What do the Events in Japan Really Mean?

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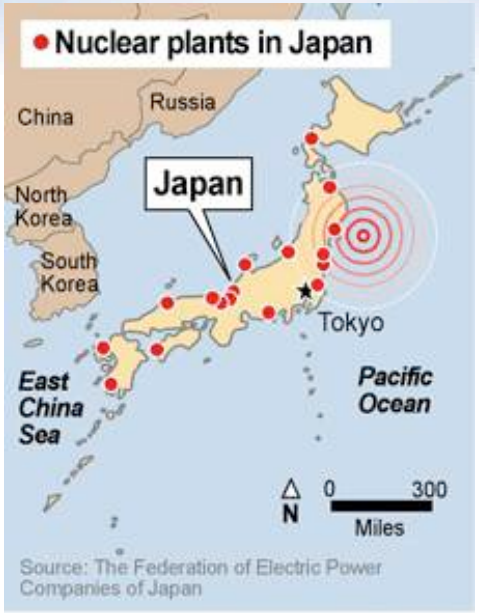
Fukushima Event Initiation

- **The Fukushima nuclear facilities were damaged in a magnitude 9.0 earthquake on March 11 (Japan time), centered offshore of the Sendai region, which contains the capital Tokyo.**
  - Plant designed for magnitude 8.2 earthquake.
  - A 9.0 magnitude earthquake is 8 times stronger than a magnitude 8.2 earthquake
- **Serious secondary effects followed including a significant tsunami, significant aftershocks and a major fire at a fossil fuel installation.**



By Janet Loehrke, USA TODAY

From presentation assembled by Duane Arnold (NEXTeraENERGY)

Timeline of Epicenter

No.	Time	Epicenter	Mag.
1	March 11, 2:46 PM	Iwate Sanriku oki	M 9.0
2	March 11, 3:15 PM	Ibaraki oki	M 7.7
3	March 11, 4:29 PM	Iwate oki	M 6.5
4	March 11, 5:40 PM	Fukushima oki	M 6.1
5	March 12, 3:59 AM	Northern Nagano	M 6.7
6	March 15, 10:31 PM	Eastern Shizuoka	M 6.4
7	March19, 6:56 PM	Northern Ibaraki	M 6.1
8	March 23, 7:12 AM	Eastern Fukushima	M 6.0
9	April 7, 11:32 PM	Miyagi oki	M 7.1
10	April 11, 5:16 PM	Eastern Fukushima	M 7.0
11	April 12, 2:07 PM	Central Fukushima	M 6.4

From presentation given by Takafumi Aoyama (Japan Atomic Energy Agency) on June 10, 2011 at the INL

Damage of the Great East Japan Earthquake

The worst disaster in Japan after the end of World War Ⅱ

In Japan

Death toll: 15,310 It may be increased significantly

The disappeared: 8,404

The injured: 5,364

Evacuees: 99,592 (down from the peak 468 thousand, on March 14)

*as of June 1, 2011, by Tokyo Metropolitan Police Department

- The earthquake led to tsunami, fire, liquefaction phenomenon, Fukushima Daiichi accident, a large range of blackout and so on.
- Tokyo and 9 prefectures had damages.
- The recovery could cost $185 billion up to $309 billion.

From presentation given by Takafumi Aoyama (Japan Atomic Energy Agency) on June 10, 2011 at the INL

Availability of Information Has Changed Significantly Since TMI and Chernobyl

- **Information was immediately available on the internet**
  - Some of it was factual, much of it was not
  - Photos of the affects of the earthquake and tsunami were plentiful, and placement of photos was often misleading

Smoke billows from fires raging at the port in Tagajo, Miyagi prefecture, March 13, 2011 following a massive earthquake and tsunami. A new explosion ripped through a troubled nuclear plant, the hydrogen blast was reported at Unit 3 of the Fukushima Daiichi nuclear plant, raising new fears of a possible nuclear meltdown. (Kim Jae-Hwan/AFP/Getty Images) From ABS News/International web site (http://abcnews.go.com/International/japan-quake-running-body-bags-stock-market-plunges/story?id=13129273)

Much of the Early Media Coverage was Misleading

Disaster in Japan

Radiation fears grow

Blasts rock nuclear sites as bodies wash up on shore

By William M. Welch
USA TODAY

Japan warned today of alarmingly high levels of radiation leaking from stricken nuclear power plants and said people within 19 miles of the reactors should stay indoors to avoid becoming sick.

The country's nuclear crisis escalated after a third explosion and fire rocked the nuclear power complex on the northeast coast devastated by earthquake and tsunami.

Prime Minister Naoto Kan went on national television to warn that potentially dangerous levels of radiation were spreading from the reactors.

"The level seems very high, and there is still a very high risk of more radiation coming out," he said.

Chief Cabinet Secretary Yukio Edano said a fourth reactor at the complex was on fire, following explosions in three other reactors in four days.

Radiation fears grew as the hunt for survivors of a massive earthquake and tsunami yielded a grim harvest. The official death count rose to 2,414.

Mighty aftershocks rattled the island nation and hundreds of bodies washed up, the sea returning what it had taken when the 33-foot wall of water struck Friday after the earthquake. On Monday, the U.S. Geological Survey revised its estimate of the quake's force up to a magnitude of 9.0.

Even as international relief supplies and crews arrived, some areas remained isolated and in need of food, clean water, medicine and blankets, said Margaret Aguirre of International Medical Corps. Many of the homeless were sleeping out

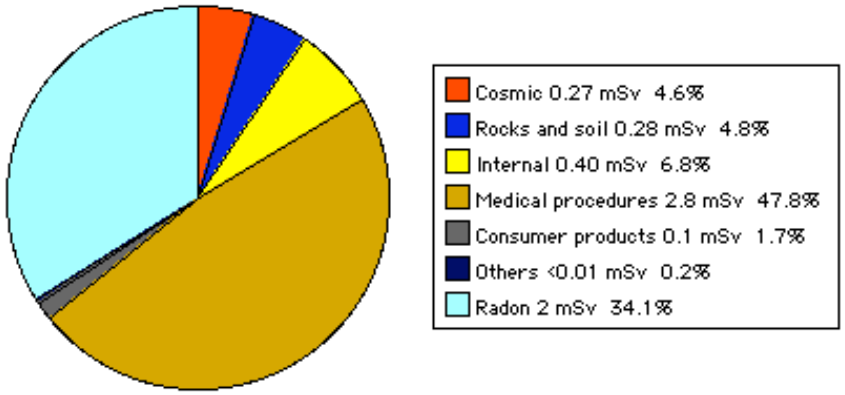
Jiji Press via AFP/Getty Images

From USA Today front page, Tuesday, March 15, 2011

Putting the Fukushima impacts into perspective

- **No one has died as a result of radiation released from the Fukushima accident and no one is expected to.**
  - Two workers drowned at Fukushima Daiichi and one worker died in a crane at Fukushima Daini when the tsunami struck
- **Those evacuated in the 20 km zone around the plant in the early stages of the accident were evacuated as a precaution against any escalation in the problems**
- **Additionally, people have been evacuated from additional areas to the northwest of the plant where rain deposited radioactive materials and where consequentially the annual dose received could exceed 20mSv a year.**
  - This is a very cautious approach as a dose of 20mSv/year would cause not measurable health effects

From: World Nuclear Association website (http://www.world-nuclear.org)



•Estimated average annual radiation exposure from various sources (in millisieverts) of an inhabitant of the United States (total = 5.86 mSv).

•Individual exposures, especially to radon and medical sources, vary widely from these average values.

•The use of medical imaging in the United States (some 67 million CT scans were performed here in 2006) has increased greatly in recent years.

From: http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/R/Radiation.html

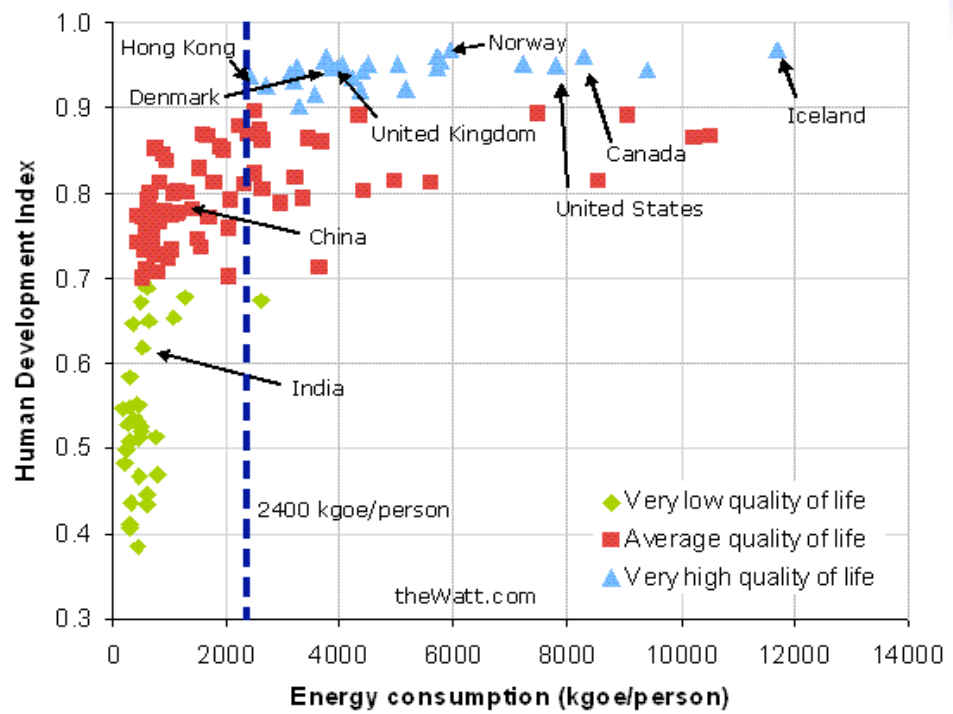
Successful industries strive for continuous improvement

- **Continuous improvement is a goal for all industries**
  - Cars come out each year with improved efficiency and safety features; the nuclear industry also strives for continuous improvement
- **Lessons learned from Fukushima are under development**
  - US Nuclear Regulatory Commission task force completed a 90-day review and released a report on its findings and recommendations yesterday (www.nrc.gov)
  - Japan Atomic Energy Agency is doing an extensive lessons learned activity
  - And many others are doing the same

Should the events in Japan change the path forward for nuclear energy?

Availability of energy is essential to achieving a high quality of life

- **Energy use will grow as developing countries achieve affluence.**
- **Affluence in developing countries will lead to more stable and peaceful world**
- **10 billion people consuming energy at US levels will result in world energy demand increasing by 10 fold**

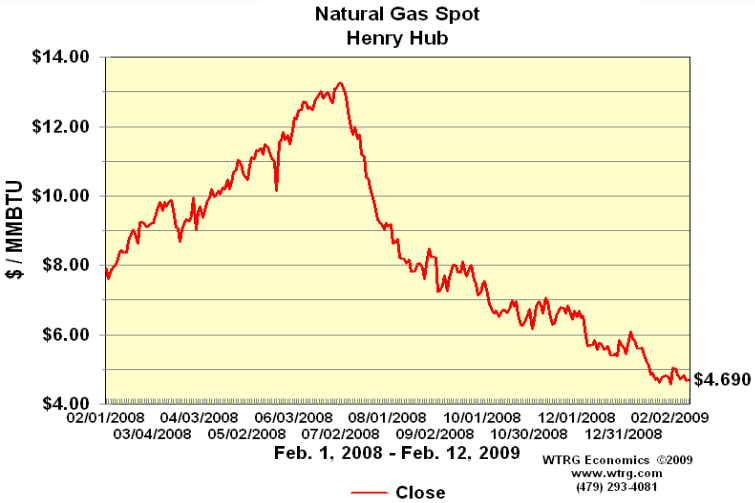


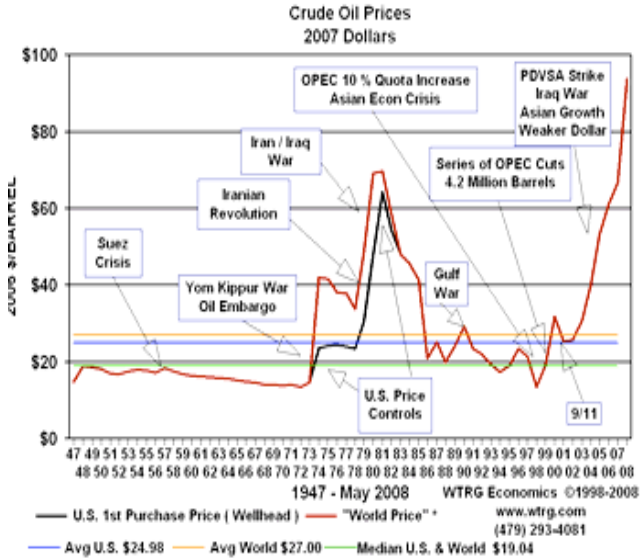
Source: United Nations Development Programme

Prosperity Requires Energy

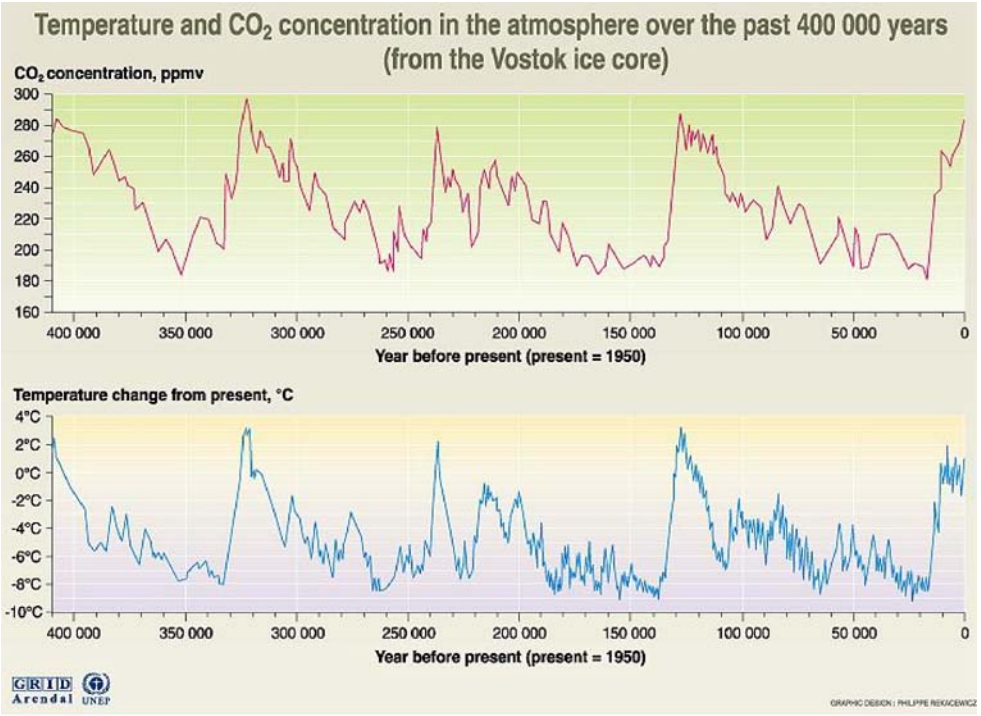
The Energy Challenge…

- Volatile prices for oil and natural gas
- Energy security
- Increased risk of climate change with burning of fossil fuels

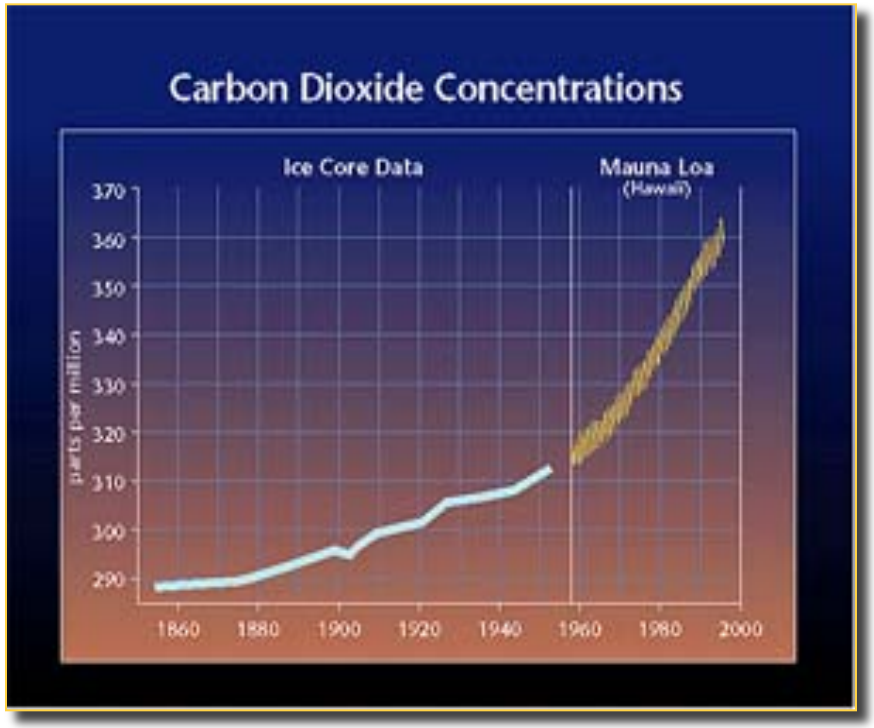




Attention on potential climate change is increasing



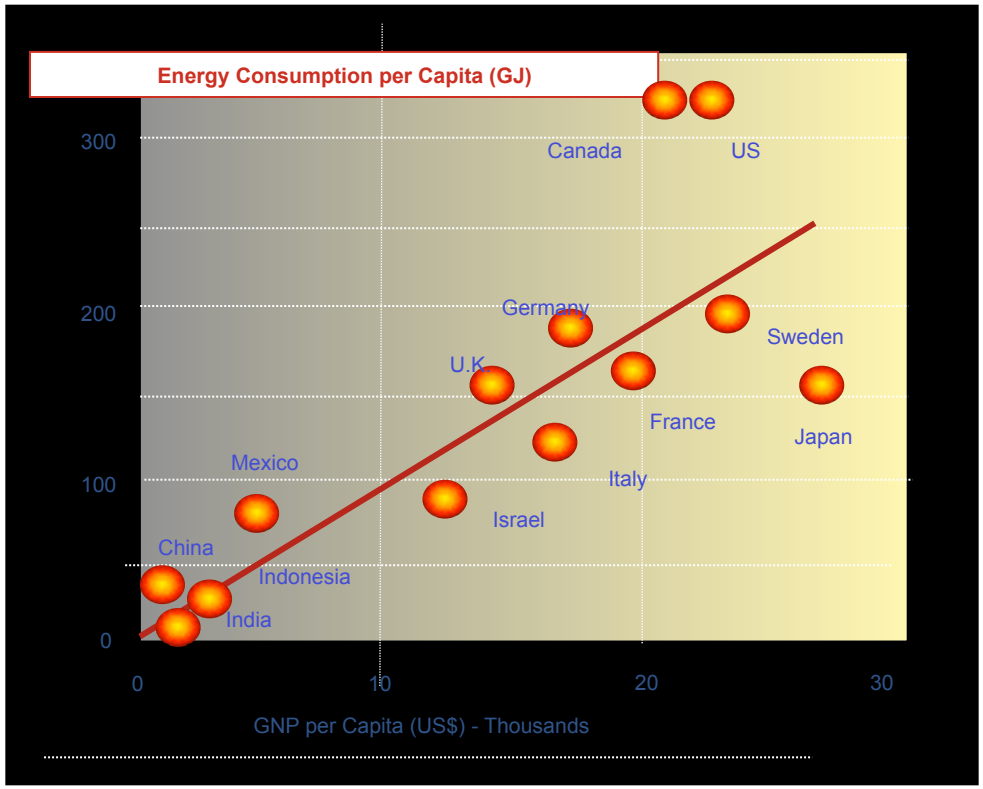
Source: J.R. Petit, J. Jouzel, et al. Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica, Nature 399 (3JUne), pp 429-436, 1999.



- *Current CO_2 levels approaching 380 ppm are unprecedented*
- *Levels of CO_2 tolerance estimates are between 450–750 ppm*
- *We may be quickly approaching an environmental crisis*

Energy consumption and GHG emissions per capita are very high in the U.S.

- **Less than 5% of the world's population live in the U.S.**
- **U.S. consumes ~25% of world's energy production**
- **U.S. contributes to 25% of the GHG emissions worldwide**
- **U.S. generates ~30% of worlds GDP**



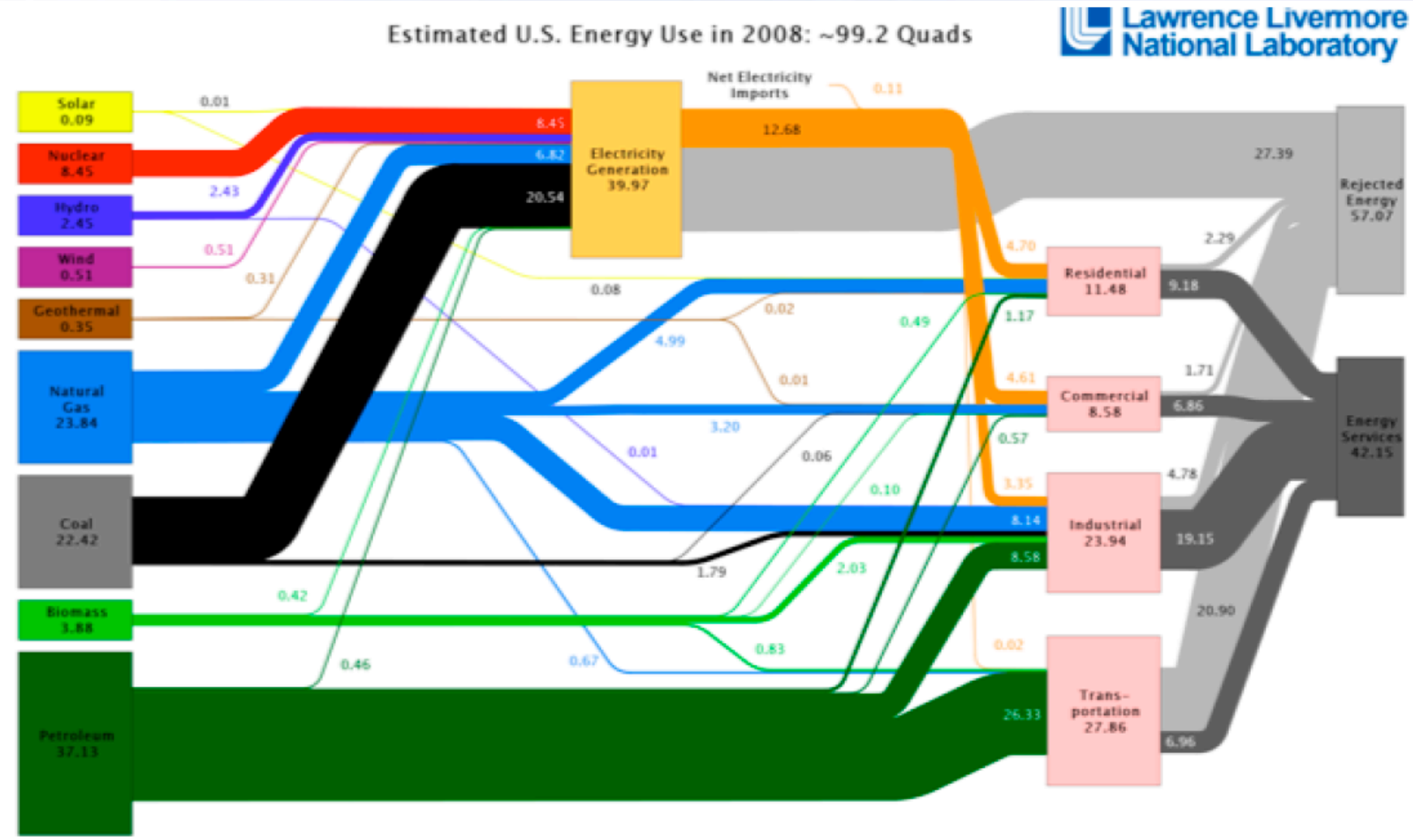
Energy needs must be met using cleaner sources without stifling economic growth

Serious changes are on the horizon for the U.S. Energy Policy

- **Transition to clean energy sources with reductions in the greenhouse gas emissions (with a quantitative goal of 80% reduction below 2005 emissions levels by 2050);**
- **Reduced dependence on foreign energy sources (primarily oil);**
- **Increased environmental and financial regulations;**
- **Targeted government intervention into market-based economics in the form of stimulus, loan guarantees, and regulations as needed**

44th President of the U.S.A. Barrack Obama announced his policy to cut GHG emissions in the U.S. by 80% by the year 2050

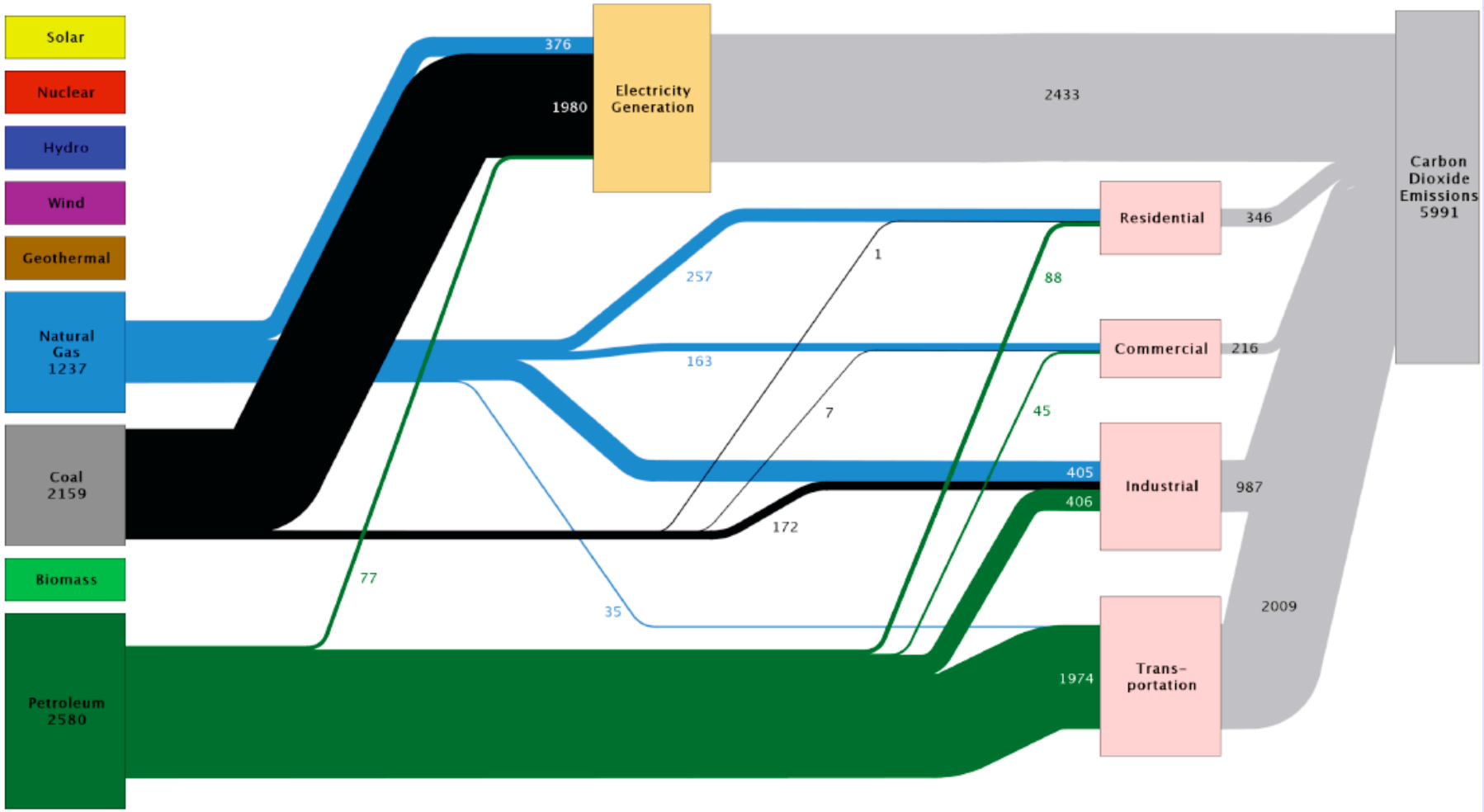
The U.S. Energy supply is dominated by fossil fuels



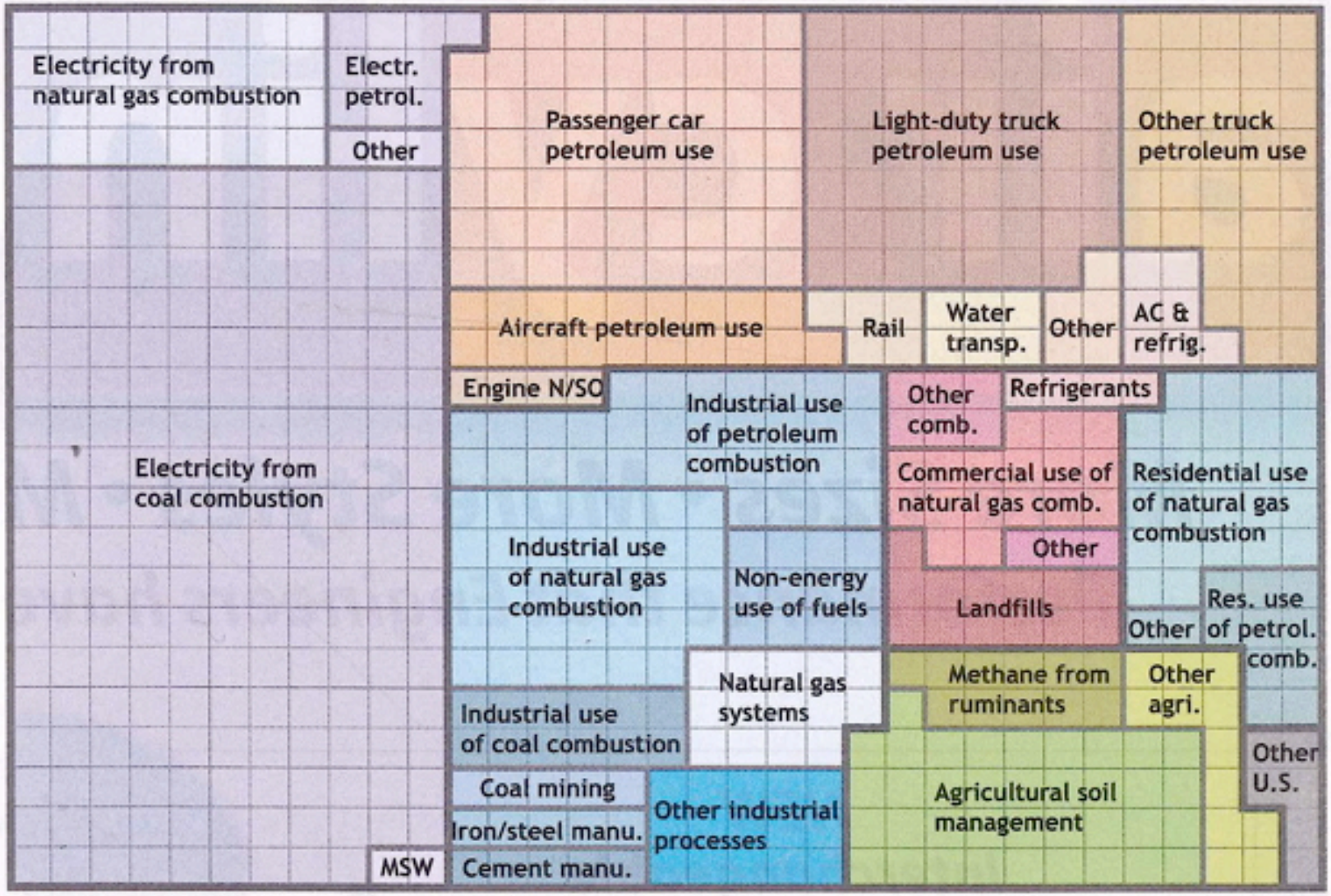
Source: LLNL 2009. Data is based on DOE/EIA-0384(2008), June 2009. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources (i.e., hydro, wind and solar) 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 80% for the residential, commercial and industrial sectors, and as 25% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

Electricity production accounts for 40% of CO2 emissions in the U.S.

Estimated U.S. Carbon Dioxide Emissions in 2007:
~5991 Million Metric Tons



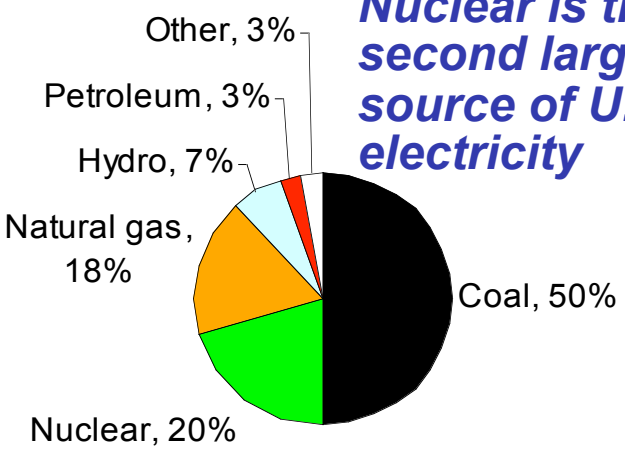
Source: LLNL 2009. Data is based on DOE/EIA-0384(2008), June 2009. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Carbon embodied in industrial and commercial products such as plastics is not shown. The flow of petroleum to electricity production includes both petroleum fuels and the plastics component of municipal solid waste. The combustion of biologically derived fuels is assumed to have zero net carbon emissions – lifecycle emissions associated with biofuels are accounted for in the Industrial and Commercial sectors. Totals may not equal sum of components due to independent rounding. LLNL-MI-411167



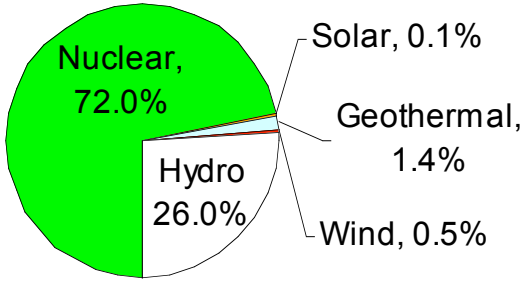
▲ Derived from a 2007 U.S. EPA report, this chart breaks down the annual U.S. emissions of greenhouse gases by source. Each of the 726 squares represents the equivalent of 10 million tons of CO_2.

Nuclear Energy is on the Critical Path to a Sustainable Future

- **As energy needs rise, oil and gas prices increase, and pace of global warming increases, nations are looking to nuclear power**
  - Nuclear and hydroelectric are the only carbon-neutral base load electricity sources
  - Low fuel and production costs, competitive operating economics and performance
- **In the US, nuclear energy displaces carbon emissions equivalent to that emitted each year by automobiles**
- **Beyond electricity, nuclear energy can be used to supplement or supplant fossil fuels**
  - High temperature process heat
  - Producing energy carriers such as hydrogen for petroleum upgrade



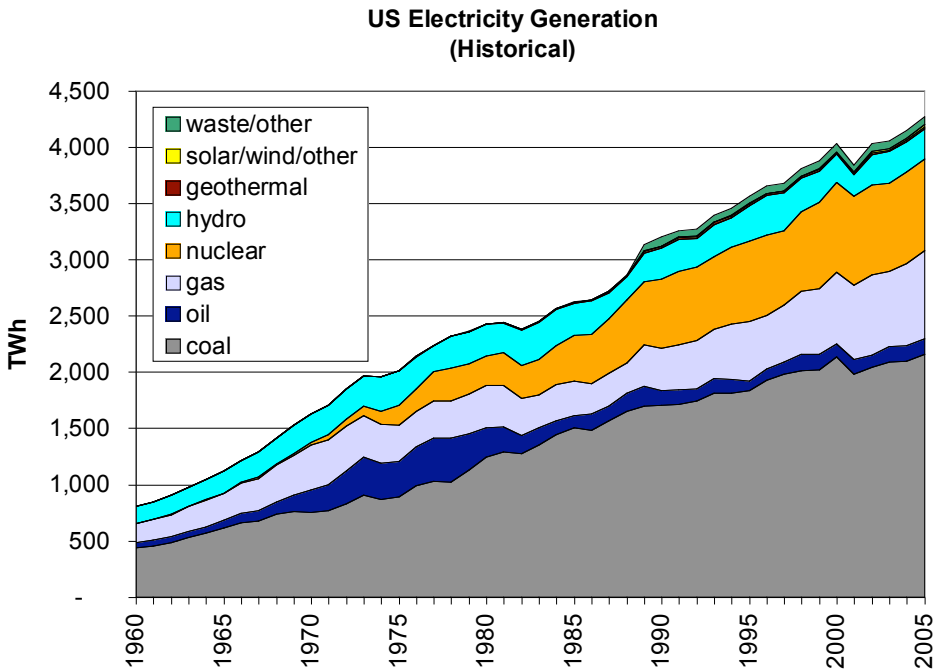
Nuclear is the second largest source of U.S. electricity

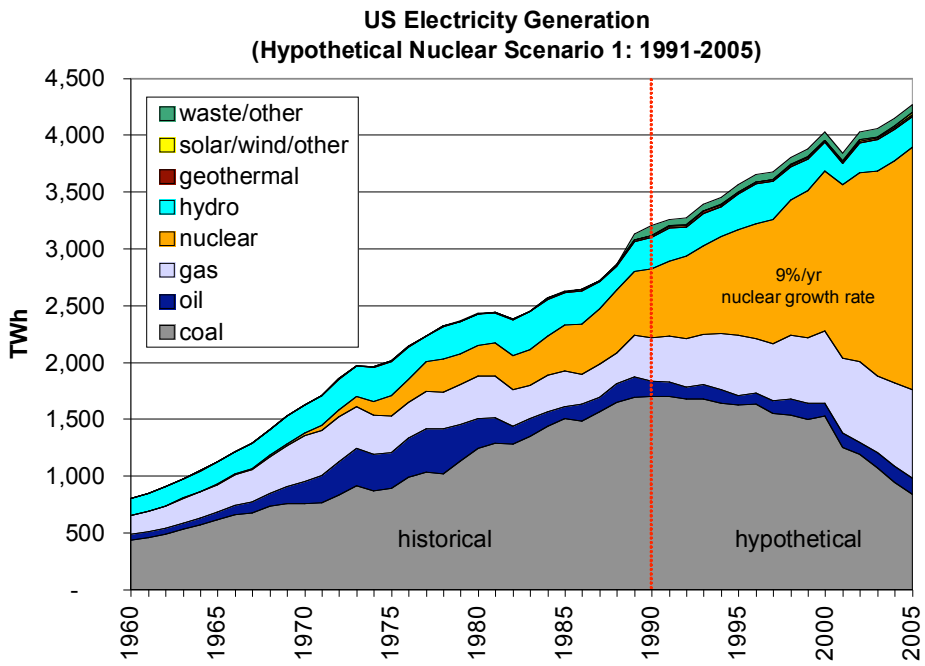


Nuclear energy is the dominant non-fossil electricity technology

In the U.S., 104 nuclear plants generate ~19% of our nation's electricity, and over 70% of our clean electricity

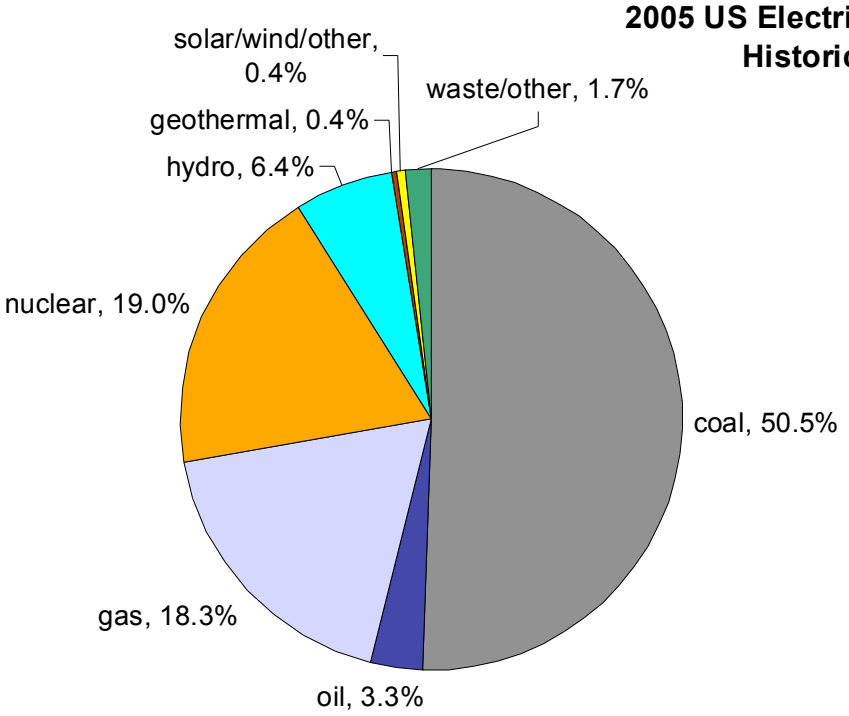
The U.S. energy landscape would be quite different if nuclear energy continued the trend in the 80s

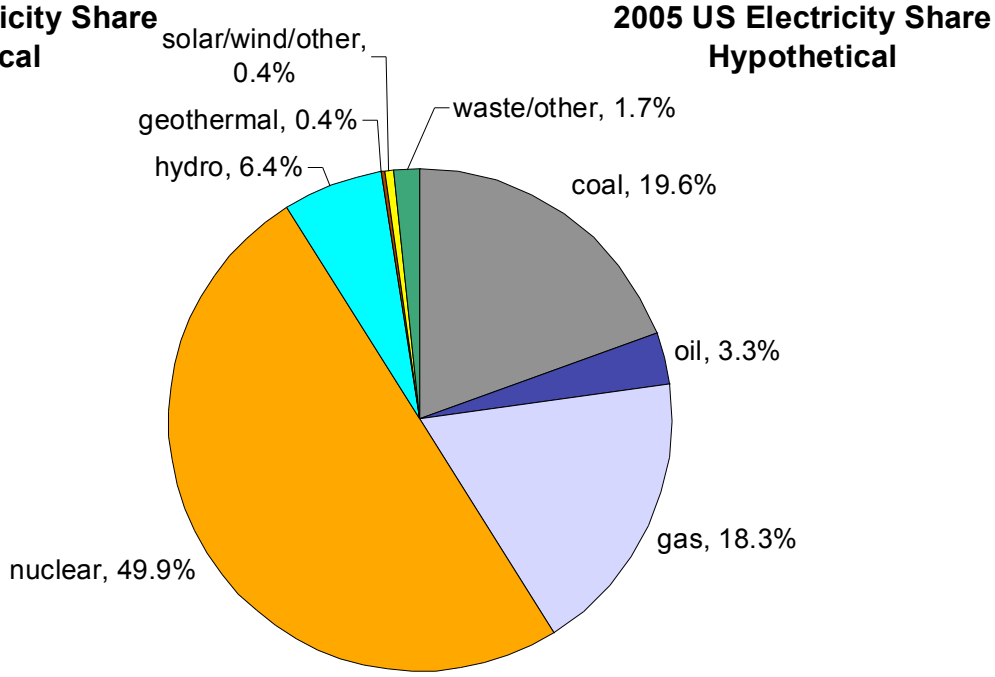




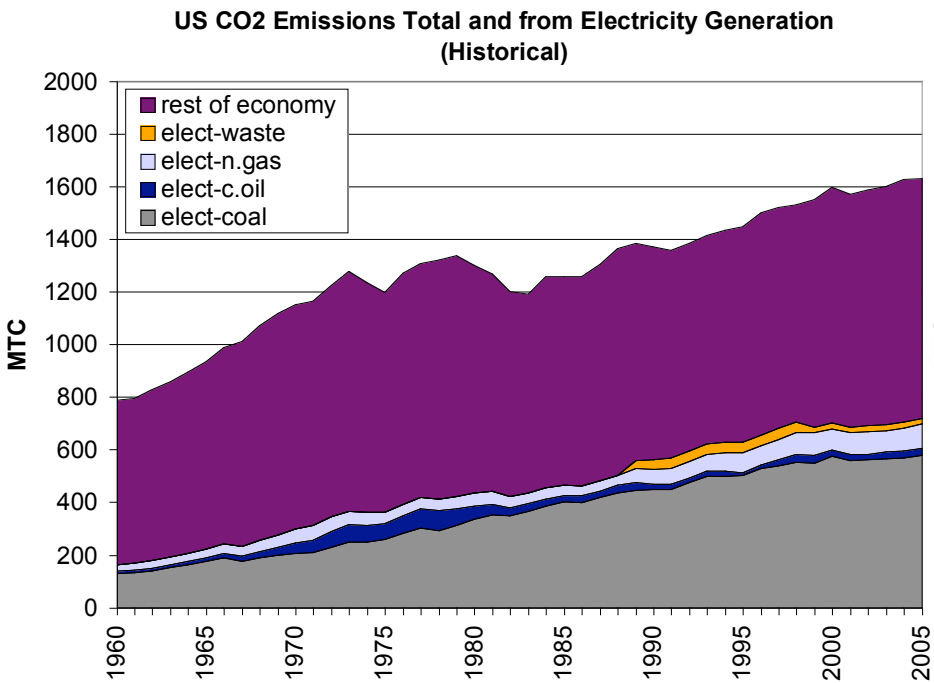
(1991-2005: 9 %/yr nuclear growth rate)

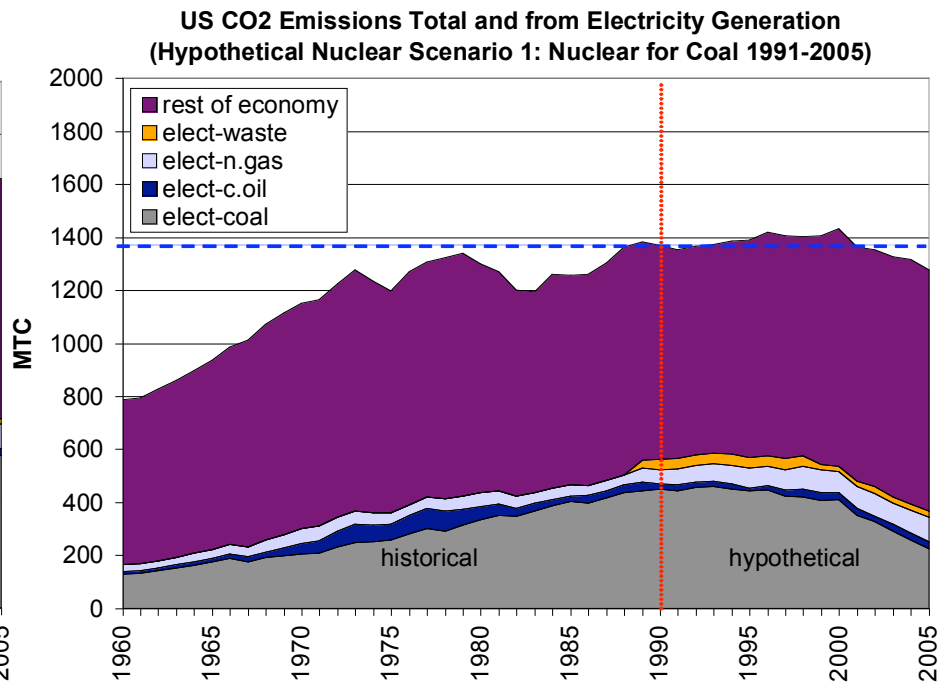
Using 80s growth rate, 50% of the electricity could be generated by nuclear power





U.S. carbon emissions today would be less than 1990 levels!

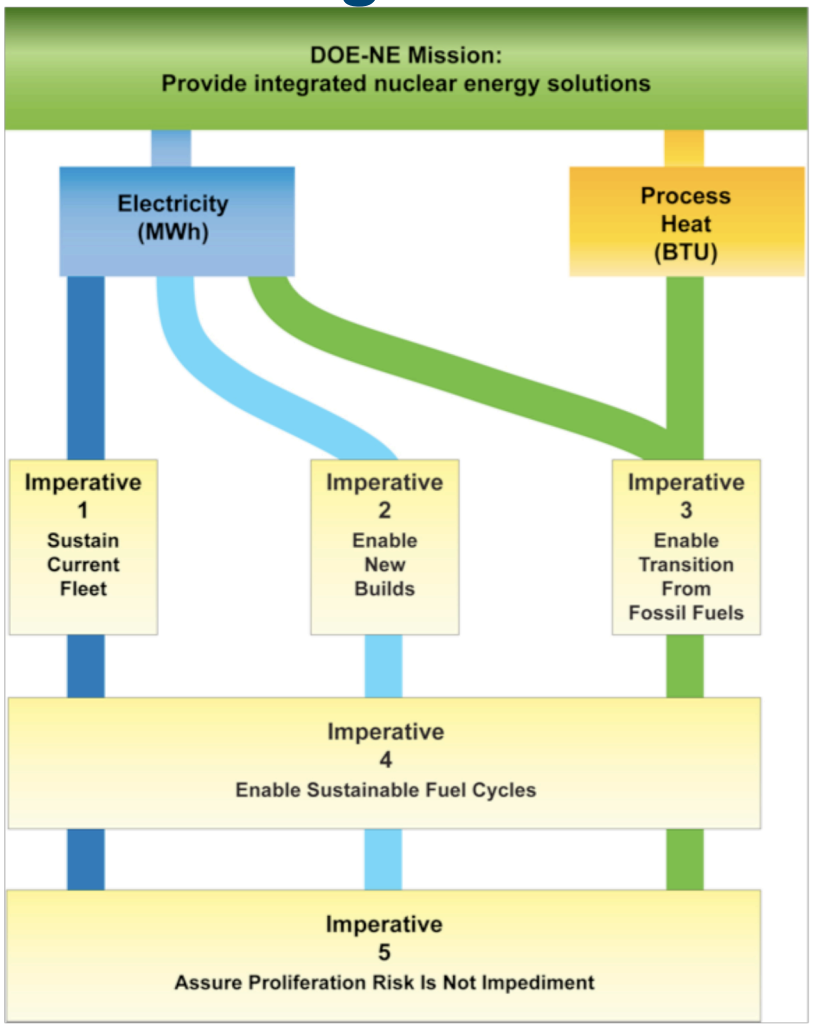




(40% from Electric Power in 2005)

We must learn from the events at Fukushima, but the need for nuclear is still strong and clear

- **Meeting GHG emission goals domestically and worldwide would be very difficult (if not impossible) without considerable increases in the use of nuclear power**
- **Used carefully, nuclear power is a gift to humanity to meet energy demand for a long time**



http://www.ne.doe.gov/ -Click on Nuclear Energy Research and Development Roadmap: Report to Congress Link

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