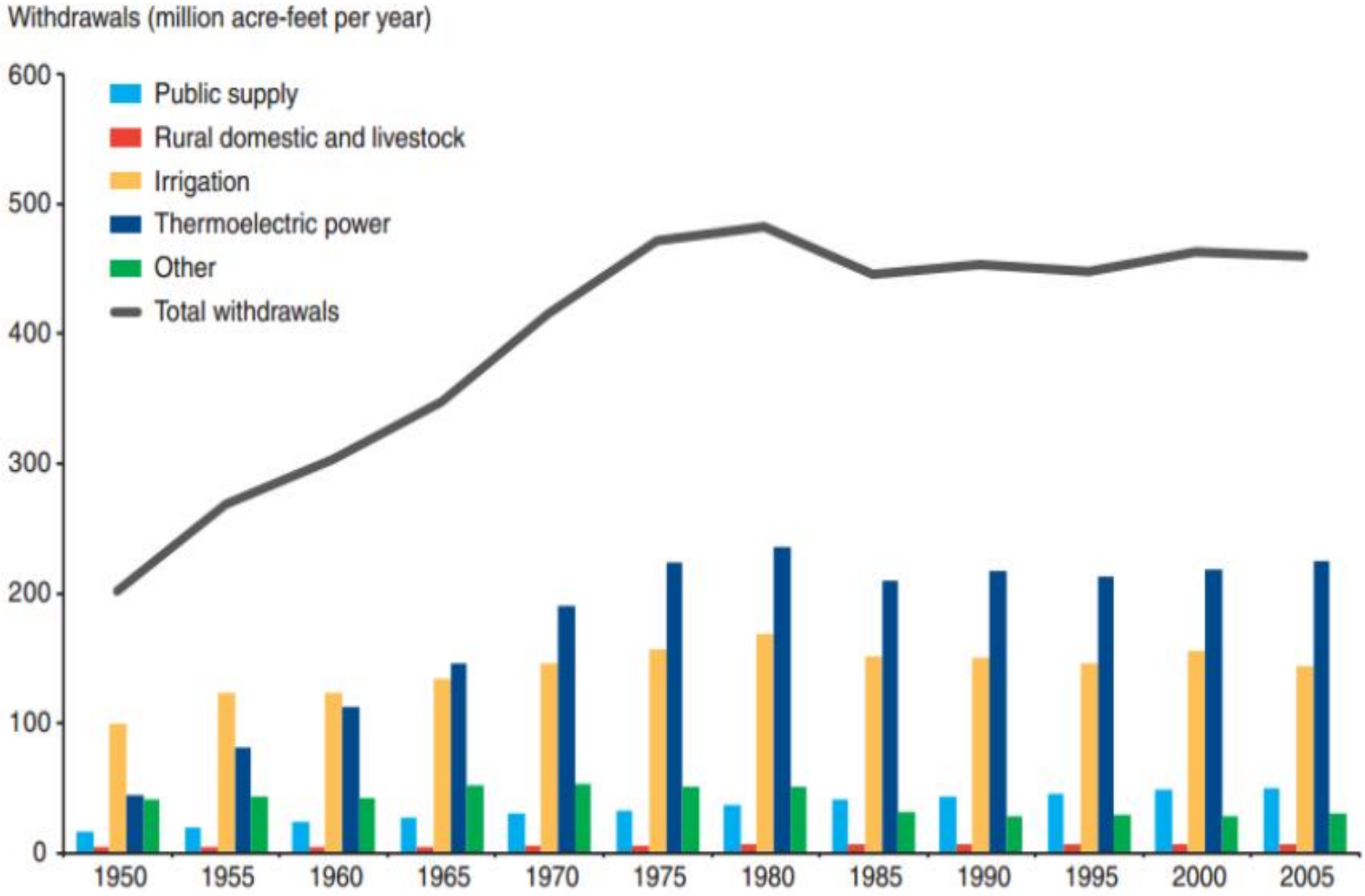
Unsustainable Centralized Power & Oil Transport Systems

Pathways for the Rooftop Solar Revolution

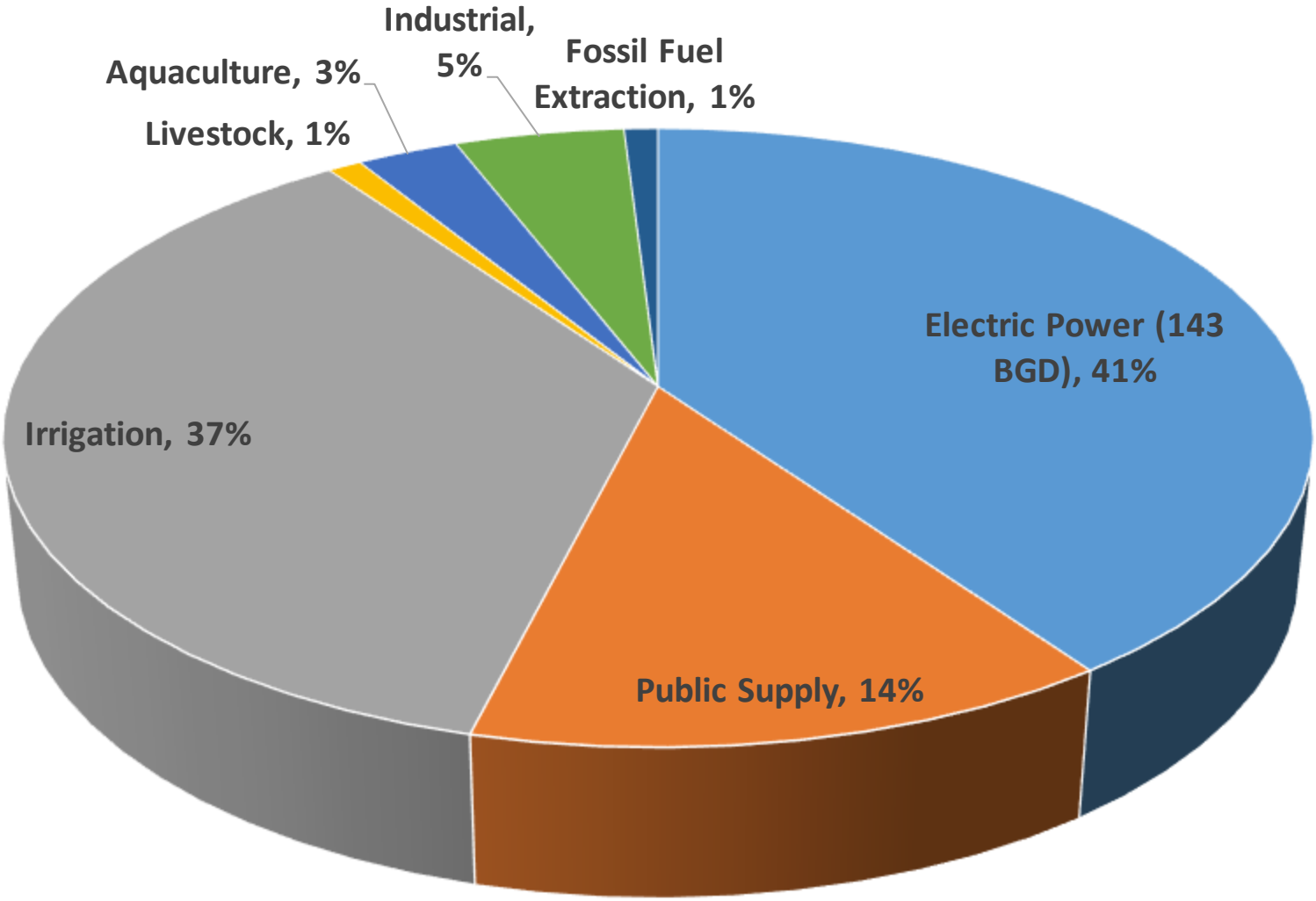
Tyson Slocum, Director
Public Citizen's Energy Program
Twitter @TysonSlocum



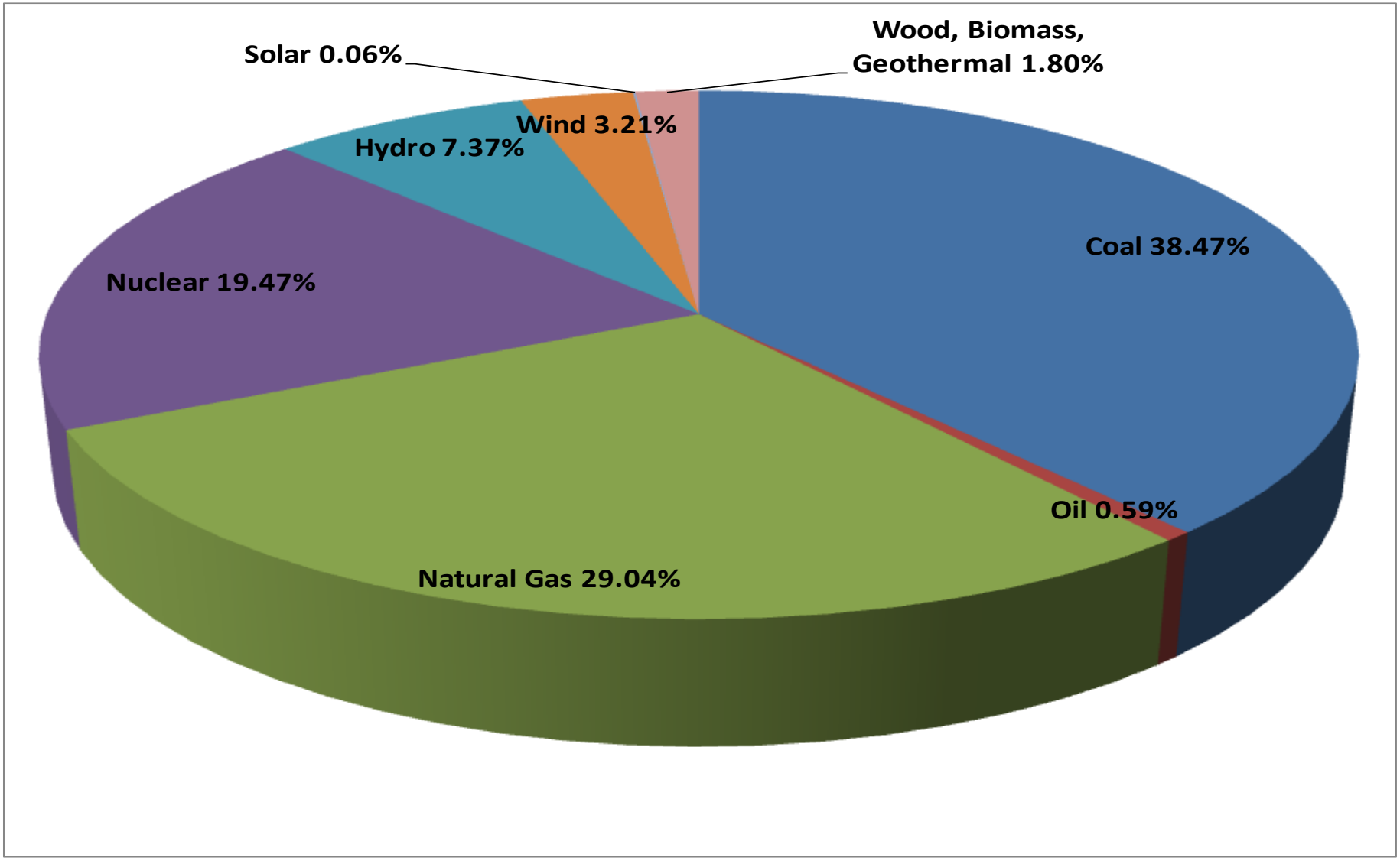
Source: USDA

Note: U.S. Geological Survey water use numbers were converted to million acre-feet units.
Source: Kenny et al., table 14, p. 43, 2009.

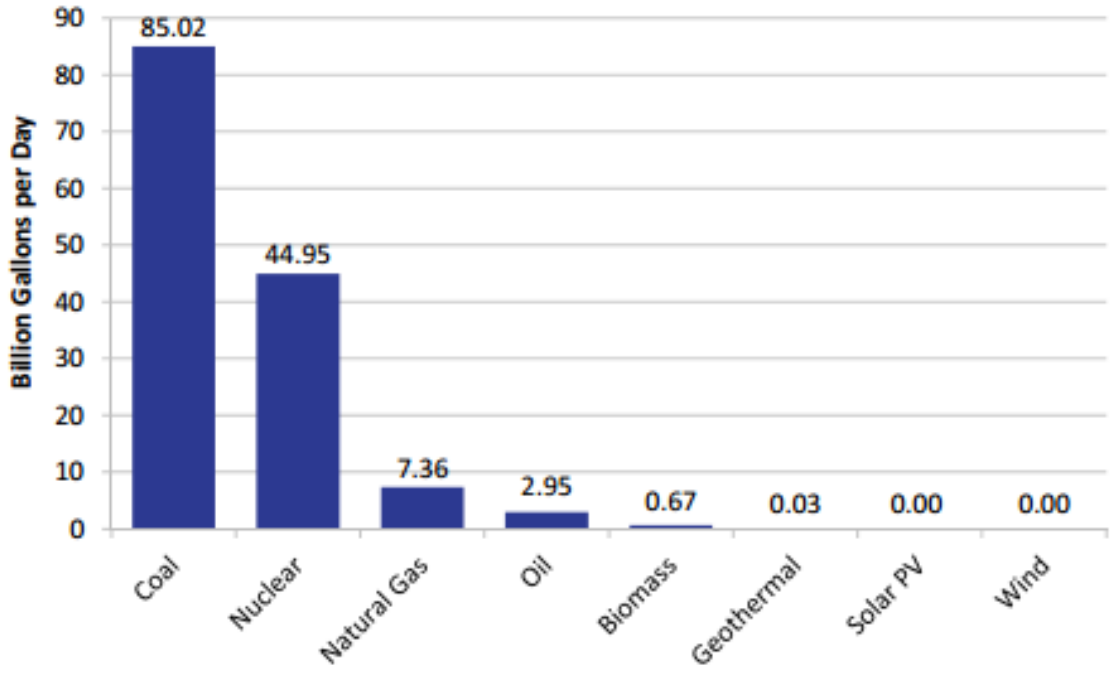
US Freshwater Withdrawl, 2005 (Pre-Fracking Boom)



US Power Generation by Energy Source



Daily Water Withdrawals for US Power Generation



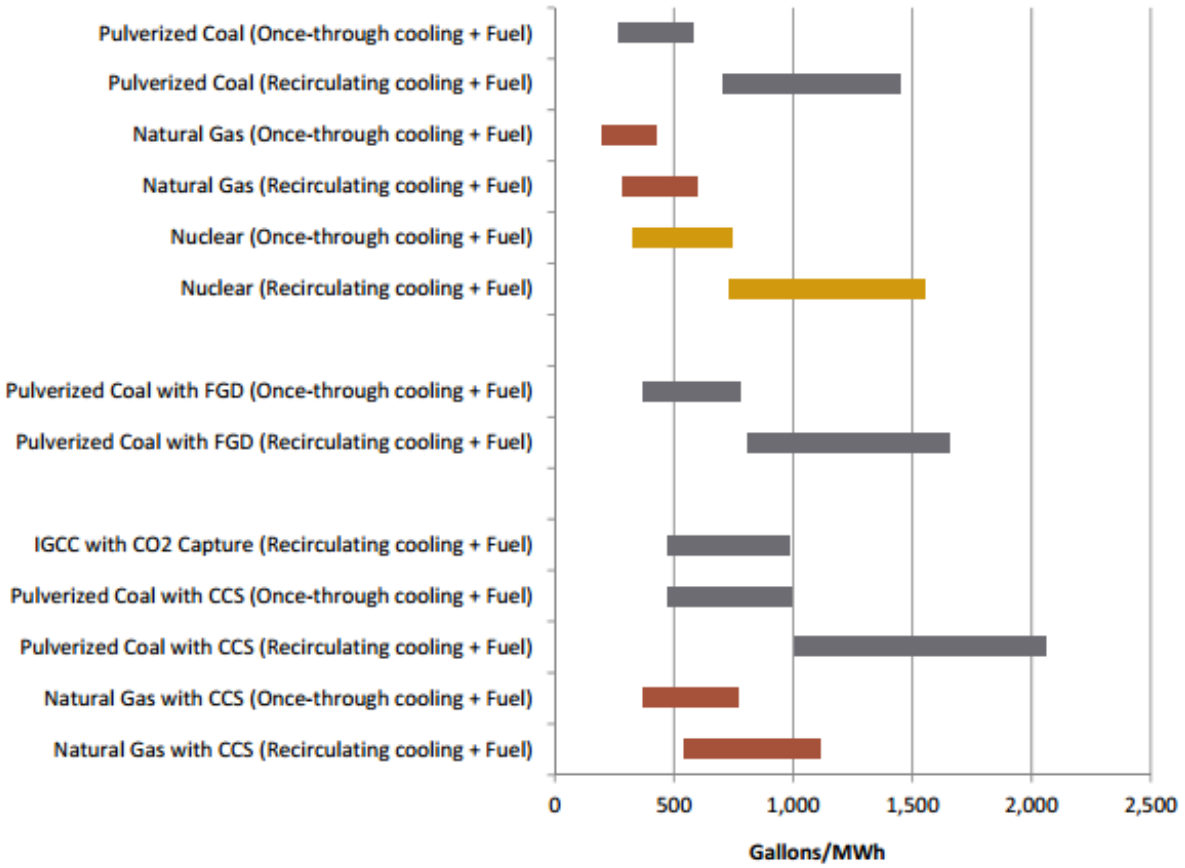
Source: Estimated by Synapse Energy Economics using the Union of Concerned Scientists' UCS EW3 Energy-Water Database V.1.3, 2012. Database sources include EIA data and Macknick 2011 withdrawal coefficients.

Water Intensity at Thermoelectric Power Plants

		Water Intensity (gal/MWh)	
Plant Type	**Cooling System**	**Withdrawal**	**Consumption**
Fossil/biomass/waste	Once-through	20,000–50,000	~300
	Cooling tower	300–600	300–480
	Cooling pond	500–600	~480
Nuclear	Once-through	25,000–60,000	~400
	Cooling tower	500–1,100	400–720
	Cooling pond	800–1,100	~720
Geothermal steam	Cooling tower	~2,000	~1,400
Natural gas, combined cycle	Once-through	7,500–20,000	100
	Cooling tower	~230	~180
Coal, integrated gasification combined cycle	Cooling tower	~250	~200

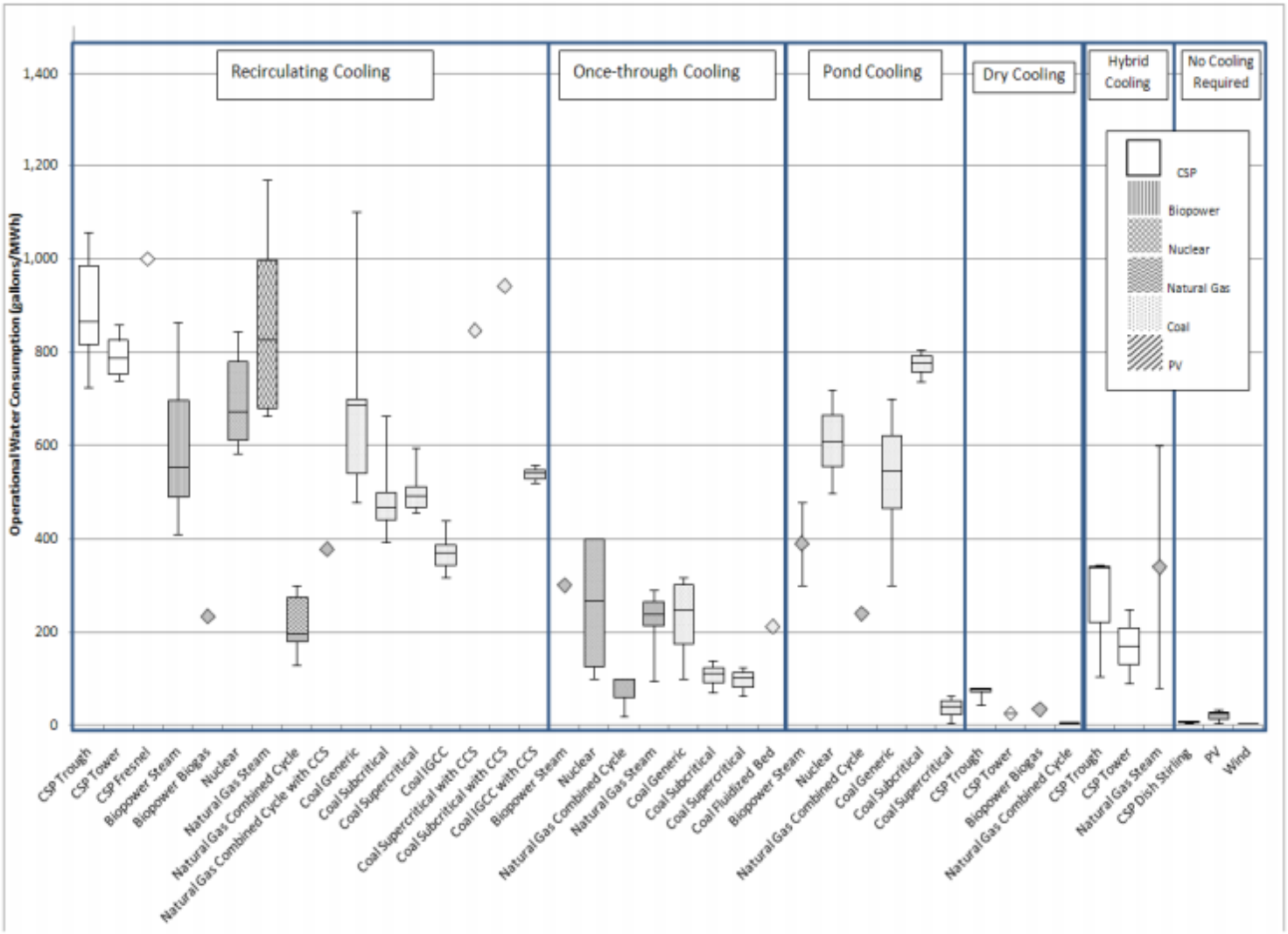
Virtually all new steam electric units built since the mid-1970s use closed-cycle cooling & most use cooling towers. Cooling towers at fossil-fueled plants require 300–600 gal/MWh, while those at nuclear plants require 500–1,100 gal/MWh & natural gas combined-cycle plants require 230 gal/MWh. Irrespective of the fuel type, steam electric power plants require a great deal of water.

Lifecycle Water Consumption for Power Generation Including Fuel Extraction, Processing, Transport & Storage Water Use

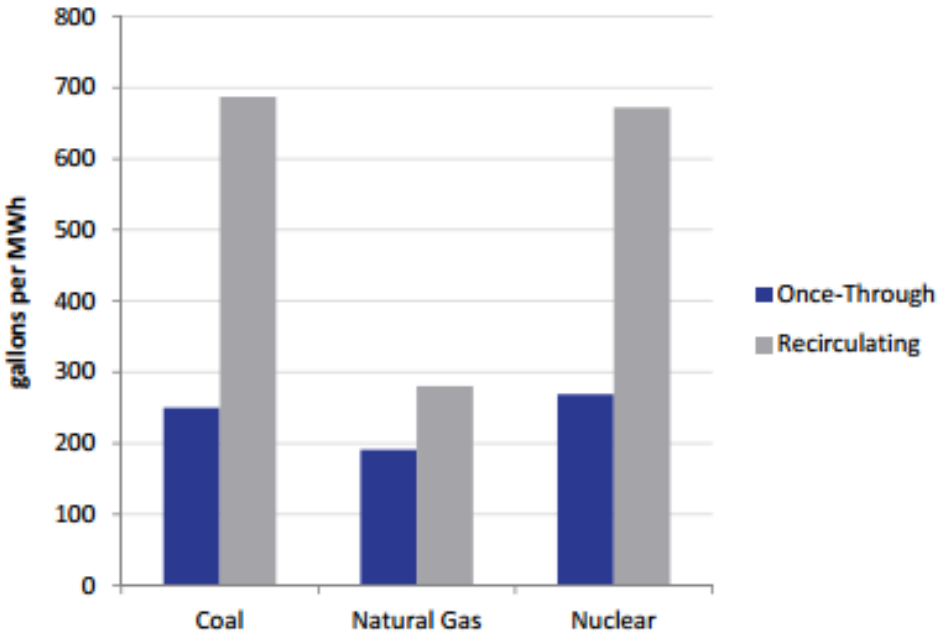


Source: Estimated by Synapse Energy Economics using the Union of Concerned Scientists' UCS EW3 Energy-Water Database V.1.3, 2012g; Mielke, Anadon, and Narayanamurti (2010); U.S. Department of Energy; National Energy Technology Laboratory (2010) and (2009), and Waughray (2011).

Ranges of Water Consumption by Generation Type (gallons/MWh)



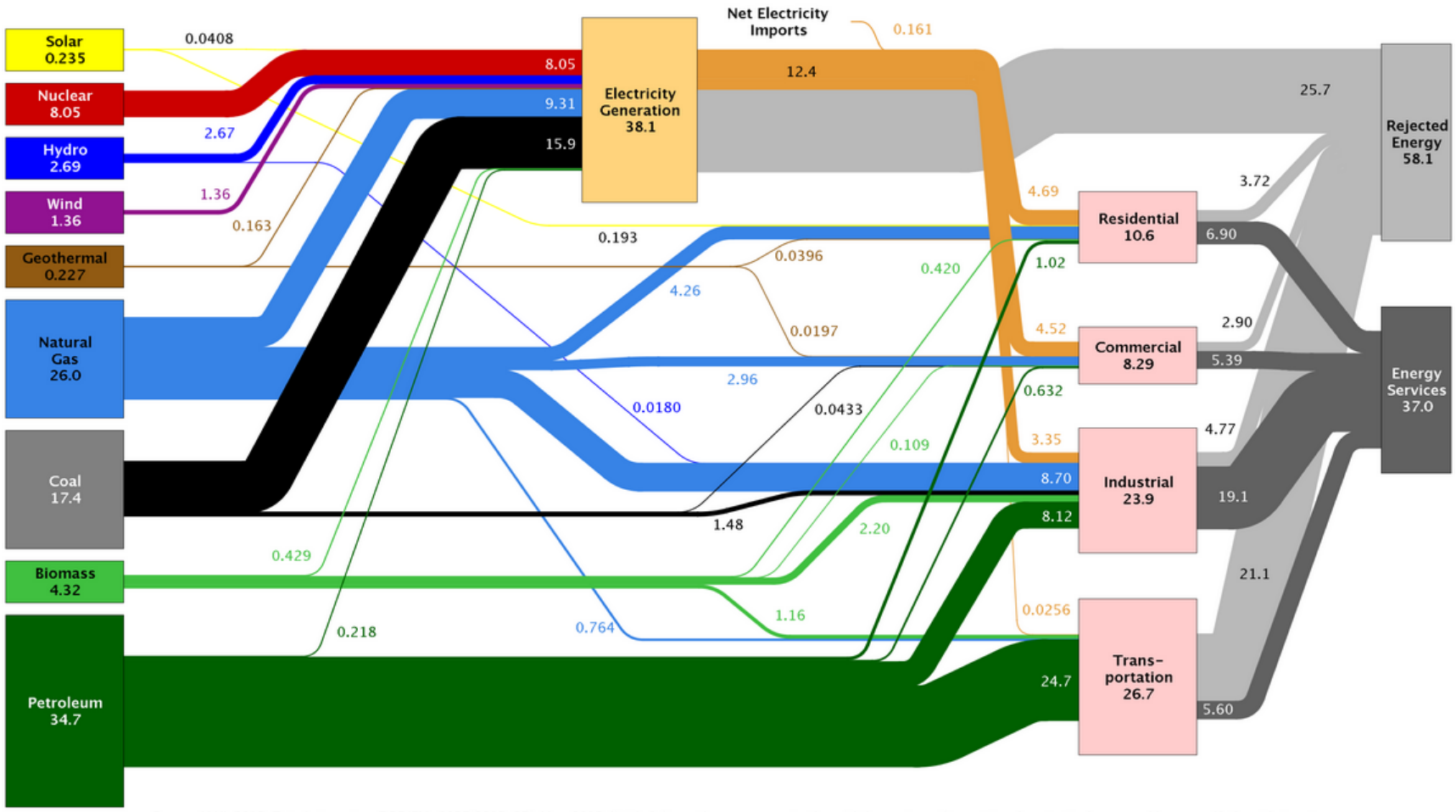
Water Consumption of US Thermoelectric Power Plants



Source: Estimated by Synapse Energy Economics using the Union of Concerned Scientists' UCS EW3 Energy-Water Database V.1.3, 2012.

Estimated U.S. Energy Use in 2012: ~95.1 Quads

Lawrence Livermore National Laboratory



Source: LLNL 2013. Data is based on DOE/EIA-0035(2013-05), May, 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

Coal power plants are the largest source of toxic water pollution in the US - larger than the other top 9 industries combined. scrubbers to control sulfur dioxide use more water; water is needed to transport/store bottom ash. 70% of the coal plants that discharge coal ash and scrubber wastewater dump unlimited volumes of arsenic, boron, cadmium, mercury and selenium into public waters.

Proposed Effluent Guidelines for the Steam Electric Power Generating Category

EPA is proposing to amend the effluent limitations guidelines and standards for the Steam Electric Power Generating category (40 CFR Part 423). A proposed rule was published on June 7, 2013.

Overview

Steam electric power plants contribute over half of all toxic pollutants discharged to surface waters by all industrial categories currently regulated in the United States under the Clean Water Act. For example, steam electric plants annually discharge:

- 64,400 lb. of lead
- 2,820 lb. of mercury
- 79,200 lb. of arsenic
- 225,000 lb. of selenium
- 1,970,000 lb. of aluminum
- 4,990,000 lb. of zinc
- 30,000,000 lb. of nitrogen
- 682,000 lb. of phosphorus
- 14,500,000 lb. of manganese
- 158,000 lb. of vanadium; and
- 27 other pollutants.

In 2005, the U.S. Senate Committee on Energy & Natural Resources mandated the Department of Energy to produce an Energy/Water Roadmap of the energy sector's water needs and the impacts on the environment, agriculture, and other residential and commercial uses.

Eight years later, it still hasn't been released to the public.

We Can Try To Make Fossil Fuel & Nuclear Power Retrofits To Conserve Water

May 11, 2012, 2:58pm EDT | **UPDATED:** May 11, 2012, 3:24pm EDT

SPX to install dry-cooling system for Dominion natural gas plant in Virginia

Jen Wilson
Associate Editor/Online-
Charlotte Business Journal
Email | Google+

SPX Corp. has been chosen to provide an air-cooled condenser for a new natural gas power plant owned by a subsidiary of Dominion (NYSE:D).

The contract was awarded to SPX by Warren County Energy Partners, a joint venture of Burns & McDonnell and Zachry Industrial Inc. Terms of the deal were not disclosed.

Xcel Energy completes wastewater project

Plan could save 1 billion gallons of water a year

Posted: Saturday, April 22, 2006

Jim McBride
jim.mcbride@amarillo.com

Millions of gallons of water literally go down the drain every day in Amarillo.

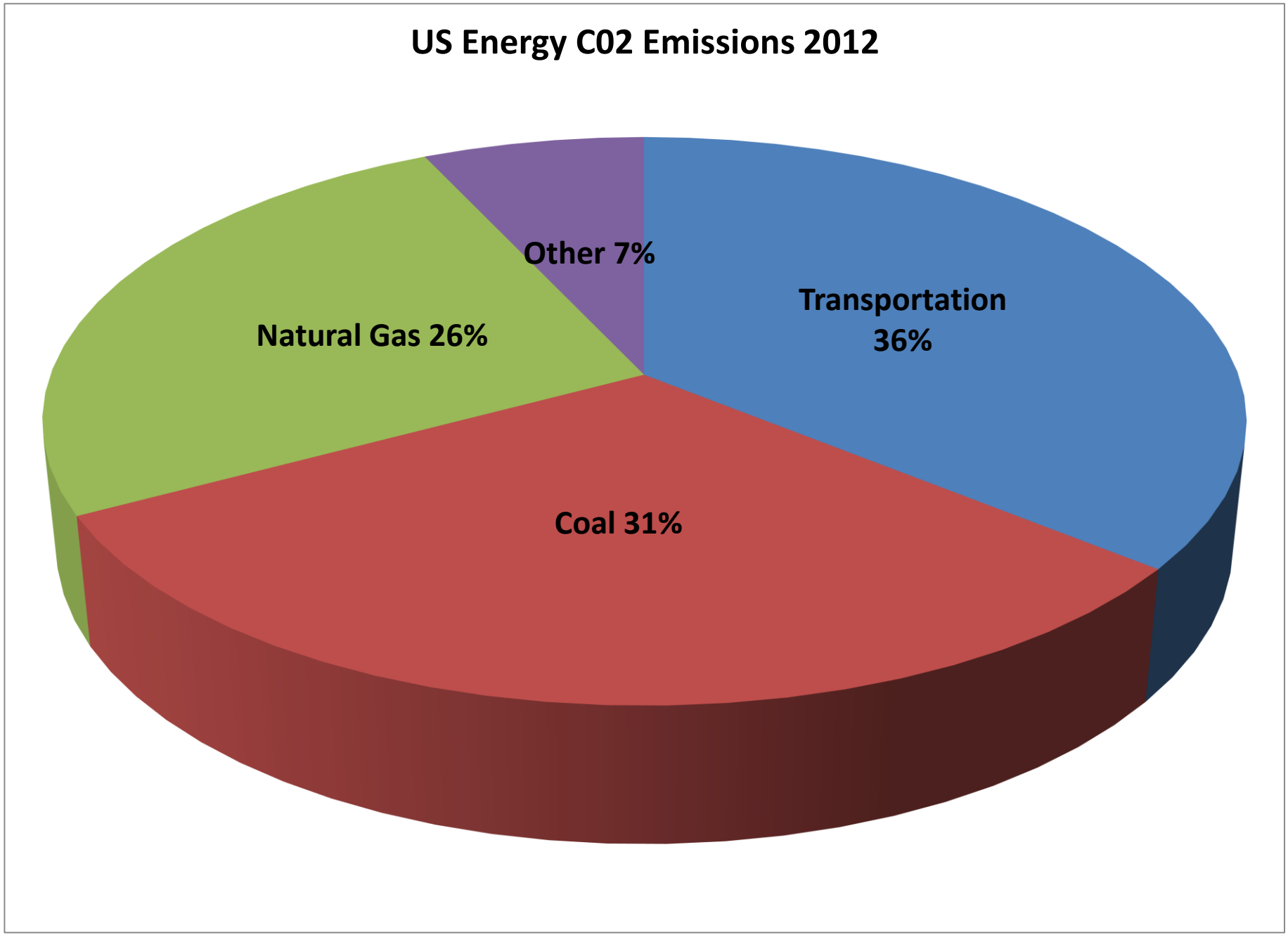
But Xcel Energy announced Friday it has finished a $25.8 million project that will pump city wastewater from the Hollywood Wastewater Treatment Plant, saving billions of gallons of potential drinking water for decades to come.

By recycling wastewater from the city, Xcel won't need to buy other water from Lake Meredith for cooling purposes at its Harrington and Nichols power stations north of Amarillo.

"It cools the steam. We use steam to produce electricity. Steam turns the turbine that turns the generator that produces electricity," Xcel Laboratory Supervisor Bernie Wieck said.

Now, more city wastewater is pumped through a pipeline to a 30-acre, 334 million-gallon reservoir near Xcel's power stations north of town.

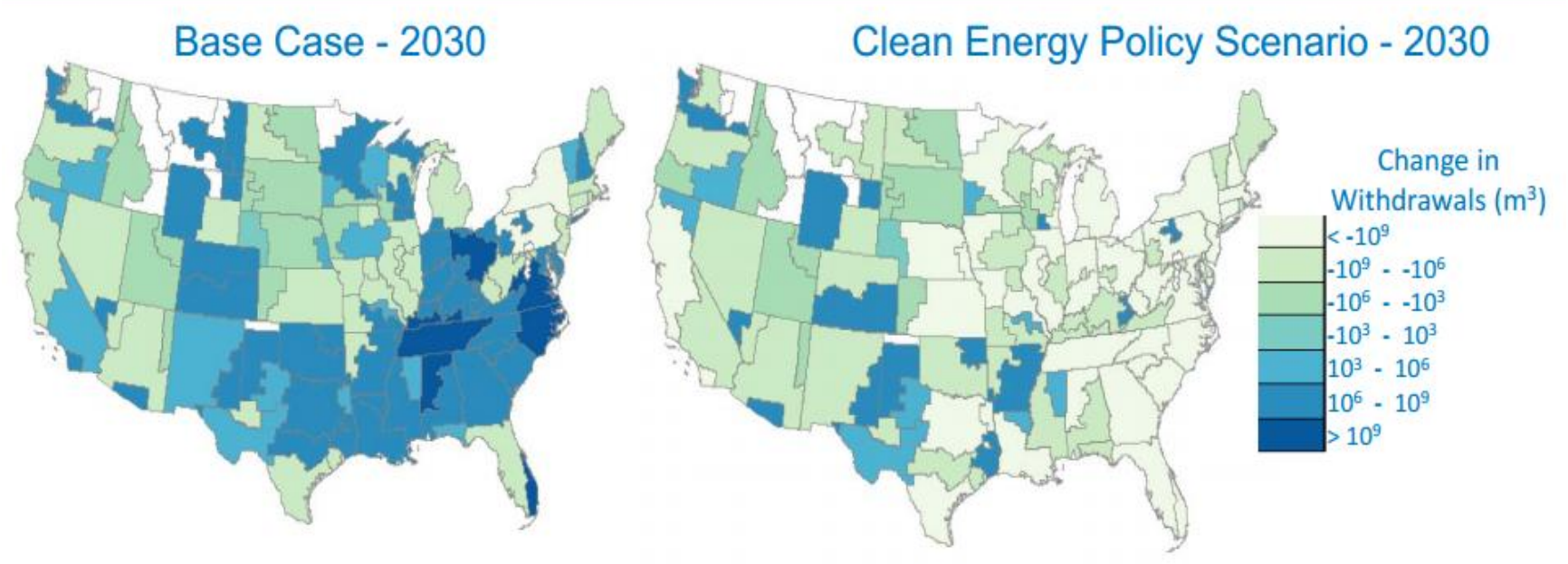
But What of Climate Change?


US Energy C02 Emissions 2012
Other 7%
Transportation 36%
Natural Gas 26%
Coal 31%

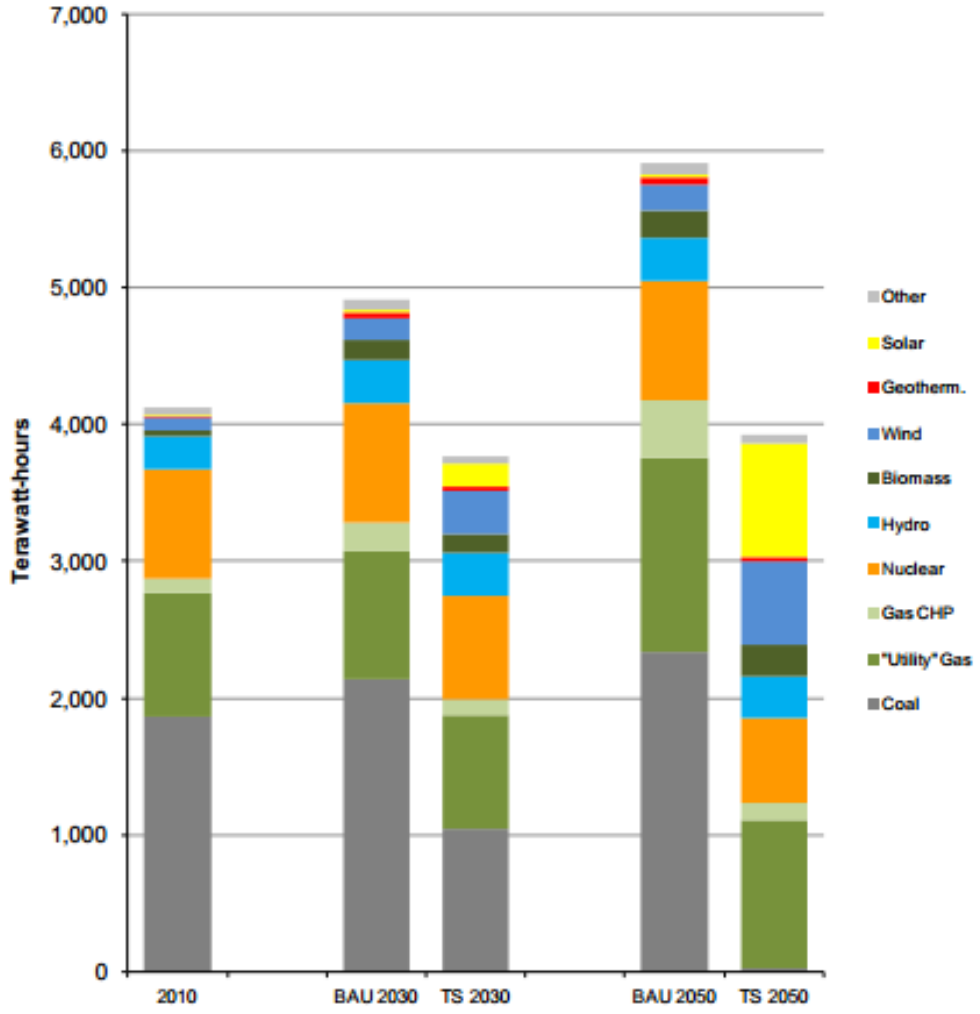
- Climate Change Affects the Flows & Timing of Precipitation
- Precipitation Less Frequent & More Intense, More Rain/Less snow
- Volume & Velocity of Runoff
- Seasonal River Flow More Erratic
- Reservoir Control
- Hotter Temps Will Increase Power Use
- Water Shortages Reduce Thermal Power Reliability

- FERC Chairman Jon Wellinghoff promoted the idea of replacing centralized, baseload generation with small-scale, distributed renewable energy in an April 2009 interview: “We may not need any [nuclear or coal plants], ever…I think baseload capacity is going to become an anachronism. Baseload capacity really used to only mean in an economic dispatch, which you dispatch first, what would be the cheapest thing to do. Well, ultimately wind’s going to be the cheapest thing to do, so you’ll dispatch that first. People talk about, ‘Oh, we need baseload.’ It’s like people saying we need more computing power, we need mainframes. We don’t need mainframes, we have distributed computing…So if you can shape your renewables, you don’t need fossil fuel or nuclear plants to run all the time. And, in fact, most plants running all the time in your system are an impediment because they’re very inflexible. You can’t ramp up and ramp down a nuclear plant. And if you have instead the ability to ramp up and ramp down loads in ways that can shape the entire system, then the old concept of baseload becomes an anachronism.”

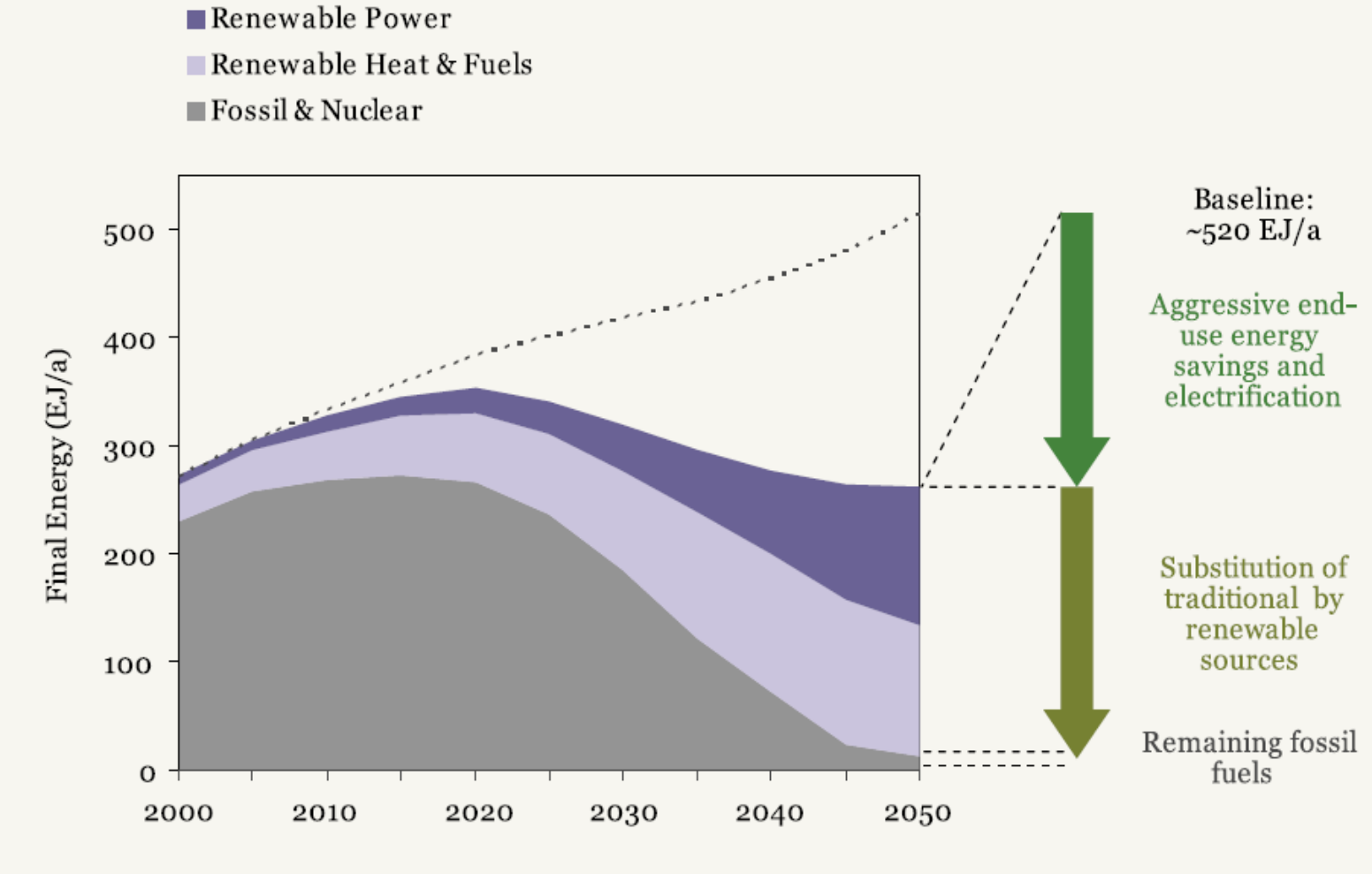
Water Use Can Decline with Aggressive Investments in Renewables, Efficiency



Synapse Energy Transition Scenario (TS)



WWF Pathway to 100% Renewables By 2050



But Utilities Fight The Future

Citibank: Utilities are dinosaurs waiting to die

Oct 9, 2013 Talk Back Free Alerts More On This Topic SHARE

Quick Take: *A new report authored by prominent Citibank analysts claims the global energy mix is shifting more rapidly than realized. If true – and these are some smart, smart people – it has major implications for generators, consumers, and most of all utilities. In fact, the study says utilities are most at risk because their business model is likely to change.*

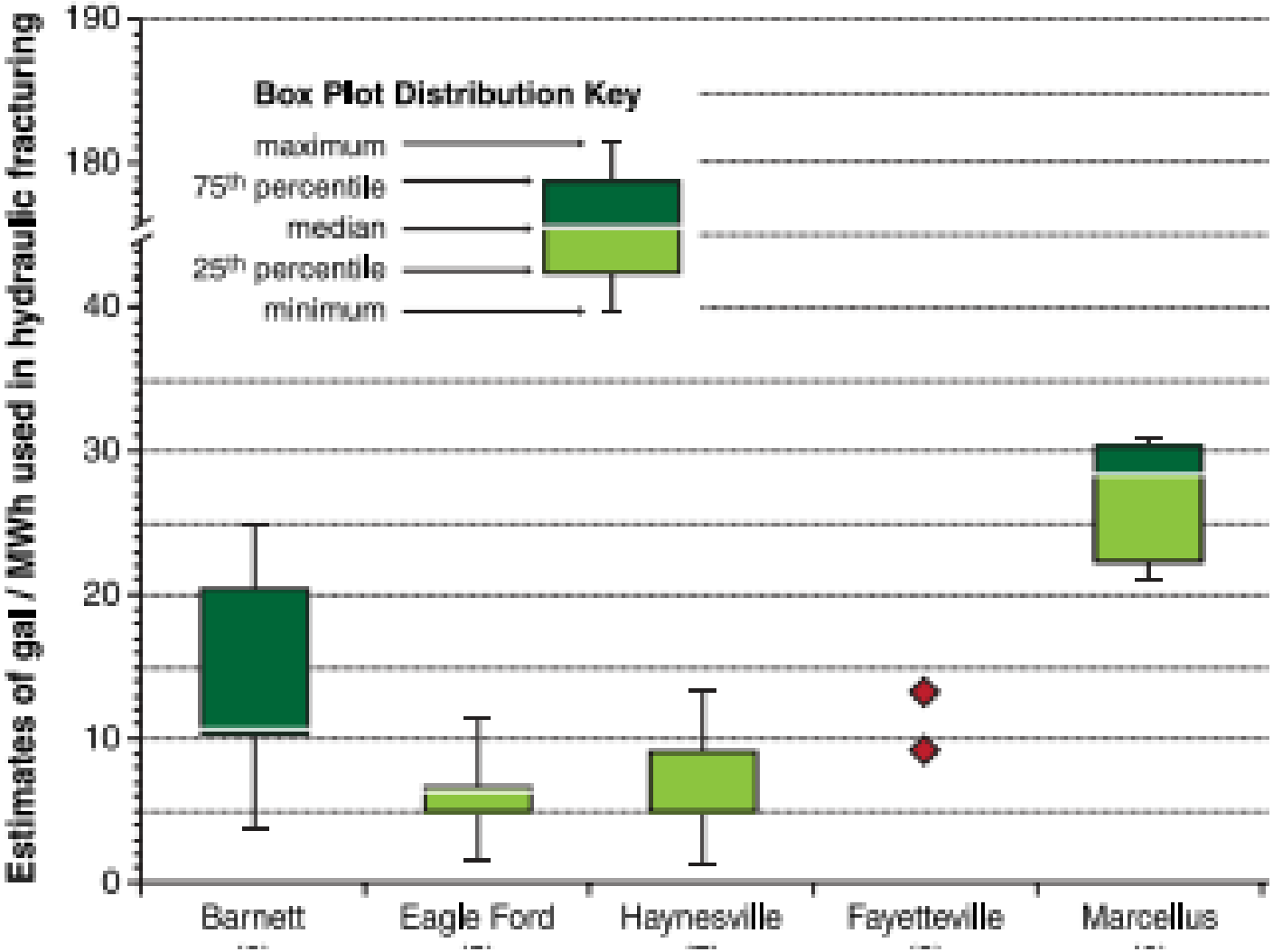
Battery-Stored Solar Power Sparks Backlash From Utilities

By Ehren Goossens & Mark Chediak - Oct 8, 2013 4:11 PM ET

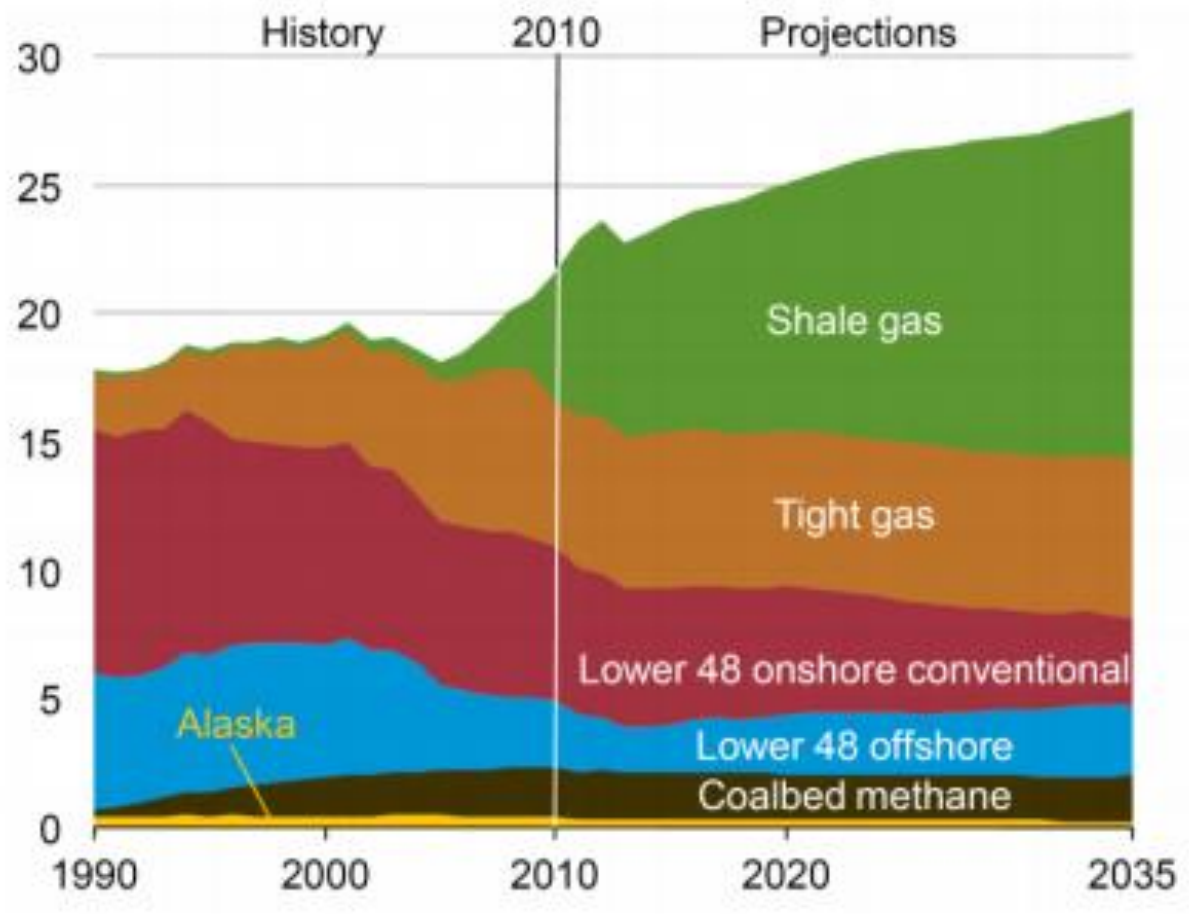
COMMENTS QUEUE

California's three biggest utilities are sparring with their own customers about systems that store energy from the sun, opening another front in the battle that's redefining the mission of electricity generators.

Life Cycle Water Use for Fracking



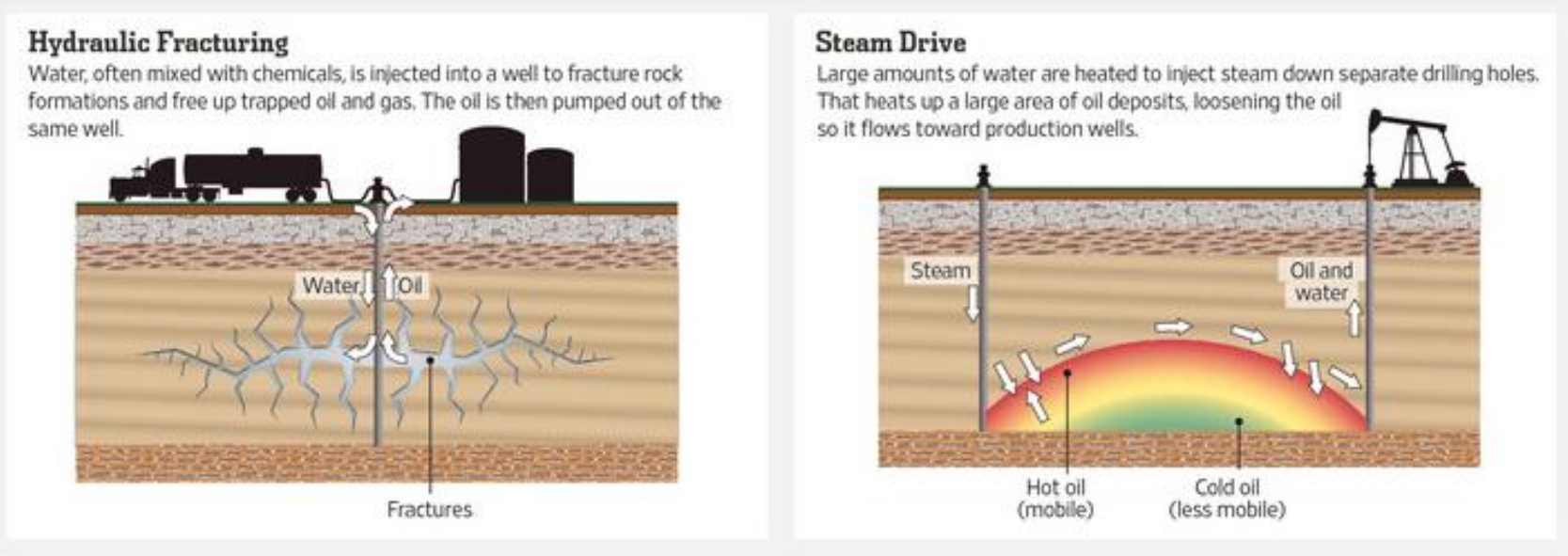
Fracking Explosion to 2035



Source: EIA (2012)

Fracking requires as much as 6 million gallons per well—and Steam Drive Uses Even More

[EPA Estimates that 35,000 Wells are Fracked Each Year]



- Methane or Fracking Fluid May Migrate Into Aquifers
- Disposal of Flowback Fracking Fluid Contaminates Drinking Water
- Chemicals As "Proprietary" Trade Secrets
- Fracking Wastewater Sent to Municipal Wastewater Facilities Not Designed to Deal with Fracking Contaminants