

Abundant American Energy and the Perfect (Manmade) Storm:

How Increasing Regulations Will
Eventually Collide with Our
Energy Demand

SPEE
APRIL 8, 2015

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“Energy Threshold”

- Man crossed an “Energy Threshold” in late 1700’s with realization that heat could be turned into physical work
- Development of steam engine about 200 years ago energized the Industrial Revolution that transformed the world

- Coal-fired steam engine led to first significant use of fossil fuels
- Coal more available than wood in Europe because forests had already been widely harvested
- Steam engine widely credited with slavery being abolished in much of world during the 19th century

Burning of Other Fossil Fuels Followed

- In 1859 Drake drilled first deliberate oil well in Pennsylvania
- Initially oil was refined for kerosene, which was used to replace expensive whale oil in lamps. (Probably saved whales from extinction in mid-19th century.)
- 1914 WWI
 - Cavalry regiments with horse-drawn cannons and steam-powered battleships

- Development of oil as source of power did not come until later
- Myth that life before 1800 was happier. In the real world before fossil fuels, our ancestor's lives included:
 - Women dying in childbirth
 - Children dying in infancy
 - People dying young from disease
 - Children not educated (working)
 - Vibrant civilizations (Greeks & Europeans) benefited small number of lucky elite supported by laborers living hard lives

- Reliable and affordable energy underpins every aspect of modern life.
 - Potable water and waste disposal
 - Food production
 - Transportation
 - Health care advances
 - Technology
 - Globalization

“Poverty is the worst polluter.”
-Indira Gandhi

The best way to protect the environment is for countries to get richer. Wealthy countries can afford to protect the environment, poor ones usually cannot.

Fossil fuels have been one of the most powerful forces in history for improving the environment and the standard of living of the common man and woman.

- And they currently account for 87% of global energy supply!

World's Population - 2014

1.	CHINA	1.39 Billion
2.	INDIA	1.27 Billion
3.	USA	323 Million
4.	INDONESIA	253 Million
5.	BRAZIL	202 Million
6.	PAKISTAN	185 Million
7.	NIGERIA	179 Million
8.	BANGLADESH	159 Million
9.	RUSSIA	142 Million
10.	JAPAN	127 Million

Total ~7.125 Billion (2013)

Global Energy Production

Electricity Generation (2012)

1.	CHINA	4,768 B kWh	1.39 billion people
2.	USA	4,047 B kWh	323 million people
3.	INDIA	1,052 B kWh	1.27 billion people
4.	RUSSIA	1,012 B kWh	142 million people
5.	JAPAN	966 B kWh	127 million people
6.	CANADA	616 B kWh	36 million people
7.	GERMANY	585 B kWh	83 million people
8.	BRAZIL	537 B kWh	209 million people
9.	FRANCE	533 B kWh	65 million people
10.	SOUTH KOREA	499 B kWh	50 million people

China's Power Sector - 2013

- Electrical generation has grown 10.8% per year over the last decade
- Doubled power generation in 7 years
- Added the equivalent of UK's entire generating capacity every year

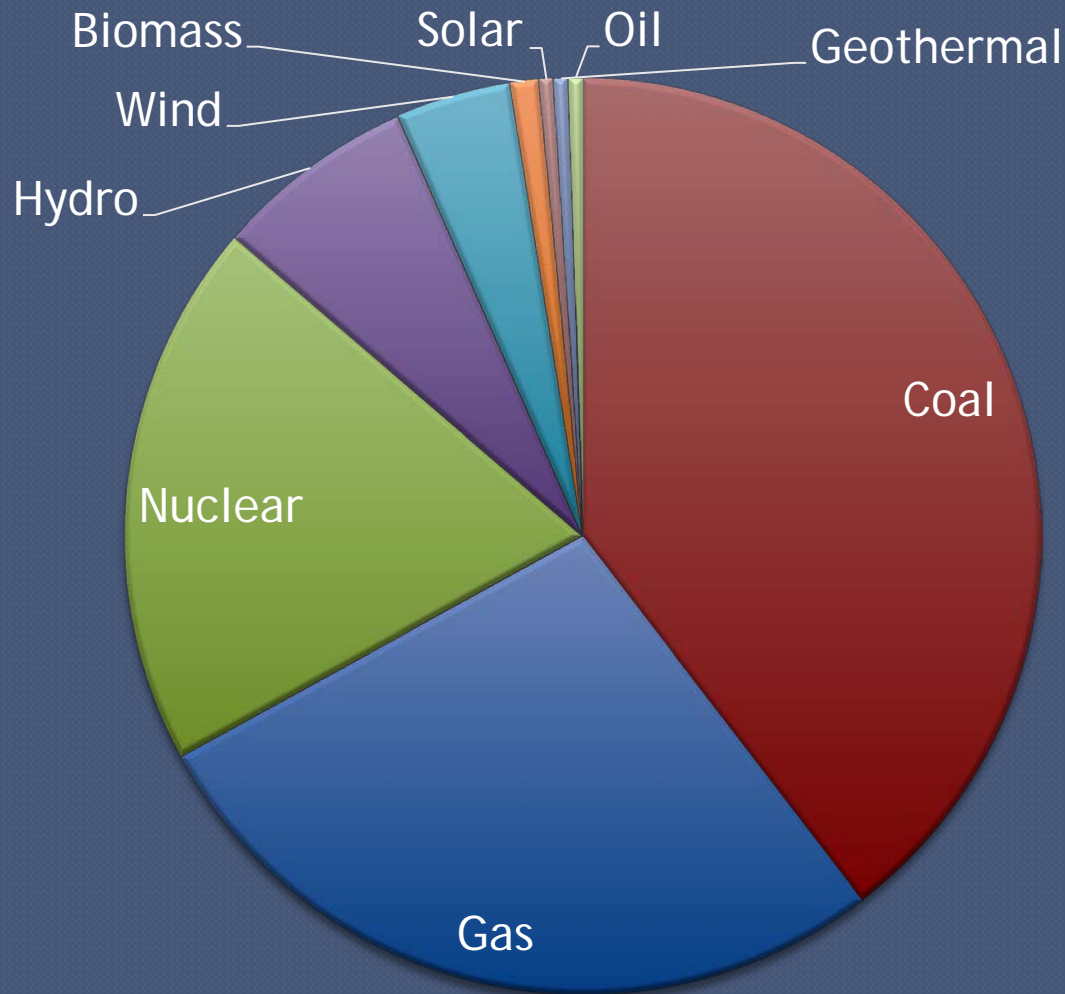
COAL	62%
HYDRO	23%
GAS	6%
WIND	6%
NUCLEAR	1%
SOLAR	1%

Source: NEA (National Energy Administration)

Global Electricity Facts

- 1.3 billion people (18%) without access to electricity
- 2.7 billion people (40%) rely on biomass for cooking and heating
- 4.3 million die prematurely every year from household pollution due to burning biomass inside

USA Supply of Electricity (2013)



Coal	39%
Gas	27%
Nuclear	19%
Hydro	7%
Wind	4%
Biomass	1%
Solar	<1%
Geothermal	<1%
Oil	<1%

USA Supply of Electricity

1990 - 2013 comparison

	1990	2013
Coal	53%	39%
Gas	13%	27%
Nuclear	19%	19%
Hydro/Wind/Biomass/ Solar/Geothermal	11%	13%
Oil	4%	<1%

Residential Cost of Electricity

Residential cost of electricity in the U.S. vs. other developed countries (2012)

Cost per kilowatt-hour
(in US dollars)

DENMARK	\$0.41
GERMANY	\$0.35
SPAIN	\$0.29
ITALY	\$0.28
JAPAN	\$0.26
EU	\$0.26
IRELAND	\$0.26
SWEDEN	\$0.25
NETHERLANDS	\$0.24
SWITZERLAND	\$0.22
UK	\$0.20
FRANCE	\$0.19
UNITED STATES	\$0.12

Top World Oil Producers 2013

Oil Producers (includes liquid hydrocarbons)

1.	USA	12.34 MMBO/Day
2.	SAUDI ARABIA	11.7 MMBO/Day
3.	RUSSIA	10.7 MMBO/Day
4.	CHINA	4.46 MMBO/Day
5.	CANADA	4.1 MMBO/Day
6.	UNITED ARAB EMIRATES	3.44 MMBO/Day
7.	IRAN	3.2 MMBO/Day
8.	IRAQ	3.0 MMBO/Day
9.	MEXICO	2.9 MMBO/Day
10.	KUWAIT	2.8 MMBO/Day

- U.S. oil (only) production now at 9.39 MMBO/D
- 2014 increase of 1.2MM BOPD was largest annual increase in country's history!

“Cowboyistan”

- *Three “R’s”*: *Rigs, Rednecks, and property Rights*
 - A make believe republic of ND, OK, and TX
 - Produces ~3.8 MMBO/D
 - Makes these 3 states the #6 oil producer in the world!

Annual Global Natural Gas Production - 2013

Natural Gas Producers

1.	USA	24,282 BCF
2.	RUSSIA	21,359 BCF
3.	IRAN	5,649 BCF (2012)
4.	QATAR	5,523 BCF (2012)
5.	CHINA	4,135 BCF
6.	NORWAY	3,840 BCF
7.	SAUDI ARABIA	3,637 BCF
8.	ALGERIA	3,053 BCF (2012)
9.	AUSTRALIA	2,179 BCF
10.	EGYPT	2,141 BCF (2012)

Thanks to “shale gas” the nation now has a price advantage for natural gas that is second to no other country on the planet.

The European Union’s price is ~3 to 4x the U.S. price and Japan is 5x our price.

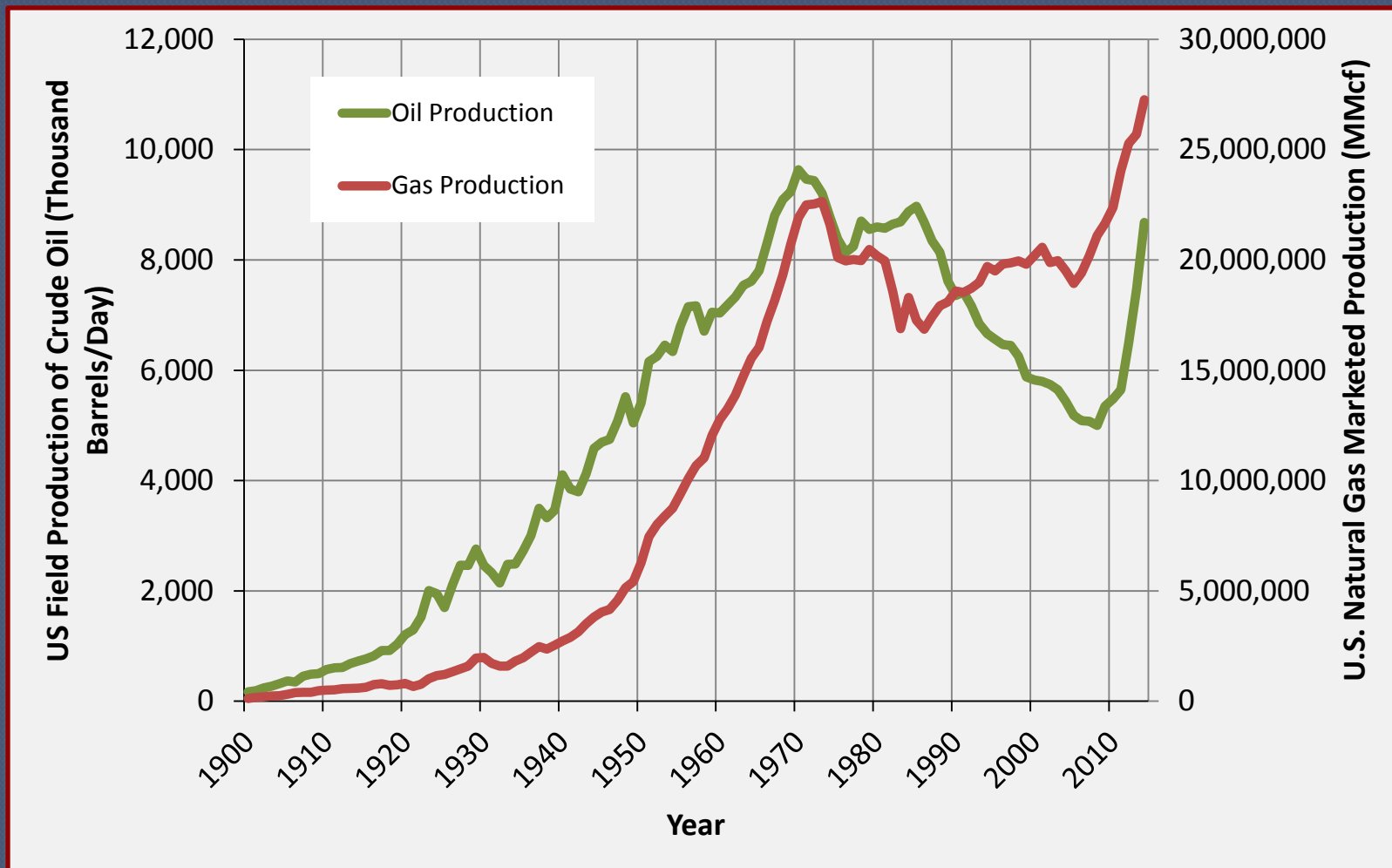
Large industrial projects and manufacturing are coming back to the U.S. due to our low energy prices.

Annual Global Coal Production - 2012

Coal Producers	Thousand Short Tons
1. CHINA	4,017,920
2. USA	1,016,458
3. INDIA	649,644
4. INDONESIA	488,112
5. AUSTRALIA	463,783
6. RUSSIA	390,152
7. SOUTH AFRICA	285,832
8. GERMANY	217,144
9. POLAND	158,000
10. KAZAKHSTAN	138,918

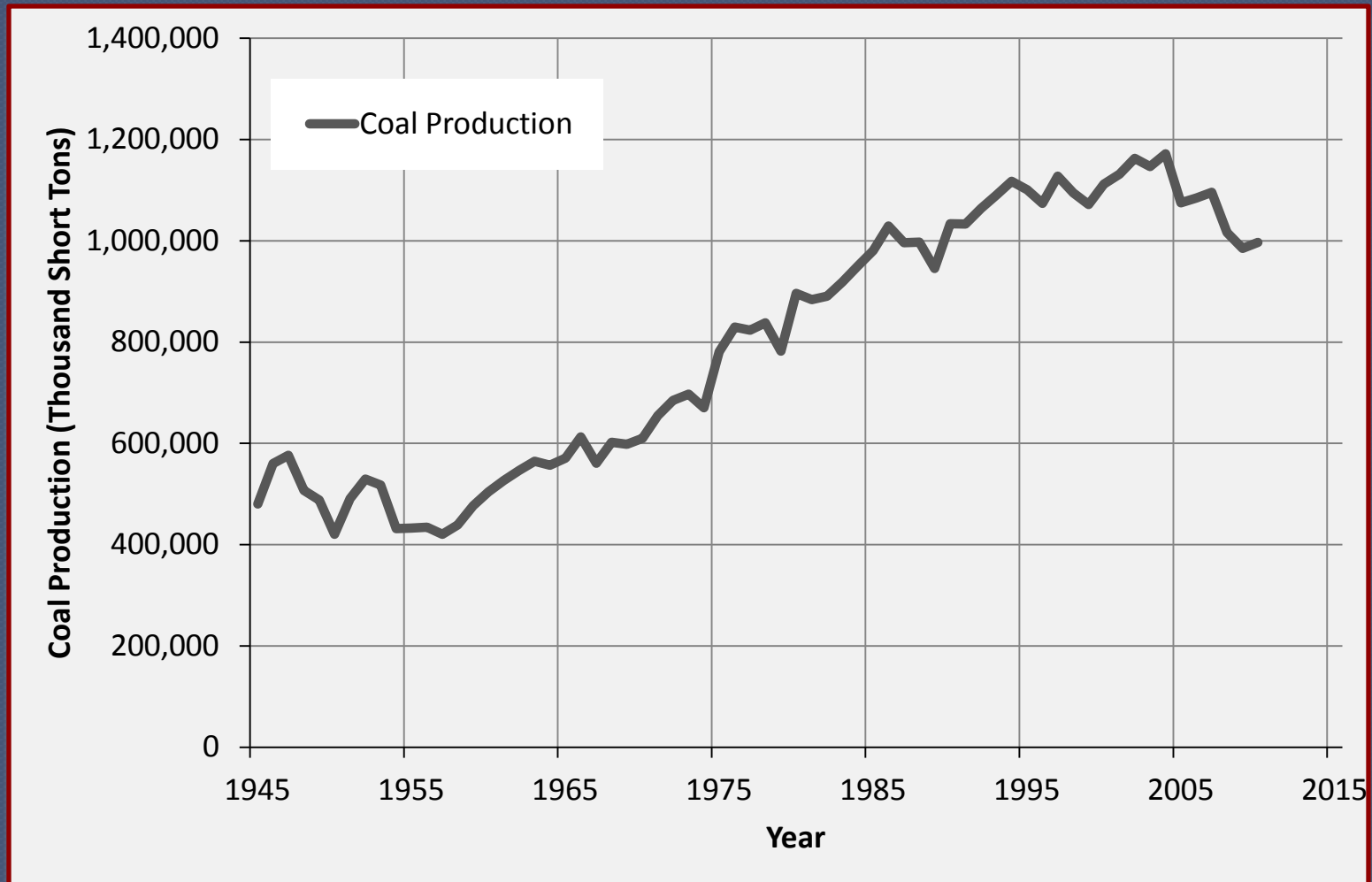
Abundant American Energy is a relatively recent change from our outlook of twenty years ago. This change is almost entirely due to horizontal drilling and multi-stage fracture completions in unconventional oil and gas source rocks.

History of US Oil & Gas Production



Source: EIA

History of US Coal Production



Source: EIA

U.S. Production Ranking (2012)

- 1st in natural gas production
- 1st in nuclear production
- 1st in refined oil product output
- 2nd in coal production
- 2nd in electricity production
- 2nd in refined-product exports
- 3rd in oil production
- 4th in hydro production

Farming:

America's farmers are among the world's most productive. The U.S. grows nearly 17% of all global grain. America's ability to feed itself means cheaper food for American consumers, especially low income people, and gives the nation food security and significant foreign-exchange revenues.

All powered by reliable, affordable energy.

Deluge of new regulations are and will continue to affect our country's ability to produce and deliver reliable, affordable energy.

EPA Recently Proposed or Finalized:

- CSAPR – Cross-State Air Pollution Rule
 - Will affect 28 states with coal-fired power plants
- MATS – Mercury and Air Toxic Standards
 - 600 affected power plants – mostly coal
 - Appealed by 21 states
 - Currently being heard by Supreme Court

- CPP – Clean Power Plan
 - Sole purpose is to cut CO₂ emissions
 - Essentially forces many coal-fired plants to close
 - FERC was not included in the process and is concerned about reliability of electrical grid
 - System has to use more natural gas and Variable Energy Resources (VERs = Renewables)

- Cooling Water Intake Structures
 - Affects 544 power plants and 521 factories
 - Seeks to limit harm to fish and other aquatic life

- NAAQS - Ozone Rule
 - Sets stricter standard on ozone
 - Would likely impose a construction ban on 18 of top 20 metro economies
 - EPA health benefits are now 3100% higher than their 2011 estimate!
 - National Association of Manufactures says this is the most expensive regulation ever imposed on the public (~\$140 B/yr) and puts 1,000,000 jobs at risk

Leading Causes of Death & Disability in the U.S.

“These are among the most common, costly, and preventable of all health problems”

- Heart Disease - kills more people than all forms of cancer combined
- Cancer
- Stroke
- Obesity
- Arthritis
- Diabetes

The High Cost of State's Renewable Energy Mandates

- 29 States (and DC + Puerto Rico) have mandates on utility companies
- Affects $\frac{2}{3}$ of U.S. population – businesses and industrial users
- Cost is high for purchasing renewable energy and building new transmission lines
- In coal-dependent states costs have risen twice the amount compared to states without mandates
- Often exorbitant rates are locked in for many years to come

Increasing renewables in a bulk electricity generation and deliverability system create huge challenges:

- Takes tremendous amounts of land to generate renewable power
- Massive new power lines necessary
- Increased cost to consumer
- Diminished grid reliability
- Traditional utilities at risk of becoming unprofitable

Areal Power Density of Natural Gas Well vs. Wind Turbines

- One well (2 acre pad) making 600 MCFD has an areal power density of 280 watts/meter²
- Wind turbines have an average areal power density of 1 watt/meter²
- Conclusion: Oil and gas activity is far less impactful on our environment

Environmentalism: The Road to a Primitive Existence

Germany's Energy Poverty: How Electricity Became a Luxury Good

- After Fukushima nuclear accident Merkel decided to phase out nuclear and adopt wind and solar
- Aggressive and reckless expansion of wind and solar comes with hefty price tag and costs fall disproportionately on the poor
- Already German consumers pay highest electricity prices in Europe and they are still rising

Germany's Energy Poverty (Cont'd)

- German industry losing competitiveness - electricity prices up 60% over last 5 years due to government subsidies of renewable energy producers
- Massive electrical lines to remote renewable locations are delayed due to protests
- CO₂ emissions increasing due to shutting down nuclear plants and therefore more coal-burning plants needed for base load generation
- Traditional utilities becoming unprofitable!
- Green delusion is finally confronting economic reality

Environmentalism: The Road to a Primitive Existence

UK's Electrical Grid Example:

- Britain closing aging coal-fired plants as well as some oil and nuclear plants to meet EU environmental laws - mainly CO₂ targets
- Energy industry regulator has warned of an impending "near-crisis" of energy supply calling the situation "horrendous"

UK's Electrical Grid (cont'd)

- Costs rising rapidly since 2005 but customers can opt for “interruptible contracts” to keep costs down – you simply lose power when the utility decides
- Chairman of Parliament's Energy and Climate Committee has recently begun making an “environmentally friendly” case in favor of fracking for shale gas

NERC - North America Electric Reliability Corporation

Who are they?

- Not for profit international regulatory authority whose mission is to assess the reliability of the bulk power system in North America (subject to oversight by FERC)

NERC - Potential Reliability Impacts of EPA's Proposed Clean Power Plan (CO₂)

- Hugely concerned by decreased diversity of supply
- Increased reliance on Variable Energy Resources (VERs = renewables) seriously affects system reliability - they are "disruptive"
- Polar vortex showed natural gas supply and deliverability risks
- Numerous key assumptions made by the EPA are incorrect
- Strong recommendation to slow down! More time is needed for such a major system transformation

Due to ever increasing regulations and a multitude of legal protest avenues, it has become extremely difficult to get any major infrastructure project approved and built.

Comparison: Trans-Alaska Pipeline System (TAPS) to Keystone XL (KXL)

TAPS

- 800 miles of oil pipeline across tundra and mountains
- 1969 - Applied for permit
- 1970 - NEPA required EIS
- 1974 - Congress approved TAPS after Arab oil embargo - construction starts
- 1977 - OIL FLOWS!
- 2015 - Almost 17 BBO have safely flowed through TAPS

KXL

- 1179 miles, but only 840 in the U.S.
- Latest technology oil pipeline through bread basket of U.S.
- First proposed in 2008
- Recently vetoed by President Obama (early 2015)
- Dead for now

EPA forcefully moving on a litany of new regulations controlling energy production is definitely a crusade against coal and fossil fuels in general.

For about a decade, the real villain for the anti-fossil fuel movement has been CO₂. The new regulations are a back door way to put a price on Carbon since they couldn't do it legislatively.

Manmade emissions of CO₂ are blamed for Anthropogenic Caused Global Warming (ACGW) - now conveniently called Climate Change. The UN's International Panel on Climate Change (IPCC) is the powerful proponent of this theory.

A Brief History of the IPCC

- Established in 1986 by the UN and the World Meteorological Organization as a part of the UN
- IPCC's key personnel and head authors appointed by governments and its Summaries for Policy makers are subject to approval by governments of the UN
- Scientists supported by government contracts
- IPCC Agenda: its role is to assess the risk of human-induced climate change
- IPCC is a political entity rather than a scientific entity

Nongovernmental International Panel on Climate Change - NIPCC

- An international panel of nongovernment scientists and scholars who have come together to understand the causes and consequences of climate change
- Published: *Climate Change Reconsidered* in 2009 and *Climate Change Reconsidered II* in 2013

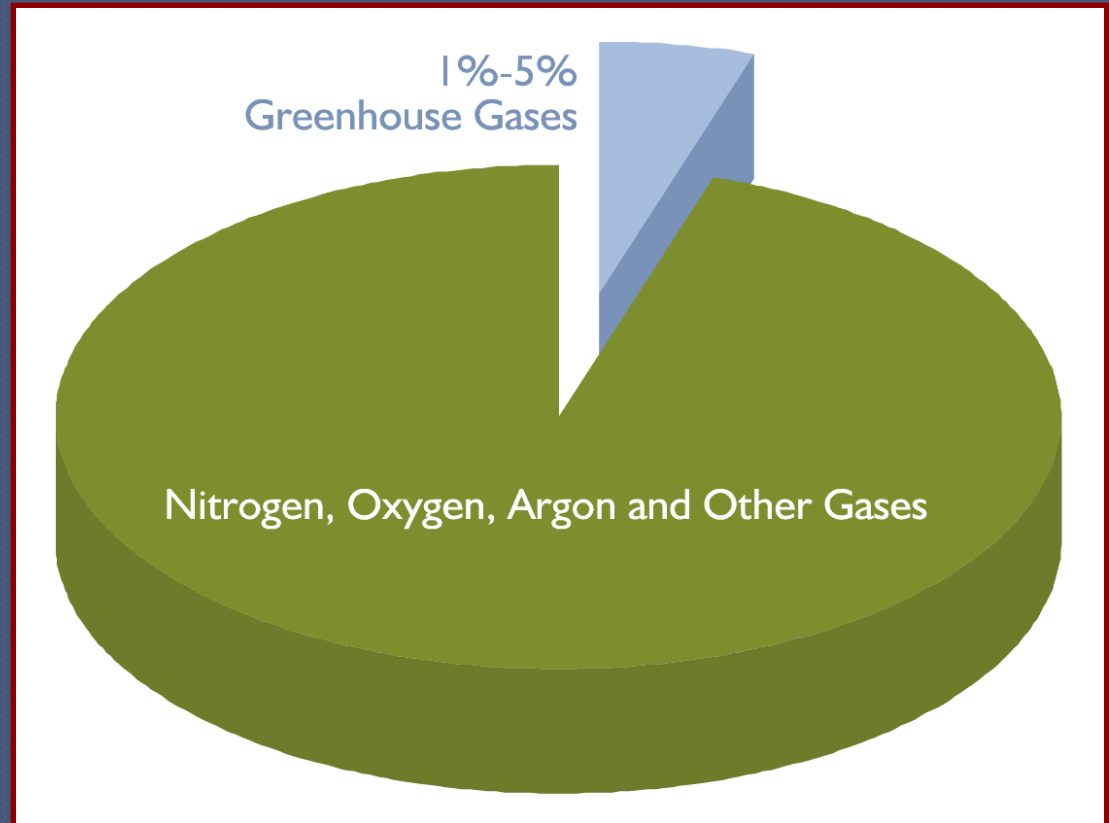
You are highly encouraged to visit their website and review their reports!

CO₂ Basics

- CO₂ is odorless, colorless, and tasteless
- Plants absorb CO₂ and emit Oxygen as a waste product
- Humans and animals breathe Oxygen and emit CO₂ as a waste product
- It is essential to life on Earth and all life - plants and animals alike - benefit from more of it

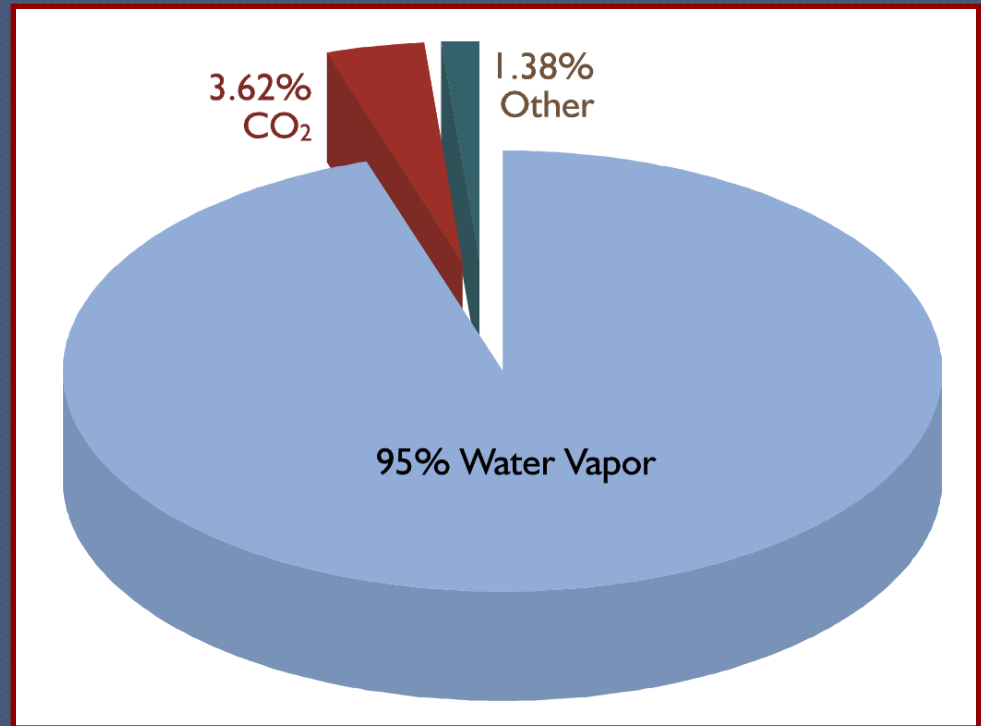
How Much of the Atmosphere is Greenhouse Gases?

- Greenhouse gases make up no more than 5% of Earth's atmosphere



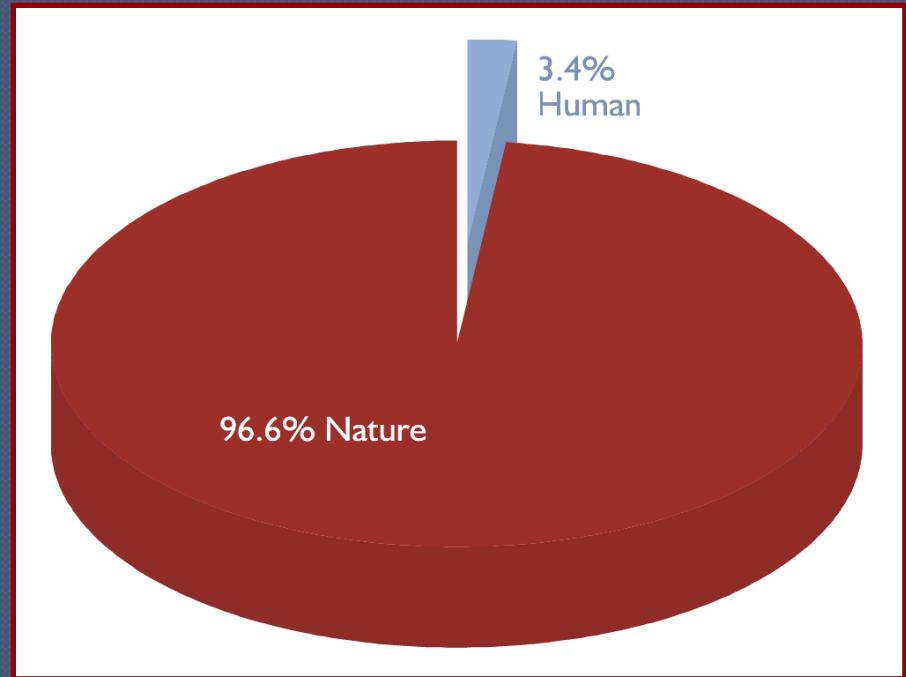
What are the Greenhouse Gases in the Atmosphere?

- CO₂ and other trace gases are only 5% of the greenhouse gases in the atmosphere
- Water vapor makes up 95% of atmosphere
- CO₂ is a naturally occurring greenhouse gas
- Humans and other animals emit CO₂ into the atmosphere when they exhale, and plants absorb it



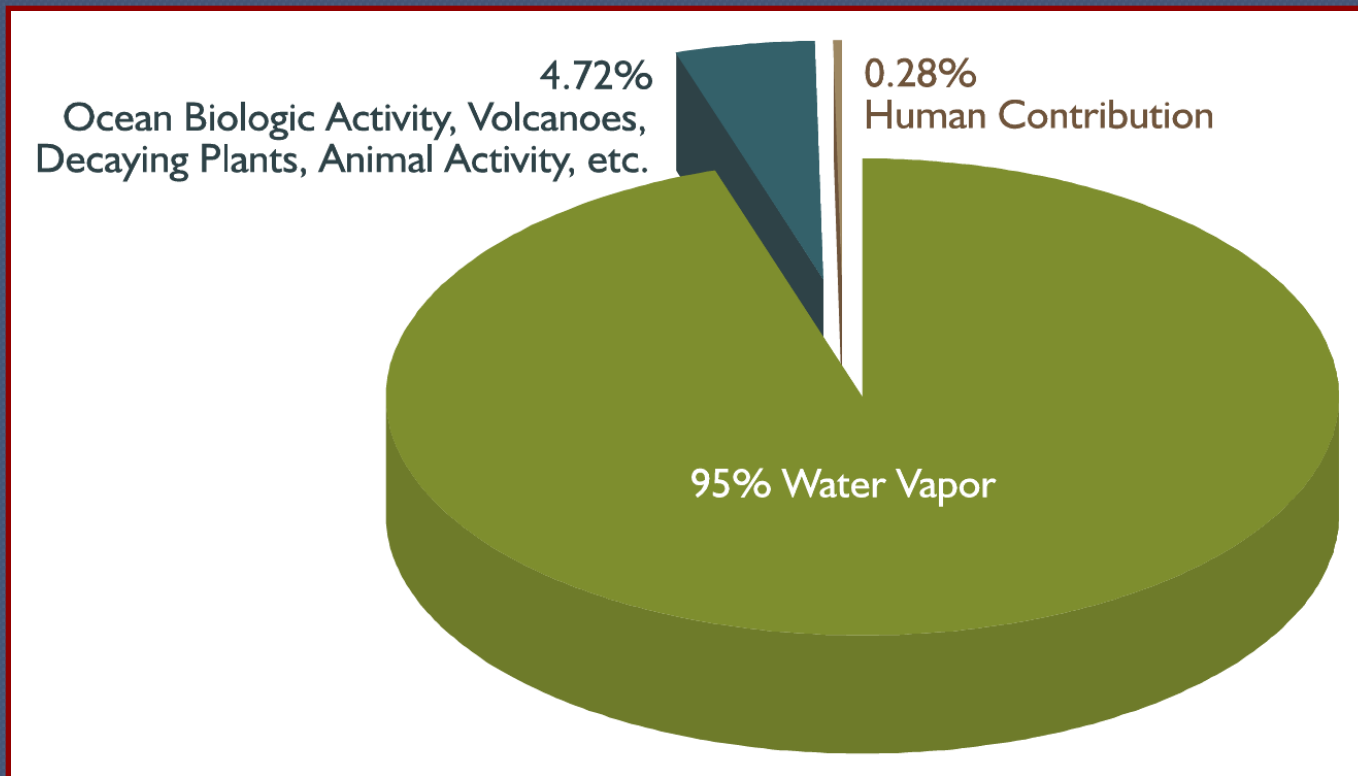
Where Do CO₂ Emissions Come From?

- Humans contribute ~3.4% of annual CO₂ emissions
- Small increases in annual CO₂ emissions (from humans or any other source) can lead to a large CO₂ accumulation over time because CO₂ molecules can remain in the atmosphere for more than a century



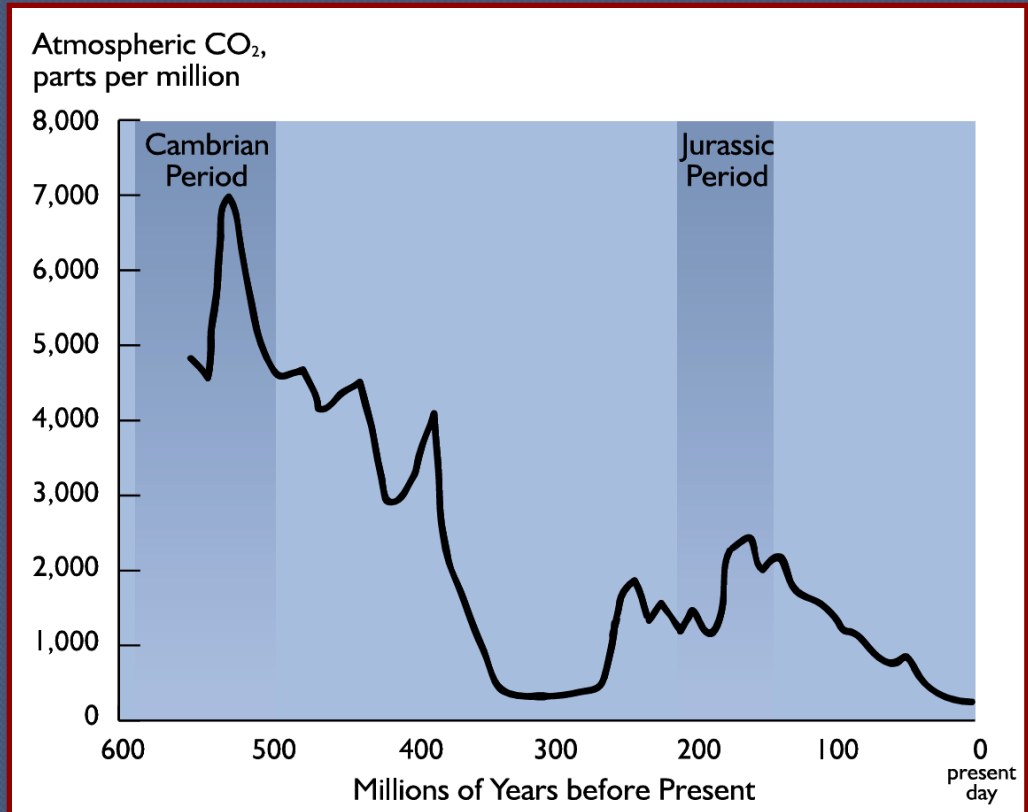
What is the Human Share of the Greenhouse Effect?

- Humanity is responsible for about $\frac{1}{4}$ of 1% of the greenhouse effect



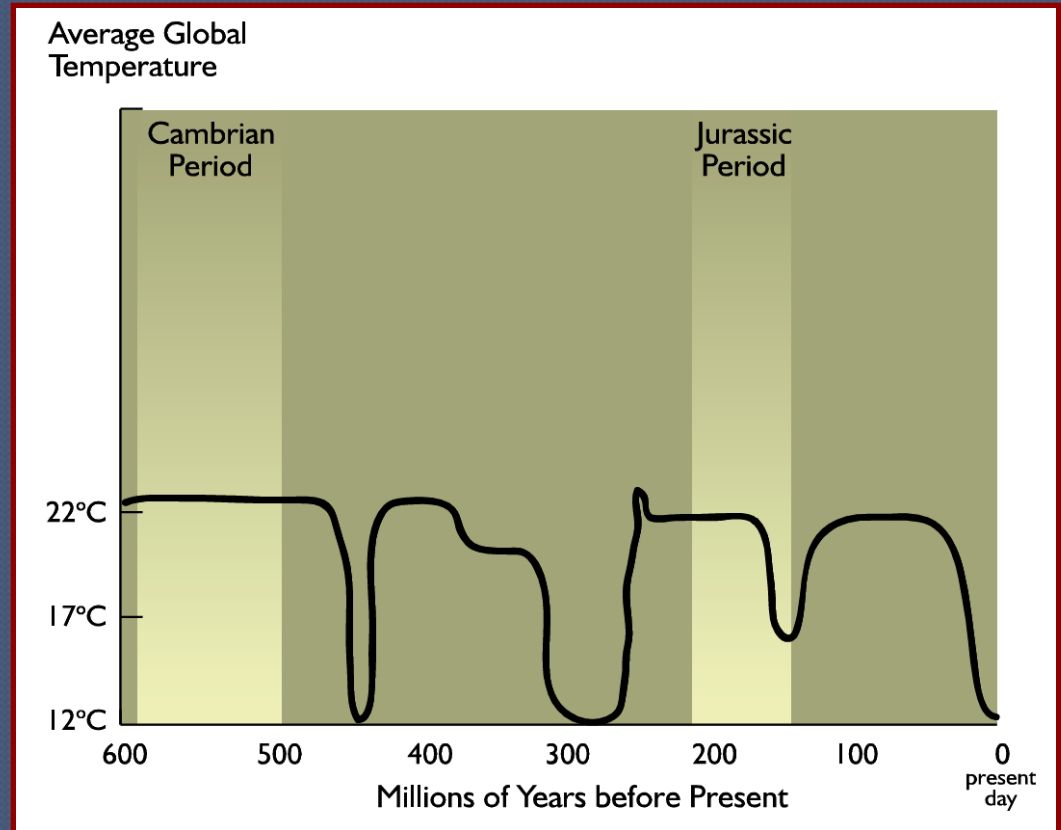
How Have CO₂ Levels Changed Over the Past 600 Million Years?

- There was an explosion of life forms 550 million years ago (Cambrian Period), when CO₂ levels were 18x higher than today
- During the Jurassic Period (when dinosaurs roamed the Earth) CO₂ levels were as much as 9x higher than today



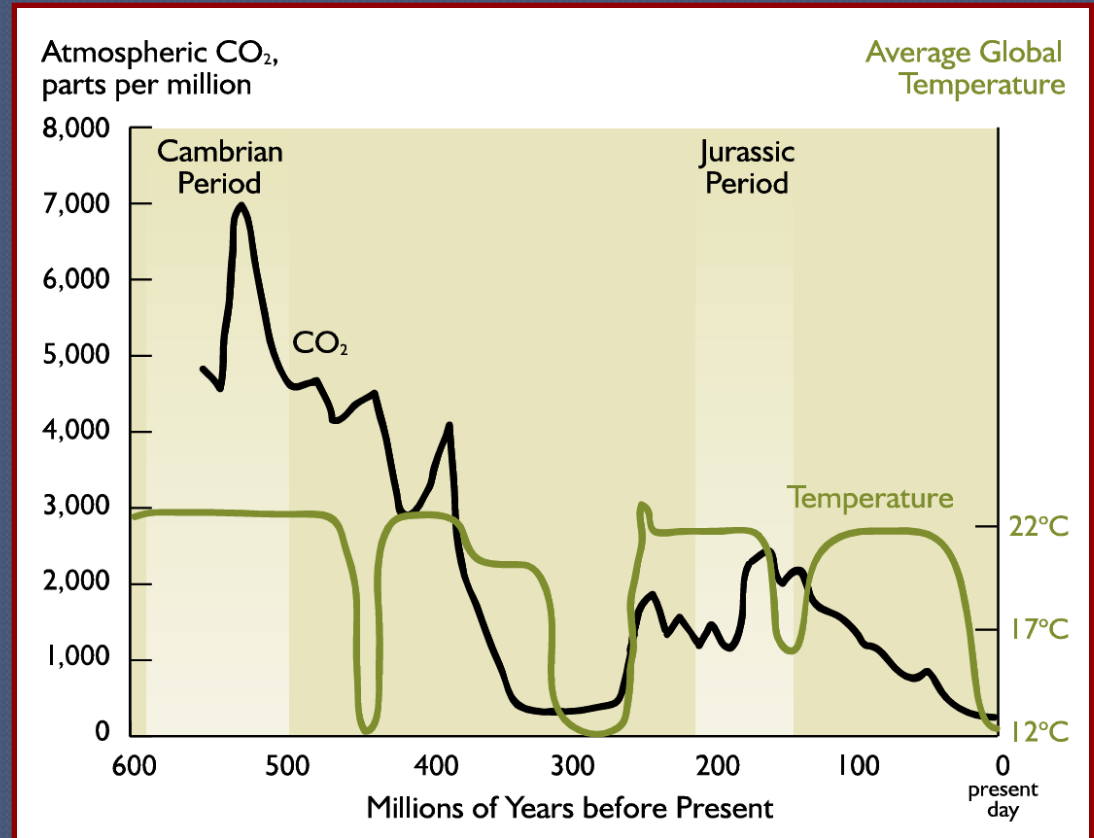
How Has the Earth's Temperature Changed over the Past 600 Million Years?

- During the Jurassic Period, the average temperature was about 18°F (10°C) warmer than it is today



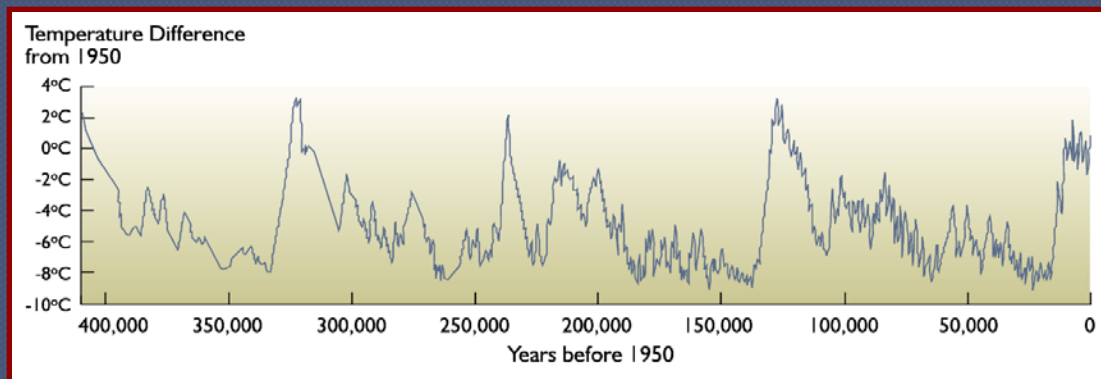
Is There a Relationship Between CO₂ and Global Temperature over the Earth's History?

- Over long periods of time, there is no close relationship between CO₂ levels and temperature



How Has the Earth's Temperature Changed over the Past 400,000 Years?

- There have been a series of ice ages lasting 100,000 years, interrupted by warm periods lasting about 10,000 years
- During ice ages the temperature drops by as much as 21°F, sea levels fall dramatically, glaciers expand, and most living things are forced to migrate toward the equator
- During periods of relative warmth, sea levels rise and glaciers retreat
- We are currently at the tail end of a warm period



Source: National Center for Policy Analysis

What Mainstream Media Won't Tell You About Global Warming

- Climate change is real and is natural - it has always existed and always will
- The Global Warming Pause has lasted 18 years
- Antarctic sea ice is at record levels and the Arctic ice cap has quit receding
- CO₂ is a nutrient, not a pollutant
- The Earth is getting greener - "more plants"
- No computer model has successfully "backcasted" past climate or predicted the 18 year "Pause"

- Historically CO₂ rises several hundred years AFTER warming - not BEFORE
- Extreme weather events have not increased
- Polar bears are alive and doing well
- Global warming is much better for human society than global cooling - these warm periods used to be called "Climate Optimums"!
- Evidence is growing that changes in Earth's surface temperature are largely driven by Earth's orbit and variations in solar activity
- The recently quiet sun and extrapolation of solar cycle patterns suggest a planetary cooling may occur over the next few decades - this would be very hard on all of society

Energy Lessons We Should Have Learned By Now

- Diversity of energy supply is extremely important - should have an "all of the above" strategy
- Forced rapid transition of a huge complex energy system is rife with problems
- We need excess supply for system reliability, economic growth, and potentially harsh natural climate change

- Energy poverty is the real “Inconvenient Truth” – low income people suffer most from rising energy costs. It is inconceivable that wealthy anti-industrialists would deprive billions of people from gaining access to electricity
- We have already created huge challenges to our electrical grid and need to slow down and re-evaluate our policies

Additional Thoughts/Predictions

- CO₂ will eventually be found to be a bogus villain (after trillions of dollars have been wasted)
- The anti-people, anti-modern society crowd, will move on to the next concocted man-made catastrophe
- Real science and the Scientific Method will continue to be weakened by political ideology

Additional Thoughts/Predictions

- It will have to get much more painful before citizens demand and politicians get serious about finding agreement across party lines to **force** solutions through the tangled bureaucratic regulatory and litigious “web” we have created.

Additional Thoughts/Predictions

- This “web” has been, and will continue to be, a significant drag on our economy and competitiveness with other developing nations. Unfortunately, it is entirely self-inflicted.