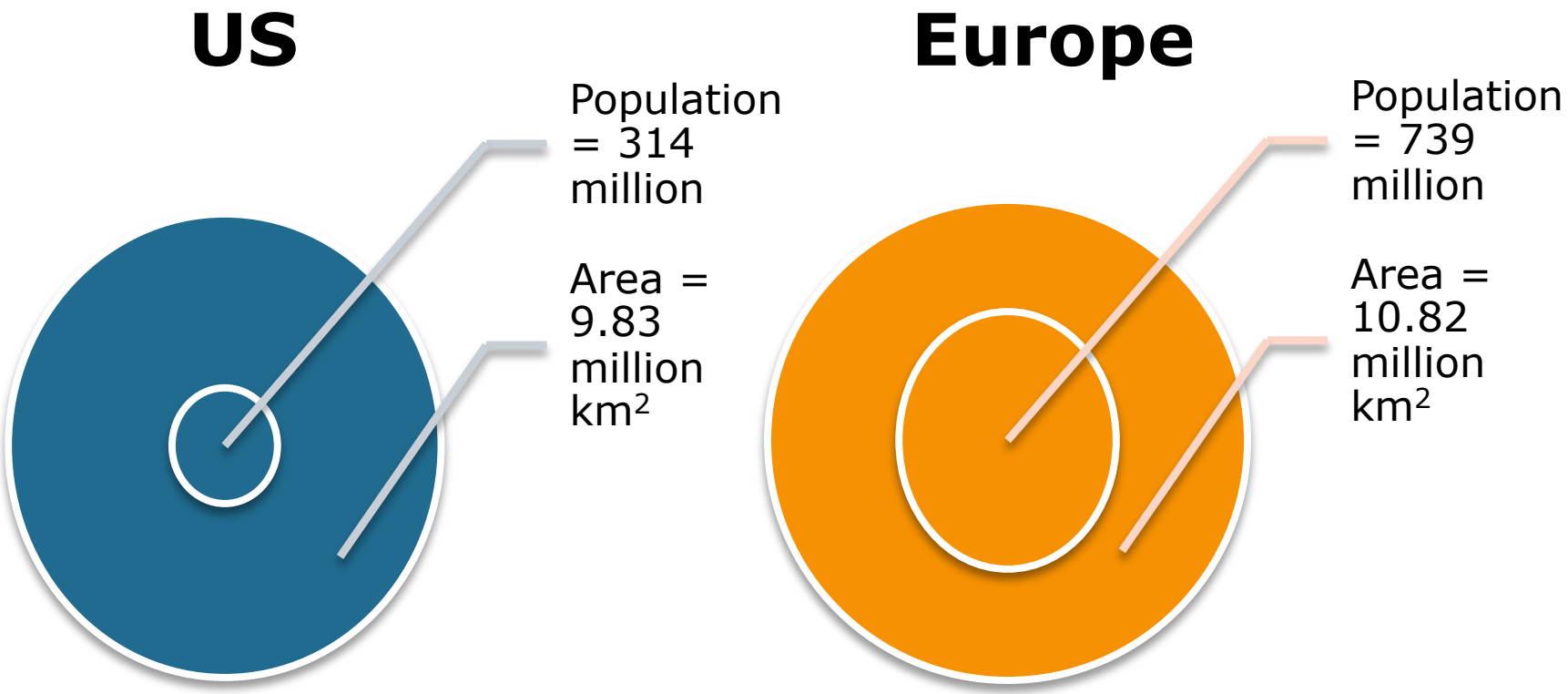
Example of heavy unconventional drilling activity

Pennsylvania, U.S. (2005 – July 2013)



Problem 2: Drilling is occurring close to residences.

Public concern & safety need to be prioritized.

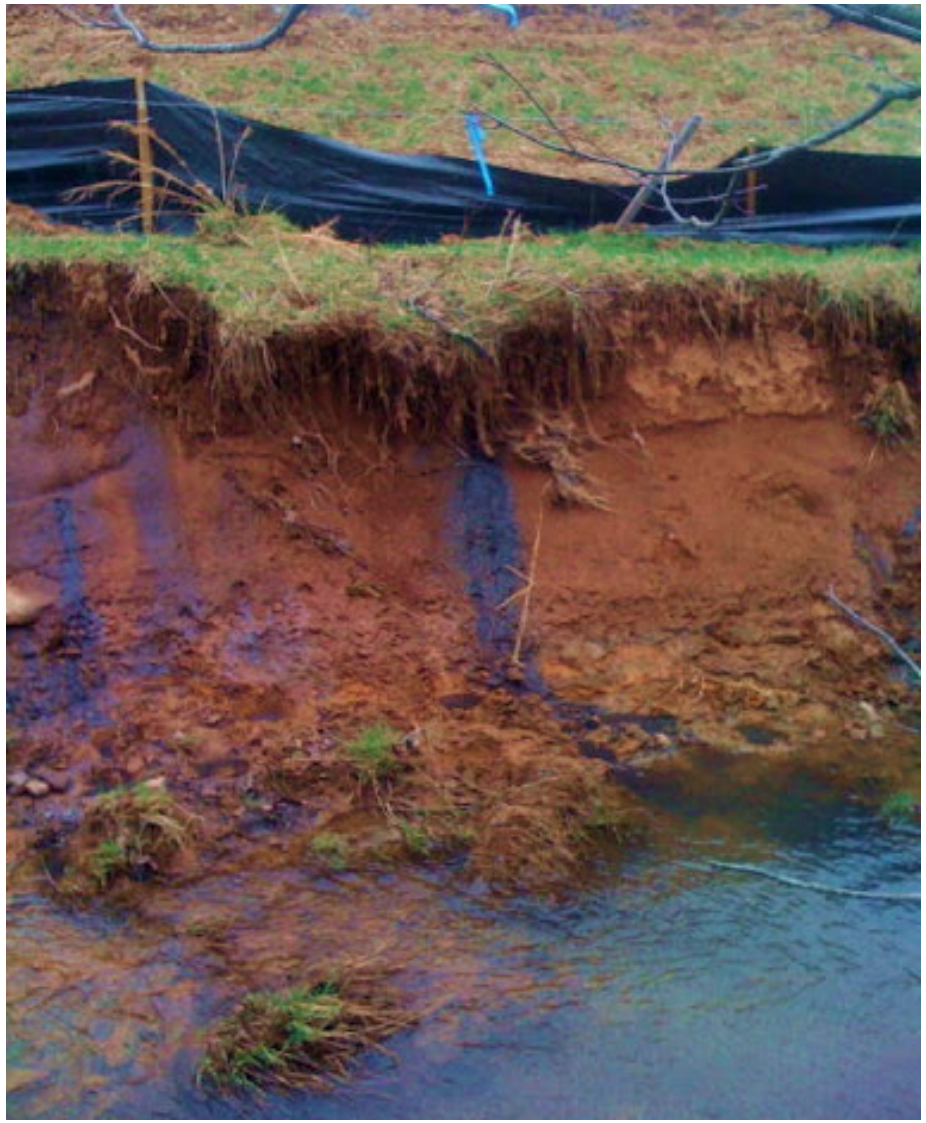

US
Population = 314 million
Area = 9.83 million km²
Europe
Population = 739 million
Area = 10.82 million km²

… and accidents happen

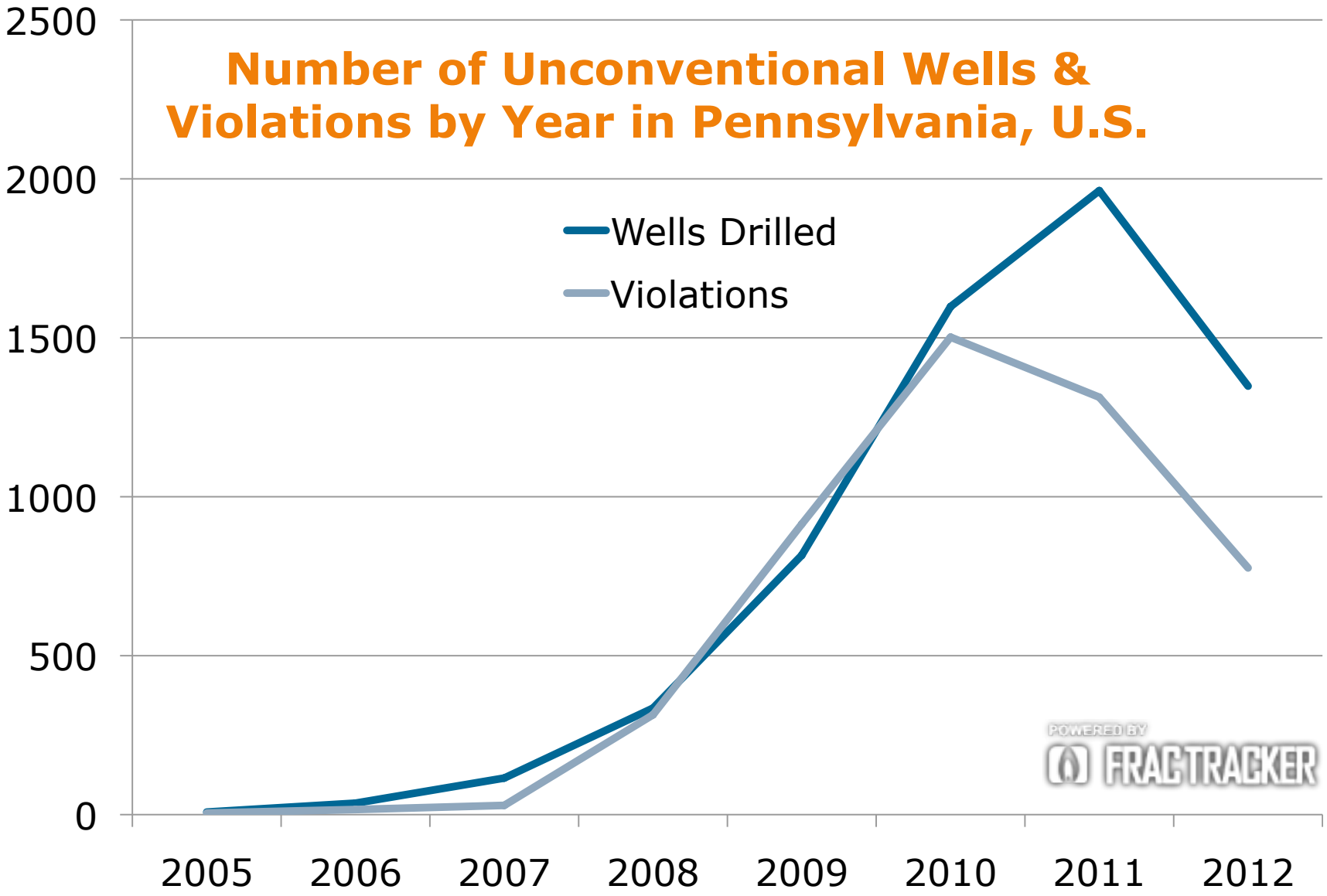
Fire on McDowell B well site near Wetzel County, WV. Burned for 9 days.
Photo Credit: Wetzel Co. Action Group, Ed Wade, Jr. (Sept. 2010)

Water Pollution Events

Buckeye Creek spill, Sept. 2009
Both photos courtesy of WV Host Farms Program (www.wvhostfarms.org)



Drill site, Harrison County, WV. Landowner reported seeing oily substance bubbling up from ground and into stream. Driller later cited for putting a well pad on top of a wetland area.



"Environmental" violations peaked in 2011. "Administrative" violations peaked in 2010. Distinctions between categories not reliable.

Problem 3: Global Climate Change Implications

Benefits:

- Natural gas burns more cleanly than traditional fossil fuels like coal and oil
- Less pervasive in atmosphere
- High energy density (when pressurized into liquid form)
- Sulfur is not released during combustion of natural gas

Continued…

Drawbacks:

- Methane often released during extraction and distribution
  - 2009: Methane emitted during oil and gas activities = 328 million metric tons of CO_2 equivalent. (~78 coal-fired power plants)
- Methane is a more potent (yet less pervasive) greenhouse gas than CO_2
- ~ 40% of gas vented or flared in onshore drilling could be captured w/available control technologies
- Some CO_2 is also released during the gas extraction lifecycle
- Natural gas – like other fossil fuels – not quickly renewable

Climate Change Research Findings

Positive

- Amount of methane emitted from shale gas operations may be lower than first thought (EPA 2013).
- Shale gas lower life cycle GHG emissions vs. coal by 20-50% (Mohan et al 2011)

Negative

- Vs. Conventional oil/ gas: Footprint for shale gas greater, especially over 20-year time span.
- Vs. Coal: Footprint for shale 20% greater, especially 20-year horizon. Comparable over 100 years (Howarth *et al.* 2011).

Problem 4: Health Concerns
Not discussed in detail here

- Air pollution (PM, Ozone, CO, NOx, VOCs, BTEX, NORMs...)
- Water pollution (primarily surface waters)
- Light, noise, and smell pollution
- Exposure to frac fluid/chemicals
- Earthquakes (due to injection of waste)
- Traffic incidents
- Occupational risks (well pad incidents, H_2S, silica sand)
- Local community/social impacts and stress.
- Read Korfmacher *et al.* 2012 to learn more

In Summary
Does Fracking Change the Energy World?

- Yes, but *how* is being determined
- Uncertainty of fustill ture reserves, production, and gas prices exist
- Shale gas has many benefits if extracted and distributed properly
- Need to focus on limiting impacts and emissions
- Data transparency and quality need improvement
- Check out FracTracker.org to learn more

POWERED BY FRACTRACKER

Samantha Malone, MPH, CPH
Manager of Science & Communications, FracTracker Alliance

Doctorate of Public Health Student, Environmental and Occupational Health Department, Graduate School of Public Health, University of Pittsburgh

malone@fractracker.org | 412-802-0273
Maps courtesy of FracTracker.org

Many thanks to my colleagues at FracTracker for their support in the development of this presentation and data.

Questions?

POWERED BY FRACTRACKER

Select References

Howarth RW, Santoro R, and Ingraffea A (2011). Climatic Change Letters, doi:10.1007/s10584-011-0061-5

Korfmacher KS, Jones WA, Malone SL, Vinci LF. (2013). Public Health and High Volume Hydraulic Fracturing. NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy 23(1), pp. 13 – 31.

Mohan Jiang et al. (2011). Life cycle greenhouse gas emissions of Marcellus shale gas. Environmental Research Letters, doi: 10.1088/1748-

US EPA (2013). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011. Accessed online.