

“FRACKING”

The Transformation of the Energy Landscape

Affordable Energy Essential For:

- Economic Growth
- National Security
- World Leadership Position
- Quality of Life
- Social Justice and Equality For All
- Balance Interests of All Stakeholders
- Both Now and Forever (Sustainable)

Other Energy Assumptions

- An energy shortage, but no shortage of energy
- Long term plans that balance a wide range of interests /stakeholders
- All forms of energy have environmental impact
- The future is more, not less!!!!
- Our lives are increasing electronic!
- Energy Independence needed
- Effective governmental policies
- Energy Time(decades) VS Political Time (2/4yrs)

Energy Landscape

- Natural Gas/Propane
- Oil/Gasoline/Ethanol
- Coal
- Nuclear (Electrical)
- Wind/Solar/BioFuels
- Hydro/Geothermal
- Hydrogen Fuel Cells
- Other

Natural Gas/Electricity

- Natural gas – a fossil fuel
- Gas turbines are commonly used when electricity utility usage is in high demand. (Peakers)
- In 2008, about 21% of the Nation's **electricity** was fueled by natural gas.
- 1/2 the CO2 emission of Coal
- Very versatile fuel



Natural Gas/Propane

- A fossil fuel (emits $\frac{1}{2}$ of CO₂ emissions/coal)
- Commonly used as electrical prod. peakers
- Versatile energy (electricity, home, water heaters, stoves, factories, transportation etc.)
- Fracking: 100 years @ today's consumption?
- Stored/used as LNG/CNG
- Propane(LP): by-product of NG/petroleum production- not easily adjusted to meet increased demand-not as clean as NG

Petroleum

- **Petroleum** – A fossil fuel
- Residual fuel oil, a product refined from crude oil.
- Petroleum was used to generate just over **1% of all electricity** in the United States in 2008.
- Fossil fuel is the dirtiest form of energy.
- Will be around for many years to come especially in the **transportation area.**



Gasoline

- One barrel of oil = 42 gallons of Gasoline
- Primary use: internal combustion engines
- 250 million vehicles on road in USA (globally: 2 billion vehicles) will be around for a while
- Stable if stored properly
- Emits hydrocarbons
- High octane rating (no-lead)
- Takes additives readily (ethanol/detergents etc,)

Ethanol

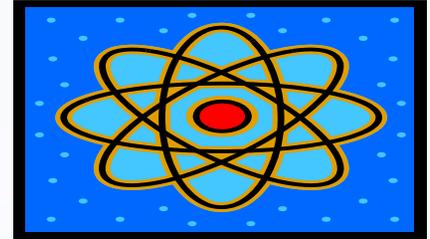
- Renewable energy source (mostly corn), “American”
- Less CO than gasoline (E10 required by law)
- Drive up corn prices for Ag related revenues
- Processing means more factories and labor
- Consumes more energy than overall output
- Over inflated food prices
- Highly corrosive/hard on engines
- E85 mileage drops 25-30% (transportation costs up)
- Environmental impact may be more than fossil fuels (deforestation, food depletion, fertilizer, fuel, etc.)

Coal- A Fossil Fuel/

- **Coal** is the most common fuel for generating electricity in the United States. In 2008, nearly half (**48%**) of the Country's 4.1 trillion kilowatt hours of electricity used coal as its source of energy.
- **600 coal plants-** avg. age is 42 yrs.
- “Clean Coal” energy a viable option
- **82% of CO2 for electrical gen. is from coal**



Nuclear



- **Nuclear power** is a method in which steam is produced by heating water through a process called **nuclear fission**. In a nuclear power plant, a reactor contains a core of nuclear fuel, primarily uranium. **When atoms of uranium fuel are hit by neutrons, they fission (split) releasing heat and more neutrons. Nuclear power (104 RX) was used to generate about 21% of all the Country's electricity in 2008.**

Solar

- **Solar power** is derived from energy from the sun. There are two main types of technologies for converting solar energy to electricity: **photovoltaic (PV) and solar-thermal electric.** PV conversion produces electricity directly from sunlight in a photovoltaic (solar) cell. **Solar-thermal** electric generators concentrate solar energy to heat a fluid and produce steam to drive turbines. In 2008, **less than 1% of the Nation's electricity was from solar power.**



Wind

- **Wind power is produced by converting wind energy into electricity.** Electricity generation from wind has increased significantly in the United States since 1970, but wind power remains a small fraction **of U.S. electricity generation, about 1% in 2008..**

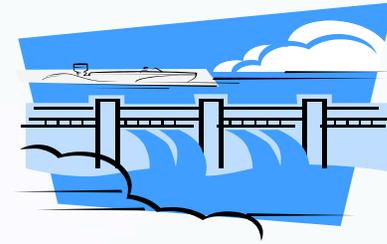


Biomass (Biofuels)



- **Biomass** - is material derived from plants or animals (i.e. biogenic) and includes lumber and paper mill wastes; food scraps, grass, leaves, paper, and wood in municipal solid waste (garbage); and forestry and agricultural residues such as wood chips, corn cobs, and wheat straw.
- Biomass accounts for about 1% of the electricity generated in the United States.
- **Ethanol** is 25% weaker than its gasoline equivalent

Hydropower



- **Hydropower**, the source **for 6% of U.S. electricity generation** in 2008, is a process in which flowing water is used to spin a turbine connected to a generator.
- All usable hydropower areas have already been used and thus has little effect on future energy supplies.

Geothermal

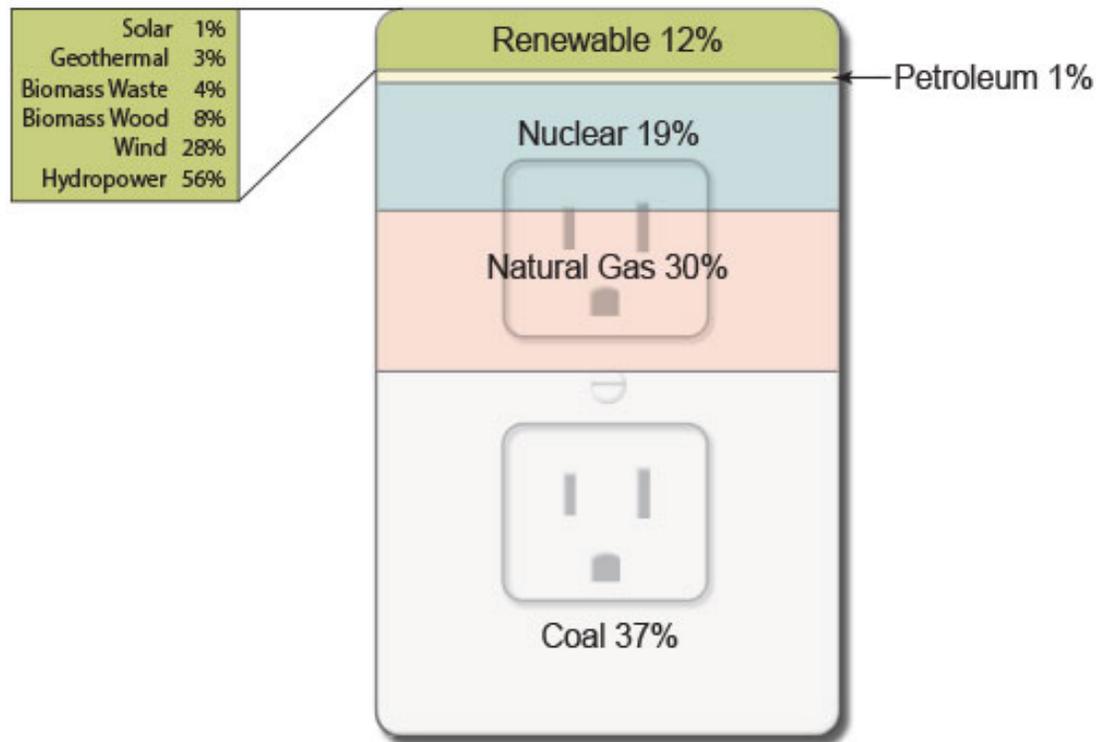
- Is thermal energy generated and stored in the Earth
- Generated less than 1% of electricity in 2012
- Geothermal power is cost effective, reliable, sustainable, and environmentally friendly,^[7] but has historically been limited to areas near tectonic plate boundaries.
- Drilling and exploration for deep resources is very expensive

Hydrogen Fuel Cells

- Hydrogen energy in vehicles mixes hydrogen and oxygen to create electricity. That means it produces zero emissions, and the car runs completely clean
- Hydrogen provides only one emission: water. This makes it an extremely clean automotive technology.
- The hydrogen fuel cell design proves to be a good idea in theory, except that one fuel cell only produces 0.7 volts of electricity.
- Fuel cells are also hard to store and distribute
- Still in developmental stages.

2012 Electrical Generation

Sources of U.S. Electricity Generation, 2012



Source: U.S. Energy Information Administration, *Electric Power Monthly* (March 2013). Percentages based on Table 1.1 and 1.1a; preliminary data for 2012.

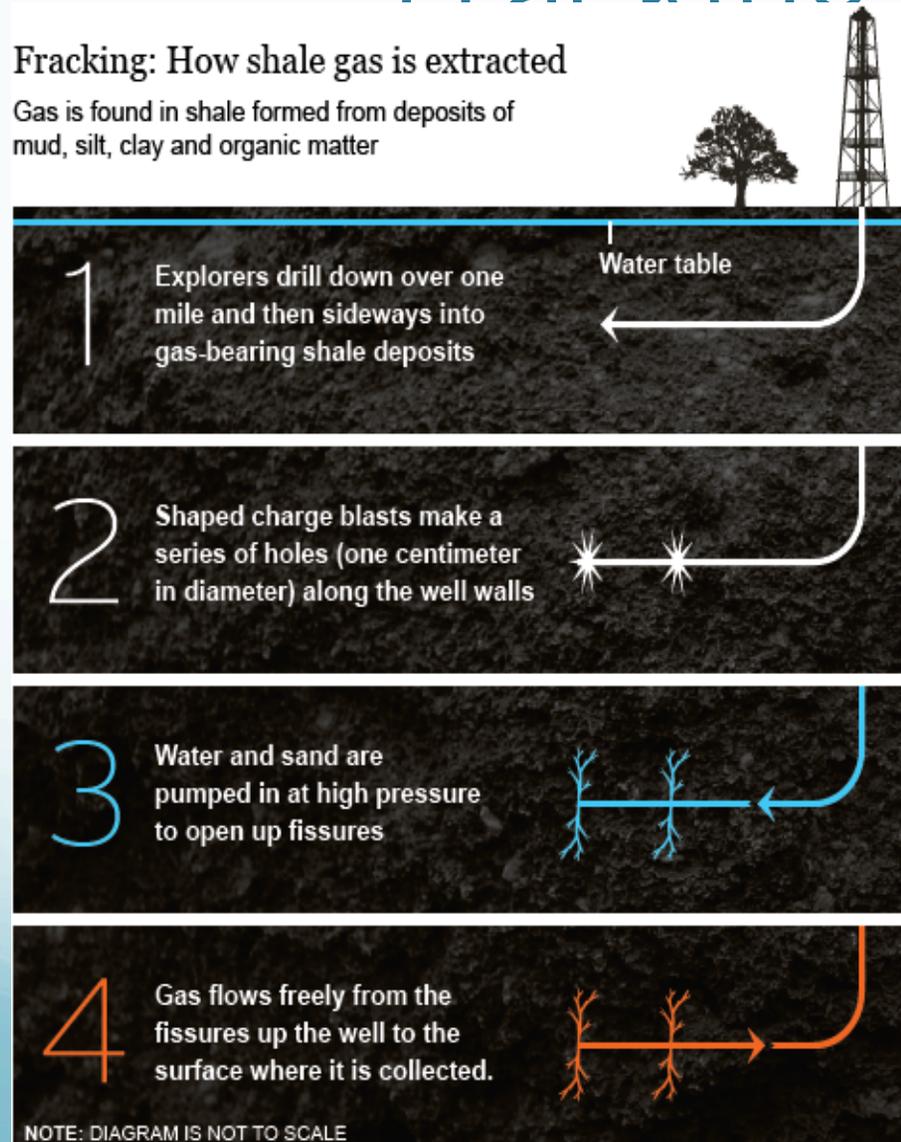
Hydraulic Fracturing (Fracking)

- First fracking experiment in 1947 (over 60 years ago)
- Technology exponentially improved over that time – used in hard to get areas for oil and gas (shale rock)
- Vertical and horizontal drilling (for several miles after kick off) over 1.3 miles below the earth's surface into shale rock
- Steel casings cemented in place and a perforating gun with explosive charges used to fracture rock.
- Further fracturing of rock (shock waves) by a pressurized liquid to release oil/gas called fishers
- Liquid is water, sand (99.5%) & chemical (.5%) mixture
- Liquid mixture injected in wellbore @15,000 psi & up to 100 barrels of liquid per minute

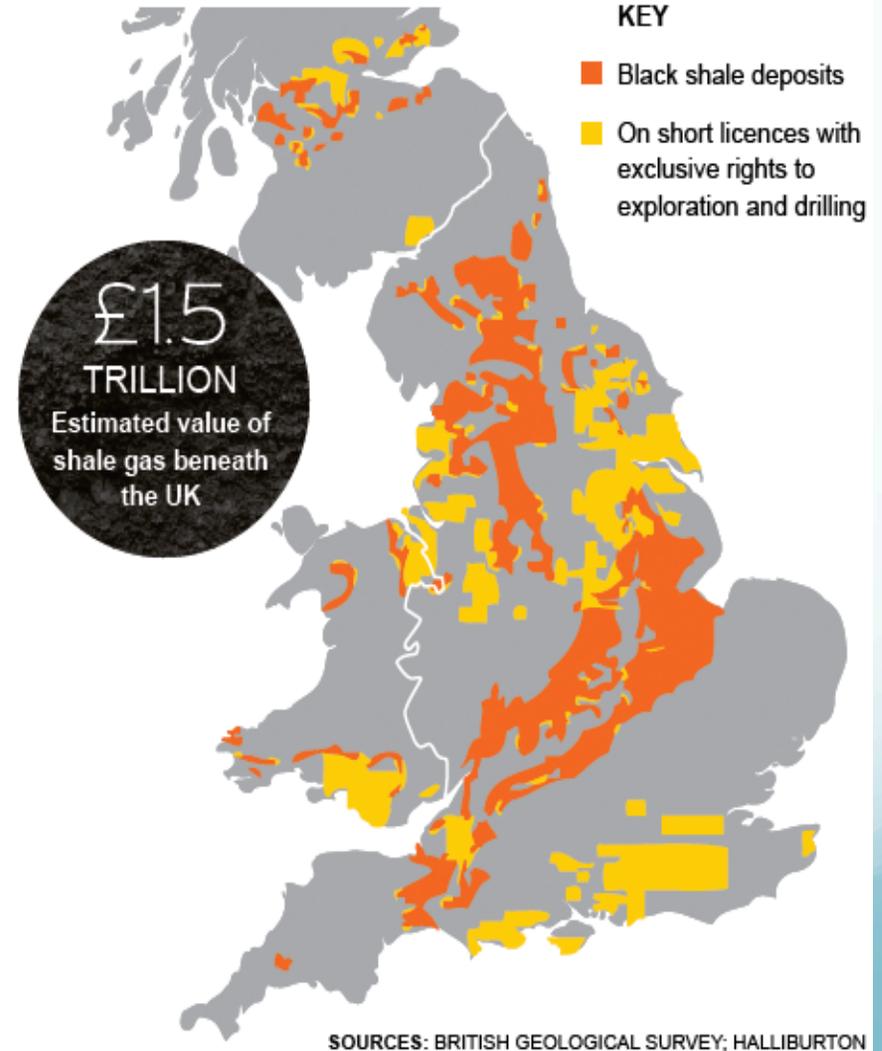
Fracking Wellbore

Fracking: How shale gas is extracted

Gas is found in shale formed from deposits of mud, silt, clay and organic matter



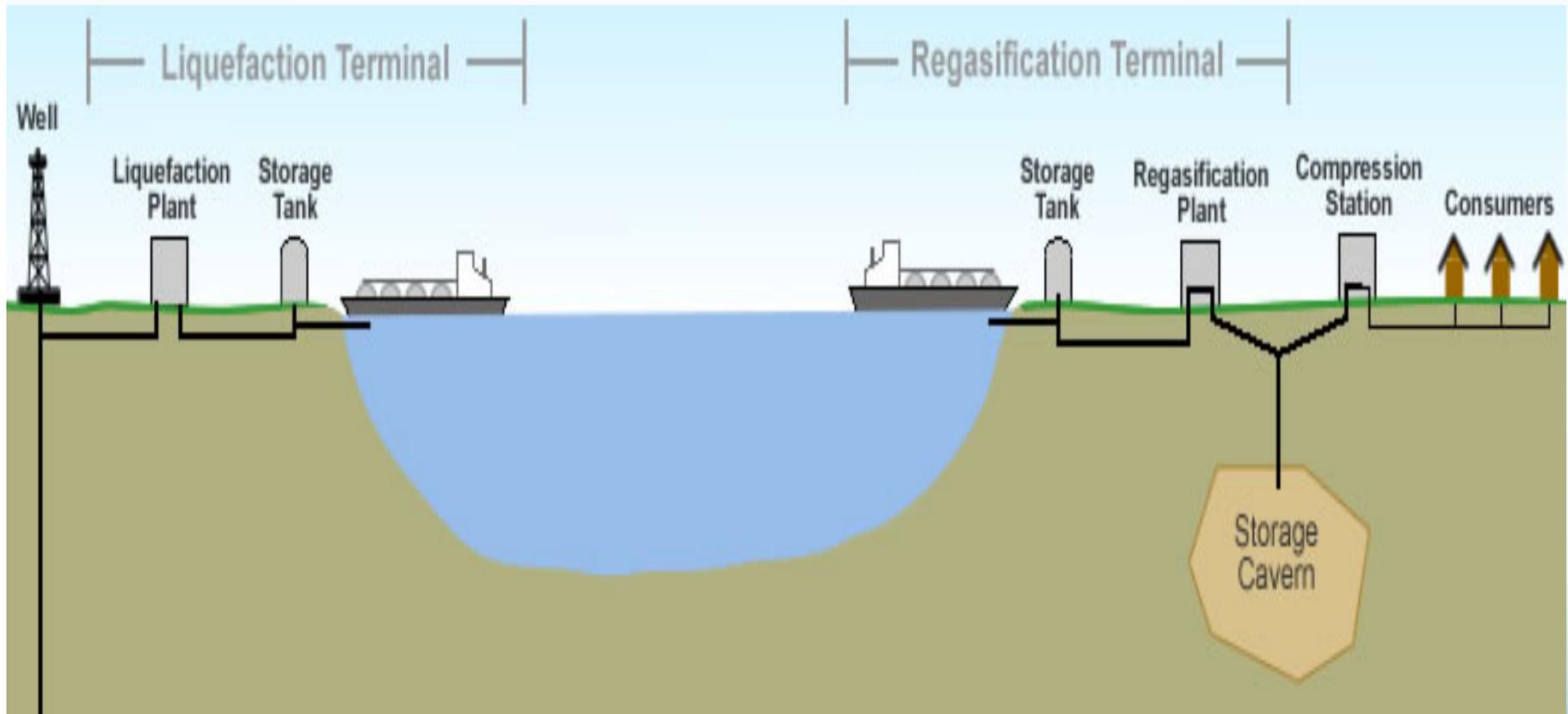
UK shale formations



Fracking continued

- Steel Wellbore casings cemented in place multiple times for leak safety
- Done correctly - no leaking into water table
- Drinking wells approx. 300-1000 ft. below earth
- 3-5 months for total process to be completed
- Oil/natural gas will flow 20-40 years
- Will sustain energy needs for 100 years (projected)
- 2.5 million wells in the world (1 million wells in the USA)
- May make USA energy independent in 10 years?????

Natural Gas Process

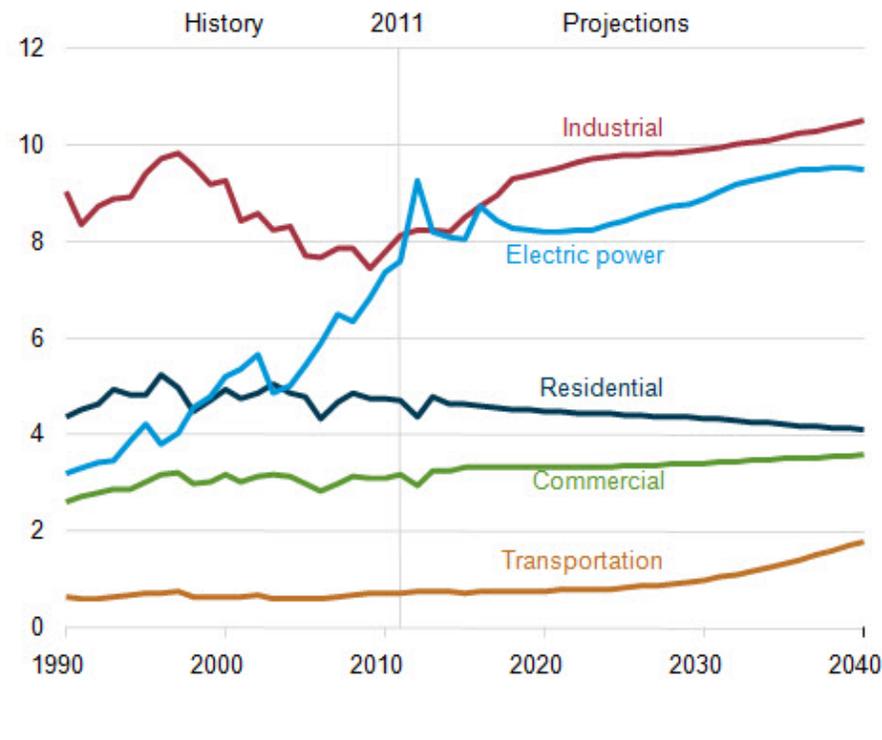


Natural Gas (LNG/NG)

- LNG -260 degrees F
- LNG-An efficient way to transport natural gas where pipelines are not available (2.4 mil mi. of pipeline in US.)
- LNG import Terminals (MD,MA(2),GA,TX,AK,LA(4))
- Regasification of LNG is usually done at a facility where the gas can be placed into storage or directly into a pipeline for transport. (add heat)
- 1 cu ft. of LNG equals 640 cu ft. NG
- CNG- used in large vehicles stored at 3100 PSIG. (2900-3600)
- NG pipeline pressure = 500 PSIG
- NG inside residential housing = 6 PSIG

Industrial and electric power sectors lead U.S. growth in natural gas consumption

Figure 85. Natural gas consumption by sector, 1990-2040 (trillion cubic feet)



Reliance on natural gas, natural gas liquids, and renewables rises as industrial energy use grows

Figure 64. Industrial energy consumption by fuel, 2011, 2025, and 2040 (quadrillion Btu)

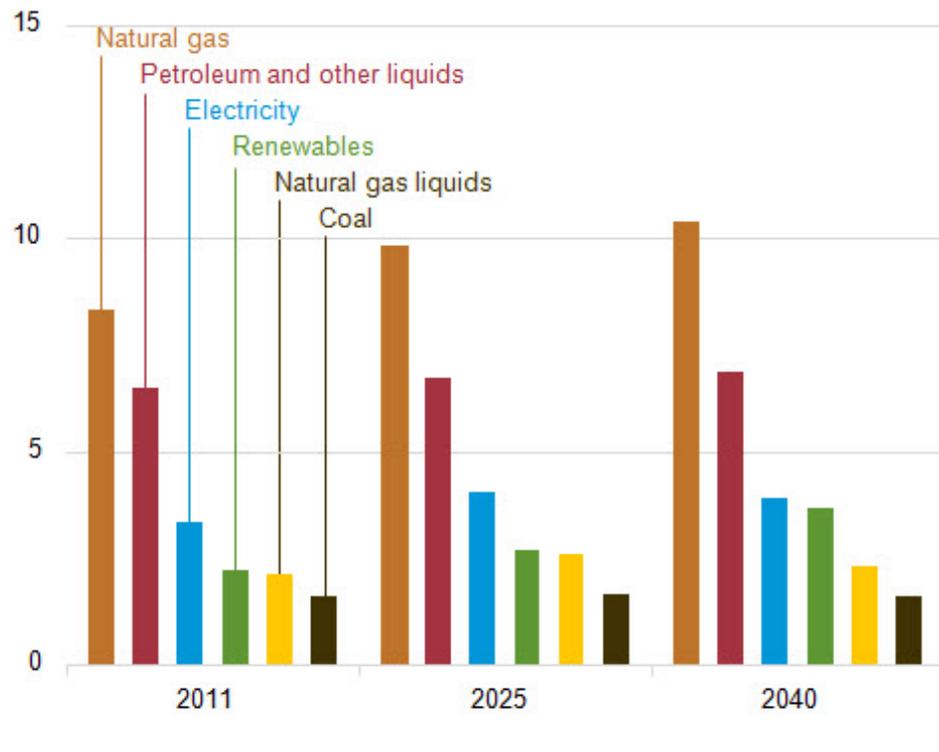


Figure 2. Total U.S. natural gas production, consumption, and net imports in the Reference case, 1990-2040 (trillion cubic feet)

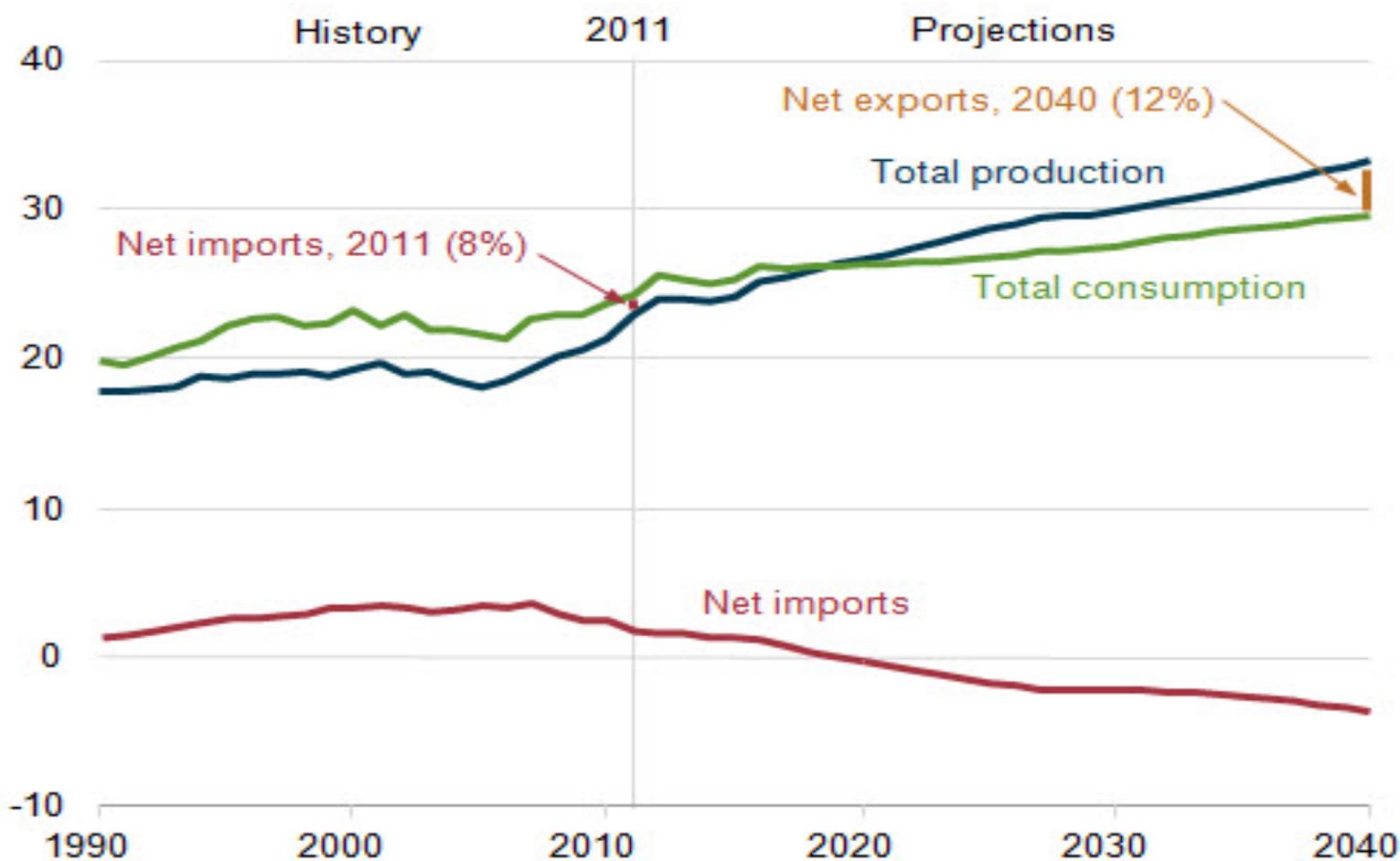
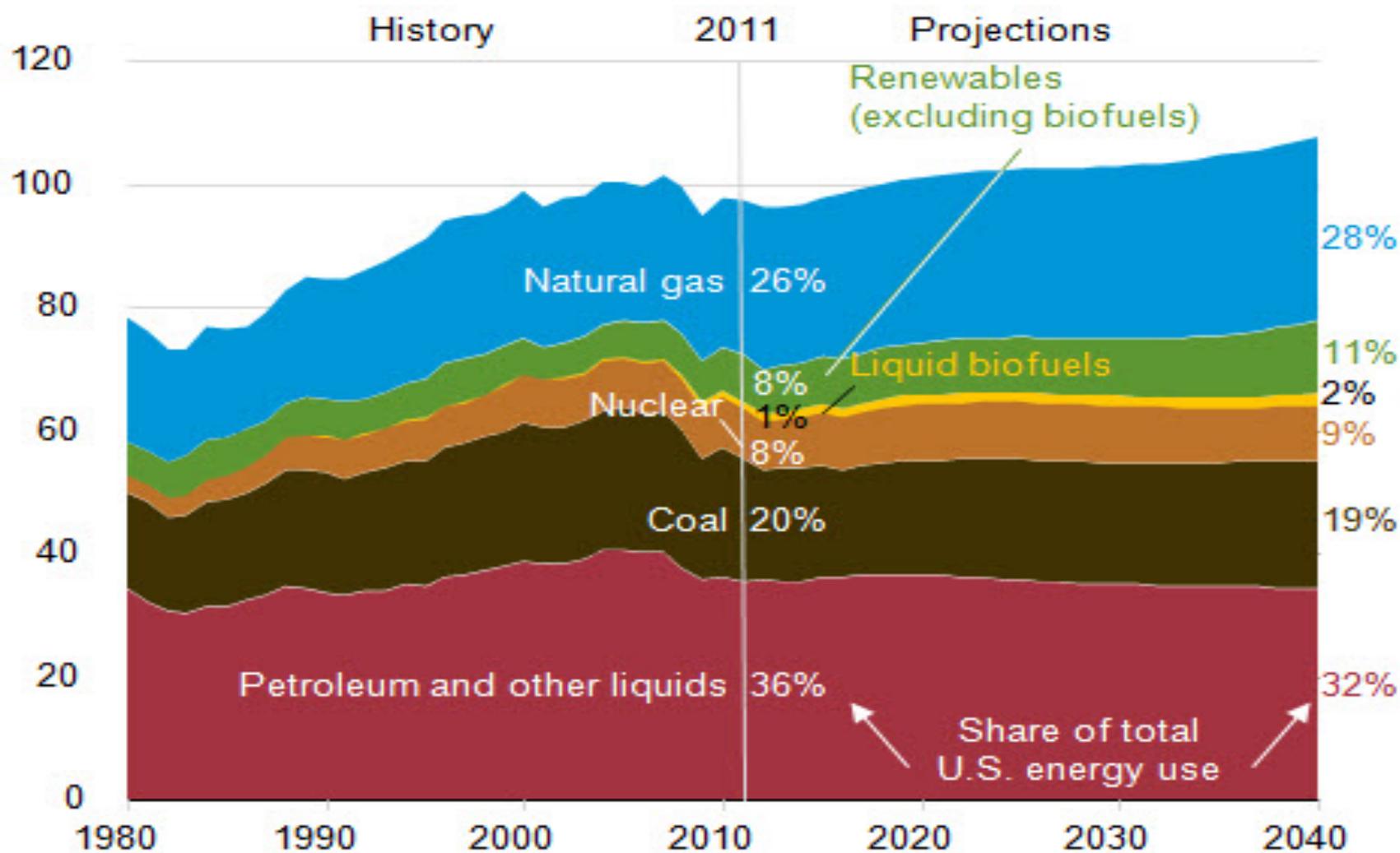
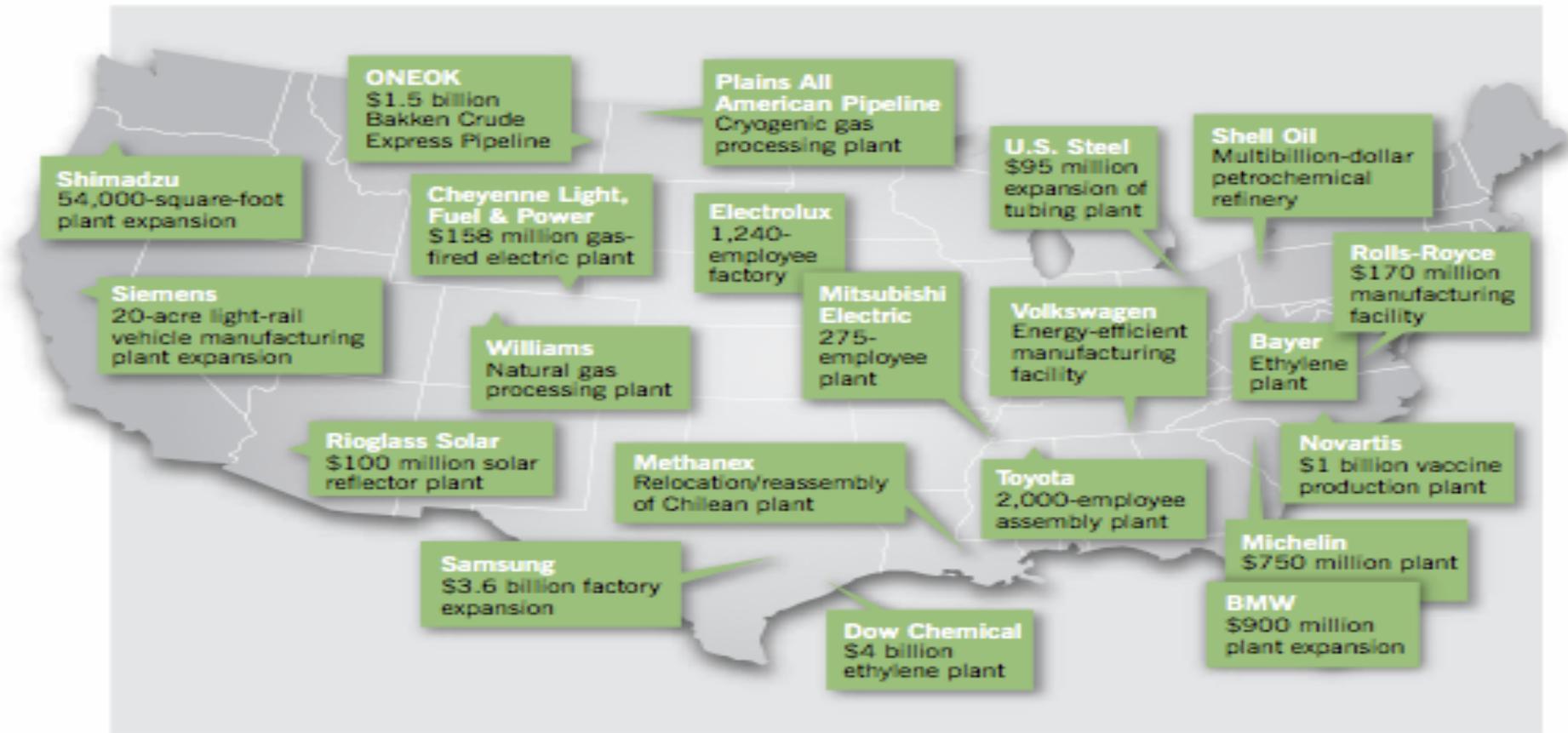


Figure 54. Primary energy use by fuel, 1980-2040 (quadrillion Btu)



Manufacturers may be among the biggest beneficiaries of the natural gas boom



Sources: *ASSEMBLY*, Associated Press, Bloomberg, Business Wire, *Daily Journal of Commerce*, Greater Phoenix Economic Council, KPAX, McClatchy-Tribune Regional News, *The News & Observer*, *The New York Times*, NPR, PR Newswire, Rolls-Royce, Volkswagen, *The Wall Street Journal* and *Wyoming Business Report*; and PricewaterhouseCoopers, *Shale Gas: A Renaissance in U.S. Manufacturing?*, December 2011.

Manufacturing Jobs

- 1 million new manufacturing jobs will open up in the next 10 years (PWC)
- 600,000 current manufacturing jobs open today around the U.S. (BLS)
- 30,000 new manufacturing jobs will be created each year in Illinois for the next ten years (IMA)

STEM Employment/ Industries

- Utilities (Nuclear, Coal, Gas, Renewables)
- Trades (Electricians, Boilermakers, Carpenters, Pipefitters, Welders, Machinists, HVAC etc.)
- Process Plants (Chemical, Oil, Gas etc.)
- Manufacturing (across the spectrum)
- Commercial Buildings (Hospitals, High Rises, Apartment Buildings, Physical Plants etc.)

Gold Collar/STEM Jobs

- Electrical Maintenance
- Mechanical Maintenance
- Instrumentation & Control Technicians (I & C)
- Pipefitters/Plumbers
- Manufacturing Technicians
- Boilermakers/Welders
- Carpenters/Construction Maintenance
- Engineering Technicians
- Chemistry Technicians
- Operators/Operating Engineers
- Radiation Protection Technicians

Example STEM Associate Degrees

- Industrial Welding Technology
- Process Operations Technology
- Automotive /Diesel Technology
- Construction Technology
- Electrical/Electronics Engineering Technology
- Electronic Automated Systems Technology
- Industrial Maintenance Technology
- HVAC Technology
- Mechanical Production Technology
- Precision Machining Technology

Electrical Maintenance

- Required:

- High School diploma or educational equivalent
- Ability to pass pre-employment testing
- Ability to work different shifts
- Ability to receive unescorted Nuclear access
- Excellent communication, teamwork and organizational skills

Preferred:

- Associates degree in a technical field
- OR
- Three years minimum related Electrical military experience
- OR
- Three years minimum Electrical Industrial Craft Maintenance experience that includes completing a bona fide trades training program
- OR
- Five years minimum Electrical Industrial Craft Maintenance experience

Operations/Maintenance Technician

- **EDUCATION, EXPERIENCE AND GENERAL REQUIREMENTS:** Successful completion and passing of the EEI Tech test. Strong aptitude in math, mechanical/electrical ability and production control. Hands on experience with all aspects of power plant operations and maintenance including some mechanical maintenance, instrument and electrical systems experience, and a strong working knowledge of power cycles. Ability to work in a high performance work system with minimum supervision. Excellent communication and team skills and a working knowledge of Excel and PC based applications. Availability for rotating shift work and overtime as required
- Associates Degree in Power Plant Technology, Engineering Technology, or Electronics OR HS Diploma with minimum of 18 months of trade or technical training in Power Plant Technology
- Successfully complete the training requirements and time in job requirements for the position including previously passing the EEI TECH test
- Availability for rotating shift work and overtime as required
- Good oral and written communication skills
- Basic computer skills

Nuclear Chemistry technician

- Position Requirements:
Required:
 - High School diploma or educational equivalent, including chemistry and mathematics courses
 - Ability to pass pre-employment testing
 - Ability to work different shifts
 - Ability to receive unescorted Nuclear access
 - Excellent communication, teamwork and organizational skills
Preferred:
 - Bachelor's Or Master's Degree in Chemistry or Chemical Engineering, or equivalent degree
 - Two years professional work experience in chemistry
 - Navy Nuclear experience as an Engineering Lab Technician (ELT)
 - Demonstrates leadership capabilities by motivating and inspiring others to accept challenges and meet or exceed expectations, and consistently achieves results, while acting as a role model for exhibiting appropriate behaviors.

Scary Truth (Daggott)

- *Fully 70% of our students graduating*
- *high school are unfit to serve in the*
- *Armed Service due to poor test scores,*
- *physical condition, criminal background*
- *check, or inability to pass a drug test.*

Future IS More, Not Less

- Lives Increasingly Electronic (Servers. Printers, Modems, Routers, HVAC Requirements etc.)
- NIMBYism (Infrastructure Stoppage)
- American Lifestyles – Cruises/Flights/250M Cars/Total Human Energy Consumption
- Political Restraints/Permits –New Capacity (100 new plants have been cancelled in last 10 years)
- 1.5 Billion People Have No Electricity
- Developing Countries /pending crises

Future Electrical Energy Mix ????????

- Natural Gas is the most versatile energy source (Preserve it if possible)
- Renewables are 25%-30% available (R & D)
- Coal and Nuclear good for only electricity
- Oil needed for transportation/gasolene
-

Government Subsidies/ Megawatt (Tax Depreciation & Research)

- **Natural Gas** .25
- **Coal** .44
- *Hydroelectric* .67
- **Nuclear Power** 1.59
- Wind 23.37
- Solar 24.34
- Current national energy course turns its back on 93% of today's energy supply

Forbes Energy Article (1/2012)

- **Renewable energy is a great concept** and a necessary concept to move us off fossil fuels, **but not if we do things to bring that technology online before it is time.**
- The real cost of that renewable energy is the cost of **premature technology and the cost of replacing it.**

There Is An Energy Shortage. But there Is No Shortage Of Energy

- Present course is a political zigzag path
- Political arrogance & incumbent incompetence
- Pro fossil/nuke energy stance has no political cheese
- Will bring blackouts, brownouts and lines at the pump (2008 statement)- Gas to the rescue
- We must look at energy holistically(not politically)
- Coal, gas, nuclear, wind, sun, water, hydrogen, and geothermal – all of these sources have a role in our electricity future if properly managed and balanced.

More Environmental Protection

- We have an opportunity to provide **global leadership** on this matter
- the **U.S.** may be the best positioned for global leadership, given that we enjoy the **highest per capita production of such emissions, have the world's largest economy, the most enjoyable lifestyles, and the best track record for rule of law in an open democracy.**

More Energy From All Sources

- Meanwhile we continue to benefit from robust **hydro-power, natural gas, coal and nuclear energy** production and out there in the future are more opportunities for **geo-thermal** power. **The bottom line is the U.S. has ample energy resources for whatever we choose to do in the future.**

A Radical Shift

- Need to use Nuclear and Clean Coal along with wind and future solar augmented by natural gas.
- Shift away from pulverized coal-fired electricity plants.
- Create an independent regulatory agency (Federal Energy Resources Board) funded by energy companies not Congress.
- Few can live without affordable energy, no one can live without clean air.



Energy Independence ?????

- Political Time VS Energy Time
- Americans use 21M barrels of oil per day
- Currently, domestic production is 7M barrels per day
- 1973, domestic production @ 10M barrels
- Politics and Energy, like oil and water, do not mix

Energy Independence ?????

- Political Time VS Energy Time
- Americans use 21M barrels of oil per day
- Currently, domestic production is 7M barrels per day
- 1973, domestic production @ 10M barrels
- Politics and Energy, like oil and water, do not mix



Energy Independence??? Keep Dreaming

- 1973 Oil Embargo – Nixon- U.S. will be energy independent by the end of his term
- 1973, U.S. imported 35% of oil
- 2011, U.S. imported 65% of oil (24% Mideast)
- 8 Presidents & 18 Congresses over 35 years can't make energy independence a reality
- Obama- during campaign and victory speeches, “we will not import any oil from the Middle East or Venezuela by 2016” ????