U.S. Energy Security and Water

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CNA Corp.

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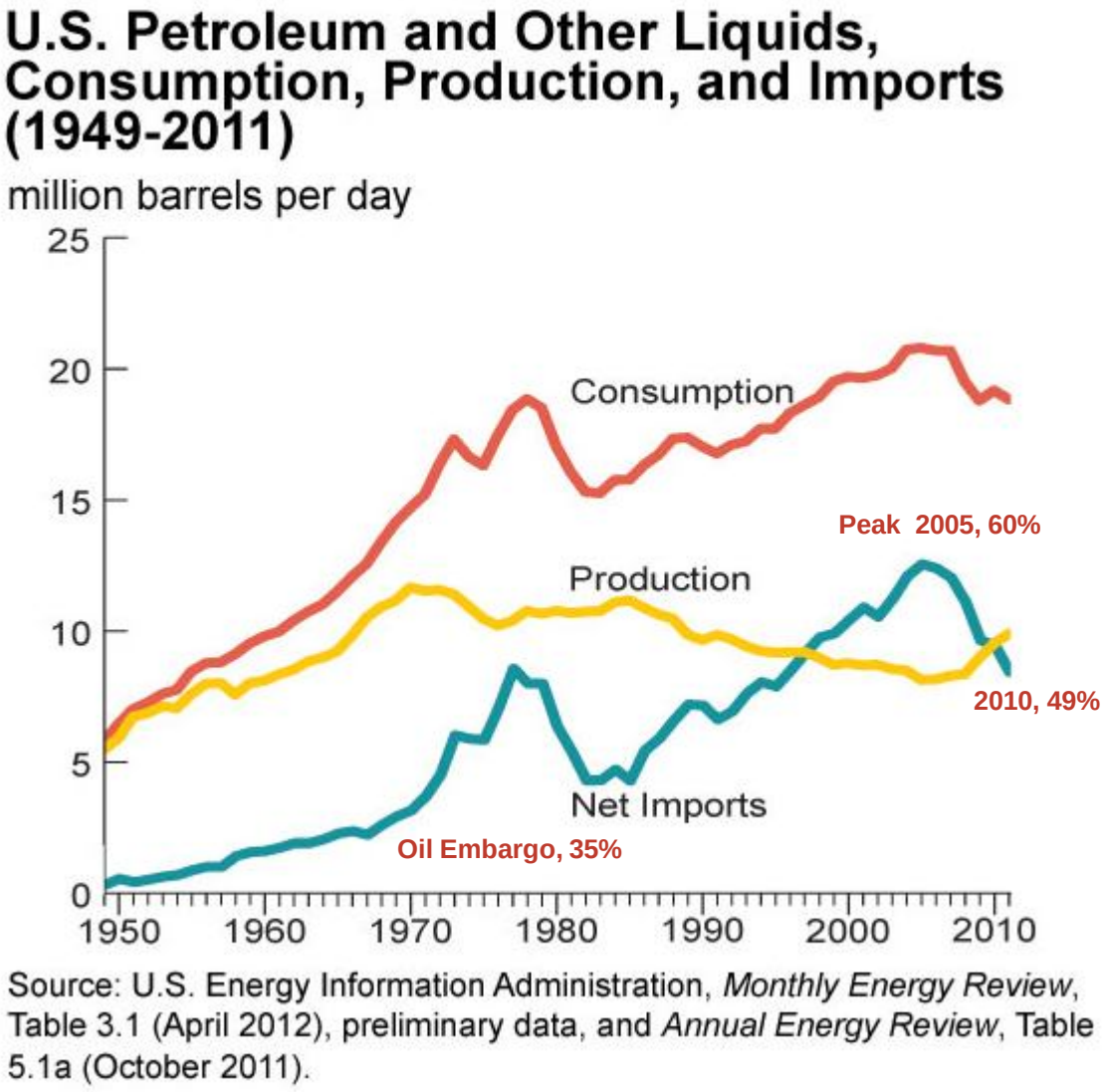
Aspects of energy security

- Sufficient supplies at prices that do not disrupt ordinary economic activity
- Dependence on oil imports
- Vulnerability to oil price shocks
- Climate change mitigation
- Climate change adaptation
- More than oil

Dependence on imported oil is declining from 2005 peak



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 3.1 (April 2012), preliminary data, and *Annual Energy Review*, Table 5.1a (October 2011).

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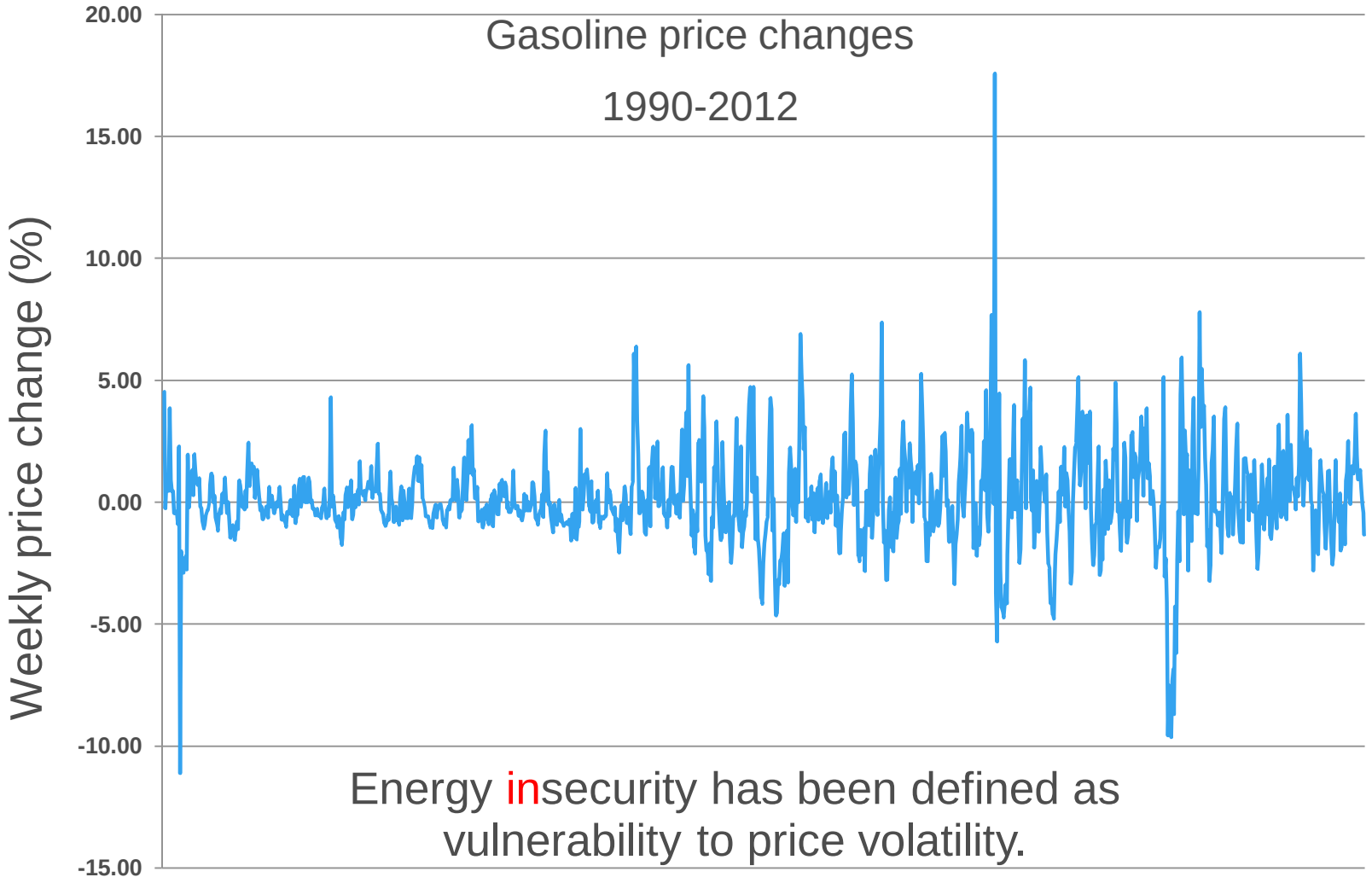
Gasoline prices have become more volatile



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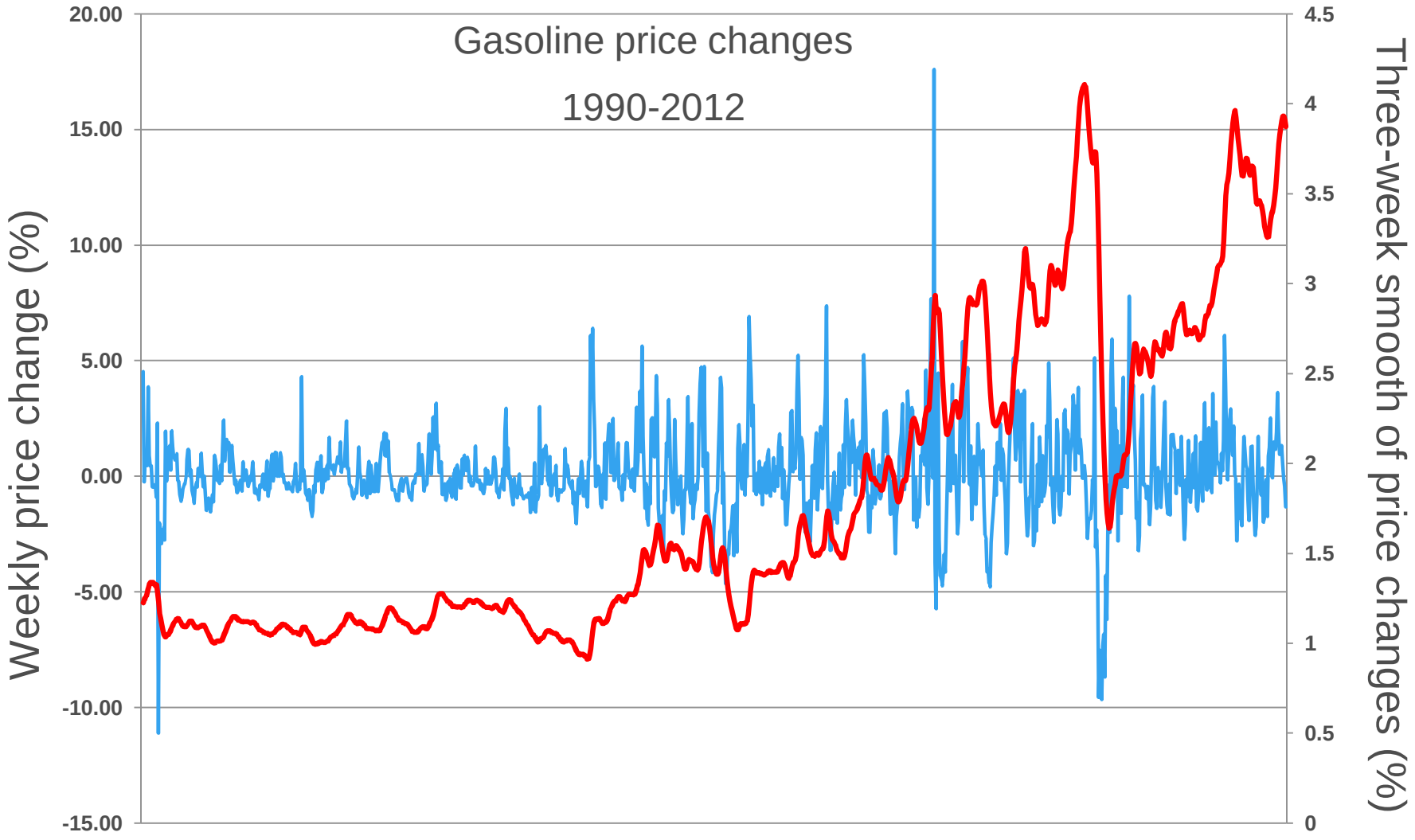

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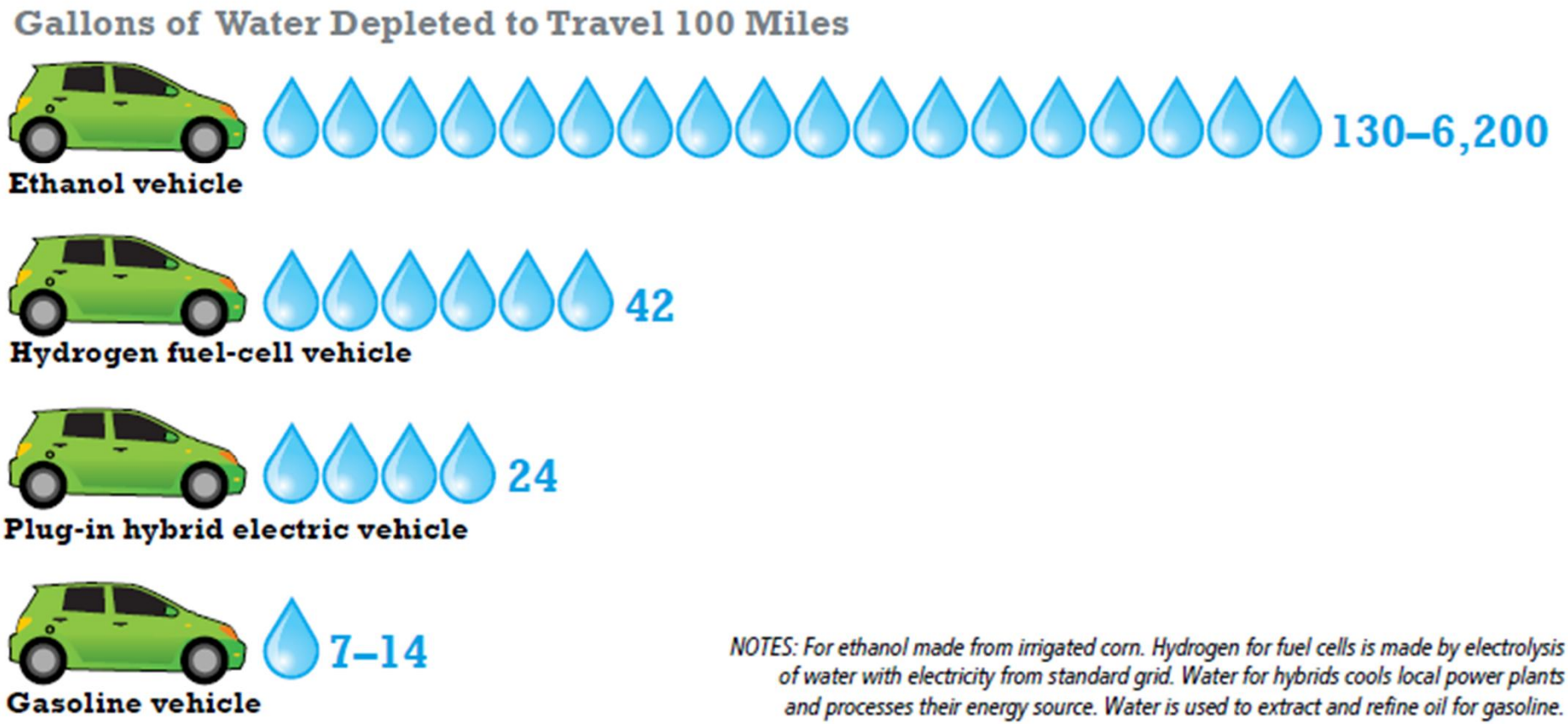
Alternative vehicles: They use less petroleum, but producing their fuel guzzles more water.



NOTES: For ethanol made from irrigated corn. Hydrogen for fuel cells is made by electrolysis of water with electricity from standard grid. Water for hybrids cools local power plants and processes their energy source. Water is used to extract and refine oil for gasoline.

Source: Webber, 2008.

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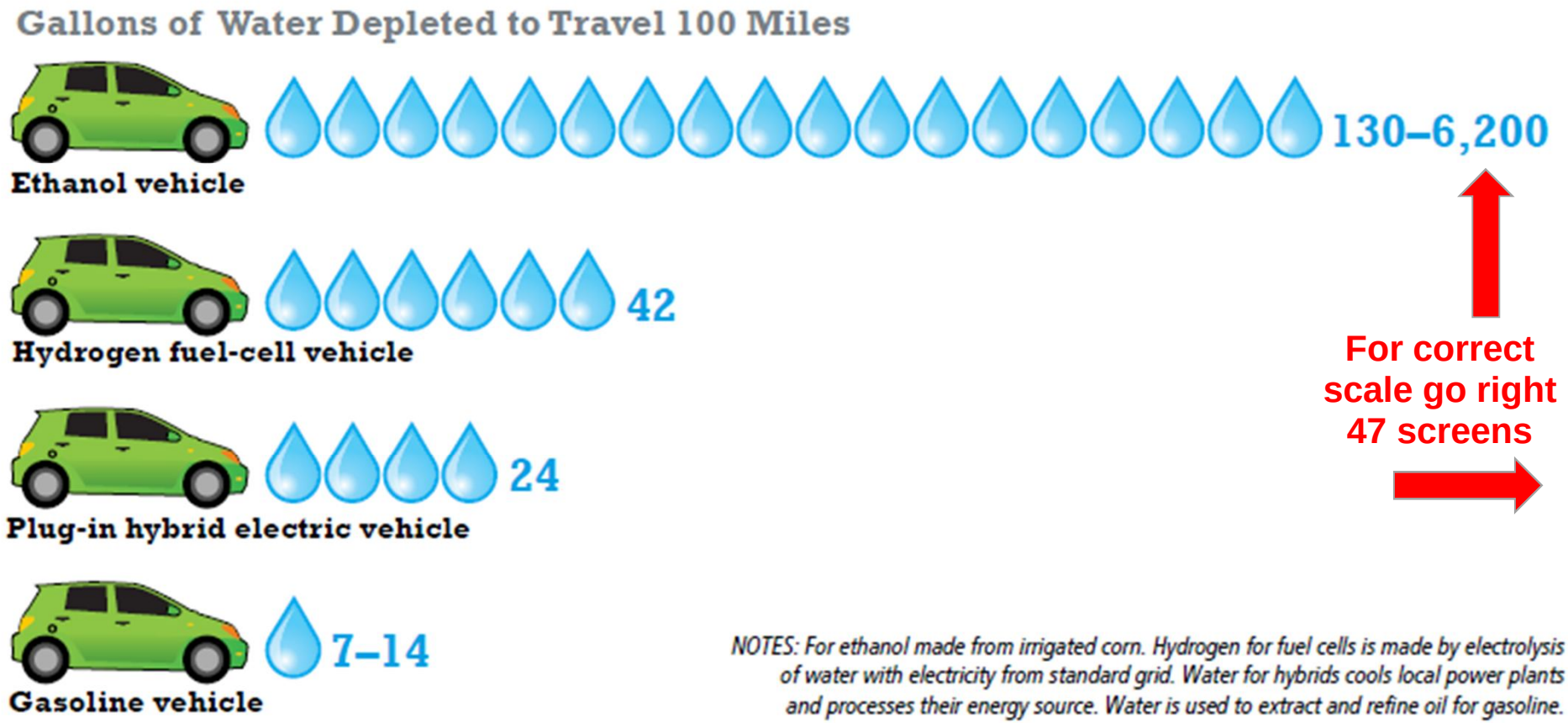

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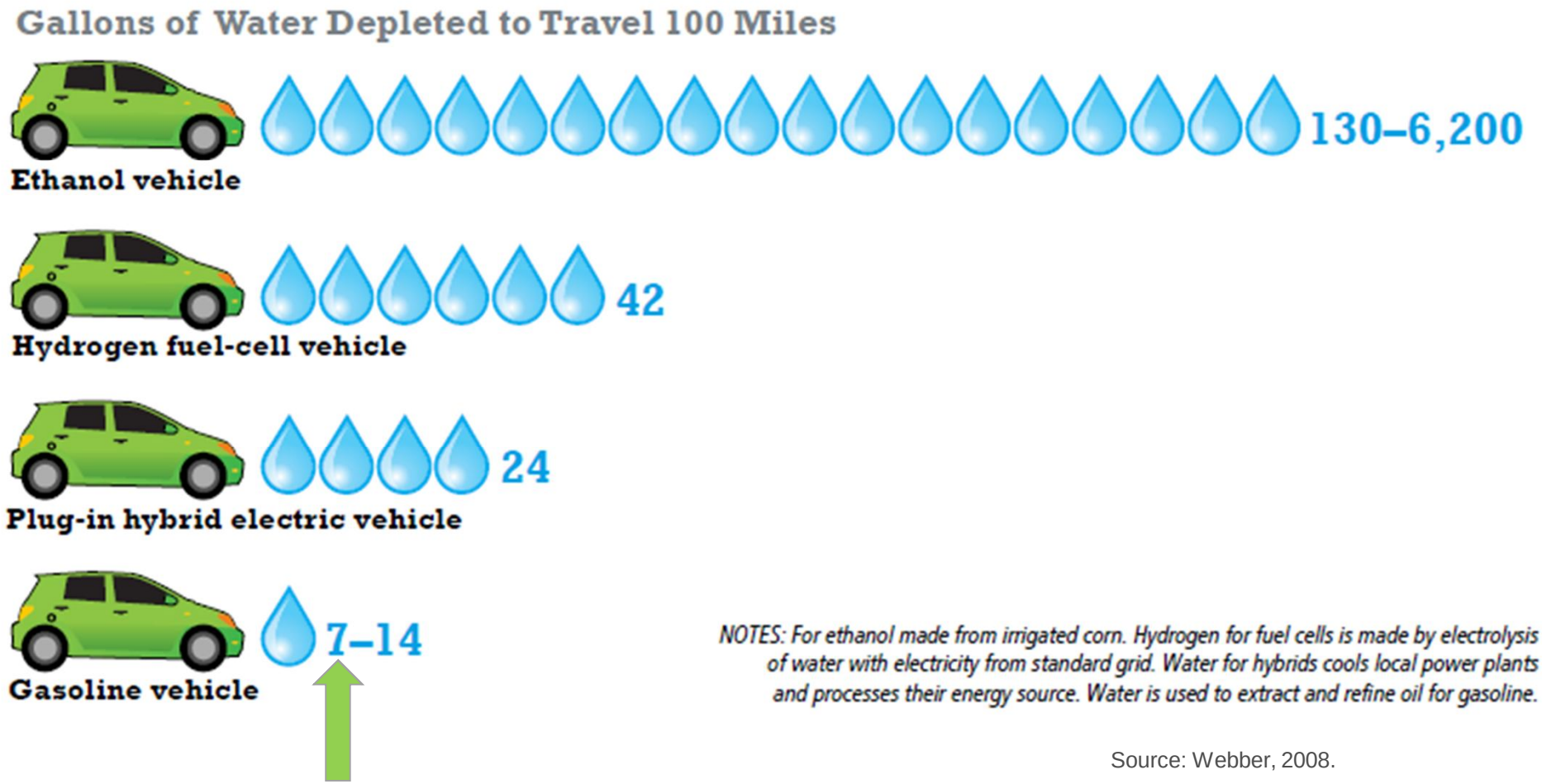

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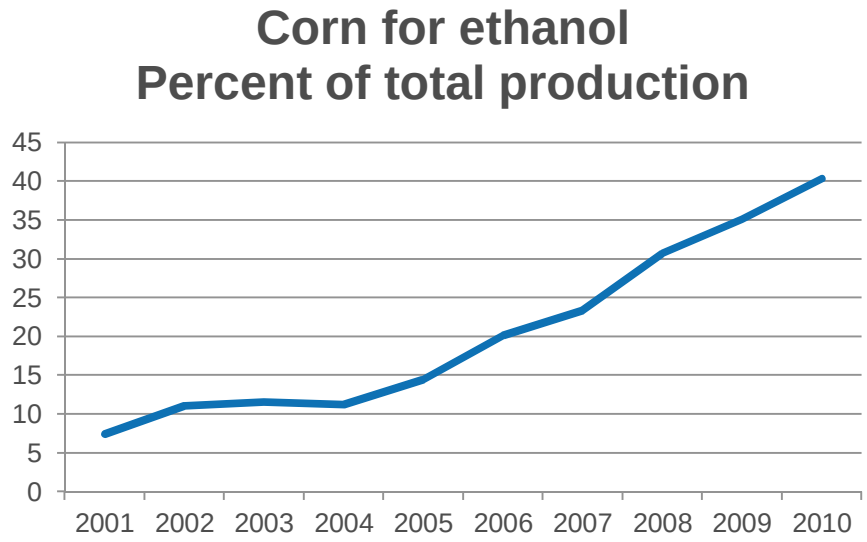
A *lot* of corn is being used for ethanol



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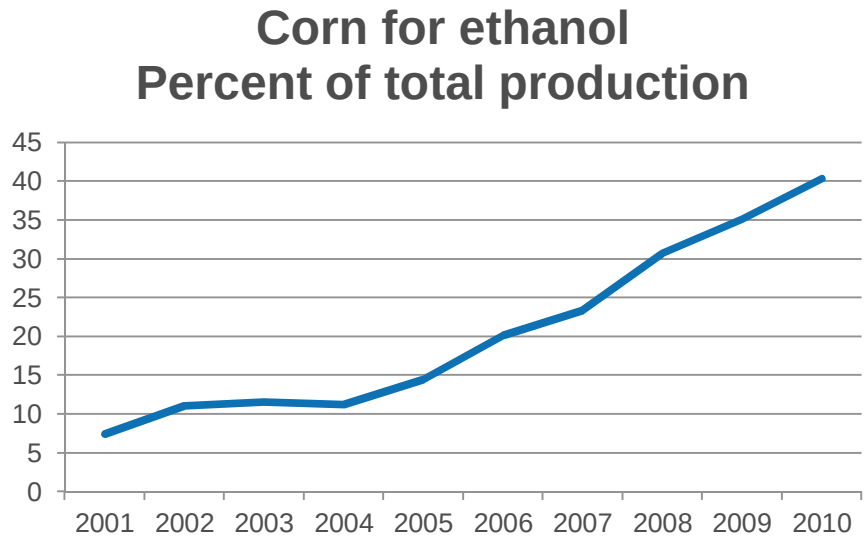
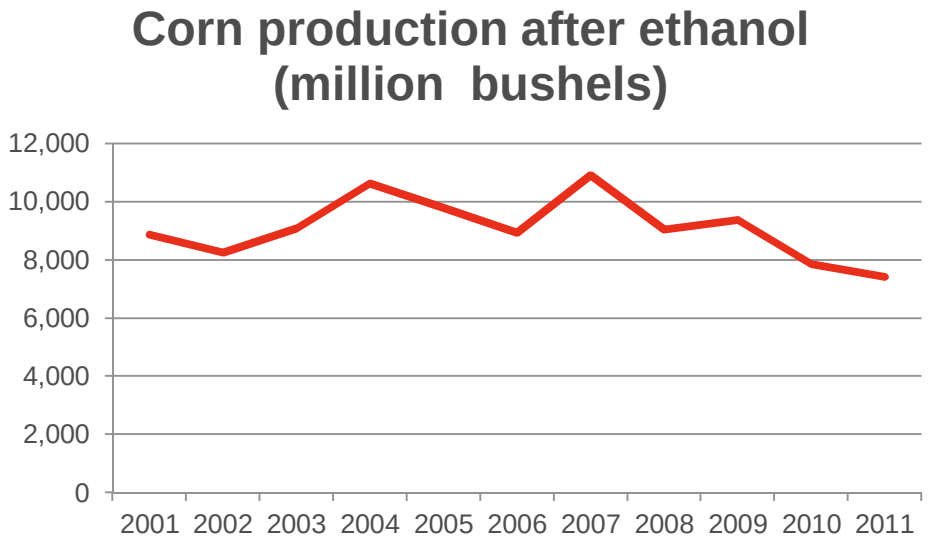


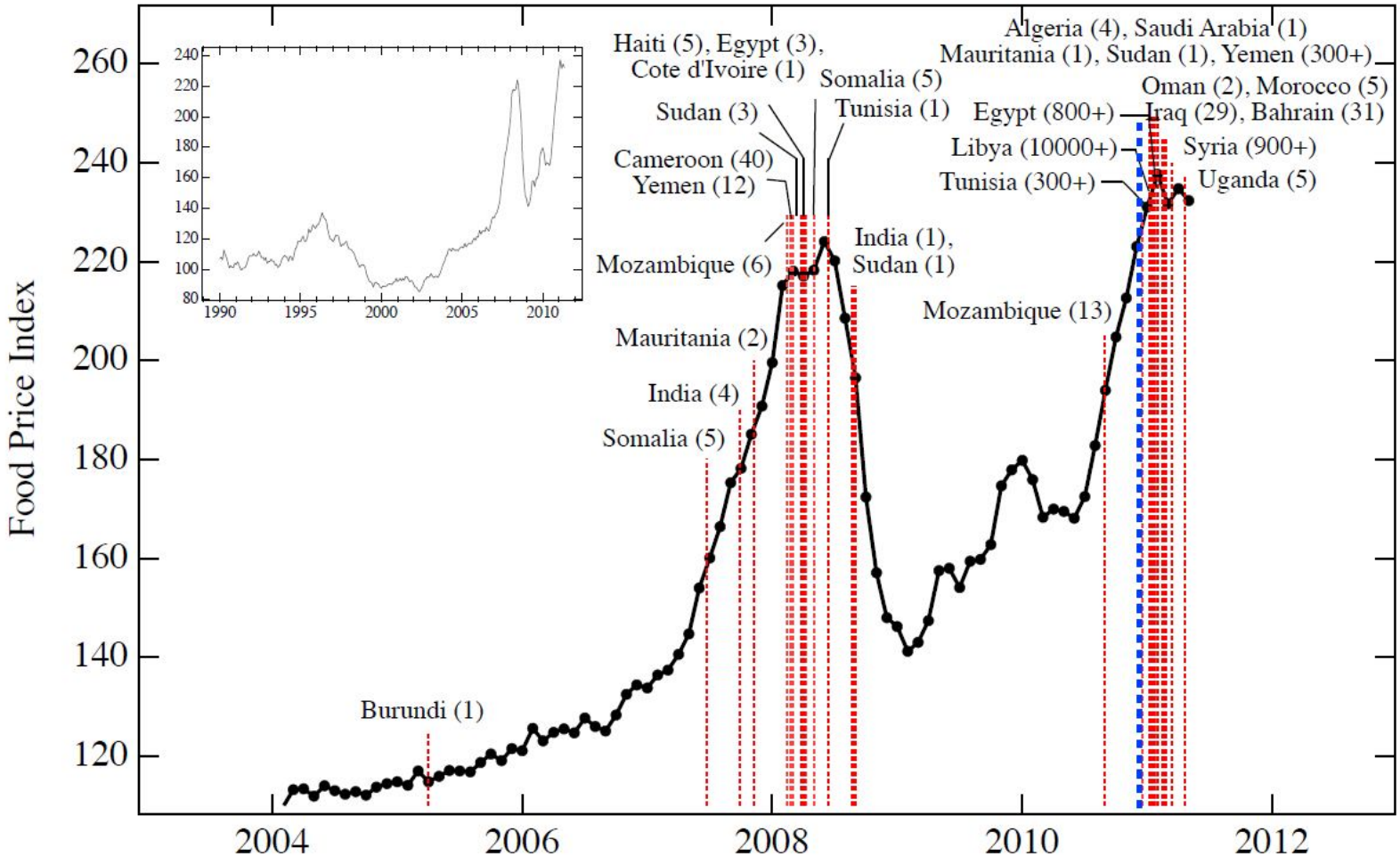


Total corn production is up 28% since 2001 but,

corn production after ethanol use is down by 8.4%

Source: Faeth, 2012

36% of food price increases due to biofuel production



Sources: Lagi, et al. 2011; Babcock and Fabiosa, 2011.

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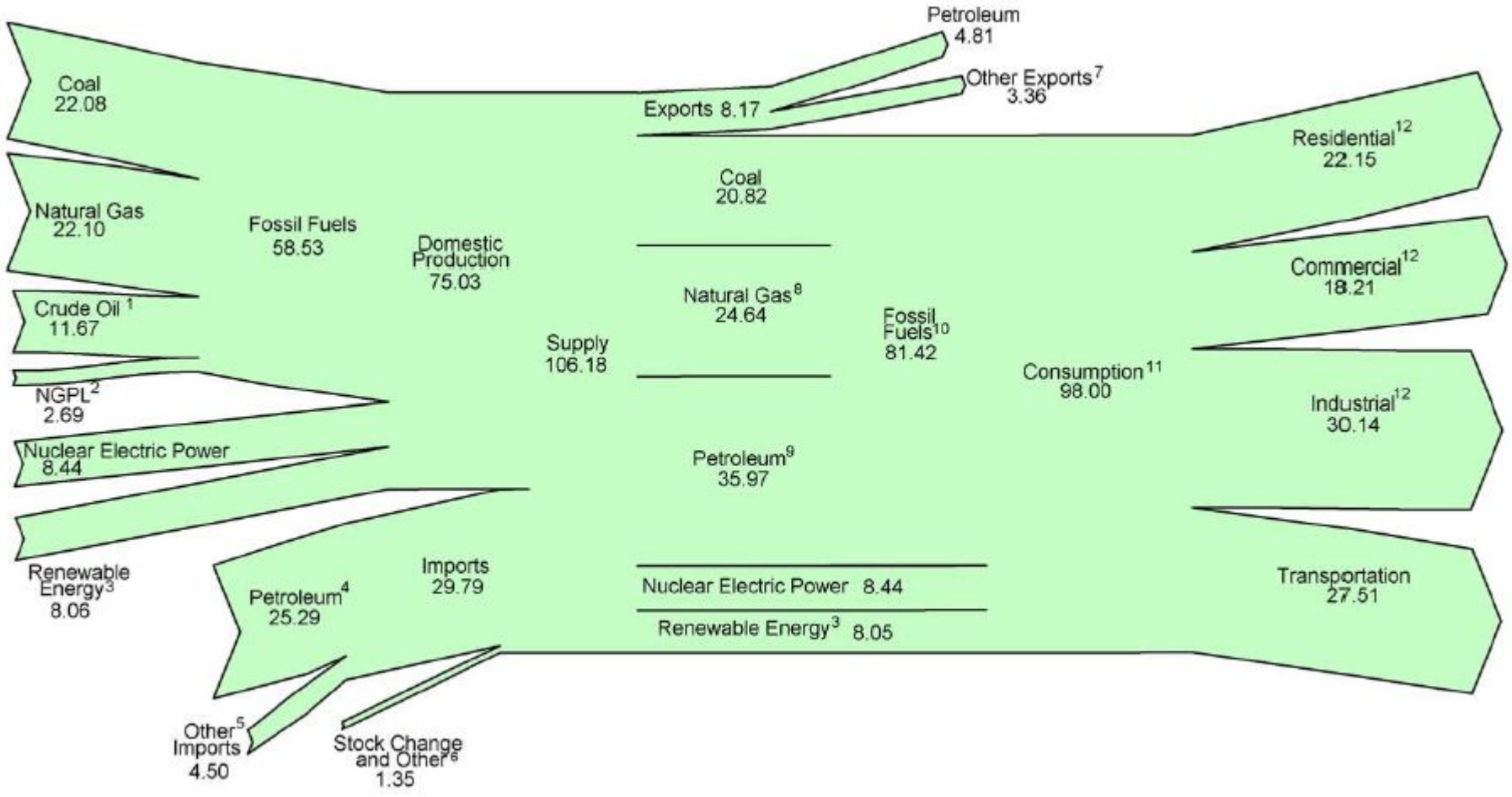
U.S. Energy Flows, 2010 (quadrillion BTUs)



Total Energy - Data - U.S. Energy Information Administration (EIA)
http://www.eia.gov/totalenergy/data/annual/diagram1.cfm

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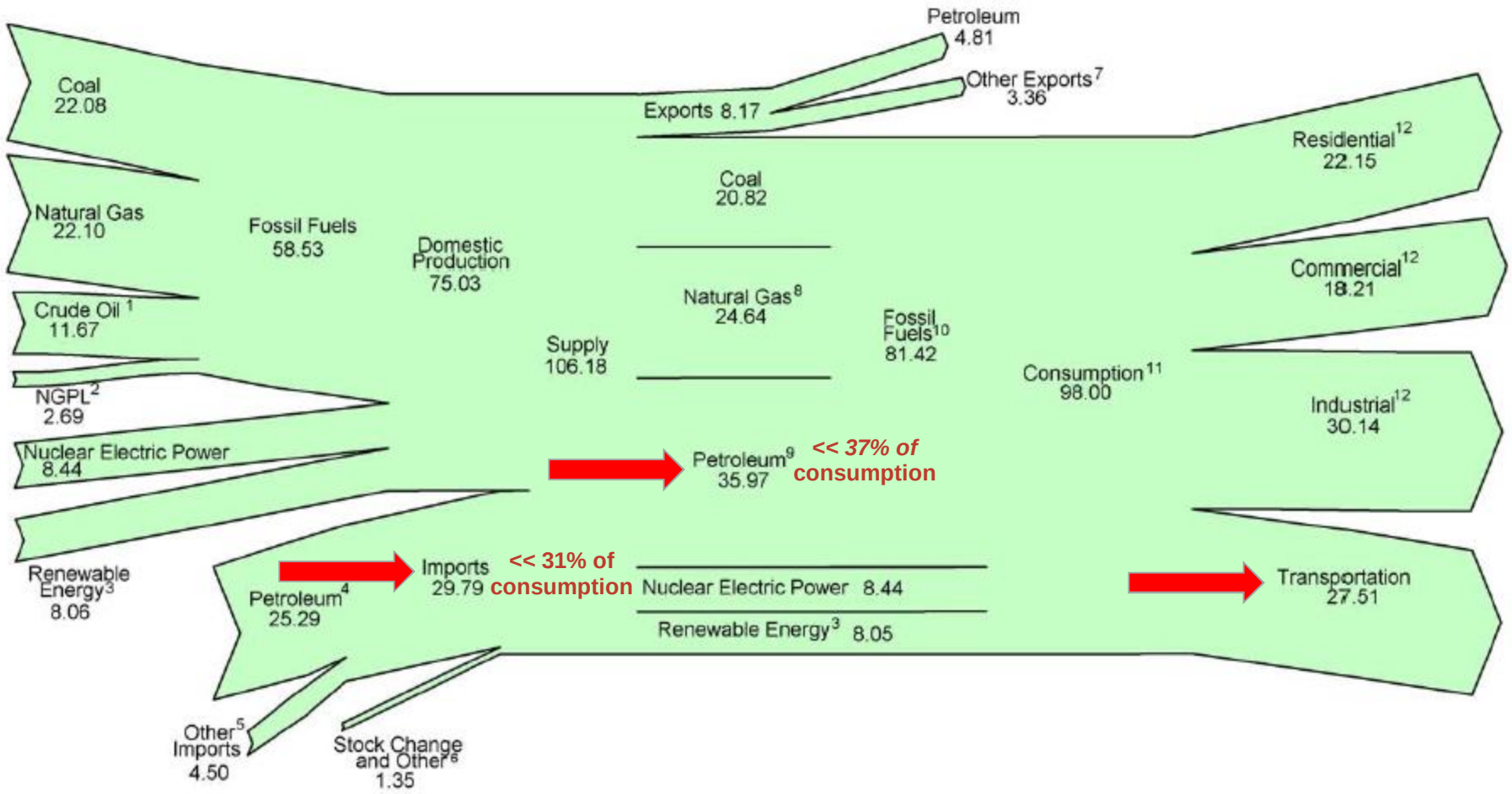

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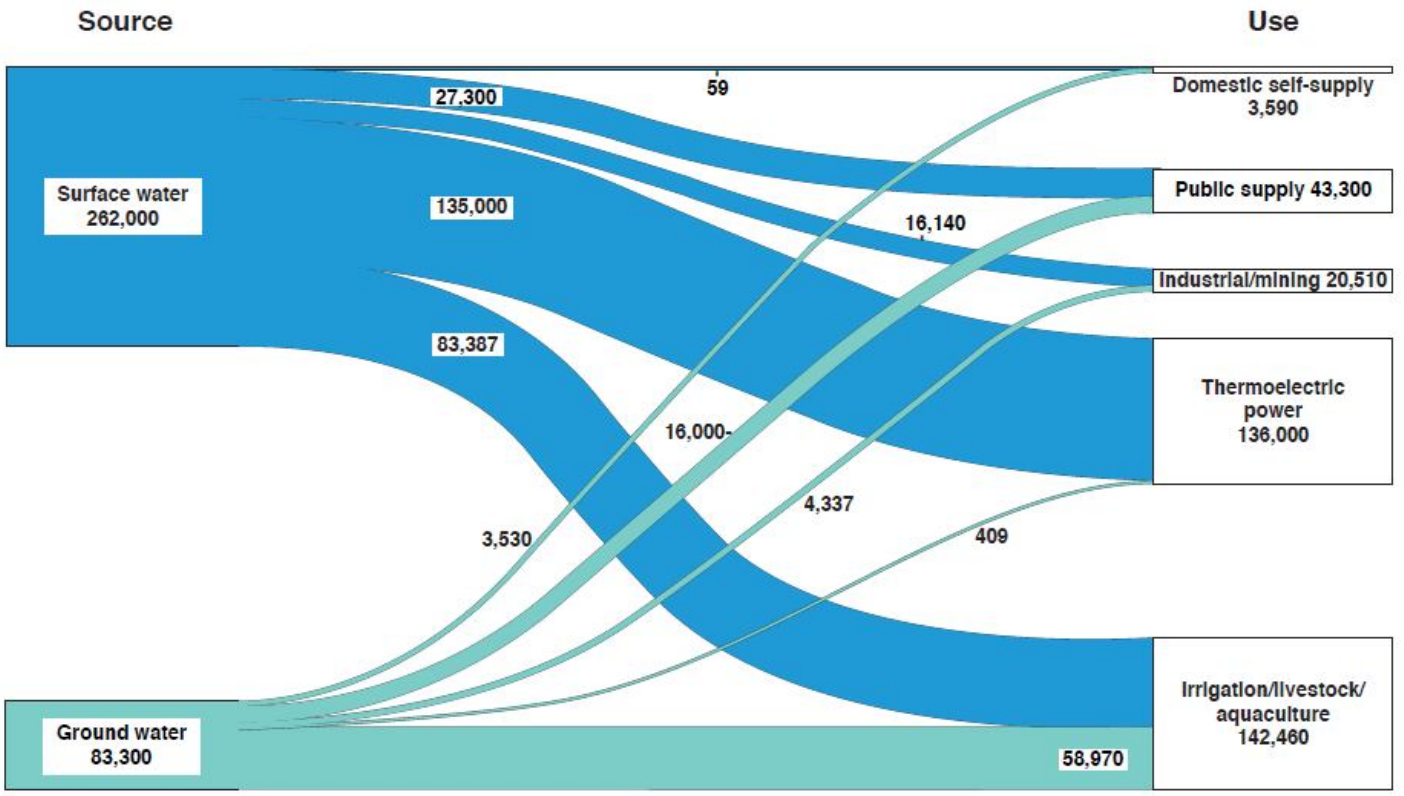
Estimated U.S. Freshwater* Withdrawals in 2000: ~345,000 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.
*In addition, 62,300 Mgal/day of saline water was withdrawn, primarily for thermoelectric use.
Note: Numbers shown may not add to totals because of independent rounding.

Lawrence Livermore National Laboratory, May 2004
http://eed.llnl.gov/flow

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Water Required to Generate One Megawatt-hour of Electricity Using …

Gas/steam combined cycle 7,400–20,000 gallons

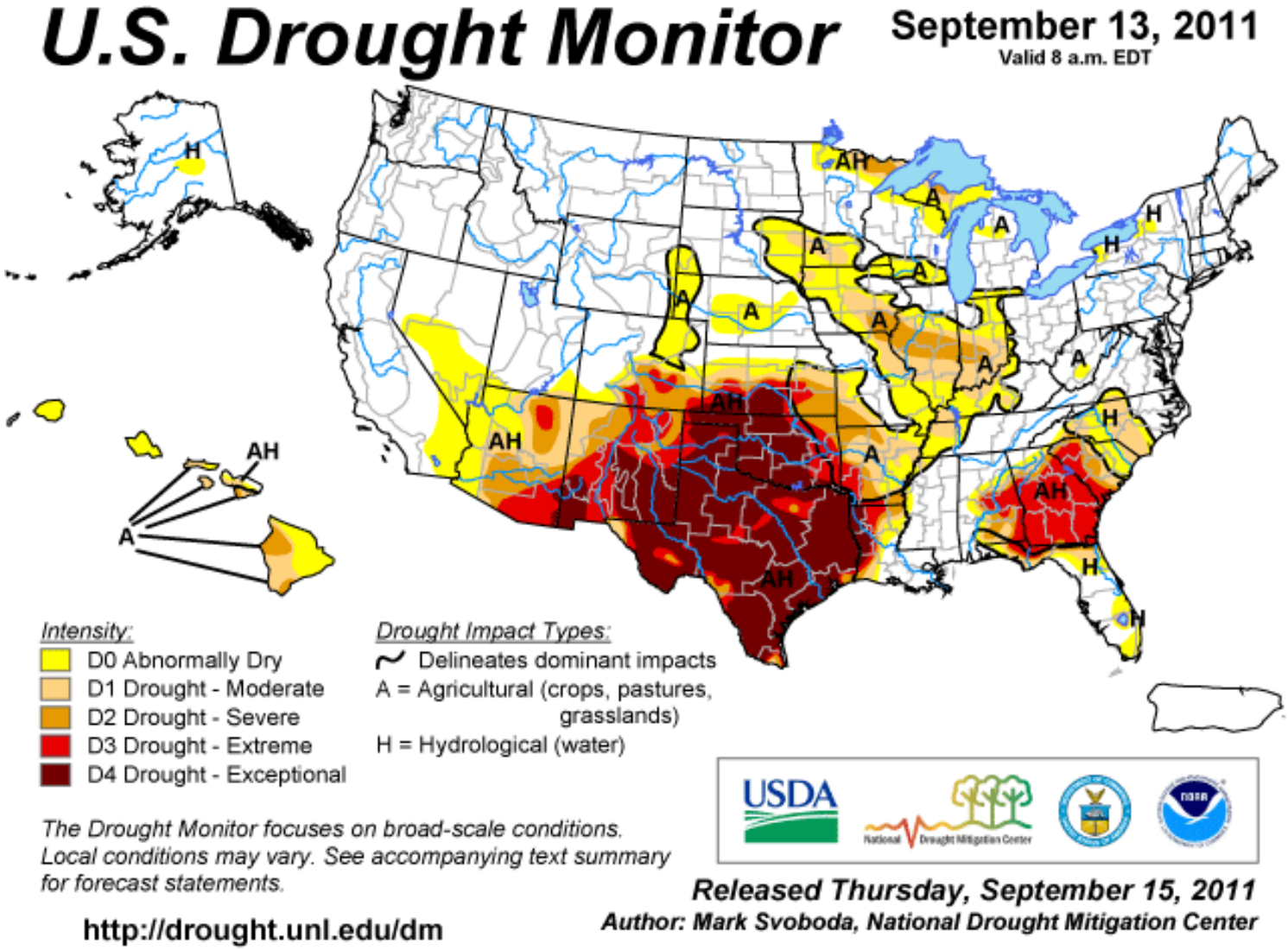
Coal and oil 21,000–50,000

Nuclear 25,000–60,000

Data are for plants that draw and dump water; plants with cooling towers use less.

Source: Webber, 2008.

Drought limited power production in Texas



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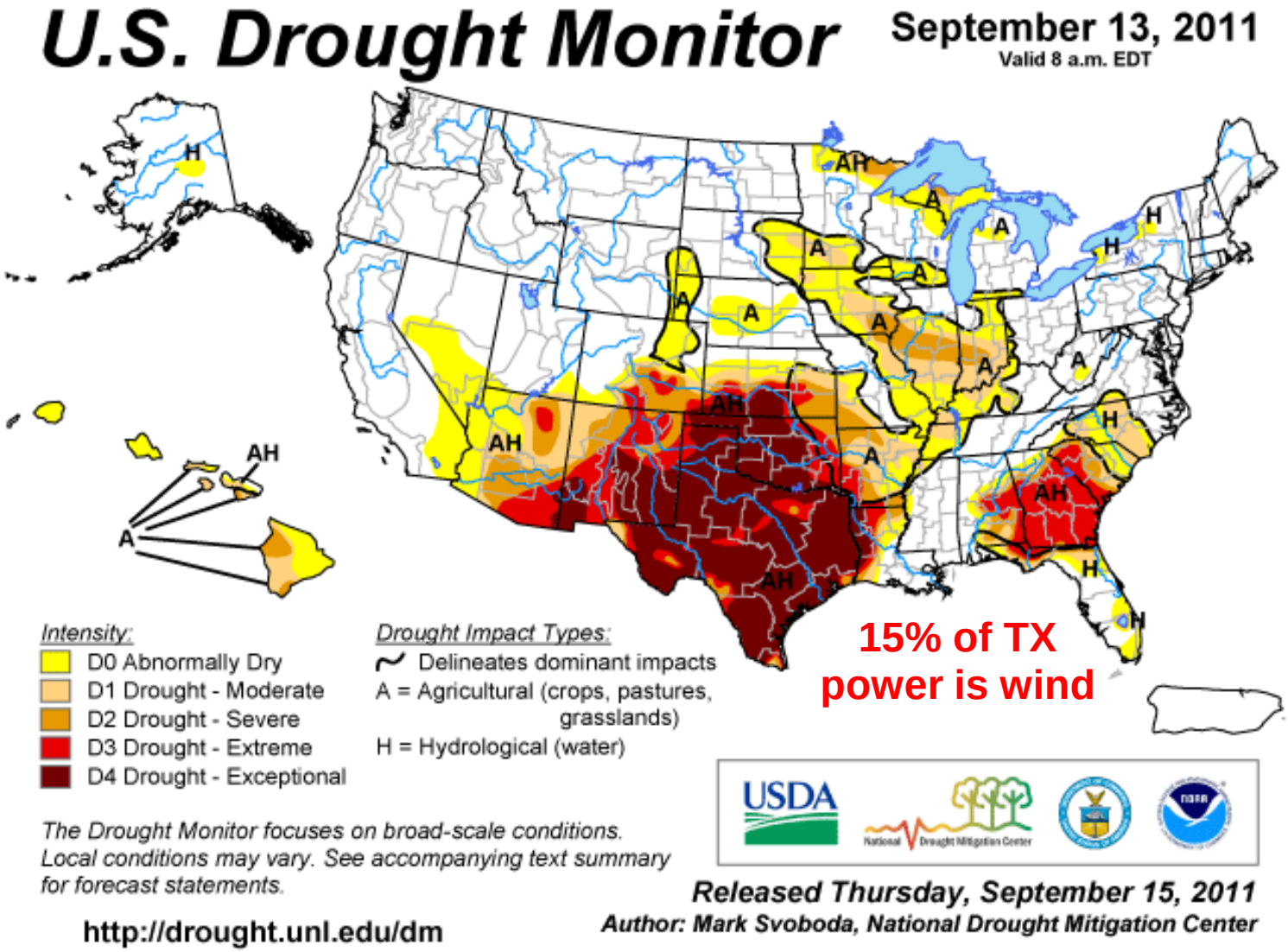
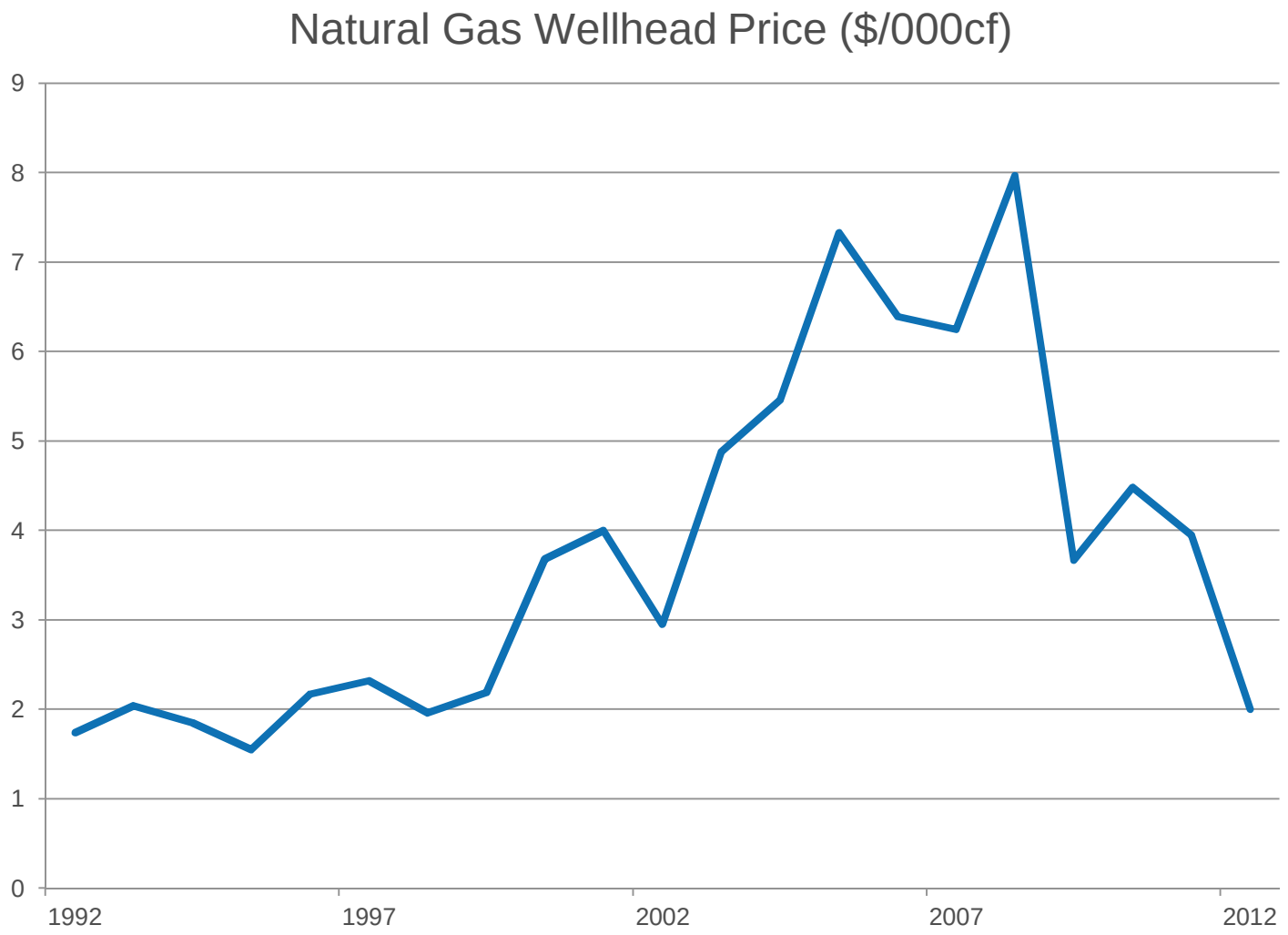
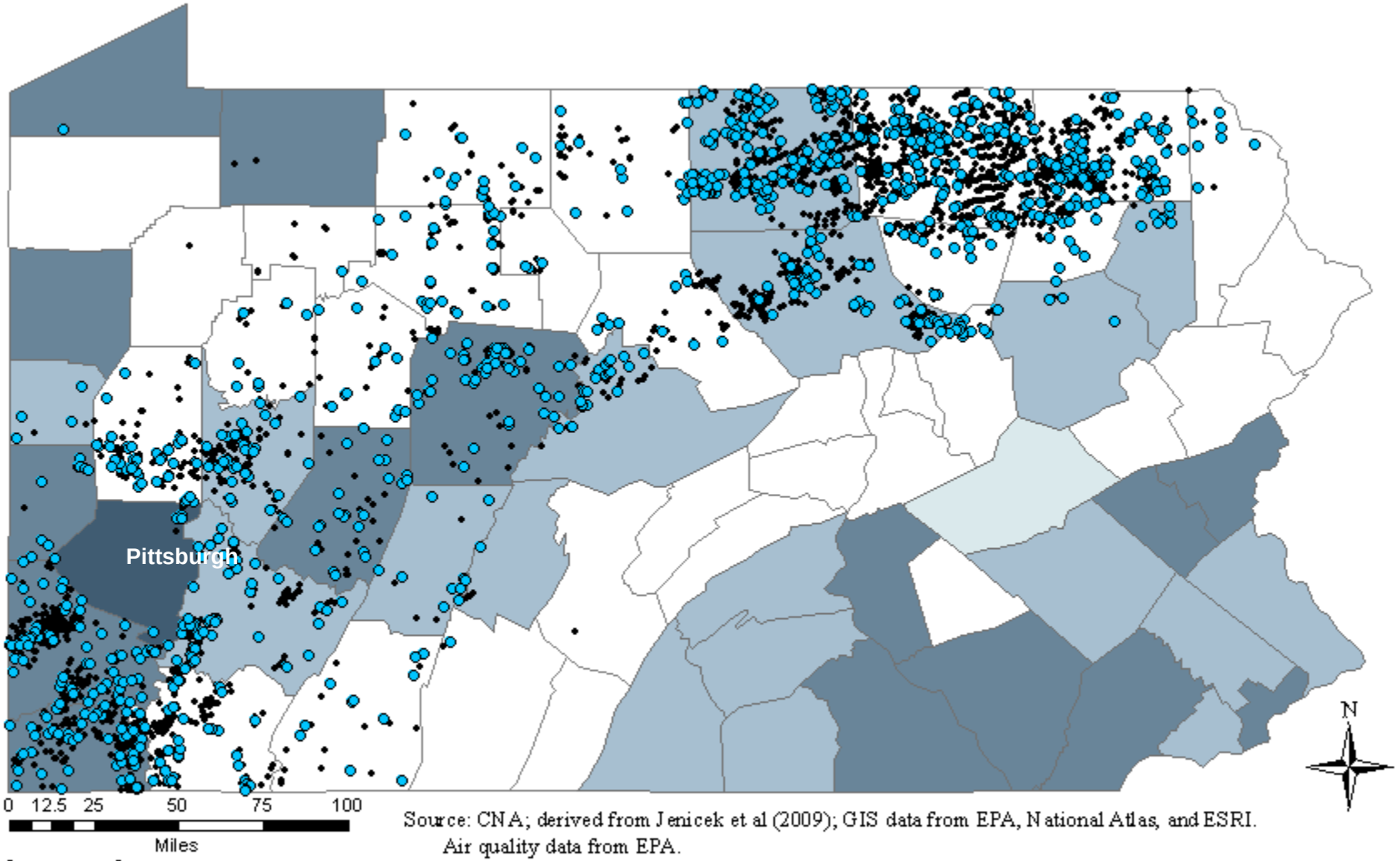
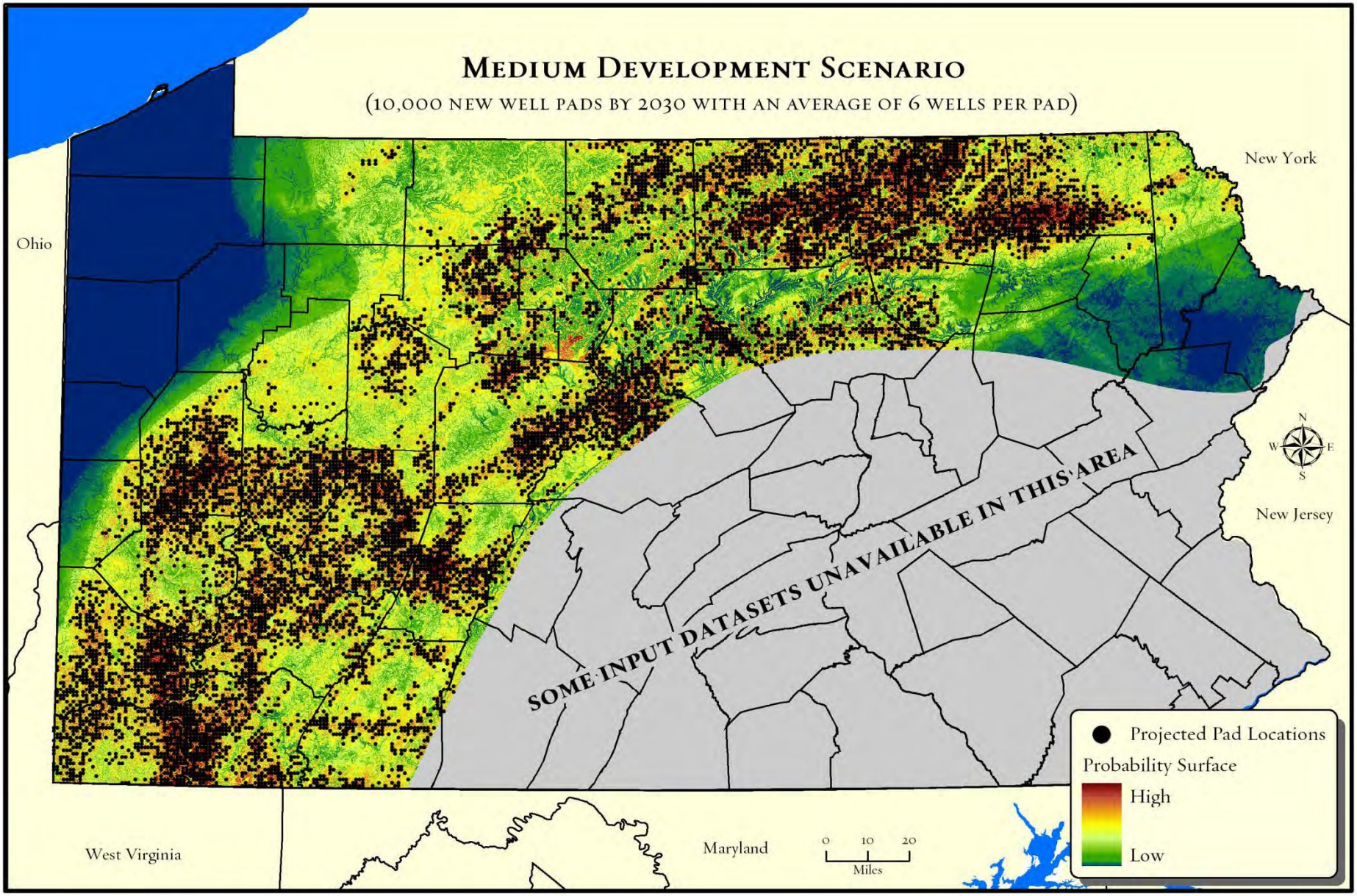


Fracking is driving down gas prices





Source: CNA; derived from Jenicek et al (2009); GIS data from EPA, National Atlas, and ESRI.
Air quality data from EPA.
Well and permit data from Pennsylvania Department of Environmental Protection.


Medium Development Scenario
(10,000 new well pads by 2030 with an average of 6 wells per pad)
New York
Ohio
N
W
E
S
New Jersey
SOME INPUT DATASETS UNAVAILABLE IN THIS AREA
Projected Pad Locations
Probability Surface
High
Low
West Virginia
Maryland
0 10 20
Miles

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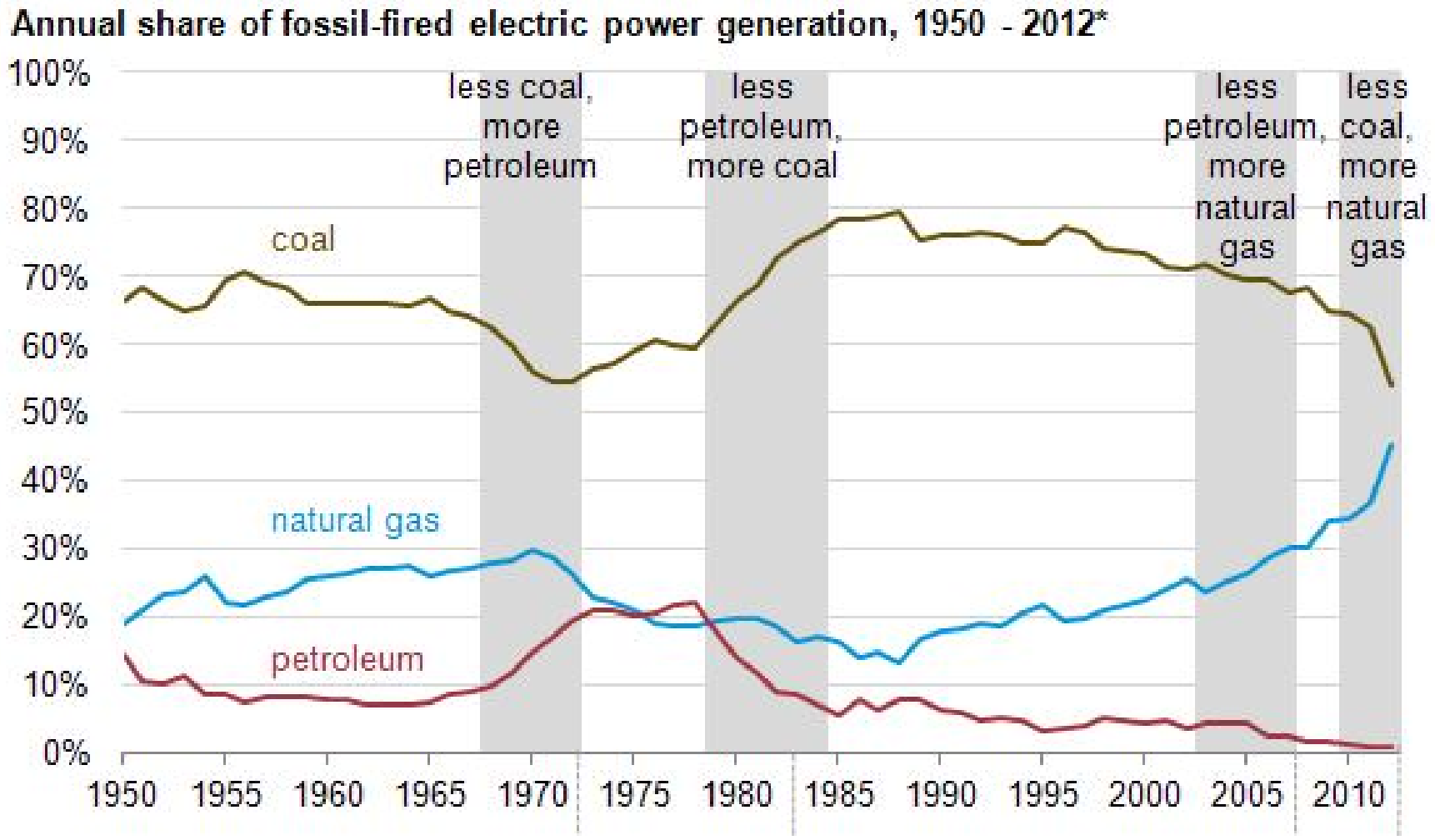
The share of gas in electric power is at an historic high.



Source: EIA, 7/13/2012

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Cost and environmental factors for power generation

Energy technology	Average levelized cost of electricity, $/MWh	Median water withdrawal by cooling type, gal/MWh	Median water consumption by cooling type, gal/MWh	CO_2, lb/MWh
Existing				
Conventional coal	62	531 - 36,350	471-250	1,886
Nuclear	59	1,101 - 44,350	672-269	—
New				
Conventional coal	95	531–17,914	493–779	1,886
Advanced coal	109	390	372	1,755
Advanced coal + CCS	126	596	540	206
NGCC	66	253	198	797
NGCC + CCS	89	496	378	86
Wind, onshore	97	—	0	—
Efficiency	25	—	0	—

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